PUNCH
consulting engineers

Popes Hill LRD, Popes Road
Blackpool, Cork

Drainage Impact Assessment
244132-PUNCH-XX-XX-RP-C-014

March 2026

Document Control

Document Number: **244132-PUNCH-XX-XX-RP-C-014**

Status	Rev	Description	Date	Prepared	Checked	Approved
A0	C01	Planning Issue	13/03/2026	A Ní Shúilleabháin	G. Souza	T. Horan
A0	C02	Updated Planning Issue	24/03/2026	A Ní Shúilleabháin	G. Souza	T. Horan

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1 Introduction

PUNCH Consulting Engineers were appointed by Pontorac Limited to carry out a Drainage Impact Assessment for a proposed mixed-use residential development at Popes Hill, The Glen, Cork City. A drainage section was included in the overall Engineering Planning Report included with the documentation submitted to Cork City Council in advance of the issue of the LRD Opinion with this report prepared to address specific requirements raised by Cork City Council. The purpose of this Drainage Impact Assessment report is to provide detailed information on the storm water elements and SuDS strategy associated with the proposed development.

1.1 Site Location

The proposed development is a brownfield site with approximately 2.581 hectares in area. The site is located at the Glen, a northern suburb of Cork City. It is bordered to the north by a military cemetery and an existing residential estate, while Collins Barracks Military Museum and its car park lie to the south and southeast. The North City Link Road (N20) is situated nearby to the west. Access to the site is provided via the existing entrance off Popes Road to the southwest. The location of the proposed site is depicted in Figure 1-1.

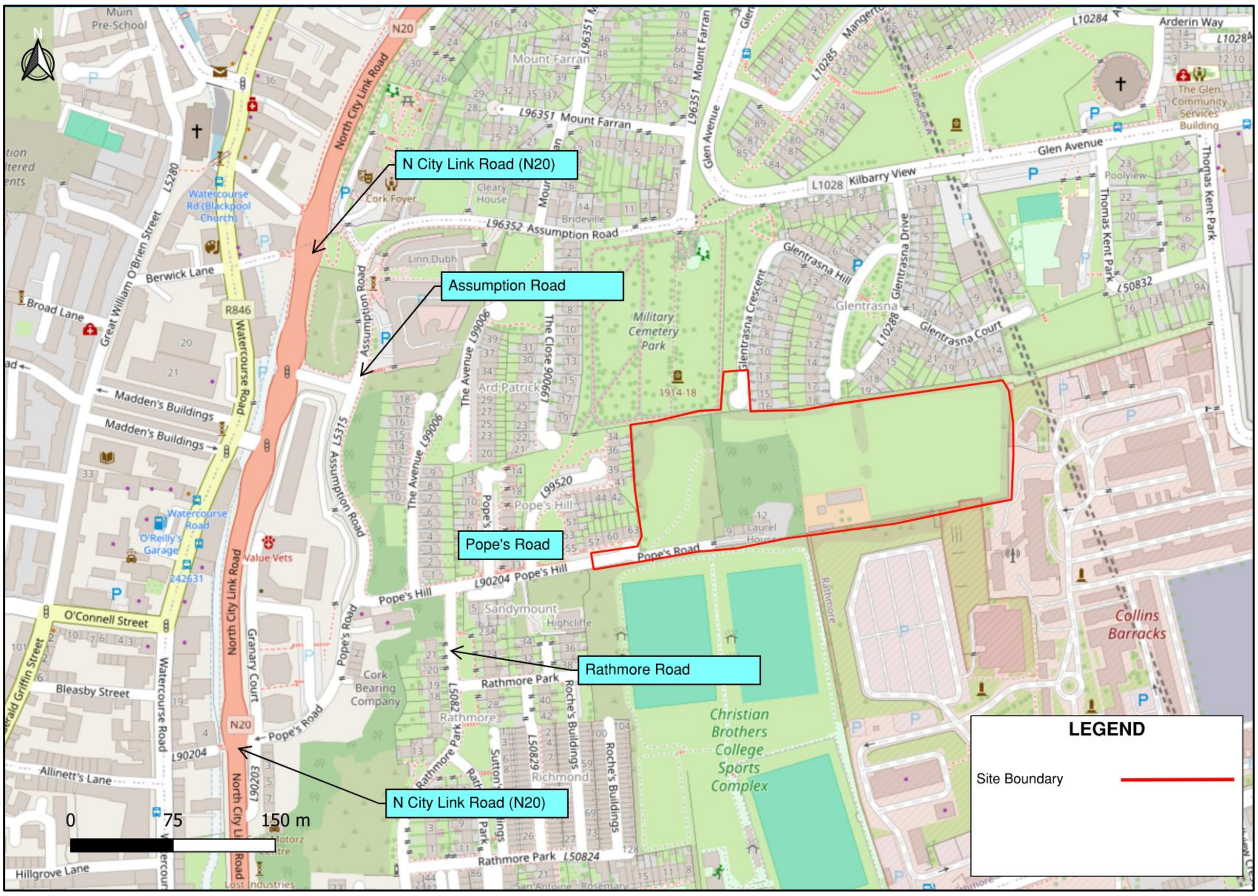


Figure 1-1: Location of Proposed Development (Site Boundary indicated in red)

1.2 Site Topography

The site's topography includes significant elevation changes, with an approximate 25-meter drop from east to west and an 8-meter level difference from north to south. The highest point, at 84m OD, is in the southeast corner, followed by the northeast at 78m OD. The elevation gradually declines towards the west, reaching 62m OD in the southwest and 56m OD in the northwest corner of the site, which is the lowest part of the site adjoining the Military graveyard. The levels result in an overall approximate gradient across the site of 10% - 12.5%.

1.3 Proposed Development

The proposed development will consist of a Large-Scale Residential Development (LRD) on a site at Pope's Hill, Pope's Road, Blackpool, Cork City which will include the demolition of a terrace of 4no. existing dwellings, 3no. of which are derelict, and ancillary sheds and their replacement with 1no. single-storey 3-bed detached bungalow accessed via a modified private driveway; and the construction of 103no. dwellings to include 50no. townhouses and 53no. duplex apartments. A total of 104no. dwellings are proposed, accessed via Pope's Road. The proposed development will also include a creche with rear garden and front set down area; 104no. car parking spaces and 128no. cycle spaces; internal roads and pathways; hard and soft landscaping, including boundary treatments; retaining walls; 2no. pedestrian connections with Glentrasna Park to the north; and all associated site development, landscaping and boundary treatment, and drainage works, including SuDS. The proposed site layout can be seen in Figure 1-2 and the accompanying planning drawings.

Figure 1-2: Proposed Site Layout

1.4 Principle Design Considerations

The following key documents and design standards were taken into consideration during the design of the storm water drainage and SuDS for the site:

- Greater Dublin Strategic Drainage Study, 2005
- Greater Dublin Regional Code of Practice for Drainage Works, 2005
- CIRIA Report C753 – The SuDS Manual v6, 2015
- CIRIA Report C768 – Guidance on the construction of SuDS, 2017

- BRE Digest 365 – Soakaway design, 2016
- Flood Studies Report, 1975
- DMURS
- Cork City Development Plan, 2022-2028
- Nature Based Management of Urban Rainwater and Urban Surface Water Discharges,2024
- Implementation of Urban Nature-based Solutions Guidance Document for Planners, Developers and Developer Agents, 2025

2 Stormwater Drainage Design

2.1 Existing Stormwater Drainage

Record mapping shows that there is an existing surface water network discharging water from Popes Hill and Popes Road located west of the proposed development site. This network was identified based on utilities surveys, inspections and record drawings provided by Cork City Council and Uisce Éireann. This network however discharges into an existing combined storm sewer network. In accordance with the confirmation of feasibility issued by Uisce Éireann, no surface water runoff from the site will be discharged into this network. An extract from Cork City Council and Uisce Éireann Record Drawings illustrating the existing stormwater drainage arrangement as shown in Figure 2-1 below.

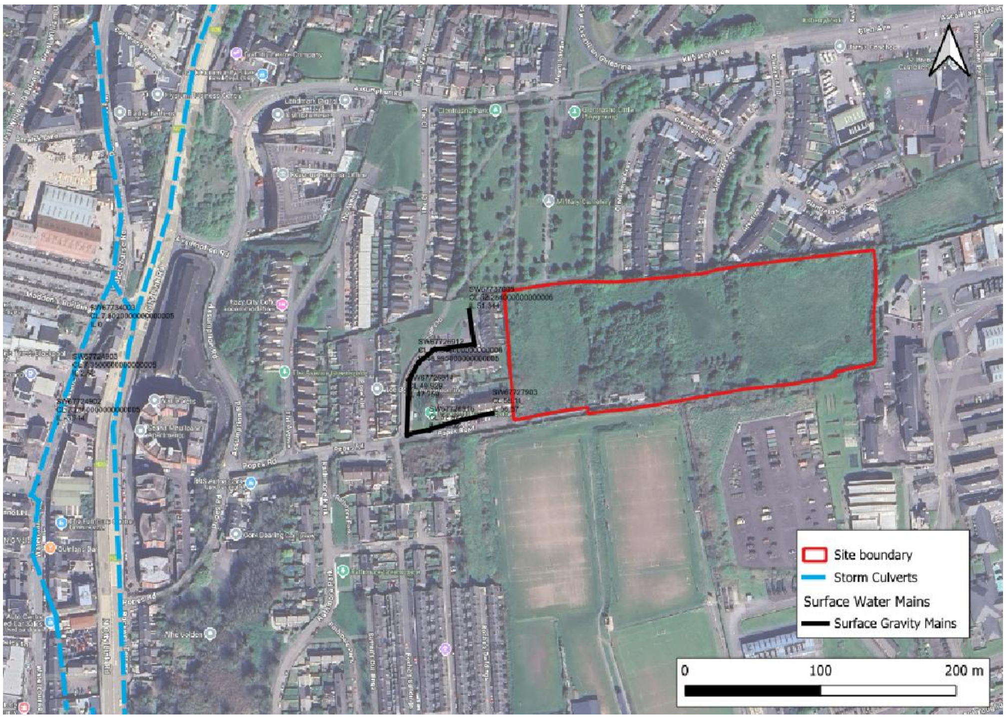


Figure 2-1: Existing storm drainage adjacent to site (extract from UE records, site boundary outlined in red)

Following consultation with Cork City Council it was determined that there are separate surface water and foul water networks within the Glentrasna area to the north of the site. PUNCH instructed a topographical / GPR survey of the Glentrasna area which was carried out in November 2025 to determine manhole locations and pipe sizes in Glentrasna. Refer to Figure 2-3 below for the record of the survey in Glentrasna.

The Figure 2-2 indicates a 225mm diameter surface water pipework shown in cyan extends through Glentrasna to the boundary of the Popes Hill site with an existing manhole in the hammerhead of the Glestrasna Crescent and a 225mm spur pipe left out of the manhole in the direction of the site. The 225mm pipework drains through Glentrasna and onto Glen Avenue. This network is suitable for an attenuated outfall from the proposed site. A separate foul water sewer was also surveyed within Glentrasna which also drains onto Glen Avenue.

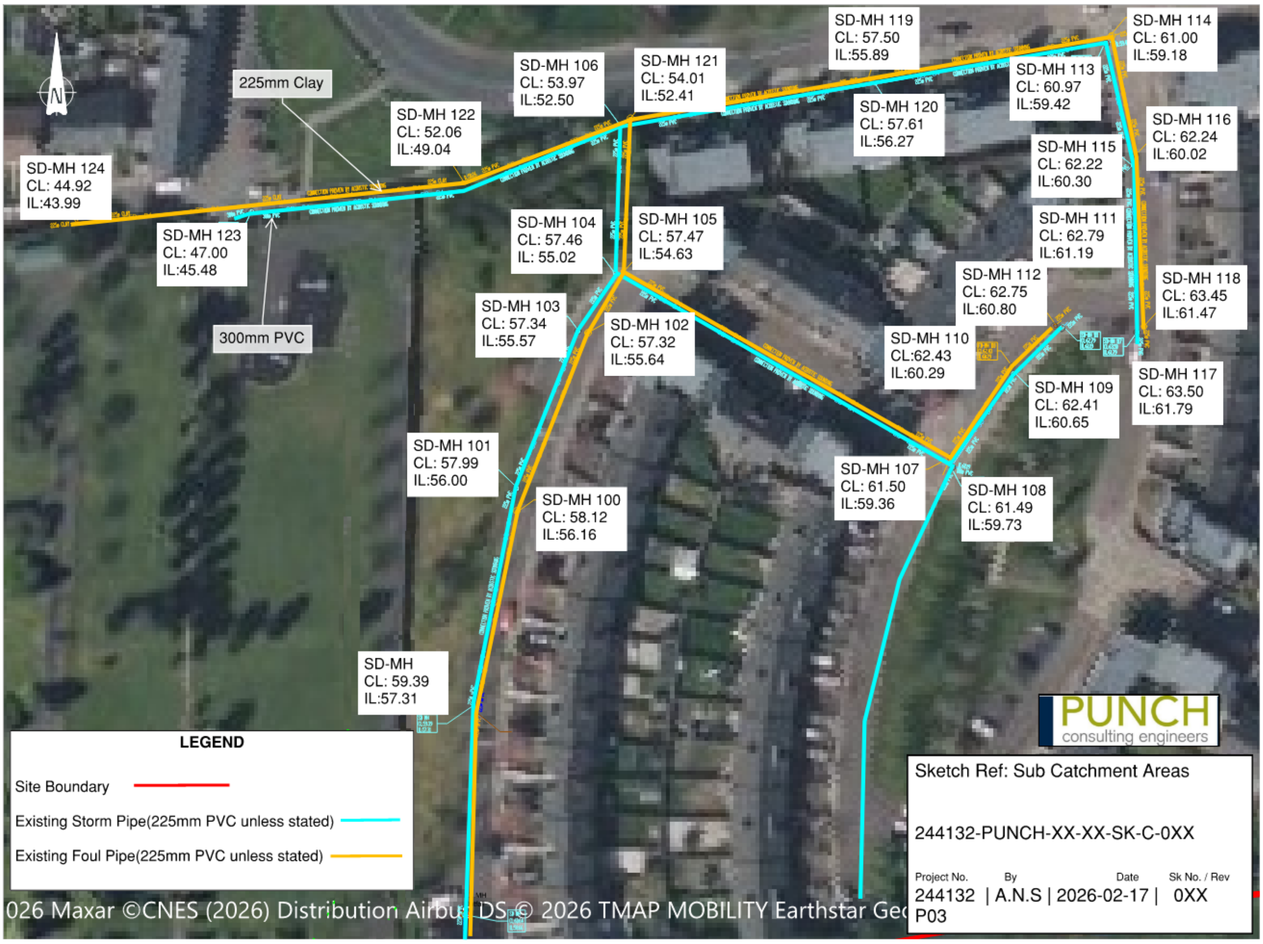


Figure 2-3 Existing Storm & Foul Drainage in Glentrasna, to the north (extract from survey)

2.2 Proposed Stormwater Drainage

The proposed surface water drainage system will be designed using Causeway Flow software in accordance with the Department of Environment and Local Government's guidance document "Recommendations for Site Development Works for Housing Areas", Further design parameters and guidance were adopted from the following documents:

Table 2-1 describes the stormwater drainage design parameters which will be used in design. Please refer to Appendix A for detailed simulation results. Additionally, please refer to drawing nos. 244132-PUNCH-XX-XX-DR-C-0100, 0101 & 0102 which shows the proposed drainage plan layout for the development with long sections shown on drawing nos. 244132-PUNCH-XX-XX-DR-C-0175, 0176 & 0177. Refer to Appendix B for Met Eireann rainfall data for the site.

Table 2-1: Stormwater Drainage Design Parameters

Description	Value	Standard Reference / Notes
Site Area (Ha)	2.368 Ha	Redline Boundary
Return period target	Pipe Design 1 in 5-year. Network Design 1 in-30 year + CC. Check 1 in 100-year + CC for flooding.	GDSDS
Climate Change	20%	GDSDS
M5-60	18.500	Met Éireann Rainfall Data (2023 Model)
Ratio R	0.264	Met Éireann Rainfall Data (2023 Model)
SAAR	1152mm	Met Éireann Rainfall Data (2023 Model)
SOIL type	2 (sandy gravelly clay)	Site Investigation
Soil value	0.3	Site Investigation
Infiltration Rate	6.23×10^{-6}m/s (22.4 mm/hr) TP03 1.598×10^{-5}m/s (57.2 mm/hr) TP07 6.53×10^{-6}m/s (23.5 mm/hr) TP09	Site Investigation.
Flow reduction parameter	QBAR	Institute of Hydrology report No. 124
Controlled Outflow	Hydrobrake Detention Basin I= 2.91l/s Hydrobrake Detention Basin II= 6.81l/s	
Flow restriction method	Hydrobrake	
Attenuation Storage Volume	Soakaway I = 18 m^3 Detention Basin I = 324m^3 Detention Basin II= 346m^3 Total volume storage= 688m^3	BRE365 & SUDS Guidance

Permeable paving	186.58m^3 (Porosity = 0.3)	
Interception Volume	N/A	Interception treatment requirement satisfied by detention basins and upstream Suds features.
Treatment Volume	N/A	Treatment volume requirement satisfied by detention basins and upstream Suds features.
Max. velocity at pipe full	3.0 m/s	
Min. velocity	1.0 m/s 0.75 m/s where not practicable	GDSDS Table 6.4
Minimum cover	1.2m under roadways 0.9m elsewhere	GDSDS Table 6.4
Rougness - ks	0.6mm	GDSDS Table 6.4

2.3 Proposed Stormwater Outfall

Surface water from the proposed development is designed to discharge to the existing surface water network within Glentrasna Estate. As part of the capacity assessment, the contributing drainage catchment entering the relevant pipes in the estate were split into Sub-Catchment I, with a contributing area of 6,364 m^2, and Sub-Catchment II, with a contributing area of 6,277 m^2. Refer to Figure 2-4 below for the mapping.

To confirm the feasibility of this connection, the capacity of the existing surface water sewer network in the Glentrasna Estate has been reviewed. The existing pipe network has an estimated capacity of 165 l/s at the outfall from Glentrasna to Glen Avenue where the pipework is at a gradient of 1/10 with a flow of 114l/s from Glentrasna based on a conservative rainfall intensity of 50 mm/hr (50 mm/hr is greater than a 1 in 120 year event) – refer to calculation below for Catchment Areas 1+2. Gradients on Glen Avenue are also c. 1/10.

The calculated QBAR for the proposed development is 6.81 L/s (refer to Appendix C), which is 4% of the pipework capacity of the existing network of 165 l/s at the outfall from Glentrasna to Glen Avenue. Further up the Glentrasna Estate in Catchment I, the surface water pipework flattens to a gradient 1/70 between manholes MH 101 & MH 103, however the existing drainage area is much less with a capacity calculation for this section of pipework also included below. Therefore, the Glentrasna Estate drainage system is capable of accommodating the greenfield flow from the proposed development.

