Project

Residential Development, Cornelscourt, Dublin 18

Report Title

Infrastructure Design Report

Client

Cornel Living Ltd.

INFRASTRUCTURE

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1. INTRODUCTION

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for a proposed residential development located at Cornelscourt Village, Old Bray Road, Cornelscourt, Dublin 18.

The proposed development ("the site") comprises of 452 apartments, 10 houses, 6 bungalows, a café / restaurant, office space, concierge and central residential amenity space on a 2.14 Ha site (approx.).

1.2 Objectives

This report provides information regarding the existing site and addresses the infrastructural demands of the proposed development including the following:

- Site Access and Road Layout
- Surface Water Drainage
- Flood Risk
- Foul Drainage
- Water Supply

1.3 Location

The site which is currently greenfield (with the exception of a temporary carpark in its north-west corner) is located adjacent to Cornelscourt Village (refer to Figure 1.1).

The N11 road is located to the north-east of the site, existing residential development (Willow Grove) is located to the south-east of the site and the AIB (and associated carparking) is located to the north-west of the site. Old Bray Road is located to the south-west of the site.

1.4 Topography

The site generally falls from its western corner towards its eastern corner at a gradient of approximately 1/24.

Existing topographic survey information is shown in the background of the Proposed Roads Layout Plan (refer to DBFL Drawing Nos. 180208-XX-XX-DR-C-2001).

1.5 Ground Conditions

Ground Investigations Ireland carried out site investigations in January 2019 (trial pit logs are included in Appendix B).

The site is overlaid by a topsoil layer of up to 300mm deep with the exception of the temporary carpark area where made ground comprising of clayey gravels were observed at surface level.

Observed subsoil material comprises of sandy / gravelly clays.

Soakaway testing was carried out at three locations (in the vicinity of the proposed attenuation facility). Infiltration was not observed at any of the test locations.

1.6 Proposed Development

The proposed development comprises of 452 apartments, 10 houses, 6 bungalows, a café / restaurant, office space, concierge, central residential amenity space and associated engineering infrastructure including access for vehicles and pedestrians from the Old Bray Road, surface water drainage, foul drainage and water supply connections (refer to DBFL Drawings 180208-XX-XX-DR-C-3001 and 180208-XX-XX-DR-C-3002).

Figure 1.1 Extract from myplan.ie viewer (Site Boundary Indicative Only).

SITE ACCESS AND STREET LAYOUT

1.1 Site Access Layout

Vehicle Access – Old Bray Road

The primary access point for motorised vehicles is from Old Bray Road. This access route also serves the AIB carpark (north-west of the site). Refer to DBFL Drawings 180208-XX-XX-DR-C-2001 & 180208-XX-XX-DR-C-2002 for the proposed site access layout.

This serves as the vehicular access route to the basement carpark and to the podium area and provides a more formalised access when compared to the existing access arrangements for the AIB carpark.

The ten houses proposed along the eastern boundary and 6 bungalows proposed along the western boundary are also accessed from Old Bray Road via the basement carpark.

The Old Bray Road has a posted speed limit of 50 km/hour. The site entrance complies with minimum visibility splays as required by DMURS (Y Distance = 45m, X Distance = 2.4m).

Line marking is provided in accordance with the Department of Transport's Traffic Signs Manual.

Pedestrian and Cycle Access

The site layout also facilitates high levels of cycle and pedestrian connectivity as noted below.

- Pedestrians and cyclists can access the development via the proposed access from Old Bray Road (as described above).
- Pedestrian access is proposed on the southern side of the site access leading towards the podium area.
- A dedicated cycle / pedestrian access route is provided along the site's north-western boundary which facilitates the following:
    - Cycle access from Old Bray Road to basement bicycle parking areas.
    - Cycle access from the basement to the existing cycle track located along the N11.
    - Pedestrian access from the podium to the proposed footpath along the N11 (this proposed footpath along the N11 aligns with objectives in the Bus Connects Emerging Preferred Route for Bray to the City Centre). Also refer to Appendix G.

We note that the cycle / pedestrian route proposed along the site's north-western boundary is completely separate from the vehicle access ramp to the basement.

A cycle / pedestrian link is also proposed at the eastern corner of the site (linking the proposed development to the existing park at the northern end of Willow Grove).

The proposed pedestrian and cycle linkages noted above are shown on DBFL Drawing 180208-XX-XX-DR-C-2001.

1.2 Vehicle Tracking

The proposed site layout has been tracked (using AutoTrack software) to demonstrate that large vehicles such as fire tender can access the site, travel onto the podium slab and access the dwellings proposed along the eastern and western boundaries (refer to DBFL Drawings No. 180208-XX-XX-DR-C-2003).

1.3 Pavement Design Standards

The primary site access off Old Bray Road is designed in accordance with the Design Manual for Urban Roads and Streets (DMURS) and Local Authority requirements.

Actual CBR values and ground conditions are to be confirmed by site specific investigations prior to road construction.

1.4 Traffic & Transportation

A separate Traffic and Transportation Assessment has been prepared as part of this planning application (refer to DBFL Report No. 180208-DBFL-RP-D-0001).

2. SURFACE WATER DRAINAGE

2.1 Existing Surface Water Drainage

The site falls from its western corner towards its eastern corner forming a single surface water catchment. An existing 225mm diameter surface water drain is located adjacent to the site's eastern corner (at the northern end of Willow Grove, refer to Figure 3.1). This pipeline outfalls to the east via a crossing under the N11, South Park and Clonkeen College. DLRCC have confirmed that this infrastructure has been "taken in charge".

An existing 600mm concrete surface water line is located adjacent to the site's north-eastern boundary. It is understood that this drain serves the N11 carriageway.

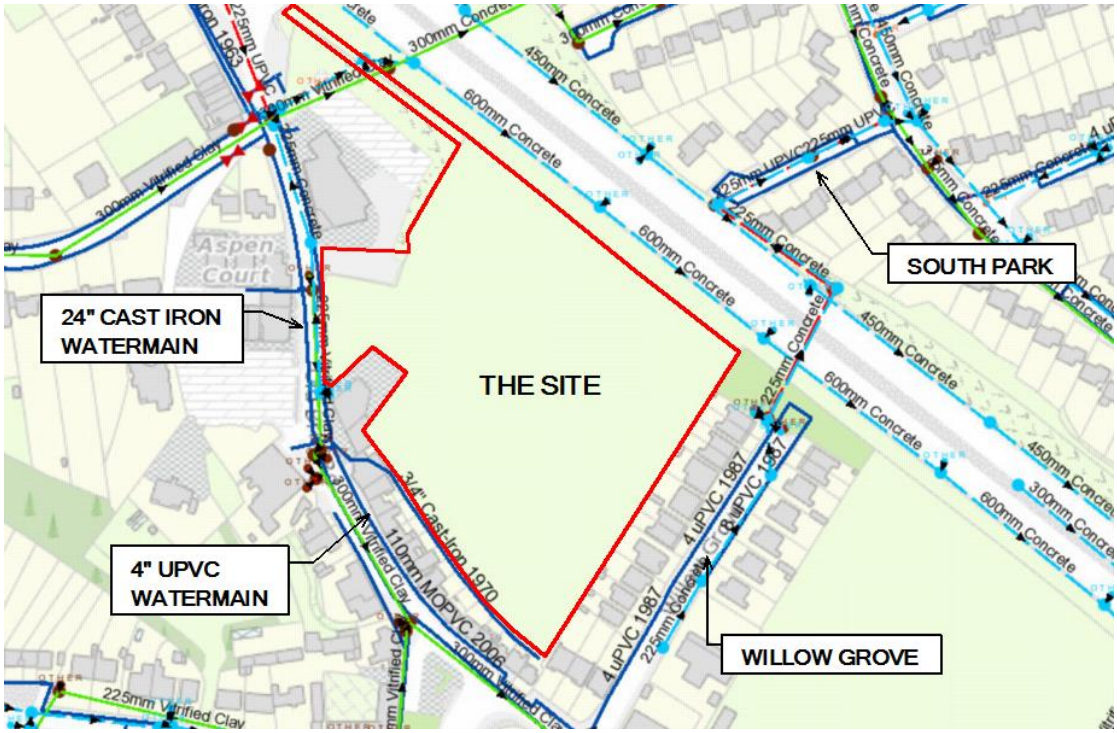


Figure 3.1 Extract from Irish Water Network Plan (**Site Boundary Indicative Only**)

2.2 Basis of Design

2.2.1 General Description of Surface Water Design

As noted previously, an existing 225mm diameter surface water drain is located adjacent to the site's eastern corner (at the northern end of Willow Grove). This pipe is expected to provide a suitable surface water outfall for the proposed development.

Refer to DBFL Drawing No. 180208-XX-XX-DR-C-3001 for proposed surface water outfall location as noted above.

Surface water discharge rates from the proposed surface water drainage network 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 from the site).

The proposed surface water drainage network will collect surface water runoff from the site via a piped network prior to discharging off site via the attenuation tank, flow control device and separator arrangement as noted above.

Surface water runoff from **apartment roofs will be captured by green roofs** (sedum blanket) prior to being routed to the piped surface water drainage network.

Surface water runoff from the **roofs of houses along the south-eastern boundary will be routed to the proposed surface water pipe network via bio-swale filter drains** (infiltration trenches) located in their rear gardens (providing an additional element of attenuation and treatment).

Surface water runoff from the **roofs of bungalows along the south-westrn boundary will be routed to the proposed surface water pipe network via a bioretention are**a (again providing an additional element of attenuation and treatment).

A **drainage reservoir (drainage board) is to be provided on the podium slab over basement** (for green areas and paved areas).

Surface water runoff from the **site's internal street network (adjacent to the houses and bungalows) will be directed to the proposed pipe network via tree pits** with overflow to conventional road gullies.

Surface water runoff from **paved areas adjacent to the site access from Old Bray Road will be directed to the proposed pipe network via conventional road gullies**.

Any incidental surface water runoff generated from the basement carpark would drain through a separate system beneath the basement slab (out falling to the proposed foul drainage network via a petrol interceptor). The detailed design of the basement drainage system has not been undertaken for planning stage but will be completed prior to construction.

2.2.2 Stormwater Audit (Stage 1)

JBA Consulting have carried out a Stage 1 Stormwater Audit of the proposed surface water drainage design (refer to Appendix H). JBA conclude that *"the surface water drainage design for the proposed development is acceptable and meets the requirement of the Stage 1 Stormwater Audit*". The Stormwater Audit should be read in conjunction with Section 3.0 of this Infrastructure Design Report.

2.2.3 Compliance with Surface Water Drainage 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 SUDS features such as permeable paving of driveways, 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 site's proximity to fluvial flood plains (up to 1 in 100-year flood event).

  Also refer to DBFL Report No. 180208-rep-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.

2.2.4 Proposed Runoff Coefficients and Factored Impermeable Areas

Proposed Runoff Coefficients

Noted below are the proposed reduction factors for the proposed development.

The proposed reduction factors have been discussed with DLRCC Water Services and are understood to be acceptable in principle (subject to review of final submission).

- Green Roof – 5% Reduction Factor

  The proposed build-up will be an extensive type with 100mm minimum construction depth and sedum planting. The soil build-up will partially absorb some of the initial run-off and once saturated will reduce flow rates through the green roof medium to the outlets and final attenuation storage location.

- Green Areas Over Podium – 15% Reduction Factor

  Soft landscaped podium areas will have typical soil depths of up to 300mm to facilitate grassed areas, plants, shrubs and trees i.e. similar to a deep intensive green roof build up.

- Permeable Paving Over Podium – 10% Reduction Factor

  On the podium will have a free draining material within the build-up and will reduce the flow rate from these areas. A reduction in velocity will also occur as the aggregate used will slow the run-off at source.

- Roof Areas Draining Via SuDS – 15% Reduction Factor

  The houses located along the site's south-eastern boundary (adjacent to Willow Grove) and the bungalows located along the site's south-western boundary drain via filter drains and a bioretention area respectively. There will be a reduction of velocity as the aggregate/filter material used in SuDS features slow the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- Permeable Paved Areas Draining via SUDS – 50% Reduction Factor

  Reduction of velocity as the aggregate / filter material used in the SuDS feature (permeable paving and tree pits) slows the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- Soft Landscaped / Grassed Areas – 60% Reduction Factor

  Grassed / Landscaped areas slows the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- Impermeable Roads (Site Access from Old Bray Road) – 5% Reduction Factor

  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

Factored Impermeable Areas

Proposed Runoff Coefficients and Factored Impermeable Areas are noted below in Table 3.1.

		Catchment A		Catchment B		Catchment C		Total (m^2)	
	Coefficients	Gross Area (m^2)	Factored Area (m^2)	Gross Area (m^2)	Factored Area (m^2)	Gross Area (m^2)	Factored Area (m^2)	Gross Total (m^2)	Factored Total (m^2)
Roofs (Houses + Bungalows) Draining Via SUDs	0.85	45	38	46	39	1,576	1,340	1,667	1,417
Green Roofs (Apartment Buildings) - Sedum Blanket	0.95	2,566	2,438	2,199	2,089	1,475	1,401	6,240	5,928
Green Areas on Podium (Over Drainage Board)	0.85	687	584	613	521	1,172	996	2,472	2,101
Permeable Paved Areas on Podium (Over Drainage Board)	0.9	778	700	298	268	609	548	1,685	1,516
Paved Areas Draining to Gullys (adjacent to Old Bray Road)	0.95	601	571	-	-	-	-	601	571
Permeable Paved Areas – Draining via Tree Pits with Overflow to Gullies	0.5	335	168	-	-	1,095	548	1,430	716
Soft Landscaping	0.4	1,039	416	767	307	5,000	2,000	6,806	2,723
		6,051	4,915	3,923	3,224	10,927	6,833	20,901	14,972

Table 3.1 Proposed Runoff Coefficients and Factored Impermeable Areas

2.2.5 Allowable Greenfield Runoff Rate

Ground Conditions

Observed subsoil material comprises of sandy / gravelly clays (refer trial pit logs included in Appendix B of this report). Three number infiltration tests were also carried out. Infiltration was not observed at any of the test locations.

Assessment of Soil Type

Drainage Group 1

Depth to Impermeable Layer 2 (40cm – 80cm)

Permeability Group 3 (Slow)

Slope 2 (gradient across site approx.) 1/24

Therefore, Soil Type 3

Table 4.5 The classification of soils by winter rain acceptance rate from soil survey data.

Drainage Group	Depth to impermeable layer (cm)	Slope classes								
		0 - 2°			2 - 8°			>8°		
		Permeability rates above impermeable layers								
		Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)
1	>80	1			1			1	2	3
	40 - 80					2	X	3		4
	<40	—	—	—	—	—	—	—	—	—
2	>80	2		3			4	—		
	40 - 80									
	<40	3								
3	>80							—		
	40 - 80				5			—		
	<40									

Winter rain acceptance indices: 1, very high; 2, high; 3, moderate; 4, low; 5, very low. Upland peat and peaty soils are in Class 5. Urban areas are unclassified.

Figure 3.2, Assessment of Soil Type

Allowable Greenfield Runoff Rate

Qbar has been assessed based on GDSDS requirements

i.e. Qbar(m3/s) = 0.00108x(Area)0.89(SAAR)1.17(SOIL)2.17

Area – Approx.2.09 Ha (for purposes of total surface water catchment area)

SAAR – 945mm (based on local information from Met Eireann)

SOIL – Soil Type 3

Qbar = 8.36 l/sec (equivalent to 4.0 l/sec/Ha)

2.2.6 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 3
- Allowable Outflow 4.0 l/sec/ha
- Time of entry 4 minutes
- M5 - 60 16.4 mm
- Ratio "r" 0.273
- 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) 10%

  (in accordance with GDSDS Volume 2, Chapter 6, Table 6.2 – see below)

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

Table 6.2 Climate Change Factors to be Applied to Drainage Design

Refer to Appendix C for Attenuation Calculations and Appendix E for Surface Water Network Design Calculations.

Surface Water Calculations have been carried out using Microdrainage WinDes analysis software.

2.2.7 SuDS

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

- Green Roof – The proposed build-up will be an extensive type with 100mm minimum construction depth and sedum planting.
- Green Areas Over Podium –Soft landscaped podium areas will have typical soil depths of up to 300mm to facilitate grassed areas, plants, shrubs and trees i.e. similar to a deep intensive green roof build up.
- Permeable Paving Over Podium – Free draining material within the build-up and will reduce the flow rate from these areas.
- Roof Areas Draining Via SuDS – Houses located along the site's south-eastern boundary (adjacent to Willow Grove) and the bungalows located along the site's south-western boundary drain via filter drains and a bioretention area respectively.
- Permeable Paved Areas Draining via SUDS – Aggregate / filter material used in the permeable paving and tree pits slow run-off at source.
- Soft Landscaped / Grassed Areas – Slows run-off at source.
- Attenuation of the 30 and 100 year return period storms within Stormtech Attenuation Chambers.
- Installation of a vortex flow control devices (Hydrobrake or equivalent), limiting surface water discharge from the site to 8.36 l/sec/ha
- Surface water discharge will also pass via a Class 1 full retention fuel / oil separator (sized in accordance with permitted discharge from the site)

2.2.8 Attenuation Calculation

Attenuation volumes have been calculated based on an allowable outflow / greenfield runoff rate of 8.36 l/sec/ha (refer to Section 3.4.2 above).

