Waterman Moylan
Engineering Consultants

Engineering Assessment Report

Proposed Residential Development at Rathmullan, Drogheda, Co. Meath

September 2019

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Comments

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1. Introduction

This report has been prepared by Waterman Moylan Consulting Engineers, on behalf of Trailford Ltd., for a residential development at Rathmullan, Drogheda, Co. Meath.

1.1 Site Location and Description

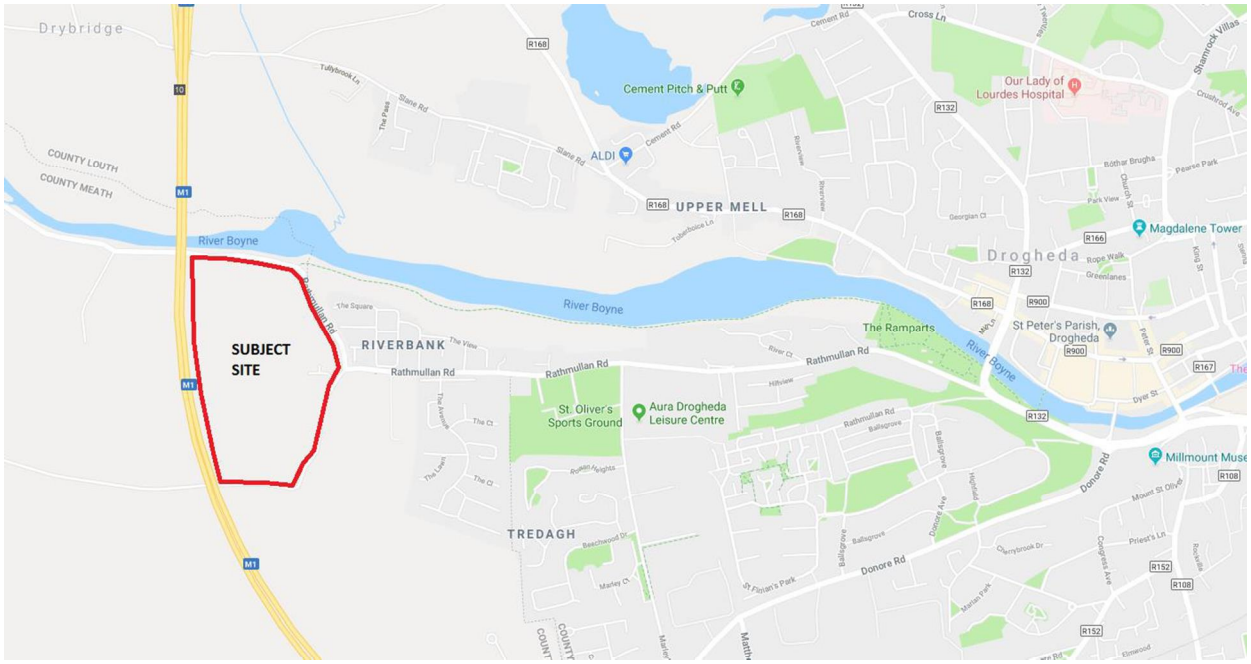
The site is located on Rathmullan Road in Drogheda, Co. Meath. The site is situated approximately 2.5 km west of Drogheda town centre as indicated in Figure 1 below.

The subject site is bounded to the north by the River Boyne, to the east by existing residential and agricultural areas, to the south by agricultural lands, and to the west by the M1 Dublin to Belfast Motorway.

The site area is c 26.21 hectares and is currently used for agricultural purposes. The lands generally slope from south-west to north-east towards the River Boyne with existing ground levels of between 38.0 m and 3.5 m OD Malin. The site is currently accessed via an existing entrance off Rathmullan Road.

Please refer to Waterman Moylan drawing No. 18-014-P001 for the exact site location and surrounding lands as outlined above.

Figure 1: Site Location



1.2 Description of the Proposed Development

The proposed development consists of a Strategic Housing Development on residential zoned lands west of Drogheda town centre. The accommodation provided on the site consists of;

- 661 residential units with a crèche and retail unit,

This application includes all associated infrastructure necessary to service the above. This includes a network of foul water and storm water pipes, watermains, and a network of roads and footpaths.

The total surfaced area of the proposed development, including roads, roofs, and other paved areas is approximately 10.39 Ha.

The proposed estate road levels around the site range from 18.73 to 36.50 m OD Malin and proposed finished floor levels range between 19.25 to 36.50 m OD Malin.

The main access for the site will be provided via a new 4 arm signalised junction with arms linking the Rathmullan Road (East), the Rathmullan Road (West) the proposed site access and the local access road to the south of the signalised junction. A second access into the housing development is proposed via a new priority junction to the south of the site onto the existing local access road.

The design and layout of the proposal has been prepared to fully comply with the current relevant design standards and specifications applicable to this form of development.

1.3 Background of Report and Summary

This report describes the criteria used to design and detail the options available for the disposal of foul water, disposal of storm water (subject to a restriction to the discharge rate), water supply and roads network to serve the development site.

It is proposed that the foul sewerage from the site will drain via a new network of gravity sewers to a new pumping station located at the low point in the north-eastern corner of the subject site. Further to a pre-connection enquiry, Irish Water have advised that this will be a 'Strategic Pumping Station' designed to accommodate the 'Riverbank' housing estate currently served by the adjacent existing pumping station (to be decommissioned) and future residential units which have been granted planning under Reg. Ref. LB170675.

Foul water will be pumped from the new pumping station and connect to the existing 110 mm diameter rising main on Rathmullan Road to the east of the subject site. This will require c. 300 m of new 110 mm rising main below the internal estate roads and a section of Rathmullan Road. Ultimately this foul water discharges to into the existing gravity sewer network on Marley's Lane c 900 m east of the subject site. Foul drainage eventually outfalls to the Drogheda Wastewater Treatment Plant. All foul water drainage details shall be in accordance with Irish Water requirements.

The quantity of storm water discharged from the proposed development to the stream will be restricted to Qbar runoff rate of 3.17 l/s/Ha based on the Institute of Hydrology report No. 124 "Flood Estimation for Small Catchments", as required by Meath County Council. This flow restriction is achieved by means of a Hydro-brake, or similar approved, installed at the outfall manhole of each surface water catchment within the development, with the excess storm water stored on site for the duration of the storm. The proposed attenuation systems will facilitate infiltration to ground. Sustainable urban drainage systems have been implemented within the proposed development to ensure that the runoff quality and rate are managed in accordance with the recommendations of the Greater Dublin Strategic Drainage Scheme, GDSDS.

It is proposed that the surface water from the proposed development will drain via gravity and discharge at a restricted rate to the existing 1200mm culvert adjacent Rathmullan Road at the north-east of the site. This culvert merges into a ditch c. 60 m to the north of the proposed outfall location. The ditch travels for c. 120 m northwards before outfalling into the River Boyne which is tidal at this location.

Water supply to the subject site will be provided via a new proposed connection to the existing 150mm HPPE watermain on Rathmullan Road to the east of the site. Irish Water have advised that this connection is feasible and that c. 140 m of 150mm ID network extension is required along with a new meter and

pressure reducing valve at the connection point. All water supply details shall be in accordance with Irish Water requirements.

Access to the subject site will be provided on Rathmullan Road to the east of the subject site by means of a proposed 4 arm signalised junction, and a secondary access on the unnamed local road to the south of the site by means of a proposed priority junction. Upgrade works are proposed to the unnamed local road to the south of the signalised junction and to Rathmullan Road to the north of the signalised junction. Pedestrian access links from the proposed development and the existing footpath on Rathmullan Road will also be provided via a new footpath which facilitates access to the River Boyne walkway.

2. Foul Water Drainage

2.1 Introduction

It is proposed that the foul sewerage from the site will drain via a new network of gravity sewers to a new pumping station located at the low point in the north-eastern corner of the subject site. Further to a pre-connection enquiry, Irish Water have advised that this pumping station will be designed to accommodate the 'Riverbank' housing estate currently served by the adjacent existing pumping station. Furthermore, a new residential development has been granted planning under Reg. Ref. LB170675 which requires the construction of a foul water pumping station to serve that development. It is proposed that the new pumping station on the subject site will be a strategic pumping station which will take the waste water from 'Riverbank' housing estate and from this proposed new residential development. This will eliminate the need for separate individual pumping stations.

Foul water will be pumped from the new pumping station and connect to the existing 110 mm diameter rising main on Rathmullan Road to the east of the subject site. This will require c. 300 m of new 110 mm rising main below the internal estate roads and a section of Rathmullan Road. Ultimately this foul water discharges to into the existing gravity sewer network on Marley's Lane c. 900 m east of the subject site. Foul drainage eventually outfalls to the Drogheda Wastewater Treatment Plant. All foul water drainage details shall be in accordance with Irish Water requirements.

Waterman Moylan drawing No's 18-014-P020 to P024 show the proposed foul water sewer network for the subject site.

2.2 Irish Water Pre-Connection Enquiry

A pre-connection enquiry was submitted to Irish Water in respect of the foul connection from the proposed development. Subsequently, Irish Water have confirmed that based on the size of the proposed development and on the capacity currently available, that subject to a valid connection agreement being put in place, the proposed connection to the Irish Water network can be facilitated.

Further to the above, Irish Water advised that a new pumping station is required to cater for the development. The new pumping station is to be sized to replace the adjacent existing old pumping station and further catchment areas. Rathmullan (LNRP) Local Network Reinforcement Project proposal are to be implemented under Irish Water growth (IW CIP funded).

The Irish Water Pre-Connection Enquiry Form Response Letter (Ref. No. 7663617994) is attached in Appendix A of this report.

2.3 Irish Water Design Acceptance

The foul drainage design for the proposed development was submitted to Irish Water. Subsequently, Irish Water issued a letter of design acceptance stating that there are no objections to the proposals. A copy of the letter has been included in Appendix B.

2.4 Foul Water – General

Foul water sewers within the proposed development will be laid to comply with the requirements of the Building Regulations, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Foul water sewers which will be taken into charge will be laid strictly in accordance with Irish Water's requirements for taking in charge.

In accordance with the Irish Water *"Code of Practice for Wastewater Supply"*, 150mm nominal internal diameter sewers have been proposed for carrying wastewater from 20 properties or less; whilst 225mm nominal internal diameter carrying Wastewater from more than 20 properties. Furthermore, where there are at least ten dwelling units connected, the 150mm diameter pipes are laid at a minimum gradient of 1:60 for up to nine connected dwelling units.

The pumping station has been located with a 20m separation distance from the nearest dwelling. This complies with Section 5.5 of the Irish Water *"Code of Practice for Wastewater Supply"*, which states that a Type 3 pumping stations require a minimum buffer zone of 15m.

2.5 Foul Water Calculations

The foul water drainage for the proposed development has been designed so that minimum cleansing velocities outlined in the "Irish Water Code of Practice for Wastewater Infrastructure" are achieved for all foul sewers. The peak foul flow is based on Irish Water recommended peak demand/flow factors which are provided in the Irish Water 'Code of Practice for Wastewater Infrastructure', Appendix D - Wastewater Flow Rates for Design. Pipe capacities and velocities have been calculated using Colebrook-White formula with a roughness coefficient (Ks) of 1.5mm.

The estimated foul flows generated from the proposed development and existing / approved developments which the new strategic pumping station will ultimately serve are as follows:

Table 1: Calculation of proposed Foul Water Flow

Description	No. of Units	Population per unit	PE	Flow l/hd/day	Infiltration Factor	Total Discharge (l/d)
Proposed Development						
Residential Units	661 Units	2.7	1,784.7	150	1.1	294,475.5
Crèche	1		55	50	1.1	3,025
Retail	1		10	30	1.1	330
					Sub - Total	***297,830***
Riverbank (Existing)						
Residential Units	200 Units	2.7	540	150	1.1	89,100

Adjacent Scheme approved under Reg. Ref. LB170675						
Residential	156 Units	2.7	421.2	150	1.1	69,498
					Total	***464,528***

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge *(from Table 1.)*	456,428	l/d
Dry Weather Flow (DWF)	5.28	l/s
Peak Foul Flow (=4.5 x DWF)	***23.77***	***l/s***

The associated calculations for all foul pipes required to serve the proposed development, which have been prepared using MICRODRAINAGE, are included in Appendix C of this report.

2.6 Foul Water Pumping Station and Preliminary Specification

2.6.1 General

As set out in 2.1 above, it is proposed to construct a new pumping station at the north-eastern side of the site. The pumping station will be sized to accommodate the proposed development as per the calculations below. However, it is noted that Irish Water have advised that this pumping station will also be required to accommodate the existing residential units currently served via the adjacent existing pumping station which is to be decommissioned, and future residential site (156 No units & crèche) which have been granted planning under Reg. Ref. LB170675. The detailed design for the upgrade of this pumping station will be subject to future discussions and correspondence with Irish Water.

2.6.2 Pumping Chamber Design Criteria

The capacity of the pumping chamber has been based on the following design criteria:

Table 2: Pumping Station Design Criteria

Static Head	26.25	m
Rising Main	110	mm Ø
Length of Rising Main	1200	m
Dry Weather Flow	5.28	l/sec

Based on the above, the volume of the foul rising main is 9.42 m³. At 5.28 l/s dry weather flow, this represents a retention time in the rising main of 0.5 hours. Therefore, there will be no septicity in the rising main.

2.6.3 Pump Design

Rising main:	Material	uPVC (Ks = 1.0)
	Length	1200 m
Proposed pump:	Motor Power	9 kW / 1425 rpm
	Pump proposed by	EPS Ireland

2.6.4 Pump Start / Stop Cycle

Minimum capacity between cut-in and cut-out:-

For 10 starts per hour			P/4V =	10	
P = 1.1 x Peak Flow = 1.1 x 5.28 (DWF) x 4.5 (Peaking Factor)					
P =	26.136	l/s	=	94.09	m³/hr
V=	94.09 / 40		=	2.35	m³
Sump	1.8m diameter RC ring		Area =	2.54	m³
Sump depth	Required =	2.35 / 2.54	=	0.93	m
	Provided =			1.0	m

2.6.5 Emergency Storage

An emergency overflow to the surface water sewer system has been provided. The total volume of storage available in the pump sump to this level is c. 9.0 m³ with a further 450 m³ available in the adjacent storage tanks.

In addition there is storage available in the foul water manholes and sewers.

At 5.28 l/sec (1*DWF) the total volume required to be stored in a 24 hour period is 456 m³, which is less than the emergency storage available.

2.6.6 Pumping Station Equipment to be provided

Mechanical and electrical equipment for the proposed pumping chamber is to be provided by an approved specialist contractor to include features as detailed on the pumping chamber drawings and to meet with Irish Water requirements.

The following is a checklist of the equipment proposed (or similar approved).

Pump Sets

2 No. submersible pumps, 1 duty 1 standby. The pumps are to be fitted with impellers capable of pumping 100-mm diameter solids. The pump motor is to be suitable for 400V/3ph/50Hz electricity power supply. The unit is fitted with over temperature protection, as well as mechanical seal monitoring.

The pumps shall be supplied complete with quick couple release mechanisms for removal and reinstallation of the pumps, 50mm diameter twin galvanised guide rails, holding brackets lifting chains etc.

Pipework & Valves

Pump pipework is to be 110 mm ductile iron, complete with couplings, riser pipes, bends and tee pieces, tapers etc as required, all complete with flange sets, consisting of zinc plated nuts, bolts, washers and gaskets.

100mm-diameter cast iron non-return valves and gate valves complete with handwheels for clockwise closing as required.

Electrical Equipment

- Pump power cables complete with cable glands.
- Earth spike and bonding.
- ESB distribution board in kiosk.

Control Equipment Panel

Ultrasonic level controller, complete with 5 programmable output relays for automatic stop and start of pumps.

Ultrasonic transducer head complete with 10m of signal cable and mounting brackets.

Control panel containing the following: -

- Cyclic relay for alternating duty pump
- Ammeters
- Hour run meters
- Hand, off, Auto switches.
- Run/trip/alarm lights
- DI relays for seal monitoring
- High level alarm beacon

Control Kiosk

A control kiosk shall be provided adjacent to the pumping station.

2.6.7 Emergency Equipment and Procedures

The pumping station is being provided with the following emergency equipment and procedures: -

- Standby pump in the event of a pump failure
- Telemetry system to facilitate Irish Water monitoring of the station
- High level alarms to warn of increases in level of effluent in the pump sump
- Storage capacity within the sump and pipe network in excess of 24 hours
- Over-pumping facilities on the rising main to facilitate the installation of a temporary external pump to empty the sump directly into the rising main

The above emergency equipment and procedures provide a very high level of redundancy and backup in the event of a failure in the mechanical systems in the pumping station.

3. Surface Water Drainage

3.1 Introduction

It is proposed that the surface water from the proposed development shall drain via gravity and discharge at a restricted rate into the existing 1200mm culvert adjacent to Rathmullan Road at the north-east of the site. This culvert merges into a ditch on the opposite side of the existing road 60 m to the north of the proposed outfall location. The ditch travels for c. 120 m northwards before outfalling into the River Boyne which is tidal at this location.

The surface water network for the subject site has been divided into four separate catchments, referred to in this report and associated drawings as Catchment A, Catchment B, Catchment C and Catchment D. These catchments operate in series with runoff from each flowing into the downstream catchment area at a restricted rate.

Runoff will be restricted to the equivalent of the Qbar runoff rate of 3.17 l/s/Ha. Surface water runoff shall be restricted via a hydrobrake installed at the outfall manhole of each surface water catchment with excess storm water attenuated in separate underground Stormtech, or similar approved, storage systems located beneath the open space areas. The Stormtech systems will facilitate infiltration and have been sized on this basis.

Sustainable urban drainage systems have been implemented within the proposed development to ensure that the runoff quality and rate are managed in accordance with the recommendations of the Greater Dublin Strategic Drainage Scheme, GDSDS. The Suds strategy for the proposed development is set out in Section 3.4 below.

The layout of the proposed surface water drainage network is shown on Waterman Moylan Drawing No's 18-014-P020 to P024.

An overview of the four surface water catchments are shown on Waterman Moylan drawing No. 18-014-P029.

3.2 Surface Water – General

Sustainable Urban Drainage systems (SUDS) have been developed and are in use to alleviate the detrimental effects of traditional urban storm water drainage practice that typically consisted of piping runoff of rainfall from developments to the nearest receiving watercourse. Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as sustainable urban drainage systems; they are typically made up of one or more structures built to manage surface water runoff.

The proposed surface water drainage system for this development has been designed as a sustainable urban drainage system and uses, water butts, permeable pavement, grass swales, attenuation storage together with flow control device and petrol interceptor to:

- Treat runoff and remove pollutants to improve quality
- Restrict outflow and to control quantity
- Increase amenity value

Strict separation of surface water and wastewater will be implemented within the development. Drains will be laid out to minimise the risk of inadvertent connection of waste pipes etc. to the surface water system.

Surface water local drains will be 150 mm to 225 mm and generally will consist of PVC (to IS 123) or concrete socket and spigot pipes (to IS 6). These drains will be laid to comply with the Requirement of the Building Regulations 2010, and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Surface water public sewers will be 225 mm to 750 mm and generally will consist of PVC or concrete socket and spigot pipes (to IS 6) and laid strictly in accordance with the requirements of Meath County Council.

3.3 Surface Water - Calculations

3.3.1 Site Characteristics

The following site characteristics are contained in the Storage Attenuation calculations included in Appendix E, and are reiterated in the following sections.

As outlined above, the site has been divided into 4 No. catchments for surface water drainage. It is also noted that there is a large open space area at the north of the development which is not drained into the new surface water network and is therefore not included in the surface water calculations.

Table 3: Surface Water Catchment Details

	Total Area (ha)	Impermeable Area (ha)	% Hardstanding
Catchment A	8.12	3.432	42.3
Catchment B	4.02	1.916	47.7
Catchment C	8.14	3.723	45.7
Catchment D	2.92	1.317	45.1
Open Space	3.01	0	-
Total	**26.21**	**10.39**	**39.6**

In addition to the areas in the table above, the following site characteristic data was also used:

- SAAR – mm 762*
- Soil Type 3**
- SOIL Index 0.37***
- Climate Change 1.2

*Met Eireann 1981-2010 Annual Average Rainfall Grid
**Obtained via Site Investigation, please see section 3.3.2 below
***GDSDS Vol2

3.3.2 Soil Type

The subject site is located on the boundary between Soil Type 1 and 2 on the 1978 Soil Map of Ireland. However, given the steep topography of the site and the moderate percolation qualities of the site soils, it was concluded that the map was not an accurate reflection of the soils on the subject site. Data from the Site Investigation was examined against the criteria outlined in the GDSDS in order to ascertain a more accurate soil type and runoff factor.

To accurately determine the soil type for the purpose of assessing the greenfield site rate of runoff, a Site Investigation was commissioned. A copy of the Site Investigation Report is included in Appendix D.

The site investigation reports that on-site soil conditions can generally be classified as per the following:

- Geotechnical Boring Records show that soils are generally classified as silty clays with some gravel and cobbles present.
- The percolation is relatively low (average of 0.03 m/s).
- The slope of the land is generally c. 3-5%.

These soils characteristics are representative of either a Soil Type 3 or 4 as set out in Appendix D-1 of the Greater Dublin Regional Drainage Study, and further detailed in the Flood Studies Report (FSR) statistical and rainfall runoff – various methods (National Environment Research Council, 1975). To ensure a conservative approach with regards to surface water management, Soil Type 3 has been adopted. Soil Type 3 is described as having a moderate winter rain acceptance parameter (i.e. moderate infiltration potential), with moderate runoff and is typical of intermediate silty soils.

3.3.3 Outflow Limits

The outflow limits are calculated in accordance with the Institute of Hydrology report No 124 "Flood Estimation for Small Catchments" for sites less than 50 Ha, where:

$Qbar = 0.00108(Area)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Greenfield Run-off = Qbar x ("n-year" factor)

Allowable Discharge = Greenfield Run-off x Area

Where:

- Area = Site area in km2 (Or 50 hectares if site is less than 50 Hectares)
- SAAR = Standard Annual Average Rainfall, taken from Met Eireann 1981-2010 Annual Average Rainfall Grid
- SOIL = Runoff constant (Varies between 0.1 and 0.53: Given as 0.37 for a Type 3 soil)

  - ⇨ $Qbar_{rural} = 0.00108(0.5)^{0.89} \times (762)^{1.17} \times (0.37)^{2.17}$
  - ⇨ $Qbar_{rural}$ = 158.6 l/s (For a 50 hectare site)
  - ⇨ $Qbar_{rural}$ = 3.17 l/s/Ha

Therefore, the permitted outflow for varying return periods has been calculated as follows:

Table 4: Surface Water Outflow

	Catchment A	Catchment B	Catchment C	Catchment D	**Total**
Catchment Area - Ha	8.12	4.02	8.14	2.92	**23.2**
$Qbar_{rural}$ – l/s	25.74	12.74	25.80	9.26	**73.54**

3.3.4 Site Infiltration and Groundwater

The attenuation systems have been designed with a permeable membrane to facilitate percolation into the ground. Percolation tests were carried out as part of the site investigation works in order to determine the infiltration rate at the areas where attenuation systems are proposed. The infiltration (f) values of the soils

at the location of the proposed attenuation systems are shown in Table 5. A full copy of the percolation test results are provided in Appendix D.

Table 5: Infiltration (f) values

Location Ref. (SI Report)	Surface Water Catchment	F value (m/min)	F value (m/s)
SA 05	Catchment A	0.00051	0.0306
SA 03	Catchment B	0.00029	0.0174
SA 03	Catchment C	0.00029	0.0174
SA 02	Catchment D	0.00068	0.0408

No groundwater strikes were noted during the Site Investigation works which included trial pits and boreholes to depths of up to 8m BGL. These works were carried out in November 2018 when it would be expected that ground water is relatively high due to the predominance of winter rainfall in Ireland.

Given the low water table and moderate percolation qualities of the soils, the water table is not expected to be an issue when constructing the drainage infrastructure.

3.3.5 Calculations – Sewer Network

Calculations for pipe sizes and gradients are based on storm water runoff from the roofs and surfaced areas using the Rational Method for surface water design (Bilhams Formula), with a storm return period (N) of 5 years.

Pipe capacities and velocities have been calculated using Colebrook-White formula with a roughness coefficient (Ks) of 0.6mm.

The total impermeable area includes roads, car-parking and roofs. The total impermeable area of each catchment is provided in Table 4 above.

These areas were used in the MICRO DRAINAGE calculations for the design of the surface water networks which are included in Appendix E. A 20% climate change factor has been factored into the design of the surface water pipe network.

The outfall sewer for the proposed development is a 300 mm pipe laid at c. 1:20 which provides a capacity of c. 250 l/s. The restricted outflow from the subject site (Catchment A, B, C & D combined) is 73.5 l/s. Therefore, there is adequate spare capacity in the outfall sewer to cater for the proposed development design flows.

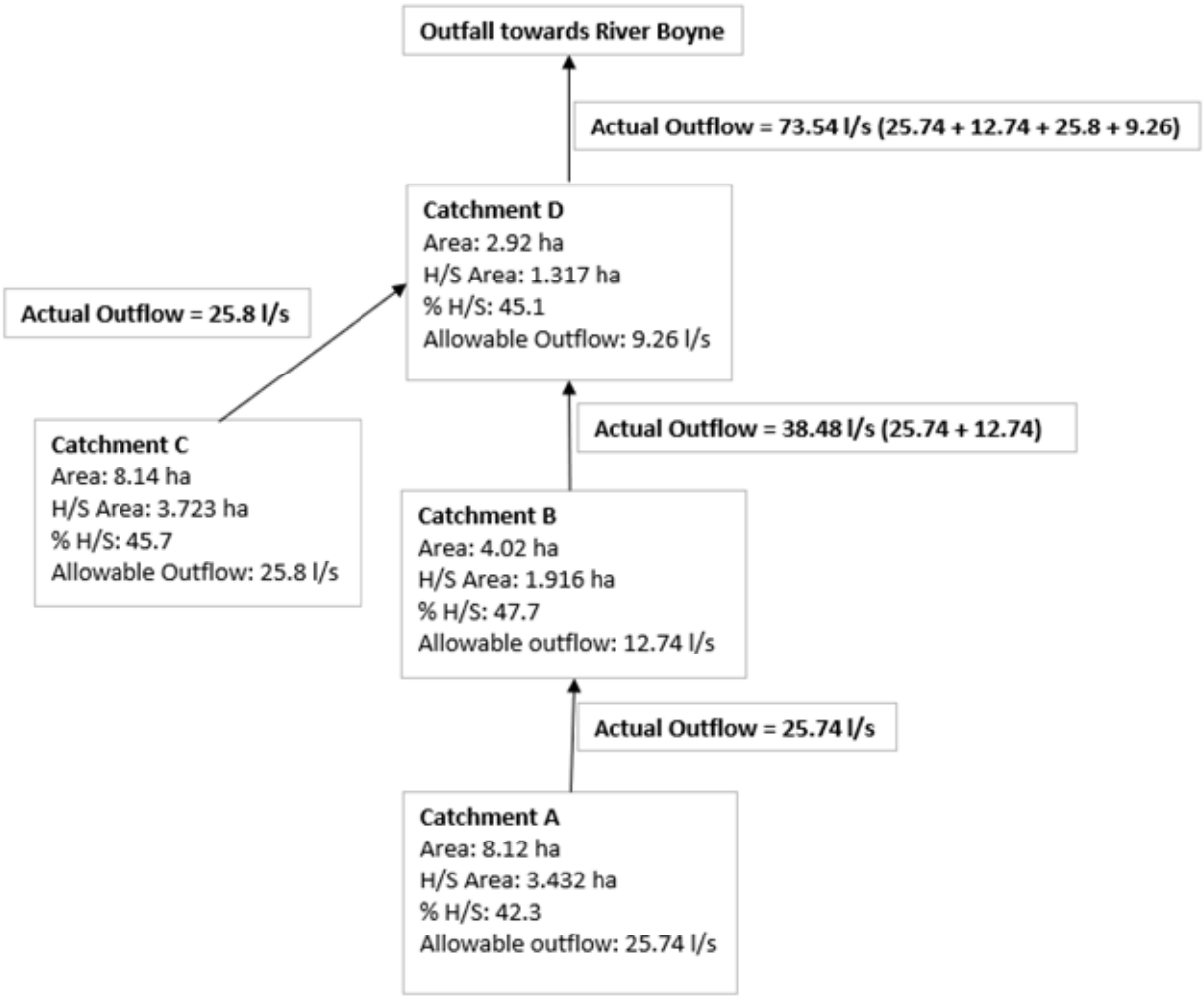
3.3.6 Calculations – Storage

It is proposed to store excess storm water up to the 1 in 100-year storm event within 4 No. underground storage systems, one per surface water catchment. The attenuation storage will normally be dry and will only fill up during storm events. The stormwater will then be released after the storm, at a controlled rate via the hydrobrake manholes.

Stormwater within the attenuation systems will also infiltrate into the ground. In accordance with the BRE Digest 365 guidance document the infiltration calculations assume infiltration from the sides of the systems only. The infiltration rates for the attenuation systems are set out in Table 5.

As discussed above, the surface water network for the subject site has been divided into four separate catchments. These catchments operate in series with runoff from each flowing into the downstream catchment area at a restricted rate. A diagram of the catchments is illustrated in Figure 2 overleaf.

Figure 2: Catchment Arrangement



The impermeable area for each surface water drainage network, as set out in Section 3.3.1 above, was used in the MICRO DRAINAGE calculations for the design of the surface water attenuation. A 20% climate change factor has been included for in the design of the attenuation storage tanks.

The storage design calculations outlined for each catchment below are included in Appendix F of this report.

Typical construction details of the proposed Stormtech MC-4500 attenuation systems are provided in Appendix G.

General details including capacity, cover level, invert level, area, length, width and depth of the underground attenuation systems for each catchment are shown on the drainage drawings.

Catchment A

Catchment A is located at the top of the catchment in the south of the site and covers an area of c. 8.12 ha. The total impermeable area is approximately 3.432 ha. The attenuation storage for this catchment is sized to accommodate the Qbar runoff rate of 25.74 l/s. Runoff will be restricted via the hydrobrake manhole with excess runoff stored in an underground Stormtech MC-4500 storage system located beneath the open space area. Water stored within the system will percolate to ground at an infiltration rate of 0.0306 m/s and this has been allowed for in the storage requirement calculations. This catchment outfalls into Catchment B at 25.74 l/s via a 300 mm diameter pipe laid at 1:200 which provides a capacity of c. 78 l/s.

