BARRETT **MAHONY**
CONSULTING ENGINEERS
CIVIL & STRUCTURAL












Civil Engineering Infrastructure Report & Flood Risk Assessment

RESIDENTIAL DEVELOPMENT AT COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

Barrett Mahony Consulting Engineers
Civil . Structural . Project Management
Offices: **Dublin,** London
Sandwith House, 52 – 54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164 Email: bmce@bmce.ie Web: www.bmce.ie

DOCUMENT LEAD SHEET

PROJECT: **RESIDENTIAL DEVELOPMENT AT A SITE ON THE COOKSTOWN ROAD, ENNISKERRY, COUNTY WICKLOW**

PROJECT NO. **18.243**

DOCUMENT TITLE: **CIVIL ENGINEERING INFRASTRUCTURE REPORT AND FLOOD RISK ASSESSMENT FOR PLANNING**

DOCUMENT NO: **18.243 – IR – 01**

Issue	Date	Description	Orig.	PE	PD	Issue Check
PL1	20/03/2020	Draft Issue to An Bord Pleanala	TMH	TMH	JC	
PL2	25/09/2020	Issued for SuDS Audit	TMH	TMH	JC	
PL3	30/10/2020	Issued for Comment	TMH	TMH	JC	
PL4	08/03/2021	Issued for Planning	NM	NM	JC	

CIVIL ENGINEERING INFRASTRUCTURE REPORT AND FLOOD RISK ASSESSMENT FOR A RESIDENTIAL DEVELOPMENT, COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

barrett mahony

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 PROJECT DESCRIPTION 1
1.2 PURPOSE OF THE REPORT 2
1.3 SCOPE OF THIS REPORT 2
1.4 PRE-PLANNING DISCUSSIONS 3
1.4.1 Irish Water 3
1.4.2 Wicklow Country Council 3
1.4.3 Tripartite Meeting 3

2.0 SURFACE WATER DRAINAGE SYSTEM 4
2.1 EXISTING SURFACE WATER INFRASTRUCTURE 4
2.2 PROPOSED SURFACE WATER DRAINAGE SYSTEM 4
2.3 COMPLIANCE WITH THE PRINCIPLES OF SUSTAINABLE DRAINAGE SYSTEMS 4
2.3.1 Introduction 4
2.3.2 Criterion 1 GDSDS – River Water Quality Protection 5
2.3.3 Criterion 2 GDSDS – River Regime Protection 6
2.3.4 Criterion 3 GDSDS – check proposed drainage system does not cause an unacceptable risk of site flooding. 6
2.3.5 Criterion 4 GDSDS – check proposed drainage system does not flood receiving watercourse. 6
2.4 SUDS MANAGEMENT TRAIN 7
2.5 INTERCEPTION STORAGE 7
2.6 SUDS CONCLUSION 8
2.7 SURFACE WATER AUDIT BY JBA CONSULTING 9

3.0 FOUL WATER DRAINAGE SYSTEM 10
3.1 EXISTING FOUL WATER DRAINAGE INFRASTRUCTURE 10
3.2 PROPOSED FOUL WATER DRAINAGE SYSTEM 10
3.3 IRISH WATER 10

4.0 WATER SUPPLY 11
4.1 EXISTING WATER SUPPLY INFRASTRUCTURE 11
4.2 PROPOSED WATER SUPPLY SYSTEM 11
4.3 IRISH WATER 11

5.0 RESPONSE TO THE AN BORD PLEANALA OPINION ON THE DRAFT SUBMISSION. ABP OPINION NO. 307089-20 12

6.0 SITE FLOOD RISK ASSESSMENT 13
6.1 INTRODUCTION 13
6.2 STAGE 1: FLOOD RISK IDENTIFICATION 13
6.2.1 Flood Maps 13
6.2.2 Fluvial Flooding 13
6.2.3 Pluvial Flooding 13
6.2.4 Coastal Flooding 14
6.2.5 Flood Zones 14

6.2.5.1 Vulnerability Class 14
6.2.5.2 Development Classification 14
6.3 STAGE 2: INITIAL FLOOD RISK ASSESSMENT 15
6.3.1 Examination of potential flooding sources that can affect the site 15
6.3.2 Appraisal of the availability and adequacy of existing information and flood zone maps 15
6.3.2.1 Tidal/Fluvial 15
6.3.3 Determination of what technical studies are appropriate 16
6.3.4 Description of what residual risks will be assessed and how they might be mitigated and potential 16
6.3.4.1 Pluvial Flooding 16
6.5 CONCLUSION 16

APPENDIX I **Foul Water and Water Supply Calculations**

APPENDIX II **Site Layout Plans**

APPENDIX III **Irish Water Confirmation of Feasibility Letter 30.09.19 & Irish water Statement of Design Accuptence 07.08.20**

APPENDIX IV **Bray Municipal Local Area Plan Flood Study**

APPENDIX V **Indicative Flood Zones, Map 3, taken from the Wicklow County Development Plan**

APPENDIX VI **Microdrainage Surface Water Full System Simulation Model 1 in 5, 30 & 100 year storm +20% Climate Change,Infiltration manhole, Circular manhole & Land Drain simulation models.**

APPENDIX VII **Microdrainage Foul Water System Design**

APPENDIX VIII **Geotechnical Site Investigation Report Extracts including Soakaway Results**

APPENDIX IX **Report by JBA Consulting, the Surface Water Design Auditor**

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Cairn Homes Properties Ltd., intend to apply to An Bord Pleanála for permission for a strategic housing development on lands within the townland of Cookstown, Enniskerry, Co. Wicklow relating to lands with an overall area of c. 6.6 hectares including a strip to facilitate footpath and lighting upgrades on the Cookstown Road. Barrett Mahony Consulting Engineers (BMCE) have been commissioned by Cairn Homes Properties Ltd. to prepare an Infrastructure Report & Flood Risk Assessment for the proposed residential development

This report will form part of the strategic housing development (SHD) submitted to An Bord Pleanála.

In summary, the proposal comprises the construction of 165 no. dwellings consisting of:

a) 105 no. 2 storey houses (49 no. 3 bedroom houses [House Types B, B1, & B2], 56 no. 4 bedroom houses [House Types A, D, E & E1];

b) 56 no. apartments/duplex apartments in 6 no. 3 storey buildings – (28 no. 2 bedroom apartments and 28 no. 3 bedroom duplex apartments) all with terrace;

c) 4 no. 1 bedroom Maisonette dwellings in a 2 storey building;

d) Part 2-storey and single storey creche (c. 510 sq. m - including storage);

e) Open space along southern boundary of c. 0.93 hectares [with pedestrian connections to boundary to 'Lover's Leap Lane' to the south and to boundary to the east and west], hard and soft landscaping (including public lighting) and open space (including boundary treatment), communal open space for duplex apartments; regrading/re-profiling of site where required [including import/export of soil as required] along with single storey bicycle/bin stores and ESB substation;

f) Vehicular access (including construction access) from the Cookstown Road from a new junction as well as 313 no. car parking spaces and 150 no. cycle spaces;

g) Surface water attenuation measures and underground attenuation systems as well as connection to water supply, and provision of foul drainage infrastructure (along the Cookstown Road to existing connection at junction with R760) and provision of underground local pumping station to Irish Water specifications;

h) 3 no. temporary (for 3 years) marketing signage structures [2 no. at the proposed entrance and 1 no. at the junction of the R760 and the Cookstown Road] and a single storey marketing suite (c. 81 sq.m) within site;

i) All ancillary site development/construction/landscaping works, along with provision of footpath/public lighting to Powerscourt National School pedestrian entrance and lighting from Powerscourt National School entrance to the junction of the R760 along southern side of Cookstown Road and pedestrian crossing across Cookstown Road.

Figure 1.1: Site Location

1.2 PURPOSE OF THE REPORT

This report has been prepared as part of the Planning Application for the Cookstown residential development. The purpose of this report is to outline the proposed civil engineering infrastructure for the development, including potable water supply, foul and storm water drainage networks and proposed Sustainable Drainage Systems (SuDS) elements.

A flood risk assessment has also been included as part of this report. The outcome of this assessment has been accounted for in the proposals for the scheme.

1.3 SCOPE OF THIS REPORT

This report describes the proposed civil engineering infrastructure for the development and how it connects to the existing public infrastructure serving the area. In particular, foul and surface water drainage and water supply. Flood risk is also considered. This report should be read in conjunction with the following Barrett Mahony drawings submitted with the application:

18243-BMD-00-ZZ-DR-C-1000	Proposed Roads Layout and Dimensions
18243-BMD-00-ZZ-DR-C-1010	Proposed Roads and Footpaths Layout
18243-BMD-00-ZZ-DR-C-1011	Proposed Access Junction and Footpaths Layout
18243-BMD-00-ZZ-DR-C-1012	Vehicle Tracking - Refuse Tender
18243-BMD-00-ZZ-DR-C-1013	Vehicle Tracking - Fire Tender
18243-BMD-00-ZZ-DR-C-1014	Proposed Junction Sightlines Layout
18243-BMD-00-ZZ-DR-C-1015	Hardstanding, Permeable Paving and Green Space Area for Surface Drainage
18243-BMD-00-ZZ-DR-C-1016	Retaining walls Layout and Details. Typical Foundation Details
18243-BMD-00-ZZ-DR-C-1020	Proposed Foul and Surface Water Drainage Layout
18243-BMD-00-ZZ-DR-C-1030	Proposed Watermain Layout
18243-BMD-00-ZZ-DR-C-1101	Roads Longsections (Sheet 1 of 3)
18243-BMD-00-ZZ-DR-C-1102	Roads Longsections (Sheet 2 of 3)
18243-BMD-00-ZZ-DR-C-1103	Roads Longsections (Sheet 3 of 3)
18243-BMD-00-ZZ-DR-C-1120	Proposed Surface Water Drainage Long Sections (Sheet 1 of 2)
18243-BMD-00-ZZ-DR-C-1121	Proposed Surface Water Drainage Long Sections (Sheet 2 of 2)
18243-BMD-00-ZZ-DR-C-1122	Proposed Foul Drainage Long Sections (Sheet 1 of 2)
18243-BMD-00-ZZ-DR-C-1123	Proposed Foul Drainage Long Sections (Sheet 2 of 2)
18243-BMD-00-ZZ-DR-C-1200	Standard Drainage Details
18243-BMD-00-ZZ-DR-C-1205	SuDS Details (Sheet 1 of 2)

18243-BMD-00-ZZ-DR-C-1206	SuDS Details (Sheet 2 of 2)
18243-BMD-00-ZZ-DR-C-1210	Roads and Hardstanding Standard Details
18243-BMD-00-ZZ-DR-C-1211	Proposed Foul Pumping Station Details
18243-BMD-00-ZZ-DR-C-1212	Rising Main Discharge Manhole & Wet Well Inlet Manhole Details

1.4 PRE-PLANNING DISCUSSIONS

1.4.1 Irish Water

A Pre-Connection Enquiry (PCE) was submitted to Irish Water in April 2019. The application underwent the standard Irish Water internal procedure of checking of the capacity of the Foul Network and Watermain network to which the site connects. In the absence of immediate infrastructure, it is proposed to discharge the foul water from the site to the existing network to the west of the site, via a new pumping station (Type 3, as per Irish Water COP)and rising main as shown on the drainage plans.

The Confirmation of Feasibility letter was issued by Irish Water on 30th September 2019 and is included in Appendix III.

A Statement of Design Acceptance was subsequently issued by Irish Water on 10th August 2020 for the foul and watermain networks proposed. Refer to Appendix III for the relevant document.

1.4.2 Wicklow Country Council

A Section 247 meeting was held with Wicklow County Council on 11th February 2020, at which, inter alia, the engineering strategies were discussed. Comments from Wicklow County Council have been addressed and are discussed further in this report, refer to Section 5.0.

1.4.3 Tripartite Meeting

A Tripartite meeting was held with Wicklow County Council, the design team, and An Bord Pleanala on 3rd July 2020, at which , inter alia, the engineering strategies were discussed. Comments from An Bord Pleanala and Wicklow County Council have been addressed and are discussed further in this report, refer to Section 5.0.

2.0 SURFACE WATER DRAINAGE SYSTEM

2.1 EXISTING SURFACE WATER INFRASTRUCTURE

Irish Water maps indicate that there is an existing 450mm diameter surface water pipe running beneath the Enniskerry Road (R760) to the west of the site, approximately 500m from the nearest site boundary. It is at a higer level than the north end of the subject site and cannot be reached by a gravity drain from the site. There are no other potential connections within the area.

The existing site is a greenfield site, used for agricultural purposes. As such there is no existing surface water network within the site area, with rainfall discharging directly to the ground. There are no watercourses in the vicinity of the site that can be reached by gravity, due to the site topography with the site sloping c. 6m downwards towards the north, down to the Cookstown Road (L1020) and away from the River Dargle south of the site.

2.2 PROPOSED SURFACE WATER DRAINAGE SYSTEM

The proposed development will be served by a new separate gravity surface water drainage network falling towards the north boundary of the site alongside the Cookstown Road, where it is proposed to install a soakaway designed in accordance with Ciria 756 guidelines. Site investigation works were carried out by Site Investigations Ltd. in 2014 and 2019 with soakaway testing performed at the intended site of the soakaway in 2014. This found that the existing ground conditions consist of 1-2m of sandy/silty gravel overlying deep beds of gravel. The infiltration rate determined on site at the soakaway location was 0.148m/hr, which is sufficient to allow for a soakaway design. The 2019 soakaway test, carried out in a different location to the south, determined a similar infiltration rate of 0.128m/hr. Refer to Appendix VIII for the soakaway test reports.

A Stormtech type soakaway/infiltration system is proposed. Substantial measures are proposed to minimise the risk of silt buildup within the soakaway, such as the use of safety factors on the infiltration rate, an isolator row, catchpit manholes on incoming pipes, and infiltration trenches/permeable paving upstream of the tank. These measures, in conjunction with a suitable maintenance schedule will ensure the soakaway operates efficiently throughtout its design life.

Wicklow County Council had requested that a surface water connection to the Dargle River to the south of the site be explored. However, as this river is approximately 300m to the south, through lands with multiple owners this option could not be feasibly pursued in this case. Also, as noted above, the natural topography of the site allows drainage to run by gravity to the north, and not naturally towards the river to the south.

Refer to Barrett Mahony drawings C1020, C1205 and C1206, for further information.

2.3 COMPLIANCE WITH THE PRINCIPLES OF SUSTAINABLE DRAINAGE SYSTEMS

2.3.1 Introduction

The development of this site will result in increased paved and impermeable areas that have the potential to create pressure on the environment and existing services due to the generation of increased run-off and pollution. In order to avoid this the development will be designed in accordance with the principles of Sustainable Urban Drainage Systems (SUDS) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS) and as set out in the

CIRIA Guide C753. Application of these principles will significantly reduce run-off rates and improve storm water quality discharging to the underlying groundwater and public storm water system. The GDSDS addresses the issue of sustainability by requiring designs to comply with a set of drainage criteria which aim to minimize the impact of urbanization by replicating the run-off characteristics of the greenfield site. The criteria provide a consistent approach to addressing the increase in both rate and volume of run-off as well as ensuring the environment is protected from pollution that is washed off roads and buildings. These drainage design criteria are as follows:

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

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

- Interception storage
- Treatment storage (not required if interception storage is provided)
- Attenuation storage
- Long term storage (not required if growth factors are not applied to Qbar when designing attenuation storage)

As explained in C753 the SuDS manual, SuDS can also improve the quality of life in a new development and urban spaces by making them more vibrant, visually attractive, sustainable and more resilient to change. This manual explains the wider social context of SuDS and how SuDS can deliver high quality drainage while supporting urban areas to cope better with severe rainfall both now and in the future.

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

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

2.3.2 Criterion 1 GDSDS – River Water Quality Protection

Run-off from natural greenfield areas contributes very little pollution and sediment to rivers and for most rainfall events direct run-off from greenfield sites to rivers does not take place with rainfall percolating into the ground. By contrast urban run-off has the potential, when drained by pipe systems, to result in run-off from virtually every rainfall event with high levels of pollution, particularly in the first phase of run-off, with little of the rainfall percolating to the ground. To prevent this happening Criterion 1 requires that interception storage is provided so that the first 5mm of rainfall from the developed site is intercepted and retained on site thereby replicating the run-off characteristics of the pre-development greenfield site.

In the context of the subject site interception storage will be provided by:

- Permeable Paving of private and visitor parking spaces
- Infiltration Trenches
- Soakaway

These measures will allow for run-off from areas with higher levels of pollutants – roads and parking bays – to undergo filtering and cleaning prior to entering the surface water network. The use of a soakaway will also allow before the run-off discharges to the ground. As is good practice for soakaway design, the base of the soakaway is at least 1m above for further filtering of pollutants the water table, which reduces the risk of pollutants entering sensitive aquifers.

While a full infiltration design is proposed through the use of an on site soakaway, interception storage has been considered separate to this, so as to distribute groundwater recharge across the site.

Based on the foregoing, Criterion 1 is deemed to be fully met.

2.3.3 Criterion 2 GDSDS – River Regime Protection

Whatever the rainfall event unchecked run-off from the developed site through traditional pipe networks will discharge into receiving waters at rates that are an order of magnitude greater than that prior to development. This can cause flash flow in the outfall river / stream that can cause scour and erosion. Attenuation storage is provided to prevent this occurring by limiting the rate of run-off to that which took place from the pre-development greenfield site. In this case, a full infiltration design is proposed, with all surface discharged being intercepted on site, and discharged directly into the underlying ground and thus Criterion 2 is fully met.

Appendix VI gives MicroDrainage simulation output showing the soakaway storage volumes required for the 100 year event + 20% Climate Change with the soakage rate from the tank being controlled by the infiltration rate determined on site. The soakaway will consist of a Stormtech system or similar, with an equivalent volume = 1200m^3.

2.3.4 Criterion 3 GDSDS – check proposed drainage system does not cause an unacceptable risk of site flooding.

No flooding should occur on site for storms up to and including the 30 year event unless temporary flood storage is provided in a designated area on site for these high intensity storms. The pipe network and the soakaway storage volumes should therefore be checked for such storms to ensure that no site flooding occurs.

No flooding of internal areas should occur during the 100 year event + 20% Climate Change. The pipe network can therefore surcharge and cause site flooding during this event but the top water level due to any such flooding must be at least 500mm below any internal floor levels, and the flood waters should be contained within the site. In addition the top water level in the soakaway during the 100 year storm must be at least 500mm below any internal floor levels.

Appendix VI gives MicroDrainage simulation output for both the pipe system and soakaway storage volumes during the 100 year event +20% Climate Change. No flooding occurs during the event and the soakaway top water level of +100.7 is well in excess of the 500mm minimum distance below the lowest internal floor level = +102.87.

Based on the foregoing, Criterion 3 is deemed to be fully met.

2.3.5 Criterion 4 GDSDS – check proposed drainage system does not flood receiving watercourse.

Criterion 4 is intended to prevent flooding of the receiving system / watercourse by either limiting the volume of run-off to the pre-development greenfield volume using “long term storage” (Option 1) or by limiting the rate of run-off for the 100 year storm to QBAR without applying growth factors using “extended attenuation storage” (Option 2).

In the context of the subject site Criterion 4 has been fully met using Option 2 by providing full infiltration.

2.4 SuDS Management Train

The SuDS measures proposed are linked in series, and this is commonly known as a SuDS Management Train, (SMT). The SMT ensures that rainwater falling on a site is captured, conveyed, stored, intercepted and removed of pollutant correctly and efficiently before it is discharged back into the surrounding water course of network.

A robust SMT will ensure that the most effective measures are utilised in the correct sequence throughout the site. Table 26.7 (Figure 2. below) in *(CIRIA, SuDS Manual 2015)* illustrates the effectiveness of each SuDS measure along the SMT.

TABLE 26.7 Indicative suitability of SuDS components within the Management Train

SuDS component	Interception[1]	Close to source/ primary treatment	Secondary treatment	Tertiary treatment
Rainwater harvesting	Y			
Filter strip	Y	Y		
Swale	Y	Y	Y	
Filter drain	Y		Y	
Permeable pavement	Y	Y		
Bioretention	Y	Y	Y	
Green roof	Y	Y		
Detention basin	Y	Y	Y	
Pond	[3]	Y[2]	Y	Y
Wetland	[3]	Y[2]	Y	Y
Infiltration system (soakaways/ trenches/ blankets/basins)	Y	Y	Y	Y
Attenuation storage tanks	Y[4]			
Catchpits and gullies		Y		
Proprietary treatment systems		Y[5]	Y[5]	Y[5]

Figure 2.2 - C573 SuDS Manual Table 26.7 (Proposed mechanisms highlighted blue)

2.5 Interception Storage

The GDSDs requires that Interception storage, where provided, should ensure that at a minimum the first 5mm and preferably the first 10mm of rainfall is intercepted on site and does not directly pass to the receiving watercourse.

Interception storage can be attained using SuDS features which allow the rainwater to infiltrate into the ground, evaporate into the atmosphere or transpire through vegetation. As per Table 24.6 of the Ciria SuDS Manual, 5mm interception storage can be assumed to be achieved for all areas which drain to a soakaway designed to infiltrate run-off for events greater than a 1 month return period.

- The soakaway proposed for this development is designed to infiltrate all run-off generated from all hardstanding surfaces on site, up and including the 1 in 100 year storm event, +20% climate change allowance.

- Permeable paving to which no additional area is drained can be assumed to be compliant. All permeable paving on site will only treat its own surface area, and has been designed to attenuate and infiltrate all surface water collected across its own area, in all events up to and including the 1 in 100 year storm, +20% climate change. As such, the required interception storage is provided for the full site area which drains to the soakaway.
- Infiltration Trenches are proposed in the landscaped area along the primary spine road through the site, as agreed with the landscape architects design. Roads and adjoining footpaths and swales will drain to these infiltration trenches, consisting of a 150mm perforated pipe in a gravel bed. The depth of the gravel bed is typically 300mm beneath the perforated pipe but the total depth of the trench is 1000mm and 600mm wide, providing interception storage at a rate of 1.2m^3/m. This does not allow for the losses into the underlying soil through infiltration, which will increase the interception storage of the trenches further. While full interception is met through the use of the soakaway, these infiltration trenches will allow for surface water to discharge to the ground over a wider area of the site, promoting local ground water recharge.
- Cookstown Road along the site frontage: Surface water drainage is to be provided along the site boundary for Cookstown Road. We have provided three road gullies, two of which will discharge into two seperate circular soakaways and one will discharge into an infiltration trench. All three are located inside the site boundary and will discharge run off from the road to the underlying gravels. The infiltration trench is sized at 1m x 4m x 3m depth, the two circular soakaways are 1.5mØ x 3m deep, with an infiltration rate of 0.148m/hr. Appendix VI includes the simulation outputs for the infiltration trench storage volume as well as the two circular soakaways during the 100 year event +20% Climate Change. No flooding occurs during the critical event and the top water level for the infiltration trench and circular soakaways are at least 500mm below the lowest internal floor level in this area.
- The southern most road of the site, Road 4: This will also be treated separately with a linear land drain due to its advantageous position adjacent to the linear park. This land drain will consist of a 225mm perforated pipe in a gravel bed. The depth of the gravel bed is typically 300mm beneath the perforated pipe and the total depth of the trench is 1200mm and 600mm wide, providing interception storage at a rate of 1.44m^3/m. This land drain is proposed to attenuate and infiltrate surface water run off from this the green field area, using an infiltration rate of 0.128m/hr. Appendix VI includes the simulation output for the infiltration trench storage volume during the 100 year event +20% Climate Change. No flooding occurs during the critical event and the infiltration trench top water level is at least 500mm below the lowest internal floor level in this area.

2.6 SuDS Conclusion

This section of the report has comprehensively discussed the various GDSDS criteria that have been addressed within the proposed surface water network design. In the case of the subject site, the full implementation of at-source SuDS Interception measures is not deemed necessary as a full infiltration design is proposed. This means that there is no impact of the development on any watercourse (of which the primary function of SuDS is to protect), or sewer.

A series of interception storage measures are proposed on site and the pipe network has been modelled in Causeway Flow Software to estimate the discharge volume with these measures in place. In conclusion, the chosen SuDS measures are effective measures which can be applied in the context of the site and these measures are effective in treating rainfall on the site to GDSDS and CIRIA SuDS manual criterion.

2.7 SURFACE WATER AUDIT BY JBA CONSULTING

A full audit of the surface water design & drawings was carried out by JBA Consulting in October 2020. Questions from JBA arising from the audit were responded to and taken on board in the design. The final report from JBA Consulting is contained in Appendix IX.

3.0 FOUL WATER DRAINAGE SYSTEM

3.1 EXISTING FOUL WATER DRAINAGE INFRASTRUCTURE

There is an existing 225mm diameter foul drain that runs from Powerscourt National School to the foul sewer on the Enniskerry Road (R760) at its junction with the Cookstown Road. The existing Enniskerry Demesne housing estate opposite the development is served by a foul pumping station. This station pumps up to the foul sewer on the R760 at its junction with the Cookstown Road.

3.2 PROPOSED FOUL WATER DRAINAGE SYSTEM

It is proposed for the gravity foul drainage network on site to drain to the northeast corner of the site, which is the lowest point of the development. From here it is to be pumped to the existing 225mm foul sewer at the R760 sewer junction. Wicklow County Council requested that the proposed development should accommodate future connections from neighbouring sites, allowing for the existing Enniskerry Demesne Foul pumping station to be decommissioned in future. The additional Sites contributing to the foul pumping station are set out in the calculations in Appendix I, they are as follows:

1. Adjoining site future development 34 no. houses
2. Existing Enniskerry Demense 14 no. houses
3. Permitted development WCC Reg Ref 16/976 6 no. houses (site adjacent to Enniskerry Demense on east side)

The new below ground foul pumping station for the development is proposed to accommodate an average flow of 1.182l/s and has a 24hr dry weather flow emergency overflow storage requirement of that equates to 102m^3, which will be met through the provision of a 102.6m^3 concrete storage tank, and the remaining volume within the pumping station wetwell.The pumping station will be built to the specifications outlined in Irish Waters Code of Practice and standard details.

The foul water is then pumped from the new below ground foul pumping station via a 100mm diameter HDPE foul rising main that connects to a new foul standoff/discharge manhole and then by a short gravity connection to the existing foul sewer on the main Enniskerry Road (R760). The peak foul flow breakdown is laid out in the calculations contained in Appendix I.

The proposed foul network within the site consists of 225mm diameter pipes with a capacity of at least 21 l/s (at 1:200). The proposed connection to the public sewer is a 100mm rising main, discharging to a stand-off manhole upstream of the existing wastewater network. All these capacities are more than adequate to accommodate the estimated flows.

Refer to drawings no. C1020 for further information relating to the foul drainage layout.

3.3 IRISH WATER

As mentioned above in section 1.4.1, the above proposal has received both a Confirmation of Feasibility, and a Statement of Design Acceptance from Irish Water.

4.0 WATER SUPPLY

4.1 EXISTING WATER SUPPLY INFRASTRUCTURE

There is an existing 180mm HDPE running beneath the northern side of the Cookstown Road, and a 100mm uPVC watermain beneath the south side. Both mains are relatively new, having been installed in 2005 and 2004 respectively.

4.2 PROPOSED WATER SUPPLY SYSTEM

The site connection will be via a 150mm diameter (internal bore) connection into the existing 180mm HDPE watermain line in Cookstown Road.Twenty-four-hour storage will be provided in each house via an attic tank to cater for possible shut-downs in the system. Refer to Appendix I for water demand calculations.

Hydrants will be provided on the ring main, subject to fire cert requirements. Sluice valves will be provided at junctions and appropriate locations to facilitate isolation and purging of the system. Air valves will be provided at high points for system verting. All watermains infrastructure is to be to Irish Waters Code of Practice and standard details.

Refer to BM Drawing no’s. C1030 & C1220 for further information on the proposed site watermain layout and the proposed location of the connection to the existing network.

4.3 IRISH WATER

As mentioned above in section 1.4.1, the above proposal has received both Confirmation of Feasibility, and a Statement of Design Acceptance from Irish Water.

5.0 RESPONSE TO THE AN BORD PLEANALA OPINION ON THE DRAFT SUBMISSION. ABP OPINION NO. 307089-20

Barrett Mahony Consulting Engineers (BMCE) have taken on board the opinion of the Bord and WCC where possible in their civils design. Set out below is the BMCE response to each item raised.

1. **ABP Comment**: Additional details and/or revised proposals in relation to site services, having regard to comments contained within the Engineer's Report dated 14/02/2020, as submitted with the Planning Authority's Opinion, as relates to surface and foul water proposals.	**BMCE Response:** The response to each item raised by WCC is set out below.
WCC ENGINEER'S REPORT DATED 14/02/2020 FOUL AND DRAINAGE SERVICES	**BMCE**
The existing foul network in Enniskerry Village is subject to excessive surface water infiltration and regularly surcharges below the town square during extreme wet weather. Without significant upgrade or storm separation works, the network has insufficient capacity for new connections without giving rise to public health risk. The proposal to pump foul water is not sustainable and will likely involve high maintenance cost and public nuisance.	The foul network in Enniskerry Village is the responsibility of Irish Water. A Confirmation of Feasibility letter & a Statement of Design Acceptance letter have both been received from Irish Water for the BMCE foul & water supply design for the Cookstown scheme. If repairs or upgrades are required by Irish Water in the Village then these can be addressed at Connection Offer stage.
There are inconsistencies between the pipe size and gradient information contained on drawing C1020 and the Micro Drainage analysis. Very flat gradients with poor self cleansing characteristics will not be acceptable.	These inconsistencies have been addressed in the updated drawings.
A cover and invert level data table should accompany drawing C1020 and adequate information should be available to show that the top water level in the proposed soakaway is below the formation level of the adjacent public road.	Manhole schedules have been provided on the updated drawings. The top water level in the soakaway for a 100 yr storm + 20% climate change is below the level of the adjacent Cookstown Road.
Infiltration test results and analysis of the infiltration capacity of the site along with details of measures to demonstrate that surface water cannot flow onto the public road should be provided.	Infiltration test results are contained in Appendix VIII of this report. Surface water is drained to the soakaway. The top water level in the soakaway for a 100 yr storm + 20% climate change is below the level of the adjacent Cookstown Road
Drainage proposals should include for the collection of surface water from the L1020 from its junction with the R760 to the eastern boundary of the site.	A number of new road gullies on the Cookstown Road, along the site frontage, have been shown on the drainage layout drawing C1020. These drain to local soakaways outside of the adjacent tree root protection zones.

6.0 SITE FLOOD RISK ASSESSMENT

6.1 INTRODUCTION

The flood risk assessment outlined below is carried out in accordance with the OPW publication "The Planning System and Flood Risk Assessment Guidelines for Planning Authorities".

The stages involved in the assessment of flood risk are listed in these publications as follows:

- Stage 1: Flood Risk Identification
- Stage 2: Initial Flood Risk Assessment
- Stage 3: Detailed Flood Risk Assessment

The OPW publication also outlines a Sequential Approach for determining whether a particular development is appropriate for a specified location in terms of flood risk. The categorization of the subject site in terms of the OPW's sequential approach is further outlined in Section 5.2 below.

6.2 STAGE 1: FLOOD RISK IDENTIFICATION

Stage 1 identifies whether there are any flooding or surface water management issues related to the site, i.e. it identifies whether a flood risk assessment is required.

6.2.1 Flood Maps

There is no OPW Flood Hazard Map available for the subject site and the surrounding area. Available information on flooding is contained in Appendix IV and V of this report. Appendix IV contains Flood risk information in the Bray Municipal Local Area Plan and Appendix V contains Flood Map 3 from the Wicklow County Development Plan. There is no indication on these maps of a flood risk on the subject site.

6.2.2 Fluvial Flooding

The southern site boundary is 125m approx. from the Dargle River. The river is in a valley and is approximately 30 metres below the site level on this boundary and is therefore not considered to be a flood risk.

The northern site boundary is 350m approx. from the Glencullen River. This river is in a valley and is approximately 60m below the site level on this boundary and is therefore not considered to be a flood risk.

Similarly, boreholes carried out on site did not find groundwater.