Run-off from the proposed development will be controlled / attenuated using vortex type flow control devices (Hydrobrake or equivalent).

The resultant storage system types, discharge limits and storage volumes for each catchment are detailed in Table 3.1.

The location of proposed attenuation systems is shown on DBFL Drawing 180208-XX-XX-DR-C-3001.

Refer to Appendix C for Attenuation Design Calculations (attenuation volumes have been calculated using Microdrainage WinDes analysis software).

In total 733m^3 of stormwater storage is provided.

Catchment / Attenuation Area	Storage System Type	Catchment Area (Total)	Impermeable Catchment Area (Total)	Allowable Outflow (Max.)	Storage Volume Required (100 Yr.)	Storage Volume Provided (100 Yr.)
A	Stormtech Underground Chamber	0.61 Ha	0.49 Ha	2 l/s	260m^3	285m^3
B	Stormtech Underground Chamber	0.39 Ha	0.32 Ha	4.18 l/s	129m^3	140m^3
C	Stormtech Underground Chamber	1.09 Ha	0.68 Ha	4.18 l/s	298m^3	308m^3
Total		2.09 Ha	1.49 Ha		687m^3	733m^3

Note, Catchment B (4.18 l/s) & Catchment C (4.18 l/s) share a single discharge point. i.e. Qbar 8.36 l/s (i.e. allowable Greenfield Runoff Rate Calculated in Section 3.2.4)

Table 3.1 – Surface Water Attenuation Storage and Discharge Limits

2.2.9 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 (within stone reservoirs beneath permeable paved driveways and within the Stormtech Attenuation Chambers).

2.3 Flood Risk

A separate Site Specific Flood Risk Assessment has been prepared as part of this planning application (refer to DBFL Report No. 180208-rep-002).

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).

2.4 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. green roofs, drainage reservoir (drainage board) on the podium slab over basement, bio-swale filter drains, bioretention areas and tree pits with overflow to conventional road gullies
- 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.

3. FOUL DRAINAGE

3.1 Existing Foul Drainage

Existing foul drainage infrastructure (225 diameter) is located adjacent to the site's eastern corner (at the northern end of Willow Grove). Similar to comments above regarding surface water drainage, this pipeline outfalls to the east via a crossing under the N11 and Southpark (refer to Figure 4.1 and the Irish Water Network Plan included in Appendix A).

As the site generally falls from its western corner towards its eastern corner, a gravity foul drainage solution can be provided for the proposed development.

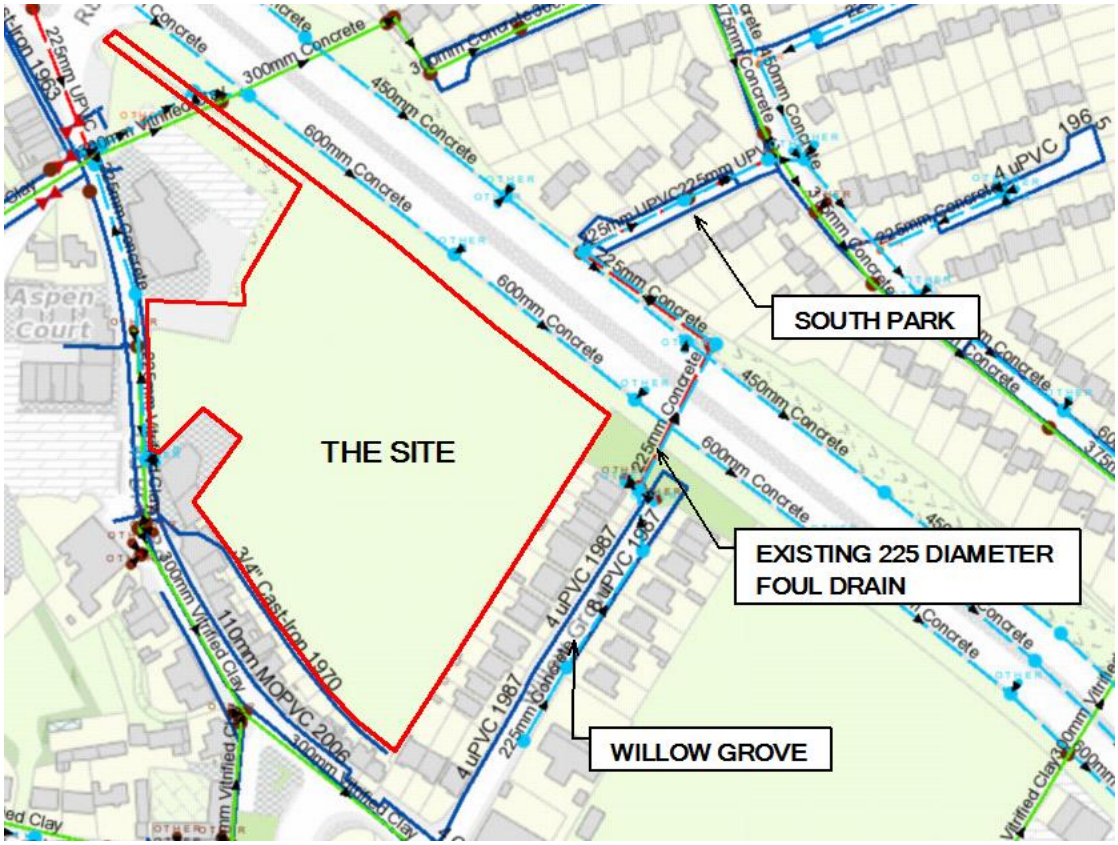


Figure 4.1 Extract from Irish Water Network Plan (Site Boundary Indicative Only)

3.2 Design Strategy

As per earlier comments regarding surface water drainage, the site falls from its South-West corner towards its North-Eastern corner forming a single foul drainage catchment.

In order to service the proposed development, it is proposed to connect the site to the existing 225mm diameter foul sewer discharging to the foul network in Willow Grove through the Eastern corner of the site. Existing on-site foul network will be replaced and routed through the proposed developments foul network.

The proposed foul drainage network will comprise of a series of 225mm diameter pipes. Each residential unit located along the site's south-eastern and south-western boundary is to be serviced by individual 100mm diameter connections.

Refer to DBFL Drawing 180208-XX-XX-DR-C-3001 for the proposed foul drainage infrastructure described above.

We note that Irish Water have issued a Statement of Design Acceptance in relation to the proposed foul drainage layout (refer to Appendix D).

3.3 Pre-Connection Feedback from Irish Water

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

- Subject to a valid connection agreement being put in place, the proposed connection to the Irish Water's foul drainage network can be facilitated.
- There is no known constraint downstream of the site, however, due to the size of the development it will be necessary to carry out further studies to confirm available capacity prior to agreeing to the proposed connection.
- The applicant has engaged with Irish Water in relation to the "further studies" noted above by way of requesting to enter into a Project Works Service Agreement (PWSA). Irish Water have confirmed that the scope of the PWSA is being reviewed. Their initial assessment indicates that the scope of the PWSA will include "flow monitoring / model update / capacity assessment" in the context of the Drainage Area Plan for the overall catchment. Also refer to e-mail correspondence between DBFL and Irish Water in Appendix D.

3.4 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

Design of the foul drainage network has been carried out using Microdrainage WinDes analysis software (refer to Appendix F for the foul drainage model).

Design Criteria:

Demand	446 l/dwelling/day
Discharge units	14 units per house (as BS8301)
Pipe Friction (Ks)	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing velocity)
Maximum Velocity	3.0 m/s (1:18 maximum pipe gradient)
Frequency Factor	0.5 for domestic use
Manhole Depths	< 4.0m

3.5 Foul Drainage – Environmental Impacts

Residential

Waste Water Discharge Calculation

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

No. of Dwellings	468
Post Development Average Discharge	2.4 l/sec
Post Development Peak Discharge	14.4 l/sec
Daily Foul Discharge Volume (446l per dwelling)	208,728 l/Day

Café / Restaurant / Office Space / Concierge and Residential Amenity Space

Waste Water Discharge Calculation

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

Assumed occupancy (persons)	75
Flow Rate / Person / Day (litres) (Based on IW Flow Rate for Design non-residential school with canteen)	50
Post Development Average Discharge (based on 8 hour occupancy)	0.15 l/sec
Post Development Peak Discharge (6 X DWF)	0.9 l/sec
Daily Foul Discharge Volume (50l per person)	3,750 l/Day

4. WATER SUPPLY AND DISTRIBUTION

4.1 Existing Public Watermains

Existing public water supply infrastructure is located along Old Bray Road (24" Cast Iron Watermain and 4" uPVC Watermain).

Refer to Figure 5.1 and the Irish Water Network Plan included in Appendix A which shows the location of these watermains.

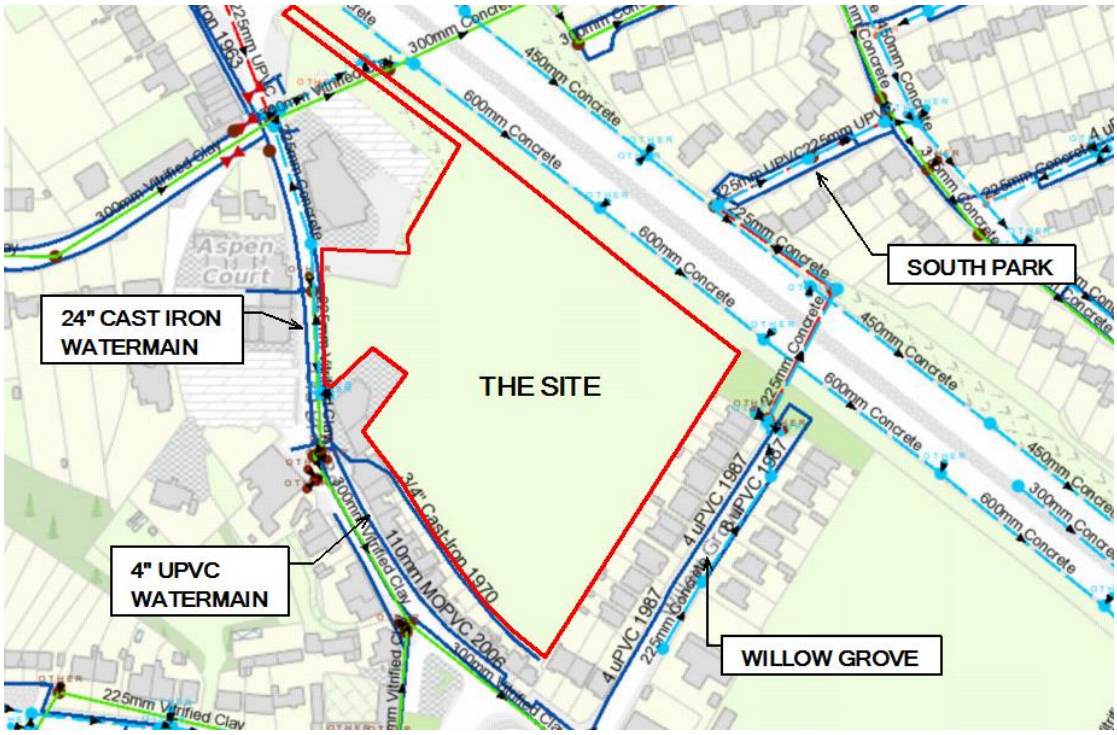


Figure 5.1 Extract from Irish Water Network Plan

4.2 Pre-Connection Feedback from Irish Water

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

- Subject to a valid connection agreement being put in place, the proposed connection to the Irish Water's water supply network can be facilitated.

4.3 Proposed Watermain Layout

As noted previously, existing 24" Cast Iron and 4" uPVC watermains are located along Old Bray Road. This infrastructure is expected to provide a suitable connection for the proposed development.

The site's proposed water main layout is shown on DBFL Drawing 180208-XX-XX-DR-C-3002. We note that Irish Water have issued a Statement of Design Acceptance in relation to the proposed water main layout (refer to Appendix D).

It is proposed to take a 200mm diameter connection off the existing 24" Cast Iron public water supply line (located along the Old Bray Road). A looped water main will be provided within the proposed development.

The proposed water main layout and connections to existing public water mains have been designed in accordance with Irish Water Standard Detail STD-W-02.

Individual houses located along the site's eastern boundary will have their own connections (25mm O.D. PE pipe) to distribution water mains via service connections and meter / boundary boxes. Individual connections are to be installed in accordance with Irish Water Standard Detail STD-W-03.

4.4 Hydrants

The proposed water main layout is arranged 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".

Hydrants shall comply with the requirements of BS 750:2012 and shall be installed in accordance with Irish Water's Code of Practice and Standard Details.

4.5 Materials

Proposed water mains are to be HDPE 100 SDR17.

Service connections (to individual houses) are to be MDPE 80 SDR11.

4.6 Water Demand

Residential

Water Demand has been calculated in accordance with the guidelines outlined in Irish Water's Pre-Connection Enquiry Application Form:

- No. of Dwellings 468
- Average Occupancy Ration (Persons Per Dwelling) 2.7
- Per-Capita Consumption (l/person/day) 150
- Average Domestic Daily Demand (l/sec) 2.2
- Post Development Average Hour Water Demand (l/sec) 2.8
  (1.25 x Average Domestic Daily Demand)
- Post Development Peak Hour Water Demand (l/sec) 14.0
  (5.0 x Post Development Average Hour Water Demand)

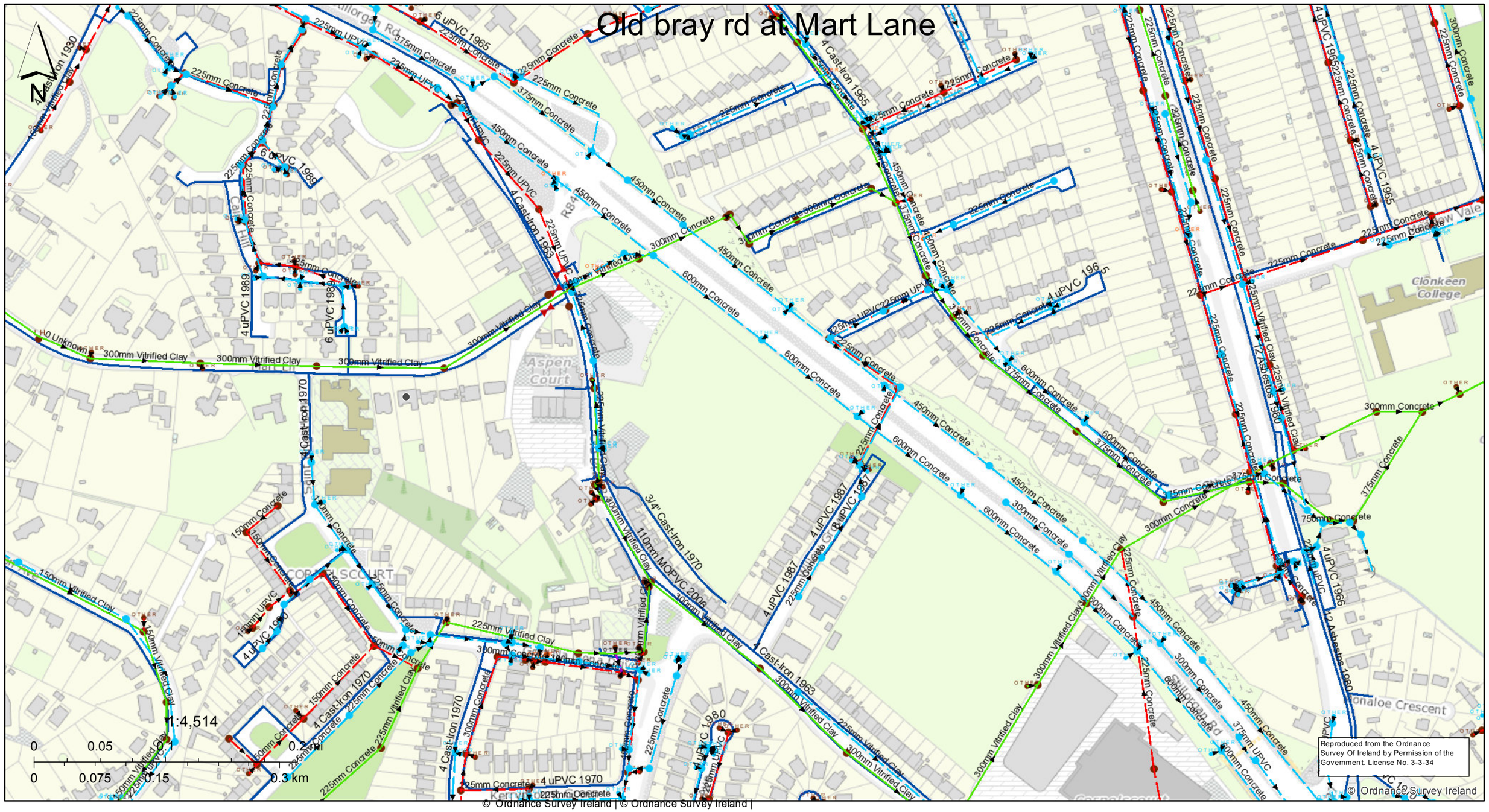
Café / Restaurant / Office Space / Concierge and Residential Amenity Space