Existing Pipework Capacity Catchment I+II combined

Catchment Area = 6,364m2 + 6,277m2 = 12,641m2 = 1.26 Ha

Impermeable Area = (1.0 x 0.63) + (0.3 x 0.63) = 0.82 Ha

(50/50 split between hard and soft surfaces)

Existing Pipe Capacity = 225mm @ 1/10, therefore capacity = 165 l/s

Existing Pipe Flow (Q)	=	2.78 x C x I (mm/hr) x A (ha)
	=	2.78 x 1.0 x 50 x 0.82 = 114 l/s

<u>Existing Pipework Capacity Catchment I Part between MH 101 & 103</u>

Catchment Area	=	5,700 = 0.57 Ha
Impermeable Area	=	(1.0 x 0.28) + (0.3 x 0.28) = 0.36 Ha

(50/50 split between hard and soft surfaces)

Existing Pipe Capacity	=	225mm @ 1/70, therefore capacity = 62 l/s
Existing Pipe Flow (Q)	=	2.78 x C x I (mm/hr) x A (ha)
	=	2.78 x 1.0 x 50 x 0.36 = 50 l/s

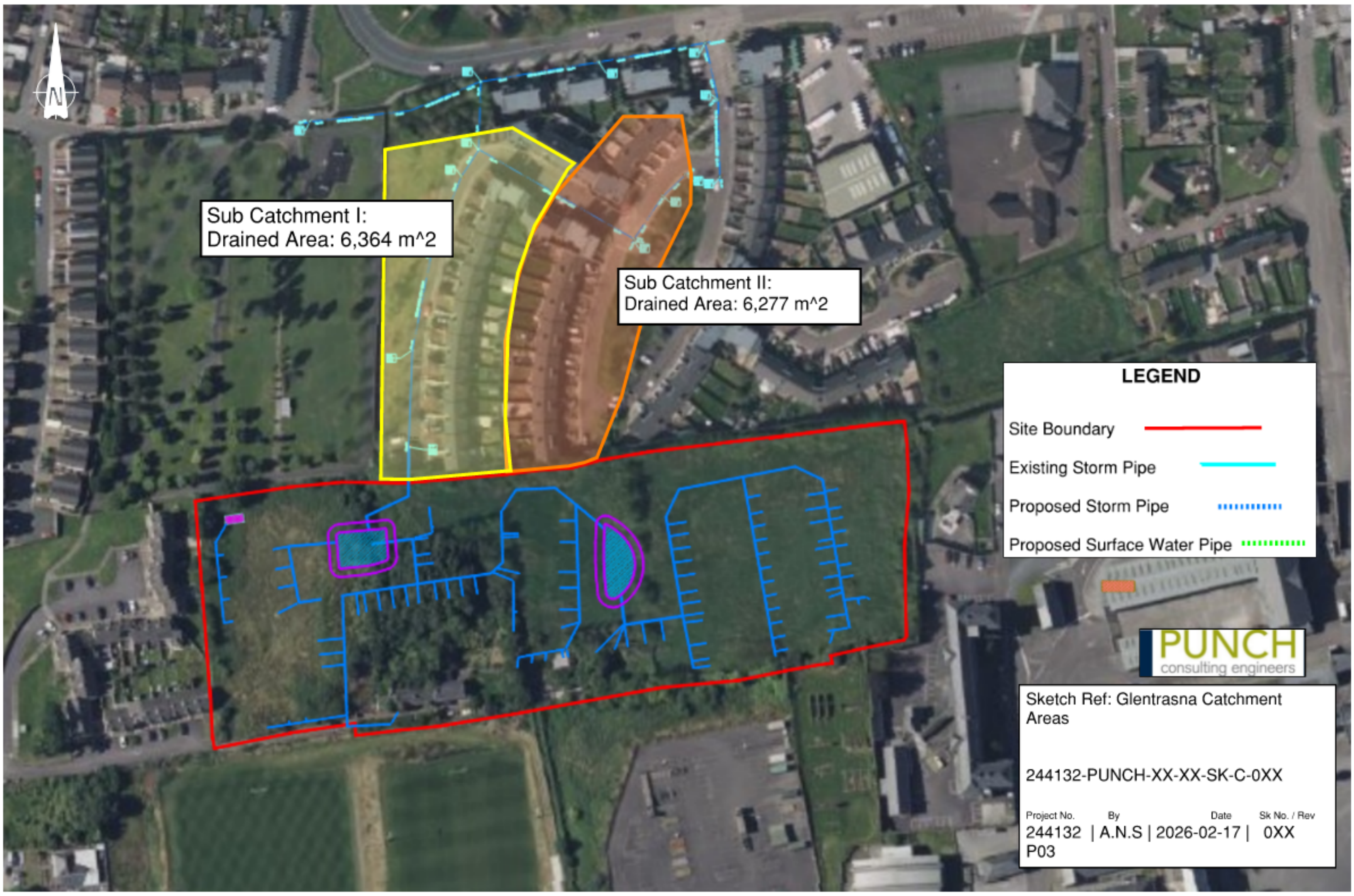


Figure 2-4 Glentrasna Outfall Catchments

2.4 Proposed Surface Water Drainage Network

The surface water drainage strategy for the proposed development will adhere to the principles of Sustainable Drainage Systems (SuDS). It is noted in the Uisce Éireann Confirmation of Feasibility included that surface water generated from the proposed site is not permitted to discharge into the Uisce Éireann network at this location. A new surface water sewer network, entirely separate from the foul water sewer network, will be provided for the development.

The overall strategy involves collecting runoff from the roofs, impermeable road, footpath and parking surfaces to a series of tree pits and bioretention areas and interconnecting filter drains. The drainage systems will allow for some infiltration at source through a Nature Based Solution approach with the filter drain pipework collected to buried surface water pipework. The buried surface water pipework will also collect runoff from the residential properties and private permeable parking areas and together with the runoff collected from filter drainage pipework all will be directed to two detention basins in areas of the site which will be levelled off to provide public parks. Soakaways are proposed to the west of the site to cater for the lower areas of the site. The design ensures outflow is limited to QBAR calculated on the basis of the effective drained area only such as impermeable areas. The combined attenuated outflow will then connect to the surface water pipe network within Glentrasna Estate.

The site is split in three main sub-catchments with a private catchment for the Creche building as shown below in Figure 2-5. Site investigations have been carried out on site which show that the existing ground conditions typically comprise original material, which is topsoil on firm sandy gravelly Clay on Gravel soils over weathered bedrock. In conjunction with the Site Investigations, soakaway tests to BRE 365

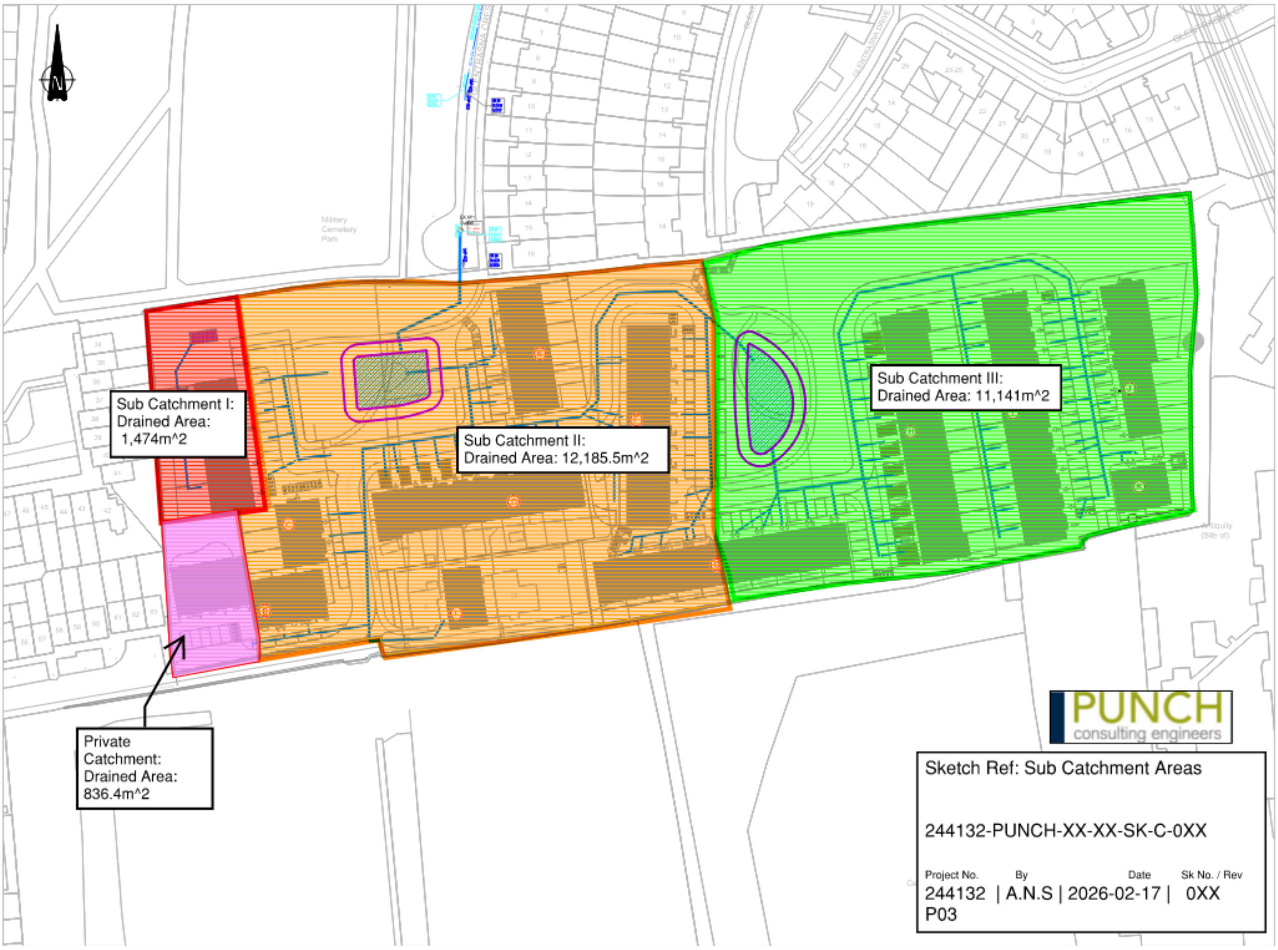


Figure 2-5 Drainage Sub-Catchment Strategy

The majority of the surface water runoff from the proposed development will be collected through a series of Suds systems to a piped network and brought to two landscaped detention basins, where a portion of the runoff will infiltrate naturally into the ground through the Suds systems and the detention basins. The southwest portion of the site, which includes a creche, siting at a significantly lower level relative to the main drainage network. Therefore, this area will drain to both a private soakaway with the front of the property and road surface and to an outfall to the adjacent road to the west which currently caters for runoff from the existing roadway.

The minimum diameter of the mainline surface water sewers is 225mm. The minimum horizontal and vertical separation distances between the proposed drainage and other services are as per the Uisce Éireann Code of Practice.

The surface water drainage network has been analysed for the risk of flooding for a 1 in 5-year flood event, 1 in 30-year rainfall event and a 1 in 100-year rainfall event by means of simulating such events in the drainage model with no flooding occurring. An increase of 20% in rainfall has been included to account for climate change. Please refer to Appendix A for detailed calculations.

3 Sustainable Urban Drainage (SUDS) Strategy

SuDS decrease the negative impact developments have on the environment by providing amenity and biodiversity, while also reducing runoff. There are 4 main objectives which are critical to meet in the design of SuDS. The objectives comprise of water quality, water quantity, Amenity and Biodiversity. Refer to **Error! Reference source not found.** below:

To expand on the four principles:

- **Water Quality:** Water Quality to be improved by providing treatment to the storm water prior to discharge
- **Water Quantity:** Infiltration to be encouraged where appropriate, and peak flows to be attenuated for in the design
- **Amenity:** The design must be functionable for the end users of the site
- **Biodiversity:** The design should provide habitat to wildlife so that they can co-exist with people. This is particularly important for flora and fauna near watercourses for feeding and nesting.

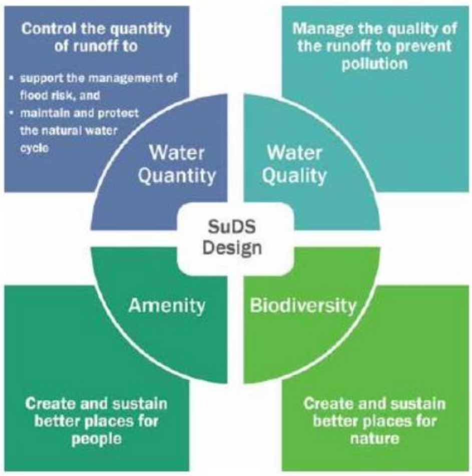


Figure 3-1 Pillars of SuDS (ref: sdcc.ie)

3.1 Compliance with GDSDS and SuDS Principles

The proposed development is designed in full accordance with the principles of Sustainable Drainage Systems (SuDS) as recommended by the Greater Dublin Strategic Drainage Study (GDSDS). The GDSDS promotes sustainability by requiring designs to comply with specific drainage criteria that aim to minimize the impact of urbanization by replicating the runoff characteristics of the greenfield site. These criteria ensure a consistent approach to managing the increase in both the rate and volume of runoff, as well as protecting the environment from pollution caused by roads and buildings. The drainage design criteria are as follows:

- Criterion 1: River Water Quality Protection

- Criterion 2: River Regime Protection
- Criterion 3: Level of Service
- Criterion 4: River Flood Protection

To satisfy SuDS requirements, developments typically incorporate:

- Interception storage
- Treatment storage (unnecessary if interception storage is adequate)
- Attenuation storage
- Long-term storage (unnecessary if QBAR growth factors are not applied in attenuation storage design)

In this case, surface water discharge will be managed entirely through infiltration via 2 no. detention basins to the east and one smaller soakaway to the northwest of the site, which are equipped to handle attenuation storage needs for storm events up to the 1% AEP event. This approach negates the need for off-site surface water discharge, ensuring full interception storage within the site and eliminating the requirement for treatment or long-term storage.

3.1.1 Criterion 1 GDSDS – River Water Quality Protection

Natural greenfield areas typically contribute minimal pollution and sediment to rivers, as most rainfall percolates into the ground, preventing direct runoff to rivers during most rainfall events. In contrast, urban areas with pipe drainage systems experience runoff from almost every rainfall event, often carrying higher levels of pollution, especially during the initial phase of runoff, with minimal percolation into the ground. To mitigate this, Criterion 1 mandates the provision of interception storage and/or treatment storage to replicate the runoff characteristics of pre-development greenfield sites.

3.1.1.1 Interception Storage

Interception storage should ensure that at least the first 5mm of rainfall is retained on-site and does not reach receiving waters. For the subject site, surface water discharge will be managed via infiltration through two large detention basin systems, one small soakaway and private soakaway systems, ensuring by default compliance with the 5mm interception requirement.

3.1.1.2 Treatment Storage

According to the GDSDS, interception and treatment storage are interchangeable. Since full interception storage is provided through the detention basins and soakaway systems, additional treatment storage is not necessary.

3.1.2 Criterion 2 GDSDS – River Regime Protection

Unchecked runoff from developed sites through traditional pipe networks discharges into receiving waters at rates significantly higher than pre-development levels, causing flash flows that can lead to scour and erosion in rivers and streams, as such the following requirements are to be met:

1. "Discharge rate equal to 1 – year Greenfield site peak runoff rate or 2 l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume".
2. "Discharge rate equal to 1 in 100-year Greenfield site peak runoff rate or 2 l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume".

No runoff shall be leaving the site, with all runoff being collected by proposed stormwater drainage and ultimately infiltrating into the ground, therefore the development meets the requirements of Criterion 2.

3.1.3 Criterion 3 GDSDS – Level of Service (Flooding) for the site

The GDSDS states that no flooding should occur on-site for storms up to and including the 1 in 30-year event. The pipe network and attenuation storage volumes must be sufficient to prevent site flooding, though partial surcharging is acceptable as long as it does not lead to flooding.

For the 1 in 100-year + 20% climate change (CC) event, the pipe network can fully surcharge and cause site flooding, but the peak water level must be at least 500mm below any vulnerable internal floor levels, and floodwaters must be contained within the site. The top water level in any attenuation device during this event must also be at least 500mm below any vulnerable internal floor levels.

Appendix A provides stormwater drainage calculations, including detention basin volumes, demonstrating that the detention basin systems will not flood during the 1 in 100-year + 20% CC event. The peak volume for this event is as follows for the three sub-catchments:

1. Sub-Catchment I – 17.5m^3 for the sub-catchment I, corresponding to a depth of 0.5m in the soakaway structure, resulting in a top water level of 55.300, which is more than 500mm below any adjacent floor levels.
2. Sub- Catchment II- 346m^3 for the sub-catchment II, corresponding to a depth of 0.8m in the detention basin, resulting in a top water level of 62.427m, which is more than 500mm below any adjacent floor levels fronting onto the open space area where the soakaway is located.
3. Sub- Catchment III – 324 m^3 for the sub-catchment III, corresponding to a depth of 0.8in the detention basin, resulting in a top water level of 71.214m, which is more than 500mm below any adjacent floor levels fronting onto the open space area where the soakaway is located.

Therefore, Criterion 3 is satisfied.

3.1.4 Criterion 4 GDSDS – River Flood Protection

Criterion 4 aims to prevent flooding of the receiving system or watercourse by either limiting the runoff volume to pre-development levels using "long-term storage" (Option 1) or by limiting the runoff rate for the 100-year storm to QBAR without growth factors using "extended attenuation storage" (Option 2).

As the proposed development includes two detention basins and a soakaway that manage all surface water on-site, there will be no discharge to river networks. The detention basins and soakways have been designed to provide sufficient storage thus meeting design Criterion 4.

3.2 SUDS Management Train

A suds management train system was used during the design of the surface water drainage system. The main principles involve source control and prevention of overland flow from a site, and to improve the water quality of a site. Refer to Figure 3-2 SuDS Principles Infographic (ref: sdcc.ie)

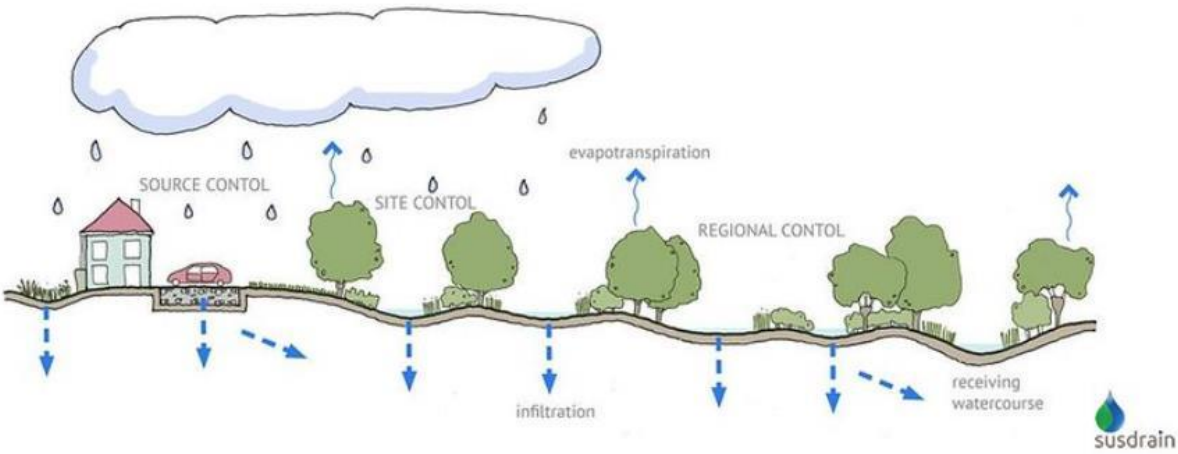


Figure 3-2 SuDS Principles Infographic (ref: sdcc.ie)

3.3 SUDS Proposals

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS). A variety of SuDS measures may be adopted to comply with Council recommendations. All SuDS measures are to be implemented with reference to the UK SuDS Manual and Cork City Council drainage requirements.

