SOCIAL HOUSING BUNDLE 3

PROPOSED DEVELOPMENT AT BURGAGE MORE

Drainage and Watermain Design Report

SHB3-BLN-CS-RPS-RP-001
Drainage and Watermain Planning
Design Report
P03

12th November 2021

rpsgroup.com

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1 INTRODUCTION

RPS are the appointed Civil and Structural Engineering Technical Advisors for the proposed residential development at Burgage More Road, Blessington, County Wicklow. This project will deliver 106 dwellings to Wicklow County Council Planning Authority.

New watermain, storm water and foul water networks will be constructed to service the proposed development. The foul water network will outfall to an existing Irish Water (IW) system on the Burgage more road. The storm water generated on site will infiltrate to ground. The watermain, storm water and foul water drainage proposals are shown in **Appendix A**.

The maximum occupancy for this development will be approximately 286 residents. The proposed maximum design population for the purposes of drainage is approximately 286 residents. This report addresses the following design streams:

- Foul flows which are dealt with in Section 2 of the report,
- Surface water flows, and infiltration are dealt with in Section 3 of the report, and
- Water supply to the site which is dealt with in Section 4 of the report.

This report should be read in conjunction with the following RPS drawings, being submitted with this planning application:

- SHB3-BLN-CS-RPS-DR- DA001 - Watermain Layout
- SHB3-BLN-CS-RPS-DR- DA002 - Foul & Storm Water Network Layout

1.1 Site Characteristics

Blessington, is located on the Kildare/Wicklow border. The site on Burgage More Road is located c1.3m south of the town centre to the south east of a local junction which is the intersection of the N81 heading East and the Burgage More Road which itself heads north to town and to the south comes to a dead end; terminating at the popular greenway walking route.

Currently the Burgage More Road is the only road frontage onto the site which itself is a relatively flat green field site of c 3.235 ha which is located to the west of Poulaphouca Reservoir Special Protection Area (SPA). A private residence and farmlands bound the site to the south. The site and the lands to the north and east are within the ownership of WCC.

1.1.1 Existing Services

A topographical and underground utility survey was completed by NCW Surveys in June 2021. This survey verified the location of the existing services as determined by the equipment and methodology employed by the surveyor. The survey provides information on service locations, indicative depth, and the nature (type) of the underground service/utility. This information is used to assist with preparing the drainage design for the proposed development.

1.1.1.1 Existing Foul and Watermain Infrastructure

IW database shows a 375mm Ø concrete foul water network and a 150mm Ø uPVC watermain on the Burgage more road. NCW survey has confirmed the location and diameter of the foul water network and the location of the watermain. It is proposed to tie into the existing foul water network and to connect to the existing watermain on the Burgage more road.

RPS propose to connect to existing IW infrastructure as shown in drawings **SHB3-BLN-CS-RPS-DR-DA001** and **SHB3-BLN-CS-RPS-DR-DA002.**

1.1.1.2 Existing Storm Water Infrastructure

IW database shows a 375mm Ø storm water pipe network mapped to the north east of the site, NCW survey confirms this. The invert levels of the available storm water network are above that of the subject site. In light of the fact that there isn't a suitably deep outfall manhole and to comply with objective WI12 of WCC's county development plan, it is proposed to discharge surface water to on-site infiltration systems.

- **WI12** - Ensure the implementation of Sustainable Urban Drainage Systems (SUDS) and in particular, to ensure that all surface water generated in a new development disposed of on-site or attenuated and treated prior to discharge to an approved surface water system.

RPS proposed Storm Water infrastructure is shown in drawing **SHB3-BLN-CS-RPS-DR-DA002.**

2 FOUL FLOWS

2.1 Foul Sewer Design Procedure

The proposed foul sewerage system was designed using the Wallingford Tables and Microdrainage design software. Wastewater loadings were based on EPA Guidance document, 'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'.

Drainage calculations submitted in **Appendix B** have been generated by 'Micro Drainage' flow modelling software, and the 'Hydraulic Design for Gravity Sewers' method to Irish Water Code of Practice for Wastewater Infrastructure. Gradients should be selected so that self-cleansing velocities can be maintained under normal operating conditions. The range of flow velocity within the sewers should be between 0.75m/s at low flow and 3m/s, when flowing full.

The proposed foul drainage network will be constructed in accordance with Irish Water Code of Practice for Wastewater Infrastructure, The Building Regulations 'Part H' & the Regional Code of Practice for Drainage Works. The sewers will be compliant with the requirements of the Irish Water Code or Practice for Wastewater Infrastructure and will be from 150mm to 225mm in diameter. Foul sewers within the building plots may be as small as 100mm dia. In accordance with TGH H – Drainage specifications and with Irish Water Code of Practice.

Foul water will outfall to the existing IW foul water network located to north west corner of the proposed development via an existing manhole, See drawing **SHB3-BLN-CS-RPS-DR- DA002** for details.

2.2 Foul Services design parameters

The following parameters were used for the basis of design (refer to **Table 2-1**).

Table 2-1 Design Parameters

Parameters	Values	Reference
Flow Rates	Varies	Irish Water Code of Practice for Wastewater Infrastructure.
Peak Flow	6.0 x Dry Weather Flow (DWF) (based on a 10hr working day)	Irish Water Code of Practice for Wastewater Infrastructure.
Min Velocity	0.75m/s.	Irish Water Code of Practice for Wastewater Infrastructure & Sewers for Adoption
Pipe Roughness	1.50mm	(Colebrook/White)
Pipe Cover	1.2m minimum without concrete encasement– light trafficked areas 0.6m minimum without concrete encasement – gardens	Irish Water Code of Practice for Wastewater Infrastructure Technical Guidance Document H – Drainage and Waste Water Disposal

2.3 Pipe and manhole numbering

The manhole numbers define the structure of the network. The foul water manholes are labelled such that labels in the direction of flow are typically in increasing order. F01, F02, etc. is used for foul sewers located inside the site boundary of this development. Existing manholes will be labelled EF01 (refer to Drawing **SHB3-BLN-CS-RPS-DR- DA002 in Appendix A**).

2.4 Foul loadings from proposed development

Foul loadings from the proposed development are shown in **Table 2.2**. The maximum foul flow from the proposed development has been calculated as 3.28 litres/sec. This value is based on a peak factor of 6:

- 446l/day per residential unit (based on 2.7 persons per unit x 150l/person/day, + a 10% increase factor).
- 446l/day/unit x 106 units = 47,276 l/day = 47.276 m3/day;
- 0.54 l/sec Average flow (1 DWF);
- 3.28 l/sec Peak Flow (6 DWF – Population between 0 and 750)

The minimum capacity of any sewer in the proposed design is **29.9 litres/sec** as such the design can cater for the proposed developments flow. For detailed output from the foul sewer design refer to **Appendix B.**

3 SURFACE WATER FLOWS

3.1 Storm Water Design Procedure

The site is approximately 3.235 ha and has a total impermeable area of 0.853ha which is to be drained to the new proposed surface water systems. Storm flows will infiltrate to ground.

All proposed developments must ensure that SUDS are incorporated into the development. SUDS requires that post development run-off rates be maintained at the equivalent to, or lower than, the pre-development run-off levels. Thus, the development must be able to retain, within its boundaries, storm water volumes from extreme storm events up to and including a design for a 1 in 100 year storm event, more commonly expressed as a 1.0% AEP (Annual Exceedance Probability), while also allowing for climate change factors.

Any new development must have physical capacity to retain storm water volumes as directed under the Greater Dublin Strategic Drainage Study (GDSDS) and, if necessary, release this attenuated surface water runoff before it enters a natural watercourse or into a public sewer, which ultimately discharges to a water body. This is to ensure the highest possible standard of storm water quality. In this instance, Infiltration storage will be provided, designed to drain the site for storm events up to and including a 1 in 100 year event, including 20% for climate change.

The new surface water system was designed using Innovyze MicroDrainage software which is based on the Wallingford Tables and the Modified Rational Method of storm flow modelling. The rainfall and climate data used in all designs was extracted directly from maps built into the program. The M5-60, R, SAAR, soil infiltration values etc were all derived for the site. Such data is given in the appropriate appendices of this report of MicroDrainage outputs for surface and grey water networks, see **Appendix B.**

Ground investigation infiltration tests were undertaken by Priority Geotechnical Limited in August 2021 to assess the infiltration rate on site. The infiltration rates were found to be favourable to the design of an infiltration system. The design shows that the proposed surface water drainage system for this development can use infiltration systems within the open spaces to drain the site for storm events up to and including a 1 in 100 year event, including 20% for climate change. Infiltration design is outlined in **section 3.7** of this report.

