Project

SHD Development at Cooldown Commons Phase 3

Report Title

Infrastructure Design Report

Client

Cairn Homes

INFRASTRUCTURE

DBFL CONSULTING ENGINEERS

June 2021

Job Title: **Cooldown Commons Phase 3**

Job Number: **190003**

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APPENDICES

1.0 INTRODUCTION

1.1 Background

DBFL were commissioned to undertake an infrastructure design report to accompany an SHD planning submission for a proposed mixed-use development at Cooldown Commons, Citywest, Dublin 24. The subject site comprises circa 3.404ha and is within the jurisdiction of South Dublin County Council. The proposed development comprises Phase 3 of a residential development, with Phases 1 & 2 under construction under ABP-302398-18.

The subject site currently benefits from two planning permissions as it straddles two sites. ABP-302398-18 received planning permission for 459 dwellings. Previous application SHD3ABP-308985-20 was submitted in December 2020 and withdraw in April 2021 proposed 429 units.

This application will modify 32 no. of these permitted duplex units by incorporating them into this application and replacing them with proposed apartments. It also replaces, in its entirety, the granted development for 129 units under SD16A/0078. Refer to Figure 1 below.

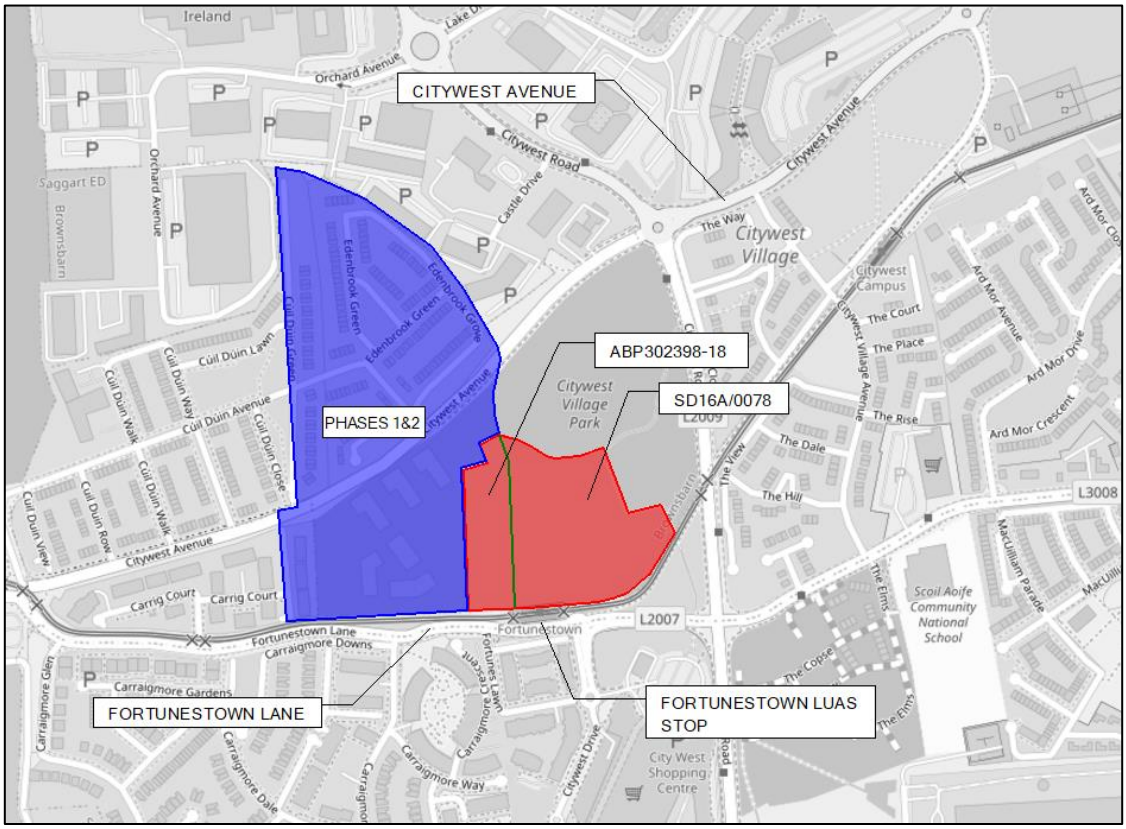


Figure 1: Site Location Map & Planning References

1.2 Objectives

This report considers the development's main infrastructure elements, including;

- Stormwater management strategy;
- Foul drainage strategy;
- Water supply;
- Road layout and site access;

1.3 Development Proposals

The proposed development will consist of the construction of 421 no. residential units within 9 no. blocks ranging in height from 1 – 13 storeys, retail/commercial/office units, residential amenity space, and open spaces along with all associated site development works and services provisions to facilitate the development including parking, bin storage, substations, landscaping and all services. A full description is provided in the statutory notices and in Chapter 3 of the EIAR.

1.4 Site Characteristics

The subject site is situated approximately 1km northwest of Saggart in the Fortunestown area of Citywest. It is bounded to the west and north by Phases 1 & 2 residential development under construction under planning reference ABP-302398-18 and to the north and east by undeveloped lands. It is also bounded to the east and south by the LUAS red line with Fortunestown LUAS Stop located at the southern boundary of the site. The N7 Naas Road is approximately 700m north of the site, with junction 3 accessed from the N82. The Baldonnell Upper Stream forms the north eastern and eastern boundary of the site. The site falls from south to north and west to east towards the Stream.

A topographical survey of the site is provided as a background to the 'Roads Layout' and 'Proposed Site Services Layout, on DBFL drawing no. 190003-DBFL-RD-SP-DR-C-1001 & 190003-DBFL-CS-SP-DR-C-1001 respectively.

2.0 ACCESS AND ROADS

2.1 Overall Road and Access Layout

It is proposed to access the development from roads infrastructure approved and under construction for Phases 1 & 2, under ABP-302398-18. Details of the road layout can be found on DBFL drawing 190003-DBFL-RD-SP-DR-C-1001, which includes sightlines and DBFL drawing 190003-DBFL-RD-SP-DR-C-1003, which includes vehicle tracking details and sightlines.

The road layout is designed in accordance with the recommendations of the Design Manual for Urban Roads and Streets (DMURS), refer to *DMURS Design Statement* included under separate cover.

2.2 Traffic & Transportation

A *Traffic & Transport Assessment (TTA) and a Mobility Management Plan (MMP)'* by DBFL Consulting Engineers is included as a separate report, with this planning submission.

3.0 SURFACE WATER DRAINAGE

3.1 General

The jurisdiction of South Dublin County Council forms part of the Greater Dublin Area (GDA) as identified in the *Greater Dublin Strategic Drainage Study* (GDSDS). The GDSDS outlines regional drainage policies to address the drainage needs of the GDA. These policies address surface water management from development sites, from the point of view of water quality, quantity, risk of flooding and compliance with relevant environmental legislation. As outlined in the GDSDS, proposed developments must be drained on separate foul and surface water drainage systems and must incorporate Sustainable Urban Drainage Systems (SuDS) for the management of surface water runoff.

Surface water runoff from the proposed development is managed in accordance with the principles of the GDSDS and South Dublin County Council's requirements, and all current guidelines, including CIRIA SuDS Guidelines.

To manage surface water runoff from the development, it is proposed to split the site into two surface water catchments, "A" and "B" corresponding to two different surface water outfalls. Catchment "A" corresponds to a portion of the site (0.24ha) which was previously granted planning permission under ABP-302398-18 for Phase 2 of the development, with surface water runoff from this catchment outfalling to the surface water drainage system within the phase 2 development. Catchment "B" corresponds to the remainder of the subject site (3.06ha) with attenuated surface water from that catchment discharging to the existing open channel which forms the eastern boundary of the site, via a new surface water outfall pipe.

3.2 Compliance with Surface Water Policy

Surface water runoff is managed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), and the policies, guidelines and the requirements of South Dublin County Council. The development's surface water design should therefore comply with the following four criteria;

- *Criterion 1: River Water Quality Protection*

  Satisfied by providing interception storage and treatment of run-off within SuDS features. This is satisfied using green roofs, permeable paving, swales, tree pits, petrol interceptor and on-line storage attenuation systems.

- *Criterion 2: River Regime Protection*

  Satisfied by attenuating run-off with flow control devices prior to discharge to the outfall.

- *Criterion 3: Level of Service (Flooding) for the Site*

  Satisfied by the site being within flood zone “C” as defined by the Guidelines. Pluvial flood risk is addressed by the development being designed to accommodate surface water runoff from a 1% AEP (Annual Exceedance Probability) plus climate change (10%) as per the recommendations of the GDSDS. Planned flood routing for storms greater than 100-year return period level considered in design and development run-off contained within site.

- *Criterion 4: River Flood Protection*

  Attenuation provided within the SUDS features i.e. permeable paving, green roofs and on-line attenuation systems.

3.3 Surface Water Management

3.3.1 General

Surface water runoff from the proposed residential development will be attenuated to Greenfield Runoff “Qbar”, in accordance with the recommendations of the GDSDS, with surface water runoff exceeding the allowable outflow rate stored for up to a 1% AEP event. Surface water storage will be provided in a combination of underground storage such as ‘Stormtech’ or similar approved systems and overground shallow detention basins. Surface water runoff would also be managed using SuDS features which are incorporated into the surface water drainage system.

To manage surface water runoff from the development, it is proposed to separate the development into two surface water catchments (“A” & “B”) corresponding to each surface water outfall. Refer to Figure 2.

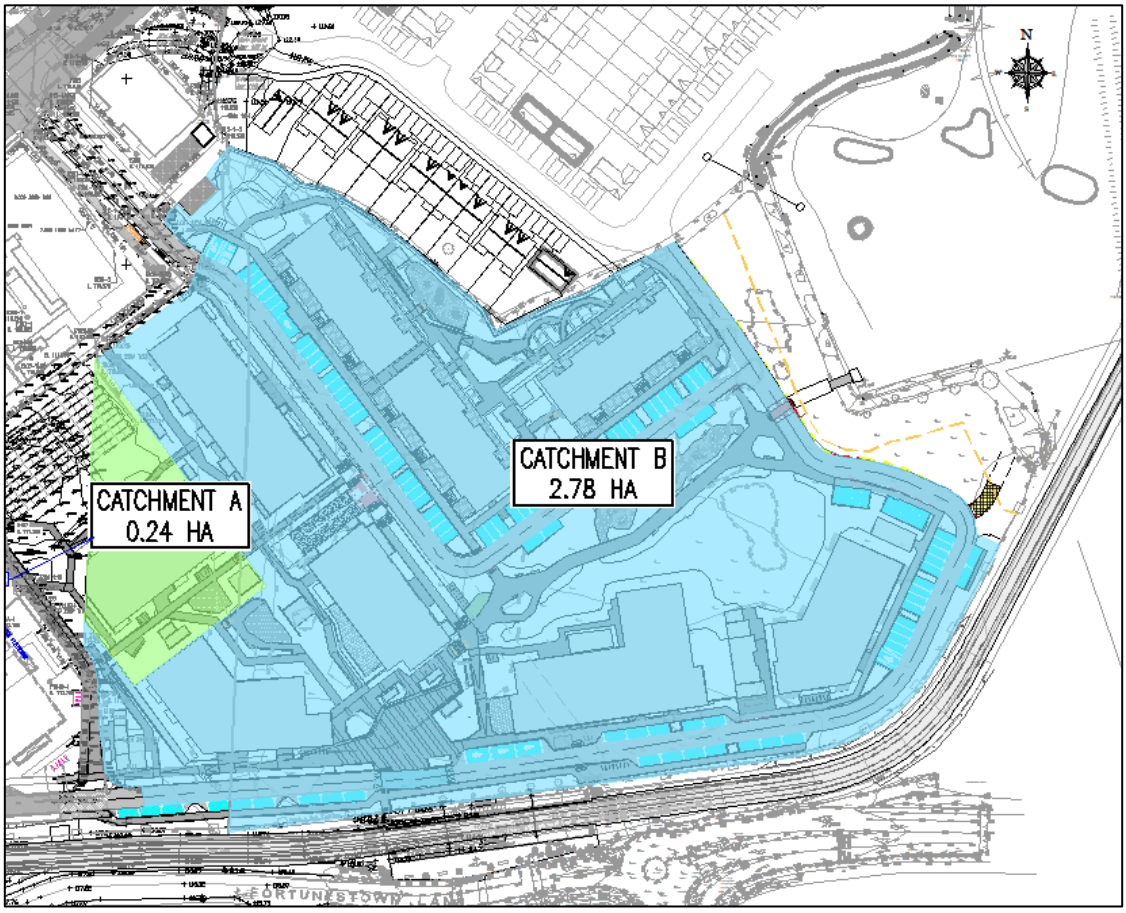


Figure 2: Surface Water Catchments

3.3.2 Surface Water Catchments

(i) *Surface Water Catchment "A"*

Catchment "A" comprises a 0.24ha portion of the subject site which was previously granted planning permission under ABP-302398-18 for Phase 2 of the development under construction. This portion of the subject site is included in surface water Catchment 1 for the approved planning application ABP-302398-18 and the surface water attenuation system (Stormtech MC3500 – storage volume of 821m^3) for that Catchment is designed to accommodate unattenuated runoff from Catchment A of the subject site. 631m^3 of the storage volume is utilized by the Phase 2 development (constructed), with the remaining storage volume of 189m^3 available for this site.

The allowable outflow rate of 2l/s was approved under ABP-302398-18 for Catchment 1 and this attenuated flow discharges through phase 1 before eventually outfalling to an existing drain to

the north of the Phase 1 lands. Refer to Figure 3 for a plan of the surface water catchments for Phases 1 and 2 of the development approved under ABP-302398-18.

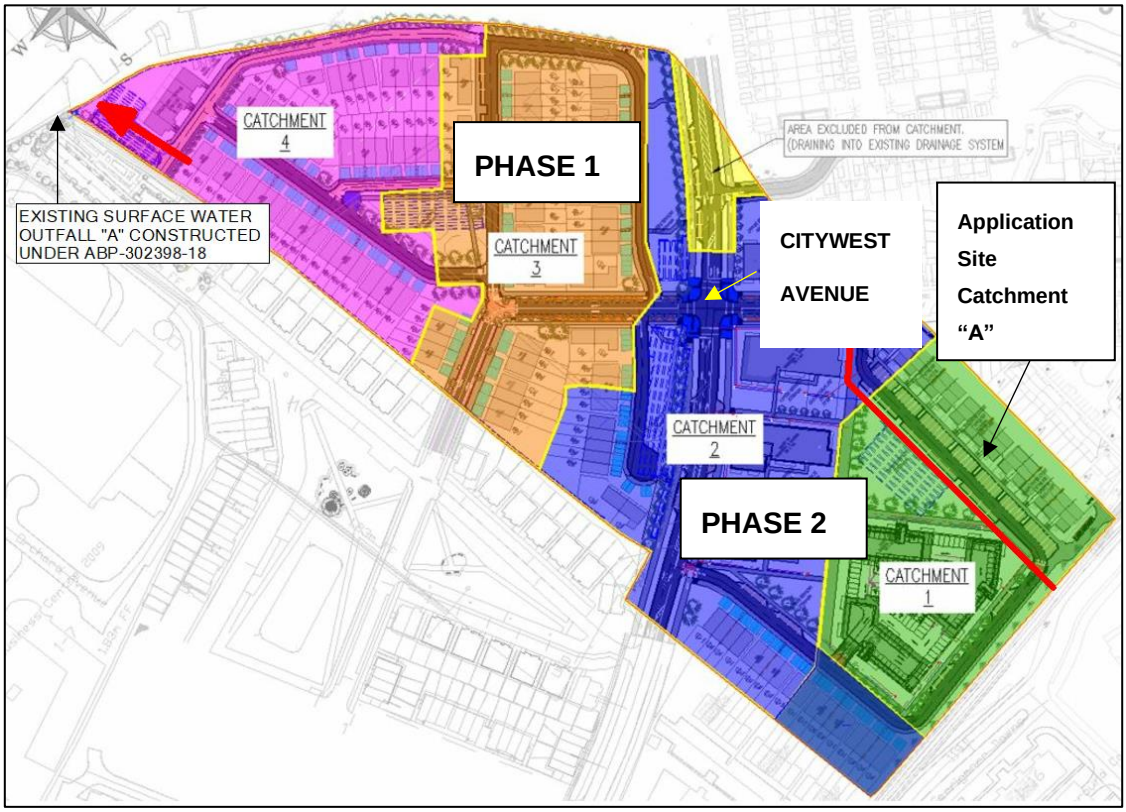


Figure 3: Surface Water Catchments for Phases 1 and 2 under construction

(ii) Surface Water Catchment "B"

Surface water catchment "B" comprises the balance of the subject site (2.78 ha), with attenuated runoff from this catchment discharging to the Baldonnell Upper Stream along the eastern boundary. Surface water storage for this catchment is provided for up to a 1% AEP storm event in the open space area to the north of Blocks E1 and E2 in a combination of underground storage and overground storage. Catchment "B", excludes the open space area which provides a buffer / riparian strip to the Baldonnell Upper Stream as it comprises grassed / landscaped open space, without any positive drainage. Therefore, this area is excluded from the Qbar calculation.

3.3.3 Surface Water Attenuation

Surface water runoff from the development would be attenuated to greenfield runoff (Qbar), in accordance with the recommendations of the GDSDS. Surface water run-off from the surface water catchment will be attenuated using a vortex flow control device (Hydrobrake or equivalent) on the surface water outlet from each catchment.

Allowable Outflow Qbar Surface Water Catchment "A"

As outlined in Section 3.2.2 above, unattenuated runoff from Catchment A discharges to Catchment 1 (Phase 2) of the previously approved scheme with Catchment 1 attenuated to 2l/s. The attenuation and storage arrangement for Catchment 1 was approved under ABP-302398-18, with an allowable outflow rate (Qbar) of 2l/s applied to that catchment area of 1.47ha giving an allowable outflow rate of 1.36l/s/ha. It is not proposed to alter the attenuated runoff arrangement for Catchment 1 to that approved and constructed under ABP-302398-18. However, there is a slight reduction in the gross area of Catchment 1, which has reduced slightly from 1.47ha to circa 1.25ha.

Allowable Outflow Qbar Surface Water Catchment "B"

Qbar is calculated using the "Institute of Hydrology" equation, as recommended in the Greater Dublin Strategic Drainage Study (GDSDS), as follows:

Q_(bar [rural]) = 0.00108 x 〖AREA〗^0.89 x 〖SAAR〗^1.17 x 〖Soil〗^2.17

Where: Qbar[rural] is the mean catchment annual flow from a rural catchment in m3/s;

AREA is the area of the catchment in km2. For a catchment area less than 50ha, calculate Qbar for 50 ha and pro rata it. Area = 50ha or 0.5km2;

SAAR is the standard average annual rainfall = 834mm.

SOIL is the soil index, with 5 soil types used and SPR values (standard percentage runoff) applied to each soil type.

The SPR values for the 5 soil types are as follows:

Soil 1 = 0.1; Soil 2 = 0.3; Soil 3 = 0.37; Soil 4 = 0.47; Soil 5 = 0.53;

A SPR value of 0.37 (Soil Type 3) is applied for the subject site.

Qbar (rural) = $0.00108 \times (0.5)^{0.89} \times (834)1.17 \times (0.37)^{2.17}$

= $0.1763 m^3$/sec or 176.3l/s for 50ha or

9.8l/s for Catchment "B" with an effective catchment area of 2.78ha

Refer also to **Appendix A** for further details of the allowable outflow calculations.

Soil type 3 is determined by site specific ground conditions. For further details on ground conditions refer to the *'Ground Investigation Report October 2020'* by GII which is included under separate cover.

3.3.4 Surface Water Storage

Catchment "A"

Catchment "A" comprises a 0.24ha portion of the subject site which was previously granted planning permission under ABP-302398-18 for Phase 2 of the development under construction. This portion of the subject site is included in surface water Catchment 1 for the approved planning application ABP-302398-18 and the surface water attenuation system (Stormtech MC3500 – storage volume of 821m^3) for that Catchment is designed to accommodate unattenuated runoff from Catchment A of the subject site. 631m^3 of the storage volume is utilized by the Phase 2 development (constructed), with the remaining storage volume of 189m^3 available for this site. Refer to Table 1 below for a breakdown of the surface water storage and attenuation for the constructed storage system in Phase 2.

Surface Water Catchment 1 (Phase 2 Constructed) Storage Arrangement			
	Total Storage Constructed	**Phase 2 Constructed**	**Application Site Catchment "A" Under Consideration**
Stormtech Unit MC 3500			
Total Storage Constructed (m^3)	821	631	189
Impermeable Area (ha)	0.880	0.720	0.160
TWL for 1% AEP Storm event plus climate change (mAOD)		112.396	112.701

Lowest FFL		116.60	115.20

Table: 1 Existing Surface Water Storage Arrangement for Catchment 1 Phase 2 (Constructed)

Catchment "B"

Surface water storage for Catchment "B" comprises underground 'Stormtech' system (or similar approved), with over ground storage in the form of a detention basin. The underground storage system was designed to store runoff from a storm with a return period of up to 1 in 80 years and the detention basin is designed to accommodate runoff from a storm with a return period between 80 and 100 years.