SUDS measures will be provided to ensure interception storage of the first 5 to 10mm of rainfall for all storm events. Relatively small volumes of rainwater collected on the respective SuDS devices will enter the public sewer network during typical low intensity storms. SuDS measures will retain rainwater until it is either used via evapotranspiration in the green areas or discharged into the proposed surface water infrastructure network.

The SuDS processes will decrease the impact of the development on the receiving environment by providing amenity and biodiversity in many cases. Regular maintenance of the SuDS proposals will be required to ensure they are operating to their optimal level throughout their design life, refer to Section 6 for detailed information on the maintenance of SuDS in this proposed development.

Table 3-1 demonstrates the selection process for SuDS measures.

Table 3-1 SUDS Selection Hierarchy for Large Scale Development.

SuDS Measure	Measures to be used on site	Rational for selecting/ not selecting measure	Area of feature (m^2)	Attenuation volume feature (m^3)
Swales	No	The contours of the site with road gradients of typically 5% are not suitable for road drainage to swale installations	-	-
Integrated constructed tree pits	yes	Roadside tree planting will be availed of to treat surface water runoff	26 No. x 1.5m2 = 39 m2	Not accounted for

SuDS Measure	Measures to be used on site	Rational for selecting/ not selecting measure	Area of feature (m^2)	Attenuation volume feature (m^3)
Rainwater Butts	yes	Considered suitable in private areas.	-	Not accounted for
Downpipe Planters	yes	Considered suitable in private areas.	-	Not accounted for
Rainwater Harvesting	No	Considered unsuitable for proposed development.	-	-
Soakaways	Yes	Allowing for delayed release and reducing the immediate pressure on stormwater infrastructure.	Soakaway I = 21m2 Private Soakaway = 15m2	Soakaway I = 18m3
Infiltration trenches	No	Soakaway system addresses SuDs requirements	-	-
Permeable pavement	Yes	Providing treatment and storage.	287m2	Not accounted for
Green Roofs	No	Considered unsuitable for proposed development.	-	N/A
Green wall	No	Considered unsuitable for proposed development.	-	-
Filter Strips	No	Considered unsuitable for proposed development.	-	-
Rain Gardens	Yes	Considered suitable in private areas.	-	Not accounted for
Bio-retention	Yes	Soakaway system addresses SuDs requirements	73.9m2	Not accounted for
Blue Roofs	No	Considered unsuitable for proposed development.	-	-

SuDS Measure	Measures to be used on site	Rational for selecting/ not selecting measure	Area of feature (m^2)	Attenuation volume feature (m^3)
Filter Drains	Yes	Providing treatment and storage.	207.1m length x 0.6m wide = 124.26m2	Not accounted for
Detention Basins	Yes	Allowing for delayed release and reducing the immediate pressure on stormwater infrastructure.	Detention Basin I = 522m2 Detention Basin II= 524m2	$324m^3$ $346m^3$
Ponds	No	Considered unsuitable for proposed development.	-	-
Wetlands	No	Considered unsuitable for proposed development.	-	-
Petrol Interceptor	No	Considered unnecessary for the proposed development with a treatment train provided for the road and parking runoff.	-	-
Attenuation Tank	No	Considered unsuitable for proposed development.	-	-

3.3.1 Bio-Retention Systems

Bio-retention systems have been included in the design of the SuDS system. The bio-retention areas will incorporate drainage stone and subsoil. The basin will allow stormwater to percolate downwards through a carefully selected filter medium, facilitating the removal of suspended solids and other finer contaminants. The performance of the bioretention system can vary based on the particle size and composition of the filter media, with different qualities achievable depending on specific site requirements. To prevent lateral seepage and ensure controlled infiltration, the base and sides of the system will be lined.

As outlined in CIRIA C753 (The SuDS Manual), bio-retention areas are highly effective in managing runoff by promoting natural infiltration and groundwater recharge. Table 24.6 specifies that interception designs for infiltration systems can be assumed to provide complete interception, with zero runoff expected from the first 5 mm of rainfall for 80% of events during the summer and 50% in winter. This applies to systems designed to infiltrate runoff from events exceeding a 1-month return period, contributing to significant runoff reduction for smaller, more frequent storms.

Refer to Figure 3-3 to Figure 3-5 for an illustration of the components of a bioretention system, section through a permeable pavement system and example photos of bioretention features in a development.

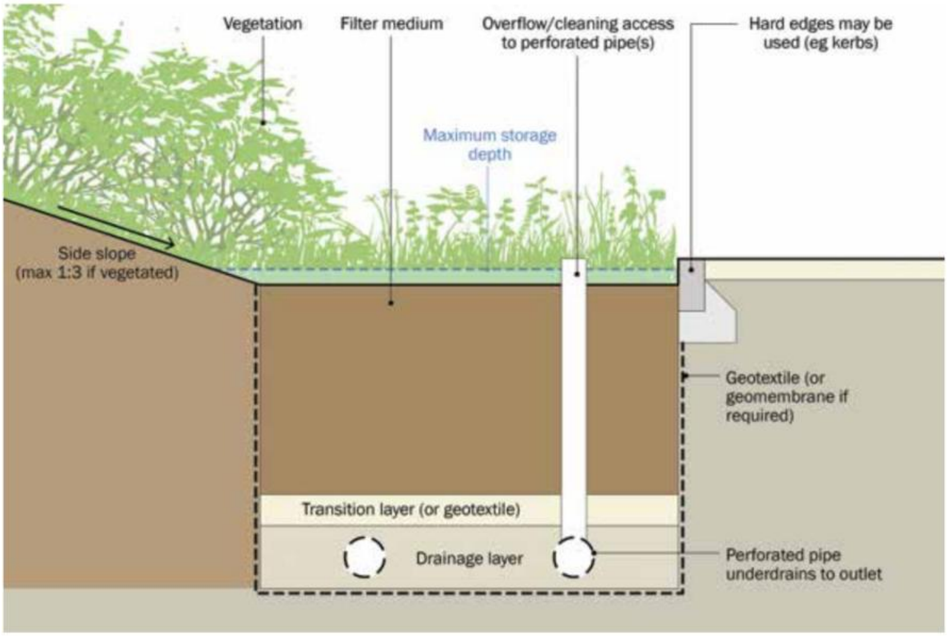


Figure 3-3: Components of a bioretention system (ref: CIRIA SuDS Manual)

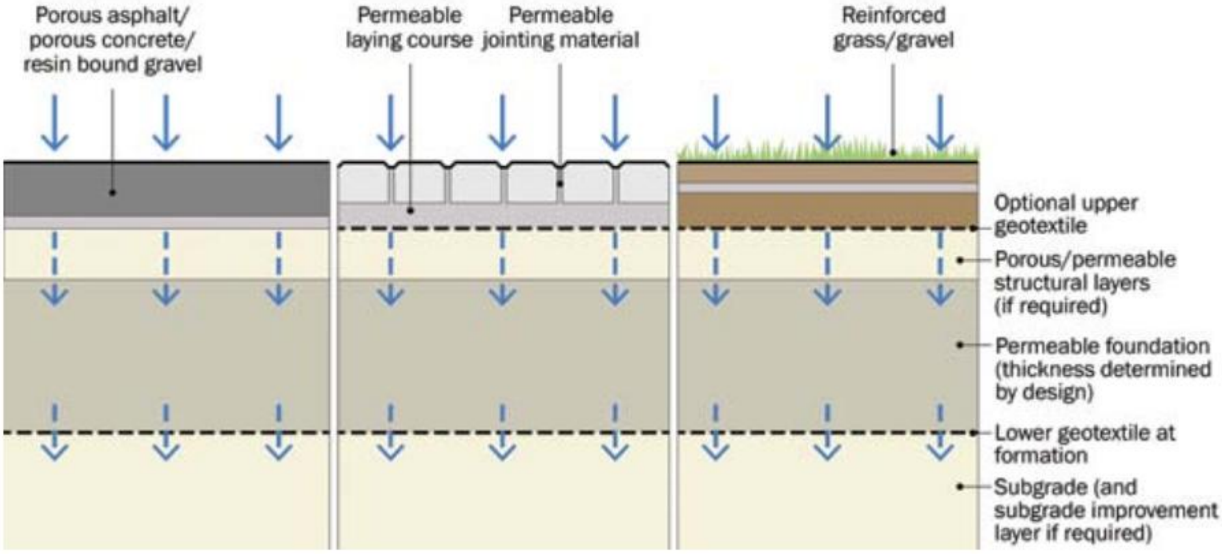


Figure 3-4: Section through a typical permeable pavement system (ref: CIRIA SuDS Manual)

Figure 10.5 Bioretention systems and rain gardens (courtesy Illman Young)

Figure 3-5 Bioretention Systems and Rain Gardens (ref: CIRIA SuDS Manual)

3.3.2 Soakaways

The rate at which water can be infiltrated depends on the infiltration capacity (permeability) of the surrounding soils. Soakaways are below-ground infiltration structures designed to collect and disperse surface water runoff into the surrounding soil. They provide attenuation and promote infiltration, helping to mimic natural drainage processes and reduce the volume of water entering the drainage network. The proposed soakaway will provide an additional level of attenuation storage within the voids in the stone within the proprietary cellular storage system.

The base and sides of the soakaway will be lined and a high-level overflow within the build-up will accommodate removal of excess water to the drainage network. The proposed soakaway will accommodate the 1% AEP (annual exceedance probability) rainfall event with an allowance for 20% climate change, using an infiltration rate of TP03, 22.4 mm/hr according to a specific site investigation carried out on 09th of July 2025, following the requirements of the (BRE Digest 365 – Soakaway design, 2016), refer to Appendix B of the Engineering Planning Report for the site investigation report.

The proposed soakaway will be made up of geocellular AquaCell Core-R type modular unit, which has been designed for use in deep applications and long-lasting solutions with the following measurements:

- Soakaway = volume 17.5m^3 - 7m long by 3m wide by 0.5 m deep

The soakaway will have a voids ratio of approximately 95%. Additionally, the soakaway will have a 0.5m sump located upstream of the soakaway inlet.

A private Soakaway is also proposed within rear gardens to the creche to cater for the runoff from the rear roofs of these units.

The design proposed follows guidelines set out in Infiltration systems Guidelines: CIRIA SuDS Manual 2015, chapter 13. Refer to Figure 3-6 for an illustration of components of soakaways system.

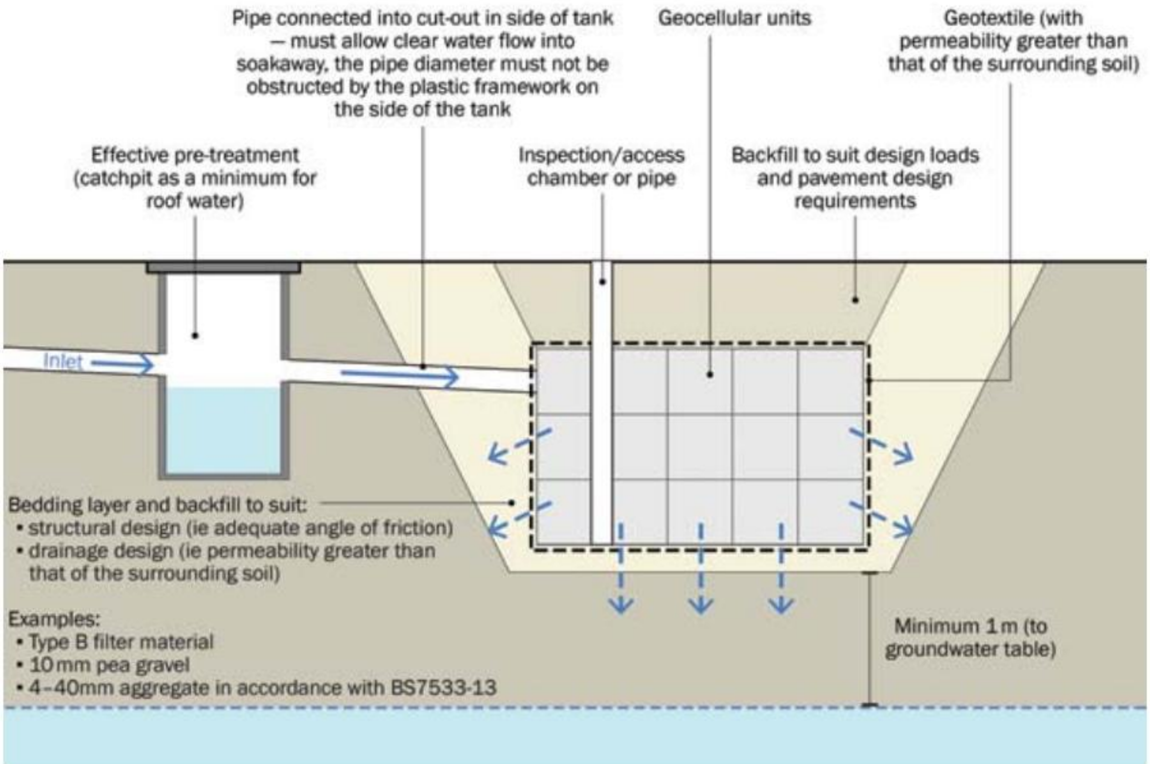


Figure 3-6 Indicative components of soakaways system

3.3.3 Tree Pits

Tree pits act as bioretention systems, allowing stormwater to filter down through engineered soil or bioretention media, which removes pollutants and promotes water infiltration. The proposed tree pits will serve both as landscape elements and as stormwater management features, providing a dual function of urban greening and surface water attenuation. Proposed surface water along the development's landscaped paved areas where possible will discharge to a SuDS element such as tree pits for interception and treatment prior to entering the drainage network.

According to CIRIA C753 (The SuDS Manual), tree pits contribute to sustainable urban drainage by capturing and retaining the first flush of stormwater, particularly for smaller, more frequent rainfall events. As per Table 24.6 of CIRIA C753, tree pits designed for interception can retain the first 5 mm of rainfall, reducing runoff for 80% of summer events and 50% of winter events, in alignment with SuDS principles. The design ensures zero runoff for many smaller events, making tree pits an effective solution for urban stormwater management.

The tree root systems will incorporate drainage stone/subsoil and will provide a level of additional attenuation. The base and sides of the tree root system will be lined to prevent lateral infiltration into surrounding structures, ensuring water is directed into the subsoil. A high-level overflow and underdrain will be incorporated to ensure excess water is effectively drained away to the stormwater network, preventing waterlogging.

The surface water runoff from areas of the road, footpath and parking will be collected to gullies or through gaps in the road kerbing and drained to tree pits. Filter pipework will run in line with the trees pits and discharge to the piped surface water system to allow for some infiltration at source enroute to the detention basins. For the purpose of the outline design, as a conservative measure, no attenuation storage has been assumed within tree pits. Refer to Figure 3-7 Tree Pit Schematic – Cross Section (ref: DMURS Advice Note 5) a tree pit schematic diagram.

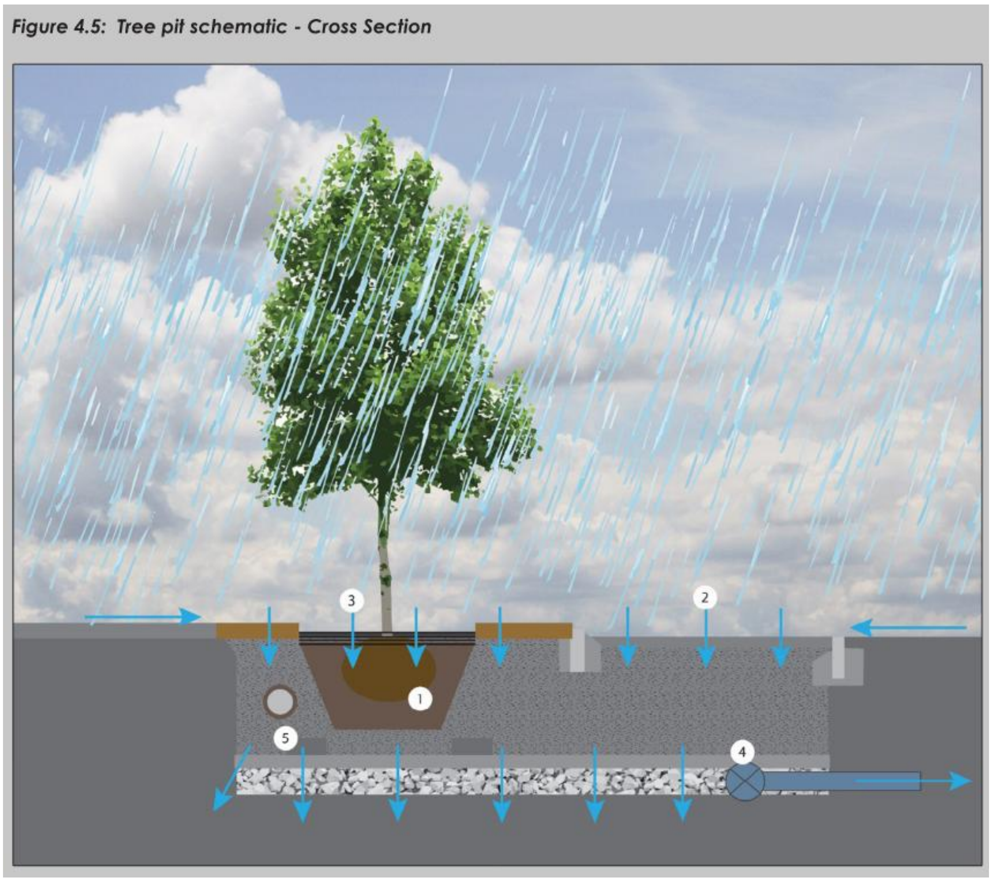


Figure 3-7 Tree Pit Schematic – Cross Section (ref: DMURS Advice Note 5)

3.3.4 Permeable Paving

Permeable pavements allow rainfall and surface runoff to infiltrate through the surface into a permeable sub-base, where it is temporarily stored, treated, and either infiltrated or conveyed away at a controlled rate. Permeable pavements are a multifunctional SuDS measure providing source control, attenuation, water-quality treatment, and reduced surface flooding. Typical systems include permeable block paving, porous asphalt, and permeable concrete surfaces.