Storage requirement's calculations indicate that for a return period of 100 years the 480-minute winter storm is the critical storm which requires a storage volume of approximately 1,479.8 m^3. The capacity of the underground storage system proposed to attenuate excess runoff from Catchment A, is approximately 1,482 m^3.

Catchment B

Catchment B is generally located on the eastern side of the site and covers an area of c. 4.02 ha. The total impermeable area is approximately 1.916 ha. The attenuation storage for this catchment is sized to accommodate the Qbar runoff rate of 12.74 l/s. Runoff will be restricted via the hydrobrake manhole with excess runoff stored in an underground Stormtech MC-4500 storage system located beneath the open space area. Water stored within the system will percolate to ground at an infiltration rate of 0.0174 m/s and this has been allowed for in the storage requirement calculations. This catchment outfalls into Catchment C at 38.48 l/s (sum of Catchment A and Catchment B) via a 300 mm diameter pipe laid at 1:200 which provides a capacity of c. 78 l/s

Storage requirement's calculations indicate that for a return period of 100 years the 480-minute winter storm is the critical storm which requires a storage volume of approximately 830 m^3. The capacity of the underground storage system proposed to attenuate excess runoff from Catchment B, is approximately 861 m^3.

Catchment C

Catchment C is generally located on the west and north-west portions of the site and covers an area of c. 8.14 ha. The total impermeable area is approximately 3.723 ha. The attenuation storage for this catchment is sized to accommodate the Qbar runoff rate of 25.80 l/s. Runoff will be restricted via the hydrobrake manhole with excess runoff stored in an underground Stormtech MC-4500 storage system located beneath the open space area. Water stored within the system will percolate to ground at an infiltration rate of 0.0174 m/s and this has been allowed for in the storage requirement calculations. This catchment outfalls into Catchment D at 25.80 l/s via a 300 mm diameter pipe laid at 1:200 which provides a capacity of c. 78 l/s

Storage requirement's calculations indicate that for a return period of 100 years the 480-minute winter storm is the critical storm which requires a storage volume of approximately 1,583.5 m^3. The capacity of the underground storage system proposed to attenuate excess runoff from Catchment C, is approximately 1,621 m^3.

Catchment D

Catchment D is generally located on the north eastern corner of the site and covers an area of c. 2.92 ha. The total impermeable area is approximately 1.317 ha. The attenuation storage for this catchment is sized to accommodate the Qbar runoff rate of 9.26 l/s. Runoff will be restricted via the hydrobrake manhole with excess runoff stored in an underground Stormtech MC-4500 storage tank located beneath the open space

area. Water stored within the system will percolate to ground at an infiltration rate of 0.0408 m/s and this has been allowed for in the storage requirement calculations. This catchment outfalls to the existing 1200 mm culvert on Rathmullan Road c. 30m from the last attenuation area at a rate of 73.54 l/s (sum of all Catchments).

Storage requirement's calculations indicate that for a return period of 100 years the 480-minute winter storm is the critical storm which requires a storage volume of approximately 556.7 m^3. The capacity of the underground storage tank proposed to attenuate excess runoff from Catchment D, is approximately 557 m^3.

Summary

The total capacity of the attenuation storage is 4,521 m^3. This is sufficient storage capacity to store water from the critical 100-year storm for the subject site with 20% climate change allowed for in the calculations to facilitate climate change.

3.4 SuDS Selection Criteria

The SUDS selection process used for this site is in accordance with SUDS selection flow chart, Volume 3, Section 6.5, Figure 48 of the GDSDS. The characteristics of the site are utilised to select the various SUDS techniques that would be applicable.

The applicant has considered the use of all appropriate SUDS devices as part of the site SUDS strategy.

- Water Butts – utilised within each residential unit
- Permeable Pavement – utilised within driveways
- Swales - utilised in grass verges alongside estate roads
- Underground Attenuation –below the open space areas
- Flow control device (e.g. hydrobrake) – installed at the outfall manhole of each catchment
- Petrol Interceptor – installed downstream of each flow control device manhole

The effectiveness of each SUDS / drainage mechanism proposed is outlined below:

Water Butts:

It is proposed to provide water butts for the individual dwellings for external gardening and wash down use only, which will ensure interception at source.

Permeable Pavement:

Permeable pavement reduces the overall impermeable area of the hard standing area, which will reduce the impact of the discharge and improve the quality of the effluent from the proposed development. Permeable pavement will be provided in private driveway areas. Waterman Moylan drawing No. 18-014-P010 included as part of the proposed submission includes the permeable paving layout and location. The permeable paving is provided for the purposes of improving the quality of the surface water runoff. No reduction in the rate of run-off as a result of the permeable paving provision is allowed for in the surface water calculations which assumes the system is in a saturated state.

Swales:

Roadside swales have been incorporated in the grass verges where appropriate throughout the development as indicated on Waterman Moylan drawing No. 18-014-P020 to P024. Water will drain into the swales via kerb inlets which are provided at c. 20m chainages. This detail is shown on the drainage drawings. The swales incorporate an infiltration trench at the invert of the swales which will encourage surface water to drain direct to ground as recommended by SUDS. A recent Site Investigation showed that conditions on site are conductive to infiltration. Any remaining water which does not filtrate direct to ground will drain to the surface water network.

Underground Attenuation:

The proposed Stormtech attenuation system will provide treatment to the storm water before it passes to the local network. The tank has been designed to be 'on-line' which ensures that runoff will drain via the 'Isolator Row' which provides treatment even in low flow conditions. This row is surrounded with filter fabric that provides for settling and filtration of sediments as the water passes through. This ensures that the majority of the solids are removed within the isolator row which prevents silt build-up in the remainder of the chambers. This minimises maintenance requirements and maintenance costs.

The attenuation system also permits infiltration to ground via the provision of a permeable geotextile membrane. The site investigation has shown that ground conditions are conducive to infiltration and that the water table is well below ground level.

The system also attenuates surface water to restrict the outflow to the equivalent of the existing agricultural runoff. This ensures the development will not give rise to any impact downstream of the site.

Flow Control Device:

It is proposed to provide a hydrobrake, or similar approved, at the outfall of each surface water catchment to restrict the outflow of water from the subject site. As required by Meath County Council, all flow control devices will have a 300mm outlet pipe which has been sized to take the outflow rate. The hydro-brakes will be fitted with a pull cord bypass and a penstock valve installed on the inlet to the manhole for maintenance purposes. Details of the hydro-brake manhole are shown on Waterman Moylan drawing No. 18-014-P030.

Petrol Interceptor:

It is proposed to provide a petrol interceptor downstream of the Catchment D hydro-brake manhole to ensure that any remaining hydro-carbons or pollutants within the runoff from trafficked areas are treated prior to outfall to the existing 1200 mm culvert. It is proposed to provide a Klargestor Bypass Separator Type NSBP0010 or similar approved. A detail is shown on Waterman Moylan drawing No. 18-014-P030.

In conclusion the water quality from this catchment should be of a high quality due to the above mentioned measures, which are applied in a treatment train to treat the water before discharge at a restricted rate to the local network.

The above measures ensure a suitable **management train** is provided.

Management Train:

The management train commences with **source control** through the provision of water butts and draw off taps in each dwelling for external reuse only. This will also reduce the water consumption required of each housing unit.

The second stage of the management train, **site control**, is provided by the introduction of permeable pavement and swales, all of which provide a degree of treatment before discharging to the proposed surface water network and attenuation system. The rate of runoff is controlled through the provision of a flow control device installed in the outfall manhole of each surface water catchment.

The underground attenuation offers a third stage of treatment, **regional control**, by slowing the storm water discharge down, promoting infiltration and removing additional silts which may remain in the storm water.

3.5 Flood Risk Assessment

JBA Consulting have prepared a detailed Site-Specific Flood Risk Assessment for the proposed development. Whilst the CFRAM study indicated that the site is within Flood Zone A/B, the assessment provided by JBA notes this study used out-dated catchment conditions and does not reflect the intersection of a watercourse and the incorporation of its flows into the M1 surface water drainage network.

JBA's assessment showed that the proposed development and its associated surface water drainage network has been appropriately designed in order to mitigate flood risk.

The Site-Specific Flood Risk Assessment is included in this SHD submission under separate cover which has been prepared by JBA Consulting.

4. Water Supply

4.1 Introduction

Water supply to the subject site will be provided via a new proposed connection to the existing 150mm HPPE watermain on Rathmullan Road to the east of the site. All water supply details shall be in accordance with Irish Water requirements.

Please refer to Waterman Moylan Drawing No's. 18-014-P040 to P044 for details of the watermain layout to serve the subject site.

4.2 Irish Water Pre Connection Enquiry

A pre-connection enquiry was submitted to Irish Water in respect of water supply to the proposed development. Subsequently, Irish Water have confirmed that based on the size of the proposed development and on the capacity currently available, that subject to a valid connection agreement being put in place, the proposed connection to the Irish Water network can be facilitated.

Further to the above, Irish Water advised that c. 140m of 150mm ID watermain network extension is required along with a new meter and a pressure reducing valve at the connection point.

The Irish Water Pre-Connection Enquiry Form Response Letter (Ref. No. 7663617994) is attached in Appendix A of this report

4.3 Water Demand Calculation

Water calculations providing details of the anticipated water consumption for the proposed development are illustrated in Table 6 below.

Table 6: Total Water Demand

Description	No. of Units	Population per Unit	PE	Flow l/h/day	Total Discharge (l/d)
Residential Units	661	2.7	1784.7	150	267,705
Crèche	1		55	50	2,750
Retail	1		10	30	300
				Total	270,755

The total water requirement from the public supply, for the development, is estimated at 270.76 m^3/day.

4.4 Water Supply – General

Water Mains suitable for Works and approved by Irish Water shall be either ductile iron (DI) or polyethylene (PE), with PE80 or PE100 rating (MDPE, HDPE or HPPE).

The minimum depth of cover from the finished ground level to the external crown of a Water Main shall be 900mm. A greater depth of cover and/or greater strength pipe and/or a higher class of bedding may be required where high traffic loading is anticipated. Depths may be altered to avoid obstructions, including

separation distances between other utility services. The desirable maximum cover for a Service Connection pipe or a Water Main should be 1200mm, where practicable.

Sluice valves will be provided so that no more than 40 houses can be isolated at any time and hydrants provided so that each part of the dwellings are within 46 metres of a hydrant.

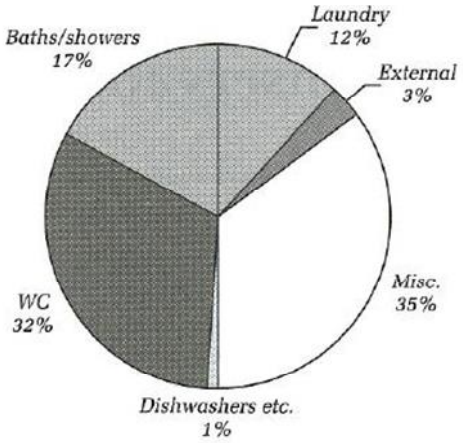
4.5 Water Conservation

The water demand for the development can be subdivided as follows:

- Potable / Non-potable Breakdown

Detailed studies have quantified the breakdown between potable and non-potable uses for residential uses.

The following diagram illustrates the current percentage breakdown of water usage in domestic circumstances and is from Griggs and Shouler 1994 as published in Chapter 11 of 'Water, Sanitary & Waste Services for Buildings' by Wise and Sheffield.



It is proposed, as part of this development, to provide rain water butts on all properties to cater for the external water demand.

In addition, water conservation measures will be used, to further reduce overall water demand, including:

- Low volume flush / dual flush WC's
- Aerated shower heads
- Spray Taps
- Draw off tap controls
- Rainwater reuse – water butts, as outlined above
- Leak detection measures – through the metering of supply

5. Transport

5.1 Description of the Proposed Development

The proposed development consists of a Strategic Housing Development on residential zoned lands c. 2.5 km west of Drogheda town centre. The accommodation provided on the site consists of;

- 661 residential units with a crèche and retail unit

The main access for the site will be provided via a new 4 arm signalised junction with arms linking the Rathmullan Road (East), the Rathmullan Road (West) the proposed site access and the local access road to the south of the signalised junction. A second access into the housing development is proposed via a new priority junction to the south of the site onto the existing local access road.

Figure 3: Site Access

5.2 Traffic and Transport Assessment

The threshold for residential developments for which a Traffic Assessment is required (as set out in the Department of Transport Traffic Management Guidelines) is a development in excess of 200 units. Since the proposed development consists of 661 No. residential Units and a crèche, and is therefore above the threshold, a separate Traffic Assessment was carried out for the development and is included in this application under separate cover.

5.3 Existing Road Network

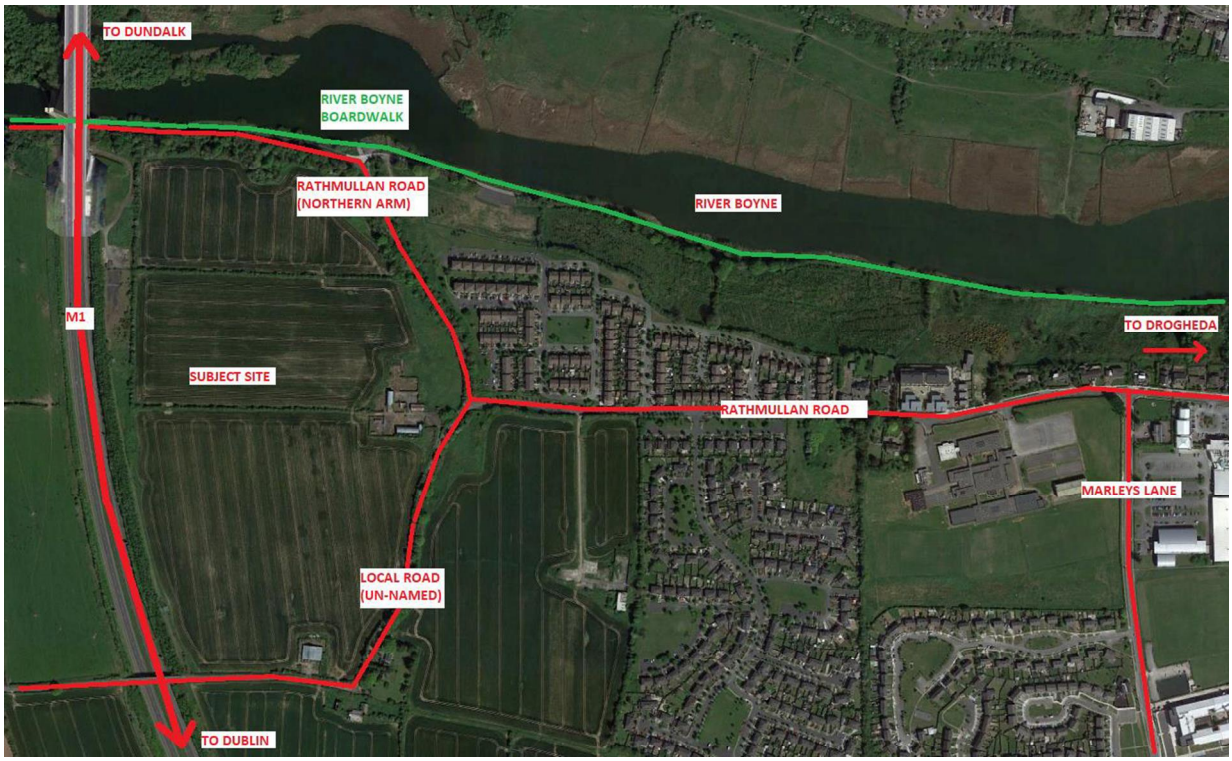
The Rathmullan Road is subject to a speed limit of 50km/h and is 2 km in length running from the priority junction with the R132 in Drogheda through to a priority junction with Rathmullan Road (Northern Arm) which continues towards the River Boyne, and a local un-named road which continues south. The Rathmullan Road along this section generally has a cross section of 7.3 m wide with footways running along both sides for the majority of its length.

The Rathmullan Road (northern arm) is a rural road with a width of c. 4m. It traverses the southern bank of the River Boyne and provides access to Oldbridge to the west. The local un-named road is a rural road with a width of c. 4 m. This provides access to several rural properties to the south and west and crosses the M1 via an over-pass.

The River Boyne Boardwalk traverses the eastern bank of the River Boyne. This is a shared pedestrian / cyclist route that provides access to Drogheda Town Centre (c. 2.5 km to the east) and Oldbridge (c. 1.8 km to the west).

An overview of the surrounding existing road network is shown in Figure 4.

Figure 4: Existing Road Network



5.4 Proposed Road Network

5.4.1 Site Access

Access to the subject site will be provided on Rathmullan Road to the east of the subject site by means of a proposed 4 arm signalised junction. The proposed position and layout of this signalised junction avoids the existing headwall and parapet wall on the drainage culvert and has been agreed with Meath County Council. Details of the signalised junction are shown on Waterman Moylan drawing No. 18-014-P050. A secondary site access is provided from the local access road to the south of the site by means of a proposed priority junction.

5.4.2 Internal Network

The proposed road layout incorporates a road hierarchy including an arterial route, link roads, local estate roads and shared surfaces / homezones. An overview of the road hierarchy is shown in Waterman Moylan drawing No. 18-014-P002 and P003.

Generally, the internal link roads and local estate roads are 6.0 m wide and footpaths are 1.8 m wide. Various traffic calming measures such as the avoidance of long straight sections, raised tables, pedestrian friendly crossings, on-street parking, and homezone areas, have been introduced to ensure a design speed of 30 km/h. Turning bays have been provided to comply with the Recommendations for Site Development Works. The proposed road layout is shown in detail on Waterman Moylan drawing No's 18-014-P006 to P009.

Pedestrian crossing points are located at various locations within the development such that unimpeded pedestrian movement along desire lines is facilitated. A network of shared cyclist / pedestrian pathways (3.0m wide) has been provided along key links throughout the development. A separated cycle track (2.0m wide) and footpath (2.0m wide) has been provided along the re-aligned local road along the site frontage to the south of the signalised junction. On low speed / low traffic volume roads such as local estate streets and homezones, cyclists will be kept on-road. The proposed pedestrian and cyclist links are shown on Waterman Moylan drawing No. 18-014-P004.

The internal road layout fully complies with the requirements of Design Manual for Urban Roads and Streets (DMURS). In this regard a separate DMURS statement has been prepared by the design team.

5.4.3 Proposed Upgrades

Further to discussions with Meath County Council, it is proposed to realign and upgrade the un-named local road along the site frontage to the south of the new signalised junction with Rathmullan Road. This road will form part of the proposed developments arterial link with a carriageway width of 7m and new kerb lines, road gullies and drainage. The proposed speed limit on this road is 50 km/h. A separated cycle track (2.0m wide) and footpath (2.0m wide) has also been provided along the extents of this road.

Upgrades are also proposed to Rathmullan Road along the site frontage to the north of the signalised junction. This includes the widening of the existing carriageway to 6 m and the provision of a 2m footpath linking the proposed development to the River Boyne Boardwalk. The proposed road and footpath upgrades are shown on Waterman Moylan drawing No. 18-014-P012.

The section of Rathmullan Road adjacent the eastern bank of the River Boyne, to the north of the subject site down to Oldbridge House, currently operates with a stop / yield one-way system in place as the River Boyne greenway is intermittently on-road in this area. It is proposed that this arrangement will be

maintained as this road is not intended to operate as a major link and therefore anticipated traffic volumes will be low.

Further to discussions with Louth County Council, it is proposed to upgrade the junction at Rathmullan Road and the R132, and also the Rathmullan Road / Marleys Lane junction. The junction upgrade works include the provision of an additional turning lanes and upgrades to the signal phasing. The details of same are provided on Waterman Moylan drawing No's. 18-014-P051 and P052. Louth County Council have advised that the proposed upgrade works are generally acceptable and have provided a letter of consent which is also included in Appendix H.

The proposed development will be constructed in 5 distinct phases which are illustrated on the enclosed Niall D Brennan Associates Architects drawing No. 17/094-PP-S-02 Rev B.

The delivery of the proposed road upgrades will be completed in tandem with the Phasing of the development. In this regard it is proposed that the new signalled controlled junction at the main access to the development will be completed as part of the Phase 1 works. The upgrade of the Rathmullan Road north of the development, which includes road widening and a new 2m wide footpath to link to the Boyne Greenway, will be completed as part of the Phase 1 & 2 works.

The proposed upgrade of the Rathmullan Road/Marleys Lane junction, within the Louth County Council administrative area will be carried out in Phase 1 of the works.

The proposed upgrade of the Rathmullan Road/R132 junction will be carried out during the Phase 2 & 3 works.

The proposed upgrade of the local road to the south of the development site, from the new signal controlled junction to the south west corner of the development will be completed as part of the Phase 3 & 4 works.

All of the road upgrades will be completed before the commencement of Phase 5.

5.5 Parking Provision

Section 11.9 of the Meath County Development Plan 2013-2019 (MCDP) sets out the maximum car parking standards for various development categories.

The car parking spaces provided with the proposed development area are set out in Table 7 below.

Table 7: Car Parking Permitted and Provided.

Land Use	Rate	Unit Numbers /GFA	Maximum Carparking Spaces Permitted (MCDP)	Carparking Spaces Provided	Visitor Carparking Spaces Provided
Dwellings	2 per dwelling	509 No. units	1,018	1,018 on-curtilage	53 on-street
1 & 2 Bedroom Apartments	1.25 per unit	22 No. units	28	28 on-street	6 on-street
3 & 4 Bedroom Apartments	2 per unit	131 No. units	262	163 on-street	37 on-street

Retail/Cafe	1 Per 20 sq. m	430.4	22	25 on-street	-
Crèche	1 per employee & dedicated set down area 1 per 5 children	486	20	10 spaces for staff and 7 Drop off spaces	
Total			**1350**	**1,251**	**96**

As can be seen from Table 7 above, the provision of car parking spaces complies with the requirements of the Meath County Development Plan 2013-2019.

5.6 Sustainable Access

5.6.1 Walking

As outlined above, a pedestrian link will be provided between the proposed development and the existing walkway along the River Boyne by the inclusion of a new 2.0m wide footpath along Rathmullan Road to the north-east. There is an existing continuous footpath along the north side of Rathmullan Road. The proposed development provides a connection to this footpath. A pedestrian link will also be facilitated between the proposed development and the adjacent residential scheme to the east, granted planning permission under Reg. Ref. LB170675.

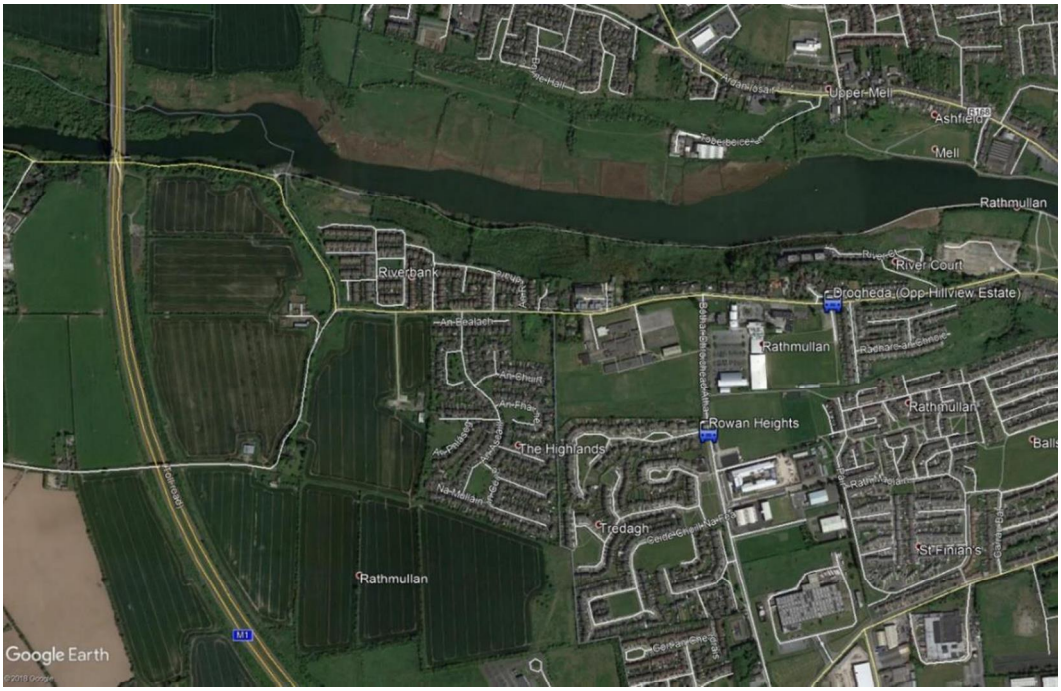
5.6.2 Cycling

The proposed development includes the provision of internal shared cyclist / pedestrian facilities and a separate off-road cycle-track along the site frontage to the south of the signalised junction. Cyclist access to Drogheda Town Centre is along Rathmullan Road or via the River Boyne greenway.

5.6.3 Public Transport

The site is not directly served by public transport services, though the closest services would be approx. 1km west of the site access, being the Drogheda (Opp Hillview Estate) stop which is served by the 173 bus route.

Figure 5: Location of Public Transport Services



A summary of these stops can be seen below;

Drogheda (Opp Hillview Estate)		
Service	Service Route	Frequency
173	West Street Drogheda - Dominick Street (Opp Church)	Hourly

Rowan Heights		
Service	Service Route	Frequency
173	West Street Drogheda - Dominick Street (Opp Church)	Hourly

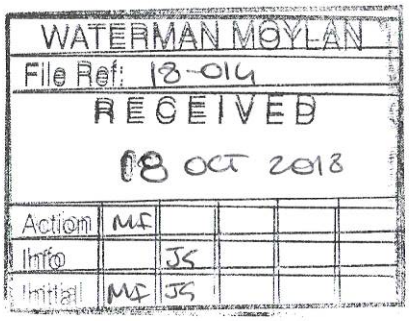
The Drogheda Bus Station is located 2.5m to the east of the subject site, which provides a high number of local and national bus routes.

The Drogheda Rail Station is located 3.5km to the east of the subject site, which is located on the Northern Commuter line running between Newry and Dublin Pearse Street. This line extends north to Belfast Central and south to Rosslare Eurosport.

APPENDICES

A. Irish Water Pre-Connection Enquiry Feedback

CLARD DEVELOPMENTS c/o JAMIE CRAMPTON
BLOCK S,EASTPOINT BUSINESS PARK
ALFIE BYRNE ROAD
DUBLIN 3



UISCE ÉIREANN : IRISH WATER

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

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

04 October 2018

Dear Sir/Madam,

Re: Customer Reference No 7663617994 pre-connection enquiry - Subject to contract | Contract denied
Connection for 700 domestic units at Rathmullen Road, Drogheda, Co. Meath

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at RATHMULLEN ROAD, DROGHEDA CO. MEATH
Based upon the details you have provided with your pre-connection enquiry and on the capacity currently available 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 can be facilitated.

Water: To facilitate this development 140 metres of 150mm ID network extension is required along with a new meter & PRV at the connection point.
Wastewater: A new pumpstation is required to cater for the full site. Adjacent existing old P.S and further catchment area to be included in sizing at Irish Water cost. A new rising main to be laid for interim and full development to Rathmullen catchment. This will be at developers cost and to IW Tec 802 P.S standard. Rathmullen (LNRP) Local Network Reinforcement Project proposals to be implemented under IW growth (IW CIP funded).

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 Utility Regulation.

If you have any further questions, please contact Allan Hannon from the design team on 01 8925318 or email ahannon@water.ie. For further information, visit **www.water.ie/connections**

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

B. Irish Water Letter of Design Acceptance

Clard Developments c/o Bradley Warren,
Waterman Moylan Engineering Consultants,
Block S,
Eastpoint Business Park,
Alfie Byrne Road,
Dublin 3

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

24 June 2019

Re: Design Submission for Development at Rathmullen Road, Drogheda, Co. Meath(the "Development") (the "Design Submission") / 7663617994.

Dear Bradley,

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: Allan Hannon
Phone: 01 8925318
Email: ahannon@water.ie

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix A

Document Title & Revision

• 18-014-P001-B	Site Location Plan
• 18-014-P021-B	Proposed Drainage Layout Sheet 1 of 4
• 18-014-P022-B	Proposed Drainage Layout Sheet 2 of 4
• 18-014-P023-B	Proposed Drainage Layout Sheet 3 of 4
• 18-014-P024-B	Proposed Drainage Layout Sheet 4 of 4
• 17-096-P025-B	Public Foul Water Drainage Details
• 17-096-P026-B	Private Foul Water Drainage Details
• 18-014-P041-B	Proposed Water Supply Layout Sheet 1 of 4
• 18-014-P042-B	Proposed Water Supply Layout Sheet 2 of 4
• 18-014-P043-B	Proposed Water Supply Layout Sheet 3 of 4
• 18-014-P044-B	Proposed Water Supply Layout Sheet 4 of 4
• 17-096-P045-B	Typical Water Supply Construction Details Sheet 1 of 3
• 17-096-P047-B	Typical Water Supply Construction Details Sheet 3 of 3

Standard Details/Code of Practice Exemption: N/A

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.

