

Ballymastone, Donabate Phase 3

Infrastructure Design Report

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Contents

1	Introduction.....	1
1.1	Background	1
1.2	Objectives	2
1.3	Location and Topography.....	2
1.3.1	Location.....	2
1.3.2	Topography.....	3
1.4	Proposed Development.....	4
1.5	Flood Risk.....	4
1.6	Existing Ground Conditions.....	4
1.7	Response to LRD Opinion Items	5
2	Access and Roads	7
2.1	Overall Road and Access Layout.....	7
2.1.1	Vehicular Access.....	7
2.1.2	Pedestrian/Cyclist Access Arrangements	8
2.2	Road Layout Design.....	9
2.3	Pavement Design Standards	10
2.4	Traffic & Transportation	10
2.5	Vehicle Tracking	10
2.6	Parking Management.....	10
3	Surface Water Drainage.....	11
3.1	Existing Surface Water	11
3.2	Surface Water Management Plan.....	11
3.2.1	General.....	11
3.2.2	Compliance with Surface Water Policy	13
3.2.3	Ground Investigation.....	14

3.3	Sustainable Drainage Systems (SuDS)	14
3.4	Greenfield Run-off Rates	18
3.5	Surface Water Attenuation Storage	19
3.6	Requirement for Underground Attenuation Storage	21
3.7	Interception Volume	21
3.8	Surface Water Drainage Design Standards	22
3.9	Climate Change	23
3.10	Flood Risk	23
4	Foul Drainage	24
4.1	Existing Foul Drainage	24
4.2	Consultation with Irish Water	24
4.3	Design Strategy	24
4.4	Design Calculations	25
4.5	Compliance with Irish Water Standards	26
4.6	Foul Environmental Impacts	26
5	Water Supply and Distribution	27
5.1	Existing Water Supply	27
5.2	Development Water Main Layout	27
5.3	Compliance with Irish Water Standards	27
5.4	Water Demand & Conservation	27
Appendix A :	SURFACE WATER ALLOWABLE OUTFLOW	A
Appendix B :	SURFACE WATER ATTENUATION CALCULATIONS	B
Appendix C :	SURFACE WATER NETWORK CALCULATIONS	C
Appendix D :	FOUL SEWER CALCULATIONS	D
Appendix E :	GROUND INVESTIGATION REPORT SUMMARIES	E
Appendix F :	IW CONFIRMATION OF FEASIBILITY AND STATEMENT OF DESIGN ACCEPTANCE	F

Figure

Figure 1: Site Layout..... 1

Figure 2: Phase 3 Site Boundary and location..... 3

Figure 3: Existing Surface Water Systems and watercourses..... 4

Figure 4: Proposed development site access locations and internal streets..... 8

Figure 5: Proposed development pedestrian/cycle site access locations and links..... 9

Figure 6: Masterplan Surface Water Catchment Plan 13

Figure 7: Rain Garden detail 17

Table

Table 1: Breakdown of Areas draining to each SUDs feature 18

Table 2: Surface Water Attenuation Storage and Discharge Limits 19

Table 3: Development Foul Flow Calculations..... 26

Table 4: Development Water Demand 28

1 Introduction

1.1 Background

DBFL were commissioned to undertake an Infrastructure Design Report to accompany a Stage 3 large-residential development (LRD) Planning Application to Fingal County Council (FCC) for the third of three phases of a residential development at Ballymastone, Donabate. Ballymastone will become a new mixed tenure residential community within a living landscape with strong connectivity to Donabate Town Centre, train station and permitted Education and Recreation Hub creating an attractive setting which integrates and complements the surrounding residential area.

This LRD Application for Phase Three of the Ballymastone masterplan development to Fingal County Council is prepared on behalf of Glenveagh Living Limited, consisting of a 11.28 Ha site area which is located at Ballymastone, Donabate, Dublin. Please see Figure 1 below indicating the site area.



Figure 1: Site Layout

In summary, the proposed development will consist of the construction of a residential development, which represents Phase 3 of the wider development of the Ballymastone Lands, ranging in height from 2- to 6-storeys, to accommodate 398 no. residential dwellings (including a mix of apartments, duplexes and houses), private amenity space, a crèche (c. 646sq.m), and a

community space (c. 100sq.m). The site will accommodate 316 no. car parking spaces in total (comprised of 288 no. residential spaces, 10 no. spaces for the proposed crèche/community space, 6 no. EV charging spaces including accessible spaces, and 12 no. spaces ducted for future provision), 1,619 total no. bicycle parking spaces, new pedestrian/cycle links, road improvements, storage, services (including water, wastewater, electricity and telecommunications) and plant areas. Landscaping will include communal amenity areas, SuDS features, and significant public open space (c. 15.3% of the net site) including outdoor exercise and play equipment.

1.2 Objectives

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

- Surface water & SUDS strategy and servicing.
- Foul drainage strategy and servicing.
- Water supply and servicing.
- Road layout and site access.

1.3 Location and Topography

1.3.1 Location

The subject site, of 11.28 hectares falls within the wider Ballymastone masterplan site which is located within the Donabate area of northeast Dublin.

The site is a large greenfield site to the east of Donabate Village. The site, currently in use as part of the construction of the other phases, is bordered by Phase 2 of the overall masterplan (FCC Reg. Ref. LRD0039/S3) lands directly south of the development with the R126 Donabate Distributor Road (DDR) running along the eastern boundary of the site. The site is bound to the west by The Links development with the Ballymastone masterplan lands to the south, and Willowbrook and The Priory developments to the north. Donabate Golf Club and St. Ita's Demesne are located to the east of the subject site. A network of hedgerows and drainage ditches are located throughout the site.

The lands are within the jurisdiction of Fingal County Council's Development Plan, 2023-2029. They are primarily zoned 'RA', Residential Area, to 'provide for new residential communities subject to the provision of the necessary social and physical infrastructure'.



1.3.2 Topography

20003-DBF-XXXX-XX-RP-C01-000101 P02
Oct 2025



Figure 3: Existing Surface Water Systems and watercourses

1.4 Proposed Development

The proposed residential development for Phase 3 seeks permission for the provision of 398 no. residential units comprising 124 no. apartments, 47 no. duplexes and 227 houses.

1.5 Flood Risk

A separate Site-Specific Flood Risk Assessment has been prepared as part of the LRD Application. Refer to DBFL Report Number 20003-DBF-XXXX-XX-RP-C01-000002.

1.6 Existing Ground Conditions

A detailed Site Investigation was carried out by Ground Investigations Ireland (GII) between February and July 2022 to ascertain the existing ground conditions on site. The final reports split the entire site into 6 areas of investigation of which only areas 3 and 4 are applicable to Phase 3 of the works. See below for descriptions of the ground make up in each of these areas.

Area 3:

The ground conditions in this area generally consist of topsoil to a maximum depth of 0.4m below ground level over made ground to a level of up to 1.2m below ground level. Under the

topsoil/made ground was a layer of light brown to grey brown/dark grey clay. Underlying this was a layer of brown sand.

Area 4:

The ground conditions in this area generally consist of topsoil to a maximum depth of 0.4m below ground level over made ground to a level of up to 1.5m below ground level. Under the topsoil/made ground was a layer of light brown to dark grey clay. Underlying this was a layer of brown grey gravel. Bedrock was found at a depth of 10.5m below ground level and was identified as Sandstone/Conglomerate.

Refer to Appendix E of this report Ground Investigation Report Summaries for further details.

1.7 Response to LRD Opinion Items

As part of the Large-scale Residential Development (LRD) process a pre-application Section 32D consultation was undertaken following which, Fingal County Council (FCC) provided feedback in their LRD opinion.

The FCC feedback included a number of points, which identified a number of infrastructure items to be addressed. The following summarises the key water and drainage items raised within the FCC feedback (in blue text) and corresponding response or clarification of how these have been addressed:

Item 1: The Site-specific Flood Risk Assessment (SSFRA) submitted with the pre-planning documentation is acknowledged and it is noted the submitted assessment confirms no flood risk. The applicant is advised a finalised SSFRA should be submitted with any application for permission that may follow.

A Finalised Site Specific Flood Risk Assessment has been submitted as part of this application. Please refer to report 20003-DBF-XXXX-XX-RP-C01-000102 Site Specific Flood Risk Assessment.

Item 2: The surface water drainage strategy submitted with the pre-planning documentation is acceptable and it is noted the proposals follow through from the permitted 'Phase 1' and 'Phase 2' developments.

FCC's response here is noted, The Surface Water Drainage Strategy is described in further detail within Section 3 of this report.

Item 3: It is noted that all below ground attenuation tanks have been confirmed to be Stormtech which aligns with Fingal County Council's taking-in-charge requirements. The applicant is advised any application for permission that may follow should clearly demonstrate same.

As per the descriptions of the proposed below ground attenuation tanks within sections 3.5 & 3.6 of this report, it should be that all new underground attenuation storage being built as part of phase 3 will utilise Stormtech Units.

Item 4: Further details are required to demonstrate how the proposed detention basins integrate into the streetscape / landscape. This should include long / cross sections and invert / top / water levels. All side slopes should to be 1:5 minimum.

As described within Section 3.3 of this report, it is proposed that all detention basins will have side slopes of minimum 1:4. Details on how these proposed detention basins integrate into the streetscape/landscape are shown on the attenuation details drawings 20003-DBF-XXXX-XX-DR-C01-530021 to 20003-DBF-XXXX-XX-DR-C01-530023.

Item 5: There are concerns regarding the proposed buffer zone around the pumping station to the north-east of the site. The higher figure of 50m should apply with all private curtilage outside of this.

FCC's concerns on this matter are noted. DBFL note that the pumping station is set back from all existing and proposed property boundaries by at least 35m. This separation distance allows the mitigation of any potential noise or vibration that may arise from the station, and is in line with the 15 metres minimum distance from the property boundary required by Irish Water. Further details on the Foul Drainage Design Strategy and the pumping station can be found within Section 4.3 of this report.

Item 6: The applicant is advised to liaise with Uisce Éireann regarding the proposed water supply and foul drainage arrangements. A Confirmation of Feasibility from Uisce Éireann is required to be submitted as part of any application for permission that may follow.

A Copy of the Uisce Éireann Confirmation of Feasibility and Statement of Design Acceptance are included within Appendix F of this document.

2 Access and Roads

2.1 Overall Road and Access Layout

2.1.1 Vehicular Access

The proposal represents Phase 3 of the overall Ballymastone development, and includes the provision of 2 no. vehicle access points, as shown in Figure 4, providing an integrated street network between the subject development, the overall Masterplan proposal and existing surrounding streets/developments, these accesses include:

- **The Links:** The Development will tie into The Links Street which forms part of the western boundary of the site. In turn this will provide a connection to the Portrane Road/The Links junction located to the east of the site. The Portrane Road/The Links junction is a signalised junction; and
- **Donabate Distributor Road:** One vehicular access, DDR Site Access 2, is proposed from the DDR in the form of a priority-controlled junction.

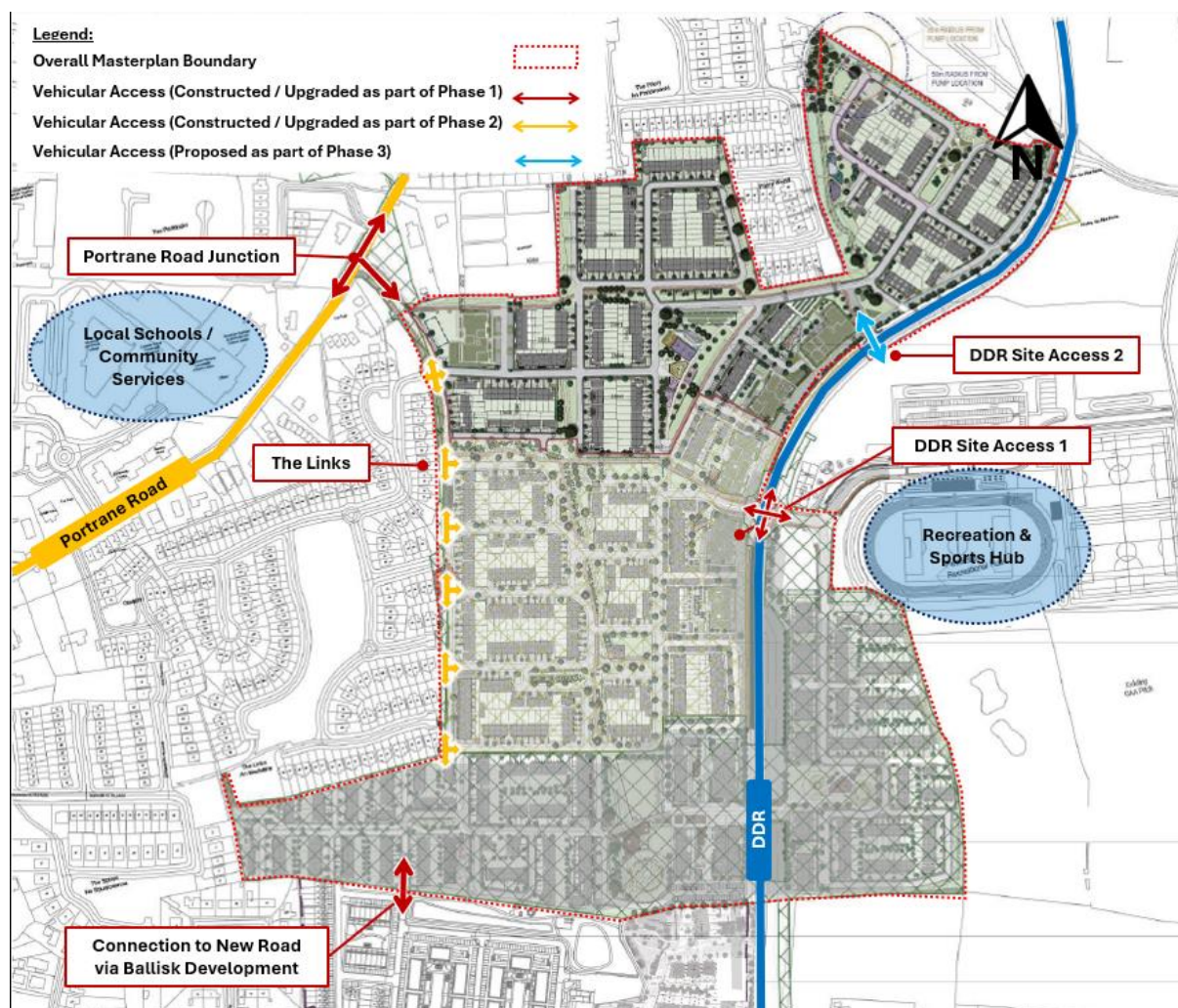


Figure 4: Proposed development site access locations and internal streets

The vehicle connection to The Links will be a priority junction. It is proposed that this junction will include raised tables to aid both traffic calming and enable pedestrian/cyclist to assert a level of priority when crossing junctions.

2.1.2 Pedestrian/Cyclist Access Arrangements

The vehicular accesses described in the previous section will also be accessible to both pedestrians and cyclists. There are several additional pedestrian/cyclist access points located along the DDR offering excellent levels of connectivity to/from the pedestrian and cycle facilities along the DDR.

As shown in Figure 5, connectivity to Donabate Village will be provided via Phase 1 and 2. This will provide links to key services in the village as well as Donabate Train Station. Within the site itself is a connected network of paths for pedestrians and cyclists. Internal junctions and crossing points have been designed in accordance with DMURS and the Cycle Design Manual (CDM) to ensure safe and direct facilities for pedestrians and cyclists in order encourage uptake in active modes.

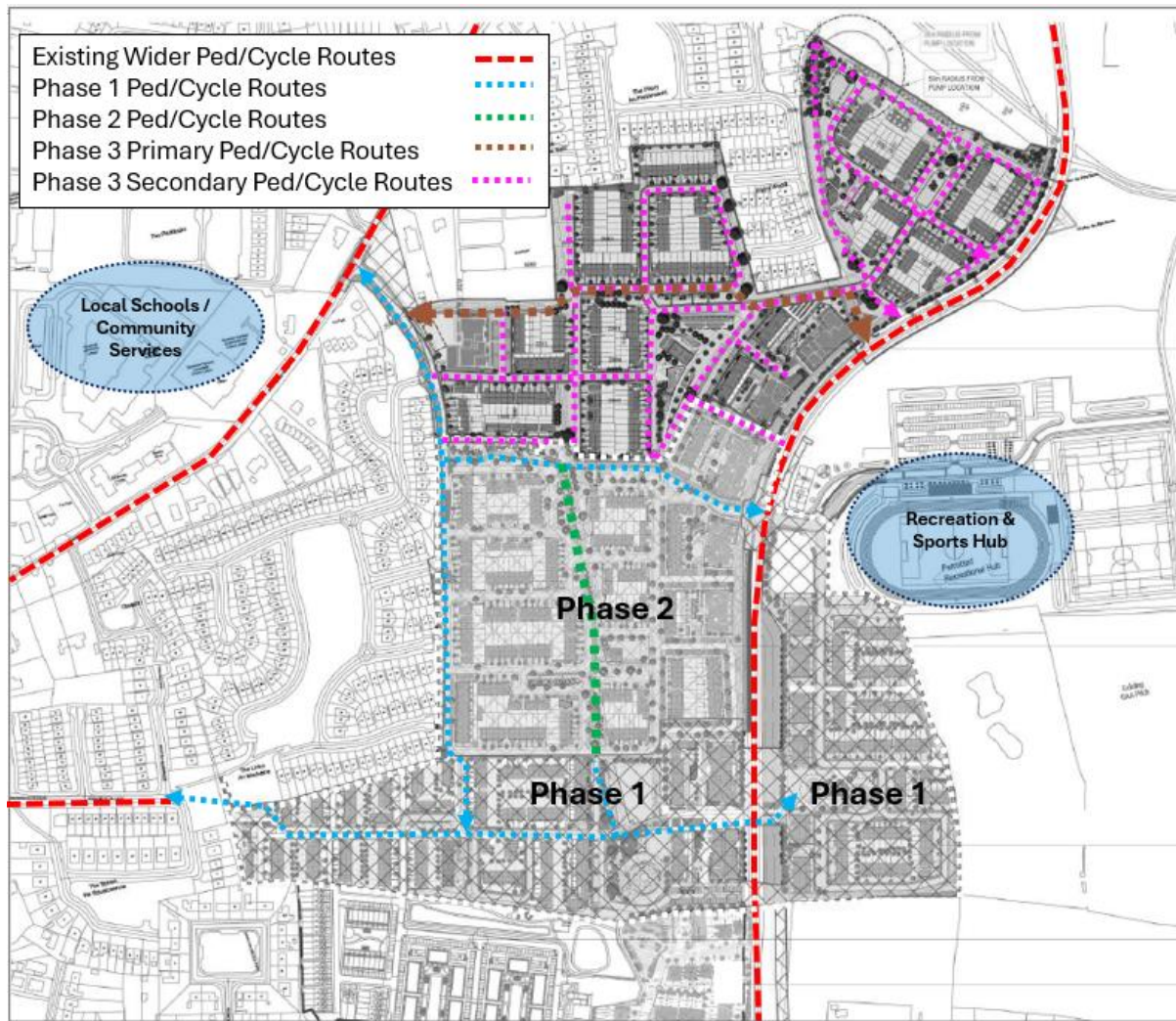


Figure 5: Proposed development pedestrian/cycle site access locations and links

2.2 Road Layout Design

The proposed development's road layout and hierarchy is shown on drawings 20003-DBF-XXXX-XX-DR-C01-123000 to 20003-DBF-XXXX-XX-DR-C01-123002 and 20003-DBF-XXXX-XX-DR-C01-123004. The road layout is designed in accordance with the recommendations of the Design Manual for Urban Roads and Streets (DMURS), as outlined in the DMURS Compliance Statement.

- Local Streets - 5.5m wide carriageway with 2m wide footpath and permeable paving parking bays on one/both sides. A grassed area is allowed for construction of a low flow swale in areas with a 3m wide parkland path adjacent.
- Home zone Streets – 4.8m wide carriageway to facilitate perpendicular parking with localised build outs to reduce carriageway width emphasise pedestrian priority within the homezone.

2.3 Pavement Design Standards

Local streets within the site are designed in accordance with the Department of the Environment Recommendations for Site Development Works, the Design Manual for Urban Roads and Streets (DMURS) and Local Authority requirements.

