Dublin – Drogheda – Limerick
+353 1 8301852
www.dfk.ie
mailroom@dfk.ie

DOHERTY FINEGAN KELLY
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Botanic Court
30-32 Botanic Road
Glasnevin, Dublin 9
D09 W2V9

Surface Water Drainage Report
Submission for Compliance

Proposed Construction of 5 Warehouse/Logistics, 3 Office Blocks and a Café/Restaurant Development

to site at

Calmount Road and Ballymount Avenue, Ballymount Industrial Estate, Dublin 12

Report DFK/23002-01-2

Project No.	23002	**Document Ref:**	Drainage Services Report 23002-01.doc

Revision	**Purpose / Description**	**Originated**	**Checked**	**Authorised**	**Date**
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Doherty Finegan Kelly, Civil & Structural Engineers,
Botanic Court, 30-32 Botanic Road, Glasnevin, Dublin 9

Directors: Francis Doherty B.Sc.(Eng), Dip.Struct.Eng, C.Eng, M.I.Struct.E, Dip.Proj.Man.
Emmet Finegan B.S.c.(Eng), Dip.Struct.Eng, C.Eng, M.I.Struct.E, M.I.E.I, RConsEI.
Cathal Kelly B.S.c.(Eng), Dip.Struct.Eng, C.Eng, M.I.Struct.E, M.I.E.I, RConsEI, Dip.Proj.Man.

Regional Director: Liam Murphy B.S.c.(Eng), Dip.Struct.Eng, C.Eng, M.I.Struct.E, M.I.E.I.

Doherty Finegan Kelly Ltd., Reg No. 376523

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1.0 INTRODUCTION

Granted Permission

Planning has been granted under Reg. Ref.: SD22A/0099 and relates to:

inter alia the construction of five no. warehouse/logistics units, 3 no. own door office buildings, a café unit, and all associated development, as permitted by SDDC on the 3rd of February 2023 (final grant date) and subject to 25 no. conditions.

As illustrated on DFK **Drg. No. 23002-01C**, the drainage details included in this compliance submission relates primarily to the southern part of the permitted development, i.e. Unit 1, 6, office buildings 5A to 5C, the café unit and the north-south road up to and the roundabout at the northern boundary of the site, for which compliance with Condition 11 (a) to (c) is sought. The surface water discharge to the rear of Units 3 & 4 will form part of this compliance, subject to slight adjustments of the cover and invert levels. The context to the proposals submitted is described below, followed by the details of the proposals submitted for compliance with Condition 11.

Detailed Design and Surface Water Management Approach

The drainage design and the surface water management for Unit 1, 6, office buildings 5A to 5C, the café unit and the main north-south road from the site entrance off Calmount Road as far as and including the roundabout towards the northern boundary of the site has been updated. The site investigations completed on site, post planning decision, confirmed infiltration is available and therefore infiltration has been prioritised as the method of controlling surface water runoff from the proposed development.

Upon detailed design of the development, it has become apparent that a new planning application will be required to alter the floor levels and associated site levels including access road levels of certain buildings, namely Units 2, 3 & 4 to ensure compliance with the current Building Regulations. This is merely a planning exercise to adjust floor levels only and not re-size or significantly alter the proposed locations of the units that might have an effect on the overall drainage design submitted as part of this application. The main north-south road is included in this compliance submission from the site entrance off Calmount Road as far as and including the roundabout towards the northern boundary of the site.

The east-west access road north of Unit 6 will be included in the new planning amendment application for the site level alterations although the surface water discharge to the rear of Units 3 & 4 will form part of this compliance, subject to slight adjustments of the cover and invert levels. The road north of Unit 2 requires slight adjustments also and will be included in this planning amendment.

There is also a site in question north of Unit 2 access road which will form part of a separate planning application and the adjusted road levels included in the proposed Planning Amendment. A colour coded site plan indicating this strategy is included on the attached DFK Engineer's Drg No. **23022-01C – Proposed Site Layout.**

SURFACE WATER MANAGEMENT STRATEGY FOLLOWING DETAILED DESIGN - DETAILS FOR COMPLIANCE WITH CONDITION 11

The original surface water design completed by DBFL took a conservative approach and infiltration was not considered as outlined in the extract below taken from the engineering service report submitted by DBFL at planning stage as no site investigation/soakaway tests were carried out for this planning application:

> Whilst modelling the network to determine attenuation volumes a conservative approach was applied where runoff coefficients were not compounded along the treatment train. In the example of figure 3.2 the runoff for the areas draining to the swale was only reduced by a factor of 0.7 when we would expect a further reduction of 0.7 as the runoff will also be routed through the bioretention area. Consequently we can expect that runoff volumes, and as such attenuation volumes, would be reduced compared to those initially modelled herein. On receipt of detailed site investigation data a determination of the infiltration rate will be made to inform calculations as to the exact reduction in runoff and attenuation that can be achieved.

Site investigations completed on site, post planning decision, confirmed infiltration is available and for this reason the surface water design has been updated and infiltration will be prioritised as the method of controlling surface water runoff from the proposed development site. The relevant extract (relevant elements of the report in relation to planning design requirements) from the site investigation report showing the infiltration rates is included in **Appendix V.** The updated design has retained the SuDs mechanisms where viable and due to the infiltration available the attenuation has been reduced. While it has not been possible to omit the below ground attenuation systems entirely, in line with SDCC development plan IE2 Objective 5, the amended design significantly reduces the attenuation required on site. There is one exception to this, Unit 1 where the SuDs meachinisms along the northern and western boundary were not viable due to the steep slope (1:2) along the northern boundary between Units 1 and 2 and the live ESB cables located along the western boundary as identified on the GPR survey. The updated surface water design is included below in section 2.0 of this report.

A GPR survey was completed along Ballymount Avenue where an existing 300mm surface water drain was identified along the eastern boundary of the subject site, which connects to the public surface water sewer network in Ballymount Road Lower, at the junction with Ballymount Avenue. The existing surface water drain includes a 225mm spur into the subject site, which is located approximately 19m from the northern boundary. The invert level of the existing spur is too high and therefore we propose to replace it, so the crowns of the pipes are kept continuous. This is the preferred connection point. A connection at this location would eliminate the need to extend the existing surface water network from Ballymount Road Lower junction to the subject site and in turn cause a lot less disruption to the existing road network. The exiting 300mm pipe, which is laid at a gradient of approx. 1:55, has the capacity for 150.0l/sec. The maximum permissible discharge for the 1 in 100 year return period is 34.12l/sec which equates to approximately 23% of the pipes capacity.

As outlined above existing ESB cables were identified along the western boundary to the rear of Unit 1 and therefore the SuDs mechanism proposed initially along this green belt are not viable.

The access road levels were amended to ensure access to and from all buildings are compliant with Part M of the building regulations and provide a cut-fill balance for an economical design. Units 2, 3, 4 and the east-west internal roads are subject to an Amendment Planning. The updated site layout is shown on DFK **Drg. No. 23002-01C.**

This report should be read in conjunction with the following drawings; which are enclosed with this submission:

Drawing number	Description
23002-01/C	Proposed Site Layout
23002-02/B	Proposed Drainage Layout for Units
23002-03/B	Proposed Drainage Layout for Internal Roads
23002-04	Proposed Drainage Layout for Units – Storm Water Only
23002-05	Proposed Drainage Layout for Internal Roads – Storm Water Only
23002-10/A	Drainage Details – Sheet 1
23002-11/A	Drainage Details – Sheet 1
23002-12/A	Typical Manhole Details

Table 1 - Drawing Schedule

2.0 SURFACE WATER

DETAILED DESIGN AND FINAL SURFACE WATER STRAGETY

The surface water network will be designed and arranged in accordance with the requirements of the GDSDS and the GDRC in conjunction with "Recommendations for Site Development Works for Housing Areas" (current edition) published by the (DOEHLG). Cognisance has also been taken of the recommendations contained within the Building Regulations Part H – Drainage and Waste Water Disposal.

The GDSDS guidelines require the following main 4 criteria to be provided by the development's surface water design.

- Criterion 1: River Water Quality Protection
- Criterion 2: River Regime Protection
- Criterion 3: Level of Service (flooding) for the site
- Criterion 4: River flood protection

The surface water network will be laid as a separate system and drains will be laid such as to minimise the risk of misconnections.

The extreme rainfall matrix table for subject site has been used to obtain a rainfall profile for calculation of storage requirements. The rainfall values have been increased by 20% to include for climate change characteristics, which is greater than the 10% required by the GDSDS.

As per the previous design the proposed surface water drainage network will consist of 8 sub-catchments. The sub-catchments are based on the boundaries of the individual logistics and offices (Units 1-6), the café unit at the entrance to the site and the roads drainage catchment (to be taken in charge). The sub-catchments cover the full proposed development footprint and provide discreet drainage, SuDS features and attenuation volume for each individual unit and for the proposed roads servicing the site.

The boundaries of each sub-catchment allow for the unit drainage to be maintained by the eventual unit purchaser/tenant through entering an agreement with a management company. The proposed roads drainage has also been designed to be standalone, collecting only roads and public open space area runoff so that it is suitable for taking in charge by the local authority. The 8 sub-catchments discharge at controlled rates to a collector sewer which in turn will exit the site at the northeast boundary and connect to the surface water sewer in Ballymount Avenue as outlined in Section 1.

Roads:

The surface water run-off from the estate roads will drain to the planted swales via kerb gullies located on each side of the road. The planted swales will include tree planting to the landscape architects' detail and a 1.0m wide by 0.75m deep trench, constructed using structural soil below. The soil will be mounded locally around some of the trees within the swale and will act as check dams. If one refers to the calculations for the trenches included in **Appendix II** it can be seen that each trench has an overflow discharge and therefore an overflow will be provided from each of the trenches to the drainage network. The overflow from the trenches will be attenuated within the modular arch system using a hydrobrake or similar approved flow control device before discharging to the collector

sewer. The section of road to the west of the roundabout will be collected via gullies and attenuated within the modular arch system proposed.

Units:
In general, the rainwater run-off from the roof areas will discharge to proposed private-side building drainage around the perimeter of the building footprint prior to discharging to the proposed SuDs mechanisms where feasible. Where the SuDs mechanisms have an overflow discharge, a high-level overflow will be provided to the drainage network.

The service yards will drain to the planted swales via kerb gullies where feasible with the remainder of the service yard collected by gullies and attenuated within the modular arch system. The carpark areas of each unit will be constructed using permeable paving/porous asphalt. The stone media below the permeable paving proposed will collect the run-off from the paving surface itself and the adjacent hardstanding areas.

Criterion 1 – River Water Quality Protection
GDSDS Section 6.3.1.2.1 requires that no run-off should directly pass to the receiving watercourse for rainfall depths of 5mm and a treatment volume (Vt) be provided in order to prevent any pollutants or sediments discharging into watercourses / rivers, etc. for rainfall depths of 15mm**.** The interception and treatment volume, both required and provided, for each sub-catchment is given in Table 2 below:

Location	Interception Volume		Treatment Volume	
	Required	*Provided	Required	*Provided
Roads	29.98m^3	127.31m^3	89.93m^3	127.31m^3
Unit 1	23.07m^3	191.82m^3	75.20m^3	191.82m^3
Unit 2	30.22m^3	231.73m^3	90.65m^3	231.73m^3
Unit 3	27.60m^3	142.98m^3	82.79m^3	142.98m^3
Unit 4	34.06m^3	137.80m^3	102.17m^3	142.15m^3
Unit 5	23.12m^3	170.49m^3	69.35m^3	193.62m^3
Unit 6	33.04m^3	154.32m^3	99.11m^3	161.82m^3
Unit 7 (Café)	4.54m^3	97.97m^3	13.62m^3	101.92m^3

*Refer to the 'Attenuation Design Criteria' calculation sheet included in Appendix I for justification on these figures
Table 2 – Interception and Treatment Volume

In addition to the above the surface water run-off from the hardstanding areas will pass through a suitably sized Class 1 Klargester by-pass Separator or similar approved. All petrol interceptors will be installed upstream of the attenuation systems. The exception to this is the internal estate roads, as the run-off passes through SuDs features, where it will be treated, prior to entering the attenuation. The section of road to the west of the roundabout, where the surface water run-off is collected via gullies will include a by-pass separator upstream of the attenuation system.

Criterion 2 - River Regime Protection
The allowable outflow, QBAR, for the whole site has been calculated as 13.12l/sec. Applying the growth curve factors in accordance with Table 6.6 of the GDSDS the allowable outflow for the 1 in 30 year return period and the 1 in 100 year return period is 27.56l/sec and 34.12l/sec respectively. The QBAR calculation is based on a SOIL factor of 0.3 which corresponds with Soil Type 2 in the Flood Studies Report.

The allowable outflow from each sub-catchment is given in Table 3 below:

Location	Allowable Outflow		
	QBAR	30 years	100 years
Growth Factor	1.0	2.1	2.6
Roads	2.19l/sec	4.59l/sec	5.69l/sec
Unit 1	1.47l/sec	3.09l/sec	3.82l/sec
Unit 2	1.85l/sec	3.88l/sec	4.80l/sec
Unit 3	2.50l/sec	3.14l/sec	3.89l/sec
Unit 4	2.28l/sec	4.79l/sec	5.92l/sec
Unit 5	1.52l/sec	3.19l/sec	3.95l/sec
Unit 6	1.89l/sec	3.96l/sec	4.91l/sec
Unit 7 (Café)	0.44l/sec	0.92l/sec	1.14l/sec

Table 3 – Sub-catchment allowable outflows.

The surface water runoff from each sub-catchment will be restricted using a hydro brake flow control devices or similar approved. The surface water run-off generated from Unit 7 (café) for the 1 in 100 year return period is dealt with onsite using infiltration and only flows in excess of the 1 in 100 year return period will leave the site.

This is similar for Unit 4 where the SuDs features have been designed where the overflow from them is less than the allowable outflow given in Table 3 above and therefore, a flow control device is not required for these units.

Units 2, 3 and 6 have been designed where the SuDs features have an overflow and therefore the allowable outflow for the allowable outflow for the attenuation calculations have been reduced to reflect this.

As per Criterion 2 the attenuation volume required for each sub-catchment, for 1 in 30 year return period and the 1 in 100 year return period which includes the additional increment in accordance with GDSDS requirements, is given in Table 4 below.

Location	Attenuation Volume		
	30Year	100 Year	Provided
Roads	25.70m^3	62.90m^3	108.10m^3
Unit 1	259.20m^3	368.50m^3	378.00m^3
Unit 2	133.70m^3	189.70m^3	191.50m^3
Unit 3	268.00m^3	358.90m^3	364.30m^3
*Unit 4	0.00m^3	0.00m^3	0.00m^3
Unit 5	34.90m^3	53.00m^3	53.60m^3
Unit 6	146.90m^3	180.80m^3	183.20m^3
*Unit 7 (Café)	0.00m^3	0.00m^3	0.00m^3

*No attenuation required

Table 4 – Attenuation Volumes.

As outlined above the amended design has retained the SuDs mechanisms where viable and due to the infiltration available the below ground attenuation has been reduced with the exception of Unit 1. The reduction is outlined in Table 5 below:

Location	Below ground Attenuation		
	Granted under Reg. Ref.: SD22A/0099	Amended Design - Proposed	Difference
Roads	435.00m^3	108.1m^3	- 326.90m^3
Unit 1	327.00m^3	378.00m^3	+ 51.00m^3
Unit 2	512.04m^3	191.50m^3	- 320.54m^3
Unit 3	512.00m^3	364.30m^3	- 147.70m^3
Unit 4	461.00m^3	0.00m^3	- 461.00m^3
Unit 5	209.00m^3	53.60m^3	- 155.40m^3
Unit 6	431.88m^3	183.20m^3	- 248.68m^3
Unit 7 (Café)	51.79m^3	0.00m^3	- 51.79m^3

Table 5 – Reduction in below ground Attenuation Volumes.

The calculations for the permeable paving proposed for the carparks are included in **Appendix II**. The overall depth of drainage stone provided below the permeable paving and grass paving is 350mm which is greater than the Hmax calculated. A factor of safety has been applied to the infiltration rate calculated on site in accordance with CIRIA 156.

Criterion 3: Level of Service (flooding) for the site

The SUDs mechanisms outlined within this report have been designed for a 1 in 100 year return period storm, as required by GDSDS "Regional Drainage Policies Vol 2 New Development". Collectively the SuDS mechanisms have been designed to ensure that no flooding will occur within the site up to the 30 year return period storm, as well as being able to deal with events up to a 1 in 100 year return period storm.

A minimum freeboard of 500mm above attenuation top water level for a 1 in 100-year flood event has been provided to all building floor levels and planned flood routing for storms greater than 100-year level have been considered in design and development run-off will be contained within site.

Criterion 4: River flood protection

It is proposed to meet the River Flood protection requirements by providing infiltration storage equal to the long-term storage as per sub-criterion 4.2. The objective is to match the runoff volume discharged to the downstream receiving watercourse after development to that which occurred prior to development. This volume will be calculated by comparing the 100-year 6-hour event for 'pre' and 'post' development and is referred to as long-term storage.

The long term storage required and provided for each sub-catchment is given in Table 6 below:

Location	Long-Term Storage Volumes	
	Required	*Provided
Roads	39.88m^3	127.31m^3
Unit 1	188.18m^3	191.82m^3
Unit 2	48.83m^3	231.73m^3
Unit 3	137.01m^3	142.98m^3
Unit 4	35.62m^3	137.80m^3
Unit 5	56.29m^3	170.49m^3
Unit 6	†-84.86m^3	154.32m^3
Unit 7 (Café)	†-66.18m^3	97.97m^3

*Refer to the 'Attenuation Design Criteria' calculation sheet included in Appendix I for justification on these figures
† The long term storage is a negative figure due to the low percentage of impermeable area (PIMP).
Table 6 – Long term storage.

The revised drainage layout is shown on DFK **Drg. 23002-02/B, 23002-03/B, 23002-04** and **23002-05.** Drainage details and typical details are included on DFK **Drg. 23002-10A, 23022-11/A** and **23002-12A.**

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APPENDIX I

SURFACE WATER + SUD'S CALCULATIONS

SURFACE WATER CALCULATIONS INDEX

- Return Period Rainfall Depths Table
- Site Catchment Characteristics – Whole Site
- Drainage Calculations – Internal Roads
- Drainage Calculations – Unit 1
- Drainage Calculations – Unit 2
- Drainage Calculations – Unit 3
- Drainage Calculations – Unit 4
- Drainage Calculations – Unit 5
- Drainage Calculations – Unit 6
- Drainage Calculations – Unit 7 (Café)

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**

Project:					
Calmount Rd, Ballymount - Internal Roads	Design: ☑		Telephone Log: ☐		
	Minutes: ☐		Other Record: ☐		
Project No:	Element:	Prepared:		Checked:	
23002	**Site Catchment Characteristics**	**NS**		**SG/CK**	

Reference | Output:

Site Catchment Characteristics

Total Site Area	10940 m²
Hardstanding - Road	4648 m²
Hardstanding - F&C/P	2846 m²
Permeable area	0 m²
Landscape	3446 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Hardstanding - Road			4648 m²
Hardstanding - F&C/P			2846 m²
		TOTAL	7494 m²

Areas Contributing into:

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.86	2.19	3.72	4.59	5.69

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Cafe)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Cafe)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	53.1 mm/hr
FOS	Minor Inconvenience	3.00
q		0.018 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	551 m²

Infriltration Trench dimensions

Length	40.40 m
Width	1.00 m

Base Area (A_b)	40.400 m²
Perimeter (**P**)	82.800 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.121
Ab/P=	0.488

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.727	-24.416
30.000 min	0.892	-15.212
60.000 min	1.080	-9.483
120.000 min	1.252	-5.828
240.000 min	1.348	-3.516
360.000 min	1.331	-2.580

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.044	-35.063
30.000 min	1.279	-21.799
60.000 min	1.537	-13.498
120.000 min	1.775	-8.265
240.000 min	1.915	-4.994
360.000 min	1.897	-3.678

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.232	-41.380
30.000 min	1.501	-25.589
60.000 min	1.794	-15.754
120.000 min	2.071	-9.641
240.000 min	2.231	-5.817
360.000 min	2.216	-4.294

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.533	-51.486
30.000 min	1.861	-31.725
60.000 min	2.211	-19.408
120.000 min	2.541	-11.829
240.000 min	2.733	-7.125
360.000 min	2.712	-5.257

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	3.784 hrs
1 in 30 years	4.203 hrs
1 in 50 years	4.367 hrs
1 in 100 years	4.566 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	40.400 m²	0.750 m	1.348 m	0.178 l/sec
30 Years	60.000 min	40.400 m²	0.750 m	1.915 m	0.486 l/sec
50 Years	60.000 min	40.400 m²	0.750 m	2.231 m	0.718 l/sec
100 Years	60.000 min	40.400 m²	0.750 m	2.733 m	1.177 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Unit 1)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Unit 1)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	152.7 mm/hr
FOS	Minor Inconvenience	3.00
q		0.051 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	425 m²

Infriltration Trench dimensions

Length	30.70 m
Width	1.00 m

Base Area (A_b)	30.700 m²
Perimeter (**P**)	63.400 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.350
Ab/P=	0.484

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.691	-8.240
30.000 min	0.806	-5.016
60.000 min	0.889	-3.008
120.000 min	0.871	-1.728
240.000 min	0.692	-0.918
360.000 min	0.518	-0.590

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.004	-11.969
30.000 min	1.177	-7.323
60.000 min	1.305	-4.415
120.000 min	1.301	-2.582
240.000 min	1.082	-1.436
360.000 min	0.856	-0.975

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.189	-14.182
30.000 min	1.390	-8.650
60.000 min	1.539	-5.205
120.000 min	1.544	-3.064
240.000 min	1.300	-1.724
360.000 min	1.045	-1.191

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.486	-17.722
30.000 min	1.736	-10.800
60.000 min	1.917	-6.485
120.000 min	1.930	-3.830
240.000 min	1.645	-2.183
360.000 min	1.341	-1.528

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	1.116 hrs
1 in 30 years	1.295 hrs
1 in 50 years	1.367 hrs
1 in 100 years	1.456 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	30.700 m²	0.750 m	0.889 m	0.031 l/sec
30 Years	60.000 min	30.700 m²	0.750 m	1.305 m	0.176 l/sec
50 Years	60.000 min	30.700 m²	0.750 m	1.544 m	0.292 l/sec
100 Years	60.000 min	30.700 m²	0.750 m	1.930 m	0.532 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:		Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads		Minutes:	☐	Other Record:	☐
Project No:	Element:	Prepared:		Checked:	
23002	**Infiltration Trench 1 (Unit 4)**	**NS**		**CK**	

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Unit 4)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	12.8 mm/hr
FOS	Minor Inconvenience	3.00
q		0.004 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	402 m²

Infriltration Trench dimensions

Length	48.00 m
Width	1.00 m

Base Area (A_b)	48.000 m²
Perimeter (**P**)	98.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.029
Ab/P=	0.490

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.457	-63.194
30.000 min	0.572	-39.659
60.000 min	0.716	-25.007
120.000 min	0.884	-15.662
240.000 min	1.069	-9.749
360.000 min	1.176	-7.355

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.654	-90.422
30.000 min	0.814	-56.503
60.000 min	1.010	-35.275
120.000 min	1.235	-21.892
240.000 min	1.483	-13.528
360.000 min	1.625	-10.163

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.771	-106.573
30.000 min	0.954	-66.194
60.000 min	1.175	-41.043
120.000 min	1.434	-25.411
240.000 min	1.714	-15.633
360.000 min	1.877	-11.739

100 Year Return Period

Duration (D)	hmax	a
15.000 min	0.958	-132.416
30.000 min	1.180	-81.884
60.000 min	1.442	-50.388
120.000 min	1.749	-31.006
240.000 min	2.081	-18.979
360.000 min	2.271	-14.201

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	14.994 hrs
1 in 30 years	16.697 hrs
1 in 50 years	17.394 hrs
1 in 100 years	18.246 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	48.000 m²	0.750 m	1.176 m	0.151 l/sec
30 Years	60.000 min	48.000 m²	0.750 m	1.625 m	0.434 l/sec
50 Years	60.000 min	48.000 m²	0.750 m	1.877 m	0.649 l/sec
100 Years	60.000 min	48.000 m²	0.750 m	2.271 m	1.073 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Unit 5C)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 1 (Unit 5C)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	555.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.185 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	299 m²

Infriltration Trench dimensions

Length	12.00 m
Width	1.00 m

Base Area (A_b)	12.000 m²
Perimeter (**P**)	26.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	1.338
Ab/P=	0.462

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.038	-3.649
30.000 min	1.039	-2.130
60.000 min	0.874	-1.184
120.000 min	0.541	-0.581
240.000 min	0.198	-0.199
360.000 min	0.045	-0.045

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.538	-5.407
30.000 min	1.570	-3.217
60.000 min	1.363	-1.847
120.000 min	0.916	-0.983
240.000 min	0.441	-0.443
360.000 min	0.226	-0.226

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.834	-6.450
30.000 min	1.875	-3.843
60.000 min	1.637	-2.220
120.000 min	1.127	-1.210
240.000 min	0.576	-0.579
360.000 min	0.328	-0.328

100 Year Return Period

Duration (D)	hmax	a
15.000 min	2.308	-8.118
30.000 min	2.369	-4.856
60.000 min	2.082	-2.823
120.000 min	1.463	-1.572
240.000 min	0.791	-0.795
360.000 min	0.487	-0.487

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.318 hrs
1 in 30 years	0.365 hrs
1 in 50 years	0.383 hrs
1 in 100 years	0.405 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	12.000 m²	0.750 m	1.039 m	0.026 l/sec
30 Years	60.000 min	12.000 m²	0.750 m	1.570 m	0.102 l/sec
50 Years	60.000 min	12.000 m²	0.750 m	1.875 m	0.162 l/sec
100 Years	60.000 min	12.000 m²	0.750 m	2.369 m	0.286 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Cafe)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Cafe)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	92.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.031 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	236 m²

Infriltration Trench dimensions

Length	15.30 m
Width	1.00 m

Base Area (A_b)	15.300 m²
Perimeter (**P**)	32.600 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.220
Ab/P=	0.469

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.803	-15.016
30.000 min	0.968	-9.293
60.000 min	1.131	-5.730
120.000 min	1.231	-3.458
240.000 min	1.182	-2.020
360.000 min	1.054	-1.438

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.158	-21.637
30.000 min	1.394	-13.389
60.000 min	1.624	-8.227
120.000 min	1.770	-4.973
240.000 min	1.720	-2.939
360.000 min	1.554	-2.121

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.368	-25.564
30.000 min	1.640	-15.745
60.000 min	1.901	-9.630
120.000 min	2.074	-5.829
240.000 min	2.019	-3.451
360.000 min	1.835	-2.504

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.704	-31.848
30.000 min	2.037	-19.561
60.000 min	2.350	-11.902
120.000 min	2.559	-7.189
240.000 min	2.495	-4.265
360.000 min	2.274	-3.103

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	2.043 hrs
1 in 30 years	2.286 hrs
1 in 50 years	2.382 hrs
1 in 100 years	2.496 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	15.300 m²	0.750 m	1.231 m	0.054 l/sec
30 Years	60.000 min	15.300 m²	0.750 m	1.770 m	0.161 l/sec
50 Years	60.000 min	15.300 m²	0.750 m	2.074 m	0.243 l/sec
100 Years	60.000 min	15.300 m²	0.750 m	2.559 m	0.407 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 1)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 1)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	144.8 mm/hr
FOS	Minor Inconvenience	3.00
q		0.048 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	627 m²

Infriltration Trench dimensions

Length	20.70 m
Width	1.00 m

Base Area (A_b)	20.700 m²
Perimeter (**P**)	43.400 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.337
Ab/P=	0.477

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.565	-19.350
30.000 min	1.866	-12.022
60.000 min	2.136	-7.461
120.000 min	2.233	-4.552
240.000 min	2.008	-2.711
360.000 min	1.706	-1.965

30 Year Return Period

Duration (D)	hmax	a
15.000 min	2.250	-27.826
30.000 min	2.680	-17.267
60.000 min	3.052	-10.658
120.000 min	3.185	-6.491
240.000 min	2.879	-3.887
360.000 min	2.464	-2.839

50 Year Return Period

Duration (D)	hmax	a
15.000 min	2.657	-32.855
30.000 min	3.148	-20.284
60.000 min	3.566	-12.454
120.000 min	3.722	-7.587
240.000 min	3.364	-4.543
360.000 min	2.890	-3.330

100 Year Return Period

Duration (D)	hmax	a
15.000 min	3.308	-40.901
30.000 min	3.906	-25.168
60.000 min	4.399	-15.363
120.000 min	4.577	-9.329
240.000 min	4.136	-5.584
360.000 min	3.555	-4.097

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	1.574 hrs
1 in 30 years	1.692 hrs
1 in 50 years	1.736 hrs
1 in 100 years	1.788 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	20.700 m²	0.750 m	2.233 m	0.226 l/sec
30 Years	60.000 min	20.700 m²	0.750 m	3.185 m	0.521 l/sec
50 Years	60.000 min	20.700 m²	0.750 m	3.722 m	0.738 l/sec
100 Years	60.000 min	20.700 m²	0.750 m	4.577 m	1.165 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 2)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 2)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	6.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.002 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	241 m²

Infriltration Trench dimensions

Length	12.50 m
Width	1.00 m

Base Area (A_b)	12.500 m²
Perimeter (**P**)	27.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.017
Ab/P=	0.463

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.060	-256.604
30.000 min	1.333	-161.601
60.000 min	1.683	-102.457
120.000 min	2.109	-64.735
240.000 min	2.619	-40.868
360.000 min	2.951	-31.205

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.514	-366.509
30.000 min	1.893	-229.593
60.000 min	2.363	-143.904
120.000 min	2.928	-89.883
240.000 min	3.597	-56.120
360.000 min	4.023	-42.537

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.784	-431.707
30.000 min	2.216	-268.712
60.000 min	2.746	-167.189
120.000 min	3.391	-104.087
240.000 min	4.142	-64.619
360.000 min	4.625	-48.901

100 Year Return Period

Duration (D)	hmax	a
15.000 min	2.215	-536.024
30.000 min	2.738	-332.047
60.000 min	3.365	-204.911
120.000 min	4.127	-126.673
240.000 min	5.007	-78.124
360.000 min	5.565	-58.836

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	34.178 hrs
1 in 30 years	35.926 hrs
1 in 50 years	36.598 hrs
1 in 100 years	37.388 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	12.500 m²	0.750 m	2.951 m	0.203 l/sec
30 Years	60.000 min	12.500 m²	0.750 m	4.023 m	0.423 l/sec
50 Years	60.000 min	12.500 m²	0.750 m	4.625 m	0.581 l/sec
100 Years	60.000 min	12.500 m²	0.750 m	5.565 m	0.885 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 3)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 3)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	6.6 mm/hr
FOS	Minor Inconvenience	3.00
q		0.002 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	268 m²

Infriltration Trench dimensions

Length	12.90 m
Width	1.00 m

Base Area (A_b)	12.900 m²
Perimeter (**P**)	27.800 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.016
Ab/P=	0.464

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.143	-289.796
30.000 min	1.437	-182.526
60.000 min	1.815	-115.745
120.000 min	2.276	-73.153
240.000 min	2.830	-46.204
360.000 min	3.193	-35.293

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.632	-413.893
30.000 min	2.041	-259.298
60.000 min	2.549	-162.544
120.000 min	3.159	-101.548
240.000 min	3.885	-63.425
360.000 min	4.350	-48.088

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.922	-487.510
30.000 min	2.388	-303.468
60.000 min	2.961	-188.836
120.000 min	3.658	-117.586
240.000 min	4.473	-73.021
360.000 min	5.000	-55.274

100 Year Return Period

Duration (D)	hmax	a
15.000 min	2.387	-605.297
30.000 min	2.951	-374.981
60.000 min	3.629	-231.429
120.000 min	4.452	-143.089
240.000 min	5.407	-88.270
360.000 min	6.015	-66.492

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	36.301 hrs
1 in 30 years	38.037 hrs
1 in 50 years	38.703 hrs
1 in 100 years	39.483 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	12.900 m²	0.750 m	3.193 m	0.232 l/sec
30 Years	60.000 min	12.900 m²	0.750 m	4.350 m	0.480 l/sec
50 Years	60.000 min	12.900 m²	0.750 m	5.000 m	0.658 l/sec
100 Years	60.000 min	12.900 m²	0.750 m	6.015 m	0.998 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 4)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 4)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	830.6 mm/hr
FOS	Minor Inconvenience	3.00
q		0.277 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	136 m²

Infriltration Trench dimensions

Length	7.00 m
Width	1.00 m

Base Area (A_b)	7.000 m²
Perimeter (**P**)	16.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	2.109
Ab/P=	0.438

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.654	-1.596
30.000 min	0.550	-0.845
60.000 min	0.331	-0.377
120.000 min	0.077	-0.078
240.000 min	0.000	0.111
360.000 min	0.000	0.187

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.010	-2.466
30.000 min	0.901	-1.382
60.000 min	0.619	-0.705
120.000 min	0.273	-0.277
240.000 min	0.010	-0.010
360.000 min	0.000	0.097

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.222	-2.981
30.000 min	1.103	-1.692
60.000 min	0.781	-0.889
120.000 min	0.384	-0.390
240.000 min	0.077	-0.077
360.000 min	0.000	0.047

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.560	-3.807
30.000 min	1.429	-2.193
60.000 min	1.043	-1.187
120.000 min	0.560	-0.568
240.000 min	0.184	-0.184
360.000 min	0.032	-0.032

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.169 hrs
1 in 30 years	0.203 hrs
1 in 50 years	0.218 hrs
1 in 100 years	0.235 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	7.000 m²	0.750 m	0.654 m	0.000 l/sec
30 Years	60.000 min	7.000 m²	0.750 m	1.010 m	0.019 l/sec
50 Years	60.000 min	7.000 m²	0.750 m	1.222 m	0.040 l/sec
100 Years	60.000 min	7.000 m²	0.750 m	1.560 m	0.083 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 6)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 2 (Unit 6)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	144.8 mm/hr
FOS	Minor Inconvenience	3.00
q		0.048 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	459 m²

Infriltration Trench dimensions

Length	33.10 m
Width	1.00 m

Base Area (A_b)	33.100 m²
Perimeter (**P**)	68.200 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.331
Ab/P=	0.485

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.696	-8.751
30.000 min	0.815	-5.338
60.000 min	0.906	-3.213
120.000 min	0.900	-1.857
240.000 min	0.734	-1.000
360.000 min	0.563	-0.652

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.010	-12.700
30.000 min	1.188	-7.781
60.000 min	1.327	-4.702
120.000 min	1.338	-2.761
240.000 min	1.137	-1.548
360.000 min	0.915	-1.060

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.196	-15.042
30.000 min	1.403	-9.186
60.000 min	1.563	-5.538
120.000 min	1.585	-3.271
240.000 min	1.361	-1.853
360.000 min	1.112	-1.288

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.494	-18.791
30.000 min	1.751	-11.462
60.000 min	1.945	-6.894
120.000 min	1.979	-4.083
240.000 min	1.717	-2.338
360.000 min	1.420	-1.645

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	1.189 hrs
1 in 30 years	1.379 hrs
1 in 50 years	1.456 hrs
1 in 100 years	1.549 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	33.100 m²	0.750 m	0.906 m	0.038 l/sec
30 Years	60.000 min	33.100 m²	0.750 m	1.338 m	0.201 l/sec
50 Years	60.000 min	33.100 m²	0.750 m	1.585 m	0.332 l/sec
100 Years	60.000 min	33.100 m²	0.750 m	1.979 m	0.598 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 2)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 2)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	6.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.002 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	388 m²

Infriltration Trench dimensions

Length	14.40 m
Width	1.00 m

Base Area (A_b)	14.400 m²
Perimeter (**P**)	30.800 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.016
Ab/P=	0.468

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.482	-362.338
30.000 min	1.864	-228.257
60.000 min	2.355	-144.786
120.000 min	2.954	-91.548
240.000 min	3.674	-57.864
360.000 min	4.144	-44.226

30 Year Return Period

Duration (D)	hmax	a
15.000 min	2.117	-517.450
30.000 min	2.647	-324.217
60.000 min	3.306	-203.282
120.000 min	4.099	-127.040
240.000 min	5.040	-79.389
360.000 min	5.643	-60.219

50 Year Return Period

Duration (D)	hmax	a
15.000 min	2.493	-609.466
30.000 min	3.098	-379.426
60.000 min	3.841	-236.145
120.000 min	4.746	-147.086
240.000 min	5.802	-91.384
360.000 min	6.484	-69.202

100 Year Return Period

Duration (D)	hmax	a
15.000 min	3.096	-756.691
30.000 min	3.828	-468.813
60.000 min	4.707	-289.382
120.000 min	5.774	-178.963
240.000 min	7.012	-110.444
360.000 min	7.798	-83.223

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	36.381 hrs
1 in 30 years	37.774 hrs
1 in 50 years	38.301 hrs
1 in 100 years	38.915 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	14.400 m²	0.750 m	4.144 m	0.360 l/sec
30 Years	60.000 min	14.400 m²	0.750 m	5.643 m	0.728 l/sec
50 Years	60.000 min	14.400 m²	0.750 m	6.484 m	0.991 l/sec
100 Years	60.000 min	14.400 m²	0.750 m	7.798 m	1.492 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 3)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 3)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	6.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.002 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	388 m²

Infriltration Trench dimensions

Length	27.10 m
Width	1.00 m

Base Area (A_b)	27.100 m²
Perimeter (**P**)	56.200 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.016
Ab/P=	0.482

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.787	-198.351
30.000 min	0.989	-124.869
60.000 min	1.248	-79.123
120.000 min	1.563	-49.946
240.000 min	1.940	-31.486
360.000 min	2.185	-24.012

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.124	-283.359
30.000 min	1.405	-177.459
60.000 min	1.754	-111.181
120.000 min	2.172	-69.397
240.000 min	2.667	-43.283
360.000 min	2.982	-32.777

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.324	-333.787
30.000 min	1.645	-207.716
60.000 min	2.038	-129.191
120.000 min	2.516	-80.384
240.000 min	3.072	-49.856
360.000 min	3.430	-37.699

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.644	-414.473
30.000 min	2.033	-256.704
60.000 min	2.498	-158.368
120.000 min	3.063	-97.854
240.000 min	3.716	-60.302
360.000 min	4.129	-45.384

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	33.143 hrs
1 in 30 years	35.400 hrs
1 in 50 years	36.286 hrs
1 in 100 years	37.341 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	27.100 m²	0.750 m	2.185 m	0.286 l/sec
30 Years	60.000 min	27.100 m²	0.750 m	2.982 m	0.625 l/sec
50 Years	60.000 min	27.100 m²	0.750 m	3.430 m	0.872 l/sec
100 Years	60.000 min	27.100 m²	0.750 m	4.129 m	1.346 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 6)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 3 (Unit 6)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	74.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.025 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	385 m²

Infriltration Trench dimensions

Length	15.30 m
Width	1.00 m

Base Area (A_b)	15.300 m²
Perimeter (**P**)	32.600 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.177
Ab/P=	0.469

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.338	-30.864
30.000 min	1.636	-19.284
60.000 min	1.962	-12.075
120.000 min	2.233	-7.477
240.000 min	2.321	-4.568
360.000 min	2.220	-3.391

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.919	-44.260
30.000 min	2.339	-27.571
60.000 min	2.783	-17.127
120.000 min	3.148	-10.543
240.000 min	3.265	-6.427
360.000 min	3.125	-4.772

50 Year Return Period

Duration (D)	hmax	a
15.000 min	2.264	-52.207
30.000 min	2.744	-32.340
60.000 min	3.244	-19.965
120.000 min	3.665	-12.274
240.000 min	3.791	-7.463
360.000 min	3.633	-5.548

100 Year Return Period

Duration (D)	hmax	a
15.000 min	2.815	-64.921
30.000 min	3.399	-40.059
60.000 min	3.991	-24.563
120.000 min	4.487	-15.027
240.000 min	4.628	-9.109
360.000 min	4.426	-6.758

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	3.032 hrs
1 in 30 years	3.241 hrs
1 in 50 years	3.320 hrs
1 in 100 years	3.412 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	15.300 m²	0.750 m	2.321 m	0.177 l/sec
30 Years	60.000 min	15.300 m²	0.750 m	3.265 m	0.398 l/sec
50 Years	60.000 min	15.300 m²	0.750 m	3.791 m	0.558 l/sec
100 Years	60.000 min	15.300 m²	0.750 m	4.628 m	0.872 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 2)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 2)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	77.1 mm/hr
FOS	Minor Inconvenience	3.00
q		0.026 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	366 m²

Infriltration Trench dimensions

Length	17.80 m
Width	1.00 m

Base Area (A_b)	17.800 m²
Perimeter (**P**)	37.600 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.181
Ab/P=	0.473

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.089	-24.615
30.000 min	1.327	-15.343
60.000 min	1.584	-9.571
120.000 min	1.788	-5.890
240.000 min	1.834	-3.560
360.000 min	1.734	-2.617

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.563	-35.342
30.000 min	1.901	-21.979
60.000 min	2.254	-13.616
120.000 min	2.534	-8.344
240.000 min	2.601	-5.049
360.000 min	2.466	-3.723

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.845	-41.705
30.000 min	2.232	-25.797
60.000 min	2.630	-15.889
120.000 min	2.955	-9.730
240.000 min	3.028	-5.878
360.000 min	2.878	-4.344

100 Year Return Period

Duration (D)	hmax	a
15.000 min	2.295	-51.886
30.000 min	2.766	-31.978
60.000 min	3.239	-19.570
120.000 min	3.624	-11.935
240.000 min	3.707	-7.196
360.000 min	3.520	-5.314

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	2.799 hrs
1 in 30 years	3.039 hrs
1 in 50 years	3.130 hrs
1 in 100 years	3.238 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	17.800 m²	0.750 m	1.834 m	0.142 l/sec
30 Years	60.000 min	17.800 m²	0.750 m	2.601 m	0.340 l/sec
50 Years	60.000 min	17.800 m²	0.750 m	3.028 m	0.487 l/sec
100 Years	60.000 min	17.800 m²	0.750 m	3.707 m	0.774 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 3)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 3)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	105.0 mm/hr
FOS	Minor Inconvenience	3.00
q		0.035 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	559 m²

Infriltration Trench dimensions

Length	41.50 m
Width	1.00 m

Base Area (A_b)	41.500 m²
Perimeter (**P**)	85.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.239
Ab/P=	0.488

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.693	-11.958
30.000 min	0.829	-7.358
60.000 min	0.955	-4.495
120.000 min	1.014	-2.668
240.000 min	0.931	-1.513
360.000 min	0.796	-1.045

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.002	-17.280
30.000 min	1.199	-10.650
60.000 min	1.382	-6.502
120.000 min	1.476	-3.886
240.000 min	1.386	-2.251
360.000 min	1.214	-1.594

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.185	-20.436
30.000 min	1.413	-12.544
60.000 min	1.622	-7.629
120.000 min	1.738	-4.574
240.000 min	1.639	-2.663
360.000 min	1.448	-1.902

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.478	-25.487
30.000 min	1.758	-15.611
60.000 min	2.010	-9.455
120.000 min	2.153	-5.667
240.000 min	2.041	-3.317
360.000 min	1.815	-2.383

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	1.723 hrs
1 in 30 years	1.972 hrs
1 in 50 years	2.071 hrs
1 in 100 years	2.191 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	41.500 m²	0.750 m	1.014 m	0.081 l/sec
30 Years	60.000 min	41.500 m²	0.750 m	1.476 m	0.312 l/sec
50 Years	60.000 min	41.500 m²	0.750 m	1.738 m	0.492 l/sec
100 Years	60.000 min	41.500 m²	0.750 m	2.153 m	0.856 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Internal Roads	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 6)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 4 (Unit 6)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	54.4 mm/hr
FOS	Minor Inconvenience	3.00
q		0.018 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	537 m²

Infriltration Trench dimensions

Length	36.90 m
Width	1.00 m

Base Area (A_b)	36.900 m²
Perimeter (**P**)	75.800 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.124
Ab/P=	0.487

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.776	-25.392
30.000 min	0.953	-15.828
60.000 min	1.153	-9.874
120.000 min	1.336	-6.077
240.000 min	1.438	-3.674
360.000 min	1.419	-2.701

30 Year Return Period

Duration (D)	hmax	a
15.000 min	1.114	-36.456
30.000 min	1.365	-22.673
60.000 min	1.640	-14.047
120.000 min	1.893	-8.608
240.000 min	2.039	-5.209
360.000 min	2.018	-3.842

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.315	-43.020
30.000 min	1.602	-26.611
60.000 min	1.914	-16.391
120.000 min	2.207	-10.038
240.000 min	2.374	-6.065
360.000 min	2.355	-4.483

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.636	-53.522
30.000 min	1.986	-32.987
60.000 min	2.357	-20.188
120.000 min	2.707	-12.312
240.000 min	2.906	-7.425
360.000 min	2.880	-5.483

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	3.767 hrs
1 in 30 years	4.163 hrs
1 in 50 years	4.317 hrs
1 in 100 years	4.503 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	36.900 m²	0.750 m	1.438 m	0.187 l/sec
30 Years	60.000 min	36.900 m²	0.750 m	2.039 m	0.492 l/sec
50 Years	60.000 min	36.900 m²	0.750 m	2.374 m	0.719 l/sec
100 Years	60.000 min	36.900 m²	0.750 m	2.906 m	1.170 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 5 (Unit 3)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 5 (Unit 3)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	409.7 mm/hr
FOS	Minor Inconvenience	3.00
q		0.137 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	653 m²

Infriltration Trench dimensions

Length	48.00 m
Width	1.00 m

Base Area (A_b)	48.000 m²
Perimeter (**P**)	98.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.929
Ab/P=	0.490

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.569	-2.742
30.000 min	0.575	-1.548
60.000 min	0.487	-0.804
120.000 min	0.278	-0.330
240.000 min	0.029	-0.030
360.000 min	0.000	0.092

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.855	-4.124
30.000 min	0.893	-2.403
60.000 min	0.802	-1.325
120.000 min	0.545	-0.646
240.000 min	0.216	-0.222
360.000 min	0.051	-0.051

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.025	-4.944
30.000 min	1.076	-2.894
60.000 min	0.979	-1.618
120.000 min	0.696	-0.825
240.000 min	0.320	-0.328
360.000 min	0.130	-0.131

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.297	-6.255
30.000 min	1.372	-3.691
60.000 min	1.266	-2.092
120.000 min	0.936	-1.109
240.000 min	0.486	-0.498
360.000 min	0.255	-0.256

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.339 hrs
1 in 30 years	0.420 hrs
1 in 50 years	0.453 hrs
1 in 100 years	0.494 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	48.000 m²	0.750 m	0.575 m	0.000 l/sec
30 Years	60.000 min	48.000 m²	0.750 m	0.893 m	0.071 l/sec
50 Years	60.000 min	48.000 m²	0.750 m	1.076 m	0.188 l/sec
100 Years	60.000 min	48.000 m²	0.750 m	1.372 m	0.439 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 5 (Unit 6)**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Infiltration Trench 5 (Unit 6)**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	285.2 mm/hr
FOS	Minor Inconvenience	3.00
q		0.095 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	747 m²

Infriltration Trench dimensions

Length	60.00 m
Width	1.00 m

Base Area (A_b)	60.000 m²
Perimeter (**P**)	122.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.644
Ab/P=	0.492