C. Foul Water Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

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)	0.000
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	0.000
Persons per House	2.70	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 - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	49.868	0.332	150.0	0.000	12	0.0	1.500	o	150	Pipe/Conduit	
F1.001	7.356	0.049	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.002	13.386	0.089	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.003	31.158	0.208	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F2.000	39.314	0.655	60.0	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
F2.001	48.408	0.807	60.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F1.004	63.069	1.051	60.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F3.000	46.685	0.467	100.0	0.000	15	0.0	1.500	o	150	Pipe/Conduit	
F3.001	46.178	0.770	60.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F1.005	63.869	0.426	150.0	0.000	12	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	33.800	0.000	0.0	12	0.0	18	0.31	0.71	12.6	0.4
F1.001	33.468	0.000	0.0	12	0.0	18	0.31	0.71	12.6	0.4
F1.002	33.419	0.000	0.0	12	0.0	18	0.31	0.71	12.6	0.4
F1.003	33.329	0.000	0.0	12	0.0	18	0.31	0.71	12.6	0.4
F2.000	34.580	0.000	0.0	6	0.0	11	0.34	1.13	20.0	0.2
F2.001	33.925	0.000	0.0	9	0.0	13	0.39	1.13	20.0	0.3
F1.004	33.043	0.000	0.0	32	0.0	21	0.55	1.48	59.0	1.0
F3.000	32.900	0.000	0.0	15	0.0	18	0.38	0.88	15.5	0.5
F3.001	32.358	0.000	0.0	19	0.0	16	0.46	1.48	59.0	0.6
F1.005	31.589	0.000	0.0	63	0.0	35	0.49	0.94	37.2	1.9

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.006	51.380	0.257	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.000	43.233	0.721	60.0	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
F5.000	47.524	0.792	60.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F5.001	52.869	0.529	100.0	0.000	6	0.0	1.500	o	150	Pipe/Conduit	
F5.002	61.729	0.412	150.0	0.000	9	0.0	1.500	o	225	Pipe/Conduit	
F4.001	22.624	0.113	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.007	64.312	0.322	200.0	0.000	14	0.0	1.500	o	225	Pipe/Conduit	
F6.000	38.594	0.772	50.0	0.000	11	0.0	1.500	o	150	Pipe/Conduit	
F6.001	38.594	0.386	100.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F1.008	60.987	1.016	60.0	0.000	15	0.0	1.500	o	225	Pipe/Conduit	
F7.000	47.382	0.790	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F8.000	37.977	0.633	60.0	0.000	12	0.0	1.500	o	150	Pipe/Conduit	
F8.001	18.604	0.124	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.006	31.163	0.000	0.0	63	0.0	38	0.44	0.81	32.2	1.9
F4.000	31.600	0.000	0.0	6	0.0	11	0.34	1.13	20.0	0.2
F5.000	32.000	0.000	0.0	8	0.0	12	0.37	1.13	20.0	0.2
F5.001	31.208	0.000	0.0	14	0.0	17	0.37	0.88	15.5	0.4
F5.002	30.604	0.000	0.0	23	0.0	22	0.36	0.94	37.2	0.7
F4.001	30.193	0.000	0.0	29	0.0	26	0.35	0.81	32.2	0.9
F1.007	30.080	0.000	0.0	106	0.0	49	0.52	0.81	32.2	3.3
F6.000	30.500	0.000	0.0	11	0.0	13	0.44	1.24	21.9	0.3
F6.001	29.728	0.000	0.0	13	0.0	17	0.37	0.88	15.5	0.4
F1.008	29.267	0.000	0.0	134	0.0	40	0.85	1.48	59.0	4.1
F7.000	28.650	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F8.000	28.335	0.000	0.0	12	0.0	14	0.42	1.13	20.0	0.4
F8.001	27.702	0.000	0.0	12	0.0	18	0.31	0.71	12.6	0.4

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F7.001	14.100	0.094	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.009	20.356	0.102	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.010	63.099	2.103	30.0	0.000	22	0.0	1.500	o	225	Pipe/Conduit	
F9.000	86.330	0.576	150.0	0.000	20	0.0	1.500	o	225	Pipe/Conduit	
F1.011	62.612	1.044	60.0	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F10.000	50.931	0.340	150.0	0.000	15	0.0	1.500	o	150	Pipe/Conduit	
F10.001	50.931	0.340	150.0	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F1.012	60.600	0.303	200.0	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F11.000	35.269	0.353	100.0	0.000	16	0.0	1.500	o	150	Pipe/Conduit	
F11.001	48.325	0.322	150.0	0.000	16	0.0	1.500	o	225	Pipe/Conduit	
F12.000	56.311	0.939	60.0	0.000	7	0.0	1.500	o	150	Pipe/Conduit	
F11.002	43.442	0.724	60.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F1.013	53.549	0.357	150.0	0.000	39	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F7.001	27.578	0.000	0.0	16	0.0	21	0.34	0.71	12.6	0.5
F1.009	27.409	0.000	0.0	150	0.0	58	0.58	0.81	32.2	4.6
F1.010	27.307	0.000	0.0	172	0.0	39	1.17	2.10	83.5	5.3
F9.000	25.250	0.000	0.0	20	0.0	20	0.34	0.94	37.2	0.6
F1.011	24.674	0.000	0.0	204	0.0	50	0.97	1.48	59.0	6.3
F10.000	24.100	0.000	0.0	15	0.0	20	0.33	0.71	12.6	0.5
F10.001	23.685	0.000	0.0	20	0.0	20	0.34	0.94	37.2	0.6
F1.012	23.346	0.000	0.0	236	0.0	73	0.65	0.81	32.2	7.3
F11.000	23.400	0.000	0.0	16	0.0	19	0.39	0.88	15.5	0.5
F11.001	22.972	0.000	0.0	32	0.0	25	0.40	0.94	37.2	1.0
F12.000	24.400	0.000	0.0	7	0.0	11	0.36	1.13	20.0	0.2
F11.002	22.650	0.000	0.0	41	0.0	23	0.59	1.48	59.0	1.3
F1.013	21.926	0.000	0.0	316	0.0	79	0.79	0.94	37.2	9.8

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.014	24.351	0.696	35.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.015	24.588	0.703	35.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F13.000	35.790	1.193	30.0	0.000	11	0.0	1.500	o	150	Pipe/Conduit	
F13.001	37.550	0.376	100.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F13.002	88.570	2.528	35.0	0.000	20	0.0	1.500	o	225	Pipe/Conduit	
F13.003	50.417	2.521	20.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F14.000	48.382	0.806	60.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F15.000	63.235	1.581	40.0	0.000	9	0.0	1.500	o	150	Pipe/Conduit	
F13.004	70.576	0.471	150.0	0.000	9	0.0	1.500	o	225	Pipe/Conduit	
F13.005	10.683	0.071	150.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F16.000	19.839	0.331	60.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F13.006	34.337	1.373	25.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F13.007	23.143	0.701	33.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.016	71.117	1.922	37.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F1.017	50.198	1.357	37.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.014	21.569	0.000	0.0	316	0.0	54	1.33	1.94	77.3	9.8
F1.015	20.873	0.000	0.0	316	0.0	54	1.33	1.94	77.3	9.8
F13.000	30.295	0.000	0.0	11	0.0	12	0.52	1.60	28.3	0.3
F13.001	29.027	0.000	0.0	22	0.0	19	0.41	1.15	45.6	0.7
F13.002	28.652	0.000	0.0	42	0.0	21	0.72	1.94	77.3	1.3
F13.003	26.123	0.000	0.0	48	0.0	19	0.91	2.57	102.3	1.5
F14.000	24.100	0.000	0.0	8	0.0	12	0.37	1.13	20.0	0.2
F15.000	24.400	0.000	0.0	9	0.0	12	0.44	1.39	24.5	0.3
F13.004	22.744	0.000	0.0	74	0.0	38	0.52	0.94	37.2	2.3
F13.005	22.274	0.000	0.0	76	0.0	38	0.52	0.94	37.2	2.4
F16.000	22.900	0.000	0.0	2	0.0	6	0.24	1.13	20.0	0.1
F13.006	22.202	0.000	0.0	78	0.0	25	0.98	2.30	91.5	2.4
F13.007	20.829	0.000	0.0	78	0.0	27	0.89	2.00	79.6	2.4
F1.016	20.128	0.000	0.0	401	0.0	62	1.40	1.89	75.2	12.4
F1.017	18.206	0.000	0.0	407	0.0	62	1.40	1.89	75.2	12.6

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.018	6.120	0.153	40.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.019	7.616	0.038	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F17.000	47.776	1.363	35.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F17.001	59.680	0.398	150.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F17.002	11.074	0.074	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F17.003	28.947	0.193	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F17.004	63.240	0.316	200.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F17.005	12.223	0.204	60.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F17.006	16.572	0.276	60.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F18.000	49.909	0.832	60.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F19.000	87.942	0.879	100.0	0.000	18	0.0	1.500	o	150	Pipe/Conduit	
F18.001	69.695	1.742	40.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F17.007	38.903	0.195	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F20.000	72.639	1.211	60.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F20.001	44.595	0.557	80.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.018	16.849	0.000	0.0	407	0.0	64	1.36	1.82	72.3	12.6
F1.019	16.696	0.000	0.0	407	0.0	98	0.76	0.81	32.2	12.6
F17.000	32.900	0.000	0.0	8	0.0	11	0.45	1.48	26.2	0.2
F17.001	31.537	0.000	0.0	16	0.0	21	0.34	0.71	12.6	0.5
F17.002	31.139	0.000	0.0	16	0.0	21	0.34	0.71	12.6	0.5
F17.003	31.065	0.000	0.0	16	0.0	21	0.34	0.71	12.6	0.5
F17.004	30.797	0.000	0.0	27	0.0	25	0.34	0.81	32.2	0.8
F17.005	30.481	0.000	0.0	30	0.0	20	0.54	1.48	59.0	0.9
F17.006	30.277	0.000	0.0	32	0.0	21	0.55	1.48	59.0	1.0
F18.000	31.600	0.000	0.0	8	0.0	12	0.37	1.13	20.0	0.2
F19.000	32.075	0.000	0.0	18	0.0	20	0.41	0.88	15.5	0.6
F18.001	30.693	0.000	0.0	34	0.0	19	0.64	1.82	72.3	1.1
F17.007	28.951	0.000	0.0	66	0.0	39	0.45	0.81	32.2	2.0
F20.000	31.520	0.000	0.0	8	0.0	12	0.37	1.13	20.0	0.2
F20.001	30.309	0.000	0.0	16	0.0	18	0.42	0.98	17.3	0.5

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F17.008	65.407	0.327	200.0	0.000	17	0.0	1.500	o	225	Pipe/Conduit	
F17.009	33.602	0.168	200.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F17.010	84.705	3.388	25.0	0.000	27	0.0	1.500	o	225	Pipe/Conduit	
F17.011	15.551	0.622	25.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F21.000	54.399	1.813	30.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F21.001	27.520	1.101	25.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F21.002	56.087	1.602	35.0	0.000	16	0.0	1.500	o	225	Pipe/Conduit	
F21.003	29.503	0.148	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F22.000	18.336	0.306	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F23.000	16.734	0.279	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F23.001	14.889	0.248	60.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	
F24.000	26.400	0.440	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F23.002	11.954	0.080	150.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F23.003	50.416	0.336	150.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F22.001	40.356	0.202	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F17.008	28.756	0.000	0.0	99	0.0	47	0.51	0.81	32.2	3.1
F17.009	28.429	0.000	0.0	106	0.0	49	0.52	0.81	32.2	3.3
F17.010	28.261	0.000	0.0	133	0.0	33	1.16	2.30	91.5	4.1
F17.011	24.873	0.000	0.0	133	0.0	33	1.16	2.30	91.5	4.1
F21.000	30.300	0.000	0.0	8	0.0	10	0.47	1.60	28.3	0.2
F21.001	28.487	0.000	0.0	12	0.0	12	0.57	1.76	31.1	0.4
F21.002	27.311	0.000	0.0	28	0.0	17	0.63	1.94	77.3	0.9
F21.003	25.708	0.000	0.0	28	0.0	26	0.35	0.81	32.2	0.9
F22.000	28.000	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F23.000	28.800	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F23.001	28.521	0.000	0.0	7	0.0	11	0.36	1.13	20.0	0.2
F24.000	28.400	0.000	0.0	4	0.0	9	0.30	1.13	20.0	0.1
F23.002	27.960	0.000	0.0	11	0.0	17	0.30	0.71	12.6	0.3
F23.003	27.880	0.000	0.0	19	0.0	22	0.36	0.71	12.6	0.6
F22.001	27.469	0.000	0.0	23	0.0	23	0.32	0.81	32.2	0.7

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F21.004	61.027	0.305	200.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F21.005	35.897	0.179	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F21.006	54.116	0.271	200.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F21.007	54.810	0.365	150.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F21.008	26.523	0.442	60.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F17.012	44.720	0.745	60.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F17.013	62.197	1.555	40.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F17.014	15.662	0.522	30.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F17.015	33.996	1.133	30.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F17.016	25.899	0.863	30.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F25.000	59.120	0.985	60.0	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
F25.001	59.120	0.985	60.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F25.002	23.014	0.384	60.0	0.000	2	0.0	1.500	o	150	Pipe/Conduit	
F25.003	44.857	1.282	35.0	0.000	4	0.0	1.500	o	150	Pipe/Conduit	
F25.004	67.734	0.339	200.0	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F25.005	76.352	0.382	200.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F17.017	10.116	0.422	24.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F17.018	22.321	0.446	50.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F21.004	25.561	0.000	0.0	58	0.0	36	0.43	0.81	32.2	1.8
F21.005	25.256	0.000	0.0	58	0.0	36	0.43	0.81	32.2	1.8
F21.006	25.076	0.000	0.0	64	0.0	38	0.45	0.81	32.2	2.0
F21.007	24.805	0.000	0.0	71	0.0	37	0.51	0.94	37.2	2.2
F21.008	24.440	0.000	0.0	74	0.0	30	0.71	1.48	59.0	2.3
F17.012	23.998	0.000	0.0	207	0.0	50	0.97	1.48	59.0	6.4
F17.013	23.253	0.000	0.0	211	0.0	46	1.13	1.82	72.3	6.5
F17.014	21.698	0.000	0.0	213	0.0	43	1.25	2.10	83.5	6.6
F17.015	21.176	0.000	0.0	224	0.0	44	1.27	2.10	83.5	6.9
F17.016	20.043	0.000	0.0	224	0.0	44	1.27	2.10	83.5	6.9
F25.000	23.300	0.000	0.0	8	0.0	12	0.37	1.13	20.0	0.2
F25.001	22.315	0.000	0.0	12	0.0	14	0.42	1.13	20.0	0.4
F25.002	21.330	0.000	0.0	14	0.0	16	0.45	1.13	20.0	0.4
F25.003	20.946	0.000	0.0	18	0.0	15	0.58	1.48	26.2	0.6
F25.004	19.589	0.000	0.0	23	0.0	23	0.32	0.81	32.2	0.7
F25.005	19.251	0.000	0.0	30	0.0	27	0.35	0.81	32.2	0.9
F17.017	18.869	0.000	0.0	254	0.0	44	1.42	2.35	93.4	7.9
F17.018	18.448	0.000	0.0	254	0.0	53	1.10	1.63	64.6	7.9

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.020	7.908	0.079	100.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.020	16.658	0.000	0.0	661	0.0	106	1.12	1.15	45.6	20.4

Manhole Schedules for Foul - Main

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)
F1	35.200	1.400	Open Manhole	1200	F1.000	33.800	150				
F2	36.000	2.532	Open Manhole	1200	F1.001	33.468	150	F1.000	33.468	150	
F3	35.900	2.481	Open Manhole	1200	F1.002	33.419	150	F1.001	33.419	150	
F4	35.350	2.021	Open Manhole	1200	F1.003	33.329	150	F1.002	33.329	150	
F5	36.400	1.820	Open Manhole	1200	F2.000	34.580	150				
F6	35.700	1.775	Open Manhole	1200	F2.001	33.925	150	F2.000	33.925	150	
F7	35.000	1.957	Open Manhole	1200	F1.004	33.043	225	F1.003	33.122	150	4
								F2.001	33.118	150	
F8	34.800	1.900	Open Manhole	1200	F3.000	32.900	150				
F9	34.150	1.792	Open Manhole	1200	F3.001	32.358	225	F3.000	32.433	150	
F10	33.750	2.161	Open Manhole	1200	F1.005	31.589	225	F1.004	31.992	225	403
								F3.001	31.589	225	
F11	33.300	2.137	Open Manhole	1200	F1.006	31.163	225	F1.005	31.163	225	
F12	33.350	1.750	Open Manhole	1200	F4.000	31.600	150				
F13	33.350	1.350	Open Manhole	1200	F5.000	32.000	150				
F14	33.050	1.842	Open Manhole	1200	F5.001	31.208	150	F5.000	31.208	150	
F15	32.500	1.896	Open Manhole	1200	F5.002	30.604	225	F5.001	30.679	150	
F16	32.950	2.757	Open Manhole	1200	F4.001	30.193	225	F4.000	30.879	150	612
								F5.002	30.193	225	
F17	32.800	2.720	Open Manhole	1200	F1.007	30.080	225	F1.006	30.906	225	826
								F4.001	30.080	225	
F18	32.200	1.700	Open Manhole	1200	F6.000	30.500	150				
F19	31.950	2.222	Open Manhole	1200	F6.001	29.728	150	F6.000	29.728	150	
F20	31.800	2.533	Open Manhole	1200	F1.008	29.267	225	F1.007	29.758	225	491
								F6.001	29.342	150	
F21	30.050	1.400	Open Manhole	1200	F7.000	28.650	150				
F22	29.900	1.565	Open Manhole	1200	F8.000	28.335	150				
F23	30.200	2.498	Open Manhole	1200	F8.001	27.702	150	F8.000	27.702	150	
F24	30.450	2.872	Open Manhole	1200	F7.001	27.578	150	F7.000	27.860	150	282
								F8.001	27.578	150	
F25	30.450	3.041	Open Manhole	1200	F1.009	27.409	225	F1.008	28.251	225	842
								F7.001	27.484	150	
F26	29.850	2.543	Open Manhole	1200	F1.010	27.307	225	F1.009	27.307	225	
F27	26.550	1.300	Open Manhole	1200	F9.000	25.250	225				
F28	27.550	2.876	Open Manhole	1200	F1.011	24.674	225	F1.010	25.204	225	529
								F9.000	24.674	225	
F29	25.150	1.050	Open Manhole	1200	F10.000	24.100	150				
F30	24.850	1.165	Open Manhole	1200	F10.001	23.685	225	F10.000	23.760	150	

Manhole Schedules for Foul - Main

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)
F31	25.850	2.504	Open Manhole	1200	F1.012	23.346	225	F1.011	23.631	225	285
								F10.001	23.346	225	
F32	24.900	1.500	Open Manhole	1200	F11.000	23.400	150				
F33	24.650	1.678	Open Manhole	1200	F11.001	22.972	225	F11.000	23.047	150	
F34	25.750	1.350	Open Manhole	1200	F12.000	24.400	150				
F35	25.400	2.750	Open Manhole	1200	F11.002	22.650	225	F11.001	22.650	225	
								F12.000	23.461	150	736
F36	25.100	3.174	Open Manhole	1200	F1.013	21.926	225	F1.012	23.043	225	1117
								F11.002	21.926	225	
F37	24.200	2.631	Open Manhole	1200	F1.014	21.569	225	F1.013	21.569	225	
F38	23.500	2.627	Open Manhole	1200	F1.015	20.873	225	F1.014	20.873	225	
F39	31.700	1.405	Open Manhole	1200	F13.000	30.295	150				
F40	31.350	2.323	Open Manhole	1200	F13.001	29.027	225	F13.000	29.102	150	
F41	30.900	2.249	Open Manhole	1200	F13.002	28.652	225	F13.001	28.652	225	
F42	27.900	1.777	Open Manhole	1200	F13.003	26.123	225	F13.002	26.123	225	
F43	25.450	1.350	Open Manhole	1200	F14.000	24.100	150				
F44	25.800	1.400	Open Manhole	1200	F15.000	24.400	150				
F45	25.100	2.356	Open Manhole	1200	F13.004	22.744	225	F13.003	23.602	225	858
								F14.000	23.294	150	475
								F15.000	22.819	150	
F46	24.400	2.126	Open Manhole	1200	F13.005	22.274	225	F13.004	22.274	225	
F47	24.300	1.400	Open Manhole	1200	F16.000	22.900	150				
F48	24.200	1.998	Open Manhole	1200	F13.006	22.202	225	F13.005	22.202	225	
								F16.000	22.569	150	292
F49	23.250	2.421	Open Manhole	1200	F13.007	20.829	225	F13.006	20.829	225	
F50	22.400	2.272	Open Manhole	1200	F1.016	20.128	225	F1.015	20.171	225	43
								F13.007	20.128	225	
F51	20.200	1.994	Open Manhole	1200	F1.017	18.206	225	F1.016	18.206	225	
F52	18.750	1.901	Open Manhole	1200	F1.018	16.849	225	F1.017	16.849	225	
F53	19.500	2.804	Open Manhole	1200	F1.019	16.696	225	F1.018	16.696	225	
F54	34.300	1.400	Open Manhole	1200	F17.000	32.900	150				
F55	33.650	2.113	Open Manhole	1200	F17.001	31.537	150	F17.000	31.537	150	
F56	32.950	1.811	Open Manhole	1200	F17.002	31.139	150	F17.001	31.139	150	
F57	32.800	1.735	Open Manhole	1200	F17.003	31.065	150	F17.002	31.065	150	
F58	32.750	1.953	Open Manhole	1200	F17.004	30.797	225	F17.003	30.872	150	
F59	32.110	1.629	Open Manhole	1200	F17.005	30.481	225	F17.004	30.481	225	
F60	31.900	1.623	Open Manhole	1200	F17.006	30.277	225	F17.005	30.277	225	
F61	33.230	1.630	Open Manhole	1200	F18.000	31.600	150				

Manhole Schedules for Foul - Main

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)
F62	33.500	1.425	Open Manhole	1200	F19.000	32.075	150				
F63	32.850	2.157	Open Manhole	1200	F18.001	30.693	225	F18.000	30.768	150	
								F19.000	31.196	150	427
F64	31.450	2.499	Open Manhole	1200	F17.007	28.951	225	F17.006	30.001	225	1050
								F18.001	28.951	225	
F65	32.870	1.350	Open Manhole	1200	F20.000	31.520	150				
F66	31.850	1.541	Open Manhole	1200	F20.001	30.309	150	F20.000	30.309	150	
F67	31.150	2.394	Open Manhole	1200	F17.008	28.756	225	F17.007	28.756	225	
								F20.001	29.752	150	921
F68	30.700	2.271	Open Manhole	1200	F17.009	28.429	225	F17.008	28.429	225	
F69	30.610	2.349	Open Manhole	1200	F17.010	28.261	225	F17.009	28.261	225	
F70	26.320	1.447	Open Manhole	1200	F17.011	24.873	225	F17.010	24.873	225	
F71	31.800	1.500	Open Manhole	1200	F21.000	30.300	150				
F72	29.850	1.363	Open Manhole	1200	F21.001	28.487	150	F21.000	28.487	150	
F73	29.000	1.689	Open Manhole	1200	F21.002	27.311	225	F21.001	27.386	150	
F74	27.150	1.442	Open Manhole	1200	F21.003	25.708	225	F21.002	25.708	225	
F75	29.400	1.400	Open Manhole	1200	F22.000	28.000	150				
F76	30.200	1.400	Open Manhole	1200	F23.000	28.800	150				
F77	30.050	1.529	Open Manhole	1200	F23.001	28.521	150	F23.000	28.521	150	
F78	29.500	1.100	Open Manhole	1200	F24.000	28.400	150				
F79	29.900	1.940	Open Manhole	1200	F23.002	27.960	150	F23.001	28.273	150	313
								F24.000	27.960	150	
F80	29.850	1.970	Open Manhole	1200	F23.003	27.880	150	F23.002	27.880	150	
F81	29.870	2.401	Open Manhole	1200	F22.001	27.469	225	F22.000	27.694	150	150
								F23.003	27.544	150	
F82	29.150	3.589	Open Manhole	1200	F21.004	25.561	225	F21.003	25.561	225	
								F22.001	27.267	225	1707
F83	27.800	2.544	Open Manhole	1200	F21.005	25.256	225	F21.004	25.256	225	
F84	28.150	3.074	Open Manhole	1200	F21.006	25.076	225	F21.005	25.076	225	
F85	28.350	3.545	Open Manhole	1200	F21.007	24.805	225	F21.006	24.805	225	
F86	27.150	2.710	Open Manhole	1200	F21.008	24.440	225	F21.007	24.440	225	
F87	26.000	2.002	Open Manhole	1200	F17.012	23.998	225	F17.011	24.251	225	253
								F21.008	23.998	225	
F88	25.000	1.747	Open Manhole	1200	F17.013	23.253	225	F17.012	23.253	225	
F89	23.500	1.802	Open Manhole	1200	F17.014	21.698	225	F17.013	21.698	225	
F90	23.000	1.824	Open Manhole	1200	F17.015	21.176	225	F17.014	21.176	225	
F91	21.900	1.857	Open Manhole	1200	F17.016	20.043	225	F17.015	20.043	225	
F92	24.840	1.540	Open Manhole	1200	F25.000	23.300	150				

Manhole Schedules for Foul - Main

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)
F93	23.900	1.585	Open Manhole	1200	F25.001	22.315	150	F25.000	22.315	150	
F94	22.950	1.620	Open Manhole	1200	F25.002	21.330	150	F25.001	21.330	150	
F95	22.350	1.404	Open Manhole	1200	F25.003	20.946	150	F25.002	20.946	150	
F96	21.000	1.411	Open Manhole	1200	F25.004	19.589	225	F25.003	19.664	150	
F97	22.800	3.549	Open Manhole	1200	F25.005	19.251	225	F25.004	19.251	225	
F98	21.000	2.131	Open Manhole	1200	F17.017	18.869	225	F17.016	19.179	225	310
								F25.005	18.869	225	
F99	20.500	2.052	Open Manhole	1200	F17.018	18.448	225	F17.017	18.448	225	
F100	19.500	2.842	Open Manhole	1200	F1.020	16.658	225	F1.019	16.658	225	
								F17.018	18.001	225	1343
F	18.500	1.921	Open Manhole	0		OUTFALL		F1.020	16.579	225	