The volume of surface water storage required for each catchment has been calculated using the "Source Control" module of "Microdrainage" software taking account of design invert levels, ground levels, and depth and type of storage system and allowable outflow rate. Refer to **Appendix B** for Microdrainage Source Control storage calculations. The total surface water storage volume required for the subject site comprises circa 1,327.8m^3 for both Catchments "A" and "B". A breakdown of the surface water attenuation and storage requirements for the subject site (both catchments) are included in Table 2 below.

Surface Water Catchment	Area of Catchment (ha)	Allowable Outflow Rate (Qbar) (l/s)	Allowable Outflow Rate/ha (Qbar) (l/s/ha)	Underground Storage 'Stormtech' Volume (m^3)	Type of Stormtech Unit	Aboveground Storage "Detention Basin" Volume (m^3)	Total Storage Volume (m^3) (100-year Return Period / 1% AEP)
A	**0.24**	*****	*****	**188.8**	**MC-3500**	**N/A**	**188.8**
B	**2.78**	**9.8**	**3.5**	**1,069**	**SC-740**	**70**	**1,139**
Total	**3.02**			**1,257.8**	**-**	**70**	**1,327.8**

Table 2: Surface Water Attenuation & Storage Requirement Arrangement for Subject Site

3.3.5 SUDS

In accordance with the GDSDS, it is proposed to incorporate Sustainable Urban Drainage Systems (SuDS) into the surface water drainage design, for the management of storm-water runoff from the development. This SuDS strategy will attenuate surface-water runoff rates and volumes; reduce pollutant concentrations in surface water; replicate the natural characteristics of surface water runoff for the site in its pre-developed state. SUDs features proposed for the development include the following:

- Permeable Paving;
- Extensive Green Roofs for Apartment Blocks (sedum blanket);
- Intensive Green Roofs in the form of soft landscaping on the podium;
- Swales;
- Tree Pits;
- Permeable paving;
- Detention basin;
- Underground storage system such as ‘Stormtech’ or similar approved;
- Hydrobrake Flow Controls;
- Petrol Interceptor;

The proposed surface water drainage layout for the scheme is detailed in DBFL drawing no. 190003-DBFL-CS-SP-DR-C-1001.

3.3.6 Maintenance of Surface Water Drainage System

Maintenance of the surface water storage system (Stormtech or similar approved) will be in accordance with the manufacturers guidelines and CIRIA SuDS Guidelines. The Stormtech system should be inspected immediately after construction and once in normal operation, the Stormtech Isolator Row should be inspected twice a year.

Maintenance of the above ground detention basin, swales and tree pits will be in accordance with CIRIA SuDS guidelines.

Refer to **Appendix H** for details of the maintenance procedures for surface water drainage elements.

3.4 Surface Water Drainage Design Standards

Surface water drainage for the proposed development is designed using the recommendations of the GDSDS, EN752 and BS8301:1985, with the following parameters applied:

- Return period for pipe network 2 years,
    - check 30-year 15 minute, no flooding;
    - check 100-year flooding in designated areas;
- Time of entry 4 minutes
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity 1.0 m/s
- Standard Average Annual Rainfall 834mm
- M5-60 18.5mm
- Ratio r (M5-60/M5-2D) 0.256
- Storage System Storm Return Event GDSDS Volume 2, p61, Criterion 3
    - 30-year no flooding on site;
    - 100-year check no internal property flooding. Flood routing plan. FFL + 500mm freeboard above 100-year flood level. No flooding to adjacent areas.
- Climate Change 10% for rainfall intensities.

The surface water drainage network including the surface water storage system has been designed and simulated for a range of storm events (including 1 in 10, 1 in 30 and 1 in 100-year storm events) using the *Network* module of *Microdrainage*. Refer to **Appendix C** for *Microdrainage* results.

A breakdown of the Impermeable areas contributing to the surface water drainage network is included in Table 3 below;

Surface Type	Runoff Co-Efficient	Catchment "A" Gross Area ha	Catchment "A" Imp Area	Catchment "B" Gross Area ha	Catchment "B" Imp Area ha	Total Imp Area (ha)
Roof Area (Extensive Green Roof)	**0.9**	0.040	0.036	0.291	0.262	0.298
Roof Area (Traditional) **Includes the portion of the roof with PV panels**	**1.00**	0.027	0.027	0.376	0.376	0.403
Podium Deck (Intensive Green Roof)	**0.75**	0.087	0.065	0.168	0.126	0.191
Paths on a Podium Deck	**0.90**	-	-	0.124	0.111	0.111
Roads to Traditional Gullies	**0.80**	-	-	0.071	0.057	0.057
Roads to SuDS	**0.75**	-	-	0.276	0.207	0.207
Paths to Traditional Gullies	**0.80**	-	-	0.457	0.366	0.366
Car Parking (Permeable)	**0.50**	-	-	0.151	0.076	0.076
Open Space	**0.37**	0.086	0.032	0.866	0.320	0.352

Total	**0.240**	**0.160**	**2.78**	**1.901**	**2.061**
			Total Impermeability (%)		**68.2**

Table 3: Breakdown of Impermeable Areas

3.4.1 Podium Drainage

The podium level comprises hard and soft landscaping, which will be drained via drainage outlets on the slab to slung drainage under the podium deck. The slung drainage will be designed at detailed design stage prior to construction.

Similarly, rainwater downpipes for roof runoff for the apartment blocks above the basement slab will discharge via a slung drainage arrangement, which would be subject to detailed design.

The podium would have a typical roof garden build up with hard landscaping comprising paving over a drainage board that would serve as a reservoir. Similarly, soft landscaping would comprise soil / grass / planting over a drainage board / reservoir. It is proposed to use a 50-60mm deck drain across the podium deck, which would function as a water storage system (reservoir) and drainage layer.

3.4.2 Basement Drainage

Any surface water runoff from the basement car park generated by incidental spillage would drain through a separate drainage system underneath the basement slab. A system of ACO drains and gullies would collect surface water and connect to a 150mm / 225mm diameter surface water sewer which drains into a petrol interceptor prior to discharge to the foul drainage system for the development.

3.5 Interception and Treatment Storage

Interception Storage

To prevent pollutants or sediments discharging into water courses the GDSDS requires "interception storage" to be incorporated into the development. The volume of interception required is based on 5mm of rainfall depth from 80% of the runoff from impermeable areas as defined in GDSDS. The interception volume attributable to each SuDs feature consists of the volume of water that can infiltrate to the ground, what will evaporate into the atmosphere and what can transpirate through plants and vegetation. Additionally, there will be some loses of water due to absorption and wetting of stone and soil media. The total interception storage required is circa 82.44m^3.

- Impermeable area (Catchment A and B) = 2.061ha (Table 2)
  = 20610m^2
- Interception Storage = 20610 x 0.005 x 0.8
  = 82.44m^3

Refer to Figure 4 below for a breakdown of the areas intercepted and Table 4 for details of interception and treatment storage for the site.

Treatment Storage

The GDSDS requires that a "treatment volume" (Vt) be provided to prevent any pollutants or sediments entering river systems. Additionally, a 'treatment train' stormwater runoff management system is required. According to CIRIA document C697 the following treatment train approach is necessary:

- Surface Water Runoff from Roofs – 1 Treatment Stage
- Surface Water Runoff from Roads – 2 Treatment Stages
- Surface Water Runoff from other Paved Areas excluding Roads — 1 Treatment Stage

The treatment volume is based on treatment 15mm of rainfall depth from 80% of the runoff from impermeable areas as defined in the GDSDS.

All run-off areas will pass through the required number of treatment stages prior to discharging to the downstream outfall. Treatment methods include permeable paving, green roofs, and 'Stormtech' attenuation system and a petrol interceptor.

- Impermeable area = 2.061ha (Table 2)
  = $20610m^2$
- Treatment Storage = 20610 x 0.015 x 0.8
  = $247.32m^3$

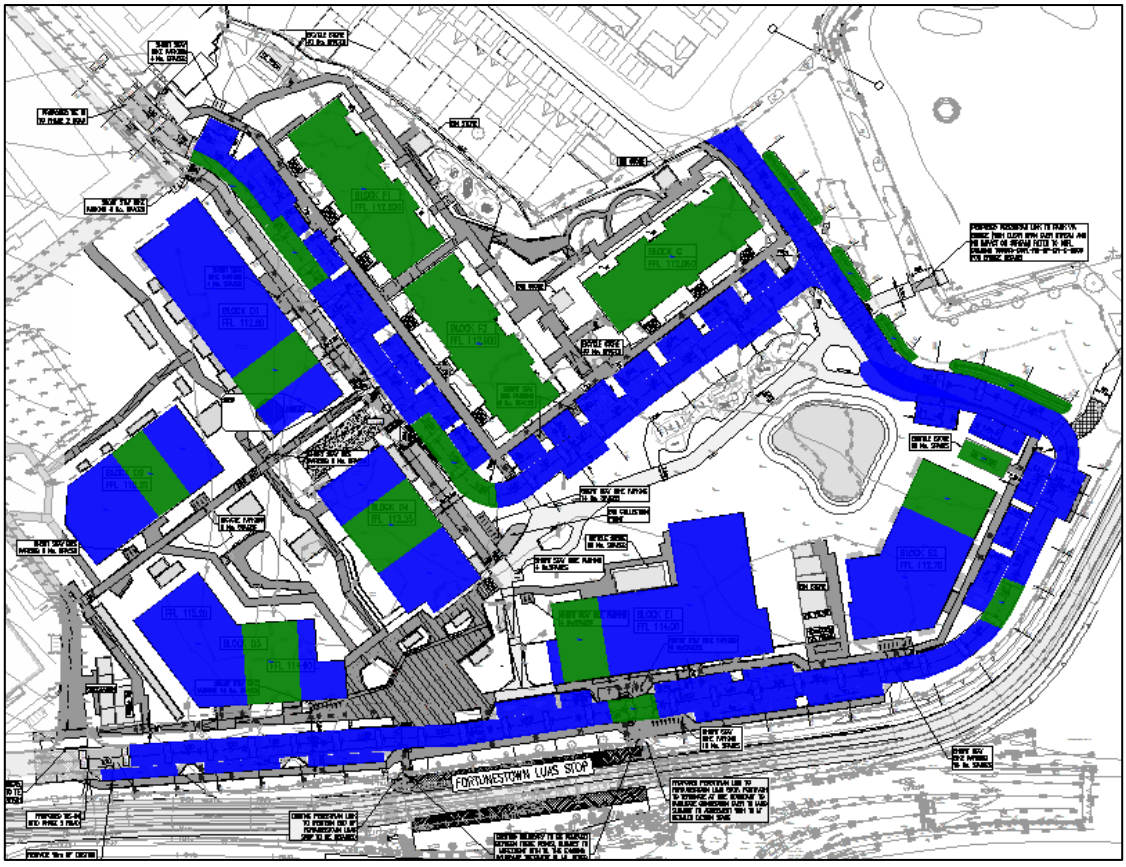
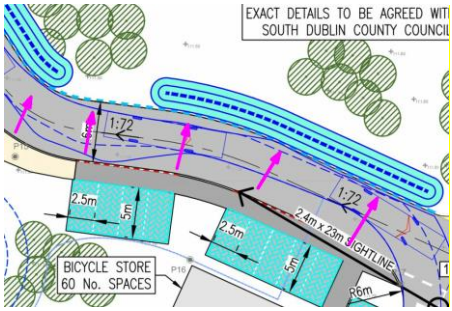
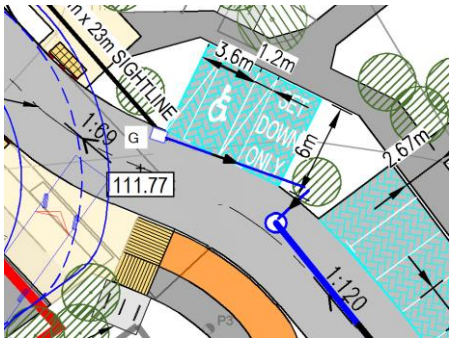


Figure 4: Plan of intercepted areas

Imp Area Type	Imp Area (ha)	Imp Area (m^2)	Interception Storage Volume Required (m^3)	Interception Storage Provided	Method & Volume of Interception Storage (m^3)	Treatment Volume Required (m^3)	Treatment Storage Provided (m^3)	Method & Volume of Treatment Storage (m^3)
Roads Traditional "Black top"	0.071	710	2.84	No	-	8.52	Yes	Runoff to detention basin 8.52 & Stormblock isolator row and stone
Road Section 1	0.068	686	2.74	Yes	Runoff to swales 22.8			
Road to Tree Pits	0.208	2080	8.32	Yes	Runoff to tree pits			
Car Parking Permeable Paving	0.151	1510	6.04	Yes	Fully intercepted 500mm depth of stone 226.5	18.12	Yes	Runoff to the stone layer 226.5

Roofs (Apartments) 60% Roofs area — Extensive Green Roofs	0.298	2980	11.92	Yes	Fully Intercepted 11.92	35.76	Yes	35.76
Roofs (Apartments) 40% Roofs area — Impermeable	0.2206	2206	8.82	No	-	26.472	Yes	Runoff to detention basin 26.472
Roofs duplex blocks	0.1824	1824	7.3	No	-	21.89	Yes	Runoff to detention basin 21.89 & Stormblock isolator row and stone
Extensive green roof – podium slab	0.191	1910	7.64	Yes	Fully Intercepted 7.64	22.92	Yes	22.92

Table 4: Details of Interception and Treatment Storage

3.6 Climate Change

Surface water calculations for the development made use of rainfall values for Cooldown Commons, provided by Met Eireann. Rainfall intensities were increased by a factor of 10% to take account of climate change, as required by the GDSDS for surface water drainage design included surface water storage design.

Refer to **Appendix B** for rainfall data.

3.7 Flood Risk

The subject Site is in Flood Zone “C” which is suitable for all types of uses including highly vulnerable development. Refer to the ‘Site Specific flood Risk Assessment’ (SSFRA) by DBFL Consulting Engineers, which is included under separate cover.

4.0 RESPONSE TO ABP OPINION

An Bord Pleanala raised a number of issues following the pre-application planning process for case reference ABP—307008-20, which must be addressed to facilitate an application for strategic housing development. These items are outlined in their opinion document dated July 2020, with point 3 of their opinion relating to water services outlined below and point 4 relating to transportation / road items:

4.1 Point 3 of ABP Opinion

3. Additional details in relation to site services, and in relation to flood risk, having regard to the requirements of South Dublin County Council, as stated in the Water Services Planning report dated 1st May 2020, and having regard to the having regard to the comments included in the Irish Water Submission on this pre-application dated 18th May 2020. These include additional details/revised proposal in relation to SuDS, and the potential need to obtain third party consents for foul and water infrastructure. In relation to flooding, additional details are required in relation to existing drainage ditch flows through the site and how this will be maintained post-development. In addition, and further to discussions at the tri-partite meeting, additional details are required in relation to any history of flooding on or around the site.

DBFL have consulted with South Dublin County Council and agreed in principle the drainage and SuDS rationale for the site, which is outlined in detail in this report. Each item raised by South Dublin County Council Water Services Section in their report to An Bord Pleanala is addressed further below.

We have also liaised with Irish Water to agree design details and include a copy of the Irish Water Design Acceptance is included in **Appendix F** of this report.

Refer to Section 5 and Section 6 of this report for details of the foul drainage connection and the watermain connection. Refer also to **Appendix G** of this report for a copy of the legal agreement confirming the right to connect to this infrastructure.

Flooding:

Refer to DBFL *Site Specific Flood Risk Assessment* (SSFRA) under separate cover for further details of the existing ditch (Baldonnell Upper stream) through the site and maintenance of same post development. Refer also to DBFL drawing numbers 190003-DBFL-RD-SP-DR-C-1001 Road Layout and 190003-DBFL-CS-SP-DR-C-1001 Proposed Site Services Layout, for the location of the proposed maintenance access to the stream.

The SSFRA also addresses any history of flooding in the vicinity of the site and notes that there is no history of flooding within the site.

The OPW document "The Planning System and Flood Risk Management Guidelines (November 2009)" requires that the proposed development be compatible with flood risk for the site. In accordance with these guidelines, the subject site is located within Flood Zone 'C'. Flood Zone C lands are suitable for all types of land use, including residential developments which are classified as "highly vulnerable" in the "Guidelines". Therefore, the proposed development is suitable for this type of flooding zoning and the Planning Guidelines Sequential Approach is passed. It is concluded that the development meets the requirements of The FRA Guidelines and that the proposed development is appropriate to this flood zoning and a justification test is not required.

South Dublin County Council require a minimum buffer of 10m to the stream. We confirm that this is achieved as a minimum and a riparian strip of varying sizes from circa 12m to circa 29m is provided.

We confirm also that the Final ECFRAMS flood extent maps identify the Baldonnell Upper Stream as a modelled channel and confirm that there is no out of channel flooding for any storm event including the 0.1% AEP event. We confirm also that the lowest FFL within the development (Block G) is circa 1m above the adjacent top of bank of the stream. All FFL's within the development are significantly higher than the 0.1% predicted flood level at the nearest node downstream of the site. Refer to the SSFRA and the Final ECFRAM Flood Extent Mapping for further details.

DBFL response to the South Dublin County Council report dated May 2020 is outlined below:

Water Services Planning Report
1.2 Based on a total surface water attenuation volume of 1,100m3 being provided for Catchment B, this volume is undersized by approximately 9%. The applicant shall revise the surface water design to show that the total surface water attenuation storage provided for Catchment B has been increased by 9%.

We confirm that the surface water attenuation storage volume has been increased. The attenuation storage is calculated using Microdraiange Windes (Source Control Module) and is simulated for various storm events up to 1% AEP showing no out of network flooding. This volume is determined by the design parameters which have been agreed with South Dublin County Council.

1.2 The applicant shall clarify what is the total surface water attenuation storage proposed for Catchment B. Page 9 of the submitted Infrastructure design report states that a total surface water attenuation storage of 1,100m3 is provided for Catchment B however the site services layout drawing states a total volume of 821m^3 is provided for Catchment B.

We confirm that storage calculations have been updated and 1184m^3 of storage is provide for Catchment B which is in excess of that require din the Microdrainage calculations (1146m^3).

1.3 The applicant shall incorporate more SuDS (Sustainable Drainage Systems) features into the surface water drainage design to improve Water quality, Bio Diversity and Public Amenity aspects.

We confirm that the following SuDS features are proposed: tree pits, swales, green roofs, extensive green roofs, permeable paving and detention basin are all proposed. We considered the Local Authority's comments in relation to reducing the underground storage, however, given the size of the site and the density, this arrangement is most suitable. However, additional SuDS features are proposed and a significant riparian strip is provided to the stream.

1.4 The applicant shall submit a drawing showing cross sectional views of all proposed SuDS features proposed for the development. Side slopes of SuDS features should be of shallow gradient to allow maintenance and terracing of side slopes should be considered. All details of SuDS side slopes must be agreed with South Dublin County Councils Public Realm Department to ensure maintenance can be carried out for those areas to be taken in charge.

Refer to DBFL drawings no. 190003-DBFL-CS-SP-DR-C-1001 Proposed Site Services for revised SuDS proposals, and to drawing no. 190003-DBFL-CS-XX-DR-C-5003 SuDS Details for sustainable drainage system details and 190003-DBFL-CS-XX-DR-C-5004 for General Arrangement Layout of Typical Attenuation Storage System including cross sectional view of proposed detention basin. Refer all to Landscape Architects drawings for further details.

1.5 The applicant shall clarify what is meant by "Factor of Safety for Infiltration" stated on page 12 of the Infrastructure Design Report and how this figure would affect surface water attenuation volume calculations.

This is not relevant and has been removed.

1.6 The applicant has proposed to provide surface water attenuation outside the red line site boundary-subject site, however this falls within the blue line boundary-Lands under the control of the applicant. Should permission be granted by An Bord Pleanala for this application, the development outside the red line would be required to form part of the granted permission.

We confirm that the red line has been updated to include all works.

1.7 The applicant shall provide a drawing showing a cross sectional detail of the proposed surface water outfall to the existing stream. The drawing shall show the level of the surface water outfall in relation to the stream flood levels. The outfall design level shall be cognizant of the stream water levels for all rainfall flood events.

Refer to DBFL drawing no. 190003-DBFL-SW-SP-DR-C-3003 Longitudinal Sections Through SW Sewers – Sheet 1 showing the showing the surface water outfall in relation to the existing bed level. Using the flood information available for downstream and upstream nodes the 1% AEP flood level at the outfall could be expected to be 109.4maOD for a 1% AEP event and 109.50mAOD for a 0.1% AEP event, both of which are below the proposed outfall level of 109.53mAOD. In the event of the outlet being submerged or partially submerged, a **tideflex non return valve** is proposed on the outfall and using Microdrainage Network Module, analysis has been simulated for various events including a submerged outlet with no negative impact on the drainage system. This is included in the surface water calculations.

Please note also, that the ECFRAMS flood extent maps do not indicate any out of channel flooding for any storm event for the Baldonnell Stream along the site boundary.

Flood Risk Report: Observations:

2.1 The applicant shall clarify if there is any existing land drainage ditches/channels traversing the subject site. If there is existing land drainage ditches/channels traversing the site the applicant shall provide a drawing and an explanation in the Flood Risk Assessment report on how the existing surface water flows within these land drainage ditches/channels will be maintained through the site.

