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CORA
CONSULTING ENGINEERS

Glebe House, Crumlin Village, Crumlin, Dublin 12

Water Services Report

May 2022

Project Number: 1968

Issue 08

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VAT NO 3507892VH
CO. REG NO 608357
QF 19 ISSUE No 02
ISSUE DATE 16/01/18

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1 Introduction

1.1 General

This report has been prepared for Seabren Developments Ltd and Circle VHA CLG to address the water services for the proposed new development at Glebe House, Crumlin, Dublin 12.

Figure 1 Site Location Plan

1.2 Proposed Development

Seabren Developments Ltd and Circle VHA CLG intend to apply to An Bord Pleanála for planning permission for a strategic housing development at this site located at Glebe House (Protected Structure, RPS Ref. 7560), including the vacant Glebe light industrial lands, and the vacant site of the former Coruba House, Saint Agnes Road, Crumlin, Dublin 12 all on a site of 0.88 Hectares. The site bounds Somerville Drive and Somerville Green to the southeast and southwest, respectively, and includes the grass margin between the Coruba site boundary and Somerville Drive. The Glebe House lies within the Crumlin Architectural Conservation Area.

A residential development of 150 no. apartments consisting of 74 one beds, 72 two beds and 4 three bed residential units, a creche and café. The proposed scheme has an overall Gross Floor Area of 15,767 sq.m.

Two apartment buildings are proposed ranging in height from 4 – 6 storeys and linked by a carpark at ground floor and a podium at first floor level comprising the following:

- Block A is 5-6 storeys and consists of 79 apartments and includes 35 no. one beds and 44 no. two beds units, ESB substation/switch room/metering room of 85sqm, 42 no. secure bicycle storage and bin storage of 44sqm

- Block B is 4-5 storeys and consists of 66 apartments and includes 38 no. one beds, 25no. two beds and 3 no. three beds, a Creche of 147 sqm at ground floor level with associated outdoor area, ground floor plant rooms of 74sqm, ESB substations/switch room/metering room/telecoms of 89sqm, 188 no. secure bicycle storage spaces in two locations, 6 no. motorbike spaces and bin storage of 75sqm.

Two no.three storey pavilion buildings either side of Glebe House to accommodate:

- One number two storey duplex 2 bed apartment above one number 1 bed apartment at ground floor in the north west pavilion and,
- One number two storey duplex 2 bed apartment above a 55 sqm ground floor café, in the south east pavilion.

The repair of fire damaged elements (following a fire 21st April 2022) and the refurbishment of Glebe House, a protected structure, into two apartments, one number 2 bed unit at lower ground floor and one number 3 bed unit at upper ground and first floor;

- Repair of fire damaged elements including the replacement of all roof coverings and structure, replacement of all first floor timber stud walls, replacement of first floor rear return joists, replacement/repair of floor joists at first floor level, replacement of internal render to kitchen/dining area in rear return building and replacement/repair of stair from upper ground to first floor level,

  - the refurbishment of Glebe House including the removal of extensions to the rear and sides of the building, restoration of the façade, replacement of pvc windows with sliding sash windows and associated works to the interior and to the curtilage of Glebe House.

  - Lowering the front boundary wall and return boundary wall to the front of Glebe House.

Demolition of all workshops, offices and sheds to the rear and sides of Glebe House Demolition of boundary walls around the Coruba land on Somerville Drive, the front entrance and between Coruba and the Glebe lands. Demolition of non-original brick column's at St Agnes Road entrance to Glebe House (1,636 sqm).

75 car parking spaces are proposed:

- 66 no. car parking spaces (includes 2 Go Car spaces) in ground floor car park below podium and partly in Block A and 4 No. visitor car parking spaces in front of Glebe House all with vehicular access from St Agnes's Road
- 5 No. assigned car parking spaces on the eastern side of Block B with vehicular access from Somerville Drive.

The development provides 905 sqm of Public Open Space to the front and side of Glebe House, and within the southeast public plaza. with a pedestrian route to the side of the Café at Pavilion B and 1,632 sqm of Communal Open Space located at podium level and to the rear of Block A.

76 no. visitor bicycle parking spaces are provided in the public accessible areas of the site.

The application also includes the provision of a new footpath along the south-eastern boundary at Somerville Drive, a new controlled gate between Somerville Drive and St Agnes Road allowing public access through the site within daylight hours and a new pedestrian access from the public open space onto St. Agnes Road, boundary treatment, landscaping, Solar Panels on the roof of Blocks A and B, provision of 4 no. Microwave link dishes to be mounted on 2 No. steel support posts affixed to the lift shaft overrun on Block A, lighting, services and connections, waste management and other ancillary site development works to facilitate the proposed development.

1.3 Existing Drainage

The existing industrial units on site is served with a 300mm diameter vitrified clay combined sewer on St. Agnes Road. The existing drainage records also note a 225mm diameter concrete sewer on Somerville Drive to the rear (South) of the site.

A review of the Office of Public Works records in relation to flooding reveals that there has been no history of flooding to the site or in the general locality. A flood risk assessment has been carried out and details are contained in Section 5. The existing site layout has been detailed on CORA drawing CORA-1968-C.001.

1.4 Reference Publications used in the production of this Report

Code of Practice – Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. ≤ 10)
Greater Dublin Strategic Drainage Study – Volumes 1 to 6
Greater Dublin Regional Code of Practice for Drainage Works – Version 6.0
Technical Guidance Documents – Part H
Recommendations for Site Development Works for Housing Areas
BRE Digest 365 – Soakaway Design (2016)
Irish Water Codes of practice for Water and Wastewater Services.

2 Foul Waste Discharge

It is intended that the proposed development shall be used as Residential Apartments. The projected potential occupancy of the development would be 466 persons. The foul discharge shall be fully separate and be connected by gravity to the public combined sewers on St. Agnes Road Somerville Drive.

Foul calculations are as follows in accordance with Irish Water Codes of Practice.

3 bed unit: population equivalent	6No.
No. of units	4No.
No. of occupants (residents):	24No.
2 bed unit: population equivalent	4No.

No. of units	73No.
No. of occupants (residents):	292No.
1 bed unit: population equivalent	2No.
No. of units	75No.
No. of occupants (residents):	150No.
Wastewater Loading:	150 litres/day/person
Café Unit	
Area:	55m^2
Number of Occupants:	55 (Occupancy Factor 1.0)
Number of sittings per day:	3
Wastewater Loading:	10 litres/day/person
Creche	
Area:	147m^2
Number of Occupants:	82 (Occupancy Factor 1.8)
Wastewater Loading:	40litres/day/person
Residential Wastewater Loading= (24+292+150) x 150	= 69,900litres per day
Café Wastewater Loading= (55 x 3) x 10	= 1,650litres per day
Community Wastewater Loading= (82) x 40	= 3,289litres per day
Total Wastewater Loading=	**= 74,839litres per day**
Average Discharge (DWF) = 74,389/ (24 x 60 x 60)	= 0.923litres per second
Peak Discharge (6DWF) = 0.831l/s x 6	**= 5.54l/s**

Two separate foul connections are proposed. One 225mm diameter pipe is proposed to connect to the existing combined 300mm diameter sewer on St. Agnes Road and a separate 225mm diameter pipe to connect to the 225mm diameter concrete sewer on Somerville Drive.

The Foul Connection falling to St Agnes Road will serve proposed Block B, Pavilion 1 & 2 and Glebe House. The proposed wastewater loading for these units has been calculated at 37,039litres/day. This equates to an average discharge of 0.428l/sec with a peak discharge of 2.57l/sec.

The Foul Connection falling to Somerville Drive will serve the proposed units in Block A. The proposed wastewater loading for these units has been calculated at 37,800litres/day. This equates to an average discharge of 0.438l/sec with a peak discharge of 2.625l/sec

The capacity of a 225mm diameter pipe with a gradient of 1:80 would be approximately 18 litres per second which exceeds the potential outflow. Calculations for the proposed foul pipes are shown in Appendix I.

Irish Water have been engaged and have confirmed that the drainage network in the area has sufficient capacity and issued a statement of design acceptance for the proposed wastewater layout. The correspondence received from Irish Water is shown in Appendix B. Details of the proposed foul drainage are shown on CORA Drawing CORA-1968–C.002. Confirmation of design acceptance has also been received from Irish Water and a copy of same is included in Appendix B.

3 Surface Water Discharge

The existing site is predominantly covered by impermeable parking and industrial surfaces. Rain-water runoff is currently directed via existing gullies to the main public drainage networks. It is proposed to remove the hardstanding surfaces and replace with appropriate SuDS measures for the development.

The proposed development includes a number of separate structures. It is proposed to implement three stages of SuDS measures to deal with the rainwater falling on the roof areas. Green roofs will intercept and reduce the rainfall falling and discharging from the roof areas, Attenuation will be provided to control the discharge from the site and the storage volume will be designed to allow infiltration for smaller rainfall volumes.

It is proposed to provide green roof surfaces on the roofs of the new apartment structures in order to reduce the volume of surface water discharging from the building footprint. Surface water run-off from the green roofs and impervious areas shall be collected via new gravity pipe networks and directed to attenuation storage tanks where the discharge rate to the public system will be controlled at 2.0 litres/second in line with the Greater Dublin Strategic Drainage Study. A schematic of the proposed surface water layout for Block B is shown in figure 2. Separate networks Details of the proposed surface water drainage are shown on CORA Drawings CORA-1968-C002 & C.005.

