Project

White Pines East Residential Development, Stocking Avenue, Dublin 16.

Report Title

Infrastructure Design Report

Client

Ardstone

INFRASTRUCTURE

DBFL CONSULTING ENGINEERS

MARCH 2021

Document Control

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Draft	Mar. 2020	Draft	SB	BK	-
-	May 2020	Issued for ABP Pre-App	SB	BK	-
A	Feb2021	ABP submission	SB	BK	-
B	Mar 2021	ABP submission	SB	BK	

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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 at lands north of Stocking Avenue, Dublin 16.

The proposed development ("the site") comprises of 241 No. residential units, residential tenant amenity space (reception area, games space, residents lounge and gym) and dedicated community space on a 2.98 Ha site.

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 Topography

The site falls from its southern boundary (adjacent to Stocking Avenue) towards its northern boundary (adjacent to the M50 motorway). Surface gradient immediately adjacent to Stocking Avenue are relatively steep (typically 1v:10h). Elsewhere, over the majority of the site and on approach to the northern boundary, surface gradients moderate somewhat (typically 1v:30h).

Existing topographic survey information is shown in the background of the Proposed Roads Layout Plan (refer to DBFL Drawing No. 190230-DBFL-RD-SP-DR-C-1001).

1.4 Location

The site (known as the "White Pines East") is located in the Woodtown area (approximately 10 km south of Dublin City Centre). The M50 motorway is located to the north of the site and Stocking Avenue runs along the site's southern boundary. An existing dwelling ("Green Acres House") and associated lands are located to the east of the site.

A retail unit and creche are currently being developed on the southern south side of Stocking Avenue by Ardstone (Application Ref SD19A/0345). Ardstone have also completed 177 dwellings immediately west of the site (known as "White Pines North", Application Ref. SD14A/0222) and 106 dwellings south of Stocking Avenue (known as "White Pines South", Application Reg. Ref. SD10A/0041).

Ardstone also have additional lands south of Stocking Avenue which are subject to a separate planning application (known as "White Pines Central"). A full and comprehensive planning history for this and surrounding sites is included in Tom Philips & Associates Planning Report.

Figure 1.1 Extent of Ardstone Land Holdings (Site Boundary Indicative Only).

1.5 Ground Conditions

GII carried out ground investigations at the site in March 2020 (refer to Appendix A for extracts from GII's Site Investigation Report).

The site is overlaid by a topsoil layer of between 200mm to 400mm deep. Observed subsoil material comprises of sandy / gravelly clays.

Soakaway testing was carried out at two locations (in the vicinity of the proposed attenuation facility). Infiltration was not observed at either of the test locations, therefore, infiltration has not been allowed for in surface water design and calculations for the proposed development. Also refer to Section 3.2.7 of this report (Attenuation Calculation).

1.6 Proposed Development

The proposed development ("the site") comprises of 241 No. residential units, residential tenant amenity space (reception area, games space, residents lounge and gym) and dedicated community space on a 2.98 Ha site (refer to John Fleming Architects Schedule of Accommodation and Site Layout Plans for further detail).

The proposed development will also include the following associated engineering infrastructure:

- Provision of internal site roads including associated footpaths and access for vehicles and pedestrians from Stocking Avenue (primary access) and White Pines North (secondary access).

  Refer to DBFL Drawings 190230-DBFL-RD-SP-DR-C-1001.

- Provision of surface water drainage, foul drainage and water supply infrastructure.

  Refer to DBFL Drawings 190230-DBFL-CS-SP-DR-C-1001 and 190230-DBFL-WM-SP-DR-C-1001.

2. SITE ACCESS AND STREET LAYOUT

2.1 Site Access

The primary access point for vehicles is located along Stocking Avenue (along the site's southern boundary). Relocation of existing bus stops will be required in order to facilitate the primary access point. DBFL have engaged with Dublin Bus in this regard (signage, tactile paving, line marking etc.). The proposed configuration of the relocated bus stops are considered an improvement over the existing facility which required cyclists to enter the carriageway in order to pass the bus stop.

Stocking Avenue has a posted speed limit of 50 km/hour. The primary site entrance complies with visibility splays as required by DMURS (Y Distance = 49m and X Distance = 2.4m on bus routes). The design also provides Signage and Line Marking in accordance with the Department of Transport's Traffic Signs Manual.

A secondary access point for vehicles is also facilitated adjacent to the site's north-west corner aligning with SDCC's LAP road linkage objectives (linking back into Ardstone's recently complete development located to the west of the subject site).

The site's road layout also facilitates a potential road linkage to lands east of the site (should they be developed in the future).

The site layout facilitates high levels of pedestrian connectivity by way of additional pedestrian access points to Stocking Avenue, a new uncontrolled crossing for pedestrians / cyclists at Stocking Avenue, linkages to the west and north-west (into Ardstone's recently completed development to the west of the site and associated trail along the site boundary with the M50) and to the existing laneway which runs north-east of the site / parallel to the M50 motorway.

The site's layout also enables future pedestrian connectivity to lands east of the site (should they be developed in the future).

Refer to DBFL Drawings 190230-DBFL-RD-SP-DR-C-1001 and 190230-DBFL-RD-SP-DR-C-1003 for the proposed site access points as described above.

2.2 Street Layout Design

The site's street layout is shown on DBFL Drawing 190230-DBFL-RD-SP-DR-C-1001. The site's roads hierarchy is outlined on DBFL Drawing 190230-DBFL-RD-SP-DR-C-1003 and explains how the proposed link street integrates with adjacent existing link streets and local roads.

DMURS Street Design guidelines incorporated in the site's road layout are detailed in DBFL Technical Note – DMURS Compliance Statement (190230-TN-01).

A design speed limit of 30 km/hour has been applied throughout the development in accordance with the Design Manual for Urban Roads and Streets (function – local road, context – neighbourhood, pedestrian priority).

2.3 Vehicle Tracking

The proposed street layout has been tracked to demonstrate that the site's proposed corner radii and turning heads will accommodate large vehicles such as refuse trucks and fire engines (refer to DBFL Drawings No. 190230-DBFL-RD-SP-DR-C-1002).

2.4 Pavement Design Standards

Local streets within the site are to be designed in accordance with SDCC's *Taken In Charge Policy – Appendix 6 – Roads Minimum Standards*.

Proposed road construction materials and thicknesses are to be based on an existing minimum subsoil CBR of 2.0% at road formation level.

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

2.5 Traffic & Transportation

A separate Traffic and Transportation Assessment has been prepared as part of this planning application (refer to DBFL Report No. 190230-rep-008).

3. SURFACE WATER DRAINAGE

3.1 Existing Surface Water Drainage

The site falls from its southern boundary along Stocking Avenue towards its northern boundary along the M50, forming a single surface water catchment. There is an existing 375mm diameter surface water line located along the site's northern boundary which extend along the M50 (within Ardstone's land ownership) prior to crossing under the M50. The location of this existing 375mm diameter surface water line is shown on DBFL Drawing 190230-DBFL-CS-SP-DR-C-1002.

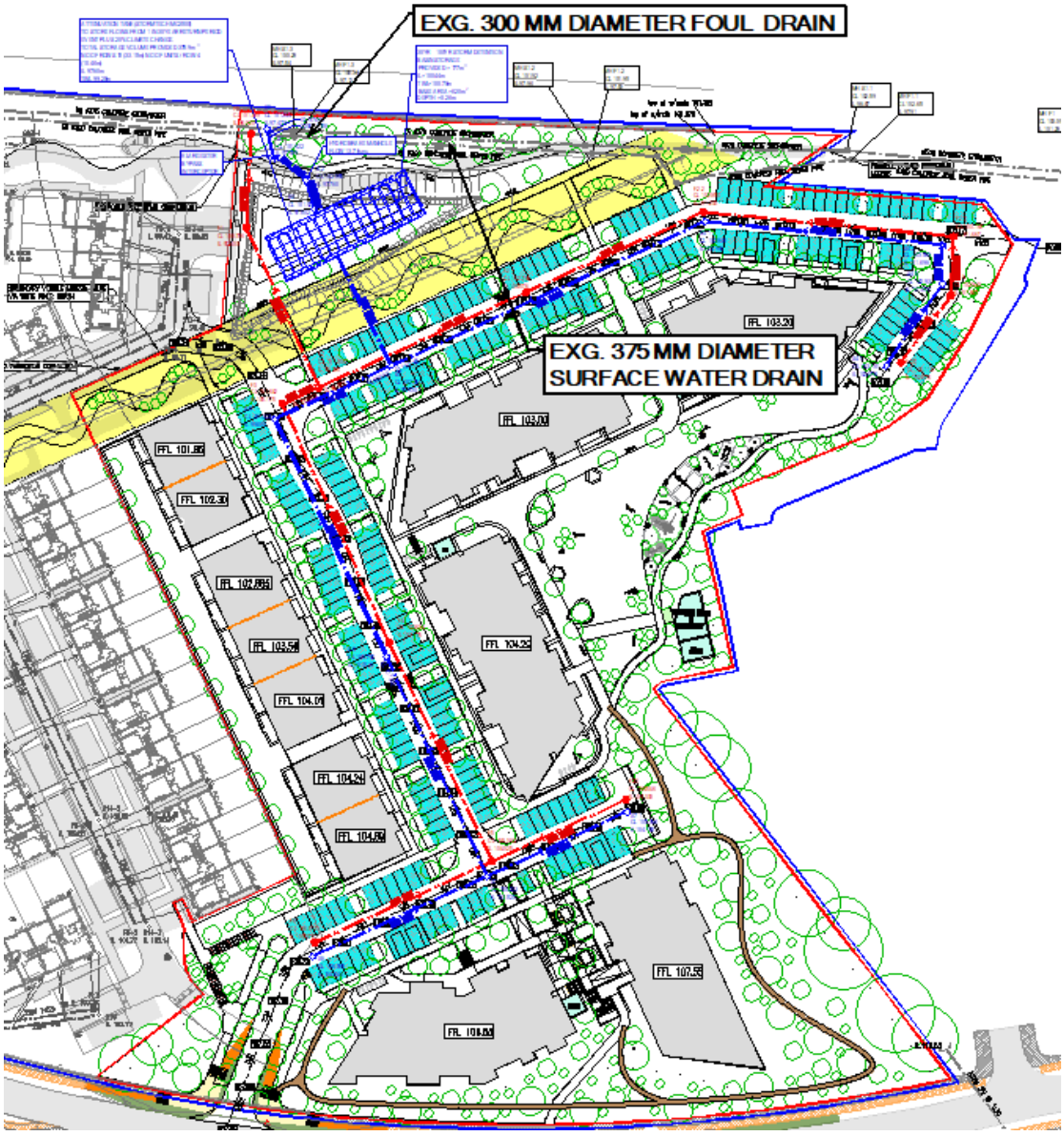

Figure 3.1 Existing Surface Water Drain – Northern Site Boundary.

3.2 Basis of Design

3.2.1 General Description of Surface Water Design

The 375mm diameter surface water line (as described above in Section 3.1) is expected to provide a suitable surface water discharge point for the proposed development.

Refer to DBFL Drawing No. 190230-DBFL-CS-SP-DR-C-1001 for proposed surface water outfall location.

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). Underground attenuation tanks are sized to attenuate the 1 in 30 year storm event. The difference between the 1 in 100 year event and the 1 in 30 year event is being attenuated above ground in shallow basins. 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 the site's road network will be directed to tree pits via conventional road gullies (with high level overflow to the piped surface water network). Surface water runoff from in curtilage parking areas will be captured by permeable paving.

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 duplex's located along the site's western boundary will be routed to the proposed surface water pipe network via the porous aggregates beneath permeable paved driveways (providing an additional element of attenuation).

3.2.2 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 sites proximity to fluvial flood plains (up to 1 in 100-year flood event).

  Also refer to DBFL Report No. 190230-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.

3.2.3 Proposed Runoff Coefficients & Factored Impermeable Areas

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

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

- Duplex's Roof Draining Via SuDS (permeable paving) – Runoff Coefficient 0.5

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

- Green Roof – Runoff Coefficient 0.75

  The proposed build-up will be an extensive type with 200mm 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.

- Impermeable Roads Drained to Road Gullies – Runoff Coefficient 0.80

  Typically, road gullies discharge to tree pits (with high level overflow to the piped surface water network). Also takes account of run-off stored within the micro and macro texture of the surfacing (i.e. runoff not collected by piped network).

- Permeable Paved Areas Draining via SUDS – Runoff Coefficient 0.5

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

- Soft Landscaped / Grassed Areas – Runoff Coefficient 0.15

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

			Catchment A	
		Runoff Coefficients	Gross Areas (m2)	Factored Areas (m2)
Duplex Roof -Draining to SUDs		0.50	1,502	751
Apartment - Green Roof		0.75	4,276	3,207
Paved Areas - Draining to Gullies		0.80	4,678	3,742
Paved Areas- Draining to SUDS (Permeable Driveways)		0.50	2,614	1,307
Soft Landscaping		0.15	16,730	2,510
			29,800	11,517

Table 3.1 Proposed Runoff Coefficients and Factored Impermeable Areas

3.2.4 Allowable Greenfield Runoff Rate

Qbar has been assessed based on GDSDS requirements (Section 6.6.1.2 / IHR 124)

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

Area – Approx.2.98 Ha

SAAR – 906mm (based on local information from Met Eireann)

SOIL – Soil Type 3, Soil Value 0.37 (taken from Flood Studies Report)

Qbar = 11.6 l/sec (equivalent to 3.9 l/sec/Ha)

Note: SOIL is the soil index, reference GDSDS Section 6.3.1.2.2. Soil Type 3 (as determined below) equates to an SPR value of 0.37.

Assessment of Soil Type (see Table 3.2)

- Drainage Group 1
- Depth to Impermeable Layer 1 (> 80cm)
- Permeability Group 3 (Slow)
- Slope 1 (2-8deg)

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	2		1	2	3
	40 - 80							3		4
	<40	—	—	—	—	—	—	—	—	—
2	>80	2	3			4		—		
	40 - 80									
	<40	3								
3	>80	5						—		
	40 - 80							—		
	<40									

Table 3.2 Classification of Soils Type (by winter rain acceptance rate from soil survey data)

3.2.5 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 3.9 l/sec/ha
- Time of entry 4 minutes
- M5 - 60 17.9 mm
- Ratio "r" 0.21
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity (based on pipe flowing full) 1.0 m/s
- Rainfall Depth Factored for Climate Change (as per GDSDS) 20%

  (in accordance with GDSDS Volume 2, Chapter 6, Table 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 B for Attenuation Design Calculations and Appendix E for Surface Water Network Design Calculations. Attenuation and surface water calculations have been carried out using Microdrainage WinDes analysis software.