3.2 Surface Water Impact Assessment

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the GDSDS and with the requirements of WCC. The guidelines require the following 4 main criteria to be provided by the design:

3.2.1 Criterion 1: River Water Quality Protection:

Interception storage of at least 5mm, and preferably 10mm, of rainfall where runoff to the receiving water can be prevented. It is proposed that the overall drainage system, serving this development, will contain a range of surface water treatment methods such as:

- Car parking spaces on site to incorporate a permeable paving system;
- Interception storage and treatment within the site
- All road gullies to be trapped

- Intensive landscaping where possible
- Fuel separator and silt trap prior to entering the infiltration area.
- Tree pits
- Swales

3.2.2 Criterion 2: River Regime Protection

Surface water will infiltrate to ground via an infiltration system designed to meet the requirements of the GDSDS.

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

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

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

3.2.3.1 Sub-Criteria 3.1

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding. Therefore, the system has capacity for the 30-year return period rainfall event without flooding. The performance of the proposed drainage system has been analysed for design rainfall events up to, and including, the 1% AEP event (including 20% for climate change) using the MicroDrainage Network Design Software, by Innovyze Inc. Refer to **Appendix B** for details of design criteria, calculations, and results. The analyses indicate that no flooding will occur for design rainfall events up to, and including, the 1% AEP.

3.2.3.2 Sub Criteria 3.2

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding. The performance of the proposed drainage system in 100-year return period storm events (including 20% for climate change) has been analysed – Refer to **Appendix B** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

3.2.3.3 Sub Criteria 3.3

There is no apparent risk of internal property flooding. The maximum water level in the proposed infiltration system will not pose a risk to the proposed buildings. It is also noted that the surface water drainage network is designed with no flooding experienced in a 1 in 100 year rainfall event (including 20% for climate change).

3.2.3.4 Sub Criteria 3.4

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding, so no flood routing off site will be experienced for such a rainfall event. The performance of the proposed drainage system in 100-year return period storm events (including 20% for climate change) has been analysed – Refer to **Appendix B** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

3.2.4 Criterion 4: River flood protection

Storage is to be provided for the 100-year return period rainfall event (including an increased 20% rainfall intensity; to allow for climate change). Surface water will infiltrate to ground via an infiltration system designed to meet the requirements of the GDSDS. Refer to **Appendix B** for details of hydraulic modelling calculations of attenuation and infiltration systems, as carried out using MicroDrainage software by Innovyze Inc.

3.3 Site Specific SUDS Measures

Sustainable Drainage Systems (SuDS) were considered for the site, in line with recommendations of Greater Dublin Strategic Drainage Strategy (GDSDS). SuDS are a method of replicating the natural characteristics of rainfall runoff from any site. The various types of SuDS considered are outlined below.

- Infiltration – Soaking water into the ground. This is the most desirable solution to runoff management as it restores the natural hydrological process. Based on site investigation infiltration testing carried out by Priority Geotechnical Ltd., infiltration rates in this area are suitable for infiltration of a 100 year, 6 hour duration storm event within the site. Infiltration to ground will also be accommodated to the rear of the proposed dwellings using a soakaway systems design to meet the requirements of BRE 365.

- Conveyance – the transfer of surface water runoff from one place to another. Controlled conveyance can provide links between various SuDS components. Conveyance is implemented within this development through the use of landscaped swales. The swales will be placed where appropriate to drain roads next to public open spaces. The swale will be broad and shallow and covered in suitable vegetation to slow water, facilitating sedimentation, filtration through root zones and soil matrix, evapotranspiration and infiltrating into the underlying soil. Excess flows will be conveyed into the stormwater system in periods of high rainfall.

- Pervious pavements – Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before infiltrating to ground. Pervious pavements are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Pervious Paving is to be provided for all car parking (i.e., Off street parking).

- Tree pits are to be provided adjacent to public footpath areas to act as a first level of treatment for surface water runoff. Each pit will have a surface depression where water will be temporarily stored before if flows down through the tree pit soil. This depression will be sized to hold the excess water from a 1:1 year, critical duration event – for water quality treatment. Each tree pit will be constructed using a suitable tree soil.

3.4 Design Parameters

The following parameters were used for the basis of design in the Innovyze MicroDrainage Module.

Table 3-1 Design Parameters Road Runoff Surface Network

Parameters	Values	Reference
Return Period	30 Year	Wallingford Procedure
M5-60	**16.4**	Wallingford Procedure
Ratio ‘R’	**0.215**	Wallingford Procedure
Max Rainfall	Paved Areas 50mm/hr Roof Areas 75mm/hr	Wallingford Procedure
Global Time Entry	5 minutes	Wallingford Procedure
Minimum Velocity	0.75m/s	Site Development Works for Housing Areas
Run-Off Co-efficient	Roof Areas 1.0 Paved Areas 0.75	BS EN 16941-1
Pipe Roughness	0.6mm Concrete / 0.15mm uPVC	Colebrook/White
Pipe Cover	1.2m minimum without concrete encasement in trafficked areas 0.6m minimum with concrete encasement in trafficked areas	Technical Guidance Document H – Drainage and Waste Water Disposal
Climate Change	20%	Transport Infrastructure Ireland Drainage Systems for National Roads - DN-DNG-03022

3.4.1 Proposed Storm Water Services

Storm water generated from new hard landscaping and roofs on site will be directed to an onsite infiltration tank. Prior to entering the infiltration tank, the proposed surface water collection networks will outfall to a hydrocarbon interceptor and silt trap manhole. Terraced housing and apartment buildings will incorporate appropriately sized soakaways to rear gardens to capture storm water runoff. The soakaways are to be designed to BRE365 specifications and will infiltrate to ground.

Surface water from trafficked areas will be intercepted by a suitable petrol interceptor prior to entering the Infiltration system. In some instances, surface water from trafficked areas will enter tree pits / landscaped swales.

The proposed storm water sewer system is shown on Drawings **SHB3-BLN-CS-RPS-DR- DA002.** For detailed outputs from the surface water network design, including network details and 100-year storm event simulation results)including 20% for climate change), refer to **Appendix B.**

3.5 Pipe and Manhole Numbering

The manhole numbers define the structure of the network. The surface manholes are labelled such that labels in the direction of flow are typically in increasing order. S01, S02, etc. is used for surface water sewers. Diverted manholes will be labelled DS01. Existing manholes will be labelled ES01. The manholes are labelled such that labels in the direction of flow are typically in increasing order. (refer to drawing **SHB3-BLN-CS-RPS-DR- DA002 in Appendix A**).

3.6 Hydrocarbon / Oil Interceptor

A hydrocarbon interceptor will be provided prior to the attenuation/infiltration areas. In accordance with the requirements of BS EN 858, 4.1 (b) '(run-off) from impervious areas, e.g., car parks, roads, factory yards areas;' the size of the separator will depend on the design, rainfall intensity and the catchment area draining to the separator.

A Class1 Bypass hydrocarbon Interceptor is proposed prior to entering the infiltration area. It is recommended to use a Kingspan Klargester or equivalent approved surrounded in 300 mm mass concrete. The location of the interceptor is outlined in drawing **SHB3-BLN-CS-RPS-DR- DA002, in Appendix A.**

The maximum rainwater flow rate Q_r in l/sec shall be calculated using the equation below in accordance with EN 752-4:

$$Q_r = \Psi . i . A$$

Where,

- i is the rainfall intensity, in litres /sec / hectare.
- A is the area receiving rainfall, measured horizontally, in ha;
- Ψ is a dimensionless coefficient (usually taken as one)

Pollution prevention guidelines (PPG 3) use rainfall intensity equal to 6.5mm/hr which corresponds to the following formula for a bypass separator:

$$NSB = 0.0018 \times A$$

Where,

- NSB: Nominal Size of Bypass separator
- A: Catchment Area in m^2

The impermeable areas draining to the proposed bypass separators is approximately 3570m^2 and 4960m^2 which includes all impermeable surfaces on the site.

NSB required:

- 0.0018 x 3570 = 6.426 l/s — NSBE015 is suitable
- 0.0018 x 4960 = 8.928 l/s — NSBE015 is suitable

Details of the sizing of the proposed interceptor for NSBE015 is provided in **Appendix D**. The maximum storm water flow that the bypass facility can cater for is 150 l/s. The maximum design flows in the storm system is 145.5 l/s for a 1 in 100yr storm event so the bypass facility has sufficient capacity to cater for this flow.

3.7 Infiltration Design

RPS carried out further investigation to assess the possibility for localised infiltration within the site. RPS assessed the groundwater vulnerability of the area complying with TII publication (Road Drainage and the Water Environment – DN-DNG-03065) This document outlines the groundwater protection response matrix for use of permeable drains in road schemes, used in this instance to assess the appropriateness of infiltration within the site.

The Groundwater protection Response Matrix requires the identification of groundwater vulnerability and groundwater resources. GSI data indicates that the area is underlain by a Generally unproductive bedrock aquifer (Figure 3.1 - Bedrock which is Generally unproductive except for Local Zones (Pl)) overlain by well-drained soil with a High subsoil permeability (Figure 3.2 & 3.3). Mapping also shows a high groundwater vulnerability (Figure 3.4).