2.4 Traffic & Transportation

A Traffic & Transport Assessment (TTA) report prepared by DBFL Consulting Engineers is included in the overall LRD Application pack (refer to DBFL Report 20003-DBF-XXXX-XX-RP-C01-000105 TTA).

2.5 Vehicle Tracking

The proposed street layout has been tracked to demonstrate that the site's proposed corner radii and turning heads will accommodate large vehicles such as refuse trucks and fire engines (refer to DBFL Drawing No.'s 20003-DBF-XXXX-XX-DR-C01-120000 to 20003-DBF-XXXX-XX-DR-C01-120002).

2.6 Parking Management

A separate Traffic & Transportation Assessment (TTA) has been prepared by DBFL Consulting Engineers as part of this LRD Application (refer to DBFL Report No. 20003-DBF-XXXX-XX-RP-C01-000105 TTA) that outlines the details of the parking strategy and provision for the development.

3 Surface Water Drainage

3.1 Existing Surface Water

The existing site is predominantly greenfield excluding the existing DDR, and the topography of the site is generally flat with a high point in the middle of the site adjacent to the DDR with a slight fall from the South to the North. Currently, the site is drained by a network of drainage ditches which traverses the site and feed into the Beaverstown stream catchment and Portrane Canal catchment.

Surface water runoff from the existing DDR is collected via road gullies into existing carrier drains running along the road and transferred into 5 attenuation ponds along the length of the DDR.

3.2 Surface Water Management Plan

3.2.1 General

A surface water drainage strategy for the Phase 3 site has been developed by DBFL and is in line with an overall surface water drainage strategy for the Ballymastone masterplan lands which has also been developed by DBFL Consulting Engineers. Surface water runoff from the development will be attenuated to greenfield runoff rates (Qbar) in accordance with the Greater Dublin Strategic Drainage Study (GDSDS).

The attenuation systems are designed to accommodate the 100-year critical storm event. Attenuation storage is provided through a combination of above ground and underground attenuation systems. A balance of underground and overground storage is required considering the urban nature of the development and density / open space requirements. SUDS features such as green roofs and the inclusions of permeable paving, tree pits and swales will provide a surface water treatment train and promote source control throughout the development while also providing attenuation storage at source. In some locations, the proposed layout has also managed to include over edge road drainage with surface water flowing directly under drained swales providing treatment and storage at source.

The Phase 3 site (this application area) crosses 2 surface water catchments included within the overall masterplan area. The overall masterplan area was divided into 5 catchments to best utilise the available surface water discharge points. Parts of catchment 4 and 5 are within the Phase 3 site boundary. Catchment 4 is separated into sub catchments with attenuation provided closer to source within the sub-catchments. Catchment 4 discharges to the existing 1350mm surface water culvert to the northwest of the site which eventually discharges to the Rogerstown Estuary to the

north. Utilising the 1350mm surface water culvert for the Ballymastone masterplan area is in line with the Donabate LAP. Catchment 5 discharge to the existing ditches which eventually flow to the Portrane Canal and then onto the Rogerstown Estuary to the north. See Figure 6 below for more details. A lot of the drainage infrastructure required for Phase 3 was constructed as part of Phase 1 of the works permitted under FCC Reg. Ref. LRD0008/S3, specifically the connection to the 1350mm culvert and the majority of the attenuation associated with Catchment 4. Similarly a lot of the drainage infrastructure required for Catchment 5 will be constructed as part of Phase 2 of the works permitted under FCC Reg. Ref. LRD0039/S3, specifically the final outfall to an existing ditch to the North West and the majority of the attenuation associated with Catchment 5.

This drainage strategy has been discussed in principle with Fingal County Council's drainage department throughout the planning for the other 2 phases. Due to existing site levels some areas to the south require levels to be raised to provide cover to the drainage network. Attenuation locations avoid the raised areas and generally the underside of attenuations are located on or below existing ground thereby maximising any existing infiltration properties. We note that SUDS / Nature-based SUDS are maximised throughout the scheme but that an element of underground storage is unavoidable due to space restrictions due to the extent of available open space, existing hedgerows & ditches limiting available space etc. It is noted that at the time writing that the majority of surface water drainage, SUDS/NBS and attenuation in Phase 1, which is currently under construction, is now in place as per the approved LRD permitted development under ABP Ref ABP-315288-22 & FCC Ref LRD0008/S3. Please refer to section 3.3, 3.5 and 3.6 for further information.

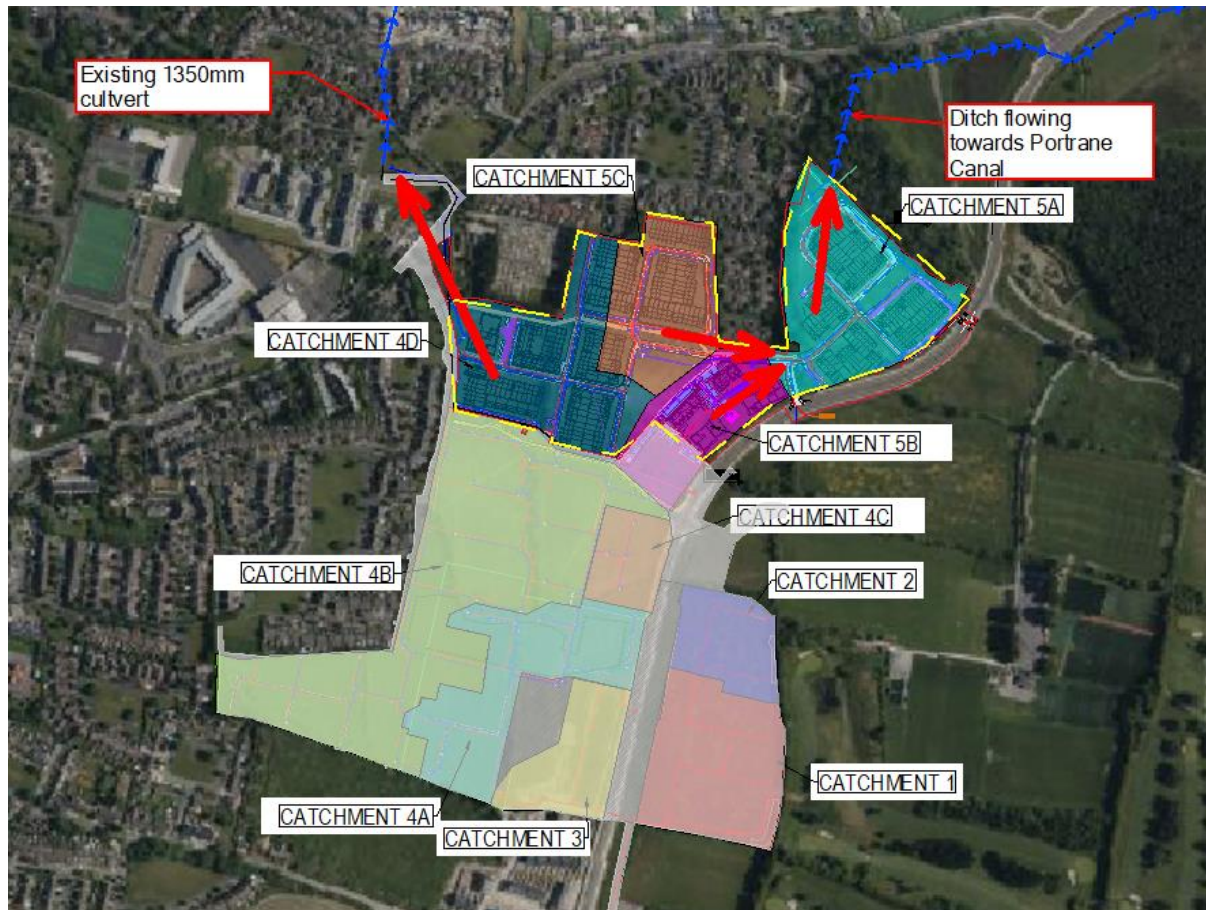


Figure 6: Masterplan Surface Water Catchment Plan

3.2.2 Compliance with Surface Water Policy

Surface water management for the proposed development is designed to comply with the Greater Dublin Strategic Drainage Study (GDSDS) policies and guidelines and the requirements of Fingal County Council. The guidelines require the following four main criteria to be provided by the development's surface water design;

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage using permeable paving in car parking spaces and swales alongside roads, treatment of run-off within the SUDS features e.g., permeable paving for parking bays and within the attenuation storage system and oil separators on the main surface water outfalls from the development.
- 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 outside the 1000 year coastal and fluvial flood zones, (See Flood Risk Assessment). Fluvial flood risk

addressed by development designed to accommodate a 100-year storm as per GDSDS. Planned flood routing for storms greater than 100-year level, considered in design, the development has been designed to provide an overland flood route from the development towards the surface water outfall.

- Criterion 4: River flood protection – attenuation and long-term storage provided within the SuDS features e.g., green roofs, permeable paving construction and attenuation facilities.

3.2.3 Ground Investigation

A detailed Site Investigation was carried out by Ground Investigations Ireland (GII) between February and July 2022 to ascertain the existing ground conditions on site. The final reports split the entire site into 6 areas of investigation of which only areas 3 and 4 are applicable to Phase 3 of the works. See Section 1.6 for descriptions of the ground make up in each of these areas.

From Infiltration tests carried out across the various areas, infiltration rates are considered negligible, therefore no benefit was taken from infiltration in the design of the attenuation facilities although some infiltration will naturally occur. Ground Investigations Ireland's summary reports for the respective areas are attached in Appendix E.

3.3 Sustainable Drainage Systems (SuDS)

In accordance with the GDSDS it is proposed to use Sustainable Urban Drainage systems (SuDS) for managing stormwater for the proposed development. The aim of the SuDS strategy for the site will be to;

- Attenuate storm-water runoff.
- Reduce storm-water runoff.
- Reduce pollution impact.
- Replicate the natural characteristics of rainfall runoff for the site.
- Recharge the groundwater profile.

The proposed layout of the drainage and SuDS is detailed on drawings 20003-DBF-XXXX-XX-DR-C01-133000 to 20003-DBF-XXXX-XX-SK-C01-133002.

An assessment of the potential SuDS that could be incorporated within the site was conducted using the SuDS Manual, CIRIA 753. The SuDS elements included in the proposed scheme design and layout include are as follows:

- 1- Permeable Paving parking spaces for on-street parking and private parking.

- 2- Pedestrian/green links to drain to surrounding landscape for reduction and treatment of run-off.
- 3- Underground storage in the form of geocellular units or similar approved systems to store runoff from a 1 in 30-year event, complimenting a detention basin to store the remainder of the 1 in 100-year event. Where flat site levels constrained drainage depth and to minimise imported fill volumes the 1:100 year event was stored underground. The storage systems will be designed to maximise water quality. Please note sections of surface water attenuation, SUDs and attenuation is constructed as part of Phase 1 under the approved LRD (ABP Ref ABP-315288-22 & FCC Ref LRD0008/S3). Some of these features are linked to Phase 3.
- 4- Detention/ Infiltration Basins with side slopes of 1:4 to provide temporary surface water attenuation in storm events and promote infiltration and ground water recharge.
- 5- Tree pits connected to gullies to be provided providing storage, treatment and infiltration at source
- 6- Green roofs - provide interception and reduction of flow rates at the beginning of the treatment train, providing source control for a large area of the development.
- 7- Rain gardens – provide attenuation, treatment and interception for nearby paved surfaces at source.
- 8- Infiltration blankets - provide attenuation, treatment and interception for nearby paved surfaces at source.
- 9- Bio-Swales with filter drain - providing additional storage at source, additional treatment of run off and also potential for notional infiltration.

Surface water run-off from each surface water catchment (Figure 6) will be throttled using a vortex flow control device (Hydrobrake or equivalent) on the surface water outlet from each catchment. A petrol interceptor is to be provided before the outfall from each catchment of the Subject Site.

The incorporation of the above SuDS elements will provide a sustainable manner in which to disperse surface water from the site, encourage groundwater recharge and provide treatment of run-off and subsequent improvement of discharge quality.

A further breakdown of some of the various sustainable drainage systems is provided below:

- Permeable Paving

It is proposed to provide permeable paving on driveways within the proposed development. Upon contact with the paved upper layer, surface water runoff infiltrates to an underlying stone reservoir. This process of interception and filtration is capable of removing pollutants before the surface water drains directly downwards into the groundwater or discharges to a nearby surface water network. The most significant benefit of permeable paving is its capacity to control both the quantity and quality of surface water runoff. It should be noted that manufacturers suggest a dissipation rate through paving joints of 2000 l/s/Ha can be achieved.

All roofs within Phase 3 of the development will drain to permeable paving.

- Green Roofs

Green roofs will be an extensive type of green roof with 80mm minimum construction depth. Impermeable roof areas will be sloped towards green roofs where possible to infiltrate water runoff through the green roof build up.

Green roofs will be utilised on top of all the apartment blocks within the development; Fingal County Council require a minimum of 60% of apartment roofs to drain via green roofs. It is proposed that 100% of the roof area will drain to the green areas of the roofs. This totals an area of 3117m² of the apartment roofs that will drain to the green roofs.

- Rain Gardens

Rain Gardens will provide source control for the areas where rain gardens are utilised, as surface water run-off will flow into the rain garden and fill a shallow varying depth of roughly 100mm before overflowing into gullies constructed at a level 100mm below local paved surfaces from where any overflow will be transferred into the overall surface water network (see Figure 7 below). Plants which are suitable for both dry and damp periods will be selected to create a self-sustaining, low maintenance growing space.

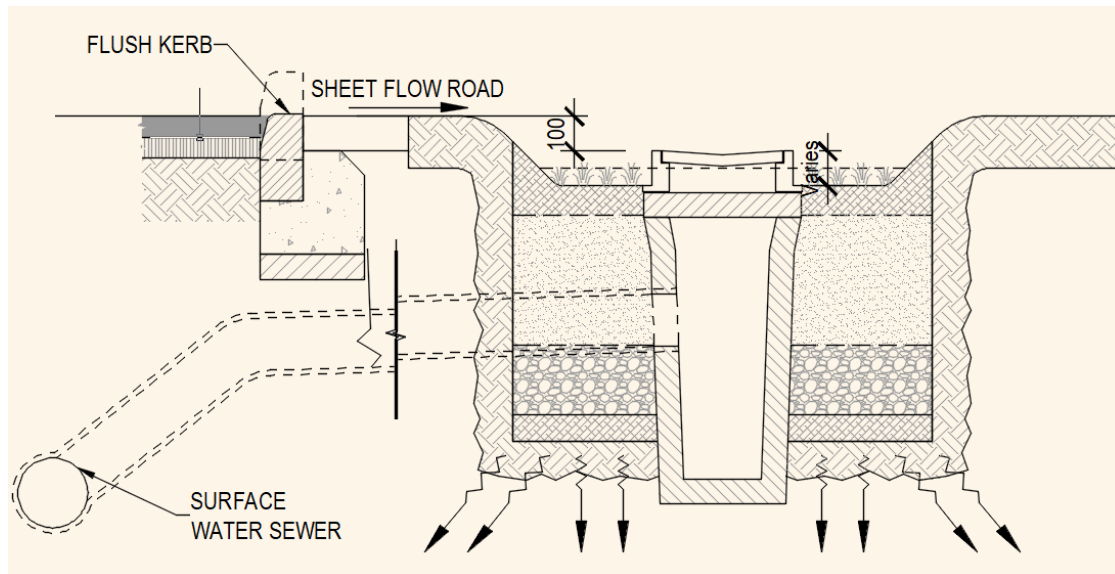


Figure 7: Rain Garden detail

- Swales with Filter drains

These shallow swales would generally be dry overland flow routes with side slopes of 1:4. During extreme rainfall events the swale could potentially fill to a depth of 200mm. The water level would quickly recede as the storm abates. Runoff from the adjacent section of street would flow by overedge drainage into the swales facilitating both groundwater recharge and evapotranspiration. Surface water runoff entering the swale will filter down through the top soil and a depth of stone infill to a perforated pipe where it can join the surface water network if not infiltrating into the groundwater system. Swales can provide interception and treatment storage for runoff in addition to providing a portion of the overall attenuation storage.

- Tree Pits

In addition to being an effective storage facility, surface water run-off directed to tree pits have the ability to facilitate both water treatment and groundwater recharge. These systems are also low maintenance.

In the entirety of Phase 3 of Ballymastone there is a total of 4.65 Ha of hardstanding area (roads, footpaths, parking, buildings etc.) which includes both proposed and existing areas within the proposed works. Of this a total of 1.01 Ha (see Table 1 below for breakdown) will drain to the various SUDs features. That's a total of 22% of the new hardstanding area within this phase that will drain to SUDs features as listed in Section 3.3.

	Runoff Coefficients	Catchment 4D		Catchment 5C		Catchment 5B		Catchment 5A		Total (m2)	
		Gross Areas (m2)	Contributing Area(m2)	Gross Areas (m2)	Contributing Area (m2)	Gross Areas (m2)	Contributing Area (m2)	Gross Areas (m2)	Contributing Area (m2)	Gross Area (m2)	Contributing Areas (m2)
Roofs Draining to SuDS	0.75	6,357	4,768	3,624	2,718	616	462	5,833	4,374	16,430	12,323
Roads and footpaths draining to SuDS	0.75	990	743	457	343	841	631	724	543	3,011	2,258
Roads and footpaths Draining to Gullies	0.95	5,181	4,922	3,638	3,456	188	179	7,569	7,191	16,576	15,747
Green Roofs	0.75	1,178	884	-	-	1,939	1,454	-	-	3,117	2,338
Permeable paving	0.5	1,687	844	2,893	1,447	578	289	2,246	1,123	7,405	3,702
		15393.250	12159.313	10612.350	7963.463	4162.400	3014.890	16371.100	13230.625	46539.100	36368.290
		1.54	1.216	1.06	0.796	0.42	0.301	1.64	1.323	4.65	3.64

Table 1: Breakdown of Areas draining to each SUDs feature

3.4 Greenfield Run-off Rates

The greenfield run-off rate has been taken as 2l/s/Ha as recommended by the GDSDS. As a conservative approach an infiltration rate of 0 has been applied to all attenuation calculations.

The resultant design attenuation volumes, discharge limits, types of storage and storage volumes for each catchment are summarised in Table 2 (See Appendix B for surface water attenuation detailed calculations).

Catchment	Catchment Area (m ²)	Storage System Type	Calculated Allowable Outflow (l/s)	Storage Volume Required (m ³) (100 years)	Constructed as part of Phase 2/3
4D	32500	Geocellular Tank and Above Ground Basin	29.7 (discharging to existing storm network)	720	Underground Tank constructed, basin to be constructed as part of phase 3
5A	35519	Geocellular Tank, Stormtech Units and Above Ground Basin	16.2	660	Geocellular Tank To be built as part of phase 2, Stormtech Units and Basin to be built as part of phase 3

5B	18830	StormTech Units	3.8 (discharging to catchment 5A)	330	To be built as part of phase 2
5C	26723	StormTech and Above Ground Basin	2.9 (discharging to catchment 5A)	470	To be constructed as part of phase 3
Total	113572	-		2180	

Table 2: Surface Water Attenuation Storage and Discharge Limits

Each of the catchments attenuation has been designed to accommodate volumes associated with areas included in the previous phases, of the Ballymastone masterplan area. Catchment 4D has been sized to accommodate volumes associated with previous phases. Catchment 5B has been sized to accommodate volumes associated with the previous Phase 2

Attenuation volumes have been designed using Micro Drainage Windes analysis software taking account of design invert levels, ground levels and depth and type of system. In total approximately 2180m³ of storm-water storage is provided within the attenuation facilities for the subject site.

Surface water storage volumes to accommodate a 100-year storm include for climate change, refer to Appendix B for Windes attenuation calculations.

3.5 Surface Water Attenuation Storage

Surface water runoff from the proposed Phase 3 development and the wider Ballymastone masterplan area will be attenuated to greenfield runoff (Qbar). For the Ballymastone masterplan area, this is calculated as 55.04 l/s using the *Institute of Hydrology* equation, as recommended in the Greater Dublin Strategic Drainage Study (GDSDS) based on an area of 11.28 Ha. This area is within the catchment of the new drainage networks and excludes open space areas not within new drainage networks. The overall catchment and a catchment plan strategy is shown on drawing number 20003-DBF-XXXX-XX-DR-C01-133015 and Figure 6.