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.562	-3.775
30.000 min	0.605	-2.198
60.000 min	0.578	-1.216
120.000 min	0.428	-0.590
240.000 min	0.179	-0.194
360.000 min	0.033	-0.034

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.833	-5.599
30.000 min	0.916	-3.326
60.000 min	0.904	-1.904
120.000 min	0.730	-1.008
240.000 min	0.413	-0.447
360.000 min	0.217	-0.222

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.994	-6.681
30.000 min	1.095	-3.975
60.000 min	1.088	-2.291
120.000 min	0.901	-1.243
240.000 min	0.544	-0.588
360.000 min	0.321	-0.327

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.252	-8.412
30.000 min	1.384	-5.027
60.000 min	1.385	-2.917
120.000 min	1.172	-1.618
240.000 min	0.751	-0.812
360.000 min	0.482	-0.492

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.501 hrs
1 in 30 years	0.611 hrs
1 in 50 years	0.657 hrs
1 in 100 years	0.715 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	60.000 m²	0.750 m	0.605 m	0.000 l/sec
30 Years	60.000 min	60.000 m²	0.750 m	0.916 m	0.103 l/sec
50 Years	60.000 min	60.000 m²	0.750 m	1.095 m	0.248 l/sec
100 Years	60.000 min	60.000 m²	0.750 m	1.385 m	0.560 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	Calmount Rd, Ballymount - Internal Roads
LOCATION:	StormTech Trench #1
DATE:	14.09.2023
CREATED BY:	SG

SYSTEM PARAMETERS

Required Total Storage		m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.2	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		2	ea
Number of units per Row		22	ea
System Installed Storage Depth (effective storage depth)	0.960	1.06	m
Tank overall installed Width at base	3.34	3.35	m
Tank overall installed Length at Base	48.44	48.5	m
Total Effective System Storage	**107.9**	**108.1**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	184	m^3
Width at base	3.35	m
Width at top	4.46	m
Length at base	48.50	m
Length at top	49.61	m
Depth Of System	0.96	m
Area of Dig at Base of System	162	m^2
Area of Dig at Top of System	221	m^2
Void Ratio	59%	
Stone Requirement - m3	126	m^3
Stone Requirement - tonne	207	tonne

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	Calmount Rd, Ballymount - Internal Roads		Minutes	☐	Other Record:: ☐
Project No:	Element:		Prepared:		Checked:
23002	**Overflow From Infiltration Trenches**		**NS**		**SG/CK**
Ref:					Output:

Site Catchment Characteristics

Element	Return period=100yr												
Duration [min]	2	5	10	15	30	60	120	240	360	720	1440	2880	4320
Infiltration Trench 1 (Cafe)	35.31	14.12	7.06	4.71	2.35	1.18	0.59	0.29	0.20	0.10	0.07	0.02	0.02
Infiltration Trench 2 (Cafe)	12.21	4.88	2.44	1.63	0.81	0.41	0.20	0.10	0.07	0.03	0.02	0.01	0.01
Infiltration Trench 1 (Unit 1)	15.96	6.38	3.19	2.13	1.06	0.53	0.27	0.13	0.09	0.04	0.03	0.01	0.01
Infiltration Trench 2 (Unit 1)	34.95	13.98	6.99	4.66	2.33	1.17	0.58	0.29	0.19	0.10	0.06	0.02	0.02
Infiltration Trench 2 (Unit 2)	26.55	10.62	5.31	3.54	1.77	0.89	0.44	0.22	0.15	0.07	0.05	0.02	0.01
Infiltration Trench 3 (Unit 2)	44.76	17.90	8.95	5.97	2.98	1.49	0.75	0.37	0.25	0.12	0.08	0.03	0.02
Infiltration Trench 4 (Unit 2)	23.22	9.29	4.64	3.10	1.55	0.77	0.39	0.19	0.13	0.06	0.04	0.02	0.01
Infiltration Trench 2 (Unit 3)	29.94	11.98	5.99	3.99	2.00	1.00	0.50	0.25	0.17	0.08	0.06	0.02	0.01
Infiltration Trench 3 (Unit 3)	40.38	16.15	8.08	5.38	2.69	1.35	0.67	0.34	0.22	0.11	0.07	0.03	0.02
Infiltration Trench 4 (Unit 3)	25.68	10.27	5.14	3.42	1.71	0.86	0.43	0.21	0.14	0.07	0.05	0.02	0.01
Infiltration Trench 2 (Unit 6)	17.94	7.18	3.59	2.39	1.20	0.60	0.30	0.15	0.10	0.05	0.03	0.01	0.01
Infiltration Trench 3 (Unit 6)	26.16	10.46	5.23	3.49	1.74	0.87	0.44	0.22	0.15	0.07	0.05	0.02	0.01
Infiltration Trench 4 (Unit 6)	35.10	14.04	7.02	4.68	2.34	1.17	0.59	0.29	0.20	0.10	0.07	0.02	0.02
Infiltration Trench 1 TP (Unit 4)	32.19	12.88	6.44	4.29	2.15	1.07	0.54	0.27	0.18	0.09	0.06	0.02	0.01
Infiltration Trench 1 TP (Unit 5C)	8.58	3.43	1.72	1.14	0.57	0.29	0.14	0.07	0.05	0.02	0.02	0.01	0.00
Infiltration Trench 2 TP (Unit 4)	2.49	1.00	0.50	0.33	0.17	0.08	0.04	0.02	0.01	0.01	0.00	0.00	0.00
Infiltration Trench 5 TP (Unit 3)	13.17	5.27	2.63	1.76	0.88	0.44	0.22	0.11	0.07	0.04	0.02	0.01	0.01
Infiltration Trench 5 TP (Unit 6)	16.80	6.72	3.36	2.24	1.12	0.56	0.28	0.14	0.09	0.05	0.03	0.01	0.01
Total Overflow Discharge (Q) [l/sec]	**441.39**	**176.56**	**88.28**	**58.85**	**29.43**	**14.71**	**7.36**	**3.68**	**2.45**	**1.23**	**0.82**	**0.31**	**0.20**

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	Calmount Rd, Ballymount - Roads		Minutes	☐	Other Record:: ☐
Project No:	Element:		Prepared:		Checked:
23002	**Site Catchment Characteristics**		**NS**		**SG/CK**

Ref: Output:

Site Catchment Characteristics

Element	Return period=30yr												
Duration [min]	2	5	10	15	30	60	120	240	360	720	1440	2880	4320
Infiltration Trench 1 (Cafe)	14.58	5.83	2.92	1.94	0.97	0.49	0.24	0.12	0.08	0.04	0.03	0.01	0.01
Infiltration Trench 2 (Cafe)	4.83	1.93	0.97	0.64	0.32	0.16	0.08	0.04	0.03	0.01	0.01	0.00	0.00
Infiltration Trench 1 (Unit 1)	5.28	2.11	1.06	0.70	0.35	0.18	0.09	0.04	0.03	0.01	0.01	0.00	0.00
Infiltration Trench 2 (Unit 1)	15.63	6.25	3.13	2.08	1.04	0.52	0.26	0.13	0.09	0.04	0.03	0.01	0.01
Infiltration Trench 2 (Unit 2)	12.69	5.08	2.54	1.69	0.85	0.42	0.21	0.11	0.07	0.04	0.02	0.01	0.01
Infiltration Trench 3 (Unit 2)	21.84	8.74	4.37	2.91	1.46	0.73	0.36	0.18	0.12	0.06	0.04	0.02	0.01
Infiltration Trench 4 (Unit 2)	10.20	4.08	2.04	1.36	0.68	0.34	0.17	0.09	0.06	0.03	0.02	0.01	0.00
Infiltration Trench 2 (Unit 3)	14.40	5.76	2.88	1.92	0.96	0.48	0.24	0.12	0.08	0.04	0.03	0.01	0.01
Infiltration Trench 3 (Unit 3)	18.75	7.50	3.75	2.50	1.25	0.63	0.31	0.16	0.10	0.05	0.03	0.01	0.01
Infiltration Trench 4 (Unit 3)	9.36	3.74	1.87	1.25	0.62	0.31	0.16	0.08	0.05	0.03	0.02	0.01	0.00
Infiltration Trench 2 (Unit 6)	6.03	2.41	1.21	0.80	0.40	0.20	0.10	0.05	0.03	0.02	0.01	0.00	0.00
Infiltration Trench 3 (Unit 6)	11.94	4.78	2.39	1.59	0.80	0.40	0.20	0.10	0.07	0.03	0.02	0.01	0.01
Infiltration Trench 4 (Unit 6)	14.76	5.90	2.95	1.97	0.98	0.49	0.25	0.12	0.08	0.04	0.03	0.01	0.01
Infiltration Trench 1 TP (Unit 4)	13.02	5.21	2.60	1.74	0.87	0.43	0.22	0.11	0.07	0.04	0.02	0.01	0.01
Infiltration Trench 1 TP (Unit 5C)	3.06	1.22	0.61	0.41	0.20	0.10	0.05	0.03	0.02	0.01	0.01	0.00	0.00
Infiltration Trench 2 TP (Unit 4)	0.57	0.23	0.11	0.08	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Infiltration Trench 5 TP (Unit 3)	2.13	0.85	0.43	0.28	0.14	0.07	0.04	0.02	0.01	0.01	0.00	0.00	0.00
Infiltration Trench 5 TP (Unit 6)	3.09	1.24	0.62	0.41	0.21	0.10	0.05	0.03	0.02	0.01	0.01	0.00	0.00
Total Overflow Discharge (Q) [l/sec]	**182.16**	**72.86**	**36.43**	**24.29**	**12.14**	**6.07**	**3.04**	**1.52**	**1.01**	**0.51**	**0.34**	**0.13**	**0.08**

JOB NAME: Calmount Rd, Ballymount - Internal Roads	**JOB NO: 23002**		
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(30 Yr Return Period)		NS	SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years			
Total Site Area =	1.0940	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof area	0.0000	ha	.....@	100%	Impermeable
Hardstanding - Footpath	0.4648	ha	.....@	80%	Impermeable
Hardstanding - Road	0.2846	ha	.....@	80%	Impermeable
Landscaping	0.3446	ha	.....@	37%	Impermeable
Total Impermeable Area =	**0.7270**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **4.59** **litres/sec**

Duration (min)	Discharge* Q (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	182.16	22	0	26	1	25.7
5	72.86	22	0	26	1	24.9
10	36.43	22	0	26	3	23.5
15	24.29	22	0	26	4	22.1
30	12.14	22	0	26	8	18.0
60	6.07	22	0	26	17	9.7
120	3.04	22	0	26	33	-6.8
240	1.52	22	0	26	66	-39.9
360	1.01	22	0	26	99	-72.9
720	0.51	22	0	26	198	-172.1
1440	0.34	29	0	35	397	-361.6
2880	0.13	22	0	26	793	-766.9
4320	0.08	22	0	26	1190	-1163.5

** Includes 20% for climate change

Storage required =	25.7	m^3		m^3

***Refer to 'Overflow from Infiltration Trench' sheet for Discharge, Q figures**

JOB NAME: Calmount Rd, Ballymount - Internal Roads JOB NO: 23002

TITLE: ATTENUATION (100 Yr Return Period)

CALCS BY: NS CHECK'D: SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	1.0940	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof area	0.0000	ha	.....@	100%	Impermeable
Hardstanding - Footpath	0.4648	ha	.....@	80%	Impermeable
Hardstanding - Road	0.2846	ha	.....@	80%	Impermeable
Landscaping	0.3446	ha	.....@	37%	Impermeable
Total Impermeable Area =	**0.7270**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **5.69** **litres/sec**

Duration (min)	Discharge* Q (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	441.39	53	0	64	1	62.9
5	176.56	53	0	64	2	61.9
10	88.28	0	0	0	3	-3.4
15	58.85	0	0	0	5	-5.1
30	29.43	0	0	0	10	-10.2
60	14.71	0	0	0	20	-20.5
120	7.36	0	0	0	41	-41.0
240	3.68	0	0	0	82	-81.9
360	2.45	0	0	0	123	-122.9
720	1.23	0	0	0	246	-245.8
1440	0.82	0	0	0	492	-491.6
2880	0.31	0	0	0	983	-983.2
4320	0.20	0	0	0	1475	-1474.8

** Includes 20% for climate change

Storage required =	62.9	m^3			m^3

***Refer to 'Overflow from Infiltration Trench' sheet for Discharge, Q figures**

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Calmount Rd, Ballymount - Internal Roads	Minutes: ☐	Other Record: ☐	

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 00.0 mm RP5 2d= 00.0 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	10940 m²
Hardstanding - Road	4648 m²
Hardstanding - F&C/P	2846 m²
Permeable area	0 m²
Landscape	3446 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled

Criterion 1

Interception Volume Required (0.005 * 0.8 * Impervious Area)	Hardstanding - Road	Hardstanding - F&C/P	Paved Area	Total
	18.59 m³	11.38 m³	0.00 m³	**29.98 m³**

Interception Volume Provided	Infiltration Trenches	StormTech		Total
	111.06 m³	16.25 m³		**127.31 m³**

OK

NOTES:
Infiltration Trenchs/Tree Pits = 493.60m x 1.0m x 0.75m dp) x 0.3 = 111.06m^3
StormTech Trench (Below IL Chambers): (3.35m x 48.5 x 0.25m) x 0.4 = 16.25m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	10940 m²
Hardstanding - Road	4648 m²
Hardstanding - F&C/P	2846 m²
Permeable area	0 m²
Landscape	3446 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 * Impervious Area)	Hardstanding - Road	Hardstanding - F&C/P	Paved Area	Total
	55.78 m³	34.15 m³	0.00 m³	**89.93 m³**

Treatment Volume Provided	Infiltration Trenches	StormTech		Total
	111.06 m³	16.25 m³		**127.31 m³**

OK

NOTES:
As outlined above

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9 Tel: 8301852 / Fax: 8602265**				
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	Calmount Rd, Ballymount - Internal Roads		Minutes:	☐	Other Record: ☐	
Project No:	Element:		Prepared:		Checked:	
23002	**Attenuation Design Criteria**		**NS**		**SG/CK**	

Reference: Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

100 year Attenuation Volume Required	**62.90 m³**

Attenuation Volume Provided	StormTech Trench			Total
	108.30 m³			108.30

OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added.

LONG TERM STORAGE (See GDSDS Cl6.3.4)

Rainfall depth for 100 year, 6 hour event	RD	92 mm
Percentage of Impermeable area	PIMP	0.685
Site Area	A	10940 m²
Soil Index (Soil Type 2)	SOIL	0.3
Percentage of impervious area draining to the network or directly to the river	α	0.62
Percentage of pervious area drainaing to the network or directly to the river	β	0.0
Long Term Storage Required	Vol_{xs}	**39.88 m³**
Long Term Storage Provided		**127.31 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta SOIL) - SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4

OK

NOTES:
Vol_{xs} is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Qbar or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-Criterion4.3)

COMMENTS

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 1	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Site Catchment Characteristics**	**NS**	**SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	7351 m²
Roof	2935 m²
Hardstanding	2632 m²
Permeable area	700 m²
Landscape	1084 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Roof			2935 m²
Hardstanding			2353 m²
		TOTAL	5288 m²

Areas Contributing into:

Permeable paving	
Location	Area
Perm paving	700 m²
Hardstanding	139 m²
TOTAL	839 m²

Bio-Retention Area	
Location	Area
Hardstanding	140 m²
TOTAL	140 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.25	1.47	2.50	3.09	3.82

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:		Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 1		Minutes:	☐	Other Record:	☐
Project No:		Prepared:		Checked:	
23002	Infiltration Drainage - Perm Paving	NS		SG/CK	

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	128.9 mm/hr
FOS	Minor Inconvenience	3.00
q		0.043 m/hr

Assume - uniform gravel (**n**)	0.35

Area to be Drained

A_D	700 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:
R= A_D/A_b= 1.00

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	700 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.017
30 min	0.000
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

30 Year Return Period

Duration (D)	h_{max}
15 min	0.037
30 min	0.023
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

50 Year Return Period

Duration (D)	h_{max}
15 min	0.049
30 min	0.038
60 min	0.001
120 min	0.000
240 min	0.000
360 min	0.000

100 Year Return Period

Duration (D)	h_{max}
15 min	0.068
30 min	0.061
60 min	0.028
120 min	0.000
240 min	0.000
360 min	0.000

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	0.135 hrs
1 in 30 years	0.300 hrs
1 in 50 years	0.398 hrs
1 in 100 years	0.554 hrs

Event	Min feasible (q)
1 in 10 years	0.0001 m/hr
1 in 30 years	0.0005 m/hr
1 in 50 years	0.0007 m/hr
1 in 100 years	0.0010 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 1	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 1	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area**	**NS**	**SG/CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	143.6 mm/hr
FOS	Minor Inconvenience	3.00
q		0.048 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	130 m²

Infriltration Trench dimensions

Length	20.00 m
Width	1.00 m

Base Area (A_b)	20.000 m²
Perimeter (**P**)	42.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.335
Ab/P=	0.476

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.306	-3.806
30.000 min	0.343	-2.223
60.000 min	0.353	-1.238
120.000 min	0.298	-0.610
240.000 min	0.157	-0.212
360.000 min	0.044	-0.051

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.453	-5.637
30.000 min	0.518	-3.356
60.000 min	0.549	-1.929
120.000 min	0.503	-1.029
240.000 min	0.344	-0.466
360.000 min	0.208	-0.240

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.540	-6.723
30.000 min	0.618	-4.008
60.000 min	0.660	-2.317
120.000 min	0.618	-1.265
240.000 min	0.449	-0.608
360.000 min	0.300	-0.346

100 Year Return Period

Duration (D)	hmax	a
15.000 min	0.680	-8.460
30.000 min	0.781	-5.063
60.000 min	0.839	-2.945
120.000 min	0.802	-1.642
240.000 min	0.615	-0.833
360.000 min	0.443	-0.512

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.714 hrs
1 in 30 years	0.930 hrs
1 in 50 years	1.023 hrs
1 in 100 years	1.146 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	20.000 m²	0.850 m	0.353 m	0.000 l/sec
30 Years	60.000 min	20.000 m²	0.850 m	0.549 m	0.000 l/sec
50 Years	60.000 min	20.000 m²	0.850 m	0.660 m	0.000 l/sec
100 Years	60.000 min	20.000 m²	0.850 m	0.839 m	0.000 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

JOB NAME: Calmount Rd, Ballymount - Unit 1	**JOB NO: 23002**		
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(30 Yr Return Period)		NS	SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years			
Total Site Area =	0.7351	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.2935	ha	.....@	100%	Impermeable
Hardstanding	0.2363	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.4825**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **3.09** **litres/sec**

Duration (min)	Rainfall 30 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.4
5	12.0	144.0	188	56	0	68	1	66.9
10	16.8	100.8	132	79	0	95	2	93.1
15	19.7	78.8	103	93	0	111	3	108.5
30	24.7	49.4	65	116	0	140	6	134.0
60	31.0	31.0	41	146	0	175	11	164.0
120	38.8	19.4	25	183	0	219	22	197.0
240	48.6	12.2	16	229	0	275	44	230.1
360	55.4	9.2	12	261	0	313	67	246.3
720	69.5	5.8	8	327	0	393	133	259.2
1440	87.0	3.6	5	410	0	491	267	224.7
2880	98.6	2.1	3	464	0	557	534	23.5
4320	108.2	1.5	2	509	0	611	800	-189.0

** Includes 20% for climate change

Storage required =	259.2	m^3		m^3

JOB NAME: Calmount Rd, Ballymount - Unit 1	JOB NO: 23002		
TITLE: ATTENUATION		CALCS BY:	CHECK'D:
(100 Yr Return Period)		NS	SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	0.7351	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.2935	ha	.....@	100%	Impermeable
Hardstanding	0.2353	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.4817**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **3.82** **litres/sec**

Duration (min)	Rainfall 100 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.5
5	17.6	211.2	276	83	0	99	1	98.1
10	24.5	147.0	192	115	0	138	2	135.9
15	28.8	115.2	150	135	0	162	3	159.0
30	35.7	71.4	93	168	0	201	7	194.5
60	44.1	44.1	58	207	0	249	14	235.0
120	54.6	27.3	36	257	0	308	28	280.4
240	67.5	16.9	22	317	0	381	55	325.7
360	76.4	12.7	17	359	0	431	83	348.4
720	94.6	7.9	10	445	0	534	165	368.5
1440	117.0	4.9	6	550	0	660	330	329.8
2880	129.6	2.7	4	609	0	731	660	70.8
4320	140.2	1.9	3	659	0	791	990	-199.4

** Includes 20% for climate change

Storage required =	368.5	**m^3**			**m^3**

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Unit 1
LOCATION:	Attenuation SC740 - Sheet 1
DATE:	15.03.2023
CREATED BY:	SG

SYSTEM PARAMETERS

Required Total Storage		m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.3	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		12	ea
Number of units per Row		10	ea
System Installed Storage Depth (effective storage depth)	1.060	1.06	m
Tank overall installed Width at base	17.79	17.8	m
Tank overall installed Length at Base	22.4	22.5	m
Total Effective System Storage	**274.8**	**275.7**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	451	m^3
Width at base	17.80	m
Width at top	19.02	m
Length at base	22.50	m
Length at top	23.72	m
Depth Of System	1.06	m
Area of Dig at Base of System	401	m^2
Area of Dig at Top of System	451	m^2
Void Ratio	61%	
Stone Requirement - m3	293	m^3
Stone Requirement - tonne	481	tonne

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Unit 1
LOCATION:	Attenuation SC740 - Sheet 2
DATE:	15.03.2023
CREATED BY:	SG

SYSTEM PARAMETERS

Required Total Storage		m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.3	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		7	ea
Number of units per Row		6	ea
System Installed Storage Depth (effective storage depth)	1.060	1.06	m
Tank overall installed Width at base	10.57	10.6	m
Tank overall installed Length at Base	13.72	13.8	m
Total Effective System Storage	**101.7**	**102.3**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	172	m^3
Width at base	10.60	m
Width at top	11.82	m
Length at base	13.80	m
Length at top	15.02	m
Depth Of System	1.06	m
Area of Dig at Base of System	146	m^2
Area of Dig at Top of System	178	m^2
Void Ratio	60%	
Stone Requirement - m3	116	m^3
Stone Requirement - tonne	190	tonne

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 1	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	7351 m²
Roof Drainage	2935 m²
Hardstanding	2632 m²
Porous Surfaces	700 m²
Landscape	1084 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	11.74 m³	10.53 m³	2.80 m³	**25.07 m³**

Interception Volume Provided	Permeable Paving	Bioretention Area	StormTech	Total
	85.75 m³	7.65 m³	98.42 m³	**191.82 m³**

OK

NOTES:

- Porous Surfaces: (700.0m^2 x 0.35m dp) x 0.35 = 85.75m^3
- Bioretention Areas: ((20.0m x 1.5m x 0.85m dp) x 0.3) = 7.65m^3
- Stone Below StormTech Chambers: (546.78m^2 x 0.45m dp) x 0.4 = 98.42m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	7351 m²
Roof Drainage	2935 m²
Hardstanding	2632 m²
Porous Surfaces	700 m²
Landscape	1084 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	35.22 m³	31.58 m³	8.40 m³	**75.20 m³**

Treatment Volume Provided	Permeable Paving	Bioretention Area	StormTech	Total
	85.75 m³	7.65 m³	98.42 m³	**191.82 m³**

OK

NOTES:

As outlined above

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9** **Tel: 8301852 / Fax: 8602265**			
	Project:	Design:		Telephone Log:	
	Calmount Rd, Ballymount - Unit 1	Minutes:		Other Record:	
Project No:	Element:	Prepared:		Checked:	
23002	**Attenuation Design Criteria**	**SG**		**CK**	

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

0 year Attenuation Volume Requir	**368.50 m³**

Attenuation Volume Provided	StormTech			Total	
	378.00 m³			378.00	OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour eve	RD	92 mm
Percentage of Impermeable area	PIMP	0.757
Site Area	A	7351 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.92
Percentage of pervious area drainaing to the network or directly	β	0.3
Long Term Storage Required	Vol_{xs}	**188.18 m³**
Long Term Storage Provided		**191.82 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8)+\left(1-\frac{PIMP}{100}\right)(\beta SOIL)-SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4 — OK

NOTES:
Vol_{xs} is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**
	Project: **Calmount Rd, Ballymount - Unit 2**	Design: ☑ Telephone Log: ☐ Minutes: ☐ Other Record: ☐
Project No: **23002**	Element: **Site Catchment Characteristics**	Prepared: **NS** Checked: **SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	9232 m²
Roof	3534 m²
Hardstanding	3185 m²
Permeable area	835 m²
Landscape	1678 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Roof			855 m²
Hardstanding			2790 m²
		TOTAL	3645 m²

Areas Contributing into:

Perm area	
Location	Area
Perm paving	835 m²
Hardstanding	305 m²
TOTAL	1140 m²

Location	Area
Roof	2645 m²
TOTAL	2645 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.57	1.85	3.14	3.88	4.80

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:		Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 2		Minutes:	☐	Other Record:	☐
Project No:		Prepared:		Checked:	
23002	Infiltration Drainage - Perm Paving	NS		SG/CK	

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	28.1 mm/hr
FOS	Minor Inconvenience	5.00
q		0.006 m/hr

Assume - uniform gravel (**n**)	0.35

Area to be Drained

A_D	1140 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:
R= A_D/A_b= 1.37

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	835 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.061
30 min	0.073
60 min	0.087
120 min	0.099
240 min	0.102
360 min	0.095

30 Year Return Period

Duration (D)	h_{max}
15 min	0.088
30 min	0.108
60 min	0.129
120 min	0.149
240 min	0.163
360 min	0.163

50 Year Return Period

Duration (D)	h_{max}
15 min	0.105
30 min	0.127
60 min	0.152
120 min	0.178
240 min	0.197
360 min	0.201

100 Year Return Period

Duration (D)	h_{max}
15 min	0.131
30 min	0.159
60 min	0.190
120 min	0.223
240 min	0.252
360 min	0.261

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	6.334 hrs
1 in 30 years	10.148 hrs
1 in 50 years	12.514 hrs
1 in 100 years	16.240 hrs

Event	Min feasible (q)
1 in 10 years	0.0007 m/hr
1 in 30 years	0.0024 m/hr
1 in 50 years	0.0029 m/hr
1 in 100 years	0.0038 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 1	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 1	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	48.3 mm/hr
FOS	Minor Inconvenience	5.00
q		0.010 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	2645 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	370.000 m²
Perimeter (**P**)	217.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.019
Ab/P=	1.705

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.386	-81.928
30.000 min	0.479	-51.020
60.000 min	0.594	-31.779
120.000 min	0.723	-19.506
240.000 min	0.854	-11.741
360.000 min	0.920	-8.598

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.554	-117.684
30.000 min	0.687	-73.141
60.000 min	0.846	-45.263
120.000 min	1.026	-27.688
240.000 min	1.215	-16.703
360.000 min	1.315	-12.284

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.654	-138.896
30.000 min	0.806	-85.867
60.000 min	0.988	-52.838
120.000 min	1.197	-32.309
240.000 min	1.416	-19.468
360.000 min	1.537	-14.355

100 Year Return Period

Duration (D)	hmax	a
15.000 min	0.814	-172.834
30.000 min	1.000	-106.473
60.000 min	1.217	-65.111
120.000 min	1.469	-39.657
240.000 min	1.735	-23.862
360.000 min	1.883	-17.587

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	10.212 hrs
1 in 30 years	13.011 hrs
1 in 50 years	14.334 hrs
1 in 100 years	16.126 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360.000 min	370.000 m²	1.000 m	0.920 m	0.000 l/sec
30 Years	360.000 min	370.000 m²	1.000 m	1.315 m	0.201 l/sec
50 Years	360.000 min	370.000 m²	1.000 m	1.537 m	0.397 l/sec
100 Years	360.000 min	370.000 m²	1.000 m	1.883 m	0.800 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

JOB NAME: Calmount Rd, Ballymount - Unit 2	JOB NO: 23002		
TITLE: ATTENUATION		CALCS BY:	CHECK'D:
(30 Yr Return Period)		NS	SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years			
Total Site Area =	0.9254	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.0855	ha	.....@	100%	Impermeable
Hardstanding	0.2790	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.3087**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **3.08** **litres/sec**

Duration (min)	Rainfall 30 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.4
5	12.0	144.0	120	36	0	43	1	42.4
10	16.8	100.8	84	51	0	61	2	58.9
15	19.7	78.8	66	59	0	71	3	68.4
30	24.7	49.4	41	74	0	89	6	83.7
60	31.0	31.0	26	93	0	112	11	100.9
120	38.8	19.4	16	117	0	140	22	118.0
240	48.6	12.2	10	146	0	176	44	131.3
360	55.4	9.2	8	167	0	200	67	133.7
720	69.5	5.8	5	209	0	251	133	118.1
1440	87.0	3.6	3	262	0	314	266	48.3
2880	98.6	2.1	2	297	0	356	532	-175.9
4320	108.2	1.5	1	326	0	391	798	-407.3

** Includes 20% for climate change

Storage required =	133.7	m^3			m^3

JOB NAME: Calmount Rd, Ballymount - Unit 2		**JOB NO: 23002**	
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(100 Yr Return Period)		NS	SG/CK
RCD.		**ISSUE.** 1	**REV.** 0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	0.9254	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.0855	ha	.....@	100%	Impermeable
Hardstanding	0.2790	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.3087**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **4.00** **litres/sec**

Duration (min)	Rainfall 100 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.5
5	17.6	211.2	177	53	0	64	1	62.4
10	24.5	147.0	123	74	0	89	2	86.1
15	28.8	115.2	96	87	0	104	4	100.5
30	35.7	71.4	60	108	0	129	7	121.8
60	44.1	44.1	37	133	0	159	14	145.0
120	54.6	27.3	23	164	0	197	29	168.5
240	67.5	16.9	14	203	0	244	58	186.3
360	76.4	12.7	11	230	0	276	86	189.7
720	94.6	7.9	7	285	0	342	173	169.1
1440	117.0	4.9	4	352	0	423	346	77.2
2880	129.6	2.7	2	390	0	468	691	-222.8
4320	140.2	1.9	2	422	0	507	1037	-530.1

** Includes 20% for climate change

Storage required =	189.7	m^3		m^3

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Unit 2
LOCATION:	StormTech Trench
DATE:	09-Mar-23
CREATED BY:	NS

SYSTEM PARAMETERS

Required Total Storage	**189.7**	m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.15	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		7	ea
Number of units per Row		13	ea
System Installed Storage Depth (effective storage depth)	0.910	.	m
Tank overall installed Width at base	10.57	10.6	m
Tank overall installed Length at Base	28.91	29	m
Total Effective System Storage	**190.8**	**191.5**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	299	m^3
Width at base	10.60	m
Width at top	11.65	m
Length at base	29.00	m
Length at top	30.05	m
Depth Of System	0.91	m
Area of Dig at Base of System	307	m^2
Area of Dig at Top of System	350	m^2
Void Ratio	64%	
Stone Requirement - m3	180	m^3
Stone Requirement - tonne	295	tonne

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 2	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	9232 m²
Roof Drainage	3534 m²
Hardstanding	3185 m²
Porous Surfaces	835 m²
Landscape	1678 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	14.14 m³	12.74 m³	3.34 m³	**30.22 m³**

Interception Volume Provided	Permeable Paving	Bioretention Area	StormTech	Total
	102.29 m³	111.00 m³	18.44 m³	**231.73 m³**

OK

NOTES:

- Porous Surfaces: (835.0m^2 x 0.35m dp) x 0.35 = 102.29m^3
- Bioretention Areas: (370.0m^2 x 1.0m dp) x 0.3) = 111.0m^3
- Stone Below IL StormTech Chambers: (10.6 x 29.0 x 0.15m dp) x 0.4 = 18.44m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	9232 m²
Roof Drainage	3534 m²
Hardstanding	3185 m²
Porous Surfaces	835 m²
Landscape	1678 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	42.41 m³	38.22 m³	10.02 m³	**90.65 m³**

Treatment Volume Provided	Permeable Paving	Bioretention Area	StormTech	Total
	102.29 m³	111.00 m³	18.44 m³	**231.73 m³**

OK

NOTES:

As outlined above

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9** **Tel: 8301852 / Fax: 8602265**			
	Project:	Design:		Telephone Log:	
	Calmount Rd, Ballymount - Unit 2	Minutes:		Other Record:	
Project No:	Element:	Prepared:		Checked:	
23002	**Attenuation Design Criteria**	**SG**		**CK**	

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

0 year Attenuation Volume Requir	**189.70 m³**

Attenuation Volume Provided	StormTech			Total	
	191.50 m³			191.50	OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour ever	RD	92 mm
Percentage of Impermeable area	PIMP	0.728
Site Area	A	9232 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.54
Percentage of pervious area drainaing to the network or directly	β	0.53
Long Term Storage Required	Volxs	**48.83 m³**
Long Term Storage Provided		**231.73 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta SOIL) - SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4 — OK

NOTES:
Volxs is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**

Project:					
Calmount Rd, Ballymount - Unit 3	Design:	☑	Telephone Log:	☐
	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Site Catchment Characteristics**	**NS**	**SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	7487 m²
Roof	3390 m²
Hardstanding	2719 m²
Permeable area	790 m²
Landscape	588 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Roof			3390 m²
Hardstanding			1140 m²
		TOTAL	4530 m²

Areas Contributing into:

Permeable Paving	
Location	Area
Paving	790 m²
Hardstanding	136 m²
TOTAL	926 m²

Bio-retention Area	
Location	Area
Hardstanding	1225 m²
TOTAL	1225 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.27	1.50	2.55	3.14	3.89

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	####	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 3	Minutes: ☐	Other Record: ☐

Project No:		Prepared:	Checked:
23002	**Infiltration Drainage - Perm Paving**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	28.1 mm/hr
FOS	Minor Inconvenience	5.00
q		0.006 m/hr

Assume - uniform gravel (**n**)	0.35

Area to be Drained

A_D	926 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:

R= A_D/A_b= 1.17

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	790 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.051
30 min	0.062
60 min	0.073
120 min	0.080
240 min	0.078
360 min	0.067

30 Year Return Period

Duration (D)	h_{max}
15 min	0.075
30 min	0.091
60 min	0.109
120 min	0.124
240 min	0.131
360 min	0.126

50 Year Return Period

Duration (D)	h_{max}
15 min	0.089
30 min	0.108
60 min	0.129
120 min	0.148
240 min	0.160
360 min	0.159

100 Year Return Period

Duration (D)	h_{max}
15 min	0.112
30 min	0.135
60 min	0.161
120 min	0.187
240 min	0.207
360 min	0.211

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	4.998 hrs
1 in 30 years	8.146 hrs
1 in 50 years	9.971 hrs
1 in 100 years	13.094 hrs

Event	Min feasible (q)
1 in 10 years	0.0006 m/hr
1 in 30 years	0.0019 m/hr
1 in 50 years	0.0023 m/hr
1 in 100 years	0.0031 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 3	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Planted swale**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 3	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Planted swale**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	193.9 mm/hr
FOS	Minor Inconvenience	5.00
q		0.039 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	1225 m²

Infriltration Trench dimensions

Length	40.00 m
Width	1.00 m

Base Area (A_b)	40.000 m²
Perimeter (**P**)	82.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.265
Ab/P=	0.488

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.604	-25.026
30.000 min	1.936	-15.597
60.000 min	2.265	-9.727
120.000 min	2.462	-5.983
240.000 min	2.362	-3.614
360.000 min	2.114	-2.655

30 Year Return Period

Duration (D)	hmax	a
15.000 min	2.304	-35.933
30.000 min	2.773	-22.345
60.000 min	3.222	-13.840
120.000 min	3.489	-8.479
240.000 min	3.352	-5.128
360.000 min	3.009	-3.780

50 Year Return Period

Duration (D)	hmax	a
15.000 min	2.719	-42.404
30.000 min	3.255	-26.227
60.000 min	3.760	-16.151
120.000 min	4.069	-9.889
240.000 min	3.903	-5.971
360.000 min	3.512	-4.411

100 Year Return Period

Duration (D)	hmax	a
15.000 min	3.382	-52.757
30.000 min	4.035	-32.513
60.000 min	4.632	-19.895
120.000 min	4.991	-12.130
240.000 min	4.779	-7.312
360.000 min	4.297	-5.398

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	2.038 hrs
1 in 30 years	2.179 hrs
1 in 50 years	2.232 hrs
1 in 100 years	2.293 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	120.000 min	40.000 m²	1.000 m	2.462 m	0.215 l/sec
30 Years	120.000 min	40.000 m²	1.000 m	3.489 m	0.514 l/sec
50 Years	120.000 min	40.000 m²	1.000 m	4.069 m	0.736 l/sec
100 Years	120.000 min	40.000 m²	1.000 m	4.991 m	1.173 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

JOB NAME: Calmount Rd, Ballymount - Unit 3		**JOB NO: 23002**	
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(30 Yr Return Period)		NS	SG/CK
RCD.		**ISSUE.** 1	**REV.** 0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years			
Total Site Area =	0.7487	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.3390	ha	.....@	100%	Impermeable
Hardstanding	0.1140	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.4302**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **1.97** **litres/sec**

Duration (min)	Rainfall 30 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.2
5	12.0	144.0	168	50	0	60	1	59.8
10	16.8	100.8	118	71	0	85	1	83.4
15	19.7	78.8	92	83	0	99	2	97.4
30	24.7	49.4	58	104	0	124	4	120.9
60	31.0	31.0	36	130	0	156	7	149.0
120	38.8	19.4	23	163	0	195	14	181.2
240	48.6	12.2	14	204	0	245	28	216.4
360	55.4	9.2	11	233	0	279	43	236.5
720	69.5	5.8	7	292	0	350	85	264.9
1440	87.0	3.6	4	365	0	438	170	268.0
2880	98.6	2.1	2	414	0	497	340	156.2
4320	108.2	1.5	2	454	0	545	511	34.3

** Includes 20% for climate change

Storage required = 268.0 **m^3**

m^3

JOB NAME: Calmount Rd, Ballymount - Unit 3		**JOB NO: 23002**	
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(100 Yr Return Period)		NS	SG/CK
RCD.		**ISSUE.** 1	**REV.** 0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	0.7487	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof	0.3390	ha	.....@	100%	Impermeable
Hardstanding	0.1140	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.4302**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **2.72** **litres/sec**

Duration (min)	Rainfall 100 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.3
5	17.6	211.2	246	74	0	89	1	87.8
10	24.5	147.0	171	103	0	123	2	121.8
15	28.8	115.2	134	121	0	145	2	142.6
30	35.7	71.4	83	150	0	180	5	174.9
60	44.1	44.1	51	185	0	222	10	212.3
120	54.6	27.3	32	229	0	275	20	255.4
240	67.5	16.9	20	283	0	340	39	300.8
360	76.4	12.7	15	321	0	385	59	326.0
720	94.6	7.9	9	397	0	476	118	358.9
1440	117.0	4.9	6	491	0	589	235	354.3
2880	129.6	2.7	3	544	0	653	470	182.7
4320	140.2	1.9	2	588	0	706	705	1.1

** Includes 20% for climate change

Storage required = 358.9 **m^3**

m^3

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Unit 3
LOCATION:	StormTech Trench
DATE:	09-Mar-23
CREATED BY:	NS

SYSTEM PARAMETERS

Required Total Storage	**359.4**	m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.2	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		10	ea
Number of units per Row		17	ea
System Installed Storage Depth (effective storage depth)	0.960	.	m
Tank overall installed Width at base	14.90	15	m
Tank overall installed Length at Base	37.59	38	m
Total Effective System Storage	**360.4**	**364.3**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	576	m^3
Width at base	15.00	m
Width at top	16.11	m
Length at base	38.00	m
Length at top	39.11	m
Depth Of System	0.96	m
Area of Dig at Base of System	570	m^2
Area of Dig at Top of System	630	m^2
Void Ratio	63%	
Stone Requirement - m3	353	m^3
Stone Requirement - tonne	579	tonne

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 3	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	7487 m²
Roof Drainage	3390 m²
Hardstanding	2719 m²
Porous Surfaces	790 m²
Landscape	588 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled

	Roof	Hardstanding	Perm Area	Total
Interception Volume Required (0.005 * 0.8 *	13.56 m³	10.88 m³	3.16 m³	**27.60 m³**

Criterion 1

Interception Volume Provided	Permeable Paving	Planted Swale	StormTech	Total
	96.78 m³	12.00 m³	34.20 m³	**142.98 m³**

OK

NOTES:

- Porous Surfaces: (790.0m^2 x 0.35m dp) x 0.35 = 96.78m^3
- Planted Swale: (40.0m x 1.0m x 1.0m dp) x 0.3) = 12.0m^3
- Stone Below IL StormTech Chambers: (15.0 x 38.0 x 0.15m dp) x 0.4 = 34.20m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	7487 m²
Roof Drainage	3390 m²
Hardstanding	2719 m²
Porous Surfaces	790 m²
Landscape	588 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

	Roof	Hardstanding	Perm Area	Total
Treatment Volume Required (0.015 * 0.8 *	40.68 m³	32.63 m³	9.48 m³	**82.79 m³**

Criterion 1

Treatment Volume Provided	Permeable Paving	Planted Swale	StormTech	Total
	96.78 m³	12.00 m³	34.20 m³	**142.98 m³**

OK

NOTES:

As outlined above

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9** **Tel: 8301852 / Fax: 8602265**			
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	Calmount Rd, Ballymount - Unit 3	Minutes:		Other Record:	
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23002	**Attenuation Design Criteria**	**SG**		**CK**	

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

0 year Attenuation Volume Requir	**358.90 m³**

Attenuation Volume Provided	StormTech			Total	
	364.30 m³			364.30	OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour ever	RD	92 mm
Percentage of Impermeable area	PIMP	0.816
Site Area	A	7487 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.74
Percentage of pervious area drainaing to the network or directly	β	0.3
Long Term Storage Required	Vol_{xs}	**137.01 m³**
Long Term Storage Provided		**142.98 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta SOIL) - SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4 — OK

NOTES:
Vol_{xs} is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Vol_{xs}) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**	
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23002 — **Site Catchment Characteristics**	**NS**	**SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	11393 m²
Roof	3433 m²
Greenroof	290 m²
Hardstanding	3911 m²
Permeable areas	880 m²
Landscape	2879 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
		TOTAL	0 m²

Areas Contributing into:

Permeable Paving	
Location	Area
Perm Paving	880 m²
Hardstanding	203 m²
TOTAL	1083 m²

Planted Swale	
Location	Area
Hardstanging	1740 m²
TOTAL	1740 m²

Bio-Retention	
Location	Area
Roof	3433 m²
Greenroof	290 m²
Hardstanding	1718 m²
TOTAL	5441 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.94	2.28	3.87	4.79	5.92

Calmount Rd, Ballymount - Extreme Rainfall Matrix

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30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
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72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

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Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 4	Minutes: ☐	Other Record: ☐

Project No:		Prepared:	Checked:
23002	**Infiltration Drainage - Perm Paving**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
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4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	491.0 mm/hr
FOS	Minor Inconvenience	5.00
q		0.098 m/hr

Assume - uniform gravel (**n**)	0.35

Area to be Drained

A_D	1083 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:

R= A_D/A_b= 1.23

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	880 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.000
30 min	0.000
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

30 Year Return Period

Duration (D)	h_{max}
15 min	0.013
30 min	0.000
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

50 Year Return Period

Duration (D)	h_{max}
15 min	0.028
30 min	0.000
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

100 Year Return Period

Duration (D)	h_{max}
15 min	0.051
30 min	0.010
60 min	0.000
120 min	0.000
240 min	0.000
360 min	0.000

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	0.000 hrs
1 in 30 years	0.046 hrs
1 in 50 years	0.099 hrs
1 in 100 years	0.183 hrs

Event	Min feasible (q)
1 in 10 years	0.0000 m/hr
1 in 30 years	0.0002 m/hr
1 in 50 years	0.0004 m/hr
1 in 100 years	0.0007 m/hr

Doherty Finegan Kelly
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Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 4	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
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60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
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Dublin 9
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Calmount Rd, Ballymount - Unit 4	Minutes: ☐	Other Record: ☐

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23002	**Bio-retention Area**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	13.7 mm/hr
FOS	Minor Inconvenience	5.00
q		0.003 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	5441 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	500.000 m²
Perimeter (**P**)	100.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.002
Ab/P=	5.000

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.598	-1312.295
30.000 min	0.752	-825.468
60.000 min	0.952	-522.395
120.000 min	1.198	-329.096
240.000 min	1.503	-206.793
360.000 min	1.712	-157.275

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.855	-1875.486
30.000 min	1.070	-1173.883
60.000 min	1.339	-734.785
120.000 min	1.668	-457.962
240.000 min	2.071	-284.948
360.000 min	2.344	-215.345

50 Year Return Period

Duration (D)	hmax	a
15.000 min	1.007	-2209.582
30.000 min	1.253	-1374.341
60.000 min	1.556	-854.105
120.000 min	1.933	-530.748
240.000 min	2.388	-328.500
360.000 min	2.699	-247.959

100 Year Return Period

Duration (D)	hmax	a
15.000 min	1.251	-2744.137
30.000 min	1.549	-1698.892
60.000 min	1.909	-1047.404
120.000 min	2.354	-646.488
240.000 min	2.891	-397.706
360.000 min	3.253	-298.869

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	74.792 hrs
1 in 30 years	95.315 hrs
1 in 50 years	105.651 hrs
1 in 100 years	120.340 hrs

Infiltration System -- Overflow

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360.000 min	500.000 m²	1.000 m	1.712 m	0.437 l/sec
30 Years	360.000 min	500.000 m²	1.000 m	2.344 m	1.157 l/sec
50 Years	360.000 min	500.000 m²	1.000 m	2.699 m	1.699 l/sec
100 Years	360.000 min	500.000 m²	1.000 m	3.253 m	2.760 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

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Calmount Rd, Ballymount - Unit 3		Minutes:	☐	Other Record:	☐
Project No:	Element:	Prepared:		Checked:	
23002	Planted Swale	NS		CK	

Reference: Output:

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From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	21.6 mm/hr
FOS	Minor Inconvenience	5.00
q		0.004 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	1740 m²

Infriltration Trench dimensions

Length	60.00 m
Width	1.00 m

Base Area (A_b)	60.000 m²
Perimeter (**P**)	122.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.029
Ab/P=	0.492

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	1.591	-218.602
30.000 min	1.997	-137.633
60.000 min	2.512	-87.225
120.000 min	3.127	-55.076
240.000 min	3.832	-34.734
360.000 min	4.262	-26.498

30 Year Return Period

Duration (D)	hmax	a
15.000 min	2.273	-312.273
30.000 min	2.837	-195.582
60.000 min	3.530	-122.550
120.000 min	4.344	-76.509
240.000 min	5.266	-47.733
360.000 min	5.815	-36.156

50 Year Return Period

Duration (D)	hmax	a
15.000 min	2.678	-367.841
30.000 min	3.321	-228.922
60.000 min	4.101	-142.396
120.000 min	5.031	-88.614
240.000 min	6.065	-54.976
360.000 min	6.688	-41.581

100 Year Return Period

Duration (D)	hmax	a
15.000 min	3.325	-456.748
30.000 min	4.104	-282.902
60.000 min	5.027	-174.545
120.000 min	6.124	-107.865
240.000 min	7.335	-66.487
360.000 min	8.050	-50.048