Permeable block paving is proposed for the private car parking bays within the site. The treatment processes that occur within permeable block paving build ups include:

1. Filtration of silt and the attached pollutants – the majority of silt is trapped within the top 30mm of the jointing material between the blocks.
2. Biodegradation of organic pollutants, such as petrol and diesel within the pavement construction.
3. Adsorption of pollutants (pollutants attach or bind to surfaces within the construction) which depends on factors such as texture, aggregate structure and moisture content.
4. Settlement and retention of solids.

The use of permeable block paving for the private driveways is proposed. The use of permeable block paving for this purpose is supported by the treatment processes outlined above. CIRIA C753 (The SuDS Manual) notes that regarding interception design of permeable pavements, studies have shown that runoff typically does not occur from permeable pavements for rainfall events up to 5 mm. For the purpose of the outline design, as a conservative measure, no attenuation storage has been assumed within the sub-base of the parking areas.

3.3.5 Detention Basins

Detention basins will form part of the site's sustainable stormwater strategy, providing both attenuation and water-quality benefits. Designed as shallow, landscaped depressions, detention basins temporarily store runoff during rainfall events before releasing flows at a controlled rate through a restricted outlet, in accordance with CIRIA C753 guidance. During storms they fill to provide effective peak-flow attenuation. Where vegetated, the basin base filters runoff as it passes across the surface, supporting sediment removal and improving water quality. This approach aligns with SuDS principles by using a nature-based solution to manage runoff close to source, reducing peak discharge rates, and integrating a functional drainage component within the landscaped environment. Refer to Figure 3-8 for an indicative cross-section of a detention basin, and refer to Figure 3-9 for an example of a detention basin within a residential development.

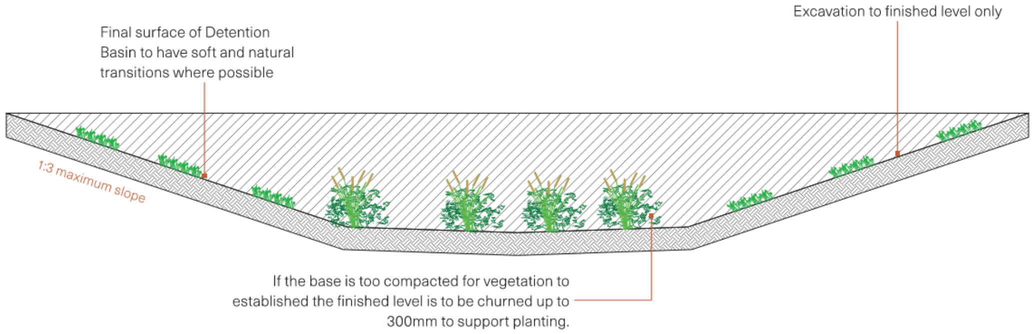


Figure 3-8 Indicative Detention Basin Cross Section

Figure 3-9 Detention Basin Example (ref: SUDS Manual)

Trial pits, soakaway tests are boreholes have been carried out as part of the ground investigation works at the locations of the detention basins to examine the underlying ground conditions including the infiltration characteristics, sub-soil characteristics, groundwater levels and depth to bedrock. Cross sections through the detention basins are shown on PUNCH drg. no. 244132-PUNCH-XX-XX-DR-C-0503 and CSR drg. no. 241842-2-201 Site Sections where plateaux's are proposed in the general topography with the base level of the basins typically above existing ground level.

Detention basin I at the centre of the site has a minimum invert level of 70.475mOD. Rotary Borehole BH03 was drilled at this location which indicates the top of the weathered sandstone at 66.66mOD, approx. 3.8m below the detention basin. The highest ground water level was found at 67.82mOD, approx. 2.65m below the detention basin (refer to section 4.2 below in relation to ground water monitoring). Refer to Figure 3.10 for a section through proposed Detention basin I.

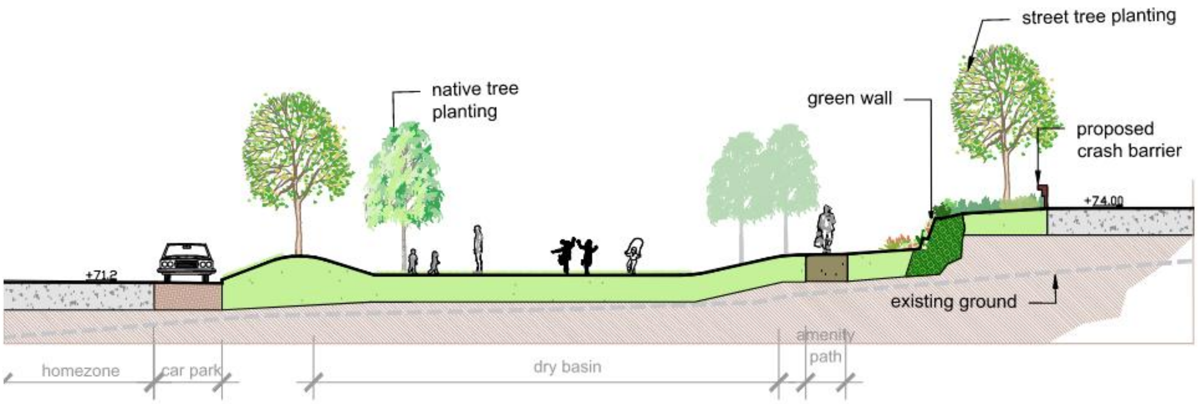


Figure 3-10 Detention Basin I Section

Detention basin II is located at the northwest boundary of the site has a minimum invert level of 61.590mOD. Rotary Borehole BH02 was drilled at this location which indicates the top of the weathered sandstone at 59.02mOD, approx. 2.6m below the detention basin. The ground water level was found at approx. 5.6m below ground level (55.92Mod), approx. 5.67m below the detention basin (refer to section 4.2 below in relation to ground water monitoring).

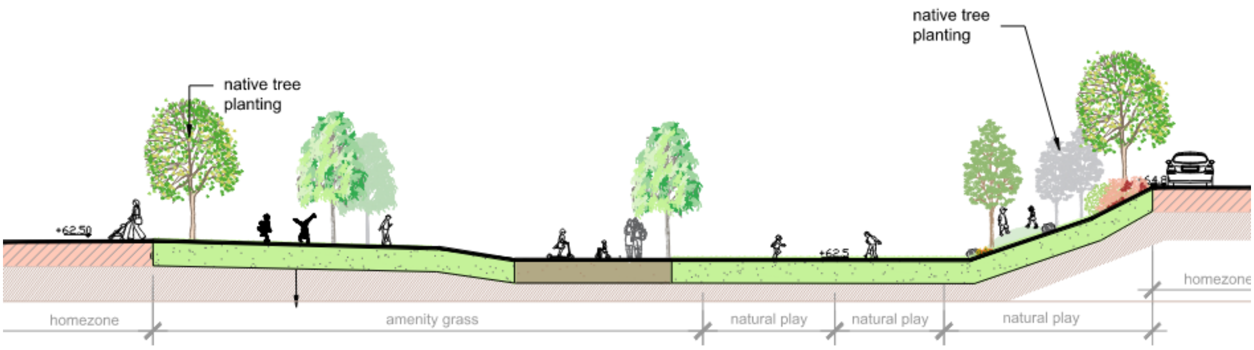


Figure 3-11 Detention Basin II Section

3.3.6 Flow Control Devices

Flow control devices are required at the outlet of each detention basin to ensure that discharge from the proposed development is restricted to the QBAR and that the downstream capacity within the receiving surface water network at Glentrasna is not exceeded. The QBAR calculations are included in Appendix C. Each unit has been sized to regulate flows during the 1-in-100-year storm event including 20% climate change allowance ensuring that attenuation storage within the basins is fully utilised before discharge begins to increase.

The following are the proposed Hydrobrakes:

- Detention basin I has a proposed hydrobrake with a design flow of 2.91l/s. The cover level is 71.275m, and the invert level is 70.475m.
- Detention basin II has a proposed hydrobrake with a design flow of 6.81l/s. The cover level is 62.390m, and invert level is 61.590m.

4 Site Hydrology

The hydrological environment of the site is shaped predominantly by its steep and varied topography, which drives surface water runoff from east to west across the lands. There are no known watercourses within the site boundary.

The nearest receiving waters identified through the EPA's online flood mapping include the Glen River to the north and west, with the Bride River joining the Glen River further west in Blackpool. The site is located within the Bride (Cork City)_020 WFD river sub-basin, however it sits at a significantly elevated position, 50 metres above the adjacent river corridors. The site gradient, averaging 10–12.5%, contributes to rapid surface runoff and limited natural attenuation capacity. The site location in relation to the nearby watercourses is as shown in Figure 4-1 below.

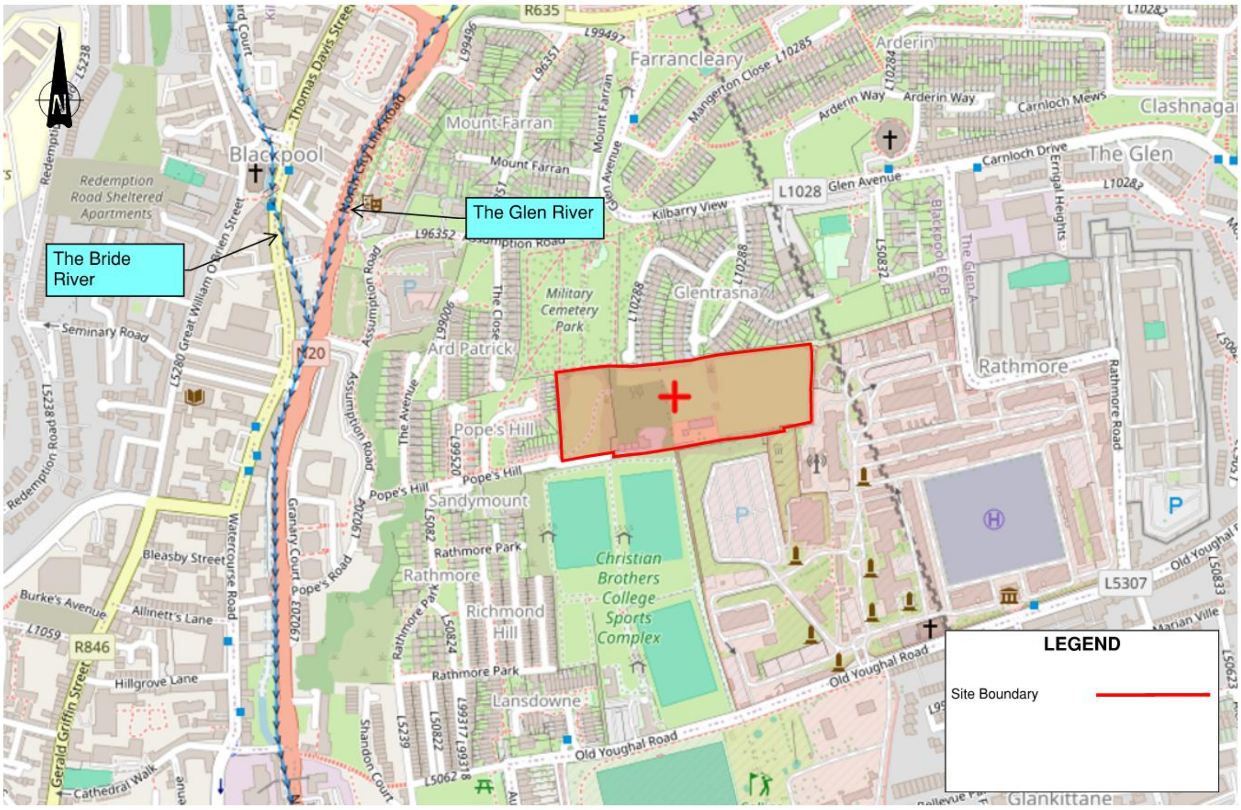


Figure 4-1: Location of proposed development and surrounding hydrological environment

4.1 Soil Infiltration Rates

A site investigation (SI) for the site was carried out by Ground Investigations Ireland on 09th of July 2025. The site investigation followed the requirements of the BRE Digest 365 – Soakaway design, 2016. The SI results revealed the infiltration rate of TP03, 22.4 mm/hr, TP07, 57.2 mm/hr and TP09, 23.5 mm/hr. Refer to Figure 4-2 below for the location of the trial pits and ST points.

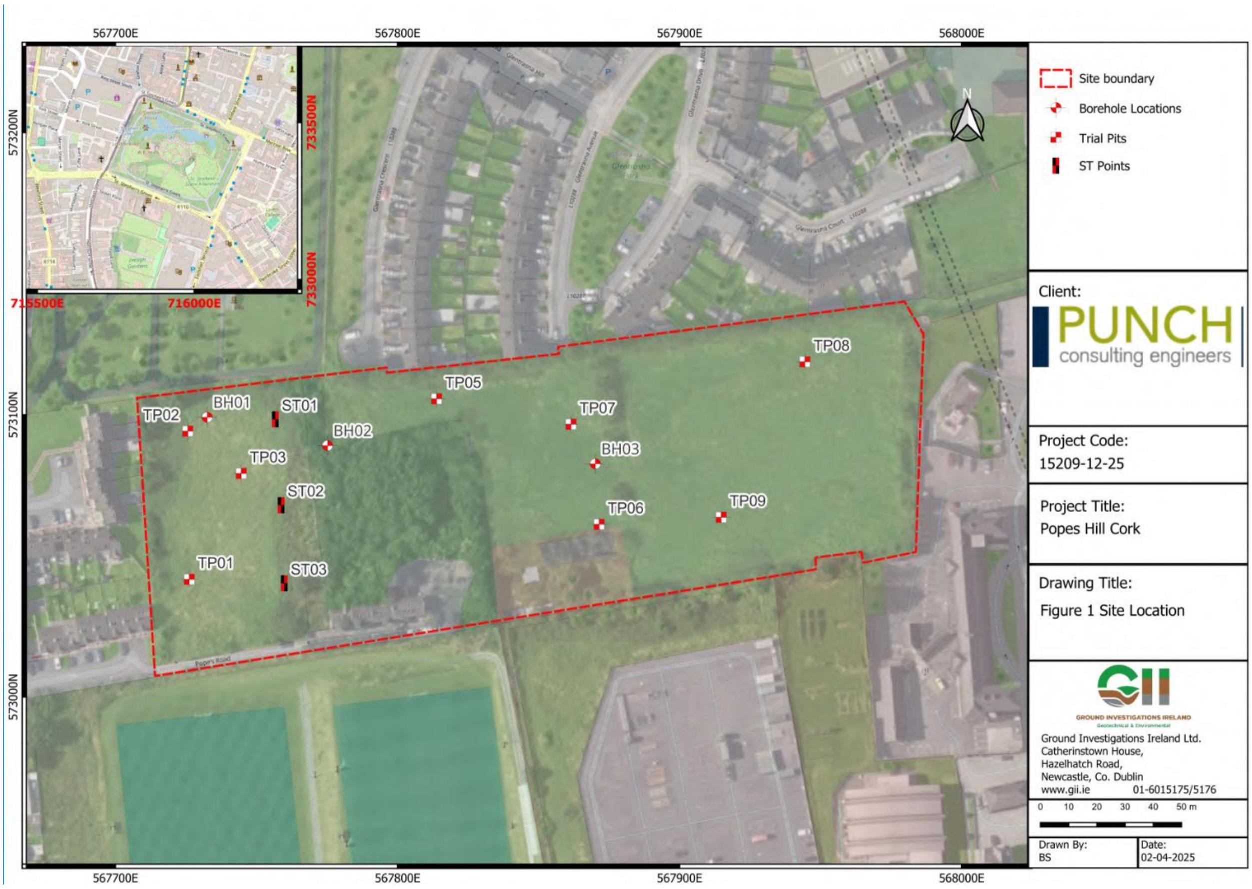


Figure 4-2 Site Investigation location of exploratory holes (GII)

4.2 Groundwater Monitoring

Site investigation works took place on 08/07/2024 which included for a series of trial pits and soakaway tests which revealed good infiltration characteristics through the gravel soils and the sandy gravelly clay deposits which overly weathered bedrock.

Further site investigations were then carried out in January 2026 which included for the drilling of 3 no. rotary core holes to confirm the depth to bedrock and allow for ground water monitoring to be carried out on the site. The weathered sandstone bedrock was encountered between 2.50m and 4.70m below ground level. Standpipes were installed in 3 rotary core holes with the readings taken shown in Figure 3-2. Data loggers were installed in 2 rotary holes BH01 & BH03 which are located at the proposed detention basins with monitoring carried out between the 6th February 2026 and the 5th March 2026. This period coincided with a period of very wet weather with 27 days of rain in February 2026 with overall rainfall 119% of the long-term average.

The ground water monitoring from the data loggers showed readings comparable to those in Figure 4-3 which are the standpipe readings with the shallowest ground water level was recorded on the 12th February 2026 in Borehole 03 with groundwater rising to c. 2.24 below ground level. This coincided with the wettest period of weather. The groundwater level in this standpipe dropped to 4.06m at the end of the heavy rainfall period. The existing groundwater levels satisfy the accepted minimum depths below infiltration Suds devices.

A summary of the groundwater readings from BH01 & BH03 are included in Appendix C with a full copy of the Site investigation Report is included with the Engineering Planning Report accompanying this application.

BOREHOLE	DATE	TIME	GROUNDWATER (m BGL)	Comments
BH01	06/02/2026		5.40	
BH02	06/02/2026		5.60	
BH03	06/02/2026		2.50	
BH01	24/02/2026	11:25:00	5.46	
BH02	24/02/2026	11:28:00	5.62	
BH03	24/02/2026	11:31:00	3.71	
BH01	05/03/2026	12:03:00	5.41	
BH02	05/03/2026	12:01:00	5.72	
BH03	05/03/2026	11:56:00	4.06	

Figure 4-3 Groundwater - Standpipe Readings (Extract from GII Report)

5 Pollution Hazard Indices Based on the Simple Index Approach

In accordance with the SuDS Manual CIRIA C753 the pollution prevention guidelines have been followed to ensure appropriate levels of treatment are provided before attenuated run-off from the site is discharged into the existing surface water sewers. The Pollution Hazard Indices, shown in Table 5-1 below, for the different proposed land uses have been derived from Table 26.2 of CIRIA C753.

Table 5-1: Pollution Hazard Indices for Different Land Uses

Land Use	TSS	Metals	Hydrocarbons
Residential roofs	0.2	0.2	0.05
Residential Car Parks	0.5	0.4	0.4
Pedestrian areas	0.5	0.4	0.4

To ensure the proposed SuDS strategy will appropriately mitigate against the potential pollution derived from these areas the Pollution Mitigation Indices (PMI) in Table 26.3 and 26.15 of CIRIA C753 have been reviewed and laid out in Table 5-2 below.