6.2.3 Pluvial Flooding

All rain falling on the site will be collected in the new surface water drainage system and diverted back to the water table via infiltration. The system is designed without flooding for a 100 year storm, +20%cc in accordance with GDSDS requirements. Therefore, the risk of pluvial flooding within the site is negligible. While there is no record of pluvial flooding occurring on the site, Wicklow County Council advised that the Cookstown Road is known as an area where surface water has collected during storm events though this flooding has not to our knowledge occurred in the section of road in the front of the subject site. It is expected that much of this is due to the lack of any ditches or public drainage along the Cookstown Road, combined with the gradients and elevations in the local area resulting in surface water gathering above ground. In order to alleviate this it is proposed to provide surface water drainage along the site boundary with the Cookstown Road. Road Gulleys will be installed, and discharge to infiltration trenches along the south side of the Cookstown Road, allowing for drainage to be provided in an area where there is no existing public drainage network.

6.2.4 Coastal Flooding

Due to the location of the site, there is no risk from coastal flooding to the proposed development.

6.2.5 Flood Zones

Geographical areas are similarly divided into three categories, based on their risk of river and tidal flooding. The three categories are as follows:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding).
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding).
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding i.e. all areas which are not within zone A or B).

The subject site is in **Flood Zone C**, as there is no indication of any part of the site being within an area where the probability of flooding from rivers or the sea is greater than 1 in 1000.

6.2.5.1 Vulnerability Class

As outlined in the OPW publication, new developments are divided into three categories which are as follows:

- ‘Highly Vulnerable Development’ – hospitals, schools, houses, student halls of residence etc.;
- ‘Less Vulnerable Development’ – retail, commercial, industrial, agriculture etc.; and
- ‘Water-compatible Development’ – docks, marinas, amenity open space etc.

The proposed development falls under the heading of Highly Vulnerable Development due to the presence of residential units across the site.

6.2.5.2 Development Classification

The matrix below, which is an extract from the OPW document, states whether a particular development is deemed ‘Appropriate’ for a geographical location. The site in question is deemed Appropriate.

Table 6.1: Matrix of vulnerability versus flood zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water compatible development	Appropriate	Appropriate	Appropriate

6.3 STAGE 2: INITIAL FLOOD RISK ASSESSMENT

The initial flood risk assessment should ensure that all relevant flood risk issues are assessed in relation to the decisions to be made and potential conflicts between flood risk and development are addressed. It should assess the adequacy of existing information and any flood defences.

6.3.1 Examination of potential flooding sources that can affect the site

The possible sources of flood water are assessed in the table below using the "**Source – Pathway – Receptor Model"**.

Table 6.2: The possible sources of flood water

Source	Pathway	Receptor	Likelihood	Consequence	Risk
Tidal Note	Overtop Breach	People Property	Very Unlikely	High	Negligible
Fluvial Note	Overtop Breach	People Property	Unlikely	Low	Negligible
Pluvial Surface water	Overflow / Blockage	People Property	Likely	Moderate	Low
Groundwater	Rising groundwater levels	People Property	Unlikely	Low	Low

6.3.2 Appraisal of the availability and adequacy of existing information and flood zone maps

6.3.2.1 Tidal/Fluvial

Good data is available on possible flooding of the surrounding area to the site in the Western CFRAM Study by the OPW. The study is a requirement of the EU 'Floods' Directive (2007/60/EC). The PFRA map is also available and considers flood risk arising from any major source of flooding, including natural sources such as river, sea, groundwater and rainfall as well as infrastructural sources such as urban drainage systems, reservoirs, water supply systems ESB and Waterways Ireland Infrastructure.

The relevant maps are contained in Appendix IV and Appendix V and show that the site is located outside of any area at risk of tidal or fluvial flooding.

6.3.3 Determination of what technical studies are appropriate

Given the comprehensive nature of the existing information available regarding flooding, it is not considered necessary to carry out any further analysis of fluvial / tidal flooding or of the sewer network serving the area. On the request of Wicklow County Council, the proposed development will help to alleviate some local pluvial flooding which occurs on parts of the Cookstown Road due to a lack of local drainage infrastructure.

6.3.4 Description of what residual risks will be assessed and how they might be mitigated and potential

6.3.4.1 Pluvial Flooding

The unlikely event of a complete blockage of the surface water drainage system on site will lead to overland flow in the site from the point of blockage. The site slopes downhill and rain water on impermeable surfaces from any surcharging manhole will be channelled between kerbs to travel downhill towards the Cookstown Road House floor levels are set 150mm above the surrounding ground level to minimise flood risk.

There is occasional localised flooding on the Cookstown Road in the vicinity of the site; just west of it in front of the Summerhill House Hotel entrance and just east of the site near its northeast corner. It is proposed to install new road gullies on the road edge on the site side, drained back into the site, to alleviate any potential issues on the road in front of the site. The Cookstown Road is at a level of +102.60m OD approx. The lowest house floor level is at +103.35. OD, and the houses are not at risk from any localised flooding on the Cookstown Road in the unlikely event that it should still occur.

6.5 CONCLUSION

The flood risk assessment has been carried out in accordance with the OPW publication "The Planning System and Flood Risk Assessment Guidelines for Planning Authorities".

There is no risk to flooding affecting the site from coastal or fluvial soures. Local knowledge suggests pluvial flooding may impact the lowest points of the site along the northern boundary with the Cookstown Road. To alleviate any surface water which may buildup at local low points of the Cookstown Road it has been proposed to provide drainage to the section bordering the site, and to bring that into the developments surface water network.

The mitigation measures to be incorporated into the design, as outlined above, ensure that any flood events on surrounding lands do not cause flooding of the proposed development, and that the development does not increase flood risk elsewhere.

Therefore, the development is deemed acceptable from a flood risk assessment perspective.

APPENDIX I

Foul Water and Water Supply Calculations

BARRETT MAHONY
CONSULTING ENGINEERS
CIVIL & STRUCTURAL

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland

Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

PROJECT TITLE:	COOKSTOWN ROAD ENNISKERRY		BY: TMH
CALCULATION:	FOUL WATER DEMAND		PAGE: 1
APPENDIX:	A		DATE: 12/03/2021

SUMMARY:		Total Peak Flow	Total Average Flow
A:	Residential: Subject Site	5.156 l/s	0.859 l/s
B:	Crèche: Subject Site	0.267 l/s	0.045 l/s
C:	Residential: Enniskerry Demense	0.433 l/s	0.072 l/s
D:	Residential: Future Development	0.186 l/s	0.031 l/s
E:	Residential: Adjoining site	1.052 l/s	0.175 l/s
	TOTAL	7.094 l/s	1.182 l/s

A: RESIDENTIAL: SUBJECT SITE & NEIGHBOURING ESTATES

The foul effluent demand from the proposed dwellings (165 no. units) and adjacent estates (34 no. units) is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure (June 2020) assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit.

No. of Units = 165

No. of Occupants = 165 x 2.7 = 445.5 use 450

Daily Flow = No. of Occupants x Dry Weather Flow

Daily Flow = 450.0 x 150 x 1.1 = 74,250 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{74{,}250 \text{ l/day}}{24 \times 60 \times 60} = 0.859 \text{ l/s}$$

Peak Flow = Average Flow x 6

Peak Flow = 0.859 l/s x 6 = 5.156 l/s

B: CRÈCHE: SUBJECT SITE

Assume conservatively 50no. children catered for. Assume staff:child ratio of 1:5 on average (based on Schedule 6 Part 1 of Child Care Act 1991 (Early Years Services) Regulations 2016.). Thus assume total of 20no. staff + 50no. children = 70no. persons. As per Irish Water CoP for WW Infrastructure Appendix D, assume flow rate for "Schools - non-residential without a canteen" = 50litres/person/day.

No. of Children = 50

Staff:Child Ratio = 1:5

Total Population = 50 + 20 = 70

Daily Flow = Population x Dry Weather Flow

Daily Flow = 70 x 50 x 1.1 = 3,850 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{3{,}850 \text{ l/day}}{24 \times 60 \times 60} = 0.045 \text{ l/s}$$

Peak Flow = Average Flow x 6

Peak Flow = 0.045 l/s x 6 = 0.267 l/s

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland

Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

C: RESIDENTIAL: ENNISKERRY DEMENSE

The foul effluent from the proposed dwellings is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure (June 2020) assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit.

No. of Units = 14
No. of Occupants = 14 x 2.7 = 37.8

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 37.8 x 150 x 1.1 = 6,237 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{6{,}237 \text{ l/day}}{24 \times 60 \times 60} = 0.072 \text{ l/s}$$

Peak Flow = Average Flow x 6
Peak Flow = 0.072 l/s x 6 = 0.433 l/s

D: RESIDENTIAL: FUTURE PERMITTED DEVELOPMENT

The foul effluent from the proposed dwellings is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure (June 2020) assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit.

No. of Units = 6
No. of Occupants = 6 x 2.7 = 16.2

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 16.2 x 150 x 1.1 = 2,673 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{2{,}673 \text{ l/day}}{24 \times 60 \times 60} = 0.031 \text{ l/s}$$

Peak Flow = Average Flow x 6
Peak Flow = 0.031 l/s x 6 = 0.186 l/s

E: RESIDENTIAL: ADJOINING SITE FUTURE DEVELOPMENT

The foul effluent from the proposed dwellings is calculated as per the Irish Water Code of Practice for Wastewater Infrastructure (June 2020) assuming dry weather flow of 150 l/head/day plus a 10% infiltration rate and using the Irish Water assumed average occupancy of 2.7 persons/unit.

No. of Units = 34
No. of Occupants = 34 x 2.7 = 91.8

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 91.8 x 150 x 1.1 = 15,147 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{15{,}147 \text{ l/day}}{24 \times 60 \times 60} = 0.175 \text{ l/s}$$

Peak Flow = Average Flow x 6
Peak Flow = 0.175 l/s x 6 = 1.052 l/s

BM
BARRETT MAHONY
CONSULTING ENGINEERS
CIVIL & STRUCTURAL

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland
Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

PROJECT TITLE:	COOKSTOWN ROAD ENNISKERRY	BY: POD
CALCULATION:	WATER DEMAND	PAGE: 1
APPENDIX:	B	DATE: 30/10/2020

SUMMARY:		**Total Peak Demand**	**Avg. Day / Peak Week Demand**
A:	Residential	4.834 l/s	0.967 l/s
B:	Creche	0.253 l/s	0.051 l/s
	TOTAL	**5.087 l/s**	**1.017 l/s**

A: RESIDENTIAL

The water demand for the proposed development has been calculated using the guidelines given in the Irish Water Code of Practice for Water Infrastructure (Dec. 17) Section 3.7.2 assuming a per-capita consumption of 150 l/head/day and using the Irish Water assumed average occupancy of 2.7 persons/unit. The average day/peak week demand is taken as 1.25 times the average daily domestic demand. The peak demand factor is taken as 5 times the average day/peak week demand.

No. of Units = 165
No. of Occupants = 165 x 2.7 = 445.5

Avg. Daily Demand = No. of Occupants x Allowance per head
Avg. Daily Demand = 445.5 x 150 = 66,825 l/day

$$\text{Avg. Day / Peak Week Demand} = \frac{\text{Daily Flow}}{\text{Flow Duration}} \times 1.25 = \frac{66{,}825 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{0.967\ l/s}$$

Peak Demand = Average Flow x 5
Peak Demand = 0.967 l/s x 5 = **4.834 l/s**

B: CRÈCHE:

Assume conservatively 50no. children catered for. Assume staff:child ratio of 1:5 on average (based on Schedule 6 Part 1 of Child Care Act 1991 (Early Years Services) Regulations 2016.). Thus assume total of 20no. staff + 50no. children = 70no. persons. As per Irish Water CoP for WW Infrastructure Appendix D, assume flow rate for "Schools - non-residential without a canteen" = 50litres/person/day. The average day/peak week demand is taken as 1.25 times the average daily domestic demand. The peak demand factor is taken as 5 times the average day/peak week demand.

No. of Children = 50
Staff:Child Ratio = 1:5
Total Population = 50 + 20 = 70

Avg. Daily Demand = No. of Workers x Dry Weather Flow
Avg. Daily Demand = 70 x 50 = 3,500 l/day

$$\text{Avg. Day / Peak Week Demand} = \frac{\text{Daily Flow}}{\text{Flow Duration}} \times 1.25 = \frac{3{,}500 \text{ l/day}}{24 \times 60 \times 60} \times 1.25 = \mathbf{0.051\ l/s}$$

Peak Demand = Average Flow x 5
Peak Demand = 0.051 l/s x 5 = **0.253 l/s**

Dublin | London | Sofia
Sandwith House,
52-54 Lower Sandwith Street,
Dublin 2, D02 WR26, Ireland

Phone +353 1 6773200
Email bmce@bmce.ie
www.bmce.ie

PROJECT TITLE:	Cookstown Road	BY: R.M.
CALCULATION:	EXISTING ON SITE - FOUL WASTEWATER	PAGE: 1
APPENDIX:	C	DATE: 30/10/2020

EXISTING ON SITE FOUL WASTEWATER

A: **INDUSTRIAL**

(Workers calculated: area in m² / area per FTE; as per Employment Densities Guide from OFFPAT). Type Warehouse & Distribution B8 – General with 70 FTE per m².

Industrial m² = 7200 m²
FTE per m² = 70
No. of FTE = 7200 m² / 70 = 102.8571

Daily Flow = No. of Occupants x Dry Weather Flow
Daily Flow = 102.8571 x 45 x 1.1 = 5,091 l/day

$$\text{Average Flow} = \frac{\text{Daily Flow}}{\text{Flow Duration}} = \frac{5{,}091 \text{ l/day}}{24 \times 60 \times 60} = 0.059 \text{ l/s} \quad 1.25 \quad = 0.074 \text{ l/s}$$

Peak Flow = Average Flow x 6
Peak Flow = 0.059 l/s x 6 = 0.354 l/s

APPENDIX II

Site Layout Plan

COOKSTOWN SITE PLAN LAYOUT

SCALE @ A0: 1:500
SCALE @ A2: 1:1000

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
PL1	05.03.21	ISSUED FOR PLANNING	NMM / TMH	TMH / JPC

DRAWING STAGE **PLANNING**

BM
BARRETT MAHONY
Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164
London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural .Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

CLIENT
CAIRN HOMES PROPERTIES LTD.

PROJECT TITLE	BM PROJECT No.	
COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW	18243	
MODEL REFERENCE	MODEL REV.	SUITABILITY
18243-BMD-00-ZZ-M3-C-1010	P1	S0

DRAWING TITLE
COOKSTOWN SITE PLAN LAYOUT

DRAWING No.

ISSUE **PL1**

APPENDIX III

Irish Water Confirmation of Feasibility Letter 30.09.19 & Irish water Statement of Design Accuptence 07.08.20

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

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Aidan McLernon
7 Grand Canal
Grand Canal Street Lower
Dublin 2
D02KW81
Dublin

30 September 2019

Dear Aidan McLernon,

Re: Connection Reference No CDS19004063 pre-connection enquiry - Subject to contract | Contract denied

Connection for Mixed Use Development of 312 unit(s) at Cookstown Road, Enniskerry, Co. Wicklow.

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Cookstown Road, Enniskerry, Co. Wicklow.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Connection to the water network is feasible, connection point to the water network shall be to the north of the development to the 180mm HDPE watermain

Wastewater connection is feasible. The proposed decommisioning of the existing pump station and connection to the new proposed pumping station acceptable. Design details of the pump station shall be finalised at connection stage.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

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,

Maria O’Dwyer

Connections and Developer Services

UISCE ÉIREANN : IRISH WATER

Aidan McLernon
7 Grand Canal
Grand Canal Street Lower
Dublin 2 D02KW81
Dublin

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

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

7 August 2020

Re: Design Submission for Cookstown Road, Enniskerry, Co. Wicklow (the "Development")
(the "Design Submission") / Connection Reference No: CDS19004063

Dear Aidan McLernon,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Alvaro Garcia
Email: agarcia@water.ie

Yours sincerely,

M O'Dwyer

Maria O'Dwyer
Connections and Developer Services

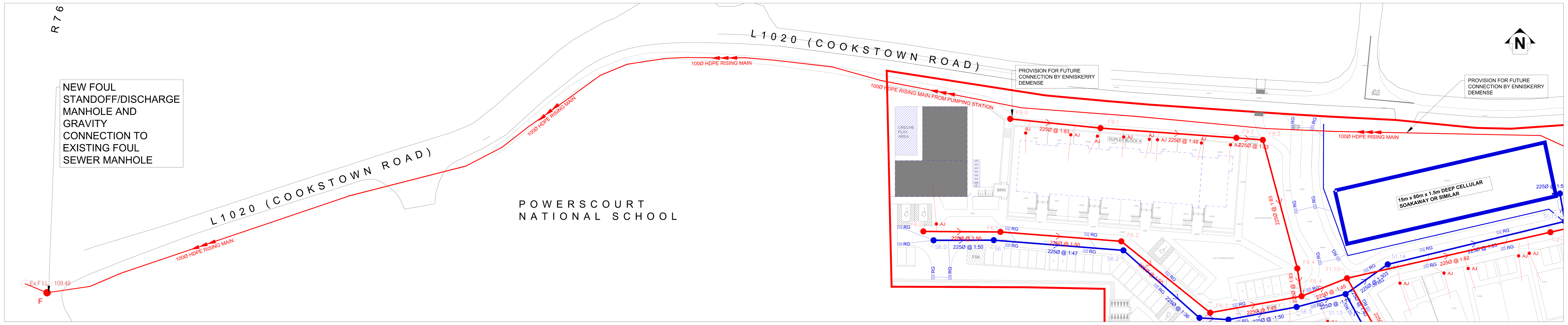
Appendix A

Document Title & Revision

- Proposed foul and surface water layout (Drawing no. 18243-BM-C3D-M-DRAINAGE-1020)
- Proposed watermain layout (Drawing no. 18243-BM-C3D-M-DRAINAGE-1030)
- Proposed foul drainage long sections (Drawing no. 18243-BM-C3D-M-DRAINAGE-1122)
- Proposed foul drainage long sections (Drawing no. 18243-BM-C3D-M-DRAINAGE-1123)

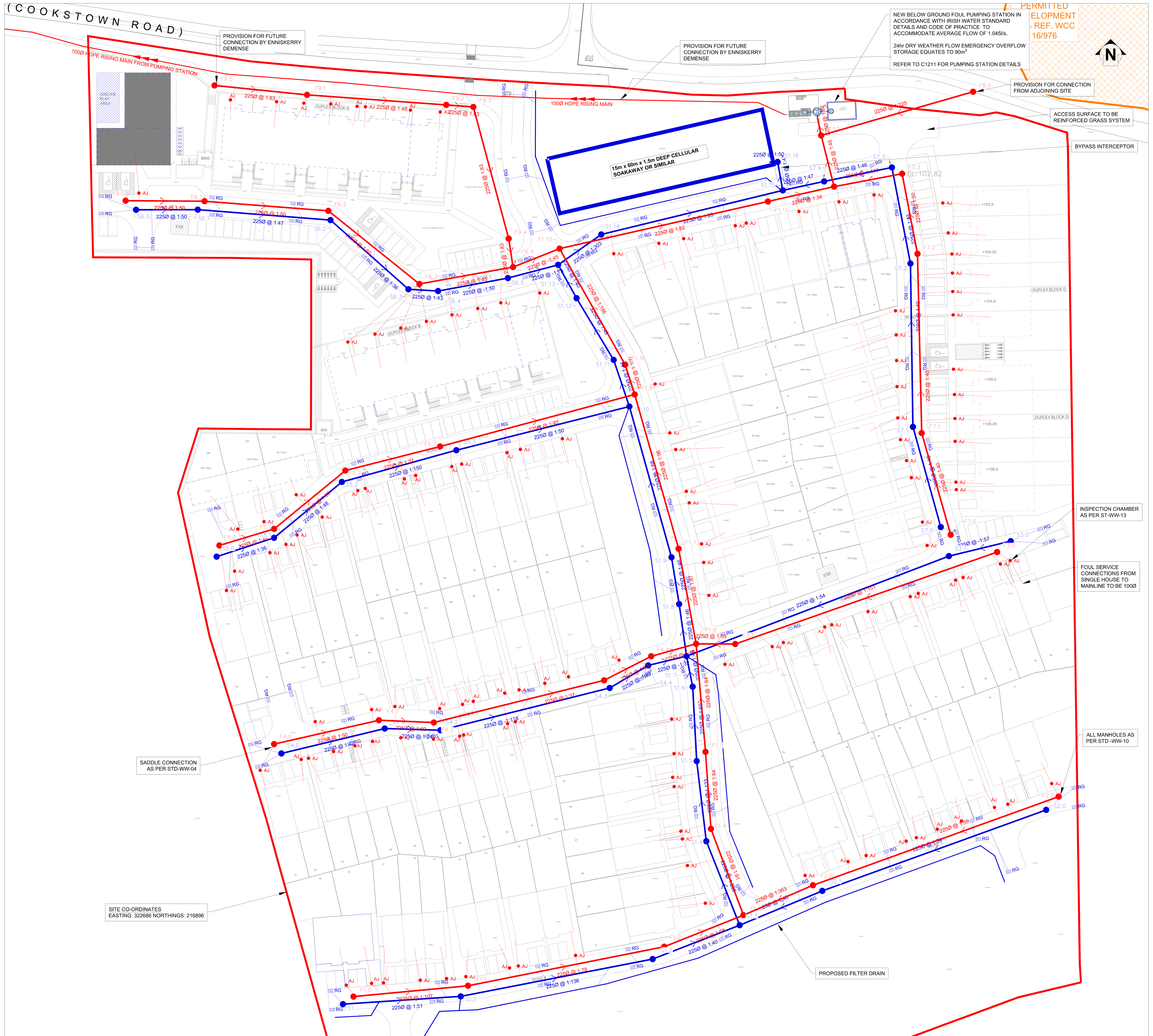
For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.



PROPOSED ROUTE OF FOUL RISING MAIN

SCALE @ A0: 1:500
SCALE @ A2: 1:1000



PROPOSED FOUL & SURFACE WATER DRAINAGE LAYOUT

SCALE @ A0: 1:500
SCALE @ A2: 1:1000

NEW FOUL DRAINAGE MANHOLE

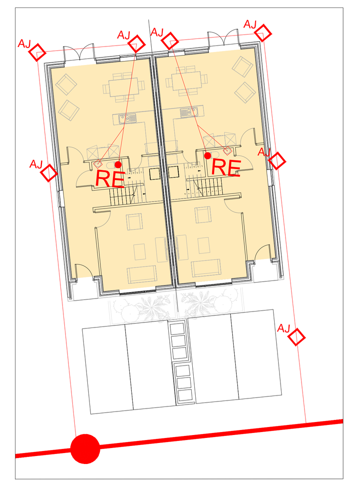
MANHOLE	COVER LEVEL	INVERT LEVEL	'E' EASTING	'N' NORTHING
F1.0	+108.68	OUT: +106.82	722619.6661	716682.7527
F1.1	+108.25	IN FROM F1.0: +106.53 OUT: +106.53	722650.6594	716685.6850
F1.2	+107.55	IN FROM F1.1: +105.84 OUT: +105.84	722703.7291	716696.2446
F1.3	+107.41	IN FROM F1.2: +105.60 IN FROM F2.1: +106.22 OUT: +105.18	722725.1697	716704.7905
F1.4	+107.73	IN FROM F1.3: +104.90 OUT: +104.80	722716.3696	716728.1462
F1.5	+107.52	IN FROM F1.4: +104.48 OUT: +104.38	722714.9013	716748.9950
F1.6	+107.32	IN FROM F1.5: +104.02 IN FROM F3.1: +105.52 IN FROM F4.4: +104.81 OUT: +103.88	722712.3645	716778.2252
F1.7	+106.96	IN FROM F1.6: +103.58 OUT: +103.48	722707.6216	716803.9747
F1.8	+105.91	IN FROM F1.7: +103.02 IN FROM F5.3: +104.62 OUT: +102.82	722695.7467	716845.7204
F1.9	+105.62	IN FROM F1.8: +102.74 OUT: +102.64	722693.1645	716853.7907
F1.10	+104.18	IN FROM F1.9: +102.45 OUT: +102.45 OUT: +102.63	722675.4189	716885.1794
F1.11	+103.10	IN FROM F1.10: +101.74 OUT: +101.74	722731.7735	716897.9376
F1.12	+103.46	IN FROM F1.11: +101.19 IN FROM F7.3: +100.72 OUT: +100.23	722749.6839	716901.9579
F1.13	+103.15	IN FROM F1.12: +99.92 IN FROM F8.0: +96.46 OUT: +96.52	722746.1877	716915.8248
F2.0	+109.61	OUT: +107.78	722810.4236	716736.8772
F2.1	+108.14	IN FROM F2.0: +106.58 OUT: +106.28	722743.9649	716712.8869
F3.0	+108.14	OUT: +106.20	722793.8046	716803.0715
F3.1	+107.38	IN FROM F3.0: +105.70 OUT: +105.70	722722.9471	716778.1780
F4.0	+110.76	OUT: +107.28	722598.1817	716751.0904
F4.1	+109.12	IN FROM F4.0: +106.69 OUT: +106.72	722626.5460	716757.5468
F4.2	+108.42	IN FROM F4.1: +106.51 OUT: +106.51	722641.3911	716756.9251
F4.3	+107.35	IN FROM F4.2: +105.24 OUT: +105.24	722687.4688	716768.3509
F4.4	+107.39	IN FROM F4.3: +105.07 OUT: +105.07	722700.2056	716774.8667
F5.0	+111.03	OUT: +108.60	722583.4027	716804.8486
F5.1	+110.00	IN FROM F5.0: +108.28 OUT: +107.78	722598.2082	716809.3331
F5.2	+108.77	IN FROM F5.1: +107.28 OUT: +107.01	722617.4595	716825.1264
F5.3	+107.56	IN FROM F5.2: +106.29 OUT: +105.93	722643.1042	716831.6393
F6.0	+108.27	OUT: +105.76	722558.0115	716898.1562
F6.1	+107.48	IN FROM F6.0: +105.33 OUT: +105.16	722579.3790	716898.0120
F6.2	+106.68	IN FROM F6.1: +104.49 OUT: +104.49	722612.8702	716895.4141
F6.3	+105.76	IN FROM F6.2: +103.86 OUT: +103.86	722637.4979	716875.6243
F6.4	+104.59	IN FROM F6.3: +103.29 IN FROM F1.10: +102.93 IN FROM F9.4: +102.93	722662.8318	716880.1892
F7.0	+108.10	OUT: +104.78	722781.2391	716807.7358
F7.1	+106.77	IN FROM F7.0: +104.06 OUT: +103.81	722773.3936	716835.2550
F7.2	+104.18	IN FROM F7.1: +102.60 OUT: +101.59	722772.2459	716883.7926
F7.3	+102.82	IN FROM F7.2: +101.15 OUT: +100.83	722768.0977	716905.4450
F8.0	+101.60	OUT: +96.65	722787.3029	716927.6403
F9.0	+106.74	OUT: +104.64	722582.0859	716929.3459
F9.1	+106.05	IN FROM F9.0: +104.33 OUT: +104.33	722607.0958	716926.8001
F9.2	+104.74	IN FROM F9.1: +103.54 OUT: +103.55	722644.7687	716924.0749
F9.3	+104.74	IN FROM F9.2: +103.47 OUT: +103.47	722652.0904	716923.5181
F9.4	+104.73	IN FROM F9.3: +103.02 OUT: +103.02	722661.6566	716887.8940

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.
3. PROPOSED GRAVITY SEWER PIPES ARE TO BE SPECIFIED IN ACCORDANCE WITH SECTION 3.13.1 OF THE WASTEWATER CODE OF PRACTICE.

CIVIL LEGEND

NEW FOUL MANHOLE	F
NEW FOUL PIPE	PIPE DESCRIPTION
NEW SURFACE WATER MANHOLE	S
NEW SURFACE WATER PIPE	PIPE DESCRIPTION
FOUL ACCESS JUNCTION	AJ
SURFACE ACCESS JUNCTION	AJ
RAINWATER PIPE	RWP
SOIL VENT PIPE	SVP
ROAD GULLEY	RG
BACK INLET GULLEY TRAP	BIGT
FOUL RODDING EYE	RE
SURFACE RODDING EYE	RE
GULLEY TRAP	GT
SITE BOUNDARY	



TYPICAL DRAINAGE ARRANGEMENT LAYOUT

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
P3	07.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM
P2	04.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM
P1	30.03.20	ISSUED FOR PLANNING	TMH / TMH	TMH / BM

DRAWING STAGE

PLANNING

BM BARRETT MAHONY

Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164

London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722

Consulting Engineers, Civil . Structural . Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

QAS INTERNATIONAL ISO 9001:2008 REGISTERED COMPANY · The Institution of Structural Engineers · ACEI · FIDIC International Federation of Consulting Engineers

CLIENT
CAIRN HOMES PROPERTIES LTD.

PROJECT TITLE
COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

BM PROJECT No.
18243

MODEL REFERENCE
18243-C1020

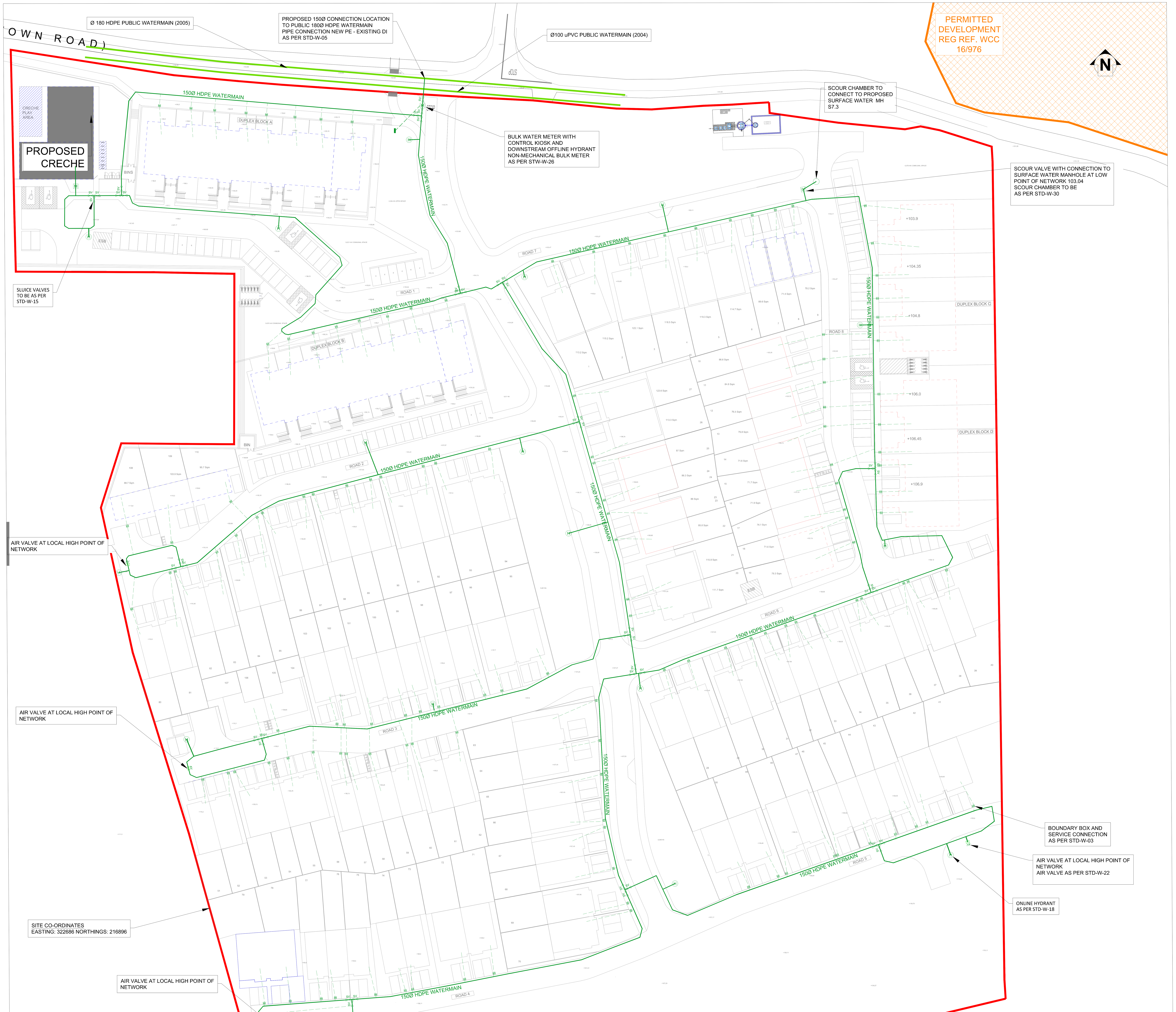
MODEL REV.