Water Demand has been calculated in accordance with the guidelines outlined in Irish Water's Pre-Connection Enquiry Application Form:

- Assumed occupancy (persons) 75
- Per-Capita Consumption (l/person/day) 50
  (Based on IW Flow Rate for Design
  non-residential school with canteen)
- Average Domestic Daily Demand (l/sec) 0.15
  (based on 8 hour occupancy)
- Post Development Average Hour Water Demand (l/sec) 0.2
  (1.25 x Average Domestic Daily Demand)
- Post Development Peak Hour Water Demand (l/sec) 1.0
  (5.0 x Post Development Average Hour Water Demand)

APPENDIX A – IRISH WATER NETWORK PLANS

Old bray rd at Mart Lane



10/10/2018 12:18:24 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)

- Surface

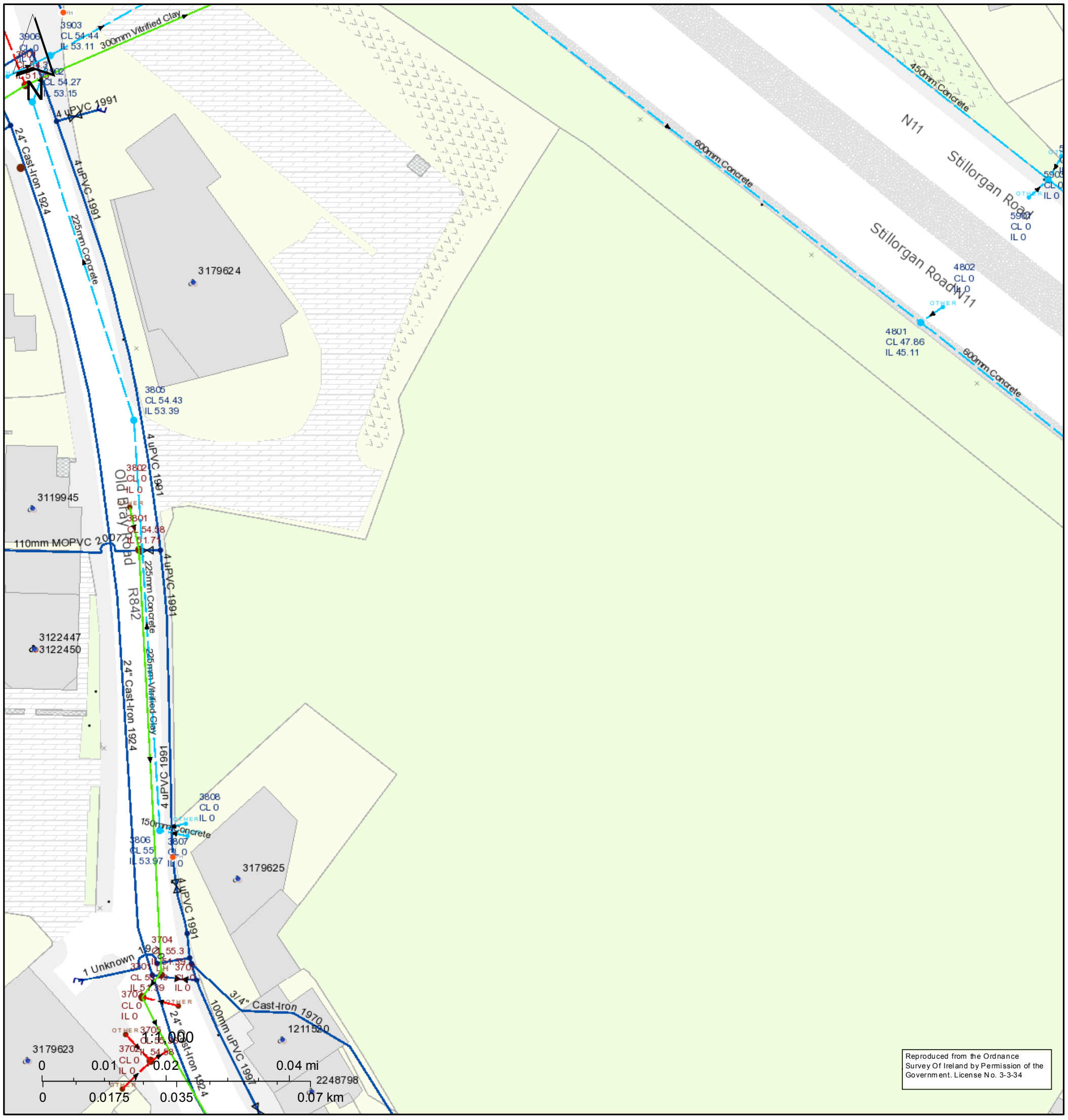
Stormwater Gravity Mains (Non-Irish Water Owned)

- Surface

Storm Manholes

- Cascade
- Catchpit
- Hatchbox

Site at Cornelscourt



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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. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated.

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

APPENDIX B – GII TRIAL PIT LOGS

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** IT01
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL.		
					(0.30) 0.50	MADE GROUND: Brown slightly sandy slightly gravelly CLAY.		
					(1.40) 1.90	Firm brown slightly sandy slightly gravelly CLAY.		
						Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	IT02

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL.		
					0.30	Firm to stiff light brown slightly sandy slightly gravelly CLAY.		
					(1.10)			
					1.40	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.50)			
					1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT02

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	IT03

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL.		
					(0.25) 0.50	Firm to stiff light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					(0.80) 1.30	Firm to stiff brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.60) 1.90	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
						Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP-01
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location (Handheld GPS)	**Dates** 21/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with fragments of conrete and plastic.		
					(0.15) 0.35	MADE GROUND: Blueish grey slightly sandy CLAY with angular to subangular, fine to coarse gravel.		
					(1.35)	Firm, brown, slightly sandy slightly gravelly CLAY with rare subangular to subrounded cobbles of granite.		
					1.70			
					(1.10)	Firm, brown, slightly sandy, slightly gravelly CLAY with occasional subangular to subrounded weathered cobbles of granite and limestone. Rare boulders of granite.		
					2.80			
					(0.20) 3.00	Firm, brown, very sandy, angular to subangular, fine to coarse gravel with rare cobbles of granite and possible weathered rock. Trial pit terminated due to sidewall collapse.		
						Complete at 3.00m		

Plan

Remarks

Groundwater encountered at 1.40m (Slight seepage), 2.10m (medium seepage) and 2.80m (medium seepage).
Trial pit sidewall collapsed between 0.70m and 2.80m BGL.
Trial pit terminated at 3.0m BGL due to sidewall collapse.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP01

Ground Investigations Ireland Ltd
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Site	Trial Pit Number
Cornelscourt	TP02

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Brown slightly sandy slightly gravelly TOPSOIL.		
					0.25			
					(0.25)	Firm to stiff light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					0.50			
					(0.80)	Firm to stiff brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.30			
					(0.60)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

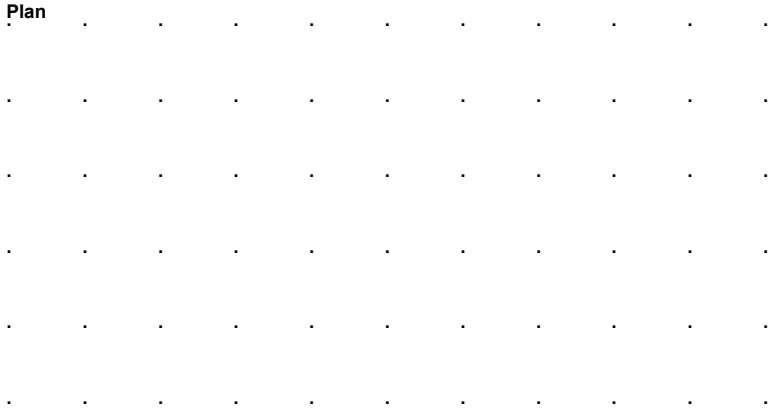
Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP03
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL with fragments of plastic and grass rootetls.		
					0.30	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.60)			
					0.90	Firm to stiff greyish brown slightly sandy gravelly CLAY with occaisonal sub-angular cobbles.		
					(2.10)			
					3.00	Terminated due to sidewalls collapsing.		
						Complete at 3.00m		

Plan



Remarks

Groundwater encountered at 2.80m BGL (Medium Seepage).
Trial pit sidewall collapsed between 0.90m and 2.30m.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP03

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP04
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootetls.		
					0.30			
					(0.30)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.60			
					(1.50)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles and rare boulders.		
					2.10			
					(1.40)	Stiff light orange/brown slightly sandy gravelly CLAY with rare sub-rounded cobbles.		
					3.50	Obstruction: Presumed Rock.		
						Complete at 3.50m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP04

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP-06
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location (Handheld GPS)	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Topsoil		
					(0.10) 0.30	MADE GROUND: Blueish grey slightly sandy CLAY with angular to subangular fine to coarse gravel.		
					(0.80) 1.10	Firm brown slightly sandy slightly gravelly CLAY with a piece of concrete slab.		
					(1.40) 2.50	Soft brown slightly sandy slightly gravelly CLAY with rare subangular cobbles of limestone and granite.		
					(0.40) 2.90	Stiff dark brown/grey slightly sandy gravelly CLAY with rare subangular cobbles.		
						Trial pit terminated.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 0.70m (Slight seepage).
Trial pit collapsed from 1.20m to 2.40m BGL.
Trial pit terminated due to sidewall collapse.

Scale (approx)	Logged By	Figure No.
1:25	TMcI	8354-01-19.TP-06

Ground Investigations Ireland Ltd
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Site Cornelscourt			**Trial Pit Number** TP07A
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with rare fragments of plastic and metal.		
					0.60			
					(0.65)	Firm light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					1.25			
					(0.25)	Soft to firm greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.50			
					(0.70)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-rounded cobbles.		
					2.20			
					(0.60)	Stiff grey mottled brown slightly sandy gravelly CLAY with occasional boulders.		
					2.80	Obstruction: Boulder or rock.		
						Complete at 3.30m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP-14

Ground Investigations Ireland Ltd
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Site Cornelscourt			**Trial Pit Number** TP08
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					0.40			
					(0.40)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.80			
					(2.10)	Firm to stiff greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and sandy gravel lenses.		
					2.90	Trial pit terminated due to sidewall collapse.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 2.00m (slight seepage) and 2.30m BGL(fast seepage).
Trial pit sidewalls collapsed.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP08

Ground Investigations Ireland Ltd
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Site	Trial Pit Number
Cornelscourt	TP09

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with occasional fragments of concrete and plastic.		
					0.40			
					(0.40)	Soft to firm light brown slightly sandy slightly gravelly CLAY.		
					0.80			
					(0.70)	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.50			
					(0.50)	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-rounded boulders of limestone.		
					2.00			
					(1.50)	Stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					3.50	Obstruction: Presumed Rock.		
						Complete at 3.50m		

Plan

Remarks

Groundwater encountered at 2.60m BGL.
Trial pit sidewalls collapsed between 1.0m and 1.80m BGL.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP09

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP11

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.80)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with frequent fragments of concrete, glass, red brick, cloth and plastic.		
					0.80 (0.20)	Soft light brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.00 (1.00)	Firm grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a strong hydrocarbon odour.		
					2.00 (1.00)	Firm to stiff grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a hydrocarbon odour.		
					3.00	Obstruction: Boulders or rock. Complete at 3.00m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit sidewall collapsed between 0.80m and 2.25m BGL.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP11

Ground Investigations Ireland Ltd
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Site	Trial Pit Number
Cornelscourt	TP12

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.30) 0.50	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.20) 0.70	Firm greu mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(2.20)	Firm to stiff gey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					2.90	Obstruction: Granite Boulder.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 2.50m (Medium seepage).
Trial pit sidewalls collapsed from 0.90m to 2.60m
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP12

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP13

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with rare fragments of metal, plastic, concrete and grass rootlets.		
					0.40			
					(0.50)	Firm to stiff light brown slightly sandy slightly gravelly CLAY.		
					0.90			
					(1.10)	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					2.00			
					(1.20)	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					3.20			
						Complete at 3.20m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP13

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP-14
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.80)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with frequent fragments of concrete, glass, red brick, cloth and plastic.		
					0.80 (0.20)	Soft light brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.00 (1.00)	Firm grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a strong hydrocarbon odour.		
					2.00 (1.30)	Firm to stiff grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a hydrocarbon odour.		
					3.30	Obstruction: Boulders or rock. Complete at 3.30m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP-14

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP16
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					0.25	Soft to firm light brown slightly sandy slightly gravelly CLAY.		
					(0.55)			
					0.80	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.50)			
					1.30	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles and sandy gravel lenses.		
					(1.40)			
					2.70	Obstruction: Presumed Rock(granite).		
						Complete at 2.70m		

Plan

Remarks

Groundwater encountered at 2.60m BGL (Medium seepage).
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP16

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP17

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.65)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.90	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-rounded cobbles limestone.		
					(1.90)			
					2.80	Light yellowish grey very sandy slightly clayey sub-angular to sub-rounded fine to coarse GRAVEL of granite(Weathered Rock).		
					(0.40)			
					3.20	Obstruction: Rock (Granite).		
						Complete at 3.20m		

Plan

Remarks

Groundwater encountered at 3.10m BGL (Medium seepage).
Trial pit sidewalls spalling.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP16

Ground Investigations Ireland Ltd
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Site	Trial Pit Number
Cornelscourt	TP20

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with rare fragments of plastic, wire, cloth and glass.		
					0.50			
					(0.20)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.70			
					(0.80)	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.50			
					(1.00)	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					2.50			
					(0.50)	Stiff to very stiff black slightly sandy gravelly CLAY with rare cobbles and boulders.		
					3.00	Obstruction: Boulder or rock.		
						Complete at 3.00m		

Plan

Remarks

Groundwater encountered at 2.0m BGL(Medium seepage).
Trial pit sidewalls spalling.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP20

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Site Cornelscourt			**Trial Pit Number** TP21
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.35) 0.60	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.35) 0.95	Firm greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and lenses of granite.		
					(0.25) 1.20	Grey very sand slightly clayey subrounded to rounded fine to coarse GRAVEL with rare sub-rounded cobbles.		
					(1.80) 3.00	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
						Obstruction: Rock (Granite).		
						Complete at 3.00m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.
Strong hydrocarbon odour upon reaching rock.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP21

APPENDIX C – ATTENUATION CALCULATION

Cascade Summary of Results for A.srcx

Upstream Structures	Outflow To	Overflow To
(None)	B.srcx	(None)

Half Drain Time : 1284 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	46.477	0.377	0.0	1.5	1.5	70.9	O K
30 min Summer	46.620	0.520	0.0	1.5	1.5	97.8	O K
60 min Summer	46.767	0.667	0.0	1.5	1.5	125.6	O K
120 min Summer	46.923	0.823	0.0	1.6	1.6	154.8	O K
180 min Summer	47.015	0.915	0.0	1.6	1.6	172.1	O K
240 min Summer	47.079	0.979	0.0	1.7	1.7	184.1	O K
360 min Summer	47.162	1.062	0.0	1.7	1.7	199.8	O K
480 min Summer	47.213	1.113	0.0	1.8	1.8	209.3	O K
600 min Summer	47.244	1.144	0.0	1.8	1.8	215.2	O K
720 min Summer	47.263	1.163	0.0	1.8	1.8	218.8	O K
960 min Summer	47.277	1.177	0.0	1.8	1.8	221.3	O K
1440 min Summer	47.273	1.173	0.0	1.8	1.8	220.7	O K
2160 min Summer	47.256	1.156	0.0	1.8	1.8	217.4	O K
2880 min Summer	47.234	1.134	0.0	1.8	1.8	213.4	O K
4320 min Summer	47.181	1.081	0.0	1.7	1.7	203.4	O K
5760 min Summer	47.120	1.020	0.0	1.7	1.7	191.9	O K
7200 min Summer	47.057	0.957	0.0	1.7	1.7	180.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	72.4	23
30 min Summer	54.456	0.0	100.3	38
60 min Summer	35.457	0.0	130.7	68
120 min Summer	22.431	0.0	165.4	128
180 min Summer	17.011	0.0	188.3	186
240 min Summer	13.956	0.0	205.8	246
360 min Summer	10.526	0.0	232.9	366
480 min Summer	8.606	0.0	254.0	486
600 min Summer	7.356	0.0	258.1	606
720 min Summer	6.469	0.0	259.5	724
960 min Summer	5.281	0.0	261.3	938
1440 min Summer	3.965	0.0	265.4	1174
2160 min Summer	2.976	0.0	395.2	1564
2880 min Summer	2.425	0.0	429.6	1992
4320 min Summer	1.815	0.0	465.7	2816
5760 min Summer	1.476	0.0	522.5	3640
7200 min Summer	1.257	0.0	556.7	4472