Table 5-2: Indicative SuDS mitigation indices for the site

SuDS Measures	TSS (PMI)	Metals (PMI)	Hydrocarbons
Conventional gully and pipe drainage	1.0	1.0	1.0
Bioretention System	0.8	0.8	0.8
Detention Basin	0.5	0.5	0.6

Permeable Pavement	0.7	0.6	0.7

Table 5-3 below shows the calculations for the total pollution prevention for each type of hard standing on site. The following formula has been used to calculate the total mitigation in line with CIRIA C753. Total SuDS **Mitigation Index = Mitigation Index 1 + 0.5 (Mitigation Index 2).**

Table 5-3 Pollution Hazard Indices for different Land Uses

Land Use	Mitigation Method 1		
	TSS	Metals	H-C
Residential roofs	Detention Basin		
(Pollution Hazard Table 5-1- Mitigation Index Table 5-2)	0.2-0.5 = -0.3	0.2-0.5 = -0.3	0.05 - 0.7 = -0.2
Residential Car Parks	Conventional gully and pipe drainage		
(Pollution Hazard Table 5-1- Mitigation Index Table 5-2)	0.7 - 1.0 = -0.3	0.6 - 1.0 = -0.4	0.7 - 1.0 = -0.3
Pedestrian areas	Bioretention System		
(Pollution Hazard Table 5-1- Mitigation Index Table 5-2	0.5 - 0.8 = -0.3	0.4 - 0.8 = -0.4	0.4 - 0.8 = -0.4
Pedestrian areas	Conventional gully and pipe drainage		
(Pollution Hazard Table 5-1- Mitigation Index Table 5-2	0.5 - 1.0 = -0.5	0.4 - 1.0 = -0.6	0.4 - 1.0 = -0.6

A hydrobrake is proposed downstream from each of the detention basins and soakaway discharging to the existing surface water network. The SuDS measures outlined above demonstrate that enough treatment has been provided.

6 Maintenance Regime for SUDS Devices

Maintenance of the bioretention is required to ensure the longevity, aesthetic and functionality are retained during operation. This is not only to guarantee its operational efficiency and extend its service life, but also to preserve its visual appeal and uphold its role in safeguarding the environment.

6.1 Bio-Retention Systems

Maintenance of the planting will be greatest in the first few years, which will include regular inspection of plant condition including inlets and outlets, removal of invasive vegetation and possibly irrigation during long dry periods. Refer to Table 6-1

Table 6-1 Operation and Maintenance Requirements for Bioretention Systems (ref: SuDS Manual 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect Inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants to maintain planting density	As required
	Remove sediment, litter and debris build up from around inlets or from forebays	Quarterly to bi-annually
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be >20 years

6.2 Soakaways

Soakaway should be visually inspected for every rainfall event for 30 days after installation and the amount of sediment measured to give the operator an idea of the expected rate of deposition. Systems should then be inspected every 6 months to verify the appropriate level of maintenance. Floating debris and solids should be removed and the sump cleaned with a conventional sump vacuum cleaner. Filter media should be replaced, and sediments, oils and grease should be removed where required.

Table 6-2 Operation and Maintenance Requirements for Soakaways (ref: SuDS Manual 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

6.3 Tree Pits

Maintenance of trees will be greatest in the first few years, which will include regular inspection of tree condition including inlets and outlets, removal of invasive vegetation and possibly irrigation during long dry periods. As any handover process (taking in charge) is medium to long term it is anticipated that the Tree Pit regime will be well established and operational with little maintenance required.

Table 6-3 Operation and Maintenance Requirements for Tree Root Systems (ref: SuDS Manual 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

6.4 Permeable Paving

The permeable paving has a design life equivalent to standard block paving. The surface blocks require routine maintenance. There are four levels of cleaning that can be conducted on a paved area:

1. General dirt should be removed by regular dry brushing.

2. Where the paving has become dull, showing a loss of colour, a wet wash with a stiff bristle brush and garden hose can be adequate.

3. For more stubborn areas, a power washer can be used, taking care not to remove the jointing materials (sand or mortar). The washer should be on a medium pressure setting or lower and should not be aimed directly at the paving surface, but at an angle of 30° approximately.

Cleaning detergents can be used; however, some detergents are acidic, and overuse can damage some paving products. It is advisable to follow the manufacturer's instructions and rinse the areas fully. The resulting runoff should be carefully channelled to either drainage points or containers from where it can be safely disposed. Replace any washed-out jointing sand with new dried sand once the paving has dried. Permeable Paving is only proposed in private curtilage. As a result, it's maintenance will be the responsibility of private occupants and not that of the council.

Table 6-4 Operation and Maintenance Requirements for Permeable Pavements (ref: SuDS Manual 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or as required
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required

	Removal of weeds or glyphosate management applied directly to weeds	As required – typically once per year
Remedial actions	Remediate any landscaping raised within 50 mm of the level of the paving	As required
	Remedial work to depressions, rutting and cracked or broken blocks; replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or sooner if infiltration performance reduces
Monitoring	Initial inspection	Monthly for the first three months
	Inspect for evidence of poor operation and/or weed growth; take remedial action if required	Three-monthly and 48h after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

6.5 Detention Basins

The proposed detention basins are designed as shallow, grassy depressions with selected planting areas to support biodiversity and increase infiltration. Post-construction maintenance requirements are minimal and primarily consist of routine landscape management. There is a requirement for periodic grass cutting and maintenance of vegetation. The basins should be visually inspected after significant rainfall events during the initial establishment period.

Table 6-5 Operation and Maintenance Requirements for Detention Basins (ref: SuDS Manual 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required

	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

6.6 Flow Control Devices

Normally little maintenance is required as there are no moving parts within a vortex control, however, after installation, flow controls should be inspected to ensure the orifice is not blocked on a monthly basis for three months and thereafter at six monthly intervals and hosed down if required. Remove rubbish or debris from flow control if present. Typically flow controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.

7 Exceedance and overflow

In the unlikely event of a partial or complete failure of the proposed drainage system, any exceedance flows will naturally follow the topography of the site, travelling along designed low points and overland flow routes towards the designated collection areas. The site layout has been designed so that exceedance pathways avoid sensitive areas such as building entrances, residential units, and access routes, thereby preventing flooding of property or critical infrastructure. Overland flow will be directed along external hardstanding areas, road corridors, and landscaped zones that are capable of safely conveying shallow surface water without causing erosion or posing a hazard to users. Figure 2-4 illustrates the predicted exceedance flow path based on the site's proposed levels. During an extreme rainfall event, any excess surface water that cannot be contained within the drainage network will be directed safely towards the detention basins where it can be retained or discharged without causing adverse impacts downstream.

Figure 2-3: Exceedance Overland Flow Routes

8 Conclusion

The content of this Drainage Impact Assessment report is to provide detailed information on the storm water elements and SuDS strategy associated with the proposed development. The report along with the associated drainage drawings details how the surface water runoff will be managed on the site with the full design and calculations included in the Appendices. Table 8-1 demonstrates how the four pillars of SuDS have been achieved in the design of the network.

Table 8-1 Four Pillars of SuDS

SuDS Pillar	Detention Basins	Bioretention Area	Tree Pits	Soakaways	Permeable Paving
Water Quantity	Water retention and slow release through green and blue elements.	Captures, stores, and provides water retention	Retains water, reducing runoff and peak flows.	Retains and attenuates water, slowly releasing through the ground.	Retains water, reducing runoff and peak flows.
Water Quality	Filters and removes contaminants via soil and vegetation.	Filters and removes contaminants via soil and vegetation.	Traps pollutants in soil and plants, improving runoff quality.	Filters pollutants through substrate and vegetation.	Traps pollutants in soil and plants, improving runoff quality.
Amenity	Creates green recreational spaces	Enhances aesthetics in urban landscapes.	Adds aesthetic value to streetscape	Creates green recreational spaces.	Support development, adaptability to future changes
Biodiversity	Offers habitat for insects, birds, and plants.	Provides habitat for local wildlife.	Offers habitat for insects, birds, and plants.	Supports diverse plants and wildlife.	Provides green infrastructure

8.1 Drainage Strategy Summary

Table 8-2 summarises the drainage strategy proposed and demonstrates compliance with Cork City Development Plan.

Table 8-2 Drainage Strategy Summary

Drainage Impact Assessment	Measure Taken
1. Full Drainage details, drawings and calculations	Full drainage drawings, details and calculations have been provided.
2. SuDS statement	A full SuDS statement has been provided in section 3 of this report.
3. Demonstrating how the 4 Pillars of SuDS are achieved	The 4 pillars of SuDS have been achieved, refer to ~~Error! Reference source not found.~~ Table 8.1
4. Source control, interception storage, volumes defined, no runoff from site for events up to 5mm	Hardstanding areas have been designed to discharge to bioretention areas. There will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter.
5. Maintenance Plan for proposed scheme	Maintenance plan has been provided in section 6 of this report.
6. Climate change factor	Climate change factor of 20 % has been applied.
7. Overall surface water drainage layout	Overall drainage layout has been provided, refer to PUNCH drawing 244132-PUNCH-XX-XX-DR-C-0100
8. Report Detailing existing site conditions	This report details the existing conditions of the site
9. Longitudinal sections and details of proposed pipe runs.	Longitudinal Sections and details have been provided, refer to PUNCH drawing 244132-PUNCH-XX-XX-DR-C-0175,0176 & 0177.
10. Identify proposed location for discharge to public drainage.	Discharge location has been identified for the surface water
11. Discharge rate applied	Discharge has been restricted to greenfield QBAR, 6.81 l/s
12. Attenuation storage	Attenuation Storage has been provided for excess runoff. 688m^3
13. Exceedance and overland flow routes	Exceedance and overland flow routes have been discussed in section 7 of this report.

Appendix A Stormwater Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	18.500	Minimum Backdrop Height (m)	0.200
Ratio-R	0.264	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1-0	0.044	5.00	78.947	1200	567957.704	573056.949	1.425
S2-0	0.026	5.00	79.049	1200	567963.727	573068.644	1.683
S1-1	0.179	5.00	78.590	1200	567955.589	573067.635	1.960
S1-2			76.326	1200	567947.369	573113.770	1.425
S1-3	0.038	5.00	75.809	1200	567936.851	573118.797	1.438
S3-0		5.00	76.046	1200	567929.247	573046.260	1.296
S1-4			74.833	1200	567916.810	573114.867	2.075
S1-5	0.102	5.00	73.563	1200	567892.232	573110.060	2.018
S1-6			73.088	1200	567887.208	573099.521	1.591
S4-0	0.076	5.00	75.430	1200	567897.761	573041.439	1.630
S1-7	0.095	5.00	74.338	1200	567893.700	573061.506	3.034
S1-8			73.187	1200	567871.364	573058.091	2.296
Basin 1 Inlet			71.465		567869.925	573069.379	0.990
S5-0	0.078	5.00	72.572	1200	567848.938	573049.288	2.172
S5-1	0.083	5.00	72.225	1200	567854.061	573059.133	1.891
Basin 1 Outlet		5.00	71.326		567868.362	573088.263	0.851
S6-1 (Hydrobrake)			71.277	1200	567866.366	573091.906	1.591
S5-2			69.992	1200	567852.631	573104.289	1.425
S5-3	0.025	5.00	69.550	1200	567844.670	573110.608	1.425
S5-4			68.887	1200	567829.624	573109.913	1.425
S5-5	0.049	5.00	68.460	1200	567824.049	573101.440	1.425
S5-6			67.528	1200	567824.508	573081.954	1.529
S5-7	0.071	5.00	67.183	1200	567819.875	573077.795	1.467
S7-0	0.035	5.00	65.578	1200	567781.441	573019.954	1.425
S7-1	0.100	5.00	64.854	1200	567764.856	573019.144	2.424
S7-2	0.071	5.00	64.493	1200	567762.994	573069.331	2.302
S5-8	0.067	5.00	65.912	1350	567791.892	573073.812	3.988
S5-9			64.936	1350	567789.984	573091.067	3.081
Basin 2 (Inlet 1)			62.981		567780.351	573089.378	1.391
S9-0	0.020	5.00	64.068	1200	567754.776	573067.884	0.928
S9-1	0.100	5.00	63.649	1200	567746.305	573066.657	0.898
S9-2			62.502	1200	567742.263	573088.185	0.747
Basin 2 (Inlet 2)			62.837		567765.516	573090.263	1.247
Basin 2 Outlet		5.00	62.709		567773.263	573094.169	1.119
S8-4 (Hydrobrake)			62.675	1200	567772.422	573098.599	1.775
S8-5			61.412	1200	567788.388	573107.475	1.262
EX.MH Outfall			60.611	1200	567788.424	573126.437	0.935

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
S 1.000	S1-0	S1-1	10.893	0.600	77.522	77.165	0.357	30.5	225	5.08	50.0
S 2.000	S2-0	S1-1	8.200	0.600	77.366	77.165	0.201	40.8	225	5.07	50.0
S 1.001	S1-1	S1-2	46.862	0.600	76.630	74.901	1.729	27.1	225	5.39	50.0
S 1.002	S1-2	S1-3	11.658	0.600	74.901	74.371	0.530	22.0	225	5.46	50.0
S 1.003	S1-3	S1-4	20.423	0.600	74.371	73.443	0.928	22.0	225	5.58	50.0
S 3.000	S3-0	S1-4	69.725	0.600	74.750	72.758	1.992	35.0	225	5.52	50.0
S 1.004	S1-4	S1-5	25.044	0.600	72.758	71.620	1.138	22.0	225	5.73	50.0
S 1.005	S1-5	S1-6	11.675	0.600	71.545	71.497	0.048	243.2	300	5.92	50.0
S 1.006	S1-6	S1-7	38.565	0.600	71.497	71.304	0.193	200.0	300	6.50	50.0
S 4.000	S4-0	S1-7	20.474	0.600	73.800	72.913	0.887	23.1	225	5.12	50.0
S 1.007	S1-7	S1-8	22.596	0.600	71.304	71.191	0.113	200.0	300	6.84	50.0
S 1.008	S1-8	Basin 1 Inlet	11.379	0.600	70.891	70.663	0.228	49.9	300	6.92	50.0
S 5.000	S5-0	S5-1	11.098	0.600	70.400	70.334	0.066	168.2	225	5.18	50.0
S 5.001	S5-1	S5-2	45.179	0.600	70.334	68.567	1.767	25.6	225	5.47	50.0
S 6.000	Basin 1 Outlet	S6-1 (Hydrobrake)	4.154	0.600	70.475	70.286	0.189	22.0	225	5.02	50.0
S 6.001	S6-1 (Hydrobrake)	S5-2	18.500	0.600	69.686	68.845	0.841	22.0	225	5.13	50.0
S 5.002	S5-2	S5-3	10.164	0.600	68.567	68.125	0.442	23.0	225	5.54	50.0
S 5.003	S5-3	S5-4	15.062	0.600	68.125	67.462	0.663	22.7	225	5.63	50.0
S 5.004	S5-4	S5-5	10.143	0.600	67.462	67.035	0.427	23.8	225	5.69	50.0
S 5.005	S5-5	S5-6	19.491	0.600	67.035	66.149	0.886	22.0	225	5.81	50.0
S 5.006	S5-6	S5-7	6.226	0.600	65.999	65.716	0.283	22.0	225	5.84	50.0
S 5.007	S5-7	S5-8	28.265	0.600	65.716	64.431	1.285	22.0	225	6.01	50.0
S 7.000	S7-0	S7-1	16.605	0.600	64.153	63.398	0.755	22.0	225	5.10	50.0
S 7.001	S7-1	S7-2	50.222	0.600	62.430	62.191	0.239	210.0	225	6.03	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
S 1.000	2.377	94.5	6.0	1.200	1.200	0.044	0.0	38	1.343
S 2.000	2.054	81.7	3.5	1.458	1.200	0.026	0.0	32	1.041
S 1.001	2.523	100.3	33.7	1.735	1.200	0.249	0.0	90	2.285
S 1.002	2.801	111.4	33.7	1.200	1.213	0.249	0.0	85	2.465
S 1.003	2.801	111.4	38.9	1.213	1.165	0.287	0.0	92	2.561
S 3.000	2.218	88.2	0.0	1.071	1.850	0.000	0.0	0	0.000
S 1.004	2.801	111.4	38.9	1.850	1.718	0.287	0.0	92	2.561
S 1.005	1.003	70.9	52.7	1.718	1.291	0.389	0.0	193	1.096
S 1.006	1.108	78.3	52.7	1.291	2.734	0.389	0.0	181	1.186
S 4.000	2.735	108.7	10.3	1.405	1.200	0.076	0.0	46	1.728
S 1.007	1.108	78.3	75.9	2.734	1.696	0.560	0.0	239	1.255
S 1.008	2.230	157.7	75.9	1.996	0.502	0.560	0.0	147	2.211
S 5.000	1.005	40.0	10.6	1.947	1.666	0.078	0.0	79	0.851
S 5.001	2.598	103.3	21.8	1.666	1.200	0.161	0.0	70	2.070
S 6.000	2.801	111.4	0.0	0.626	0.766	0.000	0.0	0	0.000
S 6.001	2.802	111.4	0.0	1.366	0.922	0.000	0.0	0	0.000
S 5.002	2.740	108.9	21.8	1.200	1.200	0.161	0.0	68	2.154
S 5.003	2.757	109.6	25.2	1.200	1.200	0.186	0.0	73	2.254
S 5.004	2.696	107.2	25.2	1.200	1.200	0.186	0.0	74	2.218
S 5.005	2.801	111.4	31.8	1.200	1.154	0.235	0.0	82	2.427
S 5.006	2.801	111.4	31.8	1.304	1.242	0.235	0.0	82	2.427
S 5.007	2.801	111.4	41.5	1.242	1.256	0.306	0.0	95	2.606
S 7.000	2.801	111.4	4.7	1.200	1.231	0.035	0.0	31	1.398
S 7.001	0.898	35.7	18.3	2.199	2.077	0.135	0.0	114	0.902

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
S 7.002	S7-2	S5-8	29.243	0.600	62.191	62.074	0.117	250.0	225	6.62	50.0
S 5.008	S5-8	S5-9	17.360	0.600	61.924	61.855	0.069	250.0	375	6.88	50.0
S 5.009	S5-9	Basin 2 (Inlet 1)	9.780	0.600	61.855	61.816	0.039	250.0	375	7.02	50.0
S 9.000	S9-0	S9-1	8.559	0.600	63.140	62.751	0.389	22.0	225	5.05	50.0
S 9.001	S9-1	S9-2	21.904	0.600	62.751	61.755	0.996	22.0	225	5.18	50.0
S 9.002	S9-2	Basin 2 (Inlet 2)	23.346	0.600	61.755	61.625	0.130	179.6	225	5.58	50.0
S 10.000	Basin 2 Outlet	S8-4 (Hydrobrake)	4.509	0.600	61.590	61.385	0.205	22.0	225	5.03	50.0
S 8.004	S8-4 (Hydrobrake)	S8-5	18.267	0.600	60.900	60.443	0.457	40.0	225	5.17	50.0
S 8.005	S8-5	EX.MH Outfall	18.962	0.600	60.150	59.676	0.474	40.0	225	5.33	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
S 7.002	0.822	32.7	27.9	2.077	3.613	0.206	0.0	160	0.921
S 5.008	1.141	126.0	78.5	3.613	2.706	0.579	0.0	215	1.201
S 5.009	1.141	126.0	78.5	2.706	0.790	0.579	0.0	215	1.201
S 9.000	2.801	111.4	2.7	0.703	0.673	0.020	0.0	24	1.190
S 9.001	2.802	111.4	16.3	0.673	0.522	0.120	0.0	58	2.010
S 9.002	0.972	38.7	16.3	0.522	0.987	0.120	0.0	102	0.930
S 10.000	2.801	111.4	0.0	0.894	1.065	0.000	0.0	0	0.000
S 8.004	2.074	82.5	0.0	1.550	0.744	0.000	0.0	0	0.000
S 8.005	2.074	82.5	0.0	1.037	0.710	0.000	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
S 1.000	10.893	30.5	225	Circular	78.947	77.522	1.200	78.590	77.165	1.200
S 2.000	8.200	40.8	225	Circular	79.049	77.366	1.458	78.590	77.165	1.200
S 1.001	46.862	27.1	225	Circular	78.590	76.630	1.735	76.326	74.901	1.200
S 1.002	11.658	22.0	225	Circular	76.326	74.901	1.200	75.809	74.371	1.213
S 1.003	20.423	22.0	225	Circular	75.809	74.371	1.213	74.833	73.443	1.165
S 3.000	69.725	35.0	225	Circular	76.046	74.750	1.071	74.833	72.758	1.850
S 1.004	25.044	22.0	225	Circular	74.833	72.758	1.850	73.563	71.620	1.718
S 1.005	11.675	243.2	300	Circular	73.563	71.545	1.718	73.088	71.497	1.291
S 1.006	38.565	200.0	300	Circular	73.088	71.497	1.291	74.338	71.304	2.734
S 4.000	20.474	23.1	225	Circular	75.430	73.800	1.405	74.338	72.913	1.200
S 1.007	22.596	200.0	300	Circular	74.338	71.304	2.734	73.187	71.191	1.696