SUITABILITY

DRAWING TITLE
PROPOSED FOUL & SURFACE WATER DRAINAGE LAYOUT

DRAWING No.
18243-BMD-00-XX-DR-C-1020

ISSUE
PL3



WATERMAIN LAYOUT

SCALE @ A1: 1:500
SCALE @ A3: 1:1000

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

CIVIL LEGEND

Ex. WATERMAIN	
WATERMAIN	
SLUICE VALVE	SV
STOP COCK	SC
AIR VALVE	AV
FIRE HYDRANT	H
MAGNETIC FLOW WATER METER	M
IRRIGATION VALVE	IV
TRUST BLOCK	*
BOUNDARY BOX	BB
SITE BOUNDARY	

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
P2	04.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM
P1	30.03.20	ISSUED FOR PLANNING	TMH / TMH	TMH / BM

DRAWING STAGE
PLANNING

BARRETT MAHONY
Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164
London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural . Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

CLIENT
CAIRN HOMES PROPERTIES LTD.

PROJECT TITLE
COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

BM PROJECT No.
18243

MODEL REFERENCE
18243-C1020

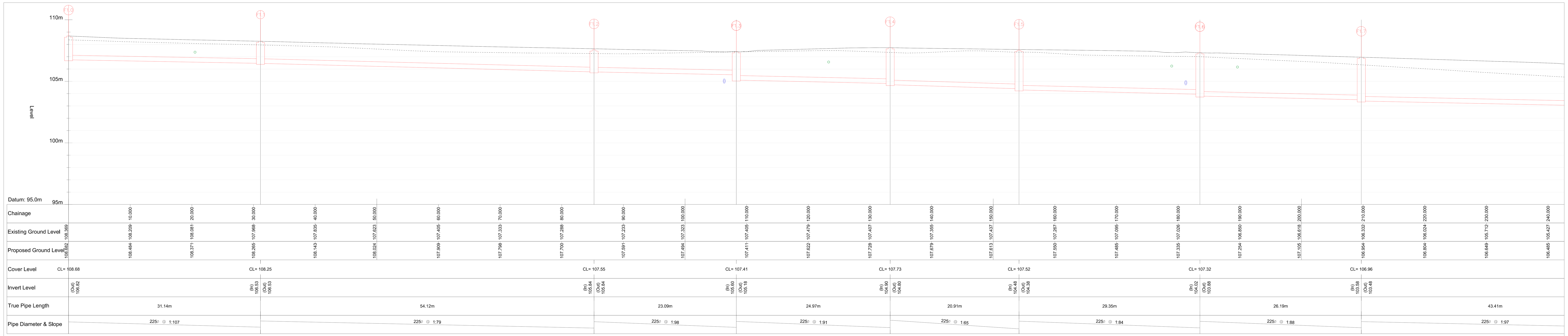
MODEL REV.

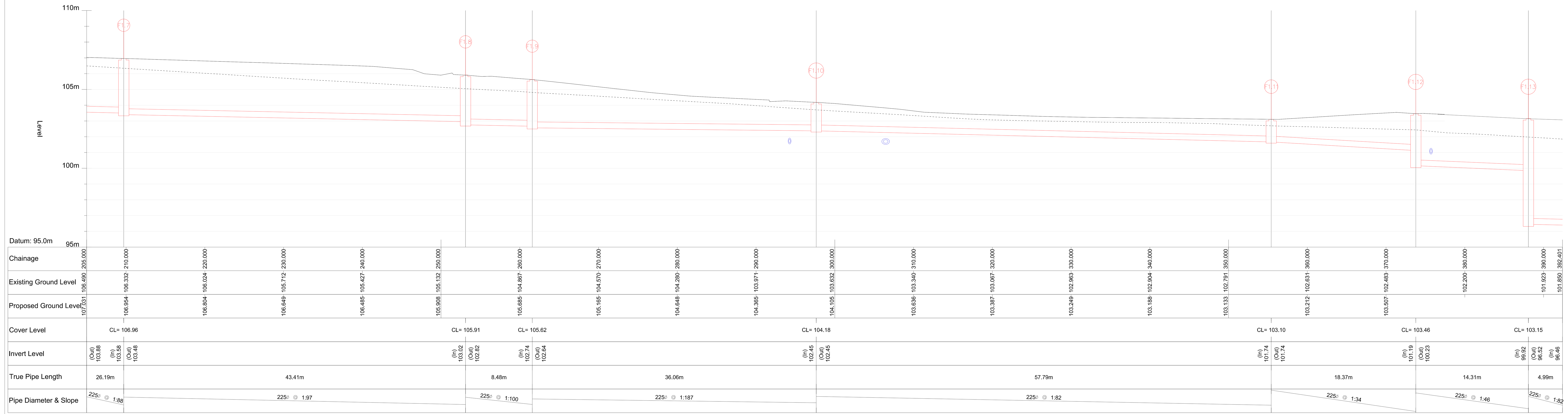
SUITABILITY

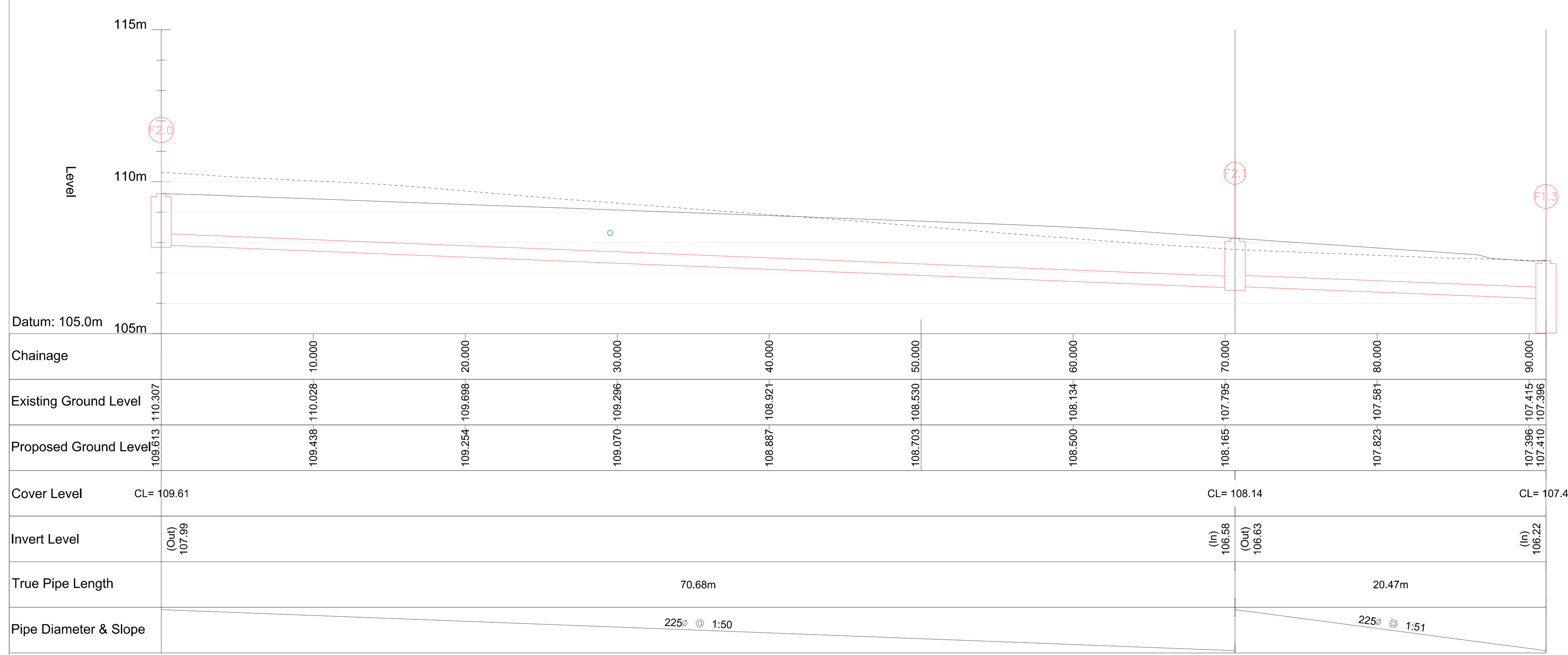
DRAWING TITLE
PROPOSED WATERMAIN LAYOUT

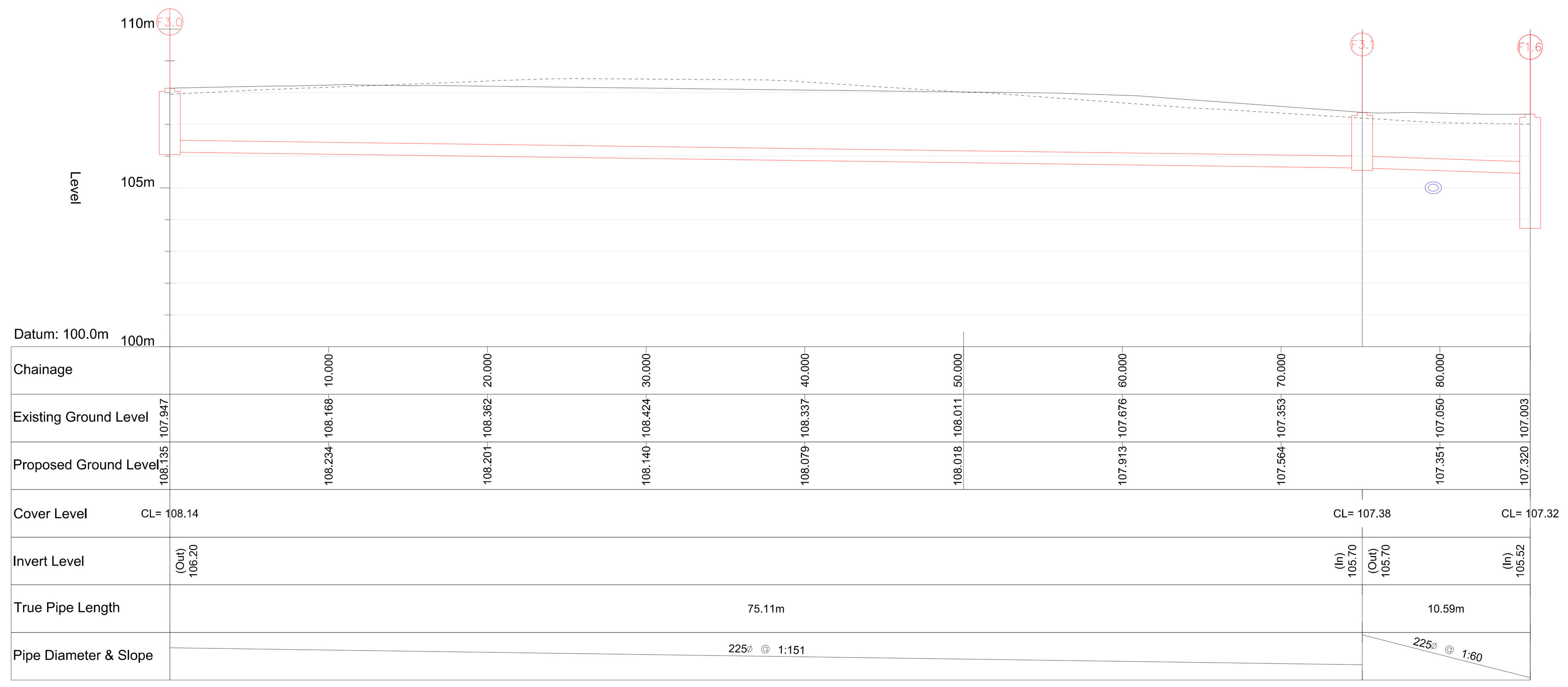
DRAWING No.
18243-BMD-00-XX-DR-C-1030

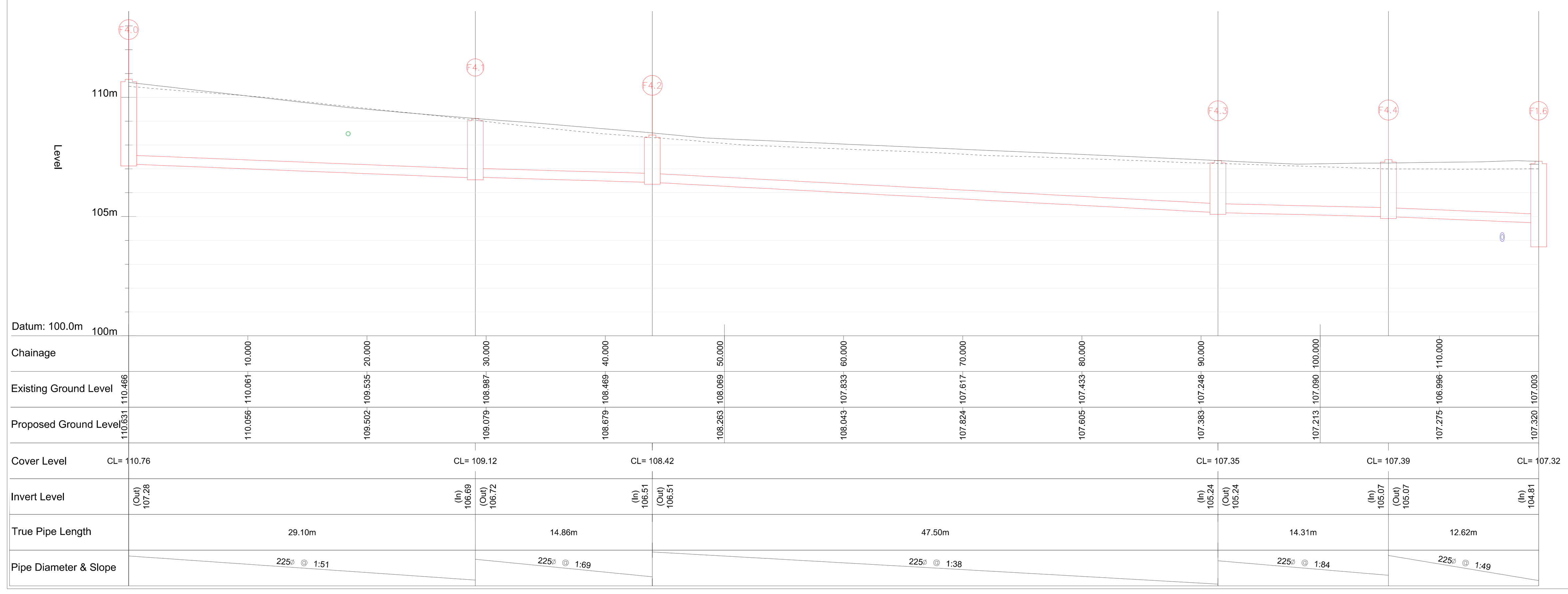
ISSUE
PL2











FOUL LONG SECTIONS

SCALE @ A0: H= 1:250 ; V= 1:50
SCALE @ A2: H= 1:500 ; V= 1:100

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
P2	06.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM
P1	04.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM

DRAWING STAGE
PLANNING

BARRETT MAHONY
Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164
London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural . Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

QAS INTERNATIONAL ISO 9001:2008 REGISTERED COMPANY Certificate No. IRE1213
The Institution of Structural Engineers
ACEI
FIDIC International Federation of Consulting Engineers

CLIENT
CAIRN HOMES PROPERTIES LTD.

PROJECT TITLE
COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

BM PROJECT No.
18243

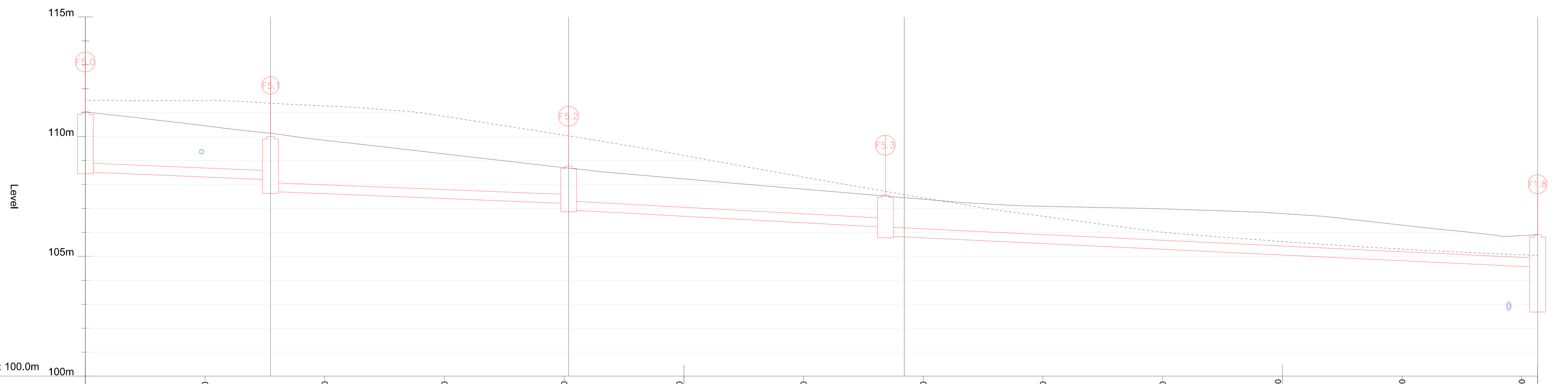
MODEL REFERENCE
18243-C1020

MODEL REV.
SUITABILITY

DRAWING TITLE
PROPOSED FOUL DRAINAGE LONG SECTIONS

DRAWING No.
18243-BMD-00-XX-DR-C-1122

ISSUE
PL2

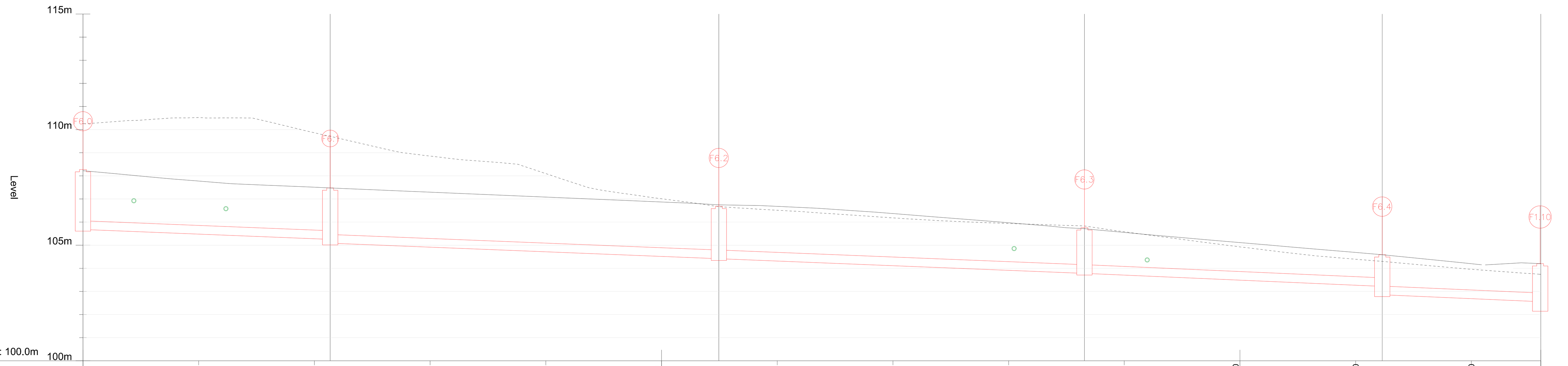


Datum: 100.0m 100m

Chainage	Existing Ground Level	Proposed Ground Level
	111.520	111.034
10.000	111.511	110.455
20.000	111.286	109.852
30.000	110.848	109.278
40.000	110.063	108.706
50.000	109.213	108.233
60.000	108.313	107.809
70.000	107.443	107.385
80.000	106.675	107.090
90.000	106.002	106.981
100.000	105.618	106.786
110.000	105.303	106.302
120.000	105.068	105.869
	105.044	105.904

Cover Level	CL= 111.03	CL= 110.00	CL= 108.77	CL= 107.56	CL= 105.91
Invert Level	(Out) 108.60	(In) 108.28 (Out) 107.78	(In) 107.28 (Out) 107.01	(In) 106.29 (Out) 105.93	(In) 104.62

True Pipe Length	15.48m	24.91m	26.47m	54.51m
Pipe Diameter & Slope	225∅ @ 1:49	225∅ @ 1:50	225∅ @ 1:37	225∅ @ 1:42

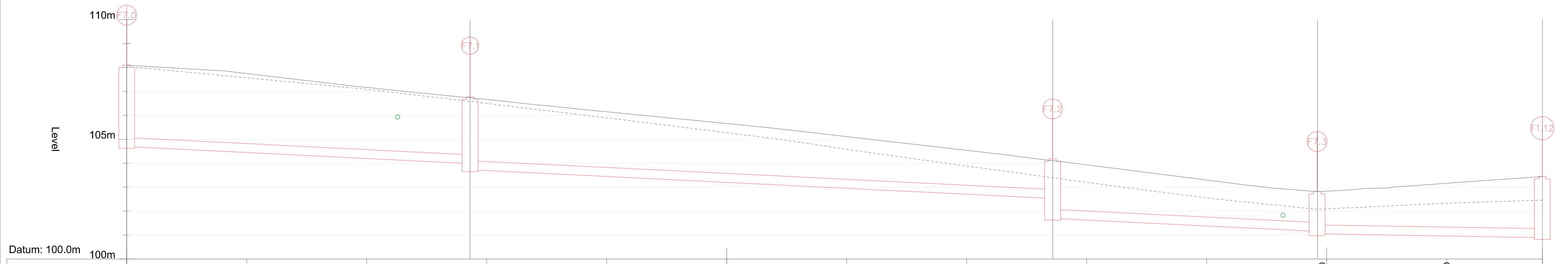


Datum: 100.0m 100m

Chainage	Existing Ground Level	Proposed Ground Level
	110.258	108.220
10.000	110.522	107.773
20.000	109.865	107.507
30.000	108.855	107.293
40.000	108.097	107.080
50.000	107.008	106.867
60.000	106.513	106.678
70.000	106.181	106.368
80.000	105.940	105.972
90.000	105.580	105.555
100.000	104.926	105.112
110.000	104.392	104.687
120.000	103.958	104.198
	103.740	104.201

Cover Level	CL= 108.27	CL= 107.48	CL= 106.68	CL= 105.76	CL= 104.59	CL= 104.20
Invert Level	(Out) 105.76	(In) 105.33 (Out) 105.16	(In) 104.49 (Out) 104.49	(In) 103.86 (Out) 103.86	(In) 103.29 (Out) 102.93	(In) 102.63

True Pipe Length	21.38m	33.60m	31.60m	25.75m	13.71m
Pipe Diameter & Slope	225∅ @ 1:51	225∅ @ 1:50	225∅ @ 1:50	225∅ @ 1:46	225∅ @ -1:46

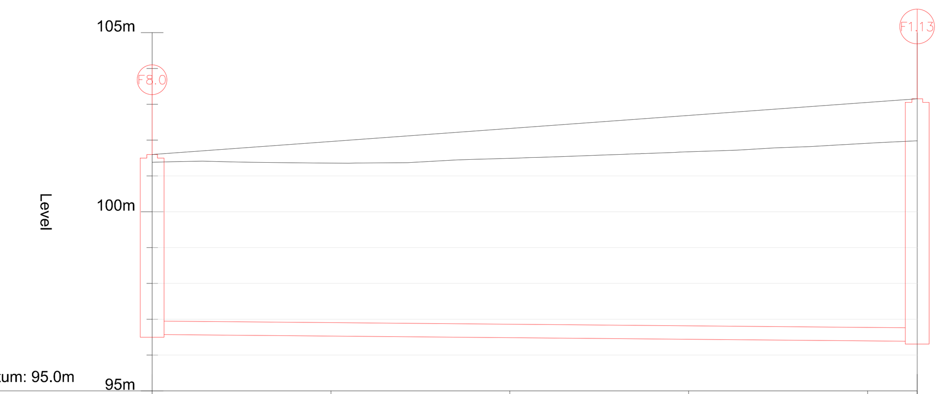


Datum: 100.0m 100m

Chainage	Existing Ground Level	Proposed Ground Level
	108.007	108.095
10.000	107.569	107.745
20.000	107.082	107.166
30.000	106.498	106.661
40.000	105.893	106.148
50.000	105.276	105.657
60.000	104.584	105.113
70.000	103.883	104.537
80.000	103.205	103.935
90.000	102.557	103.298
100.000	102.094	102.830
110.000	102.327	103.165
	102.456	103.445

Cover Level	CL= 108.10	CL= 106.77	CL= 104.18	CL= 102.82	CL= 103.44
Invert Level	(Out) 104.78	(In) 104.06 (Out) 103.81	(In) 102.60 (Out) 101.78	(In) 101.22 (Out) 101.12	(In) 100.97

True Pipe Length	28.63m	48.57m	22.06m	18.72m
Pipe Diameter & Slope	225∅ @ 1:40	225∅ @ 1:41	225∅ @ 1:41	225∅ @ 1:120

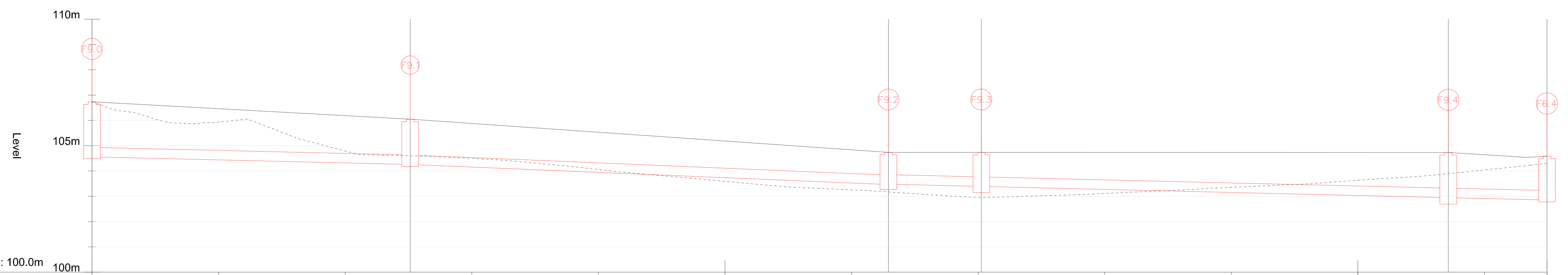


Datum: 95.0m 95m

Chainage	Existing Ground Level	Proposed Ground Level
	101.384	101.384
10.000	101.359	101.359
20.000	101.493	101.493
30.000	101.674	101.674
40.000	101.913	101.913
	101.979	101.979

Cover Level	CL= 101.60	CL= 103.15
Invert Level	(Out) 96.65	(In) 96.46

True Pipe Length	42.78m
Pipe Diameter & Slope	225∅ @ 1:226



Datum: 100.0m 100m

Chainage	Existing Ground Level	Proposed Ground Level
10.000		
20.000		
30.000		
40.000		
50.000		
60.000		
70.000		
80.000		
90.000		
100.000		
110.000		
	104.587	104.587

Cover Level	CL= 106.74	CL= 106.05	CL= 104.74	CL= 104.74	CL= 104.73	CL= 104.59
Invert Level	(Out) 104.64	(In) 104.33 (Out) 104.33	(In) 103.54 (Out) 103.55	(In) 103.47 (Out) 103.47	(In) 103.02 (Out) 103.02	(In) 102.93

True Pipe Length	25.15m	37.78m	7.35m	36.89m	7.80m
Pipe Diameter & Slope	225∅ @ 1:84	225∅ @ 1:48	225∅ @ 1:84	225∅ @ 1:84	225∅ @ 1:84

FOUL LONG SECTIONS

SCALE @ A0: H= 1:250 ; V= 1:50
SCALE @ A2: H= 1:500 ; V= 1:100

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - `ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

ISSUE	DATE	DESCRIPTION	DRN / ORIG	P.E. / P.D.
P1	04.08.20	ISSUED FOR PLANNING	NMM / TMH	TMH / BM

DRAWING STAGE **PLANNING**

BM BARRETT MAHONY
Dublin Office:
Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland.
Tel: (01) 677 3200 Fax: (01) 677 3164
London Office:
12 Mill Street, London SE1 2AY, United Kingdom
Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural . Project Management.E-mail: bmce@bmce.ie Web: www.bmce.ie

CLIENT
CAIRN HOMES PROPERTIES LTD.

PROJECT TITLE
COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW

BM PROJECT No. **18243**

MODEL REFERENCE **18243-C1020**

MODEL REV. | SUITABILITY

DRAWING TITLE
PROPOSED FOUL DRAINAGE LONG SECTIONS

DRAWING No. **18243-BMD-00-XX-DR-C-1123**

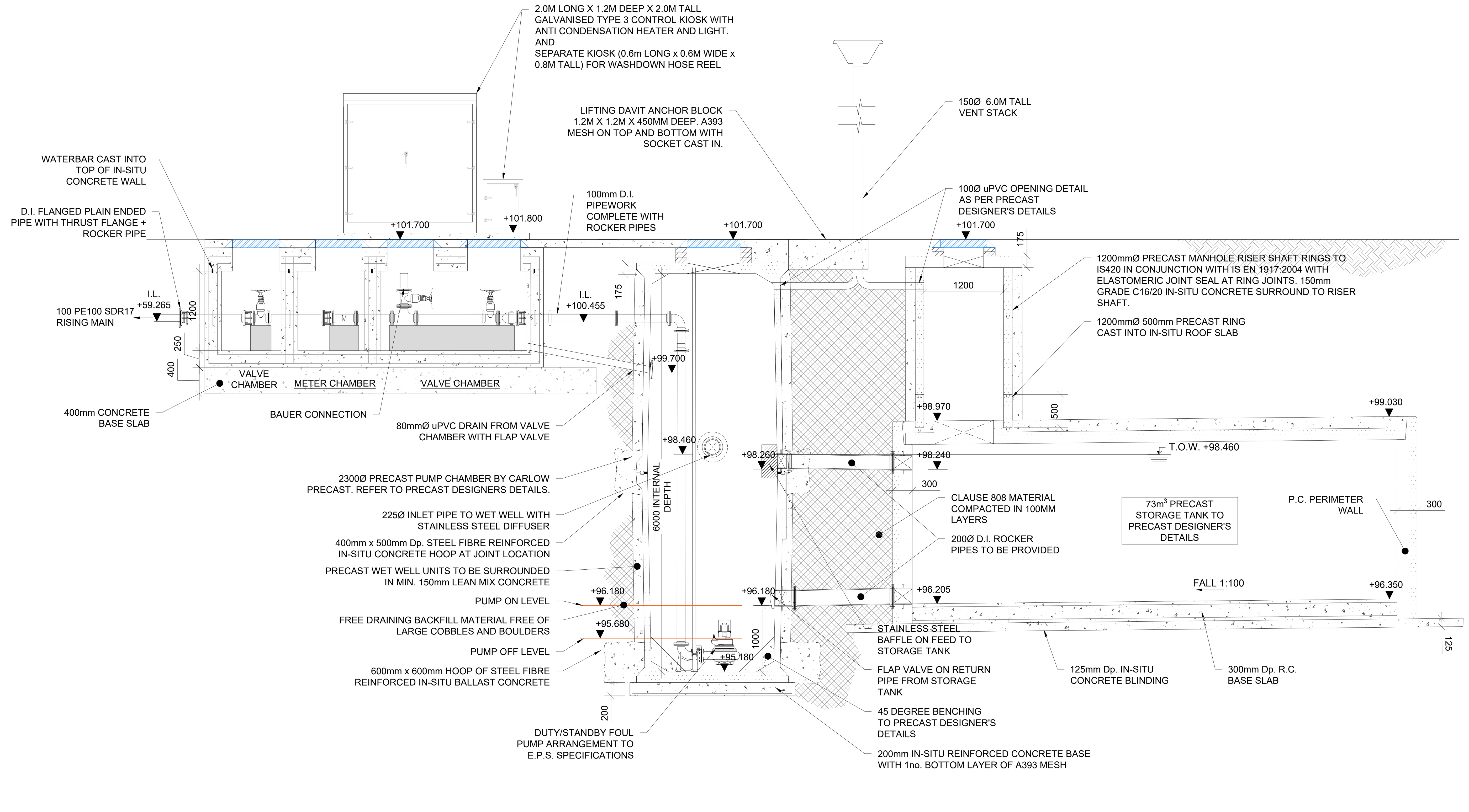
ISSUE **PL1**

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS & ARCHITECT'S DRAWINGS.FIGURED DIMENSIONS ONLY (NOT SCALING) TO BE USED. WHERE A CONFLICT OF INFORMATION EXISTS OR IF IN ANY DOUBT - 'ASK'.
2. CONSULTANTS TO BE INFORMED IMMEDIATELY OF ANY DISCREPANCIES BEFORE WORK PROCEEDS.