Cascade Summary of Results for A.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	46.994	0.894	0.0	1.6	168.2	O K
10080 min Summer	46.932	0.832	0.0	1.6	156.6	O K
15 min Winter	46.523	0.423	0.0	1.5	79.6	O K
30 min Winter	46.684	0.584	0.0	1.5	109.8	O K
60 min Winter	46.851	0.751	0.0	1.5	141.2	O K
120 min Winter	47.029	0.929	0.0	1.6	174.7	O K
180 min Winter	47.135	1.035	0.0	1.7	194.7	O K
240 min Winter	47.210	1.110	0.0	1.8	208.9	O K
360 min Winter	47.311	1.211	0.0	1.8	227.8	O K
480 min Winter	47.375	1.275	0.0	1.9	239.8	O K
600 min Winter	47.418	1.318	0.0	1.9	247.9	O K
720 min Winter	47.447	1.347	0.0	1.9	253.3	O K
960 min Winter	47.478	1.378	0.0	1.9	259.1	O K
1440 min Winter	47.482	1.382	0.0	1.9	260.0	O K
2160 min Winter	47.457	1.357	0.0	1.9	255.2	O K
2880 min Winter	47.416	1.316	0.0	1.9	247.5	O K
4320 min Winter	47.325	1.225	0.0	1.8	230.5	O K
5760 min Winter	47.224	1.124	0.0	1.8	211.4	O K
7200 min Winter	47.122	1.022	0.0	1.7	192.2	O K
8640 min Winter	47.023	0.923	0.0	1.6	173.7	O K
10080 min Winter	46.930	0.830	0.0	1.6	156.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	586.1	5280
10080 min Summer	0.987	0.0	611.8	6056
15 min Winter	78.546	0.0	81.0	23
30 min Winter	54.456	0.0	112.4	37
60 min Winter	35.457	0.0	146.5	66
120 min Winter	22.431	0.0	185.4	126
180 min Winter	17.011	0.0	210.8	184
240 min Winter	13.956	0.0	230.7	242
360 min Winter	10.526	0.0	258.4	360
480 min Winter	8.606	0.0	262.3	476
600 min Winter	7.356	0.0	264.8	588
720 min Winter	6.469	0.0	267.1	704
960 min Winter	5.281	0.0	271.8	926
1440 min Winter	3.965	0.0	279.9	1330
2160 min Winter	2.976	0.0	442.9	1668
2880 min Winter	2.425	0.0	481.0	2136
4320 min Winter	1.815	0.0	491.2	3068
5760 min Winter	1.476	0.0	585.9	3928
7200 min Winter	1.257	0.0	623.7	4824
8640 min Winter	1.103	0.0	655.8	5696
10080 min Winter	0.987	0.0	685.1	6552

Cascade Rainfall Details for A.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.492

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.492

Cascade Model Details for A.srcx

Storage is Online Cover Level (m) 52.660

Cellular Storage Structure

Invert Level (m) 46.100 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	198.0	0.0	1.601	0.0	0.0
1.600	198.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0060-2000-1600-2000
Design Head (m)	1.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	46.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.0
Flush-Flo™	0.263	1.5
Kick-Flo®	0.536	1.2
Mean Flow over Head Range	-	1.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.5	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.4	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.6
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.8		

Cascade Summary of Results for B.srcx

Upstream Structures	Outflow To	Overflow To
A.srcx	(None)	(None)

Half Drain Time : 282 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	45.794	0.394	0.0	4.0	4.0	44.9	O K
30 min Summer	45.937	0.537	0.0	4.0	4.0	61.2	O K
60 min Summer	46.079	0.679	0.0	4.0	4.0	77.4	O K
120 min Summer	46.220	0.820	0.0	4.0	4.0	93.5	O K
180 min Summer	46.288	0.888	0.0	4.0	4.0	101.3	O K
240 min Summer	46.328	0.928	0.0	4.0	4.0	105.7	O K
360 min Summer	46.362	0.962	0.0	4.0	4.0	109.6	O K
480 min Summer	46.366	0.966	0.0	4.0	4.0	110.1	O K
600 min Summer	46.361	0.961	0.0	4.0	4.0	109.6	O K
720 min Summer	46.355	0.955	0.0	4.0	4.0	108.8	O K
960 min Summer	46.339	0.939	0.0	4.0	4.0	107.0	O K
1440 min Summer	46.299	0.899	0.0	4.0	4.0	102.5	O K
2160 min Summer	46.224	0.824	0.0	4.0	4.0	94.0	O K
2880 min Summer	46.125	0.725	0.0	4.0	4.0	82.6	O K
4320 min Summer	45.872	0.472	0.0	4.0	4.0	53.8	O K
5760 min Summer	45.711	0.311	0.0	4.0	4.0	35.4	O K
7200 min Summer	45.606	0.206	0.0	4.0	4.0	23.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	119.8	22
30 min Summer	54.456	0.0	166.0	37
60 min Summer	35.457	0.0	216.2	68
120 min Summer	22.431	0.0	273.5	126
180 min Summer	17.011	0.0	311.5	186
240 min Summer	13.956	0.0	340.6	246
360 min Summer	10.526	0.0	385.3	364
480 min Summer	8.606	0.0	420.2	480
600 min Summer	7.356	0.0	435.7	538
720 min Summer	6.469	0.0	446.9	602
960 min Summer	5.281	0.0	465.3	736
1440 min Summer	3.965	0.0	495.2	1014
2160 min Summer	2.976	0.0	654.0	1452
2880 min Summer	2.425	0.0	710.7	1904
4320 min Summer	1.815	0.0	781.1	2556
5760 min Summer	1.476	0.0	864.8	3232
7200 min Summer	1.257	0.0	921.0	3888

Cascade Summary of Results for B.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	45.538	0.138	0.0	3.8	15.7	O K
10080 min Summer	45.495	0.095	0.0	3.7	10.8	O K
15 min Winter	45.844	0.444	0.0	4.0	50.6	O K
30 min Winter	46.007	0.607	0.0	4.0	69.2	O K
60 min Winter	46.174	0.774	0.0	4.0	88.2	O K
120 min Winter	46.334	0.934	0.0	4.0	106.5	O K
180 min Winter	46.417	1.017	0.0	4.0	115.9	O K
240 min Winter	46.467	1.067	0.0	4.0	121.7	O K
360 min Winter	46.518	1.118	0.0	4.0	127.4	O K
480 min Winter	46.534	1.134	0.0	4.0	129.3	O K
600 min Winter	46.533	1.133	0.0	4.0	129.1	O K
720 min Winter	46.522	1.122	0.0	4.0	127.9	O K
960 min Winter	46.494	1.094	0.0	4.0	124.8	O K
1440 min Winter	46.435	1.035	0.0	4.0	118.0	O K
2160 min Winter	46.319	0.919	0.0	4.0	104.8	O K
2880 min Winter	46.169	0.769	0.0	4.0	87.6	O K
4320 min Winter	45.771	0.371	0.0	4.0	42.3	O K
5760 min Winter	45.583	0.183	0.0	3.9	20.8	O K
7200 min Winter	45.491	0.091	0.0	3.7	10.4	O K
8640 min Winter	45.442	0.042	0.0	3.4	4.8	O K
10080 min Winter	45.422	0.022	0.0	3.2	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	969.6	4576
10080 min Summer	0.987	0.0	1012.2	5240
15 min Winter	78.546	0.0	134.1	22
30 min Winter	54.456	0.0	186.0	37
60 min Winter	35.457	0.0	242.4	66
120 min Winter	22.431	0.0	306.6	124
180 min Winter	17.011	0.0	348.8	182
240 min Winter	13.956	0.0	381.6	240
360 min Winter	10.526	0.0	429.1	354
480 min Winter	8.606	0.0	448.5	464
600 min Winter	7.356	0.0	463.8	572
720 min Winter	6.469	0.0	477.0	674
960 min Winter	5.281	0.0	500.3	768
1440 min Winter	3.965	0.0	537.4	1086
2160 min Winter	2.976	0.0	732.5	1580
2880 min Winter	2.425	0.0	795.8	2080
4320 min Winter	1.815	0.0	844.6	2684
5760 min Winter	1.476	0.0	969.1	3344
7200 min Winter	1.257	0.0	1031.7	3968
8640 min Winter	1.103	0.0	1085.3	4672
10080 min Winter	0.987	0.0	1133.4	4920

Cascade Rainfall Details for B.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.322

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.322

Cascade Model Details for B.srcx

Storage is Online Cover Level (m) 49.000

Cellular Storage Structure

Invert Level (m) 45.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	120.0	0.0	1.445	0.0	0.0
1.440	120.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.1
0.300	3.9	1.600	4.4	4.000	6.8	8.000	9.4
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.6
0.500	4.0	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.9	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.3	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

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

Half Drain Time : 646 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	45.895	0.445	0.0	4.0	4.0	97.0	O K
30 min Summer	46.060	0.610	0.0	4.0	4.0	132.9	O K
60 min Summer	46.227	0.777	0.0	4.0	4.0	169.5	O K
120 min Summer	46.394	0.944	0.0	4.0	4.0	205.9	O K
180 min Summer	46.483	1.033	0.0	4.0	4.0	225.1	O K
240 min Summer	46.538	1.088	0.0	4.0	4.0	237.2	O K
360 min Summer	46.595	1.145	0.0	4.0	4.0	249.7	O K
480 min Summer	46.616	1.166	0.0	4.0	4.0	254.2	O K
600 min Summer	46.620	1.170	0.0	4.0	4.0	255.1	O K
720 min Summer	46.620	1.170	0.0	4.0	4.0	255.2	O K
960 min Summer	46.613	1.163	0.0	4.0	4.0	253.5	O K
1440 min Summer	46.585	1.135	0.0	4.0	4.0	247.4	O K
2160 min Summer	46.528	1.078	0.0	4.0	4.0	235.0	O K
2880 min Summer	46.462	1.012	0.0	4.0	4.0	220.7	O K
4320 min Summer	46.317	0.867	0.0	4.0	4.0	189.0	O K
5760 min Summer	46.132	0.682	0.0	4.0	4.0	148.6	O K
7200 min Summer	45.973	0.523	0.0	4.0	4.0	114.0	O K
8640 min Summer	45.853	0.403	0.0	4.0	4.0	88.0	O K
10080 min Summer	45.763	0.313	0.0	4.0	4.0	68.3	O K
15 min Winter	45.950	0.500	0.0	4.0	4.0	109.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	100.5	23
30 min Summer	54.456	0.0	139.4	37
60 min Summer	35.457	0.0	181.5	68
120 min Summer	22.431	0.0	229.7	126
180 min Summer	17.011	0.0	261.3	186
240 min Summer	13.956	0.0	285.9	246
360 min Summer	10.526	0.0	323.4	364
480 min Summer	8.606	0.0	352.4	484
600 min Summer	7.356	0.0	376.6	542
720 min Summer	6.469	0.0	397.6	606
960 min Summer	5.281	0.0	432.7	736
1440 min Summer	3.965	0.0	487.5	1012
2160 min Summer	2.976	0.0	548.7	1432
2880 min Summer	2.425	0.0	596.0	1848
4320 min Summer	1.815	0.0	669.2	2684
5760 min Summer	1.476	0.0	725.7	3456
7200 min Summer	1.257	0.0	772.7	4112
8640 min Summer	1.103	0.0	813.3	4760
10080 min Summer	0.987	0.0	849.2	5448
15 min Winter	78.546	0.0	112.5	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	46.137	0.687	0.0	4.0	4.0	149.8	O K
60 min Winter	46.328	0.878	0.0	4.0	4.0	191.4	O K
120 min Winter	46.519	1.069	0.0	4.0	4.0	233.1	O K
180 min Winter	46.624	1.174	0.0	4.0	4.0	256.0	O K
240 min Winter	46.692	1.242	0.0	4.0	4.0	270.9	O K
360 min Winter	46.770	1.320	0.0	4.1	4.1	287.7	O K
480 min Winter	46.805	1.355	0.0	4.1	4.1	295.4	O K
600 min Winter	46.817	1.367	0.0	4.2	4.2	298.1	O K
720 min Winter	46.816	1.366	0.0	4.2	4.2	297.9	O K
960 min Winter	46.802	1.352	0.0	4.1	4.1	294.7	O K
1440 min Winter	46.758	1.308	0.0	4.1	4.1	285.1	O K
2160 min Winter	46.661	1.211	0.0	4.0	4.0	264.0	O K
2880 min Winter	46.551	1.101	0.0	4.0	4.0	240.0	O K
4320 min Winter	46.312	0.862	0.0	4.0	4.0	187.9	O K
5760 min Winter	46.003	0.553	0.0	4.0	4.0	120.6	O K
7200 min Winter	45.802	0.352	0.0	4.0	4.0	76.8	O K
8640 min Winter	45.677	0.227	0.0	3.9	3.9	49.5	O K
10080 min Winter	45.602	0.152	0.0	3.7	3.7	33.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	54.456	0.0	156.1	37
60 min Winter	35.457	0.0	203.4	66
120 min Winter	22.431	0.0	257.2	124
180 min Winter	17.011	0.0	292.8	182
240 min Winter	13.956	0.0	320.2	240
360 min Winter	10.526	0.0	362.4	354
480 min Winter	8.606	0.0	394.9	466
600 min Winter	7.356	0.0	422.1	574
720 min Winter	6.469	0.0	445.4	676
960 min Winter	5.281	0.0	484.7	766
1440 min Winter	3.965	0.0	546.0	1084
2160 min Winter	2.976	0.0	614.5	1540
2880 min Winter	2.425	0.0	667.7	1996
4320 min Winter	1.815	0.0	749.4	2900
5760 min Winter	1.476	0.0	813.0	3576
7200 min Winter	1.257	0.0	865.6	4184
8640 min Winter	1.103	0.0	910.8	4840
10080 min Winter	0.987	0.0	951.1	5448

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)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.683

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.683

Model Details

Storage is Online Cover Level (m) 50.000

Cellular Storage Structure

Invert Level (m) 45.450 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	229.5	0.0	1.445	0.0	0.0
1.440	229.5	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.1
0.300	3.9	1.600	4.4	4.000	6.8	8.000	9.4
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.6
0.500	4.0	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.9	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.3	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

APPENDIX D –CORRESPONDANCE WITH IRISH WATER

Ardstone Residential Partners c/o Sean Byrne
DBFL Consulting Eng,
Ormond House,
Upper Ormond Quay,
Dublin
D07W704

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

21 February 2019

Dear Sir/Madam,

Re: Customer Reference No 7745992294 pre-connection enquiry - Subject to contract | Contract denied
500 unit housing development at Old Bray Road, Cornelscourt, Dublin

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at Old Bray Road, Cornelscourt, Dublin. Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

In the case of wastewater connections this assessment does not confirm that a gravity connection is achievable. Therefore a suitably sized pumping station may be required to be installed on your site. All infrastructure should be designed and installed in accordance with the Irish Water Code of Practice.

With regard to the proposed wastewater connection, while there is no known constraint downstream of this site, due to the size of the development it will be necessary to carry out further detailed studies to confirm the available capacity and to determine the full extent of any upgrades which may be required, prior to agreeing to the proposed connection.

Should you wish to have such studies progressed by Irish Water, you will be required to enter into a Project Works Services Agreement. Irish Water will also require that you contribute a relevant portion of the cost of works to achieve such upgrades. Please contact Irish Water for further information.

Please see attached drawing for location of existing watermains and sewers. Wayleaves and appropriate separation distances shall be maintained for any infrastructure within the development site.

Strategic Housing Development
Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

A. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

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

C. In advance of submitting this development to An Bord Pleanala for full assessment, the Developer is required to have entered into a Project Works Services Agreement to deliver studies to confirm the available capacity and to determine the full extent of any upgrades which may be required to be completed to Irish Water infrastructure.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details.

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

If you have any further questions, please contact Brian O'Mahony from the design team on 022 52205 or email *bomahony@water.ie* . For further information, visit **www.water.ie/connections**

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

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

Ardstone Residential Partners c/o Sean Byrne
DBFL Consulting Eng,
Ormond House,
Upper Ormond Quay,
Dublin
D07W704

20 September 2019

Re: Design Submission for 500 unit housing development at Old Bray Road, Cornelscourt, Dublin (the "Development")
(the "Design Submission") / Connection Reference No: 7745992294

Dear Sean Byrne,

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: Brian O'Mahony
Phone: 022 52205
Email: bomahony@water.ie

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix A

Document Title & Revision

- [Site Services Layout] 180208-DBFL-XX-XX-DR-C-3001-P1
- [Watermain Layout] 180208-DBFL-XX-XX-DR-C-3002-P1
- [Longitudinal Sections Through Foul Sewer] 180208-DBFL-XX-XX-DR-C-3010-P1

*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.