3.2.6 SuDS

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

- Permeable paving in parking spaces / in curtilage areas.
- Typically, road gullies discharge to tree pits (with high level overflow to the piped surface water network)
- Surface water runoff from Duplex's roofs will be routed to the proposed surface water pipe network via the stone reservoir beneath permeable paved parking. Note, this detail does not rely on infiltration, the stone reservoir is intended to provide an additional element of attenuation storage.
- Surface water runoff from apartment roofs will be captured by green roofs (sedum blanket) prior to being routed to piped surface water drainage network.
- Attenuation of the 1 in 30 year return period storms in underground attenuation chambers (Stormtech) with the difference between the 1 in 100 year event and the 1 in 30 year event is being attenuated above ground in shallow basins. Note: Our calculation has not allowed for any infiltration when calculating the attenuation volume.
- Installation of a vortex flow control device (Hydrobrake or equivalent), limiting surface water discharge from the site to 11.6 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).

3.2.7 Attenuation Calculation

Attenuation volumes have been calculated based on an allowable outflow / greenfield runoff rate of 3.9 l/sec/ha (refer to Section 3.2.6 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 are detailed in Table 3.3.

Catchment Area (Total)	Impermeable Catchment Area (Total)	Allowable Outflow (Max.)	Storage Volume Required (100 Yr.)	Storage volume provided (30Yr. Below Ground)	Storage volume provided (100Yr. - 30Yr. Above Ground)	Total Storage Volume Provided
2.98 Ha	1.152 Ha	11.6 l/s	578m^3	464m^3	177m^3	641m^3

Table 3.3 – Surface Water Attenuation Storage and Discharge Limits

Refer to Appendix B for Attenuation Design Calculations.

Attenuation volumes have been calculated using Microdrainage WinDes analysis software taking account of the depth and type of attenuation system.

In total 641m^3 of storm-water storage is provided. Supplementing this storage volume is a further approx. 175 m3 of additional storage in SUDS measures (i.e. voids in aggregates beneath permeable paving).

The location of proposed attenuation systems is shown on DBFL Drawing 190230-DBFL-CS-SP-DR-C-1001.

3.2.8 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).

3.3 Flood Risk

A separate Site Specific Flood Risk Assessment has been prepared as part of this planning application (refer to DBFL Report No. 190230-rep-002). Flood Risk is also addressed in Chapter 10 (Hydrology) of the EIAR.

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

3.4 Surface Water Quality Impact

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

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

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

4. FOUL DRAINAGE

4.1 Existing Foul Drainage

An existing 300mm diameter foul drain is located along the site's northern boundary (parallel to the M50 motorway). This foul drain extends westwards, parallel to the M50 motorway, within the development recently completed by Ardstone to the west of the site (White Pines North). The location of this existing foul sewer is shown Figure 4.1 below and on DBFL Drawing 190230-DBFL-CS-SP-DR-C-1002.

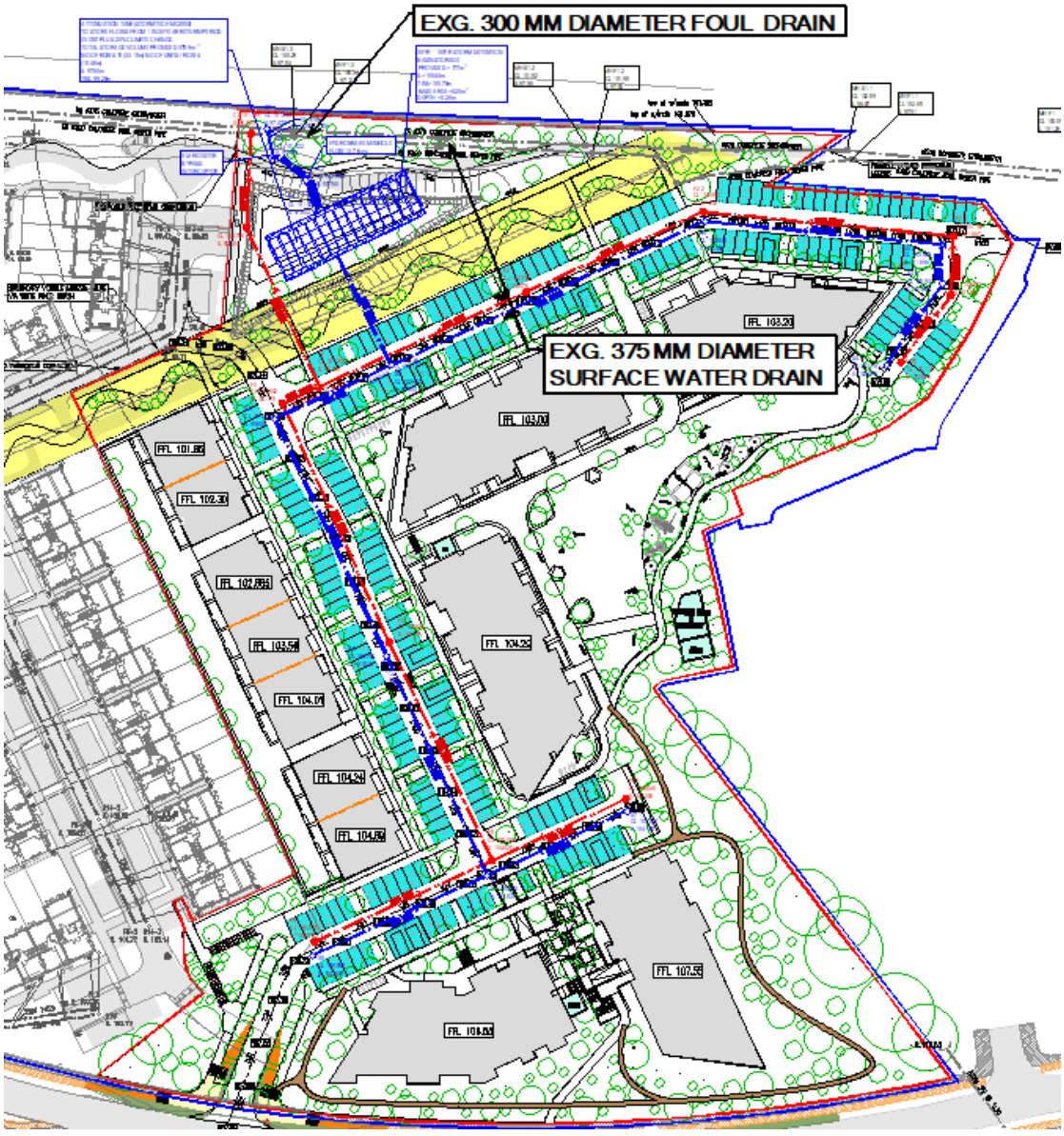

Figure 4.1 Existing Foul Drain– Northern Site Boundary.

4.2 Design Strategy

As noted previously, the site falls from its southern boundary (along Stocking Avenue) towards its northern boundary adjacent to the M50. As such it is proposed to discharge foul drainage flows from the proposed development to the existing 300mm diameter foul sewer located along the site's northern boundary (described in Section 4.1 above).

The proposed foul drainage network within the site comprises of a series of 225mm diameter pipes discharging by gravity to the existing 300mm diameter foul sewer located along the site's northern boundary.

Individual Duplex's units located along the site's western boundary will be services by individual 100mm diameter connections.

Refer to DBFL Drawing 190230-DBFL-CS-SP-DR-C-1001 for the proposed foul drainage infrastructure described above.

It is noted that Irish Water have issued a Statement of Design Acceptance in relation to the proposed foul drainage layout (refer to Appendix C).

4.3 Pre-Connection Feedback from Irish Water

Pre-connection enquiry feedback has been received from Irish Water (included in Appendix C). 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.
- New connections to the existing network are feasible subject to network upgrade (Scholarstown Branch Sewer LNRP).
- Timeline for delivery of Scholarstown Branch Sewer LNRP, as discussed with Dermot Fee, Irish Water Project Manager):
    - Successful contractor for LNRP notified in December 2020
    - D&B contract to be issued – Q1 2021
    - LNRP works to be completed – 2022
- Ardstone have commenced delivery of a portion of the LNRP works which traverses their lands at Scholarstown Road as part of the "Two Oaks" development (see Figure 4.2).

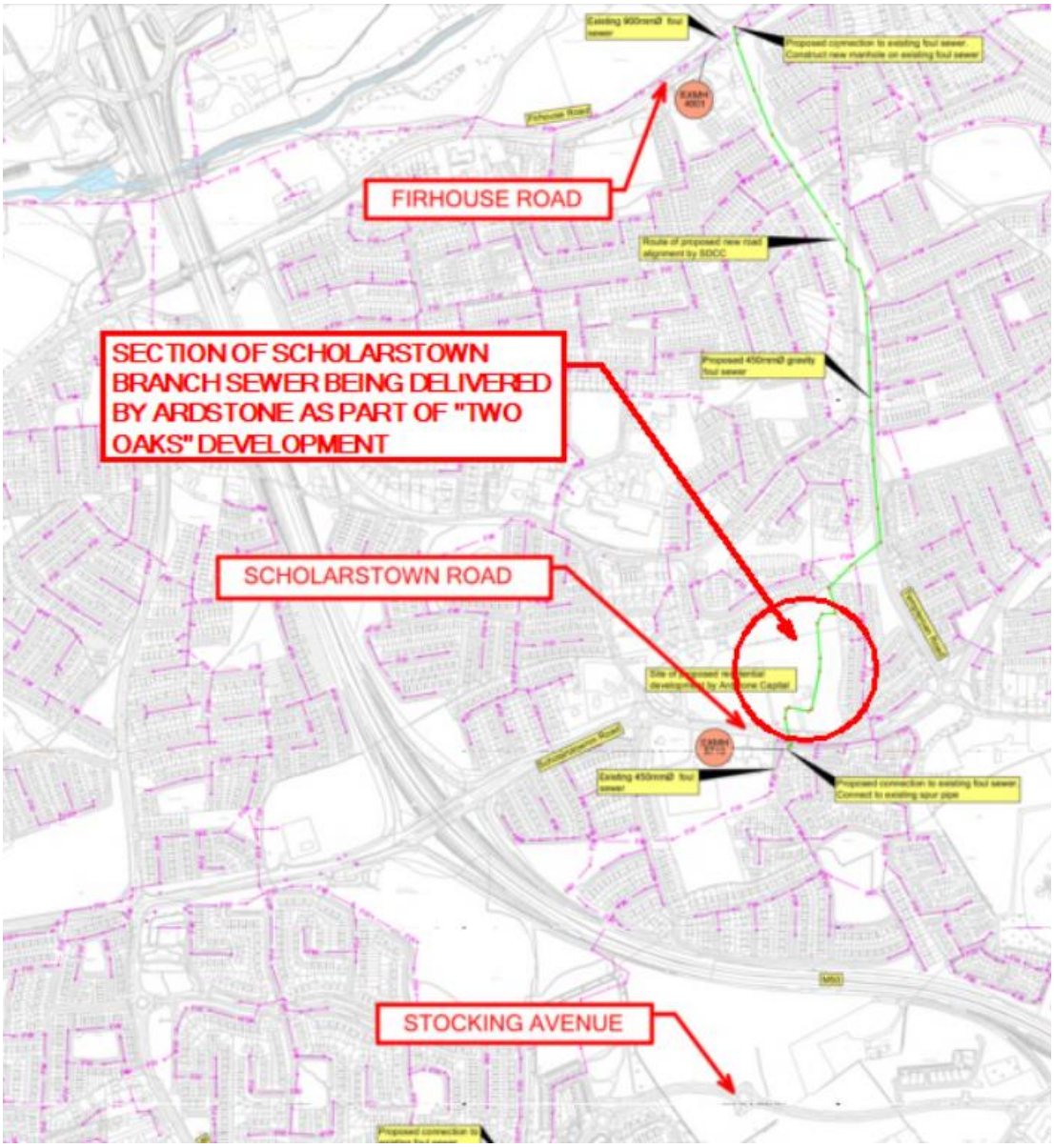

Figure 4.2 Scholarstown Branch Sewer LNRP.

4.4 Design Calculations

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

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

Foul drainage network design has been carried out using Microstation WinDes analysis software (refer to Appendix F for foul drainage network calculations).

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

4.5 Foul Drainage – Environmental Impacts

Waste Water Discharge Calculation

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

No. of Housing Units	241
Post Development Average Discharge	1.24 l/sec
Post Development Peak Discharge	7.46 l/sec
Daily Foul Discharge Volume (446l per dwelling)	107,486 l/Day

5. WATER SUPPLY AND DISTRIBUTION

5.1 Existing Public Watermains

An existing 500mm Watermain watermains running along the southern side of Stocking Avenue, adjacent to the site's southern boundary (refer to Appendix D).

An existing 150mm water main network is also located within the Stocking North development (recently completed by Ardstone).

Existing 12" and 15" diameter bulk water mains traverse the site from west to east (in the vicinity of the site's northern extents, refer to Figure 5.1 below). Irish Water has a wayleave over these water mains. Also refer to Appendix D (Irish Water record Drawings).

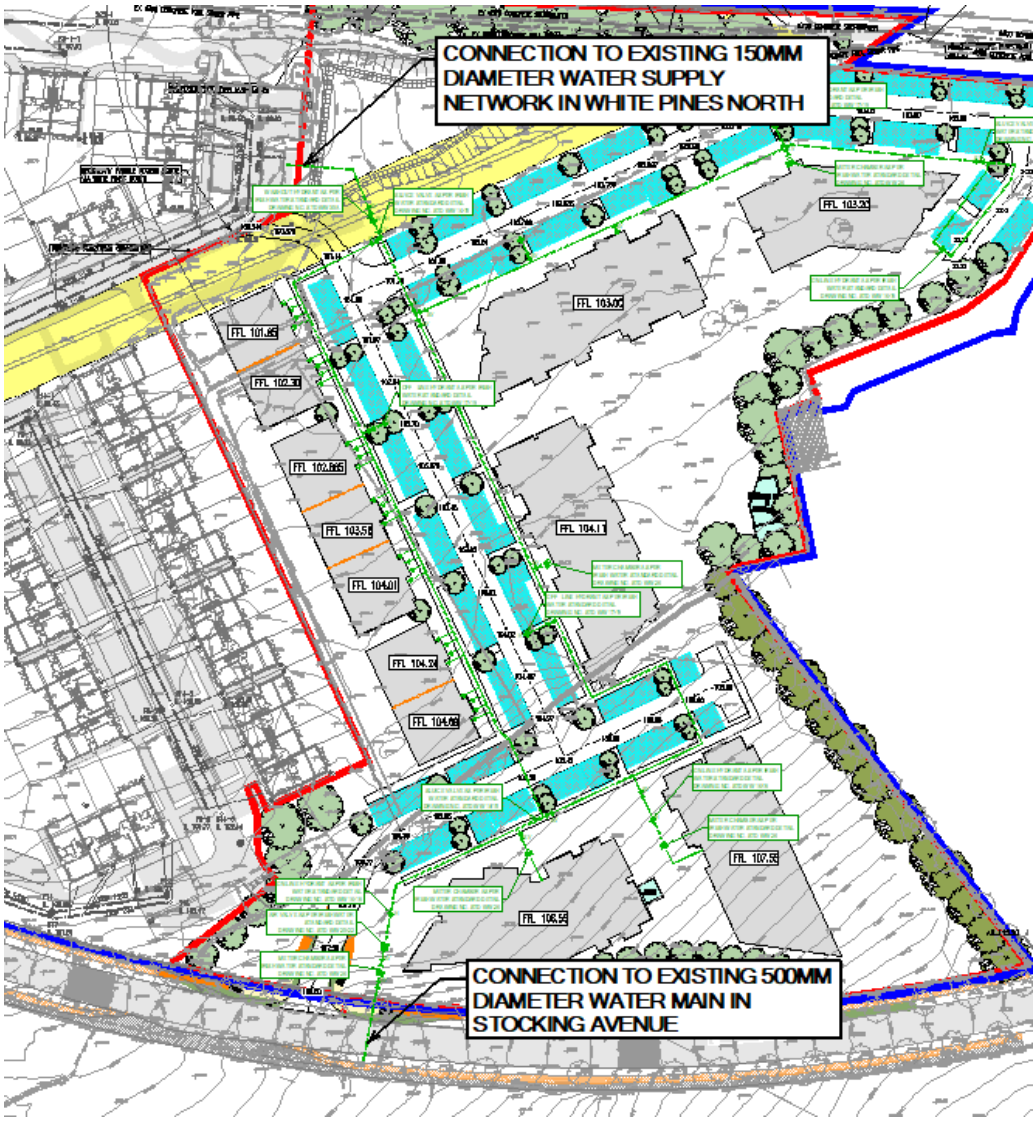

Figure 5.1 Existing Watermain layout.