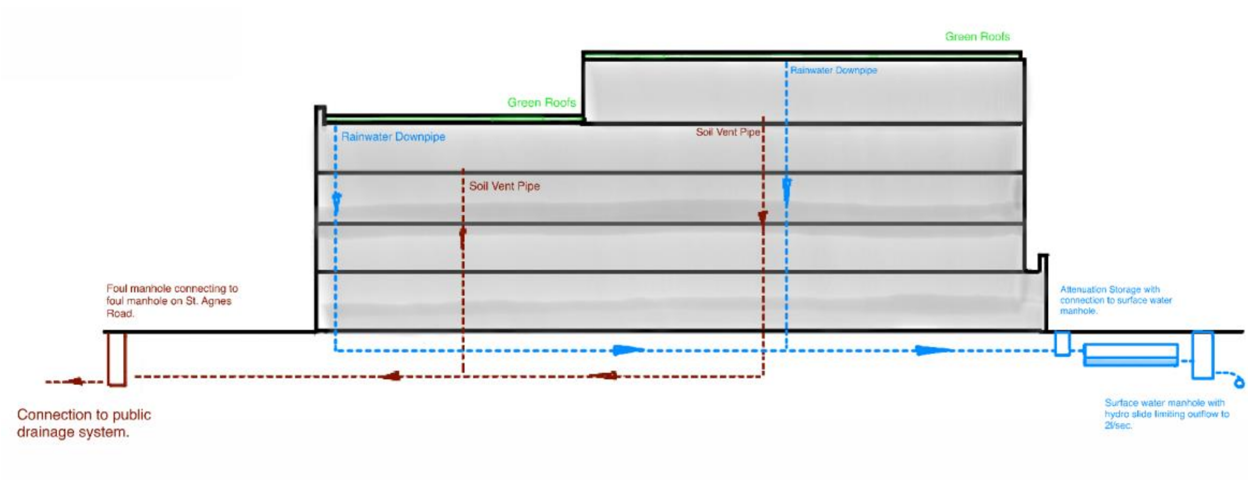


Figure 2 Drainage schematic cross section

2No. separate storage volumes will be provided across the site to cater for run off from Block A, Block B, respectively. The attenuation will be provided through Wavin Aquacell’s with a 95% voided volume. The Aquacell’s will be wrapped in a permeable geotextile material or an impermeable geomembrane. A separate soakaway will be provided for Glebe House and the Pavilion Building constructed for Wavin Aquacell's and wrapped in a terram geotextile.

The discharge from the storage volumes shall be limited to 2.0l/s through the use of a hydro-slide control valve located in the final surface water manhole before the outlet from the site. Calculations for the attenuation storage tanks are shown in the Appendix H for a 1 in 100 year event with a 30% climate change factor included. In conjunction with the climate change factor it has been conservatively assumed that the green roof shall provide a rainfall run-off reduction of only twenty five percent for calculation purposes. The tank serving Block A tanks will be installed to allow infiltration, However the volume provided has been calculated for a fully impermeable tank.

The following roof areas and corresponding storage volumes have been calculated.

	Roof Area	Attenuation Volume
Block A	1,486m^2	762m^3
Block B & podium	2,393m^2	159m^3
		Soakaway Volume
Glebe House & Pavilion Buildings	265m^2	49m^3

The proposed surface water drainage system is shown on CORA drawing CORA-1968-C002 with the extent of green roofs to be provided detailed on CORA drawing CORA-1968-C.005.

3.1 SuDS Measures

3.1.1 Green Roofs

The introduction of sections of green roof will serve to intercept, and reduce the outflow of rainfall generate from the roof area. For the proposed works the reduction in surface water run-off has been established at 25% (Bauder Green Roof Design Considerations). A Bauder Green Roof or a similar approved system will be utilised for the development. Coupled with a reduction in impermeable surfaces, there will be a reduction in the overall run-off from the site. The below graph represents the reduction in surface water runoff from the site for a 60 min rainfall with a return period of 1 year (excluding flow control/attenuation).

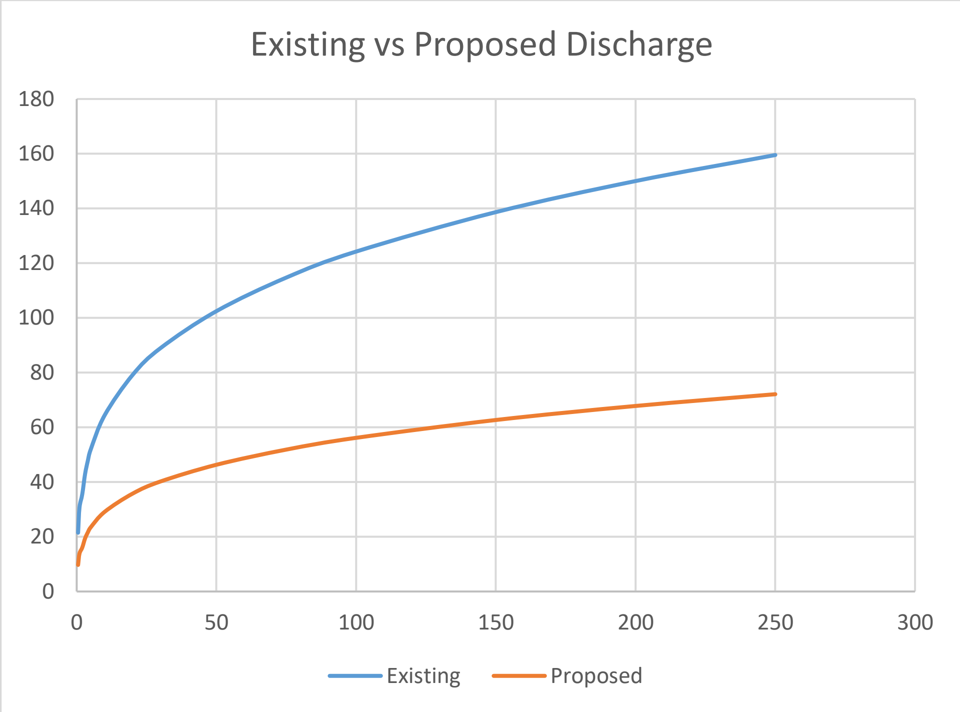


Figure 4 Reduction in site run-off

The proposed total green roof area is 744m². The Podium area of 756m² will also be installed with intensive landscaping which will provide the same interception and retention characteristics as a green roof.

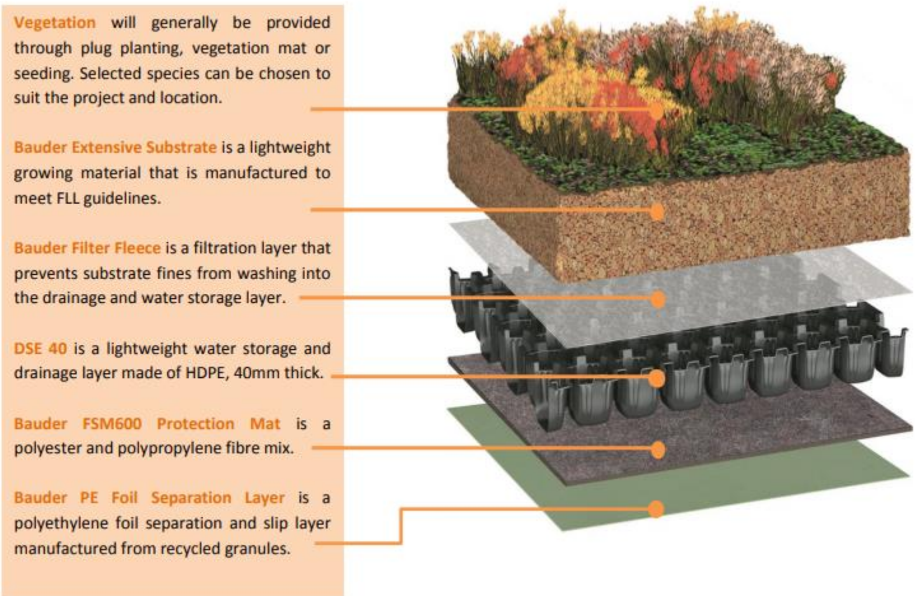


Figure 5 Bauder Green Roof Build up

The proposed surface water drainage schemes have been designed in accordance with Greater Dublin Strategic Drainage Study using sustainable drainage systems (SuDS).

3.1.2 Permeable Paving

Permeable paving is proposed for all paved areas throughout the site. In line with the SuDS manual CIRIA C753 Table 24.6, Permeable Pavements are assumed to be compliant for zero run-off from the first 5.0mm rainfall. The remaining ground level areas are landscaped, and the roof level areas will discharge to attenuation tanks, the permeable paving will not include for any additional contributory areas.

3.1.3 Attenuation

A flow control device will be fitted to the outlet manhole on the surface water network. The discharge from the surface water network shall be limited to 2.0l/s through the use of a hydro-slide control valve. The hydro-slide has been used in lieu of a hydro-break due to the larger orifice size and its ability to control head over varying flow rates. On occasions of significant storm events, where the outflow rate is exceeded the system will back up to in-line attenuation tanks. There will be two tanks within the site to cater for Building A, Building B structures respectively. Each tank has been sized for the respective tributary areas. The tank to Building A will be constructed with Wavin aquacell tanks with a 95% void ratio and wrapped in a Terram geotextile as minimum separation distances can be achieved to allow some infiltration to the ground. The tank to Building B will be constructed with Wavin aquacell tanks with a 95% void ratio and wrapped in an impermeable geomembrane as minimum setback distances cannot be achieved.

Calculations for each attenuation tank are shown in the Appendix G for a 1 in 100 year event with a 30% climate change factor included.

3.1.4 Soakaway

Soakaway tests have been conducted at each proposed location and the results are shown in appendix I. The tests show for the attenuation tanks to Building A and Building B, a soakaway will not work for a 1 in 100 year storm event as the infiltration rate is too low. There is insufficient area on site to increase the footprint sufficiently for the tank to act solely as a soakaway and as such the outlet is connected to the final manhole with the flow control device.

The surface water network to Glebe House and Pavilion buildings will discharge to a soakaway for a 1 in 100 year event. The soakaway will be treated as such for maintenance purposes with silt and leaf traps to be provided before entry and a maintenance plan drawn up.

3.2 Surface Water Impact Assessment

In line with the Greater Dublin Strategic Drainage Study, the following design criteria have been applied for the site;

3.2.1 Criterion 1 – River Water Quality Protection

As outlined in section 3.1 a number of SuDS measures are to be employed to ensure the quality of the surface water discharging from the development. Treatment of rainfall will be provided by Green Roofs, Landscaping, Silt traps and the Petrol interceptor.

3.2.2 Criterion 2 – River Regime Protection

Surface water discharge will be limited to 2.0l/s in line with the Dublin City Development Plan, through the use of a Hydro-slide flow control device. Attenuation storage has been provided for a 1 in 100 year event with a 30% climate change increase.

