Go-Ahead Bus Depot, Ballymount Road Lr, Dublin 12

Engineering Assessment Report for Additional Bus Parking and Electric Charging.

July 2021

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Client Name:	Go-Ahead Ireland
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Quality Assurance – Approval Status

Issue	Date	Prepared by	Checked by	Approved by
Issue 1	26 July 2021	N Cawley	B Gallagher	B McCann

Comments

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1. Introduction

1.1 Site Location

The existing bus depot operated by Go-Ahead Ireland is located on the northern side of Ballymount Road Lower, approximately 8km south west of Dublin City. Ballymount Road Lower runs in an east-west direction. It forms a roundabout with the Ballymount Road Upper to the west and the Walkinstown Roundabout to the east. Ballymount Road Upper provides access onto Junction 9 of the M50.

The location of the depot which has an area of 2.3 hectares is shown in Figure 1 below and the proposed site layout in Figure 2.

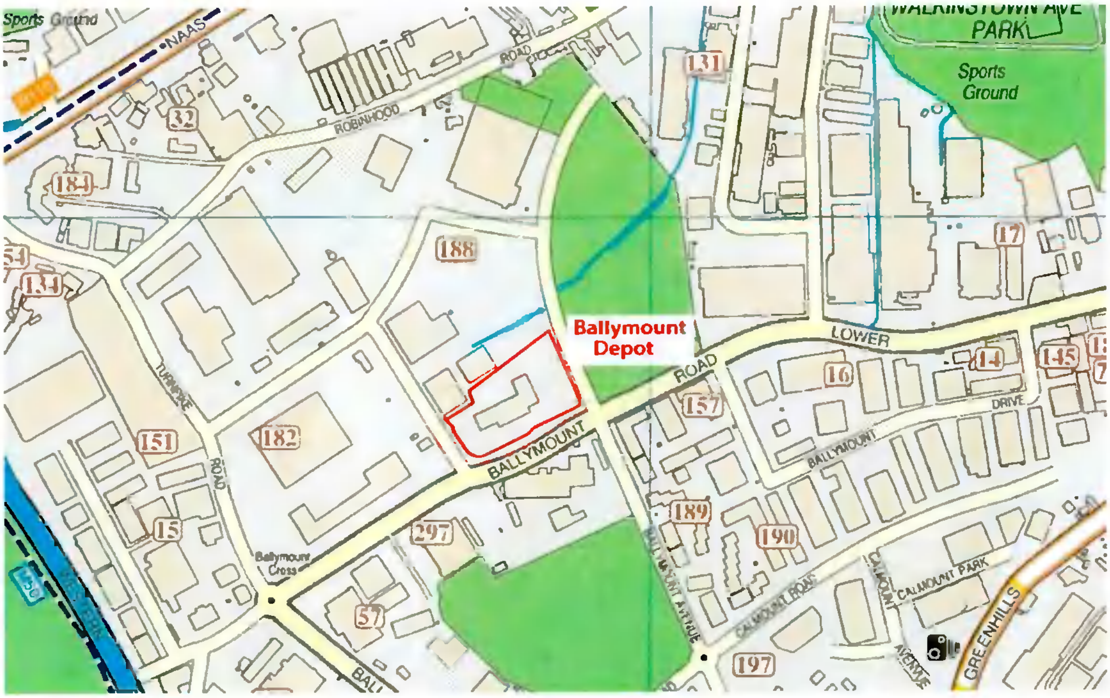

Figure 1 Site Location

1.2 Proposed Development

The proposed development at the Ballymount Bus Depot will comprise

- An increase in bus parking from 125 spaces to 221 spaces comprising: -
  - 40 x permanent parking spaces for single deck buses (no change).
  - 136 x permanent parking spaces for double deck buses (increase from 85 to 136).
  - 45 x permanent parking and charging spaces for electric buses (increase from 0 to 45).

- An increase in permanent car parking from 30 spaces to 33 spaces comprising: -
  - 14 x standard car parking spaces (decrease from 26 to 14)
  - 4 x disabled car parking spaces (increase from 1 to 4).
  - 15 x electric charging (increase from 3 to 15).
- An increase in shared car parking from 60 spaces to 250 spaces.
- An increase in motorcycle parking spaces from 0 to 5 spaces.
- An increase in cycle parking stands from 25 stands to 30 stands.
- A new vehicular access from Ballymount Avenue at the northeast corner of the site.
- Two new pedestrian accesses at the southeast and southwest corners of the site.
- An underground diversion of an overhead ESB cable along the eastern frontage of the site.
- Pole mounted site lighting.
- Facilities for charging of electric buses including a substation, two raised islands and 45 charging units.
- Facilities for charging of electric cars.
- Surface water drainage incorporating SuDS and attenuation storage for the new paving.
- Ancillary works.

1.3 Site Description

The site area is approximately 2.3 hectares.

The existing facilities comprise

- A single storey maintenance building and an attached two storey administration building with an area of 3,812 sqm.
- Surface parking for 125 buses and 30 cars.
- Bus fuelling and washing facilities.

The site has a gentle slope from the northwest to southeast.

1.4 Staff Numbers

The existing and future staff numbers at the Ballymount Depot are summarised in Table 1. Approximately 50% of the bus drivers are operating from the Ballymount depot on any particular day.

Table 1 Existing and Future Staff Numbers at Ballymount Depot

	Existing	Future
Office / Administrative	60	60
Engineering / Facilities	35	45
Bus Drivers	320	475
Total	415	580

1.5 Background of Report and Summary

This report describes the criteria used to design and detail the options available for the engineering infrastructure to support the additional bus and car parking.

No changes are proposed to the buildings or service facilities. As a result, the internal office space/facilities will remain unchanged.

The existing watermain serving the depot will remain unchanged with water usage increasing to serve additional drivers and buses.

Similarly, the existing foul sewer and internal plumbing will remain in situ with no changes to the system other than a low increase in wastewater flow from the additional drivers.