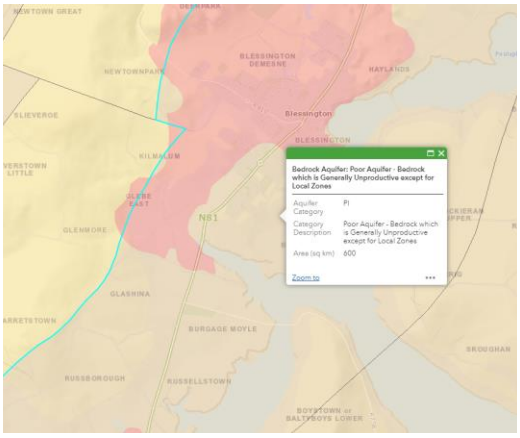


Figure 3-1 Aquifer Classification – Bedrock Aquifer

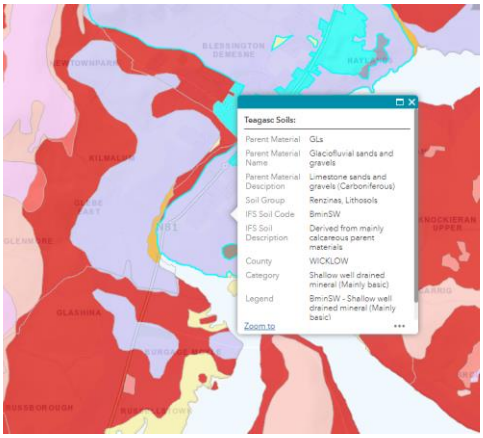


Figure 3-2 - GSI Soil Classification

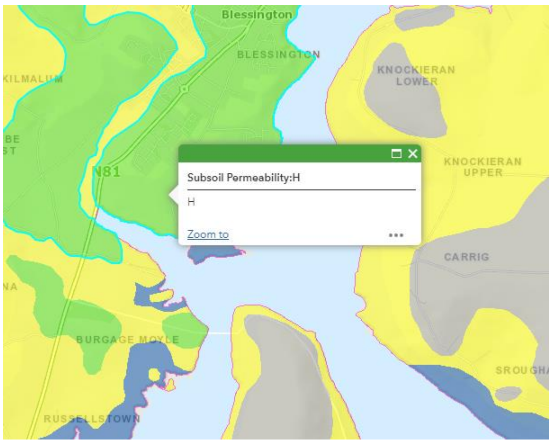


Figure 3-3 Subsoil Permeability

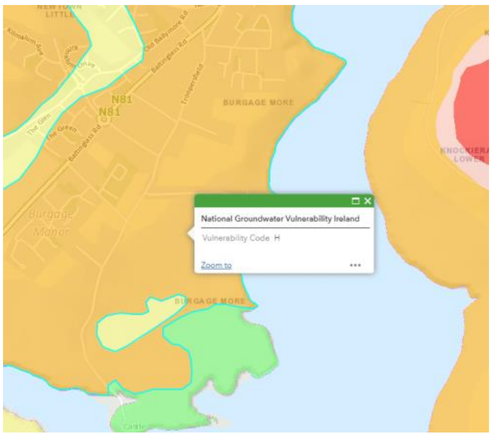


Figure 3-4 Groundwater Vulnerability

From the vulnerability rating and aquifer classifications table below (Groundwater Protection Response Matrix) of the TII document shows a resource protection rating of R2(1) for the site. This rating stipulates that certain conditions must be met to allow infiltration to be incorporated into the design. These are shown in extracts below.

Table 3-2 Extract from TII Publication – DN-DNG-03065

Vulnerability rating	Source protection area	Resource protection area (aquifer category)							
		Regionally Important Aquifer			Locally Important Aquifer			Poor aquifer	
		Rk*	Rf	Rg	Lg	Lm	Ll	Pl	Pu
Extreme: Rock near Surface or karst (X)	R4	R4	R4	R3(2)	R3(2)	R3(1)	R3(1)	R3(1)	R3(1)
Extreme (E)	R4	R2 (3)	R2 (2)	R3(2)	R3(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
High (H)	R3(2)	R2 (2)	R2 (2)	R2(2)	R2(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
Moderate (M)	R3(1)	R2 (1)	R2 (1)			R2 (1)	R2 (1)	R1	R1
Low (L)	R3(1)	R1	R1			R1	R1	R1	R1

* A small proportion of the country (~0.6%) is underlain by locally important karstic aquifers (Lk); in these areas, the groundwater protection responses for the Rk groundwater protection zone shall apply.

A rating of R2(1) requires the design to meet the minimum standard of R2(1). As the subsoil is classified as a gravelly SAND and is underlain by greywacke and shale, Table R2(1) of the TII document requires that a minimum of 1m unsaturated subsoil is required beneath the invert level of the drainage system.

R1	Acceptable subject to minimum design standards in the NRA DMRB and Notes 1 and 2.
R2	
R2(1)	Acceptable subject to minimum design standards in the NRA DMRB and to meeting the following requirements : 1. There is a consistent minimum thickness of 1 m unsaturated subsoil, or 2 m in areas of karstified rock (Rk & Lk), beneath the invert level of the drainage system (Note 1). 2. During all stages of design particular attention must be paid to the presence of karst features and additional assessments undertaken if required. If karst features are identified response R2 (3) must be applied as a minimum. 3. During all stages of design particular attention must be paid to receptors (such as; public wells, group schemes, industrial water supply sources and springs) and additional assessments undertaken if required.

Figure 3-5 - Extract from TII Document DN-DNG-03065

It is the conclusion of the investigation that infiltration to ground is suitable in this location if the minimum requirements as set out above are met.

Furthermore, a site investigation was carried out across the development area in to confirm the conceptual design assumption that there were gravelly sand beneath the area that would be suitable for infiltration. The investigation included infiltration tests that followed the guidance in BRE 365. The tests were carried out in locations identified as potential infiltration areas within the proposed site. The tests were carried out at a depth similar to the anticipated design layout of the proposed infiltration area. The infiltration rate determined on site at the Infiltration locations was sufficient to allow for a Infiltration design.

Site investigation infiltration testing results show an infiltration rates between 0.0346 m/hr and 0.45m/hr. An infiltration rate of 0.099 m/hr was determined for the lower catchment and an infiltration rate of 0.157 m/hr was determined for the upper catchment.

A factor of safety was then applied to the infiltration rate to account for possible long-term reductions in performance. Table 25.2 (Section 25.6) of CIRIA SuDS manual indicates that a factor of safety (FOS) of 5 is appropriate for a drained area of over >1000 m2 “minor damage to external areas or inconvenience if the capacity of the infiltration area is exceeded”. The design infiltration coefficient is factored within the Microdrainage programme to allow for the appropriate factor of safety. Noting that no ground water encountered during the site investigations.

The infiltration systems are designed to cater for the 1 in 100-year return period storms with an additional allowance of 20% for climate change, this in accordance with the GDSDS. Using a proprietary infiltration system, with a nominal void ratio of 95%.The typical layout is shown in Drawing **SHB3-BLN-CS-RPS-DR-DA002 in Appendix A** with a typical crate system shown in **Appendix G**. Due to a level differential on site, two infiltration areas are required. These are split between the upper section of the site and the lower section of the site. A plan area of 370m^2 will be required for the upper catchment (36.0m x 14.4m x 0.8m deep) providing a storage capacity of 280m^3. A plan area of 250m^2 will be required for the lower section (50m x 5m x 1.2m deep.) providing a storage capacity of 237m^3.

There will be sufficient storage capacity available in the infiltration systems to store water from the critical 100-year storm (plus 20% for climate change) for their respective catchments prior to infiltration to ground. The maintenance of the infiltration system should be carried out as per the manufacturer’s recommendations. Infiltration design calculations can be found in **Appendix C.**

4 WATER SUPPLY / IW PRE CONNECTION ENQUIRY

Wicklow County Council completed a Pre-connection enquiry form to establish the feasibility of a water/waste water connection. WCC submitted the application to Irish Water in 2019. WCC received feedback from Irish Water on the 22nd October 2019 via a standard confirmation of feasibility, attached in **Appendix E.**

IW database shows a 150mm Ø uPVC watermain on the Burgage More Road. NCW topographical survey has captured the location of the watermain. It is proposed to tie into this watermain to provide a watermain feed to the proposed buildings. A sluice valve and water meter will be provided prior to connection to the new building as indicated in drawings in **Appendix A**. The water main layout and details including valves, hydrants, metering etc. will be in accordance with Irish Water's Code of Practice and Standard Details for water infrastructure

A looped watermain will service the site with hydrants used to provide hydrant fire cover. This new watermain will be 150mm diameter PE100 HDPE pipe. Individual houses will have their own connections to the looped watermain via service connections and boundary boxes. Individual service boundary boxes will be of the type to suit Irish Water and to facilitate domestic meter installation. Hydrants are provided for firefighting at locations to ensure that each dwelling is within the required Building Regulations distance of a hydrant.