3.2.3 Criterion 3 – Level of Service (Flooding)

The following have been analysed for the new development;

1. There will be no flooding on the site for a 1 in 30 year rainfall event. The surface water drainage scheme has been designed for a 1 in 100 year rainfall event and will therefore have sufficient capacity for the lesser 1 in 30 year event.
2. There will be no internal property flooding for a 1 in 100 year high intensity rainfall event. As outlined above the surface water drainage scheme had been designed for a 1 in 100 year rainfall event. An allowance has been made for a 30% increase due to climate change.
3. There will be no internal property flooding for a 1 in 100 year river event and critical duration for the site. A separate flood risk assessment has been carried out which indicates a low pluvial risk to the property from a 1 in 100 year event. Please refer to CORA Site Specific Flood Risk Assessment.
4. No flooding of neighbouring properties during a 1 in 100 year high intensity event. As outlined above the surface water drainage scheme had been designed for a 1 in 100 year rainfall event. An allowance has been made for a 30% increase due to climate change.

3.2.4 Criterion 4 – River Flood Protection

Surface water discharge will be limited to 2.0l/s in line with the Dublin City Development Plan through the use of a Hydro-slide flow control device. Attenuation storage has been provided for a 1 in 100 year event with a 30% climate change increase.

4 Maintenance

4.1 Green Roofs

The Green Roof areas will be accessible through the lift and stair cores to allow for maintenance. The proposed development allows for a pathway around the footprint of the buildings. This allows for a cherry picker to access the smaller roof areas for maintenance and upkeep. A separate water feed will be provided to allow for irrigation of the green roofs during times of drought or low rainfall.

4.2 Attenuation tanks

Manhole access will be provided to each of the attenuation tanks. This will allow for flushing of silts or deposits that may build up over time. Separate Manholes with silt traps will be constructed up stream to each attenuation tank. Regular clearance of these will be included in the management and operation procedures for the development.

5 Construction of Surface Water Networks

The final phasing and construction methodology for the proposed drainage networks will be determined by the contractor and will be included in the overall construction programme. The below is an outline draft phasing for the construction of the drainage networks;

Stage 01: Block A - Internal drainage constructed as part of ground floor slab installation.
Stage 02: Block B – Internal drainage constructed as part of ground floor slab installation
Stage 03: Glebe House & Pavilions – Internal drainage constructed as part of ground floor slab installation.

Stage 04: Following completion of external finishes to Block A and removal of scaffolding, Installation of Block A attenuation tank in line with manufacturers details.
Stage 05: Connection of internal drainage network to Block A through external sub-surface network to Block A attenuation tank and completion of outlet pipes to final manhole 01 at exit of site. Installation of foul network drainage to final outfall manhole.

Stage 06: Following completion of external finishes to Block B and removal of scaffolding, Installation of Block B attenuation tank in line with manufacturers details.
Stage 07: Connection of internal drainage network to Block B through external sub-surface network to Block B attenuation tank and completion of outlet pipes to final manhole 01 at exit of site. Installation of foul network drainage to final outfall manhole.

Stage 08: Following completion of external finishes to Glebe House & Pavilions and removal of scaffolding, Installation of soakaway in line with manufacturers details.
Stage 09: Connection of internal drainage network to Glebe House & Pavilions through external sub-surface network to soakaway. Installation of foul network drainage to final outfall manhole.

Stage 10: Installation of flow control device and penstock valve on outfall manhole 01.
Stage 11: Final connection of outlet manhole 01 to respective foul and surface networks through coordination with Irish Water and Dublin City Council.

Stage 12: Final flushing/cleaning of networks and commissioning of both surface and foul systems.

6 Water Supply

The site is served with a 300mm diameter concrete water main on St. Agnus Road. It is proposed that new 100mm diameter MDPE supply be taken from this main and directed to the water storage tanks located in Block A & Block B. Two separate 80mm MDPE water mains will be taken to serve the café and crèche. Details of the proposed connection are shown on CORA drawing CORA-1968-C.003. Irish Water have been engaged and have issued a statement of design acceptance for the proposed watermain layout.

As part of confirmation of feasibility, a section of the existing water main on St. Agnes road is to be replaced by Irish Water. The existing 4-inch cast iron water main is to be replaced with a 200mm water main to the extent indicated by Irish Water. The applicants will pay a contribution to IW for the carrying out of these works by the statutory authority. The Irish Water Confirmation of feasibility and statement of design acceptance for the proposed connection is attached in Appendix B.

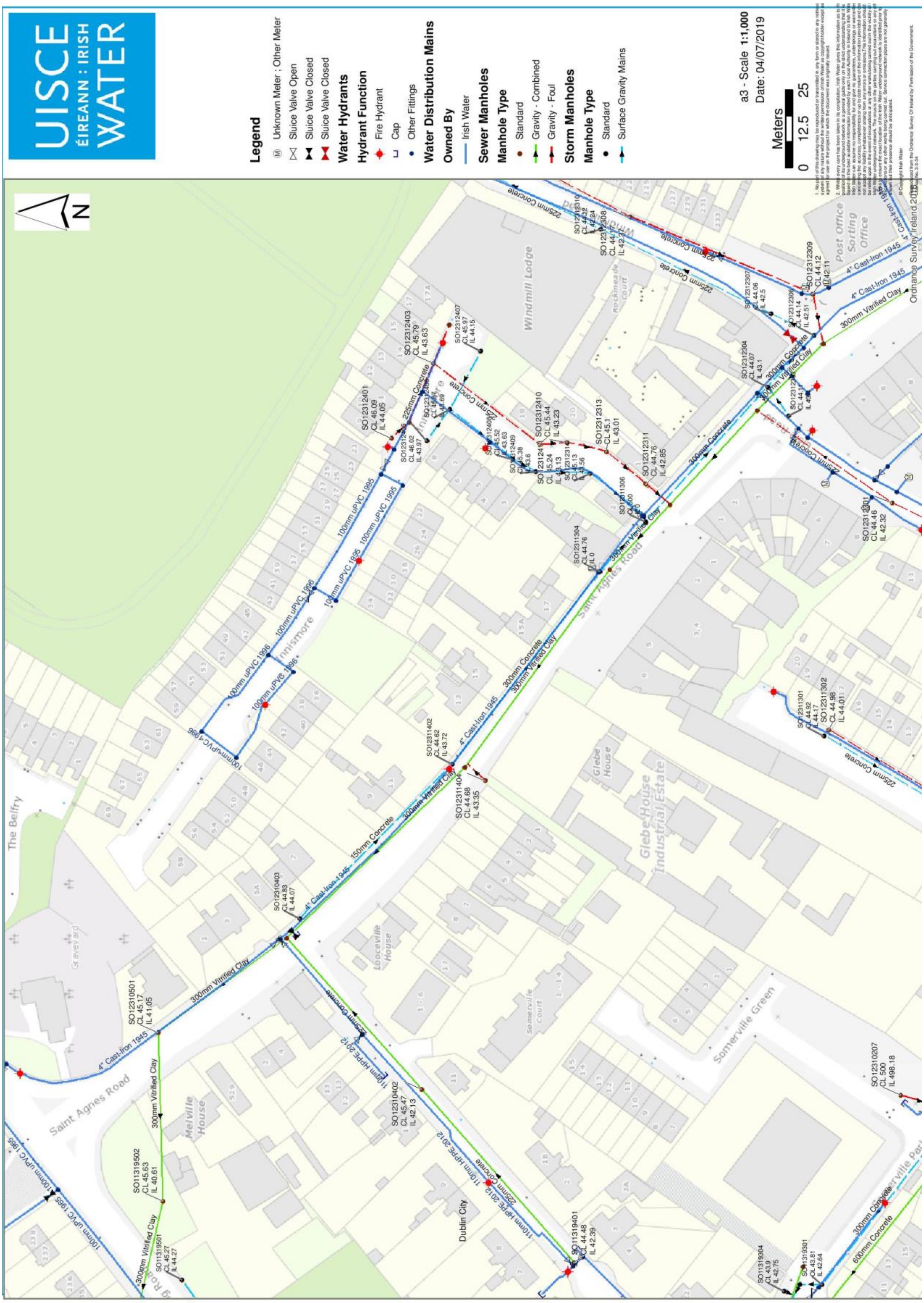
Prepared by:

Alan Garvey BSc, ME, CEng, MIEI
for CORA Consulting Engineers

Reviewed by:

John Pigott BE, Cert. Eng Tech., CEng, MIEI
for CORA Consulting Engineers.

7 Appendix A – Existing Drainage Records



8 Appendix B – Irish Water Correspondence

Cora Consulting / Alan Garvey

Behan House
10 Mount Street Lower
Dublin 2
D02HT71

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

4 November 2021

Re: CDS21006135 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 154 units at Glebe House, St. Agnes Road,, Dublin 12

Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Glebe House, St. Agnes Road,, Dublin 12 (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 Subject to upgrades
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	The Development can be supplied from 4" CI main in Saint Agnes Road subject to following network upgrades: • Approximately 105m of a new 150mm ID main (red line on the map below) to replace the existing 4" CI main in Saint Agnes Road. • Approximately 125m of a new 150mm ID main (red dashed line on the map below) to link the existing 110mm PE in Balfe Road and the 4" AC main in John McCormack Avenue. The connection main should be 150mm ID pipe with a bulk meter installed on the line.

	
Wastewater Connection	A permission to connect via third party land (from the site to the road) may be required for the proposed connection. Please note that it is developer's responsibilities to obtain all necessary consents/permissions required to facilitate the connection works. A wayleave in favour of Irish Water, will be required over the Infrastructure that is not located within the Public Space.
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 Marina Byrne from the design team via email mzbyrne@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Head of Customer Operations

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

Alan Garvey
Behan House
10 Mount Street Lower
Dublin 2 D02HT71

19 May 2022

Re: Design Submission for Glebe House, St. Agnes Road,, Dublin 12 (the "Development") (the "Design Submission") / Connection Reference No: CDS21006135

Dear Alan Garvey,

Many thanks for your recent Design Submission.