Arising from the increase in bus parking within the depot, the existing storm water drainage system will be extended to cater for the additional impermeable area. The surface water drainage for the new paving has been based on SuDS principles and incorporates the results of in-situ percolation tests carried out in January 2020. It will incorporate SuDS measures and attenuation storage.

1.6 Schedule of Drawings

Drg No 17-130 - P100 Location Map

Drg No 17-130 - P101 Topographical Survey

Drg No 17-130 - P102 Site Layout - Existing

Drg No 17-130 - P103 Paving Layout – Existing

Drg No 17-130 - P104 Services Layout – Existing

Drg No 17-130 - P105 Roof Plan - Existing

Drg No 17-130 - P106 Elevations - Existing

Drg No 17-130 - P107 Site Layout - Proposed

Drg No 17-130 - P108 Paving Layout – Proposed

Drg No 17-130 - P115 Construction Details

Drg No 17-130 - P116 Bus Charging and Site Lighting

Drg No 17-130 - P200 Surface Water Drainage - Proposed

Drg No 17-130 - P221 Private Surface Water Drainage Details-.

Drg No 17-130 - P245 Proposed Attenuation Tank Details

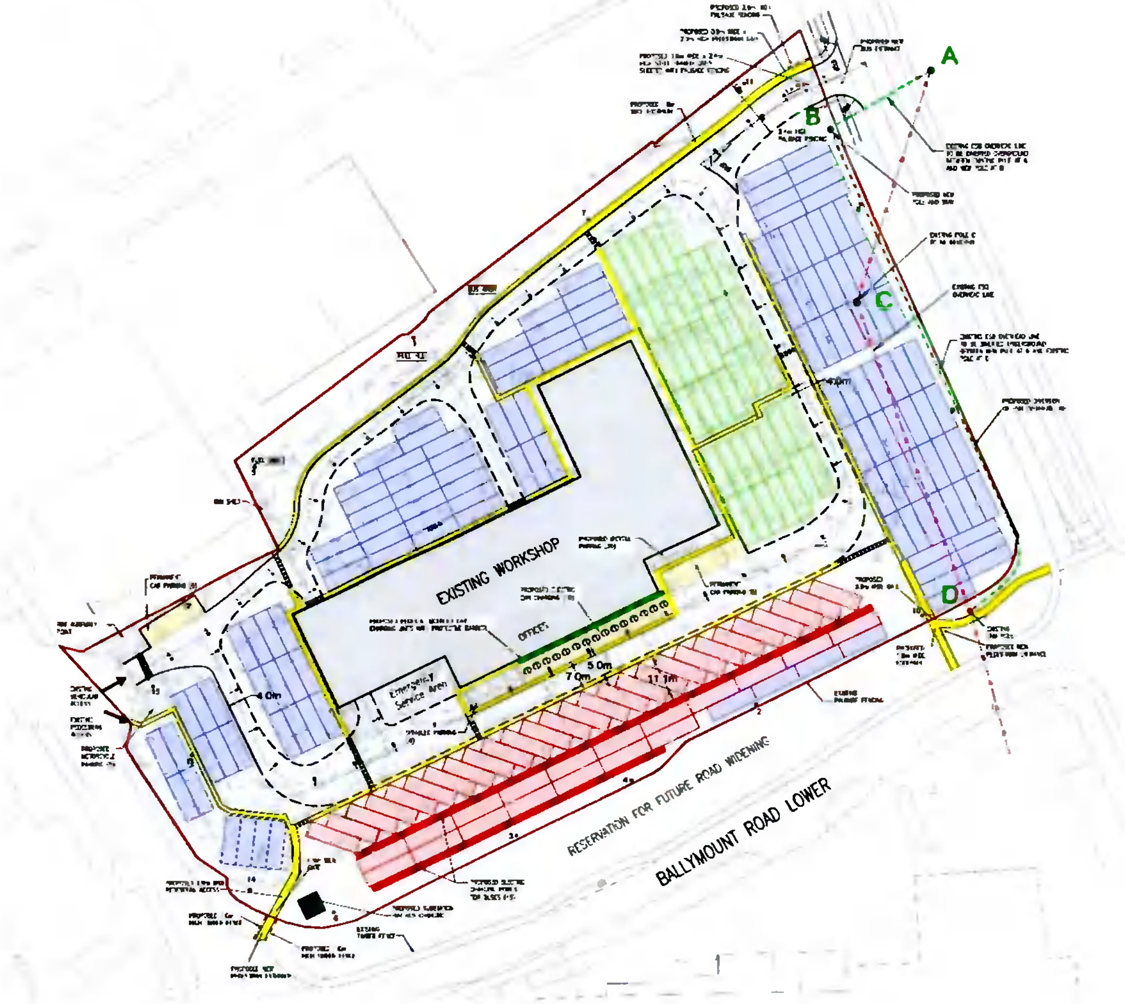

Figure 2 Proposed Site Layout

2. Water Supply

2.1 Existing Water Supply System

The existing water supply system which is shown on Waterman Moylan Drg No 17-130-P104 comprises: -

- A 150mm dia ringmain served from a public main located on the road to the west of the depot.
- An ABB Magmaster water meter.
- Connections to the and cold-water booster pump.

2.2 Facilities Provided

The existing facilities comprises

- Water storage tanks
- Cold water booster pump

In addition, the existing depot incorporates conservation measures to reduce demand including: -

- Low volume flush / dual flush WC's
- Aerated shower heads
- Spray taps
- Draw off tap controls

2.3 Existing Water Usage

The available data for water consumption at Ballymount postdates the onset of Covid-19 as the water meter at the depot was only installed in March 2021. Readings taken in March and April 2021 are presented in Table 2. The overall daily usage over the 35 days between 24 March and 28 April was 14.3 cum per day (14,300 litres).