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	20.348 hrs
1 in 30 years	21.148 hrs
1 in 50 years	21.450 hrs
1 in 100 years	21.802 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360.000 min	60.000 m²	1.000 m	4.262 m	0.240 l/sec
30 Years	360.000 min	60.000 m²	1.000 m	5.815 m	0.498 l/sec
50 Years	360.000 min	60.000 m²	1.000 m	6.688 m	0.683 l/sec
100 Years	360.000 min	60.000 m²	1.000 m	8.050 m	1.036 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 4	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	11393 m²
Roof Drainage	3433 m²
Grenroof	290 m²
Hardstanding	3911 m²
Porous Surfaces	880 m²
Landscape	2879 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled onsite

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	14.89 m³	15.64 m³	3.52 m³	**34.06 m³**

Interception Volume Provided	Permeable Paving	Bioretention Area	Planted Swale	Total
	107.80 m³	12.00 m³	18.00 m³	**137.80 m³**

OK

NOTES:

- Porous Surfaces: (880.0m^2 x 0.35m dp) x 0.35 =107.8m^3
- Bioretention Areas: (500.0m^2 x 1.0m dp) x 0.3) = 150.0m^3
- Planted Swale: (60.0 x 1.0m x 1.0m dp) x 0.4 = 18.0m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	11393 m²
Roof Drainage	3433 m²
Grenroof	290 m²
Hardstanding	3911 m²
Porous Surfaces	880 m²
Landscape	2879 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	44.68 m³	46.93 m³	10.56 m³	**102.17 m³**

Treatment Volume Provided	As Outlined above	Greenroof		Total
	137.80 m³	4.35 m³		**142.15 m³**

OK

NOTES:

As outlined above plus:

Greenroof (Assumed to treat first 15mm rainfall minimum): 290.0m^2 x 0.015m = 4.35m^3

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:		Telephone Log:	
Calmount Rd, Ballymount - Unit 4	Minutes:		Other Record:	

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

100 year Attenuation Volume Requ	**0.00 m³**

Attenuation Volume Provided				Total
				0.00

NOT OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour even	RD	92 mm
Percentage of Impermeable area	PIMP	0.369
Site Area	A	11393 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.94
Percentage of pervious area drainaing to the network or directly	β	0.30
Long Term Storage Required	Volxs	**35.62 m³**
Long Term Storage Provided		**137.80 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8)+\left(1-\frac{PIMP}{100}\right)(\beta SOIL)-SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4 — OK

NOTES:
Volxs is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Units 5A+5B+5C	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Site Catchment Characteristics**	**NS**	**SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	7587 m²
Greenroof area	1542 m²
Hardstanding	1882 m²
Permeable area	2355 m²
Landscape	1808 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Greenroof			1023 m²
Plaza			570 m²
		TOTAL	1593 m²

Areas Contributing into:

Rain Garden - Unit 5A	
Location	Area
50% Roof	252 m²
TOTAL	252 m²

Rain Garden - Unit 5B	
Location	Area
50% Roof	267 m²
TOTAL	267 m²

Permeable Paving	
Location	Area
Permebale Paving	2355 m²
Hardstanding	645 m²
TOTAL	3000 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.29	1.52	2.58	3.19	3.95

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 5	Minutes: ☐	Other Record: ☐

Project No:		Prepared:	Checked:
23002	**Infiltration Drainage - Perm Paving**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	19.2 mm/hr
FOS	Minor Inconvenience	5.00
q		0.004 m/hr

Assume - uniform gravel (**n**)	0.35

Area to be Drained

A_D	3000 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:
R= A_D/A_b= 1.27

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	2355 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.058
30 min	0.071
60 min	0.086
120 min	0.100
240 min	0.111
360 min	0.113

30 Year Return Period

Duration (D)	h_{max}
15 min	0.083
30 min	0.102
60 min	0.124
120 min	0.148
240 min	0.168
360 min	0.176

50 Year Return Period

Duration (D)	h_{max}
15 min	0.099
30 min	0.121
60 min	0.146
120 min	0.174
240 min	0.200
360 min	0.212

100 Year Return Period

Duration (D)	h_{max}
15 min	0.123
30 min	0.150
60 min	0.182
120 min	0.217
240 min	0.251
360 min	0.268

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	10.284 hrs
1 in 30 years	16.112 hrs
1 in 50 years	19.385 hrs
1 in 100 years	24.493 hrs

Event	Min feasible (q)
1 in 10 years	0.0008 m/hr
1 in 30 years	0.0026 m/hr
1 in 50 years	0.0031 m/hr
1 in 100 years	0.0039 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 5A	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Rain Garden**	**NS**	**CK/SG**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 5A	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Rain Garden**	**NS**	**CK/SG**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	19.2 mm/hr
FOS	Minor Inconvenience	5.00
q		0.004 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	250 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	174 m²
Perimeter (**P**)	117 m²

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.009
Ab/P=	1.491

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15 min	0.076	-35.496
30 min	0.093	-21.827
60 min	0.114	-13.317
120 min	0.134	-7.890
240 min	0.150	-4.456
360 min	0.154	-3.065

30 Year Return Period

Duration (D)	hmax	a
15 min	0.110	-51.309
30 min	0.135	-31.610
60 min	0.164	-19.281
120 min	0.195	-11.508
240 min	0.224	-6.650
360 min	0.235	-4.696

50 Year Return Period

Duration (D)	hmax	a
15 min	0.130	-60.690
30 min	0.159	-37.238
60 min	0.193	-22.631
120 min	0.230	-13.552
240 min	0.265	-7.873
360 min	0.281	-5.612

100 Year Return Period

Duration (D)	hmax	a
15 min	0.162	-75.699
30 min	0.198	-46.351
60 min	0.239	-28.058
120 min	0.285	-16.801
240 min	0.331	-9.816
360 min	0.353	-7.041

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	5.6 hrs
1 in 30 years	8.2 hrs
1 in 50 years	9.6 hrs
1 in 100 years	11.7 hrs

Infiltration System -- Overflow

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360 min	174 m²	0.600 m	0.154 m	0.000 l/sec
30 Years	360 min	174 m²	0.600 m	0.235 m	0.000 l/sec
50 Years	360 min	174 m²	0.600 m	0.281 m	0.000 l/sec
100 Years	360 min	174 m²	0.600 m	0.353 m	0.000 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 5B	Minutes:	☐	Other Record:	☐

Project No:	Element:	Prepared:	Checked:
23002	**Rain Garden**	**NS**	**CK/SG**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 5B	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Rain Garden**	**NS**	**CK/SG**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	19.2 mm/hr
FOS	Minor Inconvenience	5.00
q		0.004 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	267 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	183 m²
Perimeter (**P**)	117 m²

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.008
Ab/P=	1.557

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15 min	0.077	-37.776
30 min	0.095	-23.240
60 min	0.116	-14.190
120 min	0.137	-8.418
240 min	0.154	-4.767
360 min	0.158	-3.288

30 Year Return Period

Duration (D)	hmax	a
15 min	0.112	-54.593
30 min	0.138	-33.643
60 min	0.168	-20.532
120 min	0.199	-12.266
240 min	0.229	-7.100
360 min	0.241	-5.022

50 Year Return Period

Duration (D)	hmax	a
15 min	0.132	-64.569
30 min	0.162	-39.629
60 min	0.197	-24.095
120 min	0.235	-14.440
240 min	0.271	-8.401
360 min	0.288	-5.996

100 Year Return Period

Duration (D)	hmax	a
15 min	0.165	-80.530
30 min	0.202	-49.320
60 min	0.244	-29.867
120 min	0.291	-17.896
240 min	0.338	-10.467
360 min	0.361	-7.516

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	5.7 hrs
1 in 30 years	8.5 hrs
1 in 50 years	9.9 hrs
1 in 100 years	12.0 hrs

Infiltration System -- Overflow

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360 min	183 m²	0.600 m	0.158 m	0.000 l/sec
30 Years	360 min	183 m²	0.600 m	0.241 m	0.000 l/sec
50 Years	360 min	183 m²	0.600 m	0.288 m	0.000 l/sec
100 Years	360 min	183 m²	0.600 m	0.361 m	0.000 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

JOB NAME: Calmount Rd, BallymountUnits - 5A+5B+5C JOB NO: 23002

TITLE: ATTENUATION (30 Yr Return Period)

CALCS BY: NS CHECK'D: SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years		
Total Site Area =	0.7587	Hectares (ha)		
Areas Contributing to Drainage Network:				
Greenroof	0.1023	ha	.....@	80% Impermeable
Hardstanding	0.0570	ha	.....@	80% Impermeable
Permeable area	0.0000	ha	.....@	0% Impermeable
			.....@	0% Impermeable
			.....@	0% Impermeable
Total Impermeable Area =	**0.1274**	**ha**		

Site Location: Ballymount

Allowable Outflow = 3.19 litres/sec

Duration (min)	Rainfall 30 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.4
5	12.0	144.0	50	15	0	18	1	16.9
10	16.8	100.8	35	21	0	25	2	23.2
15	19.7	78.8	27	24	0	29	3	26.5
30	24.7	49.4	17	31	0	37	6	31.1
60	31.0	31.0	11	39	0	46	11	34.8
120	38.8	19.4	7	48	0	58	23	34.9
240	48.6	12.2	4	60	0	73	46	26.6
360	55.4	9.2	3	69	0	83	69	13.8
720	69.5	5.8	2	86	0	104	138	-34.1
1440	87.0	3.6	1	108	0	130	276	-145.8
2880	98.6	2.1	1	123	0	147	551	-404.1
4320	108.2	1.5	1	135	0	161	827	-665.4

** Includes 20% for climate change

Storage required = 34.9 m^3 m^3

JOB NAME: Calmount Rd, BallymountUnits - 5A+5B+5C			**JOB NO: 23002**		
TITLE: ATTENUATION				**CALCS BY:**	**CHECK'D:**
(100 Yr Return Period)				NS	SG/CK
RCD.		**ISSUE.**	**1**	**REV.**	**0**

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	0.7587	Hectares (ha)			
Areas Contributing to Drainage Network:					
Greenroof	0.1023	ha	.....@	80%	Impermeable
Hardstanding	0.0570	ha	.....@	80%	Impermeable
Permeable area	0.0000	ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.1274**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **3.95** **litres/sec**

Duration (min)	Rainfall 100 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.5
5	17.6	211.2	73	22	0	26	1	25.1
10	24.5	147.0	51	30	0	37	2	34.2
15	28.8	115.2	40	36	0	43	4	39.4
30	35.7	71.4	25	44	0	53	7	46.2
60	44.1	44.1	15	55	0	66	14	51.6
120	54.6	27.3	9	68	0	81	28	53.0
240	67.5	16.9	6	84	0	101	57	43.8
360	76.4	12.7	4	95	0	114	85	28.7
720	94.6	7.9	3	118	0	141	171	-29.5
1440	117.0	4.9	2	145	0	175	341	-166.7
2880	129.6	2.7	1	161	0	193	683	-489.2
4320	140.2	1.9	1	174	0	209	1024	-814.7

** Includes 20% for climate change

Storage required = 53.0 **m^3**

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Warehousing
LOCATION:	StormTech Trench (Unit 5)
DATE:	09-Mar-23
CREATED BY:	NS

SYSTEM PARAMETERS

Required Total Storage	**53**	m^3
Stormtech chamber model	**SC310**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.15	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		3	ea
Number of units per Row		20	ea
System Installed Storage Depth (effective storage depth)	0.555	.	m
Tank overall installed Width at base	3.50	3.5	m
Tank overall installed Length at Base	44.1	45	m
Total Effective System Storage	**52.8**	**53.6**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC310	
Unit Width	0.865	m
Unit Length	2.17	m
Unit Height	0.405	m
Min Cover Over System	0.25	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	0.42	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	96	m^3
Width at base	3.50	m
Width at top	4.14	m
Length at base	45.00	m
Length at top	45.64	m
Depth Of System	0.56	m
Area of Dig at Base of System	158	m^2
Area of Dig at Top of System	189	m^2
Void Ratio	56%	
Stone Requirement - m3	71	m^3
Stone Requirement - tonne	116	tonne

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 5	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	7587 m²
Roof Drainage	0 m²
Grenroof	1542 m²
Hardstanding	1882 m²
Porous Surfaces	2355 m²
Landscape	1808 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled onsite

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	6.17 m³	7.53 m³	9.42 m³	**23.12 m³**

Interception Volume Provided	Permeable Paving	Rain Gardens	StormTech	Total
	96.78 m³	64.26 m³	9.45 m³	**170.49 m³**

OK

NOTES:

- Porous Surfaces: (790.0m2 x 0.35m dp) x 0.35 = 96.78m^3
- Rain Garden - Unit 5A: (174.0m^2 x 0.6m dp) x 0.3) = 31.32m^3
- Rain Garden - Unit 5B: (183.0m^2 x 0.6m dp) x 0.3) = 32.94m^3
- Stone Below IL StormTech Chambers: (3.5 x 45.0 x 0.15m dp) x 0.4 = 9.45m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	7587 m²
Roof Drainage	0 m²
Grenroof	1542 m²
Hardstanding	1882 m²
Porous Surfaces	2355 m²
Landscape	1808 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	18.50 m³	22.58 m³	28.26 m³	**69.35 m³**

Treatment Volume Provided	As Outlined above	Greenroof		Total
	170.49 m³	23.13 m³		**193.62 m³**

OK

NOTES:

As outlined above plus:

Greenroof (Assumed to treat first 15mm rainfall minimum): 1542.0m^2 x 0.015m = 23.13m^3

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:		Telephone Log:	
Calmount Rd, Ballymount - Unit 5	Minutes:		Other Record:	

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

100 year Attenuation Volume Requ	**53.00 m³**

Attenuation Volume Provided	StormTech			Total
	53.60 m³			53.60

OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour even	RD	92 mm
Percentage of Impermeable area	PIMP	0.451
Site Area	A	7587 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.47
Percentage of pervious area drainaing to the network or directly	β	0.30
Long Term Storage Required	Volxs	**-56.29 m³**
Long Term Storage Provided		**170.49 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8)+\left(1-\frac{PIMP}{100}\right)(\beta SOIL)-SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4

OK

NOTES:
Volxs is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

	Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**				
	Project:		Design:	☑	Telephone Log:	☐
	Calmount Rd, Ballymount - Warehousing		Minutes:	☐	Other Record:	☐
Project No:	Element:		Prepared:		Checked:	
23014	**Site Catchment Characteristics - Unit 6**		**NS**		**SG/CK**	

Reference | Output:

Site Catchment Characteristics

Total Site Area	9435 m²
Roof	3278 m²
Greenroof	500 m²
Hardstanding	3546 m²
Permeable areas	935 m²
Landscape	1176 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Hardstanding			3186 m²
		TOTAL	3186 m²

Areas Contributing into:

Permeable paving	
Location	Area
Perm area	935 m²
Hardstanding	226 m²
TOTAL	1161 m²

Planted Swale	
Location	Area
Roof	3278 m²
Greenroof	500 m²
TOTAL	3778 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	1.60	1.89	3.21	3.96	4.91

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:		Design:	☑	Telephone Log:	☐
Calmount Rd, Ballymount - Unit 6		Minutes:	☐	Other Record:	☐
Project No:		Prepared:		Checked:	
23002	Infiltration Drainage - Perm Paving	NS		SG/CK	

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	56.9 mm/hr
FOS	Minor Inconvenience	5.00
q		0.011 m/hr

Assume - uniform gravel (**n**)	0.40

Area to be Drained

A_D	1161 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:

R= A_D/A_b= 1.24

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	935 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.044
30 min	0.051
60 min	0.054
120 min	0.047
240 min	0.018
360 min	0.000

30 Year Return Period

Duration (D)	h_{max}
15 min	0.066
30 min	0.078
60 min	0.087
120 min	0.088
240 min	0.067
360 min	0.036

50 Year Return Period

Duration (D)	h_{max}
15 min	0.079
30 min	0.093
60 min	0.106
120 min	0.110
240 min	0.094
360 min	0.066

100 Year Return Period

Duration (D)	h_{max}
15 min	0.100
30 min	0.119
60 min	0.136
120 min	0.146
240 min	0.138
360 min	0.114

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	1.894 hrs
1 in 30 years	3.080 hrs
1 in 50 years	3.879 hrs
1 in 100 years	5.149 hrs

Event	Min feasible (q)
1 in 10 years	0.0004 m/hr
1 in 30 years	0.0015 m/hr
1 in 50 years	0.0018 m/hr
1 in 100 years	0.0024 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 6	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Planted Swale**	**NS**	**CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 6	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Planted Swale**	**NS**	**CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	6.7 mm/hr
FOS	Minor Inconvenience	5.00
q		0.001 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	3778 m²

Infriltration Trench dimensions

Length	75.00 m
Width	1.00 m

Base Area (A_b)	75.000 m²
Perimeter (**P**)	152.000 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.009
Ab/P=	0.493

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	2.776	-1228.173
30.000 min	3.496	-774.100
60.000 min	4.428	-491.418
120.000 min	5.582	-311.125
240.000 min	7.008	-197.050
360.000 min	7.976	-150.864

30 Year Return Period

Duration (D)	hmax	a
15.000 min	3.964	-1753.472
30.000 min	4.963	-1099.074
60.000 min	6.214	-689.518
120.000 min	7.739	-431.320
240.000 min	9.600	-269.947
360.000 min	10.839	-205.026

50 Year Return Period

Duration (D)	hmax	a
15.000 min	4.668	-2065.090
30.000 min	5.808	-1286.045
60.000 min	7.217	-800.811
120.000 min	8.957	-499.209
240.000 min	11.044	-310.568
360.000 min	12.447	-235.446

100 Year Return Period

Duration (D)	hmax	a
15.000 min	5.795	-2563.679
30.000 min	7.175	-1588.760
60.000 min	8.841	-981.104
120.000 min	10.894	-607.162
240.000 min	13.340	-375.118
360.000 min	14.957	-282.931

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	70.315 hrs
1 in 30 years	71.862 hrs
1 in 50 years	72.436 hrs
1 in 100 years	73.098 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	360.000 min	75.000 m²	1.000 m	7.976 m	0.642 l/sec
30 Years	360.000 min	75.000 m²	1.000 m	10.839 m	1.271 l/sec
50 Years	360.000 min	75.000 m²	1.000 m	12.447 m	1.717 l/sec
100 Years	360.000 min	75.000 m²	1.000 m	14.957 m	2.565 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

JOB NAME: Calmount Rd, Ballymount - Unit 6	**JOB NO:** 23002		
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(30 Yr Return Period)		NS	SG/CK

RCD.		ISSUE.	1	REV.	0

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	30	Years			
Total Site Area =	0.9435	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof area	0.0000	ha	.....@	0%	Impermeable
Greenroof area	0.0000	ha	.....@	0%	Impermeable
Hardstanding	0.3186	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.2549**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **1.40** **litres/sec**

Duration (min)	Rainfall 30 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.2
5	12.0	144.0	99	30	0	36	0	35.4
10	16.8	100.8	70	42	0	50	1	49.3
15	19.7	78.8	54	49	0	59	1	57.5
30	24.7	49.4	34	61	0	74	3	71.2
60	31.0	31.0	21	77	0	93	5	87.5
120	38.8	19.4	13	96	0	116	10	105.7
240	48.6	12.2	8	121	0	145	20	124.9
360	55.4	9.2	6	138	0	165	30	135.1
720	69.5	5.8	4	173	0	207	60	146.9
1440	87.0	3.6	3	216	0	260	121	138.6
2880	98.6	2.1	1	245	0	294	242	52.3
4320	108.2	1.5	1	269	0	323	363	-40.0

** Includes 20% for climate change

Storage required =	146.9	m^3		m^3

JOB NAME: Calmount Rd, Ballymount - Unit 6	**JOB NO: 23002**		
TITLE: ATTENUATION		**CALCS BY:**	**CHECK'D:**
(100 Yr Return Period)		NS	SG/CK

RCD.		**ISSUE.**	**1**	**REV.**	**0**

Doherty Finegan Kelly
30-32 Botanic Road, Glasnevin, Dublin 9
Tel: 830 1852, Fax: 860 2265,
E-mail: mailroom@dfk.ie

SURFACE WATER STORAGE

Storm Return Period =	100	Years			
Total Site Area =	0.9435	Hectares (ha)			
Areas Contributing to Drainage Network:					
Roof area	0.0000	ha	.....@	0%	Impermeable
Greenroof area	0.0000	ha	.....@	0%	Impermeable
Hardstanding	0.3186	ha	.....@	80%	Impermeable
		ha	.....@	0%	Impermeable
			.....@	0%	Impermeable
Total Impermeable Area =	**0.2549**	**ha**			

Site Location: **Ballymount**

Allowable Outflow = **2.35** **litres/sec**

Duration (min)	Rainfall 100 Year (mm)	Intensity (mm/hr)	Discharge Q (= 2.71Ai) (l/s)	Proposed Runoff (m^3)	Contiguous Land Runoff (m^3)	Total ** Runoff (m^3)	Allowable Outflow (m^3)	Storage Req'd (m^3)
2	0.0	0.0	0	0	0	0	0	-0.3
5	17.6	211.2	146	44	0	53	1	51.8
10	24.5	147.0	102	61	0	73	1	71.7
15	28.8	115.2	80	72	0	86	2	83.8
30	35.7	71.4	49	89	0	107	4	102.3
60	44.1	44.1	30	110	0	132	8	123.1
120	54.6	27.3	19	136	0	163	17	146.0
240	67.5	16.9	12	168	0	201	34	167.6
360	76.4	12.7	9	190	0	228	51	177.2
720	94.6	7.9	5	235	0	282	102	180.8
1440	117.0	4.9	3	291	0	349	203	146.1
2880	129.6	2.7	2	322	0	387	406	-19.4
4320	140.2	1.9	1	349	0	418	609	-190.8

** Includes 20% for climate change

Storage required =	180.8	m^3		m^3

STORMTECH Stormwater Management System Design Tool

ver: Aug15

PROJECT REF:	23002 - Calmount Rd, Ballymount - Unit 6
LOCATION:	StormTech Trench
DATE:	09-Mar-23
CREATED BY:	NS

SYSTEM PARAMETERS

Required Total Storage	**180.8**	m^3
Stormtech chamber model	**SC740**	
Filtration Permeable Geo or Impermeable Geo	Filter geo	
Number of Isolator Rows (IR)	1	

SITE PARAMETERS

Stone Porosity		40%		
Excavation Batter Angle (degrees)		60	°	*Minimum Requirement*
Stone Above Chambers		0.2	m	*0.15*
Stone Below Chambers	(Long-Term Storage)	0	m	*0.15* *Adjust to minimum*
In-between Row Spacing		0.15	m	*0.15*
Additional Storage outside Excavation. E.g manholes, Header Pipe		0	m^3	

HEADER PIPE

Is Header pipe required within excavation	No	
Orientation of Header Pipe	Perp to IR	
Diameter of Header Pipe	0	m
Length of Header Pipe	0	m

CHAMBER SYSTEM DIMENSIONS

	Calculated	Adopted	
Number of Rows		5	ea
Number of units per Row		16	ea
System Installed Storage Depth (effective storage depth)	0.960	0.96	m
Tank overall installed Width at base	7.68	8	m
Tank overall installed Length at Base	35.42	36	
Total Effective System Storage	**176.8**	**183.2**	m^3

STORMTECH SYSTEM DETAIL

StormTech Chamber Model	SC740	
Unit Width	1.295	m
Unit Length	2.17	m
Unit Height	0.76	m
Min Cover Over System	0.3	m
Max Cover Over Chamber	2.4	m
Chamber Internal Storage Vol.	1.3	m^3
Header Pipe Internal Storage Vol in Excavation	0.0	m^3

STONE AND EXCAVATION DETAIL

Volume of Dig for System	300	m^3
Width at base	8.00	m
Width at top	9.11	m
Length at base	36.00	m
Length at top	37.11	m
Depth Of System	0.96	m
Area of Dig at Base of System	288	m^2
Area of Dig at Top of System	338	m^2
Void Ratio	61%	
Stone Requirement - m3	195	m^3
Stone Requirement - tonne	321	tonne

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 6	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	9435 m²
Roof Drainage	3278 m²
Grenroof	500 m²
Hardstanding	3546 m²
Porous Surfaces	935 m²
Landscape	1176 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled onsite

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	15.11 m³	14.18 m³	3.74 m³	**33.04 m³**

Interception Volume Provided	Permeable Paving	Bioretention Area	StormTech	Total
	114.54 m³	22.50 m³	17.28 m³	**154.32 m³**

OK

NOTES:

- Porous Surfaces: (935.0m^2 x 0.35m dp) x 0.35 =114.54m^3
- Planted Swale: (75.0m x 1.0m x 1.0m dp) x 0.3) = 22.5m^3
- Stone Below IL StormTech Chambers: (8.0 x 36.0 x 0.15m dp) x 0.4 = 17.28m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	9435 m²
Roof Drainage	3278 m²
Grenroof	500 m²
Hardstanding	3546 m²
Porous Surfaces	935 m²
Landscape	1176 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	45.34 m³	42.55 m³	11.22 m³	**99.11 m³**

Treatment Volume Provided	As Outlined above	Greenroof		Total
	154.32 m³	7.50 m³		**161.82 m³**

OK

NOTES:

As outlined above plus:

Greenroof (Assumed to treat first 15mm rainfall minimum): 500.0m^2 x 0.015m = 7.5m^3

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:		Telephone Log:	
Calmount Rd, Ballymount - Unit 6	Minutes:		Other Record:	

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

100 year Attenuation Volume Requ	**180.80 m³**

Attenuation Volume Provided	StormTech			Total
	183.20 m³			183.20

OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour even	RD	92 mm
Percentage of Impermeable area	PIMP	0.429
Site Area	A	9435 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.44
Percentage of pervious area drainaing to the network or directly	β	0.30
Long Term Storage Required	Volxs	**-84.46 m³**
Long Term Storage Provided		**154.32 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta SOIL) - SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4

OK

NOTES:
Volxs is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

Doherty Finegan Kelly ***Consulting Structural & Civil Engineers,***	**Botanic Court, 30 Botanic Road, Glasnevin,** **Dublin 9** **Tel: 8301852 / Fax: 8602265**	
Project: **Calmount Rd, Ballymount - Unit 7 (Cafe)**	Design: ☑ Minutes: ☐	Telephone Log: ☐ Other Record: ☐
Project No: **23002**	Element: **Site Catchment Characteristics**	Prepared: **NS** Checked: **SG/CK**

Reference | Output:

Site Catchment Characteristics

Total Site Area	2188 m²
Greenroof	230 m²
Hardstanding	368 m²
Permeable area	537 m²
Landscape	1053 m²

QBAR	0.092 m³/sec
SAAR	707.0 mm
SOIL	0.3
AREA **	0.50 km²
QBAR/ha (l/s/ha)	2.000

** The area taken in calculating QBAR/ha is 50 ha in accordance with paragraph 6.6.1 of Vol 2 of the GDSDS.

Areas Contributing into Drainage Network:

Location	Length	Width	Area
Greenroof			230 m²
		TOTAL	230 m²

Areas Contributing into:

Perm paving	
Location	Area
Perm paving	442 m²
Hardstanding - FP	25 m²
Bike Stand	69 m²
TOTAL	536 m²

Bio-retenntion Area #1	
Location	Area
Roof	115 m²
Patio	50 m²
TOTAL	165 m²

Bio-retenntion Area #2	
Location	Area
Roof	115 m²
Patio	170 m²
TOTAL	285 m²

Grasscrete	
Location	Area
Grasscrete	95 m²
TOTAL	95 m²

Location	Area
TOTAL	0 m²

Location	Area
TOTAL	0 m²

Allowable Outflow

Growth Curve	1 years	QBAR	10 years	30 years	100 years
Multiplier	0.85	1	1.7	2.1	2.6
Allowable Outflow (l/s)	0.37	0.44	0.74	0.92	1.14

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	####	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

Doherty Finegan Kelly
Consulting Structural & Civil Engineers
Botanic Court, 30-32 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 7 (Café)	Minutes: ☐	Other Record: ☐

Project No:		Prepared:	Checked:
23002	**Infiltration Drainage - Perm Paving**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

	RETURN PERIOD (YEARS)								
DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Plane Infiltration - Permeable Paving

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	clay	90.4 mm/hr
FOS	Minor Inconvenience	3.00
q		0.030 m/hr

Assume - uniform gravel (**n**)	0.30

Area to be Drained

A_D	536 m²

Area to be drained --

Equations Applied to Determine h_{max}

$$h_{max} = \frac{D}{n}(Ri - q) \quad (1)$$

Where:

R= A_D/A_b= 1.21

Infiltration system dimensions

Width	-
Length	-
Base Area (**A_b**)	442 m²

H_{max} Calculation

10 Year Return Period

Duration (D)	h_{max}
15 min	0.042
30 min	0.034
60 min	0.007
120 min	0.000
240 min	0.000
360 min	0.000

30 Year Return Period

Duration (D)	h_{max}
15 min	0.070
30 min	0.070
60 min	0.050
120 min	0.000
240 min	0.000
360 min	0.000

50 Year Return Period

Duration (D)	h_{max}
15 min	0.087
30 min	0.090
60 min	0.074
120 min	0.017
240 min	0.000
360 min	0.000

100 Year Return Period

Duration (D)	h_{max}
15 min	0.115
30 min	0.123
60 min	0.113
120 min	0.064
240 min	0.000
360 min	0.000

Plane Infiltration - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{nh_{max}}{q} \quad (2)$$

$$q = \frac{nh_{max}}{T_{empty}} \quad (3)$$

Event	Time to Empty
1 in 10 years	0.416 hrs
1 in 30 years	0.701 hrs
1 in 50 years	0.896 hrs
1 in 100 years	1.224 hrs

Event	Min feasible (q)
1 in 10 years	0.0003 m/hr
1 in 30 years	0.0009 m/hr
1 in 50 years	0.0011 m/hr
1 in 100 years	0.0015 m/hr

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 7 (Cafe)	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area #1**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 7 (Cafe)	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area #1**	**NS**	**SG/CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	90.4 mm/hr
FOS	Minor Inconvenience	3.00
q		0.030 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	165 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	50.000 m²
Perimeter (**P**)	33.900 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.068
Ab/P=	1.475

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.156	-9.224
30.000 min	0.176	-5.270
60.000 min	0.185	-2.809
120.000 min	0.158	-1.239
240.000 min	0.058	-0.245
360.000 min	0.000	0.157

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.233	-13.799
30.000 min	0.271	-8.100
60.000 min	0.298	-4.534
120.000 min	0.291	-2.285
240.000 min	0.210	-0.880
360.000 min	0.106	-0.315

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.279	-16.512
30.000 min	0.326	-9.728
60.000 min	0.362	-5.503
120.000 min	0.366	-2.877
240.000 min	0.294	-1.234
360.000 min	0.194	-0.580

100 Year Return Period

Duration (D)	hmax	a
15.000 min	0.352	-20.854
30.000 min	0.414	-12.364
60.000 min	0.466	-7.073
120.000 min	0.486	-3.817
240.000 min	0.428	-1.796
360.000 min	0.333	-0.993

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.842 hrs
1 in 30 years	1.291 hrs
1 in 50 years	1.538 hrs
1 in 100 years	1.943 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	50.000 m²	0.600 m	0.185 m	0.000 l/sec
30 Years	60.000 min	50.000 m²	0.600 m	0.298 m	0.000 l/sec
50 Years	60.000 min	50.000 m²	0.600 m	0.366 m	0.000 l/sec
100 Years	60.000 min	50.000 m²	0.600 m	0.486 m	0.000 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 7 (Cafe)	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area #2**	**NS**	**SG/CK**

Reference: Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 16.2 mm RP5 2d= 59.4 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	34.6	51.8	61.9	93.6	121.0	152.6	172.8	204.5	253.4
10 min	24.5	36.0	42.5	65.5	84.2	105.8	121.0	141.8	176.4
15 min	19.2	28.3	33.6	51.4	66.2	83.0	94.6	111.4	138.2
30 min	12.5	18.5	21.8	32.9	41.8	52.3	59.3	69.4	85.7
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	5.5	7.9	9.1	13.4	16.8	20.7	23.3	26.9	32.8
4 hr	3.6	5.1	5.9	8.6	10.7	13.0	14.6	16.8	20.3
6 hr	2.8	4.0	4.6	6.6	8.2	9.9	11.1	12.7	15.3
12 hr	1.9	2.6	3.0	4.2	5.2	6.3	7.0	7.9	9.5
24 hr	1.2	1.7	1.9	2.7	3.3	3.9	4.4	4.9	5.9
48 hr	0.8	1.0	1.2	1.6	1.9	2.2	2.5	2.8	3.2
72 hr	0.6	0.8	0.9	1.2	1.4	1.6	1.8	2.0	2.3

Rainfall intensity shown as mm/hr. (includes 20% allowance for climate change)

Contributing Area Plan

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Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log:
Calmount Rd, Ballymount - Unit 7 (Cafe)	Minutes: ☐	Other Record:

Project No:	Element:	Prepared:	Checked:
23002	**Bio-retention Area #2**	**NS**	**SG/CK**

Reference: Output:

Vertical Sided System

From CIRIA Report No. 156(1996) - Infiltration Drainage Manual of Good Practice

Description	Type	Result
Infiltration Rate	Soil	90.4 mm/hr
FOS	Minor Inconvenience	3.00
q		0.030 m/hr

Assume - uniform gravel (n)	0.30

Area to be Drained

A_D	285 m²

Infriltration Trench dimensions

Length	
Width	

Base Area (A_b)	157.000 m²
Perimeter (**P**)	54.670 m

Equations Applied to Determine hmax

$$h_{max} = a(e^{(-bD)} - 1) \quad (1)$$

where:

$$b = \frac{Pq}{A_b n} \quad (2)$$

and a is given by:

$$a = \frac{A_b}{P} - \frac{A_D i}{Pq} \quad (3)$$

b=	0.035
Ab/P=	2.872

H_{max} Calculation

10 Year Return Period

Duration (D)	hmax	a
15.000 min	0.075	-8.588
30.000 min	0.075	-4.353
60.000 min	0.059	-1.716
120.000 min	0.002	-0.035
240.000 min	0.000	1.029
360.000 min	0.000	1.460

30 Year Return Period

Duration (D)	hmax	a
15.000 min	0.117	-13.487
30.000 min	0.128	-7.384
60.000 min	0.122	-3.564
120.000 min	0.078	-1.156
240.000 min	0.000	0.349
360.000 min	0.000	0.955

50 Year Return Period

Duration (D)	hmax	a
15.000 min	0.143	-16.394
30.000 min	0.158	-9.128
60.000 min	0.158	-4.602
120.000 min	0.121	-1.789
240.000 min	0.004	-0.029
360.000 min	0.000	0.671

100 Year Return Period

Duration (D)	hmax	a
15.000 min	0.183	-21.044
30.000 min	0.207	-11.951
60.000 min	0.216	-6.283
120.000 min	0.189	-2.796
240.000 min	0.082	-0.631
360.000 min	0.000	0.228

Vertical Sided System - Time to Empty

The time taken to half-empty the system is given by:

$$\frac{1}{b}\log_e\left[\frac{h_{max} + \frac{A_b}{P}}{\frac{h_{max}}{2} + \frac{A_b}{P}}\right]$$

Event	Time to Empty
1 in 10 years	0.368 hrs
1 in 30 years	0.617 hrs
1 in 50 years	0.756 hrs
1 in 100 years	1.018 hrs

Infiltration System -- Overflow from French Drain

Return Period	Duration	Base Area (A_b)	$h_{PROVIDED}$	h_{max}	$Q_{OVERFLOW}$*
10 Years	60.000 min	157.000 m²	0.600 m	0.075 m	0.000 l/sec
30 Years	60.000 min	157.000 m²	0.600 m	0.128 m	0.000 l/sec
50 Years	60.000 min	157.000 m²	0.600 m	0.158 m	0.000 l/sec
100 Years	60.000 min	157.000 m²	0.600 m	0.216 m	0.000 l/sec

* $Q_{OVERFLOW}$ is the averaged flow for the duration given.

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin,
Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design: ☑	Telephone Log: ☐
Calmount Rd, Ballymount - Unit 7 (Café)	Minutes: ☐	Other Record: ☐

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

Calmount Rd, Ballymount - Extreme Rainfall Matrix

RP5 60min= 17.5 mm RP5 2d= 63.5 mm ANNUAL RAINFALL= 707.0 mm

RETURN PERIOD (YEARS)

DURATION	0.5	1	2	5	10	20	30	50	100
2 min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 min	2.9	4.3	5.2	7.8	10.1	12.7	14.4	17.0	21.1
10 min	4.1	6.0	7.1	10.9	14.0	17.6	20.2	23.6	29.4
15 min	4.8	7.1	8.4	12.8	16.6	20.8	23.6	27.8	34.6
30 min	6.2	9.2	10.9	16.4	20.9	26.2	29.6	34.7	42.8
60 min	8.3	12.0	14.0	21.0	26.5	32.9	37.2	43.2	52.9
2 hr	10.9	15.7	18.2	26.9	33.6	41.4	46.6	53.9	65.5
4 hr	14.5	20.5	23.6	34.3	42.6	52.1	58.3	67.1	81.0
6 hr	17.0	23.9	27.6	39.6	49.0	59.5	66.5	76.3	91.7
12 hr	22.6	31.2	35.8	50.6	62.2	75.0	83.4	95.0	113.5
24 hr	29.8	40.7	46.3	64.8	78.7	94.3	104.4	118.4	140.4
48 hr	37.2	49.6	55.9	76.2	91.2	107.8	118.3	133.0	155.5
72 hr	43.2	56.8	63.7	85.4	101.4	118.7	129.8	145.0	168.2

Allowance of 20% for Climate Change in accordance with GDSDS

INTERCEPTION STORAGE (First 5mm of rainfall over 80% of the impervious area, see GDSDS Vol2 Cl6.7.1 & Cl6.3.4)

Total Site Area	2188 m²
Roof Drainage	0 m²
Grenroof	230 m²
Hardstanding	368 m²
Porous Surfaces	537 m²
Landscape	1053 m²

N.B. Interception Storage is where all runoff from at least the first 5mm of rainfall can be prevented from entering the receiving water. i.e. The first 5mm of rainfall is infiltrated/recycled onsite

Criterion 1

Interception Volume Required (0.005 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	0.92 m³	1.47 m³	2.15 m³	**4.54 m³**

Interception Volume Provided	Permeable Paving	Grasscrete	Bio-retention Area	Total
	54.15 m³	6.56 m³	37.26 m³	**97.97 m³**

OK

NOTES:

- Perm Paving: (442.0m^2 x 0.35m dp) x 0.35 = 54.15m^3
- Grasscrete: (75.0m^2 x 0.2 5m dp) x 0.35 = 6.56m^3
- Bio-retention Area #1: (50.0m^2 x 0.6m dp) x 0.3) = 9.0m^3
- Bio-retention Area #2: (157.0m^2 x 0.6m dp) x 0.3) = 28.26m^3

TREATMENT STORAGE (First 15mm of rainfall over 80% of the impervious area, see GDSDS Cl6.7.1 & Cl6.3.4)

Total Site Area	2188 m²
Roof Drainage	0 m²
Grenroof	230 m²
Hardstanding	368 m²
Porous Surfaces	537 m²
Landscape	1053 m²

N.B. Interception and Treatment Storage are both part of Criterion 1. Therefore if interception storage is provided, then treatment storage is only required to provide for the remainder of the

Criterion 1

Treatment Volume Required (0.015 * 0.8 *	Roof	Hardstanding	Perm Area	Total
	2.76 m³	4.42 m³	6.44 m³	**13.62 m³**

Treatment Volume Provided	As Outlined above	Greenroof		Total
	97.97 m³	3.45 m³		**101.42 m³**

OK

NOTES:

As outlined above plus:

Greenroof (Assumed to treat first 15mm rainfall minimum): 230.0m^2 x 0.015m = 3.45m^3

Doherty Finegan Kelly
Consulting Structural & Civil Engineers,
Botanic Court, 30 Botanic Road, Glasnevin, Dublin 9
Tel: 8301852 / Fax: 8602265

Project:	Design:		Telephone Log:	
Calmount Rd, Ballymount - Unit 7 (Café)	Minutes:		Other Record:	

Project No:	Element:	Prepared:	Checked:
23002	**Attenuation Design Criteria**	**SG**	**CK**

Reference | Output:

ATTENUATION STORAGE (see GDSDS Cl6.3.4)

100 year Attenuation Volume Requ	**0.00 m³**

Attenuation Volume Provided				Total
				0.00

NOT OK

NOTES:
100 Year Attenuation Volume based on Extreme rainfall matrix with 20% allowance for climate change added

LONG TERM STORAGE (See GDSDS Cl6.3.4)

ainfall depth for 100 year, 6 hour even	RD	92 mm
Percentage of Impermeable area	PIMP	0.273
Site Area	A	2188 m²
Soil Index (Soil Type 3)	SOIL	0.3
Percentage of impervious area draining to the network or directly to	α	0.00
Percentage of pervious area drainaing to the network or directly	β	0.00
Long Term Storage Required	Volxs	**-60.18 m³**
Long Term Storage Provided		**97.97 m³**

$$Vol_{xs} = RD.A.10\left[\frac{PIMP}{100}(\alpha 0.8) + \left(1 - \frac{PIMP}{100}\right)(\beta SOIL) - SOIL\right]$$

N.B. Long term storage only represents runoff that will be infiltrated or recycled. i.e. soakaway, infiltration trench, water butt/harvesting etc. Attenuation that does not have the option to be infiltrated is not considered as long term storage.

Criterion 4 — OK

NOTES:
Volxs is the extra runoff volume for the 100 year 6 hour storm over that of the original greenfield runoff volume for the same storm. Should sufficient long term storage not be provided that can prevent all or some of this volume (Volxs) from entering the receiving waters, then the throttle should be reduced to Q_{bar} or 2l/s for all events and the runoff should be attenuated accordingly. (see GDSDS Cl6.3.4 Sub-

COMMENTS

APPENDIX II

RELEVANT EXTRACT FROM SITE INVESTIGATION

GroundCheck

WAREHOUSING / LOGISTICS & OFFICES,
CALMOUNT ROAD,
BALLYMOUNT,
DUBLIN

GROUND INVESTIGATION REPORT

CLIENT: Park Developments
JOB REF: 23-3170
ISSUED: February 2023

4.3 Soakaway Test Results

The trial pits observed that the site is mantled by a superficial layer of made ground and glacial deposits composed of a stoney silt, overlying fractured limestone bedrock that was encountered at depths ranging between 0.3 and 1.2m. The variation in the soil properties, rockhead levels and the fractured state of the upper horizons of the bedrock is reflected by the results of the soakaway tests that are presented in Table 4. The percolation values ranged between 1.4 and 212sec/mm (infiltration rate 2.6E-4 to 1.8E-6), with the highest infiltration rates being recorded where fractured rock was encountered in the base of the trial pit.