5.2 Proposed Watermain Layout

The proposed development's water supply is to be taken from the 500mm diameter water main on Stocking Avenue and connect back into the 150mm diameter network located within Stocking North. The site's proposed water main layout is shown on DBFL Drawing 190230-DBFL-WM-SP-DR-C-1001.

A 150mm diameter looped water main will be provided within the 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 Duplex's 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.

Each apartment building is to be serviced by individual connections (110mm O.D. PE pipe).

It is noted that Irish Water have issued a Statement of Design Acceptance in relation to the proposed watermain layout (refer to Appendix C).

5.3 Pre-Connection Feedback from Irish Water

Pre-connection enquiry feedback has been received from Irish Water (included in Appendix C). 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.

5.4 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.

5.5 Materials

Proposed water mains are to be HDPE 100 SDR17.

5.6 Proposed Watermain Layout

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

- No. of Housing Units 241
- Average Occupancy Ration (Persons Per Dwelling) 2.7
- Per-Capita Consumption (l/person/day) 150
- Average Domestic Daily Demand (l/sec) 1.13
- Post Development Average Hour Water Demand (l/sec) 1.41

  (1.25 x Average Domestic Daily Demand)
- Post Development Peak Hour Water Demand (l/sec) 7.06

  (5.0 x Post Development Average Hour Water Demand)

APPENDIX A – EXTRACTS FROM GII SITE INVESTIGATION REPORT

Ground Investigations Ireland Ltd
www.gii.ie

Site White Pines East			**Trial Pit Number** IT01
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.10m X 0.40m X 1.50m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(1.20)	MADE GROUND: Brown mottled grey slightly sandy gravelly Clay with some cobbles and plastic, brick, timber and concrete blocks		
					1.20			
					(0.30)	Possible MADE GROUND: Soft to firm brown slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
					1.50	Complete at 1.50m		

Plan

Remarks

No groundwater encountered
Trial pit unstable; side walls spalling
Soakaway test carried out in trial pit
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.IT01

Ground Investigations Ireland Ltd
www.gii.ie

Site White Pines East			**Trial Pit Number** IT02
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.30m X 0.40m X 1.50m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
			fast ingress(1) at 0.80m.		(1.00)	MADE GROUND: Brown mottled grey slightly sandy gravelly Clay with some cobbles and plastic, brick, timber, tiles and concrete blocks		▽1
					1.00	Complete at 1.00m		

Plan

Remarks

Groundwater encountered at 0.80m BGL; fast ingress
Trial pit unstable; side walls spalling
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.IT02

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Site White Pines East			**Trial Pit Number** IT02A
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.30m X 0.40m X 0.80m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			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 mottled grey slightly sandy gravelly Clay with some cobbles and plastic, brick, timber, tiles and concrete blocks		
			fast ingress(1) at 0.80m.		0.80	Complete at 0.80m		▽1

Plan

Remarks

Groundwater encountered at 0.80m BGL; fast ingress
Trial pit unstable; side walls spalling
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.IT02A

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Site White Pines East			**Trial Pit Number** IT02B
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.30m X 0.40m X 0.70m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.70)	MADE GROUND: Brown mottled grey slightly sandy gravelly Clay with some cobbles and plastic, brick, timber, tiles and concrete blocks		
					0.70	Complete at 0.70m		

Plan

Remarks

No groundwater encountered
Trial pit unstable; side walls spalling
Trial pit backfilled on completion of test

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.IT02B

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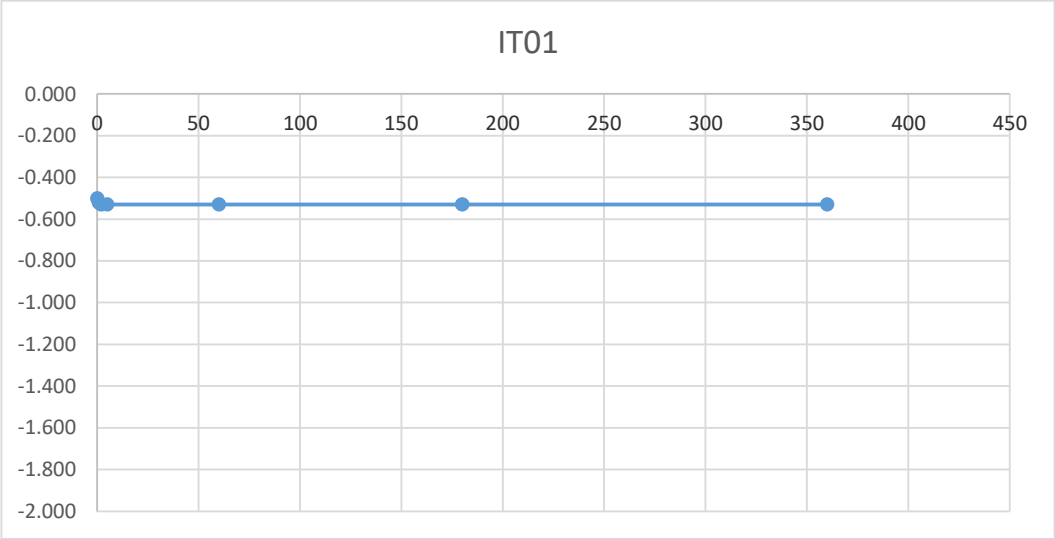
IT01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.10m x 0.40m 1.50m (L x W x D)

Date	Time	Water level (m bgl)
04/03/2020	0	-0.500
04/03/2020	1	-0.520
04/03/2020	2	-0.530
04/03/2020	5	-0.530
04/03/2020	60	-0.530
04/03/2020	180	-0.530
04/03/2020	360	-0.530

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	1.500	1.000	0.75	1.25



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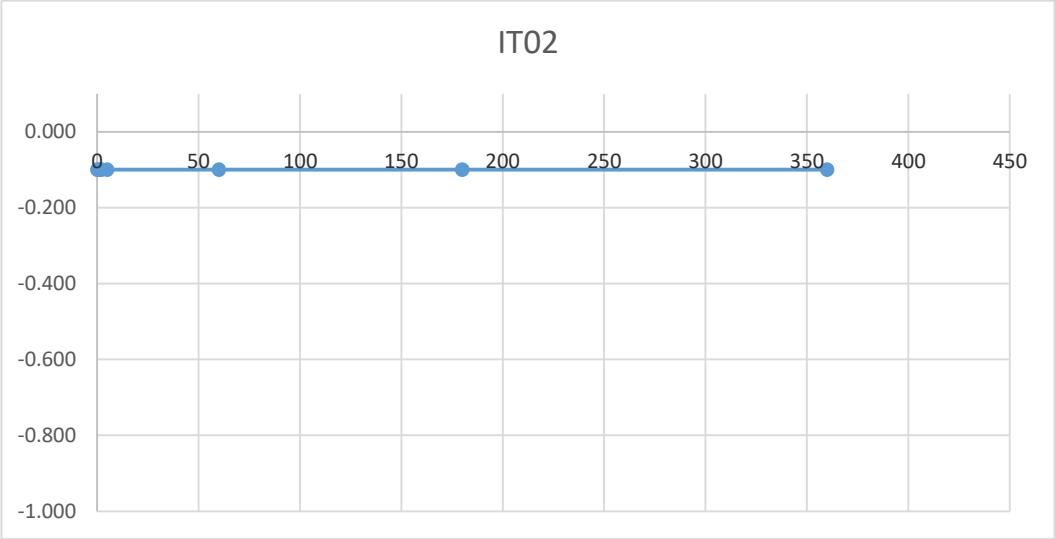
IT02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 2.10m x 0.40m 0.70m (L x W x D)

Date	Time	Water level (m bgl)
04/03/2020	0	-0.100
04/03/2020	1	-0.100
04/03/2020	2	-0.100
04/03/2020	5	-0.100
04/03/2020	60	-0.100
04/03/2020	180	-0.100
04/03/2020	360	-0.100

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.10	0.700	0.600	0.25	0.55



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Site White Pines East			**Trial Pit Number** TP01
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.40m X 0.40m X 2.60m	**Ground Level (mOD)**	**Client**	**Job Number** 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	Brown slightly sandy slightly gravelly TOPSOIL		
					0.20			
					(0.40)	Soft brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
					0.60			
0.75	ES		medium ingress(1) at 0.90m.		(0.50)	Firm brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		▽1
1.00	B				1.10			
					(0.70)	Firm brown mottled grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles		
1.75	ES				1.80			
2.00	B				(0.40)	Firm brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					2.20			
					(0.20)	Stiff brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					2.40			
					(0.20)	Very stiff dark grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					2.60	Complete at 2.60m		

Plan

Remarks

Groundwater encountered at 0.90m BGL; medium ingress
Trial pit unstable; side walls collapsed
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP01

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Site White Pines East			**Trial Pit Number** TP02
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.10m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with grass rootlets and scrap metal		
					0.20	Soft brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
					(0.50)			
					0.70	Firm brown mottled grey slightly sandy slightly gravelly CLAY with some subangular to subrounded cobbles		
0.75	ES							
1.00	B				(0.60)			
					1.30	Firm brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					(0.30)			
					1.60	Stiff brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
1.75	ES							
2.00	B				(0.90)			
					2.50	Very stiff dark grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					(0.50)			
3.00	B				3.00	Complete at 3.00m		

Plan

Remarks

No groundwater encountered
Trial pit unstable; side walls collapsed
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP02

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Site White Pines East			**Trial Pit Number** TP03
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.40m X 0.40m X 2.50m	**Ground Level (mOD)**	**Client**	**Job Number** 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.10) 0.10	MADE GROUND: Tarmacadam		
						MADE GROUND: Dark brown/brown slightly sandy gravelly Clay with some cobbles and glass, plastic, PVC, tarmacadam, and concrete pieces		
					(1.00)			
0.75	ES							
1.00	B				1.10	Possible MADE GROUND: Soft brown slightly sandy slightly gravelly Clay with some subangular to subrounded cobbles, orgranic pockets and flat granite boulders		
			medium ingress(1) at 1.50m.		(0.90)			▽1
1.75	ES							
2.00	B		fast ingress(2) at 2.00m.		2.00	Firm brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		▽2
					(0.50)			
					2.50	Complete at 2.50m		

Plan

Remarks

Groundwater encountered at 1.50m BGL; medium ingress
Second groundwater strike at 2.00m BGL; fast ingress
Trial pit unstable; side walls collapsed
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP03

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Site White Pines East			**Trial Pit Number** TP04
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.90m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 05/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40) 0.40	Brown slightly sandy slightly gravelly TOPSOIL with roots		
					(0.30) 0.70	Soft brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
0.75	ES				(0.40) 1.10	Firm to stiff brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
1.00	B				(0.30) 1.40	Stiff brown slightly sandy very gravelly CLAY with occasional angular cobbles. Gravel is angular fine to coarse of schist		
					(0.30) 1.70	Medium dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		▽1
1.75	ES		fast ingress(1) at 1.70m.		(0.30) 2.00	Dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
2.00	B				(1.00) 3.00	Dense brown/grey silty sandy angular fine to coarse GRAVEL with some angular cobbles of schist. (presumed residual Schist)		
3.00	B					Complete at 3.00m		

Plan

Remarks

Groundwater encountered at 1.70m BGL; fast ingress
Trial pit unstable; side walls spalling
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP04

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Site White Pines East			**Trial Pit Number** TP05
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.90m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**
	Location	**Dates** 05/03/2020	**Engineer** DBFL
Job Number 9411-02-20			**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40) 0.40	Brown slightly sandy slightly gravelly TOPSOIL with roots		
					(0.35) 0.75	Soft to firm brown slighlty sandy slightly gravelly CLAY		
0.75	ES				(0.45) 1.20	Soft brown slightly sandy very gravelly CLAY with occasional angular cobbles. Gravel is angular fine to coarse of schist		
1.00	B				(0.30) 1.50	Medium dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
1.75	ES				(1.10) 2.60	Dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
2.00	B				(0.40) 3.00	Dense brown/grey silty sandy angular fine to coarse GRAVEL with some angular cobbles of schist. (presumed residual Schist)		
3.00	B					Complete at 3.00m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP05

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Site White Pines East			**Trial Pit Number** TP06
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.90m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**
	Location	**Dates** 05/03/2020	**Engineer** DBFL
Job Number 9411-02-20			**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40) 0.40	MADE GROUND: Brown slightly sandy gravelly Clay with some cobbles and fragments of plastic		
0.75	ES				(0.50) 0.90	Firm brown slightly sandy gravelly CLAY with some angular cobbles of schist. Gravel is angular fine to coarse of schist		
1.00	B				(0.20) 1.10	Stiff brown slightly sandy gravelly CLAY with some angular cobbles of schist. Gravel is angular fine to coarse of schist		
1.75	ES				(1.10)	Medium dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
2.00	B				2.20			
			seepage(1) at 2.80m.		(0.80)	Dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		▽1
3.00	B				3.00	Complete at 3.00m		

Plan

Remarks

Groundwater seepage at 2.80m BGL
Trial pit unstable; side walls slightly spalling
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP06

