McArdle Doyle

Chartered Engineers
Architectural Services
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Engineering Report

P1956
Proposed Unmanned Service Station Development, Liffey Valley, Fonthill Road, Clondalkin, Dublin 22.

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1.0 Introduction

We, McArdle Doyle, are instructed by the Applicant, Certas Energy Ireland Ltd to prepare this Planning Report in respect of a new planning application for the proposed development of a new unmanned Service Station, Fonthill Road, Clondalkin Dublin 22, on lands south east of the existing Liffey Valley Shopping Centre.

The subject site extends to circa 2680 sq.m. (0.66 acres) and the application generally comprises the construction of a new service station with multi dispenser forecourt with associated canopy and underground fuel infrastructure, new car wash facilities with associated plant room as well as EV charging facilities with an associated substation building.

The design caters for an unmanned facility and prioritizes customer safety and comfort.

2.0 Scope of the Report

This report outlines proposals for the proposed development including the provisions of road pavements, parking areas, new surface water and foul sewer networks and other underground utilities associated with roads and buildings subject to obtaining the planning permission.

The report will also outline the existing drainage and water main infrastructure that supports the proposed development.

3.0 Topography of the Site

The area of the site is shown on drawing **No. P1956.C02.** The site is currently brownfield and the land topography slopes generally from north to south. The site levels vary approx. 1.1 metres across the site from 62.637m-61.500m

4.0 Existing Infrastructure

4.1 Existing Surface Water Drainage Networks

There is an existing 1050mm diameter surface water sewer located to the north of the subject site below the existing public footpath which straddles the site boundary. This sewer was identified when the topographical survey of the site was undertaken. The sewer follows the line of the footpath before changing direction at an existing public surface water manhole adjacent the pedestrian crossing adjacent the northern boundary of the site where it runs in a north easterly direction in the eastern verge of the existing Fonthill Road. This section of surface water sewer is then connected to an existing surface water manhole in the eastern verge of the Fonthill Road across from the entrance to the Liffey Valley/Tesco shopping centre complex. From this manhole location the sewer turns and

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continues in an easterly direction beneath the M50 motorway and on to Palmerstown.

4.2 Existing Foul Water

An existing 225mm diameter public foul sewer and an existing 525mm diameter public foul sewer are both located in close proximity to the eastern boundary of the site along the embankment adjacent the M50 motorway. The most easterly sewer pipework is the 525mm diameter line and the most westerly line closest to the site development is the 225mm diameter pipework.

As per the attached proposed drainage drawing P1956.C04, the foul line catering for the proposed site development of the carwash facility and associated plant room building is proposed to connect to the existing 225mm foul line at the location of new foul manhole F5. Foul Manhole F5 is proposed to be built on this existing 225mm diameter public line with a backdrop connection proposed to the existing invert level of 57.842m at this location. It is noted that the proposed 225mm diameter pipe invert from the site development is at invert level 59.865m resulting in a backdrop dimension of 2.023m. This backdrop manhole is to be constructed to Irish water 'Wastewater Infrastructure Standard Details' document IW-CDS-5030-01.

4.3 Existing Watermain

There is an existing 200mm diameter watermain located in the verge/ footpath of the Fonthill Road & associated distributor road network surrounding the entire Liffey Valley complex.

This 200mm ductile iron watermain runs along the footpath the opposite site of the Fonthill Road to the subject site northern boundary,
A branch line from this watermain crosses the road and runs to an existing hydrant located along the tarmac footpath which straddles the northern site boundary.
A proposed water connection of a 25mm diameter pipe to serve the car wash facility and associated services building is required with a new water meter and sluice valve also required to serve the site as shown on drawing P1956.C04

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5.0 Details of the Proposed Development

The proposed works encompass the construction of a new unmanned service station with multi dispenser forecourt associated canopy structure & underground fuel infrastructure, car wash facilities with associated plant room and EV charging units with associated substation.
The proposed drainage and water services will meet modern environmental standards.

In terms of sustainability the proposed car wash development will incorporate a brush wash with 50% recycling capacity, as well as this the EV charging infrastructure will cater for 4 No. EV charging Points for to cater for increasing electrical vehicle demand.
Details of the proposals are contained in the below points.