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S 1.000	S1-0	1200	Manhole	Adoptable	S1-1	1200	Manhole	Adoptable
S 2.000	S2-0	1200	Manhole	Adoptable	S1-1	1200	Manhole	Adoptable
S 1.001	S1-1	1200	Manhole	Adoptable	S1-2	1200	Manhole	Adoptable
S 1.002	S1-2	1200	Manhole	Adoptable	S1-3	1200	Manhole	Adoptable
S 1.003	S1-3	1200	Manhole	Adoptable	S1-4	1200	Manhole	Adoptable
S 3.000	S3-0	1200	Manhole	Adoptable	S1-4	1200	Manhole	Adoptable
S 1.004	S1-4	1200	Manhole	Adoptable	S1-5	1200	Manhole	Adoptable
S 1.005	S1-5	1200	Manhole	Adoptable	S1-6	1200	Manhole	Adoptable
S 1.006	S1-6	1200	Manhole	Adoptable	S1-7	1200	Manhole	Adoptable
S 4.000	S4-0	1200	Manhole	Adoptable	S1-7	1200	Manhole	Adoptable
S 1.007	S1-7	1200	Manhole	Adoptable	S1-8	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
S 1.008	11.379	49.9	300	Circular	73.187	70.891	1.996	71.465	70.663	0.502
S 5.000	11.098	168.2	225	Circular	72.572	70.400	1.947	72.225	70.334	1.666
S 5.001	45.179	25.6	225	Circular	72.225	70.334	1.666	69.992	68.567	1.200
S 6.000	4.154	22.0	225	Circular	71.326	70.475	0.626	71.277	70.286	0.766
S 6.001	18.500	22.0	225	Circular	71.277	69.686	1.366	69.992	68.845	0.922
S 5.002	10.164	23.0	225	Circular	69.992	68.567	1.200	69.550	68.125	1.200
S 5.003	15.062	22.7	225	Circular	69.550	68.125	1.200	68.887	67.462	1.200
S 5.004	10.143	23.8	225	Circular	68.887	67.462	1.200	68.460	67.035	1.200
S 5.005	19.491	22.0	225	Circular	68.460	67.035	1.200	67.528	66.149	1.154
S 5.006	6.226	22.0	225	Circular	67.528	65.999	1.304	67.183	65.716	1.242
S 5.007	28.265	22.0	225	Circular	67.183	65.716	1.242	65.912	64.431	1.256
S 7.000	16.605	22.0	225	Circular	65.578	64.153	1.200	64.854	63.398	1.231
S 7.001	50.222	210.0	225	Circular	64.854	62.430	2.199	64.493	62.191	2.077
S 7.002	29.243	250.0	225	Circular	64.493	62.191	2.077	65.912	62.074	3.613
S 5.008	17.360	250.0	375	Circular	65.912	61.924	3.613	64.936	61.855	2.706
S 5.009	9.780	250.0	375	Circular	64.936	61.855	2.706	62.981	61.816	0.790
S 9.000	8.559	22.0	225	Circular	64.068	63.140	0.703	63.649	62.751	0.673
S 9.001	21.904	22.0	225	Circular	63.649	62.751	0.673	62.502	61.755	0.522
S 9.002	23.346	179.6	225	Circular	62.502	61.755	0.522	62.837	61.625	0.987
S 10.000	4.509	22.0	225	Circular	62.709	61.590	0.894	62.675	61.385	1.065
S 8.004	18.267	40.0	225	Circular	62.675	60.900	1.550	61.412	60.443	0.744
S 8.005	18.962	40.0	225	Circular	61.412	60.150	1.037	60.611	59.676	0.710

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S 1.008	S1-8	1200	Manhole	Adoptable	Basin 1 Inlet		Junction	
S 5.000	S5-0	1200	Manhole	Adoptable	S5-1	1200	Manhole	Adoptable
S 5.001	S5-1	1200	Manhole	Adoptable	S5-2	1200	Manhole	Adoptable
S 6.000	Basin 1 Outlet		Junction		S6-1 (Hydrobrake)	1200	Manhole	Adoptable
S 6.001	S6-1 (Hydrobrake)	1200	Manhole	Adoptable	S5-2	1200	Manhole	Adoptable
S 5.002	S5-2	1200	Manhole	Adoptable	S5-3	1200	Manhole	Adoptable
S 5.003	S5-3	1200	Manhole	Adoptable	S5-4	1200	Manhole	Adoptable
S 5.004	S5-4	1200	Manhole	Adoptable	S5-5	1200	Manhole	Adoptable
S 5.005	S5-5	1200	Manhole	Adoptable	S5-6	1200	Manhole	Adoptable
S 5.006	S5-6	1200	Manhole	Adoptable	S5-7	1200	Manhole	Adoptable
S 5.007	S5-7	1200	Manhole	Adoptable	S5-8	1350	Manhole	Adoptable
S 7.000	S7-0	1200	Manhole	Adoptable	S7-1	1200	Manhole	Adoptable
S 7.001	S7-1	1200	Manhole	Adoptable	S7-2	1200	Manhole	Adoptable
S 7.002	S7-2	1200	Manhole	Adoptable	S5-8	1350	Manhole	Adoptable
S 5.008	S5-8	1350	Manhole	Adoptable	S5-9	1350	Manhole	Adoptable
S 5.009	S5-9	1350	Manhole	Adoptable	Basin 2 (Inlet 1)		Junction	
S 9.000	S9-0	1200	Manhole	Adoptable	S9-1	1200	Manhole	Adoptable
S 9.001	S9-1	1200	Manhole	Adoptable	S9-2	1200	Manhole	Adoptable
S 9.002	S9-2	1200	Manhole	Adoptable	Basin 2 (Inlet 2)		Junction	
S 10.000	Basin 2 Outlet		Junction		S8-4 (Hydrobrake)	1200	Manhole	Adoptable
S 8.004	S8-4 (Hydrobrake)	1200	Manhole	Adoptable	S8-5	1200	Manhole	Adoptable
S 8.005	S8-5	1200	Manhole	Adoptable	EX.MH Outfall	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1-0	567957.704	573056.949	78.947	1.425	1200	0	S 1.000	77.522	225
S2-0	567963.727	573068.644	79.049	1.683	1200	0	S 2.000	77.366	225
S1-1	567955.589	573067.635	78.590	1.960	1200	1	S 2.000	77.165	225
						2	S 1.000	77.165	225
						0	S 1.001	76.630	225
S1-2	567947.369	573113.770	76.326	1.425	1200	1	S 1.001	74.901	225
						0	S 1.002	74.901	225
S1-3	567936.851	573118.797	75.809	1.438	1200	1	S 1.002	74.371	225
						0	S 1.003	74.371	225
S3-0	567929.247	573046.260	76.046	1.296	1200	0	S 3.000	74.750	225
S1-4	567916.810	573114.867	74.833	2.075	1200	1	S 3.000	72.758	225
						2	S 1.003	73.443	225
						0	S 1.004	72.758	225
S1-5	567892.232	573110.060	73.563	2.018	1200	1	S 1.004	71.620	225
						0	S 1.005	71.545	300
S1-6	567887.208	573099.521	73.088	1.591	1200	1	S 1.005	71.497	300
						0	S 1.006	71.497	300
S4-0	567897.761	573041.439	75.430	1.630	1200	0	S 4.000	73.800	225
S1-7	567893.700	573061.506	74.338	3.034	1200	1	S 4.000	72.913	225
						2	S 1.006	71.304	300
						0	S 1.007	71.304	300
S1-8	567871.364	573058.091	73.187	2.296	1200	1	S 1.007	71.191	300
						0	S 1.008	70.891	300
Basin 1 Inlet	567869.925	573069.379	71.465	0.990		1	S 1.008	70.663	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S5-0	567848.938	573049.288	72.572	2.172	1200	0	S 5.000	70.400	225
S5-1	567854.061	573059.133	72.225	1.891	1200	1	S 5.000	70.334	225
						0	S 5.001	70.334	225
Basin 1 Outlet	567868.362	573088.263	71.326	0.851		0	S 6.000	70.475	225
S6-1 (Hydrobrake)	567866.366	573091.906	71.277	1.591	1200	1	S 6.000	70.286	225
						0	S 6.001	69.686	225
S5-2	567852.631	573104.289	69.992	1.425	1200	1	S 6.001	68.845	225
						2	S 5.001	68.567	225
						0	S 5.002	68.567	225
S5-3	567844.670	573110.608	69.550	1.425	1200	1	S 5.002	68.125	225
						0	S 5.003	68.125	225
S5-4	567829.624	573109.913	68.887	1.425	1200	1	S 5.003	67.462	225
						0	S 5.004	67.462	225
S5-5	567824.049	573101.440	68.460	1.425	1200	1	S 5.004	67.035	225
						0	S 5.005	67.035	225
S5-6	567824.508	573081.954	67.528	1.529	1200	1	S 5.005	66.149	225
						0	S 5.006	65.999	225
S5-7	567819.875	573077.795	67.183	1.467	1200	1	S 5.006	65.716	225
						0	S 5.007	65.716	225
S7-0	567781.441	573019.954	65.578	1.425	1200	0	S 7.000	64.153	225
S7-1	567764.856	573019.144	64.854	2.424	1200	1	S 7.000	63.398	225
						0	S 7.001	62.430	225
S7-2	567762.994	573069.331	64.493	2.302	1200	1	S 7.001	62.191	225
						0	S 7.002	62.191	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S5-8	567791.892	573073.812	65.912	3.988	1350	1	S 7.002	62.074	225
						2	S 5.007	64.431	225
						0	S 5.008	61.924	375
S5-9	567789.984	573091.067	64.936	3.081	1350	1	S 5.008	61.855	375
						0	S 5.009	61.855	375
Basin 2 (Inlet 1)	567780.351	573089.378	62.981	1.391		1	S 5.009	61.816	375
S9-0	567754.776	573067.884	64.068	0.928	1200	0	S 9.000	63.140	225
S9-1	567746.305	573066.657	63.649	0.898	1200	1	S 9.000	62.751	225
						0	S 9.001	62.751	225
S9-2	567742.263	573088.185	62.502	0.747	1200	1	S 9.001	61.755	225
						0	S 9.002	61.755	225
Basin 2 (Inlet 2)	567765.516	573090.263	62.837	1.247		1	S 9.002	61.625	225
Basin 2 Outlet	567773.263	573094.169	62.709	1.119		0	S 10.000	61.590	225
S8-4 (Hydrobrake)	567772.422	573098.599	62.675	1.775	1200	1	S 10.000	61.385	225
						0	S 8.004	60.900	225
S8-5	567788.388	573107.475	61.412	1.262	1200	1	S 8.004	60.443	225
						0	S 8.005	60.150	225
EX.MH Outfall	567788.424	573126.437	60.611	0.935	1200	1	S 8.005	59.676	225

Simulation Settings

Rainfall Methodology	FSR	Winter CV	0.840
Rainfall Events	Singular	Analysis Speed	Normal
FSR Region	Scotland and Ireland	Skip Steady State	x
M5-60 (mm)	18.500	Drain Down Time (mins)	240
Ratio-R	0.270	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Starting Level (m)	

Simulation Settings

Check Discharge Rate(s)	x	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200
30	120	240	480	720	1440	2880	5760	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
5	20	0	0
30	20	0	0
100	20	0	0

Node S6-1 (Hydrobrake) Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	69.686	Product Number	CTL-SHE-0073-2900-1589-2900
Design Depth (m)	1.589	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.9	Min Node Diameter (mm)	1200

Node S8-4 (Hydrobrake) Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	60.900	Product Number	CTL-SHE-0115-6800-1490-6800
Design Depth (m)	1.490	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.8	Min Node Diameter (mm)	1200

Node Basin 1 Outlet Infiltration Basin Storage Structure

Base Inf Coefficient (m/hr)	0.02243	Invert Level (m)	70.475
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	
Safety Factor	3.0	Analyse flow through structure	x
Porosity	1.00		

Inlets

Basin 1 Inlet

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	288.0	288.0	0.800	522.0	528.7

Node Basin 2 Outlet Infiltration Basin Storage Structure

Base Inf Coefficient (m/hr)	0.02243	Invert Level (m)	61.590
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	
Safety Factor	3.0	Analyse flow through structure	x
Porosity	1.00		

Inlets

Basin 2 (Inlet 2)	Basin 2 (Inlet 1)

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	285.0	285.0	0.800	524.7	531.3

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1-0	10	77.574	0.052	10.2	0.0590	0.0000	OK
15 minute winter	S2-0	10	77.409	0.043	6.0	0.0488	0.0000	OK
15 minute winter	S1-1	10	76.755	0.125	57.5	0.1411	0.0000	OK
15 minute winter	S1-2	10	75.026	0.125	57.0	0.1408	0.0000	OK
15 minute winter	S1-3	10	74.504	0.133	65.2	0.1506	0.0000	OK
15 minute summer	S3-0	1	74.750	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S1-4	11	72.892	0.134	64.6	0.1513	0.0000	OK
15 minute winter	S1-5	11	72.173	0.628	86.4	0.7108	0.0000	SURCHARGED
15 minute winter	S1-6	11	72.065	0.568	84.8	0.6422	0.0000	SURCHARGED
15 minute winter	S4-0	10	73.863	0.063	17.6	0.0712	0.0000	OK
15 minute winter	S1-7	11	71.794	0.490	121.4	0.5543	0.0000	SURCHARGED
15 minute winter	S1-8	11	71.105	0.214	120.8	0.2425	0.0000	OK
600 minute winter	Basin 1 Inlet	495	70.907	0.432	16.9	0.0000	0.0000	OK
15 minute winter	S5-0	10	70.511	0.111	18.0	0.1258	0.0000	OK
15 minute winter	S5-1	10	70.427	0.093	37.1	0.1054	0.0000	OK
600 minute winter	Basin 1 Outlet	495	70.901	0.426	9.9	150.4754	0.0000	SURCHARGED
600 minute winter	S6-1 (Hydrobrake)	495	70.901	1.215	17.1	1.3744	0.0000	SURCHARGED
15 minute winter	S5-2	10	68.668	0.101	39.1	0.1139	0.0000	OK
15 minute winter	S5-3	10	68.231	0.106	44.4	0.1196	0.0000	OK
15 minute winter	S5-4	11	67.572	0.110	44.1	0.1242	0.0000	OK
15 minute winter	S5-5	11	67.155	0.120	55.1	0.1360	0.0000	OK
15 minute winter	S5-6	11	66.133	0.134	55.5	0.1518	0.0000	OK
15 minute winter	S5-7	11	65.855	0.139	71.1	0.1572	0.0000	OK
15 minute winter	S7-0	10	64.195	0.042	8.1	0.0474	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1-0	S 1.000	S1-1	10.1	1.509	0.107	0.0730	
15 minute winter	S2-0	S 2.000	S1-1	6.0	1.164	0.073	0.0419	
15 minute winter	S1-1	S 1.001	S1-2	57.0	2.526	0.568	1.0573	
15 minute winter	S1-2	S 1.002	S1-3	56.4	2.401	0.506	0.2739	
15 minute winter	S1-3	S 1.003	S1-4	64.6	2.789	0.580	0.4747	
15 minute summer	S3-0	S 3.000	S1-4	0.0	0.000	0.000	0.7844	
180 minute summer	S1-4	S 1.004	S1-5	24.5	2.137	0.220	0.2913	
15 minute winter	S1-5	S 1.005	S1-6	84.8	1.204	1.195	0.8221	
15 minute winter	S1-6	S 1.006	S1-7	85.0	1.206	1.085	2.7157	
15 minute winter	S4-0	S 4.000	S1-7	17.4	1.971	0.160	0.1810	
15 minute winter	S1-7	S 1.007	S1-8	120.8	1.718	1.543	1.5397	
15 minute winter	S1-8	S 1.008	Basin 1 Inlet	120.4	2.362	0.764	0.5806	
15 minute winter	S5-0	S 5.000	S5-1	17.9	1.019	0.447	0.1946	
15 minute winter	S5-1	S 5.001	S5-2	36.7	2.245	0.356	0.7391	
15 minute summer	Basin 1 Outlet	S 6.000	S6-1 (Hydrobrake)	16.9	1.813	0.152	0.1434	
600 minute winter	Basin 1 Outlet	Infiltration		0.6				
600 minute winter	S6-1 (Hydrobrake)	S 6.001	S5-2	2.5	1.152	0.023	0.0409	
15 minute winter	S5-2	S 5.002	S5-3	38.6	2.179	0.354	0.1805	
15 minute winter	S5-3	S 5.003	S5-4	44.1	2.352	0.403	0.2827	
15 minute winter	S5-4	S 5.004	S5-5	44.3	2.169	0.413	0.2070	
15 minute winter	S5-5	S 5.005	S5-6	55.5	2.692	0.498	0.4015	
15 minute winter	S5-6	S 5.006	S5-7	55.6	2.205	0.499	0.1570	
15 minute winter	S5-7	S 5.007	S5-8	71.5	2.885	0.642	0.7002	
15 minute winter	S7-0	S 7.000	S7-1	8.0	1.608	0.072	0.0828	