PIPELINE SCHEDULES for Foul - Main

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	150	F1	35.200	33.800	1.250	Open Manhole	1200
F1.001	o	150	F2	36.000	33.468	2.382	Open Manhole	1200
F1.002	o	150	F3	35.900	33.419	2.331	Open Manhole	1200
F1.003	o	150	F4	35.350	33.329	1.871	Open Manhole	1200
F2.000	o	150	F5	36.400	34.580	1.670	Open Manhole	1200
F2.001	o	150	F6	35.700	33.925	1.625	Open Manhole	1200
F1.004	o	225	F7	35.000	33.043	1.732	Open Manhole	1200
F3.000	o	150	F8	34.800	32.900	1.750	Open Manhole	1200
F3.001	o	225	F9	34.150	32.358	1.567	Open Manhole	1200
F1.005	o	225	F10	33.750	31.589	1.936	Open Manhole	1200
F1.006	o	225	F11	33.300	31.163	1.912	Open Manhole	1200
F4.000	o	150	F12	33.350	31.600	1.600	Open Manhole	1200
F5.000	o	150	F13	33.350	32.000	1.200	Open Manhole	1200
F5.001	o	150	F14	33.050	31.208	1.692	Open Manhole	1200
F5.002	o	225	F15	32.500	30.604	1.671	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	49.868	150.0	F2	36.000	33.468	2.382	Open Manhole	1200
F1.001	7.356	150.0	F3	35.900	33.419	2.331	Open Manhole	1200
F1.002	13.386	150.0	F4	35.350	33.329	1.871	Open Manhole	1200
F1.003	31.158	150.0	F7	35.000	33.122	1.728	Open Manhole	1200
F2.000	39.314	60.0	F6	35.700	33.925	1.625	Open Manhole	1200
F2.001	48.408	60.0	F7	35.000	33.118	1.732	Open Manhole	1200
F1.004	63.069	60.0	F10	33.750	31.992	1.533	Open Manhole	1200
F3.000	46.685	100.0	F9	34.150	32.433	1.567	Open Manhole	1200
F3.001	46.178	60.0	F10	33.750	31.589	1.936	Open Manhole	1200
F1.005	63.869	150.0	F11	33.300	31.163	1.912	Open Manhole	1200
F1.006	51.380	200.0	F17	32.800	30.906	1.669	Open Manhole	1200
F4.000	43.233	60.0	F16	32.950	30.879	1.921	Open Manhole	1200
F5.000	47.524	60.0	F14	33.050	31.208	1.692	Open Manhole	1200
F5.001	52.869	100.0	F15	32.500	30.679	1.671	Open Manhole	1200
F5.002	61.729	150.0	F16	32.950	30.193	2.532	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F4.001	o	225	F16	32.950	30.193	2.532	Open Manhole	1200
F1.007	o	225	F17	32.800	30.080	2.495	Open Manhole	1200
F6.000	o	150	F18	32.200	30.500	1.550	Open Manhole	1200
F6.001	o	150	F19	31.950	29.728	2.072	Open Manhole	1200
F1.008	o	225	F20	31.800	29.267	2.308	Open Manhole	1200
F7.000	o	150	F21	30.050	28.650	1.250	Open Manhole	1200
F8.000	o	150	F22	29.900	28.335	1.415	Open Manhole	1200
F8.001	o	150	F23	30.200	27.702	2.348	Open Manhole	1200
F7.001	o	150	F24	30.450	27.578	2.722	Open Manhole	1200
F1.009	o	225	F25	30.450	27.409	2.816	Open Manhole	1200
F1.010	o	225	F26	29.850	27.307	2.318	Open Manhole	1200
F9.000	o	225	F27	26.550	25.250	1.075	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)
F4.001	22.624	200.0	F17	32.800	30.080	2.495	Open Manhole	1200
F1.007	64.312	200.0	F20	31.800	29.758	1.817	Open Manhole	1200
F6.000	38.594	50.0	F19	31.950	29.728	2.072	Open Manhole	1200
F6.001	38.594	100.0	F20	31.800	29.342	2.308	Open Manhole	1200
F1.008	60.987	60.0	F25	30.450	28.251	1.974	Open Manhole	1200
F7.000	47.382	60.0	F24	30.450	27.860	2.440	Open Manhole	1200
F8.000	37.977	60.0	F23	30.200	27.702	2.348	Open Manhole	1200
F8.001	18.604	150.0	F24	30.450	27.578	2.722	Open Manhole	1200
F7.001	14.100	150.0	F25	30.450	27.484	2.816	Open Manhole	1200
F1.009	20.356	200.0	F26	29.850	27.307	2.318	Open Manhole	1200
F1.010	63.099	30.0	F28	27.550	25.204	2.121	Open Manhole	1200
F9.000	86.330	150.0	F28	27.550	24.674	2.651	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F1.011	o	225	F28	27.550	24.674	2.651	Open Manhole	1200
F10.000	o	150	F29	25.150	24.100	0.900	Open Manhole	1200
F10.001	o	225	F30	24.850	23.685	0.940	Open Manhole	1200
F1.012	o	225	F31	25.850	23.346	2.279	Open Manhole	1200
F11.000	o	150	F32	24.900	23.400	1.350	Open Manhole	1200
F11.001	o	225	F33	24.650	22.972	1.453	Open Manhole	1200
F12.000	o	150	F34	25.750	24.400	1.200	Open Manhole	1200
F11.002	o	225	F35	25.400	22.650	2.525	Open Manhole	1200
F1.013	o	225	F36	25.100	21.926	2.949	Open Manhole	1200
F1.014	o	225	F37	24.200	21.569	2.406	Open Manhole	1200
F1.015	o	225	F38	23.500	20.873	2.402	Open Manhole	1200
F13.000	o	150	F39	31.700	30.295	1.255	Open Manhole	1200
F13.001	o	225	F40	31.350	29.027	2.098	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)
F1.011	62.612	60.0	F31	25.850	23.631	1.994	Open Manhole	1200
F10.000	50.931	150.0	F30	24.850	23.760	0.940	Open Manhole	1200
F10.001	50.931	150.0	F31	25.850	23.346	2.279	Open Manhole	1200
F1.012	60.600	200.0	F36	25.100	23.043	1.832	Open Manhole	1200
F11.000	35.269	100.0	F33	24.650	23.047	1.453	Open Manhole	1200
F11.001	48.325	150.0	F35	25.400	22.650	2.525	Open Manhole	1200
F12.000	56.311	60.0	F35	25.400	23.461	1.789	Open Manhole	1200
F11.002	43.442	60.0	F36	25.100	21.926	2.949	Open Manhole	1200
F1.013	53.549	150.0	F37	24.200	21.569	2.406	Open Manhole	1200
F1.014	24.351	35.0	F38	23.500	20.873	2.402	Open Manhole	1200
F1.015	24.588	35.0	F50	22.400	20.171	2.004	Open Manhole	1200
F13.000	35.790	30.0	F40	31.350	29.102	2.098	Open Manhole	1200
F13.001	37.550	100.0	F41	30.900	28.652	2.024	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F13.002	o	225	F41	30.900	28.652	2.024	Open Manhole	1200
F13.003	o	225	F42	27.900	26.123	1.552	Open Manhole	1200
F14.000	o	150	F43	25.450	24.100	1.200	Open Manhole	1200
F15.000	o	150	F44	25.800	24.400	1.250	Open Manhole	1200
F13.004	o	225	F45	25.100	22.744	2.131	Open Manhole	1200
F13.005	o	225	F46	24.400	22.274	1.901	Open Manhole	1200
F16.000	o	150	F47	24.300	22.900	1.250	Open Manhole	1200
F13.006	o	225	F48	24.200	22.202	1.773	Open Manhole	1200
F13.007	o	225	F49	23.250	20.829	2.196	Open Manhole	1200
F1.016	o	225	F50	22.400	20.128	2.047	Open Manhole	1200
F1.017	o	225	F51	20.200	18.206	1.769	Open Manhole	1200
F1.018	o	225	F52	18.750	16.849	1.676	Open Manhole	1200
F1.019	o	225	F53	19.500	16.696	2.579	Open Manhole	1200
F17.000	o	150	F54	34.300	32.900	1.250	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)
F13.002	88.570	35.0	F42	27.900	26.123	1.552	Open Manhole	1200
F13.003	50.417	20.0	F45	25.100	23.602	1.273	Open Manhole	1200
F14.000	48.382	60.0	F45	25.100	23.294	1.656	Open Manhole	1200
F15.000	63.235	40.0	F45	25.100	22.819	2.131	Open Manhole	1200
F13.004	70.576	150.0	F46	24.400	22.274	1.901	Open Manhole	1200
F13.005	10.683	150.0	F48	24.200	22.202	1.773	Open Manhole	1200
F16.000	19.839	60.0	F48	24.200	22.569	1.481	Open Manhole	1200
F13.006	34.337	25.0	F49	23.250	20.829	2.196	Open Manhole	1200
F13.007	23.143	33.0	F50	22.400	20.128	2.047	Open Manhole	1200
F1.016	71.117	37.0	F51	20.200	18.206	1.769	Open Manhole	1200
F1.017	50.198	37.0	F52	18.750	16.849	1.676	Open Manhole	1200
F1.018	6.120	40.0	F53	19.500	16.696	2.579	Open Manhole	1200
F1.019	7.616	200.0	F100	19.500	16.658	2.617	Open Manhole	1200
F17.000	47.776	35.0	F55	33.650	31.537	1.963	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F17.001	o	150	F55	33.650	31.537	1.963	Open Manhole	1200
F17.002	o	150	F56	32.950	31.139	1.661	Open Manhole	1200
F17.003	o	150	F57	32.800	31.065	1.585	Open Manhole	1200
F17.004	o	225	F58	32.750	30.797	1.728	Open Manhole	1200
F17.005	o	225	F59	32.110	30.481	1.404	Open Manhole	1200
F17.006	o	225	F60	31.900	30.277	1.398	Open Manhole	1200
F18.000	o	150	F61	33.230	31.600	1.480	Open Manhole	1200
F19.000	o	150	F62	33.500	32.075	1.275	Open Manhole	1200
F18.001	o	225	F63	32.850	30.693	1.932	Open Manhole	1200
F17.007	o	225	F64	31.450	28.951	2.274	Open Manhole	1200
F20.000	o	150	F65	32.870	31.520	1.200	Open Manhole	1200
F20.001	o	150	F66	31.850	30.309	1.391	Open Manhole	1200
F17.008	o	225	F67	31.150	28.756	2.169	Open Manhole	1200
F17.009	o	225	F68	30.700	28.429	2.046	Open Manhole	1200
F17.010	o	225	F69	30.610	28.261	2.124	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)
F17.001	59.680	150.0	F56	32.950	31.139	1.661	Open Manhole	1200
F17.002	11.074	150.0	F57	32.800	31.065	1.585	Open Manhole	1200
F17.003	28.947	150.0	F58	32.750	30.872	1.728	Open Manhole	1200
F17.004	63.240	200.0	F59	32.110	30.481	1.404	Open Manhole	1200
F17.005	12.223	60.0	F60	31.900	30.277	1.398	Open Manhole	1200
F17.006	16.572	60.0	F64	31.450	30.001	1.224	Open Manhole	1200
F18.000	49.909	60.0	F63	32.850	30.768	1.932	Open Manhole	1200
F19.000	87.942	100.0	F63	32.850	31.196	1.504	Open Manhole	1200
F18.001	69.695	40.0	F64	31.450	28.951	2.274	Open Manhole	1200
F17.007	38.903	200.0	F67	31.150	28.756	2.169	Open Manhole	1200
F20.000	72.639	60.0	F66	31.850	30.309	1.391	Open Manhole	1200
F20.001	44.595	80.0	F67	31.150	29.752	1.248	Open Manhole	1200
F17.008	65.407	200.0	F68	30.700	28.429	2.046	Open Manhole	1200
F17.009	33.602	200.0	F69	30.610	28.261	2.124	Open Manhole	1200
F17.010	84.705	25.0	F70	26.320	24.873	1.222	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F17.011	o	225	F70	26.320	24.873	1.222	Open Manhole	1200
F21.000	o	150	F71	31.800	30.300	1.350	Open Manhole	1200
F21.001	o	150	F72	29.850	28.487	1.213	Open Manhole	1200
F21.002	o	225	F73	29.000	27.311	1.464	Open Manhole	1200
F21.003	o	225	F74	27.150	25.708	1.217	Open Manhole	1200
F22.000	o	150	F75	29.400	28.000	1.250	Open Manhole	1200
F23.000	o	150	F76	30.200	28.800	1.250	Open Manhole	1200
F23.001	o	150	F77	30.050	28.521	1.379	Open Manhole	1200
F24.000	o	150	F78	29.500	28.400	0.950	Open Manhole	1200
F23.002	o	150	F79	29.900	27.960	1.790	Open Manhole	1200
F23.003	o	150	F80	29.850	27.880	1.820	Open Manhole	1200
F22.001	o	225	F81	29.870	27.469	2.176	Open Manhole	1200
F21.004	o	225	F82	29.150	25.561	3.364	Open Manhole	1200
F21.005	o	225	F83	27.800	25.256	2.319	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)
F17.011	15.551	25.0	F87	26.000	24.251	1.524	Open Manhole	1200
F21.000	54.399	30.0	F72	29.850	28.487	1.213	Open Manhole	1200
F21.001	27.520	25.0	F73	29.000	27.386	1.464	Open Manhole	1200
F21.002	56.087	35.0	F74	27.150	25.708	1.217	Open Manhole	1200
F21.003	29.503	200.0	F82	29.150	25.561	3.364	Open Manhole	1200
F22.000	18.336	60.0	F81	29.870	27.694	2.026	Open Manhole	1200
F23.000	16.734	60.0	F77	30.050	28.521	1.379	Open Manhole	1200
F23.001	14.889	60.0	F79	29.900	28.273	1.477	Open Manhole	1200
F24.000	26.400	60.0	F79	29.900	27.960	1.790	Open Manhole	1200
F23.002	11.954	150.0	F80	29.850	27.880	1.820	Open Manhole	1200
F23.003	50.416	150.0	F81	29.870	27.544	2.176	Open Manhole	1200
F22.001	40.356	200.0	F82	29.150	27.267	1.658	Open Manhole	1200
F21.004	61.027	200.0	F83	27.800	25.256	2.319	Open Manhole	1200
F21.005	35.897	200.0	F84	28.150	25.076	2.849	Open Manhole	1200

PIPELINE SCHEDULES for Foul - Main

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)
F21.006	o	225	F84	28.150	25.076	2.849	Open Manhole	1200
F21.007	o	225	F85	28.350	24.805	3.320	Open Manhole	1200
F21.008	o	225	F86	27.150	24.440	2.485	Open Manhole	1200
F17.012	o	225	F87	26.000	23.998	1.777	Open Manhole	1200
F17.013	o	225	F88	25.000	23.253	1.522	Open Manhole	1200
F17.014	o	225	F89	23.500	21.698	1.577	Open Manhole	1200
F17.015	o	225	F90	23.000	21.176	1.599	Open Manhole	1200
F17.016	o	225	F91	21.900	20.043	1.632	Open Manhole	1200
F25.000	o	150	F92	24.840	23.300	1.390	Open Manhole	1200
F25.001	o	150	F93	23.900	22.315	1.435	Open Manhole	1200
F25.002	o	150	F94	22.950	21.330	1.470	Open Manhole	1200
F25.003	o	150	F95	22.350	20.946	1.254	Open Manhole	1200
F25.004	o	225	F96	21.000	19.589	1.186	Open Manhole	1200
F25.005	o	225	F97	22.800	19.251	3.324	Open Manhole	1200
F17.017	o	225	F98	21.000	18.869	1.906	Open Manhole	1200
F17.018	o	225	F99	20.500	18.448	1.827	Open Manhole	1200
F1.020	o	225	F100	19.500	16.658	2.617	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)
F21.006	54.116	200.0	F85	28.350	24.805	3.320	Open Manhole	1200
F21.007	54.810	150.0	F86	27.150	24.440	2.485	Open Manhole	1200
F21.008	26.523	60.0	F87	26.000	23.998	1.777	Open Manhole	1200
F17.012	44.720	60.0	F88	25.000	23.253	1.522	Open Manhole	1200
F17.013	62.197	40.0	F89	23.500	21.698	1.577	Open Manhole	1200
F17.014	15.662	30.0	F90	23.000	21.176	1.599	Open Manhole	1200
F17.015	33.996	30.0	F91	21.900	20.043	1.632	Open Manhole	1200
F17.016	25.899	30.0	F98	21.000	19.179	1.596	Open Manhole	1200
F25.000	59.120	60.0	F93	23.900	22.315	1.435	Open Manhole	1200
F25.001	59.120	60.0	F94	22.950	21.330	1.470	Open Manhole	1200
F25.002	23.014	60.0	F95	22.350	20.946	1.254	Open Manhole	1200
F25.003	44.857	35.0	F96	21.000	19.664	1.186	Open Manhole	1200
F25.004	67.734	200.0	F97	22.800	19.251	3.324	Open Manhole	1200
F25.005	76.352	200.0	F98	21.000	18.869	1.906	Open Manhole	1200
F17.017	10.116	24.0	F99	20.500	18.448	1.827	Open Manhole	1200
F17.018	22.321	50.0	F100	19.500	18.001	1.274	Open Manhole	1200
F1.020	7.908	100.0	F	18.500	16.579	1.696	Open Manhole	0

D. Site Investigation

PRELIMINARY DRAFT REPORT

RATHMULLAN DROGHEDA
PROPOSED HOUSING
CLARD DEVELOPMENTS

WATERMAN MOYLAN
CONSULTING ENGINEERS

CONTENTS

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APPENDICES

I	**BOREHOLE LOGS**
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FOREWORD

The following Conditions and Notes on Site Investigation Procedures should be read in conjunction with this report.

General.

Recommendations made, and opinions expressed in the report are based on the strata observed in the exploratory holes, together with the results of in-situ and laboratory tests. No responsibility can be held for conditions which have not been revealed by exploratory work, or which occur between exploratory hole locations. Whilst the report may suggest the likely configuration of strata, both between exploratory hole locations, or below the maximum depth of the investigation, this is only indicative, and liability cannot be accepted for its accuracy.

Unless specifically stated, no account has been taken of possible subsidence due to mineral extraction below or close to the site.

Boring Procedures.

Unless otherwise stated, the 'Shell and Auger' technique of soft ground boring has been employed. All boring operations sampling and/or logging of soils and in-situ testing complies with the recommendations of the British Standard Code of Practice BS 5930 (1981), 'Site Investigation' and BS 1377:1990, 'Methods of test for soils for civil engineering purposes'.

Whilst the technique allows the maximum data to be obtained in soft ground, some disturbance and variation of soft and layered soils is unavoidable. Attention is drawn to this condition, whenever it is suspected. Where cobbles and boulders are recorded, no conclusion should be drawn concerning the size, presence, lithological nature, or numbers per unit volume of ground.

Where peat has been encountered during siteworks, samples have been logged in accordance with the Von Post Classification (ref. Von Post, L. 1992. Sveriges Gologiska Undersoknings torvinventering och nogra av dess hittils vunna resultat (SGU peat inventory and some preliminary results) Svenska Mosskulturforeningens Tidskrift, Jonkoping, Swedden, 36, 1-37 & Hobbs N. B. Mire morphology and the properties of some British and foreign peats. QJEG, Vol. 19, 1986).

Routine Sampling.

Undisturbed samples of soils, predominantly cohesive in nature are obtained unless otherwise stated by a 104mm diameter open-drive tube sampler. In granular soils, and where undisturbed sampling is inappropriate, disturbed samples are collected. Smaller disturbed samples are also recovered at intervals to allow a visual examination of the full strata section.

In-Situ Testing.

Standard penetration tests, utilising either the standard split spoon sampler or solid cone and automatic trip-hammer are conducted unless otherwise where required by instruction. Subsequent to a seating drive of 150mm, a summation for the number of blows for 300mm penetration is recorded on the boring records together with the blow count for each 75mm penetration. In cases where incomplete penetration is obtained, the number of blows for the recorded value of penetration are noted. In coarse granular soils, a cone end is fitted to the sampler and a similar procedure adopted.

Groundwater.

The depth of entry of any influx of groundwater is recorded during the course of boring operations. However, the normal rate of boring does not usually permit the recording of an equilibrium level for any one water strike. Where possible drilling is suspended for a period of twenty minutes to monitor the subsequent rise in water level.

Groundwater conditions observed in the borings or pits are those appertaining to the period of investigation. It should be noted however, that groundwater levels are subject to diurnal, seasonal and climatic variations and can also be affected by drainage condition, tidal variation or other causes.

Retention of Samples.

After satisfactory completion of all the scheduled laboratory tests on any sample, the remaining material is discarded unless a period of retention of samples is agreed, it is our normal practice to discard all soil samples one month after submission of our final report.

REPORT ON A SITE INVESTIGATION
FOR A HOUSING DEVELOPMENT
AT WEST DROGHEDA
COUNTY MEATH

FOR
CLARD DEVELOPMENTS LTD

WATERMAN MOYLAN
CONSULTING ENGINEERS

Report No. 21345 **NOVEMBER 2018**

I Introduction

A new housing development is proposed for a greenfield site located at Rathmullan, Drogheda West.

An investigation of sub soil conditions in the area of development has been ordered by Waterman Moylan, Consulting Engineers on behalf of Clard Developments Ltd.

The programme of the investigation included the construction of Boreholes, Trial Pits and Dynamic Probes to establish criteria on which to base foundation and infra-structural design. Work was carried out in accordance with BS 5930, Code of Practice for Site Investigations (1999).

In addition percolation testing to BRE Digest 365 was scheduled and carried out at several locations to establish soil percolation characteristics.

A programme of laboratory testing to confirm geotechnical and environmental soil parameters followed site operations.

This report includes all factual data pertaining to the project and comments on the findings relative to the new development.

II Fieldwork

The proposed development is to be undertaken on existing farm land located at Rathmullan, Drogheda West. The development area is bounded by the M1 Motorway to the West, The River Boyne to the North and The Riverbank Housing Estate to the East. The location is shown on the site map in Appendix VI. This drawing also shows the location of the various exploratory positions.

The field investigation included the following elements.

- Cable Percussion Boreholes at five locations
- Machine Excavated Trial Pits at five locations
- HD Dynamic Probes at five locations
- BRE Digest 365 Percolation Tests at five locations

The various locations have been referenced to national grid and OD levels established. Photographs of all excavations are included with this report in the relevant appendices.

Boreholes

Five exploratory holes were scheduled and bored with conventional 200mm cable-tool methods using a Dando Exploratory Rig. Each location was electronically scanned and shallow trial pits were opened to ensure that existing services were not damaged. One additional hole (BH02A) was bored when shallow refusal was recorded in the original location.

Detailed geotechnical records are contained in Appendix I to this report - the records give details of stratification, sampling, in-situ testing and groundwater. Note is also taken of any obstructions to normal boring requiring the use of the heavy chisel for advancement. In general it was not possible to recover undisturbed samples because of the high stone/cobble content of the strata encountered.

The boreholes consistently identified surface topsoil (300mm) overlying initially firm brown sandy gravelly CLAY. The gravelly CLAY stratum increases in strength to stiff and very stiff below about 1.20 metres with holes continuing to completion at depths between 5.80 and 8.50 metres. Angular and sub-angular cobbles and boulders were noted at varying depths in each borehole. The soils represent GLACIAL TILL or BOULDER CLAY deposition, typical of the region.

The final refusal depths may be indicative of boulders in the glacial clay or possibly the local bedrock horizon. Proof core drilling would be required to confirm the presence of bedrock in the area.

No water was encountered during the course of boring. Long-term ground water observation was not required.

Trial Pits

A JCB excavator was used under geotechnical engineering supervision to open trial pits at five locations.

Detailed trial pit records are presented in Appendix II. These records note stratification and ground water regime and detail sampling, obstructions and excavation stability. Photographs of each location are also included with the records.

The records confirm the borehole findings with topsoil overlying firm to stiff brown very sandy gravelly CLAY, typically containing cobble and boulder fragments. Difficulty in advancing the trial pits was noted in each location. Three pits were terminated on boulder obstructions between 1.50 and 2.00 metres BGL however TP01 continued to 2.60 metres and TP03 to 3.00 metres.

Ground water was not encountered during excavation of the trial pits. The pits were backfilled and compacted with the excavated spoil.

Dynamic Probes

Heavy Duty Probes were taken at a total of five locations each adjacent to an excavated trial pit and referenced DP01 to DP05.

Probing was in accordance with the heavy-duty probe specification of BS 1377: Part 9: 1990. In these tests, the soil resistance is measured in terms of the number of drop-hammer blows required to drive the test probe through each 100 mm increment of penetration. Probing is terminated when the blow count exceeds 25/100mm to avoid damage to the apparatus. Where loose material is present a single blow count may drive the apparatus in excess of 100mm. In this instance blow counts of zero may be recorded. Individual probe records are contained in Appendix III.

The probe graphs generally reflect a pattern of gradually increasing soil strength with penetration depth with probe refusals generally occurring between 1.20 and 3.00 metres. Isolate thin soft zones (100mm to 200mm thick) were noted at 1.70 metres BGL in DP01 and DP02.

A probe resistance of N100 = 4 with no significant underlying deterioration is indicative of an allowable bearing pressure of 100 Kpa, suitable for traditional two storey house construction.

Probe No.	**Depth to $N_{100} = 5$**	**Refusal**
DP01	0.50	2.50
DP02	1.80	3.10
DP03	0.50	1.20
DP04	0.50	1.50
DP05	0.50	1.10

Percolation Test to BRE Digest 365

Infiltration testing was performed at five locations in accordance with BRE Digest 365 'Soakaway Design'. The test pit was excavated and logged. The test material was firm to stiff brown very sandy gravelly CLAY with cobbles and boulders

To obtain a measure of the infiltration rate of the sub-soils, water is poured into the test pit, and records taken of the fall in water level against time. The test is carried out over two cycles following initial soakage.

The infiltration rate is the volume of water dispersed per unit exposed area per unit of time, and is generally expressed as metres/minute or metres/second. In these calculations the exposed area is the sum of the base area and the average internal area of the permeable stratum over the test duration. Designs are based on the slowest infiltration rate, which has been calculated from the final cycle.

In the test locations the water level dropped slowly over the test period. The design calculations are presented in Appendix IV, with the infiltration rates as follows:

SA 01	**Infiltration Rate (f)**	**0.00057 m/min**
SA02	**Infiltration Rate (f)**	**0.00068 m/min**
SA03	**Infiltration Rate (f)**	**0.00029 m/min**
SA04	**Infiltration Rate (f)**	**0.00052 m/min**
SA05	**Infiltration Rate (f)**	**0.00051 m/min**

The results are typical of low-permeability glacial till deposition.

III Testing

a. In-Situ

Standard penetration tests were carried out in each borehole at 1.00 metre intervals to establish relative soil strength. Results are presented in the right hand column of the boring records and are summarised as follows:

Stratum	**N Value Range**	**Comment**
Brown sandy gravelly CLAY		
1.00 metres BGL	10 to 18	Firm to Stiff
2.00 metres BGL	16 to 30	Stiff
3.00 metres BGL	25 to 33	Stiff to Very Stiff
4.00 metres BGL	31 to 51	Very Stiff to Hard
5.00 metres BGL	23 to 53	Stiff to Hard

b. Laboratory

All geotechnical samples from the boreholes and trial pits have been returned to the IGSL laboratory for initial visual inspection, a schedule of testing was prepared and tests carried out.

The programme of testing included the following elements and all results are presented in Appendix V. Standard geotechnical testing is carried out by IGSL in it's INAB-accredited laboratory. Chemical and environmental testing was carried out by CHEMTEST in the UK.

a. Classification (Liquid and Plastic Limits)
b. Particle size distribution (Sieve Analysis and Hydrometer)
c. Sulphate and pH determination
d. RILTA Environmental Suite

Classification and Moisture Content

Liquid and plastic limits were determined for samples of the cohesive soils from the trial pits and boreholes. Results are detailed and plotted on the standard Casagrande Classification Chart.

Particle Size Distribution

Grading curves for selected samples of the gravelly clay stratum from the boreholes were determined by wet sieve and hydrometer analysis.

Chemical (pH and Sulphate)

Four samples were submitted for chemical analysis.

RILTA Environmental Suite

Five sample were submitted for RILTA Suite (WAC) analysis.

IV Discussion

The proposed new housing development is to be undertaken on agricultural land at Rathmullan in Drogheda North.

A comprehensive investigation of sub soil conditions has been carried out for Waterman Moylan on behalf of Clard Developments Ltd.

This preliminary report is based on field findings, detailed geotechnical and environmental testing is being carried out to confirm design parameters.

The detailed findings are presented earlier in this report and these can be summarised as follows:

Boreholes indicate topsoil overlying firm brown sandy gravelly CLAY which extends to about 1.20 metres BGL. This overlies stiff to very stiff to hard brown gravelly CLAY (Brown Boulder CLAY). Boreholes were completed on refusal at depths between 5.80 and 8.50 metres. The final borehole depths are not indicative of rock horizon. No ground water was encountered.

Trial Pits confirmed this general pattern, with numerous cobble and boulder particles noted and recovered and excavation difficulty noted in several locations.

NEW HOUSE FOUNDATIONS

Standard Penetration Tests and Dynamic Probes indicate that an allowable bearing pressure of at least 125 kN/sq.m. can be taken at a depth of 1.00 metre BGL. Conventional reinforced strip or pad foundations will therefore be appropriate for this development with foundations placed 0.70 to 0.80 metres BGL.

At one probe location (DP02) a reduction in soil strength was noted between 1.60 and 1.80 metres. The overlying soils are stiff and consideration could be given to founding at 0.70 metres with a reduced bearing pressure of 75 kN/sq.m. to avoid overstressing the weaker underlying zone.

Alternatively foundations in this area could be deepened to 1.80 metres to achieve the higher allowable bearing pressure.

The sub soils increase in strength with depth and results indicate an allowable bearing pressure of 250 kN/sq.m. on the soils below 2.00 metres.

Careful visual inspection of foundation excavations is advised to ensure uniformity and suitability of the founding medium. This is particularly relevant given the variation noted at DP02.

PERCOLATION

Testing to BRE Digest 365 was carried out at five location with relatively low infiltration available in the gravelly boulder clay formation. An average infiltration rate (f) of 0.00050 metres/minute has been obtained.

ENVIRONMENTAL

CONCRETE

IGSL/JC
November 2018

Appendix I Boring Records

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	BOREHOLE NO.	BH01
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	02/11/2018
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	05/11/2018
	BOREHOLE DEPTH (m) 4.20		
CLIENT	SPT HAMMER REF. NO.	BORED BY	W.Cahill
ENGINEER Waterman Moylan	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL/subsoil			0.30						
1	Firm light brown sandy SILT/CLAY with some gravel and occasional cobbles			1.80	AA11709	B	1.00		N = 10 (2, 2, 3, 3, 2, 2)	
2	Stiff to very stiff dark brown sandy SILT/CLAY with grvael and occasional cobbles and boulders				AA11710	B	2.00		N = 21 (4, 4, 5, 5, 5, 6)	
3					AA11711	B	3.00		N = 33 (5, 5, 7, 9, 7, 10)	
4	Obstruction End of Borehole at 4.20 m			4.20	AA11712	B	4.00		N = 48/75 mm (15, 10, 48)	
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4	4.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	**BOREHOLE NO.**	**BH01A**
		SHEET	Sheet 1 of 1
CO-ORDINATES	**RIG TYPE** Dando 2000	**DATE COMMENCED**	02/11/2018
GROUND LEVEL (m AOD)	**BOREHOLE DIAMETER (mm)** 200	**DATE COMPLETED**	05/11/2018
	BOREHOLE DEPTH (m) 6.20		
CLIENT	**SPT HAMMER REF. NO.**	**BORED BY**	W.Cahill
ENGINEER Waterman Moylan	**ENERGY RATIO (%)**	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL/subsoil			0.30						
	firm light brown sandy SILT/CLAY with some gravel and occasional cobbles				AA10561	B	1.00		N = 11 (2, 3, 2, 3, 3, 3)	
1				1.80						
	Stiff to very stiff dark brown sandy SILT/CLAY with grvael and occasional cobbles and boulders				AA10562	B	2.00		N = 21 (4, 6, 4, 6, 5, 6)	
2										
					AA10563	B	3.00		N = 31 (5, 4, 5, 6, 9, 11)	
3				3.60						
	Dense grey/brown fine to coarse clayey GRAVEL with cobbles and some boulders				AA10564	B	4.00		N = 42 (6, 6, 9, 9, 10, 14)	
4				4.20						
	Very stiff dark brown SILT			4.50						
	Very stiff dark brown very gravelly SILT/CLAY with cobbbles and occasional boulders				AA10565	B	5.00		N = 41 (5, 7, 9, 9, 11, 12)	
5										
					AA10566	B	6.00		N = 50/75 mm (7, 18, 50)	
6				6.20						
	Obstruction End of Borehole at 6.20 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.5	3.7	0.75	
6	6.2	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 21345.GPJ IGSL.GDT 14/11/18

GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	BOREHOLE NO.	BH02
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	06/11/2018
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	06/11/2018
	BOREHOLE DEPTH (m) 6.50		
CLIENT	SPT HAMMER REF. NO.	BORED BY	W.Cahill
ENGINEER Waterman Moylan	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL			0.15						
	Subsoil			0.35						
	Firm to stiff light brown sandy SILT/CLAY with gravel and occasional cobbles				AA105601	B	1.00		N = 18 (2, 3, 3, 4, 6, 5)	
1										
					AA105602	B	2.00		N = 16 (3, 3, 4, 4, 4, 4)	
2				2.90						
	Very stiff to hard light brown sandy SILT/CLAY with gravel,cobbles and some boulders				AA105603	B	3.00		N = 35 (5, 6, 6, 8, 10, 11)	
3										
					AA105604	B	4.00		N = 51 (6, 9, 11, 13, 14, 13)	
4										
					AA105605	B	5.00		N = 53 (11, 13, 10, 9, 19, 15)	
5										
					AA105606	B	6.00		N = 50/75 mm (25, 50)	
6				6.50						
	Obstruction End of Borehole at 6.50 m									
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.2	4.5	0.75	
5.4	5.6	1	
6.3	6.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	BOREHOLE NO.	BH03
		SHEET	Sheet 1 of 1
CO-ORDINATES	RIG TYPE Dando 2000	DATE COMMENCED	12/11/2018
GROUND LEVEL (m AOD)	BOREHOLE DIAMETER (mm) 200	DATE COMPLETED	12/11/2018
	BOREHOLE DEPTH (m) 7.50		
CLIENT	SPT HAMMER REF. NO.	BORED BY	W.Cahill
ENGINEER Waterman Moylan	ENERGY RATIO (%)	PROCESSED BY	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL/subsoil			0.20						
1	Firm dark brown sandy SILT/CLAY with some gravel and occasional cobbles			1.60	AA105620	B	1.00		N = 15 (2, 2, 2, 3, 3, 7)	
2	Stiff light brown sandy SILT/CLAY with gravel and some cobbles and boulders				AA105621	B	2.00		N = 22 (2, 3, 4, 5, 6, 7)	
3				3.20	AA105622	B	3.00		N = 36 (4, 6, 8, 8, 9, 11)	
4	Very stiff light brown sandy SILT/CLAY with gravel and some cobbles and boulders				AA105623	B	4.00		N = 50 (7, 9, 12, 11, 12, 15)	
5					AA105624	B	5.00		N = 23 (4, 4, 4, 6, 6, 7)	
6					AA105625	B	6.00		N = 30 (5, 6, 7, 7, 8, 8)	
7				7.50	AA105626	B	7.00		N = 50/150 mm (8, 14, 16, 34)	
8	Obstruction End of Borehole at 7.50 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
4.3	4.5	0.75	
7.2	7.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	**BOREHOLE NO.**	**BH04**
		SHEET	Sheet 1 of 1
CO-ORDINATES	**RIG TYPE** Dando 2000	**DATE COMMENCED**	09/11/2018
GROUND LEVEL (m AOD)	**BOREHOLE DIAMETER (mm)** 200	**DATE COMPLETED**	09/11/2018
	BOREHOLE DEPTH (m) 8.50		
CLIENT	**SPT HAMMER REF. NO.**	**BORED BY**	W.Cahill
ENGINEER Waterman Moylan	**ENERGY RATIO (%)**	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	Soft dark brown sandy SILT/CLAY with some gravel (subsoil)			0.20						
	Firm to stiff light brown sandy SILT/CLAY with gravel and some cobbles and boulders									
1					AA105612	B	1.00		N = 17 (2, 4, 3, 5, 5, 4)	
2					AA105613	B	2.00		N = 21 (3, 2, 4, 4, 4, 9)	
3				3.30	AA105614	B	3.00		N = 25 (3, 5, 4, 5, 7, 9)	
	Very stiff brown gravelly CLAY with cobbles									
4					AA105615	B	4.00		N = 31 (6, 5, 7, 7, 9, 8)	
5				5.80	AA105616	B	5.00		N = 33 (5, 5, 5, 5, 8, 15)	
6	Stiff light brown sandy SILT/CLAY with gravel			6.80	AA105617	B	6.00		N = 24 (3, 6, 4, 5, 5, 10)	
7	Very stiff mottled light and dark brown sandy SILT/CLAY with gravel and angular cobbles				AA105618	B	7.00		N = 35 (8, 7, 9, 10, 8, 8)	
8				8.50	AA105619	B	8.00		N = 50/150 mm (8, 7, 15, 35)	
	Obstruction End of Borehole at 8.50 m									
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
5.4	5.6	0.5	
8.3	8.5	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