An underground storage tank for firefighting requirements is proposed for the site. This storage tank will be connected to the watermain and will incorporate an automated level control system. The access requirements for fire fighters will be fully agreed with the Local Area Fire Officer prior to construction. The required supply for firefighting purposes comes from the Water UK document "National guidance document on the provision of water for firefighting" which calls for 35 l/s or a site with an area of between one and two hectares.

A hydrant survey was competed in August 2021 by SES Water Management which established a flow rate of 880 l/min. the flow rate is the average maximum sustainable flow based on the 5-minute flow test. A flow rate of 880 l/min equates to a rate of approx.15 l/s. An additional firefighting flow rate of 20 l/s is required to meet the requirements of the above regulations. See **Appendix F** for hydrant testing results.

The maximum tank volume will be **72m^3** (20 l/s for a period of 1 hour) this caters fully for the requirements of the above regulations. The proposed water main layout and water storage tank location is shown on drawing No. **SHB3-BLN-CS-RPS-DR-DA001 in Appendix A.**

5 FLOODING

The subject site is a relatively flat green field site of c 3.235 ha which is located to the west of Poulaphouca Reservoir Special Protection Area (SPA). Following RPS initial review of floodinfo.ie fluvial mapping (CFRAM study), the 0.1% Annual Exceedance Probability (AEP) event (1000 year event) shows a maximum water level of 183.60mOD in the Poulaphouca Reservoir.

The subject site is approximately 300m to the west and 500m to the north of the Poulaphouca Reservoir. The lowest FFL of the proposed development is 199.125mOD, approx. 15.5m above the 0.1%AEP event.

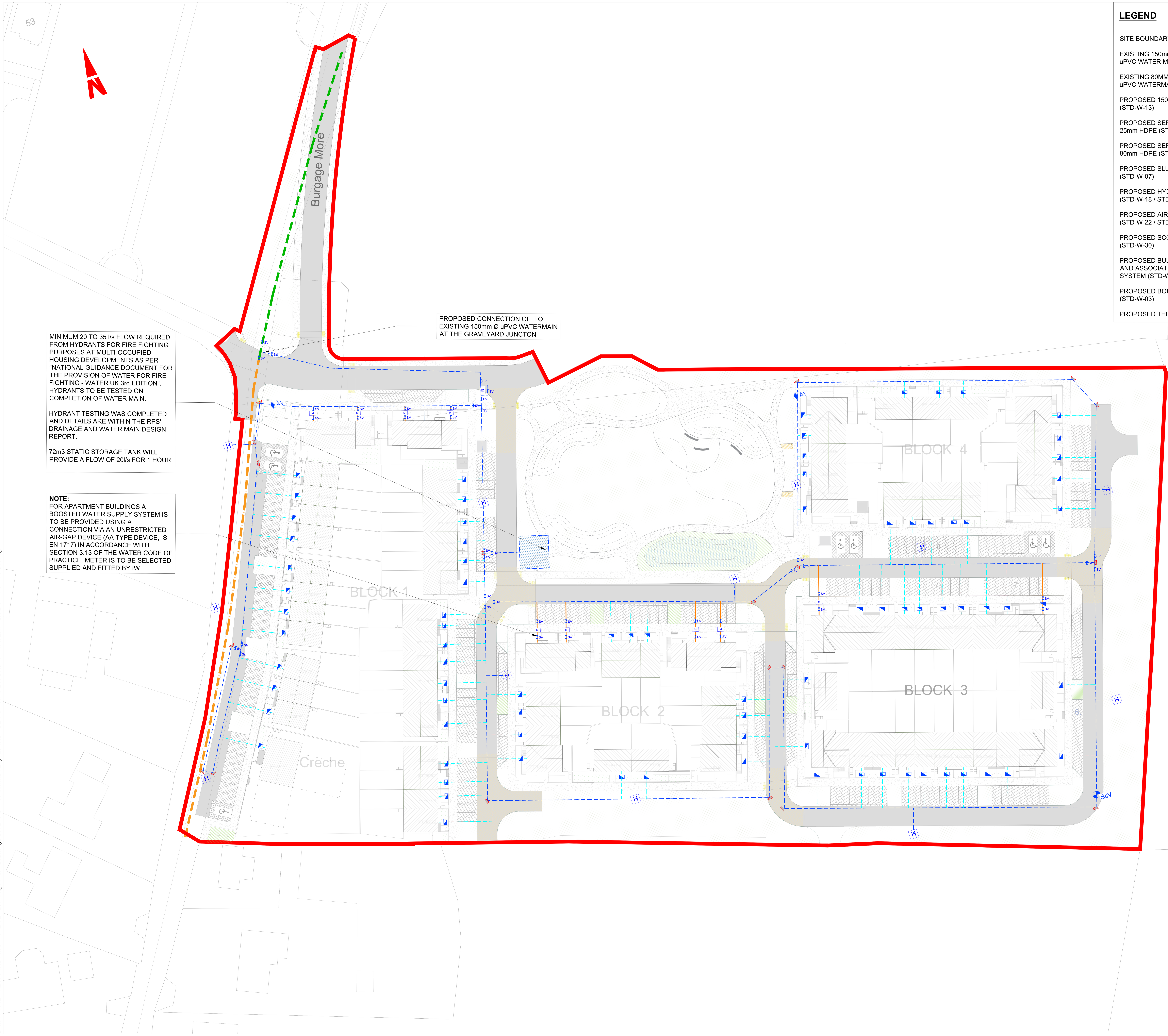
While flooding events have been recorded in the Poulaphouca Reservoir, no information indicates that the proposed site is subject to a significant flooding risk. The site is located outside the fluvial areas as modelled under the CFRAM programme/ detailed information on the extent of flooding in the Wicklow region is available at www.floodinfo.ie.

Extract from CFRAM mapping shown in **Appendix H.**

Appendix A

Drainage Layout, Detailed Drawings

- **SHB3-BLN-CS-RPS-DR-DA001 – Watermain Layout**
- **SHB3-BLN-CS-RPS-DR-DA002 – Storm and Foul Water Networks**



PROPOSED CONNECTION OF TO EXISTING 150mm Ø uPVC WATERMAIN AT THE GRAVEYARD JUNCTON

MINIMUM 20 TO 35 l/s FLOW REQUIRED FROM HYDRANTS FOR FIRE FIGHTING PURPOSES AT MULTI-OCCUPIED HOUSING DEVELOPMENTS AS PER "NATIONAL GUIDANCE DOCUMENT FOR THE PROVISION OF WATER FOR FIRE FIGHTING - WATER UK 3rd EDITION". HYDRANTS TO BE TESTED ON COMPLETION OF WATER MAIN.

HYDRANT TESTING WAS COMPLETED AND DETAILS ARE WITHIN THE RPS' DRAINAGE AND WATER MAIN DESIGN REPORT.

72m3 STATIC STORAGE TANK WILL PROVIDE A FLOW OF 20l/s FOR 1 HOUR

NOTE:
FOR APARTMENT BUILDINGS A BOOSTED WATER SUPPLY SYSTEM IS TO BE PROVIDED USING A CONNECTION VIA AN UNRESTRICTED AIR-GAP DEVICE (AA TYPE DEVICE, IS EN 1717) IN ACCORDANCE WITH SECTION 3.13 OF THE WATER CODE OF PRACTICE. METER IS TO BE SELECTED, SUPPLIED AND FITTED BY IW

LEGEND

- SITE BOUNDARY
- EXISTING 150mm uPVC WATER MAIN
- EXISTING 80MM uPVC WATERMAIN
- PROPOSED 150mm WATERMAIN (STD-W-13)
- PROPOSED SERVICE CONNECTION 25mm HDPE (STD-W-03)
- PROPOSED SERVICE CONNECTION 80mm HDPE (STD-W-03)
- PROPOSED SLUICE VALVE (STD-W-07) — SV
- PROPOSED HYDRANT (STD-W-18 / STD-W-19) — H
- PROPOSED AIR VALVE (STD-W-22 / STD-W-23) — AV
- PROPOSED SCOUR VALVE (STD-W-30) — ScV
- PROPOSED BULK FLOW METER AND ASSOCIATED TELEMETRY SYSTEM (STD-W-26 / STD-W-26A) — M
- PROPOSED BOUNDARY BOX (STD-W-03)
- PROPOSED THRUST BLOCK

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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.
(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Foul Sewer Notes:

1. All foul sewer works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
3. Foul sewer service connections and inspection chambers to each dwelling shall be in accordance with Irish Water standard detail STD-WW-02.
4. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
5. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
6. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-WW-05.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-WW-06 & 06A.

Storm Sewer Notes:

1. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
3. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
4. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.