Brendan Keogh - DBFL Consulting Engineers

From: Fionan Ginty <fginty@water.ie>
Sent: Friday 16 August 2019 11:53
To: Brendan Keogh - DBFL Consulting Engineers
Subject: RE: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Brendan,

The scope of the PWSA is still being reviewed.

There is currently a Drainage Area Plan (DAP) underway in this overall catchment. The initial assessment for this site outlined some additional flow monitoring/model update/capacity assessment, in addition to what is underway as part of the DAP.

Best Regards

Fionán Ginty
Senior Design Engineer
Connections and Developer Services - Greater Dublin Region

Uisce Éireann
Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath, Éire
Irish Water
Colvill House, 24-26 Talbot Street, Dublin 1, Ireland
T: 01 8925734 | E: fginty@water.ie
P Please consider the environment before printing this e-mail

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From: Brendan Keogh - DBFL Consulting Engineers [mailto:Brendan.Keogh@dbfl.ie]
Sent: 14 August 2019 17:04
To: Fionan Ginty
Subject: FW: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Fionan,

I'm following up on the e-mails below regarding Ardstone's site in Cornelscourt (PCE Ref. 7745992294).

Can you provide an update on progress of preparation of a PWSA ?

Can you advise the likely scope of a PWSA ?

Regards

From: Brendan Keogh - DBFL Consulting Engineers
Sent: Wednesday 17 July 2019 17:45
To: Fionan Ginty <fginty@water.ie>
Cc: Dan Reilly-DBFL Consulting Engineers <Dan.Reilly@dbfl.ie>
Subject: RE: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Thanks, much appreciated.

From: Fionan Ginty <fginty@water.ie>
Sent: Wednesday 17 July 2019 17:35
To: Brendan Keogh - DBFL Consulting Engineers <Brendan.Keogh@dbfl.ie>
Cc: Dan Reilly-DBFL Consulting Engineers <Dan.Reilly@dbfl.ie>
Subject: RE: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Brendan,

I have forwarded for scoping, noting the request to prioritise.

Regards

Fionán

From: Brendan Keogh - DBFL Consulting Engineers [mailto:Brendan.Keogh@dbfl.ie]
Sent: 17 July 2019 17:15
To: Fionan Ginty
Cc: Dan Reilly-DBFL Consulting Engineers
Subject: RE: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Fionan,

Thanks for responding to our queries.

Please proceed with preparation of a PWSA for Ardstone's site in Cornelscourt (PCE Ref. 7745992294).

The pre-app meeting at ABP is on this Friday, we'll note that Ardstone have engaged with Irish Water following receipt of PCE feedback and have requested Irish Water to issue a PWSA.

It would be greatly appreciated if you could prioritise issue of this PWSA as we'd like to include this information in the subsequent SHD application.

Feel free to contact me if you have any queries regarding the site at Cornelscourt.

Regards

From: Fionan Ginty <fginty@water.ie>
Sent: Wednesday 17 July 2019 09:48
To: Brendan Keogh - DBFL Consulting Engineers <Brendan.Keogh@dbfl.ie>
Subject: RE: 180208 - Cornelscourt - Irish Water PCE - Customer Reference No - 7745992294

Brendan,

Responses to your questions in red below:

Best Regards

Fionán Ginty
Senior Design Engineer
Connections and Developer Services - Greater Dublin Region

Uisce Éireann
Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath, Éire

Irish Water
Colvill House, 24-26 Talbot Street, Dublin 1, Ireland
T: 01 8925734 | E: fginty@water.ie
P Please consider the environment before printing this e-mail

From: Brendan Keogh - DBFL Consulting Engineers [mailto:Brendan.Keogh@dbfl.ie]
Sent: 16 July 2019 14:02
To: Brian O'Mahony
Subject: 180208 - Cornelscourt - Irish Water PCE

Brian,

I'm following up on a PCE that was issued for Ardstone's site in Cornelscourt in February 2019, reference 7745992294 (see attached). You were listed as a contact in Irish Water.

The PCE notes that there are no known constraints downstream of this site but also notes that a PWSA is required.

Ardstone have been working through the planning process and will soon attend the pre-application meeting with ABP.

Can you advise the following:

- What would be the likely scope of a PWSA include given that the PCE notes "no known constraints" ? Flow monitoring and model update in addition to the current scope of the ongoing Drainage Area Plan in this area.
- Can you advise the process by which Ardstone could engage with Irish Water on a PWSA ? Advise via email if Ardstone wish to proceed with the PWSA.
- What would be the likely timeframe for confirming the scope and cost of such a PWSA ? Timeframe for same not currently available. This generally takes a number of weeks.
- What would be the likely timeframe for carrying out any investigations required by such a PWSA ? This would depend on the scope of the required investigations.
- Have Irish Water any planned foul network upgrades in the vicinity of the site / downstream of the site ? The ongoing Drainage Area Plan in this area will outline upgrades, if any, within this catchment.

Regards

Brendan Keogh
BA BAI PGradDip CEng MIEI
Associate Director
DBFL Consulting Engineers

DUBLIN OFFICE: Ormond House, Upper Ormond Quay, Dublin 7. Tel: +353 1 400 4000
Email: brendan.keogh@dbfl.ie Web: www.dbfl.ie

CORK OFFICE: Phoenix House, Monahan Road, Cork. Tel: +353 (0) 21 2024538

WATERFORD OFFICE: Unit 2, The Chandlery, 1-2 O'Connell Street, Waterford. Tel: +353 (0) 51 309500
Fax: +353 (0) 51 844913

Thank you for your attention.

Go raibh maith agat as d’aird a thabhairt.

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Thank you for your attention.

Tá an fhaisnéis á seachadadh dírithe ar an duine nó ar an eintiteas chuig a bhfuil sí seolta amháin agus féadfar ábhar faoi rún, faoi phribhléid nó ábhar atá íogair ó thaobh tráchtála de a bheith mar chuid de. Tá aon athsheachadadh nó scaipeadh den fhaisnéis, aon athbhreithniú ar nó aon úsáid eile a bhaint as, nó aon ghníomh a dhéantar ag brath ar an bhfaisnéis seo ag daoine nó ag eintitis nach dóibh siúd an fhaisnéis seo, toirimiscthe agus féadfar é a bheith neamhdhleathach. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh iomlán agus ceart na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Ní ghlacann Uisce Éireann le haon dliteanas faoi ghnímh nó faoi iarmhairtí bunaithe ar úsáid thoirmiscthe na faisnéise seo. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh ceart agus iomlán na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Má fuair tú an teachtaireacht seo in earráid, más é do thoil é, déan teagmháil leis an seoltóir agus scrios an t-ábhar ó gach aon ríomhaire. Féadfar ríomhphost a bheith soghabhálach i leith truaillithe, idircheaptha agus i leith leasaithe neamhúdaraithe. Ní ghlacann Uisce Éireann le haon fhreagracht as athruithe nó as idircheapadh a rinneadh ar an ríomhphost seo i ndiaidh é a sheoladh nó as aon dochar do chórais na bhfaighteoirí déanta ag an teachtaireacht seo nó ag a ceangaltáin. Más é do thoil é, tabhair faoi deara chomh maith go bhféadfar monatóireacht a dhéanamh ar theachtaireachtaí chuig nó ó Uisce Éireann chun comhlíonadh le polasaithe agus le caighdeáin Uisce Éireann a chinntiú agus chun ár ngnó a chosaint. Fochuideachta gníomhaíochta de chuid Ervia is ea Uisce Éireann atá faoi theorainn scaireanna, de bhun fhorálacha an tAcht um Sheirbhísí Uisce 2013, a bhfuil a bpríomh ionad gnó ag 24-26 Teach Colvill, Sráid na Talbóide, BÁC 1.

Go raibh maith agat as d’aird a thabhairt.

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Thank you for your attention.

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an bhfaisnéis seo ag daoine nó ag eintitis nach dóibh siúd an fhaisnéis seo, toirimiscthe agus féadfar é a bheith neamhdhleathach. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh iomlán agus ceart na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Ní ghlacann Uisce Éireann le haon dliteanas faoi ghnímh nó faoi iarmhairtí bunaithe ar úsáid thoirmiscthe na faisnéise seo. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh ceart agus iomlán na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Má fuair tú an teachtaireacht seo in earráid, más é do thoil é, déan teagmháil leis an seoltóir agus scrios an t-ábhar ó gach aon ríomhaire. Féadfar ríomhphost a bheith soghabhálach i leith truaillithe, idircheaptha agus i leith leasaithe neamhúdaraithe. Ní ghlacann Uisce Éireann le haon fhreagracht as athruithe nó as idircheapadh a rinneadh ar an ríomhphost seo i ndiaidh é a sheoladh nó as aon dochar do chórais na bhfaighteoirí déanta ag an teachtaireacht seo nó ag a ceangaltáin. Más é do thoil é, tabhair faoi deara chomh maith go bhféadfar monatóireacht a dhéanamh ar theachtaireachtaí chuig nó ó Uisce Éireann chun comhlíonadh le polasaithe agus le caighdeáin Uisce Éireann a chinntiú agus chun ár ngnó a chosaint. Fochuideachta gníomhaíochta de chuid Ervia is ea Uisce Éireann atá faoi theorainn scaireanna, de bhun fhorálacha an tAcht um Sheirbhísí Uisce 2013, a bhfuil a bpríomh ionad gnó ag 24-26 Teach Colvill, Sráid na Talbóide, BÁC 1.

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Thank you for your attention.

Tá an fhaisnéis á seachadadh dírithe ar an duine nó ar an eintiteas chuig a bhfuil sí seolta amháin agus féadfar ábhar faoi rún, faoi phribhléid nó ábhar atá íogair ó thaobh tráchtála de a bheith mar chuid de. Tá aon athsheachadadh nó scaipeadh den fhaisnéis, aon athbhreithniú ar nó aon úsáid eile a bhaint as, nó aon ghníomh a dhéantar ag brath ar an bhfaisnéis seo ag daoine nó ag eintitis nach dóibh siúd an fhaisnéis seo, toirimiscthe agus féadfar é a bheith neamhdhleathach. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh iomlán agus ceart na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Ní ghlacann Uisce Éireann le haon dliteanas faoi ghnímh nó faoi iarmhairtí bunaithe ar úsáid thoirmiscthe na faisnéise seo. Níl Uisce Éireann faoi dhliteanas maidir le seachadadh ceart agus iomlán na faisnéise sa chumarsáid seo nó maidir le haon mhoill a bhaineann léi. Má fuair tú an teachtaireacht seo in earráid, más é do thoil é, déan teagmháil leis an seoltóir agus scrios an t-ábhar ó gach aon ríomhaire. Féadfar ríomhphost a bheith soghabhálach i leith truaillithe, idircheaptha agus i leith leasaithe neamhúdaraithe. Ní ghlacann Uisce Éireann le haon fhreagracht as athruithe nó as idircheapadh a rinneadh ar an ríomhphost seo i ndiaidh é a sheoladh nó as aon dochar do chórais na bhfaighteoirí déanta ag an teachtaireacht seo nó ag a ceangaltáin. Más é do thoil é, tabhair faoi deara chomh maith go bhféadfar monatóireacht a dhéanamh ar theachtaireachtaí chuig nó ó Uisce Éireann chun comhlíonadh le polasaithe agus le caighdeáin Uisce Éireann a chinntiú agus chun ár ngnó a chosaint. Fochuideachta gníomhaíochta de chuid Ervia is ea Uisce Éireann atá faoi theorainn scaireanna, de bhun fhorálacha an tAcht um Sheirbhísí Uisce 2013, a bhfuil a bpríomh ionad gnó ag 24-26 Teach Colvill, Sráid na Talbóide, BÁC 1.

Go raibh maith agat as d'aird a thabhairt.

Thank you for your attention.

Go raibh maith agat as d'aird a thabhairt.

APPENDIX E – SURFACE WATER NETWORK DESIGN CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.400	Add Flow / Climate Change (%)	10
Ratio R	0.273	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SW_1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	27.363	1.300	21.0	0.195	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.921	0.190	25.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	13.874	0.730	19.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	24.541	1.169	21.0	0.250	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	27.483	0.100	274.8	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	74.071	0.350	211.6	0.120	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	47.333	0.200	236.7	0.101	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.007	1.434	0.050	28.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.000	14.990	0.230	65.2	0.011	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	17.058	0.170	100.3	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	65.29	4.16	52.800	0.195	0.0	0.0	3.4	2.86	113.9	37.9
1.001	65.12	4.19	51.500	0.195	0.0	0.0	3.4	2.58	102.6	37.9
1.002	64.73	4.27	51.310	0.215	0.0	0.0	3.8	3.02	119.9	41.5
1.003	64.12	4.39	50.505	0.465	0.0	0.0	8.1	3.45	243.6	88.8
1.004	61.80	4.87	46.100	0.481	0.0	0.0	8.1	0.94	66.7«	88.8
1.005	58.05	5.76	45.850	0.601	0.0	0.0	9.4	1.39	221.6	103.9
1.006	55.82	6.36	45.500	0.702	0.0	0.0	10.6	1.32	209.5	116.7
1.007	55.80	6.36	45.300	0.702	0.0	0.0	10.6	3.81	605.6	116.7
2.000	65.32	4.15	51.500	0.011	0.0	0.0	0.2	1.62	64.5	2.1
2.001	64.20	4.37	51.270	0.046	0.0	0.0	0.8	1.31	51.9	8.8

Section of network containing attenuation tank. Capacity not representative of attenuation tank.

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.002	51.867	0.725	71.5	0.124	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	19.921	0.980	20.3	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	22.856	0.700	32.7	0.012	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	21.155	0.300	70.5	0.013	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.004	25.546	0.280	91.2	0.028	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.000	16.586	0.225	73.7	0.013	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.005	47.281	1.385	34.1	0.226	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.006	4.782	0.200	23.9	0.016	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.007	39.490	0.050	789.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.000	14.267	0.175	81.5	0.025	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	25.123	0.610	41.2	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.000	14.233	0.175	81.3	0.035	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.002	12.633	0.632	20.0	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.003	2.745	0.068	40.4	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.002	61.96	4.84	51.025	0.170	0.0	0.0	2.9	1.86	131.6	31.4
2.003	61.53	4.93	50.300	0.191	0.0	0.0	3.2	3.50	247.6	35.0
3.000	65.26	4.17	50.700	0.012	0.0	0.0	0.2	2.30	91.4	2.3
4.000	64.94	4.23	49.690	0.013	0.0	0.0	0.2	1.56	62.0	2.5
2.004	60.53	5.16	49.240	0.244	0.0	0.0	4.0	1.90	209.6	44.0
5.000	65.17	4.18	49.335	0.013	0.0	0.0	0.2	1.52	60.6	2.5
2.005	59.57	5.38	48.885	0.483	0.0	0.0	7.8	3.49	554.9	85.7
2.006	59.49	5.40	45.500	0.499	0.0	0.0	8.0	4.17	663.4	88.4
2.007	55.95	6.32	45.300	0.499	0.0	0.0	8.0	0.72	113.8	88.4
6.000	65.27	4.16	48.040	0.025	0.0	0.0	0.4	1.45	57.6	4.9
6.001	64.21	4.37	47.865	0.046	0.0	0.0	0.8	2.04	81.3	8.8
7.000	65.27	4.16	47.430	0.035	0.0	0.0	0.6	1.45	57.7	6.8
6.002	63.85	4.44	47.255	0.131	0.0	0.0	2.3	2.94	116.9	24.9
6.003	63.74	4.46	45.468	0.135	0.0	0.0	2.3	2.07	82.1	25.6

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.008	8.381	0.150	55.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	15.070	0.060	251.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	25.604	0.170	150.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.008	55.72	6.39	45.400	0.634	0.0	0.0	9.6	2.11	149.0	105.2
1.008	54.66	6.69	45.250	1.336	0.0	0.0	19.8	0.82	32.6«	217.6
1.009	53.35	7.09	45.190	1.336	0.0	0.0	19.8	1.06	42.3«	217.6

NOT REPRESENTATIVE OF FLOWS DOWN STREAM OF HYDROBRAKE.