The Baldonnell Upper Stream forms the north east boundary of the subject site. Refer to DBFL drawing no. 190003-DBFL-CS-SP-DR-C-1001, “Proposed Site Services Layout”, for further details. It is proposed to provide a riparian strip (measured from the top of bank) of varying widths (minimum 12.4m and maximum circa 29m) along this stream. There are no further drainage channels or ditches traversing the site. A maintenance access to the stream is provided. Refer to DBFL drawing no. 190003-DBFL-RD-SP-DR-C-1001 Roads Layout for further details.

Refer to DBFL Site Specific Flood Risk Assessment (SSFRA) in relation to existing ditch flows through the site and maintenance of same post development. The SSFRA also addresses the history of flooding in the vicinity of the site.

4.2 Point 4 of ABP Opinion

4. Details and/or revised proposals (as appropriate) that address the concerns raised by the Roads Department which are set out in the report dated 28/04/202. These include details/purpose of the 4.8m wide road to the north of the Luas Stop; a reduction in the rate of car parking proposed on the site or further justification for the level of car parking proposed on the site; details drawings showing links to adjacent sites, including the link/footbridge connection to the proposed neighbourhood park to the east of the site/revised entrance proposals to the basement car park or further justification for the single entrance as proposed; Mobility Management Plan; Public Lighting Scheme; Construction Management Plan.

Details/purpose of the 4.8m wide road to the north of the Luas Stop

The proposed design incorporates the provision of a continuous local access road which upon entering the site from the north loops around the outer extents of the site accommodating a circuitous but highly legible vehicle connection that enables the centre of the development area to be prioritised for active modes of travel and high quality public realm / landscaping areas. This approach delivers a people focused central environment with pedestrian and cyclists accommodated along key travel desire lines (to internal and external destinations) whilst directing motorised vehicles to the peripherical areas along the meandering yet slightly longer route. The alignment of the local access road has been designed to physically regulate a low speed environment whilst accommodating valuable permeable linkages to neighbouring residential sites to the northeast and west thereby accommodating valuable walk/cycle connectivity through the subject development to both the LUAS interchange and Citywest Shopping Centre to the south. This approach delivers an integrated network for all modes of travel, negating the creation of problematic cul-de-sac arrangements, eliminates the need for inefficient and unsightly vehicle turning areas, yet enables access to each apartment block (and delivery vehicle to the commercial units) in an appropriate balanced manner whilst ensuring that the majority of vehicle movements are centred upon the northern extents of the development (including access to/from basement car park facility) away from both (i) the central plaza and adjoining landscaped areas and (ii) the LUAS interchange (and onwards pedestrian / cycle connection) to the south. The design of the access road accommodates a 5.5m wide carriageway over the majority of its length with the exception of the short section of access road parallel and to the north of the Fortunestown LUAS interchange. At the interface between the LUAS interchange (and onwards pedestrian / cycle link to City West Shopping Centre) the proposed design has purposively been modified to respond to the different demands placed upon this particular lightly trafficked section of the internal access road. Reflecting the need to give a greater level of priority to vulnerable road users, traveling to/from the eastern and western approaches to the LUAS interchange (and associated crossing points of the LUAS rail line) in

addition to delivering traffic calming benefits this section of the access road has been designed to function as a shared street with the carriageway narrowed to 4.8m in width, the provision of a ramped entry / exit treatment to the shared carriageway and the implementation of material change to highlight the change in environment and the presence of pedestrians crossing the access road in this immediate area between the LUAS interchange and the developments central plaza area.

A reduction in the rate of car parking proposed on the site or further justification for the level of car parking proposed on the site

In response to the local authorities request whilst acknowledging the sustainable accessibility levels of the subject site (e.g. excellent to the east and southeast and good to the north) we confirm that the overall parking ratio including parking allocated for non residential uses, has been reduced to offer a car parking provision equivalent to 0.66 spaces per residential unit. Refer also to Section 4.2.11 of the Traffic and Transportation Assessment by DBFL for further details of the parking rationale.

Revised entrance proposals to the basement car park or further justification for the single entrance as proposed

The basement car park facilitates a total of 181 parking spaces all of which are to be assigned to residents of the proposed on-site apartment units. Reflecting the residential nature of the development and the availability of public transport LUAS and bus connections (reducing the need to travel by private car) the turnover of parking spaces on a typical weekday (or weekend) is predicted to be very low. Unlike a commercial (e.g. retail based) car park of the same size (where the same parking same could be used multiply times a day by different vehicle drivers) the turnover of each individual residential car parking space will be extremely low with the potential for some spaces between zero (e.g. car not use to commute to work) and two movements (e.g. out in the AM and inbound in the PM) per day. Furthermore, unlike a public retail focused car park were visitors will have to ‘search’ for a vacant parking spot, residents will be assigned to a specific parking bay for which they will use all the time thereby negating the need to ‘search’ and subsequently minimising internal vehicle movements within the car park area.

In reference to the submitted TTA report (Section 5.3) it can be established that approximately 79 (66 Outbound 14 inbound) and 67 (28 Outbound 38 inbound) two-way vehicle movements will be generated along the basements car parks single vehicle access / exit ramp during the AM and PM peak hours respectively. In reference to the IStructE Design Recommendation for

Multi-Story and Underground Car Parks the average capacity of a straight up and down vehicle ramp is criteria 1,850 car per hour in situations were no 'access' control measures are provided. On vehicle ramps where a gated control barrier is provided (such as the proposed security barrier) the IStructE guidance suggests a lower two-way ramp capacity of criteria 1,100 cars per hour. In reference to the maximum predicted two-way flows of only 79 vehicles (during the AM peak hour period) it can be established that approximately 90% reserve capacity remains when compared to the ultimate 1,100 vehicles an hour capacity suggested by best practice guidance. Considering the low turnover rate of residential parking spaces, the absence of any internal 'search' traffic and the provision of more that sufficient capacity at the proposed basement access/ exit ramp DBFL believe that the provision of a single vehicle access point to the proposed basement car park represents a safe and appropriate design solution.

Details drawings showing links to adjacent sites, including the link/footbridge connection to the proposed neighbourhood park to the east

Please refer to the Landscape Architects drawings for details of pedestrian linkages including the proposed link to the park to the east. Refer to DBFL drawing nos. 190003-DBFL-RD-SP-DR-C-1001 and 190003-DBFL-RD-SP-DR-C-5003 for details of road and pedestrian / cycle infrastructure including a proposed footbridge over the Baldonnell Upper Stream. (This will be a clear span bridge and will not impact the stream).

We confirm that a Mobility Management Plan (MMP) and Construction Management Plan (CMP), both by DBFL are included under separate cover.

DBFL response to the South Dublin County Council report dated May 2020 is outlined below:

Roads, Access and Parking

The Roads Department has provided a report, which can be found in the appendices. Their report concludes with the following points:

1. The development has strong Public transport links and is close to employment hubs schools, and retail facilities. The development is well served by the Luas stop which is 300m from the centre of the development and by multiple and frequent bus routes.

2. Vehicular access to the development will be provided via the existing Citywest Avenue/Edenbrook signal-controlled junction. Currently, this junction acts as a 3-arm signal-controlled junction providing access to the Edenbrook development on the northern side of the recently constructed Citywest Avenue Extension. The future fourth (southern) arm of this

junction will accommodate the permitted development (ABP-302398-18) in addition to the future subject development traffic.

3. The internal layout is compliant with DMURS and the design incorporates features to reduce speed such as narrower carriageways, homezone areas, building heights and tree planting and raised table pedestrian crossings.

4. The proposed junction radii are currently 3.0m throughout the development. These radii need to be 4.5m on local streets and 6.0m off link streets to aid bin lorry and fire tender access.

Refer to DBFL drawing no.190003-DBFL-RD-SP-DR-C-1001 for proposed junction radii in accordance with DMURS. Tracking of various vehicles is also included.

5. There is good pedestrian and cycle permeability throughout the proposed development. There are direct routes to desire lines such as the Luas stop and Bus stops. Crossings with raised tables are located along these desire lines.

6. The proposed parking residential parking ratio is 0.77. The Roads department recommend the residential parking ratio be reduced to 0.6 per unit. Therefore, the residential parking should be 250no. spaces and the commercial should be circa 15 no. spaces. A total number of 265no. spaces is recommended to be provided at this development.

Refer to Section 4.2 above.

7. The basement car park is proposed to have 203no. parking spaces. There is only one proposed in and out access to this basement. Roads recommend two entrances at separate locations to provide an alternative route in the event of a blockage.

Refer to Section 4.2 above.

8. There are 6no. bin stores located in the basement car park. The mechanism for bin collection must be clarified. If the bins are transported to ground level by conveyor then separate refuse conveyors must be created for the management refuse collection. Designated bin lorry set down areas at ground level would be beneficial.

N/A to DBFL. Refer to the Waste Management Plan by others.

9. The proposed development shall make provision for the charging of electric vehicles. A total of 100% of the apartment car parking spaces (both basement and surface) must be provided with electrical ducting and termination points to allow for the provision of future charging points, and 10% of the apartment car parking spaces (20 no. at both surface and basement level) must be provided with electric vehicle charging points initially. Details of how it is proposed to comply with these requirements including details of the design of, and signage for, the electric charging points (where they are not in areas to be taken in charge) shall be submitted to, and agreed in writing with, the planning authority prior to commencement of development. REASON: In the interest of sustainable transport.

We confirm that 10% of apartment parking spaces will be electrical charging points, while ducting will be put in place to facilitate electrical charging of 100% of spaces (both at surface and basement levels). Refer to DBFL drawing no. 190003-DBFL-RD-SP-DR-C-1001.

10. A Mobility Management Plan is to be completed within six months of opening of the proposed development. The Mobility Management Plan shall be agreed with the roads department and the agreed plan, along with the written agreement of the roads department shall be lodged to the planning file. The written commitment of the developer to implement the agreed plan shall also be lodged to the file.

We refer you to the DBFL Mobility Management Plan (MMP), under separate cover.

11. Prior to the commencement of development, the applicant shall agree in writing a public lighting scheme with South Dublin County Council Lighting Department. Once agreed, the scheme shall be constructed/installed to taking in charge standards at the expense of the developer and to the satisfaction of South Dublin County Council Lighting Department.

N/A to DBFL.

12. Prior to commencement of development a developed Construction Management Plan shall be agreed with the roads department. The agreed plan, along with the written agreement of the roads department shall be lodged to the planning file. The written commitment of the developer to implement the agreed plan shall also be lodged to the file.

We refer you to the DBFL Construction Management Plan (CMP), under separate cover.

13. SDCC reserve the right to request the applicant to install traffic calming at the applicant's expense at locations to be agreed until such time as the roads are taken in charge.

5.0 FOUL DRAINAGE

There are three foul connection points identified for the subject site, “A”, “B” and “C” corresponding to three foul catchments. Refer to Figures 5-8 below for the foul sewer catchment plan proposed connection points.

Foul connection “A” corresponds to a 225mm diameter foul sewer which has already been constructed at the north west corner of the subject site to accommodate foul flows from catchment “A”. This connection is within the subject site and the applicant has a right to connect to this sewer. Refer to **Appendix G** for a legal confirmation. This outfall continues in a north easterly direction and connects to the 300mm diameter foul sewer on Citywest Avenue.

Foul connections “B” and “C” comprise existing foul sewers constructed in Phase 2 under ABP-302398-18 and within the ownership of the applicant. These foul sewers continue in a northerly direction through Phase 2 and connect to the 300mm diameter foul sewer on Citywest Avenue.

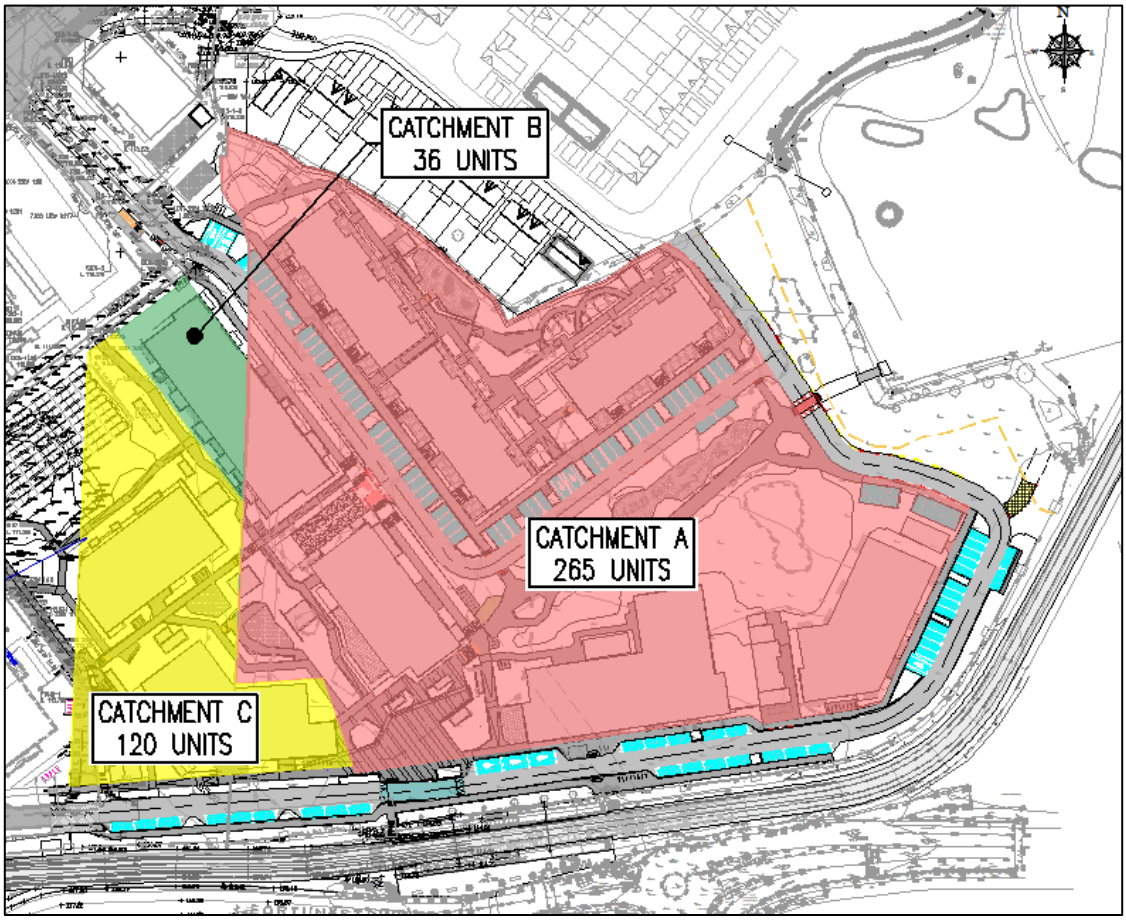


Figure 5: Foul Sewer Catchment Plan

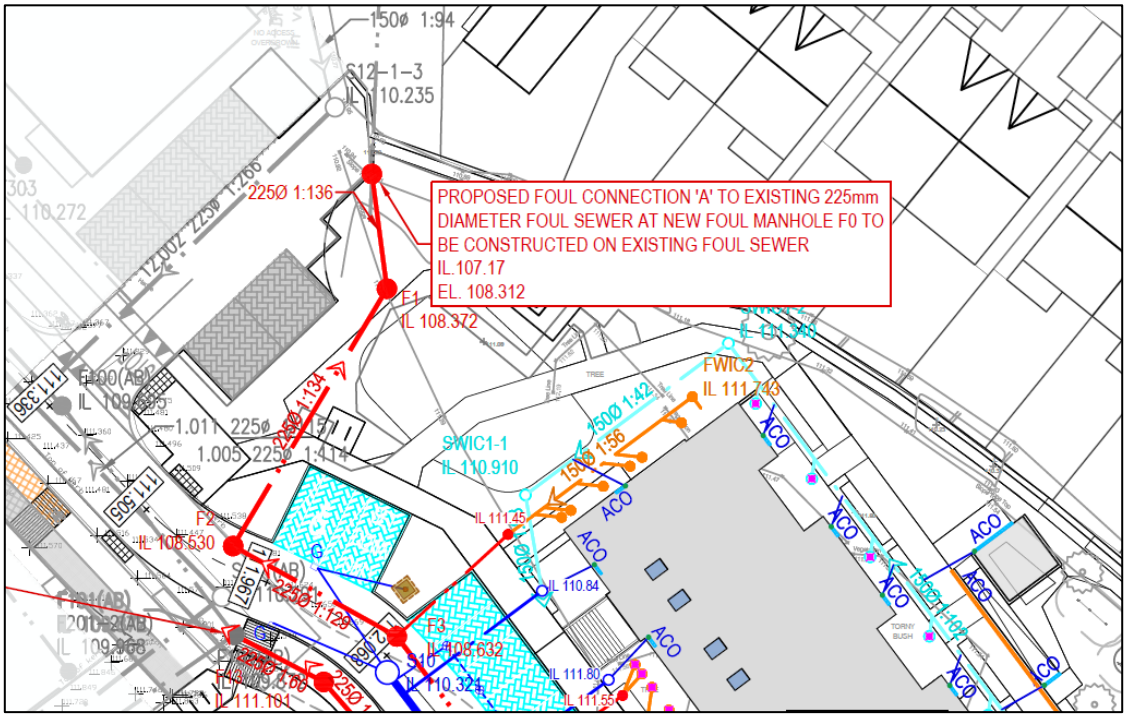


Figure 6: Foul Drainage Connection “A”

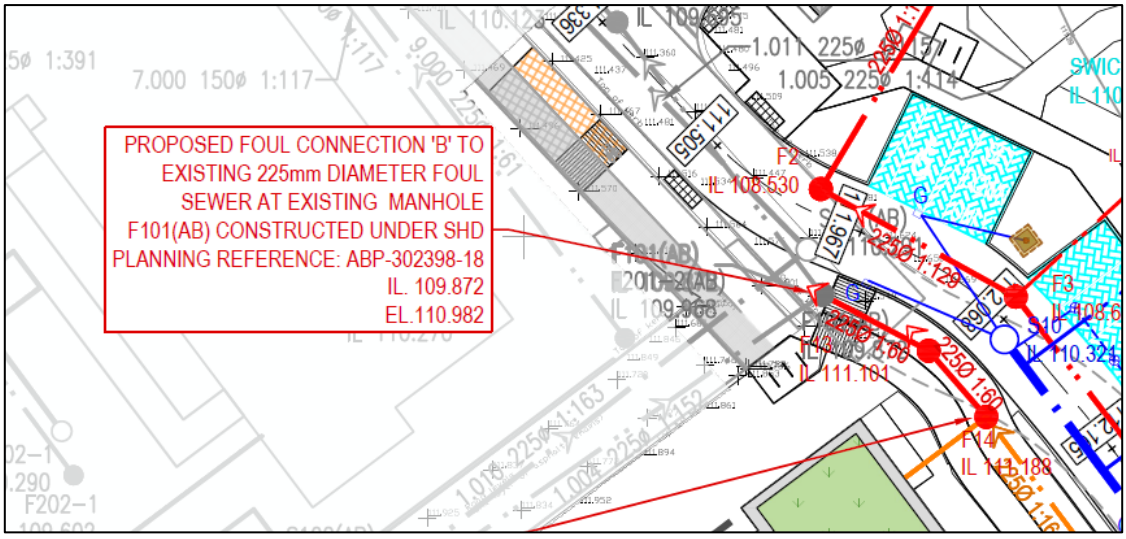


Figure 7: Foul Drainage Connection “B”

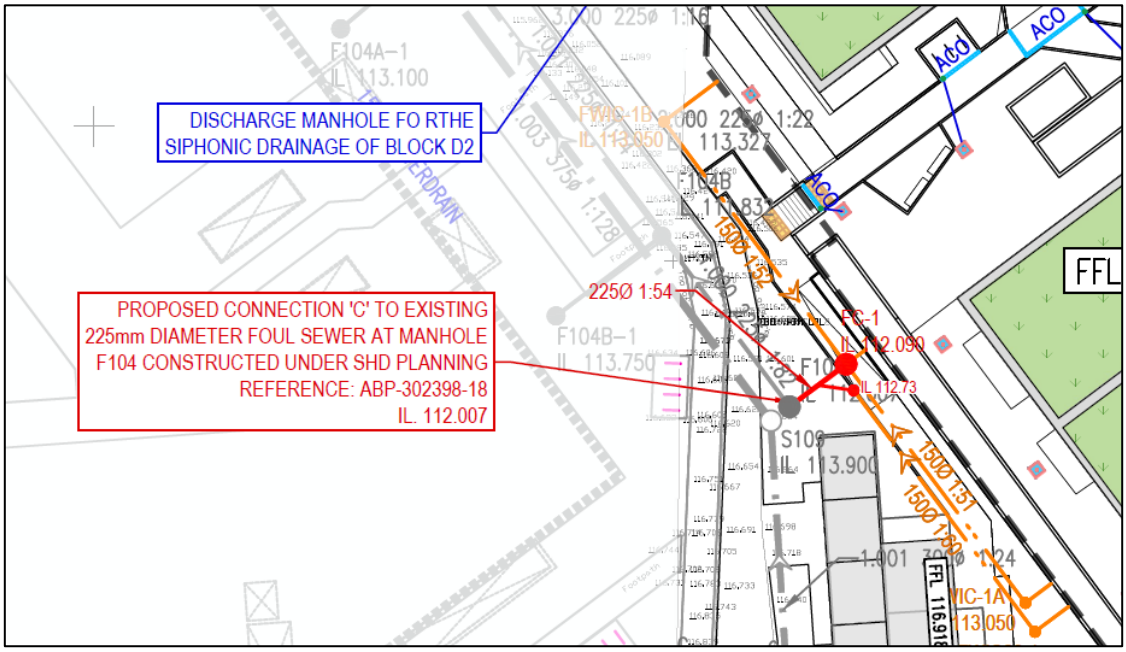


Figure 8: Foul Drainage Connection “C”

A breakdown of the number of residential units within each catchment is included in Tables 5 and 6 below.