Watermain Notes:

1. All watermain works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Water Infrastructure Document CDS-5020-03.
2. All pipe materials shall be in compliance with Section 3.9 of the Irish Water Code of Practice Document-CDS-5020-03.
3. Individual water service connections and boundary boxes to each dwelling shall be in compliance with Irish Water standard detail STD-W-02.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-W-11.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-W-12 & 12A.
6. On line and off-line air valve details shall be in accordance with Irish Water standard detail STD-W-22 & STD-W-23 respectively.
7. Sluice valve details shall be in accordance with Irish Water standard detail STD-W-15.
8. On line and off-line hydrant details shall be in accordance with Irish Water standard detail STD-W-18 & STD-W-19 respectively.
9. Scour valve and chamber details shall be in accordance with Irish Water standard detail STD-W-30.

Rev	Date	Drn Chk	Amendment / Issue	App
P04	12.11.21	OS PMGB	ISSUE FOR PLANNING	DK
P03	13.08.21	DM MGB	ISSUE FOR REVIEW	DK
P02	23.07.21	DM DK	ISSUE FOR INFORMATION	DK
P01	16.04.21	DM PMGB	ISSUE FOR INFORMATION	DK

Client

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Project
SHB 3
BLESSINGTON, CO. WICKLOW

Title
WATERMAIN LAYOUT

Model File Identifier
SHB3-BLN-CS-RPS-DR-DA001

File Identifier
SHB3-BLN-CS-RPS-DR-DA001-01

Created on	Sheets
JULY 2021	01 OF 01

Scale	Status	Rev
1:500 @ A1 1:1000 @ A3	S4	P04

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LEGEND

- SITE BOUNDARY
- EXISTING SURFACE WATER SERVICE & MANHOLE
- PROPOSED SURFACE WATER SERVICE & MANHOLE
- EXISTING FOUL WATER SERVICE & MANHOLE
- PROPOSED FOUL WATER SERVICE & MANHOLE
- FOUL NETWORK WITH CONCRETE SURROUND
- STORM NETWORK WITH CONCRETE SURROUND

SITE CATCHMENTS:

- UPPER SITE CATCHMENT OUTFALL TO INFILTRATION TANK 1
- LOWER SITE CATCHMENT OUTFALL TO INFILTRATION TANK 2

STORM WATER NETWORK DETAILS - LOWER CATCHMENT

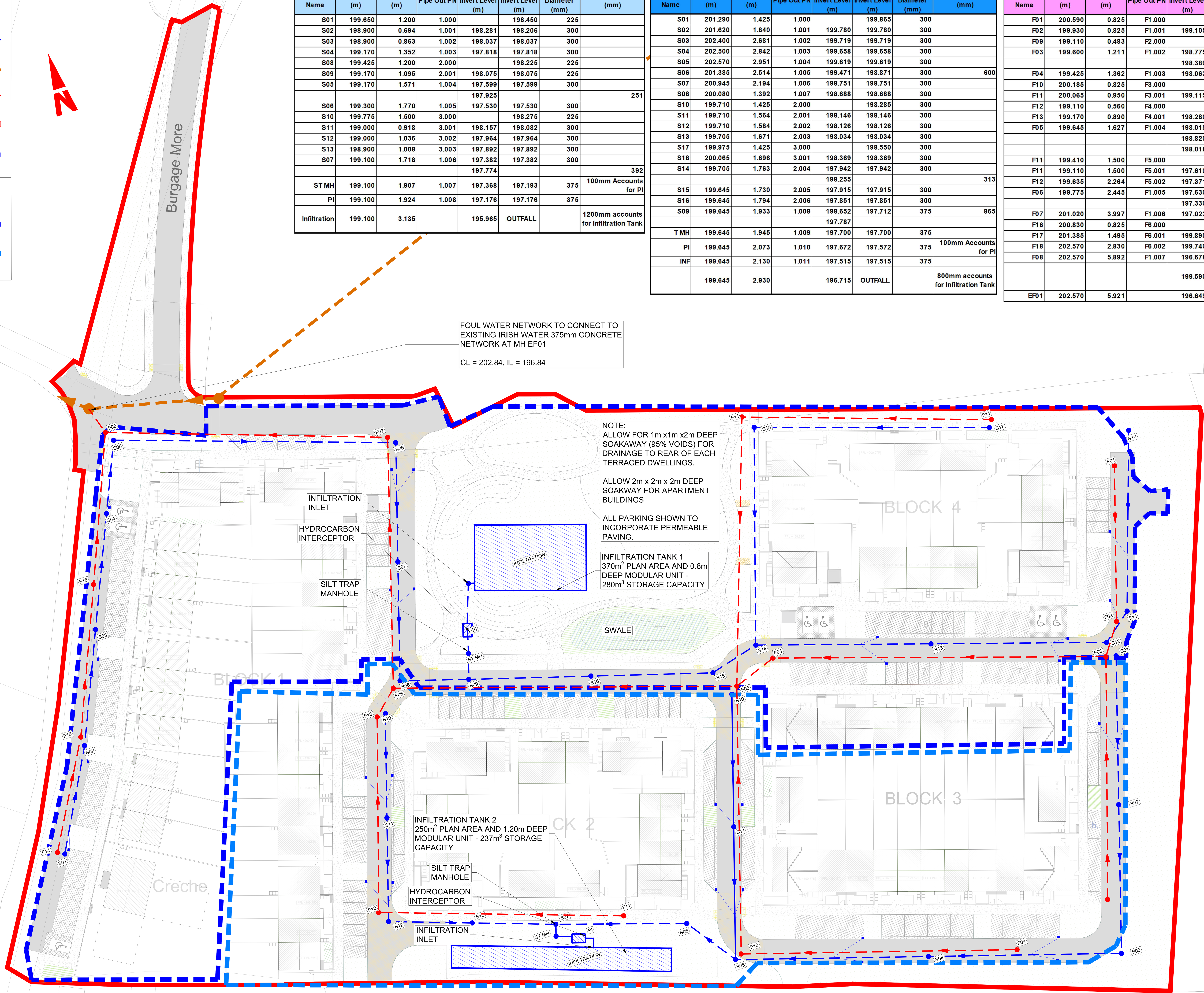
Manhole Name	Cover Level (m)	MH Depth (m)	Pipe Out PN	Pipes In Invert Level (m)	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In Backdrop (mm)
S01	199.650	1.200	1.000		198.450	225	
S02	198.900	0.694	1.001	198.281	198.206	300	
S03	198.900	0.863	1.002	198.037	198.037	300	
S04	199.170	1.352	1.003	197.818	197.818	300	
S08	199.425	1.200	2.000		198.225	225	
S09	199.170	1.095	2.001	198.075	198.075	225	
S05	199.170	1.571	1.004	197.599	197.599	300	
				197.925			251
S06	199.300	1.770	1.005	197.530	197.530	300	
S10	199.775	1.500	3.000		198.275	225	
S11	199.000	0.918	3.001	198.157	198.082	300	
S12	199.000	1.036	3.002	197.964	197.964	300	
S13	198.900	1.008	3.003	197.892	197.892	300	
S07	199.100	1.718	1.006	197.382	197.382	300	
				197.774			392
ST MH	199.100	1.907	1.007	197.368	197.193	375	100mm Accounts for PI
PI	199.100	1.924	1.008	197.176	197.176	375	
Infiltration	199.100	3.135		195.965	OUTFALL		1200mm accounts for Infiltration Tank

STORM WATER NETWORK DETAILS - UPPER CATCHMENT

Manhole Name	Cover Level (m)	MH Depth (m)	Pipe Out PN	Pipes In Invert Level (m)	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In Backdrop (mm)
S01	201.290	1.425	1.000		199.865	300	
S02	201.620	1.840	1.001	199.780	199.780	300	
S03	202.400	2.681	1.002	199.719	199.719	300	
S04	202.500	2.842	1.003	199.658	199.658	300	
S05	202.570	2.951	1.004	199.619	199.619	300	
S06	201.385	2.514	1.005	199.471	198.871	300	600
S07	200.945	2.194	1.006	198.751	198.751	300	
S08	200.080	1.392	1.007	198.688	198.688	300	
S10	199.710	1.425	2.000		198.285	300	
S11	199.710	1.564	2.001	198.146	198.146	300	
S12	199.710	1.584	2.002	198.126	198.126	300	
S13	199.705	1.671	2.003	198.034	198.034	300	
S17	199.975	1.425	3.000		198.550	300	
S18	200.065	1.696	3.001	198.369	198.369	300	
S14	199.705	1.763	2.004	197.942	197.942	300	
				198.255			313
S15	199.645	1.730	2.005	197.915	197.915	300	
S16	199.645	1.794	2.006	197.851	197.851	300	
S09	199.645	1.933	1.008	198.652	197.712	375	865
				197.787			
T MH	199.645	1.945	1.009	197.700	197.700	375	
PI	199.645	2.073	1.010	197.672	197.572	375	100mm Accounts for PI
INF	199.645	2.130	1.011	197.515	197.515	375	
	199.645	2.930		196.715	OUTFALL		800mm accounts for Infiltration Tank