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

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

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

If you have any further questions, please contact your Irish Water representative:
Name: Marina Byrne
Phone: 01 89 25991/ 087619321
Email: mzbyrne@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- CORA-1968-C002 (P12)
- CORA-1968-C003 (P12)
- CORA-1968-C006 (P4)
- CORA-1968-C007 (P5)

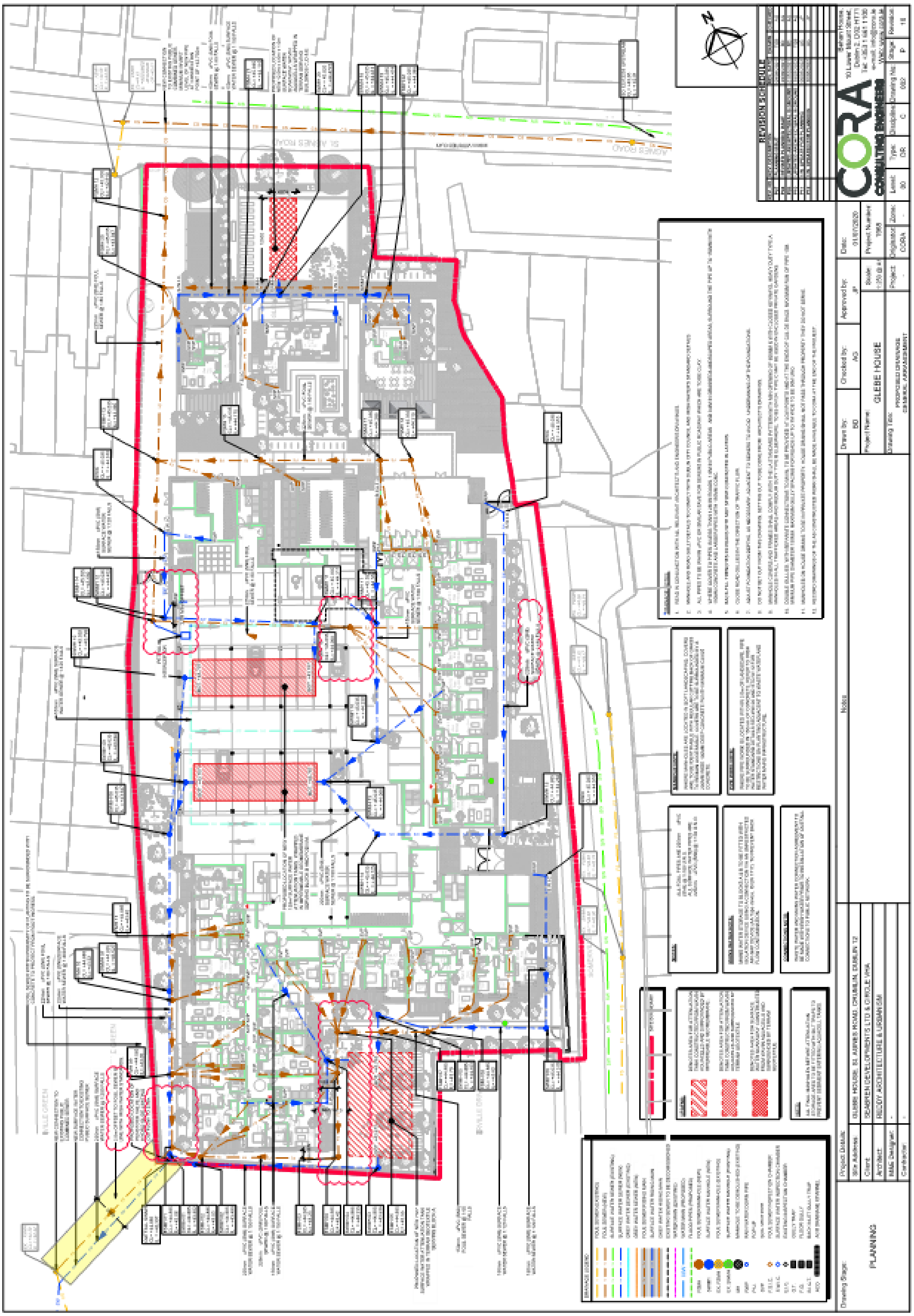
Additional Comments

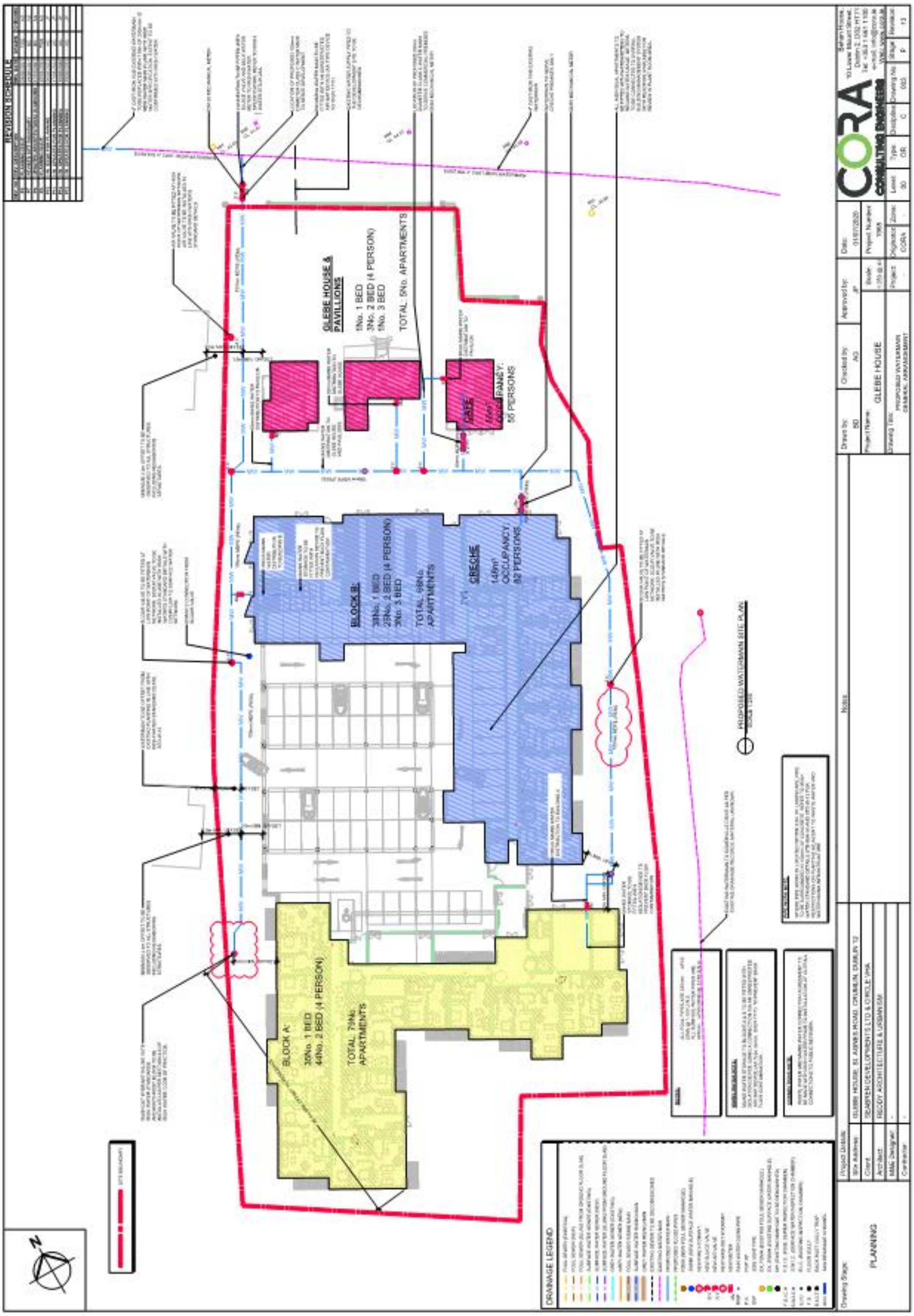
The design submission will be subject to further technical review at connection application stage.

It is recommended that the watermains and foul sewers should have 3 m clearance from the proposed buildings.

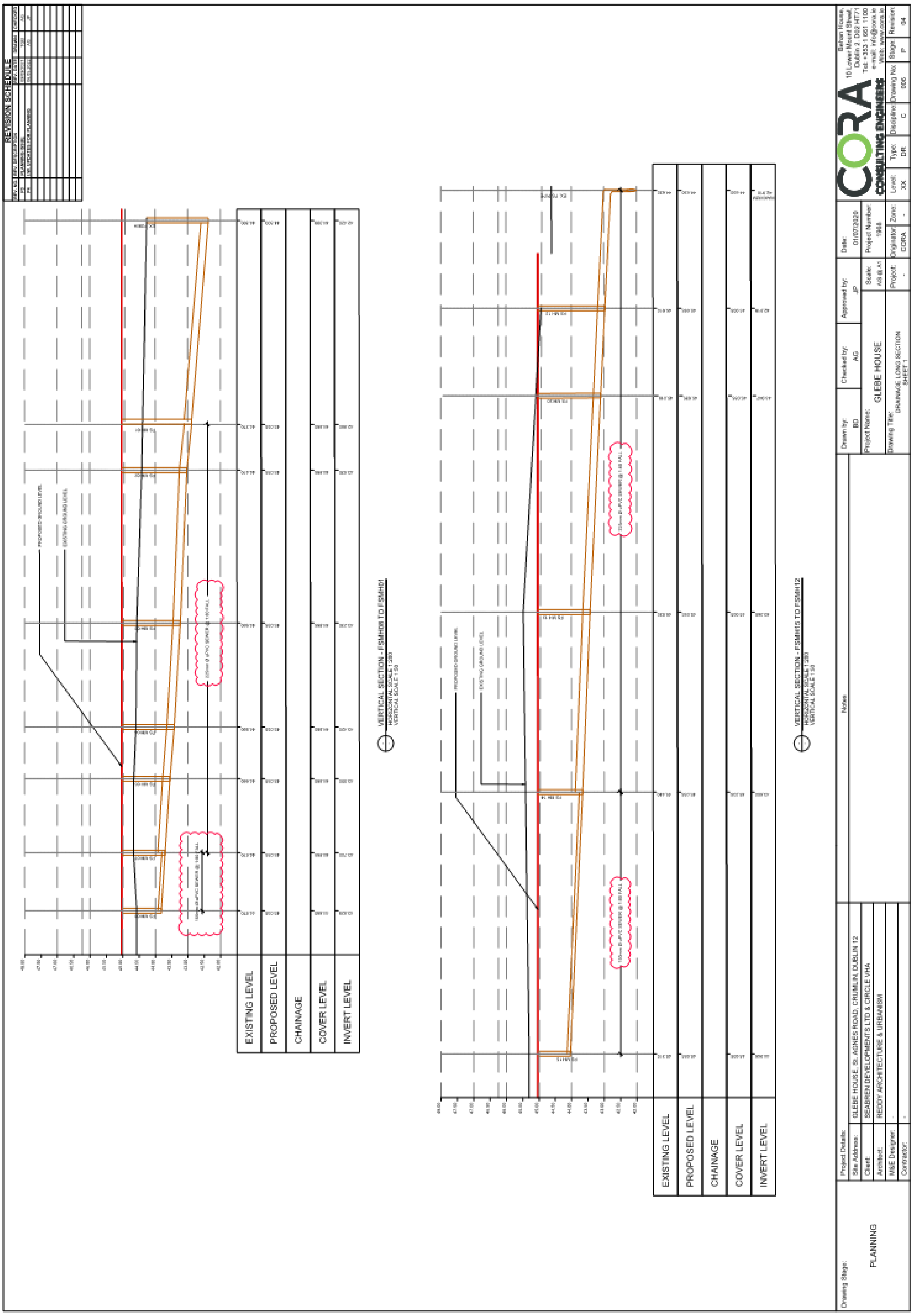
For further information, visit ***www.water.ie/connections***