Connection	Catchment A	Catchment B	Catchment C
Number of residential units	265	36	120
Non Residential Development	Refer to Table 6	N/A	Refer to Table 6

Table 5: Foul Drainage Catchments

Connection	Average occupancy	Area (m^2)	P.E	Hydraulic loading	Daily Hydraulic Loading	Equivalent houses based on IW loading of 446l/dwelling/day	Dischage units based on BS8301:1985
Catchment A							
Residential Amenity – Block D4	1 per 10m^2	555	55.5	10	555	1.24	17.36
Office – Block E1	1 per 25m^2	376	15.04	30	451.2	1.01	14.14
Retail / Commercial – Block E1	1 per 18m^2	434	24.11	5	120.55	0.27	3.78
Catchment C							
Retail / Commercial – Block D3	1 per 18m^2	285	15.8	5	79	0.18	2.52

Table 6: Foul Catchment A – Non Residential Uses

Foul sewers have been designed in accordance with the Building Regulations and specifically in accordance with the principles and methods set out in the DOE “Recommendations for Site Development Works for Housing Areas”, IS EN752 (2008), BS8301: 1985, IS EN12056: Part 2 (2000) and Irish Water’s Code of Practice for Wastewater.

The following criteria have been applied:

Demand	446l/house/day (Irish Water Code of Practice)
Discharge units	14 units per house (BS8301:1985)
Pipe Friction (Ks)	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing velocity)
Maximum Velocity	3.0 m/s (1:20 maximum pipe gradient)
Frequency Factor	0.5 for domestic use

Foul sewers throughout the development will comprise 225mm diameter main gravity sewers as indicated in DBFL drawing no. 190003-DBFL-CS-SP-DR-C-1001. Private foul drains will be 100mm diameter for single connections (dwellings) and 150mm diameter for private drainage for apartments.

The foul drainage network has been designed using the *Network* module of *Microdrainage*, the results of which are included in **Appendix D.** Phase 2 foul network capacity check calculations are included in **Appendix E**.

A copy of the Irish Water “Confirmation of Feasibility” and “Design Acceptance” is included in **Appendix F**.

Refer also to **Appendix G** of this report for a copy of the legal agreement confirming the right to connect to any private infrastructure. Connections B and C are within Cairn Homes ownership.

6.0 WATER SUPPLY

The development's water-main distribution system is indicated on drawing 190003-DBFL-WM-ST-DR-C-1001. It is proposed to connect at two locations to the 200mm diameter watermain approved and under construction under ABP- 302398-18 (Phase 2).

Connections to the public water main will include a bulk meter and sluice valves in accordance with the Irish Water requirements. Individual houses will have their own connections to the distribution main via service connections and boundary boxes.

The water main layout and details are in accordance with Irish Water, Connection and Developer Services, '*Code of Practice for Water Infrastructure'* and '*Water Infrastructure Standard Details'*.

A copy of the Irish Water "Confirmation of Feasibility" and "Design Acceptance" is included in **Appendix F.**

Please note that the existing watermains to which it is proposed to connect to are in the ownership of Cairn Homes.

Refer also to **Appendix G** of this report for a copy of the legal agreement confirming the right to connect to any private infrastructure.

Appendix A

ALLOWABLE OUTFLOW CALCULATION FOR CATCHMENT B

TITLE	Job Reference
Cooldown Commons Phase 3	
SUBJECT	**Calc. Sheet No.**
QBAR Calculation using IOH Report 124 for Sites < 25 km²	1

DRAWING NUMBER	Calculations by	Checked by	Date
190003	ASM	DMW	15.12.2020

Estimation of QBAR from IOH Report 124 for catchments less than 25 km² using the 3 variable equation

$^{1}Q_{bar} = 0.00108 * (AREA)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$

^{2}Site Area = 2.780 Ha

Site area is less than 50 Ha, calculate Qbar for a 50 Ha Site then pro-rata

AREA =	0.028	km²
SAAR =	834	mm
^{3}SOIL =	0.37	
Q_{bar} =	0.00007	cumecs/Ha
Q_{bar} =	3.5	l/s/Ha
$Q_{bar\ (rural)}$ =	9.8	l/s

Note to Institute of Hydrology Report No. 124 Eqn

Q_{bar}	The Mean Annual Flood (cumecs)
AREA	Area of the Catchment (km²)
SAAR	Standard Annual Average Rainfall (mm) *NERC Flood Studies Report, 1975*
SOIL	Soil Index Values of Catchment *Winter Rain Acceptance Potential, (Supplementary Report No. 7)*

Soil Classification for Runoff Potential FSR Maps

Soil 1	0	%
Soil 2	0	%
Soil 3	100	%
Soil 4	0	%
Soil 5	0	%

Permissible Outflow from Site using Growth Factor

Qbar growth for permitted outlows from site for given return period (assuming long term storage). (No allowance for standard factorial error)

Flood Return Event	^{5}Growth Factor	Permitted Flow (l/s)
1	0.85	8.3
QBAR	1	9.8
10	1.67	16.4
30	2.1	20.6
50	2.33	22.8
100	2.6	25.5
200	2.85	27.9
1000	3.5	34.3

^{4}QBar from Site with Factorial Error Allowance

r^2 =	0.847
n =	71
fse =	1.651

Q'_{bar} = 16.18 l/s

(With Allowance for the standard factorial error)

Is longterm storage provided?	No

Storm Return Period to be provided for =	30	Years *
QBAR (Growth) =	20.6	Litres/sec
^{6}Permissible Outflow from site =	9.8	Litres/sec
^{7}Maximum Allowable Outflow from site =	9.8	Litres/sec

(* 30, 50 or 100)

1 hectare = 10,000m² 1km² - 100 hectares

Notes

1. Based on the Institute of Hydrology Report 124 for small catchments less than 25km².
2. For catchments smaller than 50 hectares in area, flow rates are linearly interpolated for smaller areas.
3. Soil index value (SPR) calculated from Flood Studies Report Vol V Fig I 4.18(1) - The Classification of Soils from Winter Rainfall Acceptance Rate .
4. Fse is the standard factorial error
5. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year, 2.3 for 50 and 2.6 for 100 year return period events, from GDSDS Figure C2.
6. Total Permissible Outflow - $QBAR_{(rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$
7. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0l/s.
8. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change. (Value from Dublin Airport)
9. Interception Volume Vt (m3) = Impermeable Area (ha) x 10mm x 10 (GDSDS, Vol 2, Section 6.3.1.2.1).

SOIL Indices

The soil index, 'SOIL' is a composite index based on five soil types, S1 to S5, where Class S1 is very low runoff, Class S3 is moderate runoff and Class S5 is very high runoff. The guidelines for allotting classes are based on properties of soils more or less at field capacity condition. A full discussion of the soils classification may be found in section 4.2.3 of 'Flood Studies Report (FSR) I'. Tables 4.4 and 4.5 from the FSR are used to decide on the soil index for the different conditions. A general summary of the tables is included below. The FSR also included a large scale map of Ireland, which indicates a general SOIL Class of 2 for the Carlow Town area.

The SOIL value included in the equation above is therefore calculated as follows:

$$SOIL = 0.1 \times SOIL_1 + 0.3 \times SOIL_2 + 0.37 \times SOIL_3 + 0.47 \times SOIL_4 + 0.53 \times SOIL_5$$

where, $SOIL_1 - SOIL_5$ are the percentages of the catchment that fall under each soil class. It is likely that for individual development sites, a single soil class will prevail. For Carlow, this will generally be Soil Class S2.

Table 3.2: Summary of Soil Classes

General Soil Description	Soil Class	Run-off Potential	Soil Value
(i) Well drained sandy, loamy or earthy peat soils. (ii) Less permeable loamy soils over clayey soils on plateaux adjacent to very permeable soils in valleys.	S1	Very Low	0.10
(i) Very permeable soils (e.g. gravel, sand) with shallow groundwater. (ii) Permeable soils over rocks. (iii) Moderately permeable soils, some with slowly permeable subsoils.	S2	Low	0.30
(i) Very fine sands, silts and sedimentary clays. (ii) Permeable soils (e.g. gravel, sand) with shallow groundwater in low lying areas. (iii) Mixed areas of permeable and impermeable soils in similar proportions.	S3	Moderate	0.37
(i) Clayey or loamy soils.	S4	High	0.47
(i) Soils of the wet uplands. (ii) Bare rocks or cliffs. (iii) Shallow, permeable rocky soils on steep slopes. (iv) Peats with impermeable layers at shallow depth.	S5	Very High	0.53

Peak Flow Rates for Various Return Periods

QBAR can be factored using the Flood Studies Report regional growth curve for Ireland to produce peak flood flows for a number of return periods. Information on growth curves for UK and Ireland is available in Flood Studies Supplementary Report (FSSR) 14, 1987 produced by the Institute of Hydrology:-

Appendix B

SURFACE WATER STORAGE CALCULATIONS

MET EIREANN RAINFALL DATA

SURFACE WATER STORAGE CATCLULAITONS

CATCHMENT A

Calculations presented below were prepared to confirm the available capacity of the existing attenuation tank constructed under planning reference no. ABP-302398-18, within Catchment 1 of phase 2 development.

Catchment “A” comprises a 0.24ha portion of the subject site which was previously granted planning permission under ABP-302398-18 for Phase 2 of the development under construction. This portion of the subject site is included in surface water Catchment 1 for the approved planning application ABP-302398-18 and the surface water attenuation system (Stormtech MC3500 – storage volume of 821m3) for that Catchment is designed to accommodate unattenuated runoff from Catchment A of the subject site. 631m3 of the storage volume is utilized by the Phase 2 development (constructed), with the remaining storage volume of 189m3 available for this site.

EXISTING STORMTECH WITHIN PHASE 2	MAXIMUM	PHASE 2 (UNDER CONSTRUCTION)	CATCHMENT A APPLICATION SITE
STORAGE VOLUME m^3	821	631	189
MAXIMUM IMPERMEABLE AREA ha	0.88	0.72	0.16

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 2 TANK VOLUME CHECK	
Date 03/12/2020 11:12 File phase 2 - 190002 - 811c...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 4017 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	111.533	0.233	0.0	1.6	1.6	136.5	O K
30 min Summer	111.634	0.334	0.0	1.6	1.6	195.1	O K
60 min Summer	111.756	0.456	0.0	1.6	1.6	266.9	O K
120 min Summer	111.899	0.599	0.0	1.6	1.6	350.3	O K
180 min Summer	111.984	0.684	0.0	1.6	1.6	400.2	O K
240 min Summer	112.045	0.745	0.0	1.6	1.6	436.0	O K
360 min Summer	112.137	0.837	0.0	1.6	1.6	489.8	O K
480 min Summer	112.204	0.904	0.0	1.6	1.6	528.7	O K
600 min Summer	112.255	0.955	0.0	1.7	1.7	558.8	O K
720 min Summer	112.296	0.996	0.0	1.7	1.7	582.9	O K
960 min Summer	112.358	1.058	0.0	1.7	1.7	619.1	O K
1440 min Summer	112.433	1.133	0.0	1.8	1.8	663.1	O K
2160 min Summer	112.484	1.184	0.0	1.8	1.8	692.6	O K
2880 min Summer	112.501	1.201	0.0	1.8	1.8	702.5	O K
4320 min Summer	112.509	1.209	0.0	1.8	1.8	707.3	O K
5760 min Summer	112.506	1.206	0.0	1.8	1.8	705.4	O K
7200 min Summer	112.498	1.198	0.0	1.8	1.8	701.1	O K
8640 min Summer	112.489	1.189	0.0	1.8	1.8	695.7	O K
10080 min Summer	112.480	1.180	0.0	1.8	1.8	690.1	O K
15 min Winter	111.562	0.262	0.0	1.6	1.6	153.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	83.412	0.0	113.0	23
30 min Summer	59.783	0.0	132.4	38
60 min Summer	41.092	0.0	246.6	68
120 min Summer	27.165	0.0	254.7	128
180 min Summer	20.853	0.0	246.6	188
240 min Summer	17.173	0.0	242.5	248
360 min Summer	13.054	0.0	241.1	368
480 min Summer	10.718	0.0	245.9	486
600 min Summer	9.186	0.0	252.4	606
720 min Summer	8.091	0.0	257.3	726
960 min Summer	6.611	0.0	263.5	966
1440 min Summer	4.957	0.0	267.8	1446
2160 min Summer	3.702	0.0	528.9	2164
2880 min Summer	3.011	0.0	535.6	2800
4320 min Summer	2.254	0.0	527.5	3504
5760 min Summer	1.838	0.0	1029.7	4272
7200 min Summer	1.572	0.0	1005.8	5112
8640 min Summer	1.385	0.0	986.5	5960
10080 min Summer	1.247	0.0	966.1	6760
15 min Winter	83.412	0.0	121.9	23

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 2 TANK VOLUME CHECK	
Date 03/12/2020 11:12 File phase 2 - 190002 - 811c...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	111.674	0.374	0.0	1.6	1.6	218.7	O K
60 min Winter	111.812	0.512	0.0	1.6	1.6	299.4	O K
120 min Winter	111.972	0.672	0.0	1.6	1.6	393.1	O K
180 min Winter	112.068	0.768	0.0	1.6	1.6	449.3	O K
240 min Winter	112.137	0.837	0.0	1.6	1.6	489.8	O K
360 min Winter	112.242	0.942	0.0	1.6	1.6	551.1	O K
480 min Winter	112.318	1.018	0.0	1.7	1.7	595.7	O K
600 min Winter	112.378	1.078	0.0	1.7	1.7	630.4	O K
720 min Winter	112.426	1.126	0.0	1.8	1.8	658.5	O K
960 min Winter	112.499	1.199	0.0	1.8	1.8	701.2	O K
1440 min Winter	112.591	1.291	0.0	1.9	1.9	755.2	O K
2160 min Winter	112.660	1.360	0.0	1.9	1.9	795.5	O K
2880 min Winter	112.692	1.392	0.0	2.0	2.0	814.0	O K
4320 min Winter	112.701	1.401	0.0	2.0	2.0	819.8	O K
5760 min Winter	112.696	1.396	0.0	2.0	2.0	816.7	O K
7200 min Winter	112.683	1.383	0.0	2.0	2.0	809.3	O K
8640 min Winter	112.666	1.366	0.0	1.9	1.9	798.9	O K
10080 min Winter	112.645	1.345	0.0	1.9	1.9	787.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	59.783	0.0	134.2	38
60 min Winter	41.092	0.0	259.4	68
120 min Winter	27.165	0.0	249.0	126
180 min Winter	20.853	0.0	243.3	186
240 min Winter	17.173	0.0	242.7	244
360 min Winter	13.054	0.0	250.6	364
480 min Winter	10.718	0.0	260.1	482
600 min Winter	9.186	0.0	266.8	600
720 min Winter	8.091	0.0	271.7	718
960 min Winter	6.611	0.0	277.7	950
1440 min Winter	4.957	0.0	281.1	1416
2160 min Winter	3.702	0.0	560.7	2100
2880 min Winter	3.011	0.0	566.1	2768
4320 min Winter	2.254	0.0	555.2	3980
5760 min Winter	1.838	0.0	1072.2	4496
7200 min Winter	1.572	0.0	1065.2	5408
8640 min Winter	1.385	0.0	1056.4	6392
10080 min Winter	1.247	0.0	1034.3	7272

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 2 TANK VOLUME CHECK	
Date 03/12/2020 11:12 File phase 2 - 190002 - 811c...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.241	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.880

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000	4	8	0.880

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 2 TANK VOLUME CHECK	
Date 03/12/2020 11:12 File phase 2 - 190002 - 811c...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Model Details

Storage is Online Cover Level (m) 114.000

Cellular Storage Structure

Invert Level (m) 111.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.65
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	900.0	0.0	1.450	0.0	0.0
1.400	900.0	0.0	2.000	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0061-2000-1450-2000
Design Head (m)	1.450
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	61
Invert Level (m)	111.300
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	2.0
Flush-Flo™	0.270	1.6
Kick-Flo®	0.549	1.3
Mean Flow over Head Range	-	1.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	1.8	3.000	2.8	7.000	4.1
0.200	1.6	1.400	2.0	3.500	3.0	7.500	4.3
0.300	1.6	1.600	2.1	4.000	3.2	8.000	4.4
0.400	1.5	1.800	2.2	4.500	3.4	8.500	4.5
0.500	1.4	2.000	2.3	5.000	3.5	9.000	4.7
0.600	1.3	2.200	2.4	5.500	3.7	9.500	4.8
0.800	1.5	2.400	2.5	6.000	3.9		
1.000	1.7	2.600	2.6	6.500	4.0		

SURFACE WATER STORAGE CALCULATIONS

CATCHMENT B

UNDERGROUND STORAGE

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REFERENCE: 190003 CATCHMENT B UNDERGROUND	Micro Drainage
Date 21/04/2021 12:05 File Underground storage B.SRCX	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 80 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	110.050	0.350	9.7	290.4	O K
30 min Summer	110.181	0.481	9.8	399.3	O K
60 min Summer	110.319	0.619	9.8	513.8	O K
120 min Summer	110.468	0.768	9.8	637.7	O K
180 min Summer	110.560	0.860	9.8	714.0	O K
240 min Summer	110.623	0.923	9.8	766.3	O K
360 min Summer	110.704	1.004	9.8	833.3	O K
480 min Summer	110.752	1.052	9.8	872.8	O K
600 min Summer	110.780	1.080	9.8	896.6	O K
720 min Summer	110.796	1.096	9.8	910.1	O K
960 min Summer	110.813	1.113	9.8	923.8	O K
1440 min Summer	110.822	1.122	9.8	931.0	O K
2160 min Summer	110.805	1.105	9.8	917.2	O K
2880 min Summer	110.774	1.074	9.8	891.1	O K
4320 min Summer	110.694	0.994	9.8	825.1	O K
5760 min Summer	110.603	0.903	9.8	749.4	O K
7200 min Summer	110.491	0.791	9.8	656.4	O K
8640 min Summer	110.380	0.680	9.8	564.1	O K
10080 min Summer	110.287	0.587	9.8	486.9	O K
15 min Winter	110.092	0.392	9.8	325.7	O K
30 min Winter	110.240	0.540	9.8	448.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	83.297	0.0	282.2	23
30 min Summer	57.777	0.0	394.1	37
60 min Summer	37.786	0.0	530.9	68
120 min Summer	24.088	0.0	677.8	126
180 min Summer	18.381	0.0	776.0	186
240 min Summer	15.136	0.0	851.9	246
360 min Summer	11.487	0.0	968.9	366
480 min Summer	9.433	0.0	1059.8	486
600 min Summer	8.094	0.0	1134.9	604
720 min Summer	7.141	0.0	1199.0	724
960 min Summer	5.860	0.0	1303.2	832
1440 min Summer	4.429	0.0	1404.6	1088
2160 min Summer	3.342	0.0	1708.4	1500
2880 min Summer	2.734	0.0	1862.3	1932
4320 min Summer	2.059	0.0	2096.3	2768
5760 min Summer	1.682	0.0	2300.0	3584
7200 min Summer	1.439	0.0	2458.2	4392
8640 min Summer	1.267	0.0	2595.2	5096
10080 min Summer	1.137	0.0	2715.0	5752
15 min Winter	83.297	0.0	317.0	23
30 min Winter	57.777	0.0	441.9	37

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REFERENCE: 190003 CATCHMENT B UNDERGROUND	Micro Drainage
Date 21/04/2021 12:05 File Underground storage B.SRCX	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 80 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	110.397	0.697	9.8	578.2	O K
120 min Winter	110.568	0.868	9.8	720.6	O K
180 min Winter	110.672	0.972	9.8	806.7	O K
240 min Winter	110.744	1.044	9.8	866.4	O K
360 min Winter	110.839	1.139	9.8	945.7	O K
480 min Winter	110.899	1.199	9.8	994.9	O K
600 min Winter	110.937	1.237	9.8	1026.8	O K
720 min Winter	110.962	1.262	9.8	1047.4	O K
960 min Winter	110.986	1.286	9.8	1067.0	O K
1440 min Winter	110.988	1.288	9.8	1069.1	O K
2160 min Winter	110.958	1.258	9.8	1044.4	O K
2880 min Winter	110.903	1.203	9.8	998.9	O K
4320 min Winter	110.768	1.068	9.8	886.7	O K
5760 min Winter	110.617	0.917	9.8	761.0	O K
7200 min Winter	110.418	0.718	9.8	596.2	O K
8640 min Winter	110.256	0.556	9.8	461.8	O K
10080 min Winter	110.130	0.430	9.8	357.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	37.786	0.0	595.1	66
120 min Winter	24.088	0.0	759.3	126
180 min Winter	18.381	0.0	869.0	184
240 min Winter	15.136	0.0	953.8	242
360 min Winter	11.487	0.0	1084.2	358
480 min Winter	9.433	0.0	1184.8	472
600 min Winter	8.094	0.0	1267.2	586
720 min Winter	7.141	0.0	1336.1	696
960 min Winter	5.860	0.0	1438.4	908
1440 min Winter	4.429	0.0	1447.6	1144
2160 min Winter	3.342	0.0	1913.4	1608
2880 min Winter	2.734	0.0	2085.4	2080
4320 min Winter	2.059	0.0	2343.2	2988
5760 min Winter	1.682	0.0	2576.3	3912
7200 min Winter	1.439	0.0	2753.7	4616
8640 min Winter	1.267	0.0	2907.4	5280
10080 min Winter	1.137	0.0	3042.6	5952