Results for 5 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S7-1	11	62.623	0.193	31.1	0.2187	0.0000	OK
15 minute winter	S7-2	11	62.493	0.302	44.9	0.3412	0.0000	SURCHARGED
15 minute winter	S5-8	11	62.273	0.349	129.1	0.4994	0.0000	OK
15 minute winter	S5-9	11	62.155	0.300	129.3	0.4296	0.0000	OK
600 minute winter	Basin 2 (Inlet 1)	495	62.081	0.491	19.9	0.0000	0.0000	OK
15 minute winter	S9-0	10	63.171	0.031	4.6	0.0352	0.0000	OK
15 minute winter	S9-1	10	62.827	0.076	27.7	0.0858	0.0000	OK
600 minute winter	S9-2	495	62.076	0.321	3.6	0.3627	0.0000	SURCHARGED
600 minute winter	Basin 2 (Inlet 2)	495	62.076	0.486	5.7	0.0000	0.0000	OK
600 minute winter	Basin 2 Outlet	495	62.073	0.483	19.5	174.1454	0.0000	SURCHARGED
600 minute winter	S8-4 (Hydrobrake)	495	62.072	1.172	18.3	1.3259	0.0000	SURCHARGED
480 minute summer	S8-5	160	60.195	0.045	6.8	0.0504	0.0000	OK
480 minute summer	EX.MH Outfall	160	59.719	0.043	6.8	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S7-1	S 7.001	S7-2	29.0	0.826	0.812	1.7683	
15 minute winter	S7-2	S 7.002	S5-8	43.1	1.095	1.317	1.1250	
15 minute winter	S5-8	S 5.008	S5-9	129.3	1.276	1.026	1.7490	
15 minute winter	S5-9	S 5.009	Basin 2 (Inlet 1)	129.4	1.451	1.026	0.8705	
15 minute winter	S9-0	S 9.000	S9-1	4.6	0.636	0.041	0.0644	
15 minute winter	S9-1	S 9.001	S9-2	27.5	1.473	0.247	0.4149	
15 minute winter	S9-2	S 9.002	Basin 2 (Inlet 2)	27.0	1.051	0.699	0.6000	
15 minute summer	Basin 2 Outlet	S 10.000	S8-4 (Hydrobrake)	27.6	1.898	0.248	0.1704	
600 minute winter	Basin 2 Outlet	Infiltration		0.6				
480 minute summer	S8-4 (Hydrobrake)	S 8.004	S8-5	6.8	1.243	0.082	0.0998	
480 minute summer	S8-5	S 8.005	EX.MH Outfall	6.8	1.243	0.082	0.1035	226.3

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1-0	10	77.586	0.064	15.0	0.0725	0.0000	OK
15 minute winter	S2-0	10	77.419	0.053	8.8	0.0597	0.0000	OK
15 minute winter	S1-1	10	76.793	0.163	84.4	0.1842	0.0000	OK
15 minute winter	S1-2	10	75.067	0.166	83.7	0.1877	0.0000	OK
15 minute winter	S1-3	10	74.551	0.180	95.6	0.2033	0.0000	OK
15 minute summer	S3-0	1	74.750	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S1-4	12	73.513	0.755	95.0	0.8544	0.0000	SURCHARGED
15 minute winter	S1-5	12	72.726	1.181	110.3	1.3353	0.0000	SURCHARGED
15 minute winter	S1-6	12	72.540	1.043	111.1	1.1800	0.0000	SURCHARGED
15 minute winter	S4-0	10	73.877	0.077	25.8	0.0876	0.0000	OK
15 minute winter	S1-7	11	72.089	0.785	161.8	0.8881	0.0000	SURCHARGED
15 minute winter	S1-8	11	71.266	0.375	161.2	0.4239	0.0000	SURCHARGED
720 minute winter	Basin 1 Inlet	675	71.103	0.628	20.7	0.0000	0.0000	OK
15 minute winter	S5-0	10	70.541	0.141	26.5	0.1593	0.0000	OK
15 minute winter	S5-1	10	70.451	0.117	54.5	0.1320	0.0000	OK
720 minute winter	Basin 1 Outlet	690	71.097	0.622	16.6	237.1073	0.0000	FLOOD RISK
720 minute winter	S6-1 (Hydrobrake)	690	71.097	1.411	8.9	1.5956	0.0000	FLOOD RISK
15 minute winter	S5-2	10	68.694	0.127	56.1	0.1440	0.0000	OK
15 minute winter	S5-3	10	68.259	0.134	64.1	0.1512	0.0000	OK
15 minute winter	S5-4	11	67.603	0.141	63.8	0.1598	0.0000	OK
15 minute winter	S5-5	11	67.191	0.156	80.3	0.1761	0.0000	OK
15 minute winter	S5-6	11	66.183	0.184	80.3	0.2083	0.0000	OK
15 minute winter	S5-7	11	65.907	0.191	103.3	0.2161	0.0000	OK
15 minute winter	S7-0	10	64.204	0.051	11.9	0.0577	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1-0	S 1.000	S1-1	14.9	1.673	0.157	0.0969	
15 minute winter	S2-0	S 2.000	S1-1	8.7	1.291	0.107	0.0554	
15 minute winter	S1-1	S 1.001	S1-2	83.7	2.691	0.834	1.4569	
15 minute winter	S1-2	S 1.002	S1-3	82.7	2.527	0.743	0.3813	
15 minute winter	S1-3	S 1.003	S1-4	95.0	2.974	0.853	0.6514	
15 minute summer	S3-0	S 3.000	S1-4	0.0	0.000	0.000	1.3865	
240 minute winter	S1-4	S 1.004	S1-5	22.5	2.138	0.202	0.2649	
15 minute winter	S1-5	S 1.005	S1-6	111.1	1.578	1.567	0.8221	
15 minute winter	S1-6	S 1.006	S1-7	111.9	1.589	1.429	2.7157	
15 minute winter	S4-0	S 4.000	S1-7	25.6	2.184	0.235	0.2398	
15 minute winter	S1-7	S 1.007	S1-8	161.2	2.290	2.059	1.5751	
30 minute summer	S1-8	S 1.008	Basin 1 Inlet	151.6	2.434	0.962	0.7070	
15 minute winter	S5-0	S 5.000	S5-1	26.3	1.120	0.658	0.2604	
15 minute winter	S5-1	S 5.001	S5-2	54.0	2.456	0.523	0.9929	
15 minute summer	Basin 1 Outlet	S 6.000	S6-1 (Hydrobrake)	-15.8	1.864	-0.141	0.1652	
720 minute winter	Basin 1 Outlet	Infiltration		0.6				
720 minute winter	S6-1 (Hydrobrake)	S 6.001	S5-2	2.7	1.177	0.024	0.0429	
15 minute winter	S5-2	S 5.002	S5-3	55.6	2.335	0.510	0.2427	
15 minute winter	S5-3	S 5.003	S5-4	63.8	2.512	0.582	0.3827	
15 minute winter	S5-4	S 5.004	S5-5	64.0	2.302	0.597	0.2817	
15 minute winter	S5-5	S 5.005	S5-6	80.3	2.900	0.721	0.5397	
15 minute winter	S5-6	S 5.006	S5-7	80.6	2.284	0.723	0.2203	
15 minute winter	S5-7	S 5.007	S5-8	103.8	3.038	0.932	0.9639	
15 minute winter	S7-0	S 7.000	S7-1	11.8	1.794	0.106	0.1140	

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S7-1	11	63.452	1.022	45.8	1.1563	0.0000	SURCHARGED
15 minute winter	S7-2	11	63.066	0.875	65.5	0.9897	0.0000	SURCHARGED
15 minute winter	S5-8	11	62.512	0.588	190.5	0.8412	0.0000	SURCHARGED
720 minute winter	S5-9	660	62.295	0.440	23.8	0.6296	0.0000	SURCHARGED
720 minute winter	Basin 2 (Inlet 1)	660	62.295	0.705	23.6	0.0000	0.0000	OK
15 minute winter	S9-0	10	63.178	0.038	6.8	0.0425	0.0000	OK
15 minute winter	S9-1	10	62.844	0.093	40.7	0.1057	0.0000	OK
720 minute winter	S9-2	675	62.289	0.534	4.4	0.6038	0.0000	FLOOD RISK
720 minute winter	Basin 2 (Inlet 2)	675	62.289	0.699	7.0	0.0000	0.0000	OK
720 minute winter	Basin 2 Outlet	660	62.286	0.696	16.3	272.8715	0.0000	SURCHARGED
720 minute winter	S8-4 (Hydrobrake)	660	62.285	1.385	22.7	1.5665	0.0000	SURCHARGED
360 minute summer	S8-5	80	60.195	0.045	6.8	0.0504	0.0000	OK
360 minute summer	EX.MH Outfall	80	59.719	0.043	6.8	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S7-1	S 7.001	S7-2	42.8	1.076	1.198	1.9974	
15 minute winter	S7-2	S 7.002	S5-8	65.3	1.642	1.998	1.1630	
15 minute winter	S5-8	S 5.008	S5-9	190.7	1.729	1.513	1.9148	
15 minute winter	S5-9	S 5.009	Basin 2 (Inlet 1)	190.7	1.741	1.513	1.0270	
15 minute winter	S9-0	S 9.000	S9-1	6.8	0.706	0.061	0.0852	
15 minute summer	S9-1	S 9.001	S9-2	38.6	1.591	0.347	0.5409	
15 minute winter	S9-2	S 9.002	Basin 2 (Inlet 2)	39.6	1.173	1.025	0.7871	
15 minute summer	Basin 2 Outlet	S 10.000	S8-4 (Hydrobrake)	24.1	1.883	0.216	0.1793	
720 minute winter	Basin 2 Outlet	Infiltration		0.6				
360 minute summer	S8-4 (Hydrobrake)	S 8.004	S8-5	6.8	1.242	0.082	0.0997	
360 minute summer	S8-5	S 8.005	EX.MH Outfall	6.8	1.243	0.082	0.1035	205.7

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1-0	10	77.596	0.074	19.4	0.0836	0.0000	OK
15 minute winter	S2-0	10	77.427	0.061	11.5	0.0689	0.0000	OK
15 minute winter	S1-1	11	77.407	0.777	109.7	0.8788	0.0000	SURCHARGED
15 minute winter	S1-2	12	75.663	0.762	99.5	0.8618	0.0000	SURCHARGED
15 minute winter	S1-3	12	75.142	0.771	111.3	0.8723	0.0000	SURCHARGED
15 minute summer	S3-0	1	74.750	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S1-4	13	74.202	1.444	105.7	1.6331	0.0000	SURCHARGED
15 minute winter	S1-5	12	73.169	1.624	126.5	1.8369	0.0000	SURCHARGED
15 minute winter	S1-6	12	72.926	1.429	127.5	1.6167	0.0000	FLOOD RISK
15 minute winter	S4-0	10	73.890	0.090	33.6	0.1016	0.0000	OK
15 minute winter	S1-7	11	72.343	1.039	192.4	1.1748	0.0000	SURCHARGED
15 minute winter	S1-8	11	71.388	0.497	191.7	0.5625	0.0000	SURCHARGED
960 minute winter	Basin 1 Inlet	900	71.267	0.792	21.3	0.0000	0.0000	OK
15 minute winter	S5-0	10	70.569	0.169	34.5	0.1906	0.0000	OK
15 minute winter	S5-1	10	70.472	0.138	70.9	0.1562	0.0000	OK
960 minute winter	Basin 1 Outlet	900	71.260	0.785	13.0	317.9104	0.0000	FLOOD RISK
960 minute winter	S6-1 (Hydrobrake)	900	71.260	1.574	15.0	1.7801	0.0000	FLOOD RISK
15 minute winter	S5-2	10	68.720	0.153	72.5	0.1736	0.0000	OK
15 minute winter	S5-3	11	68.300	0.175	82.7	0.1983	0.0000	OK
15 minute winter	S5-4	12	67.885	0.423	82.3	0.4783	0.0000	SURCHARGED
15 minute winter	S5-5	12	67.565	0.530	102.9	0.5995	0.0000	SURCHARGED
15 minute winter	S5-6	12	66.753	0.754	94.2	0.8524	0.0000	SURCHARGED
15 minute winter	S5-7	12	66.390	0.674	120.8	0.7625	0.0000	SURCHARGED
15 minute winter	S7-0	10	64.209	0.056	15.5	0.0638	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1-0	S 1.000	S1-1	19.3	1.788	0.204	0.2704	
15 minute winter	S2-0	S 2.000	S1-1	11.4	1.386	0.140	0.1939	
15 minute summer	S1-1	S 1.001	S1-2	97.2	2.717	0.969	1.8638	
30 minute winter	S1-2	S 1.002	S1-3	89.3	2.532	0.802	0.4217	
30 minute winter	S1-3	S 1.003	S1-4	104.3	2.968	0.936	0.8122	
15 minute summer	S3-0	S 3.000	S1-4	0.0	0.000	0.000	1.3865	
15 minute winter	S1-4	S 1.004	S1-5	103.1	2.593	0.926	0.9960	
15 minute winter	S1-5	S 1.005	S1-6	127.5	1.810	1.797	0.8221	
15 minute winter	S1-6	S 1.006	S1-7	129.9	1.845	1.659	2.7157	
15 minute winter	S4-0	S 4.000	S1-7	33.3	2.338	0.306	0.2917	
15 minute winter	S1-7	S 1.007	S1-8	191.7	2.723	2.449	1.5751	
15 minute winter	S1-8	S 1.008	Basin 1 Inlet	191.4	2.718	1.214	0.7941	
15 minute winter	S5-0	S 5.000	S5-1	34.2	1.188	0.857	0.3188	
15 minute winter	S5-1	S 5.001	S5-2	70.3	2.583	0.680	1.2285	
15 minute summer	Basin 1 Outlet	S 6.000	S6-1 (Hydrobrake)	14.8	1.729	0.133	0.1652	
960 minute winter	Basin 1 Outlet	Infiltration		0.6				
960 minute winter	S6-1 (Hydrobrake)	S 6.001	S5-2	2.9	1.195	0.026	0.0445	
15 minute summer	S5-2	S 5.002	S5-3	68.6	2.432	0.630	0.2902	
15 minute winter	S5-3	S 5.003	S5-4	82.3	2.582	0.751	0.5495	
15 minute summer	S5-4	S 5.004	S5-5	78.5	2.354	0.732	0.4034	
30 minute summer	S5-5	S 5.005	S5-6	93.7	2.935	0.841	0.7752	
15 minute winter	S5-6	S 5.006	S5-7	94.8	2.385	0.851	0.2476	
30 minute winter	S5-7	S 5.007	S5-8	111.3	3.045	0.999	1.1080	
15 minute summer	S7-0	S 7.000	S7-1	14.6	1.862	0.131	0.3923	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S7-1	11	64.094	1.664	59.6	1.8824	0.0000	SURCHARGED
15 minute winter	S7-2	11	63.517	1.326	81.6	1.4997	0.0000	SURCHARGED
15 minute winter	S5-8	11	62.682	0.758	227.3	1.0844	0.0000	SURCHARGED
720 minute winter	S5-9	690	62.480	0.625	29.1	0.8944	0.0000	SURCHARGED
720 minute winter	Basin 2 (Inlet 1)	690	62.480	0.890	28.8	0.0000	0.0000	OK
15 minute winter	S9-0	10	63.183	0.043	8.8	0.0482	0.0000	OK
15 minute winter	S9-1	10	62.859	0.108	52.9	0.1225	0.0000	OK
720 minute winter	S9-2	690	62.473	0.718	5.5	0.8126	0.0000	FLOOD RISK
720 minute winter	Basin 2 (Inlet 2)	690	62.473	0.883	9.0	0.0000	0.0000	OK
720 minute winter	Basin 2 Outlet	690	62.471	0.881	24.0	368.2918	0.0000	FLOOD RISK
720 minute winter	S8-4 (Hydrobrake)	690	62.469	1.569	14.6	1.7750	0.0000	FLOOD RISK
720 minute winter	S8-5	690	60.195	0.045	6.9	0.0508	0.0000	OK
720 minute winter	EX.MH Outfall	690	59.720	0.044	6.9	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S7-1	S 7.001	S7-2	52.7	1.325	1.475	1.9974	
15 minute winter	S7-2	S 7.002	S5-8	80.1	2.015	2.451	1.1630	
15 minute winter	S5-8	S 5.008	S5-9	226.8	2.056	1.799	1.9148	
15 minute winter	S5-9	S 5.009	Basin 2 (Inlet 1)	226.5	2.055	1.797	1.0517	
15 minute winter	S9-0	S 9.000	S9-1	8.8	0.751	0.079	0.1032	
15 minute summer	S9-1	S 9.001	S9-2	50.2	1.671	0.450	0.6351	
15 minute winter	S9-2	S 9.002	Basin 2 (Inlet 2)	51.4	1.305	1.330	0.9255	
15 minute winter	Basin 2 Outlet	S 10.000	S8-4 (Hydrobrake)	28.2	1.919	0.254	0.1793	
720 minute winter	Basin 2 Outlet	Infiltration		0.6				
720 minute winter	S8-4 (Hydrobrake)	S 8.004	S8-5	6.9	1.248	0.083	0.1008	
720 minute winter	S8-5	S 8.005	EX.MH Outfall	6.9	1.248	0.083	0.1046	351.2

Appendix B Met Eireann Figures

Met Eireann

Return Period Rainfall Depths for sliding Durations

Irish Grid: Easting: 167920, Northing: 73040,

	Interval		Years										
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	120,
5 mins	3.2,	4.3,	4.9,	5.8,	6.4,	6.9,	8.4,	10.0,	11.1,	12.6,	13.9,	15.0,	15.6,
10 mins	4.4,	6.0,	6.9,	8.1,	9.0,	9.6,	11.7,	14.0,	15.5,	17.6,	19.4,	20.8,	21.8,
15 mins	5.2,	7.1,	8.1,	9.6,	10.5,	11.3,	13.7,	16.5,	18.2,	20.7,	22.8,	24.5,	25.6,
30 mins	6.9,	9.2,	10.5,	12.3,	13.5,	14.4,	17.4,	20.7,	22.8,	25.8,	28.3,	30.3,	31.6,
1 hours	9.1,	12.1,	13.6,	15.8,	17.3,	18.5,	22.1,	26.0,	28.6,	32.1,	35.1,	37.5,	39.0,
2 hours	12.0,	15.7,	17.6,	20.4,	22.2,	23.6,	28.0,	32.7,	35.8,	40.0,	43.6,	46.3,	48.2,
3 hours	14.1,	18.4,	20.5,	23.6,	25.7,	27.2,	32.1,	37.4,	40.8,	45.4,	49.4,	52.4,	54.5,
4 hours	15.8,	20.5,	22.9,	26.3,	28.5,	30.2,	35.5,	41.2,	44.8,	49.8,	54.0,	57.3,	59.4,
6 hours	18.7,	23.9,	26.6,	30.4,	32.9,	34.8,	40.7,	47.1,	51.1,	56.6,	61.3,	64.8,	67.2,
9 hours	22.0,	28.0,	31.0,	35.3,	38.1,	40.2,	46.8,	53.8,	58.3,	64.3,	69.5,	73.4,	76.0,
12 hours	24.7,	31.2,	34.5,	39.2,	42.2,	44.5,	51.6,	59.2,	64.0,	70.5,	76.0,	80.2,	82.9,
18 hours	29.0,	36.5,	40.2,	45.4,	48.8,	51.4,	59.3,	67.7,	73.0,	80.1,	86.2,	90.8,	93.8,
24 hours	32.6,	40.7,	44.8,	50.5,	54.1,	56.9,	65.5,	74.5,	80.1,	87.8,	94.2,	99.1,	102.3,
2 days	42.3,	51.8,	56.4,	62.9,	67.1,	70.2,	79.8,	89.8,	95.9,	104.2,	111.2,	116.4,	119.9,
3 days	50.3,	60.9,	66.1,	73.2,	77.8,	81.2,	91.6,	102.4,	109.0,	117.8,	125.3,	130.8,	134.5,
4 days	57.5,	69.1,	74.6,	82.4,	87.3,	90.9,	102.0,	113.5,	120.5,	129.9,	137.7,	143.5,	147.4,
6 days	70.4,	83.6,	89.9,	98.6,	104.1,	108.2,	120.5,	133.2,	140.9,	151.1,	159.6,	165.9,	170.1,
8 days	82.1,	96.7,	103.7,	113.2,	119.2,	123.6,	137.0,	150.6,	158.9,	169.9,	179.0,	185.8,	190.1,
10 days	93.1,	108.9,	116.4,	126.7,	133.1,	137.9,	152.2,	166.7,	175.5,	187.1,	196.8,	203.9,	208.5,
12 days	103.5,	120.5,	128.5,	139.4,	146.2,	151.3,	166.5,	181.8,	191.1,	203.3,	213.4,	220.9,	225.7,
16 days	123.1,	142.2,	151.1,	163.2,	170.8,	176.3,	193.0,	209.8,	220.0,	233.2,	244.2,	252.3,	257.5,
20 days	141.7,	162.6,	172.3,	185.5,	193.7,	199.8,	217.8,	235.9,	246.8,	260.9,	272.7,	281.3,	286.8,
25 days	163.9,	186.9,	197.5,	211.9,	220.9,	227.4,	247.0,	266.5,	278.2,	293.4,	306.0,	315.2,	321.1,

