Gaelcoláiste an Phiarsaigh, Rathfarnham

Infrastructure Design Report

190187-DBFL-XX-XX-RP-C-0001

INFRASTRUCTURE

April 2023

DBFL CONSULTING ENGINEERS

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Contents

Figures

Tables

1 Introduction

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for the proposed alteration and extension works at Gaelcoláiste an Phiarsaigh, Rathfarnham, Dublin 14. The project involves the refurbishment of existing buildings, the construction of a new link building and site works on the grounds of Gaelcoláiste an Phiarsaigh.

1.2 Objectives

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

- Site access and road layout,
- Surface water drainage strategy and servicing,
- Flood risk,
- Foul drainage strategy and servicing,
- Water supply and servicing.

1.3 Location

The subject site is located to the west of Grange Road, north of Convent Lane, and south of Dispensary Lane and Loreto Abbey. The site location is shown in Figure 1.1 below. The site is currently occupied by the existing school, Gaelcoláiste an Phiarsaigh and its associated facilities.

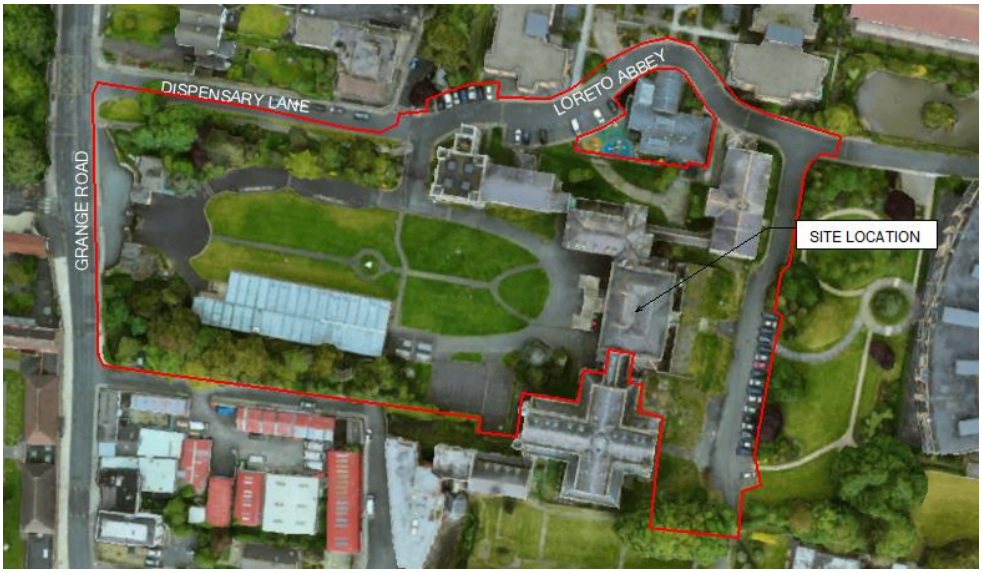


Figure 1-1: Site Location (Site Boundary Indicative Only)

1.4 Topography

A topographical survey of the site was carried out and is shown in the background of the Proposed Road Layout and Drainage Layouts (Refer to 190187-DBFL-RD-SP-DR-C-1211 and 190187-DBFL-CS-SP-DR-C-1311/1312).

The site is generally flat with a gentle slope from the south (Convent Lane) to the north (Dispensary Lane). The existing surface gradients across the site have been a key factor with regard to the surface water and foul drainage design.

1.5 Existing Ground Conditions

Preliminary ground investigations were carried out by Ground Investigations Ireland (GII) in October 2020 (Refer to GII's Site Investigation Report appended).

A layer of sandy gravelly topsoil was encountered to a maximum depth of 300 mm towards the northeast of the site, with a sandy gravelly made soil below, occasionally consisting of cobbles red brick, concrete fragments, and glass fragments. Other areas consisted of similar made soil from surface level. Cohesive deposits comprising of sandy gravelly CLAY with occasional cobbles and boulders were encountered beneath the Made Ground.

Infiltration tests were carried out at three locations (refer Site Investigation Report appended). Low infiltration rate of f=4.09 x 10-6 m/s was calculated for the soakaway location IT01 while infiltration was not recorded at the remaining test locations indicating low permeability soils close to all proposed attenuation tanks. Taking a conservative approach, infiltration has not been allowed for in the design although an element of infiltration would still be possible (i.e. ground is not impermeable).

Groundwater was not observed in the vicinity of the proposed attenuation tanks.

2 Site Access and Road Layout

2.1 Site Access

There are currently two vehicular entrances to the school grounds, one from Grange Road and the other from Dispensary Lane.

A separate vehicle entrance and exit has been proposed off Dispensary Lane. This allows for a one-way operating system with a set down area for vehicles dropping/collecting pupils. Dispensary Lane has a posted speed limit of 30 km/hour. The site entrance complies with minimum visibility splays as required by DMURS (Y Distance = 24m, X Distance =2.4m).

Access to and from the historical gates on Grange Road at the western side of the school grounds is to be closed off. This will contribute to a safer traffic management system through the grounds as there will be reduced cross movements and conflict.

A separate staff parking area has been provided to the east of the site, at the back of the school.

Good accessibility to and from the school grounds has been proposed with footpaths and raised crossings provided throughout the grounds.

2.2 Site Layout

DMURS Street Design guidelines are incorporated in the site's road layout. Refer to Drawing No. 190187-DBFL-RD-SP-DR-C-1211 for Roads Layout drawing.

2.3 Vehicle Tracking

The proposed site layout has been tracked (using AutoTrack software) to demonstrate that large vehicles such as fire tender and refuse vehicles can access and circulate around the site. Refer to Drawing No. 190187-DBFL-RD-SP-DR-C-1212.

2.4 Paving Design Standards

Pavement design at site access points and local streets within the development are to be designed in accordance with the Design Manual for Urban Roads and Streets (DMURS) and Local Authority

requirements. Actual CBR (California Bearing Ratio) values and ground conditions are to be confirmed by site specific investigations prior to construction, where required.

2.5 Traffic and Transportation

A separate Traffic and Transport Assessment has been prepared as part of this planning application (Refer to DBFL Report 190187-DBFL-TR-XX-RP-C-0001).

3 Surface Water Drainage

3.1 Existing Surface Water Drainage

As noted in Section 1.4, the site is relatively flat with a gentle slope falling from Convent Lane, south of the site, to Dispensary Road, north of the site.

An existing 525/600mm diameter public surface water drain is located to the north of the site along Dispensary Lane (refer to Figure 3.1 below). Existing surface water drainage networks within the site currently drain to this surface water infrastructure.