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GEOTECHNICAL BORING RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen,Drogheda,Co.Louth	**BOREHOLE NO.**	**BH05**
		SHEET	Sheet 1 of 1
CO-ORDINATES	**RIG TYPE** Dando 2000	**DATE COMMENCED**	07/11/2018
GROUND LEVEL (m AOD)	**BOREHOLE DIAMETER (mm)** 200	**DATE COMPLETED**	07/11/2018
	BOREHOLE DEPTH (m) 5.80		
CLIENT	**SPT HAMMER REF. NO.**	**BORED BY**	W.Cahill
ENGINEER Waterman Moylan	**ENERGY RATIO (%)**	**PROCESSED BY**	F.C

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	TOPSOIL/subsoil			0.25						
1	Firm to stiff light brown sandy SILT/CLAY with gravel,cobbles and occasional boulders			1.90	AA105607	B	1.00		N = 18 (2, 3, 3, 4, 5, 6)	
2	Very stiff dark brown sandy SILT/CLAY with gravel,cobbles and occasional boulders				AA105608	B	2.00		N = 30 (3, 4, 5, 7, 9, 9)	
3					AA105609	B	3.00		N = 50/225 mm (8, 12, 14, 15, 21)	
4					AA105610	B	4.00		N = 36 (6, 9, 9, 10, 9, 8)	
5					AA105611	B	5.00		N = 31 (2, 4, 5, 7, 7, 12)	
6	Obstruction End of Borehole at 5.80 m			5.80					N = 50/225 mm (12, 13, 16, 15, 19)	
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.1	3.3	0.75	
5.6	5.8	2	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Cat scanned location and hand dug inspection pit carried out.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 21345.GPJ IGSL.GDT 14/11/18

Appendix II Trial Pit Records

TRIAL PIT RECORD

REPORT NUMBER 21345

CONTRACT 21345	TRIAL PIT NO. TP01
	SHEET Sheet 1 of 1
LOGGED BY TOS	CO-ORDINATES
	DATE STARTED 05/11/2018
	DATE COMPLETED 05/11/2018
CLIENT	GROUND LEVEL (m)
	EXCAVATION METHOD JCB 3CX
ENGINEER Waterman Moylan	

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Firm / stiff brown sandy gravelly CLAY with medium cobble content / low boulder content. Sand is fine to coarse gravel is angular / subangular of grey limestone					AA104513	B	0.50		
1.0									
Compact very gravelly SAND with medium cobble content and medium boulder content. Sand is fine to coarse gravel is subangular / subrounded fine to coarse of grey limestone		1.30			AA104514	B	1.50		
2.0									
End of Trial Pit at 2.60m		2.60			AA104515	B	2.50		
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Good

General Remarks
Trial pit terminated at 2.6 due to refusal in Boulders

IGSL TP LOG 21345.GPJ IGSL.GDT 19/11/18

TRIAL PIT RECORD

REPORT NUMBER 21345

CONTRACT 21345	TRIAL PIT NO. TP02
	SHEET Sheet 1 of 1
LOGGED BY TOS	CO-ORDINATES
	DATE STARTED 05/11/2018
	DATE COMPLETED 05/11/2018
CLIENT	GROUND LEVEL (m)
ENGINEER Waterman Moylan	EXCAVATION METHOD JCB 3CX

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL					AA104510	B	0.20		
		0.35							
Firm / stiff orange brown slightly gravelly sandy CLAY. Sand is fine to coarse gravel is angular / subangular fine to coarse of dark grey limestone					AA104511	B	0.50		
1.0									
		1.30							
Compact BOULDERS and COBBLES with gravelly very sandy clay. Sand is fine to coarse gravel is angular / subangular fine to coarse of grey limestone					AA104512	B	1.50		
2.0									
		2.30							
End of Trial Pit at 2.30m									
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Good

General Remarks
Trial pit terminated at 2.3 due to refusal in Boulders

IGSL TP LOG 21345.GPJ IGSL.GDT 19/11/18

TRIAL PIT RECORD

REPORT NUMBER 21345

CONTRACT 21345		**TRIAL PIT NO.**	**TP03**
		SHEET	Sheet 1 of 1
LOGGED BY TOS	**CO-ORDINATES**	**DATE STARTED**	05/11/2018
		DATE COMPLETED	05/11/2018
CLIENT	**GROUND LEVEL (m)**	**EXCAVATION METHOD**	JCB 3CX
ENGINEER Waterman Moylan			

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Firm / stiff brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse gravel is subangular / subrounded fine to coarse of grey limestone		1.00			AA104506	B	0.50		
1.0 Compact very gravelly SAND with medium cobble content and medium boulder content. Sand is fine to coarse gravel is subangular / subrounded fine to coarse of grey limestone					AA104507	B	1.20		
2.0					AA104508	B	2.00		
3.0 End of Trial Pit at 3.00m		3.00			AA104509	B	3.00		
4.0									

Groundwater Conditions
Dry

Stability
Good

General Remarks
Trial pit terminated at scheduled depth

IGSL TP LOG 21345.GPJ IGSL.GDT 19/11/18

TRIAL PIT RECORD

REPORT NUMBER 21345

CONTRACT 21345	TRIAL PIT NO. TP04
	SHEET Sheet 1 of 1
LOGGED BY TOS	CO-ORDINATES
	DATE STARTED 05/11/2018
	DATE COMPLETED 05/11/2018
CLIENT	GROUND LEVEL (m)
	EXCAVATION METHOD JCB 3CX
ENGINEER Waterman Moylan	

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Firm / stiff orange brown slightly gravelly sandy CLAY. Sand is fine to coarse gravel is angular / subangular fine to coarse of dark grey limestone		0.30			AA104503	B	0.20		
					AA104504	B	0.50		
1.0									
Compact BOULDERS and COBBLES with gravelly very sandy clay. Sand is fine to coarse gravel is angular / subangular fine to coarse of grey limestone		1.50			AA104505	B	1.60		
2.0									
End of Trial Pit at 2.30m		2.30							
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Good

General Remarks
Trial pit terminated at 2.3 due to slow progress in compact boulders and cobbles

IGSL TP LOG 21345.GPJ IGSL.GDT 19/11/18

TRIAL PIT RECORD

REPORT NUMBER 21345

CONTRACT 21345	TRIAL PIT NO. TP05
	SHEET Sheet 1 of 1
LOGGED BY TOS	CO-ORDINATES
	DATE STARTED 05/11/2018
	DATE COMPLETED 05/11/2018
CLIENT	GROUND LEVEL (m)
ENGINEER Waterman Moylan	EXCAVATION METHOD JCB 3CX

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Firm / stiff orange brown slightly gravelly sandy CLAY. Sand is fine to coarse gravel is angular / subangular fine to coarse of dark grey limestone		0.40			AA104501	B	0.50		
1.0 Compact BOULDERS and COBBLES with gravelly very sandy clay. Sand is fine to coarse gravel is angular / subangular fine to coarse of grey limestone		1.00			AA104502	B	1.20		
End of Trial Pit at 1.60m		1.60							
2.0									
3.0									
4.0									

Groundwater Conditions
Dry

Stability
Good

General Remarks
Trial pit terminated at 1.6 due to slow progress in compact boulders and cobbles

IGSL TP LOG 21345.GPJ IGSL.GDT 19/11/18

Appendix III Probe Records

DYNAMIC PROBE RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen , Drogheda , Co.Louth	PROBE NO.	DP01
		SHEET	Sheet 1 of 1
CO-ORDINATES		DATE DRILLED	05/11/2018
GROUND LEVEL (mOD)	HAMMER MASS (kg) 50	DATE LOGGED	05/11/2018
CLIENT	INCREMENT SIZE (mm) 100		
ENGINEER Waterman Moylan	FALL HEIGHT (mm) 500	PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0						0.00	0
						0.10	3
						0.20	4
						0.30	4
						0.40	5
						0.50	8
						0.60	8
						0.70	5
						0.80	5
						0.90	5
1.0						1.00	6
						1.10	6
						1.20	7
						1.30	5
						1.40	4
						1.50	5
						1.60	4
						1.70	4
						1.80	2
						1.90	11
2.0						2.00	11
						2.10	11
						2.20	14
						2.30	20
						2.40	25
	End of Probe at 2.50 m						
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 21345.GPJ IGSL.GDT 6/11/18

DYNAMIC PROBE RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen , Drogheda , Co.Louth	PROBE NO.	DP02
		SHEET	Sheet 1 of 1
CO-ORDINATES		DATE DRILLED	05/11/2018
GROUND LEVEL (mOD)	HAMMER MASS (kg) 50	DATE LOGGED	05/11/2018
CLIENT	INCREMENT SIZE (mm) 100		
ENGINEER Waterman Moylan	FALL HEIGHT (mm) 500	PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0						0.00	0
						0.10	0
						0.20	1
						0.30	5
						0.40	4
						0.50	3
						0.60	5
						0.70	6
						0.80	7
						0.90	6
1.0						1.00	6
						1.10	4
						1.20	4
						1.30	3
						1.40	3
						1.50	2
						1.60	2
						1.70	1
						1.80	2
						1.90	6
2.0						2.00	10
						2.10	11
						2.20	9
						2.30	9
						2.40	11
						2.50	14
						2.60	16
						2.70	16
						2.80	18
						2.90	19
3.0	End of Probe at 3.10 m					3.00	25
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 21345.GPJ IGSL.GDT 6/11/18

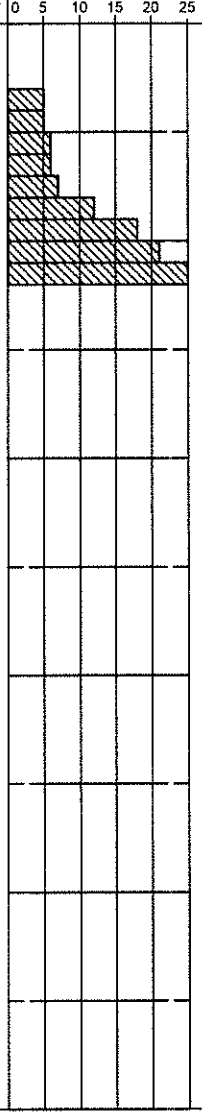
DYNAMIC PROBE RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen , Drogheda , Co.Louth	PROBE NO.	DP03
		SHEET	Sheet 1 of 1
CO-ORDINATES		DATE DRILLED	05/11/2018
GROUND LEVEL (mOD)	HAMMER MASS (kg) 50	DATE LOGGED	05/11/2018
CLIENT	INCREMENT SIZE (mm) 100	PROBE TYPE	DPH
ENGINEER Waterman Moylan	FALL HEIGHT (mm) 500		

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	0
						0.30	5
						0.40	5
						0.50	6
						0.60	6
						0.70	7
						0.80	12
						0.90	18
1.0						1.00	21
	End of Probe at 1.20 m					1.10	25
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 21345.GPJ IGSL.GDT 6/11/18

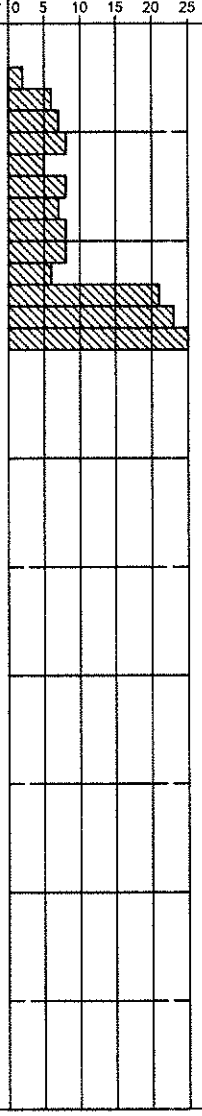
DYNAMIC PROBE RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen , Drogheda , Co.Louth	PROBE NO.	DP04
		SHEET	Sheet 1 of 1
CO-ORDINATES		DATE DRILLED	05/11/2018
GROUND LEVEL (mOD)	HAMMER MASS (kg) 50	DATE LOGGED	05/11/2018
CLIENT	INCREMENT SIZE (mm) 100	PROBE TYPE	DPH
ENGINEER Waterman Moylan	FALL HEIGHT (mm) 500		

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	6
						0.40	7
						0.50	8
						0.60	5
						0.70	8
						0.80	7
						0.90	8
1.0						1.00	8
						1.10	6
						1.20	21
						1.30	23
						1.40	25
	End of Probe at 1.50 m						
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 21345.GPJ IGSL.GDT 6/11/18

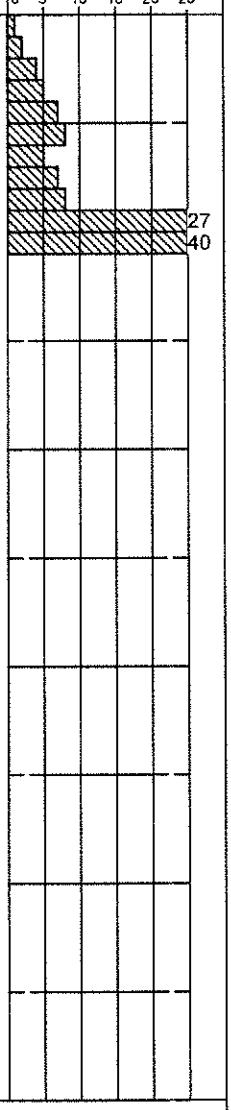
DYNAMIC PROBE RECORD

REPORT NUMBER 21345

CONTRACT	Rathmullen , Drogheda , Co.Louth	PROBE NO.	DP05
		SHEET	Sheet 1 of 1
CO-ORDINATES		DATE DRILLED	05/11/2018
GROUND LEVEL (mOD)	HAMMER MASS (kg) 50	DATE LOGGED	05/11/2018
CLIENT	INCREMENT SIZE (mm) 100	PROBE TYPE	DPH
ENGINEER Waterman Moylan	FALL HEIGHT (mm) 500		

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0						0.00	1
						0.10	2
						0.20	4
						0.30	5
						0.40	7
						0.50	8
						0.60	5
						0.70	7
						0.80	8
						0.90	27
1.0						1.00	40
	End of Probe at 1.10 m						
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 100MM INCREMENTS 21345.GPJ IGSL.GDT 6/11/18

Appendix IV BRE Digest 365

Soakaway Design f -value from field tests (F2C) IGSL

Contract: Rathmullan, Drogheda Contract No. 21345
Test No. SA01
Client Waterman Moylan
Date: 06/11/2018

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.50	Firm / stiff brown slightly gravelly sandy CLAY with medium cobble	
		content	

Notes:

Field Data

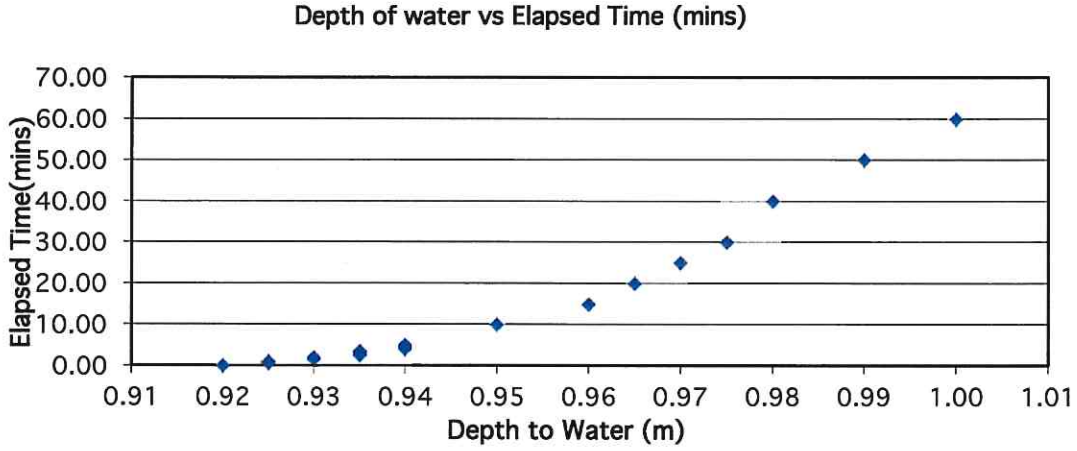
Depth to Water (m)	Elapsed Time (min)
0.92	0.00
0.93	0.50
0.93	1.00
0.93	1.50
0.93	2.00
0.94	2.50
0.94	3.00
0.94	3.50
0.94	4.00
0.94	4.50
0.94	5.00
0.95	10.00
0.96	15.00
0.97	20.00
0.97	25.00
0.98	30.00
0.98	40.00
0.99	50.00
1.00	60.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	1.50	m
Length of Pit (L)	1.80	m
Initial depth to Water =	0.92	m
Final depth to water =	1.00	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.7	m2
*Av. side area of permeable stratum over test period=	3.564	m2
Total Exposed area =	6.264	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00057 m/min or 9.5785E-06 m/sec



Soakaway Design f -value from field tests (F2C) IGSL

Contract: Rathmullan, Drogheda Contract No. 21345
Test No. SA02
Client Waterman Moylan
Date: 06/11/2018

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.50	Firm / stiff brown slightly gravelly sandy CLAY with medium cobble	
		content	

Notes:

Field Data

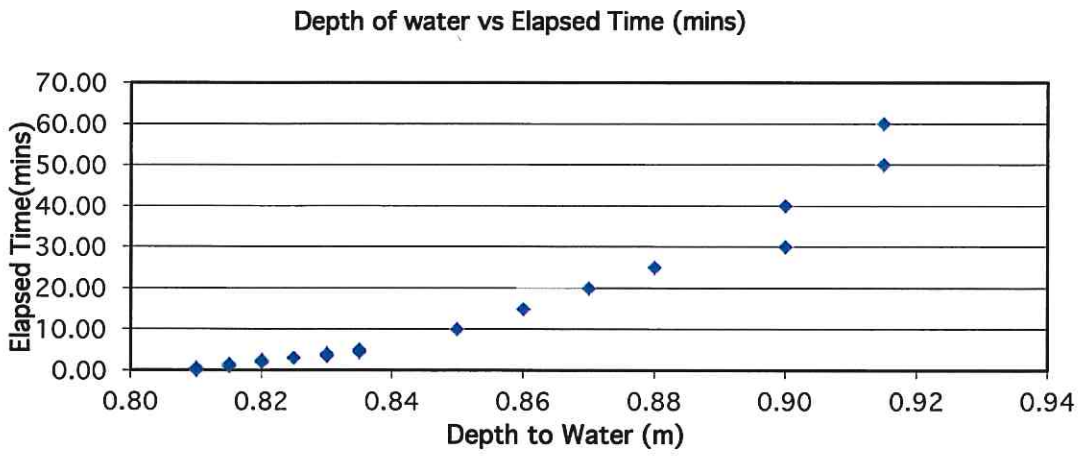
Depth to Water (m)	Elapsed Time (min)
0.81	0.00
0.81	0.50
0.82	1.00
0.82	1.50
0.82	2.00
0.82	2.50
0.83	3.00
0.83	3.50
0.83	4.00
0.84	4.50
0.84	5.00
0.85	10.00
0.86	15.00
0.87	20.00
0.88	25.00
0.90	30.00
0.90	40.00
0.92	50.00
0.92	60.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	1.50	m
Length of Pit (L)	1.80	m
Initial depth to Water =	0.81	m
Final depth to water =	0.92	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.7	m2
*Av. side area of permeable stratum over test period=	4.2075	m2
Total Exposed area =	6.9075	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00068 m/min or 1.1401E-05 m/sec



Soakaway Design f -value from field tests (F2C) IGSL

Contract: Rathmullan, Drogheda Contract No. 21345
Test No. SA03
Client Waterman Moylan
Date: 06/11/2018

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.50	Firm / stiff brown slightly gravelly sandy CLAY	

Notes:

Field Data

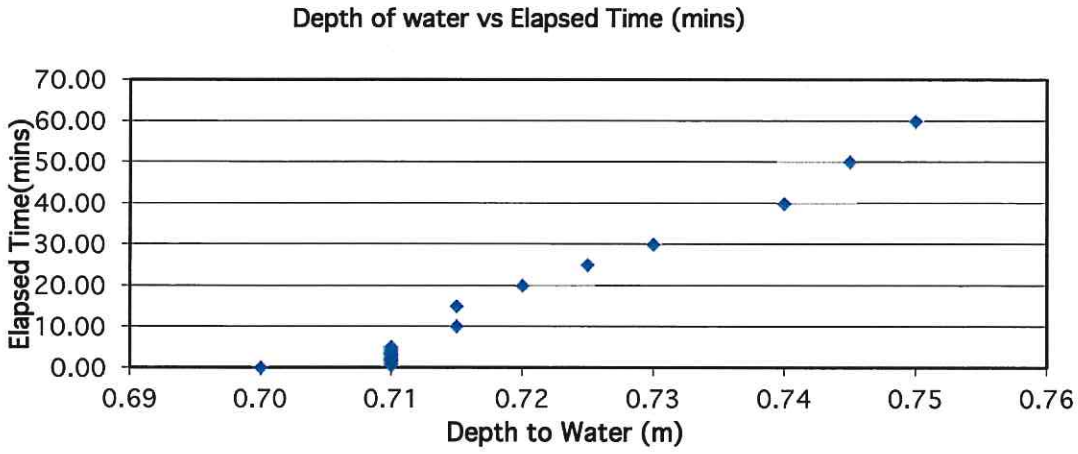
Depth to Water (m)	Elapsed Time (min)
0.70	0.00
0.71	0.50
0.71	1.00
0.71	1.50
0.71	2.00
0.71	2.50
0.71	3.00
0.71	3.50
0.71	4.00
0.71	4.50
0.71	5.00
0.72	10.00
0.72	15.00
0.72	20.00
0.73	25.00
0.73	30.00
0.74	40.00
0.75	50.00
0.75	60.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	1.50	m
Length of Pit (L)	1.80	m
Initial depth to Water =	0.70	m
Final depth to water =	0.75	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.7	m2
*Av. side area of permeable stratum over test period=	5.115	m2
Total Exposed area =	7.815	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00029 m/min or 4.7985E-06 m/sec



Soakaway Design f -value from field tests (F2C) IGSI

Contract: Rathmullan, Drogheda Contract No. 21345
Test No. SA04
Client Waterman Moylan
Date: 06/11/2018

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.50	Firm / stiff brown slightly gravelly sandy CLAY	

Notes:

Field Data

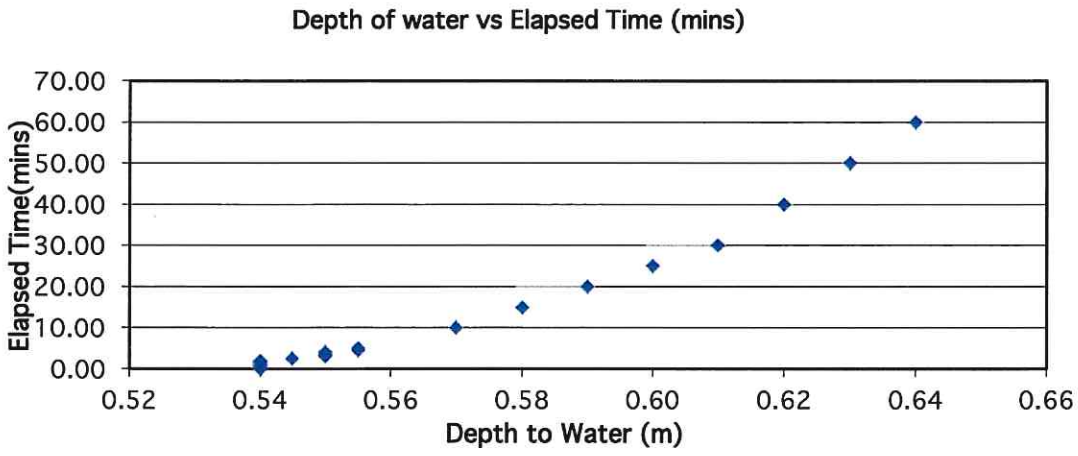
Depth to Water (m)	Elapsed Time (min)
0.54	0.00
0.54	0.50
0.54	1.00
0.54	1.50
0.54	2.00
0.55	2.50
0.55	3.00
0.55	3.50
0.55	4.00
0.56	4.50
0.56	5.00
0.57	10.00
0.58	15.00
0.59	20.00
0.60	25.00
0.61	30.00
0.62	40.00
0.63	50.00
0.64	60.00

Field Test

Depth of Pit (D)	1.50	m
Width of Pit (B)	1.50	m
Length of Pit (L)	1.80	m
Initial depth to Water =	0.54	m
Final depth to water =	0.64	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.7	m2
*Av. side area of permeable stratum over test period=	6.006	m2
Total Exposed area =	8.706	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00052 m/min or 8.6147E-06 m/sec



Soakaway Design f -value from field tests (F2C) IGSL

Contract: Rathmullan, Drogheda Contract No. 21345
Test No. SA05
Client Waterman Moylan
Date: 06/11/2018

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.30	Firm / stiff orange brown slightly gravelly sandy CLAY	

Notes: Refusal at 1.3 due to cobble

Field Data

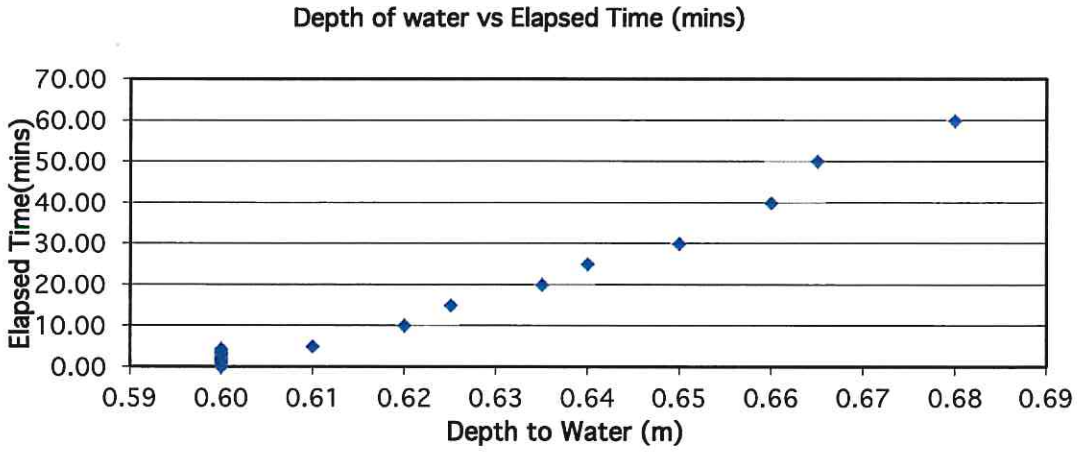
Depth to Water (m)	Elapsed Time (min)
0.60	0.00
0.60	0.50
0.60	1.00
0.60	1.50
0.60	2.00
0.60	2.50
0.60	3.00
0.60	3.50
0.60	4.00
0.60	4.50
0.61	5.00
0.62	10.00
0.63	15.00
0.64	20.00
0.64	25.00
0.65	30.00
0.66	40.00
0.67	50.00
0.68	60.00

Field Test

Depth of Pit (D)	1.30	m
Width of Pit (B)	1.50	m
Length of Pit (L)	1.80	m
Initial depth to Water =	0.60	m
Final depth to water =	0.68	m
Elapsed time (mins)=	60.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.7	m2
*Av. side area of permeable stratum over test period=	4.356	m2
Total Exposed area =	7.056	m2