Catchment 4D will include a geocellular storage below ground (which will be built as part of phase 1 and an above ground basin which will be built a bit further downstream of the geocellular units. Catchment 4D spans across all 3 phases of the development as the attenuation is the last storage before the outfall for catchment 4 to the existing 1350mm culvert. The geocellular storage will

provide for 300m³ which was constructed in phase 1. The remaining 420m³ will be stored in the above ground basin, This will be built as part of Phase 3 . A maximum outflow rate of 29.7/s is achieved by throttling.

Catchment 5 will utilise 3 main attenuation locations. The current project spans across all of the 3 attenuation locations in catchment 5:

- Catchment 5A will include a geocellular storage below ground (which will be built as part of phase 2), StormTech units and an above ground basin which will be constructed on top of of the geocellular units. Catchment 5A is the last storage before the outfall for catchment 5 to an existing drainage ditch. The geocellular storage will provide for 415m³ which will be constructed in phase 2. The Stormtech units will provide for 85m³ while the remaining 160m³ will be stored in the above ground basin, This will be built as part of Phase 3 . A maximum outflow rate of 16.2 l/s is achieved by throttling.
 - This Catchments attenuation has been altered from what was accepted as part of Phase 2's Compliance Item No.20 submission due to the initial designs proximity to the root protection zone of the existing hedgerows. Part of the underground attenuation tank has been relocated to a different location within this catchment and changed from geocellular to StormTech units as requested by FCC Water Services. This is reflected on the drainage drawings 20003-DBF-XXXX-XX-DR-C01-133000 and 20003-DBF-XXXX-XX-DR-C01-133002 where the storage areas are denoted as Tank 5A-1 and Tank 5A-2.
- Catchment 5B will be stored within StormTech units providing a storage volume of 330m³. A maximum outflow rate of 3.8l/s will be achieved by throttling.
- Catchment 5C will include both above and below ground storage. Geocellular storage will be utilised below ground which will provide 370m³ of storage below ground and an above ground storage area will provide the remaining 100m³ of storage required. A maximum outflow of 2.9 l/s will be achieved by throttling.
 - The outflow rate has been reduced below the allowable for this catchment area to reduce the total storage volume required within Catchment 5A, thus reducing the amount of geocellular units used and increasing the use of StormTech units

Refer to Appendix A for surface water allowable outflow details calculations.

3.6 Requirement for Underground Attenuation Storage

It should be noted that Glenveagh and Fingal County Council entered into a Development Agreement for the delivery of a residential scheme on the Overall Ballymastone lands at Donabate, whereby Glenveagh is obliged to seek permission in line with the approved Development Agreement, including number of units and commitment to deliver social, private-discounted and private units in an agreed breakdown.

The Development Agreement dictates the number and type of units proposed for the Ballymastone Lands, as well as the layout and extent of open space provision. The agreed layout is driven by a number of key factors, including appropriate densities to be achieved in accordance with Government policy, particularly in proximity to the rail station, and natural features on site including hedgerows, appropriate urban form responding to key infrastructure such as the Donabate Distributor Road, and mix of unit types and typologies.

In developing an agreed layout, an approach to SuDS and Nature Based Solutions was developed that aligns with the built and natural constraints and challenges on the lands. However, there is a surplus of storage required for the 100 year storm event (plus climate change) that cannot be provided in the SUDS / NBS provided and needs to go underground due to space restraints in relation to the agreed layout.

The areas where we have been restricted to provide SUDS / NBS include existing hedgerows and ditches, topography etc. Taking all of this into account, when considering attenuation volume requirements, SUDS and NBS can't provide the required storage volume required for the 100 Year Storm Event (1.0%AEP) plus 20% climate change and an element of underground storage is required. This is exacerbated by the fact that infiltration rates on site are generally low to negligible.

3.7 Interception Volume

To prevent pollutants or sediments discharging into water courses the GDSDS requires "interception storage" to be incorporated into the development. This interception storage is designed to receive the run-off for rainfall depths of 5mm up to 10mm if possible. The SUDS features including permeable parking bays, tree pits, green roofs and "open bottom" attenuation facilities will provide the necessary interception volume required by the GDSDS.

3.8 Surface Water Drainage Design Standards

Proposed surface water drainage is designed in accordance with the recommendations of Greater Dublin Strategic Drainage Strategy (GDSDS), EN752 and BS8301:1985.

Surface water pipework was sized using the MicroDrainage Windes drainage modelling software. The following parameters apply to the design:

- 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
- Discharge Limit 55.04 l/s @ 100 years for subject site
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity 1.0 m/s
- Standard Average Annual Rainfall 696mm (Met Eireann)
- M5-60 15.1mm (Met Eireann)
- Ratio r (M5-60/M5-2D) 0.271 (Met Eireann)
- 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 freeboard above 100-year flood level. No flooding to adjacent areas.
- Climate Change 20% for rainfall intensities.
- Factor of Safety for infiltration 2.0
- Runoff from Roads and Footpaths 95%
- Runoff from Roofs 95%
- Runoff from apartment block roofs 75%
- Runoff from Paved Areas 95%
- Runoff from permeable parking bays 50%
- Runoff from footpath falling into permeable parking bays 75%

- Runoff from roofs falling into permeable parking bays 75%

Refer to DBFL drawing numbers 20003-DBF-XXXX-XX-DR-C01-530001 and 20003-DBF-XXXX-XX-DR-C01-530003 for typical drainage details.

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 2, 1 in 10, 1 in 30 and 1 in 100-year storm events) using the *Network* module of *MicroDrainage*. This is based on the Modified Rational Method. The surface water drainage network is designed in accordance with IS EN 752, BS8301:1985 and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The minimum pipe diameter for public surface water sewers is 225mm. Collector drains at apartment blocks will be 150mm diameter.

Refer to DBFL drawing numbers 20003-DBF-XXXX-XX-DR-C01-130000 and 20003-DBF-XXXX-XX-DR-C01-130002 for the proposed surface water layout plan.

Surface water sewer modelling results for the main drainage networks is included in Appendix D.

3.9 Climate Change

Surface water calculations for the development made use of rainfall values for Donabate, provided by Met Eireann. Rainfall intensities were increased by a factor of 20% to take account of climate change, as required by the GDSDS for surface water drainage design included surface water storage design.

3.10 Flood Risk

The surface water network, attenuation storage and site levels are designed to accommodate a 100-year return period storm event and includes climate change provision. Floor levels of houses are set above the 100-year flood levels by a minimum of 0.5m for protection. All footpaths are falling away from houses. For storms events, exceeding a 100-year return period, the development has been designed to provide overland flood routes along the various development roads towards green areas, where possible.

Refer to the 'Site Specific flood Risk Assessment' (SSFRA) by DBFL Consulting Engineers, which is included as a separate report.

4 Foul Drainage

4.1 Existing Foul Drainage

The subject site has no existing foul loading as it is mainly greenfield. According to the records, there is an existing 300mm foul sewer running through the constructed DDR.

During the construction of Phase 2 of the development the proposed foul infrastructure leading towards and from the Foul Pump Station in the North East of the site will be put in place. The majority of phase 3 will be served by this infrastructure.

The existing foul sewers are shown on drawings 20003-DBF-XXXX-XX-DR-C01-133000 to 20003-DBF-XXXX-XX-DR-C01-133002.

4.2 Consultation with Irish Water

An Irish Water Confirmation of Feasibility (COF) and Statement of Design Acceptance (SODA) has been received a Wastewater connection can be facilitated and that the design is in accordance with Irish Water Standards for the wider Ballymastone masterplan area which includes the proposed Phase 3 development. A copy of the Feedback Form is provided in Appendix F.

A Connection offer has also been received as part of the construction of Phase 2 which states the acceptance from Irish Water of the pump station design and location.

4.3 Design Strategy

The proposed foul drainage system will have 2 different connection points to existing networks. These are all indicated on the Wastewater Catchments drawing 20003-DBF-XXXX-XX-DR-C01-133016.

There is a new Irish Water Foul pumping station recently constructed to the south of the development which will serve the southern side of the proposed Phase 3 development. The pump station is fed by a gravity foul sewer falling North to South along the DDR. A rising main takes flow from the pump station to the northern end of the DDR where it is discharged to another gravity sewer. Due to site levels and the invert levels of the gravity sewer in the DDR, the existing gravity sewer in the DDR is only suitable to serve a small portion of the Phase 3 development located in the South West of this phase.

The vast majority of the Phase 3 development will discharge to the new Foul Pump Station which is to be located in the North East of the masterplan site and has been permitted as part of Phase 2 of the overall development (FCC Reg. Ref. LRD0039/S3). Due to the level of the existing gravity

foul lines within the DDR it was not feasible to connect a lot of the site to these via gravity sewers without unrealistic amounts of build-up of the existing ground levels. The North East corner of the site was chosen as the most feasible location for the pump station as the ground levels are lowest here so the depth of the pump station could be minimised. The pumping station is set back from all existing and proposed property boundaries by at least 35m. This separation distance allows the mitigation of any potential noise or vibration that may arise from the station, and is in line with the 15 metres minimum distance from the property boundary required by Irish Water. This pump station will serve the majority of both phases 2 & 3 of the development. The rising main from the pump station will discharge to the existing gravity sewer flowing North within the DDR.

This current proposal has received Confirmation of Feasibility and Statement of Design Acceptance, both are attached in Appendix F. All foul networks are shown on drawings 20003-DBF-XXXX-XX-DR-C01-133000 to 20003-DBF-XXXX-XX-DR-C01-133002.

4.4 Design Calculations

Foul sewers have been designed in accordance with the Building Regulations and specifically in accordance with the principles and methods set out in the Irish Water Code of Practice, IS EN752 (2008), IS EN12056: Part 2 (2000) and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The following criteria have been applied:

Demand 446l/dwelling/day (based on 2.7 persons per house, a per capita wastewater flow of 150 litres per head per day and a 10% allowance for infiltration)

60l per person per day for all non-residential facilities

Discharge units 14 units per unit (BS8301:1985)

Pipe Friction (Ks) 1.5 mm

Minimum Velocity 0.75 m/s (self-cleansing velocity)

Maximum Velocity 2.5 m/s

Frequency Factor 0.5 for domestic use

Manhole Depths < 5.0m

Foul sewer design calculations from Windes are provided in Appendix D.

All foul sewers and manholes will be constructed in accordance with the Irish Water Standard Details and the Irish Water Code of Practice for Wastewater.

Longitudinal sections will be provided with the Stage planning submission.

4.5 Compliance with Irish Water Standards

The proposed foul sewer design and layout is in accordance with the Irish Water Code of Practice for Wastewater Infrastructure and The Irish Water Wastewater Infrastructure Standard Details. A Statement of Design Acceptance (SODA) has also been provided by Irish Water which outlines that there is no objections to the foul sewer design. A copy of the SODA is included in Appendix F.

4.6 Foul Environmental Impacts

As noted, the vast majority of the Phase 3 development will outfall into the new foul pumping station to the north of the development, where it will be pumped to the south of the site into an existing foul manhole on the R126 Donabate Distributor Road while the small remainder of the site will utilise the existing gravity sewer within the DDR. This pumping station will pump the wastewater north along the DDR and it will continue north to the Portrane wastewater treatment plant.

RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Unit Type	No.	Loading	Occupancy	Occupancy	Daily Loading	Daily Loading
		l/person/day	person/unit		l/day	l/s
Apartments	124	150	2.7	335	50250	0.58
Houses	227	150	2.7	613	91950	1.06
Duplexes	47	150	2.7	127	19050	0.22
Residential Daily Loading						1.86
Growth Factor						1
Infiltration @ 10% (as CoP App C 1.2.4)						0.19
Dry Weather Flow l/s						2.046
Residential Peak Factor (as CoP App C 1.2.5)						3.0
Design Foul Flow l/s						6.138
*Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix C & D						

Table 3: Development Foul Flow Calculations

5 Water Supply and Distribution

5.1 Existing Water Supply

There is an existing 225mm diameter watermain constructed throughout Phase 1 of the site which is supplied by a 400mm diameter watermain within the DDR and a 225mm in the Links. This will be utilised to serve the Phase 3 development.

5.2 Development Water Main Layout

The development's proposed water-main distribution system is indicated on drawings 20003-DBF-XXXX-XX-DR-C01-133100 to 20003-DBF-XXXX-XX-DR-C01-133102.

All of Phase 3 of the development will be served from the main 225mm watermain that has been constructed as part of Phase 1 of the works. From this a series of 160mm and 110mm pipes will be provided along the local streets to supply the development with water. The connection to the public water main will include sluice valves in accordance with the Irish Water's requirements.

Each of the apartment blocks will have their own connections to the distribution main via service connections and the type of meters to suit Irish Water specifications.

5.3 Compliance with Irish Water Standards

The proposed watermain design and layout is in accordance with the Irish Water Code of Practice for Water Infrastructure and The Irish Water, Water Infrastructure Standard Details. A Confirmation of Feasibility has also been provided by Irish Water which outlines that there is no objections to the watermain design. A copy of the SODA is included in Appendix F.

5.4 Water Demand & Conservation

The average water demand is estimated to be 2.325/s. The peak demand for sizing of the pipe network (5 times the average day, peak week demand) is calculated as 11.625/s. See calculations below in Table 5.1.

An Irish Water Feedback form has been received outlining that a Water connection can be facilitated for the proposed development. A copy of the Irish Water COF Feedback Form is provided in Appendix F.

RESIDENTIAL - WATER DEMAND						
Unit Type	No. Dwellings	Occupancy Rate person/unit	Occupancy	Per Capita Consumption l/Person/day	Average Daily Demand l/day	Average Daily Demand l/s
Apartments	124	150	2.7	335	50250	0.58
Houses	227	150	2.7	613	91950	1.06
Duplexes	47	150	2.7	127	19050	0.22
Total Average Daily Loading l/s						1.86
Average Day/Week Domestic Demand						1.25
Average Day/Peak Week Demand l/s						2.325
Peak Demand Factor						5.0
Peak Hour Water Demand l/s						11.625
*Flow rates calculated using IW CoP for Water Infrastructure						

Table 4: Development Water Demand

Appendix A : SURFACE WATER ALLOWABLE OUTFLOW

Catchment	Catchment Area (ha)	Storage System	Storage System Type	Calculated Allowable Outflow Contribution (l/s)	Outfall	Total Site Discharge (l/sec)	Storage Volume Required (m³)
4D	3.25	4D	Geocellular Tank and Above Ground Basin	6.56	1350mm Culvert	29.7	720
5A	3.55	5A	Geocellular Tank and Above Ground Basin	7.1	Existing Ditch	16.2	660
5B	1.88	5B	Stormtech Units	3.76	Existing Ditch	-	330
5C	2.67	5C	Geocellular Tank and Above Ground Basin	5.34	Existing Ditch	-	470
Total	11.35						2180

Appendix B : SURFACE WATER ATTENUATION CALCULATIONS

DBFL Consulting Engineers

Page 1

Ormond House
Upper Ormond Quay
Dublin 7

240058
Ballymastone
Phase 3

Date 29/05/2025
File 4D.CASX

Designed by RKE
Checked by BCU

Innovyze

Source Control 2020.1.3

Micro Drainage

Cascade Summary of Results for Catchment 4D.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	4.217	0.377	0.0	29.7	29.7	285.4	O K
8640 min Summer	4.166	0.326	0.0	29.7	29.7	238.1	O K
10080 min Summer	4.118	0.278	0.0	29.7	29.7	191.8	O K
15 min Winter	4.138	0.298	0.0	29.7	29.7	211.7	O K
30 min Winter	4.225	0.385	0.0	29.7	29.7	292.7	O K
60 min Winter	4.318	0.478	0.0	29.7	29.7	375.1	O K
120 min Winter	4.410	0.570	0.0	29.7	29.7	453.4	O K
180 min Winter	4.460	0.620	0.0	29.7	29.7	494.1	O K
240 min Winter	4.499	0.659	0.0	29.7	29.7	524.6	O K
360 min Winter	4.574	0.734	0.0	29.7	29.7	582.0	O K
480 min Winter	4.626	0.786	0.0	29.7	29.7	620.7	O K
600 min Winter	4.662	0.822	0.0	29.7	29.7	645.4	O K
720 min Winter	4.694	0.854	0.0	29.7	29.7	662.0	O K
960 min Winter	4.747	0.907	0.0	29.7	29.7	680.6	O K
1440 min Winter	4.755	0.915	0.0	29.7	29.7	682.6	O K
2160 min Winter	4.677	0.837	0.0	29.7	29.7	653.6	O K
2880 min Winter	4.589	0.749	0.0	29.7	29.7	593.3	O K
4320 min Winter	4.317	0.477	0.0	29.7	29.7	374.2	O K
5760 min Winter	4.251	0.411	0.0	29.7	29.7	316.1	O K
7200 min Winter	4.177	0.337	0.0	29.7	29.7	247.8	O K
8640 min Winter	4.099	0.259	0.0	29.7	29.7	173.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.296	0.0	7726.7	4248
8640 min Summer	1.137	0.0	8134.7	5016
10080 min Summer	1.018	0.0	8488.1	5752
15 min Winter	78.068	0.0	1050.5	22
30 min Winter	54.418	0.0	1466.9	36
60 min Winter	35.804	0.0	1975.9	64
120 min Winter	22.744	0.0	2510.8	122
180 min Winter	17.297	0.0	2861.7	180
240 min Winter	14.206	0.0	3130.6	240
360 min Winter	10.733	0.0	3540.6	360
480 min Winter	8.785	0.0	3852.0	476
600 min Winter	7.516	0.0	4099.1	594
720 min Winter	6.614	0.0	4295.6	708
960 min Winter	5.403	0.0	4551.2	936
1440 min Winter	4.061	0.0	4466.8	1382
2160 min Winter	3.052	0.0	6100.8	2028
2880 min Winter	2.490	0.0	6631.8	2620
4320 min Winter	1.867	0.0	7388.5	2684
5760 min Winter	1.520	0.0	8124.2	3584
7200 min Winter	1.296	0.0	8654.7	4472
8640 min Winter	1.137	0.0	9112.5	5280