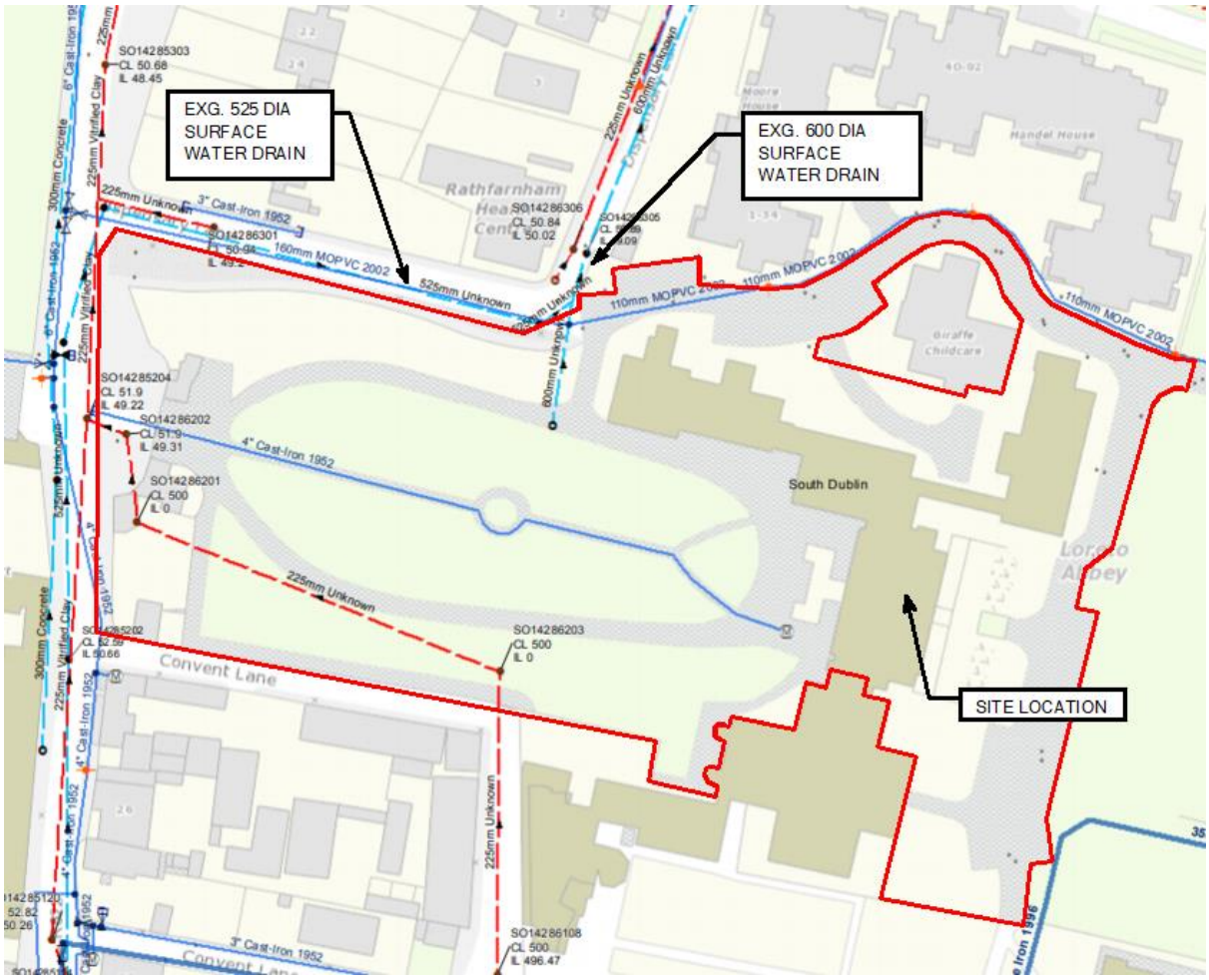


Figure 3-1: Extract from Irish Water's Network Plan.

3.2 Basis of Design

3.2.1 General Description of Surface Water Design

An overall surface water drainage strategy has been developed by DBFL Consulting Engineers for the development site. Refer to DBFL Drawing 190187-DBFL-CS-SP-DR-C-1312 Surface Water Drainage Layout.

There are 3 no. surface water catchments, each with separate discharge points due to the layout of the existing site. As such, each surface water catchment is assessed separately.

Surface water runoff for each catchment will be attenuated to greenfield runoff rates (Qbar) in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) before discharging to the existing drainage network to the east and north of the school. Refer to Appendix C for Qbar Calculations.

Surface water discharge rates from each catchment will be controlled by a vortex flow control device (Hydrobrake or equivalent) and associated underground attenuation tanks (Stormtech Chambers or equivalent). Surface water discharge will also pass via a full retention fuel / oil separator (sized in accordance with permitted discharge rate from the site).

Surface water runoff from the site's internal street network, parking areas and internal courtyards will be captured by SUDs features such as permeable areas and raingardens prior to being routed to the piped surface water drainage network.

3.2.2 Compliance with Surface Water Policy

The site's surface water management infrastructure has been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS).

The GDSDS (Vol. 2, Chapter 6.3.4) requires that the following design criteria are applied to all sites:

- Criterion 1:

River Water Quality Protection – Satisfied by providing interception storage and treatment of surface water run-off by means of SUDS features such as permeable areas, raingardens, underground attenuation tanks and full retention fuel / oil separators at surface water discharge points.

- Criterion 2:

River Regime Protection – Satisfied by attenuating surface water run-off in association with flow control devices prior to discharge off site at greenfield runoff rate. Site critical duration storm used to assess attenuation volume.

- Criterion 3:

Level of Service (Flooding) for the Site – Satisfied by reviewing available flood hazard information (e.g. Eastern CFRAM Study) relating to the sites proximity to fluvial flood plains (up to 1 in 100-year flood event).

Also refer to DBFL Report No. 190187-DBFL-XX-XX-RP-C-002 (Site Specific Flood Risk Assessment).

- Criterion 4:

River Flood Protection – Satisfied by attenuating surface water discharge to greenfield runoff rates, addressing pluvial flood risk associated with the 1 in 100 year storm and avoiding development in flood plains.

3.2.3 Design Standards

Proposed surface water drains have been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal" and BS EN 752: 2008 Drain and Sewer Systems Outside Buildings.