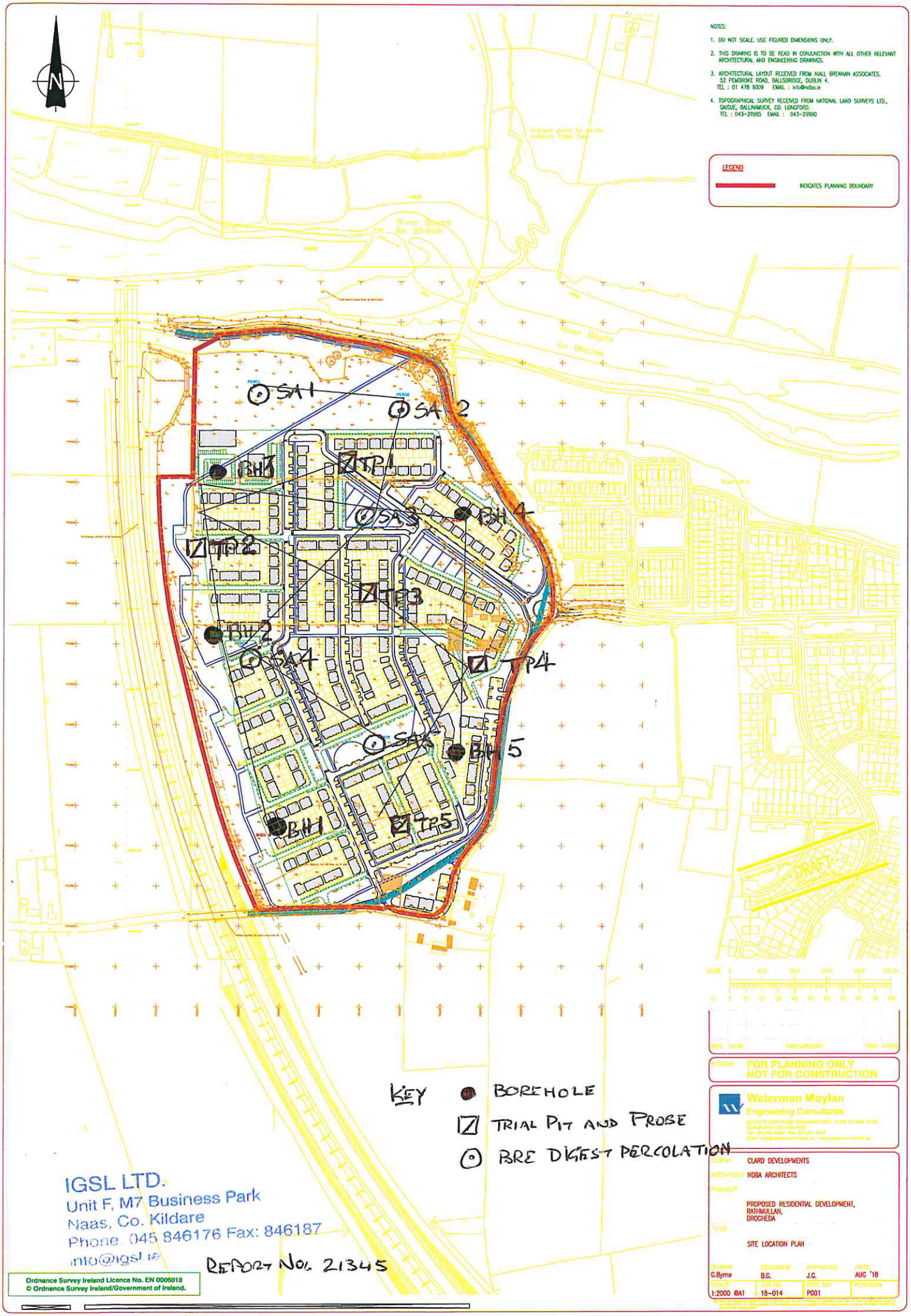
Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00051 m/min or 8.5034E-06 m/sec



Appendix V Laboratory Data

Appendix VI Site Plan


NOTES:
1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.
3. ARCHITECTURAL LAYOUT RECEIVED FROM HALL BRENNAN ASSOCIATES, 52 PEMBROKE ROAD, BALLSBRIDGE, DUBLIN 4. TEL : 01 478 9009 EMAIL : info@nbba.ie
4. TOPOGRAPHICAL SURVEY RECEIVED FROM NATIONAL LAND SURVEYS LTD., SAGUE, BALLINAMUCK, CO. LONGFORD. TEL : 043-29955 EMAIL : 043-29980
LEGEND
INDICATES PLANNING BOUNDARY
River Boyne
An Bhóinn
SA1
SA2
SA3
SA4
SA5
BH1
BH2
BH3
BH4
BH5
TP1
TP2
TP3
TP4
TP5
KEY
BOREHOLE
TRIAL PIT AND PROBE
BRE DIGEST PERCOLATION
FOR PLANNING ONLY
NOT FOR CONSTRUCTION
Waterman Moylan
Engineering Consultants
CLIENT CLARD DEVELOPMENTS
ARCHITECT NOBA ARCHITECTS
PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT, RATHMULLAN, DROGHEDA
TITLE
SITE LOCATION PLAN
DRAWN G.Byrne
DESIGNED B.G.
APPROVED J.C.
DATE AUG '18
SCALE 1:2000 @A1
JOB NO 18-014
DWG NO P001
REVISION
IGSL LTD.
Unit F, M7 Business Park
Naas, Co. Kildare
Phone: 045 846176 Fax: 846187
info@igsl.ie
REPORT NO. 21345
Ordnance Survey Ireland Licence No. EN 0006018
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E. Surface Water Pipe Network Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm_A

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.500	Add Flow / Climate Change (%)	20
Ratio R	0.300	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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

Time Area Diagram for Storm_A

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.902	4-8	2.413	8-12	0.117

Total Area Contributing (ha) = 3.432

Total Pipe Volume (m^3) = 133.397

Network Design Table for Storm_A

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
S_A1.000	28.258	0.471	60.0	0.022	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A2.000	87.506	1.458	60.0	0.160	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A1.001	62.401	1.248	50.0	0.191	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A3.000	90.003	1.000	90.0	0.289	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_A1.000	50.00	4.28	33.900	0.022	0.0	0.0	0.6	1.69	67.3	3.6
S_A2.000	50.00	4.86	34.900	0.160	0.0	0.0	4.3	1.69	67.3	26.0
S_A1.001	50.00	5.42	33.429	0.374	0.0	0.0	10.1	1.85	73.7	60.7
S_A3.000	50.00	5.09	33.300	0.289	0.0	0.0	7.8	1.38	54.8	46.9

Network Design Table for Storm_A

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
S_A1.002	68.415	0.456	150.0	0.220	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_A1.003	35.595	0.445	80.0	0.133	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_A4.000	33.336	0.833	40.0	0.093	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.001	17.610	0.440	40.0	0.076	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.002	26.125	0.523	50.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.003	48.247	0.965	50.0	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.004	31.511	0.263	120.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A5.000	51.540	0.859	60.0	0.130	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A5.001	59.116	0.739	80.0	0.122	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.005	13.987	0.093	150.0	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_A4.006	89.824	0.898	100.0	0.176	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_A4.007	13.254	0.133	100.0	0.036	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_A4.008	18.697	0.187	100.0	0.043	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_A6.000	27.458	0.137	200.0	0.106	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.009	70.135	0.234	300.0	0.131	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_A1.002	50.00	6.20	32.031	0.883	0.0	0.0	23.9	1.48	163.1	143.4
S_A1.003	50.00	6.49	31.575	1.016	0.0	0.0	27.5	2.03	223.9	165.1
S_A4.000	50.00	4.27	34.250	0.093	0.0	0.0	2.5	2.07	82.5	15.1
S_A4.001	50.00	4.41	33.417	0.169	0.0	0.0	4.6	2.07	82.5	27.5
S_A4.002	50.00	4.64	32.976	0.169	0.0	0.0	4.6	1.85	73.7	27.5
S_A4.003	50.00	5.08	32.454	0.195	0.0	0.0	5.3	1.85	73.7	31.7
S_A4.004	50.00	5.52	31.489	0.195	0.0	0.0	5.3	1.19	47.4	31.7
S_A5.000	50.00	4.51	32.800	0.130	0.0	0.0	3.5	1.69	67.3	21.1
S_A5.001	50.00	5.18	31.941	0.252	0.0	0.0	6.8	1.46	58.2	40.9
S_A4.005	50.00	5.70	31.127	0.463	0.0	0.0	12.5	1.28	90.6	75.2
S_A4.006	50.00	6.65	31.034	0.639	0.0	0.0	17.3	1.57	111.1	103.8
S_A4.007	50.00	6.79	30.136	0.675	0.0	0.0	18.3	1.57	111.1	109.7
S_A4.008	50.00	6.96	29.928	0.718	0.0	0.0	19.4	1.81	200.1	116.7
S_A6.000	50.00	4.50	29.750	0.106	0.0	0.0	2.9	0.92	36.6	17.2
S_A4.009	50.00	7.97	29.388	0.955	0.0	0.0	25.9	1.17	185.8	155.2

Network Design Table for Storm_A

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
S_A7.000	88.415	0.737	120.0	0.270	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A4.010	32.722	0.109	300.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S_A1.004	26.397	0.132	200.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S_A8.000	50.603	0.337	150.0	0.170	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A8.001	53.324	0.533	100.0	0.101	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_A8.002	66.822	0.334	200.0	0.121	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_A9.000	46.881	0.469	100.0	0.096	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A8.003	17.447	0.087	200.0	0.012	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_A10.000	88.672	0.443	200.0	0.212	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_A10.001	59.851	0.299	200.0	0.206	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_A8.004	16.494	0.082	200.0	0.027	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_A8.005	34.916	0.349	100.0	0.126	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_A11.000	87.592	0.438	200.0	0.120	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_A7.000	50.00	5.24	32.000	0.270	0.0	0.0	7.3	1.19	47.4	43.8
S_A4.010	50.00	8.39	29.079	1.225	0.0	0.0	33.2	1.29	278.8	199.0
S_A1.004	50.00	8.64	28.895	2.241	0.0	0.0	60.7	1.72	485.8	364.1
S_A8.000	50.00	4.79	31.850	0.170	0.0	0.0	4.6	1.07	42.4	27.7
S_A8.001	50.00	5.47	31.513	0.271	0.0	0.0	7.3	1.31	52.0	44.0
S_A8.002	50.00	6.48	30.904	0.392	0.0	0.0	10.6	1.11	78.3	63.7
S_A9.000	50.00	4.60	31.850	0.096	0.0	0.0	2.6	1.31	52.0	15.6
S_A8.003	50.00	6.70	30.495	0.500	0.0	0.0	13.5	1.28	141.1	81.3
S_A10.000	50.00	5.60	30.400	0.212	0.0	0.0	5.8	0.92	36.6	34.5
S_A10.001	50.00	6.51	29.882	0.418	0.0	0.0	11.3	1.11	78.3	68.0
S_A8.004	50.00	6.90	29.432	0.945	0.0	0.0	25.6	1.43	228.1	153.6
S_A8.005	50.00	7.18	29.350	1.071	0.0	0.0	29.0	2.03	323.4	174.0
S_A11.000	50.00	5.59	29.900	0.120	0.0	0.0	3.3	0.92	36.6	19.6

Network Design Table for Storm_A

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
S_A8.006	7.952	0.040	200.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_A1.005	94.205	0.628	150.0	0.000	0.00	0.0	0.600	o	600	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)
S_A8.006	50.00	7.27	29.001	1.191	0.0	0.0	32.3	1.43	228.1	193.6
S_A1.005	49.20	9.44	28.763	3.432	0.0	0.0	91.5	1.99	561.6	548.7

Manhole Schedules for Storm_A

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)	Back (m)
S_A1	35.350	1.450	Open Manhole	1200	S_A1.000	33.900	225				
S_A2	36.400	1.500	Open Manhole	1200	S_A2.000	34.900	225				
S_A3	35.000	1.571	Open Manhole	1200	S_A1.001	33.429	225	S_A1.000	33.429	225	
								S_A2.000	33.442	225	
S_A4	34.800	1.500	Open Manhole	1200	S_A3.000	33.300	225				
S_A5	33.750	1.719	Open Manhole	1350	S_A1.002	32.031	375	S_A1.001	32.181	225	
								S_A3.000	32.300	225	
S_A6	33.330	1.755	Open Manhole	1350	S_A1.003	31.575	375	S_A1.002	31.575	375	
S_A7	35.750	1.500	Open Manhole	1200	S_A4.000	34.250	225				
S_A8	34.850	1.433	Open Manhole	1200	S_A4.001	33.417	225	S_A4.000	33.417	225	
S_A9	34.550	1.574	Open Manhole	1200	S_A4.002	32.976	225	S_A4.001	32.976	225	
S_A10	34.000	1.546	Open Manhole	1200	S_A4.003	32.454	225	S_A4.002	32.454	225	
S_A11	33.150	1.661	Open Manhole	1200	S_A4.004	31.489	225	S_A4.003	31.489	225	
S_A12	34.300	1.500	Open Manhole	1200	S_A5.000	32.800	225				
S_A13	33.650	1.709	Open Manhole	1200	S_A5.001	31.941	225	S_A5.000	31.941	225	
S_A14	32.950	1.823	Open Manhole	1200	S_A4.005	31.127	300	S_A4.004	31.226	225	
								S_A5.001	31.202	225	
S_A15	32.800	1.766	Open Manhole	1200	S_A4.006	31.034	300	S_A4.005	31.034	300	
S_A16	32.110	1.974	Open Manhole	1200	S_A4.007	30.136	300	S_A4.006	30.136	300	
S_A17	31.900	1.972	Open Manhole	1350	S_A4.008	29.928	375	S_A4.007	30.003	300	
S_A18	31.200	1.450	Open Manhole	1200	S_A6.000	29.750	225				
S_A19	31.500	2.112	Open Manhole	1350	S_A4.009	29.388	450	S_A4.008	29.741	375	
								S_A6.000	29.613	225	
S_A20	33.500	1.500	Open Manhole	1200	S_A7.000	32.000	225				
S_A21	32.850	3.771	Open Manhole	1500	S_A4.010	29.079	525	S_A4.009	29.154	450	
								S_A7.000	31.263	225	
S_A22	32.750	3.855	Open Manhole	1500	S_A1.004	28.895	600	S_A1.003	31.130	375	
								S_A4.010	28.970	525	
S_A23	33.350	1.500	Open Manhole	1200	S_A8.000	31.850	225				
S_A24	33.050	1.537	Open Manhole	1200	S_A8.001	31.513	225	S_A8.000	31.513	225	
S_A25	32.500	1.596	Open Manhole	1200	S_A8.002	30.904	300	S_A8.001	30.979	225	
S_A26	33.350	1.500	Open Manhole	1200	S_A9.000	31.850	225				
S_A27	32.950	2.455	Open Manhole	1350	S_A8.003	30.495	375	S_A8.002	30.570	300	
								S_A9.000	31.381	225	
S_A28	31.900	1.500	Open Manhole	1200	S_A10.000	30.400	225				
S_A29	31.800	1.918	Open Manhole	1200	S_A10.001	29.882	300	S_A10.000	29.957	225	
S_A30	32.800	3.368	Open Manhole	1350	S_A8.004	29.432	450	S_A8.003	30.408	375	
								S_A10.001	29.582	300	

Manhole Schedules for Storm_A

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)	Back (m
S_A31	33.050	3.700	Open Manhole	1350	S_A8.005	29.350	450	S_A8.004	29.350	450	
S_A32	31.350	1.450	Open Manhole	1200	S_A11.000	29.900	225				
S_A33	32.550	3.549	Open Manhole	1350	S_A8.006	29.001	450	S_A8.005	29.001	450	
								S_A11.000	29.462	225	
S_A34	32.800	4.037	Open Manhole	1500	S_A1.005	28.763	600	S_A1.004	28.763	600	
								S_A8.006	28.961	450	
S_A33	31.500	3.365	Open Manhole	1800		OUTFALL		S_A1.005	28.135	600	

PIPELINE SCHEDULES for Storm_A

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)
S_A1.000	o	225	S_A1	35.350	33.900	1.225	Open Manhole	1200
S_A2.000	o	225	S_A2	36.400	34.900	1.275	Open Manhole	1200
S_A1.001	o	225	S_A3	35.000	33.429	1.346	Open Manhole	1200
S_A3.000	o	225	S_A4	34.800	33.300	1.275	Open Manhole	1200
S_A1.002	o	375	S_A5	33.750	32.031	1.344	Open Manhole	1350
S_A1.003	o	375	S_A6	33.330	31.575	1.380	Open Manhole	1350
S_A4.000	o	225	S_A7	35.750	34.250	1.275	Open Manhole	1200
S_A4.001	o	225	S_A8	34.850	33.417	1.208	Open Manhole	1200
S_A4.002	o	225	S_A9	34.550	32.976	1.349	Open Manhole	1200
S_A4.003	o	225	S_A10	34.000	32.454	1.321	Open Manhole	1200
S_A4.004	o	225	S_A11	33.150	31.489	1.436	Open Manhole	1200
S_A5.000	o	225	S_A12	34.300	32.800	1.275	Open Manhole	1200
S_A5.001	o	225	S_A13	33.650	31.941	1.484	Open Manhole	1200
S_A4.005	o	300	S_A14	32.950	31.127	1.523	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)
S_A1.000	28.258	60.0	S_A3	35.000	33.429	1.346	Open Manhole	1200
S_A2.000	87.506	60.0	S_A3	35.000	33.442	1.333	Open Manhole	1200
S_A1.001	62.401	50.0	S_A5	33.750	32.181	1.344	Open Manhole	1350
S_A3.000	90.003	90.0	S_A5	33.750	32.300	1.225	Open Manhole	1350
S_A1.002	68.415	150.0	S_A6	33.330	31.575	1.380	Open Manhole	1350
S_A1.003	35.595	80.0	S_A22	32.750	31.130	1.245	Open Manhole	1500
S_A4.000	33.336	40.0	S_A8	34.850	33.417	1.208	Open Manhole	1200
S_A4.001	17.610	40.0	S_A9	34.550	32.976	1.349	Open Manhole	1200
S_A4.002	26.125	50.0	S_A10	34.000	32.454	1.321	Open Manhole	1200
S_A4.003	48.247	50.0	S_A11	33.150	31.489	1.436	Open Manhole	1200
S_A4.004	31.511	120.0	S_A14	32.950	31.226	1.499	Open Manhole	1200
S_A5.000	51.540	60.0	S_A13	33.650	31.941	1.484	Open Manhole	1200
S_A5.001	59.116	80.0	S_A14	32.950	31.202	1.523	Open Manhole	1200
S_A4.005	13.987	150.0	S_A15	32.800	31.034	1.466	Open Manhole	1200

PIPELINE SCHEDULES for Storm_A

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)
S_A4.006	o	300	S_A15	32.800	31.034	1.466	Open Manhole	1200
S_A4.007	o	300	S_A16	32.110	30.136	1.674	Open Manhole	1200
S_A4.008	o	375	S_A17	31.900	29.928	1.597	Open Manhole	1350
S_A6.000	o	225	S_A18	31.200	29.750	1.225	Open Manhole	1200
S_A4.009	o	450	S_A19	31.500	29.388	1.662	Open Manhole	1350
S_A7.000	o	225	S_A20	33.500	32.000	1.275	Open Manhole	1200
S_A4.010	o	525	S_A21	32.850	29.079	3.246	Open Manhole	1500
S_A1.004	o	600	S_A22	32.750	28.895	3.255	Open Manhole	1500
S_A8.000	o	225	S_A23	33.350	31.850	1.275	Open Manhole	1200
S_A8.001	o	225	S_A24	33.050	31.513	1.312	Open Manhole	1200
S_A8.002	o	300	S_A25	32.500	30.904	1.296	Open Manhole	1200
S_A9.000	o	225	S_A26	33.350	31.850	1.275	Open Manhole	1200
S_A8.003	o	375	S_A27	32.950	30.495	2.080	Open Manhole	1350

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)
S_A4.006	89.824	100.0	S_A16	32.110	30.136	1.674	Open Manhole	1200
S_A4.007	13.254	100.0	S_A17	31.900	30.003	1.597	Open Manhole	1350
S_A4.008	18.697	100.0	S_A19	31.500	29.741	1.384	Open Manhole	1350
S_A6.000	27.458	200.0	S_A19	31.500	29.613	1.662	Open Manhole	1350
S_A4.009	70.135	300.0	S_A21	32.850	29.154	3.246	Open Manhole	1500
S_A7.000	88.415	120.0	S_A21	32.850	31.263	1.362	Open Manhole	1500
S_A4.010	32.722	300.0	S_A22	32.750	28.970	3.255	Open Manhole	1500
S_A1.004	26.397	200.0	S_A34	32.800	28.763	3.437	Open Manhole	1500
S_A8.000	50.603	150.0	S_A24	33.050	31.513	1.312	Open Manhole	1200
S_A8.001	53.324	100.0	S_A25	32.500	30.979	1.296	Open Manhole	1200
S_A8.002	66.822	200.0	S_A27	32.950	30.570	2.080	Open Manhole	1350
S_A9.000	46.881	100.0	S_A27	32.950	31.381	1.344	Open Manhole	1350
S_A8.003	17.447	200.0	S_A30	32.800	30.408	2.017	Open Manhole	1350

PIPELINE SCHEDULES for Storm_A

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)
S_A10.000	o	225	S_A28	31.900	30.400	1.275	Open Manhole	1200
S_A10.001	o	300	S_A29	31.800	29.882	1.618	Open Manhole	1200
S_A8.004	o	450	S_A30	32.800	29.432	2.918	Open Manhole	1350
S_A8.005	o	450	S_A31	33.050	29.350	3.250	Open Manhole	1350
S_A11.000	o	225	S_A32	31.350	29.900	1.225	Open Manhole	1200
S_A8.006	o	450	S_A33	32.550	29.001	3.099	Open Manhole	1350
S_A1.005	o	600	S_A34	32.800	28.763	3.437	Open Manhole	1500

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)
S_A10.000	88.672	200.0	S_A29	31.800	29.957	1.618	Open Manhole	1200
S_A10.001	59.851	200.0	S_A30	32.800	29.582	2.918	Open Manhole	1350
S_A8.004	16.494	200.0	S_A31	33.050	29.350	3.250	Open Manhole	1350
S_A8.005	34.916	100.0	S_A33	32.550	29.001	3.099	Open Manhole	1350
S_A11.000	87.592	200.0	S_A33	32.550	29.462	2.863	Open Manhole	1350
S_A8.006	7.952	200.0	S_A34	32.800	28.961	3.389	Open Manhole	1500
S_A1.005	94.205	150.0	S_A33	31.500	28.135	2.765	Open Manhole	1800

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm_B

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.500	Add Flow / Climate Change (%)	20
Ratio R	0.300	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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

Time Area Diagram for Storm_B

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.550	4-8	1.336	8-12	0.030

Total Area Contributing (ha) = 1.916

Total Pipe Volume (m^3) = 78.139

Network Design Table for Storm_B

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
S_B1.000	69.323	0.347	200.0	0.201	4.00	16.3	0.600	o	300	Pipe/Conduit	
S_B1.001	29.978	0.150	200.0	0.119	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_B2.000	66.659	0.333	200.0	0.205	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_B2.001	9.787	0.049	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_B3.000	26.879	0.134	200.0	0.069	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_B1.000	50.00	5.04	28.050	0.201	16.3	0.0	8.7	1.11	78.3	52.2
S_B1.001	50.00	5.49	27.703	0.320	16.3	0.0	11.9	1.11	78.3	71.5
S_B2.000	50.00	5.21	27.950	0.205	0.0	0.0	5.6	0.92	36.6	33.3
S_B2.001	50.00	5.38	27.617	0.205	0.0	0.0	5.6	0.92	36.6	33.3
S_B3.000	50.00	4.49	28.050	0.069	0.0	0.0	1.9	0.92	36.6	11.2

Network Design Table for Storm_B

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
S_B2.002	17.029	0.085	200.0	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_B2.003	57.099	0.285	200.0	0.083	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_B1.002	87.337	2.360	37.0	0.312	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_B1.003	15.506	0.345	45.0	0.015	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_B1.004	24.809	0.124	200.0	0.023	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_B1.005	28.454	0.142	200.0	0.052	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_B4.000	52.475	1.749	30.0	0.149	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_B4.001	55.491	1.850	30.0	0.208	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_B4.002	32.877	0.996	33.0	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_B4.003	29.408	0.147	200.0	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_B4.004	60.740	0.304	200.0	0.146	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_B4.005	35.772	0.179	200.0	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_B4.006	80.695	0.403	200.0	0.214	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_B1.006	18.875	0.126	150.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S_B1.007	48.991	0.327	150.0	0.000	0.00	0.0	0.600	o	525	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)
S_B2.002	50.00	5.64	27.493	0.320	0.0	0.0	8.7	1.11	78.3	51.9
S_B2.003	50.00	6.50	27.408	0.402	0.0	0.0	10.9	1.11	78.3	65.4
S_B1.002	50.00	6.99	27.047	1.034	16.3	0.0	31.3	2.99	329.9	187.5
S_B1.003	50.00	7.08	24.687	1.049	16.3	0.0	31.7	2.71	299.0	190.0
S_B1.004	50.00	7.37	24.267	1.072	16.3	0.0	32.3	1.43	228.1	193.8
S_B1.005	50.00	7.70	24.143	1.124	16.3	0.0	33.7	1.43	228.1	202.1
S_B4.000	50.00	4.36	30.300	0.149	0.0	0.0	4.0	2.40	95.3	24.3
S_B4.001	50.00	4.75	28.551	0.357	0.0	0.0	9.7	2.40	95.3	58.0
S_B4.002	50.00	4.99	26.701	0.390	0.0	0.0	10.6	2.29	90.9	63.4
S_B4.003	50.00	5.43	25.630	0.412	0.0	0.0	11.1	1.11	78.3	66.9
S_B4.004	50.00	6.23	25.408	0.558	0.0	0.0	15.1	1.28	141.1	90.6
S_B4.005	50.00	6.69	25.104	0.578	0.0	0.0	15.7	1.28	141.1	94.0
S_B4.006	50.00	7.74	24.925	0.793	0.0	0.0	21.5	1.28	141.1	128.8
S_B1.006	50.00	7.92	23.926	1.916	16.3	0.0	55.2	1.83	395.4	330.9
S_B1.007	50.00	8.36	23.800	1.916	16.3	0.0	55.2	1.83	395.4	330.9

Manhole Schedules for Storm_B

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)	Backdr (mm)
S_B1	31.150	3.100	Open Manhole	1200	S_B1.000	28.050	300				
S_B2	30.700	2.997	Open Manhole	1200	S_B1.001	27.703	300	S_B1.000	27.703	300	
S_B3	29.400	1.450	Open Manhole	1200	S_B2.000	27.950	225				
S_B4	29.850	2.233	Open Manhole	1200	S_B2.001	27.617	225	S_B2.000	27.617	225	
S_B5	29.500	1.450	Open Manhole	1200	S_B3.000	28.050	225				
S_B6	29.900	2.407	Open Manhole	1200	S_B2.002	27.493	300	S_B2.001	27.568	225	
								S_B3.000	27.916	225	
S_B7	30.000	2.592	Open Manhole	1200	S_B2.003	27.408	300	S_B2.002	27.408	300	
S_B8	30.600	3.553	Open Manhole	1350	S_B1.002	27.047	375	S_B1.001	27.553	300	
								S_B2.003	27.122	300	
S_B9	26.300	1.613	Open Manhole	1350	S_B1.003	24.687	375	S_B1.002	24.687	375	
S_B10	26.000	1.733	Open Manhole	1350	S_B1.004	24.267	450	S_B1.003	24.342	375	
S_B11	27.150	3.007	Open Manhole	1350	S_B1.005	24.143	450	S_B1.004	24.143	450	
S_B12	31.800	1.500	Open Manhole	1200	S_B4.000	30.300	225				
S_B13	30.000	1.449	Open Manhole	1200	S_B4.001	28.551	225	S_B4.000	28.551	225	
S_B14	28.400	1.699	Open Manhole	1200	S_B4.002	26.701	225	S_B4.001	26.701	225	
S_B15	27.150	1.520	Open Manhole	1200	S_B4.003	25.630	300	S_B4.002	25.705	225	
S_B16	29.150	3.742	Open Manhole	1350	S_B4.004	25.408	375	S_B4.003	25.483	300	
S_B17	27.800	2.696	Open Manhole	1350	S_B4.005	25.104	375	S_B4.004	25.104	375	
S_B18	28.150	3.225	Open Manhole	1350	S_B4.006	24.925	375	S_B4.005	24.925	375	
S_B19	27.750	3.824	Open Manhole	1500	S_B1.006	23.926	525	S_B1.005	24.001	450	
								S_B4.006	24.522	375	
S_B20	27.000	3.200	Open Manhole	1500	S_B1.007	23.800	525	S_B1.006	23.800	525	
S_B9	25.750	2.277	Open Manhole	1500		OUTFALL		S_B1.007	23.473	525	

PIPELINE SCHEDULES for Storm_B

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)
S_B1.000	o	300	S_B1	31.150	28.050	2.800	Open Manhole	1200
S_B1.001	o	300	S_B2	30.700	27.703	2.697	Open Manhole	1200
S_B2.000	o	225	S_B3	29.400	27.950	1.225	Open Manhole	1200
S_B2.001	o	225	S_B4	29.850	27.617	2.008	Open Manhole	1200
S_B3.000	o	225	S_B5	29.500	28.050	1.225	Open Manhole	1200
S_B2.002	o	300	S_B6	29.900	27.493	2.107	Open Manhole	1200
S_B2.003	o	300	S_B7	30.000	27.408	2.292	Open Manhole	1200
S_B1.002	o	375	S_B8	30.600	27.047	3.178	Open Manhole	1350
S_B1.003	o	375	S_B9	26.300	24.687	1.238	Open Manhole	1350
S_B1.004	o	450	S_B10	26.000	24.267	1.283	Open Manhole	1350
S_B1.005	o	450	S_B11	27.150	24.143	2.557	Open Manhole	1350
S_B4.000	o	225	S_B12	31.800	30.300	1.275	Open Manhole	1200
S_B4.001	o	225	S_B13	30.000	28.551	1.224	Open Manhole	1200
S_B4.002	o	225	S_B14	28.400	26.701	1.474	Open Manhole	1200
S_B4.003	o	300	S_B15	27.150	25.630	1.220	Open Manhole	1200
S_B4.004	o	375	S_B16	29.150	25.408	3.367	Open Manhole	1350

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)
S_B1.000	69.323	200.0	S_B2	30.700	27.703	2.697	Open Manhole	1200
S_B1.001	29.978	200.0	S_B8	30.600	27.553	2.747	Open Manhole	1350
S_B2.000	66.659	200.0	S_B4	29.850	27.617	2.008	Open Manhole	1200
S_B2.001	9.787	200.0	S_B6	29.900	27.568	2.107	Open Manhole	1200
S_B3.000	26.879	200.0	S_B6	29.900	27.916	1.759	Open Manhole	1200
S_B2.002	17.029	200.0	S_B7	30.000	27.408	2.292	Open Manhole	1200
S_B2.003	57.099	200.0	S_B8	30.600	27.122	3.178	Open Manhole	1350
S_B1.002	87.337	37.0	S_B9	26.300	24.687	1.238	Open Manhole	1350
S_B1.003	15.506	45.0	S_B10	26.000	24.342	1.283	Open Manhole	1350
S_B1.004	24.809	200.0	S_B11	27.150	24.143	2.557	Open Manhole	1350
S_B1.005	28.454	200.0	S_B19	27.750	24.001	3.299	Open Manhole	1500
S_B4.000	52.475	30.0	S_B13	30.000	28.551	1.224	Open Manhole	1200
S_B4.001	55.491	30.0	S_B14	28.400	26.701	1.474	Open Manhole	1200
S_B4.002	32.877	33.0	S_B15	27.150	25.705	1.220	Open Manhole	1200
S_B4.003	29.408	200.0	S_B16	29.150	25.483	3.367	Open Manhole	1350
S_B4.004	60.740	200.0	S_B17	27.800	25.104	2.321	Open Manhole	1350