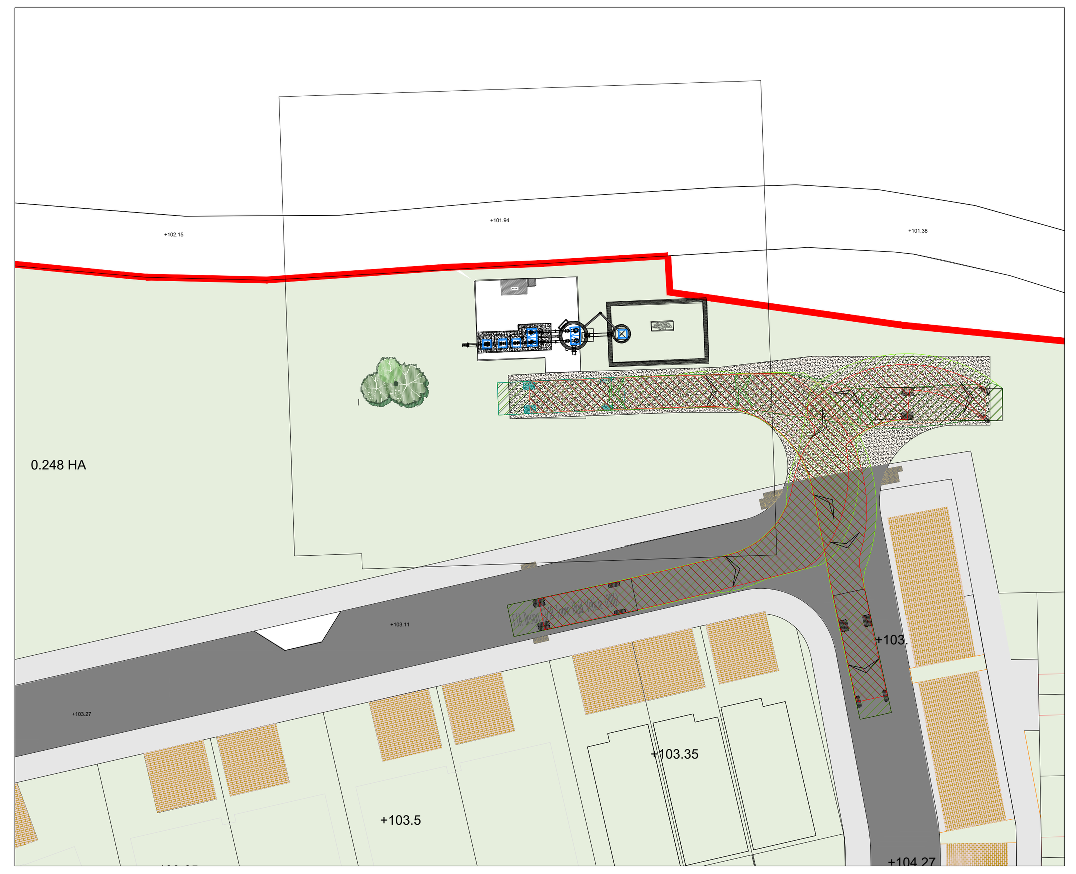
LEGEND

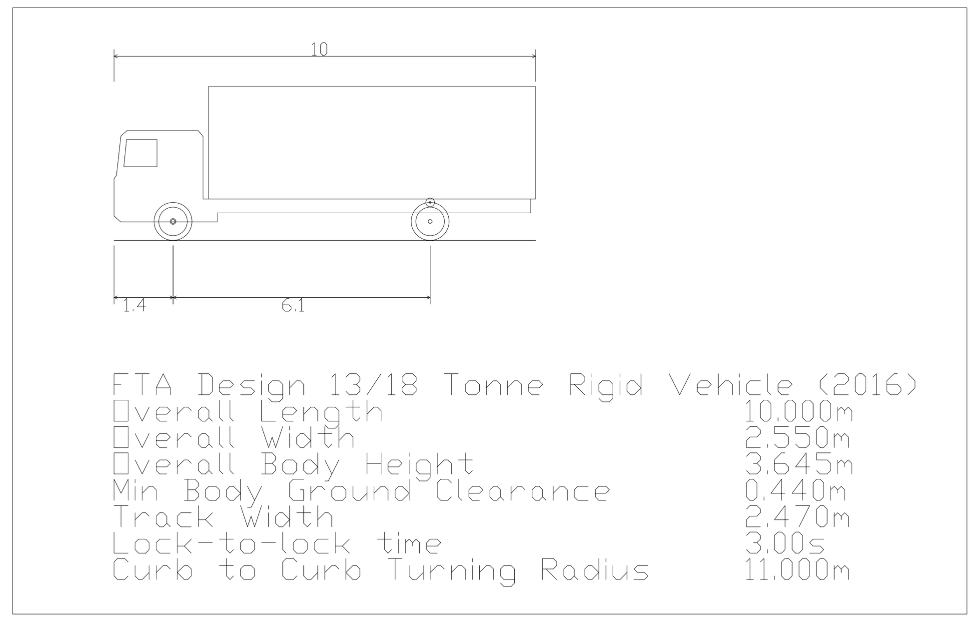
- ESB DUCT (125mm)
- POWER DUCT (100mm)
- SIGNAL DUCT (100mm)
- ESBMP — ESB MINI-PILLAR
- 1" WATERMAIN CONNECTION AND BOUNDARY BOX

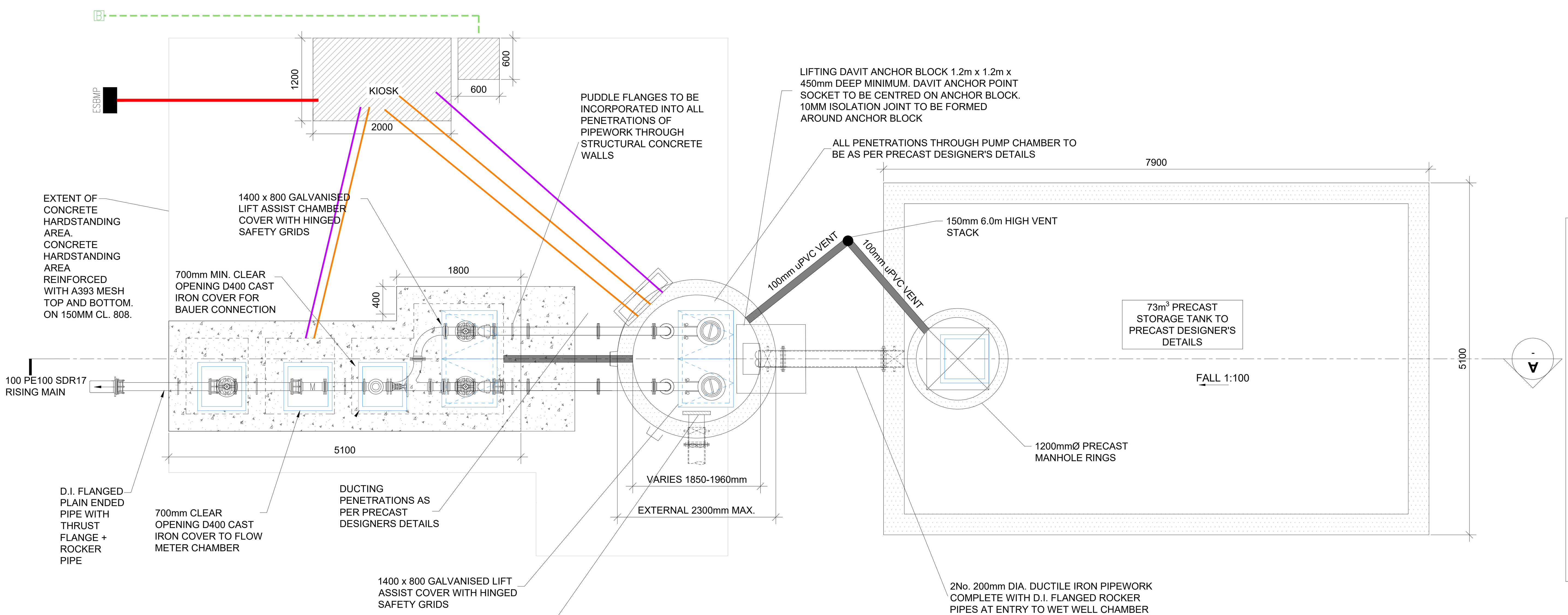


A SECTION

SCALE @ A1: 1:50
SCALE @ A3: 1:100







PLAN

SCALE @ A1: 1:50
SCALE @ A3: 1:100

NOTES:

1. ALL KIOSKS AND COVERS TO BE LPS 1175 SR3 SECURITY RATED.
2. C250 RATED 14x8 SAFETY LIFT ASSIST ACCESS COVERS (LPS 1175 SR3 SECURITY RATED) COMPLETE WITH FALL ARREST CAGES TO BE PROVIDED ON WET WELL AND VALVE CHAMBER. ALL OTHER LIDS TO BE CAST IRON D400 RATED WITH CLEAR OPENING OF 700mm x 700mm.
3. PRECAST ELEMENTS BE SURROUNDED IN CONCRETE AS SHOWN.
4. 45 DEGREE BENCHING TO BE PROVIDED IN WET WELL TOWARDS PUMPS.
5. DN225 OVERFLOW AND RETURN PIPE TO BE INSTALLED WITH ROCKER PIPES FITTED.
6. STAINLESS STEEL DIFFUSER TO BE PROVIDED ON MAIN GRAVITY INLET TO WET WELL SUMP.
7. HAND OPERATED PENSTOCK INLET VALVE TO BE PROVIDED IN FINAL FOUL MANHOLE (F1.10) UPSTREAM OF WET WELL.
8. MIN. 500mm STRAIGHT PIPE REQUIRED PRIOR AND POST F.M. BEFORE ANY VALVES. ISOLATION VALVE TO BE PROVIDED AFTER FM PRIOR TO RISING MAIN.
9. PUBLIC STREET LIGHTING FOR THE DEVELOPMENT SHALL PROVIDE MIN. 100 LUX AT GROUND LEVEL OF PUMPING STATION.
10. RISING MAIN TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS AND CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE.
11. RISING MAIN DISCHARGE MANHOLE TO BE CONSTRUCTED IN ACCORDANCE WITH DRAWING NO. 1212.

ISSUE	DATE	DESCRIPTION	DRN.	ORIG	P.E.	P.D.
P2	31.07.20	ISSUED FOR IRISH WATER REVIEW	TMH	POD	TMH	JC
P1	26.08.19	ISSUED FOR COMMENT	PR	POD	POD	BM

DRAWING STAGE: **PRELIMINARY**

BM BARRETT MAHONY
Dublin Office: Sandwith House, 52-54 Lower Sandwith Street, Dublin 2, Ireland. Tel: (01) 677 3200 Fax: (01) 677 3164
London Office: 12 Mill Street, London SE1 2AY, United Kingdom Tel: (0044) 084 5413 2722
Consulting Engineers, Civil . Structural . Project Management. E-mail: bmce@bmce.ie Web: www.bmce.ie
The Institution of Structural Engineers
ACEI
FIDIC International Federation of Consulting Engineers

CLIENT: **CAIRN HOMES PROPERTIES LTD.**

PROJECT TITLE: **COOKSTOWN ROAD, ENNISKERRY, CO. WICKLOW**

BM PROJECT No.: **18243**

MODEL REFERENCE | MODEL REV. | SUITABILITY

DRAWING TITLE: **PROPOSED FOUL PUMPING STATION DETAILS**

DRAWING No.: **18243-BMD-00-XX-DR-C-1211**

ISSUE: **P2**

APPENDIX IV

Bray Municipal Local Area Plan Flood Study

Flood Risk Zones and Justification Test

The following is an analysis of the vulnerability of land uses on sites that fall within Flood Zone A and B, and where appropriate, the application of the Justification Test for plan making. All sites are indicated on the Flood Risk Assessment Map for each settlement, the map is located at the end of each town section here.

Justification Test Note: Where the justification test has been carried out it is important to note that a flood risk assessment to an appropriate level of detail has been carried out as part of the Strategic Environmental Assessment as part of the development plan preparation process, which demonstrates that flood risk to the development can be adequately managed and the use or development of the lands will not cause unacceptable adverse impacts elsewhere.

Site No. 1

Land zoning	CA – Conservation Area
Flood zone A and/or B	A and B
Vulnerability of land use vrs.Flood Zone	Land use zoning appropriate
Requirement for Justification Test	No

Site No. 2

Land zoning	AOS – Active Open Space
Flood zone A and/or B	A and B
Vulnerability of land use vrs.Flood Zone	Land use zoning appropriate
Requirement for Justification Test	No

Site No. 3

Land zoning	POS – Passive Open Space
Flood zone A and/or B	A and B
Vulnerability of land use vrs.Flood Zone	Land use zoning appropriate
Requirement for Justification Test	No

Site No.4

Land zoning	TC –Town Centre
Flood zone A and/or B	A and B
Vulnerability of land use vs. Flood Zone	Land use zoning not appropriate
Requirement for Justification Test	Yes

Justification Test		
1	The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, as amended.	Under the Wicklow County Development Plan, Enniskerry is designated a Level 5 Small Growth Town. Under the 'Core Strategy' of the CDP, the population of Enniskerry is targeted to growth to 2,401 by 2025. Level 4 retail centres are defined as 'local centres / small towns' where the retail needs would be expected to include a newsagent, small supermarket / general grocery store, sub-post office and other small shops of a local nature serving a small, localised catchment population. One supermarket / two medium sized convenience stores (up to 1,000sqm aggregate) and c. 10-20 smaller shops.
2	The zoning or designation of the lands for the particular use or development type is required to achieve the proper and sustainable planning of the urban settlement and in particular:	
	(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	No
	(ii) Comprises significant previously developed and/or under-utilised lands;	Yes
	(iii) Is within or adjoining the core of an established or designated urban settlement;	No

	(iv) Will be essential in achieving compact or sustainable urban growth;	No
	(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	N/A – these lands are developed
Conclusion	Justification test failed.	
Recommendation	These lands are currently developed for existing Town Centre uses. As such, it is considered appropriate to retain the TC zoning objective. Applications for minor development (e.g. extensions) are unlikely to raise significant flooding issues. Should expansion of existing uses be proposed, flood mitigation measures are required (refer to CDP Flood Objectives).	

Site No. 5

Land zoning	RE –Existing Residential
Flood zone A and/or B	A and B
Vulnerability of land use vs. Flood Zone	Land use zoning not appropriate
Requirement for Justification Test	Yes

Justification Test		
1	The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, a amended.	Under the Wicklow County Development Plan, Enniskerry is designated a Level 5 Small Growth Town. Under the 'Core Strategy' of the CDP, the population of Enniskerry is targeted to growth to 2,401 by 2025.
2	The zoning or designation of the lands for the particular use or development type is required to achieve the proper and sustainable planning of the urban settlement and in particular:	
	(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	No
	(ii) Comprises significant previously developed and/or under-utilised lands;	Yes
	(iii) Is within or adjoining the core of an established or designated urban settlement;	No
	(iv) Will be essential in achieving compact or sustainable urban growth;	No
	(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	N/A – these lands are developed
Conclusion	Justification test failed.	
Recommendation	These lands are currently developed for existing Residential uses. As such, it is considered appropriate to retain the RE zoning objective. Applications for minor development (e.g. extensions) are unlikely to raise significant flooding issues. Should expansion of existing uses be proposed, flood mitigation measures are required (refer to CDP Flood Objectives).	

Site No. 6

Land zoning	RE –Existing Residential
Flood zone A and/or B	A and B
Vulnerability of land use vs. Flood Zone	Land use zoning not appropriate
Requirement for Justification Test	Yes

Justification Test		
1	The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, a amended.	Under the Wicklow County Development Plan, Enniskerry is designated a Level 5 Small Growth Town. Under the 'Core Strategy' of the CDP, the population of Enniskerry is targeted to growth to 2,401 by 2025.
2	The zoning or designation of the lands for the particular use or development type is required to achieve the proper and sustainable planning of the urban settlement and in particular:	

	(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	No
	(ii) Comprises significant previously developed and/or under-utilised lands;	Yes
	(iii) Is within or adjoining the core of an established or designated urban settlement;	No
	(iv) Will be essential in achieving compact or sustainable urban growth;	No
	(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	N/A – these lands are developed

Conclusion	Justification test failed.
Recommendation	These lands are currently developed for existing Residential uses. As such, it is considered appropriate to retain the RE zoning objective. Applications for minor development (e.g. extensions) are unlikely to raise significant flooding issues. Should expansion of existing uses be proposed, flood mitigation measures are required (refer to CDP Flood Objectives).

Site No. 7

Land zoning	PU – Public Utility
Flood zone A and/or B	A and B
Vulnerability of land use vs. Flood Zone	Land use zoning not appropriate for flood zone A
Requirement for Justification Test	Yes

Justification Test		
1	The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, a amended.	Under the Wicklow County Development Plan, Enniskerry is designated a Level 5 Small Growth Town. Under the 'Core Strategy' of the CDP, the population of Enniskerry is targeted to growth to 2,401 by 2025.
2	The zoning or designation of the lands for the particular use or development type is required to achieve the proper and sustainable planning of the urban settlement and in particular:	
	(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	No
	(ii) Comprises significant previously developed and/or under-utilised lands;	Yes
	(iii) Is within or adjoining the core of an established or designated urban settlement;	No
	(iv) Will be essential in achieving compact or sustainable urban growth;	No
	(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	N/A – these lands are developed

Conclusion	Justification test failed.
Recommendation	These lands are currently developed for existing Public Utility uses. As such, it is considered appropriate to retain the PU zoning objective. Applications for minor development (e.g. extensions) are unlikely to raise significant flooding issues. Should expansion of existing uses be proposed, flood mitigation measures are required (refer to CDP Flood Objectives).

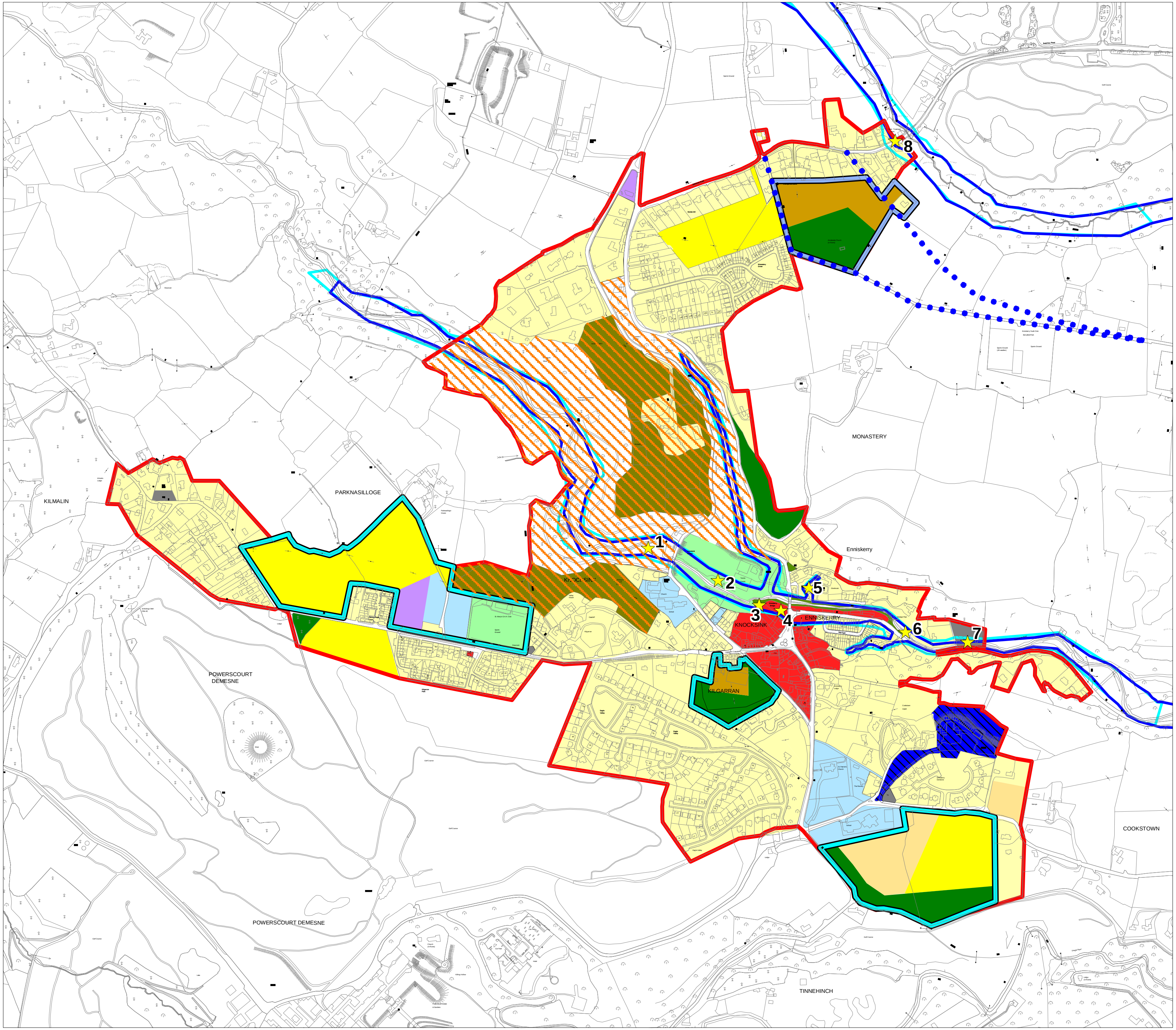
Site No. 8

Land zoning	RE –Existing Residential
Flood zone A and/or B	A and B
Vulnerability of land use vs. Flood Zone	Land use zoning not appropriate
Requirement for Justification Test	Yes

Justification Test

1	The urban settlement is targeted for growth under the National Spatial Strategy, regional planning guidelines, statutory plans as defined above or under the Planning Guidelines or Planning Directives provisions of the Planning and Development Act 2000, a amended.	Under the Wicklow County Development Plan, Enniskerry is designated a Level 5 Small Growth Town. Under the 'Core Strategy' of the CDP, the population of Enniskerry is targeted to growth to 2,401 by 2025.
2	The zoning or designation of the lands for the particular use or development type is required to achieve the proper and sustainable planning of the urban settlement and in particular:	
	(i) Is essential to facilitate regeneration and/or expansion of the centre of the urban settlement;	No
	(ii) Comprises significant previously developed and/or under-utilised lands;	Yes
	(iii) Is within or adjoining the core of an established or designated urban settlement;	No
	(iv) Will be essential in achieving compact or sustainable urban growth;	No
	(v) There are no suitable alternative lands for the particular use or development type, in areas at lower risk of flooding within or adjoining the core of the urban settlement.	N/A – these lands are developed

Conclusion	Justification test failed.
Recommendation	These lands are currently developed for existing Residential uses. As such, it is considered appropriate to retain the RE zoning objective. Applications for minor development (e.g. extensions) are unlikely to raise significant flooding issues. Should expansion of existing uses be proposed, flood mitigation measures are required (refer to CDP Flood Objectives).



Enniskerry Town Plan

DRAFT WICKLOW COUNTY DEVELOPMENT PLAN 2016-2022

- Plan Boundary
- RE - Existing Residential
- R20 - New Residential
- R10 - New Residential
- SpecialR - Special Residential
- AOS - Active Open Space
- POS - Passive Open Space
- OS - Open Space
- CE - Community and Educational
- TR - Tourism
- E - Employment
- TC - Town Centre
- PU - Public Utility
- Action Area Plan Boundary
- Specific Local Objective Boundary
- CA - Conservation Area
- Route option for Northern Access Road
- Flood Zone A
- Flood Zone B
- SFRA Site

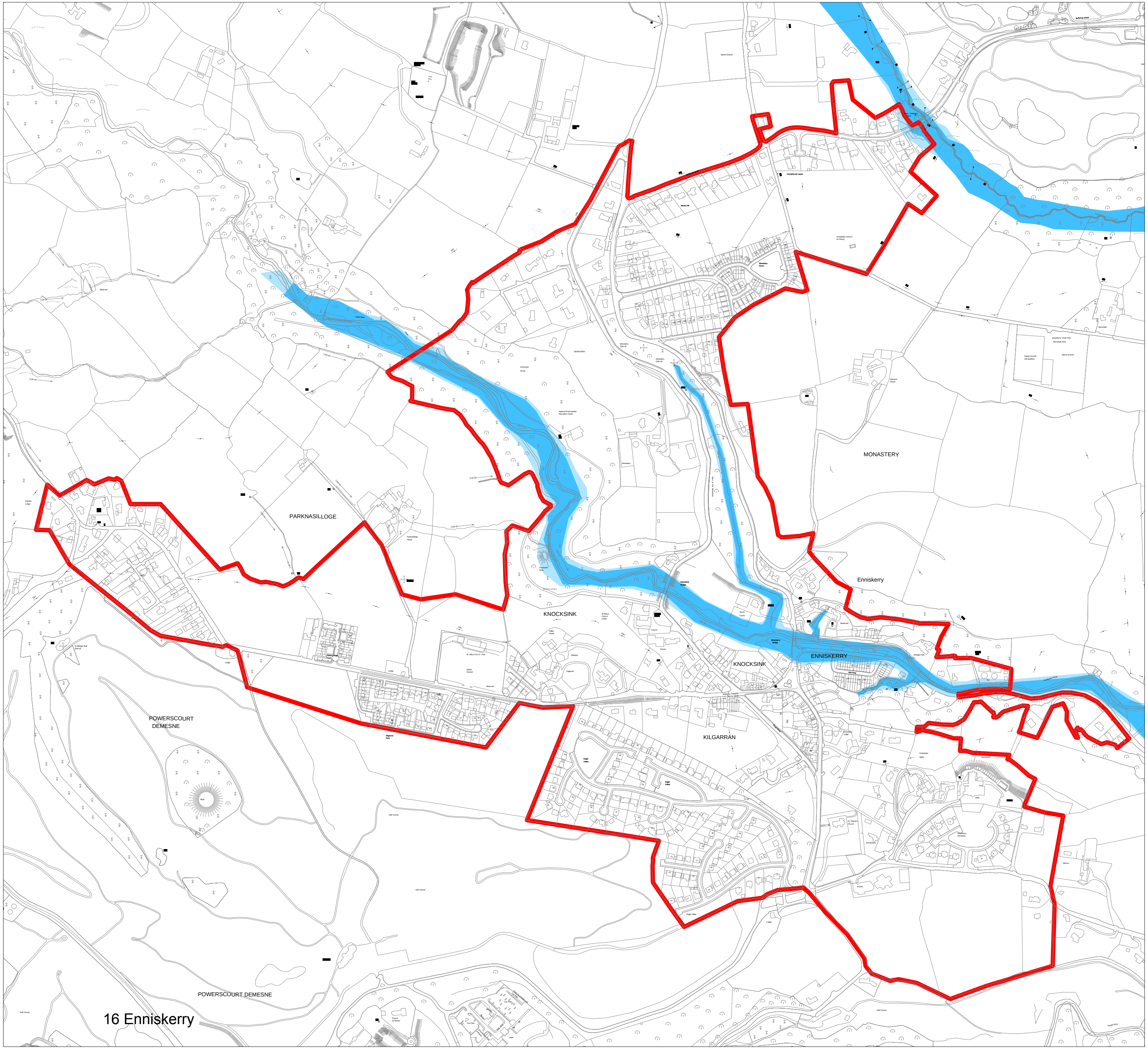
Title: Strategic Flood Risk Assessment (SFRA) - Site Assessment

Maps are not to scale

Wicklow County Council
Planning Department

APPENDIX V

Indicative Flood Zones, Map 3 taken from the Wicklow County Development Plan



16 Enniskerry

Enniskerry Town Plan

WICKLOW COUNTY DEVELOPMENT PLAN 2016-2022

Settlement Boundary

Flood Zone A: High probability of flooding

Where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding

Flood Zone B: Moderate probability of flooding

Where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding

Disclaimer

These Indicative Flood Zones were based on information available at the time of drafting and amending this plan. Any new data and analysis carried out after this date has not been integrated into this map but should be used in conjunction with this map for development proposals. All information may be substantially altered in light of future data and analysis.