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REFERENCE: 190003 CATCHMENT B UNDERGROUND	
Date 21/04/2021 12:05 File Underground storage B.SRCX	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	80	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.256	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 1.901

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	1.901

OVERALL VOLUME (UNDER AND ABOVE GROUND)

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REF: 190003 OVERALL VOLUME	Micro Drainage
Date 21/04/2021 12:07 File Catchment B - 100 YEARs...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	110.068	0.368	9.6	305.3	O K
30 min Summer	110.206	0.506	9.8	420.2	O K
60 min Summer	110.351	0.651	9.8	540.0	O K
120 min Summer	110.505	0.805	9.8	668.4	O K
180 min Summer	110.599	0.899	9.8	745.8	O K
240 min Summer	110.664	0.964	9.8	800.2	O K
360 min Summer	110.754	1.054	9.8	874.6	O K
480 min Summer	110.813	1.113	9.8	923.6	O K
600 min Summer	110.850	1.150	9.8	954.7	O K
720 min Summer	110.874	1.174	9.8	974.2	O K
960 min Summer	110.895	1.195	9.8	991.9	O K
1440 min Summer	110.904	1.204	9.8	999.2	O K
2160 min Summer	110.886	1.186	9.8	984.3	O K
2880 min Summer	110.852	1.152	9.8	955.8	O K
4320 min Summer	110.752	1.052	9.8	873.1	O K
5760 min Summer	110.638	0.938	9.8	778.7	O K
7200 min Summer	110.532	0.832	9.8	690.5	O K
8640 min Summer	110.434	0.734	9.8	609.4	O K
10080 min Summer	110.347	0.647	9.8	537.0	O K
15 min Winter	110.113	0.413	9.7	342.4	O K
30 min Winter	110.268	0.568	9.8	471.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	87.446	0.0	295.9	23
30 min Summer	60.696	0.0	413.2	38
60 min Summer	39.641	0.0	556.9	68
120 min Summer	25.222	0.0	709.6	126
180 min Summer	19.222	0.0	811.3	186
240 min Summer	15.814	0.0	889.8	246
360 min Summer	11.983	0.0	1010.4	366
480 min Summer	9.831	0.0	1103.3	486
600 min Summer	8.428	0.0	1179.4	606
720 min Summer	7.431	0.0	1243.7	724
960 min Summer	6.091	0.0	1343.5	936
1440 min Summer	4.597	0.0	1382.8	1170
2160 min Summer	3.463	0.0	1769.6	1564
2880 min Summer	2.830	0.0	1926.4	1992
4320 min Summer	2.127	0.0	2164.4	2812
5760 min Summer	1.736	0.0	2373.0	3576
7200 min Summer	1.483	0.0	2533.6	4328
8640 min Summer	1.304	0.0	2672.6	5096
10080 min Summer	1.171	0.0	2794.2	5760
15 min Winter	87.446	0.0	332.3	23
30 min Winter	60.696	0.0	463.1	37

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Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REF: 190003 OVERALL VOLUME	Micro Drainage
Date 21/04/2021 12:07 File Catchment B - 100 YEARs...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	110.432	0.732	9.8	607.4	O K
120 min Winter	110.609	0.909	9.8	754.3	O K
180 min Winter	110.718	1.018	9.8	844.9	O K
240 min Winter	110.797	1.097	9.8	910.3	O K
360 min Winter	110.903	1.203	9.8	998.7	O K
480 min Winter	110.971	1.271	9.8	1054.7	O K
600 min Winter	111.020	1.320	9.8	1092.5	O K
720 min Winter	111.383	1.683	9.8	1115.7	O K
960 min Winter	111.439	1.739	9.8	1136.1	O K
1440 min Winter	111.447	1.747	9.8	1139.0	O K
2160 min Winter	111.400	1.700	9.8	1121.1	O K
2880 min Winter	111.006	1.306	9.8	1083.7	O K
4320 min Winter	110.860	1.160	9.8	962.5	O K
5760 min Winter	110.659	0.959	9.8	796.0	O K
7200 min Winter	110.481	0.781	9.8	648.4	O K
8640 min Winter	110.332	0.632	9.8	524.7	O K
10080 min Winter	110.210	0.510	9.8	423.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	39.641	0.0	624.2	66
120 min Winter	25.222	0.0	795.0	126
180 min Winter	19.222	0.0	908.6	184
240 min Winter	15.814	0.0	995.9	242
360 min Winter	11.963	0.0	1129.4	360
480 min Winter	9.831	0.0	1231.3	474
600 min Winter	8.428	0.0	1312.9	588
720 min Winter	7.431	0.0	1378.6	698
960 min Winter	6.091	0.0	1455.8	916
1440 min Winter	4.597	0.0	1429.1	1158
2160 min Winter	3.463	0.0	1981.8	1628
2880 min Winter	2.830	0.0	2156.4	2136
4320 min Winter	2.127	0.0	2413.1	3072
5760 min Winter	1.736	0.0	2657.9	3864
7200 min Winter	1.483	0.0	2838.2	4608
8640 min Winter	1.304	0.0	2994.2	5280
10080 min Winter	1.171	0.0	3131.3	5960

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	COOLDOWN COMMONS PHASE 3 DBFL REF: 190003 OVERALL VOLUME	
Date 21/04/2021 12:07 File Catchment B - 100 YEARs...	Designed by ASM Checked by DMW	
Innovyze	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.500	Shortest Storm (mins)	15
Ratio R	0.256	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 1.901

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000	4	8	1.901

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 305122, Northing: 227176,

DURATION	Interval 6months	1year	Years 2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.5	3.7	4.4	5.4	6.1	6.7	8.6	10.7	12.2	14.3	16.2	17.7	20.0	21.8	23.4	N/A
10 mins	3.5	5.2	6.1	7.6	8.6	9.3	11.9	15.0	17.0	19.9	22.6	24.6	27.9	30.4	32.5	N/A
15 mins	4.2	6.1	7.2	8.9	10.1	11.0	14.0	17.6	20.0	23.4	26.5	29.0	32.8	35.8	38.3	N/A
30 mins	5.5	8.0	9.4	11.6	13.1	14.3	18.1	22.6	25.7	30.0	33.9	37.0	41.7	45.5	48.6	N/A
1 hours	7.2	10.5	12.4	15.1	17.0	18.5	23.5	29.2	33.0	38.4	43.3	47.2	53.2	57.8	61.7	N/A
2 hours	9.6	13.8	16.2	19.7	22.1	24.0	30.3	37.6	42.4	49.2	55.4	60.2	67.7	73.5	78.4	N/A
3 hours	11.3	16.2	18.9	23.0	25.8	28.0	35.2	43.5	49.1	56.9	64.0	69.5	78.0	84.7	90.2	N/A
4 hours	12.7	18.2	21.2	25.7	28.8	31.2	39.2	48.4	54.5	63.1	70.9	76.9	86.3	93.6	99.6	N/A
6 hours	14.9	21.3	24.8	30.0	33.6	36.4	45.6	56.1	63.1	73.0	81.8	88.7	99.4	107.7	114.6	N/A
9 hours	17.5	25.0	29.0	35.1	39.2	42.4	53.0	65.1	73.1	84.4	94.5	102.4	114.6	124.0	131.9	N/A
12 hours	19.7	28.0	32.4	39.2	43.7	47.3	59.0	72.3	81.1	93.6	104.7	113.3	126.7	137.1	145.7	N/A
18 hours	23.2	32.8	38.0	45.8	51.0	55.2	68.6	83.9	94.0	108.3	121.0	130.8	146.0	157.9	167.7	N/A
24 hours	26.0	36.7	42.5	51.1	57.0	61.5	76.4	93.2	104.4	120.0	134.0	144.8	161.5	174.5	185.3	223.0
2 days	33.0	45.1	51.5	61.0	67.4	72.3	88.0	105.6	117.1	133.0	147.1	157.9	174.4	187.2	197.7	234.2
3 days	38.6	51.9	58.9	69.0	75.8	81.0	97.5	115.8	127.7	144.0	158.4	169.3	186.0	198.8	209.3	245.6
4 days	43.5	57.8	65.2	76.0	83.1	88.5	105.8	124.7	136.9	153.7	168.3	179.5	196.4	209.3	219.9	256.3
6 days	52.2	68.2	76.3	88.0	95.7	101.6	120.1	140.2	153.0	170.5	185.7	197.2	214.5	227.8	238.6	275.4
8 days	59.9	77.2	86.0	98.6	106.8	113.0	132.6	153.6	166.9	185.1	200.8	212.6	230.4	243.9	255.0	292.4
10 days	67.0	85.5	94.8	108.1	116.8	123.3	143.8	165.7	179.5	198.3	214.4	226.5	244.8	258.6	269.8	307.8
12 days	73.6	93.3	103.1	117.0	126.1	132.9	154.2	176.8	191.1	210.4	226.9	239.3	257.9	272.0	283.4	321.9
16 days	86.0	107.5	118.2	133.3	143.0	150.4	173.1	197.1	212.1	232.4	249.6	262.5	281.9	296.4	308.2	347.7
20 days	97.4	120.7	132.1	148.2	158.6	166.3	190.3	215.5	231.2	252.2	270.1	283.5	303.4	318.4	330.4	370.9
25 days	110.9	136.0	148.3	165.5	176.5	184.8	210.1	236.6	253.0	275.0	293.5	307.4	328.0	343.4	355.9	397.4

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

Appendix C

SURFACE WATER SEWER CALCULATIONS & SIMULATION RESULTS

MICRODRAINAGE

CATCHMENT A

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT A	
Date 20/04/2021 09:11 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm - Catchment A

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.256	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm - Catchment A

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	34.301	1.410	24.3	0.160	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	12.539	0.090	139.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	7.426	0.463	16.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.21	113.275	0.160	0.0	0.0	0.0	2.66	105.9	21.7
S1.001	50.00	4.40	111.865	0.160	0.0	0.0	0.0	1.11	44.0	21.7
S1.002	50.00	4.44	111.775	0.160	0.0	0.0	0.0	3.28	130.6	21.7

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT A	Micro Drainage
Date 20/04/2021 09:11 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Manhole Schedules for Storm - Catchment A

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backd (mm)
FA1	115.000	1.725	Open Manhole	1200	S1.000	113.275	225				
EX 107-2	115.000	3.135	Open Manhole	1200	S1.001	111.865	225	S1.000	111.865	225	
EX 107-1	115.122	3.347	Open Manhole	1200	S1.002	111.775	225	S1.001	111.775	225	
EX107	114.810	3.498	Open Manhole	0		OUTFALL		S1.002	111.312	225	

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT A	
Date 20/04/2021 09:11 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

PIPELINE SCHEDULES for Storm - Catchment A

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	FA1	115.000	113.275	1.500	Open Manhole	1200
S1.001	o	225	EX 107-2	115.000	111.865	2.910	Open Manhole	1200
S1.002	o	225	EX 107-1	115.122	111.775	3.122	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	34.301	24.3	EX 107-2	115.000	111.865	2.910	Open Manhole	1200
S1.001	12.539	139.3	EX 107-1	115.122	111.775	3.122	Open Manhole	1200
S1.002	7.426	16.0	EX107	114.810	111.312	3.273	Open Manhole	0

DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT A	Micro Drainage
Date 20/04/2021 09:11 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Summary of Critical Results by Maximum Level (Rank 1) for Storm - Catchment A

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.256
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30, 100
Climate Change (%)	10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	FA1	15 Winter	100	+10%				
S1.001	EX 107-2	15 Summer	100	+10%	30/15 Summer			
S1.002	EX 107-1	15 Winter	100	+10%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	FA1	113.411	-0.089	0.000	0.68		67.3	OK	
S1.001	EX 107-2	112.279	0.189	0.000	1.78		67.4	SURCHARGED	
S1.002	EX 107-1	111.914	-0.086	0.000	0.70		66.9	OK	

CATCHMENT B

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT B	Micro Drainage
Date 21/04/2021 12:17 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm - Catchment B

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.256	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm - Catchment B

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	84.108	1.682	50.0	0.300	4.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	86.526	1.236	70.0	0.280	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	22.532	0.282	79.9	0.061	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	51.027	0.600	85.0	0.122	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	54.421	0.363	149.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	2.619	0.013	201.5	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	14.001	0.261	53.6	0.000	0.00	0.0	0.600	o	500	Pipe/Conduit	
S2.000	59.915	0.240	249.6	0.358	4.00	0.0	0.600	o	375	Pipe/Conduit	
S2.001	54.230	0.181	299.6	0.307	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.002	7.206	0.021	343.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.63	114.137	0.300	0.0	0.0	0.0	2.23	157.5	40.6
S1.001	50.00	5.29	112.455	0.580	0.0	0.0	0.0	2.17	239.5	78.5
S1.002	50.00	5.48	111.219	0.641	0.0	0.0	0.0	2.03	224.0	86.8
S1.003	50.00	5.91	110.937	0.763	0.0	0.0	0.0	1.97	217.1	103.3
S1.004	48.46	6.53	110.337	0.763	0.0	0.0	0.0	1.48	163.2	103.3
S1.005	48.36	6.56	109.974	0.763	0.0	0.0	0.0	1.27	140.6	103.3
S1.006	48.13	6.64	109.961	0.763	0.0	0.0	0.0	2.97	583.3	103.3
S2.000	50.00	4.87	110.321	0.358	0.0	0.0	0.0	1.14	126.1	48.5
S2.001	50.00	5.74	110.081	0.665	0.0	0.0	0.0	1.04	115.0	90.0
S2.002	50.00	5.87	109.900	0.665	0.0	0.0	0.0	0.97	107.4	90.0

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Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT B	
Date 21/04/2021 12:17 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Network Design Table for Storm - Catchment B

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.003	82.057	0.180	455.9	0.000	0.00	0.0	0.600	o	500	Pipe/Conduit	
S3.000	20.034	0.334	60.0	0.029	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	14.279	0.095	150.3	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	57.617	0.999	57.7	0.423	4.00	0.0	0.600	o	300	Pipe/Conduit	
S3.002	6.145	0.031	198.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.003	3.359	0.030	112.0	0.000	0.00	0.0	0.600	o	500	Pipe/Conduit	
S1.007	2.155	0.019	113.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	51.592	0.150	343.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.003	46.52	7.22	109.880	0.665	0.0	0.0	0.0	1.01	198.5	90.0
S3.000	50.00	4.20	110.265	0.029	0.0	0.0	0.0	1.69	67.3	3.9
S3.001	50.00	4.42	109.931	0.050	0.0	0.0	0.0	1.06	42.3	6.8
S4.000	50.00	4.46	110.760	0.423	0.0	0.0	0.0	2.07	146.6	57.3
S3.002	50.00	4.55	109.761	0.473	0.0	0.0	0.0	1.11	78.7	64.1
S3.003	50.00	4.58	109.730	0.473	0.0	0.0	0.0	2.05	403.0	64.1
S1.007	46.44	7.25	109.700	1.901	0.0	0.0	0.0	1.23	48.8*	239.1
S1.008	43.44	8.48	109.681	1.901	0.0	0.0	0.0	0.70	27.8*	239.1

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Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT B	Micro Drainage
Date 21/04/2021 12:17 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Manhole Schedules for Storm - Catchment B

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backd (m
SB7	115.637	1.500	Open Manhole	1200	S1.000	114.137	300				
SB6	114.130	1.675	Open Manhole	1350	S1.001	112.455	375	S1.000	112.455	300	
SB5	112.978	1.759	Open Manhole	1350	S1.002	111.219	375	S1.001	111.219	375	
SB4	112.568	1.631	Open Manhole	1350	S1.003	110.937	375	S1.002	110.937	375	
SB3	112.586	2.249	Open Manhole	1350	S1.004	110.337	375	S1.003	110.337	375	
SB2	112.035	2.061	Open Manhole	1350	S1.005	109.974	375	S1.004	109.974	375	
SB2Tank	112.065	2.104	Open Manhole	1500	S1.006	109.961	500	S1.005	109.961	375	
SB10	111.696	1.375	Open Manhole	1350	S2.000	110.321	375				
SB9	112.228	2.147	Open Manhole	1350	S2.001	110.081	375	S2.000	110.081	375	
SB8	113.185	3.285	Open Manhole	1350	S2.002	109.900	375	S2.001	109.900	375	
SB10Tank	113.053	3.174	Open Manhole	1500	S2.003	109.880	500	S2.002	109.879	375	
S13	111.690	1.425	Open Manhole	1200	S3.000	110.265	225				
SB12	111.553	1.622	Open Manhole	1200	S3.001	109.931	225	S3.000	109.931	225	
SB11-1	112.260	1.500	Open Manhole	1200	S4.000	110.760	300				
SB11	111.788	2.027	Open Manhole	1200	S3.002	109.761	300	S3.001	109.836	225	
								S4.000	109.761	300	
SB11Tank	111.921	2.191	Open Manhole	1500	S3.003	109.730	500	S3.002	109.730	300	
SB1Tank	111.929	2.229	Open Manhole	1500	S1.007	109.700	225	S1.006	109.700	500	
								S2.003	109.700	500	
								S3.003	109.700	500	
SB1	111.927	2.246	Open Manhole	1200	S1.008	109.681	225	S1.007	109.681	225	
SB0	110.500	0.969	Open Manhole	0		OUTFALL		S1.008	109.531	225	

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Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 SW CATCHMENT B	
Date 21/04/2021 12:17 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

PIPELINE SCHEDULES for Storm - Catchment B

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	300	SB7	115.637	114.137	1.200	Open Manhole	1200
S1.001	o	375	SB6	114.130	112.455	1.300	Open Manhole	1350
S1.002	o	375	SB5	112.978	111.219	1.384	Open Manhole	1350
S1.003	o	375	SB4	112.568	110.937	1.256	Open Manhole	1350
S1.004	o	375	SB3	112.586	110.337	1.874	Open Manhole	1350
S1.005	o	375	SB2	112.035	109.974	1.686	Open Manhole	1350
S1.006	o	500	SB2Tank	112.065	109.961	1.604	Open Manhole	1500
S2.000	o	375	SB10	111.696	110.321	1.000	Open Manhole	1350
S2.001	o	375	SB9	112.228	110.081	1.772	Open Manhole	1350
S2.002	o	375	SB8	113.185	109.900	2.910	Open Manhole	1350
S2.003	o	500	SB10Tank	113.053	109.880	2.673	Open Manhole	1500
S3.000	o	225	S13	111.690	110.265	1.200	Open Manhole	1200
S3.001	o	225	SB12	111.553	109.931	1.397	Open Manhole	1200
S4.000	o	300	SB11-1	112.260	110.760	1.200	Open Manhole	1200
S3.002	o	300	SB11	111.788	109.761	1.727	Open Manhole	1200
S3.003	o	500	SB11Tank	111.921	109.730	1.691	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	84.108	50.0	SB6	114.130	112.455	1.375	Open Manhole	1350
S1.001	86.526	70.0	SB5	112.978	111.219	1.384	Open Manhole	1350
S1.002	22.532	79.9	SB4	112.568	110.937	1.256	Open Manhole	1350
S1.003	51.027	85.0	SB3	112.586	110.337	1.874	Open Manhole	1350
S1.004	54.421	149.9	SB2	112.035	109.974	1.686	Open Manhole	1350
S1.005	2.619	201.5	SB2Tank	112.065	109.961	1.729	Open Manhole	1500
S1.006	14.001	53.6	SB1Tank	111.929	109.700	1.729	Open Manhole	1500
S2.000	59.915	249.6	SB9	112.228	110.081	1.772	Open Manhole	1350
S2.001	54.230	299.6	SB8	113.185	109.900	2.910	Open Manhole	1350
S2.002	7.206	343.1	SB10Tank	113.053	109.879	2.799	Open Manhole	1500
S2.003	82.057	455.9	SB1Tank	111.929	109.700	1.729	Open Manhole	1500
S3.000	20.034	60.0	SB12	111.553	109.931	1.397	Open Manhole	1200
S3.001	14.279	150.3	SB11	111.788	109.836	1.727	Open Manhole	1200
S4.000	57.617	57.7	SB11	111.788	109.761	1.727	Open Manhole	1200
S3.002	6.145	198.2	SB11Tank	111.921	109.730	1.891	Open Manhole	1500
S3.003	3.359	112.0	SB1Tank	111.929	109.700	1.729	Open Manhole	1500

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PIPELINE SCHEDULES for Storm - Catchment B