Table 4: Summary of Percolation Test Results

Test No.	Location	Sump Depth (m)	Elapsed Time (mins)		Time Difference between 75 and 25% infiltration (Seconds)	Average Percolation Value* Vp (sec/mm)
			For 75% Infiltration	For 25% infiltration		
PT01	TP01	1.0	22 36	155 136	133 100	47
PT02	TP02	0.8	5 14	19 47	14 33	9
PT03	TP03	0.9	8 12	31 45	23 33	11
PT04	TP04	0.7	11 19 23	40 61 78	29 42 55	16
PT05	TP05	0.8	21 33 35	68 102 109	47 69 74	25
PT06	TP06	0.8	42 97 101	305 201 174	263 104 73	59
PT07	TP07	0.95	6 8 9	19 23 26	13 16 17	6
PT08	TP08	0.8	27 46 75	96 229 865	69 183 790	138
PT09	TP09	0.7	13 27 30	47 98 133	35 71 103	28
PT10	TP10	0.7	10 24 28	37 98 101	27 74 74	23
PT11	TP11	0.8	2 2 2	7 8 8	5 7 7	2.5
PT12	TP12	0.9	6 7 7	18 30 42	12 22 35	9
PT13	TP13	0.8	140	670	530	212
PT14	TP14	1.2	10 19	31 34	21 15	7
PT15	TP15	0.8	2 3	6 5	4 3	1.4
PT16	TP16	1.05	200	1060	860	344
PT17	TP17	0.9	2 7	9 19	6 12	3.6
PT18	TP18	0.9	230	660	430	172
PT19	TP19	0.6	42	260	218	87
PT20	TP20	1.0	145	580	435	174

Note * Percolation test value calculated by dividing seconds time difference between 75 and 25% infiltration by 150mm

Legend Key

- Locations By Type - TP
- Project Bounds - Project Bounds
- 23-3170 Proposed1 - 1

Drawing Title

Figure 2A - Site Plan - Trial Pits

Project ID

23-3170

Project Title

Warehousing / Logistics & Offices

Project Location

Calmount Road, Ballymount, Dublin

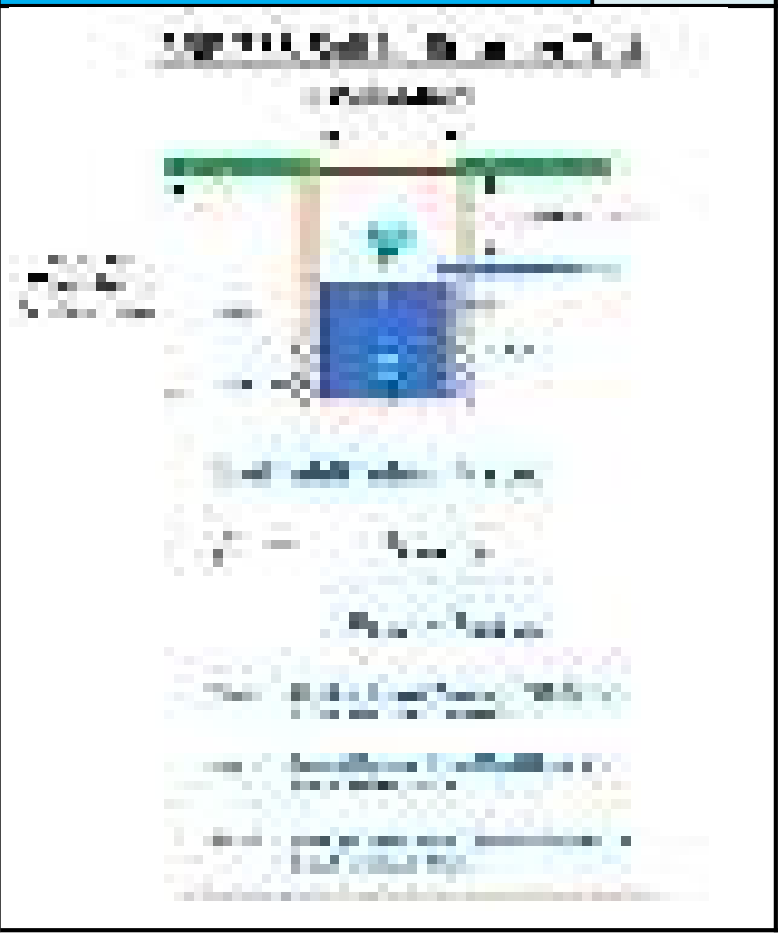
Scale: 1:2000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP01
INFILTRATION TEST No.	1	SOIL TYPE	Light brown, silty sandy CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	1.00
WATER SURFACE LEVEL (m)	0.35	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.65
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	4.00	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.75
75% Effective Water Depth (m)	0.4875	25% Effective Water Depth (m)	0.1625	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.24375
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	22	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	155	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	133

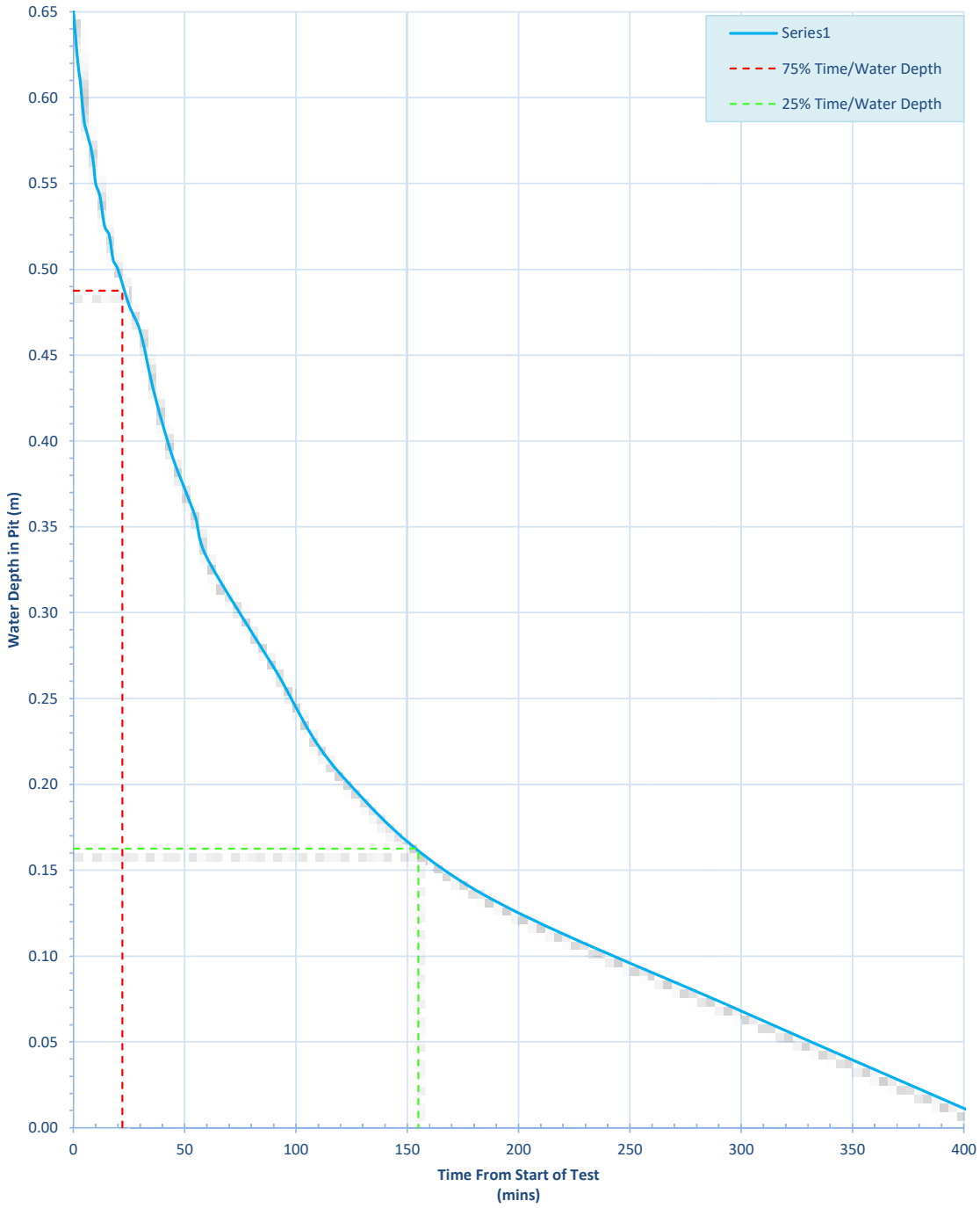
SOIL INFILTRATION RATE	1.11E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.650
09:01	1	0.635
09:02	2	0.620
09:03	3	0.610
09:04	4	0.597
09:05	5	0.585
09:06	6	0.580
09:07	7	0.575
09:08	8	0.570
09:09	9	0.562
09:10	10	0.550
09:15	12	0.542
09:30	14	0.525
09:45	16	0.520
10:00	18	0.505
10:15	20	0.500
10:30	25	0.479
10:45	30	0.464
	35	0.435
	40	0.410
	45	0.389
	50	0.372
	55	0.355
	60	0.332
	90	0.268
	120	0.206
	180	0.139
	300	0.068
	420	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1	SOIL TYPE	Light brown, silty sandy CLAY	TP01

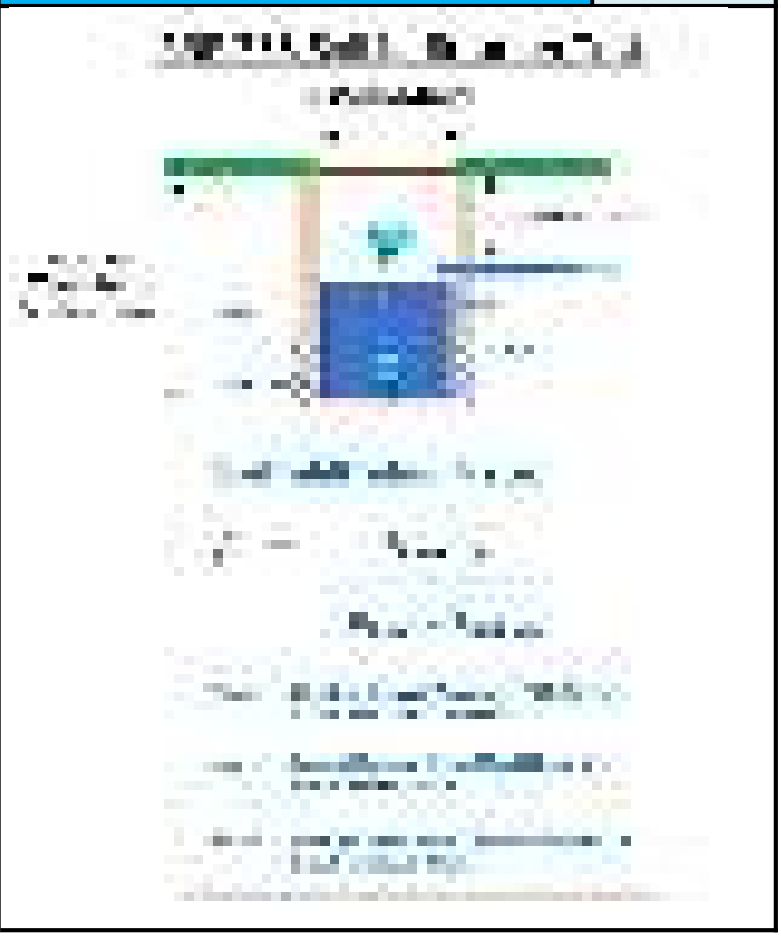


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP01
INFILTRATION TEST No.	2	SOIL TYPE	Light brown, silty sandy CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	1.00
WATER SURFACE LEVEL (m)	0.37	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.64
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	4.00	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.75
75% Effective Water Depth (m)	0.47625	25% Effective Water Depth (m)	0.15875	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.238125
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	35.5	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	136	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	100.5

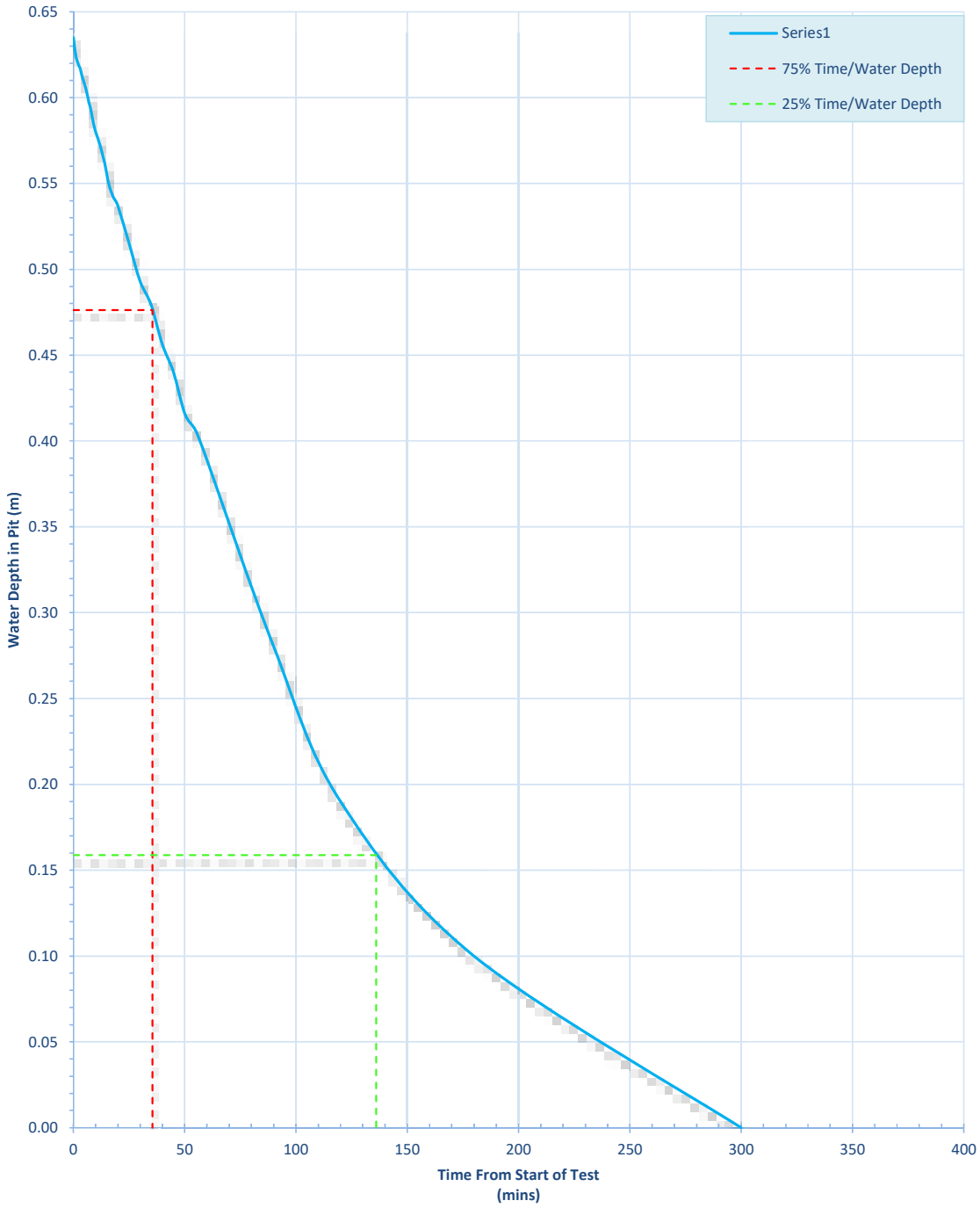
SOIL INFILTRATION RATE	1.44E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.635
09:01	1	0.625
09:02	2	0.620
09:03	3	0.617
09:04	4	0.612
09:05	5	0.608
09:06	6	0.603
09:07	7	0.597
09:08	8	0.592
09:09	9	0.585
09:10	10	0.580
09:15	12	0.572
09:30	14	0.562
09:45	16	0.549
10:00	18	0.542
10:15	20	0.537
10:30	25	0.515
10:45	30	0.493
	35	0.479
	40	0.456
	45	0.440
	50	0.416
	55	0.406
	60	0.389
	90	0.280
	120	0.190
	180	0.100
	300	0.000
	420	



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	1.00	**SOIL TYPE**	Light brown, silty sandy CLAY	**TP01**

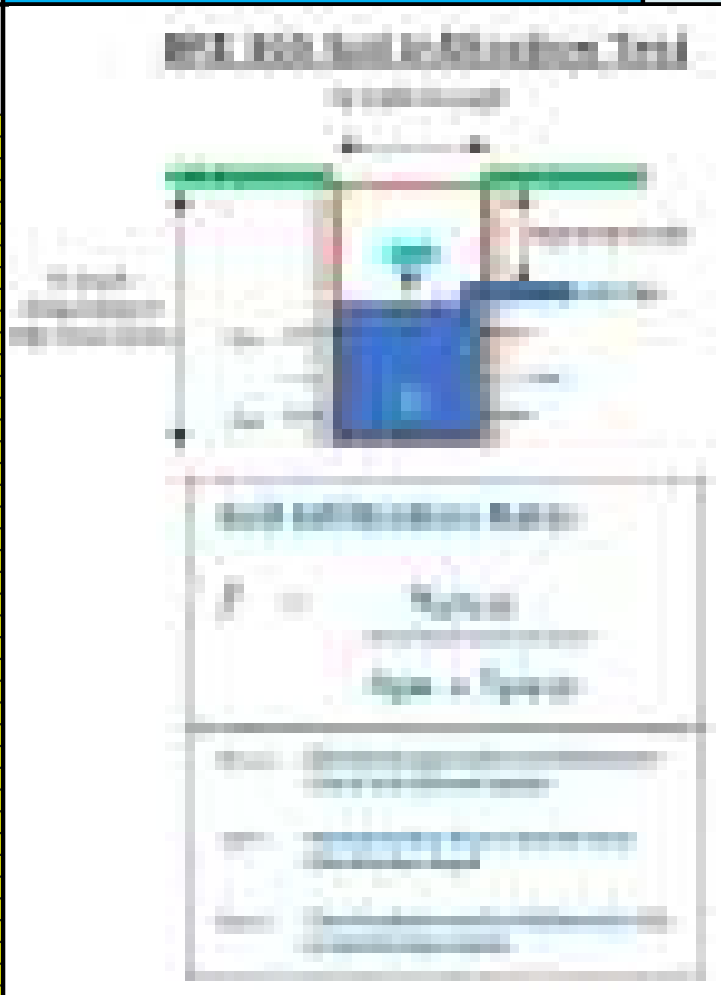


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP02
INFILTRATION TEST No.	1	SOIL TYPE	Grey, sandy, organic, clayey SILT	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.42	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.38
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.04	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.22
75% Effective Water Depth (m)	0.285	25% Effective Water Depth (m)	0.095	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.133
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	5.2	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	19	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	13.8

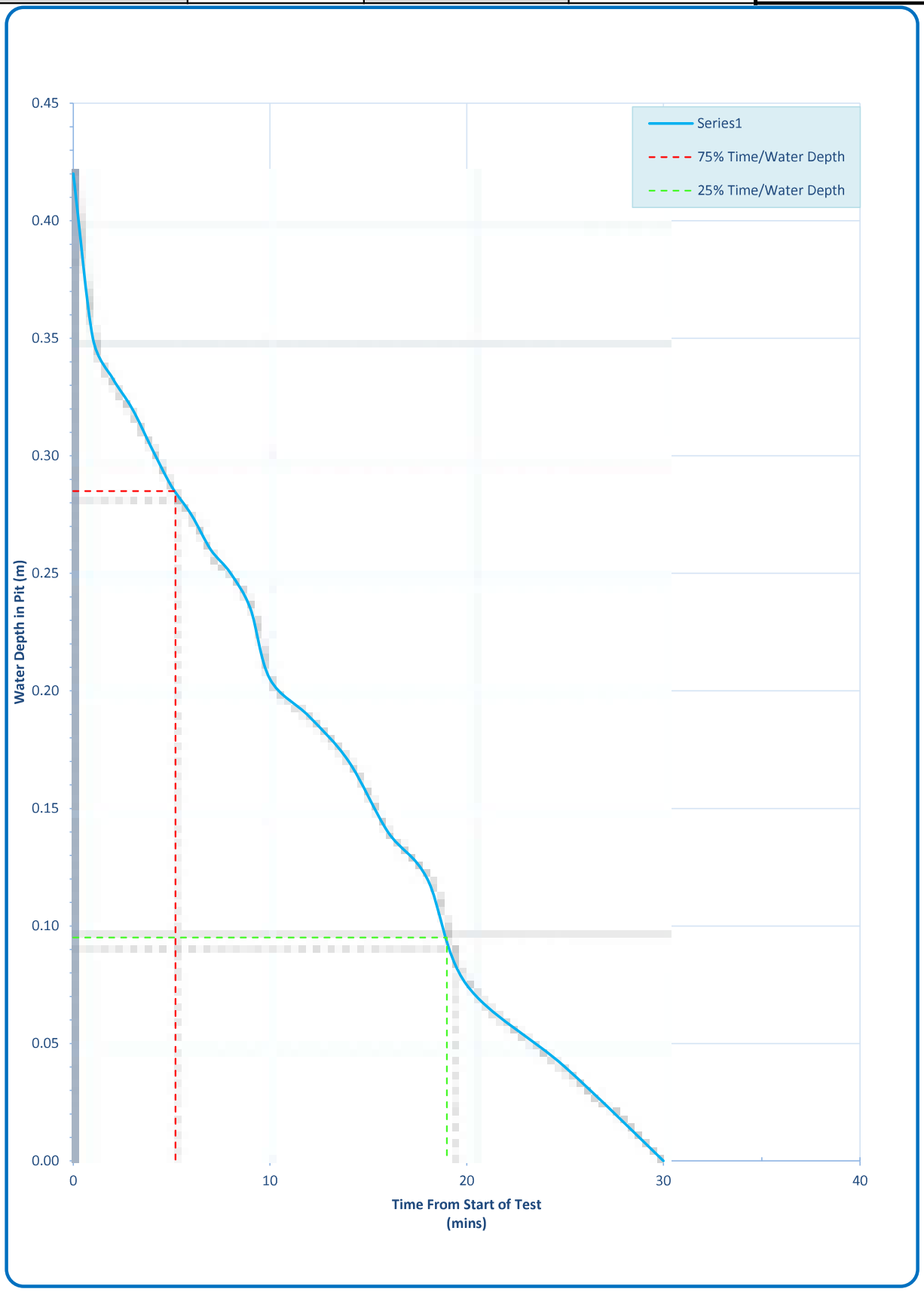
SOIL INFILTRATION RATE	7.24E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.420
09:01	1	0.350
09:02	2	0.333
09:03	3	0.320
09:04	4	0.303
09:05	5	0.287
09:06	6	0.275
09:07	7	0.260
09:08	8	0.250
09:09	9	0.235
09:10	10	0.205
09:15	12	0.189
09:30	14	0.170
09:45	16	0.140
10:00	18	0.120
10:15	20	0.075
10:30	25	0.040
10:45	30	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1	SOIL TYPE	Grey, sandy, organic, clayey SILT	TP02

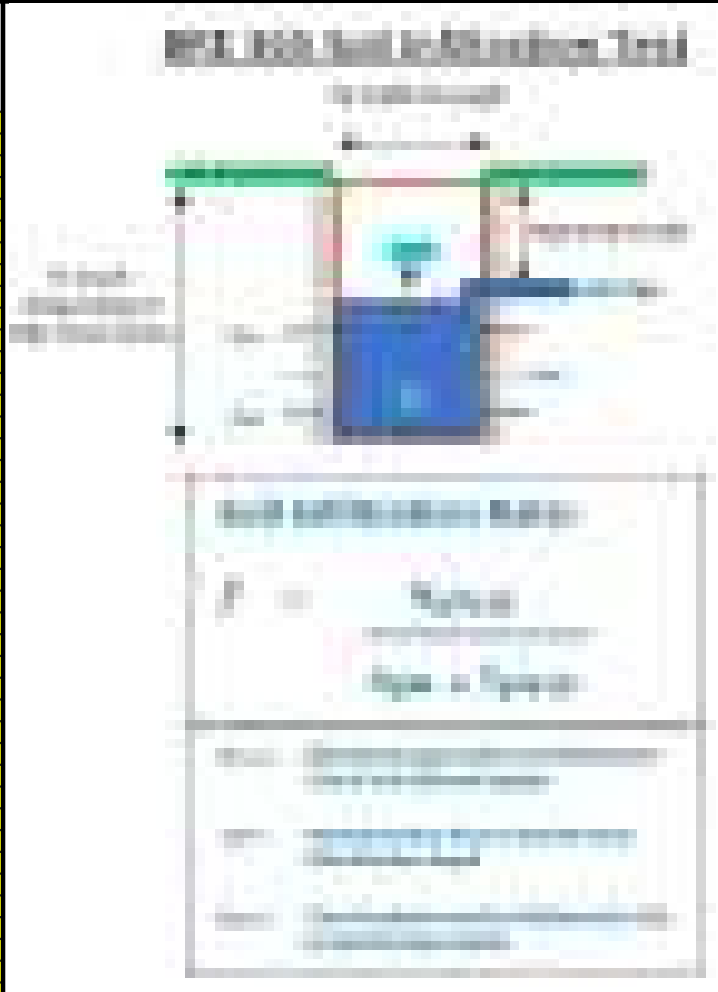


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP02
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.35	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.45
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.04	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.22
75% Effective Water Depth (m)	0.3375	25% Effective Water Depth (m)	0.1125	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1575
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	14	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	47	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	33

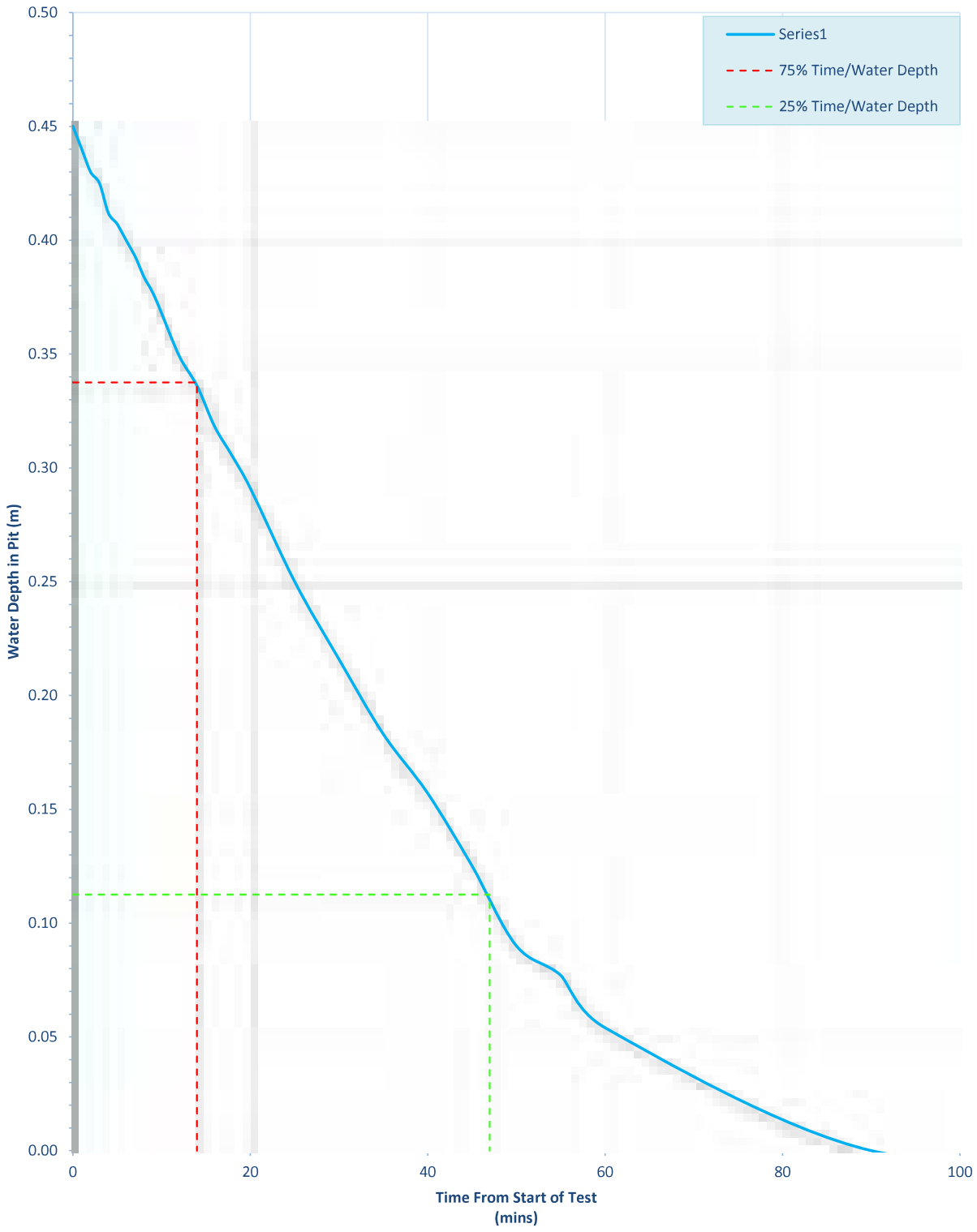
SOIL INFILTRATION RATE	3.58E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.450
09:01	1	0.440
09:02	2	0.430
09:03	3	0.425
09:04	4	0.412
09:05	5	0.407
09:06	6	0.400
09:07	7	0.393
09:08	8	0.384
09:09	9	0.377
09:10	10	0.368
09:15	12	0.349
09:30	14	0.336
09:45	16	0.318
10:00	18	0.305
10:15	20	0.291
10:30	25	0.250
10:45	30	0.216
11:00	35	0.183
11:30	40	0.157
12:00	45	0.125
12:30	50	0.090
13:00	55	0.077
13:30	60	0.054
14:00	90	0.000
14:30	120	0.000
15:00	180	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP02



BRE 365 SOIL INFILTRATION TEST

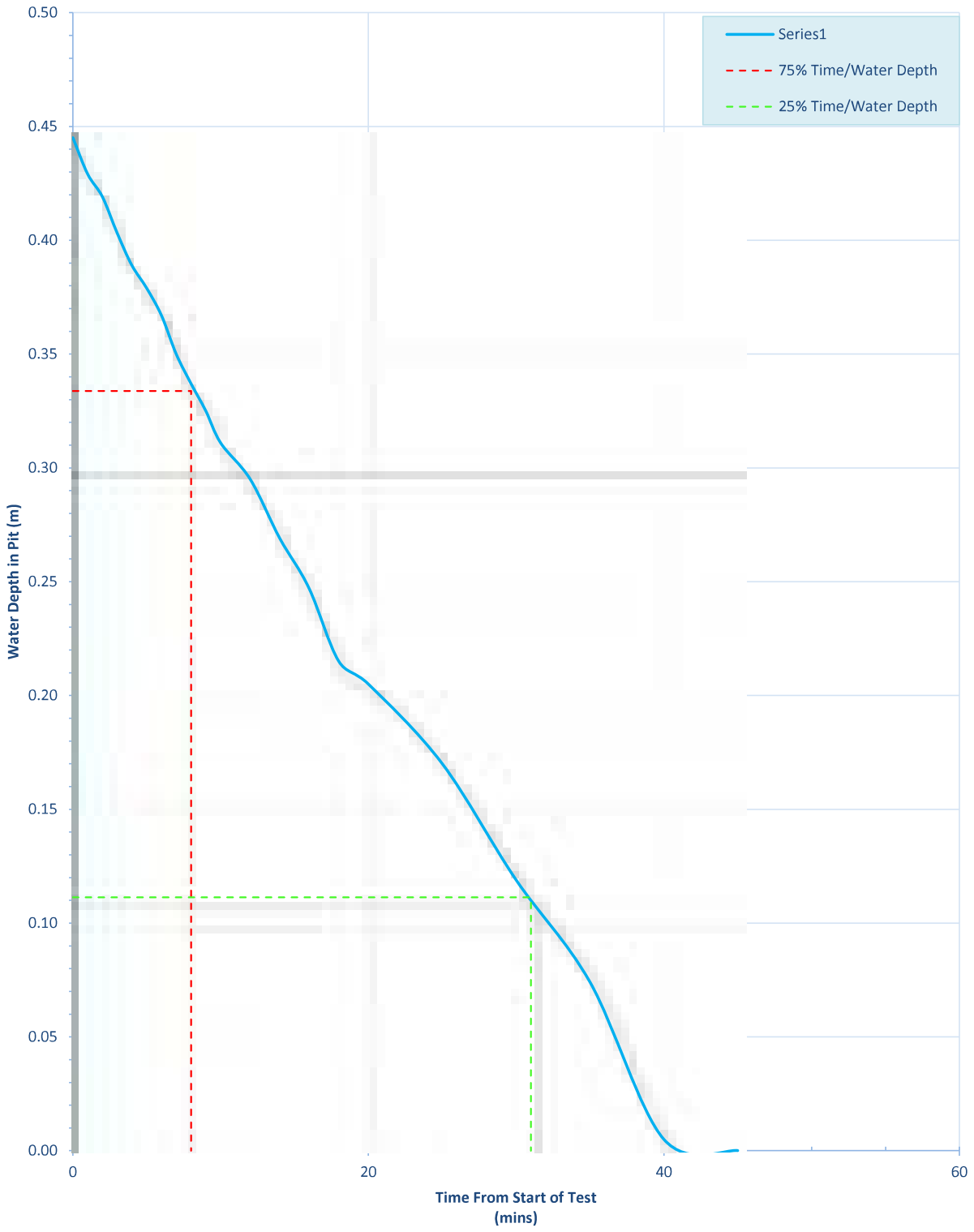
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP03
INFILTRATION TEST No.	1	SOIL TYPE	Grey silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.46	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.45
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	3.24	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.27
75% Effective Water Depth (m)	0.33375	25% Effective Water Depth (m)	0.11125	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.144625
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	8	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	31	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	23

SOIL INFILTRATION RATE	4.62E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.445
09:01	1	0.429
09:02	2	0.419
09:03	3	0.403
09:04	4	0.389
09:05	5	0.379
09:06	6	0.367
09:07	7	0.350
09:08	8	0.337
09:09	9	0.325
09:10	10	0.311
09:15	12	0.295
09:30	14	0.269
09:45	16	0.247
10:00	18	0.215
10:15	20	0.205
10:30	25	0.170
10:45	30	0.119
11:00	35	0.074
11:30	40	0.005
12:00	45	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.90	SOIL TYPE	Grey silty, sandy, gravelly CLAY	TP03



BRE 365 SOIL INFILTRATION TEST

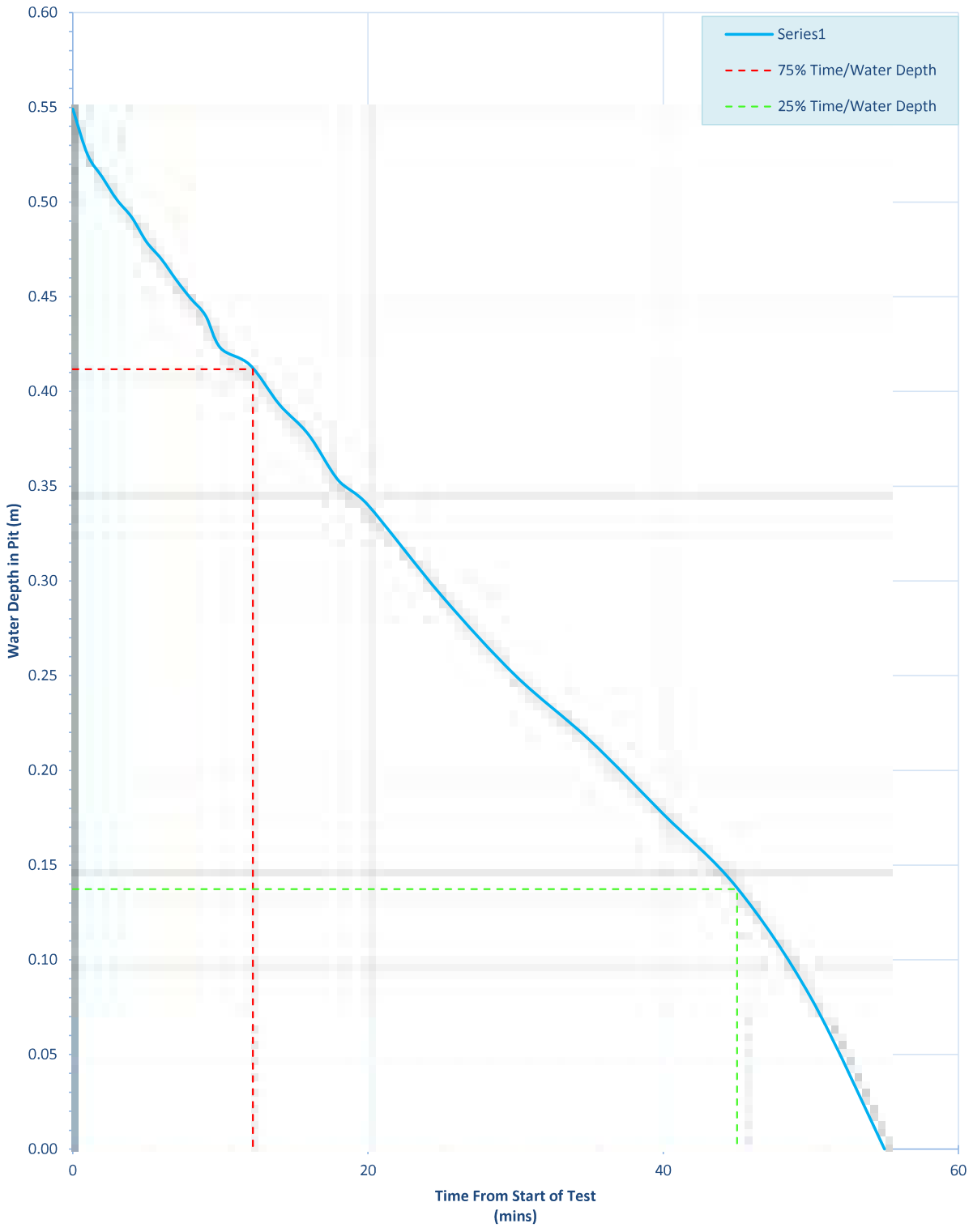
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP03
INFILTRATION TEST No.	2	SOIL TYPE	Grey silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.35	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.55
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	3.24	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.27
75% Effective Water Depth (m)	0.41175	25% Effective Water Depth (m)	0.13725	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.178425
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	12.2	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	45	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	32.8

SOIL INFILTRATION RATE	3.99E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.549
09:01	1	0.525
09:02	2	0.513
09:03	3	0.501
09:04	4	0.492
09:05	5	0.479
09:06	6	0.470
09:07	7	0.459
09:08	8	0.449
09:09	9	0.440
09:10	10	0.423
09:15	12	0.414
09:30	14	0.393
09:45	16	0.377
10:00	18	0.353
10:15	20	0.340
10:30	25	0.292
10:45	30	0.250
11:00	35	0.216
11:30	40	0.177
12:00	45	0.138
12:30	50	0.080
13:00	55	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.90	SOIL TYPE	Grey silty, sandy, gravelly CLAY	TP03



BRE 365 SOIL INFILTRATION TEST

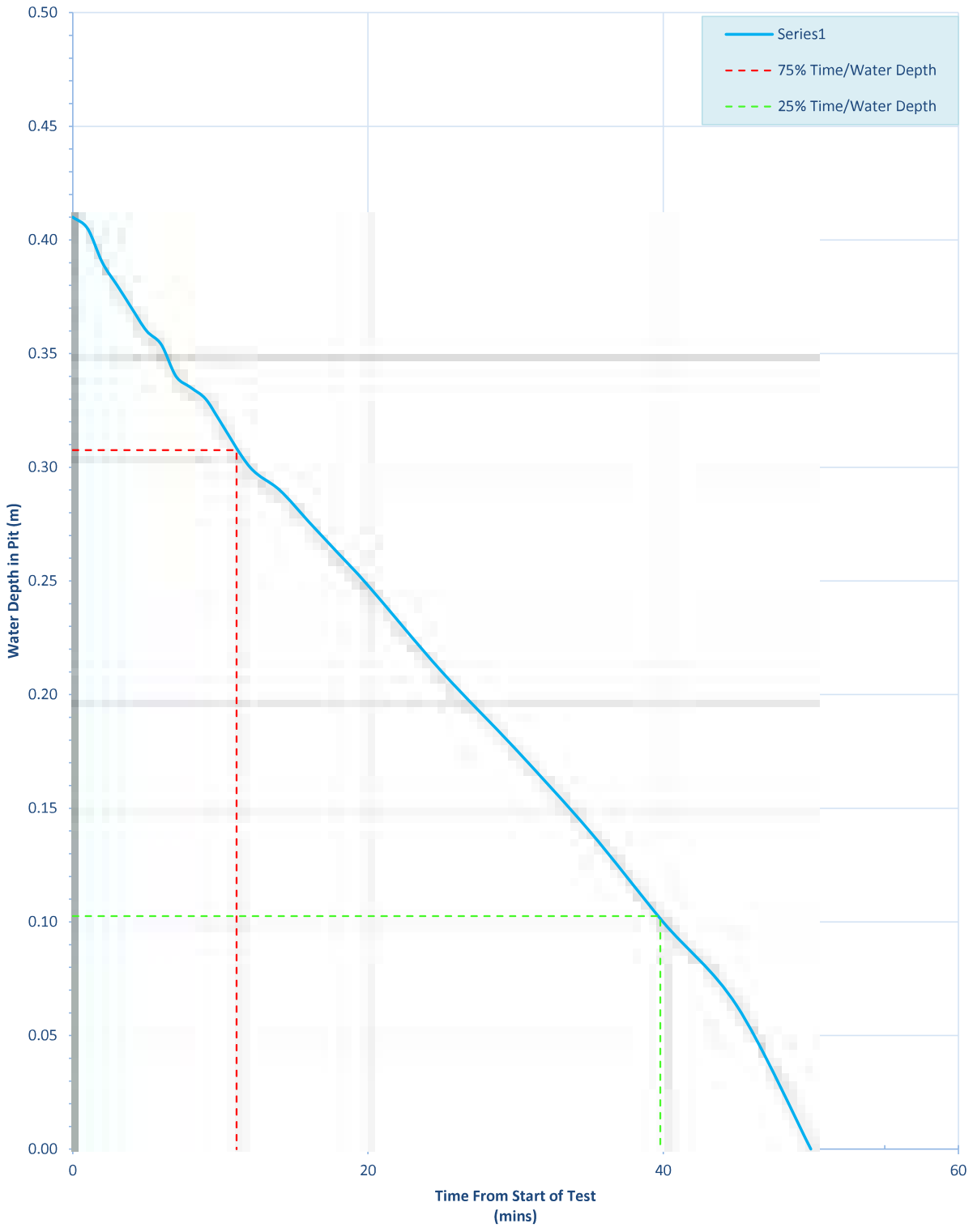
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP04
INFILTRATION TEST No.	1	SOIL TYPE	Grey silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.29	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.41
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.52	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	1.91
75% Effective Water Depth (m)	0.3075	25% Effective Water Depth (m)	0.1025	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.13325
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	11.1	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	39.8	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	28.7

SOIL INFILTRATION RATE	4.05E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.410
09:01	1	0.405
09:02	2	0.390
09:03	3	0.380
09:04	4	0.370
09:05	5	0.360
09:06	6	0.354
09:07	7	0.340
09:08	8	0.335
09:09	9	0.330
09:10	10	0.320
09:15	12	0.300
09:30	14	0.290
09:45	16	0.276
10:00	18	0.262
10:15	20	0.248
10:30	25	0.210
10:45	30	0.176
11:00	35	0.140
11:30	40	0.100
12:00	45	0.063
12:30	50	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Grey silty, sandy, gravelly CLAY	TP04

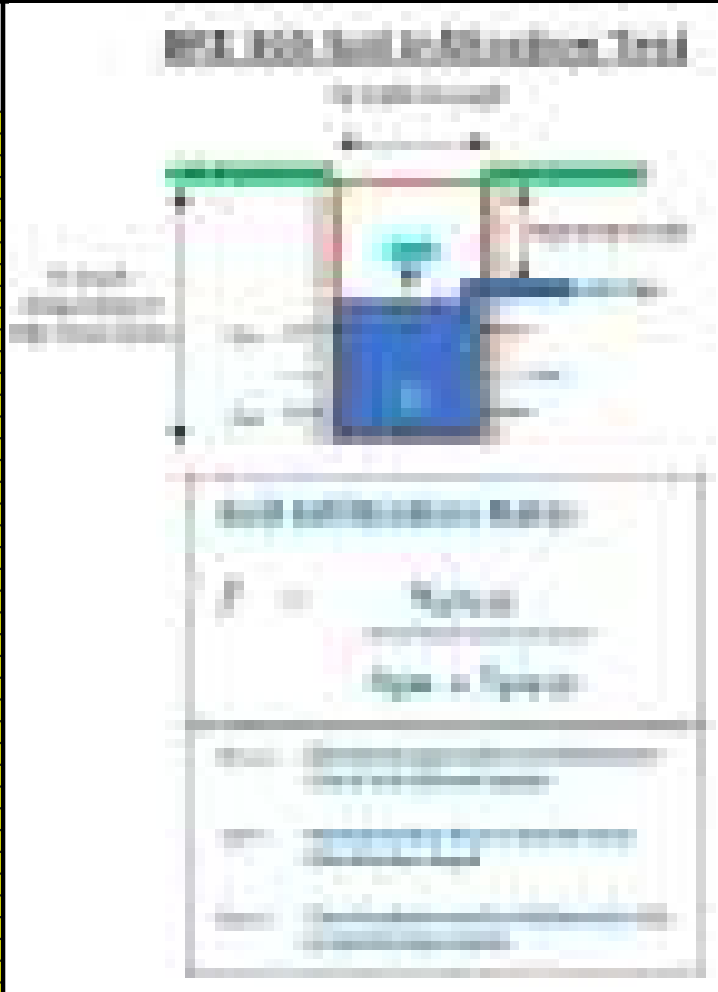


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP04
INFILTRATION TEST No.	2	SOIL TYPE	Grey silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.26	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.44
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.52	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	1.91
75% Effective Water Depth (m)	0.33	25% Effective Water Depth (m)	0.11	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.143
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	18.5	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	61	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	42.5

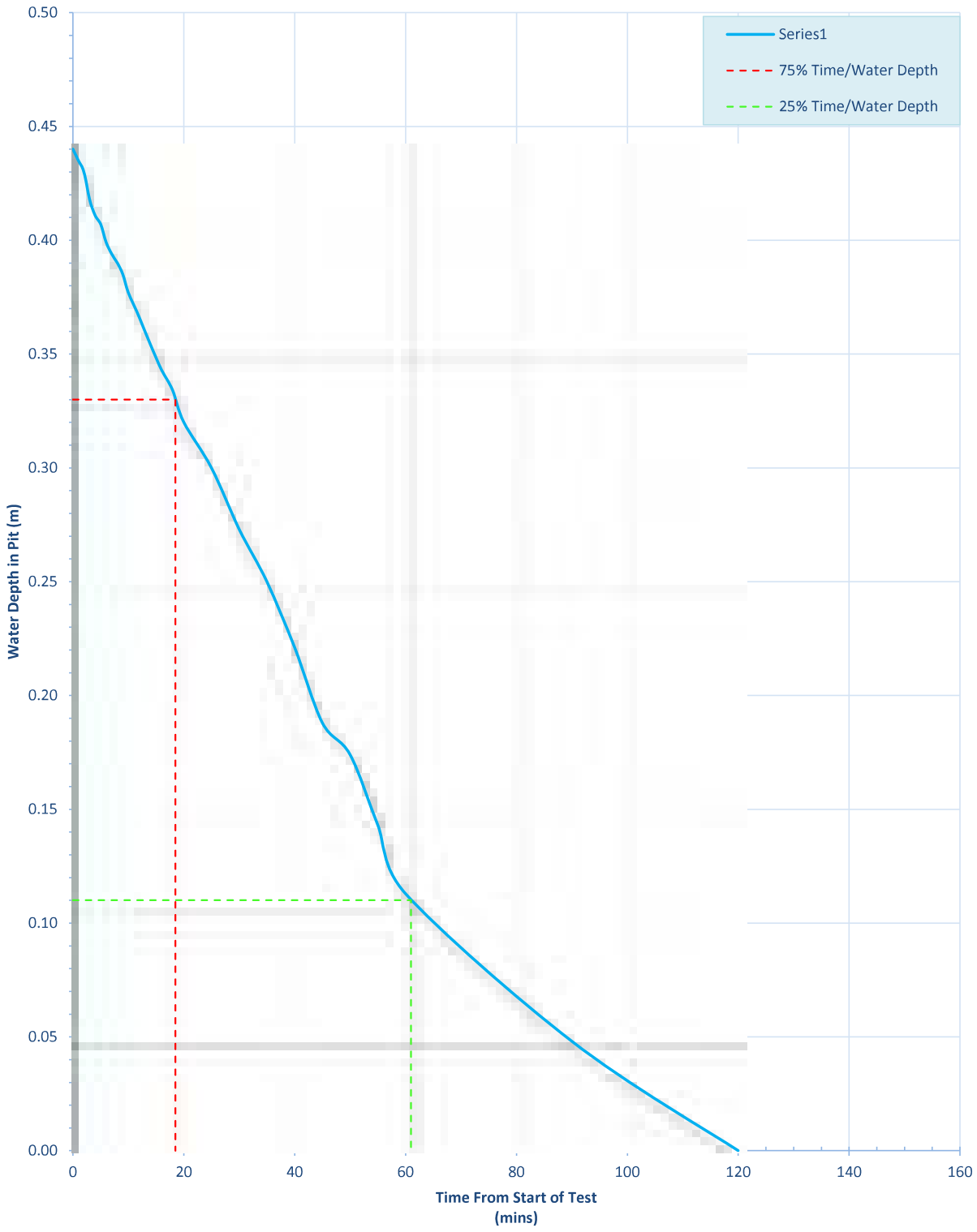
SOIL INFILTRATION RATE	2.94E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.440
09:01	1	0.435
09:02	2	0.430
09:03	3	0.418
09:04	4	0.411
09:05	5	0.407
09:06	6	0.399
09:07	7	0.394
09:08	8	0.390
09:09	9	0.385
09:10	10	0.377
09:15	12	0.366
09:30	14	0.354
09:45	16	0.343
10:00	18	0.334
10:15	20	0.320
10:30	25	0.300
10:45	30	0.273
11:00	35	0.250
11:30	40	0.221
12:00	45	0.188
12:30	50	0.174
13:00	55	0.143
13:30	60	0.113
14:00	90	0.048
14:30	120	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Grey silty, sandy, gravelly CLAY	TP04

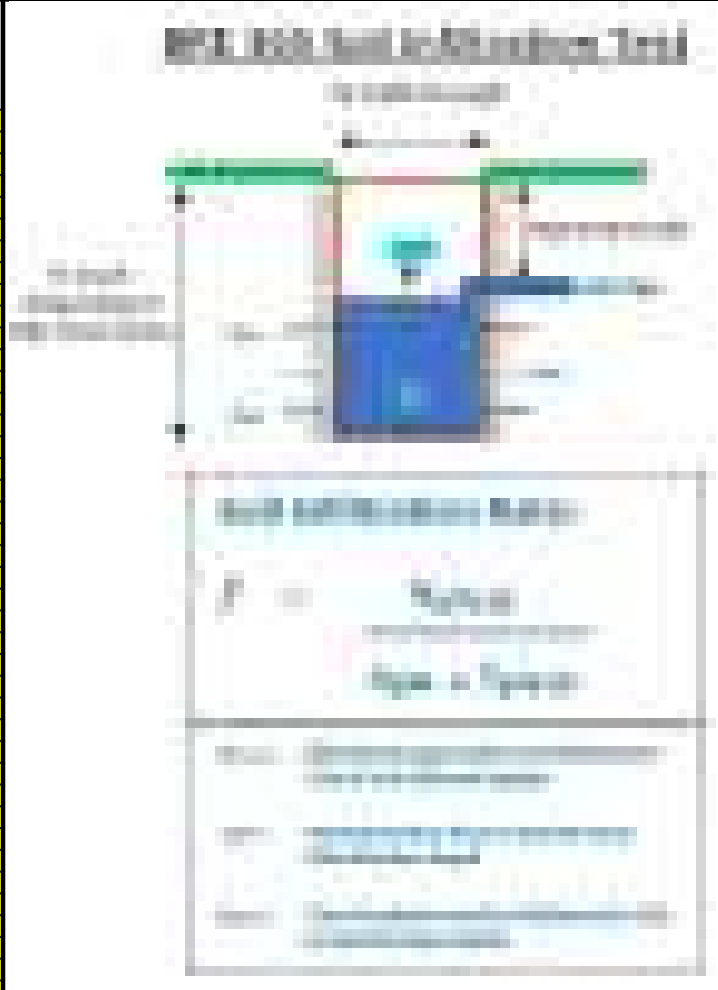


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP04
INFILTRATION TEST No.	3	SOIL TYPE	Grey silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.27	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.43
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.52	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	1.91
75% Effective Water Depth (m)	0.3225	25% Effective Water Depth (m)	0.1075	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.13975
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	23	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	78	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	55