Manhole Schedules for SW_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S10	54.310	1.510	Open Manhole	1200	1.000	52.800	225				
S9	53.200	1.700	Open Manhole	1200	1.001	51.500	225	1.000	51.500	225	
S8	53.300	1.990	Open Manhole	1200	1.002	51.310	225	1.001	51.310	225	
S7	52.500	1.995	Open Manhole	1200	1.003	50.505	300	1.002	50.580	225	
S6	52.660	6.560	Open Manhole	1200	1.004	46.100	300	1.003	49.336	300	3236
S5	49.800	3.950	Open Manhole	1350	1.005	45.850	450	1.004	46.000	300	
S4	48.130	2.630	Open Manhole	1350	1.006	45.500	450	1.005	45.500	450	
S3	48.000	2.700	Open Manhole	1350	1.007	45.300	450	1.006	45.300	450	
S2-9	53.500	2.000	Open Manhole	1200	2.000	51.500	225				
S2-8	53.000	1.730	Open Manhole	1200	2.001	51.270	225	2.000	51.270	225	
S2-7	52.870	1.845	Open Manhole	1200	2.002	51.025	300	2.001	51.100	225	
S2-6	52.000	1.700	Open Manhole	1200	2.003	50.300	300	2.002	50.300	300	
S1-5-3	52.150	1.450	Open Manhole	1200	3.000	50.700	225				
S2-5-1	51.600	1.910	Open Manhole	1200	4.000	49.690	225				
S2-5	51.400	2.160	Open Manhole	1350	2.004	49.240	375	2.003	49.320	300	5
								3.000	50.000	225	610
								4.000	49.390	225	
S1-4-1	50.900	1.565	Open Manhole	1200	5.000	49.335	225				
S2-4	50.650	1.765	Open Manhole	1350	2.005	48.885	450	2.004	48.960	375	
								5.000	49.110	225	
S2-3	49.200	3.700	Open Manhole	1350	2.006	45.500	450	2.005	47.500	450	2000
S2-2	49.100	3.800	Open Manhole	1350	2.007	45.300	450	2.006	45.300	450	
S2-1-4	51.500	3.460	Open Manhole	1200	6.000	48.040	225				
S2-1-3	49.150	1.285	Open Manhole	1200	6.001	47.865	225	6.000	47.865	225	
S2-1-2-1	49.000	1.570	Open Manhole	1200	7.000	47.430	225				
S2-1-2	48.490	1.235	Open Manhole	1200	6.002	47.255	225	6.001	47.255	225	
								7.000	47.255	225	
S2-1-1	48.280	2.812	Open Manhole	1200	6.003	45.468	225	6.002	46.623	225	1155
S2-1	48.280	3.030	Open Manhole	1350	2.008	45.400	300	2.007	45.250	450	
								6.003	45.400	225	
S2	48.000	2.750	Open Manhole	1350	1.008	45.250	225	1.007	45.250	450	
								2.008	45.250	300	
S1	47.750	2.560	Open Manhole	1200	1.009	45.190	225	1.008	45.190	225	
	46.800	1.780	Open Manhole	0		OUTFALL		1.009	45.020	225	

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	S10	54.310	52.800	1.285	Open Manhole	1200
1.001	o	225	S9	53.200	51.500	1.475	Open Manhole	1200
1.002	o	225	S8	53.300	51.310	1.765	Open Manhole	1200
1.003	o	300	S7	52.500	50.505	1.695	Open Manhole	1200
1.004	o	300	S6	52.660	46.100	6.260	Open Manhole	1200
1.005	o	450	S5	49.800	45.850	3.500	Open Manhole	1350
1.006	o	450	S4	48.130	45.500	2.180	Open Manhole	1350
1.007	o	450	S3	48.000	45.300	2.250	Open Manhole	1350
2.000	o	225	S2-9	53.500	51.500	1.775	Open Manhole	1200
2.001	o	225	S2-8	53.000	51.270	1.505	Open Manhole	1200
2.002	o	300	S2-7	52.870	51.025	1.545	Open Manhole	1200
2.003	o	300	S2-6	52.000	50.300	1.400	Open Manhole	1200
3.000	o	225	S1-5-3	52.150	50.700	1.225	Open Manhole	1200
4.000	o	225	S2-5-1	51.600	49.690	1.685	Open Manhole	1200
2.004	o	375	S2-5	51.400	49.240	1.785	Open Manhole	1350
5.000	o	225	S1-4-1	50.900	49.335	1.340	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	27.363	21.0	S9	53.200	51.500	1.475	Open Manhole	1200
1.001	4.921	25.9	S8	53.300	51.310	1.765	Open Manhole	1200
1.002	13.874	19.0	S7	52.500	50.580	1.695	Open Manhole	1200
1.003	24.541	21.0	S6	52.660	49.336	3.024	Open Manhole	1200
1.004	27.483	274.8	S5	49.800	46.000	3.500	Open Manhole	1350
1.005	74.071	211.6	S4	48.130	45.500	2.180	Open Manhole	1350
1.006	47.333	236.7	S3	48.000	45.300	2.250	Open Manhole	1350
1.007	1.434	28.7	S2	48.000	45.250	2.300	Open Manhole	1350
2.000	14.990	65.2	S2-8	53.000	51.270	1.505	Open Manhole	1200
2.001	17.058	100.3	S2-7	52.870	51.100	1.545	Open Manhole	1200
2.002	51.867	71.5	S2-6	52.000	50.300	1.400	Open Manhole	1200
2.003	19.921	20.3	S2-5	51.400	49.320	1.780	Open Manhole	1350
3.000	22.856	32.7	S2-5	51.400	50.000	1.175	Open Manhole	1350
4.000	21.155	70.5	S2-5	51.400	49.390	1.785	Open Manhole	1350
2.004	25.546	91.2	S2-4	50.650	48.960	1.315	Open Manhole	1350
5.000	16.586	73.7	S2-4	50.650	49.110	1.315	Open Manhole	1350

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	o	450	S2-4	50.650	48.885	1.315	Open Manhole	1350
2.006	o	450	S2-3	49.200	45.500	3.250	Open Manhole	1350
2.007	o	450	S2-2	49.100	45.300	3.350	Open Manhole	1350
6.000	o	225	S2-1-4	51.500	48.040	3.235	Open Manhole	1200
6.001	o	225	S2-1-3	49.150	47.865	1.060	Open Manhole	1200
7.000	o	225	S2-1-2-1	49.000	47.430	1.345	Open Manhole	1200
6.002	o	225	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
6.003	o	225	S2-1-1	48.280	45.468	2.587	Open Manhole	1200
2.008	o	300	S2-1	48.280	45.400	2.580	Open Manhole	1350
1.008	o	225	S2	48.000	45.250	2.525	Open Manhole	1350
1.009	o	225	S1	47.750	45.190	2.335	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	47.281	34.1	S2-3	49.200	47.500	1.250	Open Manhole	1350
2.006	4.782	23.9	S2-2	49.100	45.300	3.350	Open Manhole	1350
2.007	39.490	789.8	S2-1	48.280	45.250	2.580	Open Manhole	1350
6.000	14.267	81.5	S2-1-3	49.150	47.865	1.060	Open Manhole	1200
6.001	25.123	41.2	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
7.000	14.233	81.3	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
6.002	12.633	20.0	S2-1-1	48.280	46.623	1.432	Open Manhole	1200
6.003	2.745	40.4	S2-1	48.280	45.400	2.655	Open Manhole	1350
2.008	8.381	55.9	S2	48.000	45.250	2.450	Open Manhole	1350
1.008	15.070	251.2	S1	47.750	45.190	2.335	Open Manhole	1200
1.009	25.604	150.6		46.800	45.020	1.555	Open Manhole	0

Free Flowing Outfall Details for SW_1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009		46.800	45.020	0.000	0	0

Online Controls for SW_1

Hydro-Brake® Optimum Manhole: S5, DS/PN: 1.005, Volume (m³): 7.5

Unit Reference	MD-SHE-0060-2000-1600-2000
Design Head (m)	1.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	46.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.0
Flush-Flo™	0.263	1.5
Kick-Flo®	0.536	1.2
Mean Flow over Head Range	-	1.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.5	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.4	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.6
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.8		

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.007, Volume (m³): 11.2

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.007, Volume (m³): 11.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.1
0.300	3.9	1.600	4.4	4.000	6.8	8.000	9.4
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.6
0.500	4.0	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.9	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.3	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

Hydro-Brake® Optimum Manhole: S2-1, DS/PN: 2.008, Volume (m³): 10.2

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	0.300	3.9	0.500	4.0	0.800	3.3
0.200	3.7	0.400	4.0	0.600	3.9	1.000	3.5

Hydro-Brake® Optimum Manhole: S2-1, DS/PN: 2.008, Volume (m³): 10.2

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.8	2.400	5.3	5.000	7.5	8.000	9.4
1.400	4.1	2.600	5.5	5.500	7.8	8.500	9.6
1.600	4.4	3.000	5.9	6.000	8.2	9.000	9.9
1.800	4.6	3.500	6.3	6.500	8.5	9.500	10.2
2.000	4.9	4.000	6.8	7.000	8.8		
2.200	5.1	4.500	7.1	7.500	9.1		

Summary of Results for 30 minute 5 year Winter (SW_1)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S10	52.882	-0.143	0.000	0.29		30.1	OK
1.001	S9	51.612	-0.113	0.000	0.49		30.0	OK
1.002	S8	51.397	-0.138	0.000	0.31		32.9	OK
1.003	S7	50.619	-0.186	0.000	0.31		67.9	OK
1.004	S6	46.444	0.044	0.000	0.03		1.8	SURCHARGED
1.005	S5	46.445	0.145	0.000	0.01		1.5	OK
1.006	S4	45.586	-0.364	0.000	0.08		15.5	OK
1.007	S3	45.414	-0.336	0.000	0.01		2.2	OK
2.000	S2-9	51.526	-0.199	0.000	0.03		1.7	OK
2.001	S2-8	51.326	-0.169	0.000	0.14		6.6	OK
2.002	S2-7	51.114	-0.211	0.000	0.19		23.7	OK
2.003	S2-6	50.370	-0.230	0.000	0.12		26.7	OK
3.000	S1-5-3	50.723	-0.202	0.000	0.02		1.9	OK
4.000	S2-5-1	49.717	-0.198	0.000	0.04		2.0	OK
2.004	S2-5	49.350	-0.265	0.000	0.19		34.2	OK
5.000	S1-4-1	49.363	-0.197	0.000	0.04		2.0	OK
2.005	S2-4	48.995	-0.340	0.000	0.13		67.4	OK
2.006	S2-3	45.661	-0.289	0.000	0.28		69.7	OK
2.007	S2-2	45.620	-0.130	0.000	0.68		68.3	OK
6.000	S2-1-4	48.081	-0.184	0.000	0.08		3.9	OK
6.001	S2-1-3	47.910	-0.180	0.000	0.09		6.8	OK
7.000	S2-1-2-1	47.479	-0.176	0.000	0.11		5.4	OK
6.002	S2-1-2	47.321	-0.159	0.000	0.19		19.1	OK
6.003	S2-1-1	45.619	-0.074	0.000	0.54		19.7	OK
2.008	S2-1	45.619	-0.081	0.000	0.04		3.8	OK
1.008	S2	45.319	-0.156	0.000	0.21		5.9	OK
1.009	S1	45.248	-0.167	0.000	0.15		5.9	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.400	Add Flow / Climate Change (%)	10
Ratio R	0.273	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SW_1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	27.363	1.300	21.0	0.195	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.921	0.190	25.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	13.874	0.730	19.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	24.541	1.169	21.0	0.250	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	27.483	0.100	274.8	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	74.071	0.350	211.6	0.120	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	47.333	0.200	236.7	0.101	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.007	1.434	0.050	28.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.000	14.990	0.230	65.2	0.011	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	17.058	0.170	100.3	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	100.00	4.16	52.800	0.195	0.0	0.0	5.3	2.86	113.9	58.1
1.001	100.00	4.19	51.500	0.195	0.0	0.0	5.3	2.58	102.6	58.1
1.002	100.00	4.27	51.310	0.215	0.0	0.0	5.8	3.02	119.9	64.1
1.003	100.00	4.39	50.505	0.465	0.0	0.0	12.6	3.45	243.6	138.5
1.004	100.00	4.87	46.100	0.481	0.0	0.0	13.0	0.94	66.7«	143.3
1.005	100.00	5.76	45.850	0.601	0.0	0.0	16.3	1.39	221.6	179.0
1.006	100.00	6.36	45.500	0.702	0.0	0.0	19.0	1.32	209.5	209.1
1.007	100.00	6.36	45.300	0.702	0.0	0.0	19.0	3.81	605.6	209.1
2.000	100.00	4.15	51.500	0.011	0.0	0.0	0.3	1.62	64.5	3.3
2.001	100.00	4.37	51.270	0.046	0.0	0.0	1.2	1.31	51.9	13.7

Section of network containing attenuation tank. Capacity not representative of attenuation tank.

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.002	51.867	0.725	71.5	0.124	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	19.921	0.980	20.3	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	22.856	0.700	32.7	0.012	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	21.155	0.300	70.5	0.013	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.004	25.546	0.280	91.2	0.028	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.000	16.586	0.225	73.7	0.013	4.00	0.0	0.600	o	225	Pipe/Conduit	
2.005	47.281	1.385	34.1	0.226	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.006	4.782	0.200	23.9	0.016	0.00	0.0	0.600	o	450	Pipe/Conduit	
2.007	39.490	0.050	789.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.000	14.267	0.175	81.5	0.025	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.001	25.123	0.610	41.2	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.000	14.233	0.175	81.3	0.035	4.00	0.0	0.600	o	225	Pipe/Conduit	
6.002	12.633	0.632	20.0	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.003	2.745	0.068	40.4	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.002	100.00	4.84	51.025	0.170	0.0	0.0	4.6	1.86	131.6	50.6
2.003	100.00	4.93	50.300	0.191	0.0	0.0	5.2	3.50	247.6	56.9
3.000	100.00	4.17	50.700	0.012	0.0	0.0	0.3	2.30	91.4	3.6
4.000	100.00	4.23	49.690	0.013	0.0	0.0	0.4	1.56	62.0	3.9
2.004	100.00	5.16	49.240	0.244	0.0	0.0	6.6	1.90	209.6	72.7
5.000	100.00	4.18	49.335	0.013	0.0	0.0	0.4	1.52	60.6	3.9
2.005	100.00	5.38	48.885	0.483	0.0	0.0	13.1	3.49	554.9	143.9
2.006	100.00	5.40	45.500	0.499	0.0	0.0	13.5	4.17	663.4	148.7
2.007	100.00	6.32	45.300	0.499	0.0	0.0	13.5	0.72	113.8«	148.7
6.000	100.00	4.16	48.040	0.025	0.0	0.0	0.7	1.45	57.6	7.4
6.001	100.00	4.37	47.865	0.046	0.0	0.0	1.2	2.04	81.3	13.7
7.000	100.00	4.16	47.430	0.035	0.0	0.0	0.9	1.45	57.7	10.4
6.002	100.00	4.44	47.255	0.131	0.0	0.0	3.5	2.94	116.9	39.0
6.003	100.00	4.46	45.468	0.135	0.0	0.0	3.7	2.07	82.1	40.2

Section of network containing attenuation tank. Capacity not representative of attenuation tank.

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.008	8.381	0.150	55.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	15.070	0.060	251.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	25.604	0.170	150.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.008	100.00	6.39	45.400	0.634	0.0	0.0	17.2	2.11	149.0«	188.9
1.008	100.00	6.69	45.250	1.336	0.0	0.0	36.2	0.82	32.6«	398.0
1.009	98.48	7.09	45.190	1.336	0.0	0.0	36.2	1.06	42.3«	398.0

NOT REPRESENTATIVE OF FLOWS DOWN STREAM OF HYDROBRAKE.
SEE PAGE 10 OF WINDES RESULTS.