5.1 Internal Road Network

The internal traffic will be distributed in one-way arrangement. The proposed road layout is shown on drawing **No. P1956.C03.**

The proposed roads and parking areas have been designed as bituminous pavements, with cross falls and longitudinal falls to promote efficient drainage of all surfaces. Bituminous pavements will be finished with 45mm hot rolled asphalt surface course, to TII Clause 910.

The forecourt fueling slab, tanker drop-off area and tank farm slab will be concrete-paved. Concrete pavement slab will be class C35/45, 250 to 300mm thick, reinforced with A393 mesh.

All hardstanding pavements will be drained to the designed internal surface water network, through the proposed surface water gully inlets, linear slot drains and grating-type linear channels (minimum loading class D400).

The internal road layout and site access & egress have been designed to cater for a 15.4m oil tanker, a 16.5m lorry, a 7.5m long panel van and a private car. The maneuverability has been checked using the vehicle swept path analysis software, as shown on the design drawing **No. P1956.C30.**

The proposed car parking arrangement has been designed in accordance with the Design Manual for Urban Roads and Streets (Department of Transport, Tourism and Sport, 2013).

It is noted that a new point of egress to the site is proposed onto Fonthill Road on the northern boundary to accommodate a new one-way traffic arrangement.

This is clearly shown on proposed drawing P1956.C03 with tactile paving arrangement for a pedestrian crossing with associated signage and road markings which is shown on drawing P1956.C16. The available sightlines at this location is highlighted on drawing P1956.C28 which shows sight visibility splays at 2.4m from

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the existing road edge. It is noted that this egress location is the same location that was proposed for a previously granted planning application for a petrol filling station in 2013 with South Dublin County Council reference number SD13A/0183.

The internal road marking and signage has been designed in accordance with the Traffic Signs Manual, Department of Transport, 2010, as shown on drawing **No. P1956.C16.** Advisory speed limit of 5km/h has been proposed, to maximise the internal traffic safety.

The new internal road and parking lighting has been designed to EN 13201. The proposed lighting columns have been located with approximate 20m spacing, as shown on site services drawing **No. P1955.C06.**

5.2 Surface Water Network

It is proposed to construct a complete surface water drainage system to serve the development. The proposed network has been designed as an individual gravity pipe system, collecting the surface water runoff from all impermeable hardstanding areas. A New class-2 by-pass oil/fuel separator will be provided before the discharge point, to minimise risk of polluting the water course. The proposed network will tie into the existing 1050mm diameter storm sewer located on the northern pedestrian footpath adjacent the site boundary on Fonthill Road. This connection is proposed to be a backdrop connection with proposed 225mm pipe connecting into the existing 1050mm diameter storm sewer line.

Surface water from the proposed forecourt area and tanker off-loading slab will be collected in a separate contaminated storm network and will flow through the proposed class-1 full retention oil/fuel separator (10,000 Litre capacity). The fuel separator will be provided immediately upstream of the discharge to the general storm network.

The accompanying surface water design has been based on the Colebrook-White equation and the Rational Method. The criteria used in the design are as follows:

- Runoff: Q = 2.78 x Area x rainfall intensity
- Rainfall intensity: 50mm
- Pipe Material: PVC
- Minimum / maximum velocity: 0.8 / 3.0 m/s
- Pipe roughness ks: 0.06 mm

The proposed network layout is shown on drawing **No. P1956.C04.** Hydraulic calculation details for the proposed storm pipelines are included in **Appendix 1** to this Report.

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The new drainage network has been designed in accordance with guidelines set out in 'Greater Dublin Strategic Drainage Study' and 'The SUDS Manual, C697', published by CIRIA. The design embraces sustainable urban drainage (SUDS) principles – the network has been designed so that post-development runoff intensity does not exceed the pre-development equivalent greenfield runoff intensity. Surface water runoff from the hardstanding areas will be attenuated in the proposed new underground attenuation tank, before being discharged to the receiving storm sewer.

The Q_{BAR} flow rate has been calculated based on the Institute of Hydrology Report No. 124. The post-development storm return runoff rates from the proposed development have been calculated as follows:

- for 2-year storm return period: **1.51 l/s**
- for 30-year storm return period: **3.18 l/s**
- for 100-year storm return period: **3.93 l/s**

To meet the specified restricted runoff rates and control the post-development discharge runoff intensities, an underground surface water attenuation tank has been designed, with the capacity of **62m³**, to cater for the critical 100-year storm event. The tank has been sized based on the most up-to-date rainfall intensities derived from Met Eireann. 20% climate change has been additionally implemented in the attenuation capacity design, as per GDSDS requirements. It is proposed to construct a modular-type attenuation system, fully sealed, wrapped in impermeable membrane, to manufacturer's specifications. The proposed tank will be fully water-tight, to protect it from ground water ingress.