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


CORA
CONSULTING ENGINEERS
GLEBE HOUSE
PLANNING



REVISION SCHEDULE
GLEBE HOUSE & PAVILIONS
1No. 1 BED
3No. 2 BED (4 PERSON)
1No. 3 BED
TOTAL: 5No. APARTMENTS
BLOCK B:
38No. 1 BED
25No. 2 BED (4 PERSON)
3No. 3 BED
TOTAL: 66No. APARTMENTS
CRECHE
148m²
OCCUPANCY:
82 PERSONS
55 PERSONS
BLOCK A:
35No. 1 BED
44No. 2 BED (4 PERSON)
TOTAL: 79No. APARTMENTS
PROPOSED WATERMAIN SITE PLAN
DRAINAGE LEGEND
PLANNING
GLEBE HOUSE
CORA
CONSULTING ENGINEERS


REVISION SCHEDULE
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PROPOSED LEVEL
CHAINAGE
COVER LEVEL
INVERT LEVEL
GLEBE HOUSE
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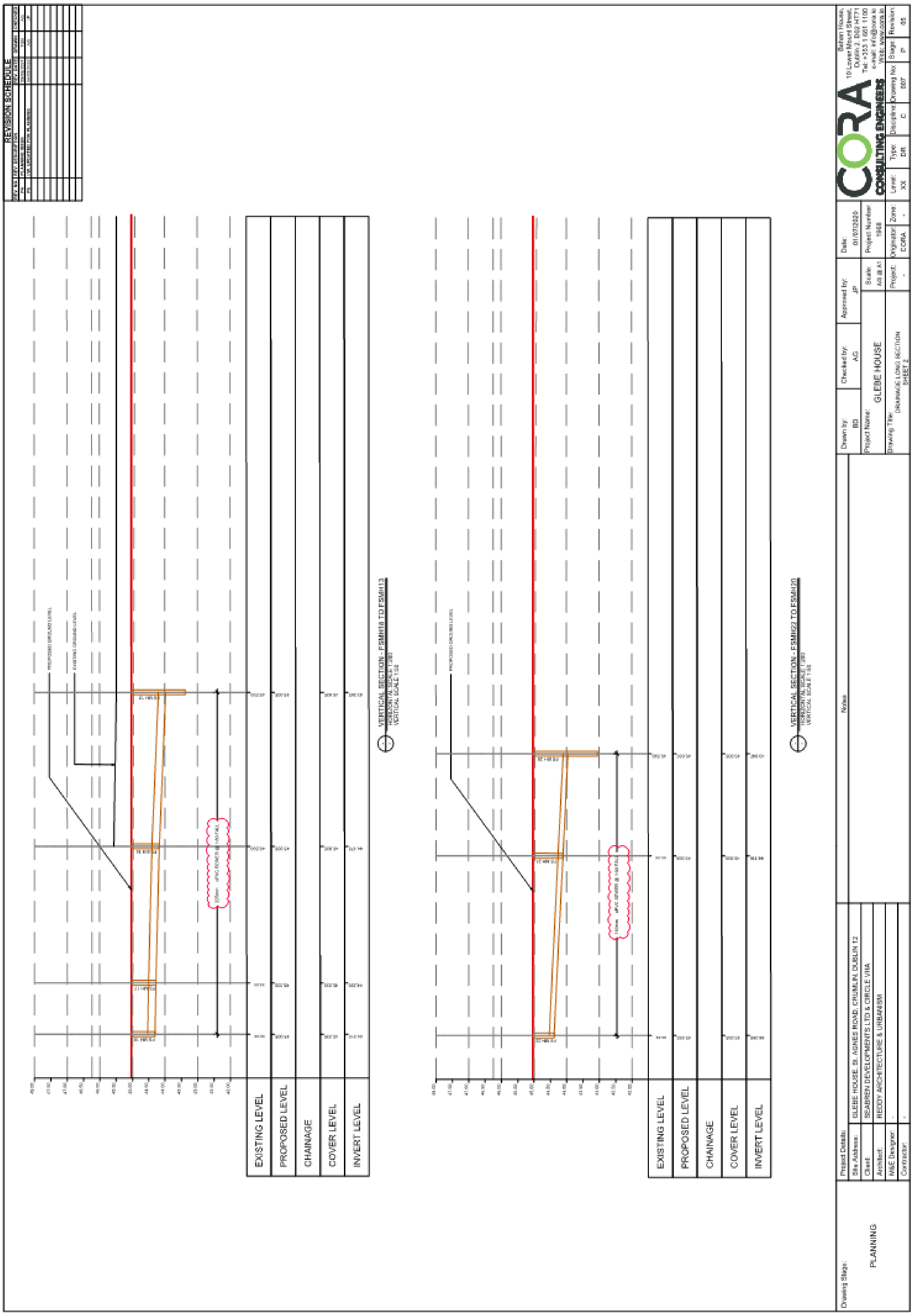
REVISION SCHEDULE
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EXISTING LEVEL
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CHAINAGE
COVER LEVEL
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9 Appendix C – Met Eireann Rainfall Return Periods

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 312085, Northing: 231385,

DURATION	Interval 6months	1year	Years 2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.5	3.6	4.2	5.1	5.8	6.3	8.0	9.9	11.3	13.1	14.8	16.1	18.2	19.8	21.2	N/A
10 mins	3.4	5.0	5.8	7.2	8.1	8.8	11.1	13.9	15.7	18.3	20.7	22.5	25.4	27.6	29.5	N/A
15 mins	4.0	5.9	6.9	8.4	9.5	10.3	13.1	16.3	18.5	21.5	24.3	26.5	29.8	32.5	34.7	N/A
30 mins	5.3	7.6	8.9	10.9	12.2	13.2	16.6	20.5	23.1	26.8	30.1	32.7	36.7	39.9	42.5	N/A
1 hours	7.0	10.0	11.6	14.0	15.6	16.9	21.0	25.8	29.0	33.4	37.4	40.5	45.2	48.9	52.0	N/A
2 hours	9.3	13.0	15.0	18.0	20.0	21.6	26.7	32.4	36.3	41.6	46.3	50.0	55.7	60.1	63.7	N/A
3 hours	10.9	15.2	17.5	20.9	23.1	24.9	30.6	37.1	41.3	47.3	52.6	56.6	62.9	67.7	71.7	N/A
4 hours	12.3	17.0	19.5	23.2	25.6	27.6	33.8	40.8	45.4	51.8	57.5	61.8	68.5	73.7	78.0	N/A
6 hours	14.4	19.8	22.6	26.9	29.7	31.8	38.8	46.7	51.8	58.9	65.2	70.0	77.4	83.1	87.8	N/A
9 hours	17.0	23.1	26.4	31.1	34.3	36.8	44.6	53.4	59.1	67.0	73.9	79.2	87.4	93.7	98.8	N/A
12 hours	19.1	25.8	29.4	34.6	38.0	40.7	49.2	58.7	64.8	73.4	80.8	86.5	95.3	102.0	107.5	N/A
18 hours	22.5	30.2	34.2	40.1	44.0	47.0	56.6	67.1	74.0	83.4	91.7	98.0	107.6	115.0	121.0	N/A
24 hours	25.2	33.7	38.1	44.5	48.8	52.0	62.4	73.8	81.2	91.4	100.2	107.0	117.3	125.2	131.6	153.9
2 days	31.2	40.8	45.7	52.8	57.5	61.1	72.4	84.6	92.4	103.1	112.4	119.4	130.0	138.1	144.8	167.4
3 days	36.0	46.5	51.9	59.6	64.6	68.4	80.4	93.4	101.6	112.8	122.5	129.8	140.8	149.2	156.0	179.2
4 days	40.2	51.5	57.2	65.4	70.7	74.8	87.4	101.0	109.6	121.3	131.3	138.9	150.3	158.9	165.9	189.8
6 days	47.5	60.2	66.5	75.5	81.4	85.8	99.6	114.2	123.4	135.9	146.6	154.7	166.8	175.9	183.3	208.2
8 days	53.9	67.8	74.6	84.4	90.7	95.4	110.1	125.7	135.5	148.7	160.0	168.4	181.1	190.6	198.3	224.3
10 days	59.8	74.7	82.0	92.4	99.1	104.1	119.7	136.1	146.4	160.2	172.0	180.8	194.0	203.9	211.9	238.8
12 days	65.3	81.1	88.9	99.8	106.9	112.2	128.5	145.7	156.4	170.8	183.0	192.2	205.9	216.1	224.4	252.1
16 days	75.5	92.9	101.5	113.5	121.2	126.9	144.6	163.2	174.7	190.1	203.1	212.9	227.4	238.3	247.1	276.4
20 days	84.9	103.8	113.0	126.0	134.2	140.3	159.3	179.0	191.2	207.5	221.3	231.6	246.9	258.3	267.5	298.2
25 days	95.9	116.5	126.4	140.4	149.3	155.9	176.2	197.3	210.3	227.6	242.2	253.1	269.2	281.2	290.9	323.1

