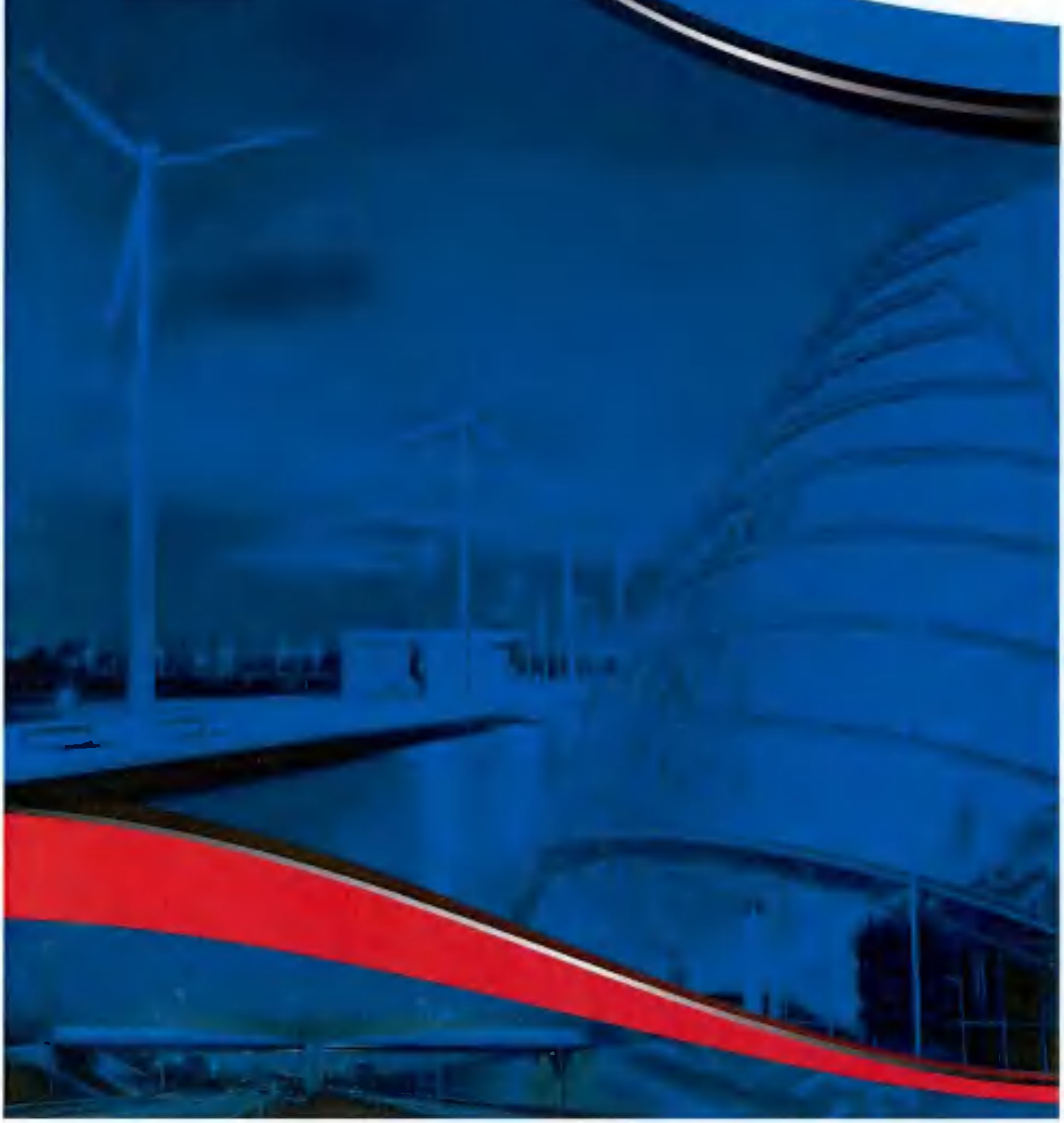
Engineering Services Report

COMMERCIAL EXTENSION
FOR TOYOTA IRELAND

PROJECT NO. T260
11th FEBRUARY 2022

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers



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COMMERCIAL EXTENSION

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PROJECT NO. T260

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Engineering Services Report

for

Commercial extention,

at Toyota Liffey Valley,

Co. Dublin.

OCSC

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NOTICE

DOCUMENT CONTROL & HISTORY

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ENGINEERING SERVICES REPORT

29TH JUNE 2021

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ENGINEERING SERVICES REPORT

11TH February 2022

1 INTRODUCTION

1.1 APPOINTMENT

O'Connor Sutton Cronin & Associates (OCSC) have been appointed by *Toyota Ireland*; to carry out the design of the civil engineering services associated with the proposed extension to the existing showroom and forecourt at Liffey Valley Motor Mall.

1.2 ADMINISTRATIVE JURISDICTION

The proposed development is located in the jurisdiction of South Dublin County Council (SDCC), and therefore the engineering services design was carried out with reference to the following:

- South Dublin County Council Development Plan 2016-2022;
- Greater Dublin Strategic Drainage Study (GDSDS);
- The Planning System and Flood Risk Management Guidelines for Planning Authorities (Department of Environment, Heritage and Local Government and the Office of Public Works);

1.3 SITE LOCATION

The subject site is located on the eastern edge of Ongar in Co. Dublin, as shown in *Figure 1.1 - Site Location*, and is immediately bound by:

- N4 slip road at junction 2 , to the north;
- Clayton Hotel, to the west;
- Vacant undeveloped lot, to the east;
- Car showroom, to the south.

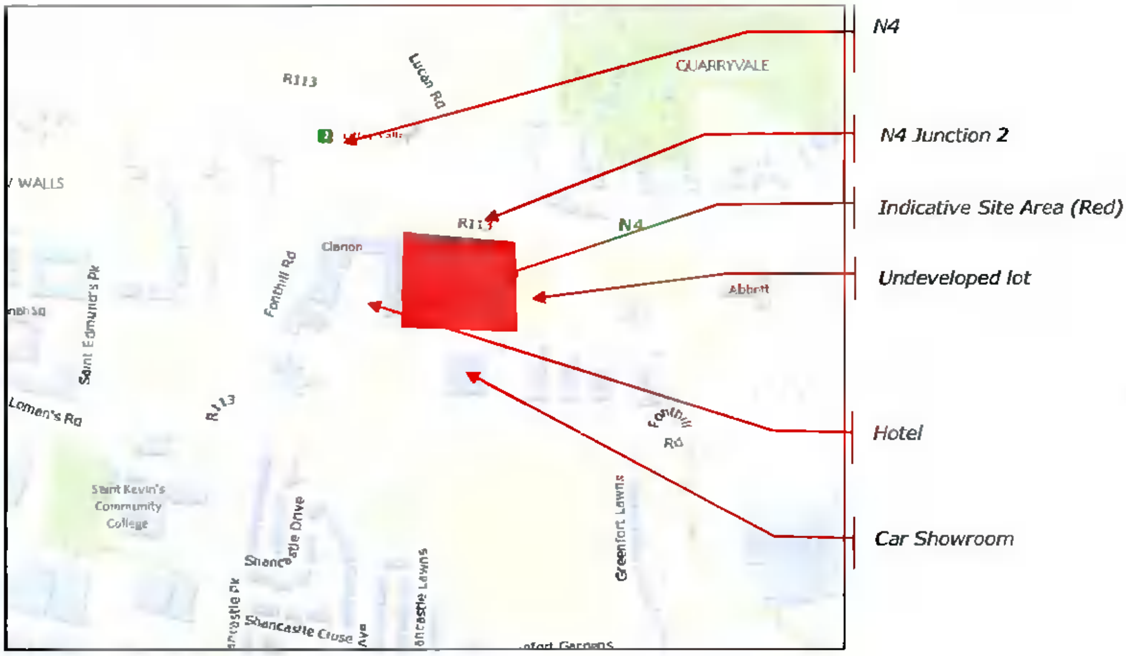

Figure 1.1 - Site Location (www.myplan.ie)

1.4 EXISTING SITE OVERVIEW

The overall site area is **c.1.4-hectares**, and is zoned by South Dublin County Council for ***MRC***. This zoning seeks to *'To protect, improve and provide for the future development of a Major Retail Centre'.*

Approximately 1.0 ha of the site area consists of the existing Toyota Liffey Showroom and yard. The remaining approximately 0.4ha of the site consists of an undeveloped vacant lot.

The existing levels of the undeveloped section of the site are typically graded from south to north with typical high points along the southern boundary in the order of +61.00mOD. Levels along the northern boundary are typically in the order if +58.25mOD with a low point of approximately +58.00mOD in the north-eastern corner. This gives a typical gradient of approximately 3.3% across the site.

1.5 PROPOSED SITE DESCRIPTION

The development will consist of: the construction of a single storey (double height) extension (c.568 sq m) to the existing Motor Sales Outlet with servicing area which will comprise a car body shop and valet area; a single storey remote sales office (c.20 sq m); a covered bike shelter; ancillary petrol fill area; alterations to vehicle storage area; alterations and relocation of the existing vehicle display provision (resulting in total of 79 no. defined display spaces (59 no. additional) together with indicative display areas with capacity for c. 72 no. vehicles); a reduction in service spaces (resulting in total of 23 no. service spaces (3 no. less)) and relocation and additions to the existing staff car parking provision (resulting in total of 25 no. staff spaces (5 no. additional); and provision of a new pedestrian site entrance.

The development will also consist of signage (3 no. signs (4.45 sq m; 2.71 sq m; 0.58 sq m); alterations and additions to the soft and hard landscaping, including the removal of existing fence, new boundary treatment and internal vehicle access gate, pedestrian paths and access, paving, tarmac and planting; relocation of vehicle sliding gate; an additional vehicle display podium; additional electric charging bays; new lighting; elevational changes to the existing building to facilitate the extension; an additional attenuation tank; all piped infrastructure and ducting; plant; and all associated site development and excavation works above and below ground.

2 SCOPE OF SERVICES REPORT

This Engineering Services Report was prepared by reviewing the available data from the Local Authority sources and national bodies *i.e.* South Dublin County Council, Irish Water, The OPW, and the wider Design Team. The report addresses the following services with respect to the proposed development:

- Surface Water Drainage;
- Wastewater Drainage;
- Flood Risk Assessment;
- Traffic and Transport.

This report should be read in conjunction with the following OCSC Civil Engineering design drawings:

T260-OCSC-XX-XX-DR-C-0110 – Swept Path Analysis – Large Car

T260-OCSC-XX-XX-DR-C-0111 – Swept Path Analysis – Fire Tender

T260-OCSC-XX-XX-DR-C-0112 – Swept Path Analysis – Small Oil Tanker

T260-OCSC-XX-XX-DR-C-0500 – Proposed Drainage Design Layout

T260-OCSC-XX-XX-DR-C-0510 – Proposed Drainage Surface Water Longsections

T260-OCSC-XX-XX-DR-C-0520 – Drainage Details Sheet 1 of 2

T260-OCSC-XX-XX-DR-C-0521 – Drainage Details Sheet 2 of 2

T260-OCSC-XX-XX-DR-C-0525 – Attenuation Tank Cross Sections

The proposed design, for the aforementioned services, have been carried out in accordance with the following technical guidelines and information:

- South Dublin County Council Development Plan 2016-2022;
- Greater Dublin Strategic Drainage Study (GDSDS);
- Greater Dublin Regional Code of Practice for Drainage Works (GDRCOP);
- Irish Water Code of Practice for Wastewater, IW-CDS-5030-03;
- Irish Water Code of Practice for Water Supply, IW-CDS-5020-03;
- The Building Regulations – Technical Guidance Document Part H;
- BE EN 752 – Drainage Outside Buildings;

- BS 7533-13 – Guide for Design of Permeable Pavements;
- The Office of Public Works, the Planning System and Flood Risk Management;
- Design Manual for Urban roads and Streets;
- South Dublin County Council and Irish Water Drainage and Watermain Records.