The post-development runoff rates will be restricted to the calculated equivalent greenfield pre-development intensities, by use of vortex-type flow control unit (Hydrobrake, or similar), located in the proposed flow control manhole chamber no. **S9**. The limited surface water runoff from the site will be discharged to the existing surface water network located on the Fonthill Road.

The proposed surface water attenuation capacity calculation details are included in **Appendix 1** to this Report.

5.3 Foul Sewer Network /Car Wash Facility

It is proposed to construct a new foul sewer drainage system, to serve the proposed car wash facility. The proposed network has been designed as an individual gravity pipe system, collecting foul effluent from the car wash development.

The accompanying design has been based on the Colebrook- White equation. The network has been designed in accordance with BS-EN 752 – Drains and Sewer Systems Outside Buildings and BS-EN 12056-2 – Gravity Drainage Systems Inside Buildings.

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The criteria used in the design are as follows:

- Pipe Material: PVC
- Minimum / maximum velocity: 0.8 / 3.0 m/s
- Pipe roughness ks: 0.6 mm
- frequency factor (k_{DU}) 0.7 (frequent use)

Hydraulic calculation details for the proposed foul pipelines are included in **Appendix 3** to this Report.

In terms of the car wash facility, a brush wash and a separate adjacent jet wash option is proposed as per drawing P1956.C04. Each of the two car wash requires approx. 280 litres per wash with an average of 30 washes per day, resulting in a daily requirement of 8,400 litres of water each however it is noted that the automatic brush wash will have a recycling capacity as described below.

5.3.1 Car Wash Recycling

The proposed brush wash system has an underground water recycling system which recycles 50% of the total volume of water required with the remaining 50% being lost through vapour spray, water remaining on cars post car washing and the requirement for fresh clean water for the final rinse.
Fresh water at a rate of 30 litres per wash is used for the final rinse (as the recycled water is dirty) resulting in a daily requirement of 4,200 litres of water which is 50% i.e., 4,200 litres less than if a recycling system was not provided.
The proposed network layout is shown on drawing **No. P1956.C04** which encompasses 3 no 6000-litre precast underground holding tanks by (S-Tank by Molloy Precast) that cater for fresh water storage, settlement and recycled water as well as a car wash separator described below. It is noted that the adjoining jet wash does not have any recycling capability and the discharge is connected directing to the car wash separator via the car wash sump.

5.3.2 Car Wash Separator

The proposed car wash requires a car wash separator to treat the water before discharge to the internal foul network which connects to the main public foul sewer at the wayleave on the eastern elevation of the site.
As per drawing P1956.C04 a proposed 3-chamber 3000 litre car wash interceptor W3/030 by Klargester or similar is required with accompanying vent located adjacent the southern site boundary minimum 2 meters above ground level.

5.4 Water Supply

The proposed car wash will be supplied by a new proposed 25mm water pipe connection from the existing watermain on the northern Fonthill Road. As per attached proposed drainage drawing P1956.C04 a proposed water meter and sluice

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valve are shown to cater for the new connection. The new 25mm water pipe is shown extended to the car wash plant room building laid to Irish water details & specifications.

5.5 EV Charging Infrastructure

The EV charging infrastructure proposed on the site consists of the Installation of 4 no. electric vehicle charging bays, each comprising a parking space and electric vehicle charging unit. These 75Kw Chargers will also require a 2-room substation and associated bollards and signage as described below.