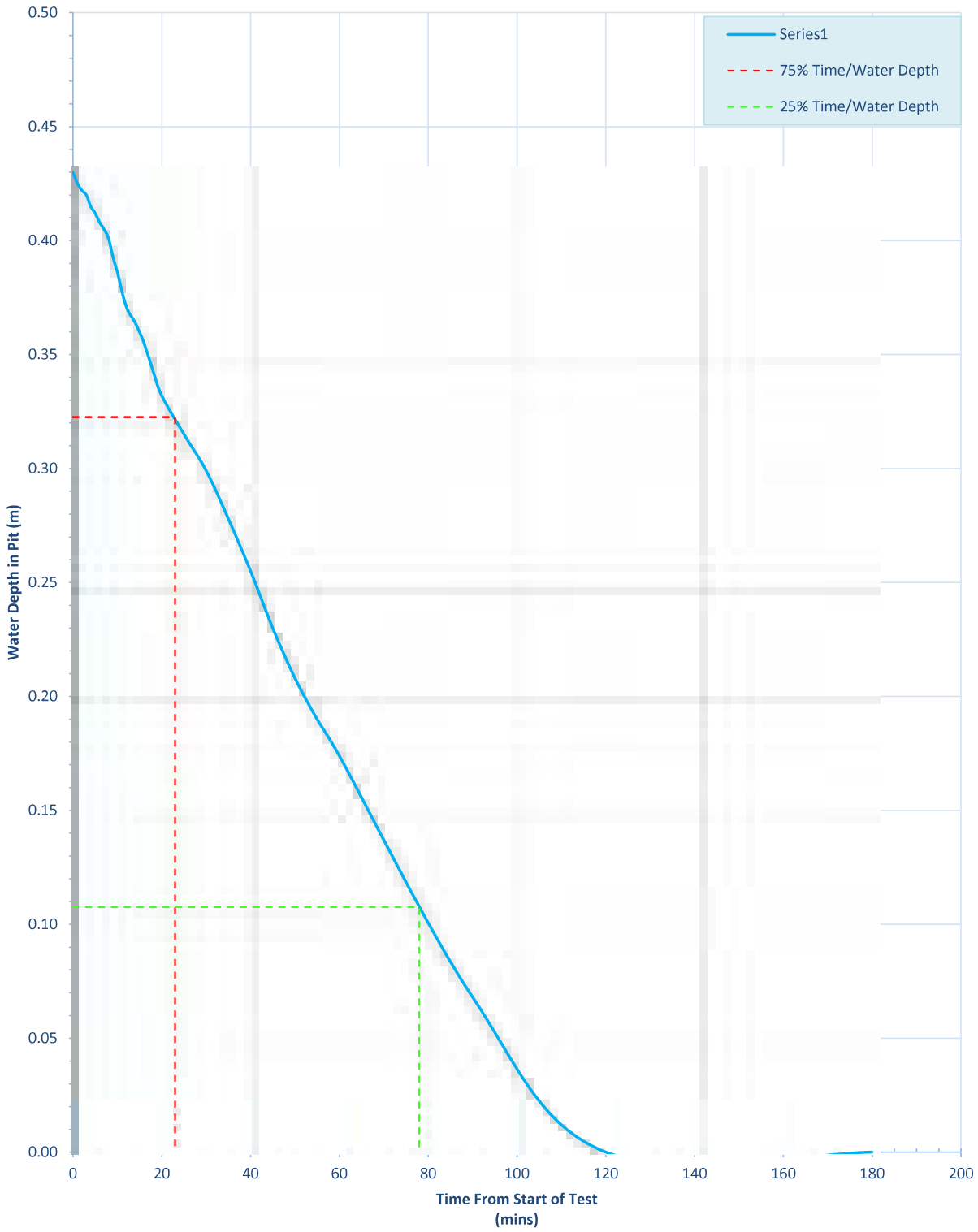
SOIL INFILTRATION RATE	2.22E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.430
09:01	1	0.425
09:02	2	0.422
09:03	3	0.420
09:04	4	0.415
09:05	5	0.412
09:06	6	0.408
09:07	7	0.405
09:08	8	0.401
09:09	9	0.393
09:10	10	0.386
09:15	12	0.371
09:30	14	0.364
09:45	16	0.355
10:00	18	0.343
10:15	20	0.332
10:30	25	0.315
10:45	30	0.299
11:00	35	0.278
11:30	40	0.255
12:00	45	0.230
12:30	50	0.208
13:00	55	0.190
13:30	60	0.174
14:00	90	0.068
14:30	120	0.000
15:00	180	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Grey silty, sandy, gravelly CLAY	TP04



BRE 365 SOIL INFILTRATION TEST

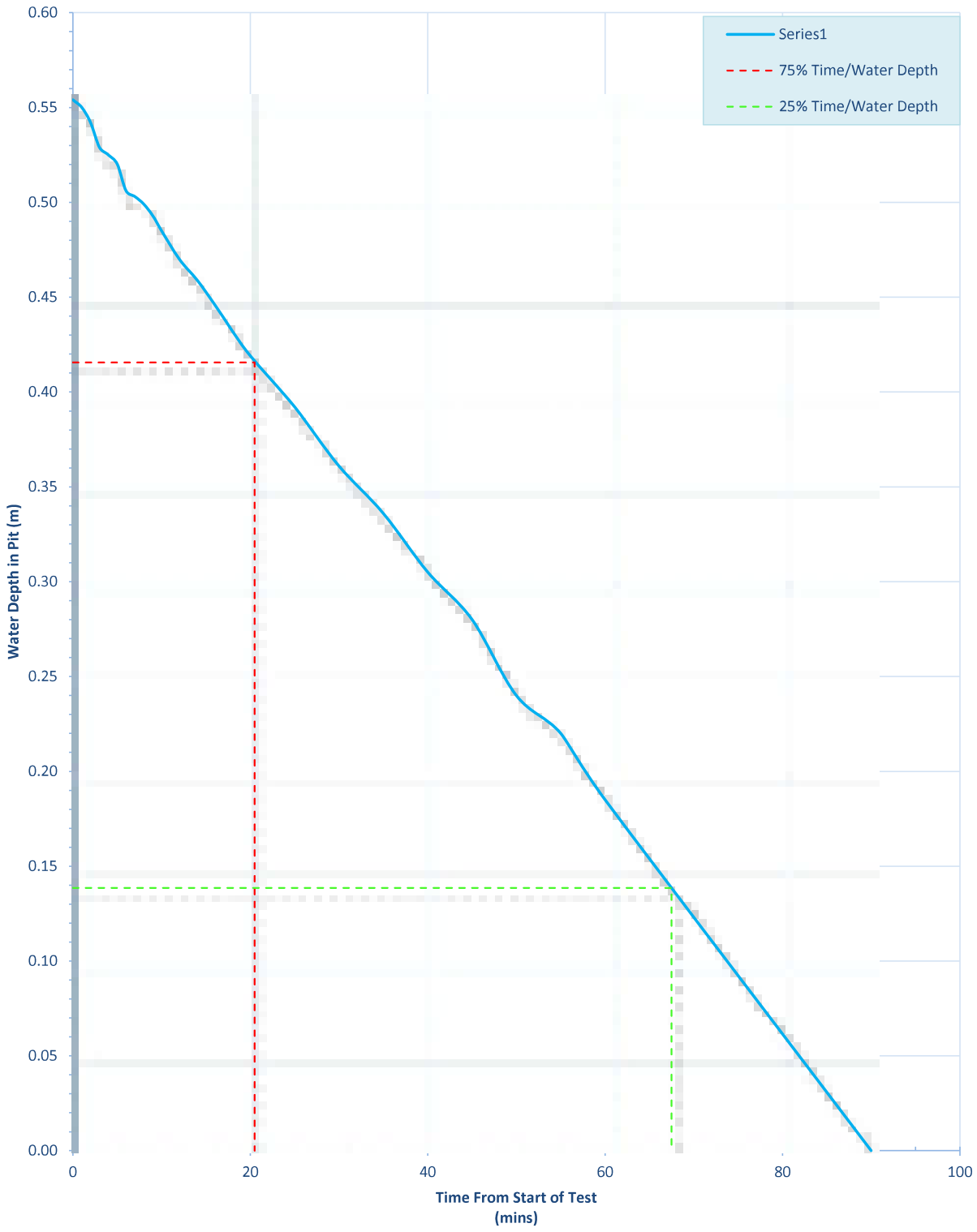
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP05
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.25	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.55
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.88	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.09
75% Effective Water Depth (m)	0.4155	25% Effective Water Depth (m)	0.1385	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.18005
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	20.5	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	67.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	47

SOIL INFILTRATION RATE	3.05E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.554
09:01	1	0.550
09:02	2	0.542
09:03	3	0.529
09:04	4	0.525
09:05	5	0.520
09:06	6	0.506
09:07	7	0.503
09:08	8	0.499
09:09	9	0.493
09:10	10	0.485
09:15	12	0.470
09:30	14	0.459
09:45	16	0.446
10:00	18	0.432
10:15	20	0.419
10:30	25	0.392
10:45	30	0.361
11:00	35	0.336
11:30	40	0.305
12:00	45	0.280
12:30	50	0.240
13:00	55	0.220
13:30	60	0.185
14:00	90	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP05

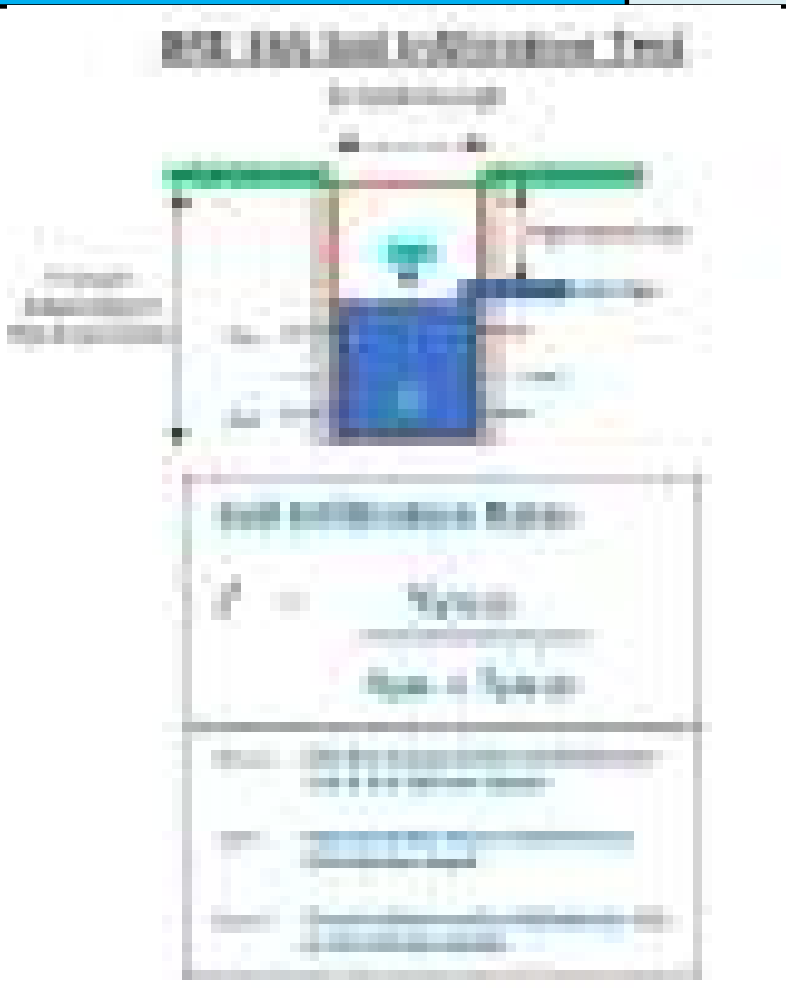


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP05
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.21	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.59
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.88	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.09
75% Effective Water Depth (m)	0.4425	25% Effective Water Depth (m)	0.1475	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.19175
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	33	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	102	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	69

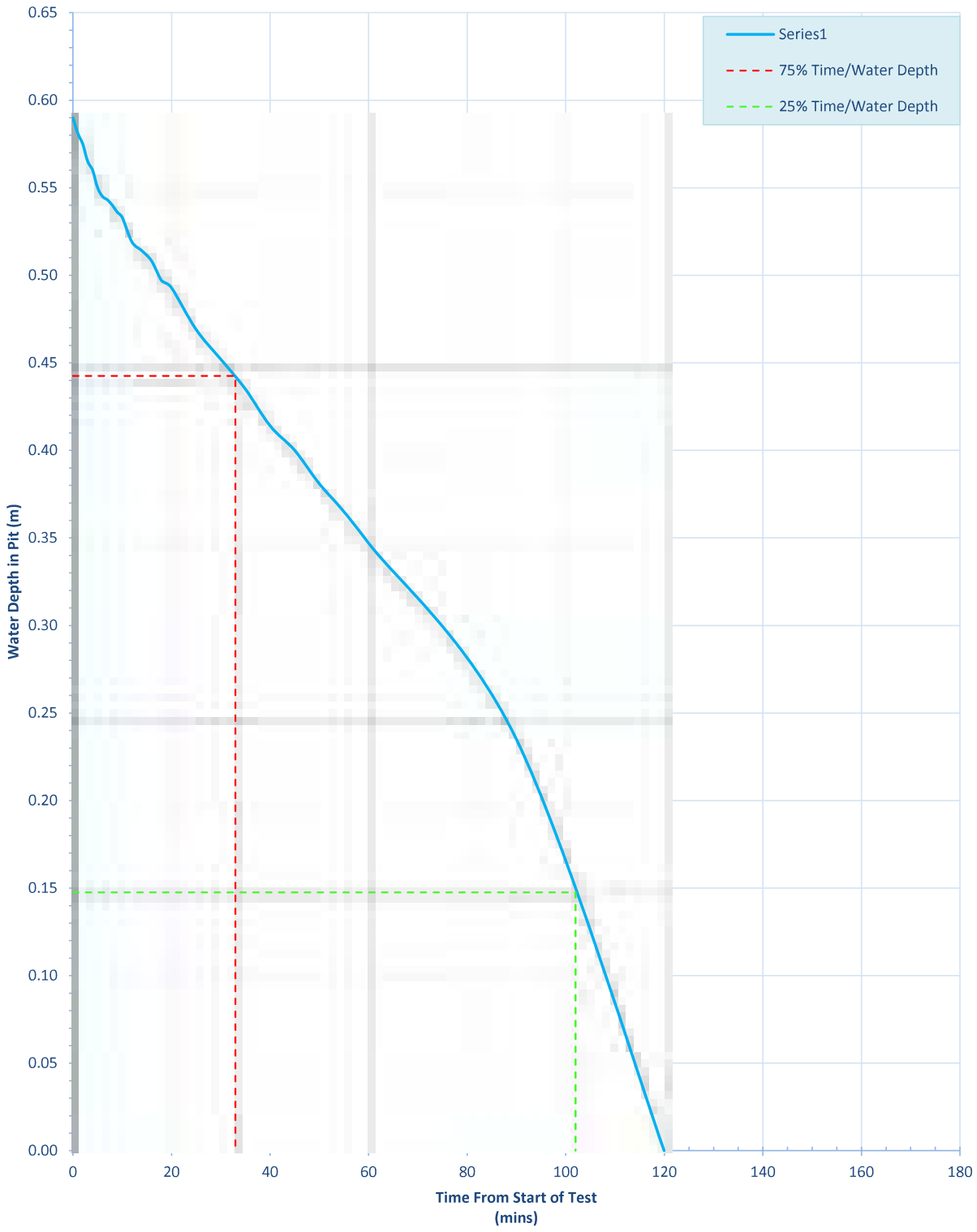
SOIL INFILTRATION RATE	2.22E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.590
09:01	1	0.581
09:02	2	0.575
09:03	3	0.565
09:04	4	0.560
09:05	5	0.550
09:06	6	0.545
09:07	7	0.543
09:08	8	0.540
09:09	9	0.536
09:10	10	0.533
09:15	12	0.519
09:30	14	0.514
09:45	16	0.508
10:00	18	0.497
10:15	20	0.493
10:30	25	0.469
10:45	30	0.452
11:00	35	0.435
11:30	40	0.414
12:00	45	0.400
12:30	50	0.381
13:00	55	0.365
13:30	60	0.347
14:00	90	0.235
14:30	120	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP05

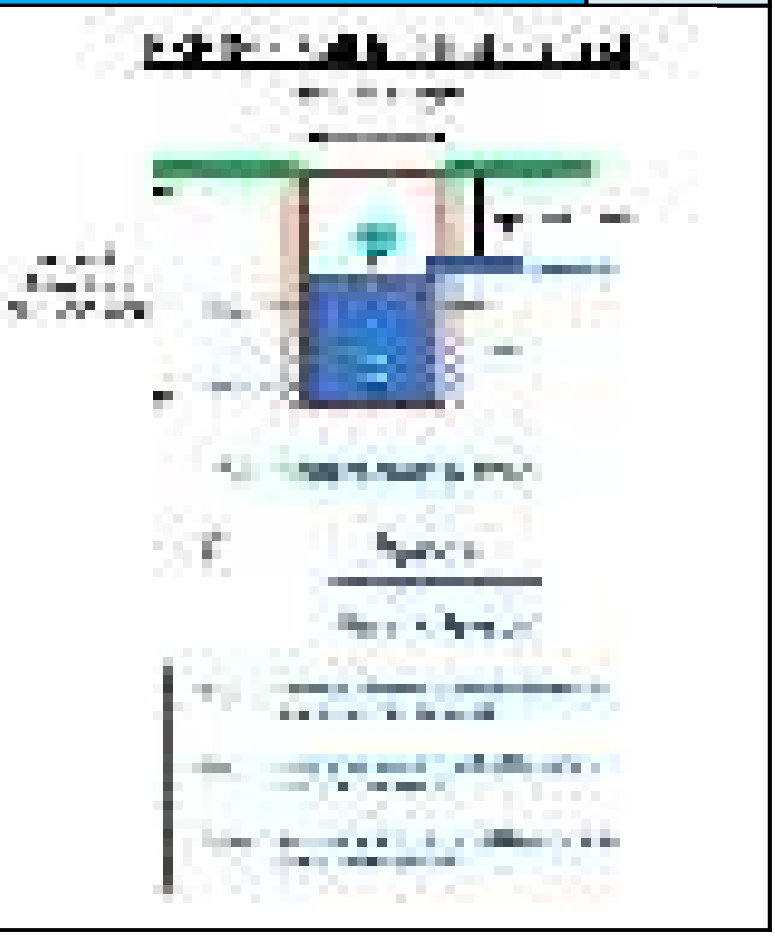


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP05
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.20	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.60
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.88	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.09
75% Effective Water Depth (m)	0.45	25% Effective Water Depth (m)	0.15	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.195
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	35	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	109	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	74

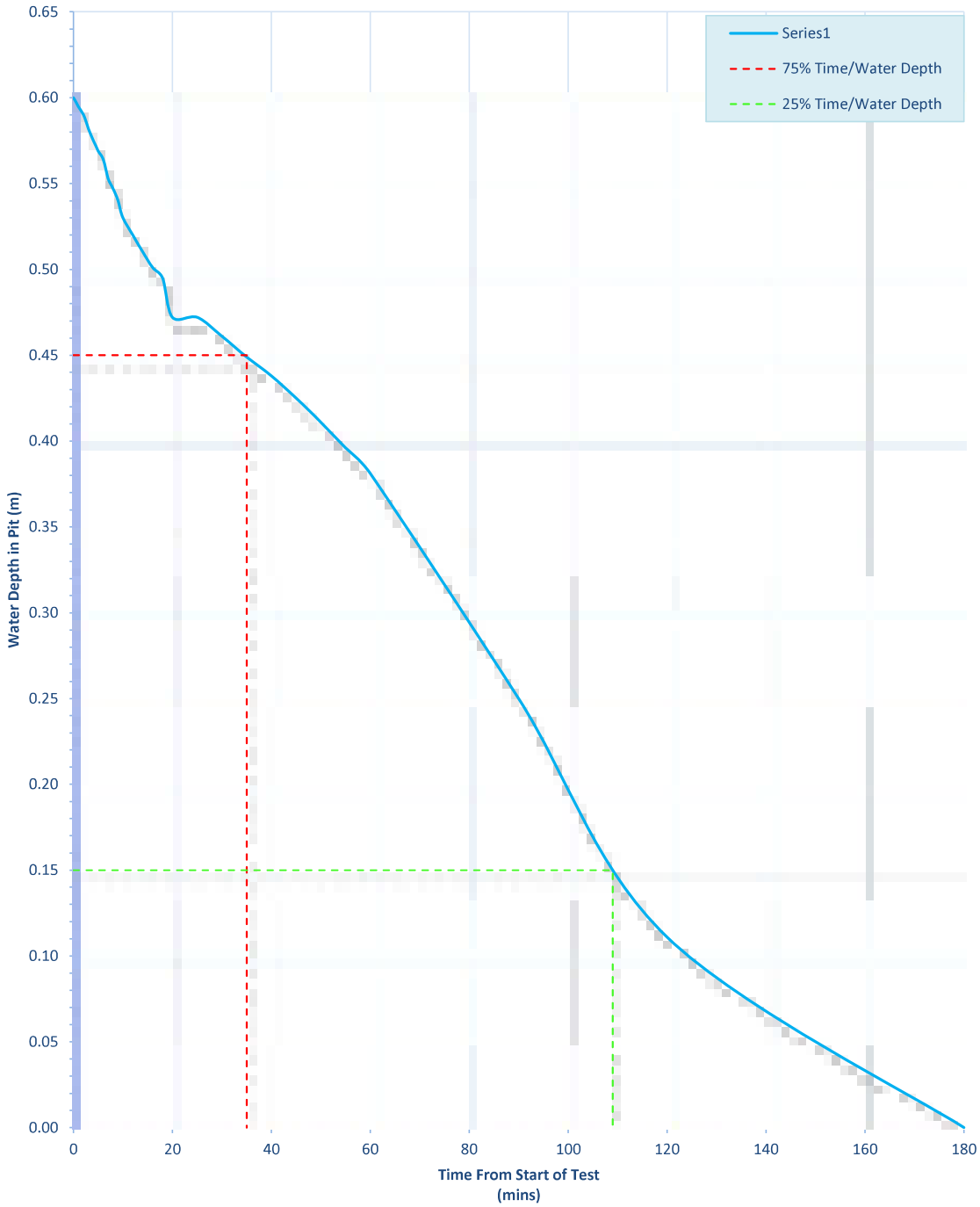
SOIL INFILTRATION RATE	2.10E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.600
09:01	1	0.595
09:02	2	0.590
09:03	3	0.582
09:04	4	0.575
09:05	5	0.569
09:06	6	0.564
09:07	7	0.553
09:08	8	0.547
09:09	9	0.540
09:10	10	0.530
09:15	12	0.520
09:30	14	0.510
09:45	16	0.501
10:00	18	0.495
10:15	20	0.472
10:30	25	0.472
10:45	30	0.461
11:00	35	0.449
11:30	40	0.438
12:00	45	0.425
12:30	50	0.411
13:00	55	0.396
13:30	60	0.381
14:00	90	0.250
14:30	120	0.111
15:00	180	0.000
15:30	240	
16:00	300	
16:30	360	
17:00	3600	
17:30	720	
18:00	780	
Interpolated	1200	
	2400	
	3600	
	4800	
	6000	
	7200	
	8400	
	12000	
	14750	



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP05

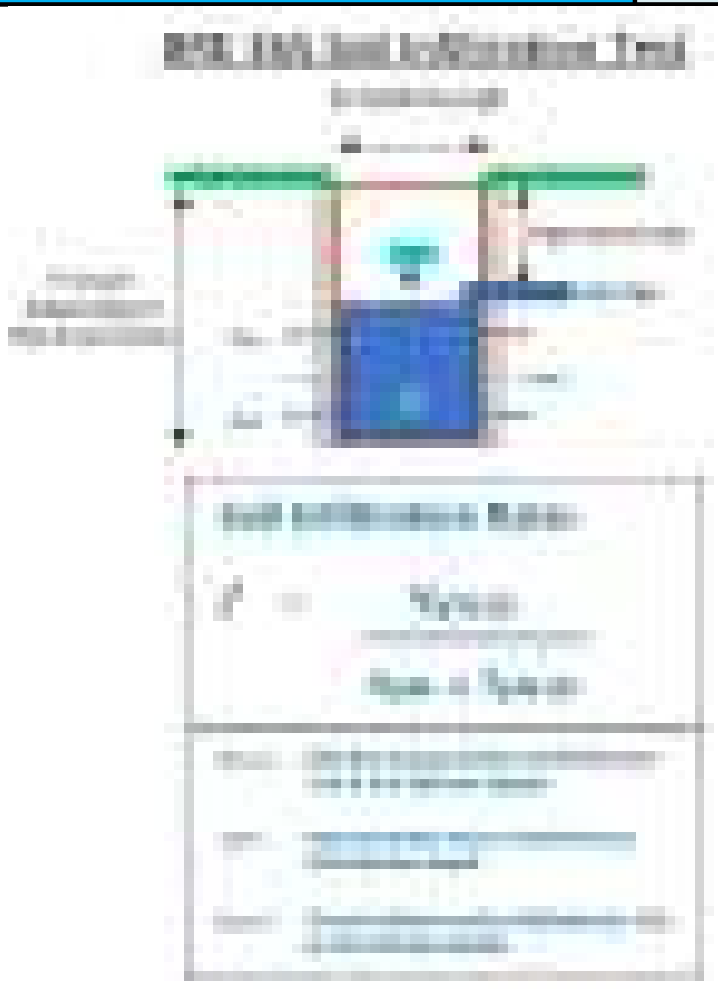


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP05
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.20	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.60
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	2.88	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.09
75% Effective Water Depth (m)	0.45	25% Effective Water Depth (m)	0.15	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.195
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	35	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	109	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	74

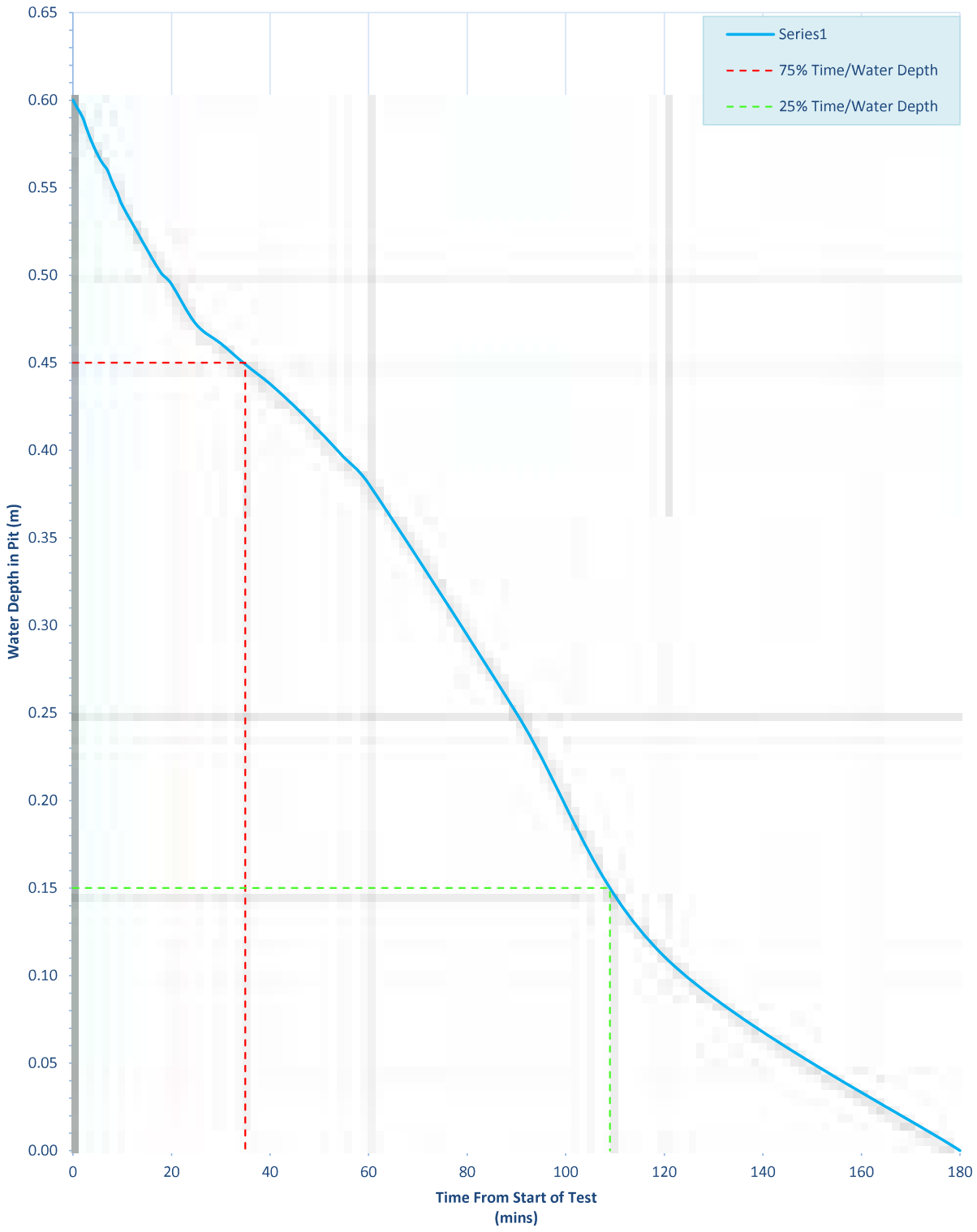
SOIL INFILTRATION RATE	2.10E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.600
09:01	1	0.595
09:02	2	0.590
09:03	3	0.582
09:04	4	0.575
09:05	5	0.569
09:06	6	0.564
09:07	7	0.560
09:08	8	0.553
09:09	9	0.547
09:10	10	0.540
09:15	12	0.530
09:30	14	0.520
09:45	16	0.510
10:00	18	0.501
10:15	20	0.495
10:30	25	0.472
10:45	30	0.461
11:00	35	0.449
11:30	40	0.438
12:00	45	0.425
12:30	50	0.411
13:00	55	0.396
13:30	60	0.381
14:00	90	0.250
14:30	120	0.111
15:00	180	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP05



BRE 365 SOIL INFILTRATION TEST

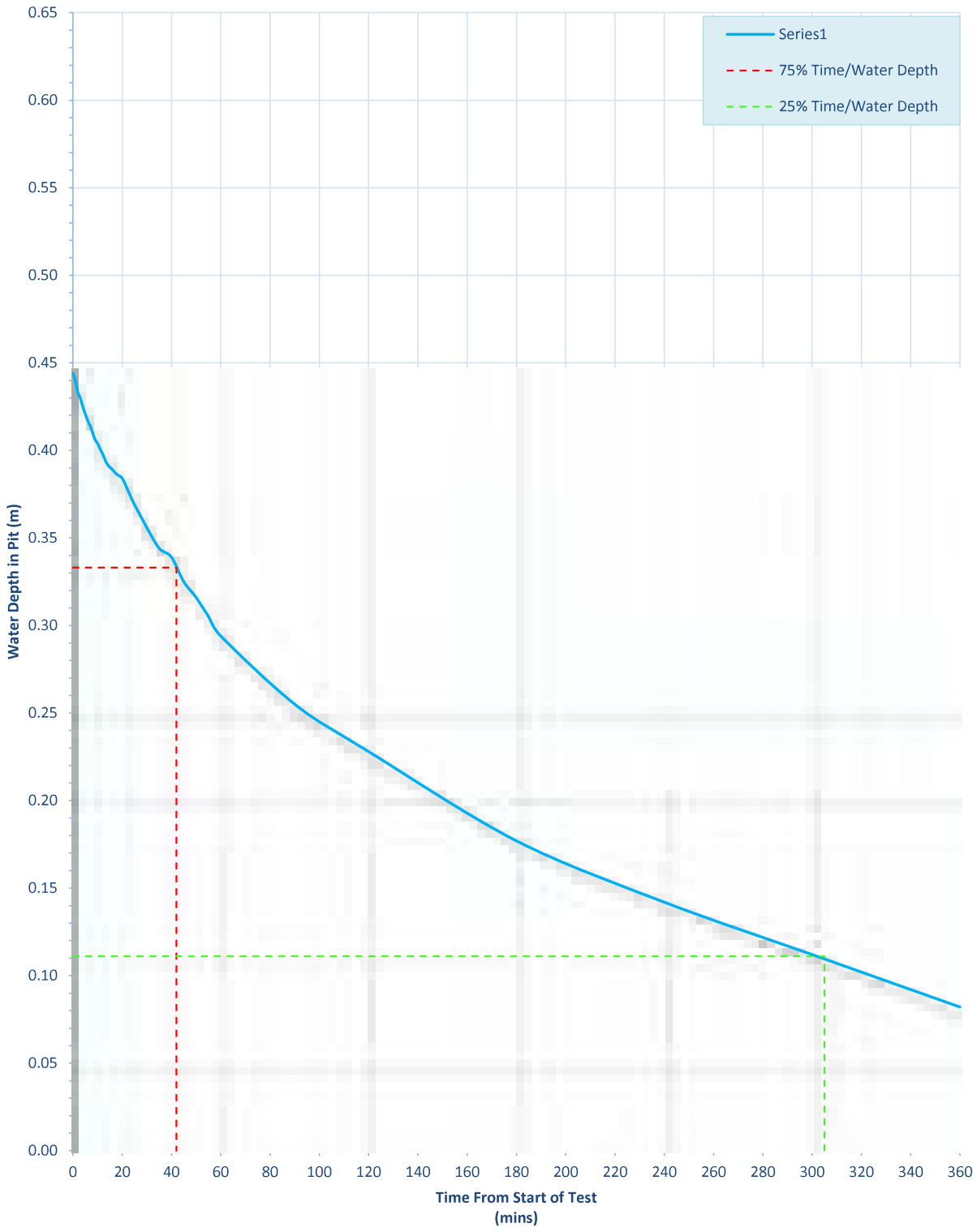
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP06
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.60	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.36	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.44
BASE SURFACE AREA (m2)	0.80	SIDEWALL SURFACE AREA (m2)	3.36	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.48
75% Effective Water Depth (m)	0.333	25% Effective Water Depth (m)	0.111	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1776
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	42	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	305	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	263

SOIL INFILTRATION RATE	4.54E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.444
09:01	1	0.440
09:02	2	0.433
09:03	3	0.430
09:04	4	0.425
09:05	5	0.421
09:06	6	0.417
09:07	7	0.414
09:08	8	0.410
09:09	9	0.406
09:10	10	0.404
09:15	12	0.398
09:30	14	0.392
09:45	16	0.389
10:00	18	0.386
10:15	20	0.384
10:30	25	0.369
10:45	30	0.356
11:00	35	0.344
11:30	40	0.339
12:00	45	0.325
12:30	50	0.316
13:00	55	0.305
13:30	60	0.294
14:00	90	0.255
14:30	120	0.228
15:00	180	0.177
16:00	240	0.142
17:00	300	0.112
18:00	360	0.082

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP06

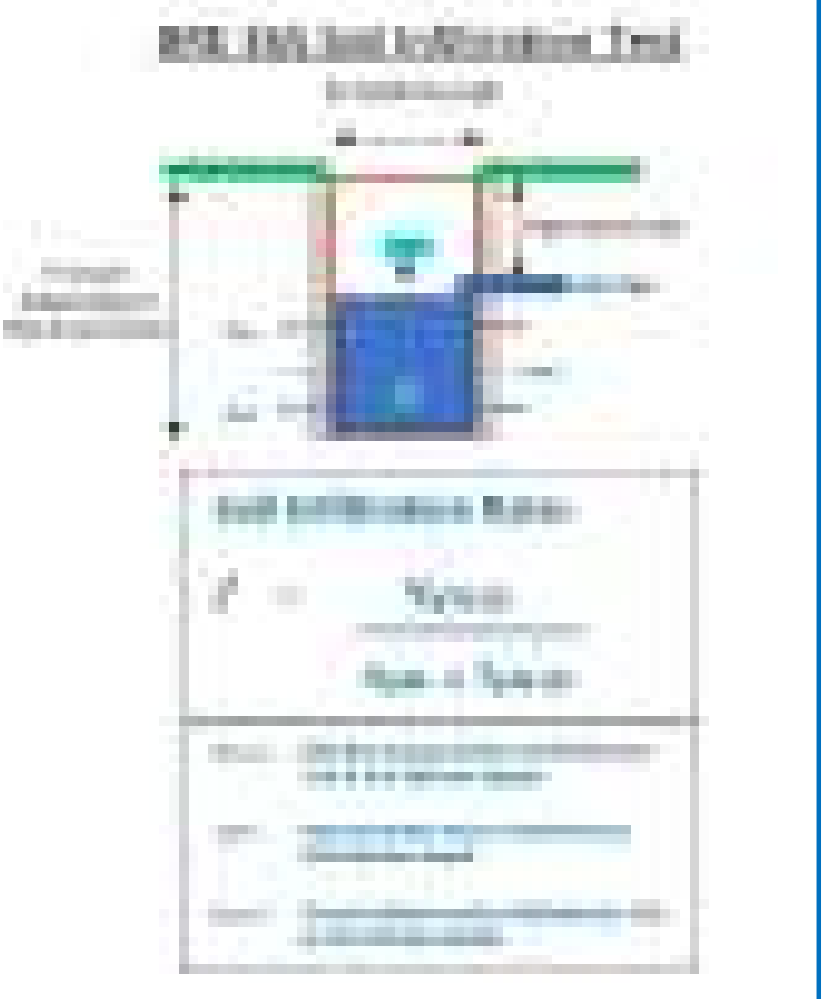


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP06
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.60	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.33	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.47
BASE SURFACE AREA (m2)	0.80	SIDEWALL SURFACE AREA (m2)	3.36	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.48
75% Effective Water Depth (m)	0.3525	25% Effective Water Depth (m)	0.1175	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.188
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	97	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	201	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	104

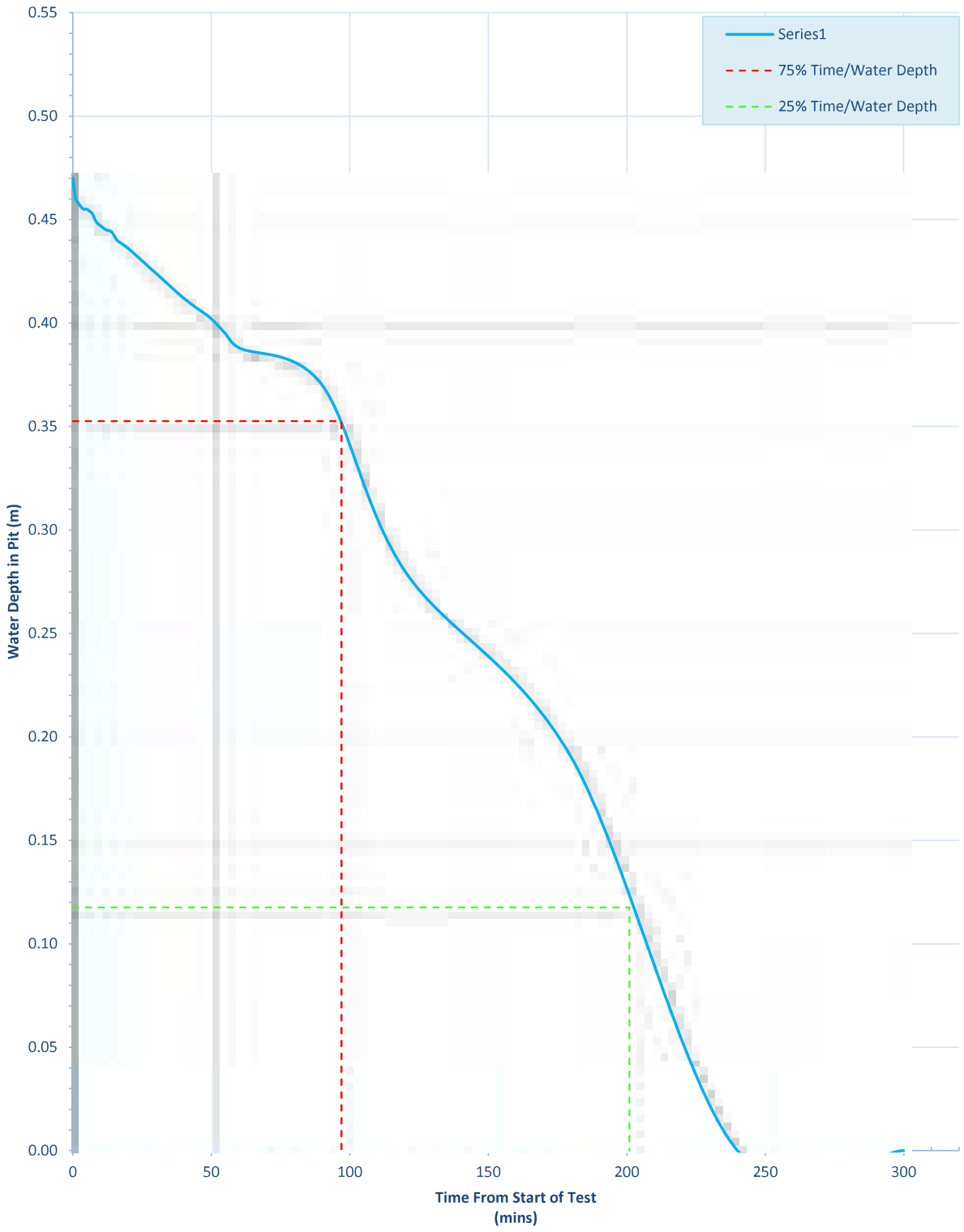
SOIL INFILTRATION RATE	1.21E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.470
09:01	1	0.460
09:02	2	0.458
09:03	3	0.456
09:04	4	0.455
09:05	5	0.455
09:06	6	0.454
09:07	7	0.453
09:08	8	0.450
09:09	9	0.448
09:10	10	0.447
09:15	12	0.445
09:30	14	0.444
09:45	16	0.440
10:00	18	0.438
10:15	20	0.436
10:30	25	0.430
10:45	30	0.424
11:00	35	0.418
11:30	40	0.412
12:00	45	0.407
12:30	50	0.402
13:00	55	0.395
13:30	60	0.388
14:00	90	0.370
14:30	120	0.280
15:00	180	0.190
16:00	240	0.000
17:00	300	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP06

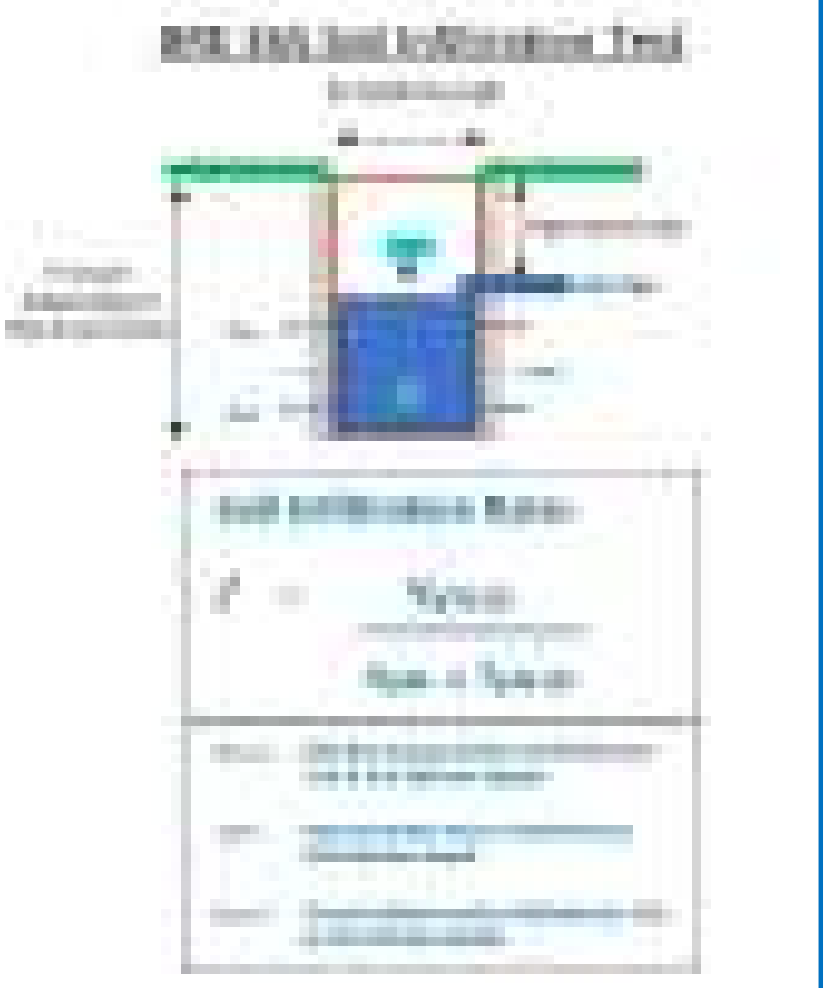


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP06
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.60	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.33	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.47
BASE SURFACE AREA (m2)	0.80	SIDEWALL SURFACE AREA (m2)	3.36	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.48
75% Effective Water Depth (m)	0.3525	25% Effective Water Depth (m)	0.1175	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.188
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	101	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	174	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	73