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Site White Pines East			**Trial Pit Number** TP07
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 3.40m X 0.40m X 2.70m	**Ground Level (mOD)**	**Client**	**Job Number** 9411-02-20
	Location	**Dates** 05/03/2020	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Brown slightly sandy slightly gravelly TOPSOIL		
					(0.30) 0.60	Soft brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
0.75	ES				(0.70)	Firm brown slightly sandy very gravelly CLAY with occasional angular cobbles. Gravel is angular fine to coarse of schist		
1.00	B				1.30			
					(0.60)	Medium dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
1.75	ES				1.90			
2.00	B				(0.40)	Dense brown/grey silty sandy angular fine to coarse GRAVEL with occasional angular cobbles of schist. (presumed residual Schist)		
					2.30	Obstruction: presumed bedrock		
2.50	B					Complete at 2.70m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP07

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Site White Pines East			**Trial Pit Number** TP08
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.90m X 0.40m X 2.30m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 05/03/2020	**Engineer** DBFL
			Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30) 0.30	Brown slightly sandy slightly gravelly TOPSOIL with roots		
					(0.45) 0.75	Soft to firm brown slighlty sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
0.75	ES				(0.45) 1.20	Firm brown/grey slightly sandy very gravelly CLAY with occasional angular cobbles. Gravel is angular fine to coarse of schist		
1.00	B							
1.75	ES		seepage(1) at 1.80m.		(1.10) 2.30	Brown/grey silty sandy angular fine to coarse GRAVEL with some angular cobbles of schist. (presumed residual Schist)		▽1
2.00	B					Obstruction: presumed bedrock		
						Complete at 2.30m		

Plan

Remarks

Groundwater seepage at 1.80m BGL
Trial pit stable
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP08

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Site White Pines East			**Trial Pit Number** TP09
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.70m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**	**Job Number** 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: Brown slightly sandy very gravelly Clay with grass rootlets		
					0.20	MADE GROUND: Brown slightly sandy gravelly Clay with some cobbles and brick, PVC and concrete		
					(0.90)			
0.75	ES							
1.00	B				1.10			
					(0.20)	Soft brown mottled grey slightly sandy slightly gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					1.30			
			seepage(1) at 1.40m.			Soft to firm brown mottled grey slightly sandy slightly gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		▽1
					(0.90)			
1.75	ES							
2.00	B				2.20			
						Firm to stiff dark grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
					(0.70)			
					2.90			
					(0.10)	Stiff dark grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
3.00	B				3.00			
						Complete at 3.00m		

Plan

Remarks

Groundwater seepage at 1.40m BGL
Trial pit stable
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP09

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Site White Pines East			**Trial Pit Number** TP10
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions** 2.70m X 0.40m X 3.00m	**Ground Level (mOD)**	**Client**
			Job Number 9411-02-20
	Location	**Dates** 04/03/2020	**Engineer** DBFL
			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 mottled grey slightly sandy gravelly Clay with some cobbles and plastic		
					0.60			
0.75	ES				(0.50)	Soft to firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional subangular to subrounded cobbles		
1.00	B				1.10			
					(1.00)	Firm brown slightly sandy gravelly CLAY with some subangular to subrounded cobbles		
1.75	ES							
2.00	B				2.10			
					(0.90)	Stiff dark grey slightly sandy gravelly CLAY with some subangular to subrounded cobbles and occasional boulders		
3.00	B				3.00	Complete at 3.00m		

Plan

Remarks

No groundwater encountered
Trial pit stable
Trial pit backfilled on completion

Scale (approx)	Logged By	Figure No.
1:25	JC	9411-02-20.TP10

APPENDIX B – ATTENUATION CALCULATION

Summary of Results for 30 year Return Period (+20%)

Half Drain Time : 304 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	98.119	0.319	0.0	11.4	11.4	130.3	O K
30 min Summer	98.247	0.447	0.0	11.5	11.5	182.6	O K
60 min Summer	98.380	0.580	0.0	11.5	11.5	237.1	O K
120 min Summer	98.509	0.709	0.0	11.5	11.5	289.6	O K
180 min Summer	98.569	0.769	0.0	11.5	11.5	314.1	O K
240 min Summer	98.597	0.797	0.0	11.5	11.5	325.7	O K
360 min Summer	98.629	0.829	0.0	11.5	11.5	338.8	O K
480 min Summer	98.650	0.850	0.0	11.5	11.5	347.1	O K
600 min Summer	98.663	0.863	0.0	11.5	11.5	352.5	O K
720 min Summer	98.671	0.871	0.0	11.5	11.5	355.7	O K
960 min Summer	98.673	0.873	0.0	11.5	11.5	356.8	O K
1440 min Summer	98.648	0.848	0.0	11.5	11.5	346.4	O K
2160 min Summer	98.574	0.774	0.0	11.5	11.5	316.2	O K
2880 min Summer	98.485	0.685	0.0	11.5	11.5	279.9	O K
4320 min Summer	98.301	0.501	0.0	11.5	11.5	204.7	O K
5760 min Summer	98.146	0.346	0.0	11.5	11.5	141.3	O K
7200 min Summer	98.022	0.222	0.0	11.4	11.4	90.6	O K
8640 min Summer	97.926	0.126	0.0	11.4	11.4	51.5	O K
10080 min Summer	97.859	0.059	0.0	11.4	11.4	24.0	O K
15 min Winter	98.161	0.361	0.0	11.5	11.5	147.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	66.054	0.0	142.4	22
30 min Summer	47.471	0.0	204.9	37
60 min Summer	32.361	0.0	279.3	66
120 min Summer	21.545	0.0	372.1	126
180 min Summer	16.872	0.0	437.0	184
240 min Summer	14.155	0.0	489.0	240
360 min Summer	11.031	0.0	571.6	304
480 min Summer	9.233	0.0	638.0	372
600 min Summer	8.041	0.0	694.6	440
720 min Summer	7.182	0.0	744.4	512
960 min Summer	6.005	0.0	830.0	652
1440 min Summer	4.660	0.0	966.1	930
2160 min Summer	3.611	0.0	1122.9	1348
2880 min Summer	3.012	0.0	1248.8	1736
4320 min Summer	2.332	0.0	1450.2	2508
5760 min Summer	1.946	0.0	1613.4	3224
7200 min Summer	1.692	0.0	1754.0	3928
8640 min Summer	1.511	0.0	1879.3	4584
10080 min Summer	1.374	0.0	1993.7	5248
15 min Winter	66.054	0.0	159.6	22

Summary of Results for 30 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	98.308	0.508	0.0	11.5	207.7	O K
60 min Winter	98.465	0.665	0.0	11.5	271.8	O K
120 min Winter	98.623	0.823	0.0	11.5	336.4	O K
180 min Winter	98.707	0.907	0.0	11.5	370.4	O K
240 min Winter	98.755	0.955	0.0	11.5	390.1	O K
360 min Winter	98.797	0.997	0.0	11.5	407.2	O K
480 min Winter	98.807	1.007	0.0	11.5	411.2	O K
600 min Winter	98.820	1.020	0.0	11.5	416.5	O K
720 min Winter	98.824	1.024	0.0	11.5	418.2	O K
960 min Winter	98.812	1.012	0.0	11.5	413.4	O K
1440 min Winter	98.745	0.945	0.0	11.5	385.8	O K
2160 min Winter	98.598	0.798	0.0	11.5	326.0	O K
2880 min Winter	98.438	0.638	0.0	11.5	260.7	O K
4320 min Winter	98.145	0.345	0.0	11.5	140.8	O K
5760 min Winter	97.922	0.122	0.0	11.4	49.8	O K
7200 min Winter	97.803	0.003	0.0	11.4	1.2	O K
8640 min Winter	97.800	0.000	0.0	10.3	0.0	O K
10080 min Winter	97.800	0.000	0.0	9.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	47.471	0.0	229.4	36
60 min Winter	32.361	0.0	312.9	66
120 min Winter	21.545	0.0	416.6	124
180 min Winter	16.872	0.0	489.6	180
240 min Winter	14.155	0.0	547.7	238
360 min Winter	11.031	0.0	640.3	344
480 min Winter	9.233	0.0	714.6	400
600 min Winter	8.041	0.0	778.1	474
720 min Winter	7.182	0.0	834.0	554
960 min Winter	6.005	0.0	929.8	710
1440 min Winter	4.660	0.0	1082.1	1016
2160 min Winter	3.611	0.0	1257.7	1456
2880 min Winter	3.012	0.0	1398.7	1852
4320 min Winter	2.332	0.0	1624.3	2596
5760 min Winter	1.946	0.0	1807.1	3240
7200 min Winter	1.692	0.0	1964.7	3680
8640 min Winter	1.511	0.0	2105.1	0
10080 min Winter	1.374	0.0	2233.2	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.900	Shortest Storm (mins)	15
Ratio R	0.207	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.152

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	1.152

Model Details

Storage is Offline Dividing Weir Level (m) 98.100
Cover Level (m) 102.000

Cellular Storage Structure

Invert Level (m) 97.800 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	430.0	0.0	1.450	0.0	0.0
1.440	430.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0149-1160-1450-1160
Design Head (m)	1.450
Design Flow (l/s)	11.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	97.780
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	11.6
Flush-Flo™	0.424	11.5
Kick-Flo®	0.908	9.3
Mean Flow over Head Range	-	10.0

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	5.4	1.200	10.6	3.000	16.4	7.000	24.6
0.200	10.5	1.400	11.4	3.500	17.6	7.500	25.4
0.300	11.3	1.600	12.1	4.000	18.8	8.000	26.2
0.400	11.5	1.800	12.8	4.500	19.9	8.500	27.0
0.500	11.5	2.000	13.5	5.000	20.9	9.000	27.7
0.600	11.3	2.200	14.1	5.500	21.9	9.500	28.5
0.800	10.4	2.400	14.7	6.000	22.8		
1.000	9.7	2.600	15.3	6.500	23.7		

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

Half Drain Time : 429 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	98.222	0.422	0.0	11.5	11.5	172.2	O K
30 min Summer	98.400	0.600	0.0	11.5	11.5	245.2	O K
60 min Summer	98.582	0.782	0.0	11.5	11.5	319.5	O K
120 min Summer	98.765	0.965	0.0	11.5	11.5	394.0	O K
180 min Summer	98.858	1.058	0.0	11.5	11.5	432.4	O K
240 min Summer	98.911	1.111	0.0	11.5	11.5	453.8	O K
360 min Summer	98.953	1.153	0.0	11.5	11.5	471.2	O K
480 min Summer	98.973	1.173	0.0	11.5	11.5	479.4	O K
600 min Summer	98.988	1.188	0.0	11.5	11.5	485.1	O K
720 min Summer	98.997	1.197	0.0	11.5	11.5	488.8	O K
960 min Summer	99.004	1.204	0.0	11.5	11.5	491.8	O K
1440 min Summer	98.983	1.183	0.0	11.5	11.5	483.3	O K
2160 min Summer	98.909	1.109	0.0	11.5	11.5	453.2	O K
2880 min Summer	98.814	1.014	0.0	11.5	11.5	414.2	O K
4320 min Summer	98.608	0.808	0.0	11.5	11.5	330.3	O K
5760 min Summer	98.414	0.614	0.0	11.5	11.5	250.6	O K
7200 min Summer	98.245	0.445	0.0	11.5	11.5	181.9	O K
8640 min Summer	98.114	0.314	0.0	11.4	11.4	128.1	O K
10080 min Summer	98.004	0.204	0.0	11.4	11.4	83.3	O K
15 min Winter	98.277	0.477	0.0	11.5	11.5	194.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	85.618	0.0	184.6	22
30 min Summer	61.986	0.0	267.6	37
60 min Summer	41.951	0.0	362.0	66
120 min Summer	27.610	0.0	476.9	126
180 min Summer	21.451	0.0	555.8	186
240 min Summer	17.887	0.0	617.8	244
360 min Summer	13.813	0.0	715.8	350
480 min Summer	11.486	0.0	793.9	412
600 min Summer	9.952	0.0	859.8	480
720 min Summer	8.851	0.0	917.7	546
960 min Summer	7.352	0.0	1016.3	680
1440 min Summer	5.647	0.0	1170.9	970
2160 min Summer	4.328	0.0	1346.2	1388
2880 min Summer	3.581	0.0	1484.7	1792
4320 min Summer	2.741	0.0	1704.8	2560
5760 min Summer	2.269	0.0	1882.2	3296
7200 min Summer	1.963	0.0	2034.9	4032
8640 min Summer	1.746	0.0	2172.1	4752
10080 min Summer	1.583	0.0	2297.5	5448
15 min Winter	85.618	0.0	206.9	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	98.480	0.680	0.0	11.5	277.9	O K
60 min Winter	98.692	0.892	0.0	11.5	364.3	O K
120 min Winter	98.910	1.110	0.0	11.5	453.4	O K
180 min Winter	99.030	1.230	0.0	11.5	502.5	O K
240 min Winter	99.105	1.305	0.0	11.5	533.0	O K
360 min Winter	99.184	1.384	0.0	11.5	565.5	O K
480 min Winter	99.212	1.412	0.0	11.5	576.7	O K
600 min Winter	99.213	1.413	0.0	11.5	577.1	O K
720 min Winter	99.216	1.416	0.0	11.5	578.2	O K
960 min Winter	99.216	1.416	0.0	11.5	578.4	O K
1440 min Winter	99.162	1.362	0.0	11.5	556.2	O K
2160 min Winter	99.015	1.215	0.0	11.5	496.3	O K
2880 min Winter	98.842	1.042	0.0	11.5	425.7	O K
4320 min Winter	98.496	0.696	0.0	11.5	284.3	O K
5760 min Winter	98.192	0.392	0.0	11.5	160.3	O K
7200 min Winter	97.967	0.167	0.0	11.4	68.3	O K
8640 min Winter	97.824	0.024	0.0	11.4	9.9	O K
10080 min Winter	97.800	0.000	0.0	10.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	61.986	0.0	299.7	37
60 min Winter	41.951	0.0	405.8	66
120 min Winter	27.610	0.0	534.4	124
180 min Winter	21.451	0.0	622.7	182
240 min Winter	17.887	0.0	692.3	238
360 min Winter	13.813	0.0	802.0	350
480 min Winter	11.486	0.0	889.1	458
600 min Winter	9.952	0.0	963.0	554
720 min Winter	8.851	0.0	1027.8	580
960 min Winter	7.352	0.0	1138.3	736
1440 min Winter	5.647	0.0	1311.4	1054
2160 min Winter	4.328	0.0	1507.7	1500
2880 min Winter	3.581	0.0	1663.1	1936
4320 min Winter	2.741	0.0	1909.4	2728
5760 min Winter	2.269	0.0	2108.1	3408
7200 min Winter	1.963	0.0	2279.2	4216
8640 min Winter	1.746	0.0	2432.5	4600
10080 min Winter	1.583	0.0	2573.5	0

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)	17.900	Shortest Storm (mins)	15
Ratio R	0.207	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.152

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	1.152

Model Details

Storage is Offline Dividing Weir Level (m) 98.100
Cover Level (m) 102.000

Cellular Storage Structure

Invert Level (m) 97.800 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	430.0	0.0	1.450	0.0	0.0
1.440	430.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0149-1160-1450-1160
Design Head (m)	1.450
Design Flow (l/s)	11.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	97.780
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	11.6
Flush-Flo™	0.424	11.5
Kick-Flo®	0.908	9.3
Mean Flow over Head Range	-	10.0

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	5.4	1.200	10.6	3.000	16.4	7.000	24.6
0.200	10.5	1.400	11.4	3.500	17.6	7.500	25.4
0.300	11.3	1.600	12.1	4.000	18.8	8.000	26.2
0.400	11.5	1.800	12.8	4.500	19.9	8.500	27.0
0.500	11.5	2.000	13.5	5.000	20.9	9.000	27.7
0.600	11.3	2.200	14.1	5.500	21.9	9.500	28.5
0.800	10.4	2.400	14.7	6.000	22.8		
1.000	9.7	2.600	15.3	6.500	23.7		

APPENDIX C – CORRESPONDANCE WITH IRISH WATER

Gary Talbot
48 Fitswilliam Square
Dublin 2
D02EF89

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

26 March 2020

Dear Gary Talbot,

Re: Connection Reference No CDS19008724 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 400 unit(s) at Stocking Avenue, Woodtown, Dublin.