Design Criteria:

• Return period for pipe work design	5 years
• Return period for attenuation design	100 years
• Soil Type	2
• Allowable Outflow	2 l/sec/ha
• Time of entry	4 minutes
• M5 - 60	18.4 mm
• Ratio "r"	0.276

• Pipe Friction (Ks) 0.6 mm

• Minimum Velocity (based on pipe flowing full) 1.0 m/s

• Rainfall Depth Factored for Climate Change (as per GDSDS) 20%

(in accordance with GDSDS Volume 2, Chapter 6, Table 3.1 – see below)

Table 3-1: Climate Change Factor to be Applied to Drainage Design

Climate Change Category	Characteristics
River flows	20% increase in flows for all return periods up to 100 years
Sea level	400+mm rise (see Climate Change policy document for sea levels as a function of return period)
Rainfall	10% increase in depth (factor all intensities by 1.1)
	Modify time series rainfall in accordance with the GDSDS climate change policy document

3.2.4 SuDS

The following methodologies are being implemented as part of the SuDS treatment train approach:

- Surface water runoff from the site's internal street network and new parking areas will be captured by permeable surfacing prior to being routed to the piped surface water drainage network.
- Surface water runoff from a portion of the internal street network and internal courtyard area will be captured by raingardens prior to being routed to the piped surface water drainage network.
- Attenuation of the 1 in 100 year return period storms in underground attenuation chambers (Stormtech). Note: Our calculation has not allowed for any infiltration when calculating the attenuation volume.
- Installation of vortex flow control devices (Hydrobrake or equivalent), limiting surface water discharge from the site to 2 l/s for each catchment.

3.2.5 Proposed Runoff Coefficients and Factored Impermeable Areas

Proposed Runoff Coefficient

- Impermeable Areas – Runoff Coefficient 0.95
  A 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing.

- Areas captured by SUDS – Runoff Coefficient 0.80
  Reduction of velocity as the aggregate/filter material used in the SuDS features (permeable paving and raingardens) slows the run-off at source ultimately reducing the peak inflow for the attenuation calculations.

- Soft Landscaped / Grassed Areas – Runoff Coefficient 0.30
  Grassed / Landscaped areas slows the run-off at source ultimately reduce the peak inflow for attenuation calculations.

Factored Impermeable Areas

	Roof/ Impermeable areas	Areas draining to SUDS features	Landscaped Area	Total (m^2)	Total (ha)
Runoff Coefficients	0.95	0.80	0.30		
Gross Areas (m^2)	2678	3615	3340	**9,632**	**0.96**
Impermeable Areas (m^2)	2544	2892	1002	**6,437**	**0.6**

Table 3-2 Proposed Runoff Coefficients and Factored Impermeable Areas

3.2.6 Attenuation Calculation

Attenuation volumes have been calculated based on an allowable discharge rate of 2 l/sec/Ha or Qbar, whichever is greater.

Due to the topography and site layout, it is proposed that the site be divided into 3 No. separate catchments, each containing an attenuated storage system. Run-off from each catchment will be controlled / attenuated using vortex type flow control devices (Hydrobrake or equivalent).

The resultant storage system, discharge limits and storage volumes for each catchment are detailed in Table 3.2 below.

Catchment	Catchment Area (Total)	Impermeable Catchment Area (Total)	Allowable Outflow (Max.)	Storage Volume Required (100 Yr.)	Storage volume provided (30Yr. Below Ground)
A	0.714 Ha	0.433 Ha	2 l/s	299.8 m^3	320.9 m^3
B	0.156 Ha	0.13 Ha	2 l/s	60.1 m^3	60.8 m^3
C	0.093 Ha	0.077 Ha	2 l/s	32.8 m^3	34.4 m^3

Table 3-3: Surface Water Attenuation Storage and Discharge Limits

The locations of the proposed attenuation systems are shown on Drawing 190187-DBFL-CS-SP-DR-C-1312. Refer to Appendix A for Attenuation Design Calculations which have been carried out using Microdrainage analysis software.

3.2.7 Interception Volume

The GDSDS (Vol. 2, Table 6.3) requires interception storage to be incorporated into surface water drainage design in order to limit discharge of sediment and pollutants into the downstream surface water drainage network and receiving water courses.

This interception storage is designed to capture surface water run-off from rainfall depths of 5mm (and up to 10mm if possible).

The SuDS features included in the development (refer to Section 3.2.4) will provide the necessary interception volume required by the GDSDS (ie permeable areas, raingardens and within the stone backfill associated with the attenuation tank).

3.3 Flood Risk

A separate Site Specific Flood Risk Assessment has been prepared as part of this submission (refer to DBFL Report No. 190187-DBFL-XX-XX-RP-C-0002).

This flood risk assessment has been undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floods.ie) and the Eastern CFRAM Study and has been carried out in accordance with the OPW's Guidelines for Planning Authorities – The Planning System and Flood Risk Management (November 2009).

3.4 Surface Water Quality Impact

Run-off rates from the site are controlled by flow control devices.

Surface water management proposals for the development also incorporate the following impact reduction measures;

- Surface water network designed in accordance with GDSDS requirements
- Incorporates SUDS features e.g. permeable areas in the higher risk parking areas (i.e. treatment / filtration provided within the stone reservoir beneath permeable paving)
- Surface water attenuation (i.e. treatment / filtration provided within the granular surround of the Stormtech Chambers) in conjunction with a final Class 1 fuel / oil separator prior to discharge to the downstream surface water network.

4 Foul Drainage

4.1 Existing Foul Drainage

Existing 225mm diameter foul drainage networks are located north of the site on Dispensary Lane which extends north and east of the site. An existing 225mm diameter foul drainage sewer is also located along the site southern boundary (in vicinity of the existing temporary accommodation classrooms) which outfalls to the existing sewer infrastructure west of the site. Refer to Figure 4.1 below.