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DBFL Consulting Engineers							Page 1																																																																																																																																																																																																																																																			
Ormond House Upper Ormond Quay Dublin 7			240058 Ballymastone PH3 Catchment 5A Attenuation Storage																																																																																																																																																																																																																																																							
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<u>Cascade Summary of Results for Catchment 5A.SRCX</u> <table><tr><th>Upstream Structures</th><th>Outflow To</th><th>Overflow To</th></tr><tr><td>Catchment 5B.SRCX</td><td>(None)</td><td>(None)</td></tr><tr><td>Catchment 5C.SRCX</td><td></td><td></td></tr></table> Half Drain Time : 255 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Σ Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>3.707</td><td>0.357</td><td>0.0</td><td>15.7</td><td>15.7</td><td>163.0</td><td>O K</td></tr><tr><td>30 min Summer</td><td>3.837</td><td>0.487</td><td>0.0</td><td>16.1</td><td>16.1</td><td>221.9</td><td>O K</td></tr><tr><td>60 min Summer</td><td>3.972</td><td>0.622</td><td>0.0</td><td>16.2</td><td>16.2</td><td>283.7</td><td>O K</td></tr><tr><td>120 min Summer</td><td>4.103</td><td>0.753</td><td>0.0</td><td>16.2</td><td>16.2</td><td>343.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>4.168</td><td>0.818</td><td>0.0</td><td>16.2</td><td>16.2</td><td>373.2</td><td>O K</td></tr><tr><td>240 min Summer</td><td>4.206</td><td>0.856</td><td>0.0</td><td>16.2</td><td>16.2</td><td>390.3</td><td>O K</td></tr><tr><td>360 min Summer</td><td>4.246</td><td>0.896</td><td>0.0</td><td>16.2</td><td>16.2</td><td>408.5</td><td>O K</td></tr><tr><td>480 min Summer</td><td>4.264</td><td>0.914</td><td>0.0</td><td>16.2</td><td>16.2</td><td>417.0</td><td>O K</td></tr><tr><td>600 min Summer</td><td>4.271</td><td>0.921</td><td>0.0</td><td>16.2</td><td>16.2</td><td>419.9</td><td>O K</td></tr><tr><td>720 min Summer</td><td>4.270</td><td>0.920</td><td>0.0</td><td>16.2</td><td>16.2</td><td>419.4</td><td>O K</td></tr><tr><td>960 min Summer</td><td>4.254</td><td>0.904</td><td>0.0</td><td>16.2</td><td>16.2</td><td>412.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>4.202</td><td>0.852</td><td>0.0</td><td>16.2</td><td>16.2</td><td>388.5</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>4.111</td><td>0.761</td><td>0.0</td><td>16.2</td><td>16.2</td><td>347.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>4.022</td><td>0.672</td><td>0.0</td><td>16.2</td><td>16.2</td><td>306.2</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>3.867</td><td>0.517</td><td>0.0</td><td>16.2</td><td>16.2</td><td>235.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>3.756</td><td>0.406</td><td>0.0</td><td>16.0</td><td>16.0</td><td>185.1</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>3.680</td><td>0.330</td><td>0.0</td><td>15.5</td><td>15.5</td><td>150.4</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>60.392</td><td>0.0</td><td>319.0</td><td>22</td></tr><tr><td>30 min Summer</td><td>41.744</td><td>0.0</td><td>440.7</td><td>37</td></tr><tr><td>60 min Summer</td><td>27.495</td><td>0.0</td><td>587.7</td><td>66</td></tr><tr><td>120 min Summer</td><td>17.594</td><td>0.0</td><td>752.2</td><td>126</td></tr><tr><td>180 min Summer</td><td>13.455</td><td>0.0</td><td>862.3</td><td>184</td></tr><tr><td>240 min Summer</td><td>11.099</td><td>0.0</td><td>947.7</td><td>244</td></tr><tr><td>360 min Summer</td><td>8.442</td><td>0.0</td><td>1078.4</td><td>310</td></tr><tr><td>480 min Summer</td><td>6.945</td><td>0.0</td><td>1174.6</td><td>378</td></tr><tr><td>600 min Summer</td><td>5.966</td><td>0.0</td><td>1240.3</td><td>444</td></tr><tr><td>720 min Summer</td><td>5.267</td><td>0.0</td><td>1294.2</td><td>512</td></tr><tr><td>960 min Summer</td><td>4.326</td><td>0.0</td><td>1384.8</td><td>650</td></tr><tr><td>1440 min Summer</td><td>3.277</td><td>0.0</td><td>1526.2</td><td>926</td></tr><tr><td>2160 min Summer</td><td>2.482</td><td>0.0</td><td>1914.8</td><td>1324</td></tr><tr><td>2880 min Summer</td><td>2.036</td><td>0.0</td><td>2092.6</td><td>1704</td></tr><tr><td>4320 min Summer</td><td>1.539</td><td>0.0</td><td>2298.0</td><td>2428</td></tr><tr><td>5760 min Summer</td><td>1.262</td><td>0.0</td><td>2599.7</td><td>3120</td></tr><tr><td>7200 min Summer</td><td>1.081</td><td>0.0</td><td>2783.9</td><td>3824</td></tr></table>								Upstream Structures	Outflow To	Overflow To	Catchment 5B.SRCX	(None)	(None)	Catchment 5C.SRCX			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	3.707	0.357	0.0	15.7	15.7	163.0	O K	30 min Summer	3.837	0.487	0.0	16.1	16.1	221.9	O K	60 min Summer	3.972	0.622	0.0	16.2	16.2	283.7	O K	120 min Summer	4.103	0.753	0.0	16.2	16.2	343.4	O K	180 min Summer	4.168	0.818	0.0	16.2	16.2	373.2	O K	240 min Summer	4.206	0.856	0.0	16.2	16.2	390.3	O K	360 min Summer	4.246	0.896	0.0	16.2	16.2	408.5	O K	480 min Summer	4.264	0.914	0.0	16.2	16.2	417.0	O K	600 min Summer	4.271	0.921	0.0	16.2	16.2	419.9	O K	720 min Summer	4.270	0.920	0.0	16.2	16.2	419.4	O K	960 min Summer	4.254	0.904	0.0	16.2	16.2	412.3	O K	1440 min Summer	4.202	0.852	0.0	16.2	16.2	388.5	O K	2160 min Summer	4.111	0.761	0.0	16.2	16.2	347.0	O K	2880 min Summer	4.022	0.672	0.0	16.2	16.2	306.2	O K	4320 min Summer	3.867	0.517	0.0	16.2	16.2	235.9	O K	5760 min Summer	3.756	0.406	0.0	16.0	16.0	185.1	O K	7200 min Summer	3.680	0.330	0.0	15.5	15.5	150.4	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	60.392	0.0	319.0	22	30 min Summer	41.744	0.0	440.7	37	60 min Summer	27.495	0.0	587.7	66	120 min Summer	17.594	0.0	752.2	126	180 min Summer	13.455	0.0	862.3	184	240 min Summer	11.099	0.0	947.7	244	360 min Summer	8.442	0.0	1078.4	310	480 min Summer	6.945	0.0	1174.6	378	600 min Summer	5.966	0.0	1240.3	444	720 min Summer	5.267	0.0	1294.2	512	960 min Summer	4.326	0.0	1384.8	650	1440 min Summer	3.277	0.0	1526.2	926	2160 min Summer	2.482	0.0	1914.8	1324	2880 min Summer	2.036	0.0	2092.6	1704	4320 min Summer	1.539	0.0	2298.0	2428	5760 min Summer	1.262	0.0	2599.7	3120	7200 min Summer	1.081	0.0	2783.9	3824
Upstream Structures	Outflow To	Overflow To																																																																																																																																																																																																																																																								
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600 min Summer	4.271	0.921	0.0	16.2	16.2	419.9	O K																																																																																																																																																																																																																																																			
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2160 min Summer	4.111	0.761	0.0	16.2	16.2	347.0	O K																																																																																																																																																																																																																																																			
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960 min Summer	4.326	0.0	1384.8	650																																																																																																																																																																																																																																																						
1440 min Summer	3.277	0.0	1526.2	926																																																																																																																																																																																																																																																						
2160 min Summer	2.482	0.0	1914.8	1324																																																																																																																																																																																																																																																						
2880 min Summer	2.036	0.0	2092.6	1704																																																																																																																																																																																																																																																						
4320 min Summer	1.539	0.0	2298.0	2428																																																																																																																																																																																																																																																						
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DBFL Consulting Engineers							Page 2
Ormond House Upper Ormond Quay Dublin 7			240058 Ballymastone PH3 Catchment 5A Attenuation Storage				
Date 28/08/2025			Designed by BCU				
File			Checked by BCM				
Innovyze			Source Control 2020.1.3				
<u>Cascade Summary of Results for Catchment 5A.SRCX</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	3.626	0.276	0.0	15.0	15.0	125.7	O K
10080 min Summer	3.587	0.237	0.0	14.5	14.5	108.0	O K
15 min Winter	3.751	0.401	0.0	15.9	15.9	182.8	O K
30 min Winter	3.896	0.546	0.0	16.2	16.2	248.9	O K
60 min Winter	4.049	0.699	0.0	16.2	16.2	318.9	O K
120 min Winter	4.201	0.851	0.0	16.2	16.2	388.1	O K
180 min Winter	4.284	0.934	0.0	16.2	16.2	426.1	O K
240 min Winter	4.338	0.988	0.0	16.2	16.2	450.3	O K
360 min Winter	4.397	1.047	0.0	16.2	16.2	477.3	O K
480 min Winter	4.420	1.070	0.0	16.2	16.2	487.8	O K
600 min Winter	4.421	1.071	0.0	16.2	16.2	488.3	O K
720 min Winter	4.414	1.064	0.0	16.2	16.2	485.2	O K
960 min Winter	4.384	1.034	0.0	16.2	16.2	471.5	O K
1440 min Winter	4.284	0.934	0.0	16.2	16.2	425.7	O K
2160 min Winter	4.117	0.767	0.0	16.2	16.2	349.9	O K
2880 min Winter	3.971	0.621	0.0	16.2	16.2	283.2	O K
4320 min Winter	3.756	0.406	0.0	16.0	16.0	185.2	O K
5760 min Winter	3.635	0.285	0.0	15.1	15.1	129.8	O K
7200 min Winter	3.568	0.218	0.0	14.2	14.2	99.6	O K
8640 min Winter	3.534	0.184	0.0	13.4	13.4	84.1	O K
10080 min Winter	3.520	0.170	0.0	12.4	12.4	77.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
8640 min Summer	0.952	0.0	2943.5	4504			
10080 min Summer	0.856	0.0	3084.6	5240			
15 min Winter	60.392	0.0	357.3	22			
30 min Winter	41.744	0.0	492.7	37			
60 min Winter	27.495	0.0	658.3	66			
120 min Winter	17.594	0.0	842.0	124			
180 min Winter	13.455	0.0	964.8	180			
240 min Winter	11.099	0.0	1059.2	238			
360 min Winter	8.442	0.0	1195.2	350			
480 min Winter	6.945	0.0	1280.9	458			
600 min Winter	5.966	0.0	1351.3	556			
720 min Winter	5.267	0.0	1412.8	578			
960 min Winter	4.326	0.0	1517.4	726			
1440 min Winter	3.277	0.0	1684.2	1016			
2160 min Winter	2.482	0.0	2143.4	1428			
2880 min Winter	2.036	0.0	2337.1	1792			
4320 min Winter	1.539	0.0	2531.5	2508			
5760 min Winter	1.262	0.0	2911.7	3120			
7200 min Winter	1.081	0.0	3117.9	3816			
8640 min Winter	0.952	0.0	3296.5	4416			
10080 min Winter	0.856	0.0	3454.9	5144			
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DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	240058 Ballymastone PH3 Catchment 5A Attenuation Storage	
Date 28/08/2025 File	Designed by BCU Checked by BCM	
Innovyze	Source Control 2020.1.3	

Cascade Rainfall Details for Catchment 5A.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.100	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.482

Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)
0	4	0.000	4	8	1.482

Time Area Diagram

Total Area (ha) 0.000

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

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7	240058 - Ballymastone Phase 3	
Date 28/08/2025 File	Designed by JOC Checked by BCU	
Innovyze	Source Control 2020.1.3	

Cascade Rainfall Details for Catchment 5B.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.100	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.601

Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)	
0 4	0.000	4 8	0.601

Time Area Diagram

Total Area (ha) 0.000

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

Time Area Diagram

Total Area (ha) 0.000

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

DBFL Consulting Engineers

Ormond House
Upper Ormond Quay
Dublin 7

Date 28/08/2025 09:39
File Cascade 100 year.CASX

Innovyze

240058 - Ballymastone Phase 3
Catchment 5A
Attenuation Storage

Designed by BCU
Checked by BCM

Source Control 2020.1.3

Page 1



Cascade Summary of Results for Catchment 5A.SRCX

Upstream Structures

Outflow To

Overflow To

Catchment 5B.SRCX

(None)

(None)

Catchment 5C.SRCX

Half Drain Time : 344 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	3.813	0.463	0.0	16.1	16.1	211.3	O K
30 min Summer	3.988	0.638	0.0	16.2	16.2	291.0	O K
60 min Summer	4.169	0.819	0.0	16.2	16.2	373.4	O K
120 min Summer	4.349	0.999	0.0	16.2	16.2	455.6	O K
180 min Summer	4.852	1.502	0.0	16.2	16.2	503.1	O K
240 min Summer	4.907	1.557	0.0	16.2	16.2	529.3	Flood Risk
360 min Summer	4.959	1.609	0.0	16.2	16.2	555.9	Flood Risk
480 min Summer	4.977	1.627	0.0	16.2	16.2	565.3	Flood Risk
600 min Summer	4.985	1.635	0.0	16.2	16.2	569.4	Flood Risk
720 min Summer	4.986	1.636	0.0	16.2	16.2	569.8	Flood Risk
960 min Summer	4.976	1.626	0.0	16.2	16.2	564.9	Flood Risk
1440 min Summer	4.940	1.590	0.0	16.2	16.2	545.7	Flood Risk
2160 min Summer	4.863	1.513	0.0	16.2	16.2	507.9	O K
2880 min Summer	4.344	0.994	0.0	16.2	16.2	453.1	O K
4320 min Summer	4.115	0.765	0.0	16.2	16.2	348.9	O K
5760 min Summer	3.947	0.597	0.0	16.2	16.2	272.4	O K
7200 min Summer	3.823	0.473	0.0	16.1	16.1	215.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.068	0.0	412.3	22
30 min Summer	54.418	0.0	569.6	37
60 min Summer	35.804	0.0	765.2	66
120 min Summer	22.744	0.0	970.7	126
180 min Summer	17.297	0.0	1103.8	186
240 min Summer	14.206	0.0	1198.0	246
360 min Summer	10.733	0.0	1317.6	364
480 min Summer	8.785	0.0	1410.2	442
600 min Summer	7.516	0.0	1487.6	502
720 min Summer	6.614	0.0	1557.6	566
960 min Summer	5.403	0.0	1676.1	698
1440 min Summer	4.061	0.0	1860.5	986
2160 min Summer	3.052	0.0	2352.5	1408
2880 min Summer	2.490	0.0	2535.1	1820
4320 min Summer	1.867	0.0	2719.2	2516
5760 min Summer	1.520	0.0	3132.2	3232
7200 min Summer	1.296	0.0	3337.0	3896

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Ormond House Upper Ormond Quay Dublin 7			240058 - Ballymastone Phase 3 Catchment 5A Attenuation Storage				
Date 28/08/2025 09:39 File Cascade 100 year.CASX			Designed by BCU Checked by BCM				
Innovyze			Source Control 2020.1.3				
<u>Cascade Summary of Results for Catchment 5A.SRCX</u>							
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
8640 min Summer	3.734	0.384	0.0	15.9	15.9	175.1	O K
10080 min Summer	3.670	0.320	0.0	15.5	15.5	146.1	O K
15 min Winter	3.870	0.520	0.0	16.2	16.2	237.0	O K
30 min Winter	4.066	0.716	0.0	16.2	16.2	326.6	O K
60 min Winter	4.272	0.922	0.0	16.2	16.2	420.4	O K
120 min Winter	4.881	1.531	0.0	16.2	16.2	516.4	O K
180 min Winter	4.982	1.632	0.0	16.2	16.2	568.0	Flood Risk
240 min Winter	5.042	1.692	0.0	16.2	16.2	600.8	Flood Risk
360 min Winter	5.106	1.756	0.0	16.2	16.2	638.3	Flood Risk
480 min Winter	5.134	1.784	0.0	16.2	16.2	655.8	Flood Risk
600 min Winter	5.142	1.792	0.0	16.2	16.2	660.9	Flood Risk
720 min Winter	5.139	1.789	0.0	16.2	16.2	658.9	Flood Risk
960 min Winter	5.126	1.776	0.0	16.2	16.2	651.0	Flood Risk
1440 min Winter	5.074	1.724	0.0	16.2	16.2	619.5	Flood Risk
2160 min Winter	4.959	1.609	0.0	16.2	16.2	555.5	Flood Risk
2880 min Winter	4.397	1.047	0.0	16.2	16.2	477.6	O K
4320 min Winter	4.013	0.663	0.0	16.2	16.2	302.2	O K
5760 min Winter	3.792	0.442	0.0	16.1	16.1	201.4	O K
7200 min Winter	3.665	0.315	0.0	15.4	15.4	143.4	O K
8640 min Winter	3.590	0.240	0.0	14.6	14.6	109.5	O K
10080 min Winter	3.547	0.197	0.0	13.8	13.8	90.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
8640 min Summer	1.137	0.0	3513.1	4584			
10080 min Summer	1.018	0.0	3667.5	5248			
15 min Winter	78.068	0.0	461.3	22			
30 min Winter	54.418	0.0	626.7	37			
60 min Winter	35.804	0.0	856.7	66			
120 min Winter	22.744	0.0	1084.5	124			
180 min Winter	17.297	0.0	1219.5	182			
240 min Winter	14.206	0.0	1306.8	240			
360 min Winter	10.733	0.0	1444.0	354			
480 min Winter	8.785	0.0	1554.5	464			
600 min Winter	7.516	0.0	1646.3	570			
720 min Winter	6.614	0.0	1726.0	666			
960 min Winter	5.403	0.0	1861.7	756			
1440 min Winter	4.061	0.0	2064.5	1072			
2160 min Winter	3.052	0.0	2627.0	1536			
2880 min Winter	2.490	0.0	2797.8	2020			
4320 min Winter	1.867	0.0	3030.8	2684			
5760 min Winter	1.520	0.0	3508.1	3296			
7200 min Winter	1.296	0.0	3737.3	3960			
8640 min Winter	1.137	0.0	3934.1	4584			
10080 min Winter	1.018	0.0	4102.4	5152			
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Ormond House
Upper Ormond Quay
Dublin 7

Date 28/08/2025 09:39
File Cascade 100 year.CASX

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240058 - Ballymastone Phase 3
Catchment 5A
Attenuation Storage

Designed by BCU
Checked by BCM

Source Control 2020.1.3

Page 1



Cascade Summary of Results for Catchment 5A.SRCX

Upstream Structures

Outflow To

Overflow To

Catchment 5B.SRCX

(None)

(None)

Catchment 5C.SRCX

Half Drain Time : 344 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	3.813	0.463	0.0	16.1	16.1	211.3	O K
30 min Summer	3.988	0.638	0.0	16.2	16.2	291.0	O K
60 min Summer	4.169	0.819	0.0	16.2	16.2	373.4	O K
120 min Summer	4.349	0.999	0.0	16.2	16.2	455.6	O K
180 min Summer	4.852	1.502	0.0	16.2	16.2	503.1	O K
240 min Summer	4.907	1.557	0.0	16.2	16.2	529.3	Flood Risk
360 min Summer	4.959	1.609	0.0	16.2	16.2	555.9	Flood Risk
480 min Summer	4.977	1.627	0.0	16.2	16.2	565.3	Flood Risk
600 min Summer	4.985	1.635	0.0	16.2	16.2	569.4	Flood Risk
720 min Summer	4.986	1.636	0.0	16.2	16.2	569.8	Flood Risk
960 min Summer	4.976	1.626	0.0	16.2	16.2	564.9	Flood Risk
1440 min Summer	4.940	1.590	0.0	16.2	16.2	545.7	Flood Risk
2160 min Summer	4.863	1.513	0.0	16.2	16.2	507.9	O K
2880 min Summer	4.344	0.994	0.0	16.2	16.2	453.1	O K
4320 min Summer	4.115	0.765	0.0	16.2	16.2	348.9	O K
5760 min Summer	3.947	0.597	0.0	16.2	16.2	272.4	O K
7200 min Summer	3.823	0.473	0.0	16.1	16.1	215.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.068	0.0	412.3	22
30 min Summer	54.418	0.0	569.6	37
60 min Summer	35.804	0.0	765.2	66
120 min Summer	22.744	0.0	970.7	126
180 min Summer	17.297	0.0	1103.8	186
240 min Summer	14.206	0.0	1198.0	246
360 min Summer	10.733	0.0	1317.6	364
480 min Summer	8.785	0.0	1410.2	442
600 min Summer	7.516	0.0	1487.6	502
720 min Summer	6.614	0.0	1557.6	566
960 min Summer	5.403	0.0	1676.1	698
1440 min Summer	4.061	0.0	1860.5	986
2160 min Summer	3.052	0.0	2352.5	1408
2880 min Summer	2.490	0.0	2535.1	1820
4320 min Summer	1.867	0.0	2719.2	2516
5760 min Summer	1.520	0.0	3132.2	3232
7200 min Summer	1.296	0.0	3337.0	3896