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

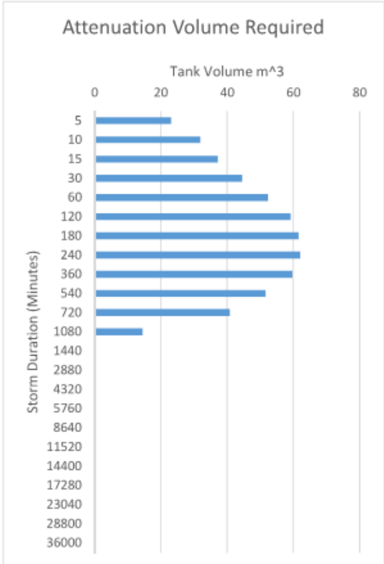
10 Appendix D – Attenuation Calculations

Block A

Roof Area	422	Paved Area	0	Green	1073	Total Area	1495
Impermeability Factor	0.9	Impermeability Factor	0.9	Impermeability Factor	0.7	Equivalent Drainage Area	1130.9
Return Period	100 years		Climate Change Increase Factor		30%	Flow Control Device	Hydro Slide

Allowable Site Discharge Rate	2	L/sec

Storm Duration (min)	Rainfall (mm)	Rainfall Volume (litres)	Discharge (litres)	Attenuation Reduired (m^3)
5	20.93	23669.737	600	23.069737
10	29.25	33078.825	1200	31.878825
15	34.45	38959.505	1800	37.159505
30	42.51	48074.559	3600	44.474559
60	52.65	59541.885	7200	52.341885
120	65	73508.5	14400	59.1085
180	73.58	83211.622	21600	61.611622
240	80.34	90856.506	28800	62.056506
360	91	102911.9	43200	59.7119
540	102.96	116437.464	64800	51.637464
720	112.45	127169.705	86400	40.769705
1080	127.4	144076.66	129600	14.47666
1440	139.1	157308.19	172800	0
2880	155.22	175538.298	345600	0
4320	168.74	190828.066	518400	0
5760	180.57	204206.613	691200	0
8640	201.11	227435.299	1036800	0
11520	218.92	247576.628	1382400	0
14400	235.04	265806.736	1728000	0
17280	249.86	282566.674	2073600	0
23040	276.77	312999.193	2764800	0
28800	301.08	340491.372	3456000	0
36000	329.03	372100.027	4320000	0



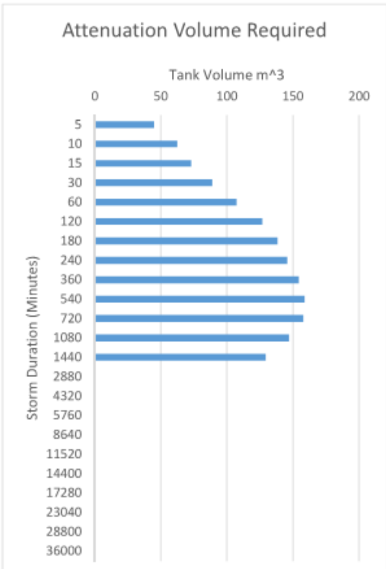
Maximum Attenuation Volume	62.056506	m^3

Block B

Roof Area	437	Podium Area	1244	Green	1209	Total Area	2890
Impermeability Factor	0.9	Impermeability Factor	0.75	Impermeability Factor	0.7	Equivalent Drainage Area	2172.6
Return Period	100 years		Climate Change Increase Factor		30%	Flow Control Device	Hydro Slide

Allowable Site Discharge Rate	2	L/sec

Storm Duration (min)	Rainfall (mm)	Rainfall Volume (litres)	Discharge (litres)	Attenuation Reduired (m^3)
5	20.93	45472.518	600	44.872518
10	29.25	63548.55	1200	62.34855
15	34.45	74846.07	1800	73.04607
30	42.51	92357.226	3600	88.757226
60	52.65	114387.39	7200	107.18739
120	65	141219	14400	126.819
180	73.58	159859.908	21600	138.259908
240	80.34	174546.684	28800	145.746684
360	91	197706.6	43200	154.5066
540	102.96	223690.896	64800	158.890896
720	112.45	244308.87	86400	157.90887
1080	127.4	276789.24	129600	147.18924
1440	139.1	302208.66	172800	129.40866
2880	155.22	337230.972	345600	0
4320	168.74	366604.524	518400	0
5760	180.57	392306.382	691200	0
8640	201.11	436931.586	1036800	0
11520	218.92	475625.592	1382400	0
14400	235.04	510647.904	1728000	0
17280	249.86	542845.836	2073600	0
23040	276.77	601310.502	2764800	0
28800	301.08	654126.408	3456000	0
36000	329.03	714850.578	4320000	0



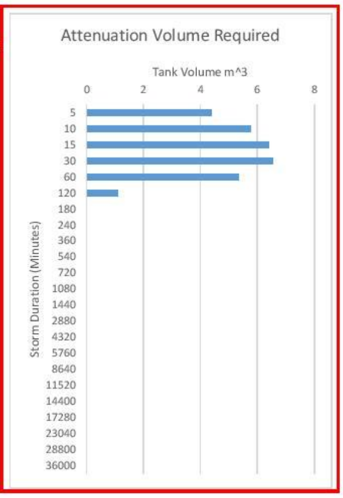
Maximum Attenuation Volume	158.890896	m^3

Glebe House & Pavilions

Roof Area	265	Paved Area	0	Green	0	Total Area	265
Impermeability Factor	0.9	Impermeability Factor	0.9	Impermeability Factor	0.7	Equivalent Drainage Area	238.5
Return Period	100 years			Climate Change Increase Factor	30%	Flow Control Device	Hydro Slide

Allowable Site Discharge Rate	2 L/sec

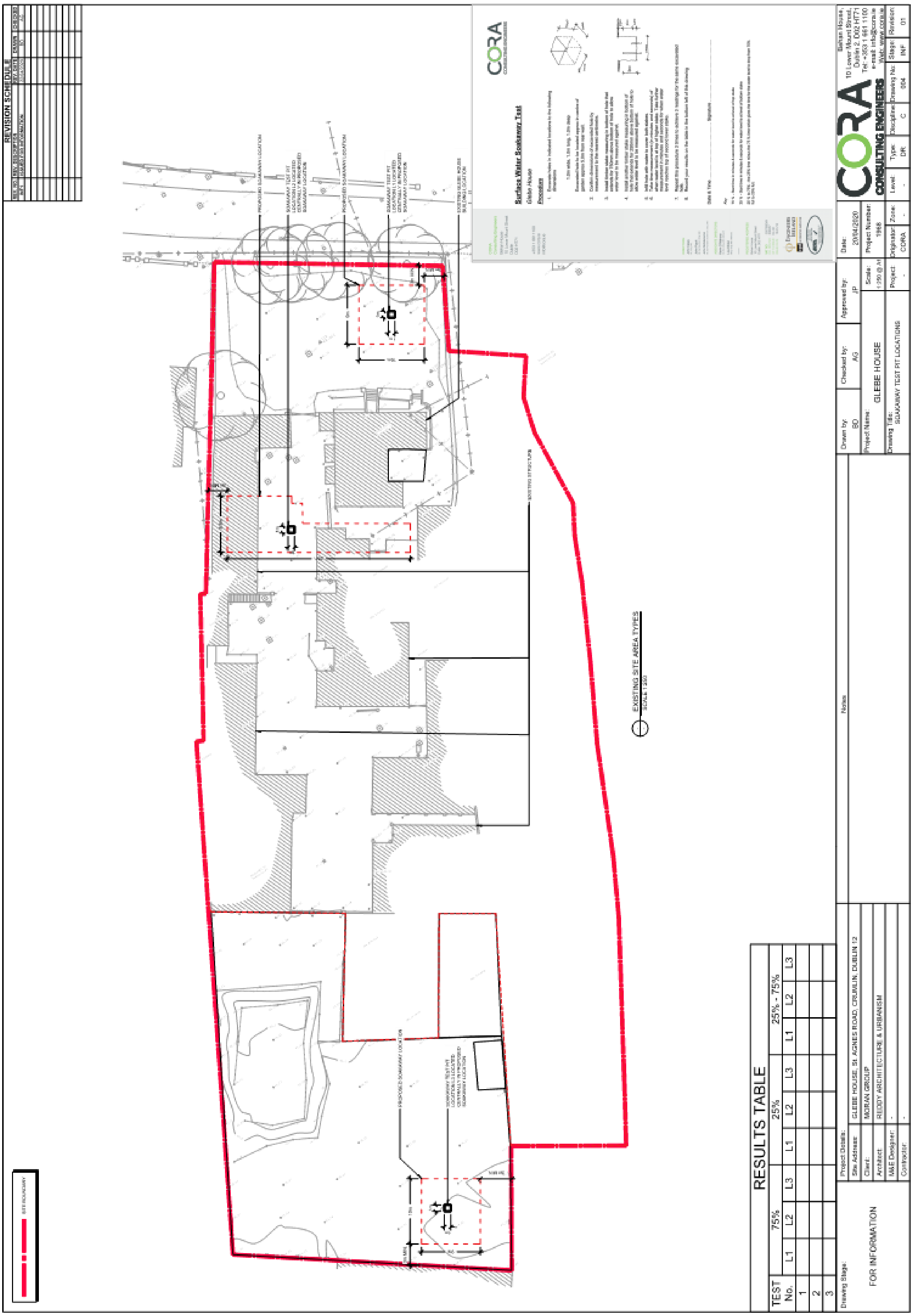
Storm Duration (min)	Rainfall (mm)	Rainfall Volume (litres)	Discharge (litres)	Attenuation Required (m^3)
5	20.93	4991.805	600	4.391805
10	29.25	6976.125	1200	5.776125
15	34.45	8216.325	1800	6.416325
30	42.51	10138.635	3600	6.538635
60	52.65	12557.025	7200	5.357025
120	65	15502.5	14400	1.1025
180	73.58	17548.83	21600	0
240	80.34	19161.09	28800	0
360	91	21703.5	43200	0
540	102.96	24555.96	64800	0
720	112.45	26819.325	86400	0
1080	127.4	30384.9	129600	0
1440	139.1	33175.35	172800	0
2880	155.22	37019.97	345600	0
4320	168.74	40244.49	518400	0
5760	180.57	43065.945	691200	0
8640	201.11	47964.735	1036800	0
11520	218.92	52212.42	1382400	0
14400	235.04	56057.04	1728000	0
17280	249.86	59591.61	2073600	0
23040	276.77	66009.645	2764800	0
28800	301.08	71807.58	3456000	0
36000	329.03	78473.655	4320000	0



Maximum Attenuation Volume	6.538635 m^3

Stormcells Required		Stormcell Size		No of Units
Length	1.14712895 m	Length	1 m	2
Width	5 m	Width	0.5 m	10
Depth	1.2 m	Depth	0.4 m	3
Assumes 95% volume ratio		Attenuation Tank Volume		11.4

11 Appendix E – Surface Water Soakaway Test Results



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Surface Water Soakaway Test

Glebe House

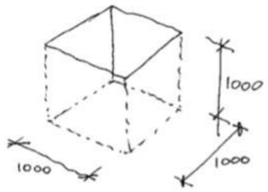
TEST HOLE	1

Procedure

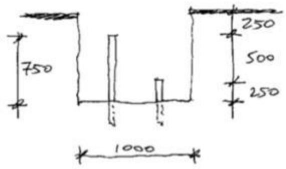
1. Excavate holes in indicated locations to the following dimensions

   1.0m wide, 1.0m long, 1.0m deep

   Excavated hole to be located approx in centre of garden approx 5.0m from rear wall.