FOUL WATER NETWORK DETAILS

Manhole Name	Cover Level (m)	MH Depth (m)	Pipe Out PN	Pipes In Invert Level (m)	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In Backdrop (mm)
F01	200.590	0.825	F1.000		199.765	225	
F02	199.930	0.825	F1.001	199.105	199.105	225	
F09	199.110	0.483	F2.000		198.627	225	
F03	199.600	1.211	F1.002	198.775	198.389	225	386
				198.389			
F04	199.425	1.362	F1.003	198.063	198.063	225	
F10	200.185	0.825	F3.000		199.360	225	
F11	200.065	0.950	F3.001	199.115	199.115	225	
F12	199.110	0.560	F4.000		198.550	225	
F13	199.170	0.890	F4.001	198.280	198.280	225	
F05	199.645	1.627	F1.004	198.018	198.018	225	
				198.820			802
				198.018			
F11	199.410	1.500	F5.000		197.910	225	
F11	199.110	1.500	F5.001	197.610	197.610	225	
F12	199.635	2.264	F5.002	197.371	197.371	225	
F06	199.775	2.445	F1.005	197.630	197.330	225	300
				197.330			
F07	201.020	3.997	F1.006	197.023	197.023	225	
F16	200.830	0.825	F6.000		200.005	225	
F17	201.385	1.495	F6.001	199.890	199.890	225	
F18	202.570	2.830	F6.002	199.740	199.740	225	
F08	202.570	5.892	F1.007	196.678	196.678	225	
				199.590			2912mm Backdrop into Existing System
EF01	202.570	5.921		196.649	OUTFALL		



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Foul Sewer Notes:

1. All foul sewer works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
3. Foul sewer service connections and inspection chambers to each dwelling shall be in accordance with Irish Water standard detail STD-WW-02.
4. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
5. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
6. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-WW-05.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-WW-06 & 06A.

Storm Sewer Notes:

1. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
3. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
4. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.

Watermain Notes:

1. All watermain works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Water Infrastructure Document CDS-5020-03.
2. All pipe materials shall be in compliance with Section 3.9 of Irish Water Code of Practice Document-CDS-5020-03.
3. Individual water service connections and boundary boxes to each dwelling shall be in compliance with Irish Water standard detail STD-W-02.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-W-11.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-W-12 & 12A.
6. On line and off-line air valve details shall be in accordance with Irish Water standard detail STD-W-22 & STD-W-23 respectively.
7. Sluice valve details shall be in accordance with Irish Water standard detail STD-W-15.
8. On line and off-line hydrant details shall be in accordance with Irish Water standard detail STD-W-18 & STD-W-19 respectively.
9. Scour valve and chamber details shall be in accordance with Irish Water standard detail STD-W-30.

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P01	16.04.21	DM / PMGB	ISSUE FOR INFORMATION	DK

Client

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Project

SHB 3
BLESSINGTON, CO. WICKLOW

Title

STORM AND FOUL WATER NETWORKS

Model File Identifier
SHB3-BLN-CS-RPS-DR-DA002

File Identifier
SHB3-BLN-CS-RPS-DR-DA002-01

Created on	Sheets	
JULY 2021	01 OF 01	
Scale: 1:500 @ A1, 1:1000 @ A3	Status: S4	Rev: P04

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Appendix B

Design Calculations

- **SHB3-BLN-CS-RPS-CA-0001 – Foul Water Design Calcultions**
- **SHB3-BLN-CS-RPS-CA-0001 –Storm Water Design Calcultions – Lower Catchment**
- **SHB3-BLN-CS-RPS-CA-0001 –Storm Water Design Calcultions – Upper Catchment**

Foul Water Design Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Domestic (l/s/ha)	0.00	Maximum Backdrop Height (m)	3.000
Industrial Peak Flow Factor	0.00	Domestic Peak Flow Factor	6.00	Min Design Depth for Optimisation (m)	0.600
Flow Per Person (l/per/day)	150.00	Add Flow / Climate Change (%)	10	Min Vel for Auto Design only (m/s)	0.75
Persons per House	2.70	Minimum Backdrop Height (m)	0.100	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	35.229	0.660	53.4	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F1.001	8.313	0.330	25.2	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	54.983	0.238	231.0	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F1.002	75.414	0.326	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.003	10.379	0.045	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	199.765	0.000	0.6	0	0.1	17	0.50	1.57	62.5	0.7
F1.001	199.105	0.000	0.6	0	0.1	14	0.65	2.29	91.1	0.7
F2.000	198.627	0.000	0.6	0	0.1	23	0.30	0.75	30.0	0.7
F1.002	198.389	0.000	1.2	0	0.1	32	0.37	0.75	30.0	1.3
F1.003	198.063	0.000	1.2	0	0.1	32	0.37	0.75	30.0	1.3

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F3.000	56.516	0.245	230.7	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F3.001	60.966	0.295	206.4	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F4.000	62.477	0.270	231.4	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F4.001	60.633	0.262	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	77.797	0.387	200.8	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F5.000	55.467	0.300	184.9	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F5.001	44.263	0.239	184.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F5.002	7.480	0.040	184.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	56.820	0.307	184.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F3.000	199.360	0.000	0.6	0	0.1	23	0.30	0.75	30.0	0.7
F3.001	199.115	0.000	0.6	0	0.1	23	0.31	0.80	31.7	0.7
F4.000	198.550	0.000	0.6	0	0.1	23	0.30	0.75	29.9	0.7
F4.001	198.280	0.000	0.6	0	0.1	23	0.30	0.75	30.0	0.7
F1.004	198.018	0.000	2.4	0	0.2	44	0.49	0.81	32.1	2.6
F5.000	197.910	0.000	0.6	0	0.1	22	0.33	0.84	33.5	0.7
F5.001	197.610	0.000	0.6	0	0.1	22	0.33	0.84	33.5	0.7
F5.002	197.371	0.000	0.6	0	0.1	22	0.33	0.84	33.5	0.7
F1.005	197.330	0.000	3.0	0	0.3	48	0.54	0.84	33.5	3.3

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.006	63.670	0.344	184.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F6.000	26.647	0.115	231.7	0.000	0	0.6	1.500	o	225	Pipe/Conduit	
F6.001	34.652	0.150	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F6.002	34.652	0.150	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F1.007	6.739	0.029	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.006	197.023	0.000	3.0	0	0.3	48	0.54	0.84	33.5	3.3
F6.000	200.005	0.000	0.6	0	0.1	23	0.30	0.75	29.9	0.7
F6.001	199.890	0.000	0.6	0	0.1	23	0.30	0.75	30.0	0.7
F6.002	199.740	0.000	0.6	0	0.1	23	0.30	0.75	30.0	0.7
F1.007	196.678	0.000	3.6	0	0.4	55	0.52	0.75	30.0	4.0

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F01	200.590	0.825	Open Manhole	1200	F1.000	199.765	225				
F02	199.930	0.825	Open Manhole	1200	F1.001	199.105	225	F1.000	199.105	225	
F09	199.110	0.483	Open Manhole	1200	F2.000	198.627	225				
F03	199.600	1.211	Open Manhole	1200	F1.002	198.389	225	F1.001	198.775	225	386
								F2.000	198.389	225	
F04	199.425	1.362	Open Manhole	1200	F1.003	198.063	225	F1.002	198.063	225	
F10	200.185	0.825	Open Manhole	1200	F3.000	199.360	225				
F11	200.065	0.950	Open Manhole	1200	F3.001	199.115	225	F3.000	199.115	225	
F12	199.110	0.560	Open Manhole	1200	F4.000	198.550	225				
F13	199.170	0.890	Open Manhole	1200	F4.001	198.280	225	F4.000	198.280	225	
F05	199.645	1.627	Open Manhole	1200	F1.004	198.018	225	F1.003	198.018	225	
								F3.001	198.820	225	802
								F4.001	198.018	225	
F11	199.410	1.500	Open Manhole	1200	F5.000	197.910	225				
F11	199.110	1.500	Open Manhole	1200	F5.001	197.610	225	F5.000	197.610	225	
F12	199.635	2.264	Open Manhole	1200	F5.002	197.371	225	F5.001	197.371	225	
F06	199.775	2.445	Open Manhole	1200	F1.005	197.330	225	F1.004	197.630	225	300
								F5.002	197.330	225	
F07	201.020	3.997	Open Manhole	1200	F1.006	197.023	225	F1.005	197.023	225	
F16	200.830	0.825	Open Manhole	1200	F6.000	200.005	225				
F17	201.385	1.495	Open Manhole	1200	F6.001	199.890	225	F6.000	199.890	225	
F18	202.570	2.830	Open Manhole	1200	F6.002	199.740	225	F6.001	199.740	225	
F08	202.570	5.892	Open Manhole	1200	F1.007	196.678	225	F1.006	196.678	225	
								F6.002	199.590	225	2912
F	202.570	5.921	Open Manhole	375		OUTFALL		F1.007	196.649	225	