Full Disclaimer is included in SFRA

Title: Indicative Flood Zones
Map No.: 3

Maps are not to scale

Wicklow County Council
Planning Department

APPENDIX VI

Surface Water Full System Simulation Model 1 in 1, 30 & 100 year storm +20% Climate Change

- Surface Water Drainage Network Design
- 1m x 4m x 3m deep infiltration trench
- 1.5mØ x 3m deep circular soakaway
- 1.2m x 0.6m land drain

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.263	Preferred Cover Depth (m)	1.000
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1.0	0.083	4.00	108.730	1200	722616.829	716680.712	1.630
S1.1	0.053	4.00	108.160	1200	722648.684	716682.816	1.379
S1.2	0.000		107.590	1200	722700.612	716692.907	1.338
S1.3	0.039	4.00	107.410	1350	722724.143	716702.074	1.561
S1.4	0.045	4.00	107.860	1350	722715.116	716724.808	2.174
S1.5	0.038	4.00	107.550	1350	722712.511	716746.485	2.082
S1.6	0.013	4.00	107.300	1350	722711.439	716766.629	1.966
S1.7	0.022	4.00	107.240	1500	722709.773	716774.881	2.037
S1.8	0.043	4.00	106.960	1500	722707.711	716788.980	1.852
S1.9	0.105	4.00	106.790	1500	722705.704	716801.641	2.170
S1.10	0.039	4.00	105.930	1500	722694.310	716842.447	2.016
S1.11	0.021	4.00	105.290	1500	722690.056	716855.072	2.290
S1.12	0.011	4.00	104.480	1500	722680.014	716871.772	2.190
S1.13	0.017	4.00	104.110	1500	722675.032	716880.792	1.998
S1.14	0.121	4.00	103.630	1500	722686.706	716889.020	1.661
S1.15	0.009	4.00	103.130	1500	722735.804	716900.950	2.325
S/Way	0.000		102.870	1500	722734.410	716908.638	2.195
S2.0	0.146	4.00	109.600	1200	722807.057	716733.281	2.110
S2.1	0.028	4.00	108.190	1200	722746.496	716711.361	1.890
S3.0	0.063	4.00	108.080	1200	722797.472	716806.015	1.580
S3.1	0.172	4.00	108.250	1200	722780.757	716801.966	1.865
S4.0	0.110	4.00	110.660	1200	722600.165	716748.553	2.460
S4.1	0.053	4.00	109.150	1200	722628.125	716755.298	1.850
S4.2	0.138	4.00	108.480	1200	722643.182	716754.839	2.080
S4.3	0.024	4.00	107.510	1200	722688.982	716766.282	1.425
S4.4	0.006	4.00	107.430	1200	722699.395	716772.384	1.425
S5.0	0.078	4.00	110.980	1200	722582.652	716801.821	2.127
S5.1	0.071	4.00	109.990	1200	722598.165	716808.914	2.260
S5.2	0.124	4.00	108.950	1200	722616.533	716822.038	2.646
S5.3	0.161	4.00	107.360	1350	722647.505	716830.629	2.460
S6.0	0.074	4.00	108.150	1200	722560.855	716895.693	1.840
S6.1	0.072	4.00	107.510	1200	722579.309	716895.737	1.790
S6.2	0.101	4.00	106.730	1200	722613.456	716892.905	2.030
S6.3	0.007	4.00	105.870	1200	722638.606	716889.915	1.658
S6.4	0.023	4.00	105.510	1200	722642.560	716873.704	1.960
S6.5	0.080	4.00	104.670	1200	722660.411	716877.218	1.720

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S7.0	0.109	4.00	108.010	1200	722778.554	716809.826	2.430
S7.1	0.193	4.00	106.640	1200	722771.017	716836.942	2.990
S7.2	0.075	4.00	104.260	1350	722770.344	716881.149	2.440
S7.3	0.033	4.00	102.970	1350	722765.336	716907.157	1.591
S7.4	0.036	4.00	103.120	1350	722746.996	716903.371	1.975
S8.0	0.004	4.00	106.580	1200	722619.209	716867.447	2.320
IC5	0.004	4.00	107.750	1200	722727.701	716712.297	0.750
IC6	0.003	4.00	107.900	1200	722721.459	716727.511	0.982
IC7	0.031	4.00	107.600	1200	722717.687	716769.903	0.895
IC8	0.000	4.00	107.500	1200	722703.262	716780.352	1.500
IC9	0.026	4.00	106.580	1200	722691.690	716834.596	0.857
IC10	0.019	4.00	102.900	1200	722668.929	716927.955	0.900
IC11	0.027	4.00	103.650	1200	722668.865	716910.184	1.814
IC12	0.040	4.00	104.150	1200	722675.619	716891.452	1.150
IC13	0.000	4.00	104.000	1200	722683.078	716893.176	1.200
IC14	0.001	4.00	103.250	1200	722731.365	716904.334	1.100

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)
1.000	S1.0	S1.1	31.924	0.600	107.100	106.781	0.319	100.0	300	4.34	50.0
1.001	S1.1	S1.2	52.899	0.600	106.781	106.252	0.529	100.0	300	4.90	50.0
1.002	S1.2	S1.3	25.254	0.600	106.252	105.999	0.253	100.0	300	5.17	50.0
1.003	S1.3	S1.4	24.461	0.600	105.849	105.686	0.163	150.0	450	5.41	50.0
1.004	S1.4	S1.5	21.833	0.600	105.686	105.468	0.218	100.0	450	5.59	50.0
1.005	S1.5	S1.6	20.173	0.600	105.468	105.334	0.134	150.0	450	5.79	50.0
1.006	S1.6	S1.7	8.418	0.600	105.334	105.278	0.056	150.0	450	5.88	50.0
1.007	S1.7	S1.8	14.249	0.600	105.203	105.108	0.095	150.0	525	6.01	50.0
1.008	S1.8	S1.9	12.819	0.600	105.108	104.894	0.214	60.0	525	6.08	50.0
1.009	S1.9	S1.10	42.367	0.600	104.620	103.914	0.706	60.0	525	6.33	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)
1.000	1.572	111.1	15.0	1.330	1.079	0.083	0.0	74	1.107
1.001	1.572	111.1	24.6	1.079	1.038	0.136	0.0	95	1.269
1.002	1.572	111.1	24.6	1.038	1.111	0.136	0.0	95	1.269
1.003	1.657	263.6	63.1	1.111	1.724	0.349	0.0	149	1.370
1.004	2.033	323.3	71.2	1.724	1.632	0.394	0.0	143	1.645
1.005	1.657	263.6	78.1	1.632	1.516	0.432	0.0	167	1.452
1.006	1.657	263.6	80.4	1.516	1.512	0.445	0.0	170	1.463
1.007	1.826	395.3	193.5	1.512	1.327	1.071	0.0	259	1.817
1.008	2.895	626.7	201.3	1.327	1.371	1.114	0.0	204	2.591
1.009	2.895	626.7	220.3	1.645	1.491	1.219	0.0	214	2.651

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)
1.010	S1.10	S1.11	13.322	0.600	103.914	103.692	0.222	60.0	525	6.40	50.0
1.011	S1.11	S1.12	19.487	0.600	103.000	102.805	0.195	100.0	525	6.55	50.0
1.012	S1.12	S1.13	10.304	0.600	102.290	102.187	0.103	100.0	525	6.63	50.0
1.013	S1.13	S1.14	14.282	0.600	102.112	101.969	0.143	100.0	600	6.72	50.0
1.014	S1.14	S1.15	50.527	0.600	101.969	101.127	0.842	60.0	600	6.99	50.0
1.015	S1.15	S/Way	7.813	0.600	100.805	100.675	0.130	60.0	600	7.03	50.0
2.000	S2.0	S2.1	64.406	0.600	107.490	106.846	0.644	100.0	300	4.68	50.0
2.001	S2.1	S1.3	24.205	0.600	106.300	106.058	0.242	100.0	300	4.94	50.0
4.000	S3.0	S3.1	17.198	0.600	106.500	106.385	0.115	150.0	300	4.22	50.0
4.001	S3.1	S1.7	75.976	0.600	106.385	105.541	0.844	90.0	300	4.99	50.0
3.000	S4.0	S4.1	28.762	0.600	108.200	107.912	0.288	100.0	225	4.37	50.0
3.001	S4.1	S4.2	15.064	0.600	107.300	107.200	0.100	150.0	225	4.60	50.0
3.002	S4.2	S4.3	47.208	0.600	106.400	106.085	0.315	150.0	300	5.22	50.0
3.003	S4.3	S4.4	12.069	0.600	106.085	106.005	0.080	150.0	300	5.37	50.0
3.004	S4.4	S1.7	10.674	0.600	106.005	105.934	0.071	150.0	300	5.51	50.0
6.000	S5.0	S5.1	17.058	0.600	108.853	108.682	0.171	100.0	225	4.22	50.0
6.001	S5.1	S5.2	22.575	0.600	107.730	107.504	0.226	100.0	300	4.46	50.0
6.002	S5.2	S5.3	32.141	0.600	106.304	105.983	0.321	100.0	300	4.80	50.0
6.003	S5.3	S1.10	48.274	0.600	104.900	104.417	0.483	100.0	375	5.24	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)
1.010	2.895	626.7	310.4	1.491	1.073	1.718	0.0	261	2.889
1.011	2.240	484.8	314.2	1.765	1.150	1.739	0.0	308	2.375
1.012	2.240	484.8	316.2	1.665	1.398	1.750	0.0	310	2.379
1.013	2.435	688.5	384.5	1.398	1.061	2.128	0.0	321	2.499
1.014	3.147	889.9	406.4	1.061	1.403	2.249	0.0	284	3.080
1.015	3.147	889.9	504.3	1.725	1.595	2.791	0.0	324	3.240
2.000	1.572	111.1	26.4	1.810	1.044	0.146	0.0	99	1.297
2.001	1.572	111.1	31.4	1.590	1.052	0.174	0.0	109	1.357
4.000	1.281	90.6	11.4	1.280	1.565	0.063	0.0	71	0.882
4.001	1.658	117.2	42.5	1.565	1.399	0.235	0.0	125	1.528
3.000	1.307	52.0	19.9	2.235	1.013	0.110	0.0	96	1.221
3.001	1.065	42.3	29.5	1.625	1.055	0.163	0.0	138	1.149
3.002	1.281	90.6	54.4	1.780	1.125	0.301	0.0	168	1.338
3.003	1.281	90.6	58.7	1.125	1.125	0.325	0.0	176	1.360
3.004	1.281	90.6	59.8	1.125	1.006	0.331	0.0	178	1.366
6.000	1.307	52.0	14.1	1.902	1.083	0.078	0.0	80	1.113
6.001	1.572	111.1	26.9	1.960	1.146	0.149	0.0	100	1.301
6.002	1.572	111.1	49.3	2.346	1.077	0.273	0.0	140	1.526
6.003	1.812	200.1	78.4	2.085	1.138	0.434	0.0	163	1.706

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)
8.000	S6.0	S6.1	18.454	0.600	106.310	106.002	0.308	60.0	225	4.18	50.0
8.001	S6.1	S6.2	34.264	0.600	105.720	105.492	0.228	150.0	225	4.72	50.0
8.002	S6.2	S6.3	25.327	0.600	104.700	104.531	0.169	150.0	300	5.05	50.0
8.003	S6.3	S6.4	16.686	0.600	104.212	104.101	0.111	150.0	300	5.26	50.0
9.000	S8.0	S6.4	24.175	0.600	104.260	103.857	0.403	60.0	300	4.20	50.0
8.004	S6.4	S6.5	18.194	0.600	103.550	103.368	0.182	100.0	300	5.46	50.0
8.005	S6.5	S1.13	15.051	0.600	102.950	102.799	0.151	100.0	300	5.62	50.0
10.000	S7.0	S7.1	28.144	0.600	105.580	105.111	0.469	60.0	225	4.28	50.0
10.001	S7.1	S7.2	44.212	0.600	103.650	102.913	0.737	60.0	300	4.64	50.0
10.002	S7.2	S7.3	26.486	0.600	101.820	101.379	0.441	60.0	375	4.83	50.0
10.003	S7.3	S7.4	18.727	0.600	101.379	101.145	0.234	80.0	375	4.98	50.0
10.004	S7.4	S1.15	11.451	0.600	101.145	101.030	0.115	100.0	375	5.09	50.0
5.000	IC5	IC6	16.445	0.600	107.000	106.918	0.082	200.0	150	4.39	50.0
5.001	IC6	IC7	42.559	0.600	106.918	106.705	0.213	200.0	150	5.39	50.0
5.002	IC7	S1.7	9.349	0.600	106.705	106.658	0.047	200.0	150	5.61	50.0
7.000	IC8	IC9	55.465	0.600	106.000	105.723	0.277	200.0	150	5.31	50.0
7.001	IC9	S1.10	8.277	0.600	105.723	105.682	0.041	200.0	150	5.50	50.0
12.000	IC10	IC11	17.771	0.600	102.000	101.911	0.089	200.0	150	4.42	50.0
11.000	IC12	IC11	19.912	0.600	103.000	102.900	0.100	200.0	150	4.47	50.0
11.001	IC11	S1.15	67.573	0.600	101.836	101.498	0.338	200.0	225	5.69	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)
8.000	1.691	67.2	13.4	1.615	1.283	0.074	0.0	68	1.329
8.001	1.065	42.3	26.4	1.565	1.013	0.146	0.0	129	1.121
8.002	1.281	90.6	44.6	1.730	1.039	0.247	0.0	149	1.276
8.003	1.281	90.6	45.9	1.358	1.109	0.254	0.0	151	1.286
9.000	2.033	143.7	0.7	2.020	1.353	0.004	0.0	16	0.538
8.004	1.572	111.1	50.8	1.660	1.002	0.281	0.0	142	1.537
8.005	1.572	111.1	65.2	1.420	1.011	0.361	0.0	166	1.633
10.000	1.691	67.2	19.7	2.205	1.304	0.109	0.0	83	1.472
10.001	2.033	143.7	54.6	2.690	1.047	0.302	0.0	128	1.899
10.002	2.342	258.7	68.1	2.065	1.216	0.377	0.0	131	1.987
10.003	2.027	223.9	74.1	1.216	1.600	0.410	0.0	148	1.828
10.004	1.812	200.1	80.6	1.600	1.725	0.446	0.0	165	1.716
5.000	0.707	12.5	0.7	0.600	0.832	0.004	0.0	24	0.381
5.001	0.707	12.5	1.3	0.832	0.745	0.007	0.0	33	0.456
5.002	0.707	12.5	6.9	0.745	0.432	0.038	0.0	79	0.723
7.000	0.707	12.5	0.0	1.350	0.707	0.000	0.0	0	0.000
7.001	0.707	12.5	4.7	0.707	0.098	0.026	0.0	64	0.656
12.000	0.707	12.5	3.4	0.750	1.589	0.019	0.0	54	0.603
11.000	0.707	12.5	7.2	1.000	0.600	0.040	0.0	82	0.732
11.001	0.921	36.6	15.5	1.589	1.407	0.086	0.0	102	0.884

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)
13.000	IC13	IC14	49.559	0.600	102.800	102.552	0.248	200.0	150	5.17	50.0
13.001	IC14	S1.15	5.582	0.600	102.150	102.057	0.093	60.0	150	5.24	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)
13.000	0.707	12.5	0.0	1.050	0.548	0.000	0.0	0	0.000
13.001	1.301	23.0	0.2	0.950	0.923	0.001	0.0	10	0.383

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)
1.000	31.924	100.0	300	Circular	108.730	107.100	1.330	108.160	106.781	1.079
1.001	52.899	100.0	300	Circular	108.160	106.781	1.079	107.590	106.252	1.038
1.002	25.254	100.0	300	Circular	107.590	106.252	1.038	107.410	105.999	1.111
1.003	24.461	150.0	450	Circular	107.410	105.849	1.111	107.860	105.686	1.724
1.004	21.833	100.0	450	Circular	107.860	105.686	1.724	107.550	105.468	1.632
1.005	20.173	150.0	450	Circular	107.550	105.468	1.632	107.300	105.334	1.516
1.006	8.418	150.0	450	Circular	107.300	105.334	1.516	107.240	105.278	1.512
1.007	14.249	150.0	525	Circular	107.240	105.203	1.512	106.960	105.108	1.327
1.008	12.819	60.0	525	Circular	106.960	105.108	1.327	106.790	104.894	1.371
1.009	42.367	60.0	525	Circular	106.790	104.620	1.645	105.930	103.914	1.491
1.010	13.322	60.0	525	Circular	105.930	103.914	1.491	105.290	103.692	1.073
1.011	19.487	100.0	525	Circular	105.290	103.000	1.765	104.480	102.805	1.150
1.012	10.304	100.0	525	Circular	104.480	102.290	1.665	104.110	102.187	1.398
1.013	14.282	100.0	600	Circular	104.110	102.112	1.398	103.630	101.969	1.061
1.014	50.527	60.0	600	Circular	103.630	101.969	1.061	103.130	101.127	1.403
1.015	7.813	60.0	600	Circular	103.130	100.805	1.725	102.870	100.675	1.595

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1.0	1200	Manhole	Adoptable	S1.1	1200	Manhole	Adoptable
1.001	S1.1	1200	Manhole	Adoptable	S1.2	1200	Manhole	Adoptable
1.002	S1.2	1200	Manhole	Adoptable	S1.3	1350	Manhole	Adoptable
1.003	S1.3	1350	Manhole	Adoptable	S1.4	1350	Manhole	Adoptable
1.004	S1.4	1350	Manhole	Adoptable	S1.5	1350	Manhole	Adoptable
1.005	S1.5	1350	Manhole	Adoptable	S1.6	1350	Manhole	Adoptable
1.006	S1.6	1350	Manhole	Adoptable	S1.7	1500	Manhole	Adoptable
1.007	S1.7	1500	Manhole	Adoptable	S1.8	1500	Manhole	Adoptable
1.008	S1.8	1500	Manhole	Adoptable	S1.9	1500	Manhole	Adoptable
1.009	S1.9	1500	Manhole	Adoptable	S1.10	1500	Manhole	Adoptable
1.010	S1.10	1500	Manhole	Adoptable	S1.11	1500	Manhole	Adoptable
1.011	S1.11	1500	Manhole	Adoptable	S1.12	1500	Manhole	Adoptable
1.012	S1.12	1500	Manhole	Adoptable	S1.13	1500	Manhole	Adoptable
1.013	S1.13	1500	Manhole	Adoptable	S1.14	1500	Manhole	Adoptable
1.014	S1.14	1500	Manhole	Adoptable	S1.15	1500	Manhole	Adoptable
1.015	S1.15	1500	Manhole	Adoptable	S/Way	1500	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)
2.000	64.406	100.0	300	Circular	109.600	107.490	1.810	108.190	106.846	1.044
2.001	24.205	100.0	300	Circular	108.190	106.300	1.590	107.410	106.058	1.052
4.000	17.198	150.0	300	Circular	108.080	106.500	1.280	108.250	106.385	1.565
4.001	75.976	90.0	300	Circular	108.250	106.385	1.565	107.240	105.541	1.399
3.000	28.762	100.0	225	Circular	110.660	108.200	2.235	109.150	107.912	1.013
3.001	15.064	150.0	225	Circular	109.150	107.300	1.625	108.480	107.200	1.055
3.002	47.208	150.0	300	Circular	108.480	106.400	1.780	107.510	106.085	1.125
3.003	12.069	150.0	300	Circular	107.510	106.085	1.125	107.430	106.005	1.125
3.004	10.674	150.0	300	Circular	107.430	106.005	1.125	107.240	105.934	1.006
6.000	17.058	100.0	225	Circular	110.980	108.853	1.902	109.990	108.682	1.083
6.001	22.575	100.0	300	Circular	109.990	107.730	1.960	108.950	107.504	1.146
6.002	32.141	100.0	300	Circular	108.950	106.304	2.346	107.360	105.983	1.077
6.003	48.274	100.0	375	Circular	107.360	104.900	2.085	105.930	104.417	1.138
8.000	18.454	60.0	225	Circular	108.150	106.310	1.615	107.510	106.002	1.283
8.001	34.264	150.0	225	Circular	107.510	105.720	1.565	106.730	105.492	1.013
8.002	25.327	150.0	300	Circular	106.730	104.700	1.730	105.870	104.531	1.039
8.003	16.686	150.0	300	Circular	105.870	104.212	1.358	105.510	104.101	1.109
9.000	24.175	60.0	300	Circular	106.580	104.260	2.020	105.510	103.857	1.353
8.004	18.194	100.0	300	Circular	105.510	103.550	1.660	104.670	103.368	1.002
8.005	15.051	100.0	300	Circular	104.670	102.950	1.420	104.110	102.799	1.011

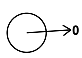
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	S2.0	1200	Manhole	Adoptable	S2.1	1200	Manhole	Adoptable
2.001	S2.1	1200	Manhole	Adoptable	S1.3	1350	Manhole	Adoptable
4.000	S3.0	1200	Manhole	Adoptable	S3.1	1200	Manhole	Adoptable
4.001	S3.1	1200	Manhole	Adoptable	S1.7	1500	Manhole	Adoptable
3.000	S4.0	1200	Manhole	Adoptable	S4.1	1200	Manhole	Adoptable
3.001	S4.1	1200	Manhole	Adoptable	S4.2	1200	Manhole	Adoptable
3.002	S4.2	1200	Manhole	Adoptable	S4.3	1200	Manhole	Adoptable
3.003	S4.3	1200	Manhole	Adoptable	S4.4	1200	Manhole	Adoptable
3.004	S4.4	1200	Manhole	Adoptable	S1.7	1500	Manhole	Adoptable
6.000	S5.0	1200	Manhole	Adoptable	S5.1	1200	Manhole	Adoptable
6.001	S5.1	1200	Manhole	Adoptable	S5.2	1200	Manhole	Adoptable
6.002	S5.2	1200	Manhole	Adoptable	S5.3	1350	Manhole	Adoptable
6.003	S5.3	1350	Manhole	Adoptable	S1.10	1500	Manhole	Adoptable
8.000	S6.0	1200	Manhole	Adoptable	S6.1	1200	Manhole	Adoptable
8.001	S6.1	1200	Manhole	Adoptable	S6.2	1200	Manhole	Adoptable
8.002	S6.2	1200	Manhole	Adoptable	S6.3	1200	Manhole	Adoptable
8.003	S6.3	1200	Manhole	Adoptable	S6.4	1200	Manhole	Adoptable
9.000	S8.0	1200	Manhole	Adoptable	S6.4	1200	Manhole	Adoptable
8.004	S6.4	1200	Manhole	Adoptable	S6.5	1200	Manhole	Adoptable
8.005	S6.5	1200	Manhole	Adoptable	S1.13	1500	Manhole	Adoptable

Pipeline Schedule

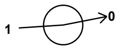
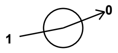
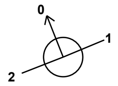
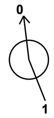
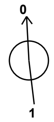
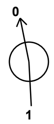
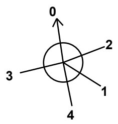
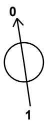
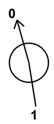
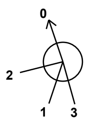
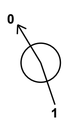
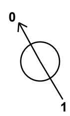
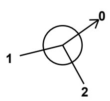
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
10.000	28.144	60.0	225	Circular	108.010	105.580	2.205	106.640	105.111	1.304
10.001	44.212	60.0	300	Circular	106.640	103.650	2.690	104.260	102.913	1.047
10.002	26.486	60.0	375	Circular	104.260	101.820	2.065	102.970	101.379	1.216
10.003	18.727	80.0	375	Circular	102.970	101.379	1.216	103.120	101.145	1.600
10.004	11.451	100.0	375	Circular	103.120	101.145	1.600	103.130	101.030	1.725
5.000	16.445	200.0	150	Circular	107.750	107.000	0.600	107.900	106.918	0.832
5.001	42.559	200.0	150	Circular	107.900	106.918	0.832	107.600	106.705	0.745
5.002	9.349	200.0	150	Circular	107.600	106.705	0.745	107.240	106.658	0.432
7.000	55.465	200.0	150	Circular	107.500	106.000	1.350	106.580	105.723	0.707
7.001	8.277	200.0	150	Circular	106.580	105.723	0.707	105.930	105.682	0.098
12.000	17.771	200.0	150	Circular	102.900	102.000	0.750	103.650	101.911	1.589
11.000	19.912	200.0	150	Circular	104.150	103.000	1.000	103.650	102.900	0.600
11.001	67.573	200.0	225	Circular	103.650	101.836	1.589	103.130	101.498	1.407
13.000	49.559	200.0	150	Circular	104.000	102.800	1.050	103.250	102.552	0.548
13.001	5.582	60.0	150	Circular	103.250	102.150	0.950	103.130	102.057	0.923

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
10.000	S7.0	1200	Manhole	Adoptable	S7.1	1200	Manhole	Adoptable
10.001	S7.1	1200	Manhole	Adoptable	S7.2	1350	Manhole	Adoptable
10.002	S7.2	1350	Manhole	Adoptable	S7.3	1350	Manhole	Adoptable
10.003	S7.3	1350	Manhole	Adoptable	S7.4	1350	Manhole	Adoptable
10.004	S7.4	1350	Manhole	Adoptable	S1.15	1500	Manhole	Adoptable
5.000	IC5	1200	Manhole	Adoptable	IC6	1200	Manhole	Adoptable
5.001	IC6	1200	Manhole	Adoptable	IC7	1200	Manhole	Adoptable
5.002	IC7	1200	Manhole	Adoptable	S1.7	1500	Manhole	Adoptable
7.000	IC8	1200	Manhole	Adoptable	IC9	1200	Manhole	Adoptable
7.001	IC9	1200	Manhole	Adoptable	S1.10	1500	Manhole	Adoptable
12.000	IC10	1200	Manhole	Adoptable	IC11	1200	Manhole	Adoptable
11.000	IC12	1200	Manhole	Adoptable	IC11	1200	Manhole	Adoptable
11.001	IC11	1200	Manhole	Adoptable	S1.15	1500	Manhole	Adoptable
13.000	IC13	1200	Manhole	Adoptable	IC14	1200	Manhole	Adoptable
13.001	IC14	1200	Manhole	Adoptable	S1.15	1500	Manhole	Adoptable

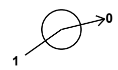
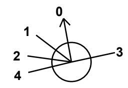
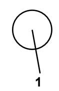
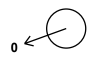
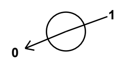
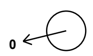
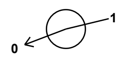
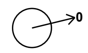
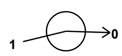
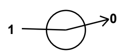
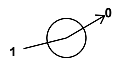
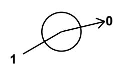
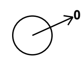
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1.0	722616.829	716680.712	108.730	1.630	1200				
						0	1.000	107.100	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S1.1	722648.684	716682.816	108.160	1.379	1200		1	1.000	106.781	300
							0	1.001	106.781	300
S1.2	722700.612	716692.907	107.590	1.338	1200		1	1.001	106.252	300
							0	1.002	106.252	300
S1.3	722724.143	716702.074	107.410	1.561	1350		1	2.001	106.058	300
							2	1.002	105.999	300
							0	1.003	105.849	450
S1.4	722715.116	716724.808	107.860	2.174	1350		1	1.003	105.686	450
							0	1.004	105.686	450
S1.5	722712.511	716746.485	107.550	2.082	1350		1	1.004	105.468	450
							0	1.005	105.468	450
S1.6	722711.439	716766.629	107.300	1.966	1350		1	1.005	105.334	450
							0	1.006	105.334	450
S1.7	722709.773	716774.881	107.240	2.037	1500		1	5.002	106.658	150
							2	4.001	105.541	300
							3	3.004	105.934	300
							4	1.006	105.278	450
							0	1.007	105.203	525
S1.8	722707.711	716788.980	106.960	1.852	1500		1	1.007	105.108	525
							0	1.008	105.108	525
S1.9	722705.704	716801.641	106.790	2.170	1500		1	1.008	104.894	525
							0	1.009	104.620	525
S1.10	722694.310	716842.447	105.930	2.016	1500		1	7.001	105.682	150
							2	6.003	104.417	375
							3	1.009	103.914	525
							0	1.010	103.914	525
S1.11	722690.056	716855.072	105.290	2.290	1500		1	1.010	103.692	525
							0	1.011	103.000	525
S1.12	722680.014	716871.772	104.480	2.190	1500		1	1.011	102.805	525
							0	1.012	102.290	525
S1.13	722675.032	716880.792	104.110	1.998	1500		1	8.005	102.799	300
							2	1.012	102.187	525
							0	1.013	102.112	600

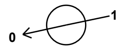
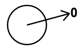
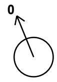
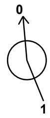
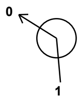
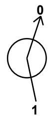
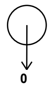
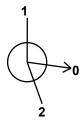
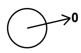
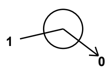
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S1.14	722686.706	716889.020	103.630	1.661	1500		1	1.013	101.969	600
							0	1.014	101.969	600
S1.15	722735.804	716900.950	103.130	2.325	1500		1	13.001	102.057	150
							2	11.001	101.498	225
							3	10.004	101.030	375
							4	1.014	101.127	600
							0	1.015	100.805	600
S/Way	722734.410	716908.638	102.870	2.195	1500		1	1.015	100.675	600
S2.0	722807.057	716733.281	109.600	2.110	1200		0	2.000	107.490	300
S2.1	722746.496	716711.361	108.190	1.890	1200		1	2.000	106.846	300
							0	2.001	106.300	300
S3.0	722797.472	716806.015	108.080	1.580	1200		0	4.000	106.500	300
S3.1	722780.757	716801.966	108.250	1.865	1200		1	4.000	106.385	300
							0	4.001	106.385	300
S4.0	722600.165	716748.553	110.660	2.460	1200		0	3.000	108.200	225
S4.1	722628.125	716755.298	109.150	1.850	1200		1	3.000	107.912	225
							0	3.001	107.300	225
S4.2	722643.182	716754.839	108.480	2.080	1200		1	3.001	107.200	225
							0	3.002	106.400	300
S4.3	722688.982	716766.282	107.510	1.425	1200		1	3.002	106.085	300
							0	3.003	106.085	300
S4.4	722699.395	716772.384	107.430	1.425	1200		1	3.003	106.005	300
							0	3.004	106.005	300
S5.0	722582.652	716801.821	110.980	2.127	1200		0	6.000	108.853	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S5.1	722598.165	716808.914	109.990	2.260	1200	1	6.000	108.682	225
						0	6.001	107.730	300
S5.2	722616.533	716822.038	108.950	2.646	1200	1	6.001	107.504	300
						0	6.002	106.304	300
S5.3	722647.505	716830.629	107.360	2.460	1350	1	6.002	105.983	300
						0	6.003	104.900	375
S6.0	722560.855	716895.693	108.150	1.840	1200	0	8.000	106.310	225
S6.1	722579.309	716895.737	107.510	1.790	1200	1	8.000	106.002	225
						0	8.001	105.720	225
S6.2	722613.456	716892.905	106.730	2.030	1200	1	8.001	105.492	225
						0	8.002	104.700	300
S6.3	722638.606	716889.915	105.870	1.658	1200	1	8.002	104.531	300
						0	8.003	104.212	300
S6.4	722642.560	716873.704	105.510	1.960	1200	1	9.000	103.857	300
						2	8.003	104.101	300
						0	8.004	103.550	300
S6.5	722660.411	716877.218	104.670	1.720	1200	1	8.004	103.368	300
						0	8.005	102.950	300
S7.0	722778.554	716809.826	108.010	2.430	1200	0	10.000	105.580	225
S7.1	722771.017	716836.942	106.640	2.990	1200	1	10.000	105.111	225
						0	10.001	103.650	300
S7.2	722770.344	716881.149	104.260	2.440	1350	1	10.001	102.913	300
						0	10.002	101.820	375
S7.3	722765.336	716907.157	102.970	1.591	1350	1	10.002	101.379	375
						0	10.003	101.379	375

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
S7.4	722746.996	716903.371	103.120	1.975	1350		1	10.003	101.145	375
							0	10.004	101.145	375
S8.0	722619.209	716867.447	106.580	2.320	1200		0	9.000	104.260	300
IC5	722727.701	716712.297	107.750	0.750	1200		0	5.000	107.000	150
IC6	722721.459	716727.511	107.900	0.982	1200		1	5.000	106.918	150
							0	5.001	106.918	150
IC7	722717.687	716769.903	107.600	0.895	1200		1	5.001	106.705	150
							0	5.002	106.705	150
IC8	722703.262	716780.352	107.500	1.500	1200		0	7.000	106.000	150
IC9	722691.690	716834.596	106.580	0.857	1200		1	7.000	105.723	150
							0	7.001	105.723	150
IC10	722668.929	716927.955	102.900	0.900	1200		0	12.000	102.000	150
IC11	722668.865	716910.184	103.650	1.814	1200		1	12.000	101.911	150
							2	11.000	102.900	150
							0	11.001	101.836	225
IC12	722675.619	716891.452	104.150	1.150	1200		0	11.000	103.000	150
IC13	722683.078	716893.176	104.000	1.200	1200		0	13.000	102.800	150
IC14	722731.365	716904.334	103.250	1.100	1200		1	13.000	102.552	150
							0	13.001	102.150	150

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.100	Additional Storage (m³/ha)	0.0
Ratio-R	0.263	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node IC6 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	0.40	Link	5.000
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	106.918	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Node IC7 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	0.40	Link	5.001
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	106.705	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	2	Diameter (mm)	600

Node IC9 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	0.40	Link	7.000
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	105.723	Surround Shape	(Trench)
Safety Factor	1.5	Time to half empty (mins)	0	Diameter (mm)	600

Node IC11 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	0.40	Link	12.000
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	101.911	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	3	Diameter (mm)	600

Node IC14 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	0.40	Link	13.000
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	102.552	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	0	Diameter (mm)	600

Node S/Way Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.12800	Invert Level (m)	98.200	Depth (m)	3.200
Side Inf Coefficient (m/hr)	0.12800	Time to half empty (mins)	1107	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	14.000	Number Required	1
Porosity	0.95	Pit Length (m)	54.000		

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1.0	10	107.177	0.077	16.3	0.0870	0.0000	OK
15 minute summer	S1.1	10	106.883	0.102	26.7	0.1149	0.0000	OK
15 minute summer	S1.2	11	106.354	0.102	26.8	0.1155	0.0000	OK
15 minute summer	S1.3	10	106.012	0.163	66.2	0.2336	0.0000	OK
15 minute summer	S1.4	11	105.844	0.158	74.2	0.2259	0.0000	OK
15 minute summer	S1.5	11	105.661	0.193	80.8	0.2756	0.0000	OK
15 minute summer	S1.6	11	105.553	0.219	84.0	0.3130	0.0000	OK
15 minute summer	S1.7	11	105.498	0.295	201.2	0.5208	0.0000	OK
15 minute summer	S1.8	11	105.354	0.246	209.3	0.4341	0.0000	OK
15 minute summer	S1.9	11	104.844	0.224	227.3	0.3958	0.0000	OK
15 minute summer	S1.10	11	104.236	0.322	319.6	0.5685	0.0000	OK
15 minute summer	S1.11	11	103.362	0.362	324.7	0.6395	0.0000	OK
15 minute summer	S1.12	11	102.670	0.380	326.8	0.6715	0.0000	OK
15 minute summer	S1.13	11	102.496	0.384	397.3	0.6789	0.0000	OK
15 minute summer	S1.14	11	102.278	0.309	416.9	0.5464	0.0000	OK
15 minute summer	S1.15	11	101.232	0.427	513.1	0.7552	0.0000	OK
960 minute summer	S/Way	660	98.987	-1.688	77.1	565.3746	0.0000	OK
15 minute summer	S2.0	10	107.595	0.105	28.8	0.1184	0.0000	OK
15 minute summer	S2.1	10	106.418	0.118	33.8	0.1339	0.0000	OK
15 minute summer	S3.0	10	106.574	0.074	12.4	0.0839	0.0000	OK
15 minute summer	S3.1	10	106.516	0.131	46.3	0.1483	0.0000	OK
15 minute summer	S4.0	10	108.305	0.105	21.7	0.1187	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1.0	1.000	S1.1	16.3	0.928	0.147	0.5627
15 minute summer	S1.1	1.001	S1.2	26.8	1.277	0.241	1.1106
15 minute summer	S1.2	1.002	S1.3	26.1	1.269	0.235	0.5187
15 minute summer	S1.3	1.003	S1.4	65.8	1.310	0.250	1.2373
15 minute summer	S1.4	1.004	S1.5	74.6	1.307	0.231	1.2477
15 minute summer	S1.5	1.005	S1.6	81.9	1.161	0.311	1.4238
15 minute summer	S1.6	1.006	S1.7	84.7	1.248	0.321	0.6451
15 minute summer	S1.7	1.007	S1.8	202.3	1.807	0.512	1.5949
15 minute summer	S1.8	1.008	S1.9	210.2	2.375	0.335	1.1355
15 minute summer	S1.9	1.009	S1.10	228.3	2.014	0.364	4.7976
15 minute summer	S1.10	1.010	S1.11	321.3	2.615	0.513	1.6352
15 minute summer	S1.11	1.011	S1.12	325.0	2.242	0.670	2.8216
15 minute summer	S1.12	1.012	S1.13	326.7	2.175	0.674	1.5439
15 minute summer	S1.13	1.013	S1.14	397.2	2.355	0.577	2.4062
15 minute summer	S1.14	1.014	S1.15	412.9	3.013	0.464	6.9567
15 minute summer	S1.15	1.015	S/Way	512.1	2.784	0.575	1.4314
960 minute summer	S/Way	Infiltration		15.3			
15 minute summer	S2.0	2.000	S2.1	28.3	1.314	0.254	1.3847
15 minute summer	S2.1	2.001	S1.3	33.3	1.344	0.300	0.6008
15 minute summer	S3.0	4.000	S3.1	12.4	0.605	0.137	0.3707
15 minute summer	S3.1	4.001	S1.7	44.9	1.546	0.383	2.2052
15 minute summer	S4.0	3.000	S4.1	21.7	1.230	0.418	0.5075