Members of the wider design team cover all other elements of the application pertaining to, sustainability, landscaping, planning and architectural detail.

3 SURFACE WATER DRAINAGE

3.1 OVERVIEW

Any planning permission sought on the subject lands are required to adhere to the Local Authority requirements, the South Dublin County Council Development Plan and as such, the Greater Dublin Strategic Drainage Study (Dublin City Council, 2005).

New developments must ensure that a comprehensive Sustainable Drainage System, SuDS, is incorporated into the development. SuDS requires that post development run-off rates be maintained at equivalent, or lower, levels than pre-development levels. Thus, the development must be able to retain, within its boundaries, surface water volumes from extreme rainfall events up to a 1 in 100-year rainfall event, more commonly expressed as a 1.0% AEP (Annual Exceedance Probability), *while also allowing for an additional climate change factor of 20% increase in rainfall intensity*. Any new development must also have the physical capacity to retain surface water volumes as directed under the Greater Dublin Strategic Drainage Strategy (GDSDS) and, if necessary, release these attenuated surface water volumes to an outfall at a controlled flow rate.

A further component of the SuDS protocol is to increase the overall water quality of surface water runoff before it enters a natural watercourse or a public sewer, which ultimately discharges to a water body. This is to ensure the highest possible standard of surface water quality.

3.2 EXISTING SITE DRAINAGE

3.2.1 EXISTING SITE CATCHMENT AREAS

As detailed in *Section 1.4*, the existing c.1.4-hectare site consists of developed and undeveloped land. The developed area of the site is 100% hardstanding, comprising of a building covering approximately 2,400m^2, the remaining area of the site is hardstanding yard used for vehicle storage. The undeveloped c0.4ha section of the site is brownfield in nature. Refer to Figure 3.1 for aerial image of the proposed site, for context.

Figure 3.1 - Existing Site, Aerial Overview (Google Earth)

3.2.2 EXISTING SURFACE WATER DRAINAGE INFRASTRUCTURE

There is an existing 750mm Ø public surface water sewer along the northern boundary of the site. Levels indicate that this sewer falls from west to east along the N4.

The vehicle storage yard contains an existing surface water network which was originally designed to accommodate run-off from rainfall events up to an including the 1 in 100-year event. The hardstanding areas are drained using filter drains along the boundary, ground levels on site have been designed to route runoff towards these filter drains. Perforated pipes within this filter drain range in diameter from 225mm to 300mm. Run-off from the network has been limited to 2.195 l/s. This is achieved through the provision of a flow control in the final manhole prior to discharge. A fuel separator is also included in the existing network prior to discharging to the public sewer.

3.2.3 EXISTING SITE RAINFALL RUNOFF

The existing site currently drains naturally to the site boundaries. Refer to *Section 1.4* for overview details of the existing site topography.

The existing site drainage as detailed above includes a flow control which limits discharge to 2.195 l/s.

Using the ICPSuDS Input, (Flood Studies Report (FSR)) Method, the rainfall runoff discharging from the greenfield site area that is to be developed in its existing condition has been estimated at $QBAR_{RURAL}$ = **1.3 l/s** (3.16 l/s/ha). Refer to *Figure 3.2* for an excerpt of the results from the MicroDrainage Runoff Calculator, which also provides the calculated QBAR runoff rate along with the discharge rate for varying Annual Recurrence Intervals (ARI).

Due to the size of an orifice that would be required to limit the discharge to the greenfield equivalent, the discharge from the undeveloped site has been limited **2.0l/s**. This flow rate has been provided in order to reduce the risk of blockages within the flow control device. Total discharge from the site is limited to 4.195 l/s (2.99 l/s/ha). This is from the existing 2.195l/s and the 2l/s from the proposed extension of the vehicle parking area. The existing flow control along with the existing network is to be maintained.

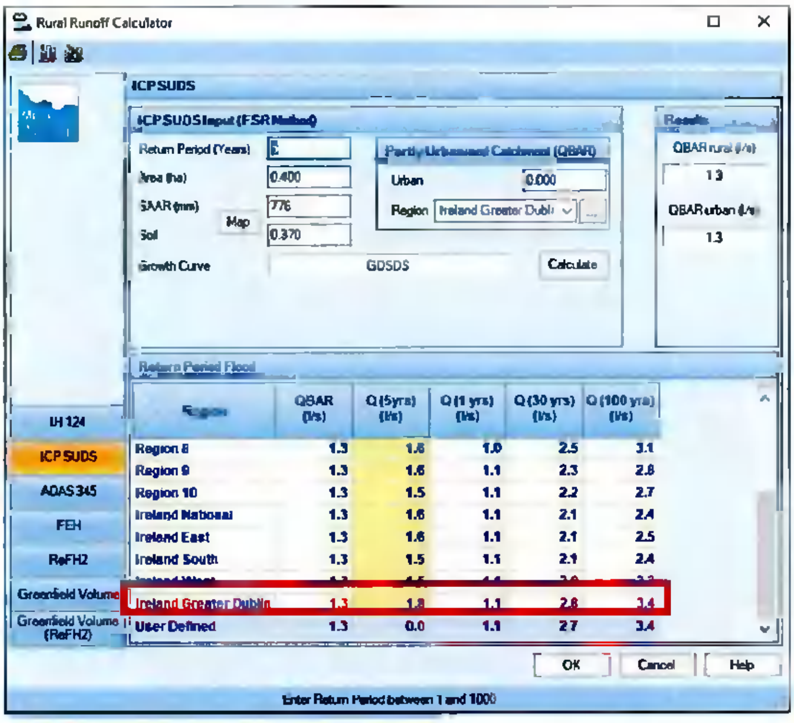

Figure 3.2 - Existing Site Runoff Calculator Results (MicroDrainage Excerpt)

3.3 PROPOSED SURFACE WATER DRAINAGE DESIGN STRATEGY

3.3.1 PROPOSED SURFACE WATER STRATEGY OVERVIEW

It is proposed to provide surface water network to serve the development in accordance with the guidelines in Section 2 above.

3.3.2 PROPOSED SURFACE WATER DESIGN CRITERIA

The proposed surface water network has been designed in accordance with the regulations and guidelines outlined in *Section 2*. Rainfall design data, such as return period rainfall depths for sliding durations and the standard annual average rainfall (SAAR) value were sourced from Met Éireann.

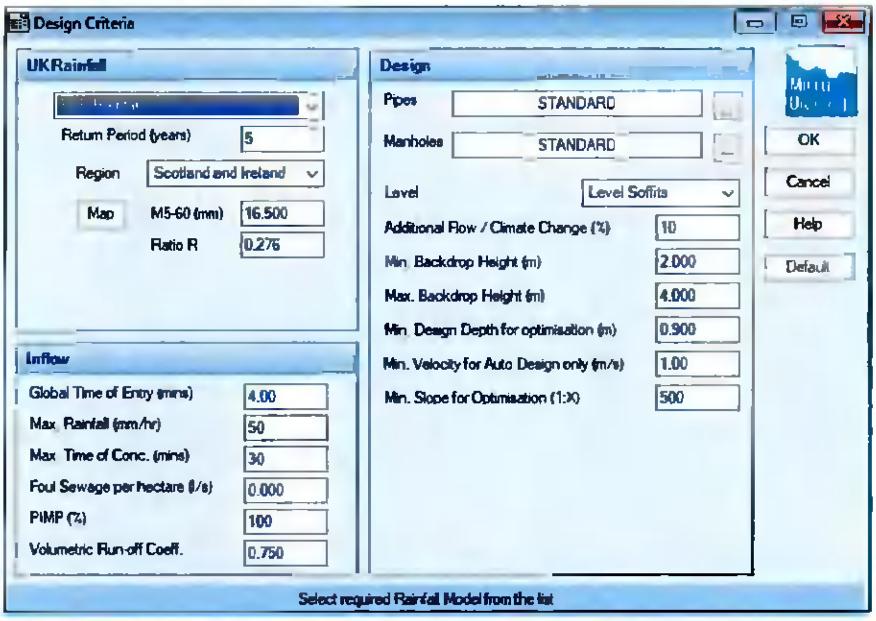

Figure 3.3 – Surface Water Design Criteria (MicroDrainage Excerpt)

As indicated in *Figure 3.3*, the proposed network has been designed to allow for an additional 20% increase in rainfall intensity, to allow for Climate Change, in accordance with the South Dublin County Council Development Plan and the GDSDS.

3.3.3 PROPOSED SURFACE WATER CATCHMENT AREAS

As previously outlined the proposed development is to consist of the extension of the service area of the car show room along with the provision of additional vehicle parking to the east of the site. The extension of the service area covers an area of approximately 550m². This area is within the existing vehicle yard and will remain as 100% impermeable.

The proposed vehicle parking area is to consist of approximately 2,800m² hardstanding area along with approximately 1215m² pervious paving. All hard standing areas have been considered as 100% impermeable.

A flow control has been provided within the final manhole to prior to discharging to the existing surface water network to limit discharge to the green field runoff rate.

For the purpose of the surface water network design simulation, all external hard standing areas (roads, pavement, driveways and roofs) as being 100% impermeable; giving a *winter* global runoff coefficient, C_v, of 0.84, in accordance with the HR Wallingford and Modified Rational Method for runoff.

3.3.4 PROPOSED DEVELOPMENT RAINFALL RUNOFF

It is proposed to reduce and restrict the rainfall runoff, discharging from the proposed development, to the greenfield equivalent, $QBAR_{RURAL}$, runoff rate, as per the FSR ICP SuDS method, which is based on the IH124 method for catchments smaller than 25km^2 in area.

This is to be achieved with the provision of a flow restrictor (Hydro-Brake Optimum by Hydro-International, or similar approved) prior to discharging to the existing surface water network at the north eastern corner of the site, with the appropriate measures of attenuation provided.

Refer to *Figure 3.2* for an excerpt from the results MicroDrainage Runoff Calculator for the development catchment area (c.0.4-hectares), which indicates the greenfield equivalent, $QBAR_{RURAL}$, value of 1.3 l/s (3.25 l/s/ha) along with the calculated runoff for varying Average Recurrence Intervals (ARI). As noted in section 3.2.3 above the discharge from the new network is to be restricted to **2.0l/s**, this has been provided due to the risk of blockage to occurring within the flow control if a smaller orifice is to be provided.

3.3.5 PROPOSED SURFACE WATER PIPE NETWORK DESIGN

The overall surface water drainage system, serving the proposed development, is to consist of a gravity sewer network that will convey runoff from the roofs and paved areas to the outfall manhole, which will discharge a controlled flow rate to the existing surface water sewer at the northern-eastern boundary of the site.

The proposed piped-network has been designed in accordance with BS EN 752 and all new infrastructure is to be compliant with the requirements of the GDSDS and the GDRCOP for Drainage Works, with minimum full bore velocities of 1.0 m/s achieved throughout.