5.5.1 Nature and Extent of EV Charging

The electric vehicle charging bays will be located along the northern boundary to the east of the new propsoed egress location and to the east of the proposed substation location.
Each charging bay will comprise a parking space and electric vehicle charging unit. The charging bays will be 5m deep & 2.5m wide with a 1.2m buffer zone between each space. This set out is consistent with the Department of Transport Chapter 07 August 2019 RRM034 detail for Electric Recharging Bay Road Markings.
It is proposed to provide four standard charging bays. Occasionally, one wider bay which can be designated accessible and be reserved for persons with a disability is included. However, in this case all spaces are provided with buffer spaces so they are all large enough to accommodate a disabled accessible space.
As per RRM034 the bays may also have green surfacing applied within the limits of the bay which is not extended into the buffer zones or main carriageway.
The individual charging units will be located to the new footpath to the rear of the car parking bays. Each charging unit will be approximately the same height as a standard fuel pump and half the width (approx. 0.6m wide X 2.4m high)

5.5.2 Electric Vehicle Services

The ducting and services requirements as well as the typical charger unit dimensions and specifications are noted on drawing P1956.C23.

5.5.3 New Substation

A new Medium Voltage 2 -room substation is required to power the proposed development. The substation which will be approximately 3.0m high, 4.38m deep and 7.6m wide will be located to the northern site boundary adjacent to the site entrance. Direct access for ESB vehicles will be provided to the front of the substation as shown on the application drawings P1956.C03 Proposed layout. The substation structure consists of RC strip footing foundations with suspended concrete slab floor, solid masonry block walls and an insitu RC concrete roof structure as per details on drawing P1956.C24.

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5.6 Services Building

A services building is proposed adjacent the car wash area to cater for a car wash plant room and a comms room. The services building structure consists of RC strip footing foundations with ground bearing concrete slab floor, solid masonry block walls and an insitu RC concrete roof structure as per details on drawing P1956.C24.

5.6.1 Car Wash Plant Room

Car wash Plant Room caters for car wash services and recycling system units for the brush & jet wash, a drainage gully is proposed located centrally in this floor to drain to the new foul system.

5.6.2 The Comms Room

The comms room is proposed to accommodate standard power and comms services as well as specific unmanned service station associated CCTV services, automated fuel & leak detection infrastructure and emergency shut requirements which is operated directly from a remote monitoring center.

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APPENDIX 1

Storm Network Design Calculations

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	17.000	Add Flow / Climate Change (%)	0
Ratio R	0.293	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	18.245	0.160	114.0	0.030	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	25.599	0.212	120.8	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	6.447	0.053	121.0	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	9.060	0.211	42.9	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	18.079	0.420	43.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	6.398	0.139	46.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	12.014	0.064	187.0	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	5.771	0.031	187.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	8.038	0.043	187.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	4.092	0.022	187.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	11.664	0.039	299.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	4.712	0.024	196.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	2.906	0.015	193.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	12.579	0.063	199.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	4.25	60.425	0.030	0.0	0.0	0.0	1.22	48.6	4.1
S1.001	50.00	4.61	60.265	0.060	0.0	0.0	0.0	1.19	47.3	8.1
S1.002	50.00	4.70	60.053	0.070	0.0	0.0	0.0	1.19	47.2	9.5
S2.000	50.00	4.08	60.770	0.020	0.0	0.0	0.0	2.00	79.6	2.7
S2.001	50.00	4.23	60.559	0.050	0.0	0.0	0.0	2.00	79.5	6.8
S2.002	50.00	4.28	60.139	0.070	0.0	0.0	0.0	1.93	76.9	9.5
S3.000	50.00	4.21	60.260	0.020	0.0	0.0	0.0	0.95	37.9	2.7
S3.001	50.00	4.31	60.196	0.040	0.0	0.0	0.0	0.95	37.9	5.4
S3.002	50.00	4.45	60.165	0.040	0.0	0.0	0.0	0.95	37.9	5.4
S3.003	50.00	4.52	60.022	0.040	0.0	0.0	0.0	0.95	37.9	5.4
S1.003	50.00	4.96	60.000	0.180	0.0	0.0	0.0	0.75	29.9	24.4
S1.004	50.00	5.04	59.961	0.180	0.0	0.0	0.0	0.93	37.0	24.4
S1.005	50.00	5.09	59.837	0.180	0.0	0.0	0.0	0.94	37.2	24.4
S1.006	50.00	5.32	59.822	0.180	0.0	0.0	0.0	0.92	36.6	24.4

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S12, DS/PN: S1.004, Volume (m³): 2.8

Unit Reference	MD-SHE-0091-3900-1200-3900
Design Head (m)	1.200
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	91
Invert Level (m)	59.961
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	3.9	Kick-Flo®	0.747	3.1
Flush-Flo™	0.364	3.9	Mean Flow over Head Range	-	3.4