This usage can be allocated as follows: -

Office / Administrative	;	10 persons x 100 litres per day	:	1,000 litres per day
Workshop / Facilities	:	35 persons x 100 litres per day	:	3,500 litres per day
Bus Driver (50% on duty)	:	160 persons x 10 litres per day	:	1,600 litres per day
Other	:	Bus wash etc	:	8,200 litres per day
		Total	:	14,300 litres per day

Table 2 Water Meter Readings

Date	Reading	Usage
24 Mar 2021	15.09	14.16 cum per day
25 Mar 2021	29.15	
27 Apr 2021	498.68	16.25 cum per day
28 Apr 2021	514.93	

2.4 Future Water Usage

With the return of the office / administrative staff post Covid and the projected increase in the number of buses and bus drivers, the water consumption at the depot is expected to increase to 24,600 litres per day made up as follows: -

Office / Administrative	;	60 persons x 100 litres per day	:	6,000 litres per day
Workshop / Facilities	:	45 persons x 100 litres per day	:	4,500 litres per day
Bus Driver (50% on duty)	:	240 persons x 10 litres per day	:	2,400 litres per day
Other	:	Bus wash etc	:	11,700 litres per day
		Total	:	24,600 litres per day

3. Foul Water Drainage

3.1 Existing Foul Drainage System

The existing foul water drainage system which is shown on Waterman Moylan Drg No 17-130-P104 comprises

(a) A 100 / 150mm dia sewer to the south of the buildings.

This sewer serves the sanitary fittings in the office and maintenance buildings.

(b) A 225mm dia sewer on the north side of the buildings.

This sewer collects run-off from the Fuel Bay and Bus Wash.

The fuel storage tank comprises a doubled skinned tank housed in a bunded area.

Recycling facilities are incorporated in the wash down area to minimise discharge to the public sewer.

Both sewers discharge to an existing 225mm diameter public foul sewer running along the eastern boundary of the depot.

3.2 Facilities Served

Domestic Facilities

The southern sewer collects discharge from the sanitary facilities staff located in the administrative and maintenance buildings.

The facilities comprise toilets, urinals, wash hand basins and showers serve a total staff of 415 persons comprising 60 office / administrative, 35 workshop / facilities and 320 bus drivers.

Vehicle Facilities

The northern sewer collects run-off from the Fuel Bay and Bus Wash. It discharges through a full retention petrol Interceptor to a 225mm dia public sewer located in the northeast area of the depot.

The fuel storage tank comprises a doubled skinned tank housed in a bunded area.

The wash down area incorporates recycling facilities to minimise discharge to the public sewer.

3.3 Future Wastewater Operation

The existing foul sewer and internal plumbing will remain in situ with no changes to the system other than a modest increase in wastewater flow from the additional drivers (increase in driver numbers from 320 to 475 with some 50% of drivers on duty at any one time).

4. Surface Water Drainage

4.1 Introduction – Existing

There is an existing network of stormwater drains which currently serve the subject site. These drain via gravity to the existing 375mm surface water drain located within the subject site to the north east.

The storm water from the proposed paving extension will discharge to the existing 375mm diameter surface water network. This will be at a restricted rate of 2.0 l/s which is achieved by means of a Hydro-brake, or similar approved flow control device, installed downstream of a proposed Stormtech attenuation tank which will store excess water during storm periods of up to 1 in 100 years. This is in accordance with the requirements of the Greater Dublin Strategic Drainage Study

The layout of the existing surface water drainage network is shown on Waterman Moylan Drawing No 17-130-P104.

Hydrocare Environmental Ltd were appointed late in 2019 to carry out infiltration testing on the subject site at the location of the proposed paving extension. Hydrocare attended site on the 16th of January 2020. Infiltration testing was carried out at 4 No. locations on the subject site in accordance with BRE Digest 365 guidance document. The report was issued on 24th of January 2020 and a copy is included in Appendix A

The infiltration rate tests carried out showed low levels of percolation on site. The results are summarised in Table 3 below:

Table 3 Summary of Infiltration Rate Tests Results

Test Hole No.	*Depth of Hole [mBGL]*	*Water Table Level [mBGL] (N/A if not encounterd)*	*Bedrock Level [mBGL] (N/A if not encounterd)*	*Infiltration Rate [m/s]*
1	1.50	NA	NA	4.28E-06
2	1.50	NA	NA	5.20E-06
3	1.50	NA	NA	4.35E-06
4	1.50	NA	NA	9.20E-06

4.2 Surface Water – General

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

The proposed surface water drainage system for this development has been designed as a sustainable urban drainage system and uses filter drains/swales, underground attenuation together with flow restrictors, petrol interceptor to:

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

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

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

The surface water drainage system was designed with reference to the Sustainable Urban Drainage Systems 'SuDS' published by the Construction Industry Research and Information Association.

4.3 Site Characteristics

The additional site paving which forms the catchment area for the extension to the surface water drainage system is illustrated in Figure 3.

Figure 3 Catchment Area

The catchment characteristics used in the Attenuation Calculations are set out in Table 4. See Appendix B for attenuation calculations.

The SAAR value for the site was established by extracting the Annual Average Rainfall figures from the Met Eireann website. See Appendix C.

Table 4: Surface Water Catchment Details

Characteristic	Proposed Development
Catchment Area (ha)	0.64 ha
Impermeable area (ha)	0.616 ha
% Hardstanding	96%
SAAR - mm	707
SOIL Index	20%
Climate Change	20%

4.4 Outflow Limits

The local authority requirements are that post-development run-off rates be limited to greenfield run-off rates for the site. The greenfield run-off rates for this site have been calculated in accordance with the Institute of Hydrology Report No 124 *"Flood Estimation for Small Catchments"*, using the UK SuDS Website. The outflow limits are as follows:

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

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

Allowable Discharge = Greenfield Run-off x Area

Where:

- Area = Site area in km^2 (Or 50 hectares if site is less than 50 Hectares)
- SAAR = Taken from "Extreme Rainfall in Ireland" maps (997mm)
- SOIL = Runoff constant (Varies between 0.1 and 0.53: Given as 0.3 for an average soil)
  - $Qbar_{rural} = 0.00108(0.5)^{0.89} \times (707)^{1.17} \times (0.3)^{2.17}$
  - $Qbar_{rural}$ = 92.19 l/s (For a 50-hectare site)
  - $Qbar_{rural}$ = 1.18 l/s/Ha

Therefore, the permitted outflow for varying return periods is as follows:

Table 5 Surface Water Outflow – Catchment

Characteristic	Proposed Development
Site Area	0.64 ha
$Qbar_{rural}$	1.18 l/s

As the permitted outflow is lower than 2 l/s which is the minimum practical flow achievable from a hydro-brake based on manufacturer's requirements, a flow of 2 l/s has been used for the purpose of calculations for this project.