2. Confirm dimensions of excavated hole by measurement to the nearest centimetre.
3. Install timber stake measuring in bottom of hole that extends for 750mm above bottom of hole to allow water level to be measured against.
4. Install another timber stake measuring in bottom of hole that extends for 250mm above bottom of hole to allow water level to be measured against.



5. Infill hole with water to cover both stakes.
6. Take time measurement (in minutes and seconds) of when water level is at top of higher stake. Take further measurement in minutes and seconds for when water level reaches top of second lower stake.
7. Repeat this procedure 3 times to achieve 3 readings for the same excavated hole.
8. Record your results on the table in the bottom left of this drawing

Date & Time Nov. 2020 Signature ....

Key

75 % - Start time in minutes & seconds for water level is at level of top stake

25 % - Start time in minutes & seconds for water level is at level of bottom stake

25 % to 75% - the 25% time minus the 75 % time which gives the time for the water level to drop from 75% full to 25% full.

TEST #	TIME 75%	TIME 25%	TIME TAKEN
1	7.00am	12.00pm	5:00hrs
2	9:30am	2.00pm	4:30hrs
3	11:40am	6.00pm	6:20hrs

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Surface Water Soakaway Test

Glebe House

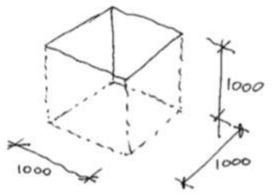
TEST HOLE	2

Procedure

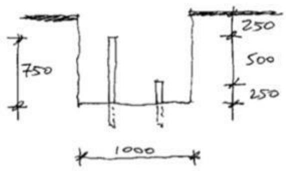
1. Excavate holes in indicated locations to the following dimensions

   1.0m wide, 1.0m long, 1.0m deep

   Excavated hole to be located approx in centre of garden approx 5.0m from rear wall.



2. Confirm dimensions of excavated hole by measurement to the nearest centimetre.
3. Install timber stake measuring in bottom of hole that extends for 750mm above bottom of hole to allow water level to be measured against.
4. Install another timber stake measuring in bottom of hole that extends for 250mm above bottom of hole to allow water level to be measured against.



5. Infill hole with water to cover both stakes.
6. Take time measurement (in minutes and seconds) of when water level is at top of higher stake. Take further measurement in minutes and seconds for when water level reaches top of second lower stake.
7. Repeat this procedure 3 times to achieve 3 readings for the same excavated hole.
8. Record your results on the table in the bottom left of this drawing

Date & Time Nov. 2020 .... Signature ....

Key

75 % - Start time in minutes & seconds for water level is at level of top stake

25 % - Start time in minutes & seconds for water level is at level of bottom stake

25 % to 75% - the 25% time minus the 75 % time which gives the time for the water level to drop from 75% full to 25% full.

TEST #	TIME 75%	TIME 25%	TIME TAKEN
1	8:15am	3:15pm	7:00 hrs
2	11:00am	7:00pm	8:00hrs
3	7:00am	5:00pm	8:00hrs

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Surface Water Soakaway Test

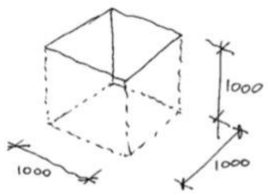
Glebe House | TEST HOLE | 3

Procedure

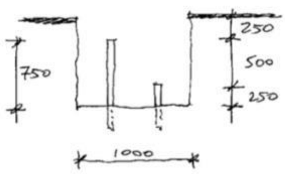
1. Excavate holes in indicated locations to the following dimensions

   1.0m wide, 1.0m long, 1.0m deep

   Excavated hole to be located approx in centre of garden approx 5.0m from rear wall.



2. Confirm dimensions of excavated hole by measurement to the nearest centimetre.
3. Install timber stake measuring in bottom of hole that extends for 750mm above bottom of hole to allow water level to be measured against.
4. Install another timber stake measuring in bottom of hole that extends for 250mm above bottom of hole to allow water level to be measured against.



5. Infill hole with water to cover both stakes.
6. Take time measurement (in minutes and seconds) of when water level is at top of higher stake. Take further measurement in minutes and seconds for when water level reaches top of second lower stake.
7. Repeat this procedure 3 times to achieve 3 readings for the same excavated hole.
8. Record your results on the table in the bottom left of this drawing

Date & Time Nov. 2020 Signature ....

Key

75 % - Start time in minutes & seconds for water level is at level of top stake

25 % - Start time in minutes & seconds for water level is at level of bottom stake

25 % to 75% - the 25% time minus the 75 % time which gives the time for the water level to drop from 75% full to 25% full.

TEST #	TIME 75%	TIME 25%	TIME TAKEN
1	7:00am	6:30pm	11:30hrs
2	9:00am	4:00pm	7:00hrs
3	12:30pm	7:00am	19:00hrs

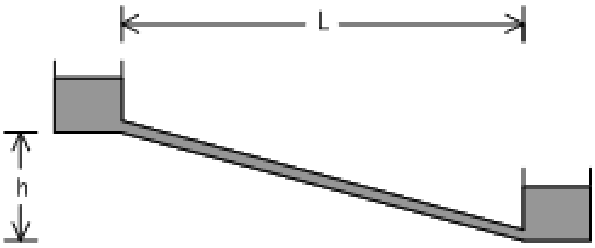
12 Appendix F – Ground Level Foul Calculations

Ground Level Foul Calculations

CORA Consulting Engineers 10 Lower Mount Street Dublin 2	Project Glebe House				Job Ref. 1968	
	Section FSMH08 - FSMH01				Sheet no./rev. 1	
	Calc. by AG	Date 11/12/2020	Chk'd by	Date	App'd by	Date

DESIGN OF A FOUL SEWER

TEDDS calculation version 1.0.03



Design pipe flow limited to 0.75 times full depth

Sewer design details

Design flow rate	Q_{design} = **510.x10^{-6}** m^3/s
Length of the sewer	L = **59.0** m
Fall along length of sewer	h = **1.0** m
Gradient of sewer	i = h / L = **0.016 (1 in 61)**
Minimum pipe diameter	D_{min} = **225** mm
Surface roughness	k_s = **1.5** mm
Mean hydraulic depth factor	m = **0.30**
Kinematic viscosity of fluid	v = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **31** mm
Nearest pipe diameter	D_{chezy} = **225** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **1.856** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035\ m^3/s)^{0.382} \times 1mm$ = **35** mm
Nearest pipe diameter	D_{escrit} = **225** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escrit} / 1mm)^{0.62} \times 1\ m/s / (\sqrt{(1 / i)} \times 60)$ = **1.633** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = \max(D_{chezy}, D_{escrit}, D_{min})$ = **225** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} / 1000mm) \times i)}$ = **0.268**
Flow velocity	$V_{full} = -2 \times Z \times \log((k_s/(3.7 \times D_{design})) + ((2.51 \times v)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **1.464** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **58.2x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.066**

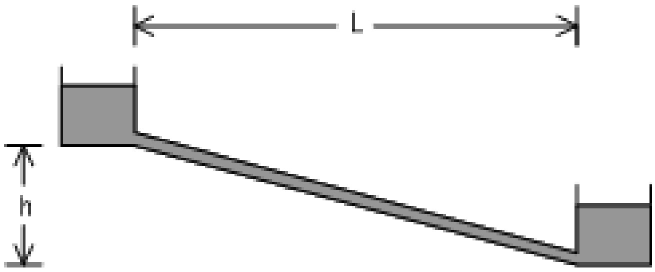
PASS - Design pipe flow less than 0.75 times full depth

Flow velocity at design flow rate	V_{design} = **0.441** m/s

CORA Consulting Engineers 10 Lower Mount Street Dublin 2	Project Glebe House				Job Ref. 1968	
	Section FSMH15 - FSMH12				Sheet no./rev. 1	
	Calc. by AG	Date 11/12/2020	Chk'd by	Date	App'd by	Date

DESIGN OF A FOUL SEWER

TEDDS calculation version 1.0.03



Design pipe flow limited to 0.75 times full depth

Sewer design details

Design flow rate	Q_{design} = **510.x10^{-6}** m^3/s
Length of the sewer	L = **91.7** m
Fall along length of sewer	h = **1.1** m
Gradient of sewer	i = h / L = **0.012 (1 in 86)**
Minimum pipe diameter	D_{min} = **225** mm
Surface roughness	k_s = **1.5** mm
Mean hydraulic depth factor	m = **0.30**
Kinematic viscosity of fluid	ν = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **33** mm
Nearest pipe diameter	D_{chezy} = **225** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **1.572** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035\ m^3/s)^{0.382} \times 1mm$ = **38** mm
Nearest pipe diameter	D_{escrit} = **225** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escritt} / 1mm)^{0.62} \times 1\ m/s / (\sqrt{(1 / i)} \times 60)$ = **1.383** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = \max(D_{chezy}, D_{escritt}, D_{min})$ = **225** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} / 1000mm) \times i)}$ = **0.227**
Flow velocity	$V_{full} = -2 \times Z \times \log((k_s/(3.7 \times D_{design})) + ((2.51 \times \nu)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **1.239** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **49.2x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.071**