Manhole Schedules for SW_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S10	54.310	1.510	Open Manhole	1200	1.000	52.800	225				
S9	53.200	1.700	Open Manhole	1200	1.001	51.500	225	1.000	51.500	225	
S8	53.300	1.990	Open Manhole	1200	1.002	51.310	225	1.001	51.310	225	
S7	52.500	1.995	Open Manhole	1200	1.003	50.505	300	1.002	50.580	225	
S6	52.660	6.560	Open Manhole	1200	1.004	46.100	300	1.003	49.336	300	3236
S5	49.800	3.950	Open Manhole	1350	1.005	45.850	450	1.004	46.000	300	
S4	48.130	2.630	Open Manhole	1350	1.006	45.500	450	1.005	45.500	450	
S3	48.000	2.700	Open Manhole	1350	1.007	45.300	450	1.006	45.300	450	
S2-9	53.500	2.000	Open Manhole	1200	2.000	51.500	225				
S2-8	53.000	1.730	Open Manhole	1200	2.001	51.270	225	2.000	51.270	225	
S2-7	52.870	1.845	Open Manhole	1200	2.002	51.025	300	2.001	51.100	225	
S2-6	52.000	1.700	Open Manhole	1200	2.003	50.300	300	2.002	50.300	300	
S1-5-3	52.150	1.450	Open Manhole	1200	3.000	50.700	225				
S2-5-1	51.600	1.910	Open Manhole	1200	4.000	49.690	225				
S2-5	51.400	2.160	Open Manhole	1350	2.004	49.240	375	2.003	49.320	300	5
								3.000	50.000	225	610
								4.000	49.390	225	
S1-4-1	50.900	1.565	Open Manhole	1200	5.000	49.335	225				
S2-4	50.650	1.765	Open Manhole	1350	2.005	48.885	450	2.004	48.960	375	
								5.000	49.110	225	
S2-3	49.200	3.700	Open Manhole	1350	2.006	45.500	450	2.005	47.500	450	2000
S2-2	49.100	3.800	Open Manhole	1350	2.007	45.300	450	2.006	45.300	450	
S2-1-4	51.500	3.460	Open Manhole	1200	6.000	48.040	225				
S2-1-3	49.150	1.285	Open Manhole	1200	6.001	47.865	225	6.000	47.865	225	
S2-1-2-1	49.000	1.570	Open Manhole	1200	7.000	47.430	225				
S2-1-2	48.490	1.235	Open Manhole	1200	6.002	47.255	225	6.001	47.255	225	
								7.000	47.255	225	
S2-1-1	48.280	2.812	Open Manhole	1200	6.003	45.468	225	6.002	46.623	225	1155
S2-1	48.280	3.030	Open Manhole	1350	2.008	45.400	300	2.007	45.250	450	
								6.003	45.400	225	
S2	48.000	2.750	Open Manhole	1350	1.008	45.250	225	1.007	45.250	450	
								2.008	45.250	300	
S1	47.750	2.560	Open Manhole	1200	1.009	45.190	225	1.008	45.190	225	
	46.800	1.780	Open Manhole	0		OUTFALL		1.009	45.020	225	

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	S10	54.310	52.800	1.285	Open Manhole	1200
1.001	o	225	S9	53.200	51.500	1.475	Open Manhole	1200
1.002	o	225	S8	53.300	51.310	1.765	Open Manhole	1200
1.003	o	300	S7	52.500	50.505	1.695	Open Manhole	1200
1.004	o	300	S6	52.660	46.100	6.260	Open Manhole	1200
1.005	o	450	S5	49.800	45.850	3.500	Open Manhole	1350
1.006	o	450	S4	48.130	45.500	2.180	Open Manhole	1350
1.007	o	450	S3	48.000	45.300	2.250	Open Manhole	1350
2.000	o	225	S2-9	53.500	51.500	1.775	Open Manhole	1200
2.001	o	225	S2-8	53.000	51.270	1.505	Open Manhole	1200
2.002	o	300	S2-7	52.870	51.025	1.545	Open Manhole	1200
2.003	o	300	S2-6	52.000	50.300	1.400	Open Manhole	1200
3.000	o	225	S1-5-3	52.150	50.700	1.225	Open Manhole	1200
4.000	o	225	S2-5-1	51.600	49.690	1.685	Open Manhole	1200
2.004	o	375	S2-5	51.400	49.240	1.785	Open Manhole	1350
5.000	o	225	S1-4-1	50.900	49.335	1.340	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	27.363	21.0	S9	53.200	51.500	1.475	Open Manhole	1200
1.001	4.921	25.9	S8	53.300	51.310	1.765	Open Manhole	1200
1.002	13.874	19.0	S7	52.500	50.580	1.695	Open Manhole	1200
1.003	24.541	21.0	S6	52.660	49.336	3.024	Open Manhole	1200
1.004	27.483	274.8	S5	49.800	46.000	3.500	Open Manhole	1350
1.005	74.071	211.6	S4	48.130	45.500	2.180	Open Manhole	1350
1.006	47.333	236.7	S3	48.000	45.300	2.250	Open Manhole	1350
1.007	1.434	28.7	S2	48.000	45.250	2.300	Open Manhole	1350
2.000	14.990	65.2	S2-8	53.000	51.270	1.505	Open Manhole	1200
2.001	17.058	100.3	S2-7	52.870	51.100	1.545	Open Manhole	1200
2.002	51.867	71.5	S2-6	52.000	50.300	1.400	Open Manhole	1200
2.003	19.921	20.3	S2-5	51.400	49.320	1.780	Open Manhole	1350
3.000	22.856	32.7	S2-5	51.400	50.000	1.175	Open Manhole	1350
4.000	21.155	70.5	S2-5	51.400	49.390	1.785	Open Manhole	1350
2.004	25.546	91.2	S2-4	50.650	48.960	1.315	Open Manhole	1350
5.000	16.586	73.7	S2-4	50.650	49.110	1.315	Open Manhole	1350

PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	o	450	S2-4	50.650	48.885	1.315	Open Manhole	1350
2.006	o	450	S2-3	49.200	45.500	3.250	Open Manhole	1350
2.007	o	450	S2-2	49.100	45.300	3.350	Open Manhole	1350
6.000	o	225	S2-1-4	51.500	48.040	3.235	Open Manhole	1200
6.001	o	225	S2-1-3	49.150	47.865	1.060	Open Manhole	1200
7.000	o	225	S2-1-2-1	49.000	47.430	1.345	Open Manhole	1200
6.002	o	225	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
6.003	o	225	S2-1-1	48.280	45.468	2.587	Open Manhole	1200
2.008	o	300	S2-1	48.280	45.400	2.580	Open Manhole	1350
1.008	o	225	S2	48.000	45.250	2.525	Open Manhole	1350
1.009	o	225	S1	47.750	45.190	2.335	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.005	47.281	34.1	S2-3	49.200	47.500	1.250	Open Manhole	1350
2.006	4.782	23.9	S2-2	49.100	45.300	3.350	Open Manhole	1350
2.007	39.490	789.8	S2-1	48.280	45.250	2.580	Open Manhole	1350
6.000	14.267	81.5	S2-1-3	49.150	47.865	1.060	Open Manhole	1200
6.001	25.123	41.2	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
7.000	14.233	81.3	S2-1-2	48.490	47.255	1.010	Open Manhole	1200
6.002	12.633	20.0	S2-1-1	48.280	46.623	1.432	Open Manhole	1200
6.003	2.745	40.4	S2-1	48.280	45.400	2.655	Open Manhole	1350
2.008	8.381	55.9	S2	48.000	45.250	2.450	Open Manhole	1350
1.008	15.070	251.2	S1	47.750	45.190	2.335	Open Manhole	1200
1.009	25.604	150.6		46.800	45.020	1.555	Open Manhole	0

Free Flowing Outfall Details for SW_1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009		46.800	45.020	0.000	0	0

Online Controls for SW_1

Hydro-Brake® Optimum Manhole: S5, DS/PN: 1.005, Volume (m³): 7.5

Unit Reference	MD-SHE-0060-2000-1600-2000
Design Head (m)	1.600
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	60
Invert Level (m)	46.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	2.0
Flush-Flo™	0.263	1.5
Kick-Flo®	0.536	1.2
Mean Flow over Head Range	-	1.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.1
0.300	1.5	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.5	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.3	2.000	2.2	5.000	3.4	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.6
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.8		

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.007, Volume (m³): 11.2

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.007, Volume (m³): 11.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.7	1.400	4.1	3.500	6.3	7.500	9.1
0.300	3.9	1.600	4.4	4.000	6.8	8.000	9.4
0.400	4.0	1.800	4.6	4.500	7.1	8.500	9.6
0.500	4.0	2.000	4.9	5.000	7.5	9.000	9.9
0.600	3.9	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.3	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

Hydro-Brake® Optimum Manhole: S2-1, DS/PN: 2.008, Volume (m³): 10.2

Unit Reference	MD-SHE-0090-4200-1445-4200
Design Head (m)	1.445
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	45.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	4.2
Flush-Flo™	0.398	4.0
Kick-Flo®	0.808	3.2
Mean Flow over Head Range	-	3.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	0.300	3.9	0.500	4.0	0.800	3.3
0.200	3.7	0.400	4.0	0.600	3.9	1.000	3.5

Hydro-Brake® Optimum Manhole: S2-1, DS/PN: 2.008, Volume (m³): 10.2

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.8	2.400	5.3	5.000	7.5	8.000	9.4
1.400	4.1	2.600	5.5	5.500	7.8	8.500	9.6
1.600	4.4	3.000	5.9	6.000	8.2	9.000	9.9
1.800	4.6	3.500	6.3	6.500	8.5	9.500	10.2
2.000	4.9	4.000	6.8	7.000	8.8		
2.200	5.1	4.500	7.1	7.500	9.1		

Summary of Results for 720 minute 100 year Winter (SW_1)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	S10	52.839	-0.186	0.000	0.07		7.4	OK
1.001	S9	51.552	-0.173	0.000	0.12		7.4	OK
1.002	S8	51.352	-0.183	0.000	0.08		8.2	OK
1.003	S7	50.562	-0.243	0.000	0.08		17.7	OK
1.004	S6	49.345	2.945	0.000	0.05		2.8	SURCHARGED
1.005	S5	49.343	3.043	0.000	0.01		2.8	SURCHARGED
1.006	S4	45.584	-0.366	0.000	0.03		5.4	OK
1.007	S3	45.577	-0.173	0.000	0.02		3.8	OK
2.000	S2-9	51.508	-0.217	0.000	0.01		0.4	OK
2.001	S2-8	51.298	-0.197	0.000	0.04		1.7	OK
2.002	S2-7	51.069	-0.256	0.000	0.05		6.5	OK
2.003	S2-6	50.336	-0.264	0.000	0.03		7.3	OK
3.000	S1-5-3	50.706	-0.219	0.000	0.01		0.5	OK
4.000	S2-5-1	49.699	-0.216	0.000	0.01		0.5	OK
2.004	S2-5	49.294	-0.321	0.000	0.05		9.3	OK
5.000	S1-4-1	49.345	-0.215	0.000	0.01		0.5	OK
2.005	S2-4	48.940	-0.395	0.000	0.04		18.3	OK
2.006	S2-3	46.357	0.407	0.000	0.07		18.8	SURCHARGED
2.007	S2-2	46.357	0.607	0.000	0.19		18.7	SURCHARGED
6.000	S2-1-4	48.060	-0.205	0.000	0.02		0.9	OK
6.001	S2-1-3	47.888	-0.202	0.000	0.02		1.7	OK
7.000	S2-1-2-1	47.454	-0.201	0.000	0.03		1.3	OK
6.002	S2-1-2	47.287	-0.193	0.000	0.05		5.0	OK
6.003	S2-1-1	46.356	0.663	0.000	0.14		5.0	SURCHARGED
2.008	S2-1	46.355	0.655	0.000	0.04		4.0	SURCHARGED
1.008	S2	45.328	-0.147	0.000	0.27		7.6	OK
1.009	S1	45.257	-0.158	0.000	0.19		7.6	OK

APPENDIX F – FOUL DRAINAGE NETWORK MODEL

FOUL SEWERAGE DESIGN

Design Criteria for FS_1

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	10
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Calculation Method	EN 752	Maximum Backdrop Height (m)	1.500
Frequency Factor	0.50	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for FS_1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	25.080	1.140	22.0	0.000	392.0	0.0	1.500	o	225	Pipe/Conduit	
F1.001	8.449	0.170	49.7	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	11.857	0.740	16.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F1.003	51.076	1.726	29.6	0.000	1540.0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	71.801	0.401	179.1	0.000	1862.0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	48.781	0.570	85.6	0.000	420.0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	20.346	0.230	88.5	0.000	392.0	0.0	1.500	o	225	Pipe/Conduit	
F2.001	16.407	0.150	109.4	0.000	126.0	0.0	1.500	o	225	Pipe/Conduit	
F2.002	9.706	0.090	107.8	0.000	98.0	0.0	1.500	o	225	Pipe/Conduit	
F2.003	12.031	0.080	150.4	0.000	126.0	0.0	1.500	o	225	Pipe/Conduit	
F2.004	45.459	1.140	39.9	0.000	140.0	0.0	1.500	o	225	Pipe/Conduit	
F3.000	26.533	0.890	29.8	0.000	28.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	52.550	0.000	0.0	392.0	1.0	51	1.62	2.45	97.5	10.9
F1.001	51.410	0.000	0.0	392.0	1.0	62	1.21	1.63	64.8	10.9
F1.002	51.240	0.000	0.0	392.0	1.0	47	1.81	2.88	114.3	10.9
F1.003	48.747	0.000	0.0	1932.0	2.2	83	1.83	2.11	84.1	24.2
F1.004	47.021	0.000	0.0	3794.0	3.1	184	0.98	0.86	34.1	33.9
F1.005	46.620	0.000	0.0	4214.0	3.2	142	1.35	1.24	49.4	35.7
F2.000	51.500	0.000	0.0	392.0	1.0	73	0.99	1.22	48.5	10.9
F2.001	51.270	0.000	0.0	518.0	1.1	83	0.95	1.10	43.6	12.5
F2.002	51.120	0.000	0.0	616.0	1.2	86	0.98	1.11	43.9	13.7
F2.003	51.030	0.000	0.0	742.0	1.4	99	0.89	0.94	37.2	15.0
F2.004	50.950	0.000	0.0	882.0	1.5	73	1.47	1.82	72.4	16.3
F3.000	50.700	0.000	0.0	28.0	0.3	29	0.98	2.11	83.8	2.9

Network Design Table for FS_1

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F2.005	26.059	0.560	46.5	0.000	28.0	0.0	1.500	o	225	Pipe/Conduit	
F2.006	46.875	1.650	28.4	0.000	560.0	0.0	1.500	o	225	Pipe/Conduit	
F2.007	47.033	1.550	30.3	0.000	840.0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	41.753	1.000	41.8	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F2.005	49.810	0.000	0.0	938.0	1.5	77	1.40	1.69	67.0	16.8
F2.006	49.250	0.000	0.0	1498.0	1.9	76	1.79	2.16	85.8	21.3
F2.007	47.600	0.000	0.0	2338.0	2.4	88	1.86	2.09	83.0	26.6
F1.006	46.050	0.000	0.0	6552.0	4.0	129	1.88	1.78	70.7	44.5

Manhole Schedules for FS_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F7	53.870	1.320	Open Manhole	1200	F1.000	52.550	225				
F6	53.350	1.940	Open Manhole	1200	F1.001	51.410	225	F1.000	51.410	225	
F5	53.300	2.060	Open Manhole	1200	F1.002	51.240	225	F1.001	51.240	225	
F4	52.600	3.853	Open Manhole	1200	F1.003	48.747	225	F1.002	50.500	225	1753
F3	48.280	1.259	Open Manhole	1200	F1.004	47.021	225	F1.003	47.021	225	
F2	48.000	1.380	Open Manhole	1200	F1.005	46.620	225	F1.004	46.620	225	
F1-8	55.580	4.080	Open Manhole	1200	F2.000	51.500	225				
F1-7	53.000	1.730	Open Manhole	1200	F2.001	51.270	225	F2.000	51.270	225	
F1-6	52.870	1.750	Open Manhole	1200	F2.002	51.120	225	F2.001	51.120	225	
F1-5	52.600	1.570	Open Manhole	1200	F2.003	51.030	225	F2.002	51.030	225	
F1-4	52.450	1.500	Open Manhole	1200	F2.004	50.950	225	F2.003	50.950	225	
F1-3-1	52.150	1.450	Open Manhole	1200	F3.000	50.700	225				
F1-3	51.400	1.590	Open Manhole	1200	F2.005	49.810	225	F2.004	49.810	225	
								F3.000	49.810	225	
F1-2	50.650	1.400	Open Manhole	1200	F2.006	49.250	225	F2.005	49.250	225	
F1-1	49.150	1.550	Open Manhole	1200	F2.007	47.600	225	F2.006	47.600	225	
F1	48.810	2.760	Open Manhole	1200	F1.006	46.050	225	F1.005	46.050	225	
								F2.007	46.050	225	
F0	46.300	1.250	Open Manhole	0		OUTFALL		F1.006	45.050	225	

PIPELINE SCHEDULES for FS_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	F7	53.870	52.550	1.095	Open Manhole	1200
F1.001	o	225	F6	53.350	51.410	1.715	Open Manhole	1200
F1.002	o	225	F5	53.300	51.240	1.835	Open Manhole	1200
F1.003	o	225	F4	52.600	48.747	3.628	Open Manhole	1200
F1.004	o	225	F3	48.280	47.021	1.034	Open Manhole	1200
F1.005	o	225	F2	48.000	46.620	1.155	Open Manhole	1200
F2.000	o	225	F1-8	55.580	51.500	3.855	Open Manhole	1200
F2.001	o	225	F1-7	53.000	51.270	1.505	Open Manhole	1200
F2.002	o	225	F1-6	52.870	51.120	1.525	Open Manhole	1200
F2.003	o	225	F1-5	52.600	51.030	1.345	Open Manhole	1200
F2.004	o	225	F1-4	52.450	50.950	1.275	Open Manhole	1200
F3.000	o	225	F1-3-1	52.150	50.700	1.225	Open Manhole	1200
F2.005	o	225	F1-3	51.400	49.810	1.365	Open Manhole	1200
F2.006	o	225	F1-2	50.650	49.250	1.175	Open Manhole	1200
F2.007	o	225	F1-1	49.150	47.600	1.325	Open Manhole	1200
F1.006	o	225	F1	48.810	46.050	2.535	Open Manhole	1200