4.5 SuDS Selection Criteria/ Treatment Train

Sustainable drainage systems aim towards maintaining or restoring a more natural hydrological regime, such that the impact of urbanisation on downstream flooding and water quality is minimised. Originally, SuDS were introduced primarily as single purpose facilities, however this has now evolved into more integrated systems which serve a variety of purposes, including habitat and amenity enhancement. The main advantages of an integrated SuDS facility are the savings on land-take and maintenance. We have outlined The SuDS proposals for the subject site are outlined in Table 6 below and together with the benefits of each measure.

SuDS minimise the impacts of urban runoff by capturing runoff as close to source as possible and then releasing it slowly. The use of SuDS to control runoff also provides the additional benefit of reducing pollutants in the surface water by settling out suspended solids, and in some cases providing biological treatment.

The stormwater management or **treatment train** approach for the subject site assures that runoff quantity and quality is addressed. The following objectives of the **treatment train** provide an integrated and balanced approach to help mitigate the changes in stormwater runoff flows that occur as land is urbanised and to help mitigate the impacts of stormwater quality on receiving systems:

1) **Source Control:** conveyance and infiltration of runoff, this is achieved though provision of swales on site.

2) **Site Control:** reduction in volume and rate of surface runoff, with some additional treatment provided. This is achieved through provision of petrol interceptor/attenuation on site.

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

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

Table 6 SuDS Measures

Stage	Measure	Measure Outline
Source Control	Swales	Swales are shallow, broad and vegetated channels designed to store and/or convey runoff and remove pollutants. They may be used as conveyance structures to pass the runoff to the next stage of the treatment train and can be designed to promote infiltration where soil and groundwater conditions allow. We have carried out percolation testing on site and the results are included within Appendix A. The results show that percolation of water to ground is available on site. Please refer to Waterman Moylan Drawing No. 17-130-C200 for further details. The swales will be provided with a high-level overflow and any water that does not percolate to ground naturally will drain back to the drainage network. Swales will be provided at the low edge of the slab extension with water flowing overland to the swales by gravity
Site Control	Petrol Interceptor	A petrol interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is typically used in road construction to prevent fuel contamination of water courses carrying away the runoff. Petrol interceptors work on the premise that some hydrocarbons such as petroleum and diesel float on the top of water. The contaminated water enters the interceptor typically after flowing off roads and entering a channel drain before being deposited into the first tank inside the interceptor. The first tank builds up a layer of the hydrocarbon as well as other scum preventing it from entering the water course. The petrol interceptor for the subject site will be installed prior to outfall to filter any pollutants out before connection to local network. Please refer to Waterman Moylan Drawing No. 17-130-C200 for further details.
	Attenuation Tank	The proposed Stormtech MC-4500 will attenuate surface water to restrict the outflow to the equivalent of the existing agricultural runoff. This ensures the development will not give rise to any impact downstream of the site. We have carried out percolation testing on site and the results are included within Appendix A. The results show that percolation of water to ground is available on site. This will benefit with surface water naturally percolating to ground as well as outflowing via the hydrobrake. For the benefit of attenuation calculations, we have not allowed for percolation to ground to form a robust sizing of tank. Please refer to Waterman Moylan Drawing No 17-130-C200 for further details.

4.6 Proposed Surface Water Attenuation Strategy

The storm water will discharge from the proposed development to the existing 375mm surface water network located to the east of the site. This will be at a restricted rate of 2 l/s which is achieved by means of a Hydro-brake, or similar approved flow control device, installed downstream of a proposed Stormtech attenuation tank which will store excess water during storm periods of up to 1 in 100 years.

Storm water which falls on the proposed paving extension will drain by gravity either to the concrete channel along the site which is connected to the storm water system or will drain into a swale along the slab edge depending on site levels. Only excess water that has not percolated naturally to the ground will connect back to the surface water network through the high-level overflow. The runoff will then pass through the attenuation tank before it finally outfalls into the existing network.

It is proposed that the 1 in 100-year critical design storm will be used for storm water attenuation volumetric calculations.

Excess storm water will be attenuated in a proposed underground storage tank as indicated on Waterman Moylan Drawings No's 17-130-P200 and 17-130-P245.

4.7 Storm Water Calculations

The total hardstanding area of the paving is c. 0.616 ha (See Table 4).

It is proposed that, in accordance with the recommendations of the *Greater Dublin Strategic Drainage Study*, that the 1 in 100-year critical design storm be used for storm water attenuation volumetric calculations.

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

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

The maximum attenuated outflow from the subject site at this location is calculated as 2 l/s.

The calculations for the attenuation storage design are included in Appendix B of this report. These indicate that for a return period of 100 years, the 1,440-minute winter storm is the critical storm and requires a storage volume of approximately 611.86 m^3 which includes 20% storage to facilitate climate change. As such, a Stormtech MC-4500 has been specified, which has a volume of 616 m^3.

Waterman Moylan Drawing No. 17-130-P245 details this attenuation tank and the drainage layout proposals.

4.8 SUDS Maintenance

For the SUDS strategy to work as designed it is important that the entire drainage system is well maintained. It will be the responsibility of the site management team to ensure the drainage system is maintained. Maintenance and cleaning of gullies, drain manholes (including catch pits), permeable paving and attenuation tanks will ensure adequate performance. The recommended program is outlined in the Table 7 below.