PASS - Design pipe flow less than 0.75 times full depth

Flow velocity at design flow rate	V_{design} = **0.393** m/s

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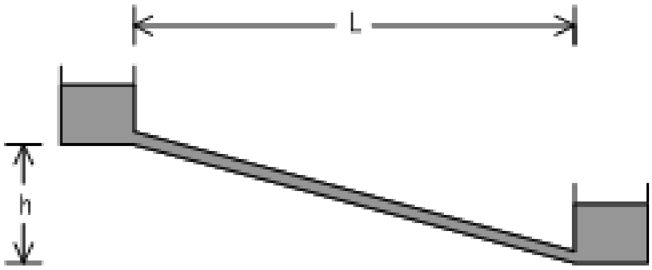
DESIGN OF A FOUL SEWER

TEDDS calculation version 1.0.03



Design pipe flow limited to 0.75 times full depth

Sewer design details

Design flow rate	Q_{design} = **510.x10^{-6}** m^3/s
Length of the sewer	L = **35.0** m
Fall along length of sewer	h = **0.8** m
Gradient of sewer	i = h / L = **0.022 (1 in 46)**
Minimum pipe diameter	D_{min} = **150** mm
Surface roughness	k_s = **1.5** mm
Mean hydraulic depth factor	m = **0.30**
Kinematic viscosity of fluid	ν = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **29** mm
Nearest pipe diameter	D_{chezy} = **150** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **1.756** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035 m^3/s)^{0.382} \times 1mm$ = **34** mm
Nearest pipe diameter	$D_{escritt}$ = **150** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escritt} / 1mm)^{0.62} \times 1 m/s / (\sqrt{(1 / i)} \times 60)$ = **1.472** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = max(D_{chezy}, D_{escritt}, D_{min})$ = **150** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} /1000mm) \times i)}$ = **0.254**
Flow velocity	$V_{full} = -2 \times Z \times log((k_s/(3.7 \times D_{design}))+((2.51 \times \nu)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **1.296** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **22.9x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.103**

PASS - Design pipe flow less than 0.75 times full depth

Flow velocity at design flow rate	V_{design} = **0.526** m/s

13 Appendix G – Ground Level Surface Calculations

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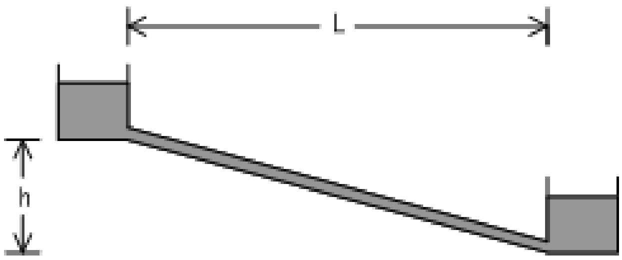
DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.03



Drain design details

Design flow rate	Q_{design} = **1.64x10^{-3}** m^3/s
Length of the drain	L = **33.0** m
Fall along length of drain	h = **0.2** m
Gradient of drain	i = h / L = **0.007 (1 in 145)**
Minimum pipe diameter	D_{min} = **150** mm
Surface roughness	k_s = **0.6** mm
Mean hydraulic depth factor	m = **0.25**
Kinematic viscosity of fluid	ν = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **60** mm
Nearest pipe diameter	D_{chezy} = **150** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **0.899** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035 m^3/s)^{0.382} \times 1mm$ = **65** mm
Nearest pipe diameter	$D_{escritt}$ = **150** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escritt} / 1mm)^{0.62} \times 1 m/s / (\sqrt{(1 / i)} \times 60)$ = **0.826** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = max(D_{chezy}, D_{escritt}, D_{min})$ = **150** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} /1000mm) \times i)}$ = **0.142**
Flow velocity	$V_{full} = -2 \times Z \times log((k_s/(3.7 \times D_{design}))+((2.51 \times \nu)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **0.827** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **14.6x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.225**
Flow velocity at design flow rate	V_{design} = **0.548** m/s

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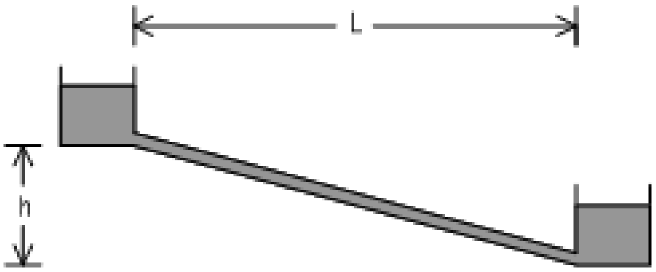
DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.03



Drain design details

Design flow rate — Q_{design} = **1.64x10^{-3}** m^3/s

Length of the drain — L = **61.0** m

Fall along length of drain — h = **0.4** m

Gradient of drain — i = h / L = **0.007 (1 in 150)**

Minimum pipe diameter — D_{min} = **150** mm

Surface roughness — k_s = **0.6** mm

Mean hydraulic depth factor — m = **0.25**

Kinematic viscosity of fluid — v = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant — c = 56

Diameter of pipe required — $D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **61** mm

Nearest pipe diameter — D_{chezy} = **150** mm

Flow velocity using Chezy — $V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **0.885** m/s

Using the Escritt equation

Diameter of pipe required — $D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035\ m^3/s)^{0.362} \times 1mm$ = **66** mm

Nearest pipe diameter — $D_{escritt}$ = **150** mm

Flow velocity using Escritt — $V_{escritt} = 26.738 \times (D_{escritt} / 1mm)^{0.62} \times 1\ m/s / (\sqrt{(1 / i)} \times 60)$ = **0.812** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter — $D_{design} = max(D_{chezy}, D_{escritt}, D_{min})$ = **150** mm

Constant — $Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} / 1000mm) \times i)}$ = **0.140**

Flow velocity — $V_{full} = -2 \times Z \times log((k_s/(3.7 \times D_{design}))+((2.51 \times v)/(D_{design} \times Z \times 1m/s))) \times 1m/s$

V_{full} = **0.814** m/s

Flow rate running full — $Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **14.4x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D — x = **0.227**

Flow velocity at design flow rate — V_{design} = **0.542** m/s

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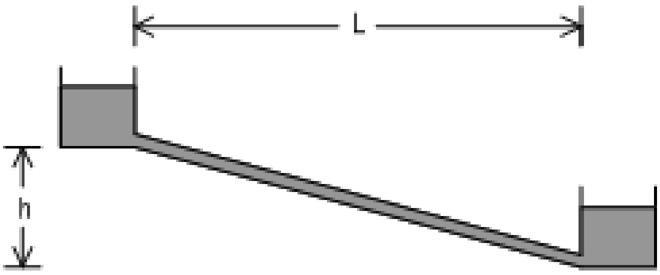
DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.03



Drain design details

Design flow rate	Q_{design} = **1.64x10^{-3}** m^3/s
Length of the drain	L = **62.0** m
Fall along length of drain	h = **0.4** m
Gradient of drain	i = h / L = **0.007 (1 in 151)**
Minimum pipe diameter	D_{min} = **150** mm
Surface roughness	k_s = **0.6** mm
Mean hydraulic depth factor	m = **0.25**
Kinematic viscosity of fluid	ν = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **61** mm
Nearest pipe diameter	D_{chezy} = **150** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **0.882** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035\ m^3/s)^{0.382} \times 1mm$ = **66** mm
Nearest pipe diameter	$D_{escritt}$ = **150** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escritt} / 1mm)^{0.62} \times 1\ m/s / (\sqrt{(1 / i)} \times 60)$ = **0.810** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = \max(D_{chezy}, D_{escritt}, D_{min})$ = **150** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} / 1000mm) \times i)}$ = **0.139**
Flow velocity	$V_{full} = -2 \times Z \times \log((k_s/(3.7 \times D_{design})) + ((2.51 \times \nu)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **0.811** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **14.3x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.227**
Flow velocity at design flow rate	V_{design} = **0.541** m/s

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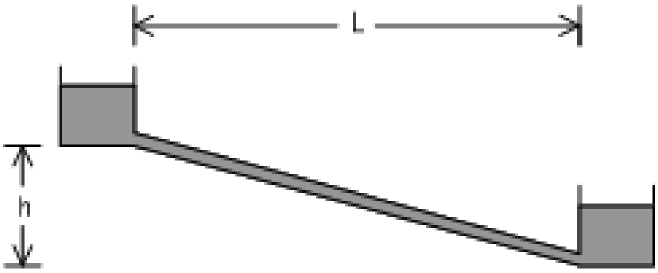
DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.03



Drain design details

Design flow rate	Q_{design} = **1.64x10^{-3}** m^3/s
Length of the drain	L = **102.0** m
Fall along length of drain	h = **0.7** m
Gradient of drain	i = h / L = **0.007 (1 in 152)**
Minimum pipe diameter	D_{min} = **150** mm
Surface roughness	k_s = **0.6** mm
Mean hydraulic depth factor	m = **0.25**
Kinematic viscosity of fluid	ν = **1.31x10^{-6}** m^2/s

Using the Chezy equation

Constant	c = 56
Diameter of pipe required	$D = ((Q_{design}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1m/s^2))^{0.2}$ = **61** mm
Nearest pipe diameter	D_{chezy} = **150** mm
Flow velocity using Chezy	$V_{chezy} = c \times \sqrt{(m \times D_{chezy} \times i \times 1m/s^2)}$ = **0.879** m/s

Using the Escritt equation

Diameter of pipe required	$D = (Q_{design} \times 1000 \times \sqrt{(1 / i)} / 0.00035\ m^3/s)^{0.382} \times 1mm$ = **66** mm
Nearest pipe diameter	D_{escrit} = **150** mm
Flow velocity using Escritt	$V_{escritt} = 26.738 \times (D_{escrit} / 1mm)^{0.62} \times 1\ m/s / (\sqrt{(1 / i)} \times 60)$ = **0.807** m/s

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter	$D_{design} = max(D_{chezy}, D_{escrit}, D_{min})$ = **150** mm
Constant	$Z = \sqrt{(2 \times (g_{acc} / 1m/s^2) \times (D_{design} / 1000mm) \times i)}$ = **0.139**
Flow velocity	$V_{full} = -2 \times Z \times log((k_s/(3.7 \times D_{design})) + ((2.51 \times \nu)/(D_{design} \times Z \times 1m/s))) \times 1m/s$
	V_{full} = **0.808** m/s
Flow rate running full	$Q_{full} = V_{full} \times \pi \times D_{design}^2 / 4$ = **14.3x10^{-3}** m^3/s

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D	x = **0.228**
Flow velocity at design flow rate	V_{design} = **0.539** m/s