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.007	o	225	SB1Tank	111.929	109.700	2.004	Open Manhole	1500
S1.008	o	225	SB1	111.927	109.681	2.021	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.007	2.155	113.4	SB1	111.927	109.681	2.021	Open Manhole	1200
S1.008	51.592	343.9	SB0	110.500	109.531	0.744	Open Manhole	0

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Online Controls for Storm - Catchment B

Hydro-Brake® Optimum Manhole: SB1, DS/PN: S1.008, Volume (m³): 2.6

Unit Reference	MD-SHE-0133-9800-1780-9800
Design Head (m)	1.780
Design Flow (l/s)	9.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	133
Invert Level (m)	109.681
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.780	9.8
Flush-Flo™	0.524	9.8
Kick-Flo®	1.083	7.8
Mean Flow over Head Range	-	8.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	8.1	3.000	12.5	7.000	18.8
0.200	8.4	1.400	8.8	3.500	13.5	7.500	19.4
0.300	9.3	1.600	9.3	4.000	14.4	8.000	20.0
0.400	9.7	1.800	9.9	4.500	15.2	8.500	20.6
0.500	9.8	2.000	10.4	5.000	16.0	9.000	21.2
0.600	9.7	2.200	10.8	5.500	16.7	9.500	21.8
0.800	9.4	2.400	11.3	6.000	17.5		
1.000	8.5	2.600	11.7	6.500	18.1		

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Summary of Critical Results by Maximum Level (Rank 1) for Storm - Catchment B

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.256
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30, 100
Climate Change (%)	10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SB7	15 Winter	100	+10%				
S1.001	SB6	15 Winter	100	+10%	100/15 Summer			
S1.002	SB5	15 Winter	100	+10%	30/15 Summer			
S1.003	SB4	15 Winter	100	+10%	30/15 Summer			
S1.004	SB3	15 Winter	100	+10%	30/15 Summer			
S1.005	SB2	1440 Winter	100	+10%	30/15 Summer			
S1.006	SB2Tank	1440 Winter	100	+10%	30/240 Winter			
S2.000	SB10	15 Winter	100	+10%	30/15 Summer			
S2.001	SB9	15 Winter	100	+10%	30/15 Summer			
S2.002	SB8	1440 Winter	100	+10%	30/15 Summer			
S2.003	SB10Tank	1440 Winter	100	+10%	30/180 Winter			
S3.000	S13	1440 Winter	100	+10%	30/360 Winter			
S3.001	SB12	1440 Winter	100	+10%	30/15 Summer			
S4.000	SB11-1	15 Winter	100	+10%	30/15 Summer			
S3.002	SB11	1440 Winter	100	+10%	30/15 Summer			
S3.003	SB11Tank	1440 Winter	100	+10%	30/120 Summer			
S1.007	SB1Tank	1440 Winter	100	+10%	30/15 Summer			

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Summary of Critical Results by Maximum Level (Rank 1) for Storm - Catchment B

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SB7	114.346	-0.091	0.000	0.81		123.1	OK	
S1.001	SB6	113.188	0.358	0.000	0.90		206.2	SURCHARGED	
S1.002	SB5	112.391	0.797	0.000	1.02		194.4	SURCHARGED	
S1.003	SB4	112.105	0.793	0.000	1.09		220.1	SURCHARGED	
S1.004	SB3	111.378	0.666	0.000	1.43		217.3	SURCHARGED	
S1.005	SB2	110.994	0.645	0.000	0.24		20.2	SURCHARGED	
S1.006	SB2Tank	110.993	0.532	0.000	0.06		20.1	SURCHARGED	
S2.000	SB10	111.632	0.936	0.000	0.96		113.7	FLOOD RISK	
S2.001	SB9	111.412	0.956	0.000	1.94		207.5	SURCHARGED	
S2.002	SB8	110.993	0.718	0.000	0.26		17.5	SURCHARGED	
S2.003	SB10Tank	110.992	0.612	0.000	0.09		17.1	SURCHARGED	
S3.000	S13	110.994	0.504	0.000	0.01		0.7	SURCHARGED	
S3.001	SB12	110.994	0.838	0.000	0.03		1.2	SURCHARGED	
S4.000	SB11-1	111.687	0.627	0.000	1.08		149.8	SURCHARGED	
S3.002	SB11	110.993	0.932	0.000	0.23		12.4	SURCHARGED	
S3.003	SB11Tank	110.992	0.762	0.000	0.07		12.3	SURCHARGED	
S1.007	SB1Tank	110.992	1.067	0.000	0.46		13.2	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm - Catchment B

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.008	SB1	1440 Winter	100	+10%	30/15 Summer				111.035

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.008	SB1	1.129	0.000	0.37		9.8	SURCHARGED	

Appendix D

FOUL DRAINAGE CALCULATIONS – MICRODRAINAGE

FOUL DRAINAGE CATCHMENT A

265 RESIDENTIAL UNITS (3710 DISCHARGE UNITS) AND 35.28 DISCHARGE UNITS CONTRIBUTING FROM NON RESIDENTIAL

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FOUL SEWERAGE DESIGN

Design Criteria for Foul - Catchment A

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Calculation Method	BS 8301
Frequency Factor	0.00
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Catchment A

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	19.399	0.504	38.5	0.000	16.6	0.0	1.500	o	225	Pipe/Conduit	
F1.001	20.110	0.522	38.5	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	15.957	0.106	150.5	0.000	882.0	0.0	1.500	o	225	Pipe/Conduit	
F1.003	28.939	0.291	99.6	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	11.610	0.105	110.6	0.000	168.0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	85.134	0.851	100.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	5.366	0.081	66.2	0.000	980.0	0.0	1.500	o	225	Pipe/Conduit	
F3.000	7.774	0.199	39.1	0.000	17.1	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	111.904	0.000	0.0	16.6	0.0	29	0.87	1.85	73.7	2.7
F1.001	111.400	0.000	0.0	16.6	0.0	29	0.87	1.85	73.7	2.7
F1.002	110.878	0.000	0.0	898.6	0.0	70	0.74	0.93	37.2	7.7
F1.003	110.772	0.000	0.0	898.6	0.0	62	0.85	1.15	45.7	7.7
F1.004	110.481	0.000	0.0	1066.6	0.0	67	0.84	1.09	43.4	8.3
F1.005	110.376	0.000	0.0	1066.6	0.0	65	0.87	1.15	45.6	8.3
F2.000	111.614	0.000	0.0	980.0	0.0	57	1.00	1.41	56.1	8.0
F3.000	111.731	0.000	0.0	17.1	0.0	29	0.86	1.84	73.1	2.7

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Network Design Table for Foul - Catchment A

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F2.001	19.362	0.449	43.1	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	12.740	0.109	116.9	0.000	1025.4	0.0	1.500	o	225	Pipe/Conduit	
F1.007	51.320	0.425	120.8	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.008	35.260	0.359	98.2	0.000	672.0	0.0	1.500	o	225	Pipe/Conduit	
F1.009	13.123	0.102	129.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.010	21.133	0.159	132.9	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.011	8.086	0.059	136.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F2.001	110.878	0.000	0.0	997.1	0.0	52	1.17	1.75	69.6	8.0
F1.006	109.525	0.000	0.0	3089.1	0.0	92	0.97	1.06	42.2	14.7
F1.007	109.416	0.000	0.0	3089.1	0.0	92	0.95	1.04	41.5	14.7
F1.008	108.992	0.000	0.0	3761.1	0.0	94	1.07	1.16	46.1	16.7
F1.009	108.633	0.000	0.0	3761.1	0.0	101	0.96	1.01	40.2	16.7
F1.010	108.531	0.000	0.0	3761.1	0.0	102	0.95	0.99	39.6	16.7
F1.011	108.372	0.000	0.0	3761.1	0.0	103	0.95	0.98	39.1	16.7

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Manhole Schedules for Foul - Catchment A

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdro (mm)
F9b	113.615	1.711	Open Manhole	1200	F1.000	111.904	225				
F9a	112.862	1.462	Open Manhole	1200	F1.001	111.400	225	F1.000	111.400	225	
FA9	112.602	1.724	Open Manhole	1200	F1.002	110.878	225	F1.001	110.878	225	
FA8	111.986	1.214	Open Manhole	1200	F1.003	110.772	225	F1.002	110.772	225	
FA7	111.704	1.222	Open Manhole	1200	F1.004	110.481	225	F1.003	110.481	225	
FA6	111.784	1.407	Open Manhole	1200	F1.005	110.376	225	F1.004	110.376	225	
FA5-1b	113.879	2.265	Open Manhole	1200	F2.000	111.614	225				
FA5-1a	113.782	2.051	Open Manhole	1200	F3.000	111.731	225				
FA5-1	113.569	2.691	Open Manhole	1200	F2.001	110.878	225	F2.000	111.533	225	65
								F3.000	111.532	225	65
FA5	112.843	3.318	Open Manhole	1200	F1.006	109.525	225	F1.005	109.525	225	
								F2.001	110.429	225	90
FA4a	112.616	3.200	Open Manhole	1200	F1.007	109.416	225	F1.006	109.416	225	
FA4	112.067	3.076	Open Manhole	1200	F1.008	108.992	225	F1.007	108.992	225	
FA3	111.732	3.099	Open Manhole	1200	F1.009	108.633	225	F1.008	108.633	225	
FA2	111.599	3.068	Open Manhole	1200	F1.010	108.531	225	F1.009	108.531	225	
FA1	111.000	2.628	Open Manhole	1200	F1.011	108.372	225	F1.010	108.372	225	
F0	110.910	2.598	Open Manhole	0		OUTFALL		F1.011	108.312	225	

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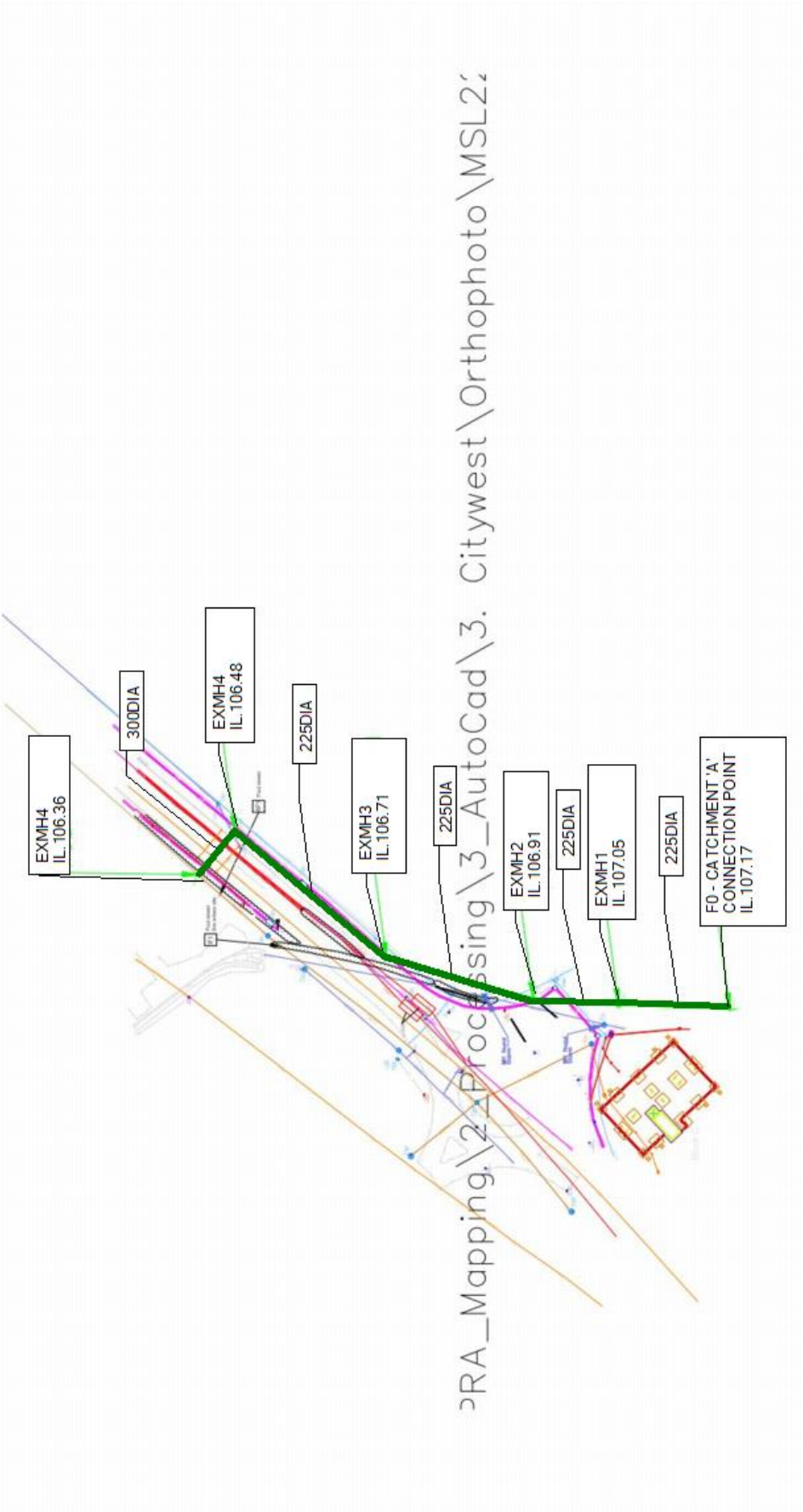
PIPELINE SCHEDULES for Foul - Catchment A

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	F9b	113.615	111.904	1.486	Open Manhole	1200
F1.001	o	225	F9a	112.862	111.400	1.237	Open Manhole	1200
F1.002	o	225	FA9	112.602	110.878	1.499	Open Manhole	1200
F1.003	o	225	FA8	111.986	110.772	0.989	Open Manhole	1200
F1.004	o	225	FA7	111.704	110.481	0.997	Open Manhole	1200
F1.005	o	225	FA6	111.784	110.376	1.182	Open Manhole	1200
F2.000	o	225	FA5-1b	113.879	111.614	2.040	Open Manhole	1200
F3.000	o	225	FA5-1a	113.782	111.731	1.826	Open Manhole	1200
F2.001	o	225	FA5-1	113.569	110.878	2.466	Open Manhole	1200
F1.006	o	225	FA5	112.843	109.525	3.093	Open Manhole	1200
F1.007	o	225	FA4a	112.616	109.416	2.975	Open Manhole	1200
F1.008	o	225	FA4	112.067	108.992	2.851	Open Manhole	1200
F1.009	o	225	FA3	111.732	108.633	2.874	Open Manhole	1200
F1.010	o	225	FA2	111.599	108.531	2.843	Open Manhole	1200
F1.011	o	225	FA1	111.000	108.372	2.403	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	19.399	38.5	F9a	112.862	111.400	1.237	Open Manhole	1200
F1.001	20.110	38.5	FA9	112.602	110.878	1.499	Open Manhole	1200
F1.002	15.957	150.5	FA8	111.986	110.772	0.989	Open Manhole	1200
F1.003	28.939	99.6	FA7	111.704	110.481	0.997	Open Manhole	1200
F1.004	11.610	110.6	FA6	111.784	110.376	1.182	Open Manhole	1200
F1.005	85.134	100.0	FA5	112.843	109.525	3.093	Open Manhole	1200
F2.000	5.366	66.2	FA5-1	113.569	111.533	1.811	Open Manhole	1200
F3.000	7.774	39.1	FA5-1	113.569	111.532	1.812	Open Manhole	1200
F2.001	19.362	43.1	FA5	112.843	110.429	2.189	Open Manhole	1200
F1.006	12.740	116.9	FA4a	112.616	109.416	2.975	Open Manhole	1200
F1.007	51.320	120.8	FA4	112.067	108.992	2.851	Open Manhole	1200
F1.008	35.260	98.2	FA3	111.732	108.633	2.874	Open Manhole	1200
F1.009	13.123	129.0	FA2	111.599	108.531	2.843	Open Manhole	1200
F1.010	21.133	132.9	FA1	111.000	108.372	2.403	Open Manhole	1200
F1.011	8.086	136.0	F0	110.910	108.312	2.373	Open Manhole	0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300DIA
EXMH4
IL.106.48
225DIA
EXMH3
IL.106.71
225DIA
EXMH2
IL.106.91
225DIA
EXMH1
IL.107.05
225DIA
F0 - CATCHMENT 'A'
CONNECTION POINT
IL.107.17
3_AutoCad\3. Citywest\Orthophoto\MSL2'
RA_Mapping\2_Processing\3_

FOUL DRAINAGE CATCHMENT B

36 RESIDENTIAL UNITS

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT B	
Date 20/04/2021 09:30 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Catchment B

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Calculation Method	BS 6301
Frequency Factor	0.00
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Catchment B

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	5.181	0.086	60.2	0.000	504.0	0.0	1.500	o	150	Pipe/Conduit	
F1.001	6.504	0.108	60.0	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	111.188	0.000	0.0	504.0	0.0	57	0.99	1.13	20.0	6.2
F1.001	111.102	0.000	0.0	504.0	0.0	57	1.00	1.13	20.0	6.2

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT B	
Date 20/04/2021 09:30 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Manhole Schedules for Foul - Catchment B

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
FB2	112.145	0.957	Open Manhole	1200	F1.000	111.188	150				
FB1	111.615	0.713	Open Manhole	1200	F1.001	111.102	150	F1.000	111.102	150	
101AB	111.742	0.748	Open Manhole	0		OUTFALL		F1.001	110.994	150	

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT B	
Date 20/04/2021 09:30 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

PIPELINE SCHEDULES for Foul - Catchment B

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	150	FB2	112.145	111.188	0.807	Open Manhole	1200
F1.001	o	150	FB1	111.815	111.102	0.563	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	5.181	60.2	FB1	111.815	111.102	0.563	Open Manhole	1200
F1.001	6.504	60.0	101AB	111.742	110.994	0.598	Open Manhole	0

FOUL DRAINAGE CATCHMENT C

120 RESIDENTIAL UNITS (1680 DISCHARGE UNITS) AND 2.52 DISCHARGE UNITS CONTRIBUTING FROM NON RESIDENTIAL

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT C	
Date 20/04/2021 09:31 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Catchment C

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Calculation Method	BS 8301
Frequency Factor	0.00
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Catchment C

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HyD SECT	DIA (mm)	Section Type	Auto Design
F2.000	4.478	0.083	54.0	0.000	1682.5	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F2.000	112.090	0.000	0.0	1682.5	0.0	62	1.16	1.56	62.2	10.3

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT C	
Date 20/04/2021 09:31 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

Manhole Schedules for Foul - Catchment C

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
FC1	116.400	4.310	Open Manhole	1200	F2.000	112.090	225				
F104	116.087	4.080	Open Manhole	0		OUTFALL		F2.000	112.007	225	

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	Citywest Phase 3 DBFL REF: 190003 FW CATCHMENT C	
Date 20/04/2021 09:31 File Foul and storm 20.04.20...	Designed by CS Checked by KJS	
Innovyze	Network 2018.1.1	

PIPELINE SCHEDULES for Foul - Catchment C

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F2.000	o	225	FC1	116.400	112.090	4.085	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F2.000	4.478	54.0	F104	116.087	112.007	3.855	Open Manhole	0

Appendix E

PHASE 2 – FOUL CAPACITY CHECK – MICRODRAINAGE

PHASE 2 – NETWORK PLAN

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Cooldown Commons Phase 2 Foul network capacity check	Micro Drainage
Date 20/04/2021 09:46 File Foul capacity check.MDX	Designed by ASM Checked by DMW	
Innovyze	Network 2018.1.1	

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Unit

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Calculation Method	EN 752	Maximum Backdrop Height (m)	1.500
Frequency Factor	0.50	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Unit

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	13.400#	0.163	82.2	0.000	1682.5	0.0	1.500	o	225	Pipe/Conduit	
F1.001	23.600#	0.319	74.0	0.000	784.0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	41.800#	0.529	79.0	0.000	742.0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	16.100#	0.413	39.0	0.000	630.0	0.0	1.500	o	225	Pipe/Conduit	
F2.001	27.300#	0.369	74.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.003	57.800#	0.932	62.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	29.000#	0.191	152.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	56.800#	0.493	115.2	0.000	574.0	0.0	1.500	o	225	Pipe/Conduit	
F3.000	29.900#	1.189	25.1	0.000	840.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	112.007	0.000	0.0	1682.5	0.0	100	1.20	1.27	50.4	20.5
F1.001	111.832	0.000	0.0	2466.5	0.0	108	1.31	1.34	53.1	24.8
F1.002	111.533	0.000	0.0	3208.5	0.0	119	1.32	1.29	51.4	28.3
F2.000	112.600	0.000	0.0	630.0	0.0	63	1.38	1.84	73.2	12.5
F2.001	112.200	0.000	0.0	630.0	0.0	74	1.09	1.34	53.1	12.5
F1.003	111.000	0.000	0.0	3838.5	0.0	117	1.48	1.46	58.0	31.0
F1.004	110.630	0.000	0.0	3838.5	0.0	158	1.04	0.93	37.0	31.0
F1.005	109.872	0.000	0.0	4412.5	0.0	150	1.18	1.07	42.5	33.2
F3.000	110.574	0.000	0.0	840.0	0.0	61	1.68	2.29	91.2	14.5

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	Cooldown Commons Phase 2 Foul network capacity check	
Date 20/04/2021 09:46 File Foul capacity check.MDX	Designed by ASM Checked by DMW	
Innovyze	Network 2018.1.1	