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DBFL Consulting Engineers							Page 2
Ormond House Upper Ormond Quay Dublin 7			240058 - Ballymastone Phase 3 Catchment 5A Attenuation Storage				
Date 28/08/2025 09:39 File Cascade 100 year.CASX			Designed by BCU Checked by BCM				
Innovyze			Source Control 2020.1.3				
<u>Cascade Summary of Results for Catchment 5A.SRCX</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	3.734	0.384	0.0	15.9	15.9	175.1	O K
10080 min Summer	3.670	0.320	0.0	15.5	15.5	146.1	O K
15 min Winter	3.870	0.520	0.0	16.2	16.2	237.0	O K
30 min Winter	4.066	0.716	0.0	16.2	16.2	326.6	O K
60 min Winter	4.272	0.922	0.0	16.2	16.2	420.4	O K
120 min Winter	4.881	1.531	0.0	16.2	16.2	516.4	O K
180 min Winter	4.982	1.632	0.0	16.2	16.2	568.0	Flood Risk
240 min Winter	5.042	1.692	0.0	16.2	16.2	600.8	Flood Risk
360 min Winter	5.106	1.756	0.0	16.2	16.2	638.3	Flood Risk
480 min Winter	5.134	1.784	0.0	16.2	16.2	655.8	Flood Risk
600 min Winter	5.142	1.792	0.0	16.2	16.2	660.9	Flood Risk
720 min Winter	5.139	1.789	0.0	16.2	16.2	658.9	Flood Risk
960 min Winter	5.126	1.776	0.0	16.2	16.2	651.0	Flood Risk
1440 min Winter	5.074	1.724	0.0	16.2	16.2	619.5	Flood Risk
2160 min Winter	4.959	1.609	0.0	16.2	16.2	555.5	Flood Risk
2880 min Winter	4.397	1.047	0.0	16.2	16.2	477.6	O K
4320 min Winter	4.013	0.663	0.0	16.2	16.2	302.2	O K
5760 min Winter	3.792	0.442	0.0	16.1	16.1	201.4	O K
7200 min Winter	3.665	0.315	0.0	15.4	15.4	143.4	O K
8640 min Winter	3.590	0.240	0.0	14.6	14.6	109.5	O K
10080 min Winter	3.547	0.197	0.0	13.8	13.8	90.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
8640 min Summer	1.137	0.0	3513.1	4584			
10080 min Summer	1.018	0.0	3667.5	5248			
15 min Winter	78.068	0.0	461.3	22			
30 min Winter	54.418	0.0	626.7	37			
60 min Winter	35.804	0.0	856.7	66			
120 min Winter	22.744	0.0	1084.5	124			
180 min Winter	17.297	0.0	1219.5	182			
240 min Winter	14.206	0.0	1306.8	240			
360 min Winter	10.733	0.0	1444.0	354			
480 min Winter	8.785	0.0	1554.5	464			
600 min Winter	7.516	0.0	1646.3	570			
720 min Winter	6.614	0.0	1726.0	666			
960 min Winter	5.403	0.0	1861.7	756			
1440 min Winter	4.061	0.0	2064.5	1072			
2160 min Winter	3.052	0.0	2627.0	1536			
2880 min Winter	2.490	0.0	2797.8	2020			
4320 min Winter	1.867	0.0	3030.8	2684			
5760 min Winter	1.520	0.0	3508.1	3296			
7200 min Winter	1.296	0.0	3737.3	3960			
8640 min Winter	1.137	0.0	3934.1	4584			
10080 min Winter	1.018	0.0	4102.4	5152			
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Ormond House Upper Ormond Quay Dublin 7	240058 - Ballymastone Phase 3 Catchment 5A Attenuation Storage	
Date 28/08/2025 09:39 File Cascade 100_year.CASX	Designed by BCU Checked by BCM	
Innovyze	Source Control 2020.1.3	

Cascade Rainfall Details for Catchment 5A.SRCX

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)	15.100	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.482

Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)	
0 4 0.000		4 8 1.482	

Time Area Diagram

Total Area (ha) 0.000

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

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Ormond House Upper Ormond Quay Dublin 7			240058 - Ballymastone Phase 3				
Date 28/08/2025 File Cascade 100 year.CASX			Designed by BCU Checked by DD				
Innovyze			Source Control 2020.1.3				
<u>Cascade Summary of Results for Catchment 5C.SRCX</u>							
Upstream Structures			Outflow To		Overflow To		
(None)			Catchment 5A.SRCX		(None)		
Half Drain Time : 1632 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	5.577	0.416	0.0	2.1	2.1	112.1	O K
30 min Summer	5.673	0.512	0.0	2.1	2.1	155.4	O K
60 min Summer	5.782	0.621	0.0	2.1	2.1	202.5	O K
120 min Summer	5.906	0.745	0.0	2.1	2.1	252.5	O K
180 min Summer	5.991	0.830	0.0	2.1	2.1	282.9	O K
240 min Summer	6.059	0.898	0.0	2.1	2.1	304.6	O K
360 min Summer	6.181	1.020	0.0	2.1	2.1	334.2	O K
480 min Summer	6.277	1.116	0.0	2.2	2.2	353.5	O K
600 min Summer	6.326	1.165	0.0	2.3	2.3	366.8	O K
720 min Summer	6.880	1.719	0.0	2.7	2.7	374.0	O K
960 min Summer	6.905	1.744	0.0	2.7	2.7	381.2	O K
1440 min Summer	6.917	1.756	0.0	2.7	2.7	385.1	O K
2160 min Summer	6.916	1.755	0.0	2.7	2.7	384.5	O K
2880 min Summer	6.905	1.744	0.0	2.7	2.7	381.2	O K
4320 min Summer	6.874	1.713	0.0	2.7	2.7	372.2	O K
5760 min Summer	6.314	1.153	0.0	2.3	2.3	363.2	O K
7200 min Summer	6.253	1.092	0.0	2.2	2.2	348.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
15 min Summer	78.068	0.0	114.2	23			
30 min Summer	54.418	0.0	159.2	38			
60 min Summer	35.804	0.0	209.5	68			
120 min Summer	22.744	0.0	266.1	128			
180 min Summer	17.297	0.0	303.6	188			
240 min Summer	14.206	0.0	332.1	246			
360 min Summer	10.733	0.0	336.9	366			
480 min Summer	8.785	0.0	337.5	486			
600 min Summer	7.516	0.0	338.5	606			
720 min Summer	6.614	0.0	342.5	724			
960 min Summer	5.403	0.0	349.6	964			
1440 min Summer	4.061	0.0	361.9	1216			
2160 min Summer	3.052	0.0	642.7	1604			
2880 min Summer	2.490	0.0	692.1	2020			
4320 min Summer	1.867	0.0	644.0	2856			
5760 min Summer	1.520	0.0	853.7	3752			
7200 min Summer	1.296	0.0	909.6	4616			
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Ormond House
Upper Ormond Quay
Dublin 7

Date 28/08/2025
File Cascade 100 year.CASX

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240058 - Ballymastone Phase 3

Designed by BCU
Checked by DD

Source Control 2020.1.3

Page 2



Cascade Summary of Results for Catchment 5C.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	6.178	1.017	0.0	2.1	2.1	333.5	O K
10080 min Summer	6.107	0.946	0.0	2.1	2.1	317.6	O K
15 min Winter	5.607	0.446	0.0	2.1	2.1	125.8	O K
30 min Winter	5.716	0.555	0.0	2.1	2.1	174.6	O K
60 min Winter	5.843	0.682	0.0	2.1	2.1	227.7	O K
120 min Winter	5.995	0.834	0.0	2.1	2.1	284.5	O K
180 min Winter	6.114	0.953	0.0	2.1	2.1	319.4	O K
240 min Winter	6.231	1.070	0.0	2.2	2.2	344.4	O K
360 min Winter	6.894	1.733	0.0	2.7	2.7	378.2	O K
480 min Winter	6.963	1.802	0.0	2.8	2.8	399.7	O K
600 min Winter	7.010	1.849	0.0	2.8	2.8	415.1	O K
720 min Winter	7.042	1.881	0.0	2.8	2.8	426.4	O K
960 min Winter	7.081	1.920	0.0	2.8	2.8	440.7	O K
1440 min Winter	7.106	1.945	0.0	2.9	2.9	450.1	O K
2160 min Winter	7.102	1.941	0.0	2.9	2.9	448.8	O K
2880 min Winter	7.085	1.924	0.0	2.8	2.8	442.1	O K
4320 min Winter	7.026	1.865	0.0	2.8	2.8	420.9	O K
5760 min Winter	6.958	1.797	0.0	2.8	2.8	397.9	O K
7200 min Winter	6.888	1.727	0.0	2.7	2.7	376.3	O K
8640 min Winter	6.302	1.141	0.0	2.2	2.2	359.8	O K
10080 min Winter	6.186	1.025	0.0	2.1	2.1	335.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.137	0.0	957.8	5448
10080 min Summer	1.018	0.0	1000.4	6256
15 min Winter	78.068	0.0	127.9	23
30 min Winter	54.418	0.0	174.4	37
60 min Winter	35.804	0.0	234.6	68
120 min Winter	22.744	0.0	298.0	126
180 min Winter	17.297	0.0	335.5	184
240 min Winter	14.206	0.0	337.9	244
360 min Winter	10.733	0.0	342.4	360
480 min Winter	8.785	0.0	349.7	476
600 min Winter	7.516	0.0	355.8	592
720 min Winter	6.614	0.0	361.3	704
960 min Winter	5.403	0.0	372.2	928
1440 min Winter	4.061	0.0	389.8	1358
2160 min Winter	3.052	0.0	719.9	1692
2880 min Winter	2.490	0.0	731.8	2164
4320 min Winter	1.867	0.0	702.6	3076
5760 min Winter	1.520	0.0	956.1	3976
7200 min Winter	1.296	0.0	1018.7	4832
8640 min Winter	1.137	0.0	1072.7	5880
10080 min Winter	1.018	0.0	1120.5	6760

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Appendix C : SURFACE WATER NETWORK CALCULATIONS

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	15.200	Add Flow / Climate Change (%)	20
Ratio R	0.270	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 SW_4

« - 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
1.000	37.502	0.221	169.7	0.088	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	68.059	0.400	170.1	0.090	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	38.637	0.221	174.8	0.106	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	38.820	0.491	79.1	0.086	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	68.281	0.279	244.7	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	49.468	0.300	164.9	0.151	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.62	7.430	0.088	0.0	0.0	2.4	1.00	39.8	14.3
1.001	50.00	5.76	7.209	0.177	0.0	0.0	4.8	1.00	39.7	28.8
2.000	50.00	4.65	7.030	0.106	0.0	0.0	2.9	0.99	39.2	17.3
3.000	50.00	4.44	7.300	0.086	0.0	0.0	2.3	1.47	58.5	13.9
1.002	50.00	6.90	6.734	0.393	0.0	0.0	10.6	1.00	70.7	63.8
4.000	50.00	4.81	6.830	0.151	0.0	0.0	4.1	1.02	40.4	24.6

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Ormond House Upper Ormond Quay Dublin 7						20003 Ballymastone Phase 3						
Date 28/08/2025 File 240058 - Network (JOC).MDX						Designed by JOC Checked by BCU						
Innovyze						Network 2020.1.3						
Network Design Table for SW_4												
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	
9.006	38.977	0.128	304.5	0.077	0.00	0.0	0.600	o	375	Pipe/Conduit		
1.015	29.751	0.033	901.5	0.002	0.00	0.0	0.600	o	900	Pipe/Conduit		
12.000	36.532	0.215	169.9	0.143	4.00	0.0	0.600	o	225	Pipe/Conduit		
13.000	26.964	0.172	156.8	0.078	4.00	0.0	0.600	o	225	Pipe/Conduit		
12.001	60.621	0.247	245.4	0.086	0.00	0.0	0.600	o	300	Pipe/Conduit		
14.000	8.400	0.049	171.4	0.026	4.00	0.0	0.600	o	225	Pipe/Conduit		
14.001	59.968	0.353	169.9	0.135	0.00	0.0	0.600	o	225	Pipe/Conduit		
14.002	9.483	0.056	168.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
12.002	71.804	0.221	324.9	0.138	0.00	0.0	0.600	o	375	Pipe/Conduit		
15.000	30.049	0.176	170.7	0.015	4.00	0.0	0.600	o	225	Pipe/Conduit		
15.001	11.286	0.066	171.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
15.002	41.707	0.245	170.2	0.081	0.00	0.0	0.600	o	225	Pipe/Conduit		
15.003	9.822	0.058	170.0	0.034	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)		
9.006	50.00	7.86	5.250	0.689	0.0	0.0	18.7	1.03	114.1	112.0		
1.015	50.00	14.62	4.545	2.871	0.0	0.0	77.8	1.04	658.6	466.5		
12.000	50.00	4.61	7.637	0.143	0.0	0.0	3.9	1.00	39.8	23.2		
13.000	50.00	4.43	7.594	0.078	0.0	0.0	2.1	1.04	41.4	12.7		
12.001	50.00	5.62	7.347	0.307	0.0	0.0	8.3	1.00	70.6	50.0		
14.000	50.00	4.14	7.633	0.026	0.0	0.0	0.7	1.00	39.6	4.1		
14.001	50.00	5.14	7.584	0.160	0.0	0.0	4.3	1.00	39.8	26.0		
14.002	50.00	5.30	7.231	0.160	0.0	0.0	4.3	1.01	40.0	26.0		
12.002	50.00	6.82	7.025	0.606	0.0	0.0	16.4	1.00	110.4	98.4		
15.000	50.00	4.50	7.499	0.015	0.0	0.0	0.4	1.00	39.7	2.5		
15.001	50.00	4.69	7.323	0.015	0.0	0.0	0.4	1.00	39.6	2.5		
15.002	50.00	5.39	7.257	0.096	0.0	0.0	2.6	1.00	39.7	15.7		
15.003	50.00	5.55	7.012	0.130	0.0	0.0	3.5	1.00	39.8	21.2		
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DBFL Consulting Engineers										Page 6		
Ormond House Upper Ormond Quay Dublin 7					20003 Ballymastone Phase 3							
Date 28/08/2025 File 240058 - Network (JOC).MDX					Designed by JOC Checked by BCU							
Innovyze					Network 2020.1.3							
Network Design Table for SW_4												
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
12.012	49.094	0.287	171.1	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit		
20.000	27.431	0.343	80.0	0.122	4.00	0.0	0.600	o	225	Pipe/Conduit		
21.000	35.178	0.352	99.9	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit		
21.001	31.707	0.317	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
20.001	10.527	0.132	80.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
22.000	33.077	0.414	79.9	0.159	4.00	0.0	0.600	o	225	Pipe/Conduit		
23.000	36.396	0.191	190.6	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit		
23.001	31.986	0.223	143.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
22.001	7.871	0.098	80.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
24.000	32.318	0.033	979.3	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit		
20.002	22.056	0.130	170.0	0.062	0.00	0.0	0.600	o	225	Pipe/Conduit		
20.003	17.546	0.100	175.0	0.012	0.00	1.9	0.600	o	225	Pipe/Conduit		
12.013	18.602	0.110	169.1	0.033	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)		
12.012	50.00	5.48	6.131	0.133		6.1	0.0	4.8	1.00	39.6	28.9	
20.000	50.00	4.31	6.810	0.122		0.0	0.0	3.3	1.46	58.2	19.8	
21.000	50.00	4.45	7.136	0.000		0.0	0.0	0.0	1.31	52.0	0.0	
21.001	50.00	4.85	6.784	0.000		0.0	0.0	0.0	1.31	52.0	0.0	
20.001	50.00	4.97	6.467	0.122		0.0	0.0	3.3	1.46	58.2	19.8	
22.000	50.00	4.38	6.716	0.159		0.0	0.0	4.3	1.46	58.2	25.9	
23.000	50.00	4.64	6.716	0.000		0.0	0.0	0.0	0.94	37.5	0.0	
23.001	50.00	5.13	6.525	0.000		0.0	0.0	0.0	1.09	43.3	0.0	
22.001	50.00	5.22	6.302	0.159		0.0	0.0	4.3	1.46	58.1	25.9	
24.000	50.00	5.31	6.107	0.000		0.0	0.0	0.0	0.41	16.3	0.0	
20.002	50.00	5.68	6.074	0.343		0.0	0.0	9.3	1.00	39.8	55.8	
20.003	50.00	4.30	5.944	0.000		1.9	0.0	0.3	0.99	39.2	1.9	
12.013	50.00	5.79	5.844	0.166		8.0	0.0	6.1	1.00	39.9	36.5	
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DBFL Consulting Engineers										Page 7	
Ormond House Upper Ormond Quay Dublin 7					20003 Ballymastone Phase 3						
Date 28/08/2025 File 240058 - Network (JOC).MDX					Designed by JOC Checked by BCU						
Innovyze					Network 2020.1.3						
Network Design Table for SW_4											
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
25.000	61.311	0.360	170.3	0.148	4.00	0.0	0.600	o	225	Pipe/Conduit	
12.014	57.228	0.233	245.6	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	
26.000	18.610	0.921	20.2	0.090	4.00	0.0	0.600	o	225	Pipe/Conduit	
26.001	29.623	0.305	97.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
12.015	4.607	0.014	325.0	0.064	0.00	0.0	0.600	o	375	Pipe/Conduit	
12.016	9.325	0.029	321.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
12.017	43.853	0.135	324.8	0.076	0.00	0.0	0.600	o	375	Pipe/Conduit	
12.018	13.761	0.042	326.0	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.016	13.357	0.011	1214.3	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.017	44.553	0.112	397.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.018	65.926	0.165	399.5	0.097	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.019	32.760	0.082	399.5	0.019	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.020	28.385	0.071	399.8	0.038	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.021	29.429	0.074	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
27.000	71.920	0.366	196.5	0.122	4.00	0.0	0.600	o	225	Pipe/Conduit	
27.001	8.224	0.048	170.0	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)	
25.000	50.00	5.02	6.019	0.148	0.0	0.0	4.0	1.00	39.7	24.0	
12.014	50.00	6.75	5.659	0.368	8.0	0.0	11.6	1.00	70.6	69.4	
26.000	50.00	4.11	7.573	0.090	0.0	0.0	2.4	2.92	116.3	14.6	
26.001	50.00	4.48	6.652	0.090	0.0	0.0	2.4	1.33	52.8	14.6	
12.015	50.00	6.82	5.351	0.522	8.0	0.0	15.7	1.00	110.4	94.5	
12.016	50.00	6.98	5.337	0.522	8.0	0.0	15.7	1.00	111.0	94.5	
12.017	50.00	7.71	5.308	0.598	8.0	0.0	17.8	1.00	110.4	106.8	
12.018	50.00	7.94	5.173	0.620	8.0	0.0	18.4	1.00	110.2«	110.3	
1.016	50.00	14.83	4.512	3.491	8.0	0.0	96.1	1.06	1204.3	576.8	
1.017	50.00	4.73	4.501	0.000	23.4	0.0	3.9	1.01	161.1	23.4	
1.018	50.00	5.82	4.389	0.097	23.4	0.0	7.3	1.01	160.8	43.8	
1.019	50.00	6.36	4.224	0.116	23.4	0.0	7.8	1.01	160.8	46.9	
1.020	50.00	6.83	4.142	0.153	23.4	0.0	8.8	1.01	160.7	53.0	
1.021	50.00	7.31	4.071	0.153	23.4	0.0	8.8	1.01	160.7	53.0	
27.000	50.00	5.29	6.089	0.122	0.0	0.0	3.3	0.93	36.9	19.8	
27.001	50.00	5.43	5.723	0.122	0.0	0.0	3.3	1.00	39.8	19.8	
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DBFL Consulting Engineers											Page 8	
Ormond House Upper Ormond Quay Dublin 7					20003 Ballymastone Phase 3							
Date 28/08/2025 File 240058 - Network (JOC).MDX					Designed by JOC Checked by BCU							
Innovyze					Network 2020.1.3							
Network Design Table for SW_4												
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	
28.000	51.358	0.245	209.6	0.131	4.00	0.0	0.600	o	225	Pipe/Conduit		
27.002	23.507	0.191	123.1	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit		
27.003	61.554	0.252	244.3	0.164	0.00	0.0	0.600	o	300	Pipe/Conduit		
29.000	8.419	0.050	168.0	0.014	4.00	0.0	0.600	o	225	Pipe/Conduit		
29.001	65.940	0.388	169.9	0.108	0.00	0.0	0.600	o	225	Pipe/Conduit		
29.002	67.989	0.400	170.0	0.098	0.00	0.0	0.600	o	225	Pipe/Conduit		
30.000	62.784	0.374	167.9	0.117	4.00	0.0	0.600	o	225	Pipe/Conduit		
27.004	74.841	0.374	200.1	0.112	0.00	0.0	0.600	o	525	Pipe/Conduit		
31.000	54.926	0.438	125.4	0.185	4.00	0.0	0.600	o	300	Pipe/Conduit		
27.005	57.251	0.229	250.0	0.165	0.00	0.0	0.600	o	525	Pipe/Conduit		
1.022	11.482	0.020	574.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit		
1.023	13.863	0.035	396.1	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit		
1.024	39.631	0.040	990.8	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit		
1.025	9.171	0.031	299.0	0.000	0.00	0.0	0.600	o	450	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)		
28.000	50.00	4.95	5.920	0.131	0.0	0.0	3.6	0.90	35.8	21.3		
27.002	50.00	5.70	5.600	0.278	0.0	0.0	7.5	1.42	100.1	45.2		
27.003	50.00	6.73	5.409	0.442	0.0	0.0	12.0	1.00	70.8«	71.8		
29.000	50.00	4.14	6.503	0.014	0.0	0.0	0.4	1.01	40.0	2.2		
29.001	50.00	5.24	6.453	0.122	0.0	0.0	3.3	1.00	39.8	19.8		
29.002	50.00	6.37	6.065	0.220	0.0	0.0	6.0	1.00	39.8	35.8		
30.000	50.00	5.04	5.944	0.117	0.0	0.0	3.2	1.01	40.0	19.0		
27.004	50.00	7.52	4.583	0.891	0.0	0.0	24.1	1.58	342.0	144.8		
31.000	50.00	4.65	4.872	0.185	0.0	0.0	5.0	1.40	99.1	30.0		
27.005	50.00	8.19	4.209	1.241	0.0	0.0	33.6	1.41	305.7	201.6		
1.022	50.00	8.38	3.905	1.394	23.4	0.0	42.4	1.01	285.3	254.6		
1.023	50.00	8.57	3.885	1.394	23.4	0.0	42.4	1.22	344.2	254.6		
1.024	50.00	9.13	3.850	1.394	23.4	0.0	42.4	1.18	1334.7	254.6		
1.025	50.00	4.13	3.810	0.000	29.7	0.0	5.0	1.17	186.2	29.7		
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DBFL Consulting Engineers		Page 9
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025	Designed by JOC	
File 240058 - Network (JOC).MDX	Checked by BCU	
Innovyze	Network 2020.1.3	