Irish Water has reviewed your pre-connection enquiry in relation to a water connection at Stocking Avenue, Woodtown, Dublin.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Water

New connection to the existing network is feasible without upgrade

Wastewater

In order to accommodate the proposed connection at the Premises, upgrade works are required to the Irish Water network. There is currently a project underway (Ballycullen / Oldcourt LNRP) which will provide the necessary upgrade and capacity. This upgrade project is scheduled to be completed by Q4 2021 (this may be subject to change) and the proposed connection could be completed as soon as possibly practicable after this date.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. In advance of submitting your full application to An Bord 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.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

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

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

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

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Gary Talbot
48 Fitswilliam Square
Dublin 2
D02EF89

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

5 February 2021

Re: Design Submission for Stocking Avenue, Woodtown, Dublin (the "Development") (the "Design Submission") / Connection Reference No: CDS19008724

Dear Gary Talbot,

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: Marko Komso
Email: mkomso@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

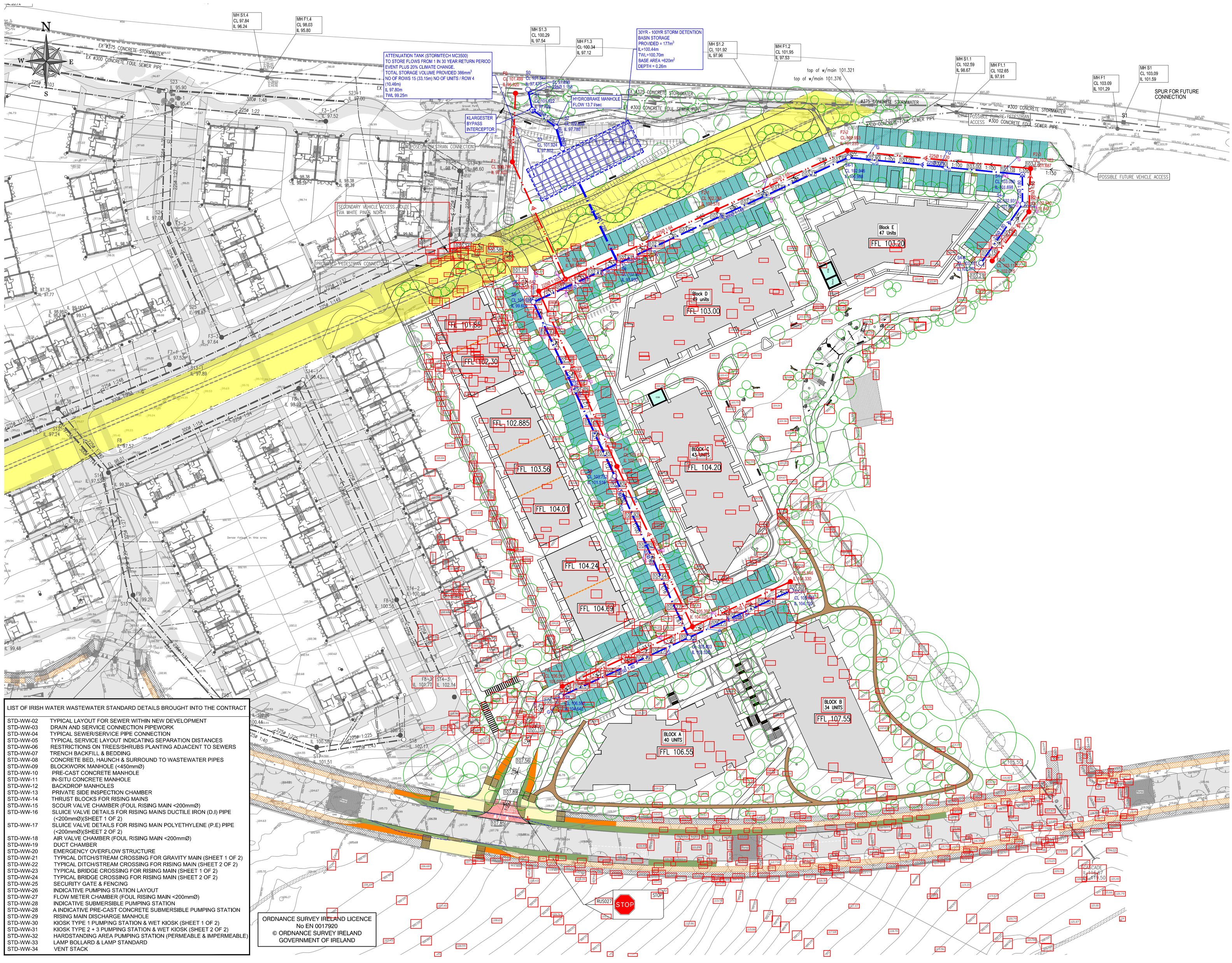
Appendix A

Document Title & Revision

- [WATERMAIN LAYOUT] 190230-DBFL-WM-SP-DR-C-1001-P01
- [COMBINED SERVICES] 190230-DBFL-CS-SP-DR-C-1001-P01
- [FOUL SEWER LONGSECTIONS] 190230-DBFL-FW-SP-DR-C-3001-P0

*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.



LIST OF IRISH WATER WASTEWATER STANDARD DETAILS BROUGHT INTO THE CONTRACT	
STD-WW-02	TYPICAL LAYOUT FOR SEWER WITHIN NEW DEVELOPMENT
STD-WW-03	DRAIN AND SERVICE CONNECTION PIPEWORK
STD-WW-04	TYPICAL SEWER/SERVICE PIPE CONNECTION
STD-WW-05	TYPICAL SERVICE LAYOUT INDICATING SEPARATION DISTANCES
STD-WW-06	RESTRICTIONS ON TREES/SHRUBS PLANTING ADJACENT TO SEWERS
STD-WW-07	TRENCH BACKFILL & BEDDING
STD-WW-08	CONCRETE BED, HAUNCH & SURROUND TO WASTEWATER PIPES
STD-WW-09	BLOCKWORK MANHOLE (<450mmØ)
STD-WW-10	PRE-CAST CONCRETE MANHOLE
STD-WW-11	IN-SITU CONCRETE MANHOLE
STD-WW-12	BACKDROP MANHOLES
STD-WW-13	PRIVATE SIDE INSPECTION CHAMBER
STD-WW-14	THRUST BLOCKS FOR RISING MAINS
STD-WW-15	SCOUR VALVE CHAMBER (FOUL RISING MAIN <200mmØ)
STD-WW-16	SLUICE VALVE DETAILS FOR RISING MAINS DUCTILE IRON (D.I) PIPE (<200mmØ)(SHEET 1 OF 2)
STD-WW-17	SLUICE VALVE DETAILS FOR RISING MAIN POLYETHYLENE (P.E) PIPE (<200mmØ)(SHEET 2 OF 2)
STD-WW-18	AIR VALVE CHAMBER (FOUL RISING MAIN <200mmØ)
STD-WW-19	DUCT CHAMBER
STD-WW-20	EMERGENCY OVERFLOW STRUCTURE
STD-WW-21	TYPICAL DITCH/STREAM CROSSING FOR GRAVITY MAIN (SHEET 1 OF 2)
STD-WW-22	TYPICAL DITCH/STREAM CROSSING FOR RISING MAIN (SHEET 2 OF 2)
STD-WW-23	TYPICAL BRIDGE CROSSING FOR RISING MAIN (SHEET 1 OF 2)
STD-WW-24	TYPICAL BRIDGE CROSSING FOR RISING MAIN (SHEET 2 OF 2)
STD-WW-25	SECURITY GATE & FENCING
STD-WW-26	INDICATIVE PUMPING STATION LAYOUT
STD-WW-27	FLOW METER CHAMBER (FOUL RISING MAIN <200mmØ)
STD-WW-28	INDICATIVE SUBMERSIBLE PUMPING STATION
STD-WW-28	A INDICATIVE PRE-CAST CONCRETE SUBMERSIBLE PUMPING STATION
STD-WW-29	RISING MAIN DISCHARGE MANHOLE
STD-WW-30	KIOSK TYPE 1 PUMPING STATION & WET KIOSK (SHEET 1 OF 2)
STD-WW-31	KIOSK TYPE 2 + 3 PUMPING STATION & WET KIOSK (SHEET 2 OF 2)
STD-WW-32	HARDSTANDING AREA PUMPING STATION (PERMEABLE & IMPERMEABLE)
STD-WW-33	LAMP BOLLARD & LAMP STANDARD
STD-WW-34	VENT STACK

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

GENERAL NOTES:
1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE WORKS REQUIREMENTS.
2. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
3. ALL CO-ORDINATES ARE TO IRISH TRANSVERSE MERCATOR.
4. ALL LEVELS ARE TO ORDNANCE DATUM (MALIN HEAD).
5. ALL TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT SHALL COMPLY FULLY WITH THE WORKS REQUIREMENTS
6. THE CONTRACTOR MUST LIAISE DIRECTLY WITH LOCAL AUTHORITY DEPARTMENTS AS DIRECTED IN THE WORKS REQUIREMENTS.
7. ALL VEHICULAR & PEDESTRIAN, CYCLE & PRIVATE ACCESS ROUTES WITHIN AND SURROUNDING THE WORKS EXTENTS MUST BE MAINTAINED THROUGHOUT THE WORKS IN ACCORDANCE WITH THE CONTRACTORS APPROVED TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT PLAN.

DRAWING SPECIFIC NOTES
1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES.
2. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF EXISTING DRAINAGE LEVELS & THE LOCATION OF EXISTING SERVICES ON SITE PRIOR TO COMMENCEMENT OF WORKS ON SITE.
3. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NRA SPECIFICATION FOR ROAD WORKS UNLESS NOTED OTHERWISE.
4. MANHOLE COVER LEVELS ARE TO CONFORM WITH FINISHED ROAD AND PATH LEVELS
5. ALL SURFACE WATER DRAINAGE WORKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL AUTHORITY'S CODE OF PRACTICE FOR DRAINAGE AND THE GDSDS.
6. ALL FOUL DRAINAGE WORKS TO BE IN ACCORDANCE WITH IRISH WATERS' CODE OF PRACTICE FOR WASTEWATER SUPPLY AND WASTEWATER INFRASTRUCTURE STANDARD DETAILS.
7. FOUL SEWERS TO BE CONCRETE PIPES (SPIGOT AND SOCKET JOINTS AND RUBBER RING FITTINGS COMPLYING WITH IS EN 1916) OR THERMOPLASTIC STRUCTURED WALL PIPES (COMPLYING WITH THE PROVISION OF IS EN 13476 AND WIS 4-35-01 2000) AND COMPLY WITH THE REQUIREMENTS OF THE IRISH WATER CODE OF PRACTICE
10. ALL SURFACE WATER SEWERS TO BE CLASS H CONCRETE TO EN1916 & IS 6 2004.
11. SURFACE WATER COLLECTOR DRAINS 150mm DIA.
12. FOUL HOUSE CONNECTIONS TO BE 100mm DIA.
13. THIS DRAWING IS BASED ON TOPO SURVEY BY J&L SURVEY Ltd. DATED 06/2016
14. CONTRACTOR SHALL INSPECT THE ROUTE & CONFIRM LOCATIONS OF ALL TREES, FEATURES, ENTRANCES & ASPECTS IMPACTING CONSTRUCTION OF THE WORKS
15. NOTE THAT THE CONTRACTOR AND/OR ARCHITECT ARE RESPONSIBLE FOR CONNECTIONS INTO THE BUILDING

LEGEND:

- SITE BOUNDARY
- BLUE SITE BOUNDARY
- 1:999 — PROPOSED ROAD GRADIENT
- 99.99 — EXISTING LEVELS
- 99.99 — PROPOSED LEVELS
- FFL 99.999 — FINISHED FLOOR LEVEL
- PROPOSED STORMWATER PIPE
- PROPOSED FOUL WATER PIPE
- EXISTING FOUL WATER PIPE
- EXISTING STORM WATER PIPE
- S9 CL 100.00 IL 99.00 — PROPOSED STORMWATER MANHOLE
- IC — PROPOSED STORMWATER INSPECTION CHAMBER
- F9 CL 100.00 IL 99.99 — PROPOSED FOUL WATER MANHOLE
- IC — PROPOSED FOUL WATER INSPECTION CHAMBER
- G — PROPOSED SURFACE WATER GULLY
- G — PROPOSED SURFACE WATER GULLY CONNECTED TO TREE PIT
- ExMH CL 100.00 IL 99.00 — EXISTING FOUL WATER MANHOLE
- ExMH CL 11.494 IL TBC — EXISTING STORMWATER MANHOLE
- PROPOSED ROAD
- PROPOSED PATH
- PROPOSED SHARED AREA
- PROPOSED PERMEABLE PAVING
- DETENTION BASIN
- STORMTECH ATTENUATION SYSTEM

rev	date	description	by	chkd.
P01	04-02-21	APB APPLICATION	JJB	SB

client approval
- A - Approved
- B - Approved with comments
- C - Do not use

suitability: S0 - WORK IN PROGRESS
issue purpose: PLANNING

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project ref.
WHITE PINES EAST ,
RATHFARNHAM, DUBLIN 14

drawing title
COMBINED SERVICES

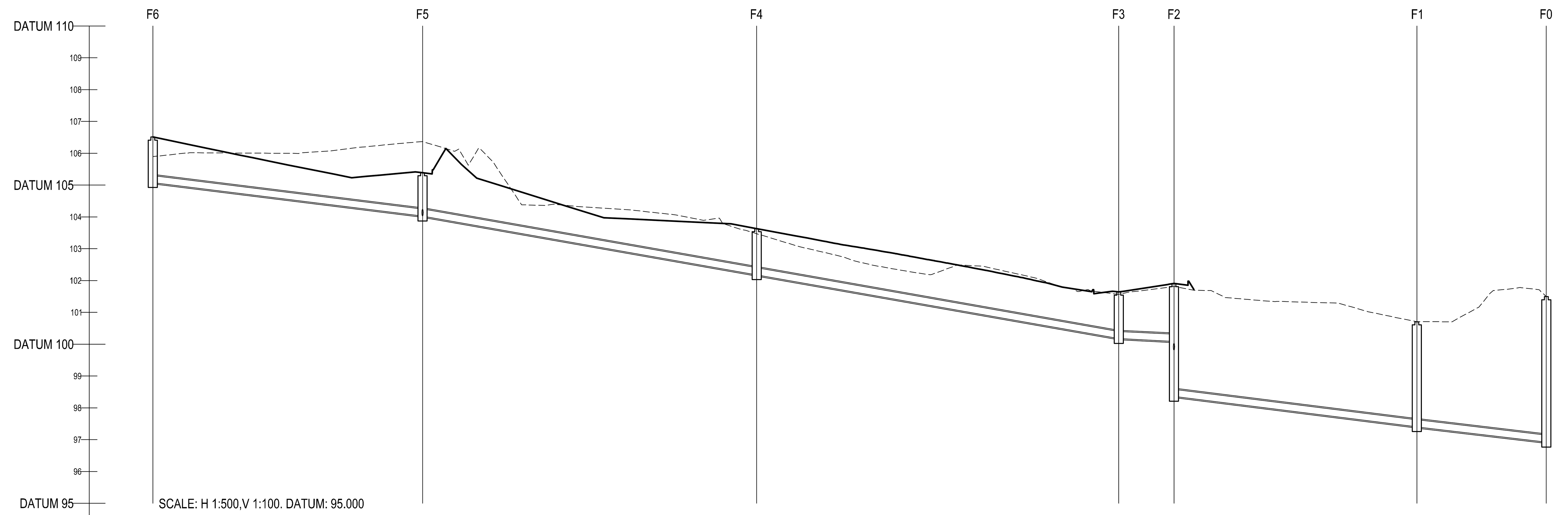
client
ARDSTONE CAPITAL LTD

designed by	author	scale	sheet size
SB	JJB	1:500	A1

drawing no. 190230-DBFL-CS-SP-DR-C-1001
revision P01

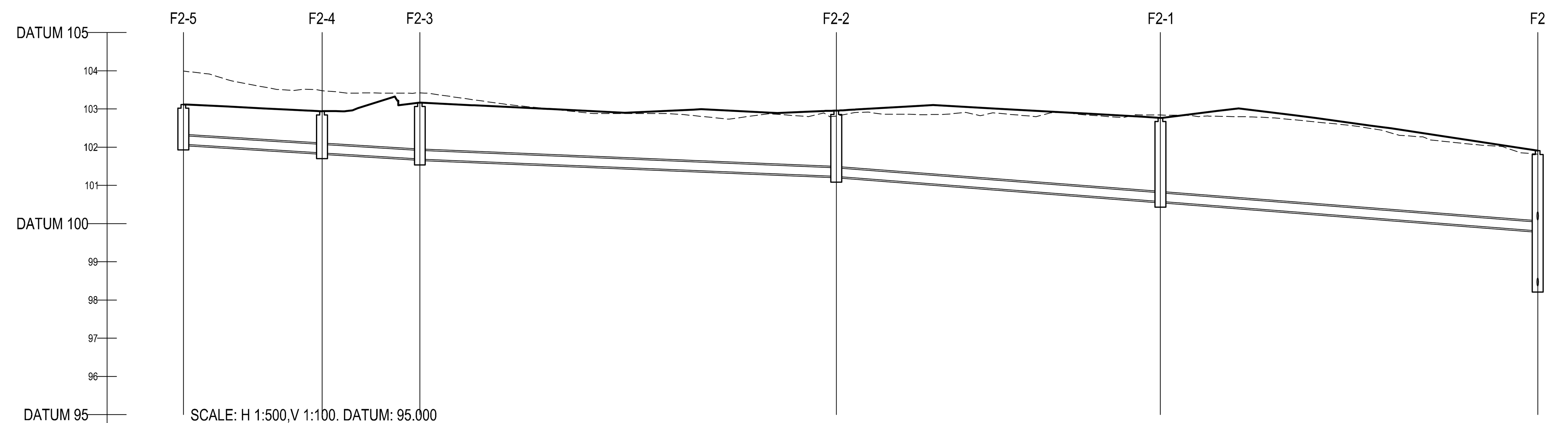
ON ORIGINAL

0 5 10 15 20 25 30 40 50mm



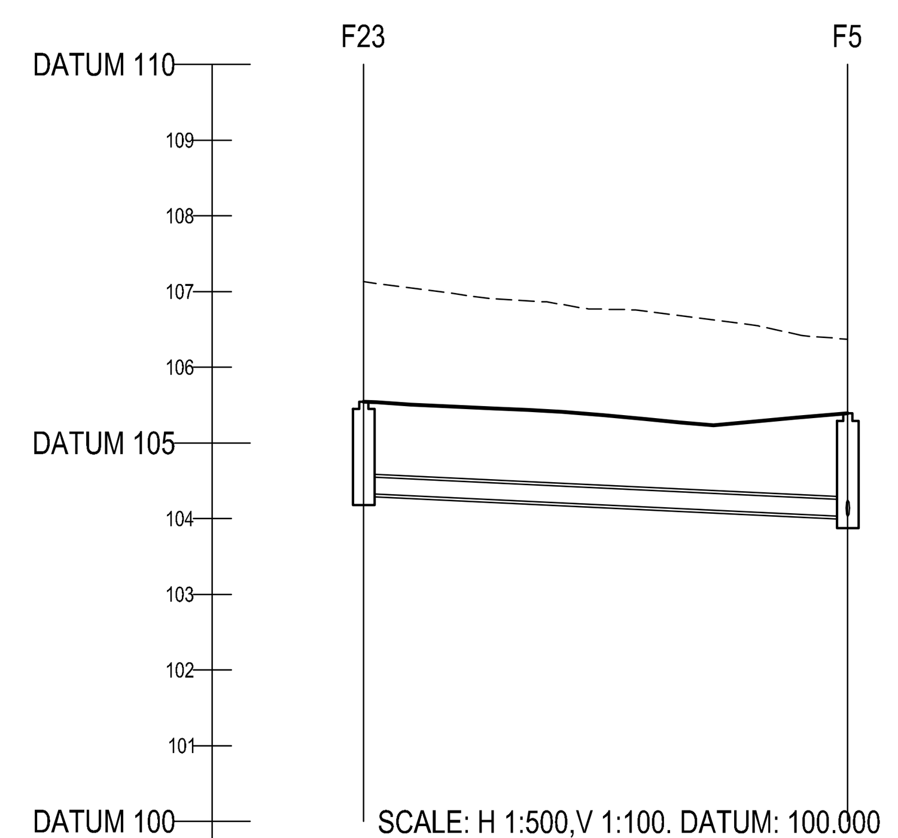
SCALE: H 1:500,V 1:100. DATUM: 95.000

	F6		F5		F4		F3		F2		F1		F0
COVER LEVEL	106.515		105.392		103.634		101.642		101.908		100.706		101.499
INVERT LEVEL	105.075	1.003	104.025 104.025	1.004	102.178 102.178	1.005	100.175 100.175	1.006	100.088 98.358	1.007	97.403 97.403	1.008	96.920
DEPTH (m)	1.440		1.367		1.456		1.467		3.550		3.303		4.579
DISTANCE (m)		42.38		52.50		56.89		8.69		38.16		20.33	
PIPE SLOPE		1:40		1:28		1:28		1:100		1:40		1:42	
PIPE SIZE		225mm		225mm		225mm		225mm		225mm		225mm	



SCALE: H 1:500,V 1:100. DATUM: 95.000

	F2-5		F2-4		F2-3		F2-2		F2-1		F2
COVER LEVEL	103.118		102.940		103.163		102.953		102.768		101.908
INVERT LEVEL	102.075	Pipe324	101.847 101.847	2.000	101.687 101.687	2.001	101.233 101.233	2.002	100.578 100.578	2.003	99.810
DEPTH (m)	1.043		1.093		1.476		1.720		2.190		3.550
DISTANCE (m)		18.16		12.80		54.53		42.44		49.42	
PIPE SLOPE		1:80		1:80		1:120		1:65		1:64	
PIPE SIZE		225mm		225mm		225mm		225mm		225mm	



SCALE: H 1:500,V 1:100. DATUM: 100.000

	F23		F5
COVER LEVEL	105.546		105.392
INVERT LEVEL	104.330	Pipe326	104.025
DEPTH (m)	1.216		1.367
DISTANCE (m)		31.97	
PIPE SLOPE		1:105	
PIPE SIZE		225mm	

NOTES:

1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES
2. ALL LEVELS ARE IN METRES AND ARE RELATED TO ORDNANCE DATUM
3. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF PAVEMENT LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORKS ON SITE
4. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NRA SPECIFICATION FOR ROAD WORKS UNLESS NOTED OTHERWISE
5. THIS DRAWING IS FOR PLANNING PURPOSES ONLY
6. MANHOLE COVER LEVELS ARE TO CONFORM WITH FINISHED ROAD AND PATH LEVELS
7. WHERE COVER TO PIPE IS LESS THAN 1200mm (ROAD/PATH/VERGE) OR 900mm (OPEN SPACE) SURROUND PIPE IN MINIMUM 150mm CONCRETE

KEY

EXISTING GROUND PROFILE
PROPOSED GROUND PROFILE

rev	date	description	by	chkd.
client approval		A - Approved		
		B - Approved with comments		
		C - Do not use		

suitability: S0 - WORK IN PROGRESS
issue purpose: PLANNING

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project ref.
WHITE PINES EAST ,
RATHFARNHAM, DUBLIN 14

drawing title
FOUL SEWER LONGSECTIONS

client
ARDSTONE CAPITAL LTD

designed by	author	scale	sheet size
SB	JJB	1:500H 1:100V	A1
drawing no.			revision
190230-DBFL-FW-SP-DR-C-3001			P0

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

NOTES:

GENERAL NOTES:

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE WORKS REQUIREMENTS.
2. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
3. ALL CO-ORDINATES ARE TO IRISH TRANSVERSE MERCATOR.
4. ALL LEVELS ARE TO ORDNANCE DATUM (MALIN HEAD).
5. ALL TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT SHALL COMPLY FULLY WITH THE WORKS REQUIREMENTS
6. THE CONTRACTOR MUST LIAISE DIRECTLY WITH LOCAL AUTHORITY DEPARTMENTS AS DIRECTED IN THE WORKS REQUIREMENTS.
7. ALL VEHICULAR & PEDESTRIAN, CYCLE & PRIVATE ACCESS ROUTES WITHIN AND SURROUNDING THE WORKS EXTENTS MUST BE MAINTAINED THROUGHOUT THE WORKS IN ACCORDANCE WITH THE CONTRACTORS APPROVED TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT PLAN.

DRAWING SPECIFIC NOTES

1. WATERMAIN INSTALLATION AND ALL WATER SUPPLY WORKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER'S CODE OF PRACTICE FOR WATER SUPPLY AND WATER INFRASTRUCTURE STANDARD DETAILS
2. WATERMAIN (AND SERVICE CONNECTIONS) TO BE PE-100 SDR 17 AND CONFORM TO IS EN 12201 (PART 1, PART 2 & PART 3)
3. AT 90 DEG. TURNS USE 2 No. 45 DEG. BENDS.
4. COVER TO WATERMAIN TO BE 900mm.
5. CONNECTION BETWEEN EXISTING AND PROPOSED WATERMAINS TO BE CARRIED OUT IN ACCORDANCE WITH IRISH WATER STANDARD DETAILS STD-W-03 TO STD-W-10.
6. ANCHOR BLOCKS TO BE POSITIONED AT DEAD ENDS, TEES, BENDS AND AT EACH SIDE OF HYDRANTS AND VALVES IN ACCORDANCE WITH THE REQUIREMENTS OF IRISH WATER STANDARD DETAIL STD-W-28 (WATER MAIN THRUST AND SUPPORT BLOCKS.
7. HYDRANT OUTLET TO BE 200mm BELOW GROUND LEVEL UNLESS REQUESTED OTHERWISE.
8. WHERE COVER TO PIPE IS LESS THAN 900mm IN GREEN AREAS AND 1200mm IN TRAFFICKED AREAS, ENCASE PIPE IN NEW 150mm CONCRETE WITH MOVEMENT JOINTS.
9. NOTE THAT THE CONTRACTOR IS RESPONSIBLE FOR CONNECTIONS INTO THE BUILDING.
10. CONNECTION TO INDIVIDUAL HOUSES IN ACCORDANCE WITH IRISH WATER STD-W-03 (I.E. 25mm OD PE PIPE).
11. CONTRACTOR SHALL SATISFY THEMSELVES AS TO THE ACCRACY OF EXISTING SERVICES INFORMATION AND THE LOCATION OF EXISTING SERVICES ON SITE PRIOR TO COMMENCING INSTALLATION OF WATERMAINS.
12. INSTALLATION OF SLUICE VALVES AND HYDRANTS SHALL BE IN ACCORDANCE WITH IRISH WATER'S STANDARD DETAILS STD-W-14 TO STD-W-19.
13. HYDRANT AND WASH OUT HYDRANT RISER PIPES TO BE DN80(DOUBLE FLANGED DUCTILE IRON).
14. MARKER POSTS AND PLATES ARE TO BE PROVIDED IN ACCORDANCE WITH IRISH WATER STANDARD DETAIL STD-W-27.
15. CONNECTION TO EXISTING WATERMAINS TO BE COORDINATED BY THE CONTRACTOR WITH IRISH WATER AND/OR THE LOCAL AUTHORITY.
16. CONTRACTOR TO LIASE WITH IRISH WATER AND / OR THE LOCAL AUTHORITY AS REQUIRED REGARDING CLEANSING AND STERILISATION OF WATERMAINS

LEGEND:

- SITE BOUNDARY
- LANDS UNDER APPLICANTS OWNERSHIP
- WATERMAIN — EXISTING WATERMAIN
- SV — SLUICE VALVE AS PER IRISH WATER STD-WW-15
- H — HYDRANT AS PER IRISH WATER STD-WW-18
- 150ømm WATERMAIN — WATERMAIN
- 100ømm WATERMAIN — WATERMAIN
- AV — AIR VALVE AS PER IRISH WATER STD-WW-20/22
- M — WATER METER AS PER IRISH WATER STD-WW-26
- K — WATER KIOSK
- WOH — WASHOUT HYDRANT AS PER I.W. STD-W-30A
- ScV — SCOUR VALVE AS PER I.W. STD-W-30
- B — BOUNDARY BOX

rev	date	description	by	chkd.
P01	04-02-21	ABP APPLICATION	JJB	SB

client approval: A - Approved; B - Approved with comments; C - Do not use

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project ref.