Manhole Schedules for Foul - Main

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F01	697783.408	713205.885	697783.408	713205.885	Required	
F02	697773.081	713172.204	697773.081	713172.204	Required	
F09	697751.890	713112.910	697751.890	713112.910	Required	
F03	697768.342	713165.373	697768.342	713165.373	Required	
F04	697696.458	713188.176	697696.458	713188.176	Required	
F10	697760.092	713224.394	697760.092	713224.394	Required	
F11	697706.483	713242.284	697706.483	713242.284	Required	
F12	697728.847	713108.399	697728.847	713108.399	Required	
F13	697669.080	713126.600	697669.080	713126.600	Required	
F05	697686.710	713184.613	697686.710	713184.613	Required	

Manhole Schedules for Foul - Main

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F11	697646.365	713142.984	697646.365	713142.984	Required	
F11	697593.804	713160.704	697593.804	713160.704	Required	
F12	697607.029	713202.945	697607.029	713202.945	Required	
F06	697612.520	713208.026	697612.520	713208.026	Required	
F07	697628.703	713262.492	697628.703	713262.492	Required	
F16	697528.727	713195.945	697528.727	713195.945	Required	
F17	697541.746	713219.196	697541.746	713219.196	Required	
F18	697555.110	713251.167	697555.110	713251.167	Required	
F08	697568.474	713283.138	697568.474	713283.138	Required	
F	697565.965	713289.393			No Entry	

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.007	F	202.570	196.649	0.000	375	0

REPORT

Storm Water Design Calculations Lower Catchment

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm 1 - Lower Site

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	16.400	Volumetric Runoff Coeff.	1.000	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.215	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	20	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.100		

Designed with Level Soffits

Time Area Diagram for Storm 1 - Lower Site

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.208	4-8	0.148	8-12	0.001

Total Area Contributing (ha) = 0.357

Total Pipe Volume (m³) = 21.589

Network Design Table for Storm 1 - Lower Site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm 1 - Lower Site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	33.687	0.169	199.3	0.028	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	33.687	0.169	199.3	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	43.700	0.219	199.5	0.036	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	43.700	0.219	199.5	0.043	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	30.030	0.150	200.2	0.035	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	30.030	0.150	200.2	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	13.749	0.069	199.3	0.027	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	29.621	0.148	200.1	0.008	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	23.567	0.118	199.7	0.039	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	23.567	0.118	199.7	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.002	14.363	0.072	199.5	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.61	198.450	0.028	0.0	0.0	1.0	0.92	36.7	6.1
1.001	50.00	6.11	198.206	0.054	0.0	0.0	2.0	1.11	78.5	11.8
1.002	50.00	6.77	198.037	0.091	0.0	0.0	3.3	1.11	78.4	19.6
1.003	50.00	7.43	197.818	0.134	0.0	0.0	4.8	1.11	78.4	28.9
2.000	50.00	5.54	198.225	0.035	0.0	0.0	1.3	0.92	36.6	7.5
2.001	50.00	6.09	198.075	0.067	0.0	0.0	2.4	0.92	36.6	14.6
1.004	50.00	7.63	197.599	0.228	0.0	0.0	8.2	1.11	78.5	49.5
1.005	50.00	8.08	197.530	0.236	0.0	0.0	8.5	1.11	78.3	51.2
3.000	50.00	5.43	198.275	0.039	0.0	0.0	1.4	0.92	36.6	8.5
3.001	50.00	5.78	198.082	0.073	0.0	0.0	2.6	1.11	78.4	15.8
3.002	50.00	6.00	197.964	0.110	0.0	0.0	4.0	1.11	78.4	23.7

Network Design Table for Storm 1 - Lower Site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.003	23.535	0.118	199.4	0.005	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	2.740	0.014	195.7	0.006	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	4.173	0.017	245.5	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	2.716	0.011	250.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.003	50.00	6.35	197.892	0.115	0.0	0.0	4.1	1.11	78.4	24.9
1.006	50.00	8.12	197.382	0.357	0.0	0.0	12.9	1.12	79.2	77.3
1.007	50.00	8.18	197.193	0.357	0.0	0.0	12.9	1.15	127.2	77.3
1.008	50.00	8.22	197.176	0.357	0.0	0.0	12.9	1.14	126.1	77.3

Manhole Schedules for Storm 1 - Lower Site

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S01	199.650	1.200	Open Manhole	1200	1.000	198.450	225				
S02	198.900	0.694	Open Manhole	1200	1.001	198.206	300	1.000	198.281	225	
S03	198.900	0.863	Open Manhole	1200	1.002	198.037	300	1.001	198.037	300	
S04	199.170	1.352	Open Manhole	1200	1.003	197.818	300	1.002	197.818	300	
S08	199.425	1.200	Open Manhole	1200	2.000	198.225	225				
S09	199.170	1.095	Open Manhole	1200	2.001	198.075	225	2.000	198.075	225	
S05	199.170	1.571	Open Manhole	1200	1.004	197.599	300	1.003	197.599	300	
								2.001	197.925	225	251
S06	199.300	1.770	Open Manhole	1200	1.005	197.530	300	1.004	197.530	300	
S10	199.775	1.500	Open Manhole	1200	3.000	198.275	225				
S11	199.000	0.918	Open Manhole	1200	3.001	198.082	300	3.000	198.157	225	
S12	199.000	1.036	Open Manhole	1200	3.002	197.964	300	3.001	197.964	300	
S13	198.900	1.008	Open Manhole	1200	3.003	197.892	300	3.002	197.892	300	
S07	199.100	1.718	Open Manhole	1200	1.006	197.382	300	1.005	197.382	300	
								3.003	197.774	300	392
ST MH	199.100	1.907	Open Manhole	1350	1.007	197.193	375	1.006	197.368	300	100
PI	199.100	1.924	Open Manhole	1350	1.008	197.176	375	1.007	197.176	375	
Infiltration	199.100	1.935	Open Manhole	0		OUTFALL		1.008	197.165	375	

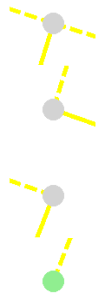
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S01	697770.599	713164.841	697770.599	713164.841	Required	

Manhole Schedules for Storm 1 - Lower Site

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S02	697760.838	713132.599	697760.838	713132.599	Required	
S03	697751.078	713100.356	697751.078	713100.356	Required	
S04	697709.276	713113.094	697709.276	713113.094	Required	
S08	697685.085	713183.250	697685.085	713183.250	Required	
S09	697676.280	713154.541	697676.280	713154.541	Required	
S05	697667.474	713125.831	697667.474	713125.831	Required	
S06	697659.433	713136.985	697659.433	713136.985	Required	
S10	697609.028	713203.115	697609.028	713203.115	Required	
S11	697602.156	713180.572	697602.156	713180.572	Required	
S12	697595.284	713158.029	697595.284	713158.029	Required	
S13	697608.851	713153.316	697608.851	713153.316	Required	

Manhole Schedules for Storm 1 - Lower Site

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S07	697631.173	713145.858	697631.173	713145.858	Required	
ST MH	697630.371	713143.238	697630.371	713143.238	Required	
PI	697634.312	713141.865	697634.312	713141.865	Required	
Infiltration	697633.331	713139.332			No Entry	



Area Summary for Storm 1 - Lower Site

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	pavement	75	0.011	0.009	0.009
	Classification	Permeable Pavement	60	0.008	0.005	0.014
	Classification	Pitched Roof	90	0.016	0.015	0.028
1.001	Classification	pavement	75	0.019	0.014	0.014
	Classification	Permeable Pavement	60	0.015	0.009	0.023
	Classification	Pitched Roof	90	0.003	0.003	0.026
1.002	Classification	pavement	75	0.018	0.014	0.014
	Classification	Permeable Pavement	60	0.013	0.008	0.021
	Classification	Pitched Roof	90	0.017	0.015	0.036
1.003	Classification	pavement	75	0.021	0.016	0.016
	Classification	Permeable Pavement	60	0.016	0.010	0.026
	Classification	Pitched Roof	90	0.019	0.017	0.043
2.000	Classification	pavement	75	0.012	0.009	0.009
	Classification	Permeable Pavement	60	0.010	0.006	0.015
	Classification	Permeable Pavement	60	0.009	0.005	0.020
	Classification	Pitched Roof	90	0.007	0.006	0.026
	Classification	Flat Roof	90	0.010	0.009	0.035
2.001	Classification	pavement	75	0.018	0.013	0.013
	Classification	Permeable Pavement	60	0.007	0.004	0.018
	Classification	Permeable Pavement	60	0.008	0.005	0.023
	Classification	Pitched Roof	90	0.008	0.007	0.030
	Classification	Pitched Roof	90	0.003	0.003	0.033
1.004	Classification	pavement	75	0.013	0.010	0.010
	Classification	Permeable Pavement	60	0.014	0.009	0.018
	Classification	Flat Roof	90	0.010	0.009	0.027
1.005	Classification	pavement	75	0.007	0.005	0.005
	Classification	Flat Roof	90	0.003	0.003	0.008
3.000	Classification	pavement	75	0.014	0.010	0.010
	Classification	Permeable Pavement	60	0.013	0.008	0.018
	Classification	Permeable Pavement	60	0.008	0.005	0.023
	Classification	Pitched Roof	90	0.018	0.016	0.039
3.001	Classification	pavement	75	0.014	0.011	0.011
	Classification	Permeable Pavement	60	0.012	0.007	0.018
	Classification	Permeable Pavement	60	0.009	0.005	0.023
	Classification	Pitched Roof	90	0.012	0.011	0.034