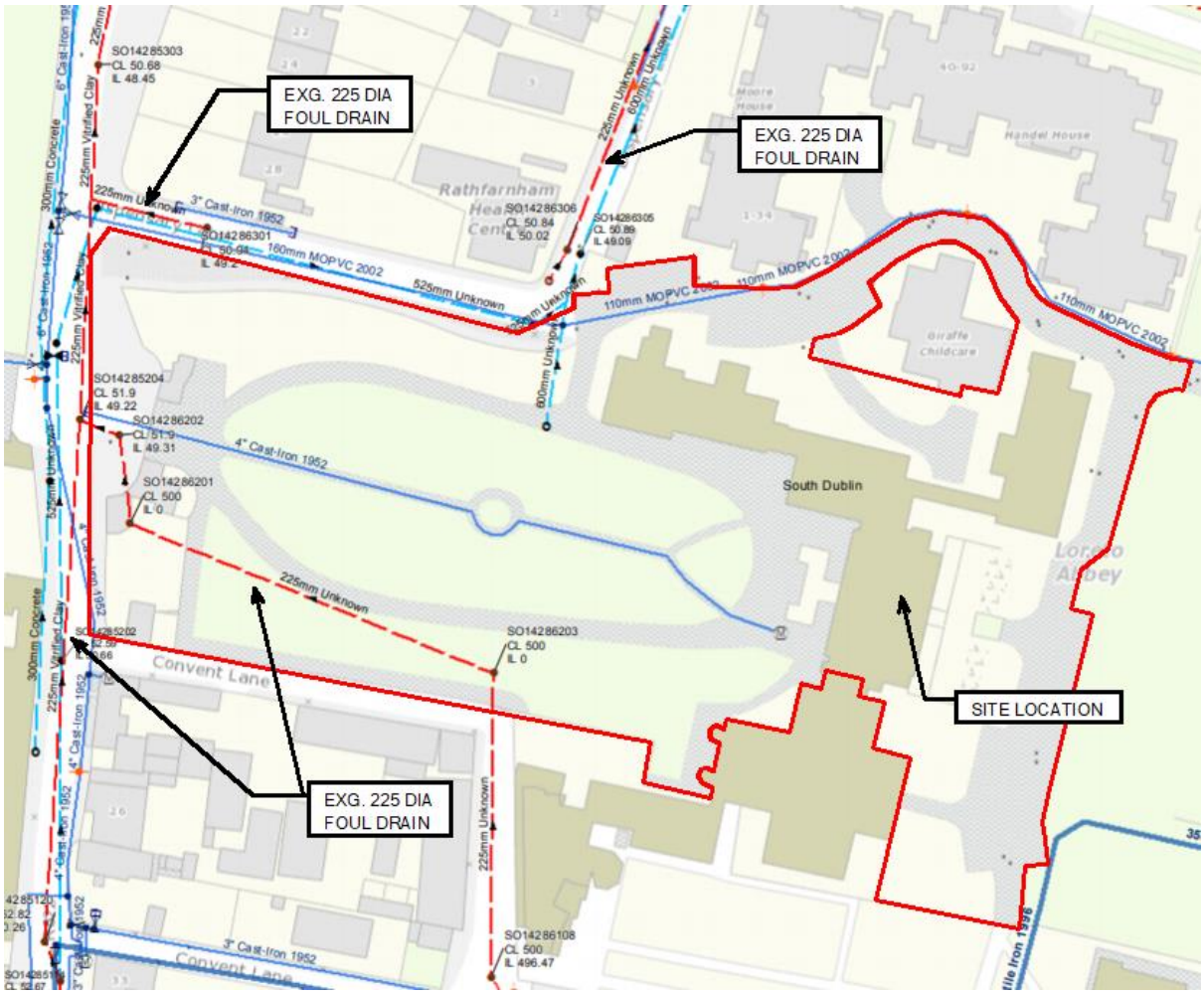


Figure 4-1: Extract from Irish Water's Network Plan

Proposed foul drainage works include removal of existing drainage lines to facilitate construction of the new link building and provision of new drains local to the school which facilitate the internal layout (location of WC's, hand basins etc.). Such drains will connect to the existing foul drainage infrastructure to the north and east of the site.

The proposed foul drainage upgrades for the site are shown on Drawing no. 190187-DBFL-CS-SP-DR-C-1311.

4.2 Pre-Connection Feedback from Irish Water

Pre-connection enquiry feedback has been received from Irish Water (included in Appendix B). Irish Water has advised as follows:

"Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time."

It also states that the wastewater connection is "Feasible without infrastructure upgrade by Irish Water".

4.3 Design Strategy

It is proposed to discharge foul drainage flows to the existing 225mm diameter foul sewer located along Dispensary Lane. Upgrades are also proposed to the existing infrastructure discharging southeast of the site, behind the existing school building.

4.4 Design Calculations

The foul drainage network for the proposed development has been designed in accordance with the following guidelines:

- Irish Water Code of Practice for Wastewater Infrastructure
- Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal"
- BS EN 752: 2008 Drain and Sewer Systems Outside Buildings
- IS EN 12056: Part 2 (2000) Gravity Drainage Systems Inside Buildings

4.5 Foul Drainage – Environmental Impacts

Waste Water Discharge Calculation

(as outlined in Irish Water's Pre-Connection Enquiry Application Form)

No. of Students	500
Post Development Average Discharge (Over 7 hours)	0.99 l/sec
Post Development Peak Discharge	5.95 l/sec

5 Water Supply and Distribution

5.1 Existing Public Watermains

The buildings on the site including Gaelcholáiste an Phiarsaigh and the existing temporary accommodation classrooms are served by a 4 inch cast-iron watermain traversing the site. An existing 6" diameter cast iron watermain is also located along Grange Road west of the site. Refer to Figure 5.1 below.