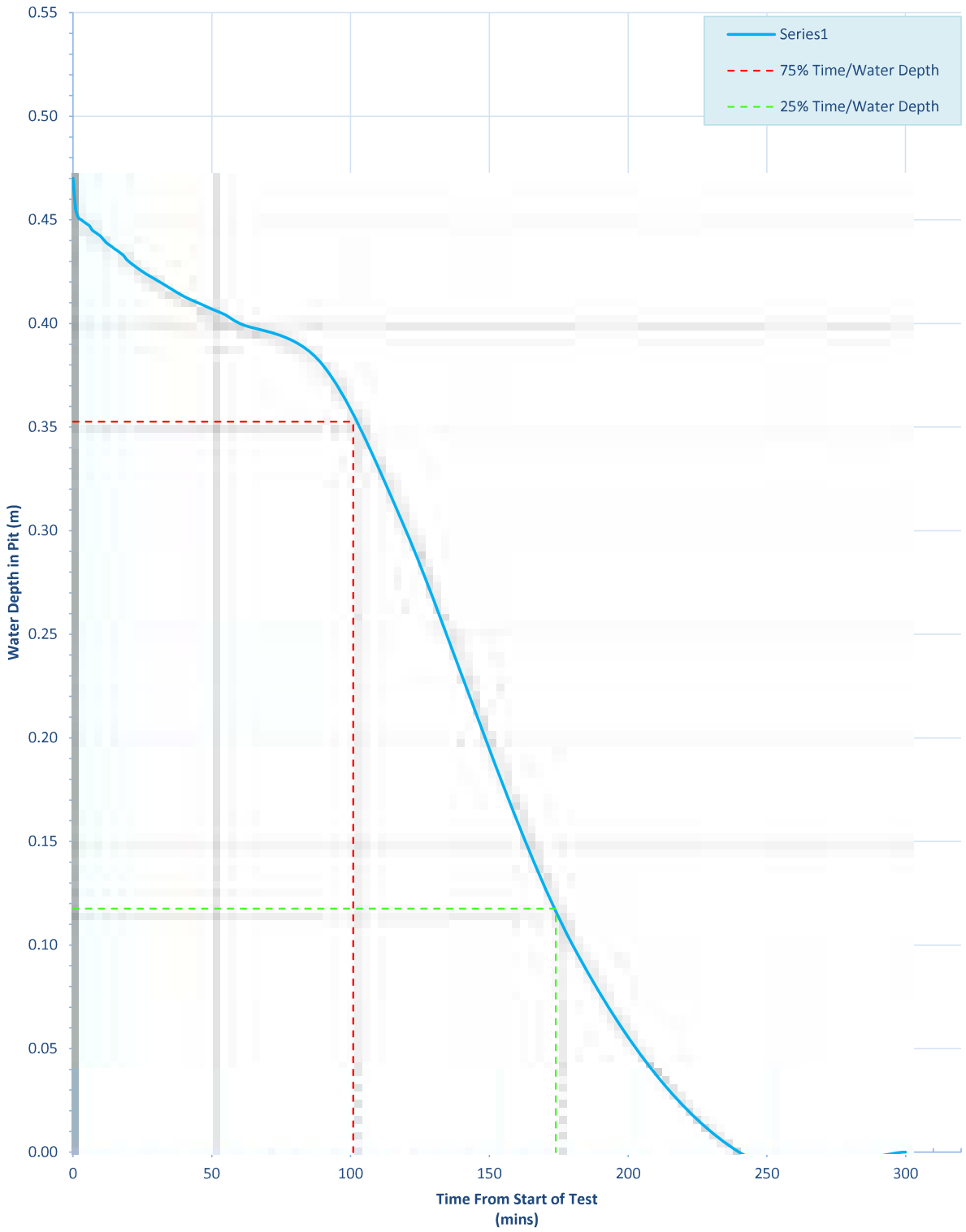
SOIL INFILTRATION RATE	1.73E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.470
09:01	1	0.455
09:02	2	0.451
09:03	3	0.450
09:04	4	0.449
09:05	5	0.448
09:06	6	0.447
09:07	7	0.445
09:08	8	0.444
09:09	9	0.443
09:10	10	0.442
09:15	12	0.439
09:30	14	0.437
09:45	16	0.435
10:00	18	0.433
10:15	20	0.430
10:30	25	0.425
10:45	30	0.421
11:00	35	0.417
11:30	40	0.413
12:00	45	0.410
12:30	50	0.407
13:00	55	0.404
13:30	60	0.400
14:00	90	0.380
14:30	120	0.300
15:00	180	0.100
15:30	240	0.000
16:00	300	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP06

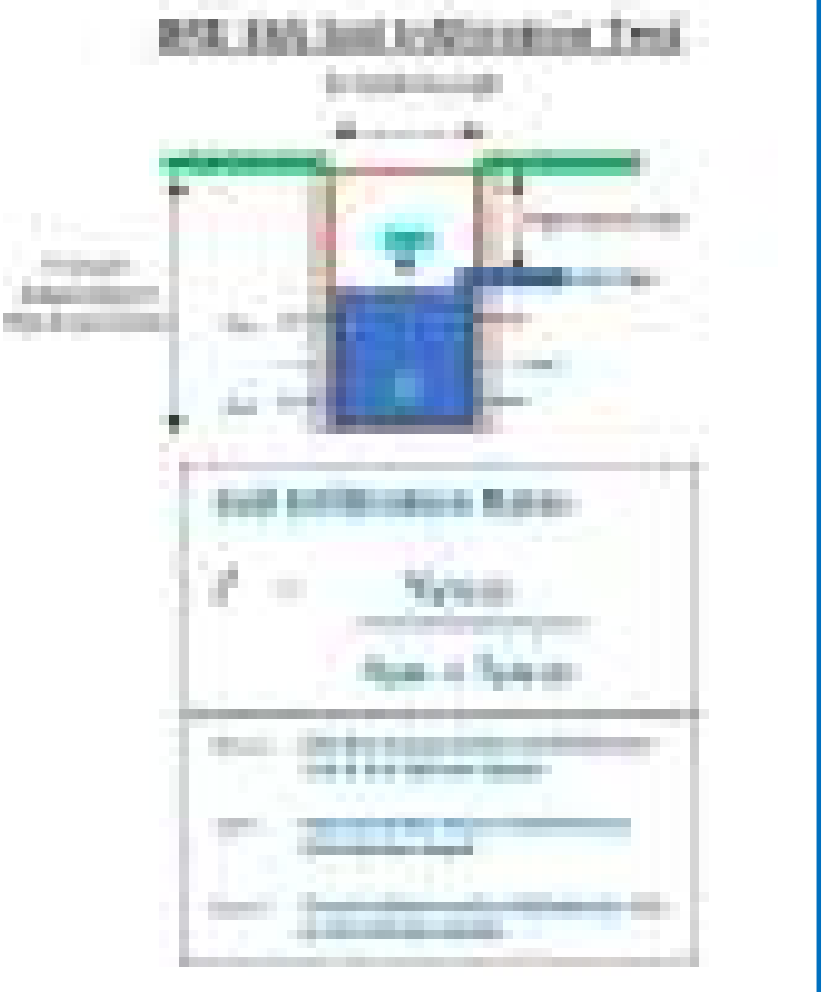


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP07
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.95
WATER SURFACE LEVEL (m)	0.33	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.62
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.36
75% Effective Water Depth (m)	0.465	25% Effective Water Depth (m)	0.155	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.2015
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	6.3	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	19	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	12.7

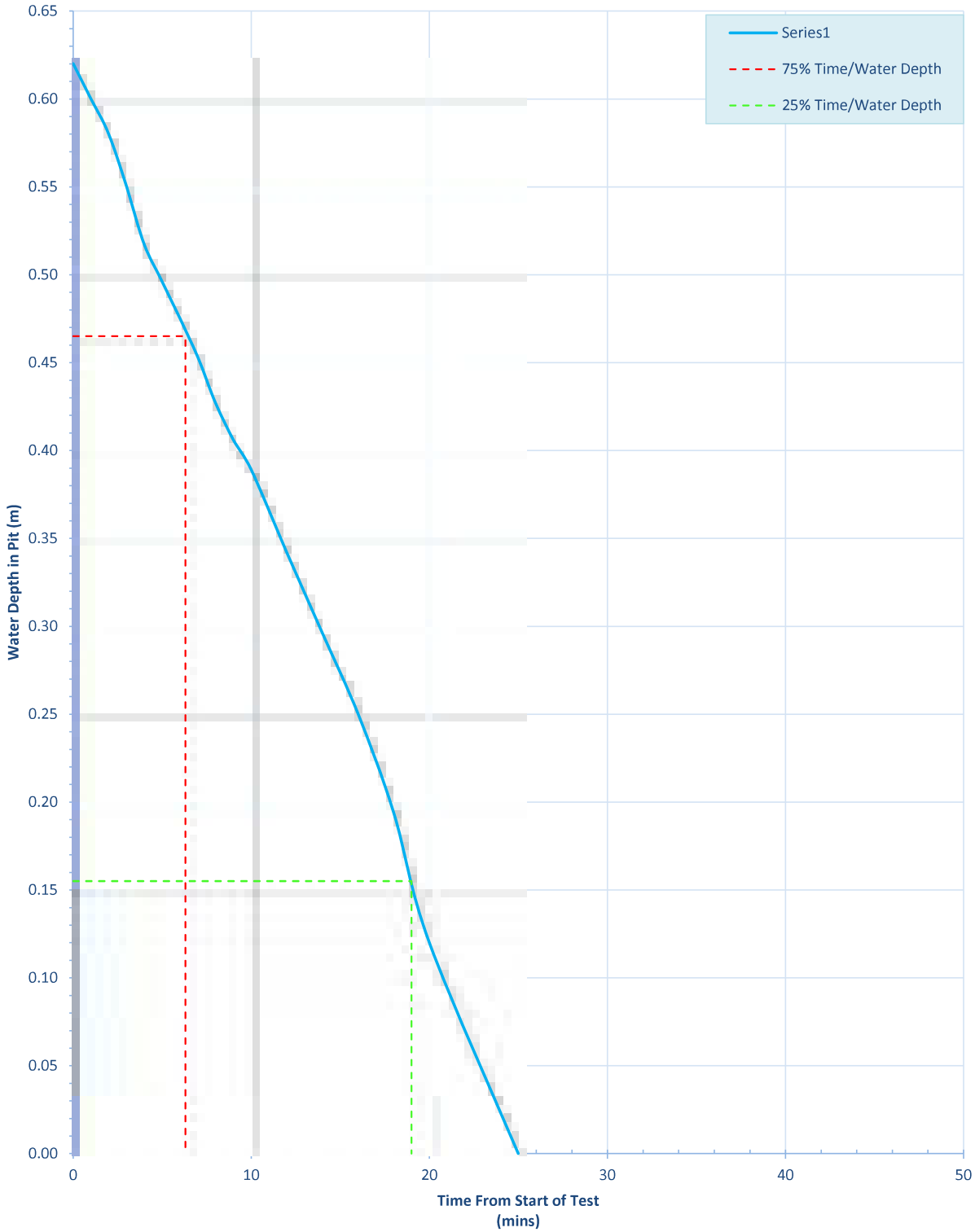
SOIL INFILTRATION RATE	1.12E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.620
09:01	1	0.600
09:02	2	0.580
09:03	3	0.550
09:04	4	0.517
09:05	5	0.496
09:06	6	0.475
09:07	7	0.453
09:08	8	0.427
09:09	9	0.406
09:10	10	0.389
09:15	12	0.342
09:30	14	0.296
09:45	16	0.250
10:00	18	0.194
10:15	20	0.120
10:30	25	0.000
10:45		



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.95	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP07

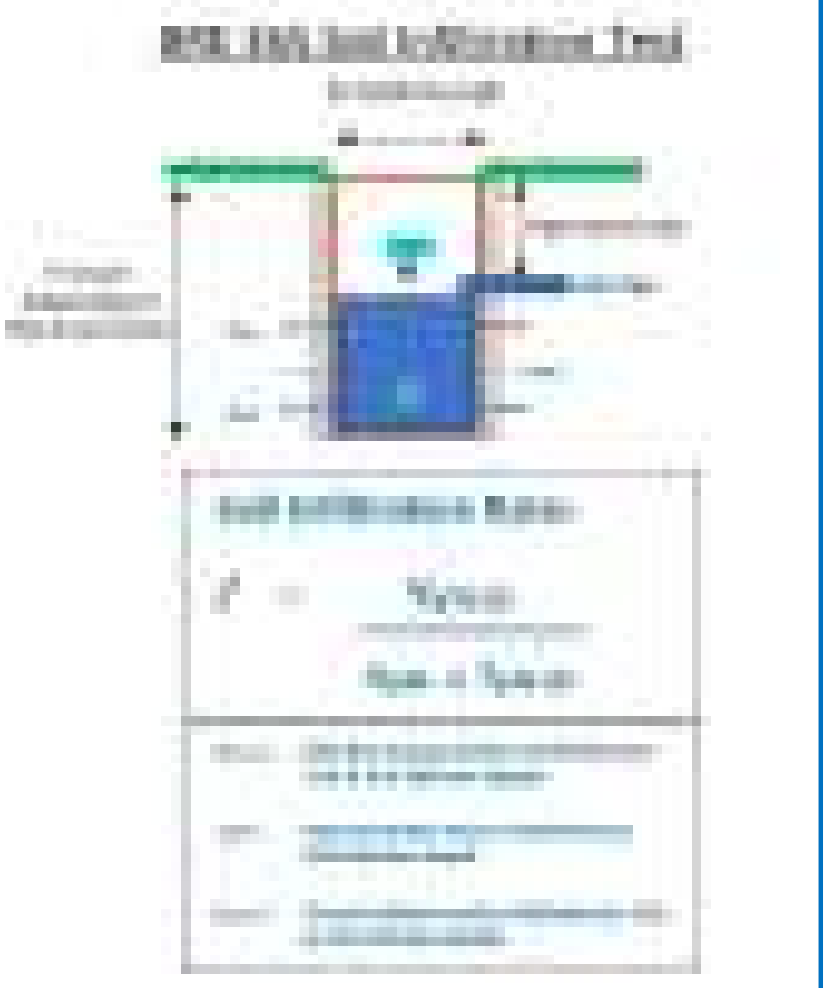


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP07
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.95
WATER SURFACE LEVEL (m)	0.34	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.61
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.36
75% Effective Water Depth (m)	0.4575	25% Effective Water Depth (m)	0.1525	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.19825
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	8	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	23.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	15.5

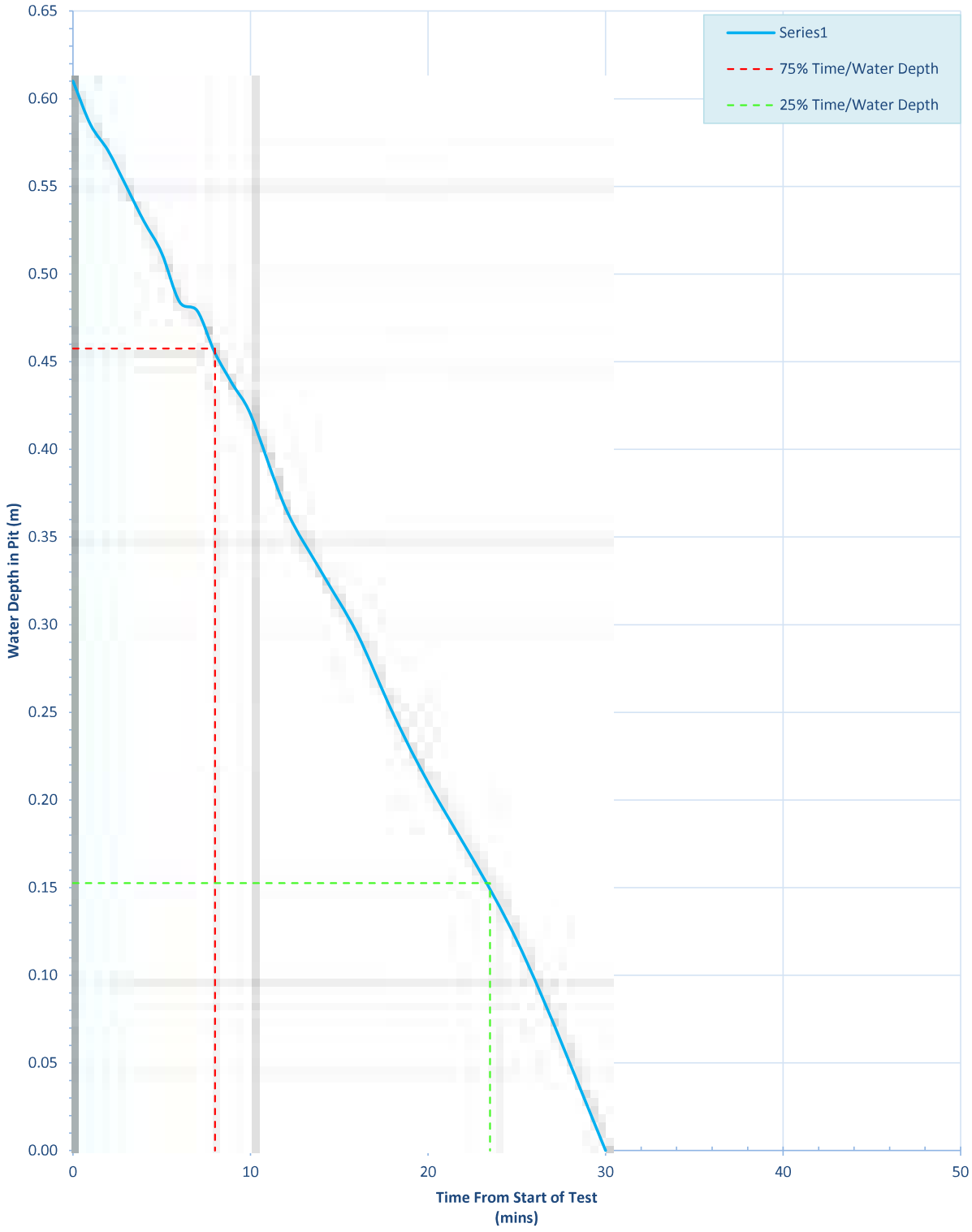
SOIL INFILTRATION RATE	9.03E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.610
09:01	1	0.585
09:02	2	0.570
09:03	3	0.550
09:04	4	0.530
09:05	5	0.512
09:06	6	0.484
09:07	7	0.479
09:08	8	0.455
09:09	9	0.437
09:10	10	0.420
09:15	12	0.366
09:30	14	0.330
09:45	16	0.295
10:00	18	0.250
10:15	20	0.210
10:30	25	0.120
10:45	30	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	0.95	**SOIL TYPE**	Light brown silty, sandy, gravelly CLAY	**TP07**

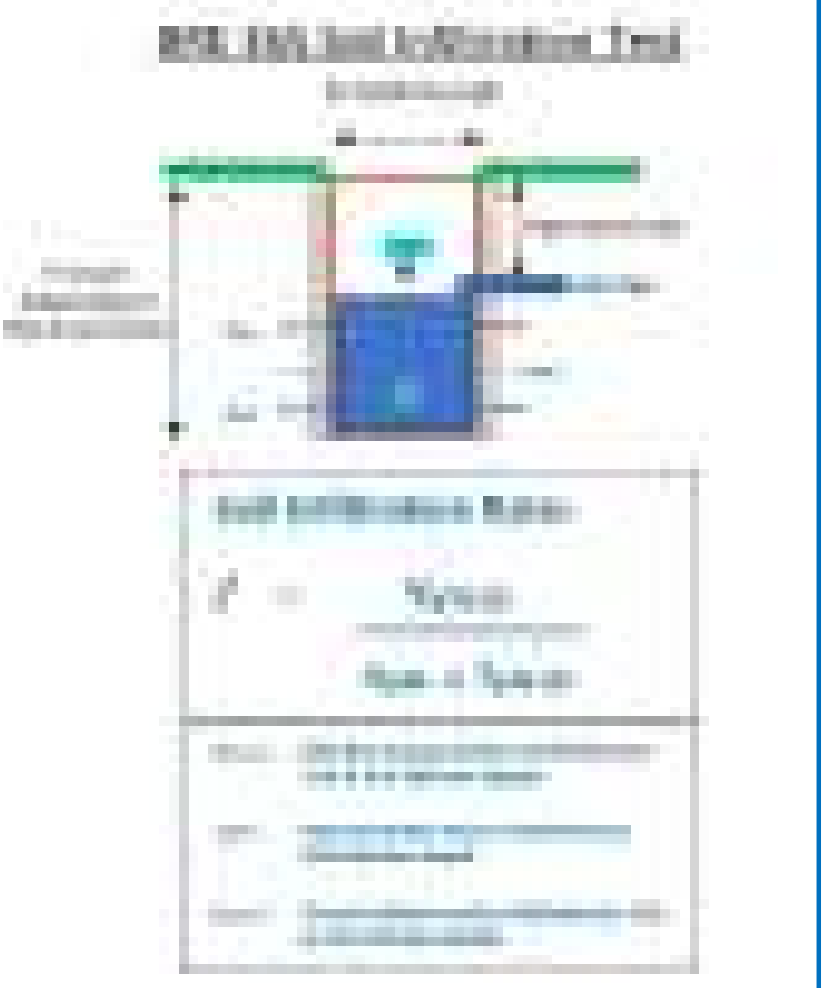


BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP07
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.30	TEST PIT DEPTH (m)	0.95
WATER SURFACE LEVEL (m)	0.32	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.63
BASE SURFACE AREA (m2)	0.65	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.36
75% Effective Water Depth (m)	0.4725	25% Effective Water Depth (m)	0.1575	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.20475
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	8.8	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	26	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	17.2

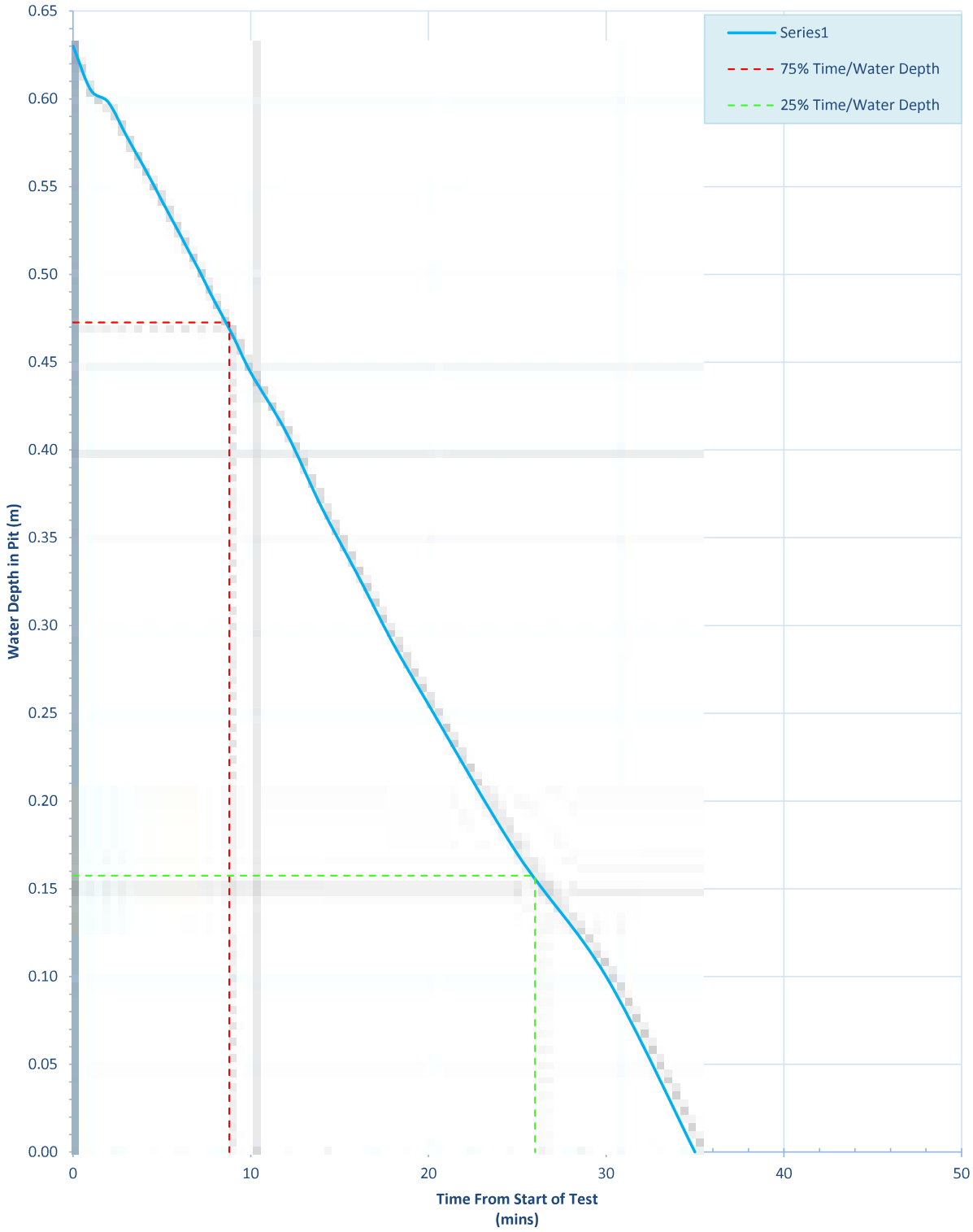
SOIL INFILTRATION RATE	8.41E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.630
09:01	1	0.605
09:02	2	0.598
09:03	3	0.579
09:04	4	0.561
09:05	5	0.542
09:06	6	0.523
09:07	7	0.504
09:08	8	0.484
09:09	9	0.465
09:10	10	0.444
09:15	12	0.410
09:30	14	0.367
09:45	16	0.329
10:00	18	0.290
10:15	20	0.255
10:30	25	0.170
10:45	30	0.100
11:00	35	0.000



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.95	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP07



BRE 365 SOIL INFILTRATION TEST

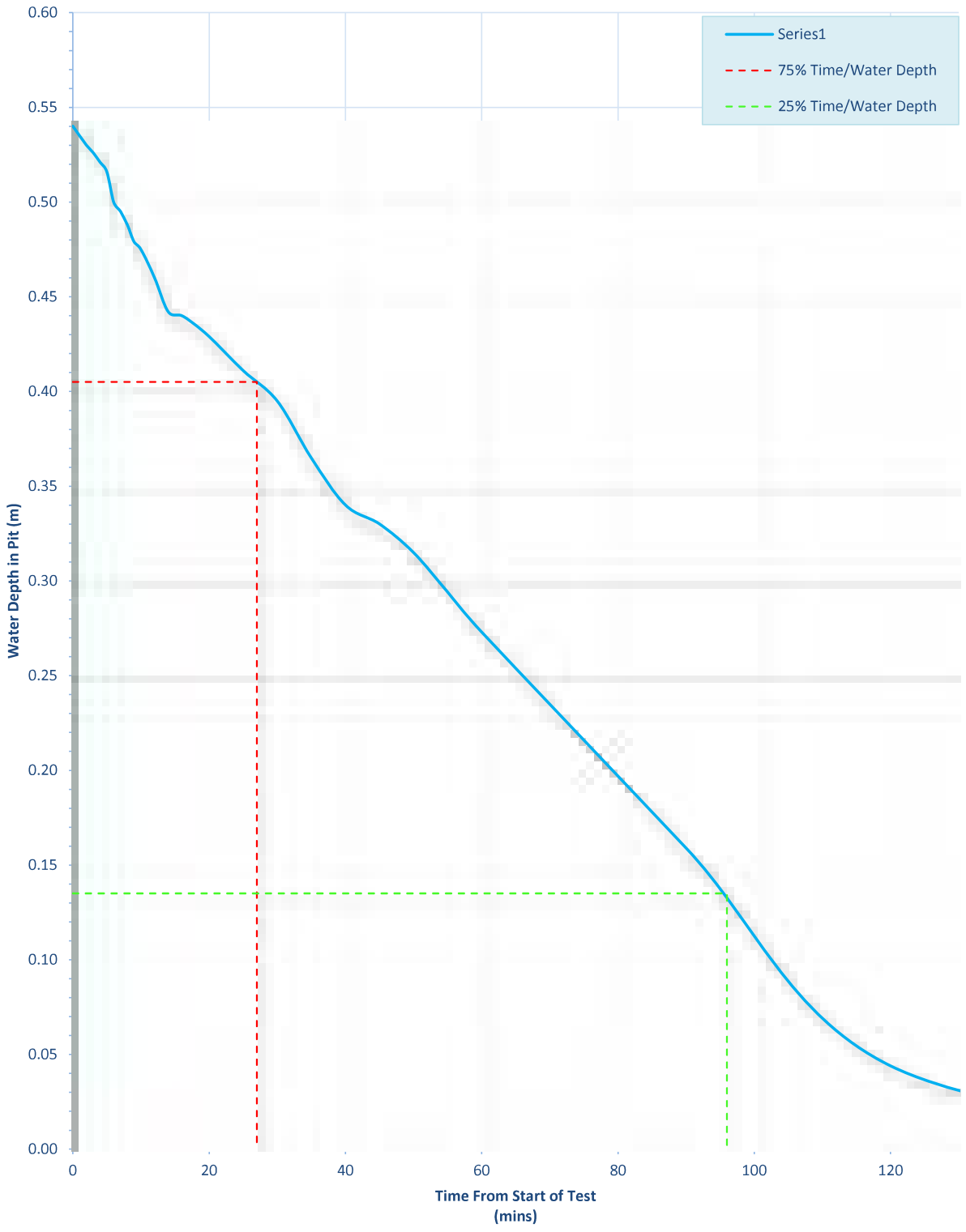
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP08
INFILTRATION TEST No.	1	SOIL TYPE	Grey, sandy, organic, clayey SILT	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.26	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.54
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.04	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.22
75% Effective Water Depth (m)	0.405	25% Effective Water Depth (m)	0.135	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.189
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	27	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	96	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	69

SOIL INFILTRATION RATE	2.06E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.540
09:01	1	0.535
09:02	2	0.530
09:03	3	0.526
09:04	4	0.521
09:05	5	0.516
09:06	6	0.500
09:07	7	0.495
09:08	8	0.488
09:09	9	0.479
09:10	10	0.475
09:15	12	0.460
09:30	14	0.442
09:45	16	0.440
10:00	18	0.435
10:15	20	0.429
10:30	25	0.411
10:45	30	0.395
11:00	35	0.365
11:30	40	0.340
12:00	45	0.330
12:30	50	0.315
13:00	55	0.294
13:30	60	0.273
14:00	90	0.159
14:30	120	0.044
15:00	180	0.000
15:30	240	

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1	SOIL TYPE	Grey, sandy, organic, clayey SILT	TP08



BRE 365 SOIL INFILTRATION TEST

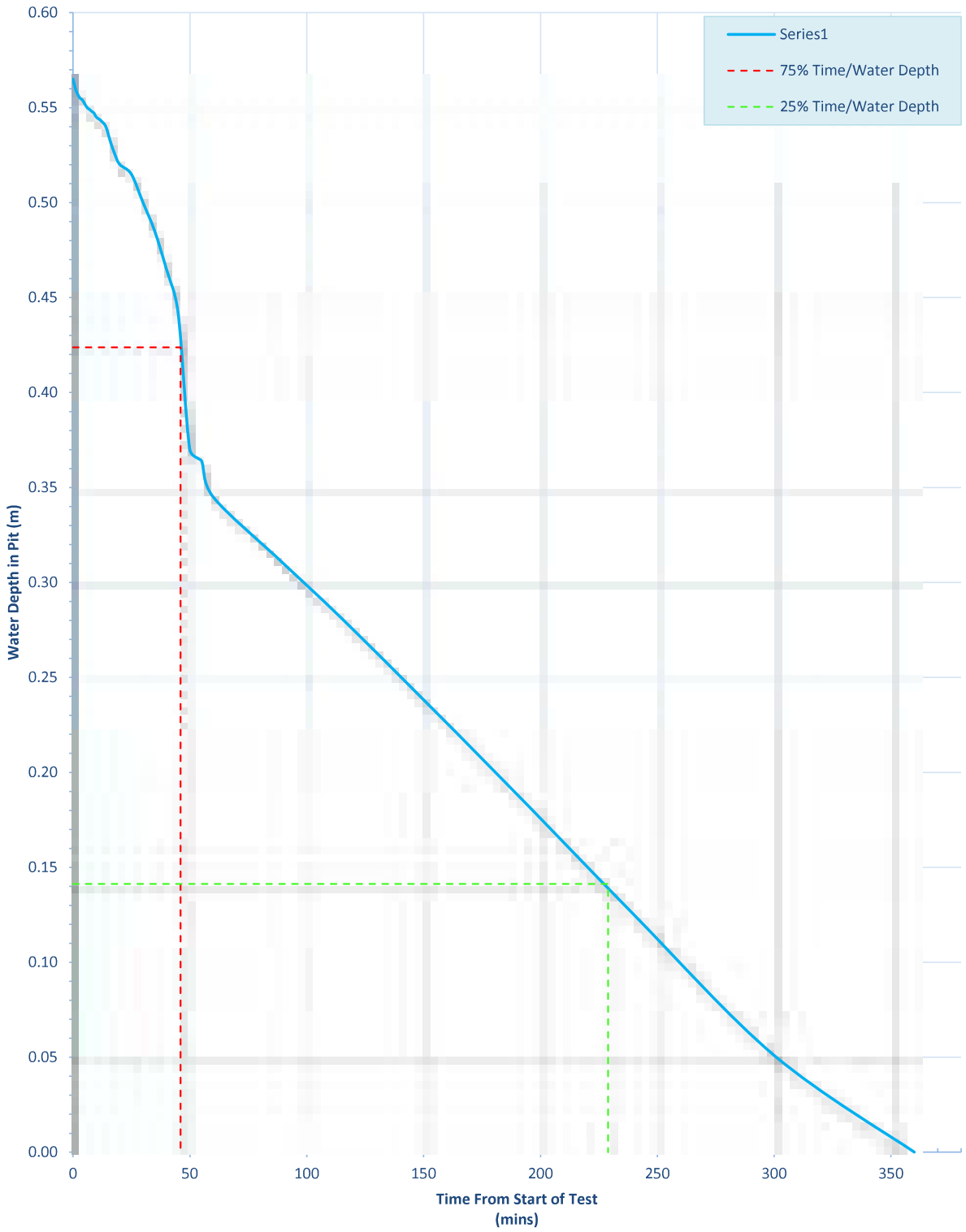
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP08
INFILTRATION TEST No.	2	SOIL TYPE	Grey, sandy, organic, clayey SILT	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.24	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.57
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.04	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.22
75% Effective Water Depth (m)	0.42375	25% Effective Water Depth (m)	0.14125	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.19775
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	46	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	229	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	183

SOIL INFILTRATION RATE	8.11E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.565
09:01	1	0.560
09:02	2	0.557
09:03	3	0.555
09:04	4	0.554
09:05	5	0.552
09:06	6	0.550
09:07	7	0.549
09:08	8	0.548
09:09	9	0.547
09:10	10	0.545
09:15	12	0.543
09:30	14	0.540
09:45	16	0.532
10:00	18	0.525
10:15	20	0.520
10:30	25	0.515
10:45	30	0.500
11:00	35	0.485
11:30	40	0.465
12:00	45	0.442
12:30	50	0.370
13:00	55	0.364
13:30	60	0.345
14:00	90	0.310
14:30	120	0.275
15:00	180	0.201
15:30	240	0.125
16:00	300	0.051
16:30	360	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	2	SOIL TYPE	Grey, sandy, organic, clayey SILT	TP08



BRE 365 SOIL INFILTRATION TEST

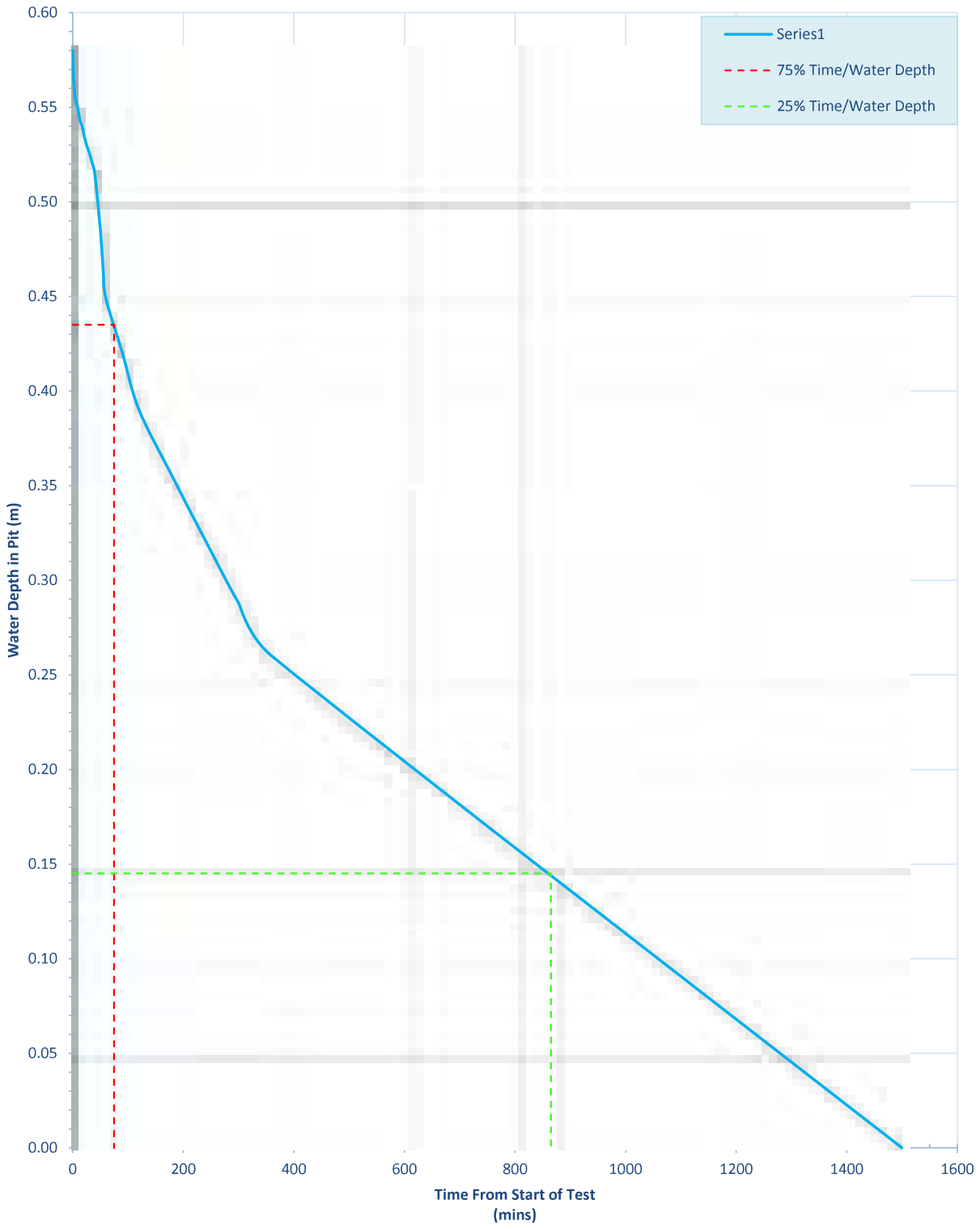
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP08
INFILTRATION TEST No.	3	SOIL TYPE	Grey, sandy, organic, clayey SILT	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.22	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.58
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.04	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.22
75% Effective Water Depth (m)	0.435	25% Effective Water Depth (m)	0.145	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.203
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	75	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	865	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	790

SOIL INFILTRATION RATE	1.93E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.580
09:01	1	0.570
09:02	2	0.564
09:03	3	0.560
09:04	4	0.556
09:05	5	0.554
09:06	6	0.553
09:07	7	0.552
09:08	8	0.551
09:09	9	0.550
09:10	10	0.548
09:15	12	0.545
09:30	14	0.542
09:45	16	0.541
10:00	18	0.539
10:15	20	0.536
10:30	25	0.530
10:45	30	0.526
11:00	35	0.521
11:30	40	0.515
12:00	45	0.501
12:30	50	0.485
13:00	55	0.465
13:30	60	0.449
14:00	90	0.420
14:30	120	0.390
15:00	180	0.355
15:30	240	0.321
16:00	300	0.288
16:30	360	0.260
17:00	1500	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	3	SOIL TYPE	Grey, sandy, organic, clayey SILT	TP08



BRE 365 SOIL INFILTRATION TEST

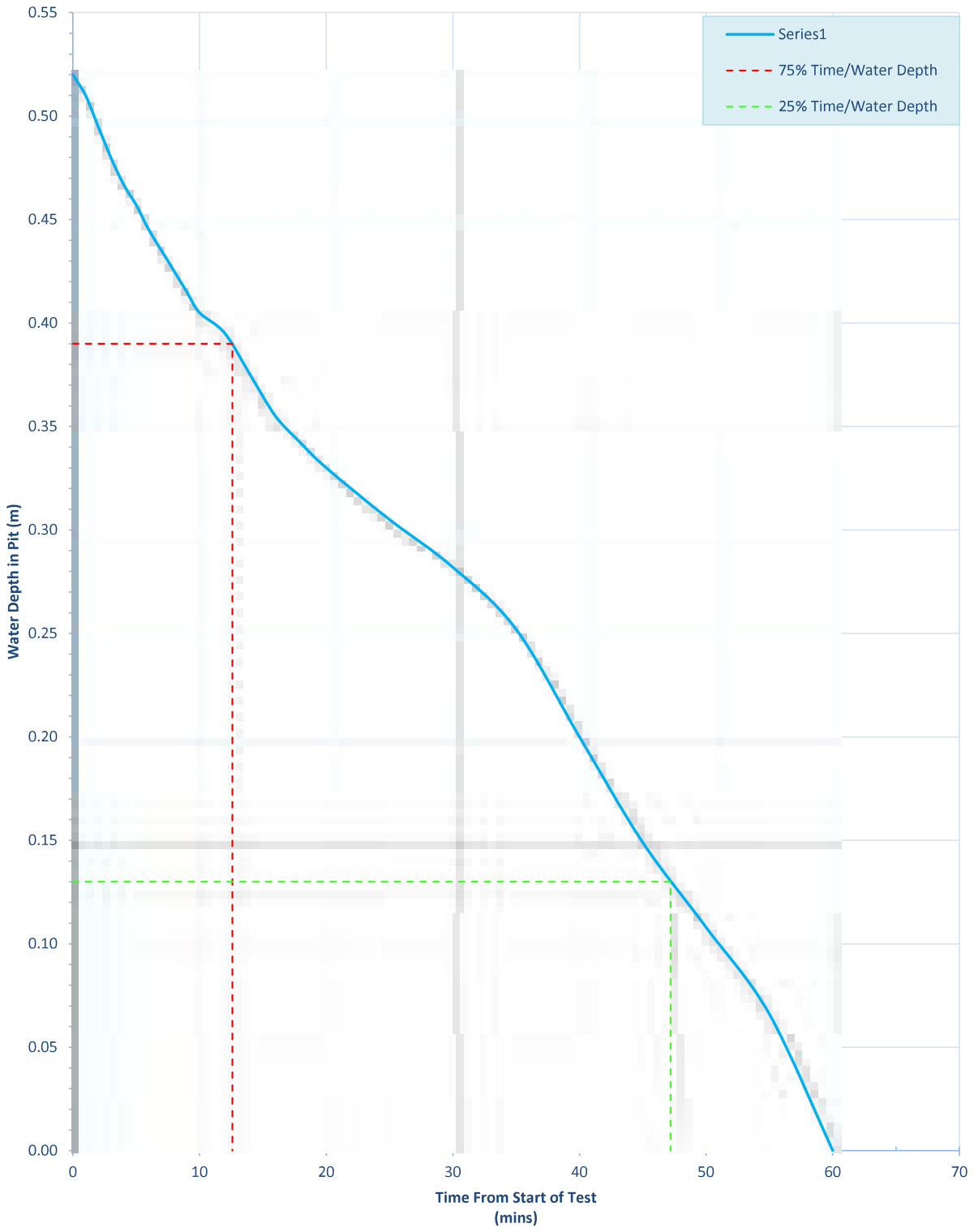
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP09
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.18	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.52
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	2.66	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.03
75% Effective Water Depth (m)	0.39	25% Effective Water Depth (m)	0.13	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.182
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	12.6	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	47.2	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	34.6

SOIL INFILTRATION RATE	4.32E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.520
09:01	1	0.510
09:02	2	0.495
09:03	3	0.480
09:04	4	0.467
09:05	5	0.457
09:06	6	0.445
09:07	7	0.435
09:08	8	0.425
09:09	9	0.415
09:10	10	0.405
09:15	12	0.395
09:30	14	0.375
09:45	16	0.355
10:00	18	0.342
10:15	20	0.330
10:30	25	0.305
10:45	30	0.282
11:00	35	0.252
11:30	40	0.200
12:00	45	0.149
12:30	50	0.108
13:00	55	0.066
13:30	60	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP09



BRE 365 SOIL INFILTRATION TEST

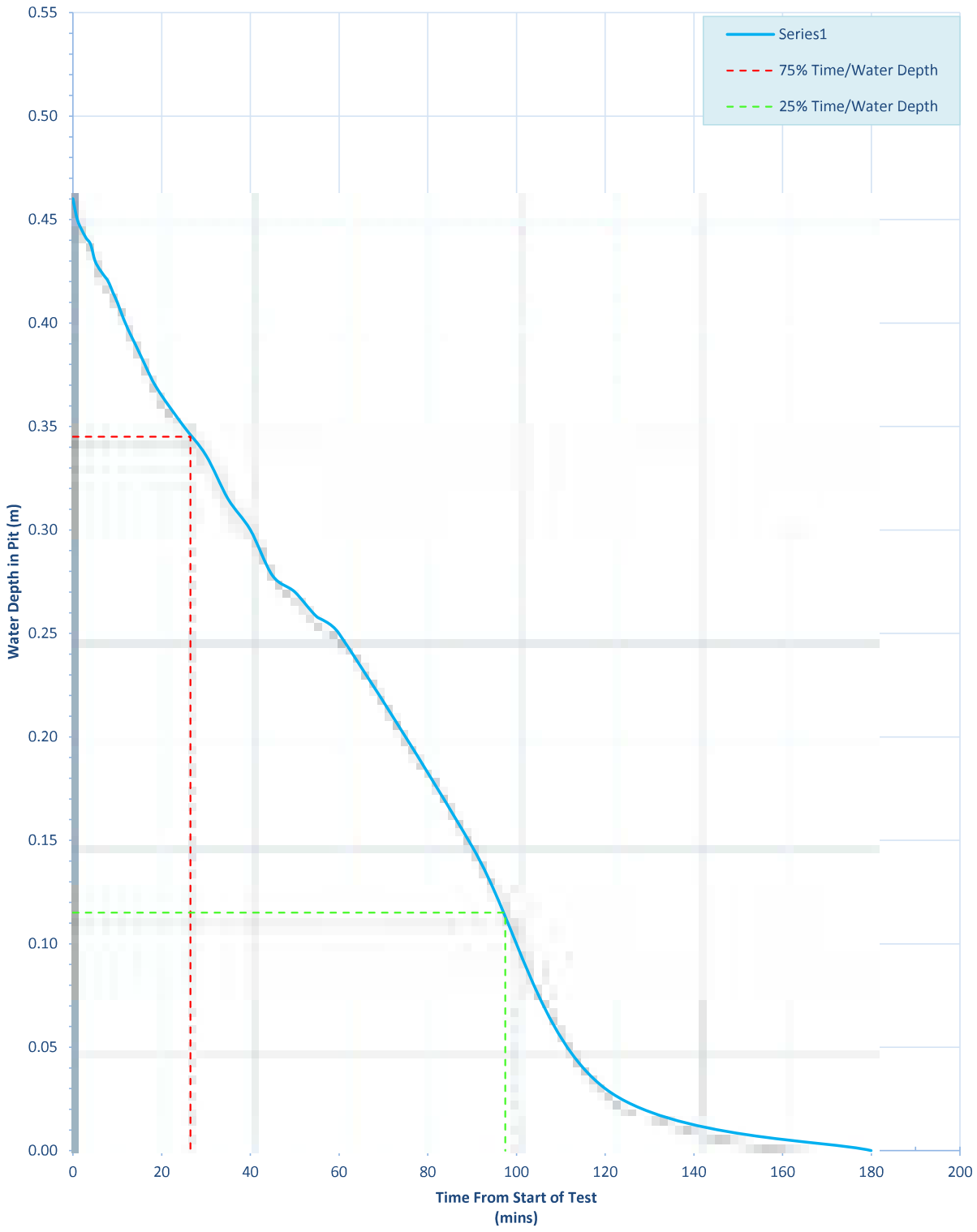
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP09
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.24	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.46
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	2.66	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.03
75% Effective Water Depth (m)	0.345	25% Effective Water Depth (m)	0.115	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.161
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	26.5	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	97.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	71