PIPELINE SCHEDULES for Storm_B

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)
S_B4.005	o	375	S_B17	27.800	25.104	2.321	Open Manhole	1350
S_B4.006	o	375	S_B18	28.150	24.925	2.850	Open Manhole	1350
S_B1.006	o	525	S_B19	27.750	23.926	3.299	Open Manhole	1500
S_B1.007	o	525	S_B20	27.000	23.800	2.675	Open Manhole	1500

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)
S_B4.005	35.772	200.0	S_B18	28.150	24.925	2.850	Open Manhole	1350
S_B4.006	80.695	200.0	S_B19	27.750	24.522	2.853	Open Manhole	1500
S_B1.006	18.875	150.0	S_B20	27.000	23.800	2.675	Open Manhole	1500
S_B1.007	48.991	150.0	S_B9	25.750	23.473	1.752	Open Manhole	1500

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm_C

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.500	Add Flow / Climate Change (%)	20
Ratio R	0.300	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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

Time Area Diagram for Storm_C

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.987	4-8	2.670	8-12	0.066

Total Area Contributing (ha) = 3.723

Total Pipe Volume (m³) = 146.536

Network Design Table for Storm_C

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
S_C3.000	53.011	1.178	45.0	0.210	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C4.000	42.728	0.214	200.0	0.167	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C4.001	14.878	0.074	200.0	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_C5.000	42.695	0.213	200.0	0.107	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_C3.000	50.00	4.45	30.000	0.210	0.0	0.0	5.7	1.96	77.7	34.1
S_C4.000	50.00	4.77	28.350	0.167	0.0	0.0	4.5	0.92	36.6	27.2
S_C4.001	50.00	5.04	28.136	0.175	0.0	0.0	4.7	0.92	36.6	28.5
S_C5.000	50.00	4.77	28.600	0.107	0.0	0.0	2.9	0.92	36.6	17.4

Network Design Table for Storm_C

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
S_C4.002	12.661	0.063	200.0	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_C3.001	21.183	0.106	200.0	0.032	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_C3.002	60.863	2.032	30.0	0.214	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_C6.000	55.768	0.279	200.0	0.165	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C6.001	55.616	0.278	200.0	0.115	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_C3.003	62.650	0.313	200.0	0.209	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_C7.000	59.880	0.299	200.0	0.180	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C7.001	59.880	0.299	200.0	0.127	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_C3.004	8.304	0.042	200.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S_C8.000	49.411	0.247	200.0	0.225	4.00	0.0	0.600	o	300	Pipe/Conduit	
S_C9.000	34.981	0.175	199.9	0.106	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C9.001	45.005	0.225	200.0	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_C10.000	30.797	0.154	200.0	0.054	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C10.001	57.482	0.287	200.0	0.118	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_C4.002	50.00	5.23	27.987	0.294	0.0	0.0	8.0	1.11	78.3	47.8
S_C3.001	50.00	5.51	27.849	0.536	0.0	0.0	14.5	1.28	141.1	87.1
S_C3.002	50.00	5.81	27.743	0.750	0.0	0.0	20.3	3.32	366.8	121.8
S_C6.000	50.00	5.01	24.450	0.165	0.0	0.0	4.5	0.92	36.6	26.9
S_C6.001	50.00	5.85	24.096	0.280	0.0	0.0	7.6	1.11	78.3	45.5
S_C3.003	50.00	6.57	23.668	1.239	0.0	0.0	33.6	1.43	228.1	201.3
S_C7.000	50.00	5.08	23.550	0.180	0.0	0.0	4.9	0.92	36.6	29.3
S_C7.001	50.00	5.98	23.176	0.307	0.0	0.0	8.3	1.11	78.3	49.9
S_C3.004	50.00	6.66	22.651	1.546	0.0	0.0	41.9	1.58	342.1	251.3
S_C8.000	50.00	4.74	22.800	0.225	0.0	0.0	6.1	1.11	78.3	36.6
S_C9.000	50.00	4.63	23.600	0.106	0.0	0.0	2.9	0.92	36.6	17.2
S_C9.001	50.00	5.45	23.425	0.218	0.0	0.0	5.9	0.92	36.6	35.5
S_C10.000	50.00	4.56	23.600	0.054	0.0	0.0	1.5	0.92	36.6	8.8
S_C10.001	50.00	5.42	23.371	0.172	0.0	0.0	4.7	1.11	78.3	28.0

Network Design Table for Storm_C

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
S_C9.002	43.242	0.216	200.0	0.100	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_C8.001	56.612	0.283	200.0	0.239	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_C3.005	70.665	0.353	200.0	0.138	0.00	0.0	0.600	o	600	Pipe/Conduit	
S_C11.000	37.347	0.373	100.0	0.138	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C11.001	34.488	0.345	100.0	0.171	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_C11.002	71.812	2.394	30.0	0.235	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_C11.003	71.812	3.591	20.0	0.194	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_C12.000	72.904	0.486	150.0	0.167	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C3.006	55.576	0.278	200.0	0.116	0.00	0.0	0.600	o	675	Pipe/Conduit	
S_C13.000	14.750	0.074	200.0	0.063	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_C3.007	7.317	0.037	200.0	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
S_C3.008	65.561	0.328	200.0	0.000	0.00	0.0	0.600	o	675	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)
S_C9.002	50.00	6.01	23.009	0.491	0.0	0.0	13.3	1.28	141.1	79.8
S_C8.001	50.00	6.67	22.403	0.955	0.0	0.0	25.9	1.43	228.1	155.2
S_C3.005	50.00	7.36	21.970	2.640	0.0	0.0	71.5	1.72	485.8	428.9
S_C11.000	50.00	4.48	30.200	0.138	0.0	0.0	3.7	1.31	52.0	22.4
S_C11.001	50.00	4.92	29.827	0.309	0.0	0.0	8.4	1.31	52.0	50.2
S_C11.002	50.00	5.41	29.482	0.544	0.0	0.0	14.7	2.40	95.3	88.4
S_C11.003	50.00	5.75	27.013	0.738	0.0	0.0	20.0	3.53	249.6	119.9
S_C12.000	50.00	5.14	24.100	0.167	0.0	0.0	4.5	1.07	42.4	27.1
S_C3.006	50.00	7.86	21.542	3.660	0.0	0.0	99.1	1.85	661.9	594.8
S_C13.000	50.00	4.27	22.900	0.063	0.0	0.0	1.7	0.92	36.6	10.3
S_C3.007	50.00	7.92	21.264	3.723	0.0	0.0	100.8	1.85	661.9	605.0
S_C3.008	50.00	8.51	21.227	3.723	0.0	0.0	100.8	1.85	661.9	605.0

Manhole Schedules for Storm_C

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)	Back (m)
S_C1	31.500	1.500	Open Manhole	1200	S_C3.000	30.000	225				
S_C2	29.850	1.500	Open Manhole	1200	S_C4.000	28.350	225				
S_C3	30.200	2.064	Open Manhole	1200	S_C4.001	28.136	225	S_C4.000	28.136	225	
S_C4	30.100	1.500	Open Manhole	1200	S_C5.000	28.600	225				
S_C5	30.400	2.413	Open Manhole	1200	S_C4.002	27.987	300	S_C4.001	28.062	225	
								S_C5.000	28.387	225	
S_C6	30.450	2.601	Open Manhole	1350	S_C3.001	27.849	375	S_C3.000	28.822	225	
								S_C4.002	27.924	300	
S_C7	29.850	2.107	Open Manhole	1350	S_C3.002	27.743	375	S_C3.001	27.743	375	
S_C8	25.950	1.500	Open Manhole	1200	S_C6.000	24.450	225				
S_C9	26.850	2.754	Open Manhole	1200	S_C6.001	24.096	300	S_C6.000	24.171	225	
S_C10	27.550	3.882	Open Manhole	1350	S_C3.003	23.668	450	S_C3.002	25.711	375	
								S_C6.001	23.818	300	
S_C11	25.050	1.500	Open Manhole	1200	S_C7.000	23.550	225				
S_C12	25.450	2.274	Open Manhole	1200	S_C7.001	23.176	300	S_C7.000	23.251	225	
S_C13	25.850	3.199	Open Manhole	1500	S_C3.004	22.651	525	S_C3.003	23.355	450	
								S_C7.001	22.876	300	
S_C14	24.300	1.500	Open Manhole	1200	S_C8.000	22.800	300				
S_C15	24.900	1.300	Open Manhole	1200	S_C9.000	23.600	225				
S_C16	24.650	1.225	Open Manhole	1200	S_C9.001	23.425	225	S_C9.000	23.425	225	
S_C17	25.080	1.480	Open Manhole	1200	S_C10.000	23.600	225				
S_C18	25.750	2.379	Open Manhole	1200	S_C10.001	23.371	300	S_C10.000	23.446	225	
S_C19	25.400	2.391	Open Manhole	1350	S_C9.002	23.009	375	S_C9.001	23.200	225	
								S_C10.001	23.084	300	
S_C20	25.050	2.647	Open Manhole	1350	S_C8.001	22.403	450	S_C8.000	22.553	300	
								S_C9.002	22.792	375	
S_C21	25.600	3.630	Open Manhole	1500	S_C3.005	21.970	600	S_C3.004	22.610	525	
								S_C8.001	22.120	450	
S_C22	31.700	1.500	Open Manhole	1200	S_C11.000	30.200	225				
S_C23	31.350	1.523	Open Manhole	1200	S_C11.001	29.827	225	S_C11.000	29.827	225	
S_C24	30.950	1.468	Open Manhole	1200	S_C11.002	29.482	225	S_C11.001	29.482	225	
S_C25	28.700	1.687	Open Manhole	1200	S_C11.003	27.013	300	S_C11.002	27.088	225	
S_C26	25.600	1.500	Open Manhole	1200	S_C12.000	24.100	225				
S_C27	25.100	3.558	Open Manhole	1500	S_C3.006	21.542	675	S_C3.005	21.617	600	
								S_C11.003	23.422	300	
								S_C12.000	23.614	225	
S_C28	24.350	1.450	Open Manhole	1200	S_C13.000	22.900	225				
S_C29	24.550	3.286	Open Manhole	1500	S_C3.007	21.264	675	S_C3.006	21.264	675	

Manhole Schedules for Storm_C

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)	Backd (mm
								S_C13.000	22.826	225	
S_C30	24.600	3.373	Open Manhole	1500	S_C3.008	21.227	675	S_C3.007	21.227	675	
S_C	24.800	3.901	Open Manhole	0		OUTFALL		S_C3.008	20.899	675	

PIPELINE SCHEDULES for Storm_C

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)
S_C3.000	o	225	S_C1	31.500	30.000	1.275	Open Manhole	1200
S_C4.000	o	225	S_C2	29.850	28.350	1.275	Open Manhole	1200
S_C4.001	o	225	S_C3	30.200	28.136	1.839	Open Manhole	1200
S_C5.000	o	225	S_C4	30.100	28.600	1.275	Open Manhole	1200
S_C4.002	o	300	S_C5	30.400	27.987	2.113	Open Manhole	1200
S_C3.001	o	375	S_C6	30.450	27.849	2.226	Open Manhole	1350
S_C3.002	o	375	S_C7	29.850	27.743	1.732	Open Manhole	1350
S_C6.000	o	225	S_C8	25.950	24.450	1.275	Open Manhole	1200
S_C6.001	o	300	S_C9	26.850	24.096	2.454	Open Manhole	1200
S_C3.003	o	450	S_C10	27.550	23.668	3.432	Open Manhole	1350
S_C7.000	o	225	S_C11	25.050	23.550	1.275	Open Manhole	1200
S_C7.001	o	300	S_C12	25.450	23.176	1.974	Open Manhole	1200
S_C3.004	o	525	S_C13	25.850	22.651	2.674	Open Manhole	1500

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)
S_C3.000	53.011	45.0	S_C6	30.450	28.822	1.403	Open Manhole	1350
S_C4.000	42.728	200.0	S_C3	30.200	28.136	1.839	Open Manhole	1200
S_C4.001	14.878	200.0	S_C5	30.400	28.062	2.113	Open Manhole	1200
S_C5.000	42.695	200.0	S_C5	30.400	28.387	1.788	Open Manhole	1200
S_C4.002	12.661	200.0	S_C6	30.450	27.924	2.226	Open Manhole	1350
S_C3.001	21.183	200.0	S_C7	29.850	27.743	1.732	Open Manhole	1350
S_C3.002	60.863	30.0	S_C10	27.550	25.711	1.464	Open Manhole	1350
S_C6.000	55.768	200.0	S_C9	26.850	24.171	2.454	Open Manhole	1200
S_C6.001	55.616	200.0	S_C10	27.550	23.818	3.432	Open Manhole	1350
S_C3.003	62.650	200.0	S_C13	25.850	23.355	2.045	Open Manhole	1500
S_C7.000	59.880	200.0	S_C12	25.450	23.251	1.974	Open Manhole	1200
S_C7.001	59.880	200.0	S_C13	25.850	22.876	2.674	Open Manhole	1500
S_C3.004	8.304	200.0	S_C21	25.600	22.610	2.465	Open Manhole	1500

PIPELINE SCHEDULES for Storm_C

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)
S_C8.000	o	300	S_C14	24.300	22.800	1.200	Open Manhole	1200
S_C9.000	o	225	S_C15	24.900	23.600	1.075	Open Manhole	1200
S_C9.001	o	225	S_C16	24.650	23.425	1.000	Open Manhole	1200
S_C10.000	o	225	S_C17	25.080	23.600	1.255	Open Manhole	1200
S_C10.001	o	300	S_C18	25.750	23.371	2.079	Open Manhole	1200
S_C9.002	o	375	S_C19	25.400	23.009	2.016	Open Manhole	1350
S_C8.001	o	450	S_C20	25.050	22.403	2.197	Open Manhole	1350
S_C3.005	o	600	S_C21	25.600	21.970	3.030	Open Manhole	1500
S_C11.000	o	225	S_C22	31.700	30.200	1.275	Open Manhole	1200
S_C11.001	o	225	S_C23	31.350	29.827	1.298	Open Manhole	1200
S_C11.002	o	225	S_C24	30.950	29.482	1.243	Open Manhole	1200
S_C11.003	o	300	S_C25	28.700	27.013	1.387	Open Manhole	1200
S_C12.000	o	225	S_C26	25.600	24.100	1.275	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)
S_C8.000	49.411	200.0	S_C20	25.050	22.553	2.197	Open Manhole	1350
S_C9.000	34.981	199.9	S_C16	24.650	23.425	1.000	Open Manhole	1200
S_C9.001	45.005	200.0	S_C19	25.400	23.200	1.975	Open Manhole	1350
S_C10.000	30.797	200.0	S_C18	25.750	23.446	2.079	Open Manhole	1200
S_C10.001	57.482	200.0	S_C19	25.400	23.084	2.016	Open Manhole	1350
S_C9.002	43.242	200.0	S_C20	25.050	22.792	1.883	Open Manhole	1350
S_C8.001	56.612	200.0	S_C21	25.600	22.120	3.030	Open Manhole	1500
S_C3.005	70.665	200.0	S_C27	25.100	21.617	2.883	Open Manhole	1500
S_C11.000	37.347	100.0	S_C23	31.350	29.827	1.298	Open Manhole	1200
S_C11.001	34.488	100.0	S_C24	30.950	29.482	1.243	Open Manhole	1200
S_C11.002	71.812	30.0	S_C25	28.700	27.088	1.387	Open Manhole	1200
S_C11.003	71.812	20.0	S_C27	25.100	23.422	1.378	Open Manhole	1500
S_C12.000	72.904	150.0	S_C27	25.100	23.614	1.261	Open Manhole	1500

PIPELINE SCHEDULES for Storm_C

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)
S_C3.006	o	675	S_C27	25.100	21.542	2.883	Open Manhole	1500
S_C13.000	o	225	S_C28	24.350	22.900	1.225	Open Manhole	1200
S_C3.007	o	675	S_C29	24.550	21.264	2.611	Open Manhole	1500
S_C3.008	o	675	S_C30	24.600	21.227	2.698	Open Manhole	1500

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)
S_C3.006	55.576	200.0	S_C29	24.550	21.264	2.611	Open Manhole	1500
S_C13.000	14.750	200.0	S_C29	24.550	22.826	1.499	Open Manhole	1500
S_C3.007	7.317	200.0	S_C30	24.600	21.227	2.698	Open Manhole	1500
S_C3.008	65.561	200.0	S_C	24.800	20.899	3.226	Open Manhole	0

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm_D

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.500	Add Flow / Climate Change (%)	20
Ratio R	0.300	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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

Time Area Diagram for Storm_D

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.447	4-8	0.843	8-12	0.027

Total Area Contributing (ha) = 1.317

Total Pipe Volume (m³) = 56.789

Network Design Table for Storm_D

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
S_D1.000	41.247	0.687	60.0	0.134	4.00	8.8	0.600	o	225	Pipe/Conduit	
S_D1.001	21.648	0.108	200.0	0.000	0.00	17.3	0.600	o	300	Pipe/Conduit	
S_D2.000	37.282	0.746	50.0	0.070	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_D1.002	17.460	0.087	200.0	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_D1.003	34.950	0.233	150.0	0.087	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S_D1.000	50.00	4.41	23.000	0.134	8.8	0.0	5.4	1.69	67.3	32.3
S_D1.001	50.00	4.73	20.800	0.134	26.1	0.0	8.8	1.11	78.3	53.0
S_D2.000	50.00	4.34	22.800	0.070	0.0	0.0	1.9	1.85	73.7	11.3
S_D1.002	50.00	4.99	20.692	0.212	26.1	0.0	11.0	1.11	78.3	65.8
S_D1.003	50.00	5.45	20.604	0.300	26.1	0.0	13.3	1.28	90.6	80.0

Network Design Table for Storm_D

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
S_D1.004	27.800	0.927	30.0	0.033	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_D3.000	24.599	1.230	20.0	0.029	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_D4.000	23.815	0.794	30.0	0.034	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_D3.001	71.118	2.371	30.0	0.151	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_D3.002	49.833	0.997	50.0	0.131	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_D3.003	6.938	0.023	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_D3.004	30.147	0.100	300.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_D3.005	11.009	0.037	300.0	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	
S_D1.005	20.241	0.067	300.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S_D5.000	58.921	0.982	60.0	0.212	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_D5.001	58.921	0.982	60.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_D6.000	32.133	0.161	200.0	0.035	4.00	0.0	0.600	o	225	Pipe/Conduit	
S_D5.002	24.392	0.244	100.0	0.068	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_D5.003	47.574	0.951	50.0	0.076	0.00	0.0	0.600	o	225	Pipe/Conduit	
S_D5.004	66.232	0.221	300.0	0.081	0.00	0.0	0.600	o	375	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)
S_D1.004	50.00	5.61	20.371	0.333	26.1	0.0	14.2	2.88	203.7	85.5
S_D3.000	50.00	4.14	22.050	0.029	0.0	0.0	0.8	2.94	116.9	4.7
S_D4.000	50.00	4.17	21.650	0.034	0.0	0.0	0.9	2.40	95.3	5.5
S_D3.001	50.00	4.66	20.820	0.214	0.0	0.0	5.8	2.40	95.3	34.8
S_D3.002	50.00	5.11	18.449	0.345	0.0	0.0	9.4	1.85	73.7	56.1
S_D3.003	50.00	5.24	17.378	0.345	0.0	0.0	9.4	0.90	63.8	56.1
S_D3.004	50.00	5.79	17.355	0.345	0.0	0.0	9.4	0.90	63.8	56.1
S_D3.005	50.00	6.00	17.254	0.364	0.0	0.0	9.8	0.90	63.8	59.1
S_D1.005	50.00	6.28	17.067	0.697	26.1	0.0	24.1	1.17	185.8	144.6
S_D5.000	50.00	4.58	23.300	0.212	0.0	0.0	5.7	1.69	67.3	34.4
S_D5.001	50.00	5.16	22.318	0.212	0.0	0.0	5.7	1.69	67.3	34.4
S_D6.000	50.00	4.58	21.000	0.035	0.0	0.0	1.0	0.92	36.6	5.8
S_D5.002	50.00	5.47	20.839	0.316	0.0	0.0	8.5	1.31	52.0	51.3
S_D5.003	50.00	5.90	20.595	0.392	0.0	0.0	10.6	1.85	73.7	63.6
S_D5.004	50.00	6.96	19.494	0.472	0.0	0.0	12.8	1.04	115.0	76.7

Network Design Table for Storm_D

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
S_D5.005	56.544	0.188	300.0	0.147	0.00	0.0	0.600	o	375	Pipe/Conduit	
S_D1.006	3.892	0.013	300.0	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S_D1.007	45.672	0.152	300.0	0.000	0.00	0.0	0.600	o	525	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)
S_D5.005	50.00	7.87	19.273	0.620	0.0	0.0	16.8	1.04	115.0	100.7
S_D1.006	50.00	7.92	16.925	1.317	26.1	0.0	40.9	1.29	278.8	245.3
S_D1.007	50.00	8.51	16.912	1.317	26.1	0.0	40.9	1.29	278.8	245.3

Manhole Schedules for Storm_D

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)	Backdr (mm)
S_D1	25.000	2.000	Open Manhole	1200	S_D1.000	23.000	225				
S_D2	23.900	3.100	Open Manhole	1200	S_D1.001	20.800	300	S_D1.000	22.313	225	14
S_D3	24.300	1.500	Open Manhole	1200	S_D2.000	22.800	225				
S_D4	23.500	2.808	Open Manhole	1200	S_D1.002	20.692	300	S_D1.001	20.692	300	
								S_D2.000	22.054	225	12
S_D5	23.000	2.396	Open Manhole	1200	S_D1.003	20.604	300	S_D1.002	20.604	300	
S_D6	21.900	1.529	Open Manhole	1200	S_D1.004	20.371	300	S_D1.003	20.371	300	
S_D7	23.500	1.450	Open Manhole	1200	S_D3.000	22.050	225				
S_D8	23.250	1.600	Open Manhole	1200	S_D4.000	21.650	225				
S_D9	22.300	1.480	Open Manhole	1200	S_D3.001	20.820	225	S_D3.000	20.820	225	
								S_D4.000	20.856	225	
S_D10	20.200	1.751	Open Manhole	1200	S_D3.002	18.449	225	S_D3.001	18.449	225	
S_D11	18.750	1.372	Open Manhole	1200	S_D3.003	17.378	300	S_D3.002	17.453	225	
S_D12	19.500	2.145	Open Manhole	1200	S_D3.004	17.355	300	S_D3.003	17.355	300	
S_D13	20.500	3.246	Open Manhole	1200	S_D3.005	17.254	300	S_D3.004	17.254	300	
S_D14	21.000	3.933	Open Manhole	1350	S_D1.005	17.067	450	S_D1.004	19.445	300	22
								S_D3.005	17.217	300	
S_D15	24.800	1.500	Open Manhole	1200	S_D5.000	23.300	225				
S_D16	23.850	1.532	Open Manhole	1200	S_D5.001	22.318	225	S_D5.000	22.318	225	
S_D17	22.450	1.450	Open Manhole	1200	S_D6.000	21.000	225				
S_D18	22.950	2.111	Open Manhole	1200	S_D5.002	20.839	225	S_D5.001	21.336	225	4
								S_D6.000	20.839	225	
S_D19	22.350	1.755	Open Manhole	1200	S_D5.003	20.595	225	S_D5.002	20.595	225	
S_D20	21.000	1.506	Open Manhole	1350	S_D5.004	19.494	375	S_D5.003	19.644	225	
S_D21	22.750	3.477	Open Manhole	1350	S_D5.005	19.273	375	S_D5.004	19.273	375	
S_D22	21.800	4.875	Open Manhole	1500	S_D1.006	16.925	525	S_D1.005	17.000	450	
								S_D5.005	19.085	375	20
S_D23	21.750	4.838	Open Manhole	1500	S_D1.007	16.912	525	S_D1.006	16.912	525	
S_D	22.750	5.990	Open Manhole	0		OUTFALL		S_D1.007	16.760	525	

PIPELINE SCHEDULES for Storm_D

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)
S_D1.000	o	225	S_D1	25.000	23.000	1.775	Open Manhole	1200
S_D1.001	o	300	S_D2	23.900	20.800	2.800	Open Manhole	1200
S_D2.000	o	225	S_D3	24.300	22.800	1.275	Open Manhole	1200
S_D1.002	o	300	S_D4	23.500	20.692	2.508	Open Manhole	1200
S_D1.003	o	300	S_D5	23.000	20.604	2.096	Open Manhole	1200
S_D1.004	o	300	S_D6	21.900	20.371	1.229	Open Manhole	1200
S_D3.000	o	225	S_D7	23.500	22.050	1.225	Open Manhole	1200
S_D4.000	o	225	S_D8	23.250	21.650	1.375	Open Manhole	1200
S_D3.001	o	225	S_D9	22.300	20.820	1.255	Open Manhole	1200
S_D3.002	o	225	S_D10	20.200	18.449	1.526	Open Manhole	1200
S_D3.003	o	300	S_D11	18.750	17.378	1.072	Open Manhole	1200
S_D3.004	o	300	S_D12	19.500	17.355	1.845	Open Manhole	1200
S_D3.005	o	300	S_D13	20.500	17.254	2.946	Open Manhole	1200
S_D1.005	o	450	S_D14	21.000	17.067	3.483	Open Manhole	1350

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)
S_D1.000	41.247	60.0	S_D2	23.900	22.313	1.362	Open Manhole	1200
S_D1.001	21.648	200.0	S_D4	23.500	20.692	2.508	Open Manhole	1200
S_D2.000	37.282	50.0	S_D4	23.500	22.054	1.221	Open Manhole	1200
S_D1.002	17.460	200.0	S_D5	23.000	20.604	2.096	Open Manhole	1200
S_D1.003	34.950	150.0	S_D6	21.900	20.371	1.229	Open Manhole	1200
S_D1.004	27.800	30.0	S_D14	21.000	19.445	1.255	Open Manhole	1350
S_D3.000	24.599	20.0	S_D9	22.300	20.820	1.255	Open Manhole	1200
S_D4.000	23.815	30.0	S_D9	22.300	20.856	1.219	Open Manhole	1200
S_D3.001	71.118	30.0	S_D10	20.200	18.449	1.526	Open Manhole	1200
S_D3.002	49.833	50.0	S_D11	18.750	17.453	1.072	Open Manhole	1200
S_D3.003	6.938	300.0	S_D12	19.500	17.355	1.845	Open Manhole	1200
S_D3.004	30.147	300.0	S_D13	20.500	17.254	2.946	Open Manhole	1200
S_D3.005	11.009	300.0	S_D14	21.000	17.217	3.483	Open Manhole	1350
S_D1.005	20.241	300.0	S_D22	21.800	17.000	4.350	Open Manhole	1500

PIPELINE SCHEDULES for Storm_D

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)
S_D5.000	o	225	S_D15	24.800	23.300	1.275	Open Manhole	1200
S_D5.001	o	225	S_D16	23.850	22.318	1.307	Open Manhole	1200
S_D6.000	o	225	S_D17	22.450	21.000	1.225	Open Manhole	1200
S_D5.002	o	225	S_D18	22.950	20.839	1.886	Open Manhole	1200
S_D5.003	o	225	S_D19	22.350	20.595	1.530	Open Manhole	1200
S_D5.004	o	375	S_D20	21.000	19.494	1.131	Open Manhole	1350
S_D5.005	o	375	S_D21	22.750	19.273	3.102	Open Manhole	1350
S_D1.006	o	525	S_D22	21.800	16.925	4.350	Open Manhole	1500
S_D1.007	o	525	S_D23	21.750	16.912	4.313	Open Manhole	1500

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)
S_D5.000	58.921	60.0	S_D16	23.850	22.318	1.307	Open Manhole	1200
S_D5.001	58.921	60.0	S_D18	22.950	21.336	1.389	Open Manhole	1200
S_D6.000	32.133	200.0	S_D18	22.950	20.839	1.886	Open Manhole	1200
S_D5.002	24.392	100.0	S_D19	22.350	20.595	1.530	Open Manhole	1200
S_D5.003	47.574	50.0	S_D20	21.000	19.644	1.131	Open Manhole	1350
S_D5.004	66.232	300.0	S_D21	22.750	19.273	3.102	Open Manhole	1350
S_D5.005	56.544	300.0	S_D22	21.800	19.085	2.340	Open Manhole	1500
S_D1.006	3.892	300.0	S_D23	21.750	16.912	4.313	Open Manhole	1500
S_D1.007	45.672	300.0	S_D	22.750	16.760	5.465	Open Manhole	0