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S4.1	10	107.459	0.159	32.1	0.1793	0.0000	OK
15 minute summer	S4.2	10	106.582	0.182	59.2	0.2058	0.0000	OK
15 minute summer	S4.3	10	106.299	0.214	64.1	0.2424	0.0000	OK
15 minute summer	S4.4	11	106.211	0.206	63.5	0.2328	0.0000	OK
15 minute summer	S5.0	10	108.941	0.088	15.4	0.0994	0.0000	OK
15 minute summer	S5.1	10	107.840	0.110	29.4	0.1247	0.0000	OK
15 minute summer	S5.2	10	106.459	0.155	53.8	0.1748	0.0000	OK
15 minute summer	S5.3	10	105.077	0.177	85.5	0.2529	0.0000	OK
15 minute summer	S6.0	10	106.384	0.074	14.6	0.0837	0.0000	OK
15 minute summer	S6.1	10	105.861	0.141	28.8	0.1595	0.0000	OK
15 minute summer	S6.2	10	104.865	0.165	48.5	0.1867	0.0000	OK
15 minute summer	S6.3	10	104.383	0.171	49.6	0.1932	0.0000	OK
15 minute summer	S6.4	10	103.710	0.160	54.3	0.1808	0.0000	OK
15 minute summer	S6.5	10	103.140	0.190	69.3	0.2146	0.0000	OK
15 minute summer	S7.0	10	105.670	0.090	21.5	0.1021	0.0000	OK
15 minute summer	S7.1	10	103.789	0.139	59.5	0.1572	0.0000	OK
15 minute summer	S7.2	10	101.962	0.142	74.3	0.2034	0.0000	OK
15 minute summer	S7.3	10	101.550	0.171	80.8	0.2448	0.0000	OK
15 minute summer	S7.4	11	101.342	0.196	87.7	0.2812	0.0000	OK
15 minute summer	S8.0	10	104.276	0.016	0.8	0.0181	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S4.1	3.001	S4.2	32.1	1.126	0.757	0.4286
15 minute summer	S4.2	3.002	S4.3	59.4	1.203	0.656	2.3259
15 minute summer	S4.3	3.003	S4.4	62.3	1.186	0.688	0.6341
15 minute summer	S4.4	3.004	S1.7	63.6	1.318	0.702	0.5150
15 minute summer	S5.0	6.000	S5.1	15.4	1.113	0.296	0.2362
15 minute summer	S5.1	6.001	S5.2	29.4	1.302	0.265	0.5106
15 minute summer	S5.2	6.002	S5.3	53.8	1.527	0.484	1.1322
15 minute summer	S5.3	6.003	S1.10	84.5	1.714	0.422	2.3796
15 minute summer	S6.0	8.000	S6.1	14.6	1.325	0.217	0.2034
15 minute summer	S6.1	8.001	S6.2	28.6	1.126	0.676	0.8713
15 minute summer	S6.2	8.002	S6.3	48.2	1.268	0.532	0.9625
15 minute summer	S6.3	8.003	S6.4	49.0	1.258	0.542	0.6528
15 minute summer	S6.4	8.004	S6.5	53.6	1.502	0.482	0.6538
15 minute summer	S6.5	8.005	S1.13	68.3	1.571	0.614	0.6581
15 minute summer	S7.0	10.000	S7.1	21.5	1.482	0.320	0.4083
15 minute summer	S7.1	10.001	S7.2	59.5	1.916	0.414	1.3729
15 minute summer	S7.2	10.002	S7.3	74.3	1.706	0.287	1.1546
15 minute summer	S7.3	10.003	S7.4	80.6	1.504	0.360	1.0037
15 minute summer	S7.4	10.004	S1.15	87.0	1.629	0.435	0.6818
15 minute summer	S8.0	9.000	S6.4	0.8	0.543	0.005	0.0345

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	IC5	10	107.026	0.026	0.8	0.0290	0.0000	OK
15 minute summer	IC6	11	106.948	0.030	1.4	0.0530	0.0000	OK
15 minute summer	IC7	11	106.784	0.079	7.1	0.2078	0.0000	OK
15 minute summer	IC8	1	106.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC9	10	105.788	0.065	5.1	0.1548	0.0000	OK
15 minute summer	IC10	10	102.057	0.057	3.7	0.0647	0.0000	OK
15 minute summer	IC11	11	101.939	0.103	16.8	0.1331	0.0000	OK
15 minute summer	IC12	10	103.090	0.090	7.9	0.1014	0.0000	OK
15 minute summer	IC13	1	102.800	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC14	11	102.160	0.010	0.2	0.0115	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	IC5	5.000	IC6	0.8	0.383	0.064	0.0364
15 minute summer	IC6	5.001	IC7	1.1	0.200	0.089	0.2526
15 minute summer	IC6	Infiltration		0.1			
15 minute summer	IC7	5.002	S1.7	6.2	0.700	0.497	0.0828
15 minute summer	IC7	Infiltration		0.3			
15 minute summer	IC8	7.000	IC9	0.0	0.000	0.000	0.2016
15 minute summer	IC9	7.001	S1.10	4.4	0.633	0.350	0.0572
15 minute summer	IC9	Infiltration		0.3			
15 minute summer	IC10	12.000	IC11	3.7	0.612	0.294	0.1064
15 minute summer	IC11	11.001	S1.15	15.6	0.888	0.425	1.1856
15 minute summer	IC11	Infiltration		0.1			
15 minute summer	IC12	11.000	IC11	7.8	0.756	0.628	0.2066
15 minute summer	IC13	13.000	IC14	0.0	0.000	0.000	0.0000
15 minute summer	IC14	13.001	S1.15	0.2	0.396	0.009	0.0028
15 minute summer	IC14	Infiltration		0.0			

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1.0	10	107.220	0.120	36.3	0.1352	0.0000	OK
15 minute summer	S1.1	10	106.942	0.160	59.5	0.1815	0.0000	OK
15 minute summer	S1.2	10	106.417	0.165	59.9	0.1866	0.0000	OK
15 minute summer	S1.3	10	106.122	0.273	150.3	0.3908	0.0000	OK
15 minute summer	S1.4	11	105.978	0.292	168.9	0.4172	0.0000	OK
15 minute summer	S1.5	11	105.943	0.474	183.3	0.6790	0.0000	SURCHARGED
15 minute summer	S1.6	11	105.848	0.514	179.9	0.7353	0.0000	SURCHARGED
15 minute summer	S1.7	11	105.788	0.585	430.6	1.0338	0.0000	SURCHARGED
15 minute summer	S1.8	11	105.557	0.449	445.6	0.7932	0.0000	OK
15 minute summer	S1.9	11	105.336	0.716	481.1	1.2646	0.0000	SURCHARGED
15 minute summer	S1.10	11	104.812	0.898	678.6	1.5866	0.0000	SURCHARGED
15 minute summer	S1.11	11	104.319	1.319	671.6	2.3306	0.0000	SURCHARGED
15 minute summer	S1.12	11	103.704	1.414	672.5	2.4990	0.0000	SURCHARGED
15 minute summer	S1.13	11	103.263	1.151	818.1	2.0337	0.0000	SURCHARGED
15 minute summer	S1.14	11	102.846	0.877	860.1	1.5502	0.0000	SURCHARGED
15 minute summer	S1.15	11	101.821	1.016	1070.9	1.7946	0.0000	SURCHARGED
960 minute summer	S/Way	765	100.092	-0.583	145.1	1359.0120	0.0000	OK
15 minute summer	S2.0	10	107.657	0.167	63.9	0.1887	0.0000	OK
15 minute summer	S2.1	10	106.496	0.196	75.7	0.2219	0.0000	OK
15 minute summer	S3.0	10	106.619	0.119	27.6	0.1348	0.0000	OK
15 minute summer	S3.1	10	106.607	0.222	102.6	0.2510	0.0000	OK
15 minute summer	S4.0	10	108.383	0.183	48.1	0.2070	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1.0	1.000	S1.1	36.3	1.126	0.327	1.0298
15 minute summer	S1.1	1.001	S1.2	59.9	1.535	0.539	2.0639
15 minute summer	S1.2	1.002	S1.3	58.1	1.552	0.523	0.9534
15 minute summer	S1.3	1.003	S1.4	149.2	1.493	0.566	2.5412
15 minute summer	S1.4	1.004	S1.5	166.7	1.407	0.516	2.9157
15 minute summer	S1.5	1.005	S1.6	177.1	1.219	0.672	3.1963
15 minute summer	S1.6	1.006	S1.7	188.1	1.244	0.713	1.3338
15 minute summer	S1.7	1.007	S1.8	430.1	2.040	1.088	2.9401
15 minute summer	S1.8	1.008	S1.9	443.2	2.764	0.707	2.5033
15 minute summer	S1.9	1.009	S1.10	477.9	2.213	0.763	9.1527
15 minute summer	S1.10	1.010	S1.11	664.0	3.074	1.059	2.8780
15 minute summer	S1.11	1.011	S1.12	670.1	3.102	1.382	4.2098
15 minute summer	S1.12	1.012	S1.13	678.6	3.142	1.400	2.2260
15 minute summer	S1.13	1.013	S1.14	817.3	2.902	1.187	4.0229
15 minute summer	S1.14	1.014	S1.15	858.9	3.213	0.965	14.2323
15 minute summer	S1.15	1.015	S/Way	1070.2	3.800	1.203	2.2001
960 minute summer	S/Way	Infiltration		18.0			
15 minute summer	S2.0	2.000	S2.1	63.4	1.615	0.571	2.5300
15 minute summer	S2.1	2.001	S1.3	75.2	1.626	0.677	1.1196
15 minute summer	S3.0	4.000	S3.1	27.3	0.716	0.302	0.7045
15 minute summer	S3.1	4.001	S1.7	100.3	1.844	0.856	4.2579
15 minute summer	S4.0	3.000	S4.1	48.1	1.445	0.925	0.9557

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S4.1	10	107.873	0.573	71.3	0.6481	0.0000	SURCHARGED
15 minute summer	S4.2	10	107.517	1.117	129.3	1.2637	0.0000	SURCHARGED
15 minute summer	S4.3	10	106.780	0.695	138.0	0.7855	0.0000	SURCHARGED
15 minute summer	S4.4	10	106.490	0.485	139.6	0.5482	0.0000	SURCHARGED
15 minute summer	S5.0	10	108.996	0.143	34.1	0.1620	0.0000	OK
15 minute summer	S5.1	10	107.908	0.178	65.2	0.2013	0.0000	OK
15 minute summer	S5.2	10	106.669	0.365	119.6	0.4129	0.0000	SURCHARGED
15 minute summer	S5.3	10	105.207	0.307	188.7	0.4387	0.0000	OK
15 minute summer	S6.0	9	106.426	0.116	32.4	0.1312	0.0000	OK
15 minute summer	S6.1	10	106.202	0.482	64.6	0.5453	0.0000	SURCHARGED
15 minute summer	S6.2	10	105.060	0.360	105.1	0.4066	0.0000	SURCHARGED
15 minute summer	S6.3	10	104.574	0.362	107.5	0.4091	0.0000	SURCHARGED
15 minute summer	S6.4	11	103.896	0.346	118.5	0.3912	0.0000	SURCHARGED
15 minute summer	S6.5	11	103.635	0.685	146.9	0.7751	0.0000	SURCHARGED
15 minute summer	S7.0	10	105.728	0.148	47.7	0.1678	0.0000	OK
15 minute summer	S7.1	10	103.894	0.244	132.2	0.2763	0.0000	OK
15 minute summer	S7.2	11	102.349	0.528	164.9	0.7563	0.0000	SURCHARGED
15 minute summer	S7.3	11	102.158	0.779	166.2	1.1151	0.0000	SURCHARGED
15 minute summer	S7.4	11	101.978	0.832	177.3	1.1912	0.0000	SURCHARGED
15 minute summer	S8.0	10	104.284	0.024	1.8	0.0267	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S4.1	3.001	S4.2	68.9	1.733	1.627	0.5991
15 minute summer	S4.2	3.002	S4.3	127.5	1.810	1.408	3.3244
15 minute summer	S4.3	3.003	S4.4	137.0	1.946	1.513	0.8499
15 minute summer	S4.4	3.004	S1.7	139.1	1.976	1.536	0.7386
15 minute summer	S5.0	6.000	S5.1	34.1	1.343	0.656	0.4330
15 minute summer	S5.1	6.001	S5.2	65.3	1.579	0.588	0.9337
15 minute summer	S5.2	6.002	S5.3	118.2	1.723	1.064	2.1839
15 minute summer	S5.3	6.003	S1.10	184.1	2.003	0.920	4.8055
15 minute summer	S6.0	8.000	S6.1	33.1	1.595	0.493	0.5300
15 minute summer	S6.1	8.001	S6.2	60.9	1.533	1.438	1.3228
15 minute summer	S6.2	8.002	S6.3	104.4	1.497	1.153	1.6862
15 minute summer	S6.3	8.003	S6.4	106.7	1.528	1.178	1.1151
15 minute summer	S6.4	8.004	S6.5	116.0	1.720	1.044	1.2436
15 minute summer	S6.5	8.005	S1.13	145.4	2.065	1.309	1.0599
15 minute summer	S7.0	10.000	S7.1	47.7	1.785	0.710	0.7523
15 minute summer	S7.1	10.001	S7.2	132.1	2.246	0.919	2.5994
15 minute summer	S7.2	10.002	S7.3	151.8	1.867	0.587	2.9213
15 minute summer	S7.3	10.003	S7.4	164.3	1.580	0.734	2.0655
15 minute summer	S7.4	10.004	S1.15	177.5	1.694	0.887	1.2630
15 minute summer	S8.0	9.000	S6.4	1.8	0.699	0.012	0.0919

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	IC5	10	107.038	0.038	1.8	0.0433	0.0000	OK
15 minute summer	IC6	11	106.965	0.046	3.1	0.0959	0.0000	OK
15 minute summer	IC7	11	106.847	0.142	16.1	0.5464	0.0000	OK
15 minute summer	IC8	1	106.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC9	10	105.830	0.107	11.4	0.3399	0.0000	OK
15 minute summer	IC10	10	102.093	0.093	8.3	0.1055	0.0000	OK
15 minute summer	IC11	11	102.018	0.182	37.1	0.4184	0.0000	OK
15 minute summer	IC12	10	103.223	0.223	17.5	0.2525	0.0000	SURCHARGED
15 minute summer	IC13	1	102.800	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC14	11	102.164	0.014	0.4	0.0159	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	IC5	5.000	IC6	1.8	0.458	0.144	0.0661
15 minute summer	IC6	5.001	IC7	2.6	0.226	0.211	0.4660
15 minute summer	IC6	Infiltration		0.2			
15 minute summer	IC7	5.002	S1.7	13.7	0.871	1.096	0.1445
15 minute summer	IC7	Infiltration		0.6			
15 minute summer	IC8	7.000	IC9	0.0	0.000	0.000	0.3739
15 minute summer	IC9	7.001	S1.10	9.9	0.796	0.790	0.1025
15 minute summer	IC9	Infiltration		0.5			
15 minute summer	IC10	12.000	IC11	8.3	0.742	0.664	0.2081
15 minute summer	IC11	11.001	S1.15	34.1	0.983	0.930	2.5036
15 minute summer	IC11	Infiltration		0.3			
15 minute summer	IC12	11.000	IC11	17.0	0.984	1.362	0.3262
15 minute summer	IC13	13.000	IC14	0.0	0.000	0.000	0.0000
15 minute summer	IC14	13.001	S1.15	0.4	0.489	0.017	0.0046
15 minute summer	IC14	Infiltration		0.0			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1.0	10	107.241	0.141	47.1	0.1590	0.0000	OK
15 minute summer	S1.1	12	107.042	0.261	77.1	0.2952	0.0000	OK
15 minute summer	S1.2	12	106.964	0.712	77.7	0.8051	0.0000	SURCHARGED
15 minute summer	S1.3	11	106.905	1.056	195.0	1.5112	0.0000	SURCHARGED
15 minute summer	S1.4	11	106.839	1.153	188.1	1.6505	0.0000	SURCHARGED
15 minute summer	S1.5	11	106.765	1.297	210.0	1.8560	0.0000	SURCHARGED
15 minute summer	S1.6	11	106.680	1.346	218.1	1.9264	0.0000	SURCHARGED
15 minute summer	S1.7	11	106.631	1.428	448.9	2.5239	0.0000	SURCHARGED
15 minute summer	S1.8	11	106.417	1.309	472.2	2.3131	0.0000	SURCHARGED
15 minute summer	S1.9	11	106.203	1.583	505.4	2.7966	0.0000	SURCHARGED
15 minute summer	S1.10	11	105.643	1.729	731.4	3.0555	0.0000	FLOOD RISK
15 minute summer	S1.11	11	105.055	2.055	736.3	3.6311	0.0000	FLOOD RISK
15 minute summer	S1.12	11	104.315	2.025	738.6	3.5778	0.0000	FLOOD RISK
15 minute summer	S1.13	11	103.782	1.670	904.1	2.9501	0.0000	SURCHARGED
15 minute summer	S1.14	11	103.274	1.305	958.4	2.3058	0.0000	SURCHARGED
15 minute summer	S1.15	11	102.002	1.197	1227.3	2.1157	0.0000	SURCHARGED
960 minute summer	S/Way	810	100.714	0.039	179.5	1805.8820	0.0000	OK
15 minute summer	S2.0	10	107.689	0.199	82.9	0.2250	0.0000	OK
15 minute summer	S2.1	12	107.049	0.749	98.3	0.8466	0.0000	SURCHARGED
15 minute summer	S3.0	11	107.420	0.920	35.8	1.0405	0.0000	SURCHARGED
15 minute summer	S3.1	11	107.395	1.010	131.0	1.1422	0.0000	SURCHARGED
15 minute summer	S4.0	11	109.069	0.869	62.4	0.9830	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1.0	1.000	S1.1	47.1	1.181	0.424	1.3560
15 minute summer	S1.1	1.001	S1.2	77.7	1.619	0.699	3.5838
15 minute summer	S1.2	1.002	S1.3	87.8	1.590	0.790	1.7784
15 minute summer	S1.3	1.003	S1.4	162.6	1.494	0.617	3.8757
15 minute summer	S1.4	1.004	S1.5	205.4	1.400	0.635	3.4593
15 minute summer	S1.5	1.005	S1.6	216.5	1.366	0.821	3.1963
15 minute summer	S1.6	1.006	S1.7	222.9	1.527	0.845	1.3338
15 minute summer	S1.7	1.007	S1.8	464.9	2.152	1.176	3.0783
15 minute summer	S1.8	1.008	S1.9	487.7	2.820	0.778	2.7693
15 minute summer	S1.9	1.009	S1.10	520.3	2.409	0.830	9.1527
15 minute summer	S1.10	1.010	S1.11	726.4	3.363	1.159	2.8780
15 minute summer	S1.11	1.011	S1.12	733.4	3.395	1.513	4.2098
15 minute summer	S1.12	1.012	S1.13	738.3	3.418	1.523	2.2260
15 minute summer	S1.13	1.013	S1.14	911.0	3.235	1.323	4.0229
15 minute summer	S1.14	1.014	S1.15	957.3	3.399	1.076	14.2323
15 minute summer	S1.15	1.015	S/Way	1227.6	4.359	1.380	2.1997
960 minute summer	S/Way	Infiltration		19.5			
15 minute summer	S2.0	2.000	S2.1	82.4	1.707	0.741	3.1085
15 minute summer	S2.1	2.001	S1.3	98.2	1.646	0.884	1.7045
15 minute summer	S3.0	4.000	S3.1	33.5	0.737	0.369	1.2111
15 minute summer	S3.1	4.001	S1.7	112.5	1.824	0.960	5.3502
15 minute summer	S4.0	3.000	S4.1	55.6	1.399	1.070	1.1439

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S4.1	11	108.706	1.406	85.7	1.5896	0.0000	SURCHARGED
15 minute summer	S4.2	11	108.233	1.833	158.1	2.0732	0.0000	FLOOD RISK
15 minute summer	S4.3	11	107.306	1.221	167.5	1.3805	0.0000	FLOOD RISK
15 minute summer	S4.4	11	106.951	0.946	168.8	1.0695	0.0000	SURCHARGED
15 minute summer	S5.0	10	109.028	0.175	44.3	0.1979	0.0000	OK
15 minute summer	S5.1	10	107.944	0.214	84.6	0.2424	0.0000	OK
15 minute summer	S5.2	10	107.015	0.711	155.0	0.8045	0.0000	SURCHARGED
15 minute summer	S5.3	11	106.299	1.399	246.5	2.0020	0.0000	SURCHARGED
15 minute summer	S6.0	10	106.698	0.388	42.0	0.4387	0.0000	SURCHARGED
15 minute summer	S6.1	10	106.563	0.843	79.5	0.9534	0.0000	SURCHARGED
15 minute summer	S6.2	10	105.259	0.559	134.4	0.6325	0.0000	SURCHARGED
15 minute summer	S6.3	11	104.858	0.646	136.7	0.7306	0.0000	SURCHARGED
15 minute summer	S6.4	11	104.597	1.047	149.3	1.1845	0.0000	SURCHARGED
15 minute summer	S6.5	11	104.252	1.302	164.7	1.4728	0.0000	SURCHARGED
15 minute summer	S7.0	10	105.765	0.185	61.9	0.2091	0.0000	OK
15 minute summer	S7.1	10	104.394	0.744	171.4	0.8413	0.0000	SURCHARGED
15 minute summer	S7.2	10	102.981	1.161	214.0	1.6611	0.0000	SURCHARGED
15 minute summer	S7.3	10	102.591	1.212	227.3	1.7346	0.0000	SURCHARGED
15 minute summer	S7.4	11	102.271	1.126	242.6	1.6112	0.0000	SURCHARGED
15 minute summer	S8.0	11	104.607	0.347	2.3	0.3927	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S4.1	3.001	S4.2	79.9	2.009	1.887	0.5991
15 minute summer	S4.2	3.002	S4.3	153.9	2.186	1.699	3.3244
15 minute summer	S4.3	3.003	S4.4	165.4	2.349	1.827	0.8499
15 minute summer	S4.4	3.004	S1.7	165.5	2.350	1.827	0.7517
15 minute summer	S5.0	6.000	S5.1	44.3	1.408	0.853	0.5361
15 minute summer	S5.1	6.001	S5.2	84.7	1.663	0.762	1.1492
15 minute summer	S5.2	6.002	S5.3	155.2	2.204	1.396	2.2633
15 minute summer	S5.3	6.003	S1.10	232.9	2.112	1.164	5.3245
15 minute summer	S6.0	8.000	S6.1	38.7	1.587	0.575	0.7339
15 minute summer	S6.1	8.001	S6.2	77.2	1.941	1.823	1.3484
15 minute summer	S6.2	8.002	S6.3	132.7	1.886	1.466	1.7835
15 minute summer	S6.3	8.003	S6.4	135.5	1.924	1.496	1.1750
15 minute summer	S6.4	8.004	S6.5	133.8	1.900	1.204	1.2812
15 minute summer	S6.5	8.005	S1.13	160.4	2.279	1.444	1.0599
15 minute summer	S7.0	10.000	S7.1	61.9	1.853	0.921	0.9392
15 minute summer	S7.1	10.001	S7.2	171.5	2.435	1.193	3.0819
15 minute summer	S7.2	10.002	S7.3	208.6	1.891	0.806	2.9213
15 minute summer	S7.3	10.003	S7.4	222.2	2.015	0.993	2.0655
15 minute summer	S7.4	10.004	S1.15	238.7	2.165	1.193	1.2630
15 minute summer	S8.0	9.000	S6.4	7.8	0.653	0.054	1.7024

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	IC5	10	107.043	0.043	2.3	0.0491	0.0000	OK
15 minute summer	IC6	11	106.972	0.054	4.0	0.1178	0.0000	OK
15 minute summer	IC7	11	106.892	0.186	20.9	0.9132	0.0000	SURCHARGED
15 minute summer	IC8	1	106.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC9	11	105.854	0.131	14.8	0.4734	0.0000	OK
15 minute summer	IC10	12	102.343	0.343	10.8	0.3879	0.0000	SURCHARGED
15 minute summer	IC11	12	102.313	0.477	44.8	1.9363	0.0000	SURCHARGED
15 minute summer	IC12	10	103.367	0.367	22.7	0.4155	0.0000	SURCHARGED
15 minute summer	IC13	1	102.800	0.000	0.0	0.0000	0.0000	OK
15 minute summer	IC14	10	102.167	0.017	0.6	0.0194	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	IC5	5.000	IC6	2.3	0.491	0.184	0.0804
15 minute summer	IC6	5.001	IC7	3.5	0.252	0.277	0.4950
15 minute summer	IC6	Infiltration		0.2			
15 minute summer	IC7	5.002	S1.7	16.9	0.979	1.354	0.1530
15 minute summer	IC7	Infiltration		0.8			
15 minute summer	IC8	7.000	IC9	0.0	0.000	0.000	0.4519
15 minute summer	IC9	7.001	S1.10	12.7	0.855	1.014	0.1217
15 minute summer	IC9	Infiltration		0.6			
15 minute summer	IC10	12.000	IC11	10.0	0.769	0.802	0.3129
15 minute summer	IC11	11.001	S1.15	36.8	1.044	1.005	2.6875
15 minute summer	IC11	Infiltration		0.5			
15 minute summer	IC12	11.000	IC11	21.9	1.244	1.752	0.3401
15 minute summer	IC13	13.000	IC14	0.0	0.000	0.000	0.0000
15 minute summer	IC14	13.001	S1.15	0.6	0.550	0.026	0.0061
15 minute summer	IC14	Infiltration		0.0			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.263	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.010	4.00	100.000	1200	1.000
S2			100.000	1200	1.027

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)
1.1	S1	S2	4.000	0.600	99.000	98.973	0.027	150.0	150	4.08	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)
1.1	0.818	14.5	1.8	0.850	0.877	0.010	0.0	36	0.561

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)
1.1	4.000	150.0	150	Circular	100.000	99.000	0.850	100.000	98.973	0.877

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.1	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.100	Additional Storage (m³/ha)	20.0
Ratio-R	0.263	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node S2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Invert Level (m)	97.000	Depth (m)	3.000
Side Inf Coefficient (m/hr)	0.14800	Time to half empty (mins)	85	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	1.300	Number Required	1
Porosity	0.40	Pit Length (m)	1.300		

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 95.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1	10	99.040	0.040	2.0	0.0531	0.0000	OK
240 minute summer	S2	160	98.358	-0.615	0.6	0.9183	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1	1.1	S2	2.0	0.556	0.138	0.0144
240 minute summer	S2	Infiltration		0.2			

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 95.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	S1	128	99.289	0.289	1.6	0.3842	0.0000	SURCHARGED
180 minute summer	S2	128	99.289	0.316	1.6	1.9046	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute summer	S1	1.1	S2	1.6	0.522	0.109	0.0704
180 minute summer	S2	Infiltration		0.3			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 95.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	S1	164	99.617	0.617	1.7	0.8209	0.0000	SURCHARGED
240 minute summer	S2	164	99.617	0.644	1.5	2.4975	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
240 minute summer	S1	1.1	S2	1.5	0.513	0.103	0.0704
240 minute summer	S2	Infiltration		0.3			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.263	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.010	4.00	100.000	1200	1.100
S2			100.000	1200	1.140

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)
1.1	S1	S2	6.000	0.600	98.900	98.860	0.040	150.0	150	4.12	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)
1.1	0.818	14.5	1.8	0.950	0.990	0.010	0.0	36	0.561

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)
1.1	6.000	150.0	150	Circular	100.000	98.900	0.950	100.000	98.860	0.990

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.1	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.100	Additional Storage (m³/ha)	20.0
Ratio-R	0.263	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	S1	124	99.106	0.206	0.8	0.2706	0.0000	SURCHARGED
180 minute summer	S2	124	99.106	0.246	0.6	0.7784	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute summer	S1	1.1	S2	0.6	0.275	0.041	0.1056
180 minute summer	S2	Infiltration		0.2			

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	S1	128	99.450	0.550	1.6	0.7224	0.0000	SURCHARGED
180 minute summer	S2	128	99.450	0.590	1.2	1.9936	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
180 minute summer	S1	1.1	S2	1.2	0.275	0.085	0.1056
180 minute summer	S2	Infiltration		0.3			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	S1	164	99.651	0.751	1.7	0.9864	0.0000	SURCHARGED
240 minute summer	S2	164	99.651	0.791	1.3	2.7036	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
240 minute summer	S1	1.1	S2	1.3	0.275	0.090	0.1056
240 minute summer	S2	Infiltration		0.3			

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	17.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.263	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1	0.066	4.00	100.000	1200	1.100
S2	0.066		100.000	1200	1.287

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)
1.1	S1	S2	187.000	0.600	98.900	98.713	0.187	1000.0	225	11.69	43.8

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)
1.1	0.405	16.1	10.5	0.875	1.062	0.066	0.0	132	0.431

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)
1.1	187.000	1000.0	225	Circular	100.000	98.900	0.875	100.000	98.713	1.062

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.1	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	17.100	Additional Storage (m³/ha)	20.0
Ratio-R	0.263	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node S2 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.14800	Porosity	1.00	Link	1.1
Side Inf Coefficient (m/hr)	0.14800	Invert Level (m)	98.713	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	216	Diameter (mm)	600

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 97.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	S1	11	99.022	0.122	13.0	0.2840	0.0000	OK
180 minute summer	S2	116	98.924	0.211	9.7	9.8353	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)
15 minute summer	S1	1.1	S2	9.4	0.427	0.581	4.1079
180 minute summer	S2	Infiltration		3.2			

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 97.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	19	99.222	0.322	26.7	0.7516	0.0000	SURCHARGED
180 minute summer	S2	124	99.097	0.384	19.6	26.3020	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S1	1.1	S2	19.3	0.486	1.198	7.4372
180 minute summer	S2	Infiltration		4.5			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 97.46%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	19	99.594	0.694	34.8	1.6167	0.0000	SURCHARGED
180 minute summer	S2	124	99.200	0.487	24.0	37.7439	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	S1	1.1	S2	28.5	0.716	1.768	7.4372
180 minute summer	S2	Infiltration		5.3			