Downstream Manhole

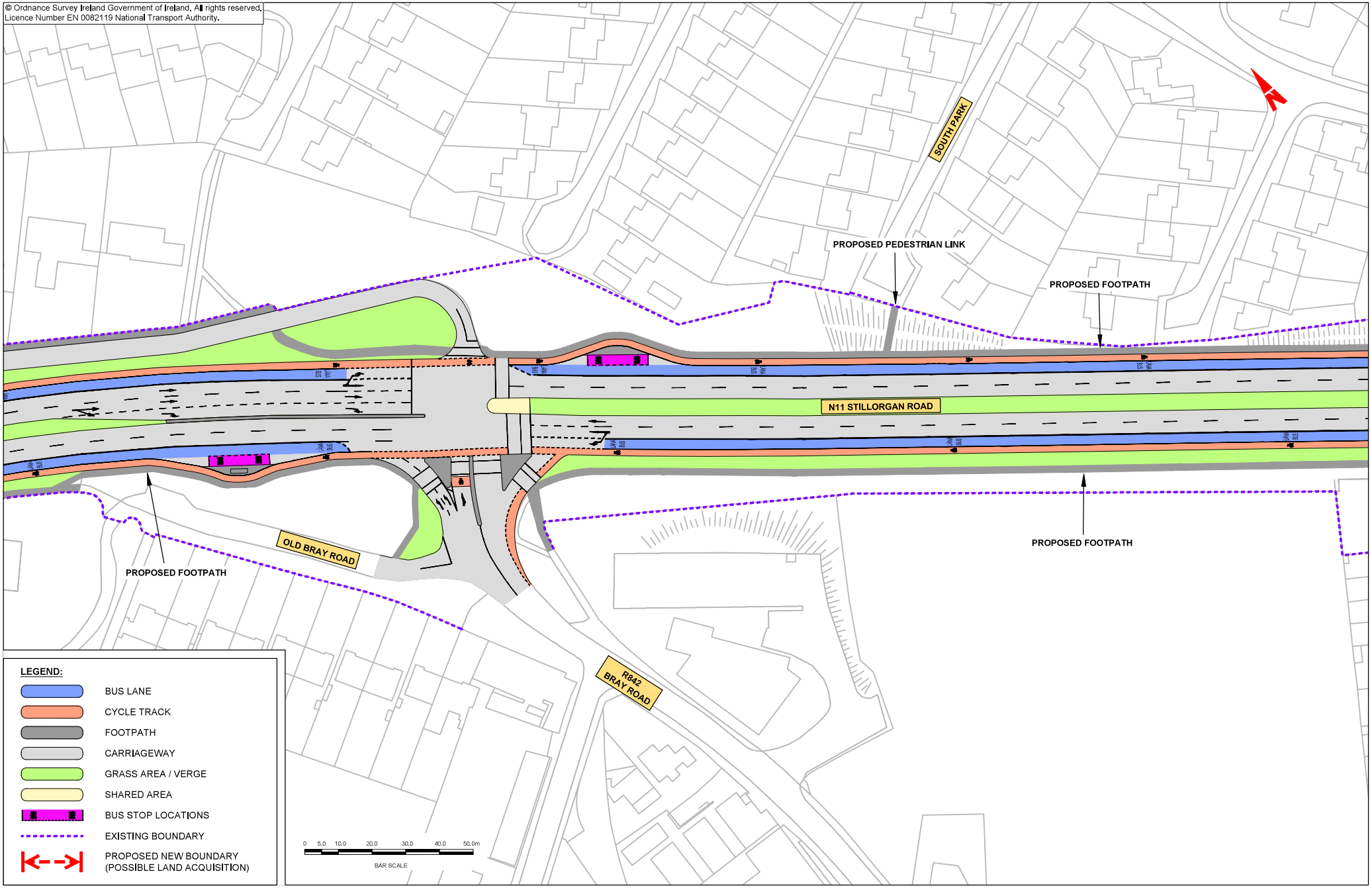
PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	25.080	22.0	F6	53.350	51.410	1.715	Open Manhole	1200
F1.001	8.449	49.7	F5	53.300	51.240	1.835	Open Manhole	1200
F1.002	11.857	16.0	F4	52.600	50.500	1.875	Open Manhole	1200
F1.003	51.076	29.6	F3	48.280	47.021	1.034	Open Manhole	1200
F1.004	71.801	179.1	F2	48.000	46.620	1.155	Open Manhole	1200
F1.005	48.781	85.6	F1	48.810	46.050	2.535	Open Manhole	1200
F2.000	20.346	88.5	F1-7	53.000	51.270	1.505	Open Manhole	1200
F2.001	16.407	109.4	F1-6	52.870	51.120	1.525	Open Manhole	1200
F2.002	9.706	107.8	F1-5	52.600	51.030	1.345	Open Manhole	1200
F2.003	12.031	150.4	F1-4	52.450	50.950	1.275	Open Manhole	1200
F2.004	45.459	39.9	F1-3	51.400	49.810	1.365	Open Manhole	1200
F3.000	26.533	29.8	F1-3	51.400	49.810	1.365	Open Manhole	1200
F2.005	26.059	46.5	F1-2	50.650	49.250	1.175	Open Manhole	1200
F2.006	46.875	28.4	F1-1	49.150	47.600	1.325	Open Manhole	1200
F2.007	47.033	30.3	F1	48.810	46.050	2.535	Open Manhole	1200
F1.006	41.753	41.8	F0	46.300	45.050	1.025	Open Manhole	0

Free Flowing Outfall Details for FS_1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.006	F0	46.300	45.050	0.000	0	0

APPENDIX G – BUS CONNECTS CBC BRAY TO CITY CENTRE

MAP 31: Emerging Preferred Route



APPENDIX H – SURFACE WATER AUDIT

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2019s1156
Contract	Residential Development at Cornelscourt, Dublin 18
Client	Cornel Living Ltd.
Date	18th October 2019
Author	Jamie Cullen
Subject	**Stormwater Audit - Stage 1 Report**

1 Residential Development at Cornelscourt Village, Old Bray Road, Cornelscourt, Dublin 18.

1.1 Introduction

JBA Consulting have been contracted by Cornel Living Ltd. to undertake a Stage 1 audit of the surface water drainage design by DBFL for the proposed residential development at Cornelscourt Village, Old Bray Road, Cornelscourt, Dublin 18.

The results of the audit are set out in the table below.

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The subject site is located adjacent to Cornelscourt Village with the N11 located to the north-east of the site. The proposed development will comprise 469 residential units made up of both houses and apartments together with residential amenity space, office space and a café. The total site area is stated to be C.2.05 hectares (ha). The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development.
Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • The SuDS Manual (CIRIA C753); • Recommendations for Site Development Works for Housing Areas (DoEHLG); • Greater Dublin Strategic Drainage Strategy (GDSDS);
Key Considerations & Benefits of SUDs	The key benefits and objectives of SuDS considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.
Site Characteristics	**Soil:** The soil at the site has been indicated as being Soil type 3 (SPR 0.37) following site investigation by Ground Investigations Ireland in January 2019, typically brown slightly sandy gravelly topsoil overlying made ground and/or firm to stiff light brown slightly sandy slightly gravelly clay. Infiltration testing was carried out as part of the SI to 3nr infiltration test locations. Infiltration was not observed at any of the test locations. Therefore, for the calculation of QBAR the adoption of soil type 3 is considered conservative in terms of the design. **Rainfall (basis for surface water pipeline network design):** Rainfall parameters can be estimated using Met Éireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Éireann method can be more representative of a site if selected correctly. A comparison of values estimated by DBFL and JBA is shown below:

	DBFL value / **JBA Value** Rainfall model: GDSDS / Met Éireann M5-60 (mm): 16.40mm / 16.40mm Ratio R: 0.273 / 0.273 The above variances are within acceptable limits. DBFL propose to discharge to existing surface water sewers bounding the site. Using an SPR value of 0.37 for the site, the greenfield runoff rates (QBAR) for the site area have been calculated by DBFL as 8.36 l/sec. JBA, for the same input data calculated this as 8.53 l/sec and as such the proposed discharge rate of 8.36l/sec is deemed acceptable. As the QBAR figure is greater than the 2l/sec/ha allowance in the GDSDS, QBAR will be the limiting discharge for all storm events from the subject development. **Windes Calculations** The Windes models as submitted for the attenuation calculations account for the total equivalent impermeable areas as calculated. The surface water drainage network has been designed to 5-year return period which is considered an appropriate standard of design for sewer network design. Attenuation provision is made for the 1 in 100-year event plus 10% Climate Change.
SuDS Measures Considered	DBFL have included the following SUDs measures within the proposed development. No reference has been made to any other measures considered.

SUDS Technology	Comments
Blue/Green Roofs	Green roofs are proposed to all apartment blocks
Swale/ Filter Drain / Infiltration trench	Bio-swale filter drains (infiltration trenches) are proposed to the rear of dwellings along south-east corner of the site for interception and infiltration purposes of roof surfaces.
Permeable Paving	A drainage reservoir (drainage board) is provided on the podium slab over basement
Petrol Interceptor	It is proposed to include a hydrocarbon interceptor prior to discharge from site.
Surface Water Attenuation	Attenuation will be provided by way of: A. 3 nr attenuation systems. B. Bio-retention areas. C. Drainage reservoir / board D. Bio-swale filter drains E. Green roofs to apartment blocks.
Site Run-off Rates	DBFL propose to limit discharge to the equivalent of QBAR for all storm events.
Detention Basins, Retention Ponds, Stormwater Wetlands	N/A

	Tree Root Structural Cell Systems, Bio-retention, rain garden: Bio retention areas are provided for roof water from bungalows along the south-west corner of the development. Tree pits are provided for internal streets.
Surface Water Drainage Design	All surface water flows generated by the development will be attenuated and discharged to existing surface water sewer at a rate QBAR.
SuDS Management Train	**Source Control** and **Site Control** are addressed by the use of SuDS devices (interception storage) and attenuation with outflow controlled by a Hydrobrake. A petrol interceptor has been proposed prior to discharge from site. As recommended with the SUDs Manual (Table 3.3) assuming effective pre-treatment is in place the following number of treatment train components are recommended:

	No. of treatment train components recommended	Comment/Proposals
Roof areas	1	Green roofs, Bio-swale filter drains and bio-retention areas have been proposed to intercept runoff from the roof of the houses
Residential roads, parking areas, commercial zones	2	Drainage reservoir / board is proposed for the podium slab over basement and tree pits are proposed for internal streets. A full retention separator has been proposed for all flows prior to discharge from site.
Refuse collection, industrial areas, loading bays, lorry parks and highways.	3	Not applicable.

A hydrobrake designed for a linear discharge profile will be provided at the outfalls of the attenuation structures to limit flows to a maximum of QBAR to the existing surface water sewer.

Climate Change	An allowance of 10% increase in rainfall depth factor has been included for climate change for the rainfall intensities for the purposes of sizing the attenuation storage. This is the minimum requirement of the GDSDS.
Volume Storage	DBFL have run a Windes model to assess the attenuation volumes provided. The proposed attenuation structure is sized such that surcharging to a level greater than 300mm below manhole cover level will not occur. Volumes account for the 100-year return storm event + 10% climate change.
Volume Run-off	No comparison of pre and post development storm volumes have been provided, however, as it is proposed to limit discharge to QBAR for all storm events, such a calculation is not deemed necessary.
Treatment Volume / Water Quality Improvement	Interception storage is now proposed by way of bio-swale filter drains in rear gardens, green roofs, drainage boards, and tree pits.

Return Period	A 100-year return period plus 10% for climate change has been used in the design for the attenuation systems.
Exceedance flows	DBFL have considered exceedance flows with the extent of SuDS features provide throughout the entire site. DBFL have incorporated additional gullies to minimise risk associated with blocked gullies.
Health & Safety and Maintenance Issues	The proposed drainage system comprises SuDS devices, traditional road gullies, attenuation systems and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. At detailed design stage, it is recommended that a maintenance regime be adopted. Particular consideration is required at detailed design stage to the design, maintenance requirements and whole life plan (and replacement) of the SuDS system as a whole. Regular maintenance of the flow control device will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptor be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance are recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.

Design Review Process	Upon review of the initial drainage design, JBA Consulting provided feedback, resulting in some modifications, namely:
	
	• The discharge rate has been reduced to reflect the revised calculation of QBAR
	• Runoff from green open spaces have been incorporated into the attenuation storage calculations
	
	• Attenuation storage has been increased due to a reduced calculation of QBAR and additional runoff from green open spaces
	• Increased source control / interception by the
	  ○ provision of tree pits along the road bounding the eastern part of the site
	  ○ provision of a bio-retention area for houses along the south-west corner of the site
	
	• Additional road gullies have been provided to minimise risk of flooding should some gullies become blocked
	
	A summary of comments and record of the audit trail are appended to this report.
	
	Based on this being at preliminary design stage and a Stage 1 Surface Water Audit, JBA Consulting's comments have all been satisfactorily addressed or sufficient commitment provided that details will be confirmed at detailed design stage.

Summary of items to be considered at Detailed Design Stage	There are a number of items that can be addressed at detailed design stage. A summary of same are as follows: • Full details of the green roof details to be developed and agreed. • Proper detail design and construction of SuDS devices is paramount to ensure long term optimum hydraulic performance as well as maximisation of biodiversity opportunity. It is recommended that a collaborated approach to detail design is adopted between engineers, architects, ecologies and landscape architects. • Maintenance regime for each of the components on site to be prepared and submitted to Dun Laoghaire Rathdown Co Council; • Hydrobrake selection to be give due consideration to hydraulic performance, actual head behind the unit, maximum potential clear passage size and maintenance requirements.
Audit Result	JBA Consulting considers that the surface water drainage design for the proposed development is acceptable and meets the requirements of the Stage 1 Stormwater Audit.

Audit Report Prepared by: Jamie Cullen BEng (Hons) MSc.
Assistant Engineer

Approved by: Declan White BE CEng MIEI IMaPS
Principal Engineer

Note:

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

Appendix A – Audit Trail Record

JBA Consulting Stormwater Audit	
Project:	Residential Development at Cornelscourt, Dublin 18
Date:	10/09/2019
JBA Reviewers	Leanne Leonard - Engineer

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	10/09/2019		10/10/2019	
Documents provided	Infrastructure Design Report dated June 2019 Drg. No. 180208-DBFL-XX-XX-DR-C-3001 Rev P0 Drg. No. 180208-DBFL-XX-XX-DR-C-3003 Rev P0			
1	Allowable Greenfield Runoff Rate For the input data indicated in section 3.2.4 of the infrastructure design report (Area = 2.11ha, SAAR = 945mm and SOIL Type 3), JBA estimate the Qbar value to be 8.61l/sec which is lower than the 10l/sec as proposed	DBFL to review	**Refer to DBFL's Infrastructure Design Report, Section 3.2.4. Qbar is calculated as 8.36 l/sec.**	**Acceptable**
2	Attenuation Calculations Pending item 1 above, the attenuation volumes may need to be revised given a reduced Qbar value	DBFL to review	**Refer to updated Source Control Calculations for Catchment A, Catchment B & Catchment C. The results are summarised in DBFL's Infrastructure Design Report, Section 3.2.7.**	**Acceptable**
3	Factored Impermeable Area Table 3.1 indicates that soft landscaping areas will have zero runoff to the storm drainage system with no subsequent requirement for associated storage. Given there is minimal infiltration potential, some runoff allowance may be required, especially for exceedance rainfall.	DBFL to review	**Table 3.1 has been updated. Soft Landscaping has a runoff co-efficient of 0.15. Also refer to DBFL's Infrastructure Design Report, Section 3.2.3.**	**Acceptable**
4	Design Standards The ratio "r" as indicated in section 3.2.5 of the infrastructure design report is 0.25 whereas site specific rainfall from Met Eireann would suggest the "r" value is 0.273 (M5-60 = 16.4mm and M5-2 day is 60mm) thereby increasing storage requirements	DBFL to review	**Refer to DBFL's Infrastructure Design Report, Section 3.2.5. Ratio "R" is noted as 0.273. This is also reflected in the Source Control and Network Design Calculations.**	**Acceptable**
5	SuDS Provision SuDS extent is noted in section 3..6 of the infrastructure design report. However, we note that the section of road along the eastern boundary of the site does not appear to have any interception provision.	DBFL to review and advise if additionla SuDS can be provided.	**RE: Road Along Eastern Boundary of Site. Surface water runoff from this paved area (permeable) will be directed to the piped network via tree pits with a overflow to conventional gullies. Refer to DBFL Drawing 3001 for the location of gullies draining via tree pits and DBFL Drawing 3010 for a typical detail of same.**	**Acceptable**
6	Roof Drainage Roof water to houses along eastern boundary are noted to connect to bio-swale filter drains to rear of houses. It is not apparent how roof of houses along south-western boundary are intercepted / connected to main storm network	DBFL to review and advise	**A bioretention area has been included in the design as a SUDS measure for draining roofs located along the site's south-western boundary (refer to DBFL Drawing 3001). A typical detail for same is shown on DBFL Drawing 3012.**	**Acceptable**