All main surface water carrier pipes have been sized to ensure no surcharging of the proposed drainage network for rainfall events up to, and including, the 1 in 5-year ARI event, with a projected climate change allowance of 20% increase in rainfall intensity.

3.3.6 EXTENSION ROOF DRAINAGE

The existing surface water network around the building is to be maintained. It is proposed to provide connections from the new service bay downpipes to this existing network. The existing area is currently 100% impermeable asphalt and will remain 100% impermeable with the new roof area. Therefore there will be no requirement to modify the existing attenuation and flow control.

3.3.7 PROPOSED SURFACE WATER ATTENUATION

Temporary storage is to be provided in the form of swales, pervious paving and filter drains in order to restrict the run-off to the greenfield equivalent rate, this storage has been designed to temporarily store run-off from events up to an including the 1% AEP event with an increase of 20% in rainfall intensity.

Initial interim attenuation is provided in the base course of the proposed pervious paving in car parking areas to reduce the flow rate & improve water quality prior to entering the main surface water network. The pervious paving has been designed to temporary store and treat runoff for the developments roads as well as the car parking itself. This will aid in increasing the quality of the water entering the developments surface water network. Perforated pipes are to be provided within the pervious paving base course, which will connect to the main surface water drainage network. A total of 110m^3 temporary storage is provided within the base course of the pervious paving.

Filter drains are to be provided in order to convey the run-off from the hardstanding area within the vehicle parking area. These filter drains are to be located along the northern and eastern boundaries of the site. Filter drains will aid in increasing the quality of the run-off while also providing temporary storage within the stone. A total of 25m^3 temporary storage is provided within the base course of the filter drains. These filter drains are to contain a perforated pipe which are to connect to the main attenuation.

Swales will collect runoff from roads and will facilitate treatment and infiltration and provide attenuation storage. The Swale is designed in accordance with CIRIA C753 SuDS Manual. This temporary storage has been designed in order to store excess runoff from rainfall events up to and including the 1 in 100 ARI allowing for a 20% increase for climate change. A total of $50m^3$ temporary storage is to be provided. The discharge from this area of the development is to be restricted by a flow control device in the final manhole, prior to discharging to the existing surface water infrastructure, which limits discharge from the whole site to the Greenfield runoff rate (Q_{bar}) of 2.0 l/s (5.0/s/ha).

Interception storage is to be provided below the developments attenuations. This is to treat the rainfall runoff by allowing the first 5mm rainfall on the development to drain naturally. This runoff will not contribute to the volume of discharge from the development to the existing surface water network. The provision of this interception storage will aid in improving the quality of the runoff being allowed to infiltrate into the ground water Refer to *Section 3.4* below for calculation of required interception storage.

A total of 185m3 temporary storage is to be provided comprising of the swale(50 m3), pervious paving (110 m3), and filter drain (25m 3)

3.4 SPECIFIC SUDS MEASURES PROPOSED

The proposed development is to contain the following measures of Sustainable Drainage Systems:

Limiting discharge. The design outflow from the overall development (c. 0.40-ha development catchment) is to be restricted to a maximum total outflow rate of **2.0 l/s** (5.0 l/s/ha), which is the equivalent Greenfield runoff. Refer to *Section 3.2.3* for further details.

Flow Control device is to be provided immediately downstream of the last filter drain, in order to restrict the surface water discharge from site to a flow rate equivalent to the natural greenfield runoff rate.

It is proposed to provide the Hydro-brake optimum vortex flow control unit (or similar approved by MCC).

Further, it is noted that the required aperture of the proposed Hydro-Brake outlets have been designed to be greater than 150mm diameter, to mitigate the risk of blockage.

Each flow control chamber is to be fitted with a penstock valve at the inlet and a bypass lever at the outlet (if required), to allow for easy access and maintenance.

Figure 3.4 - Vortex Hydro-Brake Flow Control Unit (Hydro International)

<u>Pervious Paving</u> provide a pavement finish suitable for both pedestrian and vehicular traffic, while also allowing rainwater to infiltrate the surface layer and into the underlying pervious structural layers. Here, the rainwater is temporarily stored beneath the overlying finished surface before either infiltration to the ground or / and controlled discharge to the main surface water drainage network.

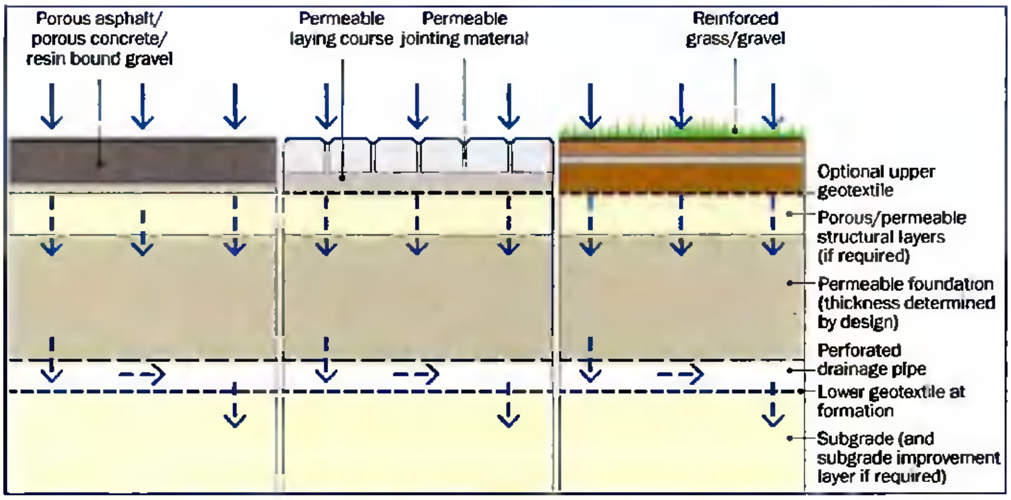

Figure 3.5 - Detail of Type B Pervious Paving (CIRIA C753)

Pervious paving systems are an efficient means of treating the rainwater at source by providing initial interception of the rainwater, reducing the volume and frequency of the runoff and improving the surface water quality by providing at source treatment of the rainfall runoff leaving the site. This is achieved by helping remove and retain pollutants prior to discharge to the drainage system and / or groundwater system.

Rainfall runoff from roof level of the proposed housing units can also discharge to the permeable base course of the pervious paving, via a diffuser unit. This will allow for initial interception of rainfall, along with attenuation for each individual house unit.

A **Type B** pervious paving, with a 300mm depth of open graded crushed rock as sub-base course, is to be provided in the car park area. An overflow pipe, from the base-course, will be provided to the drainage network, which will allow for interception of initial rainfall, groundwater discharge, with an attenuated outflow to the main network in extreme rainfall events.

Swales will be provided along the eastern road. These will typically be Type Swales in accordance with CIRIA C753 SuDS Manual. Swales will be provided to temporarily store the 1 in 100 year ARI including a 20% allowance for climate change A total of 40m3 temporary storage is to be provided in the swale.

A total of 185m3 temporary storage is to be provided comprising of the proprietary system (50 m3), pervious paving (110 m3), and filter drain (25m 3). Refer to Section 3.3.6 for details of proposed attenuation.

Filter Drains are to be provided along the northern and eastern boundary of the development. Hardstanding areas will be allowed to drain into these filter drains which will act as over the edge drainage. These will provide a small amount of attenuation along with providing treatment of runoff through the provision of drainage stone, these filter drains will increase the time of concentration for the runoff entering the surface water network. The proposed filter drains will convey runoff from the hardstanding areas to the main attenuation through the use of perforated pipes.

Oil separators are designed to separate gross amounts of oil and large (>250μm) suspended solids from the surface water, mainly through sedimentation process.

The proposed surface water network already provides sufficient mitigation measures, through the provisions listed previously (principally the pervious paving, filter drains, trapped road gullies and silt traps). However, a Class 1 bypass fuel separator is to be provided as an additional and final mitigation measure, prior to surface water discharge to both the network and watercourse.

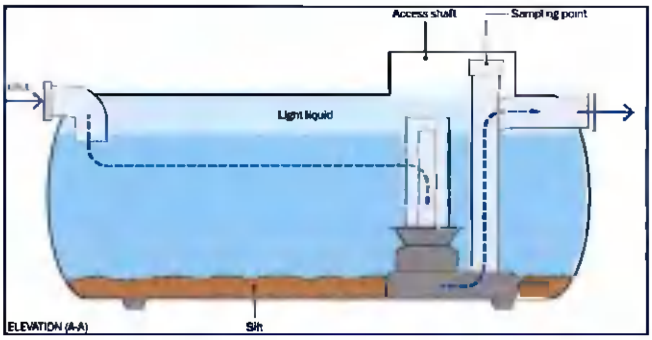

Figure 3.6 - Typical Section Detail of Fuel Separator (CIRIA C753)

Water Quality of the surface water, discharging from site, is to be improved with the following provisions:

- Pervious Paving in parking areas, as described above;
- Filter drains to act as over the edge drainage;
- Interception storage below the attenuation;
- Silt traps to be provided on manholes immediately upstream of attenuation systems, as a further preventative measure to trap silt and other gross pollutants;
- Class 1 bypass fuel separator to be provided prior to discharging from site.

3.5 TAKING IN CHARGE

It is proposed that all new surface water infrastructure, **is not** to be offered to be taken in charge by South Dublin County Council.

3.6 MAINTENANCE

Road gullies, flow control devices and attenuation systems, should be maintained, as appropriate and in accordance with manufacturer's recommendations and guidelines.

3.7 SURFACE WATER IMPACT ASSESSMENT

The design criteria for the drainage system are established in GDSDS-RDP Volume 2, Section 6.3.4 and explained further in GDSDS-RDP Volume 2, Appendix E. There are four design criteria, each of which has been considered for the subject site:

- River Water Quality Protection;
- River Regime Protection;
- Level of Service (flooding) for the site and;
- River Flood Protection.

3.8 CRITERION 1 – RIVER WATER QUALITY PROTECTION

It is proposed that the overall drainage system, serving this development, will contain a range of surface water treatment methods, as outlined previously in

Section 3.5, which will improve the quality of surface water being discharged from the proposed development.

Gross pollutants, sediments, hydrocarbons, and other impurities, will be removed at source with the following provisions:

a) Pervious Paving to parking areas;
b) Filter Drains, as over the edge drainage ;
c) Infiltration;
d) Silt-traps prior to attenuation storage area;
e) Fuel separator prior to discharge from the development.

3.9 CRITERION 2 – RIVER REGIME PROTECTION

Surface water discharge from the overall development will be restricted to an equivalent rural runoff rate of **2.0 l/s** (5.0 l/s/ha), as per the South Dublin County Council Development Plan and the GDSDS. Refer to *Section 3.2.3* for further details.

This will be achieved with the provision of a flow restrictor (Hydro-Brake Optimum, by Hydro-International, or similar approved) upstream of the outfall manhole.

Refer also to **Appendix B** for results $QBAR_{RURAL}$ calculation results, which have been carried out using the ICP SUDS Method on MicroDrainage software.