APPENDIX VII

Microdrainage Foul Water System Design

Design Settings

Frequency of use (kDU)	1.00	Minimum Velocity (m/s)	0.75
Flow per dwelling per day (l/day)	2673	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Dwellings	Cover Level (m)	Manhole Type	Easting (m)	Northing (m)	Depth (m)
F1.0	5	108.730	Adoptable	722619.666	716682.753	1.350
F1.1	4	108.300	Adoptable	722650.659	716685.685	1.439
F1.2	1	107.550	Adoptable	722703.729	716696.245	1.916
F1.3	2	107.470	Adoptable	722725.170	716704.791	2.221
F1.4	3	107.730	Adoptable	722716.370	716728.146	2.868
F1.5	2	107.520	Adoptable	722714.690	716751.494	2.892
F1.6	2	107.360	Adoptable	722712.365	716778.225	2.911
F1.7	5	106.960	Adoptable	722707.622	716803.975	2.686
F1.8	1	106.000	Adoptable	722695.747	716845.720	2.015
F1.9	0	105.620	Adoptable	722693.165	716853.791	4.159
F1.10	5	104.260	Adoptable	722675.419	716885.179	3.039
F1.11	2	103.090	Adoptable	722731.774	716897.938	2.254
F1.12	0	103.380	Adoptable	722749.684	716901.958	2.897
F1.13	0	103.180	Adoptable	722746.715	716911.452	2.763
F1.14	0	103.030	Adoptable	722745.327	716917.620	2.655
F2.0	9	109.670	Adoptable	722810.424	716736.877	1.890
F2.1	1	108.460	Adoptable	722743.965	716712.887	2.180
F3.0	12	108.140	Adoptable	722793.805	716803.072	1.350
F3.1	1	107.400	Adoptable	722722.947	716778.178	2.314
F4.0	8	110.680	Adoptable	722598.182	716751.090	3.400
F4.1	3	109.160	Adoptable	722626.546	716757.547	2.365
F4.2	11	108.560	Adoptable	722641.391	716756.925	2.013
F4.3	1	107.390	Adoptable	722687.469	716768.351	1.634
F4.4	0	107.300	Adoptable	722698.830	716774.819	2.510
F5.0	4	110.990	Adoptable	722583.403	716804.849	2.390
F5.1	4	110.150	Adoptable	722598.208	716809.333	2.370
F5.2	4	108.830	Adoptable	722617.460	716825.126	2.280
F5.3	5	107.520	Adoptable	722643.104	716831.639	1.990
F6.0	9	107.440	Adoptable	722558.012	716898.156	1.940
F6.1	8	107.090	Adoptable	722576.513	716897.785	2.539
F6.2	8	106.370	Adoptable	722612.870	716895.414	2.870
F6.3	0	104.660	Adoptable	722640.845	716892.508	1.670
F6.4	6	105.400	Adoptable	722644.465	716876.265	2.576
F6.5	2	104.770	Adoptable	722659.213	716879.188	2.096
F7.0	10	108.100	Adoptable	722781.239	716807.736	2.300
F7.1	18	106.730	Adoptable	722773.394	716835.255	3.530
F7.2	6	104.060	Adoptable	722772.246	716883.793	2.680
F7.3	2	102.900	Adoptable	722768.098	716905.445	2.169
F9.0	0	106.300	Adoptable	722578.913	716930.137	1.425
F10.0	8	106.580	Adoptable	722616.627	716868.734	2.882

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	F1.0	F1.1	31.131	1.500	107.380	106.861	0.519	60.0	150
1.001	F1.1	F1.2	54.110	1.500	106.861	105.959	0.902	60.0	150
1.002	F1.2	F1.3	23.081	1.500	105.634	105.249	0.385	60.0	150
1.003	F1.3	F1.4	24.958	1.500	105.249	104.937	0.312	80.0	150
1.004	F1.4	F1.5	23.408	1.500	104.862	104.628	0.234	100.0	225
1.005	F1.5	F1.6	26.832	1.500	104.628	104.449	0.179	150.0	225
1.006	F1.6	F1.7	26.183	1.500	104.449	104.274	0.175	150.0	225
1.007	F1.7	F1.8	43.401	1.500	104.274	103.985	0.289	150.0	225
1.008	F1.8	F1.9	8.474	1.500	103.985	103.929	0.056	150.0	225
1.009	F1.9	F1.10	36.057	1.500	101.461	101.221	0.240	150.0	225
1.010	F1.10	F1.11	57.781	1.500	101.221	100.836	0.385	150.0	225
1.011	F1.11	F1.12	18.356	1.500	100.836	100.714	0.122	150.0	225
1.012	F1.12	F1.13	9.947	1.500	100.483	100.417	0.066	150.0	225
1.013	F1.13	F1.14	6.322	1.500	100.417	100.375	0.042	150.0	225
2.000	F2.0	F2.1	70.656	1.500	107.780	106.602	1.178	60.0	150
2.001	F2.1	F1.3	20.465	1.500	106.280	105.939	0.341	60.0	150
4.000	F3.0	F3.1	75.104	1.500	106.790	105.538	1.252	60.0	150
4.001	F3.1	F1.6	10.582	1.500	105.086	104.910	0.176	60.0	150
3.000	F4.0	F4.1	29.090	1.500	107.280	106.795	0.485	60.0	150
3.001	F4.1	F4.2	14.858	1.500	106.795	106.547	0.248	60.0	150
3.002	F4.2	F4.3	47.474	1.500	106.547	105.756	0.791	60.0	150

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)
1.000	0.227	1.132	20.0	0.2	1.200	1.289	0.000	5	0.0	0.0	10	0.318
1.001	0.274	1.132	20.0	0.3	1.289	1.441	0.000	9	0.0	0.0	13	0.385
1.002	0.274	1.132	20.0	0.3	1.766	2.071	0.000	10	0.0	0.0	13	0.398
1.003	0.333	0.980	17.3	0.7	2.071	2.643	0.000	22	0.0	0.0	21	0.470
1.004	0.303	1.148	45.6	0.8	2.643	2.667	0.000	25	0.0	0.0	21	0.425
1.005	0.270	0.936	37.2	0.8	2.667	2.686	0.000	27	0.0	0.0	23	0.375
1.006	0.356	0.936	37.2	2.0	2.686	2.461	0.000	65	0.0	0.0	36	0.495
1.007	0.365	0.936	37.2	2.2	2.461	1.790	0.000	70	0.0	0.0	37	0.511
1.008	0.385	0.936	37.2	2.7	1.790	1.466	0.000	88	0.0	0.0	42	0.547
1.009	0.385	0.936	37.2	2.7	3.934	2.814	0.000	88	0.0	0.0	42	0.547
1.010	0.438	0.936	37.2	4.1	2.814	2.029	0.000	134	0.0	0.0	51	0.615
1.011	0.447	0.936	37.2	4.2	2.029	2.441	0.000	136	0.0	0.0	51	0.621
1.012	0.479	0.936	37.2	5.3	2.672	2.538	0.000	172	0.0	0.0	58	0.664
1.013	0.479	0.936	37.2	5.3	2.538	2.430	0.000	172	0.0	0.0	58	0.664
2.000	0.274	1.132	20.0	0.3	1.740	1.708	0.000	9	0.0	0.0	13	0.385
2.001	0.274	1.132	20.0	0.3	2.030	1.381	0.000	10	0.0	0.0	13	0.398
4.000	0.290	1.132	20.0	0.4	1.200	1.712	0.000	12	0.0	0.0	14	0.422
4.001	0.304	1.132	20.0	0.4	2.164	2.300	0.000	13	0.0	0.0	15	0.434
3.000	0.259	1.132	20.0	0.2	3.250	2.215	0.000	8	0.0	0.0	12	0.372
3.001	0.290	1.132	20.0	0.3	2.215	1.863	0.000	11	0.0	0.0	14	0.410
3.002	0.359	1.132	20.0	0.7	1.863	1.484	0.000	22	0.0	0.0	19	0.512

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
3.003	F4.3	F4.4	13.073	1.500	105.756	105.538	0.218	60.0	150
3.004	F4.4	F1.6	13.957	1.500	104.790	104.557	0.233	60.0	150
5.000	F5.0	F5.1	15.469	1.500	108.600	108.342	0.258	60.0	150
5.001	F5.1	F5.2	24.901	1.500	107.780	107.365	0.415	60.0	150
5.002	F5.2	F5.3	26.458	1.500	106.550	106.109	0.441	60.0	150
5.003	F5.3	F1.8	54.494	1.500	105.530	104.622	0.908	60.0	150
7.000	F6.0	F6.1	18.505	1.500	105.500	105.269	0.231	80.0	225
6.001	F6.1	F6.2	36.434	1.500	104.551	104.187	0.364	100.0	225
6.002	F6.2	F6.3	28.126	1.500	103.500	103.219	0.281	100.0	225
6.003	F6.3	F6.4	16.641	1.500	102.990	102.824	0.166	100.0	225
6.004	F6.4	F6.5	15.035	1.500	102.824	102.674	0.150	100.0	225
6.005	F6.5	F1.10	17.278	1.500	102.674	102.501	0.173	100.0	225
6.000	F9.0	F6.1	32.441	1.500	104.875	104.551	0.324	100.0	225
8.000	F10.0	F6.4	28.839	1.500	103.698	103.217	0.481	60.0	150
9.000	F7.0	F7.1	28.615	1.500	105.800	105.323	0.477	60.0	150
9.001	F7.1	F7.2	48.552	1.500	103.200	102.593	0.607	80.0	225
9.002	F7.2	F7.3	22.046	1.500	101.380	101.104	0.276	80.0	225
9.003	F7.3	F1.12	18.741	1.500	100.731	100.544	0.187	100.0	225

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)
3.003	0.372	1.132	20.0	0.7	1.484	1.612	0.000	23	0.0	0.0	20	0.523
3.004	0.372	1.132	20.0	0.7	2.360	2.653	0.000	23	0.0	0.0	20	0.523
5.000	0.210	1.132	20.0	0.1	2.240	1.658	0.000	4	0.0	0.0	8	0.290
5.001	0.259	1.132	20.0	0.2	2.220	1.315	0.000	8	0.0	0.0	12	0.372
5.002	0.290	1.132	20.0	0.4	2.130	1.261	0.000	12	0.0	0.0	14	0.422
5.003	0.332	1.132	20.0	0.5	1.840	1.228	0.000	17	0.0	0.0	17	0.480
7.000	0.228	1.284	51.0	0.3	1.715	1.596	0.000	9	0.0	0.0	12	0.322
6.001	0.256	1.148	45.6	0.5	2.314	1.958	0.000	17	0.0	0.0	17	0.373
6.002	0.303	1.148	45.6	0.8	2.645	1.216	0.000	25	0.0	0.0	21	0.425
6.003	0.303	1.148	45.6	0.8	1.445	2.351	0.000	25	0.0	0.0	21	0.425
6.004	0.346	1.148	45.6	1.2	2.351	1.871	0.000	39	0.0	0.0	25	0.483
6.005	0.346	1.148	45.6	1.3	1.871	1.534	0.000	41	0.0	0.0	26	0.495
6.000	0.000	1.148	45.6	0.0	1.200	2.314	0.000	0	0.0	0.0	0	0.000
8.000	0.259	1.132	20.0	0.2	2.732	2.033	0.000	8	0.0	0.0	12	0.372
9.000	0.274	1.132	20.0	0.3	2.150	1.257	0.000	10	0.0	0.0	13	0.398
9.001	0.339	1.284	51.0	0.9	3.305	1.242	0.000	28	0.0	0.0	21	0.475
9.002	0.356	1.284	51.0	1.1	2.455	1.571	0.000	34	0.0	0.0	22	0.502
9.003	0.332	1.148	45.6	1.1	1.944	2.611	0.000	36	0.0	0.0	24	0.472

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)
1.000	31.131	60.0	150	Circular	108.730	107.380	1.200	108.300	106.861	1.289
1.001	54.110	60.0	150	Circular	108.300	106.861	1.289	107.550	105.959	1.441
1.002	23.081	60.0	150	Circular	107.550	105.634	1.766	107.470	105.249	2.071
1.003	24.958	80.0	150	Circular	107.470	105.249	2.071	107.730	104.937	2.643
1.004	23.408	100.0	225	Circular	107.730	104.862	2.643	107.520	104.628	2.667
1.005	26.832	150.0	225	Circular	107.520	104.628	2.667	107.360	104.449	2.686
1.006	26.183	150.0	225	Circular	107.360	104.449	2.686	106.960	104.274	2.461
1.007	43.401	150.0	225	Circular	106.960	104.274	2.461	106.000	103.985	1.790
1.008	8.474	150.0	225	Circular	106.000	103.985	1.790	105.620	103.929	1.466
1.009	36.057	150.0	225	Circular	105.620	101.461	3.934	104.260	101.221	2.814
1.010	57.781	150.0	225	Circular	104.260	101.221	2.814	103.090	100.836	2.029
1.011	18.356	150.0	225	Circular	103.090	100.836	2.029	103.380	100.714	2.441
1.012	9.947	150.0	225	Circular	103.380	100.483	2.672	103.180	100.417	2.538
1.013	6.322	150.0	225	Circular	103.180	100.417	2.538	103.030	100.375	2.430
2.000	70.656	60.0	150	Circular	109.670	107.780	1.740	108.460	106.602	1.708
2.001	20.465	60.0	150	Circular	108.460	106.280	2.030	107.470	105.939	1.381
4.000	75.104	60.0	150	Circular	108.140	106.790	1.200	107.400	105.538	1.712
4.001	10.582	60.0	150	Circular	107.400	105.086	2.164	107.360	104.910	2.300
3.000	29.090	60.0	150	Circular	110.680	107.280	3.250	109.160	106.795	2.215
3.001	14.858	60.0	150	Circular	109.160	106.795	2.215	108.560	106.547	1.863
3.002	47.474	60.0	150	Circular	108.560	106.547	1.863	107.390	105.756	1.484
3.003	13.073	60.0	150	Circular	107.390	105.756	1.484	107.300	105.538	1.612

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	F1.0	1200	Manhole	Adoptable	F1.1	1200	Manhole	Adoptable
1.001	F1.1	1200	Manhole	Adoptable	F1.2	1200	Manhole	Adoptable
1.002	F1.2	1200	Manhole	Adoptable	F1.3	1200	Manhole	Adoptable
1.003	F1.3	1200	Manhole	Adoptable	F1.4	1200	Manhole	Adoptable
1.004	F1.4	1200	Manhole	Adoptable	F1.5	1200	Manhole	Adoptable
1.005	F1.5	1200	Manhole	Adoptable	F1.6	1200	Manhole	Adoptable
1.006	F1.6	1200	Manhole	Adoptable	F1.7	1200	Manhole	Adoptable
1.007	F1.7	1200	Manhole	Adoptable	F1.8	1200	Manhole	Adoptable
1.008	F1.8	1200	Manhole	Adoptable	F1.9	1200	Manhole	Adoptable
1.009	F1.9	1200	Manhole	Adoptable	F1.10	1200	Manhole	Adoptable
1.010	F1.10	1200	Manhole	Adoptable	F1.11	1200	Manhole	Adoptable
1.011	F1.11	1200	Manhole	Adoptable	F1.12	1200	Manhole	Adoptable
1.012	F1.12	1200	Manhole	Adoptable	F1.13	1200	Manhole	Adoptable
1.013	F1.13	1200	Manhole	Adoptable	F1.14	1200	Manhole	Adoptable
2.000	F2.0	1200	Manhole	Adoptable	F2.1	1200	Manhole	Adoptable
2.001	F2.1	1200	Manhole	Adoptable	F1.3	1200	Manhole	Adoptable
4.000	F3.0	1200	Manhole	Adoptable	F3.1	1200	Manhole	Adoptable
4.001	F3.1	1200	Manhole	Adoptable	F1.6	1200	Manhole	Adoptable
3.000	F4.0	1200	Manhole	Adoptable	F4.1	1200	Manhole	Adoptable
3.001	F4.1	1200	Manhole	Adoptable	F4.2	1200	Manhole	Adoptable
3.002	F4.2	1200	Manhole	Adoptable	F4.3	1200	Manhole	Adoptable
3.003	F4.3	1200	Manhole	Adoptable	F4.4	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)
3.004	13.957	60.0	150	Circular	107.300	104.790	2.360	107.360	104.557	2.653
5.000	15.469	60.0	150	Circular	110.990	108.600	2.240	110.150	108.342	1.658
5.001	24.901	60.0	150	Circular	110.150	107.780	2.220	108.830	107.365	1.315
5.002	26.458	60.0	150	Circular	108.830	106.550	2.130	107.520	106.109	1.261
5.003	54.494	60.0	150	Circular	107.520	105.530	1.840	106.000	104.622	1.228
7.000	18.505	80.0	225	Circular	107.440	105.500	1.715	107.090	105.269	1.596
6.001	36.434	100.0	225	Circular	107.090	104.551	2.314	106.370	104.187	1.958
6.002	28.126	100.0	225	Circular	106.370	103.500	2.645	104.660	103.219	1.216
6.003	16.641	100.0	225	Circular	104.660	102.990	1.445	105.400	102.824	2.351
6.004	15.035	100.0	225	Circular	105.400	102.824	2.351	104.770	102.674	1.871
6.005	17.278	100.0	225	Circular	104.770	102.674	1.871	104.260	102.501	1.534
6.000	32.441	100.0	225	Circular	106.300	104.875	1.200	107.090	104.551	2.314
8.000	28.839	60.0	150	Circular	106.580	103.698	2.732	105.400	103.217	2.033
9.000	28.615	60.0	150	Circular	108.100	105.800	2.150	106.730	105.323	1.257
9.001	48.552	80.0	225	Circular	106.730	103.200	3.305	104.060	102.593	1.242
9.002	22.046	80.0	225	Circular	104.060	101.380	2.455	102.900	101.104	1.571
9.003	18.741	100.0	225	Circular	102.900	100.731	1.944	103.380	100.544	2.611

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3.004	F4.4	1200	Manhole	Adoptable	F1.6	1200	Manhole	Adoptable
5.000	F5.0	1200	Manhole	Adoptable	F5.1	1200	Manhole	Adoptable
5.001	F5.1	1200	Manhole	Adoptable	F5.2	1200	Manhole	Adoptable
5.002	F5.2	1200	Manhole	Adoptable	F5.3	1200	Manhole	Adoptable
5.003	F5.3	1200	Manhole	Adoptable	F1.8	1200	Manhole	Adoptable
7.000	F6.0	1200	Manhole	Adoptable	F6.1	1200	Manhole	Adoptable
6.001	F6.1	1200	Manhole	Adoptable	F6.2	1200	Manhole	Adoptable
6.002	F6.2	1200	Manhole	Adoptable	F6.3	1200	Manhole	Adoptable
6.003	F6.3	1200	Manhole	Adoptable	F6.4	1200	Manhole	Adoptable
6.004	F6.4	1200	Manhole	Adoptable	F6.5	1200	Manhole	Adoptable
6.005	F6.5	1200	Manhole	Adoptable	F1.10	1200	Manhole	Adoptable
6.000	F9.0	1200	Manhole	Adoptable	F6.1	1200	Manhole	Adoptable
8.000	F10.0	1200	Manhole	Adoptable	F6.4	1200	Manhole	Adoptable
9.000	F7.0	1200	Manhole	Adoptable	F7.1	1200	Manhole	Adoptable
9.001	F7.1	1200	Manhole	Adoptable	F7.2	1200	Manhole	Adoptable
9.002	F7.2	1200	Manhole	Adoptable	F7.3	1200	Manhole	Adoptable
9.003	F7.3	1200	Manhole	Adoptable	F1.12	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1.0	722619.666	716682.753	108.730	1.350	1200	0	1.000	107.380	150
F1.1	722650.659	716685.685	108.300	1.439	1200	1	1.000	106.861	150
						0	1.001	106.861	150
F1.2	722703.729	716696.245	107.550	1.916	1200	1	1.001	105.959	150
						0	1.002	105.634	150
F1.3	722725.170	716704.791	107.470	2.221	1200	1	2.001	105.939	150
						2	1.002	105.249	150
						0	1.003	105.249	150
F1.4	722716.370	716728.146	107.730	2.868	1200	1	1.003	104.937	150
						0	1.004	104.862	225
F1.5	722714.690	716751.494	107.520	2.892	1200	1	1.004	104.628	225
						0	1.005	104.628	225
F1.6	722712.365	716778.225	107.360	2.911	1200	1	4.001	104.910	150
						2	3.004	104.557	150
						3	1.005	104.449	225
						0	1.006	104.449	225
F1.7	722707.622	716803.975	106.960	2.686	1200	1	1.006	104.274	225
						0	1.007	104.274	225
F1.8	722695.747	716845.720	106.000	2.015	1200	1	5.003	104.622	150
						2	1.007	103.985	225
						0	1.008	103.985	225
F1.9	722693.165	716853.791	105.620	4.159	1200	1	1.008	103.929	225
						0	1.009	101.461	225
F1.10	722675.419	716885.179	104.260	3.039	1200	1	6.005	102.501	225
						2	1.009	101.221	225
						0	1.010	101.221	225
F1.11	722731.774	716897.938	103.090	2.254	1200	1	1.010	100.836	225
						0	1.011	100.836	225
F1.12	722749.684	716901.958	103.380	2.897	1200	1	9.003	100.544	225
						2	1.011	100.714	225
						0	1.012	100.483	225

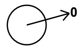
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1.13	722746.715	716911.452	103.180	2.763	1200	1	1.012	100.417	225
						0	1.013	100.417	225
F1.14	722745.327	716917.620	103.030	2.655	1200	1	1.013	100.375	225
F2.0	722810.424	716736.877	109.670	1.890	1200	0	2.000	107.780	150
F2.1	722743.965	716712.887	108.460	2.180	1200	1	2.000	106.602	150
						0	2.001	106.280	150
F3.0	722793.805	716803.072	108.140	1.350	1200	0	4.000	106.790	150
F3.1	722722.947	716778.178	107.400	2.314	1200	1	4.000	105.538	150
						0	4.001	105.086	150
F4.0	722598.182	716751.090	110.680	3.400	1200	0	3.000	107.280	150
F4.1	722626.546	716757.547	109.160	2.365	1200	1	3.000	106.795	150
						0	3.001	106.795	150
F4.2	722641.391	716756.925	108.560	2.013	1200	1	3.001	106.547	150
						0	3.002	106.547	150
F4.3	722687.469	716768.351	107.390	1.634	1200	1	3.002	105.756	150
						0	3.003	105.756	150
F4.4	722698.830	716774.819	107.300	2.510	1200	1	3.003	105.538	150
						0	3.004	104.790	150
F5.0	722583.403	716804.849	110.990	2.390	1200	0	5.000	108.600	150
F5.1	722598.208	716809.333	110.150	2.370	1200	1	5.000	108.342	150
						0	5.001	107.780	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F5.2	722617.460	716825.126	108.830	2.280	1200	1	5.001	107.365	150
						0	5.002	106.550	150
F5.3	722643.104	716831.639	107.520	1.990	1200	1	5.002	106.109	150
						0	5.003	105.530	150
F6.0	722558.012	716898.156	107.440	1.940	1200	0	7.000	105.500	225
F6.1	722576.513	716897.785	107.090	2.539	1200	1	7.000	105.269	225
						2	6.000	104.551	225
						0	6.001	104.551	225
F6.2	722612.870	716895.414	106.370	2.870	1200	1	6.001	104.187	225
						0	6.002	103.500	225
F6.3	722640.845	716892.508	104.660	1.670	1200	1	6.002	103.219	225
						0	6.003	102.990	225
F6.4	722644.465	716876.265	105.400	2.576	1200	1	8.000	103.217	150
						2	6.003	102.824	225
						0	6.004	102.824	225
F6.5	722659.213	716879.188	104.770	2.096	1200	1	6.004	102.674	225
						0	6.005	102.674	225
F7.0	722781.239	716807.736	108.100	2.300	1200	0	9.000	105.800	150
F7.1	722773.394	716835.255	106.730	3.530	1200	1	9.000	105.323	150
						0	9.001	103.200	225
F7.2	722772.246	716883.793	104.060	2.680	1200	1	9.001	102.593	225
						0	9.002	101.380	225
F7.3	722768.098	716905.445	102.900	2.169	1200	1	9.002	101.104	225
						0	9.003	100.731	225
F9.0	722578.913	716930.137	106.300	1.425	1200	0	6.000	104.875	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F10.0	722616.627	716868.734	106.580	2.882	1200				
						0	8.000	103.698	150

APPENDIX VIII

Geotechnical Site Investigation Report Extracts including Soakaway Results

S.I. Ltd Contract No: 5638

Client:	Cairn Homes Ltd
Engineer:	Barrett Mahony
Contractor:	Site Investigations Ltd

Cookstown Lane, Enniskerry, Co. Dublin Site Investigation Report

Prepared by:

....

Stephen Letch

Issue Date:	08/10/2019
Status	Final
Revision	1

Contents: Page No.

1.	Introduction	1
2.	Fieldwork	1
3.	Laboratory Testing	3
4.	Ground Conditions	3
5.	Recommendations and Conclusions	4

Appendices:

1. Cable Percussion Borehole Logs
2. Trial Pit Logs and Photographs
3. Soakaway Test Results and Photographs
4. Geotechnical Laboratory Test Results
5. Environmental Laboratory Test Results
6. Survey Data

1. Introduction

On the instructions of Barrett Mahony, Site Investigations Ltd (SIL) were appointed to complete a ground investigation at Cookstown Lane, Enniskerry, Co. Dublin. The investigation was for a new residential development of the site and was completed on behalf of the Client, Cairn Homes Ltd.

The fieldworks comprised a programme of cable percussion boreholes, trial pits, soakaway tests and California Bearing Ratio tests. All fieldwork was carried out in accordance with BS 5930:2015, Engineers Ireland GI Specification and Related Document 2nd Edition 2016 and Eurocode 7: Geotechnical Design. Geotechnical and environmental laboratory testing was completed on representative soil samples recovered from the boreholes and trial pits and these are in accordance with the relevant specification.

This report presents the factual geotechnical data obtained from the field and laboratory testing with interpretation of the ground conditions discussed.

2. Fieldwork

The geotechnical fieldworks were started and completed in September 2019 and comprised the following:

- 3 No. cable percussive boreholes
- 18 No. trial pits
- 1 No. soakaway test
- 9 No. California Bearing Ratio tests

2.1. Cable Percussive Boreholes

Cable percussion boring was undertaken at 3 No. locations using a Dando 150 rig and constructed 200mm diameter boreholes. The boreholes terminated at the scheduled depth of 7.50mbgl. It was not possible to collect undisturbed samples due to the gravel and cobble content in the cohesive soils and the lack of cohesion in the granular soils so bulk disturbed samples were recovered at regular intervals where possible.

To test the strength of the stratum, Standard Penetration Tests (SPT's) were performed at 1.00m intervals in accordance with BS 1377 (1990). In soils with high gravel and cobble content it is appropriate to use a solid cone (60°) (CPT) instead of the split spoon and this was used throughout the testing. The test is completed over 450mm and the cone is driven 150mm into the stratum to ensure that the test is conducted over an undisturbed zone. The cone is then driven the remaining 300mm and the blows recorded to report the N-Value. The report shows the N-Value with the 75mm incremental blows listed in brackets (e.g. BH01 at

1.00mbgl where N=14-(3,4/3,3,4,4)). Where refusal of 50 blows across the test zone was encountered was achieved during testing, the penetration depth is also reported (e.g. BH02 at 6.00mbgl where N=50-(7,8/50 for 50mm)).

At BH01 and BH03, groundwater standpipes were installed to allow for long term monitoring. These were formed of a slotted standpipe with a gravel pack surround to allow for the groundwater to ingress into the pipe and stabilise. Bentonite seals were placed above the pipe to ensure that water does not migrate into the hole from the surface.

The logs are presented in Appendix 1.

2.2. Trial Pits

18 No. trial pits were excavated using a tracked excavator to the scheduled depth of 3.00mbgl. They were logged by a SIL geotechnical engineer and this included the soil strata, any groundwater ingresses and the pit wall stability. Representative disturbed bulk samples were also recovered as the pits were excavated and they were also returned to the laboratory for testing. Finally, before backfilling the trial pits with the arisings, photographs of the pit, sidewall and spoil heap were taken for the record.

The trial pit logs and photographs are presented in Appendix 2.

2.3. Soakaway Test

1 No. soakaway test was completed using a tracked excavator and they were logged by SIL geotechnical engineer. The soakaway test is used to identify possible areas for storm water drainage. The pit was filled with water and the level of the groundwater was recorded over time. As stipulated by BRE Special Digest 365, the pit should be filled three times and that the final cycle is used to provide the infiltration rate. The time taken for the water level to fall from 75% volume to 25% volume is required to calculate the rate of infiltration. However, if the water level does not fall at a steady rate then the test is deemed to have failed and the area is unsuitable for storm water drainage.

The soakaway log and photographs are presented in Appendix 3.

2.4. Surveying

Following completion of all the fieldworks, a survey of the exploratory hole locations was completed using a GeoMax GPS Rover. The data is supplied on each individual log and along with a site plan in Appendix 6.

3. Laboratory Testing

Geotechnical laboratory testing was undertaken on representative soil samples in accordance with BS 1377 (1990). Testing includes:

- 9 No. Moisture content
- 6 No. Atterberg limits
- 9 No. Particle size gradings
- 3 No. Hydrometers
- 3 No. pH, sulphate and chloride content

Environmental testing was completed by ALS Environmental Ltd. and consisted of the following:

- 7 No. Rilta Analysis

The geotechnical laboratory test results are presented in Appendix 4 with the environmental results in Appendix 5.

4. Ground Conditions

4.1. Overburden

The natural overburden deposits vary slightly across the site with the boreholes encountering SAND (BH01), SILT (BH02) and CLAY (BH03) overlying GRAVEL. The trial pits are dominated by granular SAND and GRAVEL soils across the site although some CLAY strata were occasionally recorded.

The laboratory tests of the cohesive soils confirm that both CLAY and SILT soils are present on site with low plasticity indexes of 3 to 15% recorded. The particle size distribution curves were poorly sorted straight-line curves and also confirmed that all soil types are present on site.

4.2. Groundwater

Groundwater details in the boreholes and trial pits during the fieldworks are noted on the logs in Appendices 1 and 2. Groundwater was not recorded in any of the boreholes or trial pits during the fieldworks period.

5.0. Recommendations and Conclusions

Please note the following caveats:

The recommendations given, and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between the exploratory hole locations or below the final level of excavation, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for adjacent unexpected conditions that have not been revealed by the exploratory holes. It is further recommended that all bearing surfaces when excavated should be inspected by a suitably qualified Engineer to verify the information given in this report.

Excavated surfaces in clay strata should be kept dry to avoid softening prior to foundation placement. Foundations should always be taken to a minimum depth of 0.50mBGL to avoid the effects of frost action and possible seasonal shrinkage/swelling.

If it is intended that on-site materials are to be used as fill, then the necessary laboratory testing should be specified by the Client to confirm the suitability. Also, relevant lab testing should be specified where stability of side slopes to excavations is a concern, or where contamination may be an issue.

5.1. Shallow Foundations

Due to the unknown depth of foundation and no longer-term groundwater information, this analysis assumes the groundwater will not influence the construction or performance of these foundations.

Due to the varied nature of the soils across the site, analysis of bearing capacities from the SPT N-values is provided below in the table. In the cohesive soils, Stroud and Butler proposed a correlation between the SPT N-value and undrained shear strength using the Atterberg Limits and using the indices of 10%, a correlation of Cu=6N has been chosen for this site. This can be used to calculate the ultimate bearing capacity (UBC), and finally, a factor of safety is applied and with a factor of 3 chosen to give the allowable bearing capacity (ABC).

In granular soils, the SPT N-value can then be used to calculate the allowable bearing capacity, as per Terzaghi and Peck, using the correlation of SPT N-value x 10 = ABC. All capacities shown below are in kN/m^2

BH No.	1.00m					2.00m				
	Cohesive Soils			Granular Soils		Cohesive Soils			Granular Soils	
	C_u	UBC	ABC	N-Value	ABC	C_u	UBC	ABC	N-Value	ABC
BH01				14	**130**				16	**160**
BH02	102	540	**180**						18	**160**
BH03	102	540	**180**						28	**280**

The following assumptions were made as part of these analyses. If any of these assumptions are not in accordance with detailed design or observations made during construction these recommendations should be re-evaluated.

- The foundation is to be 1m wide.
- Foundations are to be constructed on a level formation of uniform material type (described above).
- All man-made or filled material is to be removed prior to construction.
- The bulk unit weight of the material in this stratum has a minimum density of 19kN/m^3.
- Based on groundwater observations this analysis assumes the groundwater will not influence the construction or performance of these foundations.
- All founding strata to be inspected by a suitably qualified Engineer prior to pouring the foundations.