Table 7 Attenuation Tank Maintenance Schedule

Element	Maintenance		
Attenuation Tanks	Maintenance Issues	Failure of components, blockage from debris	
	Maintenance Period	Maintenance Task	Frequency
	Regular	Inspect and identify any elements that are not operating correctly. If required, take remedial action.	Monthly for three months, then annually
		Remove sediment/debris from catchment surface that may lead to blockage of structures.	Monthly or as required
		Remove sediment/debris from catch pits/ gullies and control structures.	Annually, after severe storms or as required
	Remedial Work	Repair inlets, outlets, vents, overflows and control structures.	As required
	Monitoring	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are in good condition and operating as designed.	Annually or after severe storms
		Survey inside of tank for sediment build-up and remove if necessary	Every year or as required

Appendices

Appendix A Report on Infiltration Rate Testing, Hydrocare Environmental Limited, January 2020.

Appendix B Attenuation Calculations

Appendix C Annual Average Rainfall

Appendix A

Report on Infiltration Rate Testing, Hydrocare Environmental Ltd, Jan 2020.

INFILTRATION RATE TESTING

Per

BRE Digest 365 TEST METHOD

DRAFT

Applicant: Go Ahead

Site Location: Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12

DATE OF REPORT: 24th January 2020

Prepared by

HYDROCARE ENVIRONMENTAL LTD

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Environmental Consultants
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HCE Ref: 20-002

Waterman Moylan
Block S,
Eastpoint Business Park,
Alfie Byrne Road,
Co. Dublin

24th January 2020

FAO: Joe Gibbons, Director

Applicant: Go Ahead
Site Location: Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12

Infiltration testing was carried out on 16th January 2020 at the above location per BRE digest 365 method. Results of testing are summarised below for your information.

Test Hole No.	*Depth of Hole [mBGL]*	*Water Table Level [mBGL] (N/A if not encounterd)*	*Bedrock Level [mBGL] (N/A if not encounterd)*	*Infiltration Rate [m/s]*
1	1.50	NA	NA	4.28E-06
2	1.50	NA	NA	5.20E-06
3	1.50	NA	NA	4.35E-06
4	1.50	NA	NA	9.20E-06

Further information relating to specific test details are appended herewith for your information.

Yours sincerely,

Seán O'Connor, M. Appd. Sc., Dip. Public Health, P.G. Dip. Envir. Engr. Fetac Approved Site Assessor

Hydrocare Environmental Ltd. - BRE365 Design Calculations

CLIENT:	**Go Ahead**
LOCATION:	**Go Ahead Bus Depot, Lower Ballymount Road, Dublin :**
TEST HOLE NO.:	**1**

Infiltration Rate

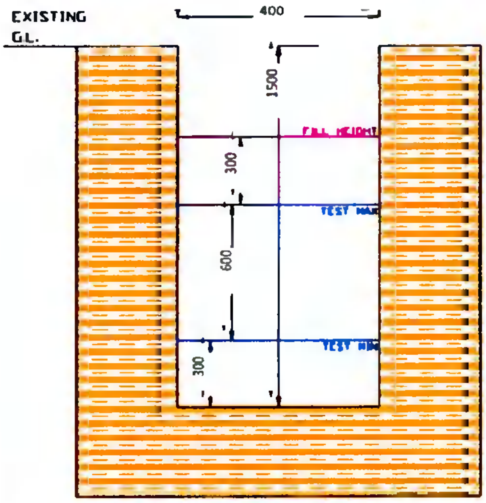
Test Hole Information:	
Length [m]	1.00
Width [m]	0.40
Depth of hole [m]	1.50
Water filled to [mBGL]	0.30
Water Table [mBGL]	NA
Base of Test [mBGL]	1.50
Bedrock [mBGL]	NA
Drop Time [min]	449

$$V_{p75-25} = 1 \times 0.4 \times (0.9 - 0.3) = 0.24 \ m^3$$

$$A_{p50} = (1 \times 0.6 \times 2) + (0.4 \times 0.6 \times 2) + (1 \times 0.4) = 2.08 \ m^2$$

$$f = \frac{0.24}{2.08 \times 448.818897637795 \times 60} = 4.28E\text{-}06 \ m/s$$

Note: Base of test is bottom of test hole unless water table is encountered



BRE 365 TEST HOLE

Date: 16th January 2020
Client: Go Ahead
Location: Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12

Hydrocare Environmental Ltd. - BRE365 Design Calculations

CLIENT:	**Go Ahead**
LOCATION:	**Go Ahead Bus Depot, Lower Ballymount Road, Dublin :**
TEST HOLE NO.:	**2**

Infiltration Rate

Test Hole Information:	
Length [m]	1.10
Width [m]	0.40
Depth of hole [m]	1.50
Water filled to [mBGL]	0.30
Water Table [mBGL]	NA
Base of Test [mBGL]	1.50
Bedrock [mBGL]	NA
Drop Time [min]	378

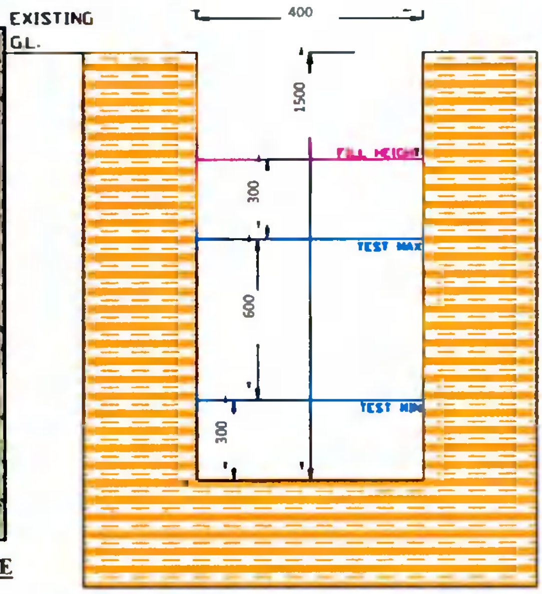
V_{p75-25} = 1.1 x 0.4 x (0.9 - 0.3) = 0.264 m^3