3.10 CRITERION 3 – LEVEL OF SERVICE (FLOODING) SITE

There are four sub-criteria for the required level of service, for a new development; as set out in the *GDSDS Volume 2, Section 6.3.4 (Table 6.3).*

- No flooding on site except where planned (30-year high intensity rainfall event);
- No internal property flooding (100-year high intensity rainfall event);
- No internal property flooding (100-year river event and critical duration for site) and;
- No flood routing off site except where specifically planned. (100-year high intensity rainfall event).

3.10.1 SUB-CRITERION 3.1

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding. Therefore, the system has capacity for the 30-year return period rainfall event without flooding.

The performance of the proposed drainage system has been analysed for design rainfall events up to, and including, the 1% AEP event (incl. 20% climate change allowance) using the *MicroDrainage Network Design Software*, by Innovyze Inc. Refer to **Appendix C** for details of design criteria, calculations and results. The analyses indicate that no flooding will occur for design rainfall events up to, and including, the 1% AEP.

3.10.2 SUB-CRITERION 3.2

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding.

The performance of the proposed drainage system in 100-year return period storm events (incl. 20% climate change allowance) has been analysed – Refer **Appendix C** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

3.10.3 SUB-CRITERION 3.3

Details of the flood risk assessment associated with the proposed development is outlined in *Section 4* of this report. The assessment indicates that there is no apparent risk of internal property flooding for a design 100-year return period pluvial rainfall event (including 20% climate change allowance).

3.10.4 SUB-CRITERION 3.4

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding, so no flood routing off site will be experienced for such a rainfall event.

The performance of the proposed drainage system in 100-year return period storm events (incl. 20% climate change allowance) has been analysed – Refer **Appendix C** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

Details of the flood risk assessment associated with the proposed development is outlined in *Section 4* of this report. This assessment, along with the network design simulation results, from the MicroDrainage Network Analysis, indicates that no internal property flooding will occur in a 100-year return period fluvial flood event (including 20% climate change allowance).

3.11 CRITERION 4 – RIVER FLOOD PROTECTION

As outlined in *Section 3.10* (Criterion 2), the surface water runoff from the development's catchment will be limited to a maximum of **2.0 l/s** (5.0 l/s/ha).

Refer to *Section 3.2.4* and *Section 3.4* for further details on the limiting discharge rates. The *GDSDS Volume 2, Appendix E* states that this practice ensures *"that sufficient stormwater runoff retention is achieved to protect the river during extreme events".*

Attenuation storage is to be provided for the 100-year return period rainfall event (including an increased 20% rainfall intensity; to allow for climate change). Discharge from site is to be achieved through the use of a vortex flow control device (e.g. Hydro-Brake Optimum, by Hydro-International, or similar approved), which will reduce the risk of blockage present with other flow devices.

Refer to **Appendix C** for details of hydraulic modelling calculations of attenuation and flow control facilities, as carried out using MicroDrainage software by Innovyze Inc.

4 WASTEWATER DRAINAGE

4.1 OVERVIEW

The proposed gravity wastewater sewer has been designed in accordance with the Irish Water's Code of Practice for Wastewater Infrastructure. This sewer is to be provided to service the proposed extension of service bays

4.2 EXISTING WASTEWATER INFRASTRUCTURE

The site contains an existing wastewater network which serves the existing building, this network was installed as part of the original development and is comprised of 150mm Ø pipes which connect at a single location to an existing 225mm Ø wastewater sewer which bounds the site to the north.

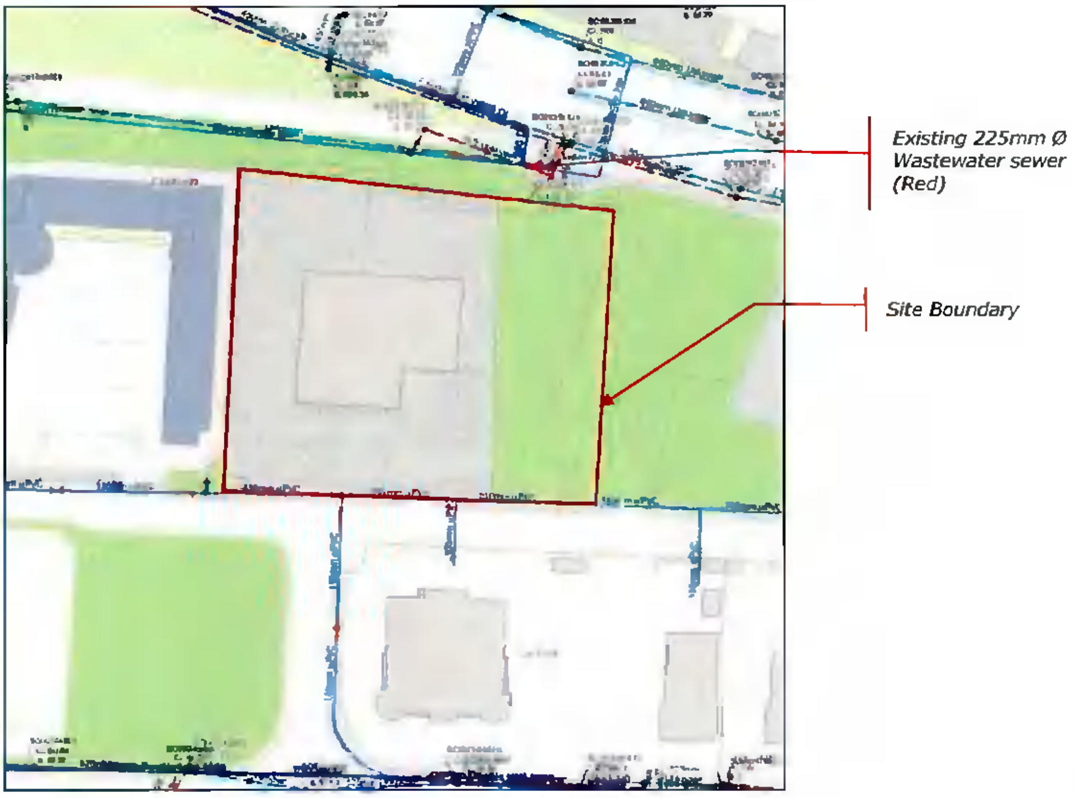

Figure 4.1 – Existing Services (excerpt from www.floodmaps.ie)

Refer to **Appendix A** for existing services records.

4.3 PROPOSED WASTEWATER DRAINAGE STRATEGY

It is proposed to separate the wastewater and surface water networks which are to serve the proposed development. A new wastewater sewer is to be installed within the site to serve the proposed extension. A class 1 fuel separator is to be provided on this sewer to aid in removing gross pollutants, prior to connecting to the existing wastewater sewer on site. The new wastewater sewer is to consist of 150mm Ø pipes.

In order to serve the proposed fuel fill area a connection is to be provided to the existing wastewater sewer. This wastewater sewer contains a class 1 fuel separator which is to be utilised by this new connection.

Refer to detailed drawing **T260-OCSC-XX-XX-DR-C-0500** for the proposed drainage layout.

5 FLOOD RISK ASSESSMENT

This section assesses the potential flood risks associated with the proposed development, as per the regulations and guidelines outlined in *Section 2*.

The risk of a flood event is a function of the probability of occurrence in any given year. Traditionally, this has been expressed as a return period (e.g. 1-in-100-year return period). However, this has led to misconceptions about the likelihood of repeat occurrences. A less ambiguous expression of probability is the *Annual Exceedance Probability* (AEP), which may be defined as the probability of a flood event being exceeded in any given year. A 1-in-100-year return period flood event is therefore expressed as a 1% AEP flood event. Likewise, a 1-in-1year return period flood event is expressed as a 100% AEP flood event.

The *Greater Dublin Strategic Drainage Study* (GDSDS), published by the Local Authorities in the Greater Dublin Region, and The *Planning System and Flood Risk Management Guidelines for Planning Authorities* (PSFRM) set out the best practice standards for flood risk in Ireland. These are summarised in *Table 1 - Summary Level of Service*, below.

Flooding Source	Drainage	River	Tidal/Coastal
Residential	1% AEP	0.1% AEP	0.1% AEP
Commercial	1% AEP	1% AEP	0.5% AEP
Water-compatible	–	>1% AEP	>0.5% AEP

Table 1 - Summary Level of Service

In addition, the *GDSDS* requires that ground floor levels of houses be provided with a 500mm freeboard over the 1% AEP fluvial flood level.

5.4 CLIMATE CHANGE

Both the *GDSDS* and *PSFRM* Guidelines require that account be taken of the effects of climate change over the design life of a development, typically 100 years. Design parameters to take account of climate change were established in the *GDSDS* and revised following later studies (as advised by Dublin City Council). These parameters are set out in **Table 2 - Climate Change - Impact on Design Parameters**, below.

Design Category	Impact of Climate Change
Drainage	20% increase in rainfall
Fluvial (River)	20% increase in flood flow
Tidal/Coastal	Sea level rise of 500mm

Table 2 - Climate Change - Impact on Design Parameters

5.5 FLOOD RISK ZONES

The *PSFRM Guidelines* adopt a sequential approach to managing flood risk by reducing exposure to flooding through land-use planning. The approach adopted by the PSFRM Guidelines establishes three zones (*PSFRM Guidelines paragraph 2.23*) on a sliding scale of flood risk – refer to **Table 3 - Flood Risk Zones**, below.

Zone A	**High Probability of Flooding** Where the annual probability of flooding is: greater than 1% for fluvial flooding or greater than 0.5% for coastal flooding
Zone B	**Moderate Probability of Flooding** Where the annual probability of flooding is: between 0.1% and 1% for fluvial flooding or between 0.1% and 0.5% for coastal flooding

Zone C	**Low Probability of Flooding** Where the annual probability of flooding is: less than 0.1% for fluvial flooding and less than 0.1% for coastal flooding

Table 3 - Flood Risk Zones

Flood risk zones are determined on the basis of the probability of river and coastal flooding only (*PSFRM Guidelines paragraph 2.24*). Other sources of flooding (such as groundwater, infrastructure and pluvial) do not affect the delineation of flood risk zones. These other sources of flooding should be considered and mitigated in design. Flood risk zones are determined on the basis of the current flood risk, i.e. without the inclusion of climate change factors (*PSFRM Guidelines paragraph 2.24*).

5.6 DEVELOPMENT VULNERABILITY

The *PSFRM Guidelines* classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in *Table 3.1* of the *PSFRM Guidelines*, which is reproduced in **Table 4 - Development Vulnerability Class**, below.

Vulnerability Class	Land uses and types of development which include:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment,

	and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, **commercial**, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Table 4 - Development Vulnerability Class

The proposed development is for the extension to a commercial building and vehicle storage area, therefore, the proposed development is considered ***Less Vulnerable Development***.

5.7 DEVELOPMENT 'APPROPRIATENESS'

The *PSFRM Guidelines* define the zones in which each class of development is appropriate – this is summarised in *Table 5 - "Appropriateness" Matrix,* below. The *PSFRM Guidelines* recognises that flood risks should not be the only deciding factor in zoning for development. They also recognise that circumstances will exist where development of a site within a floodplain is desirable; in order to achieve compact and sustainable development of the core of urban settlements. In order to allow consideration of such development, the *PSFRM Guidelines* provide a **Justification Test,** which establishes the criteria under which desirable development of a site in a floodplain may be warranted.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	**Appropriate**
Water-compatible Development	Appropriate	Appropriate	Appropriate

Table 5 - "Appropriateness" Matrix

The proposed residential development is considered a ***Less Vulnerable Development***, and in Flood Zone C and therefor does not require a justification test to be carried out.