The trial pits indicate that excavations should be stable for a short while at least. However, when granular soils are encountered then the stability of the pit walls are reduced compared to cohesive soils and therefore regular inspection of temporary excavations should be completed during construction to ensure that all slopes are stable. Temporary support should be used on any excavation that will be left open for an extended period.

5.2. Groundwater

The caveats below relating to interpretation of groundwater levels should be noted:

There is always considerable uncertainty as to the likely rates of water ingress into excavations in clayey soil sites due to the possibility of localised unforeseen sand and gravel lenses acting as permeable conduits for unknown volumes of water.

Furthermore, water levels noted on the borehole and trial pit logs do not generally give an accurate indication of the actual groundwater conditions as the borehole or trial pit is rarely left open for sufficient time for the water level to reach equilibrium.

Also, during boring procedures, a permeable stratum may have been sealed off by the borehole casing, or water may have been added to aid drilling. Therefore, an extended period *of groundwater monitoring using any constructed standpipes is required to provide more accurate information regarding groundwater conditions. Finally, groundwater levels vary with time of year, rainfall, nearby construction and tides.*

Pumping tests would be required to determine likely seepage rates and persistence into excavations taken below the groundwater level. Deep trial pits also aid estimation of seepage rates.

As discussed previously there were no water strikes in the boreholes or trial pits. The site is dominated by granular soils and this would suggest that the soils are very well drained and the groundwater table is low.

If groundwater is encountered during excavations then mechanical pumps will be required to remove the groundwater from sumps. Sumps should be carefully located and constructed to ensure that groundwater is efficiently removed from excavations and trenches.

5.3. Soakaway Test

The tests show that the test was completed in the granular soils and this passed the test. The f-value was calculated as **3.58×10^{-5}** and this value should be used for the soakaway design.

5.4. Contamination

Environmental testing was carried out on seven samples from the investigation and the results are shown in Appendix 5. For material to be removed from site, Rilta Suite testing was carried out to determine if the material is hazardous or non-hazardous and then the leachate results were compared with the published waste acceptance limits of BS EN 12457-2 to determine whether the material on the site could be accepted as 'inert material' by an Irish landfill.

The Waste Classification report created using HazWasteOnline™ software shows that the material tested can be classified as non-hazardous material. The Total Petroleum Hydrocarbon (TPH) results did record levels above the limit of detection in one of the seven samples (TP04), but the levels recorded are low and not in liquid form so therefore, the sample can be recorded as non-hazardous.

Following this analysis of the solid test results, the leachate disposal suite results indicate that the soils tested would be able to be treated as Inert Waste. The sample from TP01 did exceed the loss on ignition results but the remaining results are low.

Seven samples were tested for analysis but it cannot be discounted that any localised contamination may have been missed. Any MADE GROUND excavated on site should be stockpiled separately to natural soils to avoid any potential cross contamination of the soils. Additional testing of these soils may be requested by the individual landfill before acceptance and a testing regime designed by an environmental engineer would be recommended to satisfy the landfill.

5.5. Aggressive Ground Conditions

The chemical test results in Appendix 4 indicate a general pH value between 7.80 and 8.15, which is close to neutral and below the level of 9, therefore no special precautions are required.

The maximum value obtained for water soluble sulphate was 126mg/l as SO_3. The BRE Special Digest 1:2005 – '*Concrete in Aggressive Ground'* guidelines require SO_4 values and after conversion ($SO_4 = SO_3 \times 1.2$), the maximum value of 151mg/l shows Class 1 conditions and no special precautions are required.

Appendix 3

Soakaway Test Results and Photographs

SOAKAWAY TEST

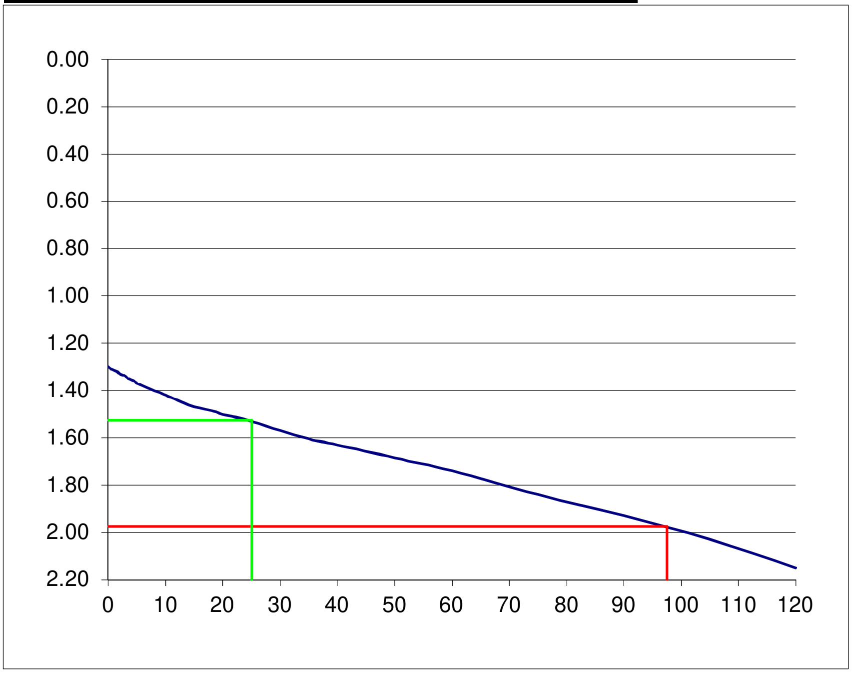
Project Reference:	5638
Contract name:	Cookstown Road
Location:	Enniskerry, Co. Dublin
Test No:	SA01
Date:	03/09/2019

Ground Conditions

From	To	
0.00	0.30	TOPSOIL.
0.30	1.30	Light brown silty gravelly SAND with low cobble content.
1.30	2.20	Grey silty very sandy GRAVEL with medium cobble content.

Elapsed Time (mins)	Fall of Water (m)
0	1.30
0.5	1.31
1	1.32
1.5	1.32
2	1.33
2.5	1.34
3	1.34
3.5	1.35
4	1.36
4.5	1.36
5	1.37
6	1.38
7	1.39
8	1.40
9	1.41
10	1.42
12	1.44
14	1.46
16	1.48
18	1.49
20	1.50
25	1.53
30	1.57
35	1.61
40	1.63
50	1.69
60	1.74
75	1.84
90	1.93
105	2.03
120	2.15

Pit Dimensions (m)		
Length (m)	2.30	m
Width (m)	0.60	m
Depth	2.20	m
Water		
Start Depth of Water	1.30	m
Depth of Water	0.90	m
75% Full	1.53	m
25% Full	1.98	m
75%-25%	0.45	m
Volume of water (75%-25%)	**0.62**	m3
Area of Drainage	**12.76**	m2
Area of Drainage (75%-25%)	**3.99**	m2
Time		
75% Full	25	min
25% Full	97.5	min
Time 75% to 25%	**72.5**	min
Time 75% to 25% (sec)	**4350**	sec



f = 0.00215 or **3.58E-05**

m/min **m/s**

SOAKAWAY TEST f-Value Calculations SIL

Project Reference:	5170
Contract name:	Cookstown Road Housing Development
Location:	Enniskerry, Co. Wicklow
Test No:	SP01
Date:	06/06/2014

Ground Conditions

From	To	
0.00	0.30	TOPSOIL
0.30	0.50	Orange brown silty fine to medium SAND.
0.50	1.70	Brown silty fine to coarse SAND.
1.70	2.10	Grey sandy fine to coarse GRAVEL.

Comments:

Minor collapse of pit walls in GRAVEL strata.

Elapsed Time (mins)	Fall of Water (m)
0	-1.170
1	-1.200
2	-1.225
3	-1.250
4	-1.275
5	-1.300
6	-1.325
7	-1.350
8	-1.375
9	-1.400
10	-1.420
12	-1.450
14	-1.480
16	-1.510
18	-1.535
20	-1.560
25	-1.590
30	-1.620
35	-1.640
40	-1.660
50	-1.720
60	-1.780
75	-1.850
90	-1.920
105	-2.000

Pit Dimensions (m)		
Length (m)	2.30	m
Width (m)	0.70	m
Depth	2.10	m

Water		
Start Depth of Water	1.16	m
Depth of Water	0.94	m
75% Full	1.395	m
25% Full	1.865	m
75%-25%	0.47	m
Volume of water (75%-25%)	**0.7567**	m3

Area of Drainage	**12.6**	m2
Area of Drainage (75%-25%)	**4.43**	m2

Time		
75% Full	8.75	min
25% Full	78	min
Time 75% to 25%	69.25	min
Time 75% to 25% (sec)	4155	sec

f = 0.00247 or **4.11E-05**

m/min **m/s**

Legend Key

- Locations By Type - CP
- Locations By Type - IP
- Locations By Type - TP

Contract No:	5638
Contract Name:	Cookstown Road
Location:	Enniskerry, Co. Dublin
Client:	Cairn Homes Ltd
Engineer:	Barrett Mahony
Title:	Site Plan
Scale:	1:1750
Drawn By:	SL

Site Investigations Ltd
The Grange
12th Lock Road
Lucan
Co. Dublin
T: 01 6108768
e: info@siteinvestigations.ie

APPENDIX IX

Report by the Surface Water Design Auditor

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2020s1192
Contract	Residential Development Cookstown, Enniskerry, Co. Wicklow
Client	Cairn Homes Properties Ltd.
Date	03rd November 2020
Author	Jamie Cullen
Subject	**Stormwater Audit - Stage 1 Report**

1 Proposed Residential Development, Cookstown, Enniskerry, Co Wicklow.

1.1 Introduction

JBA Consulting have been contracted by Cairn Homes Properties Ltd. c/o Barrett Mahony Consulting Engineers (BMCE) to undertake a Stage 1 audit of the surface water drainage design for the proposed residential development at Cookstown, Enniskerry, Co. Wicklow. The surface water audit was undertaken in advance of a planning submission.

A review of the flood risk assessment, also included in the Civil Engineering Infrastructure Report and Flood Risk Assessment, has also been undertaken and is provided in Section 2 of this document.

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The site is a greenfield area, used for agriculture land, with no existing structures or infrastructure within the bounds of the site. The proposed development will consist of the construction of 165 no. dwellings consisting of 104 no. 2 storey houses, 56 no. apartments/duplex apartments in 4 no. 3 storey blocks, 4 no. 1 bedroom Maisonette dwellings in a 2-storey building and a single storey creche with a 2-storey element. The total site area is stated to be 6.36 hectares (ha). The total impermeable area arising from the proposed development is 2.565ha. The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development.
Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • Greater Dublin Strategic Drainage Strategy (GDSDS); • Greater Dublin Regional Code of Practice for Drainage Works; • The SuDS Manual (CIRIA C753). • BRE Digest 365 • The audit is based on the BMCE Infrastructure Report & Flood Risk Assessment for Planning dated 25th September 2020 (rev PL2) and associated drawings.
Key Considerations & Benefits of SUDs	The key benefits and objectives of SUDs considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.
Site Characteristics	**Soil:** Site Investigations Ltd. carried out soakaway tests on site in 2014 & 2019, refer Appendix VIII of the BMCE Infrastructure Report. For each occasion it seems that one soakaway test was carried out in each year. Further infiltration testing in accordance with BRE Digest 365 will be carried out at detail design stage. From the soakaway tests carried out an infiltration rate of 0.148m/hr was obtained in 2014 and 0.128m/hr in 2019. This shows the soil has good infiltration capacity and can be considered as being soil type 2.

	Rainfall (basis for surface water pipeline network design): Rainfall parameters can be estimated using Met Eireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Eireann method can be more representative of a site if selected correctly. A comparison of values estimated by CSC and JBA is shown below: **BMCE value** / **JBA Value** Rainfall model: Met Éireann / Met Éireann M5-60 (mm): 17.10mm / 17.20mm Ratio R: 0.263 / 0.267 The above variances are within acceptable limits with no meaningful impact on the design. **Greenfield Runoff Rate (basis of surface water attenuation design):** There will be no discharge from site to any watercourses or existing storm network pipes with the drainage being kept within the site boundaries. It is proposed that the primary surface network will discharge to ground in a soakaway located to the northern boundary of the site with local infiltration also provided throughout the development in infiltration trenches. Therefore, limiting discharge rates as per the GDSDS do not apply in this instance. **FLOW & Windes Calculations** The FLOW and Windes models as submitted for the storm sewer calculations account for 2.565ha which coincides with the hardstanding area indicated within Appendix VIII page 3 of the Micro Drainage calculations of the Infrastructure Report. The design of the storm network is indicated as 100 years return period which is deemed acceptable. 20% has also been added for climate change purposes. **Gradient:** There is a topographical fall across the site in a northern direction from a high of c. 110m at the southern boundary to a low of c. 104m along the northern boundary. The adopted finished floor levels together with final site levels would allow for most SUDs technologies being feasible for the site.
SuDS Measures Considered	BMCE confirmed the following SUDs measures were considered and conclusions reached:

SUDS Technology	Comments
Green / Blue Roofs	No green roof system is proposed.
Swale/ Filter Drain / Infiltration trench	BMCE are proposing infiltration to ground to the underside of the filter drains, permeable paving and soakaway. An SPR value of 0.3 and an infiltration rate of f = 4.11x10-5 m/s shows there is great infiltration potential available on site and it is a sufficient means of dealing with the stormwater.
Permeable Paving	Permeable paving systems are proposed for the private and visitor parking spaces. It is proposed that all the permeable paving on site will only treat its own surface area, it is designed to attenuate and infiltrate all surface water collected across its own area, for all events including the 1 in 100 year storm +20% climate change.

Soakaways	There is one soakaway proposed for the development and it is designed to infiltrate all run-off generated from all hardstanding surfaces on site up to and including the 1 in 100-year storm event +20% climate change.
Petrol Interceptor	It is proposed to include a by-pass petrol interceptor prior to the storm water entering the StormTech soakaway.
Other Sediment Management	The majority of runoff from the development will pass through infiltration trenches, permeable paving and a petrol interceptor prior to entering the final soakaway where it will infiltrate to ground.
Surface Water Attenuation	No surface water attenuation required as the run-off from all hardstanding areas will drain to the soakaway with no flows required to be attenuated before discharging from site.
Site Run-off Rates	No discharging from site.
Rainwater Harvesting	None proposed.
Detention Basins, Retention Ponds, Stormwater Wetlands	Not included in design.
Tree Root Structural Cell Systems, Bio-retention, rain garden	Not included in design.

Surface Water Drainage Design	All surface water flows generated from the hardstanding areas of the proposed development will be discharged to a soakaway located at the northern boundary of the site. No impact on existing storm sewer networks or watercourses due to the construction of this development.
SUDs Management Train	**Source Control** and **Site Control** are addressed by the use of infiltration systems (interception storage). Infiltration potential has been provided through infiltration trenches, permeable paving and the soakaway. A petrol interceptor is also incorporated into the design to treat surface water run-off from trafficked areas which are not picked up by the infiltration trenches. **Regional Control** does not apply at the level of this development. As recommended with the SUDs Manual (Table 3.3) assuming effective pre-treatment is in place the following number of treatment train components are recommended:

	No. of treatment train components recommended	Comment/Proposals
Roof areas	1	Soakaway. 1st 5mm of rainfall is intercepted.

	<table><tr><td>**Residential roads, parking areas, commercial zones**</td><td>2</td><td>Infiltration trenches, permeable paving in private and visitor parking bays and soakaway. 1st 5mm of rainfall is intercepted.</td></tr><tr><td>**Refuse collection, industrial areas, loading bays, lorry parks and highways.**</td><td>3</td><td>Not applicable.</td></tr></table> Generally, site proposals meet the treatment train recommendations within the SuDS Manual.
Climate Change	An allowance of 20% increase in flows has been included for climate change, both for the storm sewer calculations and the soakaway design. This is in compliance with Section 6.3.2.4 of the GDSDS.
Volume Storage	BMCE have provided calculations for the proposed soakaway volume. Currently, BMCE are proposing a soakaway volume of 1105.8m^3 (which has been sized for the 100-year return period + climate change) and is based on Criterion 4.2, Table 6.3 of the GDSDS. Finished floor levels should be a minimum of 500mm above the top water level (TWL) of the attenuation structure. The invert level of the attenuation structure is c.98.1m and the TWL 100.66m while the lowest finished floor level is 103.35m.
Treatment Volume / Water Quality Improvement	As per Table 24.6 of the CIRIA SuDS manual, 5mm interception storage can be assumed to be achieved for all areas which drain to the soakaway which is proposed to infiltrate all run-off generated from all hardstanding areas up to and including the 1 in 100-year storm event +20% climate change.
Biodiversity	Unless a permanent pond is incorporated into the design, not deemed viable to enhance biodiversity any further.
Return Period	A 100-year return period plus 20% for climate change has been used in the design for the stormwater network and soakaway system.
Exceedance flows	BMCE have considered exceedance flows. BMCE have made a provision on site to infiltrate all run-off from hardstanding areas up to and including the 1 in 100-year storm event (plus an allowance for climate change) below ground. Proposed site levels are such that any exceedance flows in the event of blockage etc. will be conveyed to the north-eastern boundary of the site. At detail design stage it is recommended that the surface water management system is further investigated to suitably manage exceedance flows so that they are contained within the green open space and site boundary.
Health & Safety and Maintenance Issues	The proposed drainage system comprises traditional road gullies, manholes, a petrol interceptor, underground pipes and infiltration capacity to the underside of the interception storage units. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. At detailed design stage, it is recommended that a

	maintenance regime be adopted. Particular consideration is required at detailed design stage to the design, maintenance requirements and whole life plan (and replacement) of the soakaway/interceptor storage. Regular maintenance and cleaning of the isolator row will be required to remove any sediments, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptor be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance is recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.
Design Review Process	Upon review of BMCE initial drainage design, JBA Consulting did not require any meaningful modifications to the design, other than: • More consistency with values used for pipe diameters and slopes throughout calculations and drawings. • No gullies to be connected directly to each other with separate connections required to filter drains. • Remove backdrop manhole at S7.1 as this induced a 3.3m deep sewer with no incoming sewer to warrant such a depth. • Provision of a land/filter drain along the southern boundary of the site to intercept overland flows and control the volume of surface water being conveyed to the soakaway system at the northern boundary. A summary of comments and record of the audit trail are appended to this report. Based on this being at preliminary design stage and a Stage 1 Surface Water Audit, JBA Consulting's comments have all been satisfactorily addressed or sufficient commitment provided that details will be confirmed at detailed design stage following further geotechnical site investigations on site by BMCE.
Audit Result	JBA Consulting considers that the surface water drainage design for the proposed development is acceptable and meets the requirements of the Stage 1 Stormwater Audit.

Audit Report Prepared by:	Jamie Cullen BEng (Hons) MSc. Assistant Engineer
Approved by:	Declan White BEng (Hons) CEng FIEI Technical Director

Note:

*JBA Consulting Engineers & Scientists Ltd. role on this project is as an independent reviewer/auditor. JBA Consulting Engineers & Scientists hold no design responsibility on this project. All issues raised and comments made by JBA are for the consideration of the Design Engineer (*Barrett Mahony Consulting Engineers). *Final design, construction supervision, with sign-off and/or commissioning of the surface water system so that the final product is fit for purpose with a suitable design, capacity and life-span, remains the responsibility of the Design Engineers.*

2 Flood Risk Assessment Review

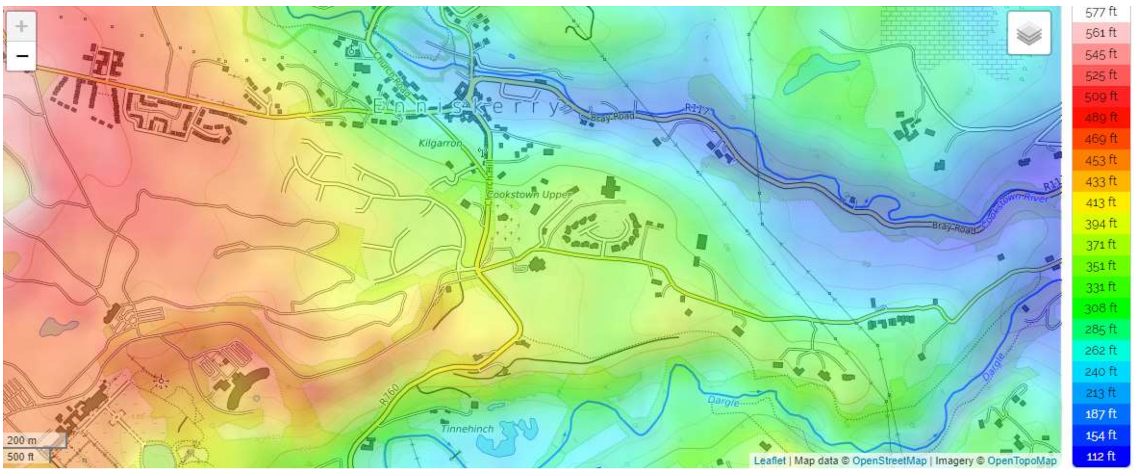
2.1 Overview

The Engineering Report includes, in Section 5, a site risk assessment which provides a Stage 1 and 2 review of flood risk to the site. The assessment determines that the site is in Flood Zone C and not at risk from fluvial or coastal sources. Surface water flood risk at low points along the northern boundary of the site is highlighted and will be addressed through the drainage system on site.

2.2 Review of the FRA

A number of observations on the FRA are made and detailed below.

- Section 5.2.1 refers to Floodmaps.ie and mentions report is included in Appendix V. Report is not provided in Appendix V. Floodmaps.ie shows no flood events within or near the site, which is positive.
- Section 5.3.2.1 mentions the OPW's CFRAM Study. However, there is no OPW CFRAM mapping available for Enniskerry, which was not one of the areas included in the CFRAM study. The mapping provided in Appendix IV is from the Enniskerry Town Plan and includes Flood Zones derived from PFRA mapping, which it should be noted has since been withdrawn by the OPW pending release of the second-generation flood maps. Including this plan within the report is acceptable however, it would be helpful to highlight and focus in on the site area. Appendix V is a reproduction of the indicative Flood Zones, again taken from the County Development Plan based on the PFRA mapping.
- The Glencullen River is located c.370m north of the site and the Dargle River is located c. 125m south of the site. Two major watercourses in close vicinity to the proposed residential development and no detailed hydraulic modelling has been carried out. Given the extent of the Flood Zones shown in the PFRA for the Glencullen, flood risk can reasonably be screened out. However, there has been no demonstration of the extent of risk from the Dargle. This should be confirmed in the FRA and could be by a comparison of top of bank and site levels. The map below is taken from https://en-ie.topographic-map.com/maps/5h/Ireland/ and in the absence of local topographic survey could be referred to and comparison of levels provided.



- As the development is considered highly vulnerable some reference to bank levels or general topography (as above) should be made to confirm that the FFLs are appropriately set.
- Pluvial flooding seems to be a concern for Wicklow County Council along Cookstown Road at the northern boundary of the site. It has been proposed to provide surface water drainage along the northern boundary of the site to mitigate against pluvial flooding. This approach has been reviewed

under the SUDS review. For clarity in the FRA, it would be helpful if this were illustrated in the context of the site and the proposed housing locations, with flow paths into the low spots indicated.

- There is no provision for the setting of finished floor levels in the FRA. Although fluvial risk is not a driver for FFL, for the management of pluvial risk it is recommended that FFL are set a minimum of 150mm above surrounding ground levels.

2.3 Conclusion

Notwithstanding the points above, it is considered the site is in Flood Zone C and, although being a highly vulnerable use, is an appropriate form of development in this location. However, the FRA needs to be made slightly more robust and refer to the correct supporting data sets to provide a high level of confidence in the assessment.

Appendix A – Audit Trail Record

JBA Consulting Stormwater Audit - Stage 1 Feedback Form	
Project:	Residential Development at Cookstown, Enniskerry, Co. Wicklow
Date:	30/09/2020
JBA Reviewers	Jamie Cullen - Assistant Engineer
Project Number:	2020s1192

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	30/09/2020			
	Reference Documents - 18.243-IR-01-civil - PL2 AUDIT ISSUE - 18243-BMD-00-ZZ-DR-C-1020 PROPOSED FOUL & SURFACE WATER DRAINAGE LAYOUT - 18243-BMD-00-ZZ-DR-C-1120 PROPOSED SURFACE WATER LS 1 OF 2 - 18243-BMD-00-ZZ-DR-C-1121 PROPOSED SURFACE WATER LS 2 OF 2 - 18243-BMD-00-ZZ-DR-C-1200 STANDARD DETAILS DRAINAGE - 18243-BMD-00-ZZ-DR-C1205 SuDS DETAILS - 18243-BMD-00-ZZ-DR-C-1210 ROAD & HARDSTANDING STANDARD DETAILS			
1	In Appendix VII Geotechnical Site Investigation Report only 1 soakaway test seems to have carried out in both 2014 and 2019. As required by BRE 365, the pit should be filled 3 times and that the final cycle is used to provide the infiltration rate. Can you confirm if 3nr consecurtve tests were undertaken and if not, will they be carried out at detailed design stage?	Barrett Mahony to review and advise	**From the Site investigation report in 2019, it has been stated that the soakaway test was was carried out as stipulated by BRE Special Digest 365. An extract from the report section 5.3 states, '5.3. Soakaway Test: The tests show that the test was completed in the granular soils and this passed the test. The f-value was calculated as 3.58 x 10-5 and this value should be used for the soakaway design.' The results of these test can be found in appendix 3 of the Site Investigation Report. Further testing can be undertaken to confirm local infiltration rates during the detailed design stage.**	**Acceptable**
2	In Appendix VI the Surface Netwrok Design pg. 2 to 5 the diameter and falls of individual pipe runs do not match what is shown on drawing's 1020, 1120 and 1121 (the drainaeg plan and longitudial storm sections).	Barrett Mahony to review and advise	**This has now been rectified.**	**See Note 14**
3	In the flow results on page 2 the infiltration trenches are shown IC1 to IC15, however, they are not labelled on drawing 1020 so it is hard to pinpoint where these are in relation to on site.	Barrett Mahony to review and advise	**This has now been rectified.**	**Acceptable**
4	In terms of source control and avoiding the conveyance of all storm flows to a single soakaway system towards the northern boundary of the site, does the filter drain along the southern side of road 4 need to connect to the dedicated storm network	Barrett Mahony to assess if a standalone soakaway system could/should be provided within the green area to the south of the site for road 4 drainage and/or runoff from the green open space itself.	**A 1.2.m x 06m infiltration trench has been proposed to allow for Road 4 to be treated locally as suggested.**	**Acceptable**
5	If this site is to be taken-in-charge no pipe diameters for the storm network should be less than 225mm. In the infiltration trenches the pipe diameters are shown to be 150mm.	Barrett Mahony to review and advise	**The infiltration trenches are intended to be privately maintained SuDS features, and not a public surface network. If these are to be taken in charge by WCC the details of these will be agreed in the detailed tender stage.**	**Acceptable**
6	The cumulative drained area is not shown on the storm calculations to assess the % breakdown of hardstanding and green open space areas to enable an assessment of attenuation storage volume?	Barrett Mahony to review and advise	**Please see attached Drawing no. 18243-BMD-00-ZZ-DR-C-1015. We have indicated on the drawing the areas. 45% of the site is hard standing, 6% is permeable paving and 41% is green open spaces**	**Acceptable**
7	Time of travel and time of concentration and associated rainfall intensity is not shown on the calcualtion output	Barrett Mahony to provide	**Maximum time of concentration and time of entry are shown on the design settings section of the Flow Output. The average and peak rainfall intensity for each storm event in the simulation has been added to the output report.**	**See Note 15**
8	There is a backdrop manhole proposed at manhole, S7.1 on drawing nr 1121 which induces a 3.3m depth of sewer and there is no apparent incoming sewer to warrant such a depth. It should be possible to provide a gradient similar to the road topography without the proportional velocities being too high	Barrett Mahony to review and advise	**This has now been rectified.To keep to IW COP of 1.2m min cover there are 2 backdrop manholes. One at S7.1 with a manhole depth of 2.474m and S7.2 with a manhole depth of 1.834m with max gradients of 1:40.**	**See Note 16**
9	It is noted that gullies are connected into other gullies at the entrane into the estate which is not acceptable and they need to be independently connected to the filter drain	Barrett Mahony to review and advise	**This has been rectified.**	**Acceptable**
10	From the Microdrainage soakaway calcs in Appendix VI, it is not stated what infiltration rate was used.	Barrett Mahony to review and advise	**An infiltration rate of 0.148m/hr has been applied to all infiltration systems in the Flow simulation.**	**Acceptable**
11	The flow output shows negative velocity and outflow at link 11.002 for the 30yr and 100yr storm events. Please clarify as to why this is as it would suggest that the infiltration trench is not functioning correctly.	Barrett Mahony to review and advise	**Negative flow in the critical storm events is due to the conveyance pipe surcharging due to the water level within S1.14, which has also surcharged. As a result in the critical storm some surface water backs up into the conveyance pipe in the trench, before discharging again as the levels in the main line reduce. This does not result in any flooding of links upstream of 11.002, and cannot be prevented in the model due to the cover levels upstream making it impossible to connect to S1.14 above the surcharged level. A non-return valve can be fitted at the end of the infiltration trench to prevent this occuring in practice.**	**Acceptable**

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
12	For the 1 in 100yr storm event + 20% climate change flow results it shows that S1.3, S7.3 and IC11 are under flood risk status. What threshold has been set for the onset of flood risk?	Barrett Mahony to review and advise	**The flood risk threshold has been set at 300mm below cover level. This information has been added to the output report.**	See Note 17
13	Re the filter drains provided for drainage of Cookstown Road, does the 1m x 0.6m infiltration trenches as proposed need any consideration given proximity of the primary soakaway system for the subject site	Barrett Mahony to review and advise	**The proposed infiltration trenches are there to collect the surface water runoff from the main Cookstown road along the site boundary, and to prevent any excess water from entering the site. At closest, the trench is 5m from the soakaway - this occurs at the northwest corner of the soakaway, and is inline with the separation requirements for a soakaway from adjacent structures.**	Acceptable
	22/10/2020			
14	On drawing 1020 the pipe diameters and the slopes have been updated however, these do not match the pipe and slopes shown on drawing 1120 & 1121. There seems to also be no consistency with values in the FLOW results and drawings for example, S1.5 to S1.6 in FLOW is shown to be 300mm diameter pipe at 1:150 slope, on drawing 1020 this pipe run is shown to be 300mm diameter pipe at 1:134 slope and on drawing 1120 this is shown as 225mm diameter pipe at 1:151 slope. Another example S1.8 to S1.9 in FLOW is a 375mm diameter pipe at 1:200 slope, on dwg. 1020 this pipe run is shown to be 450mm diamter at 1:200 slope and on drawing 1120 it is a 225mm diameter at 1:201 slope.	Barrett Mahony to review and advise	**Flow model and drawings have been amended to show consistent information.**	Acceptable
15	In the design settings section of FLOW this gives the information on what the FLOW output is calculated from, the time of concentration and rainfall intensity can be added to the Links results in the FLOW software and be displayed on pg. 2, 3, 4 & 5. It is also noted that no simulation settings have been provided for the storm events.	Barrett Mahony to review and advise	**TOC and rainfall intensity have now been added to link results. Simulation settings have also been added to report output (pg 11+12).**	Acceptable
16	On Dwg. 1020 S7.0 to S7.1, S7.1 to S7.2 & S7.2 to S7.3 are shown to have slopes of 1:40. In the FLOW output & Dwg. 1121 for these three pipe runs the slopes are shown to be 1:150, 1:150 & 1:200 respectively, the longitudinal section shown on Dwg. 1121 received on the 21/10/20 is displaying the same as the drawing recieved on the 30/09/20.	Barrett Mahony to review and advise	**Flow Model and longsections have been amended to reflect the 1:40 slope required to minimise surface water manhole depths.**	Acceptable
17	This is an acceptable flood risk threshold level. We note that the initial FLOW results received on the 30/09/20 indicated no flooding, however, the latest FLOW results received on the 21/10/20 indicates flooding occuring at S1.3 during the 100-year storm + 20% climate change and given the proximity to the raised speed table on the northern side of the T-Junction, there is potential for the build up of water at this location. Given the road level at this location is the same as the FFL of the semi-detached houses on the west side of the junction, and although the prediceted flood volume is small, there is a potential flood risk.	Barrett Mahony to review and advise	**This has been amended to eliminate the flooding simulated at S1.3. No flooding occurs in the revised model for any storm event.**	Acceptable