NOTES:

These values are derived from a Depth Duration Frequency (DDF) Model update 2023

For details refer to:

'Mateus C., and Coonan, B. 2023. Estimation of point rainfall frequencies in Ireland. Technical Note No. 68. Met Eireann',

Available for download at:

http://hdl.handle.net/2262/102417

M5_60 = 18.5

M5_2d = 70.2

R = 0.264

Appendix C QBAR Calculations

PUNCH consulting engineers

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Popes Hill, Cork**

Project no.: **244132**

Designed: **Geraldo Souza** Date: **18/12/2025**

(Complete figures in **blue** only)

Q Bar = 0.00108 x Area $^{0.89}$ x SAAR$^{1.17}$ x Soil$^{2.17}$

Where			**Units**
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steep, rocky areas

Area description:

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)

=> Soil index = 0.40

Area = 0.5 km^2 (**5612** m^2)

Catchment 1

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = **1152** mm

Refer to Annual Average Rainfall Diagram on following spreadsheet

Q Bar = 0.3047 m^3/s

= 304.70 l/s

or

= 542.95 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar}	**=**	**3.42**	**l/s**

2 litres/second/hectare =	**1.12**	**l/s**

Growth Curve

Region:	Ireland South	
Return Period Q_{t1}:	1	year
Growth Factor for Q_{t1}:	0.85	
Allowable Discharge for 1 year return period:	**2.91**	**l/s**
Return Period Q_{t2}:	5	year
Growth Factor for Q_{t2}:	1.19	
Allowable Discharge for 5 year return period:	**4.07**	**l/s**
Return Period Q_{t2}:	25	year
Growth Factor for Q_{t2}:	1.55	
Allowable Discharge for 25 year return period:	**5.30**	**l/s**
Return Period Q_{t3}:	100	year
Growth Factor for Q_{t3}:	1.84	
Allowable Discharge for 100 year return period:	**6.29**	**l/s**

Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Region	MD Region	Return Period (Years)							
		1	2	5	10	25	50	100	200
Nationa	11	0.85	0.96	1.2	1.35	1.55	1.7	1.84	1.99
Ireland	12	0.85	0.96	1.21	1.38	1.59	1.74	1.9	2.05
Ireland	13	0.85	0.96	1.19	1.35	1.55	1.7	1.84	1.99
Ireland	14	0.85	0.96	1.18	1.33	1.51	1.64	1.78	1.91

PUNCH consulting engineers

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Popes Hill, Cork**

Project no.: **244132**

Designed: **Geraldo Souza** Date: **18/12/2025**

(Complete figures in **blue** only)

Q Bar = 0.00108 x Area $^{0.89}$ x SAAR$^{1.17}$ x Soil$^{2.17}$

Where			**Units**
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steep, rocky areas

Area description:

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)

=> Soil index = 0.40

Area = 0.5 km^2 (**6333.9** m^2)

Catchment 2

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = **1152** mm

Refer to Annual Average Rainfall Diagram on following spreadsheet

Q Bar = 0.3047 m^3/s

= 304.70 l/s

or

= 481.07 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar}	**=**	**3.86**	**l/s**

2 litres/second/hectare =	**1.27**	**l/s**

Growth Curve

Region: Ireland South

Return Period Q_{t1}: 1 year

Growth Factor for Q_{t1}: 0.85

Allowable Discharge for 1 year return period: 3.28 l/s

Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Return Period Q_{t2}: 5 year

Growth Factor for Q_{t2}: 1.19

Allowable Discharge for 5 year return period: 4.59 l/s

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Return Period Q_{t2}: 25 year

Growth Factor for Q_{t2}: 1.55

Allowable Discharge for 25 year return period: 5.98 l/s

Return Period Q_{t3}: 100 year

Growth Factor for Q_{t3}: 1.84

Allowable Discharge for 100 year return period: 7.10 l/s

Region	MD Region N	Return Period (Years)							
		1	2	5	10	25	50	100	200
Nationa	11	0.85	0.96	1.2	1.35	1.55	1.7	1.84	1.99
Ireland	12	0.85	0.96	1.21	1.38	1.59	1.74	1.9	2.05
Ireland	13	0.85	0.96	1.19	1.35	1.55	1.7	1.84	1.99
Ireland	14	0.85	0.96	1.18	1.33	1.51	1.64	1.78	1.91

PUNCH consulting engineers

Mean Annual Flood Flow Rate Equation for Greenfield Catchments IH124

(Based on Institute of Hydrology report No. 124)

Project title: **Popes Hill, Cork**

Project no.: **244132**

Designed: **Geraldo Souza** Date: **18/12/2025**

(Complete figures in **blue** only)

Q Bar = 0.00108 x Area $^{0.89}$ x SAAR$^{1.17}$ x Soil$^{2.17}$

Where			**Units**
Q Bar	=	Mean Annual Peak Flow	m^3/s
Area	=	Catchment area	km^2
SARR	=	Standard Annual Average Rainfall	mm
Soil	=	Soil Index	-

Table 1

Soil	WRAP	Runoff	Soil value	Soil Characteristics
1	Very high	Very low	0.15	Sandy, well drained
2	High	Low	0.3	Intermediate soils (sandy)
3	Moderate	Moderate	0.4	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very low	Very high	0.5	Steep, rocky areas

Area description:

Soil characteristics: Soil type (See Table 1) **3** (Intermediate soils - Silty)

=> Soil index = 0.40

Area = 0.5 km^2 (**1200** m^2)

Catchment 3

Where developments are smaller than 50 ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50 ha.(Ref: Interim Code of Practice for Sustainable Drainage Systems)

SAAR = **1152** mm

Refer to Annual Average Rainfall Diagram on following spreadsheet

Q Bar = 0.3047 m^3/s

= 304.70 l/s

or

= 2539.19 l/s/ha

Linear Interpolation of Q Bar based on ratio of development to 50 ha

Peak greenfield discharge rate, Q_{Bar}	**=**	**0.73**	**l/s**

2 litres/second/hectare =	**0.24**	**l/s**

Growth Curve

Region:	Ireland South	
Return Period Q_{t1}:	1	year
Growth Factor for Q_{t1}:	0.85	
Allowable Discharge for 1 year return period:	**0.62**	**l/s**
Return Period Q_{t2}:	5	year
Growth Factor for Q_{t2}:	1.19	
Allowable Discharge for 5 year return period:	**0.87**	**l/s**
Return Period Q_{t2}:	25	year
Growth Factor for Q_{t2}:	1.55	
Allowable Discharge for 25 year return period:	**1.13**	**l/s**
Return Period Q_{t3}:	100	year
Growth Factor for Q_{t3}:	1.84	
Allowable Discharge for 100 year return period:	**1.35**	**l/s**

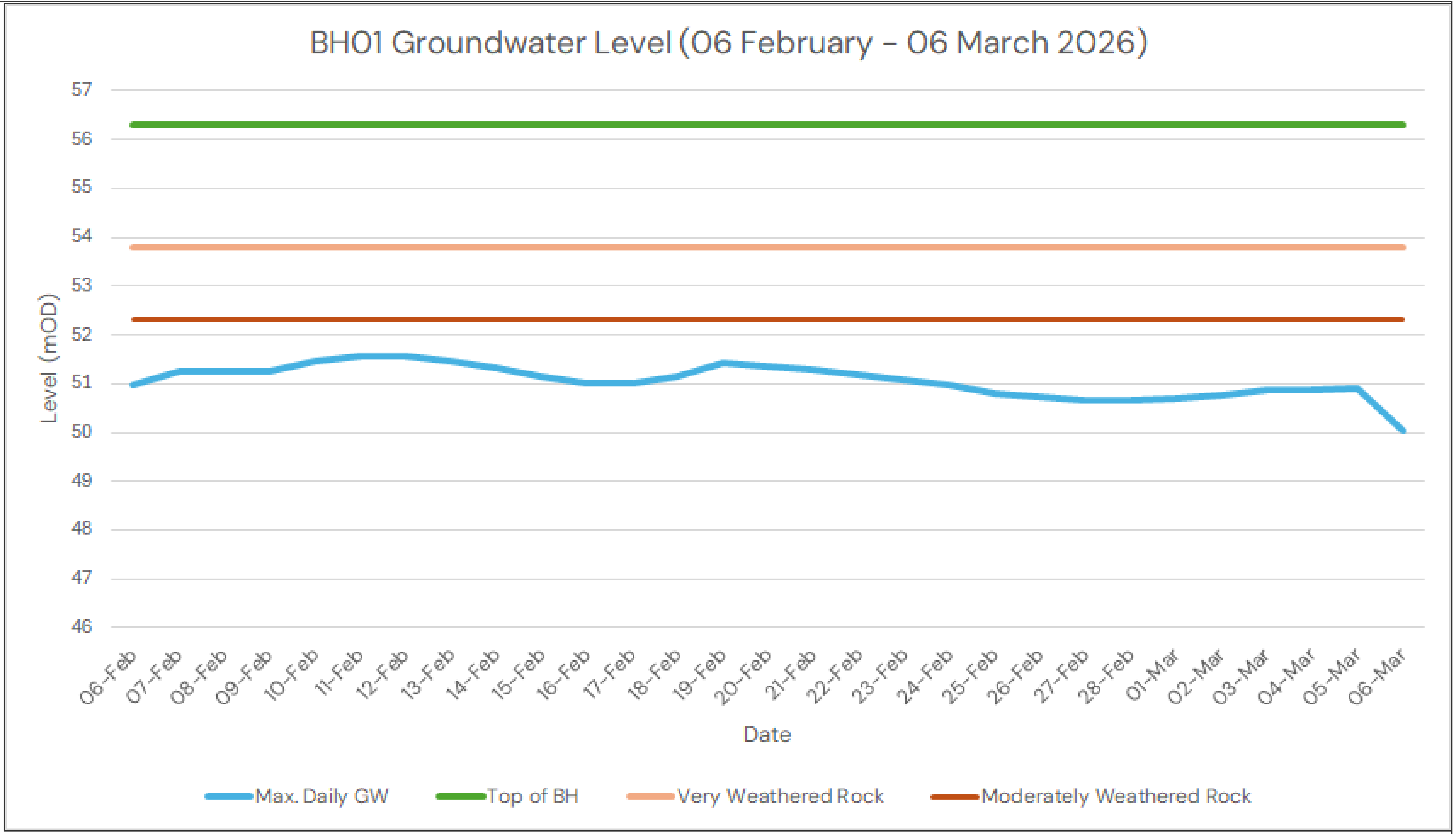
Discharge rate equal to 1 year greenfield site peak runoff rate or 2l/s/ha, whichever is the greater. Site critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Discharge rate equal to 1 in 100 year critical duration storm to be used to assess attenuation storage volume.(Ref: Greater Dublin Strategic Drainage Study)

Region	MD Region N	Return Period (Years)							
		1	2	5	10	25	50	100	200
Nationa	11	0.85	0.96	1.2	1.35	1.55	1.7	1.84	1.99
Ireland	12	0.85	0.96	1.21	1.38	1.59	1.74	1.9	2.05
Ireland	13	0.85	0.96	1.19	1.35	1.55	1.7	1.84	1.99
Ireland	14	0.85	0.96	1.18	1.33	1.51	1.64	1.78	1.91

Appendix D Groundwater Monitoring Summary Graphs

2026		
Months	Days	Max. Daily GW lvl (mOD)
Feb	06-Feb	50.971
	07-Feb	51.244
	08-Feb	51.265
	09-Feb	51.25
	10-Feb	51.46
	11-Feb	51.565
	12-Feb	51.56
	13-Feb	51.473
	14-Feb	51.311
	15-Feb	51.143
	16-Feb	51.01
	17-Feb	51.008
	18-Feb	51.145
	19-Feb	51.411
	20-Feb	51.343
	21-Feb	51.274
	22-Feb	51.179
	23-Feb	51.088
	24-Feb	50.984
	25-Feb	50.804
	26-Feb	50.72
	27-Feb	50.651
	28-Feb	50.655
Mar	01-Mar	50.711
	02-Mar	50.758
	03-Mar	50.876
	04-Mar	50.885
	05-Mar	50.9
	06-Mar	50.039



Top of BH	Very Weathered Rock	Moderately Weathered Rock
56.31 mOD	53.81 mOD	52.31 mOD

Record Photos from BH01

Pope's Hill , The Glen, Cork.

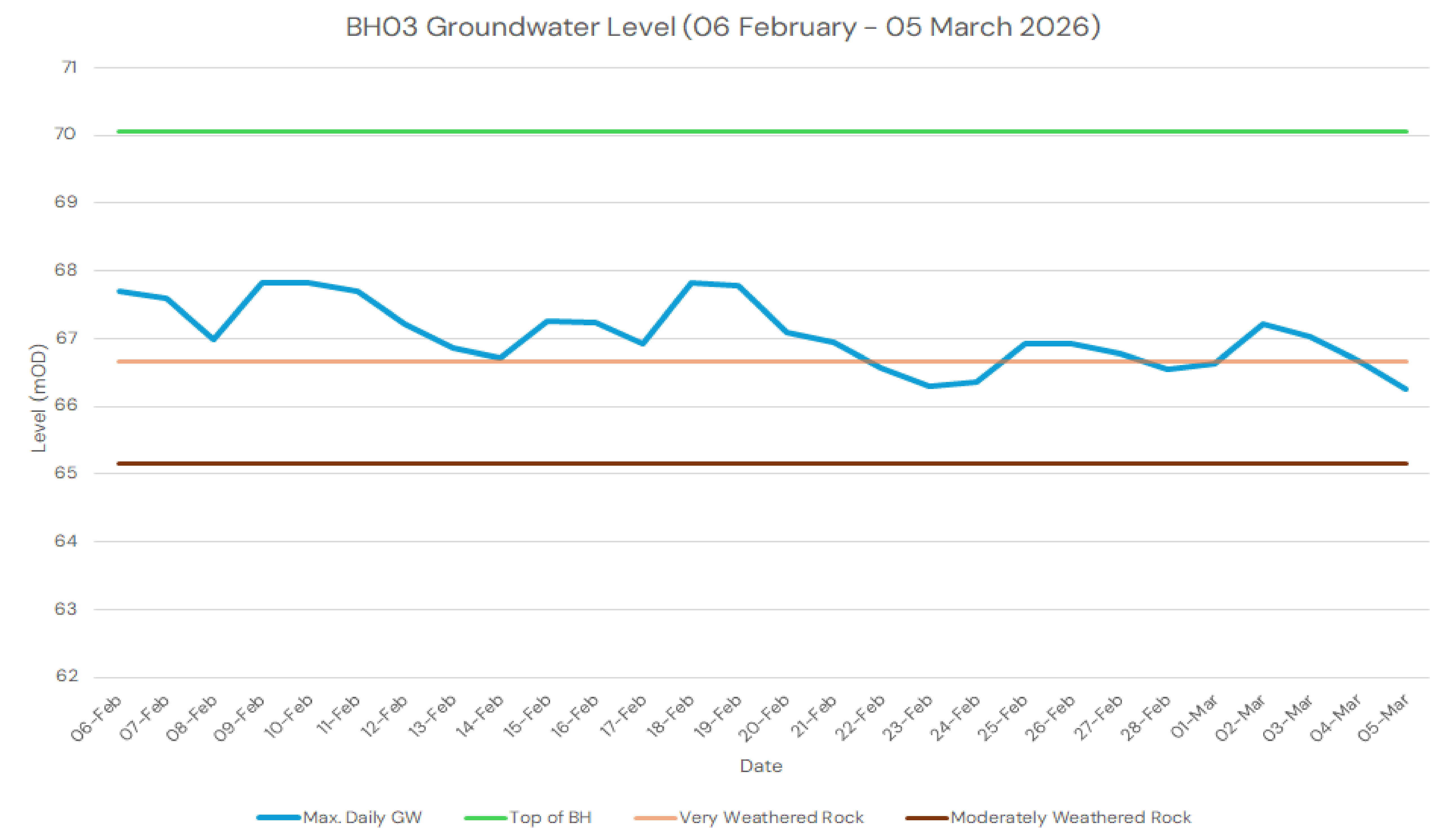
PUNCH consulting engineers

Sketch Ref: **GII Data Summary**

244132-PUNCH-XX-XX-SKS-0001

Date: 12/03/2026

Months	Days	Max. Daily GW lvl (mOD)
Feb	06-Feb	67.6987
	07-Feb	67.5916
	08-Feb	66.9858
	09-Feb	67.82
	10-Feb	67.8211
	11-Feb	67.6917
	12-Feb	67.217
	13-Feb	66.8556
	14-Feb	66.7114
	15-Feb	67.2669
	16-Feb	67.227
	17-Feb	66.9151
	18-Feb	67.8225
	19-Feb	67.7921
	20-Feb	67.09
	21-Feb	66.9397
	22-Feb	66.5637
	23-Feb	66.3006
	24-Feb	66.353
	25-Feb	66.9176
	26-Feb	66.9186
	27-Feb	66.7844
	28-Feb	66.5515
Mar	01-Mar	66.6249
	02-Mar	67.2238
	03-Mar	67.0253
	04-Mar	66.6736
	05-Mar	66.2564



Level (mOD)		
Top of BH	Very Weathered Rock	Moderately Weathered Rock
70.06mOD	66.66mOD	65.16mOD

Record Photos from BH01

Pope's Hill , The Glen, Cork.

PUNCH consulting engineers

Sketch Ref: **GII Data Summary**

244132-PUNCH-XX-XX-SKS-0001

Date: 12/03/2026