5.8 HISTORICAL FLOODING

The OPW collates reports of flooding, these reports are available at the OPW website www.floodinfo.ie

There is one reported incident of flooding in the vicinity of the site. The flooding occurred in 2002. The flood reported convers a large area within the Fingal county council area, with no specific cause of flooding identified. There is no reported incidence of flooding within the site

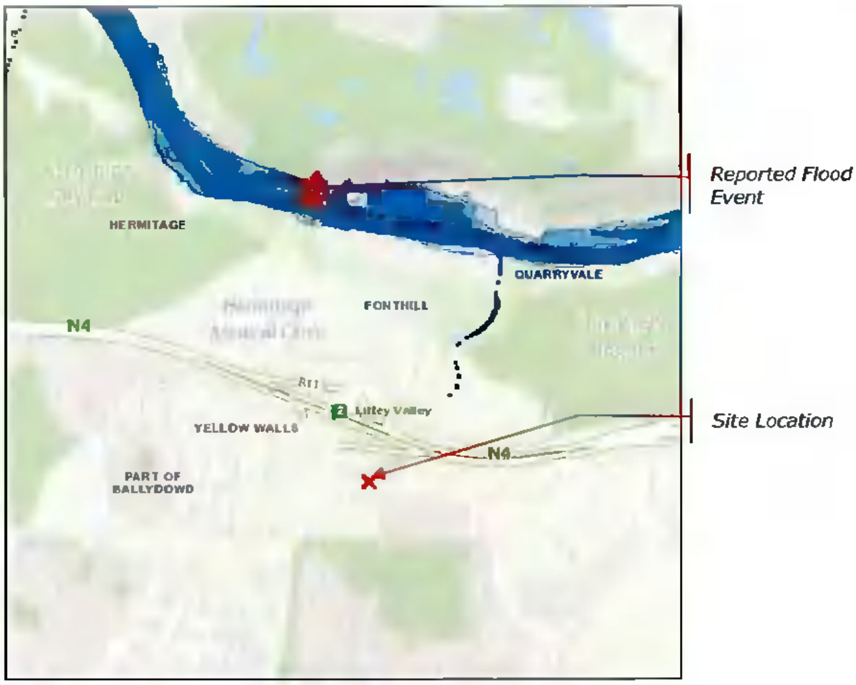

Figure 5.1 - National Flood Hazard Mapping (excerpt from www.floodmaps.ie)

5.9 FLUVIAL FLOODING

The proposed development is located approximately 600m south of the River Liffey. A review of the OPWs Catchment Flood Risk Assessment Mapping (CFRAM) indicates that the proposed development is located outside of Flood Zone A and Flood Zone B of the predicted 1% AEP flood extent of the River Liffey. The excerpt below shows the extent of the flooding modelled for the River Liffey.

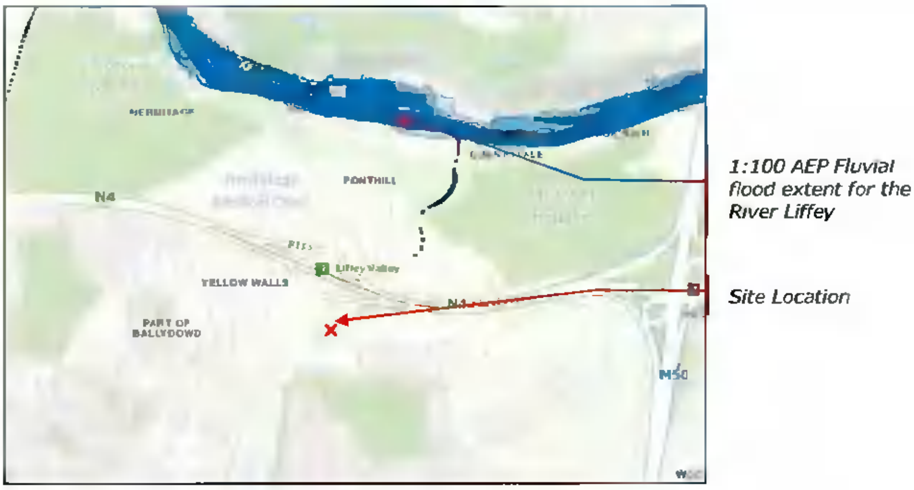

Figure 5.2 - River Liffey CFRAM extent (excerpt from www.floodinfo.ie)

Therefore, the proposed development is not considered at risk of fluvial flooding from the River Liffey and is deemed acceptable for use.

5.10 COASTAL FLOODING

The proposed development is not at risk of coastal flooding, due to the location of the site which is approximately 15km from the eastern coast.

5.11 PLUVIAL FLOODING

A review of the OPW's online pluvial flood risk mapping does not indicate pluvial flooding within the site

As detailed within *Section 3* of this report, the proposed surface water drainage network of this development has been designed to ensure that no flooding is experienced during design rainfall events up to and including the 1% AEP including an additional 20% intensity for climate change projections.

The above ensures that pluvial flooding is not considered a significant risk to the proposed the development, nor as a result of the proposed development.

6 Traffic and Transport

6.1 SITE ACCESSIBILITY

BUS

There are a number of Dublin Bus routes serving stops in the local area within an approximate 15 minute walk from the development site, as outlined in the figure below.

Figure 6.1: Local Bus Facilities

As can be seen, the nearest bus stop is located directly adjacent to the development site. The bus services located within 15 minutes walking from the proposed development site are summarised following.

Route	Description	Service Frequency
25	Merrion Square - Lucan	60 mins
25a	Merrion Square - Lucan	30 mins
25b	Merrion Square - Adamstown Rail Station	30 mins
66 / 67	Merrion Square - Maynooth	30 mins
66a /b	Merrion Square - Leixlip	60 mins
767	Dublin Airport - Maynooth	30 mins

Table 6: Local Bus Services

Relative to the development site, the existing cycle facilities are shown following.

Figure 6.2: Local Cycle Infrastructure

There are segregated cycle lanes along a number of the roads locally including many of the key arteries such as the N4

In term of pedestrian access, the existing footpaths locally are in good condition with public lighting provided and dedicated crossing facilities at the major junctions locally including at the Fonthill Road/ St. Loman's Road roundabout and on the internal access road south of the development site

Figure 6.3: Existing Zebra Crossing South of Development Site

6.2 PARKING PROVISION

The proposed development will see the building extension located on existing hardstanding space in the north east corner of the site which facilitated storage and display of vehicles for sale as well as staff parking. This parking will be relocated to the expanded eastern portion of the site with the majority of this space again dedicated to storage and display of vehicles for sale. Relative to the existing provision, the proposals will result in the following:

- Increase in staff parking spaces by 5 no.;
- Decrease in services bays by 3 no.;
- Increase in spaces for display of vehicles for sale by 59 no.

The South Dublin County Council Development Plan 2016-2022 sets out standards for the provision of parking at various types of development in Table 11.23. However, car show rooms are not specified in this table with the Plan stating:

"For any commercial use not specified within Table 11.23 the default parking rate will be calculated based on those of a comparable use and/or determined as part of Transport and Traffic Assessment".

The increased spaces for storage and display of vehicles for sale would not be considered car parking in the traditional sense and would be more appropriately classed as storage space for retail goods which are delivered in bulk. Similarly, the service bays are directly linked to the commercial activity at the development, facilitating storage and working on cars that are being serviced at the development.

On this basis, the effective increase in car parking is limited to an additional 5 no. staff parking spaces which is considered proportional to the increase in the size and activity at the development as a result of the proposed works. Thus, the proposed car parking provision is considered to be in line with the Development Plan standards.

With respect to cycle parking, the Development Plan sets out standards for the provision of same in Table 11.22. Again, a car show room use is not specified in that table. As a result, a proportional increase of 2 no spaces in addition to the existing 14 no. spaces is proposed which is considered appropriate.

6.3 POTENTIAL IMPACT OF DEVELOPMENT CONSTRUCTION

Relative to the operation stage, the construction period will be temporary in nature. Construction traffic is expected to consist of the following categories:

- Private vehicles owned and driven by site construction staff and by full time site supervisory staff and occasional professional supervisory staff i.e. design team members and supervisory staff from utility companies;
- Materials delivery and removal vehicles.

It is difficult to assess the exact quantum of traffic that will be generated during the construction period as it will vary throughout the construction process as different activities have different associated transportation needs. However, the following points are noted with regard to construction traffic:

- In general, the construction day will begin and end outside of peak travel hours. As a result, the majority of workers travelling to and from the site will arrive before the a.m. peak hour and depart after the p.m. peak hour;
- No on-site parking will be provided for use by critical staff only with the remainder of staff encouraged to travel by the numerous public transport options serving the locality;
- Adequate on-site compounding will be provided to prevent any potential overflow onto the local transport network;
- The potential for construction staff to be brought to the site in vans/minibuses will be investigated;
- Excavation and materials delivery vehicles travelling to and from the site will be spread across the course of the working day meaning the number of HGV's travelling during the peak hours will be relatively low.

Overall, it is expected that the level of traffic generated by the construction works will be extremely low given the relatively simple nature of the project and will generally occur outside of peak traffic times making any associated impact negligible.

Nevertheless, prior to construction, it is expected that a Construction Management Plan will be submitted by the appointed contractor to the Local Authority for agreement prior to the commencement of construction, giving details on the following:

- Daily and weekly working hours;
- Agreed haul routes for incoming materials;
- Licensed hauliers to be used;
- Disposal sites;
- Travel arrangements for construction personnel;
- Appropriate on-site parking arrangements for construction personnel to prevent overspill parking on the local road network;
- Temporary construction entrances to be provided;
- Wheel wash facilities if required;
- Road cleaning and sweeping measures to be put in place if required;
- Temporary construction signage to be put in place and maintained;
- Any proposed traffic management measures such as temporary traffic lights and signage on any public roads.

6.4 POTENTIAL IMPACT OF DEVELOPMENT OPERATION

The nature of the proposed development will see a minor increase in capacity at the existing development, providing increased space for storage of vehicles for sale at the existing car showroom and a slight relatively minor of the existing maintenance activity.

The *Traffic and Transport Assessment Guidelines* (Transport Infrastructure Ireland, 2014) provides guidance as to when the potential impact of a development require further detailed assessment and analysis.

Section 2 of TII Guidelines document highlights the thresholds where a Traffic & Transport Assessment is required, the primary thresholds are set out in Table 2.1 of the guidance, and are as follows:

- Traffic to and from the development exceeds 20% of the traffic flow on the adjoining road;
- Traffic to and from the development exceeds 5% of the traffic flow on the adjoining road where congestion exists or the location is sensitive;
- Residential development in excess of 200 dwellings;
- Retail and leisure development in excess of 1,000m^2;
- Office, education and hospital development in excess of 2,500m^2;
- Industrial development in excess of 5,000m^2;
- Distribution and warehousing in excess of 10,000m^2

The scale of development is considerably below the threshold for industrial uses set out above which is considered to be the most comparable to the proposed use.

With respect to the increase in traffic on the local road network, it is again noted that the majority of spaces are to be used for the storage and display of vehicles for sale. Such vehicles will be transported to the site by low loader or similar, at staggered intervals, significantly reducing the associated number of trips to negligible levels. Such servicing activity will follow the existing strategy and systems in place at the site meaning there will be a negligible impact on the public road network.