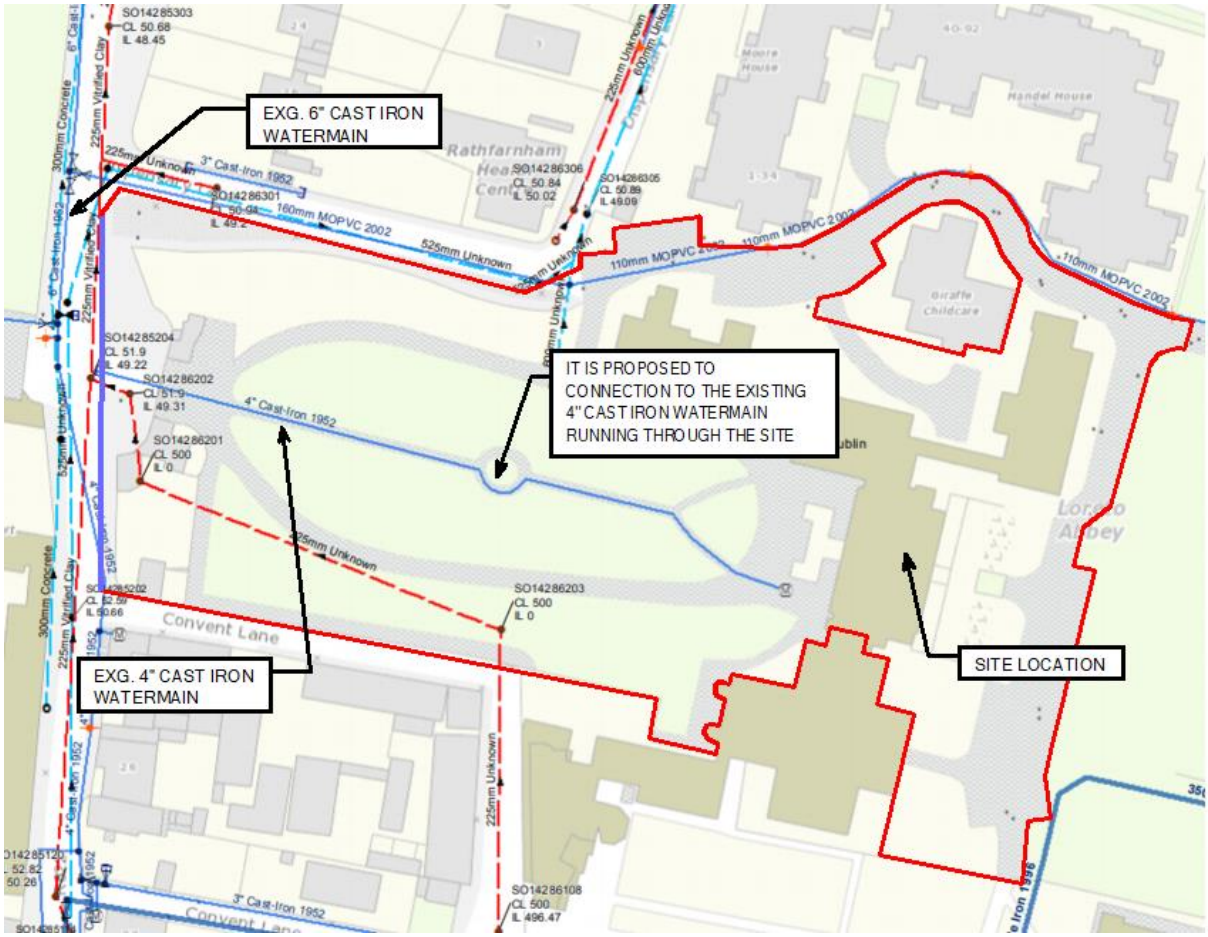


Figure 5-1: Existing Watermain Layout

5.2 Proposed Watermain Layout

It is proposed that the existing watermain infrastructure will service the proposed development. Refer to DBFL Drawing no. 190187-DBFL-WM-SP-DR-C-1411 for the proposed Watermain Layout. The construction of approximately 50m of 100mm ID new main may be required to facilitate the connection as stipulated below in the pre- connection feedback from Irish Water. This will be agreed at connection application stage.

5.3 Pre-Connection Feedback from Irish Water

Pre-connection enquiry feedback has been received from Irish Water (included in Appendix B). Irish Water has advised as follows:

"Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time."

Irish Water also stated that "In order to accommodate the proposed connection to Irish Water network at the Premises the following works are required:

- Connection Main - 50 metres (approx.) of 100mm ID new main to be connected to the existing 6" CI
- On site storage for the average day peak week demand of the commercial section. Separate storage is required to supply this demand for 24 hours and have a re-fill time of 12 hours."

The details of the extent of these works can be clarified during the connection application process.

5.4 Hydrants

Review of the topographic survey indicates existing hydrants are located to the east and west of Loreto Abbey, adjacent to the access off Grange Road and around the school grounds. These hydrants appear to be located such that all buildings are a maximum of 46.0m from a hydrant in accordance with the Department of the Environment's Building Regulations "Technical Guidance Document Part B Fire Safety".

Due to the realignment of the road and parking areas to the back of the school, an existing hydrant will need to be relocated. It is recommended that hydrant locations are reviewed as part of the overall fire safety strategy for the development. Refer to watermain layout drawing no. 190187-DBFL-WM-SP-DR-C-1411 for hydrant locations.

5.5 Materials

Proposed water mains are to be HDPE 100 SDR17.

Appendix A: Attenuation Calculation

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

Half Drain Time : 1664 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	49.977	0.325	0.0	1.5	1.5	77.9	O K
30 min Summer	50.096	0.444	0.0	1.5	1.5	106.2	O K
60 min Summer	50.220	0.568	0.0	1.5	1.5	135.9	O K
120 min Summer	50.353	0.701	0.0	1.5	1.5	167.8	O K
180 min Summer	50.434	0.782	0.0	1.5	1.5	187.2	O K
240 min Summer	50.492	0.840	0.0	1.5	1.5	201.0	O K
360 min Summer	50.571	0.919	0.0	1.5	1.5	219.9	O K
480 min Summer	50.622	0.970	0.0	1.6	1.6	232.2	O K
600 min Summer	50.658	1.006	0.0	1.6	1.6	240.8	O K
720 min Summer	50.683	1.031	0.0	1.6	1.6	246.8	O K
960 min Summer	50.712	1.060	0.0	1.6	1.6	253.9	O K
1440 min Summer	50.730	1.078	0.0	1.6	1.6	258.0	O K
2160 min Summer	50.730	1.078	0.0	1.6	1.6	258.0	O K
2880 min Summer	50.717	1.065	0.0	1.6	1.6	254.9	O K
4320 min Summer	50.678	1.026	0.0	1.6	1.6	245.5	O K
5760 min Summer	50.632	0.980	0.0	1.6	1.6	234.6	O K
7200 min Summer	50.585	0.933	0.0	1.5	1.5	223.3	O K
8640 min Summer	50.537	0.885	0.0	1.5	1.5	211.8	O K
10080 min Summer	50.489	0.837	0.0	1.5	1.5	200.5	O K
15 min Winter	50.017	0.365	0.0	1.5	1.5	87.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.305	0.0	75.9	19
30 min Summer	66.658	0.0	102.5	34
60 min Summer	43.030	0.0	138.1	64
120 min Summer	27.070	0.0	173.4	124
180 min Summer	20.492	0.0	196.1	184
240 min Summer	16.780	0.0	212.6	242
360 min Summer	12.632	0.0	231.6	362
480 min Summer	10.315	0.0	235.1	482
600 min Summer	8.810	0.0	235.4	602
720 min Summer	7.744	0.0	235.2	722
960 min Summer	6.316	0.0	234.6	960
1440 min Summer	4.738	0.0	235.8	1256
2160 min Summer	3.548	0.0	412.2	1648
2880 min Summer	2.887	0.0	443.5	2048
4320 min Summer	2.156	0.0	428.5	2896
5760 min Summer	1.752	0.0	545.7	3696
7200 min Summer	1.491	0.0	580.5	4544
8640 min Summer	1.307	0.0	610.4	5360
10080 min Summer	1.170	0.0	636.7	6160
15 min Winter	97.305	0.0	84.8	19