Network Design Table for Foul - Unit

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F3.001	10.400#	0.064	163.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F3.002	29.000#	0.420	69.0	0.000	882.0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	7.300#	0.210	34.8	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.007	19.300#	0.146	132.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.008	36.600#	0.270	135.6	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.009	128.000#	0.240	533.3	0.000	196.0	0.0	1.500	o	300	Pipe/Conduit	
F1.010	23.800#	0.141	168.8	0.000	1862.0	0.0	1.500	o	300	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F3.001	109.385	0.000	0.0	840.0	0.0	100	0.85	0.90	35.7	14.5
F3.002	109.320	0.000	0.0	1722.0	0.0	96	1.29	1.38	55.0	20.7
F1.006	107.260	0.000	0.0	6134.5	0.0	113	1.96	1.95	77.6	39.2
F1.007	107.050	0.000	0.0	6134.5	0.0	182	1.14	1.00	39.7	39.2
F1.008	106.900	0.000	0.0	6134.5	0.0	185	1.12	0.99	39.2	39.2
F1.009	106.630	0.000	0.0	6330.5	0.0	232	0.68	0.60	42.2	39.8
F1.010	106.390	0.000	0.0	8192.5	0.0	168	1.11	1.07	75.4	45.3

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	Cooldown Commons Phase 2 Foul network capacity check	Micro Drainage
Date 20/04/2021 09:46 File Foul capacity check.MDX	Designed by ASM Checked by DMN	
Innovyze	Network 2018.1.1	

Manhole Schedules for Foul - Unit

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F104	0.000		Open Manhole	1200	F1.000	112.007	225				
F104B	0.000		Open Manhole	1200	F1.001	111.832	225	F1.000	111.844	225	12
F104A	0.000		Open Manhole	1200	F1.002	111.533	225	F1.001	111.513	225	
F103-2	0.000		Open Manhole	1200	F2.000	112.600	225				
F104-4	0.000		Open Manhole	1200	F2.001	112.200	225	F2.000	112.187	225	
F103	0.000		Open Manhole	1200	F1.003	111.000	225	F1.002	111.004	225	4
								F2.001	111.831	225	831
F102AB	0.000		Open Manhole	1200	F1.004	110.630	225	F1.003	110.068	225	
F101AB	0.000		Open Manhole	1200	F1.005	109.872	225	F1.004	110.439	225	567
F204AB	0.000		Open Manhole	1200	F3.000	110.574	225				
F203AB	0.000		Open Manhole	1200	F3.001	109.385	225	F3.000	109.385	225	
F201AB	0.000		Open Manhole	1200	F3.002	109.320	225	F3.001	109.321	225	1
F6-1AB	0.000		Open Manhole	1200	F1.006	107.260	225	F1.005	109.379	225	2119
								F3.002	108.900	225	1640
F6-2	0.000		Open Manhole	1200	F1.007	107.050	225	F1.006	107.050	225	
FEXMH1	0.000		Open Manhole	1200	F1.008	106.900	225	F1.007	106.904	225	4
FEXMH2	0.000		Open Manhole	1200	F1.009	106.630	300	F1.008	106.630	225	
FEXMH3	0.000		Open Manhole	1200	F1.010	106.390	300	F1.009	106.390	300	
F	0.000		Open Manhole	0		OUTFALL		F1.010	106.249	300	

DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7	Cooldown Commons Phase 2 Foul network capacity check	
Date 20/04/2021 09:46 File Foul capacity check.MDX	Designed by ASM Checked by DMW	
Innovyze	Network 2018.1.1	

PIPELINE SCHEDULES for Foul - Unit

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	F104	0.000	112.007		Open Manhole	1200
F1.001	o	225	F104B	0.000	111.832		Open Manhole	1200
F1.002	o	225	F104A	0.000	111.533		Open Manhole	1200
F2.000	o	225	F103-2	0.000	112.600		Open Manhole	1200
F2.001	o	225	F104-4	0.000	112.200		Open Manhole	1200
F1.003	o	225	F103	0.000	111.000		Open Manhole	1200
F1.004	o	225	F102AB	0.000	110.630		Open Manhole	1200
F1.005	o	225	F101AB	0.000	109.872		Open Manhole	1200
F3.000	o	225	F204AB	0.000	110.574		Open Manhole	1200
F3.001	o	225	F203AB	0.000	109.385		Open Manhole	1200
F3.002	o	225	F201AB	0.000	109.320		Open Manhole	1200
F1.006	o	225	F6-1AB	0.000	107.260		Open Manhole	1200
F1.007	o	225	F6-2	0.000	107.050		Open Manhole	1200
F1.008	o	225	FEXMH1	0.000	106.900		Open Manhole	1200
F1.009	o	300	FEXMH2	0.000	106.630		Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	13.400#	82.2	F104B	0.000	111.844		Open Manhole	1200
F1.001	23.600#	74.0	F104A	0.000	111.513		Open Manhole	1200
F1.002	41.800#	79.0	F103	0.000	111.004		Open Manhole	1200
F2.000	16.100#	39.0	F104-4	0.000	112.187		Open Manhole	1200
F2.001	27.300#	74.0	F103	0.000	111.831		Open Manhole	1200
F1.003	57.800#	62.0	F102AB	0.000	110.068		Open Manhole	1200
F1.004	29.000#	152.0	F101AB	0.000	110.439		Open Manhole	1200
F1.005	56.800#	115.2	F6-1AB	0.000	109.379		Open Manhole	1200
F3.000	29.900#	25.1	F203AB	0.000	109.385		Open Manhole	1200
F3.001	10.400#	163.0	F201AB	0.000	109.321		Open Manhole	1200
F3.002	29.000#	69.0	F6-1AB	0.000	108.900		Open Manhole	1200
F1.006	7.300#	34.8	F6-2	0.000	107.050		Open Manhole	1200
F1.007	19.300#	132.0	FEXMH1	0.000	106.904		Open Manhole	1200
F1.008	36.600#	135.6	FEXMH2	0.000	106.630		Open Manhole	1200
F1.009	128.000#	533.3	FEXMH3	0.000	106.390		Open Manhole	1200

DBFL Consulting Engineers		Page 5
Ormond House Upper Ormond Quay Dublin 7	Cooldown Commons Phase 2 Foul network capacity check	
Date 20/04/2021 09:46 File Foul capacity check.MDX	Designed by ASM Checked by DMW	
Innovyze	Network 2018.1.1	

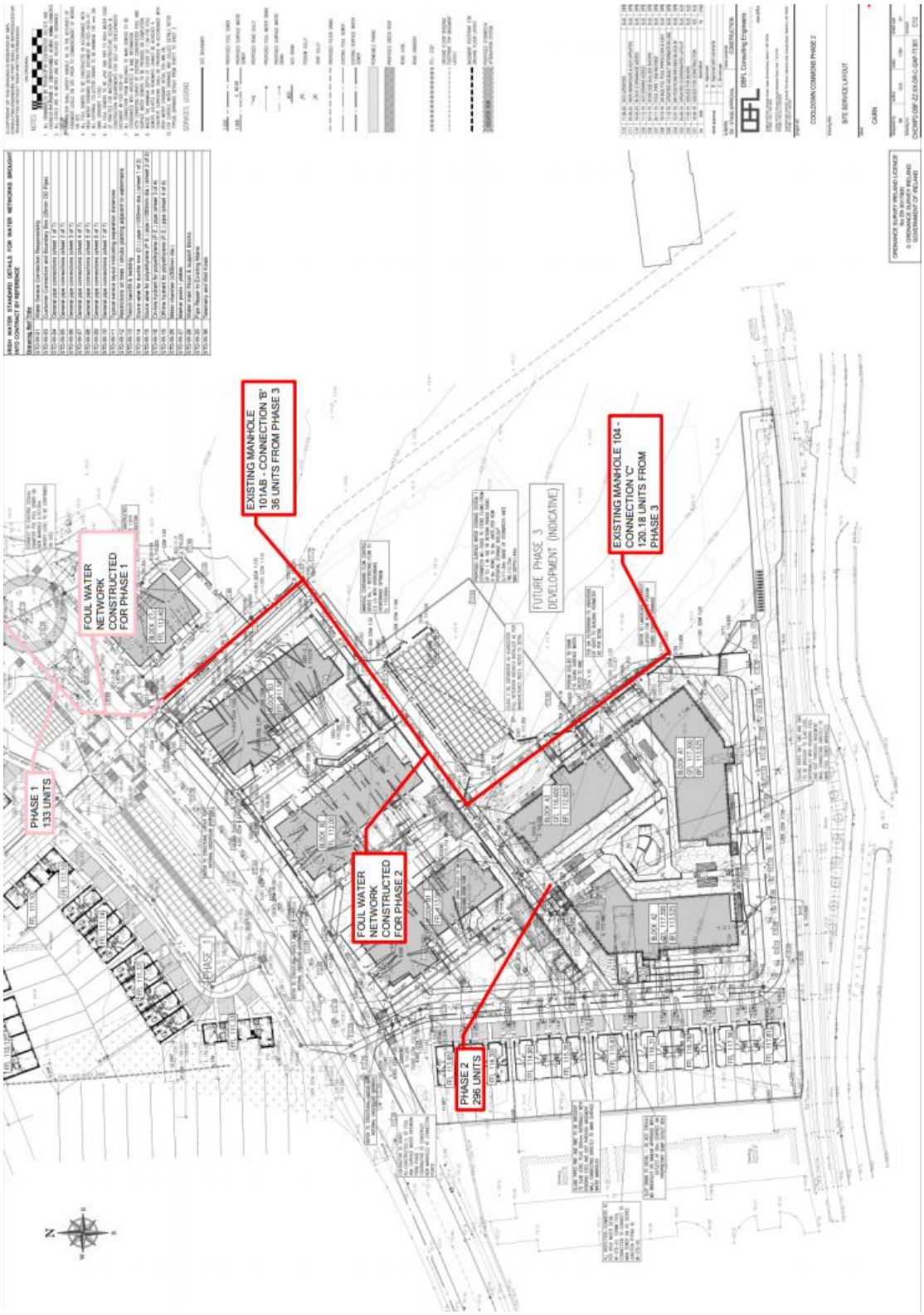
PIPELINE SCHEDULES for Foul - Unit

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.010	o	300	FEXMH3	0.000	106.390		Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.010	23.800#	168.8	F	0.000	106.249		Open Manhole	0


EXISTING MANHOLE 101AB - CONNECTION 'B' 36 UNITS FROM PHASE 3
EXISTING MANHOLE 104 - CONNECTION 'C' 120.18 UNITS FROM PHASE 3
FUTURE PHASE 3 DEVELOPMENT (INDICATIVE)
FOUL WATER NETWORK CONSTRUCTED FOR PHASE 1
FOUL WATER NETWORK CONSTRUCTED FOR PHASE 2
PHASE 1 133 UNITS
PHASE 2 296 UNITS

Appendix F

IRISH WATER CORRESPONDENCE

CONFIRMATION OF FEASIBILITY

STATEMENT OF DESIGN ACCEPTANCE

Dermot Grogan
DBFL
Ormond House
Upper Ormond Quay
Dublin 7

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

14 April 2020

Dear Dermot Grogan,

Re: Connection Reference No CDS20001790 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 450 unit(s) at Cooldown Commons, Dublin

Irish Water has reviewed your pre-connection enquiry in relation to a water and wastewater connection at Cooldown Commons, Dublin

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.

Water:

New connection to the existing network is feasible without upgrade. Connection via new 200 mm pipe main to connect the site development to the existing 180 mm main. Bulk meter to be installed on the connection main.

This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water cannot guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you may need to provide adequate fire storage capacity within your development.

In order to determine the potential flow that could be delivered during normal operational conditions, an onsite assessment of the existing network is required.

Wastewater:

New connection to the existing network is feasible without upgrade.

The proposed wastewater connection for this development connects to the Irish Water network via infrastructure that has not been taken in charge by Irish Water (Third Party Infrastructure). Please be advised that at connection application stage and prior to the commencement of any Self-Lay Works, you have to:

- identify and procure transfer to Irish Water of the arterial water and wastewater Infrastructure within the Third Party Infrastructure;
- demonstrate that the arterial infrastructure are in compliance with requirements of Irish Water Code of Practice and Standard Details and in adequate condition and capacity to cater for additional load from the Development.

There are Irish Water pipes within and in close proximity of the site boundaries (please find attached Irish Water GIS record of the area as a general guide only). The Developer will be required to survey the site to determine the exact location of the pipes. Any trial investigations should be carried out with the agreement and in the presence of the Local Authority Inspector.

You are advised that structures or works over or in close proximity to Irish Water infrastructure that will inhibit access for maintenance or endanger structural or functional integrity of the infrastructure are not allowed. Separation distances between the Irish Water infrastructure and proposed structures, other services, trees, etc. have to be in accordance with the Irish Water Codes of Practice and Standard Details. Prior to submitting your planning application, you are required to contact Irish Water Diversion Team via diversions@water.ie to agree the required separation distances or proposed diversion associated with the infrastructure.

Strategic Housing Development:

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord Pleanála for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

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.

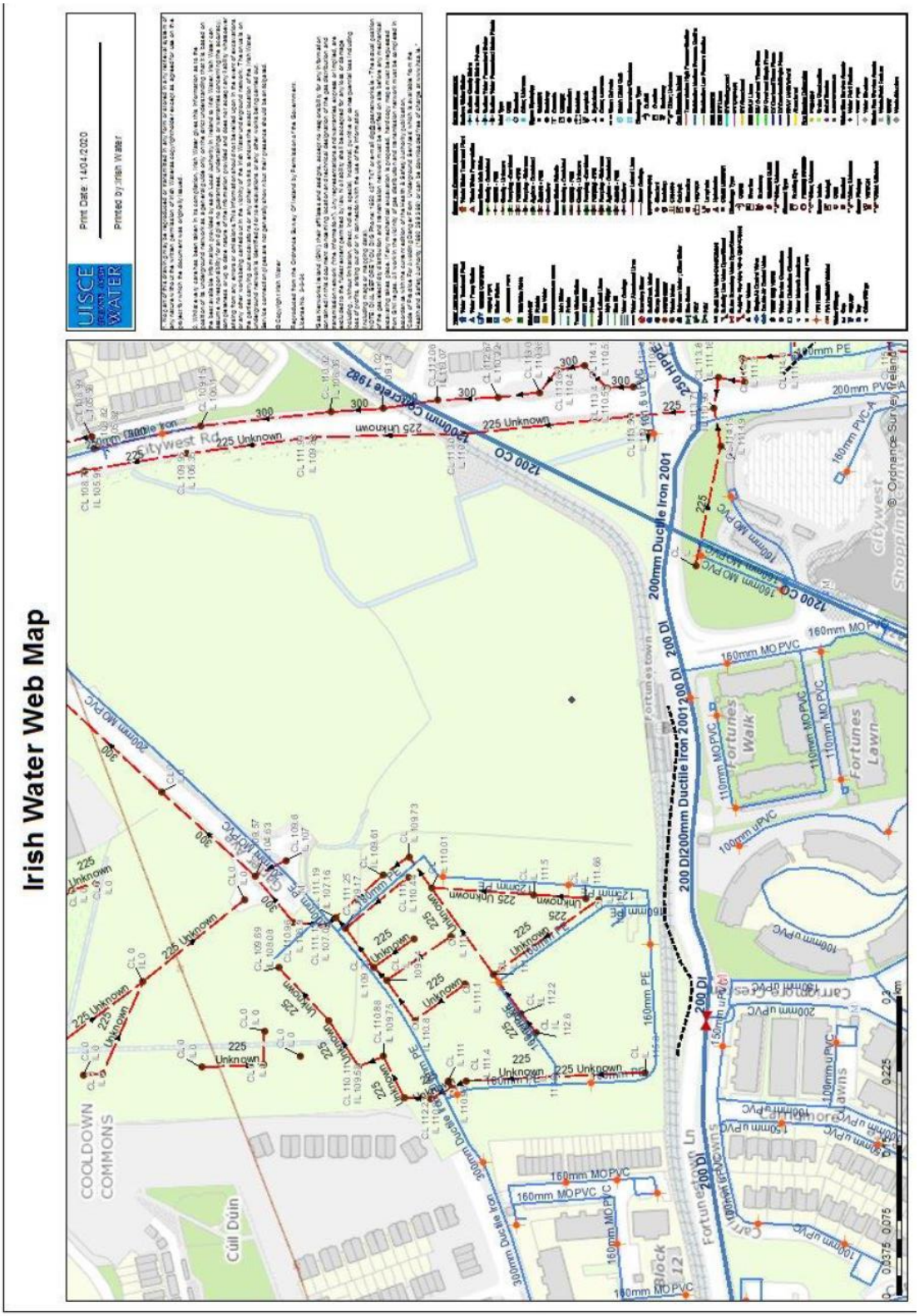
If you have any further questions, please contact Deirdre Ryan from the design team on 022 54620 or email deiryan@water.ie. For further information, visit www.water.ie/connections.

Yours sincerely,

M. O'Dwyer

Maria O'Dwyer

Connections and Developer Services


Irish Water Web Map
Print Date: 14/04/2020
Printed by: Irish Water
UISCE EIREANN WATER
Cooldown Commons
Cúil Duin
Fortunestown Ln
Fortunes Walk
Fortunes Lawn
Citywest Rd
200mm Ductile Iron
200mm PVC-A
160mm MO PVC
160mm PE
200mm uPVC
100mm uPVC
225 Unknown
300
200 DI
250 DI
© Ordnance Survey Ireland

Aneta Smietana
Ormond House
Upper Ormond Quay
Dublin 7 D07W704

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

23 April 2021

Re: Design Submission for Cooldown Commons, Dublin, Co. Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS20001790

Dear Dermot Grogan,

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: Deirdre Ryan
Phone: 022 54620
Email: deiryan@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- 190003-DBFL-WM-SP-DR-C-1001 PROPOSED WATERMAIN LAYOUT
- 190003-DBFL-CS-SP-DR-C-1001 PROPOSED SITE SERVICES LAYOUT
- 190003-DBFL-FW-SP-DR-C-3001 LONGITUDINAL SECTIONS THROUGH FOUL WATER – CATCHMENT A

Standard Details/Code of Practice Exemption: N/A

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.

Appendix G

LEGAL AGREEMENT

EVERSHEDS SUTHERLAND

One Earlsfort Centre
Earlsfort Terrace
Dublin 2
Ireland

T: +353 1 6644 200
F: +353 1 6644 300
E: info@eversheds-sutherland.ie
DX 146 Dublin
Eversheds-sutherland.ie

Your Ref:MOR/mre/41869-0147
Our Ref:
Date: 18 December 2020

DD:
E-mail:

Cairn Plc
7 Grand Canal
Grand Canal Street Lower
Dublin 2

By email

Re: Your lands at Citywest, Dublin comprising property contained in folios DN 137043F and DN139566F and parts of the property contained in folios DN1381, DN6324 and DN6459F outlined in green on the attached plan (the "Cairn Land")

Dear Sirs

We refer to your proposed application to An Bord Pleanala for planning permission to develop the above referenced Cairn Land.

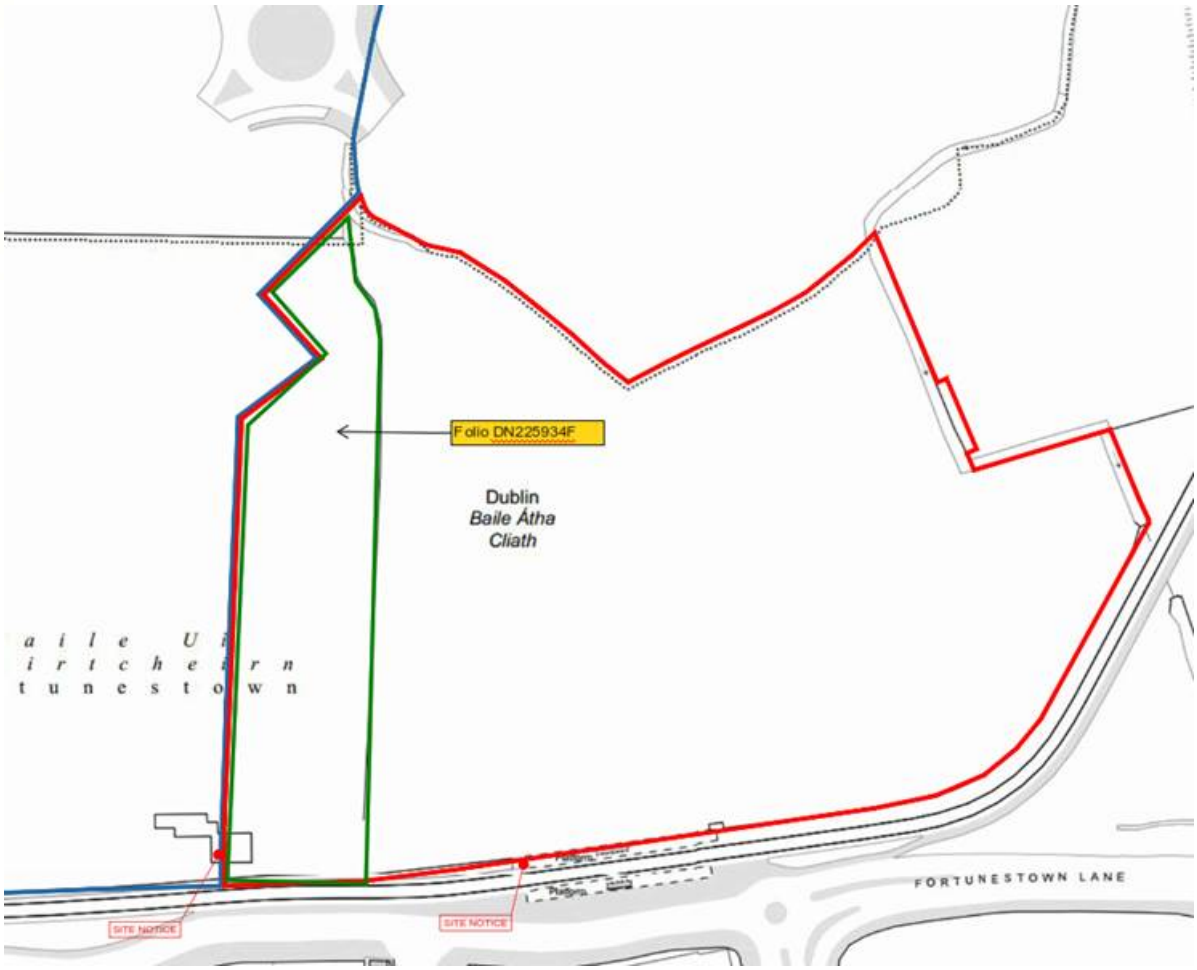
We confirm that Cairn Homes Properties Limited is entitled to easements which permit connections to and the use of foul water sewers, drains, pipes, ducts, mains and other conduits for the passage and running of the usual services and supplies ("**Conduits**"). These easements apply to any such Conduits in or under or passing through the adjoining/neighbouring lands of Kerasoun Limited, Citywest Homes Developments Limited and Citywest Limited including the part of Garter Avenue comprised in folio DN151227F and DN128253F.