A_{p50} = (1.1 x 0.6 x 2) + (0.4 x 0.6 x 2) + (1.1 x 0.4) = 2.24 m^2

$$f = \frac{0.264}{2.24 \times 377.952755905512 \times 60} = 5.20E\text{-}06 \text{ m/s}$$

Note: Base of test is bottom of test hole unless water table is encountered

BRE 365 TEST HOLE



Date:	16th January 2020
Client:	Go Ahead
Location:	Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12

Hydrocare Environmental Ltd. - BRE365 Design Calculations

CLIENT:	**Go Ahead**
LOCATION:	**Go Ahead Bus Depot, Lower Ballymount Road, Dublin :**
TEST HOLE NO.:	**3**

Infiltration Rate

Test Hole Information:

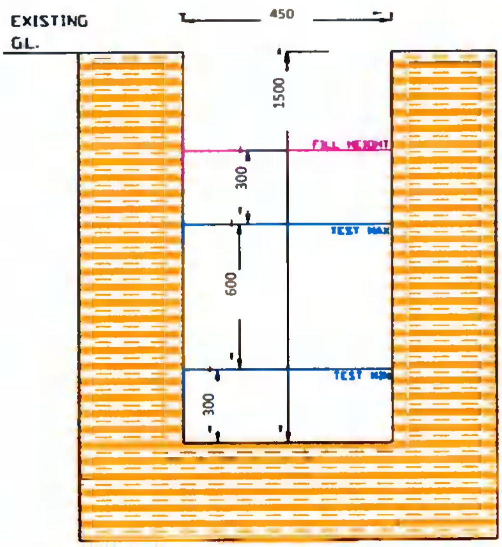
Length [m]	1.00
Width [m]	0.45
Depth of hole [m]	1.50
Water filled to [mBGL]	0.30
Water Table [mBGL]	NA
Base of Test [mBGL]	1.50
Bedrock [mBGL]	NA
Drop Time [min]	472

V_{p75-25} = 1 x 0.45 x (0.9 - 0.3) = 0.27 m^3

A_{p50} = (1 x 0.6 x 2) + (0.45 x 0.6 x 2) + (1 x 0.45) = 2.19 m^2

$$f = \frac{0.27}{2.19 \times 472.44094488189 \times 60} = 4.35E\text{-}06 \text{ m/s}$$

Note: Base of test is bottom of test hole unless water table is encountered



BRE 365 TEST HOLE

Date:	16th January 2020
Client:	Go Ahead
Location:	Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12

CLIENT:	**Go Ahead**
LOCATION:	**Go Ahead Bus Depot, Lower Ballymount Road, Dublin :**
TEST HOLE NO.:	**4**

Infiltration Rate

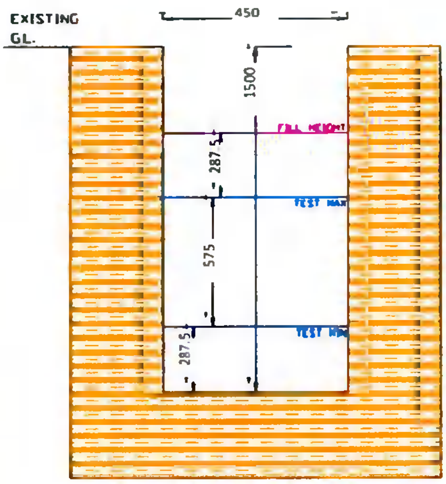
Test Hole Information:	
Length [m]	1.10
Width [m]	0.45
Depth of hole [m]	1.50
Water filled to [mBGL]	0.35
Water Table [mBGL]	NA
Base of Test [mBGL]	1.50
Bedrock [mBGL]	NA
Drop Time [min]	226

$V_{p75\text{-}25} = 1.1 \times 0.45 \times (0.8625 - 0.2875) = 0.284625\ m^3$

$A_{p50} = (1.1 \times 0.575 \times 2) + (0.45 \times 0.575 \times 2) + (1.1 \times 0.45) = 2.2775\ m^2$