Similarly, the loss of 3 no. servicing bays is expected to result in a very small decrease in associated daily traffic which will be spread across the course of the day. Staff parking is proposed to increase by just 5 no. spaces which will, assuming a worst case scenario, result in an additional 5 no. arrivals during the A.M. peak hour and 5 no. departures during the P.M. peak hour which is considered to be a negligible increase in the context of the traffic on the existing wider road network.

Taking the above into consideration, the proposed development is expected to result in negligible increases in traffic associated with the site, particularly during peak hours and so is considered to be below the aforementioned TII thresholds.

Neverthtless, Section 2 of TII Guidance sets out a further series of sub-thresholds where if two or more are breached, a detailed assessment is recommended. These thresholds criteria are listed in following:

- The character and total number of trips in / out combined per day are such that as to cause concern;
- The site is not consistent with national guidance or local plan policy or accessibility criteria contained in the Development Plan;
- The development is part of incremental development that will have significant transport implications;
- The development may generate traffic at peak times in heavily trafficked/ congested area or near a junction with a main traffic route;
- The development may generate traffic, particularly heavy vehicles in a residential area;
- There are concerns over the development's potential effects on road safely;
- The development is in a tourist area with potential to cause congestion;
- The planning authority considers that the proposal will result in a material change in trips patterns or raises other significant transport implications.

Taking into consideration the nature of the proposed development as an extension to an existing facility and the aforementioned limited additional trip generation potential, it is considered that the proposed development does not exceed more than two of these criteria based on the nature and scale of the proposed development.

Thus, the development is shown to be below all applicable thresholds set by the TII Guidance which is the industry standard in this regard. It is therefore considered that the further detailed traffic analysis is not deemed necessary and the overall impact of the development operation will be negligible.

Daire O Mahoney

(B.Eng M.Eng MIEI)

For OCSC MULTIDISCIPLINARY CONSULTING ENGINEERS

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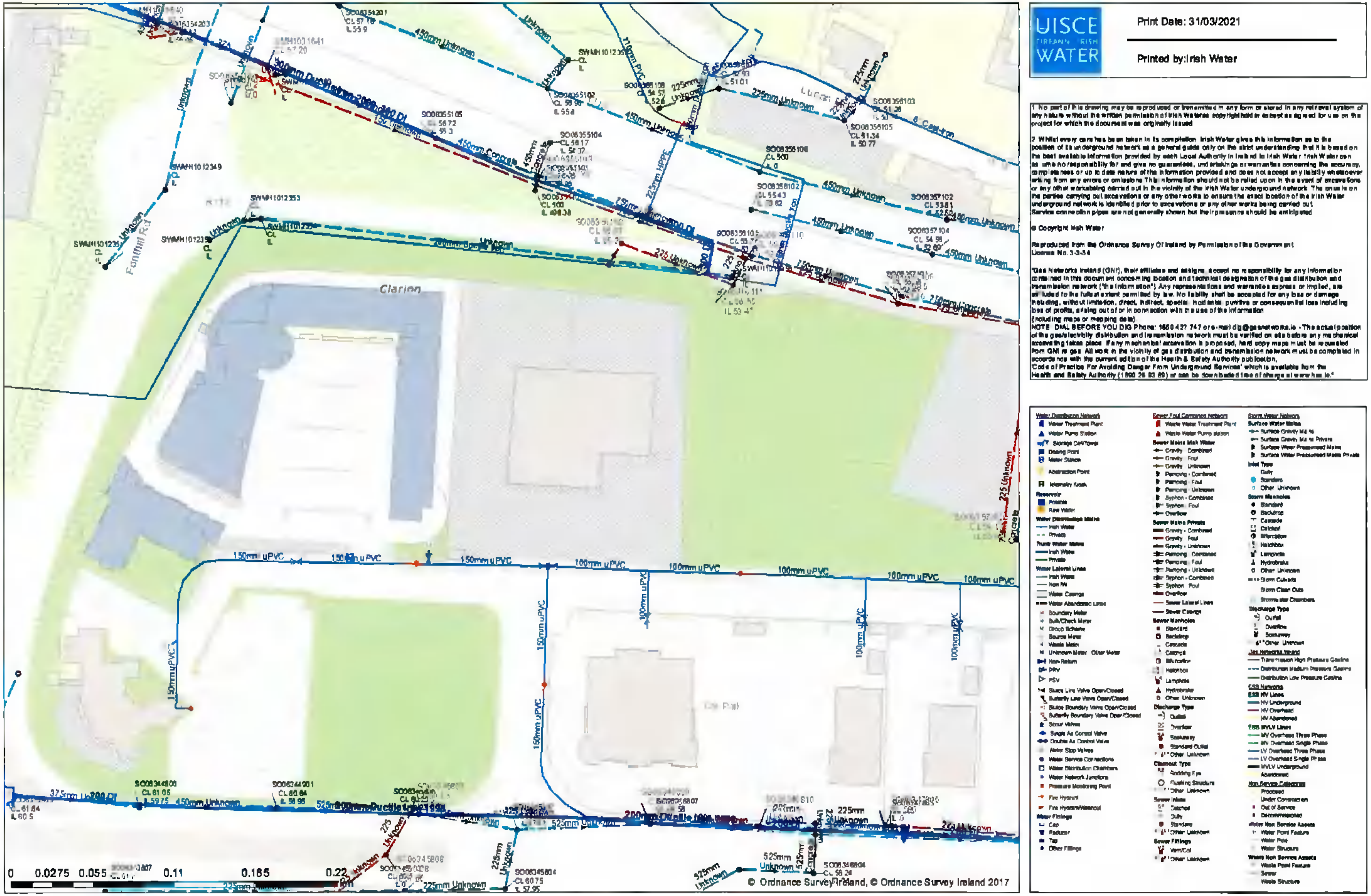
APPENDIX A. SOUTH DUBLIN COUNTY COUNCIL AND IRISH WATER PUBLIC RECORDS

Appendix A

South Dublin Co.Co. & Irish Water Public Records

Irish Water Web Map



UISCE ÉIREANN IRISH WATER

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APPENDIX B. QBAR RUNOFF CALCULATIONS & MET EIREANN DATA

Appendix B

QBAR Runoff Calculations

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 306638, Northing: 235056,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.3,	3.4,	4.1,	5.0,	5.6,	6.2,	7.9,	9.8,	11.2,	13.1,	14.8,	16.2,	18.3,	19.9,	21.3,	N/A ,
10 mins	3.3,	4.8,	5.7,	7.0,	7.9,	8.6,	11.0,	13.7,	15.6,	18.2,	20.6,	22.5,	25.5,	27.8,	29.7,	N/A ,
15 mins	3.8,	5.7,	6.7,	8.2,	9.3,	10.1,	12.9,	16.1,	18.3,	21.4,	24.3,	26.5,	29.9,	32.7,	34.9,	N/A ,
30 mins	5.1,	7.4,	8.6,	10.6,	11.9,	12.9,	16.3,	20.3,	22.9,	26.7,	30.1,	32.7,	36.9,	40.1,	42.8,	N/A ,
1 hours	6.7,	9.6,	11.2,	13.6,	15.2,	16.5,	20.7,	25.5,	28.7,	33.2,	37.3,	40.5,	45.4,	49.2,	52.4,	N/A ,
2 hours	8.9,	12.5,	14.5,	17.5,	19.5,	21.1,	26.2,	32.1,	36.0,	41.4,	46.3,	50.0,	55.9,	60.4,	64.2,	N/A ,
3 hours	10.4,	14.6,	16.9,	20.3,	22.6,	24.3,	30.1,	36.7,	41.0,	47.1,	52.5,	56.7,	63.1,	68.1,	72.2,	N/A ,
4 hours	11.7,	16.4,	18.8,	22.5,	25.0,	27.0,	33.3,	40.4,	45.0,	51.6,	57.4,	61.9,	68.8,	74.1,	78.6,	N/A ,
6 hours	13.8,	19.1,	21.9,	26.1,	28.9,	31.1,	38.2,	46.1,	51.4,	58.6,	65.1,	70.0,	77.7,	83.6,	88.4,	N/A ,
9 hours	16.2,	22.3,	25.5,	30.3,	33.5,	35.9,	43.9,	52.8,	58.6,	66.7,	73.8,	79.3,	87.7,	94.2,	99.6,	N/A ,
12 hours	18.2,	24.9,	28.4,	33.6,	37.1,	39.8,	48.4,	58.0,	64.3,	73.0,	80.7,	86.6,	95.6,	102.6,	108.3,	N/A ,
18 hours	21.5,	29.1,	33.1,	39.0,	42.9,	45.9,	55.6,	66.4,	73.4,	83.0,	91.5,	98.0,	108.0,	115.6,	121.9,	N/A ,
24 hours	24.1,	32.5,	36.9,	43.3,	47.6,	50.9,	61.4,	73.0,	80.5,	90.9,	100.1,	107.1,	117.7,	125.9,	132.6,	155.8,
2 days	30.0,	39.5,	44.4,	51.4,	56.1,	59.6,	70.9,	83.2,	91.0,	101.8,	111.2,	118.3,	129.1,	137.3,	144.0,	167.1,
3 days	34.8,	45.2,	50.4,	58.0,	63.0,	66.8,	78.7,	91.6,	99.7,	110.9,	120.6,	127.9,	138.9,	147.3,	154.2,	177.5,
4 days	39.0,	50.1,	55.7,	63.8,	69.0,	73.0,	85.5,	98.9,	107.4,	118.9,	128.9,	136.4,	147.7,	156.2,	163.2,	186.9,
6 days	46.3,	58.7,	64.9,	73.7,	79.4,	83.7,	97.2,	111.5,	120.6,	132.8,	143.2,	151.1,	162.9,	171.8,	179.1,	203.5,
8 days	52.8,	66.3,	73.0,	82.4,	88.5,	93.1,	107.5,	122.6,	132.1,	144.9,	155.8,	164.0,	176.2,	185.5,	192.9,	218.1,
10 days	58.8,	73.2,	80.3,	90.4,	96.8,	101.7,	116.7,	132.6,	142.5,	155.8,	167.1,	175.6,	188.2,	197.7,	205.4,	231.3,
12 days	64.3,	79.6,	87.1,	97.7,	104.5,	109.6,	125.3,	141.8,	152.0,	165.8,	177.5,	186.3,	199.3,	209.1,	217.0,	243.4,
16 days	74.7,	91.5,	99.7,	111.2,	118.5,	124.0,	140.9,	158.6,	169.5,	184.1,	196.5,	205.7,	219.4,	229.6,	237.9,	265.5,
20 days	84.2,	102.4,	111.2,	123.5,	131.4,	137.2,	155.2,	173.8,	185.3,	200.7,	213.6,	223.3,	237.6,	248.2,	256.8,	285.4,
25 days	95.4,	115.1,	124.6,	137.9,	146.2,	152.5,	171.6,	191.4,	203.5,	219.7,	233.3,	243.4,	258.3,	269.5,	278.4,	308.1,

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

ICP SUDS Mean Annual Flood

Input

Return Period (years)	5	Soil	0.370
Area (ha)	0.600	Urban	0.000
SAAR (mm)	776	Region Number	User Defined

User Defined Growth Curve

Filename GDSDS.gcfx Description GDSDS

Return Period (years)	**Growth Curve Factor**
1	0.850
2	0.000
5	0.000
10	0.000
20	0.000
25	0.000
30	2.100
50	0.000
100	2.600
200	0.000
500	0.000
1000	0.000

Results	**l/s**
QBAR Rural	1.9
QBAR Urban	1.9
Q5 years	0.0
Q1 year	1.7
Q30 years	4.1
Q100 years	5.1

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APPENDIX C. SURFACE WATER DESIGN & ATTENUATION CALCULATIONS

- Design Criteria;
- Area Summary;
- Network Design & Results Table;
- Simulation Criteria;
- Hydrobrake / Controls & Storage Design;
- Summary of Results.