WHITE PINES EAST ,
RATHFARNHAM, DUBLIN 14

drawing title

WATERMAIN LAYOUT

client

ARDSTONE CAPITAL LTD

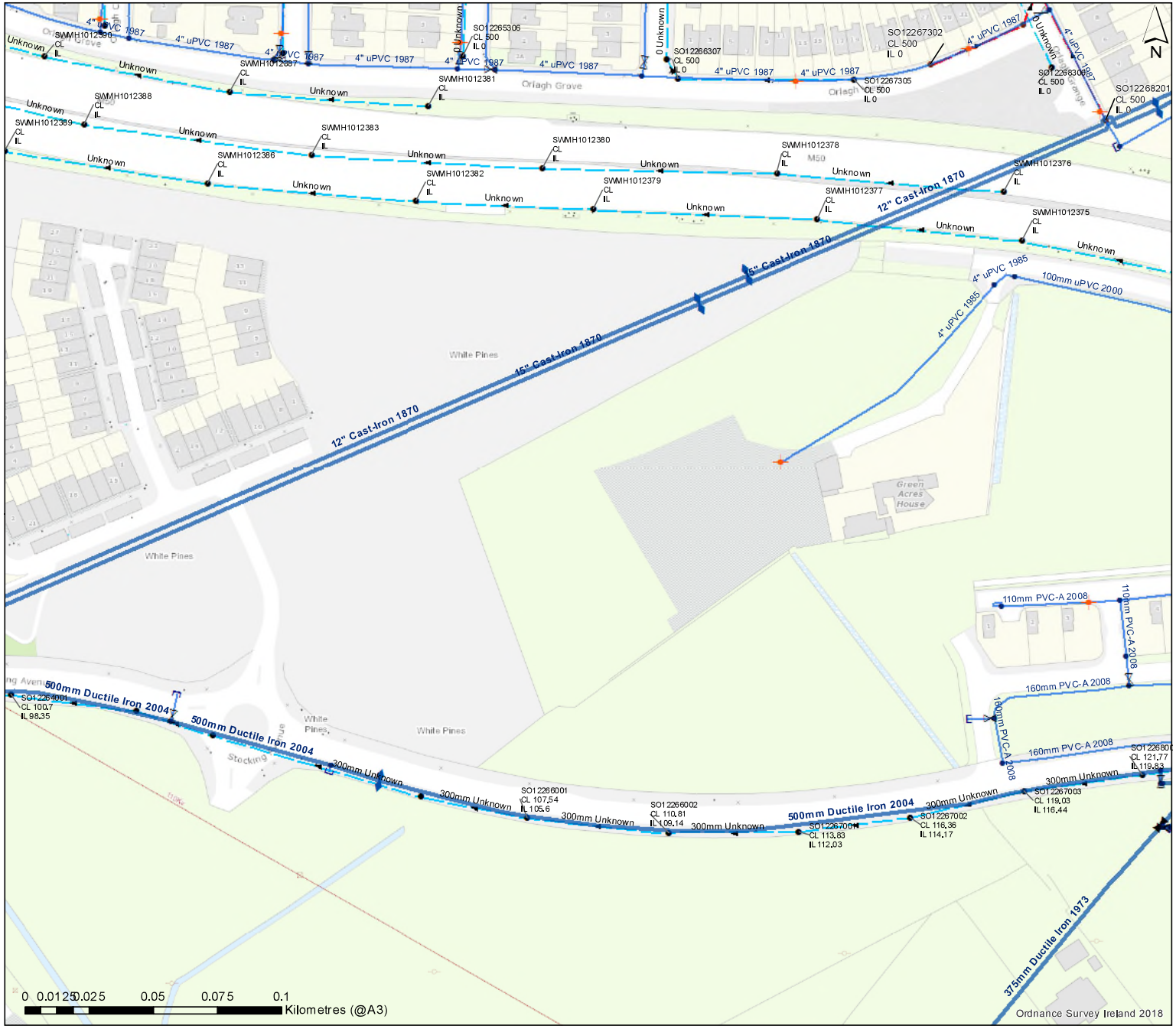
designed by	author	scalle	sheet size
BK	DJR	1:500	A1

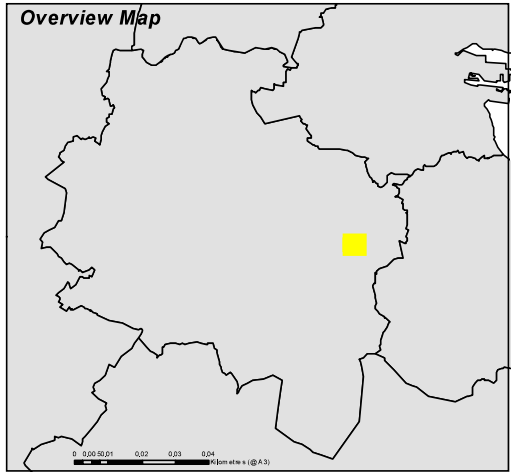
drawing no.: 190230-DBFL-WM-SP-DR-C-1001

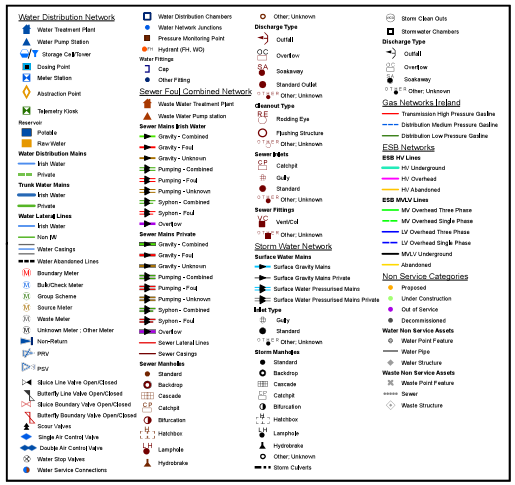
revision: P01

APPENDIX D – IRISH WATER RECORD DRAWING (WATER MAIN)

IWGIS Water Utilities Network







UISCE ÉIREANN : IRISH WATER

Print Date: 27/03/2020

Printed by: cbolger

APPENDIX E – SURFACE WATER NETWORK DESIGN CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	17.900	Add Flow / Climate Change (%)	20
Ratio R	0.207	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	41.624	1.040	40.0	0.161	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	33.351	0.520	64.1	0.106	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	52.650	1.935	27.2	0.142	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	56.915	1.916	29.7	0.152	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	27.633	0.276	100.0	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	21.362	0.268	79.7	0.045	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	8.710	0.109	79.9	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	51.825	0.710	73.0	0.085	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.33	104.640	0.161	0.0	0.0	4.4	2.07	82.5	26.2
S2.000	50.00	4.34	104.120	0.106	0.0	0.0	2.9	1.64	65.0	17.2
S1.001	50.00	4.63	103.525	0.409	0.0	0.0	11.1	3.03	213.9	66.5
S1.002	50.00	4.91	101.515	0.561	0.0	0.0	15.2	3.34	368.4	91.2
S1.003	50.00	5.17	99.599	0.582	0.0	0.0	15.8	1.81	200.1	94.6
S3.000	50.00	4.24	102.075	0.045	0.0	0.0	1.2	1.47	58.3	7.3
S3.001	50.00	4.34	101.807	0.058	0.0	0.0	1.6	1.46	58.2	9.4
S3.002	50.00	4.91	101.698	0.143	0.0	0.0	3.9	1.53	60.9	23.2

Network Design Table for Storm

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
S3.003	75.092	0.508	147.8	0.144	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	37.873	0.127	298.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	6.597	0.022	299.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	8.679	0.051	170.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	6.177	0.039	158.4	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)
S3.003	50.00	5.88	100.988	0.287	0.0	0.0	7.8	1.29	91.3	46.6
S1.004	50.00	6.41	97.929	0.869	0.0	0.0	23.5	1.17	186.4	141.2
S1.005	50.00	6.51	97.802	0.869	0.0	0.0	23.5	1.17	185.9	141.2
S1.006	50.00	6.65	97.780	0.869	0.0	0.0	23.5	1.00	39.7«	141.2
S1.007	50.00	6.75	97.729	0.869	0.0	0.0	23.5	1.04	41.2«	141.2

Flow shown at on these lines not reflective of flow after hydrobrake, see last page for summary of results

Manhole Schedules for Storm

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)
SS8	106.595	1.955	Open Manhole	1200	S1.000	104.640	225				
SS7-1	105.546	1.426	Open Manhole	1200	S2.000	104.120	225				
SS7	105.403	1.878	Open Manhole	1200	S1.001	103.525	300	S1.000	103.600	225	
								S2.000	103.600	225	
SS6	103.752	2.237	Open Manhole	1350	S1.002	101.515	375	S1.001	101.590	300	
SS5	101.624	2.025	Open Manhole	1350	S1.003	99.599	375	S1.002	99.599	375	
SS4-4	103.161	1.086	Open Manhole	1200	S3.000	102.075	225				
SS4-3	102.931	1.124	Open Manhole	1200	S3.001	101.807	225	S3.000	101.807	225	
SS4-2	103.090	1.392	Open Manhole	1200	S3.002	101.698	225	S3.001	101.698	225	
SS4-1	102.946	1.958	Open Manhole	1200	S3.003	100.988	300	S3.002	100.988	225	
SS4	102.381	4.452	Open Manhole	1350	S1.004	97.929	450	S1.003	99.323	375	1319
								S3.003	100.480	300	2401
SS3	101.924	4.122	Open Manhole	1350	S1.005	97.802	450	S1.004	97.802	450	
SS2	102.055	4.275	Open Manhole	1350	S1.006	97.780	225	S1.005	97.780	450	
SS1	101.922	4.193	Open Manhole	1200	S1.007	97.729	225	S1.006	97.729	225	
SS0	101.344	3.654	Open Manhole	1200		OUTFALL		S1.007	97.690	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	SS8	106.595	104.640	1.730	Open Manhole	1200
S2.000	o	225	SS7-1	105.546	104.120	1.201	Open Manhole	1200
S1.001	o	300	SS7	105.403	103.525	1.578	Open Manhole	1200
S1.002	o	375	SS6	103.752	101.515	1.862	Open Manhole	1350
S1.003	o	375	SS5	101.624	99.599	1.650	Open Manhole	1350
S3.000	o	225	SS4-4	103.161	102.075	0.861	Open Manhole	1200
S3.001	o	225	SS4-3	102.931	101.807	0.899	Open Manhole	1200
S3.002	o	225	SS4-2	103.090	101.698	1.167	Open Manhole	1200
S3.003	o	300	SS4-1	102.946	100.988	1.658	Open Manhole	1200
S1.004	o	450	SS4	102.381	97.929	4.002	Open Manhole	1350
S1.005	o	450	SS3	101.924	97.802	3.672	Open Manhole	1350
S1.006	o	225	SS2	102.055	97.780	4.050	Open Manhole	1350
S1.007	o	225	SS1	101.922	97.729	3.968	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	41.624	40.0	SS7	105.403	103.600	1.578	Open Manhole	1200
S2.000	33.351	64.1	SS7	105.403	103.600	1.578	Open Manhole	1200
S1.001	52.650	27.2	SS6	103.752	101.590	1.862	Open Manhole	1350
S1.002	56.915	29.7	SS5	101.624	99.599	1.650	Open Manhole	1350
S1.003	27.633	100.0	SS4	102.381	99.323	2.683	Open Manhole	1350
S3.000	21.362	79.7	SS4-3	102.931	101.807	0.899	Open Manhole	1200
S3.001	8.710	79.9	SS4-2	103.090	101.698	1.167	Open Manhole	1200
S3.002	51.825	73.0	SS4-1	102.946	100.988	1.733	Open Manhole	1200
S3.003	75.092	147.8	SS4	102.381	100.480	1.601	Open Manhole	1350
S1.004	37.873	298.2	SS3	101.924	97.802	3.672	Open Manhole	1350
S1.005	6.597	299.9	SS2	102.055	97.780	3.825	Open Manhole	1350
S1.006	8.679	170.2	SS1	101.922	97.729	3.968	Open Manhole	1200
S1.007	6.177	158.4	SS0	101.344	97.690	3.429	Open Manhole	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	SS0	101.344	97.690	0.000	1200	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS3, DS/PN: S1.005, Volume (m³): 11.7

Unit Reference	MD-SHE-0129-1160-2898-1160
Design Head (m)	2.898
Design Flow (l/s)	11.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	129
Invert Level (m)	97.802
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.898	11.6
Flush-Flo™	0.560	9.5
Kick-Flo®	1.154	7.5
Mean Flow over Head Range	-	9.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	7.7	3.000	11.8	7.000	17.7
0.200	8.1	1.400	8.2	3.500	12.7	7.500	18.2
0.300	8.9	1.600	8.8	4.000	13.5	8.000	18.8
0.400	9.3	1.800	9.3	4.500	14.3	8.500	19.4
0.500	9.5	2.000	9.7	5.000	15.0	9.000	19.9
0.600	9.5	2.200	10.2	5.500	15.7	9.500	20.4
0.800	9.3	2.400	10.6	6.000	16.4		
1.000	8.6	2.600	11.0	6.500	17.0		

Summary of Results for 30 minute 5 year Summer (Storm)

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
S1.000	SS8	104.741	-0.124	0.000	0.41		32.2	OK
S2.000	SS7-1	104.212	-0.133	0.000	0.34		21.1	OK
S1.001	SS7	103.654	-0.171	0.000	0.38		76.9	OK
S1.002	SS6	101.654	-0.236	0.000	0.30		101.8	OK
S1.003	SS5	99.809	-0.165	0.000	0.59		104.2	OK
S3.000	SS4-4	102.138	-0.162	0.000	0.17		9.1	OK
S3.001	SS4-3	101.882	-0.150	0.000	0.24		11.2	OK
S3.002	SS4-2	101.801	-0.122	0.000	0.43		24.9	OK
S3.003	SS4-1	101.149	-0.139	0.000	0.55		48.6	OK
S1.004	SS4	98.270	-0.109	0.000	0.91		150.2	OK
S1.005	SS3	98.037	-0.215	0.000	0.06		7.4	OK
S1.006	SS2	97.853	-0.152	0.000	0.23		7.4	OK
S1.007	SS1	97.804	-0.150	0.000	0.25		7.4	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	17.900	Add Flow / Climate Change (%)	20
Ratio R	0.207	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	41.624	1.040	40.0	0.161	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	33.351	0.520	64.1	0.106	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	52.650	1.935	27.2	0.142	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	56.915	1.916	29.7	0.152	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	27.633	0.276	100.0	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	21.362	0.268	79.7	0.045	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	8.710	0.109	79.9	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	51.825	0.710	73.0	0.085	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