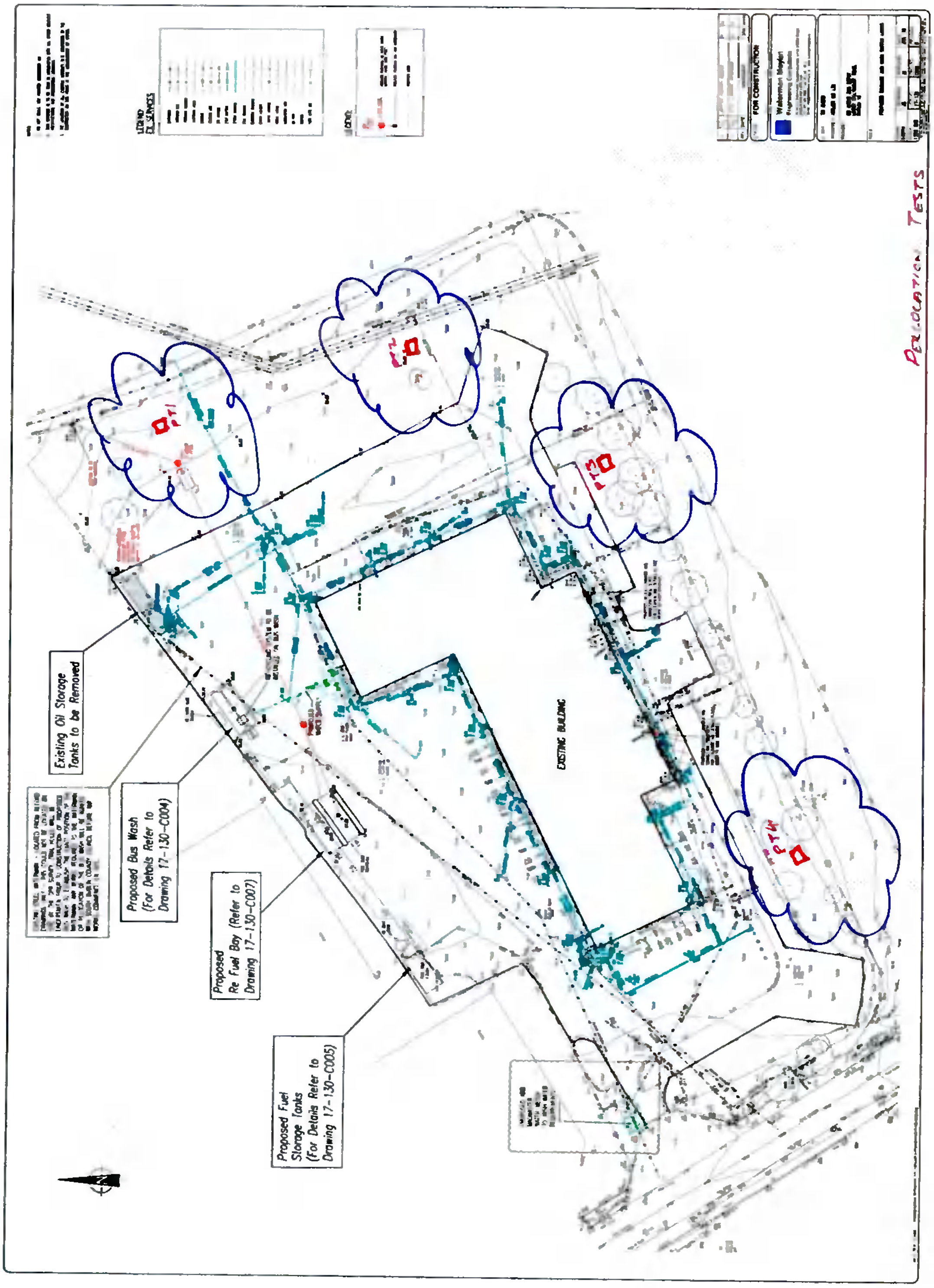
$$f = \frac{0.284625}{2.2775 \times 226.377952755906 \times 60} = 9.20E\text{-}06\ m/s$$

Note: Base of test is bottom of test hole unless water table is encountered



BRE 365 TEST HOLE

Date:	16th January 2020
Client:	Go Ahead
Location:	Go Ahead Bus Depot, Lower Ballymount Road, Dublin 12



Existing Oil Storage Tanks to be Removed
Proposed Bus Wash (For Details Refer to Drawing 17-130-C004)
Proposed Re Fuel Bay (Refer to Drawing 17-130-C007)
Proposed Fuel Storage Tanks (For Details Refer to Drawing 17-130-C005)
EXISTING BUILDING
PERCOLATION TESTS
PT1
PT2
PT3
PT4
FOR CONSTRUCTION

Appendix B

Attenuation Calculations

Column	Proposed Development
Site Area (Catchment) – Ha	0.640
Impermeable Area - Ha	0.616
% Hardstanding	96%
SAAR - mm	707
SOIL Index	0.3
Climate Change	20%

0.0010

Soil Type	SOIL
1	0.1
2	0.3
3	0.37
4	0.47
5	0.53

QBAR (50 Hectares) 92.19 l/s
QBAR per Hectare 1.84 l/s/Ha

Column1	Proposed Development
Site Area (Catchment)	0.6403
$Qbar_{rural}$	2.00

Imp Area 6160 m2

Rainfall (mm) http://archive.met.ie/climate/products03.asp

Duration	Insert Rainfall Data							
(min)	1	5	10	20	30	50	100	
30	7.6	13.5	17.2	21.5	24.4	28.5	35.1	0.5 Hrs
60	10	17.3	21.8	27.1	30.6	35.5	43.4	1 Hrs
120	13	22.1	27.7	34.1	38.3	44.3	53.8	2 Hrs
240	19.8	32.7	40.4	49.1	54.8	62.8	75.5	4 Hrs
360	23.1	37.8	46.4	56.2	62.6	71.5	85.5	6 Hrs
720	25.8	41.8	51.3	61.8	68.7	78.4	93.5	12 Hrs
1,440	33.6	53.5	65	77.8	86.2	97.7	115.8	24 Hrs
2,880	41	62.9	75.3	88.8	97.6	109.6	128.2	48 Hrs

Inflow (m3)

Duration	Return Period (Years)							
(min)	1	5	10	20	30	50	100	
30.00	51.50	91.48	116.55	145.68	165.33	193.12	237.84	0.5 Hrs
60.00	67.76	117.22	147.72	183.63	207.35	240.55	294.08	1 Hrs
120.00	88.09	149.75	187.70	231.06	259.52	300.18	364.55	2 Hrs
240.00	134.16	221.58	273.75	332.70	371.32	425.53	511.59	4 Hrs
360.00	156.53	256.13	314.41	380.81	424.18	484.48	579.35	6 Hrs
720.00	174.82	283.24	347.61	418.76	465.51	531.24	633.56	12 Hrs
1,440.00	227.67	362.52	440.44	527.17	584.09	662.02	784.66	24 Hrs
2,880.00	277.82	426.21	510.23	601.71	661.34	742.65	868.68	48 Hrs

Outflow (m3)

Duration	Return Period (Years)							
(min)	1	5	10	20	30	50	100	
30.00	3.60	3.60	3.60	3.60	3.60	3.60	3.60	0.5 Hrs
60.00	7.20	7.20	7.20	7.20	7.20	7.20	7.20	1 Hrs
120.00	14.40	14.40	14.40	14.40	14.40	14.40	14.40	2 Hrs
240.00	28.80	28.80	28.80	28.80	28.80	28.80	28.80	4 Hrs
360.00	43.20	43.20	43.20	43.20	43.20	43.20	43.20	6 Hrs
720.00	86.40	86.40	86.40	86.40	86.40	86.40	86.40	12 Hrs
1,440.00	172.80	172.80	172.80	172.80	172.80	172.80	172.80	24 Hrs
2,880.00	345.60	345.60	345.60	345.60	345.60	345.60	345.60	48 Hrs