Yours faithfully

Sent by email and accordingly bears no signature

Eversheds Sutherland

EVERSHEDS SUTHERLAND



PHILIPLEE

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London, W2 6LG,
United Kingdom
T: +44 (0)20 3934 7010

info@philiplee.ie
philiplee.ie

Cairn PLC
7 Grand Canal
Grand Canal Street Lower
Dublin 2

18 December 2020
Our Ref: EF/LH/CAI002/0006

Lands and Citywest the subject of dealing number D2019LR016921H comprising all of Folio DN15537 outlined in red on the attached plan 1 ("Cairn Land").

Dear Sirs

We refer to your proposed application to An Bord Pleanala for planning permission to develop the above referenced Cairn Land.

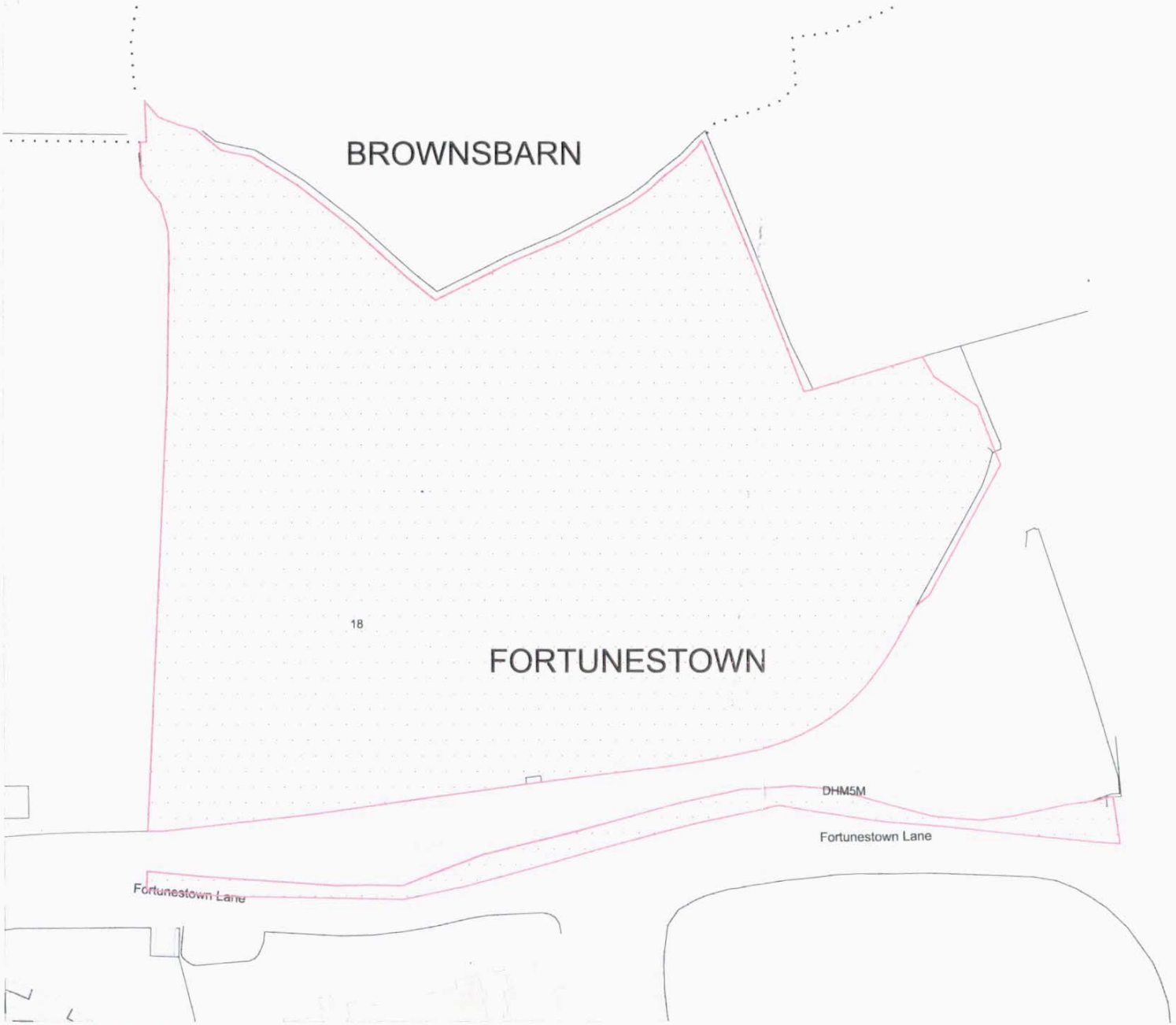
We can confirm that Cairn Homes Properties Limited is entitled to a right to connect to a foul sewer pipe and avail of the pipe for the free passage of running water, soil, foul water and sewage as marked on the attached plan 2.

Yours faithfully

Philip Lee

PHILIP LEE

705260 mE, 727360 mN



704940 mE, 727100 mN

Date Printed: 16/01/2018

Creation Date: 16 January 2018 15:01:00

Application Number: P2017LR093221P

The Property Registration Authority
An tÚdarás Clárúcháin Maoine

Folio: DN15537

This map should be read in conjunction with the folio.

Registry maps are based on OSi topographic mapping. Where registry maps are printed at a scale that is larger than the OSi published scale, accuracy is limited to that of the orignial OSi map scale.

For details of the terms of use and limitations as to scale, accuracy and other conditions relating to Land Registry maps, see www.prai.ie.

(centre-line of parcel(s) edged)

- Freehold
- Leasehold
- SubLeasehold

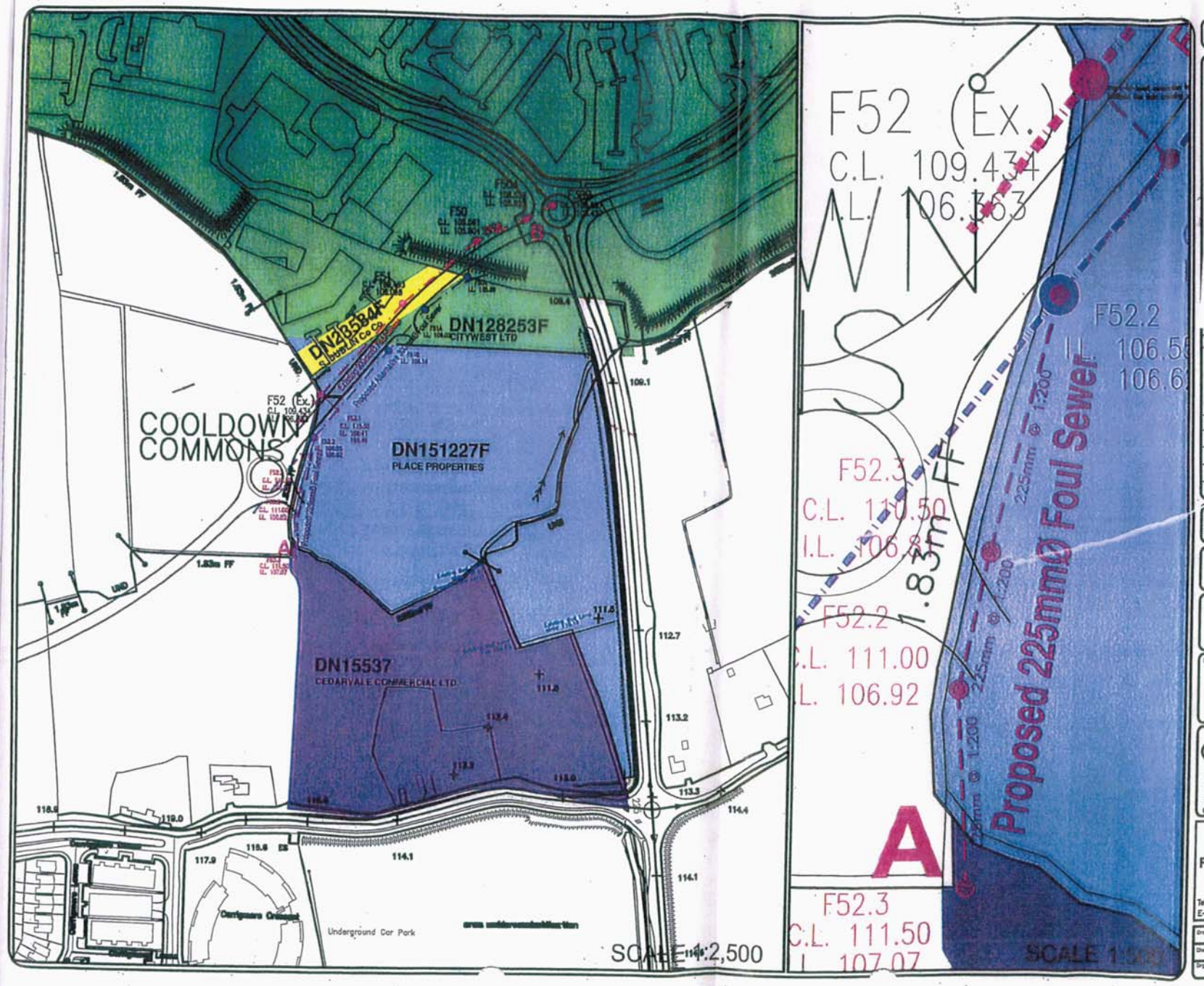
Burdens (may not all be represented on map)

- Right of Way / Wayleave
- Turbary
- Pipeline
- Well
- Pump
- Septic Tank
- Soak Pit

A full list of burdens and their symbology can be found at: www.landdirect.ie

The registry operates a non-conclusive boundary system. The Registry Map identifies properties not boundaries meaning neither the description of land in a register nor its identification by reference to a registry map is conclusive as to the boundaries or extent. (see Section 85 of the Registration of Title Act, 1964). As inserted by Section 62 of the Registration of Deed and Title Act 2006.

1:1000 Scale



NOTES A3

1. Figured Dimensions Only to be Taken from this Drawing. All Dimensions to be Checked on Site.
2. This drawing to be read in Conjunction with all other Architectural & Engineering drawings & all other relevant drawings & Specification
3. All Levels Relate to O.S. Datum At Malin Head.
4. Property Boundaries are Indicitive only and Not definitive

PLAN NO. 6.

PROPOSED 225mm FOUL SEWER

Rev.	Date	By	Revision
D	08/01/08	GW	Alternative 300mm sewer added
C	06/12/07	GW	Point "B" updated Shading amended
B	03/12/07	GW	Properties and Note 4 Added Minor Amendments
A	9-3-06	CD	VIEWPORTS AMENDED

Status: NOT FOR CONSTRUCTION

Client: CITYWEST LTD

Project: CITYWEST CAMPUS

Drg.Title: PROPOSED 300mm FOUL SEWER. PLAN 6

ISO 9001:2000

FAHY FITZPATRICK
Consulting Engineers
2057 Castle Drive, Citywest Campus
Naas Road, Dublin 24.
Tel:(01) 466 0568 Fax:(01) 466 0567
E-Mail mailroom@fahyfitz.com

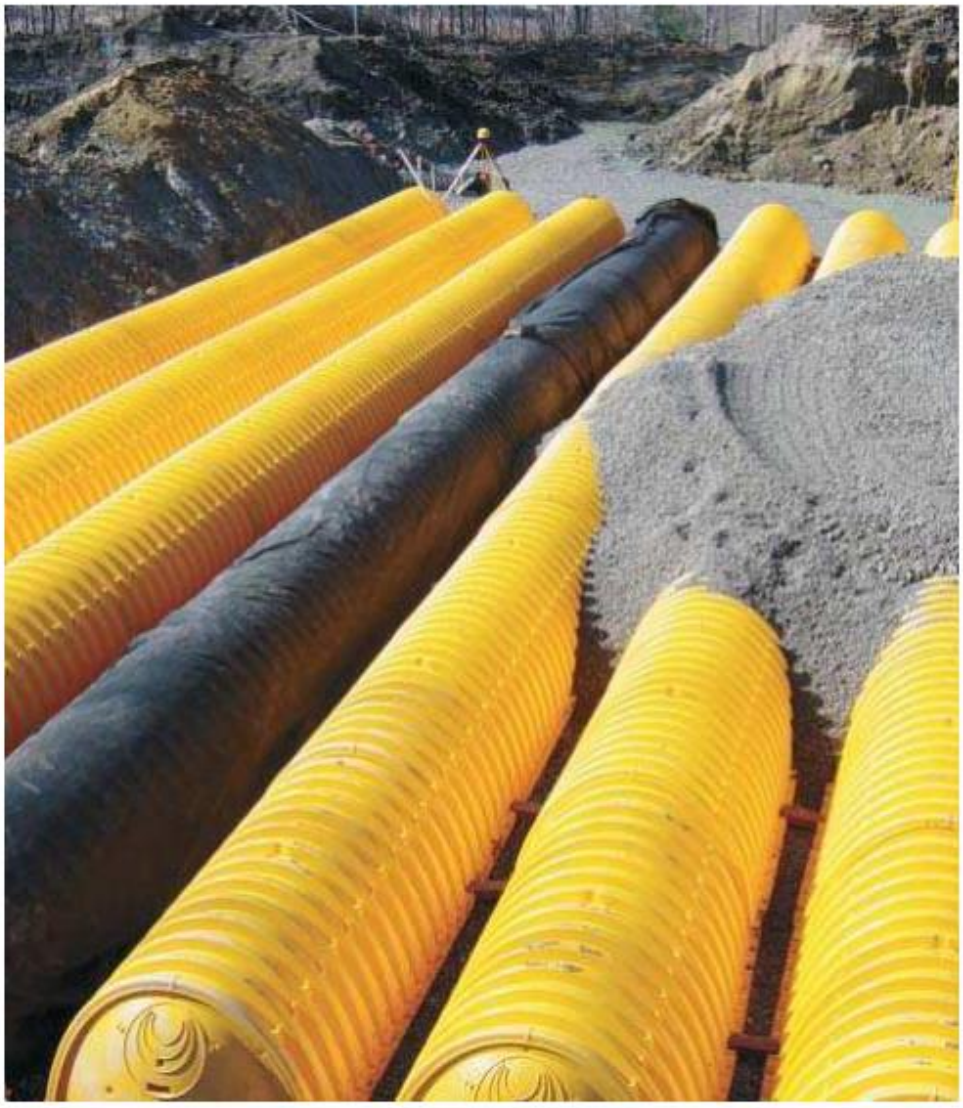
Drawn By CD	Scale 1:500 & 1:2500
Checked By GW	Date 24-01-08
Drg.No. F9015-1907	Rev. D

Appendix H

MAINTENANCE PROCEDURES FOR SURFACE WATER DRAINAGE ELEMENTS

STORMTECH MANAGEMENT BROCHURE

StormTech®
Detention • Retention • Recharge
Subsurface Stormwater Management™



Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator™ Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR™ ROW

The Isolator Row is a row of StormTech chambers, either SC-740 or SC-310 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

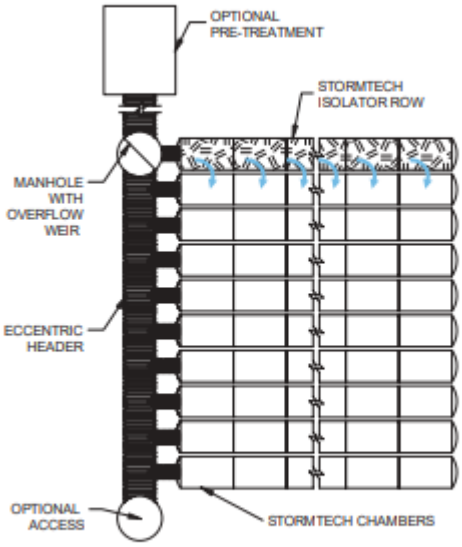
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

StormTech

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

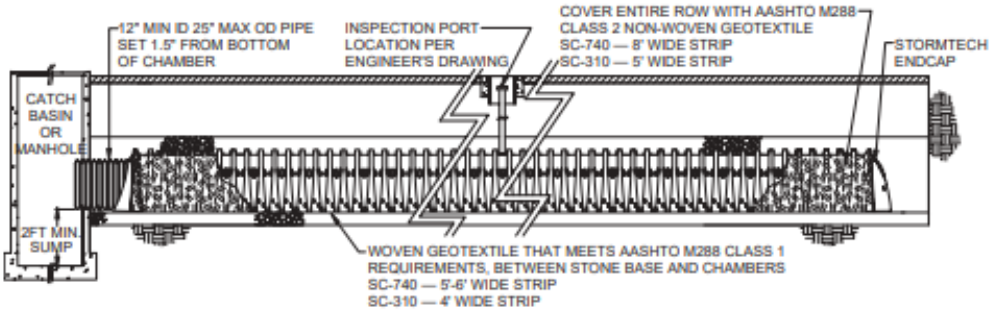
2.2 MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

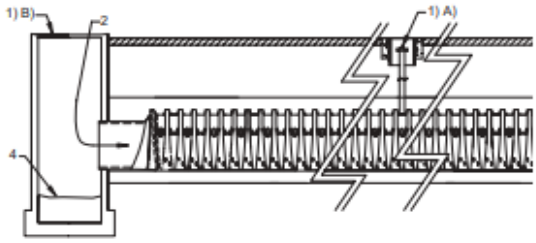
StormTech Isolator Row (not to scale)



3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process
- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

StormTech
Detention • Retention • Recharge
Subsurface Stormwater Management℠

20 Beaver Road, Suite 104 | Wethersfield | Connecticut | 06109
860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

S090104-1

GREEN ROOFS MAINTENANCE
CIRIA SUDS MANUAL

CIRIA SuDS Manual 2015

TABLE 12.5 Operation and maintenance requirements for green roofs

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

CDM 2015 requires designers to ensure that all maintenance risks have been identified and eliminated, reduced or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in Chapter 36.

FILTER DRAINS MAINTENANCE
CIRIA SUDS MANUAL

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Sediments excavated from upstream pre-treatment devices that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate waste management protocols and compliance with legislation. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on site, if there is an appropriate safe and acceptable location to do so. Any damage due to sediment removal or erosion should be repaired and immediately reseeded or planted.

▶ Further detail on waste management is provided in Chapter 32.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the filter drain should be monitored and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in Chapter 36.

SWALES MAINTENANCE
CIRIA SUDS MANUAL

CIRIA SuDS Manual 2015

TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

TREES MAINTENANCE
CIRIA SUDS MANUAL

TABLE 19.3 Operation and maintenance requirements for trees (after CRWA, 2009)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Sediments excavated from a tree pit or planter that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For runoff, from busy streets with high vehicle traffic sediment testing will be essential.

▶ Further detail on waste management is provided in Chapter 33.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the tree pits/planters should be monitored and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 31.

PERMEABLE PAVING MAINTENANCE
CIRIA SUDS MANUAL

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

▶ Generic health and safety guidance is presented in Chapter 36.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

DETENTION BASIN MAINTENANCE
CIRIA SUDS MANUAL

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

22.13 REFERENCE

KENNARD, M F, HOSKINS, C G and FLETCHER, M (1996) *Small embankment reservoirs*, R161, CIRIA, London, UK (ISBN: 978-0-86017-461-5). Go to: **www.ciria.org**

Statutes

Reservoir Act 1975 (c.23)

Health and Safety at Work (etc) Act 1974 (c.37)

Building Act 1984 (c.55)

Flood and Water Management Act 2010 (c.29)

Construction (Design and Management) Regulations (CDM) 2015