Appendix C

Surface Water Design and Attenuation Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.500	Add Flow / Climate Change (%)	10
Ratio R	0.276	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	20.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
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	4.432	0.000	9900.4	0.000	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)
S1.000	50.00	4.60	57.800	0.000	0.0	0.0	0.0	0.12	4.9	0.0

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
S2.000	29.296	0.172	170.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	1.715	0.010	170.0	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	1.427	0.008	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	11.354	0.067	169.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	21.807	0.128	170.0	0.051	4.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	1.715	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	1.432	0.008	170.0	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)
S2.000	50.00	4.49	59.250	0.000	0.0	0.0	0.0	1.00	39.8	0.0
S2.001	50.00	4.52	59.078	0.040	0.0	0.0	0.5	1.00	39.8	5.9
S2.002	50.00	4.54	59.068	0.040	0.0	0.0	0.5	1.00	39.8	5.9
S1.001	50.00	4.79	57.800	0.040	0.0	0.0	0.5	1.00	39.8	5.9
S3.000	50.00	4.36	58.725	0.051	0.0	0.0	0.7	1.00	39.8	7.6
S3.001	50.00	4.39	58.597	0.051	0.0	0.0	0.7	1.00	39.8	7.6
S3.002	50.00	4.42	58.587	0.051	0.0	0.0	0.7	1.00	39.8	7.6

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
S1.002	16.014	0.094	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S4.000	21.807	0.128	170.0	0.047	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S4.001	1.715	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S4.002	1.330	0.008	169.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.003	15.589	0.092	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S5.000	23.085	0.136	170.0	0.018	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S5.001	8.899	0.052	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S5.002	21.807	0.128	170.0	0.027	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)
S1.002	50.00	5.06	57.733	0.091	0.0	0.0	1.2	1.00	39.8	13.5
S4.000	50.00	4.36	58.325	0.047	0.0	0.0	0.6	1.00	39.8	7.0
S4.001	50.00	4.39	58.197	0.047	0.0	0.0	0.6	1.00	39.8	7.0
S4.002	50.00	4.41	58.187	0.047	0.0	0.0	0.6	1.00	39.8	7.0
S1.003	50.00	5.32	57.638	0.138	0.0	0.0	1.9	1.00	39.8	20.5
S5.000	50.00	4.38	57.930	0.018	0.0	0.0	0.2	1.00	39.8	2.7
S5.001	50.00	4.53	57.794	0.018	0.0	0.0	0.2	1.00	39.8	2.7
S5.002	50.00	4.90	57.742	0.045	0.0	0.0	0.6	1.00	39.8	6.6

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
S5.003	1.694	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.004	1.568	0.009	174.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	6.518	0.038	171.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	21.807	0.128	170.0	0.022	4.00	0.0	0.600	o	225	Pipe/Conduit	
S6.001	1.715	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.002	1.644	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	11.397	0.067	170.1	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)
S5.003	50.00	4.92	57.614	0.045	0.0	0.0	0.6	1.00	39.8	6.6
S5.004	50.00	4.95	57.604	0.045	0.0	0.0	0.6	0.99	39.3	6.6
S1.004	50.00	5.43	57.547	0.182	0.0	0.0	2.5	1.00	39.6	27.2
S6.000	50.00	4.36	57.767	0.022	0.0	0.0	0.3	1.00	39.8	3.2
S6.001	50.00	4.39	57.639	0.022	0.0	0.0	0.3	1.00	39.8	3.2
S6.002	50.00	4.42	57.629	0.022	0.0	0.0	0.3	1.00	39.8	3.2
S1.005	50.00	5.62	57.509	0.204	0.0	0.0	2.8	1.00	39.7	30.4

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
S7.000	21.807	0.128	170.0	0.047	4.00	0.0	0.600	o	225	Pipe/Conduit	
S7.001	1.741	0.010	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S7.002	1.569	0.009	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	29.296	0.293	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	32.796	0.193	169.9	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	16.361	0.096	170.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S7.000	50.00	4.36	57.480	0.047	0.0	0.0	0.6	1.00	39.8	6.9
S7.001	50.00	4.39	57.352	0.047	0.0	0.0	0.6	1.00	39.8	6.9
S7.002	50.00	4.42	57.341	0.047	0.0	0.0	0.6	1.00	39.8	6.9
S1.006	50.00	5.99	57.332	0.251	0.0	0.0	3.4	1.31	52.0	37.3
S1.007	50.00	6.45	56.964	0.302	0.0	0.0	4.1	1.20	85.1	44.9
S1.008	50.00	4.27	56.771	0.000	2.0	0.0	0.2	1.00	39.7	2.0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
2.001	User	-	100	0.040	0.040	0.040
2.002	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.051	0.051	0.051
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.047	0.047	0.047
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.018	0.018	0.018
5.001	-	-	100	0.000	0.000	0.000
5.002	User	-	100	0.027	0.027	0.027
5.003	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
6.000	User	-	100	0.022	0.022	0.022
6.001	-	-	100	0.000	0.000	0.000
6.002	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
7.000	User	-	100	0.047	0.047	0.047
7.001	-	-	100	0.000	0.000	0.000
7.002	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	User	-	100	0.015	0.015	0.015

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.036	0.036	0.051
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.302	0.302	0.302

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.008	S	58.920	56.675	55.135	0	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S29, DS/PN: S1.008, Volume (m³): 4.2

Unit Reference	MD-SHE-0064-2000-1200-2000	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	64
Design Flow (l/s)	2.0	Invert Level (m)	56.771
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	2.0	Kick-Flo®	0.573	1.4
Flush-Flo™	0.282	1.8	Mean Flow over Head Range	-	1.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.5	0.600	1.5	1.600	2.3	2.600	2.8	5.000	3.9	7.500	4.7
0.200	1.7	0.800	1.7	1.800	2.4	3.000	3.0	5.500	4.0	8.000	4.8
0.300	1.8	1.000	1.8	2.000	2.5	3.500	3.3	6.000	4.2	8.500	5.0
0.400	1.7	1.200	2.0	2.200	2.6	4.000	3.5	6.500	4.4	9.000	5.1
0.500	1.6	1.400	2.1	2.400	2.7	4.500	3.7	7.000	4.5	9.500	5.2

Storage Structures for Storm

Filter Drain Manhole: S1, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.800	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	4.5		

Porous Car Park Manhole: S2, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	41.7	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	59.250	Membrane Depth (mm)	300

Filter Drain Manhole: S5, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.800	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	11.0		

Porous Car Park Manhole: S6, DS/PN: S3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	62.5	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	58.725	Membrane Depth (mm)	300

Filter Drain Manhole: S9, DS/PN: S1.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.733	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	16.0		

Porous Car Park Manhole: S10, DS/PN: S4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	62.5	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	58.325	Membrane Depth (mm)	300

Filter Drain Manhole: S13, DS/PN: S1.003

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.639	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	16.0		

Porous Car Park Manhole: S14, DS/PN: S5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	17.5
Max Percolation (l/s)	24.3	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	57.930	Membrane Depth (mm)	300

Porous Car Park Manhole: S16, DS/PN: S5.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	31.3	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	57.742	Membrane Depth (mm)	300

Filter Drain Manhole: S19, DS/PN: S1.004

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.520	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	6.5		

Porous Car Park Manhole: S20, DS/PN: S6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	31.3	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	57.767	Membrane Depth (mm)	300

Filter Drain Manhole: S23, DS/PN: S1.005

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	57.481	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	11.4		

Porous Car Park Manhole: S24, DS/PN: S7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.5
Max Percolation (l/s)	62.5	Slope (1:X)	170.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	1
Invert Level (m)	57.480	Membrane Depth (mm)	300

Complex Manhole: S27, DS/PN: S1.006

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.300
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	245.0
Invert Level (m)	57.332	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	32.0		

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Base Width (m)	2.0
Infiltration Coefficient Side (m/hr)	0.00000	Length (m)	26.0
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	170.0
Invert Level (m)	57.332	Cap Volume Depth (m)	0.000

Swale

Cap Infiltration Depth (m) 0.000 Include Swale Volume Yes

Filter Drain Manhole: S28, DS/PN: S1.007

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.225
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	170.0
Invert Level (m)	56.964	Cap Volume Depth (m)	0.000
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	33.0		

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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 15 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.500 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 5 year Winter I+20%	59.600	57.859	-0.166	0.000	0.01	0.124	0.1	0.3	OK
S2.000	S2	15 minute 5 year Summer I+20%	60.250	59.250	-0.225	0.000	0.00	0.000	0.0	0.0	OK
S2.001	S3	15 minute 5 year Winter I+20%	60.000	59.151	-0.151	0.000	0.23	0.158	0.6	6.8	OK
S2.002	S4	15 minute 5 year Winter I+20%	60.000	59.141	-0.152	0.000	0.23	0.078	0.6	6.9	OK*
S1.001	S5	15 minute 5 year Winter I+20%	59.550	57.863	-0.162	0.000	0.18	0.187	0.7	6.4	OK*
S3.000	S6	15 minute 5 year Winter I+20%	59.725	58.795	-0.155	0.000	0.21	1.309	0.7	7.5	OK
S3.001	S7	15 minute 5 year Winter I+20%	59.725	58.673	-0.148	0.000	0.25	0.164	0.6	7.4	OK
S3.002	S8	15 minute 5 year Winter I+20%	59.725	58.663	-0.149	0.000	0.25	0.081	0.6	7.5	OK*
S1.002	S9	15 minute 5 year Winter I+20%	59.325	57.824	-0.134	0.000	0.34	0.393	0.9	13.7	OK*
S4.000	S10	30 minute 5 year Summer I+20%	59.325	58.391	-0.159	0.000	0.19	1.185	0.7	6.8	OK
S4.001	S11	30 minute 5 year Summer I+20%	59.325	58.270	-0.152	0.000	0.23	0.156	0.6	6.8	OK
S4.002	S12	15 minute 5 year Winter I+20%	59.325	58.259	-0.152	0.000	0.23	0.077	0.6	6.8	OK*
S1.003	S13	15 minute 5 year Winter I+20%	58.876	57.753	-0.111	0.000	0.50	0.582	1.0	19.9	OK*
S5.000	S14	15 minute 5 year Winter I+20%	58.930	57.975	-0.180	0.000	0.09	0.305	0.6	3.1	OK
S5.001	S15	15 minute 5 year Winter I+20%	58.930	57.841	-0.178	0.000	0.10	0.097	0.5	3.2	OK
S5.002	S16	15 minute 5 year Winter I+20%	58.930	57.806	-0.161	0.000	0.18	0.637	0.7	6.4	OK
S5.003	S17	600 minute 5 year Winter I+20%	58.930	57.725	-0.114	0.000	0.04	0.260	0.4	1.2	OK
S5.004	S18	600 minute 5 year Winter I+20%	58.930	57.725	-0.104	0.000	0.04	0.133	0.4	1.2	OK*
S1.004	S19	600 minute 5 year Winter I+20%	58.530	57.725	-0.047	0.000	0.16	1.012	0.6	4.9	OK*
S6.000	S20	15 minute 5 year Winter I+20%	58.767	57.816	-0.176	0.000	0.10	0.356	0.6	3.8	OK
S6.001	S21	600 minute 5 year Winter I+20%	58.767	57.724	-0.140	0.000	0.02	0.183	0.4	0.6	OK
S6.002	S22	600 minute 5 year Winter I+20%	58.767	57.724	-0.130	0.000	0.02	0.102	0.4	0.6	OK*
S1.005	S23	600 minute 5 year Winter I+20%	58.467	57.724	-0.010	0.000	0.14	1.339	0.7	5.3	OK*
S7.000	S24	600 minute 5 year Winter I+20%	58.480	57.723	0.018	0.000	0.03	12.194	0.5	1.0	SURCHARGED
S7.001	S25	600 minute 5 year Winter I+20%	58.480	57.722	0.146	0.000	0.03	1.224	0.3	0.8	SURCHARGED
S7.002	S26	960 minute 5 year Winter I+20%	58.480	57.566	0.000	0.000	0.02	0.411	0.2	0.6	SURCHARGED*