Network Design Table for SW_4

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.026	49.392	0.123	401.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.027	16.406	0.041	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.028	11.252	0.028	400.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.029	20.234	0.067	300.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.030	33.993	0.078	438.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.031	26.225	0.058	450.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.032	66.783	0.148	450.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.026	50.00	4.95	3.779	0.000	29.7	0.0	5.9	1.01	160.4	35.6
1.027	50.00	5.22	3.656	0.000	29.7	0.0	5.9	1.01	160.7	35.6
1.028	50.00	5.40	3.615	0.000	29.7	0.0	5.9	1.01	160.7	35.6
1.029	50.00	5.69	3.587	0.000	29.7	0.0	5.9	1.17	185.8	35.6
1.030	50.00	6.28	3.430	0.000	29.7	0.0	5.9	0.96	153.5	35.6
1.031	50.00	6.74	3.352	0.000	29.7	0.0	5.9	0.95	151.4	35.6
1.032	50.00	7.91	3.050	0.000	29.7	0.0	5.9	0.95	151.4	35.6

Free Flowing Outfall Details for SW_4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.032	SD0	6.280	2.902	0.000	0	0

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_5

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	15.100	Add Flow / Climate Change (%)	0
Ratio R	0.270	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 SW_5

« - 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
1.000	48.657	0.292	166.6	0.102	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	54.099	0.318	170.1	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	42.475	0.250	169.9	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	11.412	0.228	50.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	11.458	0.067	171.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.003	17.592	0.103	170.8	0.011	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	36.211	0.316	114.6	0.188	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	45.63	4.80	6.771	0.102	0.0	0.0	0.0	1.01	40.2	12.6
2.000	45.29	4.90	7.250	0.000	0.0	0.0	0.0	1.00	39.7	0.0
3.000	45.95	4.71	7.730	0.000	0.0	0.0	0.0	1.00	39.8	0.0
3.001	45.60	4.81	7.480	0.000	0.0	0.0	0.0	1.85	73.7	0.0
3.002	44.96	5.00	7.047	0.016	0.0	0.0	0.0	1.00	39.6	1.9
3.003	44.02	5.30	6.980	0.027	0.0	0.0	0.0	1.00	39.7	3.2
2.001	42.55	5.79	5.776	0.215	0.0	0.0	0.0	1.22	48.5	24.8

DBFL Consulting Engineers										Page 2	
Ormond House Upper Ormond Quay Dublin 7					20003 Ballymastone Phase 3						
Date 28/08/2025 File 240058 - Network (JOC).MDX					Designed by JOC Checked by BCU						
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Network Design Table for SW_5											
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.001	37.471	0.187	200.0	0.056	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	32.385	0.162	200.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	35.190	0.176	200.0	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	22.205	0.131	169.5	0.100	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	49.630	0.153	324.4	0.071	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	20.013	0.118	169.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	51.988	0.311	167.2	0.152	4.00	0.0	0.600	o	225	Pipe/Conduit	
5.001	4.625	0.028	165.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.002	31.757	0.187	169.8	0.093	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.003	57.385	0.179	320.6	0.105	0.00	0.0	0.600	o	375	Pipe/Conduit	
6.000	77.431	0.455	170.2	0.110	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	14.917	0.088	169.5	0.018	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.002	82.376	0.333	247.4	0.130	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.004	8.181	0.025	327.2	0.022	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.005	29.265	0.091	321.6	0.025	0.00	0.0	0.600	o	375	Pipe/Conduit	
7.000	28.637	0.173	165.5	0.069	4.00	0.0	0.600	o	225	Pipe/Conduit	
Network Results Table											
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	
1.001	41.01	6.35	6.479	0.374	0.0	0.0	0.0	1.11	78.3	41.5	
1.002	39.79	6.84	6.292	0.422	0.0	0.0	0.0	1.11	78.3	45.4	
1.003	38.56	7.37	6.130	0.430	0.0	0.0	0.0	1.11	78.3	45.4	
4.000	47.17	4.37	6.310	0.100	0.0	0.0	0.0	1.00	39.8	12.8	
1.004	37.00	8.11	5.954	0.601	0.0	0.0	0.0	1.12	178.7	60.3	
1.005	47.30	4.33	5.830	0.000	3.7	0.0	0.0	1.00	39.8	3.7	
5.000	45.44	4.86	6.249	0.152	0.0	0.0	0.0	1.01	40.1	18.7	
5.001	45.18	4.94	5.938	0.152	0.0	0.0	0.0	1.01	40.3	18.7	
5.002	43.50	5.46	5.915	0.245	0.0	0.0	0.0	1.00	39.8	28.8	
5.003	40.85	6.41	5.579	0.350	0.0	0.0	0.0	1.01	111.2	38.7	
6.000	44.04	5.29	6.276	0.110	0.0	0.0	0.0	1.00	39.7	13.1	
6.001	43.28	5.54	5.821	0.128	0.0	0.0	0.0	1.00	39.8	15.0	
6.002	39.60	6.92	5.733	0.258	0.0	0.0	0.0	1.00	70.3	27.6	
5.004	39.28	7.06	5.400	0.630	0.0	0.0	0.0	1.00	110.0	67.0	
5.005	38.18	7.54	5.375	0.655	0.0	0.0	0.0	1.00	111.0	67.7	
7.000	46.79	4.47	5.522	0.069	0.0	0.0	0.0	1.01	40.3	8.8	
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Date 28/08/2025
File 240058 - Network (JOC).MDX

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Phase 3

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Network 2020.1.3

Page 3



Network Design Table for SW_5

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
7.001	10.630	0.065	163.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
8.000	51.919	0.305	170.2	0.056	4.00	0.0	0.600	o	225	Pipe/Conduit		
8.001	11.300	0.066	171.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
5.006	61.532	0.062	992.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
5.007	24.971	0.149	167.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
5.008	45.847	0.268	171.1	0.059	0.00	0.0	0.600	o	225	Pipe/Conduit		
1.006	43.839	0.179	244.9	0.057	0.00	0.0	0.600	o	300	Pipe/Conduit		
9.000	26.931	0.269	100.0	0.145	4.00	0.0	0.600	o	225	Pipe/Conduit		
9.001	15.037	0.150	100.0	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit		
1.007	20.146	0.082	245.7	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit		
10.000	25.218	0.252	100.0	0.079	4.00	0.0	0.600	o	225	Pipe/Conduit		
10.001	10.794	0.108	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
1.008	27.904	0.114	244.8	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.009	55.236	0.226	244.4	0.111	0.00	0.0	0.600	o	300	Pipe/Conduit		

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
7.001	46.17	4.64	5.349	0.069	0.0	0.0	0.0	1.02	40.5	8.8		
8.000	45.41	4.87	5.655	0.056	0.0	0.0	0.0	1.00	39.7	6.9		
8.001	44.79	5.06	5.350	0.056	0.0	0.0	0.0	1.00	39.6	6.9		
5.006	34.70	9.35	5.284	0.780	0.0	0.0	0.0	0.57	62.6«	73.3		
5.007	47.01	4.41	5.161	0.000	5.3	0.0	0.0	1.01	40.0	5.3		
5.008	44.39	5.18	5.012	0.059	5.3	0.0	0.0	1.00	39.6	12.4		
1.006	42.21	5.91	4.669	0.116	9.0	0.0	0.0	1.00	70.7	22.3		
9.000	47.26	4.34	6.612	0.145	0.0	0.0	0.0	1.31	52.0	18.5		
9.001	46.56	4.53	6.343	0.157	0.0	0.0	0.0	1.31	52.0	19.8		
1.007	41.29	6.25	4.490	0.293	9.0	0.0	0.0	1.00	70.6	41.8		
10.000	47.35	4.32	6.006	0.079	0.0	0.0	0.0	1.31	52.0	10.1		
10.001	46.84	4.46	5.408	0.079	0.0	0.0	0.0	1.31	52.0	10.1		
1.008	40.10	6.71	4.408	0.403	9.0	0.0	0.0	1.00	70.7	52.8		
1.009	37.99	7.63	4.294	0.513	9.0	0.0	0.0	1.00	70.8	61.8		

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Date 28/08/2025
File 240058 - Network (JOC).MDX

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20003 Ballymastone
Phase 3

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Network 2020.1.3

Page 4

Micro Drainage

Network Design Table for SW_5

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
11.000	6.318	0.021	300.9	0.000	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	60.221	0.251	240.0	0.096	0.00	0.0	0.600	o	300	Pipe/Conduit	
12.000	29.788	0.175	170.2	0.051	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	32.948	0.103	320.0	0.044	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.012	15.492	0.050	310.0	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.013	12.810	0.040	320.3	0.032	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.014	30.354	0.154	197.1	0.030	0.00	0.0	0.600	o	375	Pipe/Conduit	
13.000	60.977	0.359	169.9	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
13.001	77.550	0.247	314.0	0.190	0.00	0.0	0.600	o	375	Pipe/Conduit	
14.000	29.213	0.183	159.6	0.056	4.00	0.0	0.600	o	225	Pipe/Conduit	
14.001	33.673	0.210	160.3	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
14.002	6.915	0.043	160.8	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
14.003	51.929	0.325	159.8	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
14.004	12.323	0.077	160.0	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
13.002	15.158	0.052	291.5	0.006	0.00	0.0	0.600	o	450	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)
11.000	48.13	4.12	4.089	0.000	0.0	0.0	0.0	0.90	63.7	0.0
1.010	36.00	8.62	4.068	0.610	9.0	0.0	0.0	1.01	71.4	68.5
12.000	46.70	4.50	4.067	0.051	0.0	0.0	0.0	1.00	39.7	6.4
1.011	35.01	9.17	3.742	0.705	9.0	0.0	0.0	1.01	111.3	75.8
1.012	34.58	9.42	3.639	0.718	9.0	0.0	0.0	1.02	113.1	76.3
1.013	34.22	9.63	3.589	0.750	9.0	0.0	0.0	1.01	111.2	78.5
1.014	33.59	10.03	3.549	0.780	9.0	0.0	0.0	1.29	142.1	80.0
13.000	44.91	5.02	4.515	0.089	0.0	0.0	0.0	1.00	39.8	10.9
13.001	41.19	6.29	4.006	0.279	0.0	0.0	0.0	1.02	112.3	31.1
14.000	46.79	4.47	4.747	0.056	0.0	0.0	0.0	1.03	41.0	7.1
14.001	44.91	5.02	4.564	0.099	0.0	0.0	0.0	1.03	40.9	12.1
14.002	44.55	5.13	4.354	0.121	0.0	0.0	0.0	1.03	40.9	14.6
14.003	42.05	5.97	4.311	0.165	0.0	0.0	0.0	1.03	41.0	18.8
14.004	41.50	6.17	3.986	0.184	0.0	0.0	0.0	1.03	41.0	20.7
13.002	40.63	6.50	3.684	0.469	0.0	0.0	0.0	1.19	188.6	51.6

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Appendix D : FOUL SEWER CALCULATIONS

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

FOUL SEWERAGE DESIGN

Design Criteria for FS_3

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)	2.000
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 FS_3

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
2.000	47.310	0.473	100.0	0.000	140.0	0.0	1.500	o	150	Pipe/Conduit	
2.001	48.329	0.460	105.1	0.000	70.0	0.0	1.500	o	150	Pipe/Conduit	
2.002	68.131	0.341	199.8	0.000	112.0	0.0	1.500	o	225	Pipe/Conduit	
3.000	90.265	1.693	53.3	0.000	252.0	0.0	1.500	o	150	Pipe/Conduit	
2.003	57.080	0.285	200.3	0.000	112.0	0.0	1.500	o	225	Pipe/Conduit	
4.000	26.235	0.437	60.0	0.000	56.0	0.0	1.500	o	150	Pipe/Conduit	
5.000	35.679	0.595	60.0	0.000	70.0	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)
2.000	5.959	0.000	0.0	140.0	0.0	54	0.75	0.88	15.5	4.3
2.001	5.486	0.000	0.0	210.0	0.0	58	0.75	0.85	15.1	4.7
2.002	4.951	0.000	0.0	322.0	0.0	62	0.60	0.81	32.2	5.3
3.000	6.378	0.000	0.0	252.0	0.0	49	0.98	1.20	21.2	5.0
2.003	4.610	0.000	0.0	686.0	0.0	71	0.64	0.81	32.2	6.9
4.000	6.439	0.000	0.0	56.0	0.0	42	0.85	1.13	20.0	3.5
5.000	6.597	0.000	0.0	70.0	0.0	43	0.86	1.13	20.0	3.6

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

Network Design Table for FS_3

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
4.001	19.408	0.190	102.0	0.000	56.0	0.0	1.500	o	150	Pipe/Conduit	
4.002	12.142	0.119	102.0	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
4.003	14.123	0.143	98.6	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
4.004	40.434	0.319	126.8	0.000	56.0	0.0	1.500	o	150	Pipe/Conduit	
6.000	43.163	0.204	211.6	0.000	588.0	0.0	1.500	o	225	Pipe/Conduit	
7.000	35.278	0.381	92.6	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
7.001	34.715	0.290	119.7	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
6.001	8.708	0.068	128.1	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
8.000	33.250	0.207	160.6	0.000	420.0	0.0	1.500	o	225	Pipe/Conduit	
9.000	34.099	0.341	100.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
9.001	35.057	0.350	100.2	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
8.001	5.956	0.122	48.8	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
6.002	39.835	0.362	110.0	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)
4.001	6.002	0.000	0.0	182.0	0.0	56	0.75	0.87	15.3	4.5
4.002	5.811	0.000	0.0	182.0	0.0	56	0.75	0.87	15.3	4.5
4.003	5.692	0.000	0.0	182.0	0.0	56	0.76	0.88	15.6	4.5
4.004	5.549	0.000	0.0	238.0	0.0	62	0.71	0.78	13.7	4.9
6.000	6.995	0.000	0.0	588.0	0.0	70	0.62	0.79	31.3	6.5
7.000	7.326	0.000	0.0	0.0	0.0	0	0.00	1.19	47.4	0.0
7.001	6.945	0.000	0.0	0.0	0.0	0	0.00	1.05	41.7	0.0
6.001	6.655	0.000	0.0	588.0	0.0	61	0.74	1.01	40.3	6.5
8.000	6.831	0.000	0.0	420.0	0.0	61	0.66	0.90	36.0	5.8
9.000	7.315	0.000	0.0	0.0	0.0	0	0.00	1.15	45.6	0.0
9.001	6.974	0.000	0.0	0.0	0.0	0	0.00	1.15	45.6	0.0
8.001	6.624	0.000	0.0	420.0	0.0	45	1.01	1.65	65.4	5.8
6.002	6.587	0.000	0.0	1008.0	0.0	66	0.84	1.09	43.5	8.1

DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

Network Design Table for FS_3

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
13.001	22.704	0.252	90.1	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
13.002	9.607	0.227	42.3	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
12.001	12.051	0.060	200.9	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
12.002	16.316	0.208	78.4	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
12.003	86.546	1.009	85.8	0.000	112.0	0.0	1.500	o	225	Pipe/Conduit	
2.006	29.181	0.146	199.9	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
15.000	70.283	1.171	60.0	0.000	70.0	0.0	1.500	o	150	Pipe/Conduit	
15.001	19.992	0.333	60.0	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
2.007	28.451	0.142	200.4	0.000	84.0	0.0	1.500	o	225	Pipe/Conduit	
2.008	27.371	0.462	59.3	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
2.009	9.349	0.087	107.5	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
2.010	5.202	0.026	201.0	0.000	126.0	0.0	1.500	o	225	Pipe/Conduit	
16.000	10.851	0.180	60.3	0.000	140.0	0.0	1.500	o	150	Pipe/Conduit	
16.001	8.771	0.146	60.1	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
2.011	43.796	0.218	200.9	0.000	84.0	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)
13.001	6.043	0.000	0.0	154.0	0.0	46	0.75	1.21	48.1	4.4
13.002	5.791	0.000	0.0	154.0	0.0	38	0.98	1.77	70.3	4.4
12.001	5.564	0.000	0.0	238.0	0.0	59	0.58	0.81	32.1	4.9
12.002	5.203	0.000	0.0	238.0	0.0	47	0.81	1.30	51.6	4.9
12.003	5.040	0.000	0.0	350.0	0.0	51	0.82	1.24	49.3	5.5
2.006	4.031	0.000	0.0	3150.0	0.0	107	0.79	0.81	32.2	14.9
15.000	5.464	0.000	0.0	70.0	0.0	43	0.86	1.13	20.0	3.6
15.001	4.293	0.000	0.0	70.0	0.0	43	0.86	1.13	20.0	3.6
2.007	3.885	0.000	0.0	3304.0	0.0	109	0.80	0.81	32.2	15.3
2.008	3.743	0.000	0.0	3304.0	0.0	78	1.25	1.49	59.3	15.3
2.009	3.281	0.000	0.0	3304.0	0.0	92	1.01	1.11	44.0	15.3
2.010	3.194	0.000	0.0	3430.0	0.0	111	0.80	0.81	32.1	15.7
16.000	5.380	0.000	0.0	140.0	0.0	47	0.90	1.13	20.0	4.3
16.001	5.200	0.000	0.0	140.0	0.0	47	0.90	1.13	20.0	4.3
2.011	3.168	0.000	0.0	3654.0	0.0	114	0.81	0.81	32.1	16.4