SOIL INFILTRATION RATE	1.86E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.460
09:01	1	0.450
09:02	2	0.445
09:03	3	0.441
09:04	4	0.438
09:05	5	0.430
09:06	6	0.426
09:07	7	0.423
09:08	8	0.420
09:09	9	0.415
09:10	10	0.410
09:15	12	0.399
09:30	14	0.390
09:45	16	0.381
10:00	18	0.372
10:15	20	0.365
10:30	25	0.350
10:45	30	0.336
11:00	35	0.315
11:30	40	0.300
12:00	45	0.278
12:30	50	0.270
13:00	55	0.258
13:30	60	0.250
14:00	90	0.147
14:30	120	0.030
15:00	180	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP09



BRE 365 SOIL INFILTRATION TEST

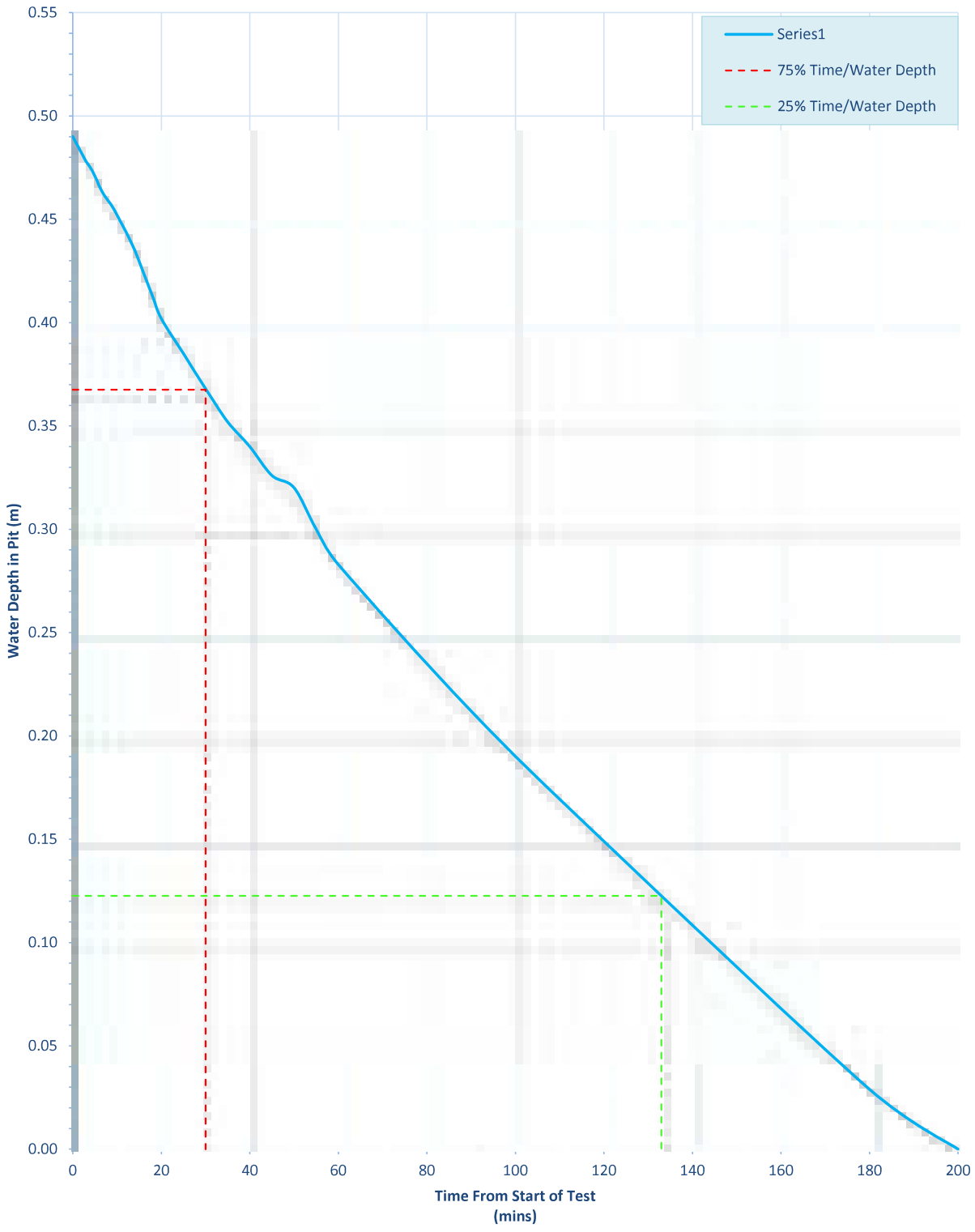
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP09
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.21	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.49
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	2.66	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.03
75% Effective Water Depth (m)	0.3675	25% Effective Water Depth (m)	0.1225	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1715
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	30	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	133	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	103

SOIL INFILTRATION RATE	1.37E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.490
09:01	1	0.486
09:02	2	0.482
09:03	3	0.478
09:04	4	0.475
09:05	5	0.471
09:06	6	0.466
09:07	7	0.462
09:08	8	0.459
09:09	9	0.456
09:10	10	0.452
09:15	12	0.444
09:30	14	0.435
09:45	16	0.424
10:00	18	0.413
10:15	20	0.402
10:30	25	0.385
10:45	30	0.368
11:00	35	0.352
11:30	40	0.340
12:00	45	0.326
12:30	50	0.320
13:00	55	0.300
13:30	60	0.283
14:00	90	0.212
14:30	120	0.149
15:00	180	0.029
15:30	200	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP09



BRE 365 SOIL INFILTRATION TEST

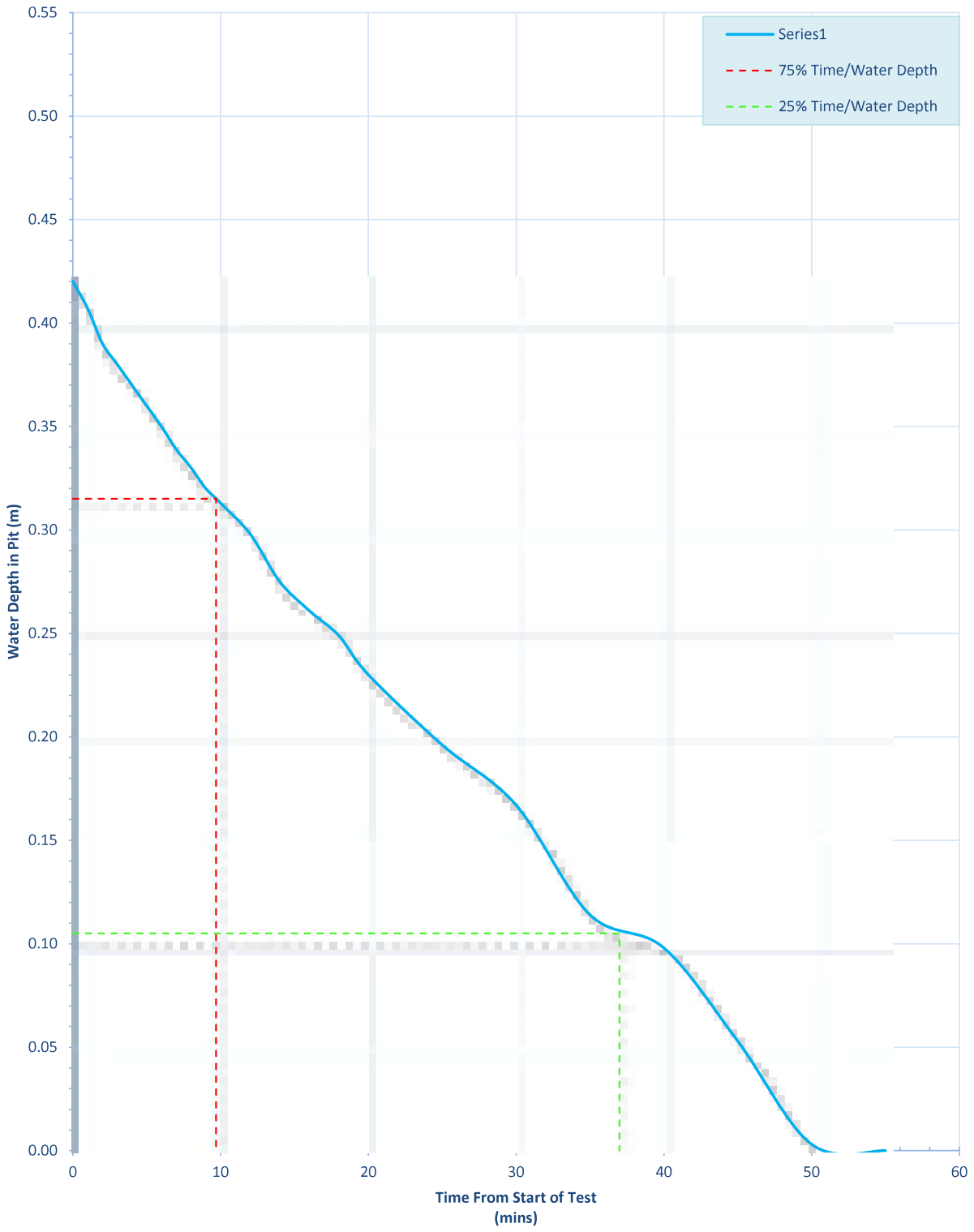
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP10
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.28	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.42
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	2.80	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.15
75% Effective Water Depth (m)	0.315	25% Effective Water Depth (m)	0.105	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1575
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	9.7	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	37	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	27.3

SOIL INFILTRATION RATE	4.47E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.420
09:01	1	0.407
09:02	2	0.390
09:03	3	0.380
09:04	4	0.370
09:05	5	0.360
09:06	6	0.350
09:07	7	0.339
09:08	8	0.330
09:09	9	0.320
09:10	10	0.313
09:15	12	0.298
09:30	14	0.275
09:45	16	0.261
10:00	18	0.249
10:15	20	0.230
10:30	25	0.196
10:45	30	0.167
11:00	35	0.114
11:30	40	0.098
12:00	45	0.053
12:30	50	0.003
13:00	55	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP10



BRE 365 SOIL INFILTRATION TEST

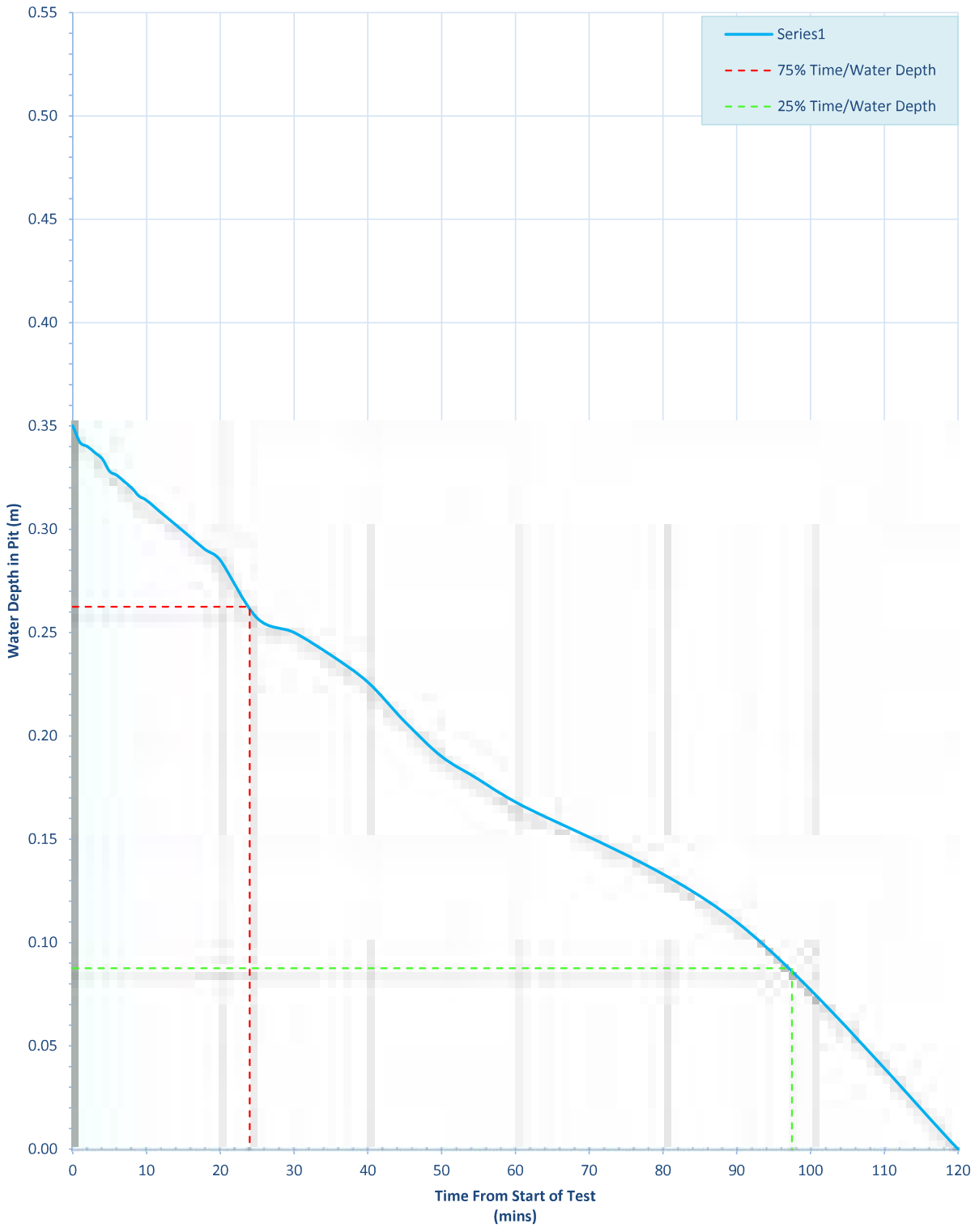
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP10
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.35	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.35
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	2.80	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.15
75% Effective Water Depth (m)	0.2625	25% Effective Water Depth (m)	0.0875	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.13125
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	24	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	97.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	73.5

SOIL INFILTRATION RATE	1.38E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.350
09:01	1	0.342
09:02	2	0.340
09:03	3	0.337
09:04	4	0.334
09:05	5	0.328
09:06	6	0.326
09:07	7	0.323
09:08	8	0.320
09:09	9	0.316
09:10	10	0.314
09:15	12	0.308
09:30	14	0.302
09:45	16	0.296
10:00	18	0.290
10:15	20	0.285
10:30	25	0.257
10:45	30	0.250
11:00	35	0.239
11:30	40	0.226
12:00	45	0.207
12:30	50	0.190
13:00	55	0.179
13:30	60	0.168
14:00	90	0.110
14:30	120	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP10



BRE 365 SOIL INFILTRATION TEST

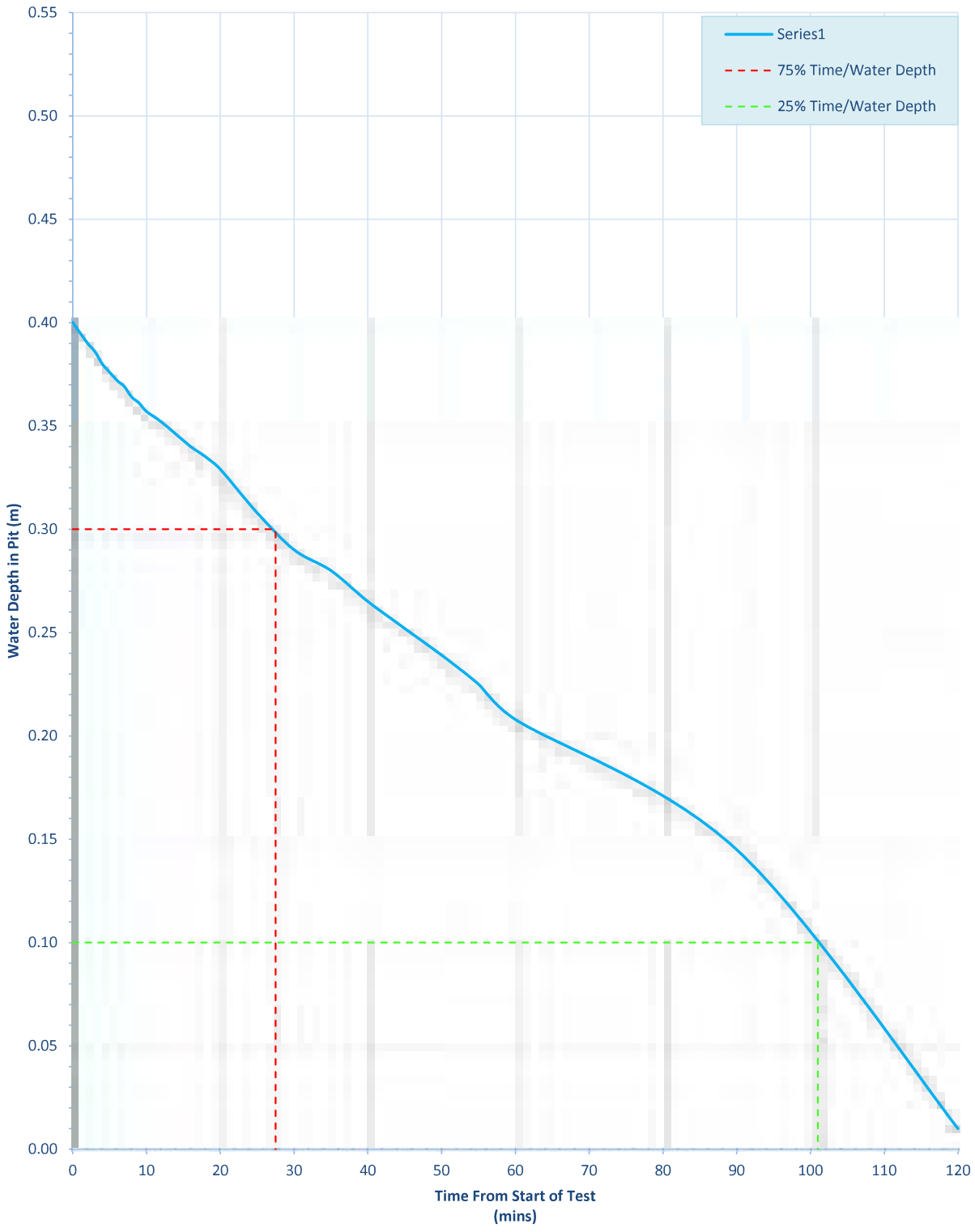
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP10
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.70
WATER SURFACE LEVEL (m)	0.30	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.40
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	2.80	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.15
75% Effective Water Depth (m)	0.3	25% Effective Water Depth (m)	0.1	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.15
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	27.5	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	101	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	73.5

SOIL INFILTRATION RATE	1.58E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.400
09:01	1	0.395
09:02	2	0.390
09:03	3	0.386
09:04	4	0.380
09:05	5	0.376
09:06	6	0.372
09:07	7	0.369
09:08	8	0.364
09:09	9	0.361
09:10	10	0.357
09:15	12	0.352
09:30	14	0.346
09:45	16	0.340
10:00	18	0.335
10:15	20	0.329
10:30	25	0.308
10:45	30	0.290
11:00	35	0.280
11:30	40	0.265
12:00	45	0.252
12:30	50	0.239
13:00	55	0.225
13:30	60	0.208
14:00	90	0.145
14:30	120	0.010

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.70	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP10



BRE 365 SOIL INFILTRATION TEST

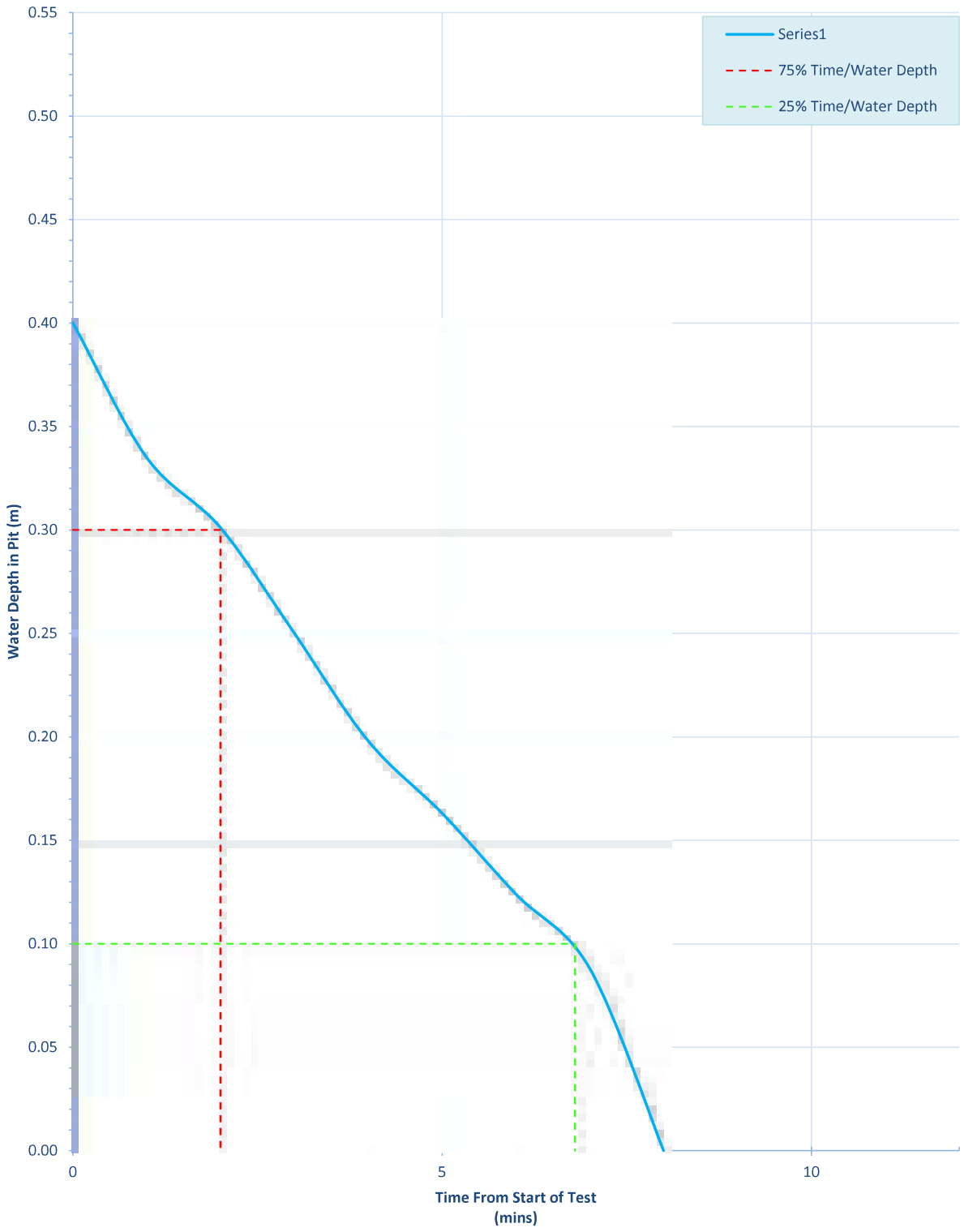
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP11
INFILTRATION TEST No.	1	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.40	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.40
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	3.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.35
75% Effective Water Depth (m)	0.3	25% Effective Water Depth (m)	0.1	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.15
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	2	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	6.8	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	4.8

SOIL INFILTRATION RATE	2.22E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.400
09:01	1	0.335
09:02	2	0.301
09:03	3	0.250
09:04	4	0.198
09:05	5	0.163
09:06	6	0.124
09:07	7	0.088
09:08	8	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP11



BRE 365 SOIL INFILTRATION TEST

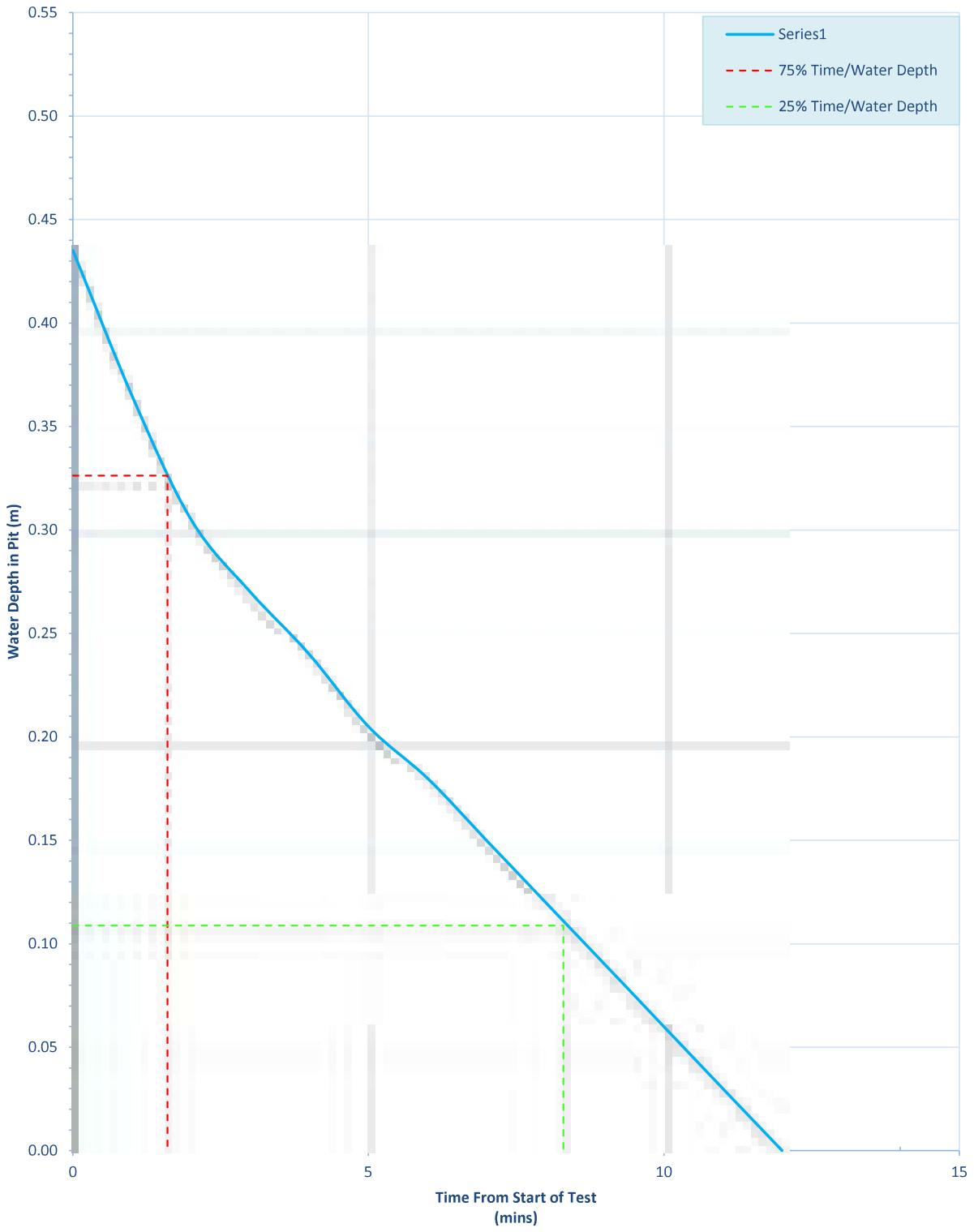
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP11
INFILTRATION TEST No.	2	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.37	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.44
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	3.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.35
75% Effective Water Depth (m)	0.32625	25% Effective Water Depth (m)	0.10875	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.163125
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	1.6	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	8.3	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	6.7

SOIL INFILTRATION RATE	1.73E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.435
09:01	1	0.365
09:02	2	0.305
09:03	3	0.270
09:04	4	0.240
09:05	5	0.205
09:06	6	0.180
09:07	7	0.150
09:08	8	0.120
	9	0.090
	10	0.060
	12	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP11



BRE 365 SOIL INFILTRATION TEST

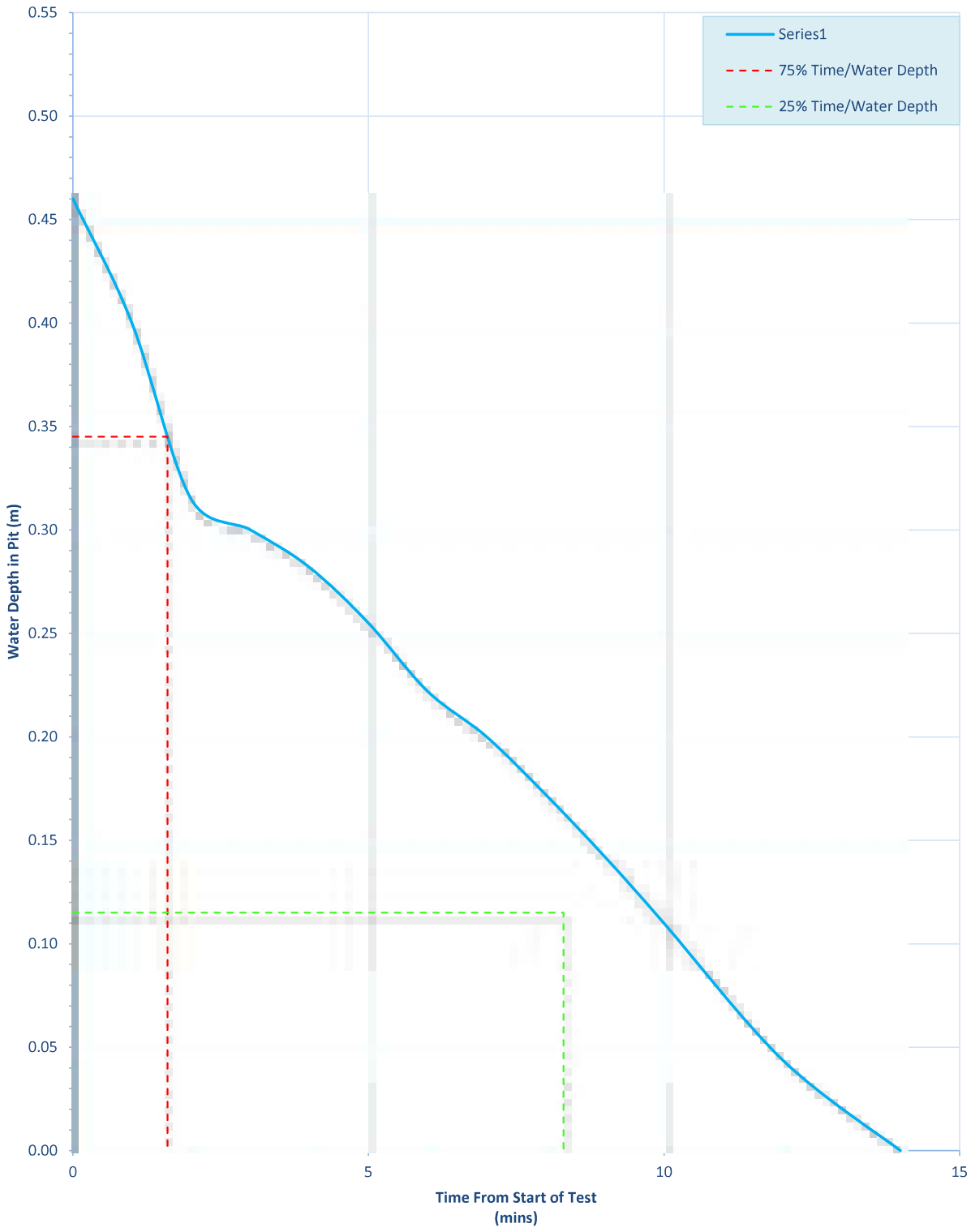
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP11
INFILTRATION TEST No.	3	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.34	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.46
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	3.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.35
75% Effective Water Depth (m)	0.345	25% Effective Water Depth (m)	0.115	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1725
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	1.6	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	8.3	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	6.7

SOIL INFILTRATION RATE	1.83E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
09:00	0	0.460
09:01	1	0.400
09:02	2	0.315
09:03	3	0.300
09:04	4	0.282
09:05	5	0.255
09:06	6	0.222
09:07	7	0.200
09:08	8	0.172
	9	0.142
	10	0.110
	12	0.044
	14	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	Light brown silty, sandy, gravelly CLAY	TP11



BRE 365 SOIL INFILTRATION TEST

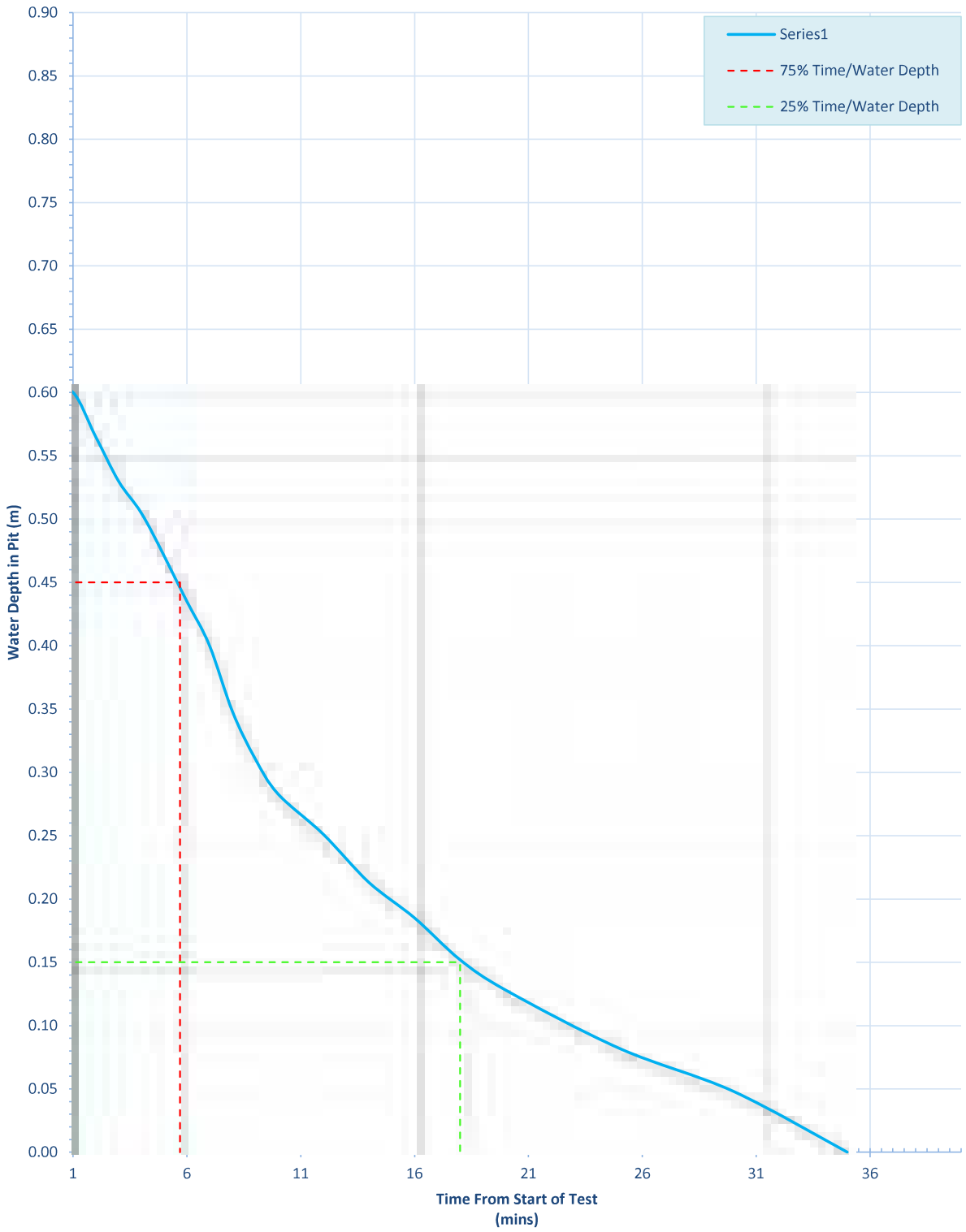
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP12
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.30	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.60
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.45	25% Effective Water Depth (m)	0.15	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.21
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	5.7	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	18	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	12.3

SOIL INFILTRATION RATE	1.18E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.600
10:31	1	0.600
10:32	2	0.565
10:33	3	0.530
10:34	4	0.505
10:35	5	0.471
10:36	6	0.435
10:37	7	0.400
10:38	8	0.348
10:39	9	0.311
10:40	10	0.283
10:42	12	0.251
10:44	14	0.213
10:46	16	0.185
10:48	18	0.152
10:50	20	0.128
10:55	25	0.082
11:00	30	0.048
11:05	35	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.90	SOIL TYPE	See TP Log	TP12



BRE 365 SOIL INFILTRATION TEST

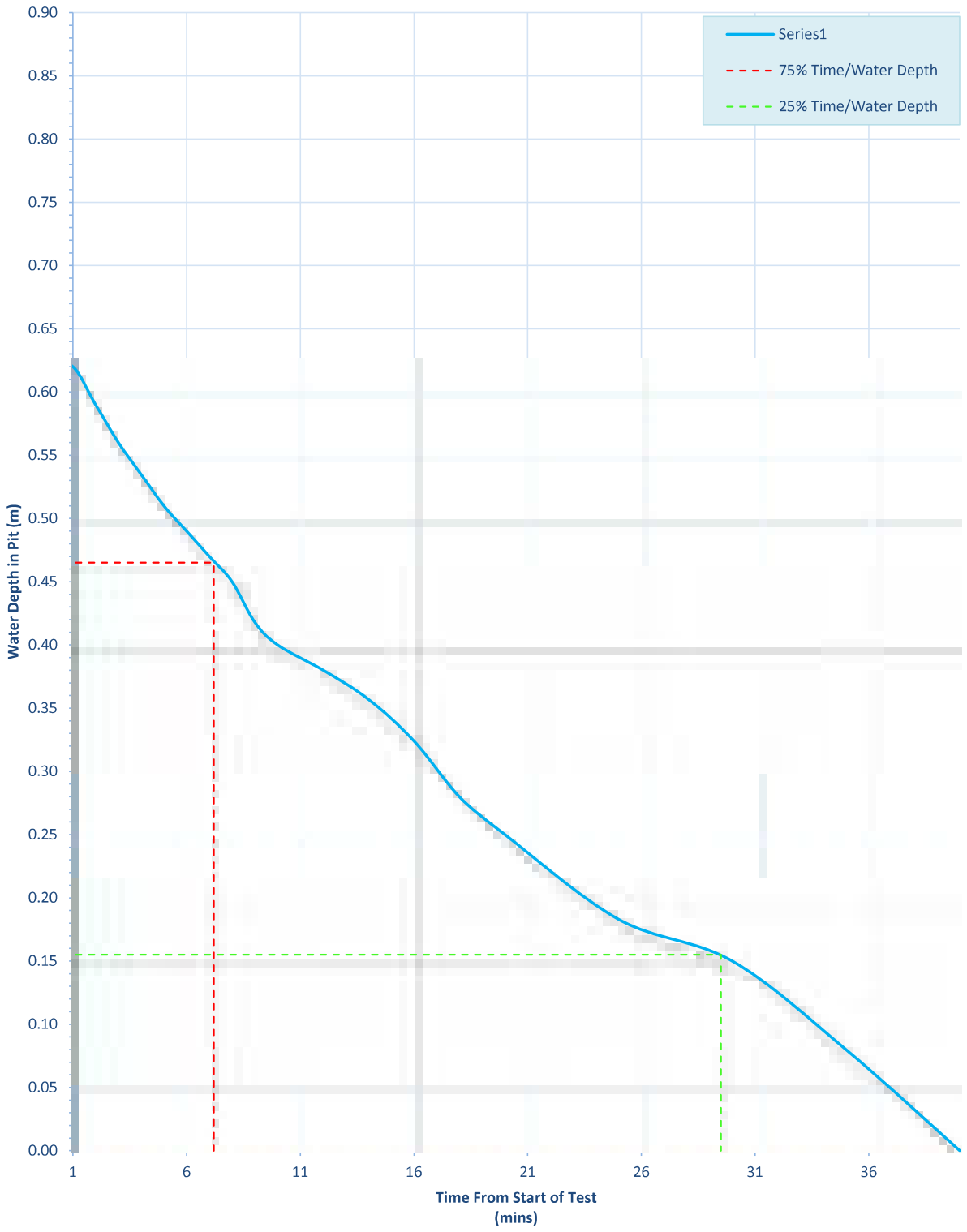
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP12
INFILTRATION TEST No.	2	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.28	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.62
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.465	25% Effective Water Depth (m)	0.155	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.217
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	7.2	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	29.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	22.3

SOIL INFILTRATION RATE	6.73E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.620
11:22	1	0.620
11:23	2	0.590
11:24	3	0.560
11:25	4	0.535
11:26	5	0.510
11:27	6	0.490
11:28	7	0.470
11:29	8	0.450
11:30	9	0.418
11:31	10	0.400
11:33	12	0.380
11:35	14	0.357
11:37	16	0.324
11:39	18	0.280
11:41	20	0.250
11:46	25	0.183
11:51	30	0.150
11:56	35	0.080
12:01	40	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	0.90	**SOIL TYPE**	See TP Log	**TP12**



BRE 365 SOIL INFILTRATION TEST

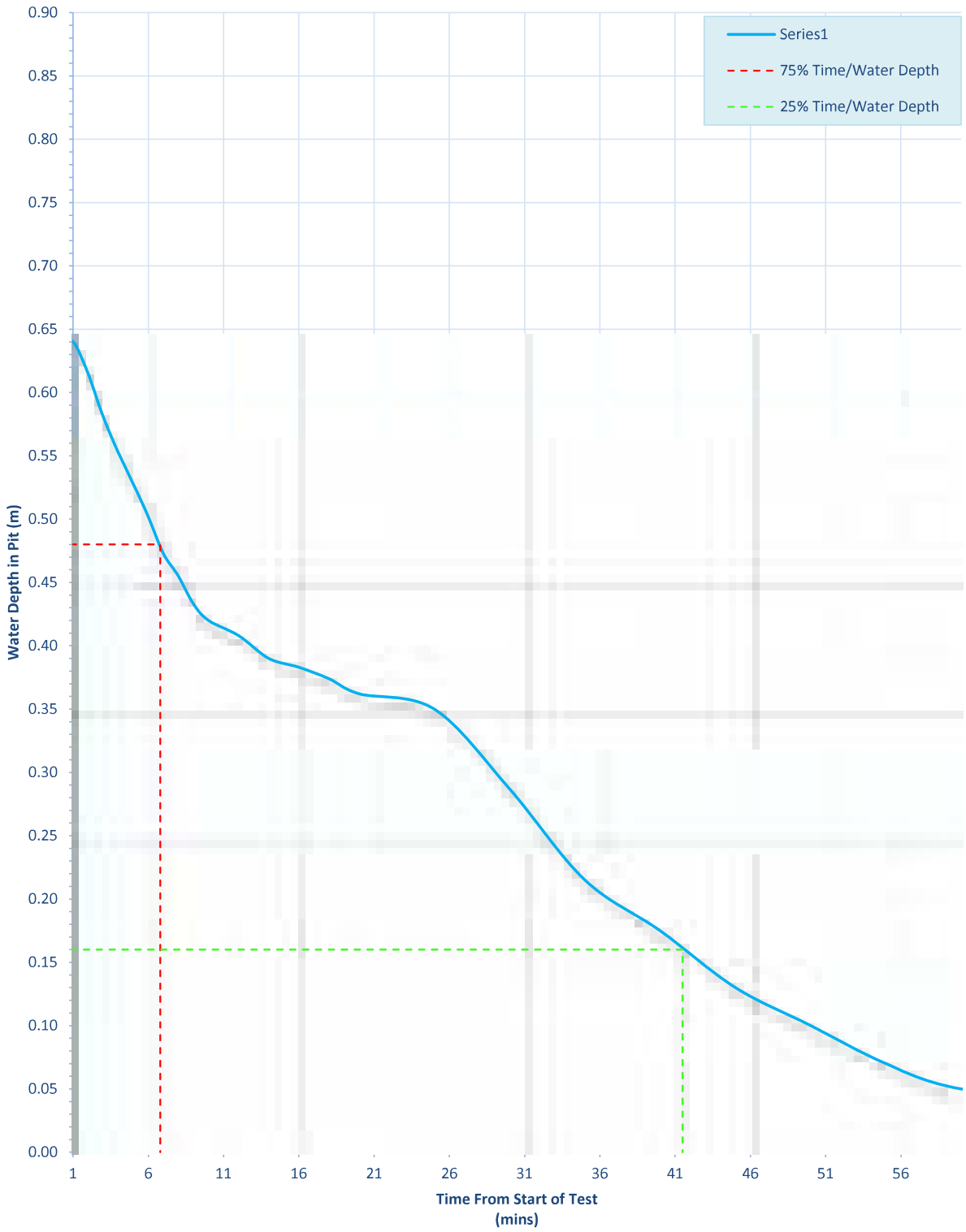
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP12
INFILTRATION TEST No.	3	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.26	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.64
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.48	25% Effective Water Depth (m)	0.16	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.224
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	6.8	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	41.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	34.7

SOIL INFILTRATION RATE	4.46E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.640
11:22	1	0.640
11:23	2	0.615
11:24	3	0.581
11:25	4	0.553
11:26	5	0.528
11:27	6	0.502
11:28	7	0.473
11:29	8	0.455
11:30	9	0.433
11:31	10	0.420
11:33	12	0.408
11:35	14	0.390
11:37	16	0.383
11:39	18	0.374
11:41	20	0.362
11:46	25	0.350
11:51	30	0.287
11:56	35	0.215
12:01	40	0.175
12:06	45	0.130
12:11	50	0.100
12:16	55	0.070
12:21	60	0.050
12:51	90	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.90	SOIL TYPE	See TP Log	TP12