Storage Reqd. (m3)

Duration	Return Period (Years)							
(min)	1	5	10	20	30	50	100	
30.00	47.90	87.88	112.95	142.08	161.73	189.52	234.24	0.5 Hrs
60.00	60.56	110.02	140.52	176.43	200.15	233.35	286.88	1 Hrs
120.00	73.69	135.35	173.30	216.66	245.12	285.78	350.15	2 Hrs
240.00	105.36	192.78	244.95	303.90	342.52	396.73	482.79	4 Hrs
360.00	113.33	212.93	271.21	337.61	380.98	441.28	536.15	6 Hrs
720.00	88.42	196.84	261.21	332.36	379.11	444.84	547.16	12 Hrs
1,440.00	54.87	189.72	267.64	354.37	411.29	489.22	611.86	24 Hrs
2,880.00	0.00	80.61	164.63	256.11	315.74	397.05	523.08	48 Hrs

Appendix C

Annual Average Rainfall

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 309796, Northing: 230737,

	Interval		Years												
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.4,	3.6,	4.2,	5.2,	5.9,	6.5,	8.3,	10.4,	11.9,	13.9,	15.8,	17.3,	19.6,	21.4,	22.9,	N/A ,
10 mins	3.4,	5.0,	5.9,	7.3,	8.2,	9.0,	11.5,	14.5,	16.5,	19.4,	22.0,	24.1,	27.3,	29.8,	32.0,	N/A ,
15 mins	3.9,	5.9,	6.9,	8.6,	9.7,	10.6,	13.6,	17.1,	19.4,	22.8,	25.9,	28.3,	32.1,	35.1,	37.6,	N/A ,
30 mins	5.2,	7.6,	9.0,	11.0,	12.4,	13.5,	17.2,	21.5,	24.4,	28.5,	32.2,	35.1,	39.6,	43.2,	46.1,	N/A ,
1 hours	6.9,	10.0,	11.6,	14.2,	15.9,	17.3,	21.8,	27.1,	30.6,	35.5,	40.0,	43.4,	48.8,	53.1,	56.6,	N/A ,
2 hours	9.1,	13.0,	15.1,	18.3,	20.5,	22.1,	27.7,	34.1,	38.3,	44.3,	49.6,	53.8,	60.2,	65.2,	69.4,	N/A ,
3 hours	10.7,	15.2,	17.6,	21.2,	23.7,	25.6,	31.8,	39.0,	43.7,	50.4,	56.3,	61.0,	68.1,	73.6,	78.2,	N/A ,
4 hours	12.0,	16.9,	19.6,	23.5,	26.2,	28.3,	35.2,	42.9,	48.0,	55.2,	61.6,	66.6,	74.3,	80.2,	85.2,	N/A ,
6 hours	14.1,	19.8,	22.8,	27.3,	30.3,	32.7,	40.4,	49.1,	54.8,	62.8,	70.0,	75.5,	84.0,	90.5,	96.0,	N/A ,
9 hours	16.6,	23.1,	26.5,	31.7,	35.1,	37.8,	46.4,	56.2,	62.6,	71.5,	79.4,	85.5,	94.9,	102.2,	108.2,	N/A ,
12 hours	18.7,	25.8,	29.5,	35.2,	38.9,	41.8,	51.2,	61.8,	68.7,	78.4,	86.9,	93.4,	103.5,	111.3,	117.7,	N/A ,
18 hours	22.0,	30.1,	34.4,	40.8,	45.0,	48.3,	58.9,	70.7,	78.4,	89.2,	98.6,	105.9,	117.0,	125.6,	132.7,	N/A ,
24 hours	24.7,	33.6,	38.3,	45.3,	49.9,	53.5,	65.0,	77.8,	86.1,	97.7,	107.9,	115.7,	127.7,	136.9,	144.4,	170.7,
2 days	30.8,	40.9,	46.2,	53.9,	59.0,	62.9,	75.2,	88.8,	97.6,	109.6,	120.1,	128.1,	140.3,	149.6,	157.2,	183.4,
3 days	35.7,	46.9,	52.6,	60.8,	66.3,	70.4,	83.6,	97.8,	107.0,	119.5,	130.3,	138.6,	151.1,	160.6,	168.4,	195.0,
4 days	40.0,	52.0,	58.1,	66.9,	72.6,	77.0,	90.8,	105.7,	115.2,	128.1,	139.3,	147.8,	160.6,	170.4,	178.3,	205.4,
6 days	47.6,	60.9,	67.7,	77.3,	83.6,	88.4,	103.3,	119.2,	129.4,	143.1,	154.9,	163.8,	177.2,	187.4,	195.7,	223.7,
8 days	54.2,	68.8,	76.1,	86.5,	93.2,	98.3,	114.1,	131.0,	141.7,	156.1,	168.5,	177.8,	191.7,	202.2,	210.8,	239.6,
10 days	60.3,	75.9,	83.7,	94.7,	101.9,	107.2,	124.0,	141.7,	152.8,	167.8,	180.6,	190.3,	204.7,	215.6,	224.4,	254.1,
12 days	66.0,	82.6,	90.8,	102.4,	109.9,	115.5,	133.0,	151.5,	163.0,	178.6,	191.9,	201.8,	216.7,	227.9,	236.9,	267.4,
16 days	76.6,	94.9,	103.8,	116.5,	124.6,	130.7,	149.6,	169.3,	181.7,	198.2,	212.3,	222.8,	238.4,	250.2,	259.7,	291.4,
20 days	86.3,	106.1,	115.8,	129.4,	138.1,	144.6,	164.6,	185.5,	198.5,	215.9,	230.7,	241.7,	258.0,	270.3,	280.2,	313.1,
25 days	97.8,	119.2,	129.7,	144.3,	153.6,	160.6,	182.0,	204.2,	217.9,	236.3,	251.8,	263.3,	280.5,	293.2,	303.6,	337.9,

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

UK and Ireland Office Locations