DBFL Consulting Engineers										Page 5	
Ormond House Upper Ormond Quay Dublin 7					20003 Ballymastone Phase 3						
Date 28/08/2025 File 240058 - Network (JOC).MDX					Designed by JOC Checked by BCU						
Innovyze					Network 2020.1.3						
<u>Network Design Table for FS_3</u>											
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
17.000	54.651	0.273	200.2	0.000	532.0	0.0	1.500	o	225	Pipe/Conduit	
2.012	75.297	0.378	199.2	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
18.000	75.438	0.754	100.1	0.000	140.0	0.0	1.500	o	150	Pipe/Conduit	
18.001	10.189	0.180	56.6	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
19.000	54.054	0.932	58.0	0.000	126.0	0.0	1.500	o	150	Pipe/Conduit	
18.002	78.869	0.760	103.8	0.000	252.0	0.0	1.500	o	150	Pipe/Conduit	
20.000	64.627	1.504	43.0	0.000	140.0	0.0	1.500	o	150	Pipe/Conduit	
21.000	60.941	0.609	100.1	0.000	280.0	0.0	1.500	o	225	Pipe/Conduit	
21.001	5.083	0.051	99.7	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
2.013	72.434	0.376	192.6	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
22.000	40.452	0.672	60.2	0.000	140.0	0.0	1.500	o	150	Pipe/Conduit	
22.001	13.458	0.223	60.3	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
22.002	69.883	1.864	37.5	0.000	168.0	0.0	1.500	o	225	Pipe/Conduit	
<u>Network Results Table</u>											
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)	
17.000	4.673	0.000	0.0	532.0	0.0	67	0.63	0.81	32.2	6.3	
2.012	2.950	0.000	0.0	4186.0	0.0	120	0.83	0.81	32.3	18.1	
18.000	6.184	0.000	0.0	140.0	0.0	54	0.75	0.88	15.5	4.3	
18.001	5.430	0.000	0.0	140.0	0.0	46	0.92	1.17	20.6	4.3	
19.000	6.182	0.000	0.0	126.0	0.0	46	0.90	1.15	20.4	4.1	
18.002	5.250	0.000	0.0	518.0	0.0	67	0.82	0.86	15.2	6.2	
20.000	5.704	0.000	0.0	140.0	0.0	43	1.01	1.34	23.7	4.3	
21.000	5.109	0.000	0.0	280.0	0.0	51	0.76	1.15	45.6	5.1	
21.001	4.500	0.000	0.0	280.0	0.0	51	0.76	1.15	45.7	5.1	
2.013	2.572	0.000	0.0	5124.0	0.0	131	0.88	0.83	32.8	21.0	
22.000	7.355	0.000	0.0	140.0	0.0	47	0.90	1.13	20.0	4.3	
22.001	6.683	0.000	0.0	140.0	0.0	47	0.90	1.13	20.0	4.3	
22.002	6.385	0.000	0.0	308.0	0.0	40	1.08	1.88	74.7	5.3	
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DBFL Consulting Engineers		Page 9
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

Network Design Table for FS_3

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
35.000	23.807	0.397	60.0	0.000	42.0	0.0	1.500	o	150	Pipe/Conduit	
35.001	4.772	0.079	60.4	0.000	14.0	0.0	1.500	o	150	Pipe/Conduit	
2.025	13.483	0.045	299.6	0.000	0.0	0.0	1.500	o	375	Pipe/Conduit	
2.026	16.876	0.056	301.4	0.000	0.0	0.0	1.500	o	375	Pipe/Conduit	
2.027	47.572	0.158	301.1	0.000	0.0	0.0	1.500	o	375	Pipe/Conduit	
36.000	52.552	0.873	60.2	0.000	98.0	0.0	1.500	o	150	Pipe/Conduit	
36.001	13.376	0.131	102.1	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
37.000	34.200	0.342	100.0	0.000	70.0	0.0	1.500	o	150	Pipe/Conduit	
37.001	7.752	0.091	85.2	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
2.028	7.404	0.025	296.2	0.000	0.0	0.0	1.500	o	375	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)
35.000	3.795	0.000	0.0	42.0	0.0	41	0.83	1.13	20.0	3.3
35.001	2.511	0.000	0.0	56.0	0.0	42	0.84	1.13	19.9	3.5
2.025	0.531	0.000	0.0	8302.0	0.0	136	0.80	0.92	102.1	28.6
2.026	0.486	0.000	0.0	8302.0	0.0	136	0.79	0.92	101.8	28.6
2.027	0.430	0.000	0.0	8302.0	0.0	136	0.79	0.92	101.8	28.6
36.000	3.694	0.000	0.0	98.0	0.0	45	0.88	1.13	20.0	3.9
36.001	2.821	0.000	0.0	98.0	0.0	52	0.72	0.87	15.3	3.9
37.000	4.218	0.000	0.0	70.0	0.0	50	0.71	0.88	15.5	3.6
37.001	2.778	0.000	0.0	70.0	0.0	48	0.76	0.95	16.8	3.6
2.028	0.272	0.000	0.0	8470.0	0.0	136	0.80	0.93	102.7	29.0

Free Flowing Outfall Details for FS_3

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.028	FD0	0.000	0.247	0.000	1350	0

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

FOUL SEWERAGE DESIGN

Design Criteria for FS_4

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 FS_4

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
1.000	44.946	0.361	124.5	0.000	266.0	0.0	1.500	o	225	Pipe/Conduit	
1.001	30.633	0.153	200.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
2.000	46.887	0.700	67.0	0.000	266.0	0.0	1.500	o	225	Pipe/Conduit	
1.002	4.334	0.022	197.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
1.003	8.620	0.043	200.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
3.000	51.435	0.257	200.1	0.000	350.0	0.0	1.500	o	225	Pipe/Conduit	
3.001	35.141	0.176	199.7	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)
1.000	7.585	0.000	0.0	266.0	0.0	53	0.70	1.03	40.9	5.0
1.001	7.136	0.000	0.0	266.0	0.0	60	0.59	0.81	32.2	5.0
2.000	7.706	0.000	0.0	266.0	0.0	46	0.87	1.40	55.8	5.0
1.002	6.983	0.000	0.0	532.0	0.0	67	0.63	0.82	32.5	6.3
1.003	6.961	0.000	0.0	532.0	0.0	67	0.63	0.81	32.2	6.3
3.000	7.351	0.000	0.0	350.0	0.0	63	0.60	0.81	32.2	5.5
3.001	7.094	0.000	0.0	350.0	0.0	63	0.60	0.81	32.2	5.5

DBFL Consulting Engineers		Page 2
Ormond House Upper Ormond Quay Dublin 7	20003 Ballymastone Phase 3	
Date 28/08/2025 File 240058 - Network (JOC).MDX	Designed by JOC Checked by BCU	
Innovyze	Network 2020.1.3	

Network Design Table for FS_4

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
1.004	30.614	0.153	200.1	0.000	252.0	0.0	1.500	o	225	Pipe/Conduit	
4.000	15.593	0.464	33.6	0.000	98.0	0.0	1.500	o	225	Pipe/Conduit	
1.005	18.441	0.092	200.4	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)
1.004	6.918	0.000	0.0	1134.0	0.0	79	0.68	0.81	32.2	8.5
4.000	7.229	0.000	0.0	98.0	0.0	34	1.03	1.98	78.9	3.9
1.005	6.765	0.000	0.0	1232.0	0.0	81	0.69	0.81	32.2	8.8

Free Flowing Outfall Details for FS_4

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005		0.000	6.673	0.000	0	0

Appendix E : GROUND INVESTIGATION REPORT SUMMARIES



GROUND INVESTIGATIONS IRELAND

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Ground Investigations Ireland

Ballymastone Area 3

DBFL Consulting Engineers

Ground Investigation Report

July 2022





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DOCUMENT CONTROL SHEET

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A	Final	J Stokes	D MagLochlainn	C Finnerty	Dublin	09 July 2022

Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client. The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.



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CONTENTS

1.0	Preamble.....	1
2.0	Overview.....	1
2.1.	Background.....	1
2.2.	Purpose and Scope	1
3.0	Subsurface Exploration	1
3.1.	General	1
3.2.	Trial Pits.....	2
3.3.	Soakaway Testing	2
3.4.	Dynamic Probing	2
3.5.	Insitu Plate Bearing Test.....	2
3.6.	Slit Trenching.....	2
3.7.	Cable Percussion Boreholes.....	3
3.8.	Rotary Boreholes.....	3
3.9.	Surveying	4
3.10.	Groundwater Monitoring Installations	4
3.11.	Laboratory Testing	4
4.0	Ground Conditions.....	5
4.1.	General	5
4.2.	Insitu Strength Testing	6
4.3.	Groundwater	6
4.4.	Laboratory Testing	6
4.4.1.	Geotechnical Laboratory Testing	6
4.4.2.	Chemical Laboratory Testing	6
4.4.3.	Environmental Laboratory Testing	7
5.0	Recommendations & Conclusions	8
5.1.	General	8
5.2.	Foundations	8
5.3.	External Pavements	10
5.4.	Excavations.....	10
5.5.	Soakaway Design	10



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APPENDICES

Appendix 1	Site Location Plan
Appendix 2	Trial Pit Records
Appendix 3	Soakaway Test Results
Appendix 4	Dynamic Probe Records
Appendix 5	Plate Bearing Test Results
Appendix 6	Slit Trench Records
Appendix 7	Cable Percussion and Rotary Core Borehole Records
Appendix 8	Laboratory Testing



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1.0 Preamble

On the instructions of DBFL Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between February and July 2022 at the site of the proposed Residential Development in Donabate North Co. Dublin.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently green field and located east of Donabate Village on the new R126 Donabate Distributor Road in North Co. Dublin. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 58 No. Trial Pits to a maximum depth of 3.70m BGL
- Carry out 2 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Carry out 59 No. Dynamic Probes to determine soil strength/density characteristics
- Carry out 23 No. Plate Bearing Tests to ascertain the subgrade modulus
- Carry out 3 No. Slit Trenches to locate the gas main running east west through the site
- Carry out 5 No. Cable Percussion boreholes to a maximum depth of 6.10m BGL
- Carry out 1 No. Rotary Core Boreholes to a maximum depth of 14.70m BGL
- Installation of 1 No. Groundwater monitoring wells
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ

testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a 13T tracked excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 3 of this Report.

3.4. Dynamic Probing

The dynamic probe tests (DPH) were carried out at the locations shown in the location plan in Appendix 1 in accordance with B.S. 1377: Part 9 1990. The test consists of mechanically driving a cone with a 50kg weight in 100mm intervals and monitoring the number of blows required. An equivalent Standard Penetration Test (SPT) 'N' value may be calculated by dividing the total number of blows over a 300mm drive length by 1.5. The dynamic probe logs are provided in Appendix 4 of this Report.

3.5. Insitu Plate Bearing Test

The plate bearing tests were carried out using a 450mm diameter plate at the locations shown on the site plan in Appendix 1. The plate was loaded in increments using a hydraulic jack and an excavator to provide a reaction and the displacement was monitored in accordance with BS1377 Part 9 using independently mounted digital strain gauges. The constrained modulus and equivalent CBR are calculated in accordance with HD29/75 and are provided on the test reports in Appendix 5 of this Report.

3.6. Slit Trenching

The slit trenches were excavated using a JCB 3CX at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering

services during the excavation. The soil was slowly stripped using a spotter on the trench to alert the driver if any services were seen, to avoid damage to any underlying services. The slit trenches were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the slit trench records which are provided in Appendix 6 of this Report.

3.7. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata. Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60° cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 7 of this Report.

3.8. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric

of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the “overshoot” recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 7 of this Report.

3.9. Surveying

The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.10. Groundwater Monitoring Installations

Groundwater Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm uPVC/HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.11. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.

Environmental & Chemical testing as required by the specification, including the Rilta Suite/Engineers Ireland Suite I, pH and sulphate testing was carried out by Element Materials Technology Laboratory in the UK. The Rilta suite testing includes both Solid Waste and Leachate Waste Acceptance Criteria.

Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD), hydrometer, Moisture Condition Value (MCV) tests were carried out in NMTL’s Geotechnical Laboratory in Carlow.

The results of the laboratory testing are included in Appendix 8 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were variable across the site and generally comprised;

- Topsoil
- Made Ground
- Cohesive Deposits
- Granular Deposits

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.40m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil or from surface at locations TP122 and TP123 and were present to depths of up to 1.20m BGL. This deposit was described as *brown grey slightly sandy slightly gravelly Clay*.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground or Topsoil and were described typically as *light brown slightly sandy slightly gravelly CLAY with occasional cobbles and boulders* overlying a *brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles and boulders* overlying *dark grey slightly sandy slightly gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the cohesive till matrix. The strength of the cohesive deposits typically increased with depth and was firm or firm to stiff below 1.5m BGL in the majority of the exploratory holes. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

GRANULAR DEPOSITS: Granular deposits were encountered within the cohesive deposits at location BH18. The Granular deposit was described as *Brown slightly gravelly slightly silty fine to coarse SAND with occasional cobbles and rare boulders*. The secondary sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble and boulder content also present where noted on the exploratory hole logs.

Based on the DPH N100 values the deposits are typically dense.

4.2. Insitu Strength Testing

The correlated DPH blow counts indicate that the overburden deposits are soft or soft to firm to depth of 1.0m to 1.5m BGL and become firm or firm to stiff with depth. At locations DPH103, DPH122, DPH133, DPH138, DPH141, DPH148, DPH153, DPH154 and DPH156 had low blow counts in the soft to firm cohesive deposits to depths of between 1.70m BGL to 2.10m BGL which corresponds to the descriptions in the adjacent trial pits.

4.3. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors. For this reason, a standpipe was installed in BH08 to allow the equilibrium groundwater level to be determined.

4.4. Laboratory Testing

4.4.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 10.3% and 58% generally with fines contents of 19.6% to 66.1%.

The Particle Size Distribution tests confirm that generally the granular deposits are well-graded/gap graded with percentages of sands/gravels and silt/clay typically between 6.3% and 16.3% with a gravel/sand content of typically 11.5% to 71.8%.

The classification testing indicates that the samples tested would classify for reuse as Class 2 General Stony Cohesive FILL in its current state.

The MCV test results ranged from 1.9 to 9.8. A typical value for acceptability for this material is a value of 7 or greater.

4.4.2. Chemical Laboratory Testing

The pH and sulphate testing carried out indicate that pH results are near neutral and that the water soluble sulphate results is low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.

4.4.3. Environmental Laboratory Testing

A number of samples were analysed for a suite of parameters which allows for the assessment of the sampled material in terms of total pollutant content for classification of materials as *hazardous* or *non-hazardous*. The suite also allows for the assessment of the sampled material in terms of suitability for placement at licenced landfills (inert, stable non-reactive, hazardous etc.). The parameter list for the suite includes analysis of the solid samples for arsenic, barium, cadmium, chromium, copper, cyanide, lead, nickel, mercury, zinc, speciated aliphatic and aromatic petroleum hydrocarbons, pH, sulphate, sulphide, moisture content, soil organic matter and an asbestos screen.

The suite also includes those parameters specified in the EU Council Decision establishing criteria for the acceptance of waste at Landfills (Council Decision 2003/33/EC), which for the solid samples are total organic carbon (TOC), speciated aliphatic and aromatic petroleum hydrocarbons, BTEX, phenol, polychlorinated biphenyls (PCB) and PAH.

As part of the suite a leachate is generated from the solid sample which is analysed for antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, chloride, fluoride, soluble sulphate, sulphide, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS).

While the laboratory report provides a comparison with the waste acceptance criteria limits it does not provide a waste classification of the material sampled nor does it comment on any potentially hazardous properties of the materials tested. The possibility for contamination, not revealed by the testing undertaken should be borne in mind particularly where Made Ground deposits are present, or the previous site use or location indicate a risk of environmental variation. The waste classification report is included under the cover of a separate report by Ground Investigations Ireland.

The results from the completed laboratory testing are included in Appendix 8 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

At the location of the proposed structures an allowable bearing capacity of 80 kN/m² and 125 kN/m² is recommended for conventional strip or pad foundations on the stiff cohesive deposits at the depths outlined in the table below.

The possibility for variation in the depth of the made ground in the vicinity of these foundations should be considered and foundation inspections should be carried out. Any soft spots encountered at the proposed foundation depths should be excavated and replaced with lean mix concrete.

Allowable Bearing Capacity							
DPH No.	ABC	Depth	Comment	DPH No.	ABC	Depth	Comment
	kN/m ²	BGL			kN/m ²	BGL	
DPH101	80	1.00	Cohesive	DPH101	125	2.00	Cohesive
DPH102	100	1.10	Cohesive	DPH102	125	1.50	Cohesive
DPH103	N/A			DPH103	125	2.10	Cohesive
DPH104	80	1.20	Cohesive	DPH104	125	2.00	Cohesive
DPH105	125	1.00	Cohesive	DPH105			
DPH106	80	1.20	Cohesive	DPH106	125	1.50	Cohesive
DPH107	N/A			DPH107	80	1.50	Cohesive
DPH108	125	1.10	Cohesive	DPH108			
DPH109	N/A			DPH109	125	1.50	Cohesive
DPH110	80	1.20	Cohesive	DPH110	125	1.60	Cohesive
DPH111	125	1.20	Cohesive	DPH111			
DPH112	125	1.00	Cohesive	DPH112			
DPH113	80	1.00	Cohesive	DPH113	125	1.50	Cohesive
DPH114	100	1.00	Cohesive	DPH114	125	1.40	Cohesive
DPH115	125	1.20	Cohesive	DPH115			
DPH116	100	1.00	Cohesive	DPH116	125	1.60	Cohesive
DPH118	125	1.10	Cohesive	DPH118			
DPH119	80	1.00	Cohesive	DPH119	125	1.50	Cohesive
DPH120	125	1.20	Cohesive	DPH120			
DPH121	N/A			DPH121	125	1.50	Cohesive
DPH122	N/A			DPH122	125	1.80	Cohesive
DPH123	N/A			DPH123	125	1.50	Cohesive

DPH124	100	1.00	Cohesive	DPH124	125	1.50	Cohesive
DPH126	125	1.00	Cohesive	DPH126			
DPH127	80	1.00	Cohesive	DPH127	125	1.30	Cohesive
DPH128	125	1.20	Cohesive	DPH128			
DPH129	80	1.20	Cohesive	DPH129	125	1.60	Cohesive
DPH130	100	1.10	Cohesive	DPH130	125	1.70	Cohesive
DPH131	125	1.20	Cohesive	DPH131			
DPH132	125	1.10	Cohesive	DPH132			
DPH133	N/A			DPH133	125	1.70	Cohesive
DPH134	80	2.10	Cohesive	DPH134	125	2.10	Cohesive
DPH135	80	1.20	Cohesive	DPH135	125	2.00	Cohesive
DPH136	125	1.00	Cohesive	DPH136			
DPH137	125	1.20	Cohesive	DPH137			
DPH138	N/A			DPH138	100	1.70	Cohesive
DPH139	125	1.20	Cohesive	DPH139			
DPH140	125	1.00	Cohesive	DPH140			
DPH141	N/A			DPH141	125	1.90	Cohesive
DPH142	125	1.20	Cohesive	DPH142			
DPH143	125	1.20	Cohesive	DPH143			
DPH144	125	1.20	Cohesive	DPH144			
DPH145	80	1.20	Cohesive	DPH145	125	1.70	Cohesive
DPH147	100	1.20	Cohesive	DPH147	125	1.70	Cohesive
DPH148	N/A			DPH148	125	1.70	Cohesive
DPH149	80	1.20	Cohesive	DPH149	125	1.70	Cohesive
DPH150	125	1.00	Cohesive	DPH150			
DPH151	80	1.00	Cohesive	DPH151	125	2.10	Cohesive
DPH152	N/A			DPH152	125	1.40	Cohesive
DPH153	N/A			DPH153	125	1.70	Cohesive
DPH154	N/A			DPH154	125	1.70	Cohesive
DPH155	125	1.10	Cohesive	DPH155			
DPH156	N/A			DPH156	125	2.10	Cohesive
DPH157	125	1.10	Cohesive	DPH157			
DPH158	80	1.00	Cohesive	DPH158			

An allowable bearing capacity of 250 kN/m² is recommended for conventional strip or pad foundations on the stiff cohesive deposits at a depth of 2.0m BGL the location of BH08, BH09, BH10, BH15, BH14 and BH18.

A ground bearing floor slab is recommended to be based on the firm to stiff cohesive deposits with an appropriate depth of compacted hardcore specified by the consulting engineer and in accordance with the limits and guidelines in SR21:2014 +A1:2016 and/or NRA SRW CL808 Type E granular stone fill. Where the depth of Made Ground/Soft deposits exceeds 0.9m then suspended floor slabs should be considered. The pH and sulphate testing completed on samples recovered from the exploratory holes indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE

Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack. The samples tested were below the limits of DS1 in the BRE Special Digest 1:2005.

5.3. External Pavements

The proposed pavements are recommended to be designed in accordance with the CBR test results included in the Appendices of this Report. The low CBR test results indicate that a capping layer or a sufficient depth of crushed stone fill may be required. Plate bearing tests are recommended at the time of construction to verify the design assumptions for the proposed pavement make up and to verify adequate compaction has been achieved.

The use of a geogrid and separation membrane may improve the performance of the proposed pavement and enable a more economical pavement design to be achieved, a specialist supplier is recommended to advise of the required strength, depth and type of geotextile for the proposed design.