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	50.150	0.498	0.0	1.5	1.5	119.2	O K
60 min Winter	50.289	0.637	0.0	1.5	1.5	152.5	O K
120 min Winter	50.440	0.788	0.0	1.5	1.5	188.7	O K
180 min Winter	50.533	0.881	0.0	1.5	1.5	210.9	O K
240 min Winter	50.599	0.947	0.0	1.5	1.5	226.8	O K
360 min Winter	50.692	1.040	0.0	1.6	1.6	248.9	O K
480 min Winter	50.753	1.101	0.0	1.7	1.7	263.7	O K
600 min Winter	50.798	1.146	0.0	1.7	1.7	274.3	O K
720 min Winter	50.830	1.178	0.0	1.7	1.7	282.0	O K
960 min Winter	50.872	1.220	0.0	1.7	1.7	292.1	O K
1440 min Winter	50.904	1.252	0.0	1.8	1.8	299.8	O K
2160 min Winter	50.899	1.247	0.0	1.7	1.7	298.5	O K
2880 min Winter	50.881	1.229	0.0	1.7	1.7	294.2	O K
4320 min Winter	50.817	1.165	0.0	1.7	1.7	278.9	O K
5760 min Winter	50.742	1.090	0.0	1.6	1.6	260.8	O K
7200 min Winter	50.664	1.012	0.0	1.6	1.6	242.3	O K
8640 min Winter	50.588	0.936	0.0	1.5	1.5	224.0	O K
10080 min Winter	50.513	0.861	0.0	1.5	1.5	206.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	66.658	0.0	112.2	33
60 min Winter	43.030	0.0	154.6	64
120 min Winter	27.070	0.0	193.6	122
180 min Winter	20.492	0.0	217.6	180
240 min Winter	16.780	0.0	231.9	240
360 min Winter	12.632	0.0	238.6	356
480 min Winter	10.315	0.0	239.8	472
600 min Winter	8.810	0.0	240.7	588
720 min Winter	7.744	0.0	241.6	702
960 min Winter	6.316	0.0	244.6	930
1440 min Winter	4.738	0.0	250.2	1358
2160 min Winter	3.548	0.0	459.7	1728
2880 min Winter	2.887	0.0	477.3	2188
4320 min Winter	2.156	0.0	452.7	3112
5760 min Winter	1.752	0.0	611.2	4032
7200 min Winter	1.491	0.0	650.1	4904
8640 min Winter	1.307	0.0	683.5	5792
10080 min Winter	1.170	0.0	712.5	6656

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.400	Shortest Storm (mins)	15
Ratio R	0.276	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.433

Time (mins) From:	To:	Area (ha)
0	4	0.433

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

Half Drain Time : 356 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	50.929	0.239	0.0	1.5	1.5	22.7	O K
30 min Summer	51.012	0.322	0.0	1.5	1.5	30.6	O K
60 min Summer	51.091	0.401	0.0	1.5	1.5	38.1	O K
120 min Summer	51.165	0.475	0.0	1.5	1.5	45.1	O K
180 min Summer	51.202	0.512	0.0	1.5	1.5	48.6	O K
240 min Summer	51.222	0.532	0.0	1.5	1.5	50.6	O K
360 min Summer	51.236	0.546	0.0	1.5	1.5	51.8	O K
480 min Summer	51.237	0.547	0.0	1.5	1.5	52.0	O K
600 min Summer	51.234	0.544	0.0	1.5	1.5	51.6	O K
720 min Summer	51.227	0.537	0.0	1.5	1.5	51.1	O K
960 min Summer	51.209	0.519	0.0	1.5	1.5	49.3	O K
1440 min Summer	51.164	0.474	0.0	1.5	1.5	45.1	O K
2160 min Summer	51.094	0.404	0.0	1.5	1.5	38.4	O K
2880 min Summer	51.029	0.339	0.0	1.5	1.5	32.2	O K
4320 min Summer	50.926	0.236	0.0	1.5	1.5	22.4	O K
5760 min Summer	50.858	0.168	0.0	1.4	1.4	16.0	O K
7200 min Summer	50.816	0.126	0.0	1.3	1.3	12.0	O K
8640 min Summer	50.789	0.099	0.0	1.3	1.3	9.4	O K
10080 min Summer	50.774	0.084	0.0	1.2	1.2	8.0	O K
15 min Winter	50.959	0.269	0.0	1.5	1.5	25.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.305	0.0	23.4	18
30 min Summer	66.658	0.0	32.2	33
60 min Summer	43.030	0.0	41.8	62
120 min Summer	27.070	0.0	52.6	122
180 min Summer	20.492	0.0	59.8	182
240 min Summer	16.780	0.0	65.3	240
360 min Summer	12.632	0.0	73.7	338
480 min Summer	10.315	0.0	80.3	396
600 min Summer	8.810	0.0	85.7	464
720 min Summer	7.744	0.0	90.4	528
960 min Summer	6.316	0.0	98.3	662
1440 min Summer	4.738	0.0	110.6	924
2160 min Summer	3.548	0.0	124.5	1320
2880 min Summer	2.887	0.0	135.0	1700
4320 min Summer	2.156	0.0	151.1	2416
5760 min Summer	1.752	0.0	163.9	3112
7200 min Summer	1.491	0.0	174.4	3752
8640 min Summer	1.307	0.0	183.5	4488
10080 min Summer	1.170	0.0	191.4	5144
15 min Winter	97.305	0.0	26.3	18

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

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30	min Winter	51.052	0.362	0.0	1.5	1.5	34.4	O K
60	min Winter	51.144	0.454	0.0	1.5	1.5	43.1	O K
120	min Winter	51.234	0.544	0.0	1.5	1.5	51.6	O K
180	min Winter	51.278	0.588	0.0	1.5	1.5	55.9	O K
240	min Winter	51.303	0.613	0.0	1.5	1.5	58.2	O K
360	min Winter	51.323	0.633	0.0	1.5	1.5	60.1	O K
480	min Winter	51.322	0.632	0.0	1.5	1.5	60.1	O K
600	min Winter	51.316	0.626	0.0	1.5	1.5	59.5	O K
720	min Winter	51.308	0.618	0.0	1.5	1.5	58.7	O K
960	min Winter	51.284	0.594	0.0	1.5	1.5	56.4	O K
1440	min Winter	51.213	0.523	0.0	1.5	1.5	49.7	O K
2160	min Winter	51.090	0.400	0.0	1.5	1.5	38.0	O K
2880	min Winter	50.989	0.299	0.0	1.5	1.5	28.4	O K
4320	min Winter	50.856	0.166	0.0	1.4	1.4	15.7	O K
5760	min Winter	50.792	0.102	0.0	1.3	1.3	9.7	O K
7200	min Winter	50.768	0.078	0.0	1.1	1.1	7.4	O K
8640	min Winter	50.757	0.067	0.0	1.0	1.0	6.4	O K
10080	min Winter	50.750	0.060	0.0	0.9	0.9	5.7	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30	min Winter	66.658	0.0	36.1	33
60	min Winter	43.030	0.0	46.9	62
120	min Winter	27.070	0.0	59.0	120
180	min Winter	20.492	0.0	67.0	178
240	min Winter	16.780	0.0	73.1	234
360	min Winter	12.632	0.0	82.6	344
480	min Winter	10.315	0.0	89.9	446
600	min Winter	8.810	0.0	96.0	482
720	min Winter	7.744	0.0	101.3	558
960	min Winter	6.316	0.0	110.1	714
1440	min Winter	4.738	0.0	123.9	1024
2160	min Winter	3.548	0.0	139.4	1408
2880	min Winter	2.887	0.0	151.2	1784
4320	min Winter	2.156	0.0	169.3	2460
5760	min Winter	1.752	0.0	183.6	3104
7200	min Winter	1.491	0.0	195.4	3712
8640	min Winter	1.307	0.0	205.5	4408
10080	min Winter	1.170	0.0	214.4	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.400	Shortest Storm (mins)	15
Ratio R	0.276	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.130