BRE 365 SOIL INFILTRATION TEST

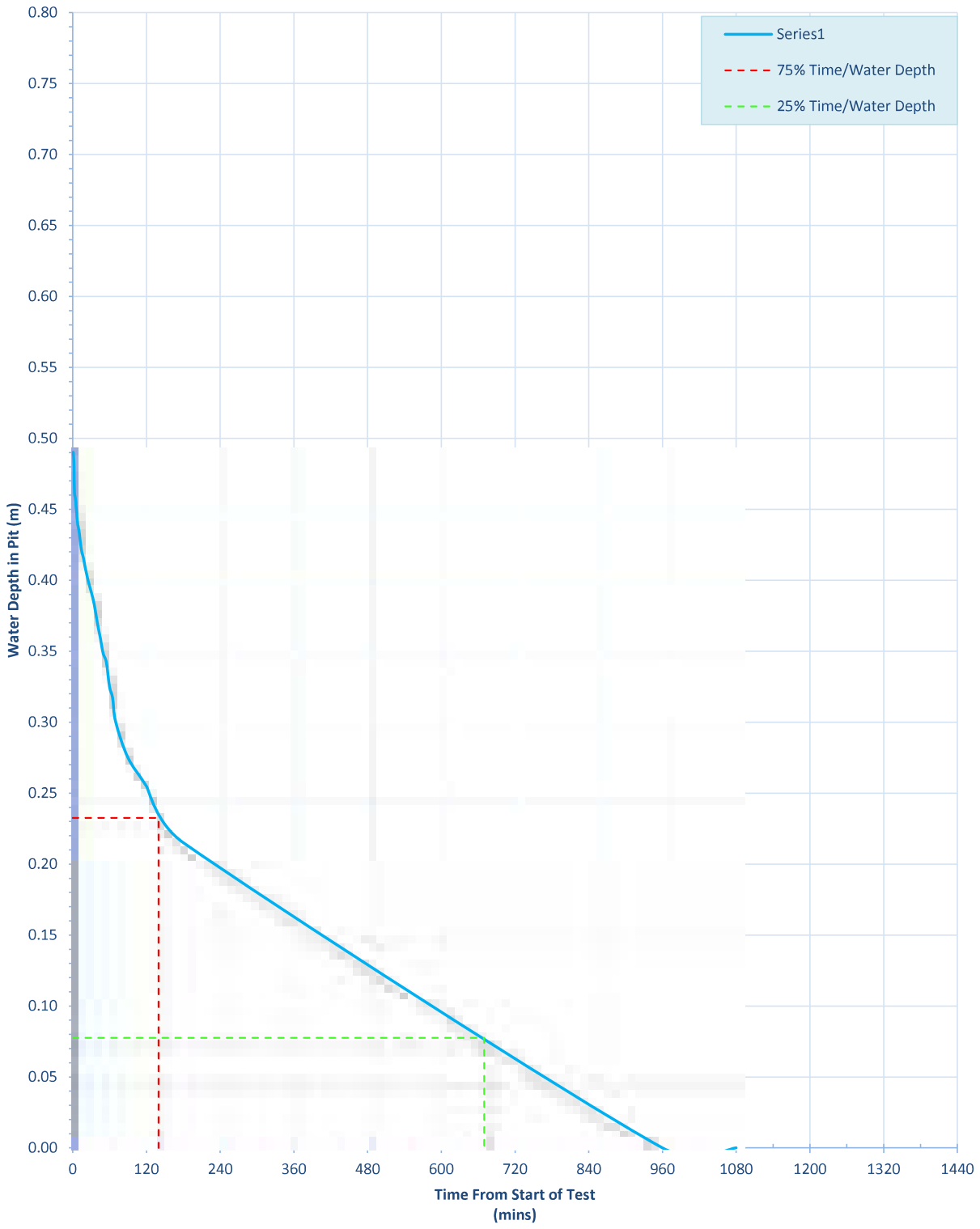
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP13
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.60	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.49	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.31
BASE SURFACE AREA (m2)	0.80	SIDEWALL SURFACE AREA (m2)	3.36	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.48
75% Effective Water Depth (m)	0.2325	25% Effective Water Depth (m)	0.0775	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.124
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	140	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	670	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	530

SOIL INFILTRATION RATE	1.57E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
15:22	0	0.490
15:23	1	0.490
15:24	2	0.480
15:25	3	0.461
15:26	4	0.459
15:27	5	0.455
15:28	6	0.450
15:29	7	0.445
15:30	8	0.440
15:31	9	0.438
15:32	10	0.435
15:34	12	0.429
15:36	14	0.422
15:38	16	0.418
15:40	18	0.415
15:42	20	0.410
15:47	25	0.400
15:52	30	0.392
15:57	35	0.383
16:02	40	0.370
16:07	45	0.359
16:12	50	0.348
16:17	55	0.342
16:22	60	0.325
16:27	65	0.317
16:32	70	0.300
16:52	90	0.275
17:22	120	0.255
17:52	180	0.215
Interplated	960	0.000
	1080	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	See TP Log	TP13



BRE 365 SOIL INFILTRATION TEST

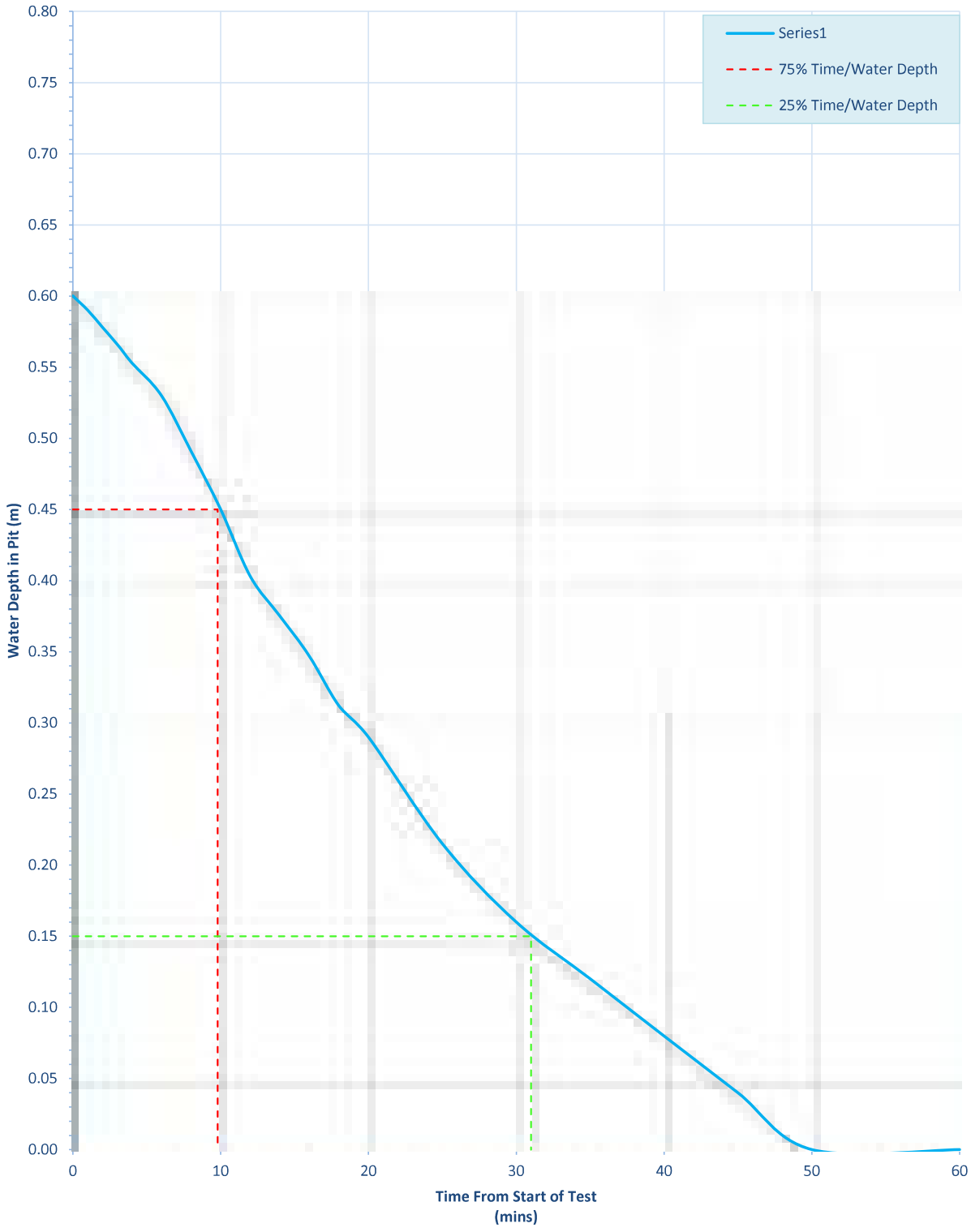
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP14
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.10	TEST PIT DEPTH (m)	1.20
WATER SURFACE LEVEL (m)	0.60	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.60
BASE SURFACE AREA (m2)	0.55	SIDEWALL SURFACE AREA (m2)	3.84	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.47
75% Effective Water Depth (m)	0.45	25% Effective Water Depth (m)	0.15	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.165
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	9.8	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	31	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	21.2

SOIL INFILTRATION RATE	5.25E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
15:22	0	0.600
15:23	1	0.590
15:24	2	0.578
15:25	3	0.566
15:26	4	0.553
15:28	6	0.530
15:30	8	0.491
15:32	10	0.450
15:34	12	0.403
15:36	14	0.375
15:38	16	0.347
15:40	18	0.312
15:42	20	0.290
15:47	25	0.215
15:52	30	0.160
15:57	35	0.120
16:02	40	0.080
16:07	45	0.040
16:12	50	0.000
	60	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1.20	SOIL TYPE	See TP Log	TP14



BRE 365 SOIL INFILTRATION TEST

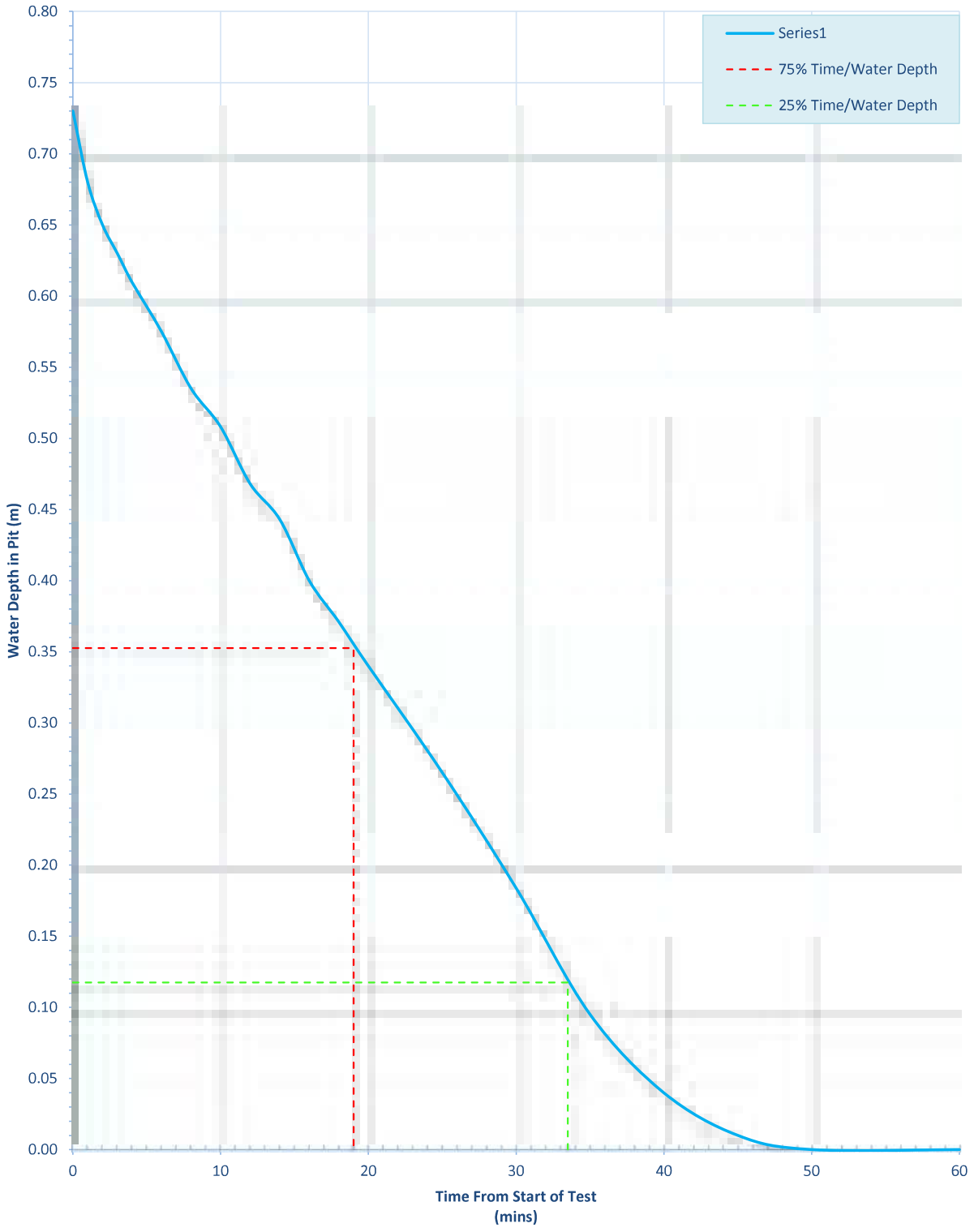
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP14
INFILTRATION TEST No.	2	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.10	TEST PIT DEPTH (m)	1.20
WATER SURFACE LEVEL (m)	0.73	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.47
BASE SURFACE AREA (m2)	0.55	SIDEWALL SURFACE AREA (m2)	3.84	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.47
75% Effective Water Depth (m)	0.3525	25% Effective Water Depth (m)	0.1175	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.12925
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	19	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	33.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	14.5

SOIL INFILTRATION RATE	6.01E-05	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
15:22	0	0.730
15:23	1	0.680
15:24	2	0.650
15:25	3	0.630
15:26	4	0.610
15:28	6	0.575
15:30	8	0.535
15:32	10	0.508
15:34	12	0.468
15:36	14	0.443
15:38	16	0.400
15:40	18	0.371
15:42	20	0.340
15:47	25	0.265
15:52	30	0.184
15:57	35	0.095
16:02	40	0.040
16:07	45	0.010
16:12	50	0.000
	60	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1.20	SOIL TYPE	See TP Log	TP14



BRE 365 SOIL INFILTRATION TEST

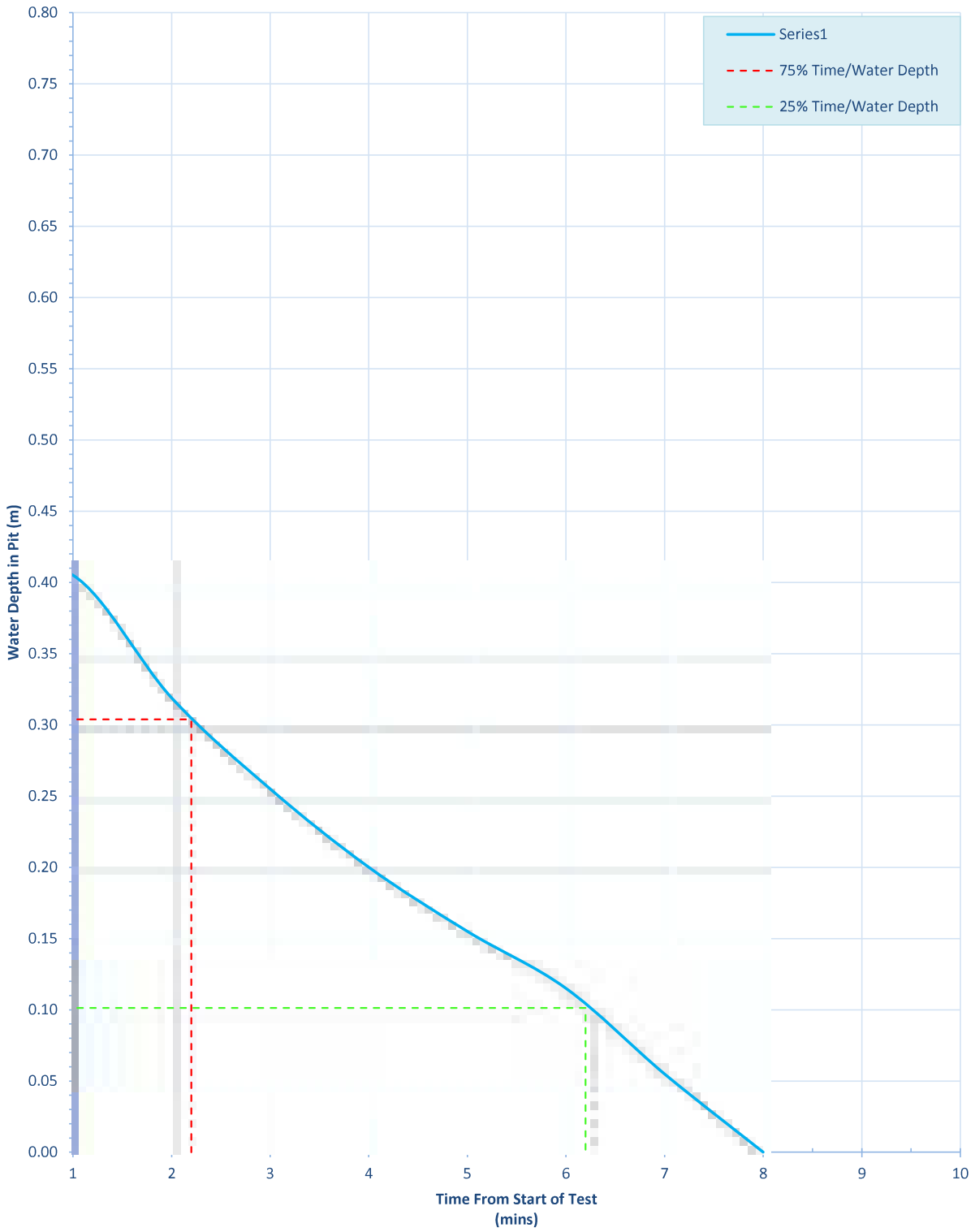
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP15
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.40	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.41
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	3.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.35
75% Effective Water Depth (m)	0.30375	25% Effective Water Depth (m)	0.10125	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.151875
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	2.2	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	6.2	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	4

SOIL INFILTRATION RATE	2.69E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.405
10:31	1	0.405
10:32	2	0.319
10:33	3	0.255
10:34	4	0.200
10:35	5	0.155
10:36	6	0.115
10:37	7	0.055
10:38	8	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	See TP Log	TP15



BRE 365 SOIL INFILTRATION TEST

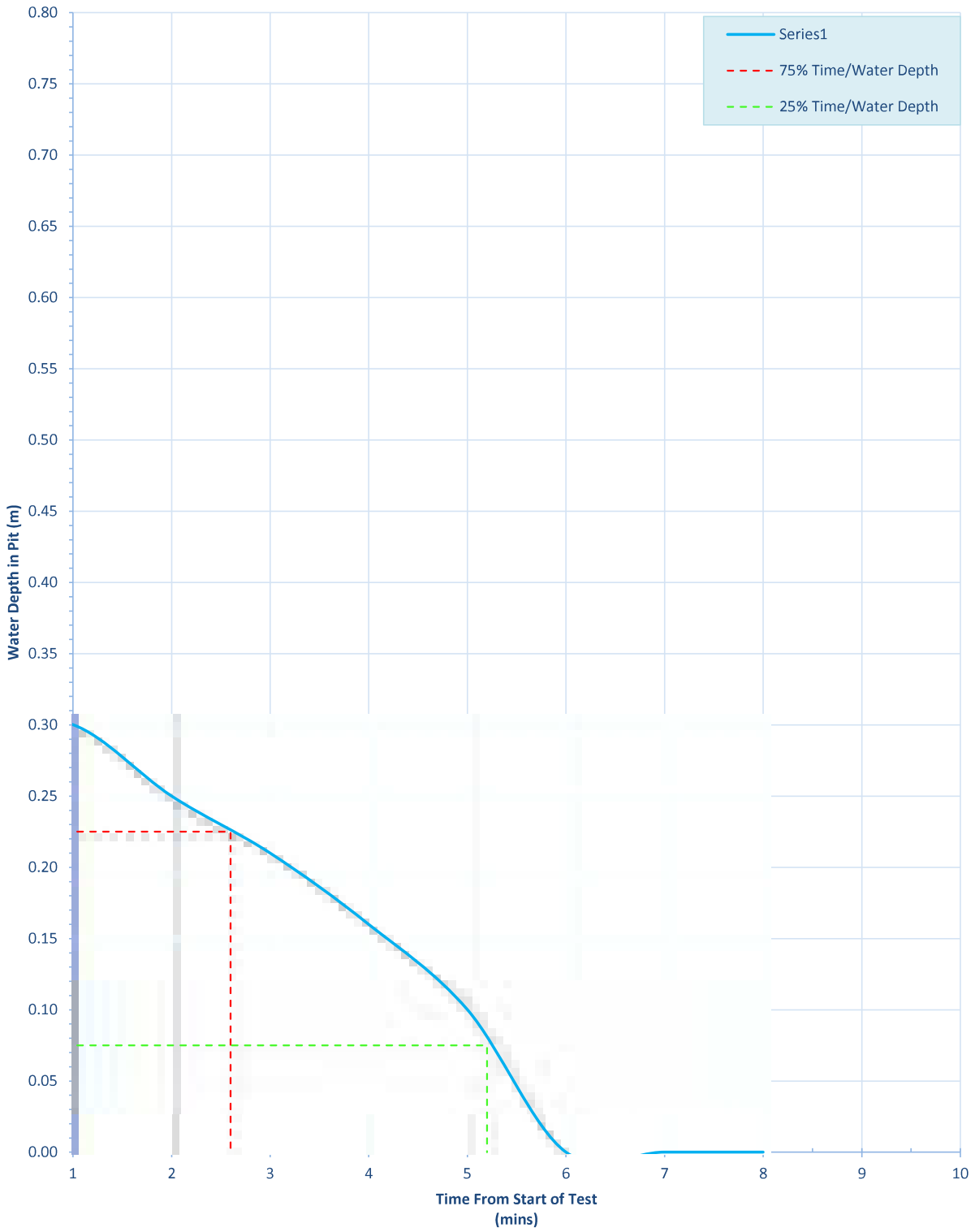
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP15
INFILTRATION TEST No.	2	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	0.80
WATER SURFACE LEVEL (m)	0.50	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.30
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	3.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.35
75% Effective Water Depth (m)	0.225	25% Effective Water Depth (m)	0.075	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.1125
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	2.6	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	5.2	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	2.6

SOIL INFILTRATION RATE	3.07E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.300
10:31	1	0.300
10:32	2	0.250
10:33	3	0.210
10:34	4	0.160
10:35	5	0.100
10:36	6	0.000
10:37	7	0.000
10:38	8	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.80	SOIL TYPE	See TP Log	TP15



BRE 365 SOIL INFILTRATION TEST

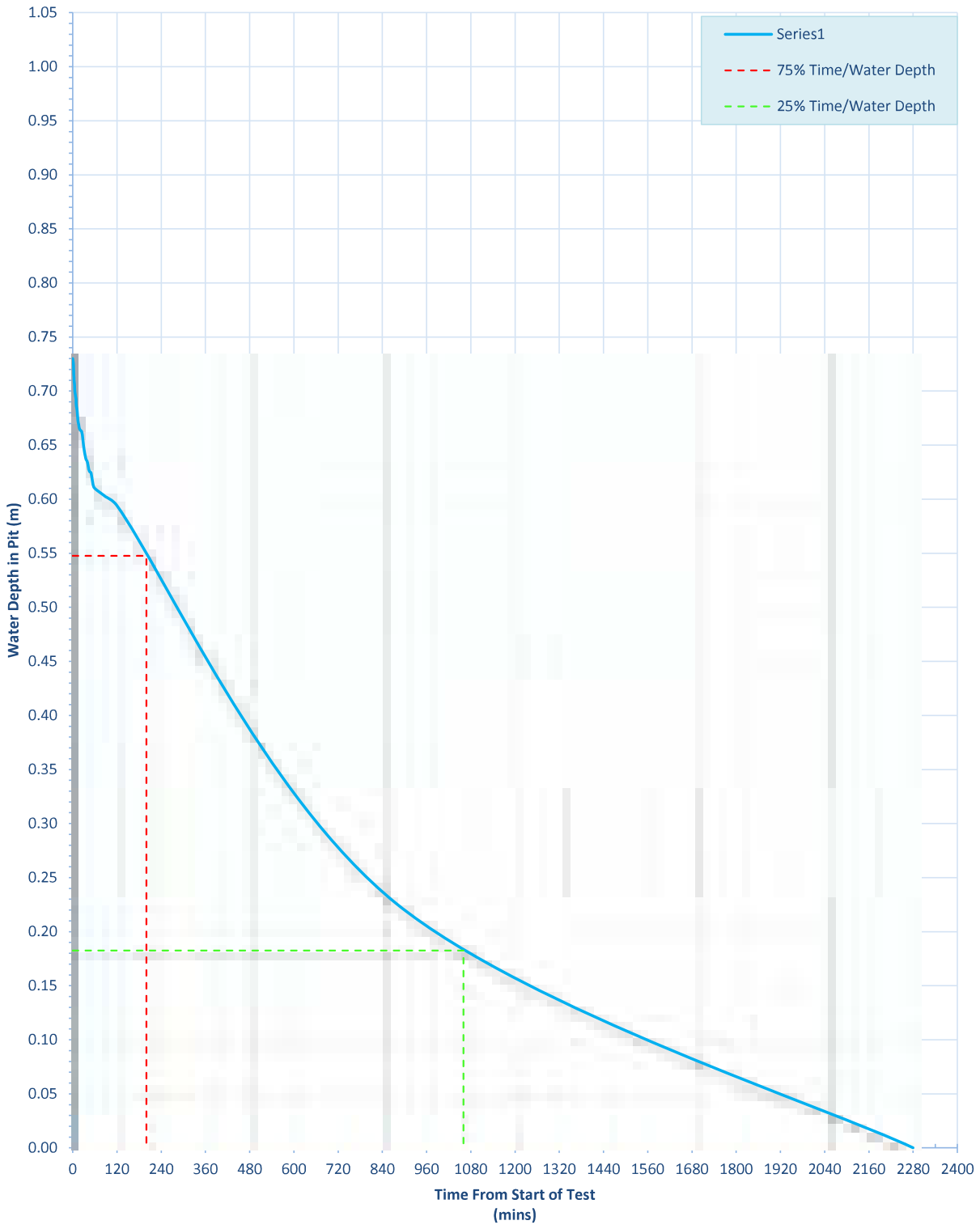
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP16
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.50	TEST PIT DEPTH (m)	1.05
WATER SURFACE LEVEL (m)	0.32	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.73
BASE SURFACE AREA (m2)	0.75	SIDEWALL SURFACE AREA (m2)	4.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.85
75% Effective Water Depth (m)	0.5475	25% Effective Water Depth (m)	0.1825	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.27375
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	200	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	1060	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	860

SOIL INFILTRATION RATE	1.86E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
15:22	0	0.730
15:23	1	0.728
15:24	2	0.724
15:25	3	0.715
15:26	4	0.710
15:27	5	0.706
15:28	6	0.700
15:29	7	0.697
15:30	8	0.695
15:31	9	0.692
15:32	10	0.686
15:34	12	0.682
15:36	14	0.673
15:38	16	0.669
15:40	18	0.666
15:42	20	0.664
15:47	25	0.662
15:52	30	0.649
15:57	35	0.638
16:02	40	0.634
16:07	45	0.626
16:12	50	0.624
16:17	55	0.614
16:22	60	0.610
16:52	90	0.602
17:22	120	0.594
09:00	878	0.226
Interpolated	2280	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	1.05	SOIL TYPE	See TP Log	TP16



BRE 365 SOIL INFILTRATION TEST

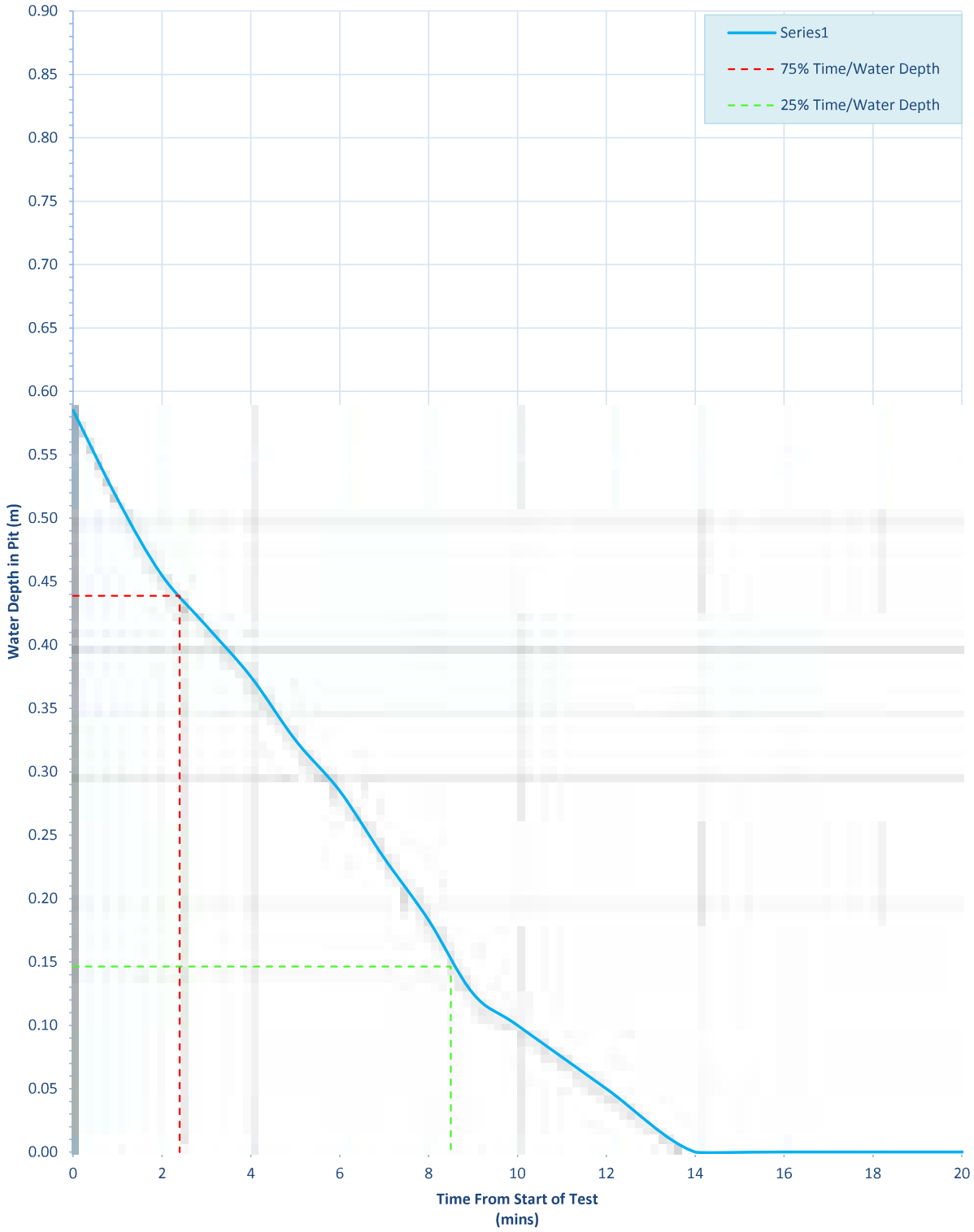
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP17
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.32	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.59
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.43875	25% Effective Water Depth (m)	0.14625	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.20475
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	2.4	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	8.5	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	6.1

SOIL INFILTRATION RATE	2.32E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.585
10:31	1	0.515
10:32	2	0.455
10:33	3	0.415
10:34	4	0.375
10:35	5	0.325
10:36	6	0.285
10:37	7	0.232
10:38	8	0.183
10:39	9	0.125
10:40	10	0.100
10:42	12	0.050
10:44	14	0.000
10:46	16	0.000
00:00	60	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	0.90	**SOIL TYPE**	See TP Log	**TP17**



BRE 365 SOIL INFILTRATION TEST

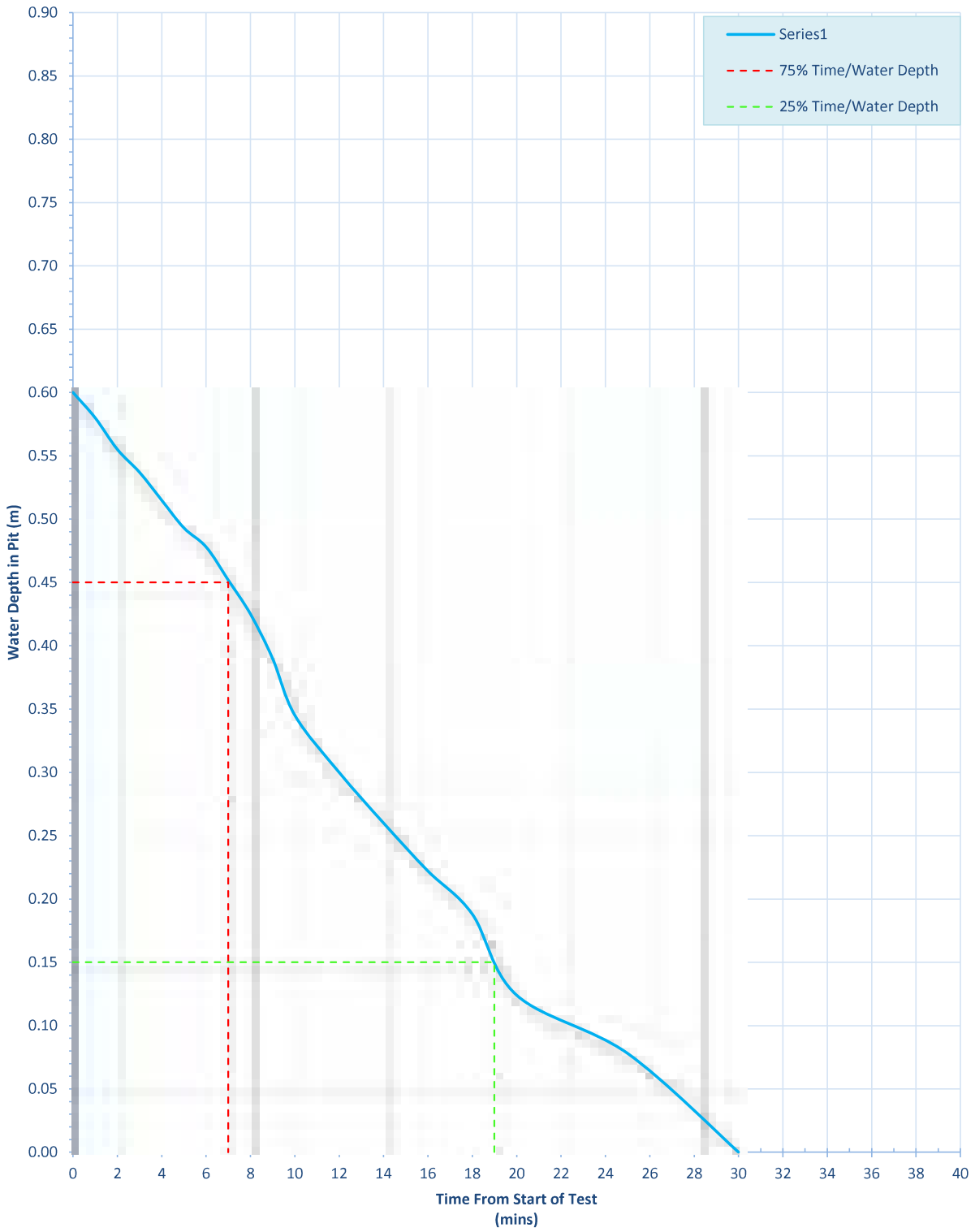
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP17
INFILTRATION TEST No.	2	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.30	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.60
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.45	25% Effective Water Depth (m)	0.15	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.21
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	7	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	19	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	12

SOIL INFILTRATION RATE	1.21E-04	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.600
10:31	1	0.580
10:32	2	0.555
10:33	3	0.537
10:34	4	0.515
10:35	5	0.493
10:36	6	0.478
10:37	7	0.452
10:38	8	0.425
10:39	9	0.390
10:40	10	0.345
10:42	12	0.300
10:44	14	0.260
10:46	16	0.222
10:48	18	0.188
10:50	20	0.124
10:55	25	0.078
11:00	30	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	0.90	**SOIL TYPE**	See TP Log	**TP17**



BRE 365 SOIL INFILTRATION TEST

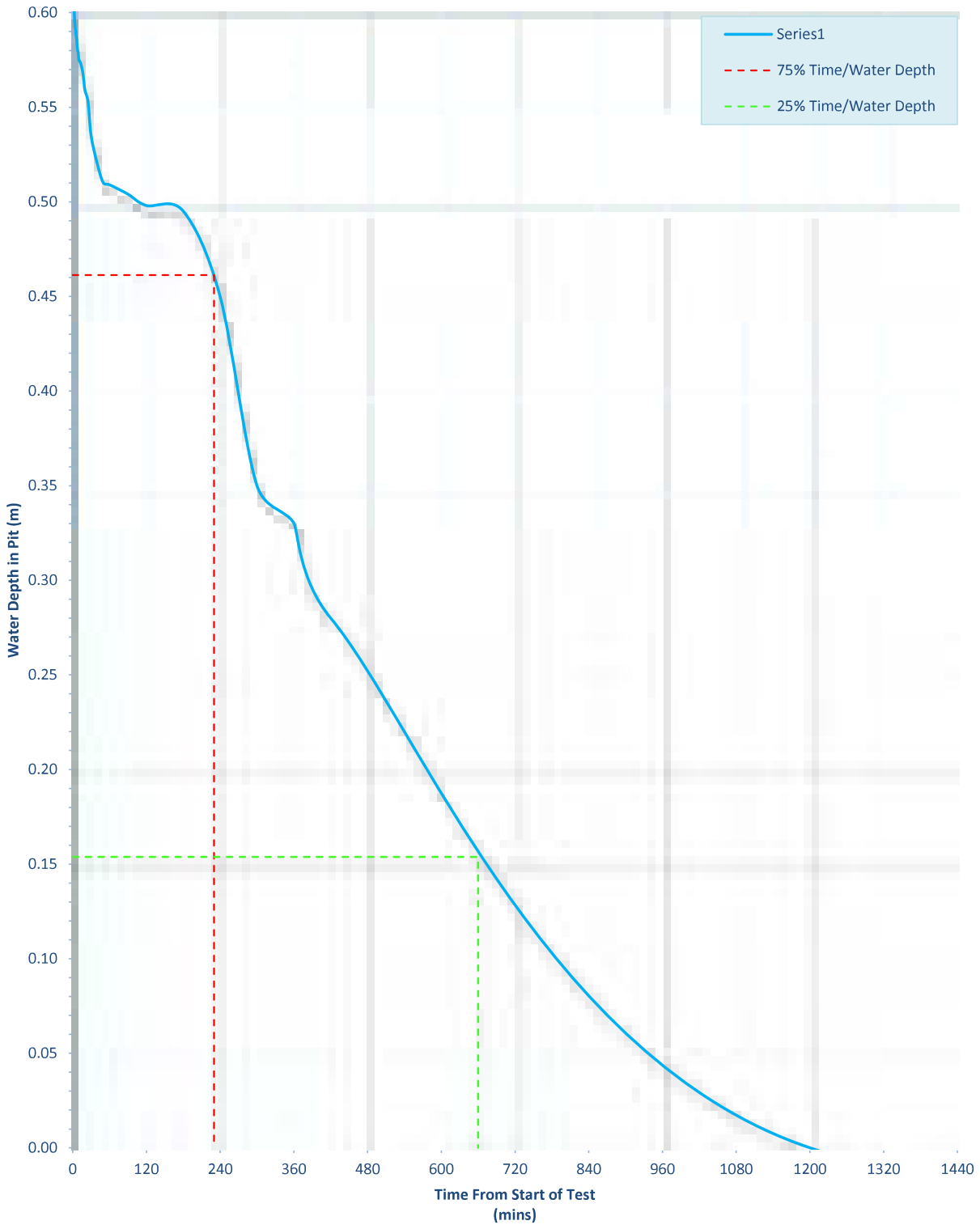
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP18
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.40	TEST PIT DEPTH (m)	0.90
WATER SURFACE LEVEL (m)	0.29	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.62
BASE SURFACE AREA (m2)	0.70	SIDEWALL SURFACE AREA (m2)	3.42	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.41
75% Effective Water Depth (m)	0.46125	25% Effective Water Depth (m)	0.15375	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.21525
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	230	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	660	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	430

SOIL INFILTRATION RATE	3.46E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.615
10:31	1	0.607
10:32	2	0.605
10:33	3	0.597
10:34	4	0.593
10:35	5	0.590
10:36	6	0.587
10:37	7	0.584
10:38	8	0.580
10:39	9	0.579
10:40	10	0.575
10:42	12	0.574
10:44	14	0.572
10:46	16	0.569
10:48	18	0.565
10:50	20	0.559
10:55	25	0.553
11:00	30	0.535
11:10	40	0.520
11:20	50	0.510
11:30	60	0.509
12:00	90	0.504
12:30	120	0.498
13:30	180	0.495
14:30	240	0.450
15:30	300	0.350
16:30	360	0.330
17:30	420	0.280
Interpolated	1200	0.000
	3000	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.90	SOIL TYPE	See TP Log	TP18



BRE 365 SOIL INFILTRATION TEST

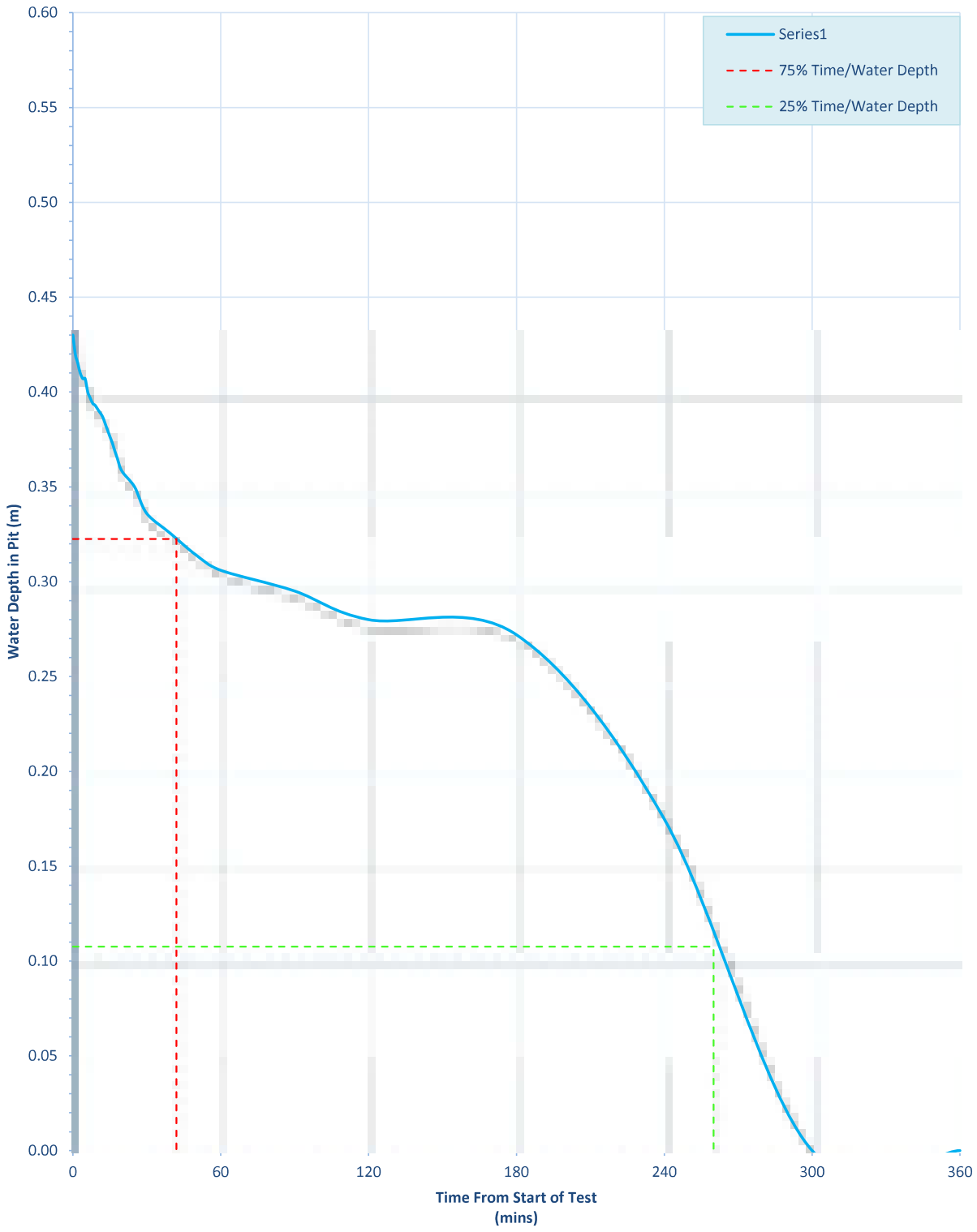
JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP19
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.10	TEST PIT DEPTH (m)	0.60
WATER SURFACE LEVEL (m)	0.17	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.43
BASE SURFACE AREA (m2)	0.55	SIDEWALL SURFACE AREA (m2)	1.92	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	1.51
75% Effective Water Depth (m)	0.3225	25% Effective Water Depth (m)	0.1075	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.11825
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	42	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	260	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	218

SOIL INFILTRATION RATE	5.99E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.430
10:31	1	0.420
10:32	2	0.415
10:33	3	0.410
10:34	4	0.407
10:35	5	0.407
10:36	6	0.400
10:37	7	0.397
10:38	8	0.394
10:39	9	0.393
10:40	10	0.391
10:42	12	0.387
10:44	14	0.380
10:46	16	0.373
10:48	18	0.365
10:50	20	0.358
10:55	25	0.350
11:00	30	0.336
11:10	40	0.325
11:20	50	0.314
11:30	60	0.306
12:00	90	0.295
12:30	120	0.280
13:30	180	0.272
14:30	240	0.175
15:30	300	0.000
16:30	360	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.
TEST PIT DEPTH (m)	0.60	SOIL TYPE	See TP Log	TP19



BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	SITE	Calmount Drive, Dublin	TRIAL PIT No.	TP20
INFILTRATION TEST No.	1	SOIL TYPE	See TP Log	WEATHER CONDITIONS	DRY
TEST PIT WIDTH (m)	0.50	TEST PIT LENGTH (m)	1.60	TEST PIT DEPTH (m)	1.00
WATER SURFACE LEVEL (m)	0.28	GROUNDWATER DEPTH (m)	Dry	HEAD OF WATER IN PIT (m)	0.72
BASE SURFACE AREA (m2)	0.80	SIDEWALL SURFACE AREA (m2)	4.20	a(p50) Internal Surface Area @ 50% Effective Depth (m2)	2.90
75% Effective Water Depth (m)	0.54	25% Effective Water Depth (m)	0.18	V(p75-25) Volume of Hole Between 75 & 25% Effective Water Depth (m3)	0.288
t(p75) Time for Water Level to Drain to 75% Effective Depth (mins)	145	t(p25) Time for Water Level to Drain to 25% Effective Depth (mins)	580	t(p75-25) Time for Water Level to Drain from 75to 25% Effective Depth (mins)	435

SOIL INFILTRATION RATE	3.80E-06	m/sec

24 Hr Clock Time hh:mm	Time Elapsed (mins)	Depth of Water in Pit (m)
10:30	0	0.720
10:31	1	0.719
10:32	2	0.715
10:33	3	0.710
10:34	4	0.705
10:35	5	0.700
10:36	6	0.695
10:37	7	0.691
10:38	8	0.688
10:39	9	0.684
10:40	10	0.682
10:42	12	0.668
10:44	14	0.667
10:46	16	0.666
10:48	18	0.665
10:50	20	0.665
10:55	25	0.664
11:00	30	0.662
11:10	40	0.600
11:20	50	0.566
11:30	60	0.568
12:00	90	0.560
12:30	120	0.558
13:30	180	0.505
14:30	240	0.388
15:30	300	0.360
16:30	360	0.330
17:30	420	0.290
Interpolated	1080	0.000
	3000	0.000

BRE 365 SOIL INFILTRATION TEST

JOB No.	23-3170	**SITE**	Calmount Drive, Dublin	**TRIAL PIT No.**
TEST PIT DEPTH (m)	1.00	**SOIL TYPE**	See TP Log	**TP20**