5.4. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.

Excavations in the Made Ground or soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.

Any excavations which penetrate the granular deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.

The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations.

Any waste material to be removed off site should be disposed of to a suitably licenced landfill.

The environmental testing completed during the ground investigation is reported under the cover of a separate GII Waste Classification/Subsoil Assessment Report.

5.5. Soakaway Design

At the locations IT07 and IT08 the water level dropped too slowly to allow calculation of 'f' the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



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Ground Investigations Ireland

Ballymastone Area 4

DBFL Consulting Engineers

Ground Investigation Report

August 2022





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Ground Investigations Ireland Ltd. present the results of the fieldworks and laboratory testing in accordance with the specification and related documents provided by or on behalf of the client. The possibility of variation in the ground and/or groundwater conditions between or below exploratory locations or due to the investigation techniques employed must be taken into account when this report and the appendices inform designs or decisions where such variation may be considered relevant. Ground and/or groundwater conditions may vary due to seasonal, man-made or other activities not apparent during the fieldworks and no responsibility can be taken for such variation. The data presented and the recommendations included in this report and associated appendices are intended for the use of the client and the client's geotechnical representative only and any duty of care to others is excluded unless approved in writing.



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CONTENTS

1.0	Preamble.....	1
2.0	Overview.....	1
2.1.	Background.....	1
2.2.	Purpose and Scope	1
3.0	Subsurface Exploration	1
3.1.	General	1
3.2.	Trial Pits.....	2
3.3.	Soakaway Testing	2
3.4.	Dynamic Probing	2
3.5.	Insitu Plate Bearing Test.....	2
3.6.	Slit Trenching.....	2
3.7.	Cable Percussion Boreholes.....	3
3.8.	Rotary Boreholes.....	3
3.9.	Surveying	4
3.10.	Groundwater Monitoring Installations	4
3.11.	Laboratory Testing	4
4.0	Ground Conditions.....	5
4.1.	General	5
4.2.	Insitu Strength Testing	6
4.3.	Groundwater	6
4.4.	Laboratory Testing	6
4.4.1.	Geotechnical Laboratory Testing	6
4.4.2.	Chemical Laboratory Testing	7
4.4.3.	Environmental Laboratory Testing	7
5.0	Recommendations & Conclusions	8
5.1.	General	8
5.2.	Foundations	8
5.3.	External Pavements	10
5.4.	Excavations.....	10
5.5.	Soakaway Design	11



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APPENDICES

Appendix 1	Site Location Plan
Appendix 2	Trial Pit Records
Appendix 3	Soakaway Test Results
Appendix 4	Dynamic Probe Records
Appendix 5	Plate Bearing Test Results
Appendix 6	Slit Trench Records
Appendix 7	Cable Percussion and Rotary Core Borehole Records
Appendix 8	Laboratory Testing



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1.0 Preamble

On the instructions of DBFL Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between February and August 2022 at the site of the proposed Residential Development in Donabate North Co. Dublin.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently green field and located east of Donabate Village on the new R126 Donabate Distributor Road in North Co. Dublin. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 61 No. Trial Pits to a maximum depth of 3.70m BGL
- Carry out 2 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Carry out 69 No. Dynamic Probes to determine soil strength/density characteristics
- Carry out 18 No. Plate Bearing Tests to ascertain the subgrade modulus
- Carry out 2 No. Slit Trenches to locate the gas main running east west through the site
- Carry out 2 No. Cable Percussion boreholes to a maximum depth of 6.50m BGL
- Carry out 1 No. Rotary Core Boreholes to a maximum depth of 12.80m BGL
- Installation of 1 No. Groundwater monitoring wells
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ

testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.

The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a 13T tracked excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Soakaway Testing

The soakaway testing was carried out in selected trial pits at the locations shown in the exploratory hole location plan in Appendix 1. These pits were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 3 of this Report.

3.4. Dynamic Probing

The dynamic probe tests (DPH) were carried out at the locations shown in the location plan in Appendix 1 in accordance with B.S. 1377: Part 9 1990. The test consists of mechanically driving a cone with a 50kg weight in 100mm intervals and monitoring the number of blows required. An equivalent Standard Penetration Test (SPT) 'N' value may be calculated by dividing the total number of blows over a 300mm drive length by 1.5. The dynamic probe logs are provided in Appendix 4 of this Report.

3.5. Insitu Plate Bearing Test

The plate bearing tests were carried out using a 450mm diameter plate at the locations shown on the site plan in Appendix 1. The plate was loaded in increments using a hydraulic jack and an excavator to provide a reaction and the displacement was monitored in accordance with BS1377 Part 9 using independently mounted digital strain gauges. The constrained modulus and equivalent CBR are calculated in accordance with HD29/75 and are provided on the test reports in Appendix 5 of this Report.

3.6. Slit Trenching

The slit trenches were excavated using a JCB 3CX at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering

services during the excavation. The soil was slowly stripped using a spotter on the trench to alert the driver if any services were seen, to avoid damage to any underlying services. The slit trenches were sampled, logged and photographed by an Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the slit trench records which are provided in Appendix 6 of this Report.

3.7. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata. Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60° cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 7 of this Report.

3.8. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric

of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the “overshoot” recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 7 of this Report.

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The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

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Groundwater Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm uPVC/HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

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Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.

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The results of the laboratory testing are included in Appendix 8 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were variable across the site and generally comprised;

- Topsoil
- Cohesive Deposits
- Granular Deposits
- Bedrock

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.40m BGL.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Topsoil and were described typically as *light brown slightly sandy slightly gravelly CLAY with occasional cobbles and boulders* overlying a *brown mottled grey slightly sandy slightly gravelly CLAY with occasional cobbles and boulders* overlying *dark grey slightly sandy slightly gravelly CLAY with occasional cobbles and boulders*. At location BH19 a *reddish brown slightly sandy slightly gravelly CLAY with occasional cobbles and boulders* was encountered beneath the dark grey CLAY. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the cohesive till matrix. The strength of the cohesive deposits typically increased with depth and was firm or firm to stiff below 1.5m BGL in the majority of the exploratory holes. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

GRANULAR DEPOSITS: Granular deposits were encountered within the cohesive deposits at location TP215 to the southwest of this portion of the site. The Granular deposit was described as *Brown grey slightly clayey sandy angular to subangular fine to coarse GRAVEL with occasional cobbles and rare boulders*. The secondary sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble and boulder content also present where noted on the exploratory hole logs. Based on the DPH N100 values the deposits are typically medium dense.

BEDROCK: The rotary core boreholes recovered *Medium strong to strong reddish grey massive lithic arkose fine to medium grain CONGLOMERATE with quartz cementation* and *Medium strong to strong reddish grey massive lithic arkose fine to medium grain SANDSTONE with quartz cementation*.

This is typical of the Donabate Formation, which is noted on the geological mapping running from the southwest through to the northeast of the proposed site.

The depth to rock encountered was 10.50m BGL. The total core recovery is good, typically 93% with some of the uppermost runs dropping to 90%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Insitu Strength Testing

The correlated DPH blow counts indicate that the overburden deposits are soft or soft to firm to depth of 1.0m to 1.5m BGL and become firm or firm to stiff with depth. At locations DPH166, DPH177, DPH178, DPH197, DPH201, DPH224 and DPH225 had low blow counts in the soft to firm cohesive deposits to depths of between 1.60m BGL to 2.20m BGL which corresponds to the descriptions in the adjacent trial pits.

4.3. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors. For this reason, a standpipe was installed in BH019 to allow the equilibrium groundwater level to be determined.

4.4. Laboratory Testing

4.4.1. Geotechnical Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests confirm that generally the cohesive deposits are well-graded with percentages of sands and gravels ranging between 10.3% and 58% generally with fines contents of 19.6% to 66.1%.

The Particle Size Distribution tests confirm that generally the granular deposits are well-graded/gap graded with percentages of sands/gravels and silt/clay typically between 6.3% and 16.3% with a gravel/sand content of typically 11.5% to 71.8%.

The classification testing indicates that the samples tested would classify for reuse as Class 2 General Stony Cohesive FILL in its current state.

The MCV test results ranged from 1.9 to 9.8. A typical value for acceptability for this material is a value of 7 or greater.

4.4.2. Chemical Laboratory Testing

The pH and sulphate testing carried out indicate that pH results are near neutral and that the water soluble sulphate results is low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.

4.4.3. Environmental Laboratory Testing

A number of samples were analysed for a suite of parameters which allows for the assessment of the sampled material in terms of total pollutant content for classification of materials as *hazardous* or *non-hazardous*. The suite also allows for the assessment of the sampled material in terms of suitability for placement at licenced landfills (inert, stable non-reactive, hazardous etc.). The parameter list for the suite includes analysis of the solid samples for arsenic, barium, cadmium, chromium, copper, cyanide, lead, nickel, mercury, zinc, speciated aliphatic and aromatic petroleum hydrocarbons, pH, sulphate, sulphide, moisture content, soil organic matter and an asbestos screen.

The suite also includes those parameters specified in the EU Council Decision establishing criteria for the acceptance of waste at Landfills (Council Decision 2003/33/EC), which for the solid samples are total organic carbon (TOC), speciated aliphatic and aromatic petroleum hydrocarbons, BTEX, phenol, polychlorinated biphenyls (PCB) and PAH.

As part of the suite a leachate is generated from the solid sample which is analysed for antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, chloride, fluoride, soluble sulphate, sulphide, phenols, dissolved organic carbon (DOC) and total dissolved solids (TDS).

While the laboratory report provides a comparison with the waste acceptance criteria limits it does not provide a waste classification of the material sampled nor does it comment on any potentially hazardous properties of the materials tested. The possibility for contamination, not revealed by the testing undertaken should be borne in mind particularly where Made Ground deposits are present, or the previous site use or location indicate a risk of environmental variation. The waste classification report is included under the cover of a separate report by Ground Investigations Ireland.

The results from the completed laboratory testing are included in Appendix 8 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

At the location of the proposed structures an allowable bearing capacity of 80 kN/m² and 125 kN/m² is recommended for conventional strip or pad foundations on the stiff cohesive deposits at the depths outlined in the table below.

The possibility for variation in the depth of the made ground in the vicinity of these foundations should be considered and foundation inspections should be carried out. Any soft spots encountered at the proposed foundation depths should be excavated and replaced with lean mix concrete.

Allowable Bearing Capacity							
DPH No.	ABC	Depth	Comment	DPH No.	ABC	Depth	Comment
	kN/m ²	BGL			kN/m ²	BGL	
DPH159	80	1.00	Cohesive	DPH159	125	1.50	Cohesive
DPH160	125	1.10	Cohesive	DPH160			
DPH161	80	1.00	Cohesive	DPH161	125	1.70	Cohesive
DPH162	N/A			DPH162			
DPH163	125	1.00	Cohesive	DPH163			
DPH164	100	1.10	Cohesive	DPH164	125	1.60	Cohesive
DPH165	125	1.10	Cohesive	DPH165			
DPH166	N/A			DPH166	125	2.20	Cohesive
DPH167	125	1.00	Cohesive	DPH167			
DPH168	125	1.00	Cohesive	DPH168			
DPH169	125	1.20	Cohesive	DPH169			
DPH170	125	1.20	Cohesive	DPH170			
DPH171	125	1.20	Cohesive	DPH171			
DPH172	N/A			DPH172	125	1.50	Cohesive
DPH173	80	1.00	Cohesive	DPH173	125	1.70	Cohesive
DPH174	125	1.00	Cohesive	DPH174			
DPH175	125	1.00	Cohesive	DPH175			
DPH176	N/A			DPH176	125	1.40	Cohesive
DPH177	N/A			DPH177	125	2.00	Cohesive
DPH178	N/A			DPH178	125	1.60	Cohesive
DPH179	125	1.20	Cohesive	DPH179			

DPH180	80	1.10	Cohesive	DPH180	125	1.60	Cohesive
DPH181	80	1.20	Cohesive	DPH181	100	1.80	Cohesive
DPH182	80	1.00	Cohesive	DPH182	125	1.40	Cohesive
DPH183	125	1.20	Cohesive	DPH183			
DPH184	125	1.00	Cohesive	DPH184			
DPH185	100	1.00	Cohesive	DPH185	125	1.50	Cohesive
DPH186	125	1.00	Cohesive	DPH186			
DPH187	N/A			DPH187	125	1.40	
DPH188	100	1.10	Cohesive	DPH188	125	1.60	Cohesive
DPH189	100	1.00	Cohesive	DPH189	125	2.00	Cohesive
DPH190	80	1.00	Cohesive	DPH190	125	1.50	Cohesive
DPH191	100	1.00	Cohesive	DPH191	125	1.50	Cohesive
DPH192	N/A			DPH192	125	1.40	
DPH193	80	1.00	Cohesive	DPH193	125	1.40	Cohesive
DPH194	100	1.20	Cohesive	DPH194	125	2.20	Cohesive
DPH195	80	1.00	Cohesive	DPH195	125	1.70	Cohesive
DPH196	80	1.00	Cohesive	DPH196	125	1.50	Cohesive
DPH197	N/A			DPH197	125	2.00	Cohesive
DPH198	125	1.00	Cohesive	DPH198			
DPH199	100	1.00	Cohesive	DPH199	125	1.90	Cohesive
DPH200	125	1.20	Cohesive	DPH200			
DPH201	N/A			DPH201	125	2.20	Cohesive
DPH202	N/A			DPH202	125	1.60	Cohesive
DPH203	125	1.00	Cohesive	DPH203			
DPH204	80	1.00		DPH204	125	2.00	
DPH205	125	1.20		DPH205			
DPH206	125	1.00	Cohesive	DPH206			
DPH207	N/A			DPH207	125	1.40	Cohesive
DPH208	125	1.20	Cohesive	DPH208			
DPH209	125	1.20		DPH209			
DPH210	80	1.10	Cohesive	DPH210	125	2.00	Cohesive
DPH211	125	1.20		DPH211			
DPH212	80	1.10	Cohesive	DPH212	125	1.50	Cohesive
DPH213	80	1.00	Cohesive	DPH213	125	1.50	Cohesive
DPH214	80	1.00	Cohesive	DPH214	125	1.50	Cohesive
DPH215	N/A			DPH215	125	1.50	Cohesive
DPH216	125	1.10	Cohesive	DPH216			
DPH217	80	1.00	Cohesive	DPH217	125	1.50	Cohesive
DPH218	125	1.00	Cohesive	DPH218			
DPH219	100	1.00	Cohesive	DPH219			
DPH220	80	1.00	Cohesive	DPH220			
DPH221	80	1.00	Cohesive	DPH221	125	2.00	Cohesive
DPH222	80	1.00	Cohesive	DPH222	125	1.70	Cohesive
DPH223	100	1.20	Cohesive	DPH223	125	2.00	Cohesive
DPH224	N/A			DPH224	125	1.80	Cohesive

DPH225	N/A			DPH225	125	1.80	Cohesive
DPH226	125	1.20	Cohesive	DPH226			

An allowable bearing capacity of 250 kN/m² is recommended for conventional strip or pad foundations on the stiff cohesive deposits at a depth of 2.0m BGL the location of BH11 and BH19.

A ground bearing floor slab is recommended to be based on the firm to stiff cohesive deposits with an appropriate depth of compacted hardcore specified by the consulting engineer and in accordance with the limits and guidelines in SR21:2014 +A1:2016 and/or NRA SRW CL808 Type E granular stone fill. Where the depth of Made Ground/Soft deposits exceeds 0.9m then suspended floor slabs should be considered. The pH and sulphate testing completed on samples recovered from the exploratory holes indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack. The samples tested were below the limits of DS1 in the BRE Special Digest 1:2005.

5.3. External Pavements

The proposed pavements are recommended to be designed in accordance with the CBR test results included in the Appendices of this Report. The low CBR test results indicate that a capping layer or a sufficient depth of crushed stone fill may be required. Plate bearing tests are recommended at the time of construction to verify the design assumptions for the proposed pavement make up and to verify adequate compaction has been achieved.

The use of a geogrid and separation membrane may improve the performance of the proposed pavement and enable a more economical pavement design to be achieved, a specialist supplier is recommended to advise of the required strength, depth and type of geotextile for the proposed design.

5.4. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.

Excavations in the Made Ground or soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.

Any excavations which penetrate the granular deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.

The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations.

Any waste material to be removed off site should be disposed of to a suitably licenced landfill.

The environmental testing completed during the ground investigation is reported under the cover of a separate GII Waste Classification/Subsoil Assessment Report.

5.5. Soakaway Design

At the locations IT09 and IT11 the water level dropped too slowly to allow calculation of 'f' the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



www.gii.ie

Appendix F : IW CONFIRMATION OF FEASIBILITY AND STATEMENT OF DESIGN ACCEPTANCE

CONFIRMATION OF FEASIBILITY

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www.water.ie

3 October 2023

**Our Ref: CDS23007102 Pre-Connection Enquiry
Ballymastone, Donabate, Dublin**

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 364 unit(s) at Ballymastone, Donabate, Dublin, (the **Development**).

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

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

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

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

Stiúrthóirí / Directors: Tony Keohane (Cathaoirleach / Chairman), Niall Gleeson (POF / CEO), Christopher Banks, Fred Barry, Gerard Britchfield, Liz Joyce, Patricia King, Eileen Maher, Cathy Mannion, Michael Walsh.

Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin, Ireland D01NP86

Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Uisce Éireann is a design activity company, limited by shares. Cláraithe in Éirinn Uimh.: 530363 / Registered in Ireland No.: 530363.

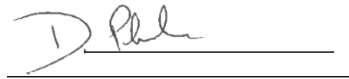
Where can you find more information?

- **Section A** - What is important to know?

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

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

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'D. Phelan', is written over a horizontal line. Below this line is another horizontal line, creating a space for a printed name.

Dermot Phelan
Connections Delivery Manager

Section A - What is important to know?

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

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

Jack O'Callaghan
DBFL Cons. Engineers
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12 September 2025

**Re: Design Submission for Site At, Ballymastone, Donabate, Dublin (the “Development”)
(the “Design Submission”) / Connection Reference No: CDS25002479**

Dear Jack O'Callaghan,

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, Uisce Éireann has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before you can connect to our network you must sign a connection agreement with Uisce Éireann. This can be applied for by completing the connection application form at www.water.ie/connections. Uisce Éireann'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 Uisce Éireann's network(s) (the “**Self-Lay Works**”), as reflected in your Design Submission. Acceptance of the Design Submission by Uisce Éireann does not, in any way, render Uisce Éireann liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Uisce Éireann representative:

Name: Alicia Ros Bernal

Email: ailciarosbernal.bernal@water.ie

Yours sincerely,



Dermot Phelan
Connections Delivery Manager

Stiúrthóirí / Directors: Niall Gleeson (POF / CEO), Jerry Grant (Cathaoirleach / Chairperson), Gerard Britchfield, Liz Joyce, Michael Nolan, Patricia King, Eileen Maher, Cathy Mannion, Paul Reid, Michael Walsh.

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Appendix A

Document Title & Revision

- 20003-DBF-XXXX-XX-DR-C01-133100 Proposed Overall Watermain Layout
- 20003-DBF-XXXX-XX-DR-C01-133000 Proposed Overall Drainage Layout
- 20003-DBF-XXXX-XX-DR-C01-333001 Foul Wastewater Longitudinal Section Sheet 1
- 20003-DBF-XXXX-XX-DR-C01-333002 Foul Wastewater Longitudinal Section Sheet 2
- 20003-DBF-XXXX-XX-DR-C01-333003 Foul Wastewater Longitudinal Section Sheet 3
- 20003-DBF-XXXX-XX-DR-C01-333004 Foul Wastewater Longitudinal Section Sheet 4
- 20003-DBF-XXXX-XX-DR-C01-333005 Foul Wastewater Longitudinal Section Sheet 5

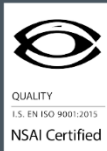
Additional Comments

The design submission will be subject to further technical review at connection application stage.

Uisce Éireann cannot guarantee that its Network in any location will have the capacity to deliver a particular flow rate and associated residual pressure to meet the requirements of the relevant Fire Authority, see Section 1.17 of Water Code of Practice.

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 Uisce Éireann will not, in any way, render Uisce Éireann liable for any elements of the design and/or construction of the Self-Lay Works.



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