Time (mins) From:	To:	Area (ha)
0	4	0.130

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

Half Drain Time : 155 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	50.606	0.386	0.0	1.9	1.9	15.6	O K
30 min Summer	50.732	0.512	0.0	1.9	1.9	20.7	O K
60 min Summer	50.842	0.622	0.0	1.9	1.9	25.1	O K
120 min Summer	50.911	0.691	0.0	1.9	1.9	27.9	O K
180 min Summer	50.923	0.703	0.0	1.9	1.9	28.4	O K
240 min Summer	50.923	0.703	0.0	1.9	1.9	28.4	O K
360 min Summer	50.907	0.687	0.0	1.9	1.9	27.7	O K
480 min Summer	50.882	0.662	0.0	1.9	1.9	26.7	O K
600 min Summer	50.853	0.633	0.0	1.9	1.9	25.6	O K
720 min Summer	50.820	0.600	0.0	1.9	1.9	24.2	O K
960 min Summer	50.741	0.521	0.0	1.9	1.9	21.0	O K
1440 min Summer	50.609	0.389	0.0	1.9	1.9	15.7	O K
2160 min Summer	50.469	0.249	0.0	1.9	1.9	10.1	O K
2880 min Summer	50.389	0.169	0.0	1.8	1.8	6.8	O K
4320 min Summer	50.316	0.096	0.0	1.6	1.6	3.9	O K
5760 min Summer	50.295	0.075	0.0	1.3	1.3	3.0	O K
7200 min Summer	50.284	0.064	0.0	1.1	1.1	2.6	O K
8640 min Summer	50.277	0.057	0.0	1.0	1.0	2.3	O K
10080 min Summer	50.273	0.053	0.0	0.9	0.9	2.1	O K
15 min Winter	50.656	0.436	0.0	1.9	1.9	17.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	97.305	0.0	16.9	18
30 min Summer	66.658	0.0	23.2	32
60 min Summer	43.030	0.0	30.0	62
120 min Summer	27.070	0.0	37.7	120
180 min Summer	20.492	0.0	42.9	152
240 min Summer	16.780	0.0	46.8	186
360 min Summer	12.632	0.0	52.8	254
480 min Summer	10.315	0.0	57.5	324
600 min Summer	8.810	0.0	61.4	394
720 min Summer	7.744	0.0	64.8	464
960 min Summer	6.316	0.0	70.5	588
1440 min Summer	4.738	0.0	79.3	836
2160 min Summer	3.548	0.0	89.1	1188
2880 min Summer	2.887	0.0	96.6	1528
4320 min Summer	2.156	0.0	108.2	2204
5760 min Summer	1.752	0.0	117.3	2936
7200 min Summer	1.491	0.0	124.8	3672
8640 min Summer	1.307	0.0	131.3	4376
10080 min Summer	1.170	0.0	137.0	5088
15 min Winter	97.305	0.0	19.0	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	50.802	0.582	0.0	1.9	1.9	23.5	O K
60 min Winter	50.929	0.709	0.0	1.9	1.9	28.6	O K
120 min Winter	51.016	0.796	0.0	1.9	1.9	32.1	O K
180 min Winter	51.032	0.812	0.0	1.9	1.9	32.8	O K
240 min Winter	51.028	0.808	0.0	1.9	1.9	32.6	O K
360 min Winter	51.003	0.783	0.0	1.9	1.9	31.6	O K
480 min Winter	50.963	0.743	0.0	1.9	1.9	30.0	O K
600 min Winter	50.916	0.696	0.0	1.9	1.9	28.1	O K
720 min Winter	50.864	0.644	0.0	1.9	1.9	26.0	O K
960 min Winter	50.732	0.512	0.0	1.9	1.9	20.7	O K
1440 min Winter	50.531	0.311	0.0	1.9	1.9	12.6	O K
2160 min Winter	50.374	0.154	0.0	1.8	1.8	6.2	O K
2880 min Winter	50.313	0.093	0.0	1.6	1.6	3.8	O K
4320 min Winter	50.287	0.067	0.0	1.2	1.2	2.7	O K
5760 min Winter	50.276	0.056	0.0	1.0	1.0	2.2	O K
7200 min Winter	50.270	0.050	0.0	0.8	0.8	2.0	O K
8640 min Winter	50.266	0.046	0.0	0.7	0.7	1.8	O K
10080 min Winter	50.262	0.042	0.0	0.6	0.6	1.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	66.658	0.0	26.0	32
60 min Winter	43.030	0.0	33.6	60
120 min Winter	27.070	0.0	42.3	116
180 min Winter	20.492	0.0	48.0	170
240 min Winter	16.780	0.0	52.4	194
360 min Winter	12.632	0.0	59.2	272
480 min Winter	10.315	0.0	64.4	350
600 min Winter	8.810	0.0	68.8	428
720 min Winter	7.744	0.0	72.6	504
960 min Winter	6.316	0.0	78.9	634
1440 min Winter	4.738	0.0	88.8	866
2160 min Winter	3.548	0.0	99.8	1188
2880 min Winter	2.887	0.0	108.2	1500
4320 min Winter	2.156	0.0	121.2	2192
5760 min Winter	1.752	0.0	131.4	2872
7200 min Winter	1.491	0.0	139.8	3640
8640 min Winter	1.307	0.0	147.0	4376
10080 min Winter	1.170	0.0	153.5	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	18.400	Shortest Storm (mins)	15
Ratio R	0.276	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.093

Time (mins) From:	To:	Area (ha)
0	4	0.093

Appendix B: Correspondence with Irish Water

Emma Daly

Ormond House
Upper Ormond Quay
Dublin 7
Co. Dublin
D07W704

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

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

www.water.ie

14 July 2021

Re: CDS20007567 pre-connection enquiry - Subject to contract | Contract denied

Connection for Business Connection of 1 unit(s) at Gaelcholaiste An Phiarsaigh, Rathfarnham, Co. Dublin