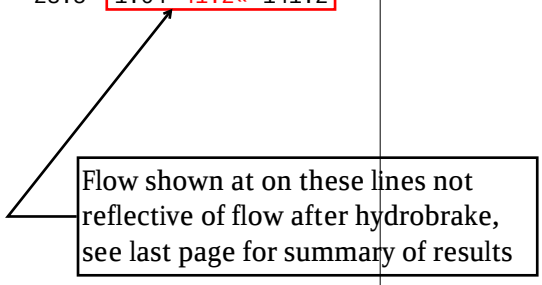
PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.33	104.640	0.161	0.0	0.0	4.4	2.07	82.5	26.2
S2.000	50.00	4.34	104.120	0.106	0.0	0.0	2.9	1.64	65.0	17.2
S1.001	50.00	4.63	103.525	0.409	0.0	0.0	11.1	3.03	213.9	66.5
S1.002	50.00	4.91	101.515	0.561	0.0	0.0	15.2	3.34	368.4	91.2
S1.003	50.00	5.17	99.599	0.582	0.0	0.0	15.8	1.81	200.1	94.6
S3.000	50.00	4.24	102.075	0.045	0.0	0.0	1.2	1.47	58.3	7.3
S3.001	50.00	4.34	101.807	0.058	0.0	0.0	1.6	1.46	58.2	9.4
S3.002	50.00	4.91	101.698	0.143	0.0	0.0	3.9	1.53	60.9	23.2

Network Design Table for Storm

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
S3.003	75.092	0.508	147.8	0.144	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	37.873	0.127	298.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	6.597	0.022	299.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	8.679	0.051	170.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	6.177	0.039	158.4	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)
S3.003	50.00	5.88	100.988	0.287	0.0	0.0	7.8	1.29	91.3	46.6
S1.004	50.00	6.41	97.929	0.869	0.0	0.0	23.5	1.17	186.4	141.2
S1.005	50.00	6.51	97.802	0.869	0.0	0.0	23.5	1.17	185.9	141.2
S1.006	50.00	6.65	97.780	0.869	0.0	0.0	23.5	1.00	39.7«	141.2
S1.007	50.00	6.75	97.729	0.869	0.0	0.0	23.5	1.04	41.2«	141.2



Manhole Schedules for Storm

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)
SS8	106.595	1.955	Open Manhole	1200	S1.000	104.640	225				
SS7-1	105.546	1.426	Open Manhole	1200	S2.000	104.120	225				
SS7	105.403	1.878	Open Manhole	1200	S1.001	103.525	300	S1.000	103.600	225	
								S2.000	103.600	225	
SS6	103.752	2.237	Open Manhole	1350	S1.002	101.515	375	S1.001	101.590	300	
SS5	101.624	2.025	Open Manhole	1350	S1.003	99.599	375	S1.002	99.599	375	
SS4-4	103.161	1.086	Open Manhole	1200	S3.000	102.075	225				
SS4-3	102.931	1.124	Open Manhole	1200	S3.001	101.807	225	S3.000	101.807	225	
SS4-2	103.090	1.392	Open Manhole	1200	S3.002	101.698	225	S3.001	101.698	225	
SS4-1	102.946	1.958	Open Manhole	1200	S3.003	100.988	300	S3.002	100.988	225	
SS4	102.381	4.452	Open Manhole	1350	S1.004	97.929	450	S1.003	99.323	375	1319
								S3.003	100.480	300	2401
SS3	101.924	4.122	Open Manhole	1350	S1.005	97.802	450	S1.004	97.802	450	
SS2	102.055	4.275	Open Manhole	1350	S1.006	97.780	225	S1.005	97.780	450	
SS1	101.922	4.193	Open Manhole	1200	S1.007	97.729	225	S1.006	97.729	225	
SS0	101.344	3.654	Open Manhole	1200		OUTFALL		S1.007	97.690	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	SS8	106.595	104.640	1.730	Open Manhole	1200
S2.000	o	225	SS7-1	105.546	104.120	1.201	Open Manhole	1200
S1.001	o	300	SS7	105.403	103.525	1.578	Open Manhole	1200
S1.002	o	375	SS6	103.752	101.515	1.862	Open Manhole	1350
S1.003	o	375	SS5	101.624	99.599	1.650	Open Manhole	1350
S3.000	o	225	SS4-4	103.161	102.075	0.861	Open Manhole	1200
S3.001	o	225	SS4-3	102.931	101.807	0.899	Open Manhole	1200
S3.002	o	225	SS4-2	103.090	101.698	1.167	Open Manhole	1200
S3.003	o	300	SS4-1	102.946	100.988	1.658	Open Manhole	1200
S1.004	o	450	SS4	102.381	97.929	4.002	Open Manhole	1350
S1.005	o	450	SS3	101.924	97.802	3.672	Open Manhole	1350
S1.006	o	225	SS2	102.055	97.780	4.050	Open Manhole	1350
S1.007	o	225	SS1	101.922	97.729	3.968	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	41.624	40.0	SS7	105.403	103.600	1.578	Open Manhole	1200
S2.000	33.351	64.1	SS7	105.403	103.600	1.578	Open Manhole	1200
S1.001	52.650	27.2	SS6	103.752	101.590	1.862	Open Manhole	1350
S1.002	56.915	29.7	SS5	101.624	99.599	1.650	Open Manhole	1350
S1.003	27.633	100.0	SS4	102.381	99.323	2.683	Open Manhole	1350
S3.000	21.362	79.7	SS4-3	102.931	101.807	0.899	Open Manhole	1200
S3.001	8.710	79.9	SS4-2	103.090	101.698	1.167	Open Manhole	1200
S3.002	51.825	73.0	SS4-1	102.946	100.988	1.733	Open Manhole	1200
S3.003	75.092	147.8	SS4	102.381	100.480	1.601	Open Manhole	1350
S1.004	37.873	298.2	SS3	101.924	97.802	3.672	Open Manhole	1350
S1.005	6.597	299.9	SS2	102.055	97.780	3.825	Open Manhole	1350
S1.006	8.679	170.2	SS1	101.922	97.729	3.968	Open Manhole	1200
S1.007	6.177	158.4	SS0	101.344	97.690	3.429	Open Manhole	1200

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	SS0	101.344	97.690	0.000	1200	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS3, DS/PN: S1.005, Volume (m³): 11.7

Unit Reference	MD-SHE-0129-1160-2898-1160
Design Head (m)	2.898
Design Flow (l/s)	11.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	129
Invert Level (m)	97.802
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.898	11.6
Flush-Flo™	0.560	9.5
Kick-Flo®	1.154	7.5
Mean Flow over Head Range	-	9.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	7.7	3.000	11.8	7.000	17.7
0.200	8.1	1.400	8.2	3.500	12.7	7.500	18.2
0.300	8.9	1.600	8.8	4.000	13.5	8.000	18.8
0.400	9.3	1.800	9.3	4.500	14.3	8.500	19.4
0.500	9.5	2.000	9.7	5.000	15.0	9.000	19.9
0.600	9.5	2.200	10.2	5.500	15.7	9.500	20.4
0.800	9.3	2.400	10.6	6.000	16.4		
1.000	8.6	2.600	11.0	6.500	17.0		

Summary of Results for 720 minute 100 year Summer (Storm)

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
S1.000	SS8	104.696	-0.169	0.000	0.14		11.2	OK
S2.000	SS7-1	104.172	-0.173	0.000	0.12		7.4	OK
S1.001	SS7	103.600	-0.225	0.000	0.14		28.5	OK
S1.002	SS6	101.599	-0.291	0.000	0.11		39.1	OK
S1.003	SS5	99.721	-0.253	0.000	0.23		40.6	OK
S3.000	SS4-4	102.110	-0.190	0.000	0.06		3.1	OK
S3.001	SS4-3	101.851	-0.181	0.000	0.09		4.0	OK
S3.002	SS4-2	101.760	-0.163	0.000	0.17		10.0	OK
S3.003	SS4-1	101.085	-0.203	0.000	0.23		20.0	OK
S1.004	SS4	98.863	0.484	0.000	0.37		60.5	SURCHARGED
S1.005	SS3	98.859	0.607	0.000	0.08		9.5	SURCHARGED
S1.006	SS2	97.864	-0.141	0.000	0.30		9.5	OK
S1.007	SS1	97.816	-0.138	0.000	0.32		9.5	OK

APPENDIX F – FOUL DRAINAGE NETWORK DESIGN CALCULATIONS

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Unit

Pipe Sizes STANDARD Manhole Sizes STANDARD

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

Designed with Level Soffits

Network Design Table for Foul - Unit

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	42.382	1.050	40.4	0.000	560.0	0.0	0.600	o	225	Pipe/Conduit	
F2.000	31.970	0.305	104.8	0.000	476.0	0.0	0.600	o	225	Pipe/Conduit	
F1.001	52.497	1.847	28.4	0.000	630.0	0.0	0.600	o	225	Pipe/Conduit	
F1.002	56.890	2.003	28.4	0.000	630.0	0.0	0.600	o	225	Pipe/Conduit	
F1.003	8.686	0.087	100.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F3.000	18.158	0.228	79.6	0.000	280.0	0.0	0.600	o	225	Pipe/Conduit	
F3.001	12.802	0.160	80.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F3.002	54.530	0.454	120.1	0.000	280.0	0.0	0.600	o	225	Pipe/Conduit	
F3.003	42.437	0.655	64.8	0.000	98.0	0.0	0.600	o	225	Pipe/Conduit	
F3.004	49.417	0.768	64.3	0.000	420.0	0.0	0.600	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	105.075	0.000	0.0	560.0	0.0	57	1.48	2.07	82.1	11.8
F2.000	104.330	0.000	0.0	476.0	0.0	71	1.02	1.28	50.8	10.9
F1.001	104.025	0.000	0.0	1666.0	0.0	69	1.95	2.46	98.0	20.4
F1.002	102.178	0.000	0.0	2296.0	0.0	76	2.05	2.46	98.0	24.0
F1.003	100.175	0.000	0.0	2296.0	0.0	107	1.28	1.31	52.0	24.0
F3.000	102.075	0.000	0.0	280.0	0.0	57	1.05	1.47	58.3	8.4
F3.001	101.847	0.000	0.0	280.0	0.0	57	1.05	1.46	58.2	8.4
F3.002	101.687	0.000	0.0	560.0	0.0	76	0.99	1.19	47.4	11.8
F3.003	101.233	0.000	0.0	658.0	0.0	68	1.27	1.63	64.7	12.8
F3.004	100.578	0.000	0.0	1078.0	0.0	77	1.37	1.63	64.9	16.4

Network Design Table for Foul - Unit

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.004	38.162	0.955	40.0	0.000	0.0	0.0	0.600	o	225	Pipe/Conduit	
F1.005	20.335	0.483	42.1	0.000	0.0	0.0	0.600	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)
F1.004	98.358	0.000	0.0	3374.0	0.0	92	1.90	2.08	82.5	29.0
F1.005	97.403	0.000	0.0	3374.0	0.0	93	1.86	2.02	80.4	29.0

Manhole Schedules for Foul - Unit

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
FF6	106.515	1.440	Open Manhole	1200	F1.000	105.075	225				
FF23	105.546	1.216	Open Manhole	1200	F2.000	104.330	225				
FF5	105.392	1.367	Open Manhole	1200	F1.001	104.025	225	F1.000	104.025	225	
								F2.000	104.025	225	
FF4	103.634	1.456	Open Manhole	1200	F1.002	102.178	225	F1.001	102.178	225	
FF3	101.642	1.467	Open Manhole	1200	F1.003	100.175	225	F1.002	100.175	225	
FF2-5	103.118	1.043	Open Manhole	1200	F3.000	102.075	225				
FF2-4	103.476	1.629	Open Manhole	1200	F3.001	101.847	225	F3.000	101.847	225	
FF2-3	103.163	1.476	Open Manhole	1200	F3.002	101.687	225	F3.001	101.687	225	
FF2-2	102.953	1.720	Open Manhole	1200	F3.003	101.233	225	F3.002	101.233	225	
FF2-1	102.768	2.190	Open Manhole	1200	F3.004	100.578	225	F3.003	100.578	225	
FF2	101.908	3.550	Open Manhole	1200	F1.004	98.358	225	F1.003	100.088	225	1730
								F3.004	99.810	225	1452
FF1	100.706	3.303	Open Manhole	1200	F1.005	97.403	225	F1.004	97.403	225	
FF0	101.499	4.579	Open Manhole	1200		OUTFALL		F1.005	96.920	225	

PIPELINE SCHEDULES for Foul - Unit

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	FF6	106.515	105.075	1.215	Open Manhole	1200
F2.000	o	225	FF23	105.546	104.330	0.991	Open Manhole	1200
F1.001	o	225	FF5	105.392	104.025	1.142	Open Manhole	1200
F1.002	o	225	FF4	103.634	102.178	1.231	Open Manhole	1200
F1.003	o	225	FF3	101.642	100.175	1.242	Open Manhole	1200
F3.000	o	225	FF2-5	103.118	102.075	0.818	Open Manhole	1200
F3.001	o	225	FF2-4	103.476	101.847	1.404	Open Manhole	1200
F3.002	o	225	FF2-3	103.163	101.687	1.251	Open Manhole	1200
F3.003	o	225	FF2-2	102.953	101.233	1.495	Open Manhole	1200
F3.004	o	225	FF2-1	102.768	100.578	1.965	Open Manhole	1200
F1.004	o	225	FF2	101.908	98.358	3.325	Open Manhole	1200
F1.005	o	225	FF1	100.706	97.403	3.078	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	42.382	40.4	FF5	105.392	104.025	1.142	Open Manhole	1200
F2.000	31.970	104.8	FF5	105.392	104.025	1.142	Open Manhole	1200
F1.001	52.497	28.4	FF4	103.634	102.178	1.231	Open Manhole	1200
F1.002	56.890	28.4	FF3	101.642	100.175	1.242	Open Manhole	1200
F1.003	8.686	100.0	FF2	101.908	100.088	1.595	Open Manhole	1200
F3.000	18.158	79.6	FF2-4	103.476	101.847	1.404	Open Manhole	1200
F3.001	12.802	80.0	FF2-3	103.163	101.687	1.251	Open Manhole	1200
F3.002	54.530	120.1	FF2-2	102.953	101.233	1.495	Open Manhole	1200
F3.003	42.437	64.8	FF2-1	102.768	100.578	1.965	Open Manhole	1200
F3.004	49.417	64.3	FF2	101.908	99.810	1.873	Open Manhole	1200
F1.004	38.162	40.0	FF1	100.706	97.403	3.078	Open Manhole	1200
F1.005	20.335	42.1	FF0	101.499	96.920	4.354	Open Manhole	1200