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S1.006	S27	600 minute 5 year Winter I+20%	58.200	57.722	0.165	0.000	0.08	31.709	0.8	4.0	SURCHARGED*
S1.007	S28	480 minute 5 year Winter I+20%	58.200	57.722	0.457	0.000	0.03	9.451	0.6	2.6	SURCHARGED
S1.008	S29	480 minute 5 year Winter I+20%	58.500	57.722	0.726	0.000	0.05	3.303	0.5	1.8	SURCHARGED

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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 15 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.500 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status

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

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 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 15 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.500 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S1.000	S1	600 minute 100 year Winter I+20%	59.600	57.964	-0.061	0.000	0.00	0.404	0.0	0.0	OK
S2.000	S2	15 minute 100 year Summer I+20%	60.250	59.250	-0.225	0.000	0.00	0.000	0.0	0.0	OK
S2.001	S3	15 minute 100 year Winter I+20%	60.000	59.198	-0.105	0.000	0.56	0.317	0.8	16.5	OK
S2.002	S4	15 minute 100 year Winter I+20%	60.000	59.187	-0.105	0.000	0.55	0.132	0.8	16.3	OK*
S1.001	S5	600 minute 100 year Winter I+20%	59.550	57.964	-0.061	0.000	0.05	0.718	0.5	1.9	OK*
S3.000	S6	15 minute 100 year Winter I+20%	59.725	58.827	-0.123	0.000	0.42	2.771	0.9	15.2	OK
S3.001	S7	15 minute 100 year Winter I+20%	59.725	58.711	-0.111	0.000	0.51	0.275	0.7	15.0	OK
S3.002	S8	15 minute 100 year Winter I+20%	59.725	58.700	-0.111	0.000	0.51	0.124	0.8	15.1	OK*
S1.002	S9	600 minute 100 year Winter I+20%	59.325	57.963	0.006	0.000	0.11	1.639	0.7	4.2	SURCHARGED*
S4.000	S10	15 minute 100 year Winter I+20%	59.325	58.423	-0.127	0.000	0.39	2.533	0.9	14.0	OK
S4.001	S11	15 minute 100 year Winter I+20%	59.325	58.305	-0.116	0.000	0.47	0.247	0.7	13.8	OK
S4.002	S12	15 minute 100 year Winter I+20%	59.325	58.295	-0.117	0.000	0.47	0.118	0.7	13.9	OK*
S1.003	S13	600 minute 100 year Winter I+20%	58.876	57.962	0.099	0.000	0.15	2.648	0.7	6.0	SURCHARGED*
S5.000	S14	15 minute 100 year Winter I+20%	58.930	57.994	-0.161	0.000	0.18	0.597	0.7	6.5	OK
S5.001	S15	600 minute 100 year Winter I+20%	58.930	57.962	-0.058	0.000	0.03	0.554	0.4	0.9	OK
S5.002	S16	600 minute 100 year Winter I+20%	58.930	57.961	-0.005	0.000	0.06	5.676	0.5	2.0	OK
S5.003	S17	600 minute 100 year Winter I+20%	58.930	57.961	0.122	0.000	0.06	1.192	0.4	1.9	SURCHARGED
S5.004	S18	1440 minute 100 year Winter I+20%	58.930	57.829	0.000	0.000	0.03	0.376	0.4	1.0	SURCHARGED*
S1.004	S19	600 minute 100 year Winter I+20%	58.530	57.961	0.189	0.000	0.25	2.121	0.6	7.3	SURCHARGED*
S6.000	S20	600 minute 100 year Winter I+20%	58.767	57.960	-0.032	0.000	0.03	4.482	0.5	1.0	OK
S6.001	S21	600 minute 100 year Winter I+20%	58.767	57.960	0.096	0.000	0.03	1.156	0.4	0.9	SURCHARGED
S6.002	S22	1440 minute 100 year Winter I+20%	58.767	57.854	0.000	0.000	0.02	0.351	0.4	0.5	SURCHARGED*
S1.005	S23	600 minute 100 year Winter I+20%	58.467	57.960	0.226	0.000	0.21	2.638	0.7	7.8	SURCHARGED*
S7.000	S24	600 minute 100 year Winter I+20%	58.480	57.959	0.254	0.000	0.03	28.379	0.5	1.0	SURCHARGED
S7.001	S25	600 minute 100 year Winter I+20%	58.480	57.958	0.381	0.000	0.03	1.500	0.3	0.8	SURCHARGED
S7.002	S26	15 minute 100 year Summer I+20%	58.480	57.566	0.000	0.000	0.41	0.346	0.7	12.2	SURCHARGED*

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

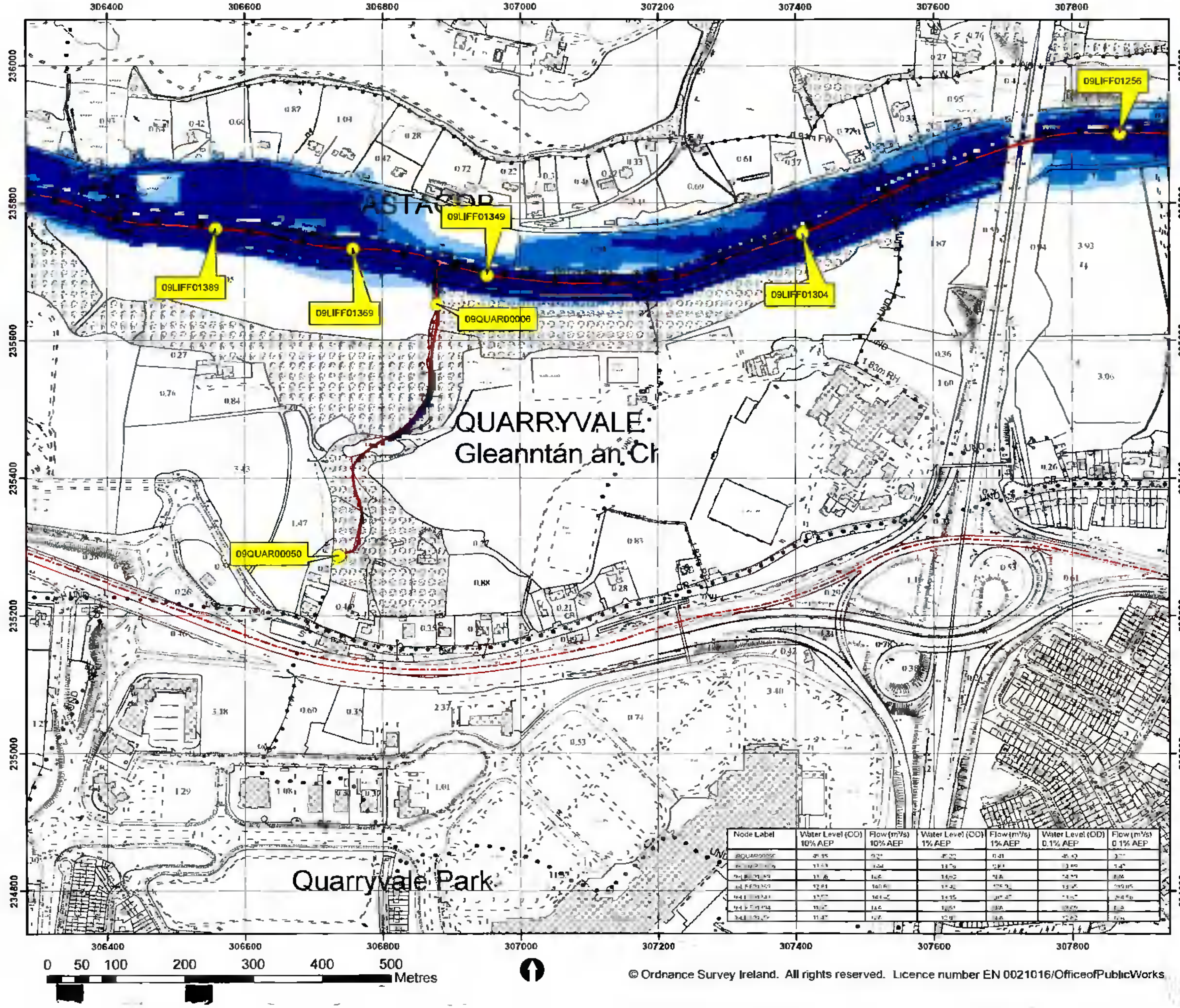
PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
S1.006	S27	600 minute 100 year Winter I+20%	58.200	57.958	0.401	0.000	0.07	68.279	0.8	3.5	FLOOD RISK*
S1.007	S28	720 minute 100 year Winter I+20%	58.200	57.957	0.693	0.000	0.03	12.047	0.6	2.3	FLOOD RISK
S1.008	S29	600 minute 100 year Winter I+20%	58.500	57.958	0.962	0.000	0.06	3.570	0.5	2.0	SURCHARGED

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary
Consulting Engineers

APPENDIX D. OPW FLOOD MAPS

Appendix D

OPW FLOOD MAPS



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
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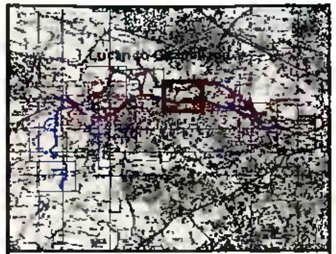

IMPORTANT USER NOTE
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

- 10% Fluvial AEP Event
- 1% Fluvial AEP Event
- 0.1% Fluvial AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID Node Label

FINAL

REV:	NOTE:	DATE

CFRAM STUDY

OPW

RPS

Map
Lucan to Chapelizod Fluvial Flood Extents

Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn By: C.C.	Date: 27 July 2016
Checked By: S.P.	Date: 27 July 2016
Approved By: G.G.	Date: 27 July 2016

Drawing No.:
E09LUC_EXFCD_F0_09

Map Series: Page 9 of 12

Drawing Scale: 1:5,000 @A3