F. Surface Water Attenuation Calculations

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

Half Drain Time : 477 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	29.199	0.899	0.9	25.7	26.4	550.0	O K
30 min Summer	29.513	1.213	1.2	25.7	26.4	742.2	O K
60 min Summer	29.817	1.517	1.5	25.7	26.4	928.5	O K
120 min Summer	30.108	1.808	1.7	25.7	26.4	1106.6	O K
180 min Summer	30.248	1.948	1.9	25.7	26.4	1192.1	O K
240 min Summer	30.326	2.026	1.9	25.7	26.4	1239.6	O K
360 min Summer	30.385	2.085	2.0	25.7	26.4	1275.9	O K
480 min Summer	30.391	2.091	2.0	25.7	26.4	1279.4	O K
600 min Summer	30.384	2.084	2.0	25.7	26.4	1275.3	O K
720 min Summer	30.369	2.069	2.0	25.7	26.4	1266.0	O K
960 min Summer	30.326	2.026	1.9	25.7	26.4	1240.1	O K
1440 min Summer	30.220	1.920	1.8	25.7	26.4	1174.8	O K
2160 min Summer	30.040	1.740	1.7	25.7	26.4	1064.7	O K
2880 min Summer	29.824	1.524	1.5	25.7	26.4	932.4	O K
4320 min Summer	29.401	1.101	1.1	25.7	26.4	673.8	O K
5760 min Summer	29.100	0.800	0.8	25.7	26.4	489.8	O K
7200 min Summer	28.894	0.594	0.6	25.5	26.0	363.7	O K
8640 min Summer	28.754	0.454	0.4	24.6	25.1	278.0	O K
10080 min Summer	28.660	0.360	0.3	23.5	23.9	220.1	O K
15 min Winter	29.310	1.010	1.0	25.7	26.4	618.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.088	0.0	570.5	23
30 min Summer	60.746	0.0	778.1	37
60 min Summer	38.900	0.0	1001.3	66
120 min Summer	24.244	0.0	1248.1	126
180 min Summer	18.233	0.0	1407.9	184
240 min Summer	14.867	0.0	1530.5	244
360 min Summer	11.120	0.0	1716.8	360
480 min Summer	9.037	0.0	1860.1	420
600 min Summer	7.690	0.0	1978.2	484
720 min Summer	6.737	0.0	2079.6	548
960 min Summer	5.466	0.0	2249.1	684
1440 min Summer	4.069	0.0	2509.7	968
2160 min Summer	3.029	0.0	2806.9	1388
2880 min Summer	2.455	0.0	3033.2	1792
4320 min Summer	1.823	0.0	3378.3	2512
5760 min Summer	1.475	0.0	3645.7	3176
7200 min Summer	1.251	0.0	3865.2	3888
8640 min Summer	1.094	0.0	4053.3	4576
10080 min Summer	0.976	0.0	4218.8	5248
15 min Winter	89.088	0.0	639.0	23

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	29.666	1.366	1.3	25.7	26.4	835.9	O K
60 min Winter	30.015	1.715	1.7	25.7	26.4	1049.4	O K
120 min Winter	30.346	2.046	2.0	25.7	26.4	1252.4	O K
180 min Winter	30.514	2.214	2.1	25.7	26.4	1354.8	O K
240 min Winter	30.612	2.312	2.2	25.7	26.5	1415.0	O K
360 min Winter	30.701	2.401	2.3	25.7	27.0	1469.6	O K
480 min Winter	30.718	2.418	2.3	25.7	27.1	1479.8	O K
600 min Winter	30.699	2.399	2.3	25.7	27.0	1468.2	O K
720 min Winter	30.680	2.380	2.3	25.7	26.9	1456.4	O K
960 min Winter	30.620	2.320	2.2	25.7	26.6	1419.9	O K
1440 min Winter	30.453	2.153	2.1	25.7	26.4	1317.9	O K
2160 min Winter	30.167	1.867	1.8	25.7	26.4	1142.8	O K
2880 min Winter	29.823	1.523	1.5	25.7	26.4	932.1	O K
4320 min Winter	29.187	0.887	0.9	25.7	26.4	543.1	O K
5760 min Winter	28.831	0.531	0.5	25.2	25.7	325.0	O K
7200 min Winter	28.645	0.345	0.3	23.3	23.7	211.1	O K
8640 min Winter	28.545	0.245	0.2	21.3	21.5	149.8	O K
10080 min Winter	28.503	0.203	0.2	19.5	19.7	124.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	60.746	0.0	871.4	37
60 min Winter	38.900	0.0	1121.4	66
120 min Winter	24.244	0.0	1397.8	124
180 min Winter	18.233	0.0	1576.6	182
240 min Winter	14.867	0.0	1714.0	238
360 min Winter	11.120	0.0	1922.6	350
480 min Winter	9.037	0.0	2083.1	456
600 min Winter	7.690	0.0	2215.3	546
720 min Winter	6.737	0.0	2328.8	574
960 min Winter	5.466	0.0	2518.6	728
1440 min Winter	4.069	0.0	2810.1	1042
2160 min Winter	3.029	0.0	3143.7	1496
2880 min Winter	2.455	0.0	3397.2	1936
4320 min Winter	1.823	0.0	3784.0	2600
5760 min Winter	1.475	0.0	4083.1	3232
7200 min Winter	1.251	0.0	4329.0	3888
8640 min Winter	1.094	0.0	4539.7	4504
10080 min Winter	0.976	0.0	4725.5	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.500	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 3.432

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.902	4	8	2.413	8	12	0.117

Model Details

Storage is Online Cover Level (m) 31.600

Infiltration Basin Structure

Invert Level (m) 28.300 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.03060

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1020.0	0.900	1020.0	1.800	1020.0	2.700	0.0
0.100	1020.0	1.000	1020.0	1.900	1020.0	2.800	0.0
0.200	1020.0	1.100	1020.0	2.000	1020.0	2.900	0.0
0.300	1020.0	1.200	1020.0	2.100	1020.0	3.000	0.0
0.400	1020.0	1.300	1020.0	2.200	1020.0	3.100	0.0
0.500	1020.0	1.400	1020.0	2.300	1020.0	3.200	0.0
0.600	1020.0	1.500	1020.0	2.400	1020.0		
0.700	1020.0	1.600	1020.0	2.500	1020.0		
0.800	1020.0	1.700	1020.0	2.600	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0198-2570-2600-2570
Design Head (m)	2.600
Design Flow (l/s)	25.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	198
Invert Level (m)	28.294
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.600	25.7
Flush-Flo™	0.749	25.7
Kick-Flo®	1.565	20.1
Mean Flow over Head Range	-	22.4

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	6.8	0.500	25.0	1.200	24.4	2.000	22.6
0.200	18.6	0.600	25.5	1.400	22.7	2.200	23.7
0.300	22.4	0.800	25.7	1.600	20.4	2.400	24.7
0.400	24.0	1.000	25.3	1.800	21.5	2.600	25.7

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
3.000	27.5	5.000	35.1	7.000	41.3	9.000	46.7
3.500	29.6	5.500	36.8	7.500	42.7	9.500	47.9
4.000	31.6	6.000	38.4	8.000	44.1		
4.500	33.4	6.500	39.9	8.500	45.4		

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

Half Drain Time : 587 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	24.321	0.771	0.3	11.5	11.5	305.3	O K
30 min Summer	24.592	1.042	0.5	11.5	11.5	412.5	O K
60 min Summer	24.850	1.300	0.6	11.5	11.5	514.9	O K
120 min Summer	25.095	1.545	0.7	11.5	12.0	611.9	O K
180 min Summer	25.214	1.664	0.7	11.6	12.3	658.8	O K
240 min Summer	25.280	1.730	0.8	11.8	12.5	685.1	O K
360 min Summer	25.329	1.779	0.8	11.9	12.7	704.6	O K
480 min Summer	25.321	1.771	0.8	11.9	12.6	701.4	O K
600 min Summer	25.302	1.752	0.8	11.8	12.6	693.6	O K
720 min Summer	25.285	1.735	0.8	11.8	12.5	687.0	O K
960 min Summer	25.253	1.703	0.7	11.7	12.4	674.3	O K
1440 min Summer	25.187	1.637	0.7	11.5	12.2	648.1	O K
2160 min Summer	25.072	1.522	0.7	11.5	11.9	602.6	O K
2880 min Summer	24.950	1.400	0.6	11.5	11.5	554.3	O K
4320 min Summer	24.702	1.152	0.5	11.5	11.5	456.3	O K
5760 min Summer	24.455	0.905	0.4	11.5	11.5	358.3	O K
7200 min Summer	24.150	0.600	0.3	11.5	11.5	237.6	O K
8640 min Summer	23.940	0.390	0.2	11.5	11.5	154.6	O K
10080 min Summer	23.790	0.240	0.1	11.5	11.5	94.9	O K
15 min Winter	24.419	0.869	0.4	11.5	11.5	344.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.088	0.0	319.6	23
30 min Summer	60.746	0.0	436.1	37
60 min Summer	38.900	0.0	558.8	66
120 min Summer	24.244	0.0	696.1	126
180 min Summer	18.233	0.0	786.4	186
240 min Summer	14.867	0.0	854.6	244
360 min Summer	11.120	0.0	958.2	362
480 min Summer	9.037	0.0	1038.4	454
600 min Summer	7.690	0.0	1104.8	512
720 min Summer	6.737	0.0	1162.1	576
960 min Summer	5.466	0.0	1257.2	706
1440 min Summer	4.069	0.0	1403.8	984
2160 min Summer	3.029	0.0	1567.7	1404
2880 min Summer	2.455	0.0	1694.7	1820
4320 min Summer	1.823	0.0	1886.3	2640
5760 min Summer	1.475	0.0	2036.6	3456
7200 min Summer	1.251	0.0	2158.9	4112
8640 min Summer	1.094	0.0	2263.0	4760
10080 min Summer	0.976	0.0	2355.8	5440
15 min Winter	89.088	0.0	358.3	23

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	24.725	1.175	0.5	11.5	11.5	465.2	O K
60 min Winter	25.021	1.471	0.6	11.5	11.7	582.7	O K
120 min Winter	25.309	1.759	0.8	11.8	12.6	696.4	O K
180 min Winter	25.456	1.906	0.8	12.2	13.0	754.7	O K
240 min Winter	25.543	1.993	0.9	12.4	13.3	789.4	O K
360 min Winter	25.627	2.077	0.9	12.6	13.5	822.4	O K
480 min Winter	25.646	2.096	0.9	12.7	13.6	830.0	O K
600 min Winter	25.632	2.082	0.9	12.6	13.5	824.3	O K
720 min Winter	25.600	2.050	0.9	12.6	13.5	811.7	O K
960 min Winter	25.546	1.996	0.9	12.4	13.3	790.2	O K
1440 min Winter	25.443	1.893	0.8	12.2	13.0	749.6	O K
2160 min Winter	25.255	1.705	0.8	11.7	12.4	675.3	O K
2880 min Winter	25.057	1.507	0.7	11.5	11.8	596.8	O K
4320 min Winter	24.667	1.117	0.5	11.5	11.5	442.4	O K
5760 min Winter	24.185	0.635	0.3	11.5	11.5	251.3	O K
7200 min Winter	23.825	0.275	0.1	11.5	11.5	109.0	O K
8640 min Winter	23.622	0.072	0.0	11.4	11.4	28.6	O K
10080 min Winter	23.550	0.000	0.0	11.0	11.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	60.746	0.0	489.2	37
60 min Winter	38.900	0.0	626.3	66
120 min Winter	24.244	0.0	780.5	124
180 min Winter	18.233	0.0	880.2	182
240 min Winter	14.867	0.0	956.6	238
360 min Winter	11.120	0.0	1073.5	352
480 min Winter	9.037	0.0	1164.0	462
600 min Winter	7.690	0.0	1237.2	566
720 min Winter	6.737	0.0	1301.8	608
960 min Winter	5.466	0.0	1407.9	746
1440 min Winter	4.069	0.0	1572.4	1058
2160 min Winter	3.029	0.0	1755.1	1516
2880 min Winter	2.455	0.0	1896.0	1964
4320 min Winter	1.823	0.0	2112.2	2816
5760 min Winter	1.475	0.0	2278.5	3576
7200 min Winter	1.251	0.0	2415.7	4176
8640 min Winter	1.094	0.0	2534.7	4672
10080 min Winter	0.976	0.0	2638.4	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)	16.500	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.916

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.550	4	8	1.336	8	12	0.030

Model Details

Storage is Online Cover Level (m) 26.150

Infiltration Basin Structure

Invert Level (m) 23.550 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.01740

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	660.0	0.700	660.0	1.400	660.0	2.100	660.0
0.100	660.0	0.800	660.0	1.500	660.0	2.200	660.0
0.200	660.0	0.900	660.0	1.600	660.0	2.300	0.0
0.300	660.0	1.000	660.0	1.700	660.0	2.400	0.0
0.400	660.0	1.100	660.0	1.800	660.0	2.500	0.0
0.500	660.0	1.200	660.0	1.900	660.0		
0.600	660.0	1.300	660.0	2.000	660.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0139-1270-2550-1270
Design Head (m)	2.550
Design Flow (l/s)	12.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	139
Invert Level (m)	23.108
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.550	12.7
Flush-Flo™	0.605	11.5
Kick-Flo®	1.243	9.0
Mean Flow over Head Range	-	10.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	0.800	11.3	2.000	11.3	4.000	15.7
0.200	9.5	1.000	10.7	2.200	11.8	4.500	16.6
0.300	10.6	1.200	9.5	2.400	12.3	5.000	17.5
0.400	11.1	1.400	9.6	2.600	12.8	5.500	18.3
0.500	11.4	1.600	10.2	3.000	13.7	6.000	19.1
0.600	11.5	1.800	10.8	3.500	14.7	6.500	19.8

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	20.5	8.000	21.9	9.000	23.2		
7.500	21.2	8.500	22.6	9.500	23.8		

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

Half Drain Time : 531 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	21.910	0.910	0.5	25.8	26.1	589.6	O K
30 min Summer	22.228	1.228	0.7	25.8	26.1	796.1	O K
60 min Summer	22.537	1.537	0.9	25.8	26.1	996.0	O K
120 min Summer	22.823	1.823	1.0	25.8	26.1	1181.4	O K
180 min Summer	22.959	1.959	1.1	25.8	26.1	1269.7	O K
240 min Summer	23.033	2.033	1.1	25.8	26.1	1317.6	O K
360 min Summer	23.086	2.086	1.2	25.8	26.1	1351.4	O K
480 min Summer	23.075	2.075	1.2	25.8	26.1	1344.7	O K
600 min Summer	23.051	2.051	1.2	25.8	26.1	1329.3	O K
720 min Summer	23.027	2.027	1.1	25.8	26.1	1313.4	O K
960 min Summer	22.980	1.980	1.1	25.8	26.1	1283.4	O K
1440 min Summer	22.884	1.884	1.1	25.8	26.1	1221.1	O K
2160 min Summer	22.723	1.723	1.0	25.8	26.1	1116.5	O K
2880 min Summer	22.545	1.545	0.9	25.8	26.1	1001.3	O K
4320 min Summer	22.109	1.109	0.6	25.8	26.1	718.5	O K
5760 min Summer	21.775	0.775	0.4	25.8	26.1	502.0	O K
7200 min Summer	21.533	0.533	0.3	25.8	26.1	345.5	O K
8640 min Summer	21.362	0.362	0.2	25.3	25.5	234.4	O K
10080 min Summer	21.242	0.242	0.1	24.5	24.7	157.1	O K
15 min Winter	22.025	1.025	0.6	25.8	26.1	664.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.088	0.0	621.0	23
30 min Summer	60.746	0.0	847.6	37
60 min Summer	38.900	0.0	1085.6	66
120 min Summer	24.244	0.0	1354.3	126
180 min Summer	18.233	0.0	1526.3	186
240 min Summer	14.867	0.0	1659.3	244
360 min Summer	11.120	0.0	1862.2	362
480 min Summer	9.037	0.0	2018.7	450
600 min Summer	7.690	0.0	2146.3	508
720 min Summer	6.737	0.0	2258.1	572
960 min Summer	5.466	0.0	2442.3	704
1440 min Summer	4.069	0.0	2727.0	984
2160 min Summer	3.029	0.0	3047.1	1408
2880 min Summer	2.455	0.0	3289.3	1820
4320 min Summer	1.823	0.0	3666.1	2556
5760 min Summer	1.475	0.0	3955.4	3280
7200 min Summer	1.251	0.0	4190.6	3960
8640 min Summer	1.094	0.0	4399.2	4592
10080 min Summer	0.976	0.0	4578.1	5336
15 min Winter	89.088	0.0	696.6	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	22.389	1.389	0.8	25.8	26.1	899.8	O K
60 min Winter	22.740	1.740	1.0	25.8	26.1	1127.3	O K
120 min Winter	23.074	2.074	1.2	25.8	26.1	1344.0	O K
180 min Winter	23.242	2.242	1.3	25.8	26.1	1453.1	O K
240 min Winter	23.340	2.340	1.3	25.8	26.4	1516.6	O K
360 min Winter	23.429	2.429	1.4	25.8	26.9	1573.9	O K
480 min Winter	23.444	2.444	1.4	25.8	27.0	1583.5	O K
600 min Winter	23.421	2.421	1.4	25.8	26.8	1568.8	O K
720 min Winter	23.383	2.383	1.3	25.8	26.7	1543.9	O K
960 min Winter	23.311	2.311	1.3	25.8	26.3	1497.8	O K
1440 min Winter	23.160	2.160	1.2	25.8	26.1	1399.7	O K
2160 min Winter	22.901	1.901	1.1	25.8	26.1	1231.9	O K
2880 min Winter	22.617	1.617	0.9	25.8	26.1	1047.6	O K
4320 min Winter	21.929	0.929	0.5	25.8	26.1	601.8	O K
5760 min Winter	21.494	0.494	0.3	25.7	26.0	320.3	O K
7200 min Winter	21.247	0.247	0.1	24.6	24.7	160.2	O K
8640 min Winter	21.109	0.109	0.1	22.7	22.8	70.9	O K
10080 min Winter	21.030	0.030	0.0	20.9	20.9	19.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	60.746	0.0	950.1	37
60 min Winter	38.900	0.0	1215.4	66
120 min Winter	24.244	0.0	1516.8	124
180 min Winter	18.233	0.0	1710.9	182
240 min Winter	14.867	0.0	1858.9	238
360 min Winter	11.120	0.0	2087.7	352
480 min Winter	9.037	0.0	2260.5	460
600 min Winter	7.690	0.0	2405.5	564
720 min Winter	6.737	0.0	2527.7	596
960 min Winter	5.466	0.0	2734.8	744
1440 min Winter	4.069	0.0	3055.0	1058
2160 min Winter	3.029	0.0	3410.7	1516
2880 min Winter	2.455	0.0	3683.1	1968
4320 min Winter	1.823	0.0	4106.1	2684
5760 min Winter	1.475	0.0	4430.1	3344
7200 min Winter	1.251	0.0	4695.1	3968
8640 min Winter	1.094	0.0	4925.0	4592
10080 min Winter	0.976	0.0	5126.8	5248

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.500	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 3.723

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.987	4	8	2.670	8	12	0.066

Model Details

Storage is Online Cover Level (m) 24.600

Infiltration Basin Structure

Invert Level (m) 21.000 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.01740

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1080.0	0.800	1080.0	1.600	1080.0	2.400	1080.0
0.100	1080.0	0.900	1080.0	1.700	1080.0	2.500	1080.0
0.200	1080.0	1.000	1080.0	1.800	1080.0	2.600	0.0
0.300	1080.0	1.100	1080.0	1.900	1080.0	2.700	0.0
0.400	1080.0	1.200	1080.0	2.000	1080.0	2.800	0.0
0.500	1080.0	1.300	1080.0	2.100	1080.0	2.900	0.0
0.600	1080.0	1.400	1080.0	2.200	1080.0	3.000	0.0
0.700	1080.0	1.500	1080.0	2.300	1080.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0197-2580-2700-2580
Design Head (m)	2.700
Design Flow (l/s)	25.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	197
Invert Level (m)	20.784
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	25.8
Flush-Flo™	0.783	25.8
Kick-Flo®	1.625	20.2
Mean Flow over Head Range	-	22.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	0.600	25.4	1.600	20.7	2.600	25.3
0.200	18.5	0.800	25.8	1.800	21.2	3.000	27.1
0.300	22.2	1.000	25.5	2.000	22.3	3.500	29.2
0.400	23.9	1.200	24.7	2.200	23.4	4.000	31.1
0.500	24.9	1.400	23.3	2.400	24.4	4.500	32.9

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
5.000	34.7	6.500	39.3	8.000	43.5	9.500	47.3
5.500	36.3	7.000	40.8	8.500	44.8		
6.000	37.8	7.500	42.1	9.000	46.0		

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

Half Drain Time : 487 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.629	0.779	0.7	8.8	9.2	210.4	O K
30 min Summer	17.904	1.054	0.9	8.8	9.2	284.5	O K
60 min Summer	18.165	1.315	1.1	8.8	9.2	355.1	O K
120 min Summer	18.406	1.556	1.3	8.8	9.5	420.2	O K
180 min Summer	18.521	1.671	1.4	8.8	9.9	451.1	O K
240 min Summer	18.582	1.732	1.5	8.8	10.1	467.6	O K
360 min Summer	18.623	1.773	1.5	8.8	10.2	478.8	O K
480 min Summer	18.627	1.777	1.5	8.8	10.2	479.8	O K
600 min Summer	18.620	1.770	1.5	8.8	10.2	477.9	O K
720 min Summer	18.607	1.757	1.5	8.8	10.2	474.4	O K
960 min Summer	18.572	1.722	1.5	8.8	10.1	464.9	O K
1440 min Summer	18.488	1.638	1.4	8.8	9.8	442.1	O K
2160 min Summer	18.353	1.503	1.3	8.8	9.4	405.8	O K
2880 min Summer	18.215	1.365	1.2	8.8	9.2	368.5	O K
4320 min Summer	17.923	1.073	0.9	8.8	9.2	289.7	O K
5760 min Summer	17.608	0.758	0.6	8.8	9.2	204.7	O K
7200 min Summer	17.402	0.552	0.5	8.8	9.2	149.1	O K
8640 min Summer	17.257	0.407	0.3	8.7	9.1	109.8	O K
10080 min Summer	17.156	0.306	0.3	8.5	8.7	82.7	O K
15 min Winter	17.727	0.877	0.7	8.8	9.2	236.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	89.088	0.0	219.8	22
30 min Summer	60.746	0.0	299.8	37
60 min Summer	38.900	0.0	384.2	66
120 min Summer	24.244	0.0	478.8	126
180 min Summer	18.233	0.0	540.0	184
240 min Summer	14.867	0.0	587.1	242
360 min Summer	11.120	0.0	658.8	354
480 min Summer	9.037	0.0	713.9	410
600 min Summer	7.690	0.0	759.3	474
720 min Summer	6.737	0.0	798.4	538
960 min Summer	5.466	0.0	863.6	674
1440 min Summer	4.069	0.0	964.4	956
2160 min Summer	3.029	0.0	1076.8	1368
2880 min Summer	2.455	0.0	1163.6	1788
4320 min Summer	1.823	0.0	1296.4	2600
5760 min Summer	1.475	0.0	1398.4	3280
7200 min Summer	1.251	0.0	1482.6	3960
8640 min Summer	1.094	0.0	1554.9	4592
10080 min Summer	0.976	0.0	1618.7	5336
15 min Winter	89.088	0.0	246.1	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	18.037	1.187	1.0	8.8	9.2	320.5	O K
60 min Winter	18.334	1.484	1.3	8.8	9.3	400.6	O K
120 min Winter	18.615	1.765	1.5	8.8	10.2	476.6	O K
180 min Winter	18.755	1.905	1.6	9.0	10.6	514.5	O K
240 min Winter	18.835	1.985	1.7	9.2	10.9	536.1	O K
360 min Winter	18.904	2.054	1.8	9.3	11.1	554.6	O K
480 min Winter	18.912	2.062	1.8	9.3	11.1	556.7	O K
600 min Winter	18.897	2.047	1.7	9.3	11.0	552.7	O K
720 min Winter	18.882	2.032	1.7	9.3	11.0	548.6	O K
960 min Winter	18.830	1.980	1.7	9.2	10.8	534.7	O K
1440 min Winter	18.695	1.845	1.6	8.9	10.4	498.2	O K
2160 min Winter	18.478	1.628	1.4	8.8	9.8	439.5	O K
2880 min Winter	18.261	1.411	1.2	8.8	9.2	380.8	O K
4320 min Winter	17.749	0.899	0.8	8.8	9.2	242.7	O K
5760 min Winter	17.369	0.519	0.4	8.8	9.2	140.1	O K
7200 min Winter	17.160	0.310	0.3	8.5	8.8	83.7	O K
8640 min Winter	17.048	0.198	0.2	7.9	8.1	53.4	O K
10080 min Winter	16.983	0.133	0.1	7.3	7.4	36.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	60.746	0.0	335.9	37
60 min Winter	38.900	0.0	430.1	66
120 min Winter	24.244	0.0	536.3	124
180 min Winter	18.233	0.0	604.9	180
240 min Winter	14.867	0.0	657.7	238
360 min Winter	11.120	0.0	737.9	348
480 min Winter	9.037	0.0	799.6	452
600 min Winter	7.690	0.0	850.4	490
720 min Winter	6.737	0.0	894.2	564
960 min Winter	5.466	0.0	967.2	720
1440 min Winter	4.069	0.0	1080.1	1028
2160 min Winter	3.029	0.0	1206.1	1476
2880 min Winter	2.455	0.0	1303.2	1928
4320 min Winter	1.823	0.0	1452.0	2724
5760 min Winter	1.475	0.0	1566.4	3344
7200 min Winter	1.251	0.0	1660.8	3968
8640 min Winter	1.094	0.0	1741.5	4584
10080 min Winter	0.976	0.0	1812.8	5248

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.500	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.317

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.447	4	8	0.843	8	12	0.027

Model Details

Storage is Online Cover Level (m) 21.750

Infiltration Basin Structure

Invert Level (m) 16.850 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Side (m/hr) 0.04080

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	450.0	0.700	450.0	1.400	450.0	2.100	450.0
0.100	450.0	0.800	450.0	1.500	450.0	2.200	0.0
0.200	450.0	0.900	450.0	1.600	450.0	2.300	0.0
0.300	450.0	1.000	450.0	1.700	450.0	2.400	0.0
0.400	450.0	1.100	450.0	1.800	450.0	2.500	0.0
0.500	450.0	1.200	450.0	1.900	450.0		
0.600	450.0	1.300	450.0	2.000	450.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0125-9300-2090-9300
Design Head (m)	2.090
Design Flow (l/s)	9.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	16.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.090	9.3
Flush-Flo™	0.543	8.8
Kick-Flo®	1.116	6.9
Mean Flow over Head Range	-	7.8

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	4.5	0.800	8.5	2.000	9.1	4.000	12.6
0.200	7.5	1.000	7.8	2.200	9.5	4.500	13.4
0.300	8.2	1.200	7.2	2.400	9.9	5.000	14.0
0.400	8.6	1.400	7.7	2.600	10.3	5.500	14.7
0.500	8.7	1.600	8.2	3.000	11.0	6.000	15.3
0.600	8.7	1.800	8.7	3.500	11.9	6.500	15.9

Hydro-Brake® Optimum Outflow Control

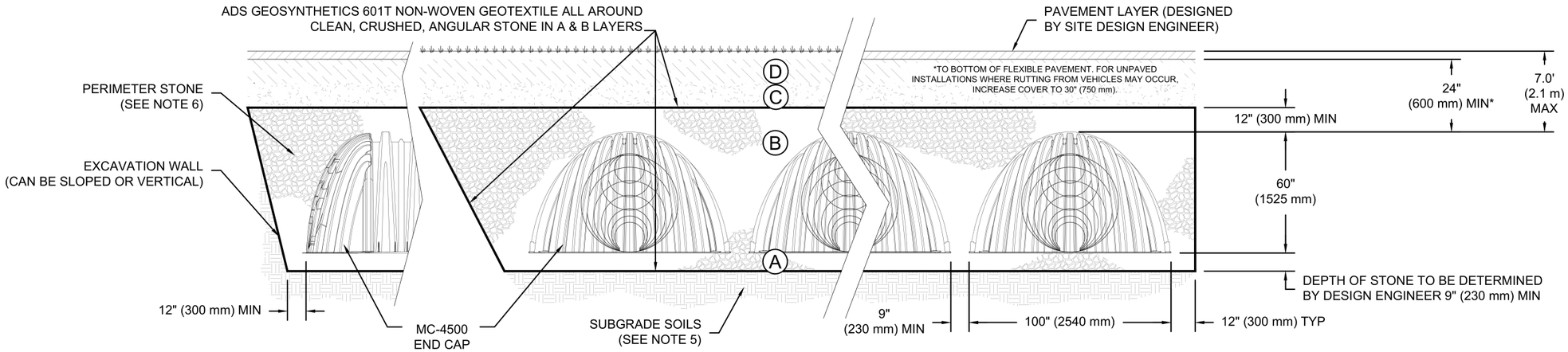
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	16.5	8.000	17.6	9.000	18.6		
7.500	17.0	8.500	18.1	9.500	19.1		

G. Typical Stormtech MC-4500 Construction Details

ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. [2] [3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.



NOTES:

1. MC-4500 CHAMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-4500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION REQUIREMENTS FOR FOUNDATION, EMBEDMENT, AND FILL MATERIALS.
4. THE "SITE DESIGN ENGINEER" REFERS TO THE ENGINEER RESPONSIBLE FOR THE DESIGN AND LAYOUT OF THE STORMTECH CHAMBERS FOR THIS PROJECT.
5. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
6. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
7. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.

18-014
Rathmullen_SWA

DATE: 11/14/2018 | DRAWN: BW | PROJECT #: Tool | CHECKED: ---

REV | DRW | CHK | DESCRIPTION

StormTech®
Detention • Retention • Water Quality
70 INWOOD ROAD, SUITE 3 | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

H. Louth County Council Consent Letter: proposed junction upgrades

Comhairle Contae **Lú**
Louth County Council

Mr Joe Gibbons
Waterman Moylan
Block S, East Point Business Park
Alfie Byrne Road
Dublin
D03 H3F4

26th June 2019

Re: Residential Development at Rathmullan, Drogheda Co Louth
SHD Planning Application Ref : ABP-303439-19

Dear Sirs,

I refer to the above matter and wish to advise that Louth County Council consents to the making of a planning application in relation to lands which is in its ownership at Rathmullan, Drogheda and for the proposed layout of the junction upgrades at Rathmullan Road/R132 junction and also the Rathmullan Road/Marleys Lane junction Drogheda, Co Louth, are generally acceptable, in order to mitigate the effect of additional traffic on these junctions, with regard to a pre-application submission to be made to An Bord Pleanala under the Strategic Housing Development (SHD) provisions of the Planning and Development Act. See attached drawings :-

Drawing No's 18-014/S100 prepared by Waterman Moylan Consulting Engineers

Drawing No's 18-014/S101 prepared by Waterman Moylan Consulting Engineers

Please be advised that nothing contained herein shall constitute or be construed as a contract or memorandum of same to the satisfaction of the Statute of Frauds (Ireland) Act, 1965. No binding agreement shall come into existence until such time as contracts in duplicate are agreed, executed, exchanged, returned and full contract deposit paid and accepted.

Yours sincerely

Alan Sherry
Senior Executive Officer

Comhairle Contae Lú
Halla an Chontae
Ionad na Milaoise
Dún Dealgan
Contae Lú
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