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	2.8	1.200	3.9	3.000	6.0	7.000	8.9
0.200	3.7	1.400	4.2	3.500	6.4	7.500	9.2
0.300	3.9	1.600	4.5	4.000	6.8	8.000	9.5
0.400	3.9	1.800	4.7	4.500	7.2	8.500	9.8
0.500	3.8	2.000	4.9	5.000	7.6	9.000	10.0
0.600	3.7	2.200	5.2	5.500	7.9	9.500	10.3
0.800	3.2	2.400	5.4	6.000	8.3		
1.000	3.6	2.600	5.6	6.500	8.6		

Storage Structures for Storm

Cellular Storage Manhole: S12, DS/PN: S1.004

Invert Level (m) 59.961 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	54.0	0.0	2.600	0.0	0.0
0.200	54.0	0.0	2.800	0.0	0.0
0.400	54.0	0.0	3.000	0.0	0.0
0.600	54.0	0.0	3.200	0.0	0.0
0.800	54.0	0.0	3.400	0.0	0.0
1.000	54.0	0.0	3.600	0.0	0.0
1.200	54.0	0.0	3.800	0.0	0.0
1.400	0.0	0.0	4.000	0.0	0.0
1.600	0.0	0.0	4.200	0.0	0.0
1.800	0.0	0.0	4.400	0.0	0.0
2.000	0.0	0.0	4.600	0.0	0.0
2.200	0.0	0.0	4.800	0.0	0.0
2.400	0.0	0.0	5.000	0.0	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.280
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.600	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+20%	100/120 Winter				60.472
S1.001	S2	15 Winter	1	+20%	30/120 Winter				60.329
S1.002	S3	120 Winter	1	+20%	30/15 Summer	100/960 Summer			60.182
S2.000	S4	15 Winter	1	+20%					60.801
S2.001	S5	15 Winter	1	+20%					60.604
S2.002	S6	15 Winter	1	+20%	30/30 Winter				60.200
S3.000	S7	15 Summer	1	+20%	30/120 Winter				60.305
S3.001	S8	15 Winter	1	+20%	30/60 Winter				60.261
S3.002	S9	15 Winter	1	+20%	30/60 Summer				60.228
S3.003	S10	120 Winter	1	+20%	30/15 Summer				60.181
S1.003	S11	120 Winter	1	+20%	30/15 Summer	30/720 Summer			60.181
S1.004	S12	120 Winter	1	+20%	30/15 Summer				60.178
S1.005	S13	120 Winter	1	+20%					59.892
S1.006	S14	120 Winter	1	+20%					59.873

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.178	0.000	0.10		4.4	OK	
S1.001	S2	-0.161	0.000	0.18		7.7	OK	
S1.002	S3	-0.096	0.000	0.11		3.5	OK	
S2.000	S4	-0.194	0.000	0.05		2.9	OK	
S2.001	S5	-0.180	0.000	0.09		6.4	OK	
S2.002	S6	-0.164	0.000	0.16		8.7	OK	
S3.000	S7	-0.180	0.000	0.09		2.9	OK	
S3.001	S8	-0.160	0.000	0.18		5.2	OK	
S3.002	S9	-0.162	0.000	0.17		5.2	OK	
S3.003	S10	-0.066	0.000	0.09		2.2	OK	
S1.003	S11	-0.044	0.000	0.33		8.5	OK	
S1.004	S12	-0.008	0.000	0.14		3.7	OK	
S1.005	S13	-0.170	0.000	0.14		3.7	OK	
S1.006	S14	-0.174	0.000	0.12		3.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.280
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.600	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+20%	100/120 Winter				60.497
S1.001	S2	120 Winter	30	+20%	30/120 Winter				60.492
S1.002	S3	180 Winter	30	+20%	30/15 Summer	100/960 Summer			60.530
S2.000	S4	15 Winter	30	+20%					60.817
S2.001	S5	15 Summer	30	+20%					60.631
S2.002	S6	180 Summer	30	+20%	30/30 Winter				60.516
S3.000	S7	120 Winter	30	+20%	30/120 Winter				60.490
S3.001	S8	120 Winter	30	+20%	30/60 Winter				60.489
S3.002	S9	180 Winter	30	+20%	30/60 Summer				60.493
S3.003	S10	180 Winter	30	+20%	30/15 Summer				60.492
S1.003	S11	240 Summer	30	+20%	30/15 Summer	30/720 Summer			60.563
S1.004	S12	180 Winter	30	+20%	30/15 Summer				60.482
S1.005	S13	60 Winter	30	+20%					59.893
S1.006	S14	180 Summer	30	+20%					59.874