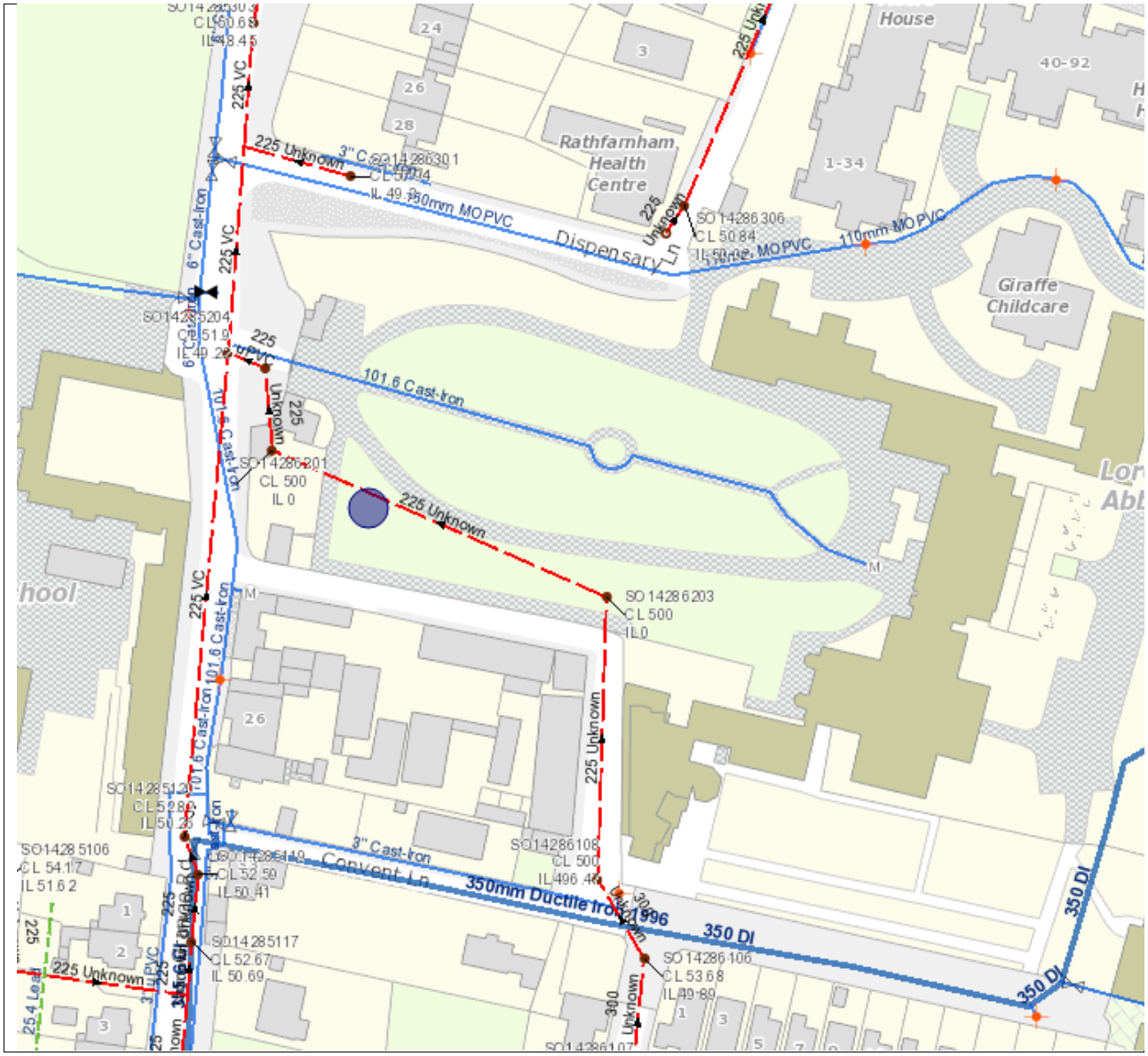
Dear Sir/Madam,

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

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	In order to accommodate the proposed connection to Irish Water network at the Premises the following works are required: • Connection Main - 50 metres (approx.) of 100mm ID new main to be connected from the site location to the existing 6" CI • On site storage for the average day peak week demand of the commercial section. Separate storage is required to supply this demand for 24 hours and have a re-fill time of 12 hours. Should you wish to progress with the connection you will be required to fund this extension.
Wastewater Connection	N/A

The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.

The map included below outlines the current Irish Water infrastructure adjacent to your site:



Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact

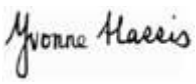
location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

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

If you have any further questions, please contact Marko Komso from the design team on 022 54611 or email mkomso@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

Appendix C: QBAR Calculations

S

PROJECT			JOB REF.
Gaelcholaiste an Phiarsaigh			190187
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations Allowable Outflow Catchment 1			1
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190187-DBFL-CS-SP-DR-C-1312	EJD	BK	11.01.2023

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Catchment Area

What is the overall site/catchment area? **0.71** Hectares (ha) Site is Less than 50 Hectares

(Area of site within catchment of new drainage networks excludes open space areas not within new drainage networks)

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

Catchment	1	
Area	0.71	Hectares (ha)
Drainage Group	1	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope (o)	1	Class
SOIL Type	**2**	rom FSR Table
[1]**SOIL Index**	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? Yes

How many sub-catchments? 2

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 813.0 mm

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 1.60 Litres/sec

[7]Site Discharge = **2.00** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{xs} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

PROJECT			JOB REF.
Gaelcholaiste an Phiarsaigh			190187
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations Allowable Outflow Catchment 2			2
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190187-DBFL-CS-SP-DR-C-1312	EJD	BK	11.01.2023

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Catchment Area

What is the overall site/catchment area? **0.16** Hectares (ha) Site is Less than 50 Hectares

(Area of site within catchment of new drainage networks excludes open space areas not within new drainage networks)

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

Catchment	2	
Area	0.16	Hectares (ha)
Drainage Group	1	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope [o]	1	Class
SOIL Type	2	from FSR Table
[1]SOIL Index	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? Yes

How many sub-catchments? 2

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 813.0 mm

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 0.40 Litres/sec

[7]Site Discharge = **2.00** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{xs} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

PROJECT			JOB REF.
Gaelcholaiste an Phiarsaigh			190187
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations Allowable Outflow Catchment 3			3
Drawing ref.	**Calculations by**	**Checked by**	**Date**
190187-DBFL-CS-SP-DR-C-1312	EJD	BK	11.01.2023

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Catchment Area

What is the overall site/catchment area? **0.09** Hectares (ha) Site is Less than 50 Hectares

(Area of site within catchment of new drainage networks excludes open space areas not within new drainage networks)

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

Catchment	3	
Area	0.09	Hectares (ha)
Drainage Group	1	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope [o]	1	Class
SOIL Type	**2**	rom FSR Table
[1]**SOIL Index**	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? Yes

How many sub-catchments? 2

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 813.0 mm

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 0.30 Litres/sec

[7]Site Discharge = **2.00** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{xs} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

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