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.153	0.000	0.22		9.7	OK	
S1.001	S2	0.002	0.000	0.15		6.5	SURCHARGED	
S1.002	S3	0.252	0.000	0.16		5.1	SURCHARGED	
S2.000	S4	-0.178	0.000	0.10		6.5	OK	
S2.001	S5	-0.153	0.000	0.23		16.3	OK	
S2.002	S6	0.152	0.000	0.14		7.4	SURCHARGED	
S3.000	S7	0.005	0.000	0.07		2.1	SURCHARGED	
S3.001	S8	0.069	0.000	0.14		4.0	SURCHARGED	
S3.002	S9	0.103	0.000	0.10		2.9	SURCHARGED	
S3.003	S10	0.245	0.000	0.08		2.1	SURCHARGED	
S1.003	S11	0.338	0.000	0.50		12.7	SURCHARGED	
S1.004	S12	0.296	0.000	0.15		3.9	SURCHARGED	
S1.005	S13	-0.169	0.000	0.14		3.9	OK	
S1.006	S14	-0.173	0.000	0.12		3.9	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.280
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	16.600	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	180 Winter	100	+20%	100/120 Winter				60.705
S1.001	S2	180 Winter	100	+20%	30/120 Winter				60.720
S1.002	S3	180 Winter	100	+20%	30/15 Summer	100/960 Summer			60.715
S2.000	S4	15 Winter	100	+20%					60.824
S2.001	S5	180 Winter	100	+20%					60.698
S2.002	S6	180 Winter	100	+20%	30/30 Winter				60.716
S3.000	S7	180 Winter	100	+20%	30/120 Winter				60.698
S3.001	S8	180 Winter	100	+20%	30/60 Winter				60.699
S3.002	S9	180 Winter	100	+20%	30/60 Summer				60.700
S3.003	S10	180 Winter	100	+20%	30/15 Summer				60.700
S1.003	S11	180 Winter	100	+20%	30/15 Summer	30/720 Summer			60.708
S1.004	S12	180 Winter	100	+20%	30/15 Summer				60.695
S1.005	S13	15 Summer	100	+20%					59.893
S1.006	S14	15 Summer	100	+20%					59.874

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.055	0.000	0.08		3.3	SURCHARGED	
S1.001	S2	0.230	0.000	0.14		6.0	SURCHARGED	
S1.002	S3	0.437	0.000	0.19		6.2	SURCHARGED	
S2.000	S4	-0.171	0.000	0.13		8.4	OK	
S2.001	S5	-0.086	0.000	0.08		5.5	OK	
S2.002	S6	0.352	0.000	0.13		7.1	SURCHARGED	
S3.000	S7	0.213	0.000	0.06		1.9	SURCHARGED	
S3.001	S8	0.279	0.000	0.12		3.5	SURCHARGED	
S3.002	S9	0.310	0.000	0.11		3.3	SURCHARGED	
S3.003	S10	0.453	0.000	0.07		1.8	SURCHARGED	
S1.003	S11	0.483	0.000	0.55		14.1	SURCHARGED	
S1.004	S12	0.510	0.000	0.15		3.9	SURCHARGED	
S1.005	S13	-0.169	0.000	0.14		3.9	OK	
S1.006	S14	-0.173	0.000	0.12		3.9	OK	

APPENDIX 2

Foul Network Design Calculations

McArdle Doyle Ltd
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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)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	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	6.281	0.100	62.8	0.000	0	0.2	1.500	o	225	Pipe/Conduit	
F1.001	35.053	0.351	100.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	13.595	0.139	97.5	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)
F1.000	60.455	0.000	0.2	0	0.0	10	0.32	1.45	57.6	0.2
F1.001	60.355	0.000	0.2	0	0.0	11	0.27	1.15	45.6	0.2
F1.002	60.004	0.000	0.2	0	0.0	11	0.28	1.16	46.2	0.2