Area Summary for Storm 1 - Lower Site

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
3.002	Classification	Flat Roof	90	0.007	0.006	0.006
	Classification	Pitched Roof	90	0.008	0.007	0.013
	Classification	pavement	75	0.019	0.014	0.028
	Classification	Permeable Pavement	60	0.015	0.009	0.037
3.003	Classification	pavement	75	0.007	0.005	0.005
1.006	Classification	Pitched Roof	90	0.007	0.006	0.006
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.478	0.357	0.357

Free Flowing Outfall Details for Storm 1 - Lower Site

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	Infiltration	199.100	197.165	0.000	0	0

Simulation Criteria for Storm 1 - Lower Site

Volumetric Runoff Coeff	1.000	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Region	Scotland and Ireland	Ratio R	0.215
Return Period (years)	100	M5-60 (mm)	16.400	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer) 1.000 Cv (Winter) 1.000 Storm Duration (mins) 30

Storage Structures for Storm 1 - Lower Site

Infiltration Basin Manhole: PI, DS/PN: 1.008

Invert Level (m) 196.259 Infiltration Coefficient Side (m/hr) 0.09900 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.09900 Safety Factor 5.0

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	1.200	250.0	1.201	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm 1 - Lower Site

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.500 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.233 Cv (Winter) 1.000

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S01	15 minute 100 year Summer I+20%		199.650	198.546	-0.129	0.000	0.37	0.103	5.745		12.9	OK
1.001	S02	30 minute 100 year Summer I+20%		198.900	198.338	-0.168	0.000	0.34	0.210	15.822		24.8	OK
1.002	S03	30 minute 100 year Summer I+20%		198.900	198.304	-0.033	0.000	0.51	1.683	26.367		37.1	OK
1.003	S04	30 minute 100 year Summer I+20%		199.170	198.262	0.144	0.000	0.61	3.346	38.834		44.7	SURCHARGED
2.000	S08	15 minute 100 year Summer I+20%		199.425	198.335	-0.115	0.000	0.47	0.118	7.089		15.9	OK
2.001	S09	30 minute 100 year Summer I+20%		199.170	198.264	-0.036	0.000	0.89	0.775	19.618		30.3	OK
1.004	S05	30 minute 100 year Summer I+20%		199.170	198.186	0.287	0.000	1.17	4.578	66.406		75.9	SURCHARGED
1.005	S06	30 minute 100 year Summer I+20%		199.300	198.093	0.263	0.000	1.10	1.518	68.705		78.0	SURCHARGED
3.000	S10	15 minute 100 year Summer I+20%		199.775	198.394	-0.106	0.000	0.53	0.129	7.982		18.0	OK
3.001	S11	15 minute 100 year Summer I+20%		199.000	198.235	-0.147	0.000	0.49	0.280	14.854		34.2	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm 1 - Lower Site

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
3.002	S12	15 minute 100 year Summer I+20%		199.000	198.173	-0.091	0.000	0.80	0.986	22.371		52.3	OK
3.003	S13	15 minute 100 year Summer I+20%		198.900	198.095	-0.097	0.000	0.79	0.737	23.435		54.8	OK
1.006	S07	30 minute 100 year Summer I+20%		199.100	197.917	0.235	0.000	2.47	2.979	103.837		128.1	SURCHARGED
1.007	ST MH	30 minute 100 year Summer I+20%		199.100	197.639	0.071	0.000	1.61	0.716	103.840		128.0	SURCHARGED
1.008	PI	1440 minute 100 year Summer I+20%		199.100	197.243	-0.308	0.000	0.07	235.089	66.732	1752	6.2	OK

Storm Water Design Calculations
Upper Catchment

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm 2 - Upper site

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	2.000
M5-60 (mm)	16.100	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	0.900
Ratio R	0.222	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	20	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.100		

Designed with Level Soffits

Time Area Diagram for Storm 2 - Upper site

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.160	4-8	0.306	8-12	0.031

Total Area Contributing (ha) = 0.496

Total Pipe Volume (m³) = 41.610

Network Design Table for Storm 2 - Upper site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm 2 - Upper site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	24.908	0.085	293.0	0.018	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	26.410	0.061	433.0	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	26.410	0.061	433.0	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	16.677	0.039	427.6	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	63.912	0.148	431.8	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	26.948	0.120	224.6	0.046	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	26.948	0.063	427.7	0.031	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	15.585	0.036	432.9	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	40.970	0.139	294.7	0.039	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	8.450	0.020	422.5	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	39.757	0.092	432.1	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	39.757	0.092	432.1	0.066	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.45	199.865	0.018	0.0	0.0	0.5	0.91	64.6	3.0
1.001	50.00	6.04	199.780	0.034	0.0	0.0	0.9	0.75	53.0	5.6
1.002	50.00	6.63	199.719	0.053	0.0	0.0	1.4	0.75	53.0	8.6
1.003	50.00	7.00	199.658	0.078	0.0	0.0	2.1	0.75	53.3	12.6
1.004	50.00	8.42	199.619	0.096	0.0	0.0	2.6	0.75	53.0	15.5
1.005	50.00	8.85	198.871	0.142	0.0	0.0	3.8	1.05	73.9	23.1
1.006	50.00	9.44	198.751	0.173	0.0	0.0	4.7	0.75	53.3	28.1
1.007	50.00	9.79	198.688	0.201	0.0	0.0	5.4	0.75	53.0	32.7
2.000	50.00	5.75	198.285	0.039	0.0	0.0	1.1	0.91	64.4	6.4
2.001	50.00	5.94	198.146	0.059	0.0	0.0	1.6	0.76	53.6	9.5
2.002	50.00	6.82	198.126	0.078	0.0	0.0	2.1	0.75	53.0	12.6
2.003	50.00	7.70	198.034	0.144	0.0	0.0	3.9	0.75	53.0	23.4

Network Design Table for Storm 2 - Upper site

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	53.269	0.181	294.3	0.009	5.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	49.318	0.114	432.6	0.032	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.004	11.504	0.027	426.1	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.005	27.654	0.064	432.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.006	27.654	0.064	432.1	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	5.904	0.012	492.0	0.012	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	7.031	0.028	250.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	14.233	0.057	249.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	12.850	0.051	254.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	50.00	5.97	198.550	0.009	0.0	0.0	0.2	0.91	64.4	1.5
3.001	50.00	7.07	198.369	0.041	0.0	0.0	1.1	0.75	53.0	6.7
2.004	50.00	7.96	197.942	0.229	0.0	0.0	6.2	0.76	53.4	37.2
2.005	50.00	8.57	197.915	0.229	0.0	0.0	6.2	0.75	53.0	37.2
2.006	50.00	9.19	197.851	0.284	0.0	0.0	7.7	0.75	53.0	46.1
1.008	50.00	9.91	197.712	0.496	0.0	0.0	13.4	0.81	89.5	80.7
1.009	50.00	10.01	197.700	0.496	0.0	0.0	13.4	1.14	126.1	80.7
1.010	50.00	10.22	197.572	0.496	0.0	0.0	13.4	1.14	126.1	80.7
1.011	50.00	10.41	197.515	0.496	0.0	0.0	13.4	1.13	125.0	80.7

Manhole Schedules for Storm 2 - Upper site

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S01	201.290	1.425	Open Manhole	1200	1.000	199.865	300				
S02	201.620	1.840	Open Manhole	1200	1.001	199.780	300	1.000	199.780	300	
S03	202.400	2.681	Open Manhole	1200	1.002	199.719	300	1.001	199.719	300	
S04	202.500	2.842	Open Manhole	1200	1.003	199.658	300	1.002	199.658	300	
S05	202.570	2.951	Open Manhole	1200	1.004	199.619	300	1.003	199.619	300	
S06	201.385	2.514	Open Manhole	1200	1.005	198.871	300	1.004	199.471	300	600
S07	200.945	2.194	Open Manhole	1200	1.006	198.751	300	1.005	198.751	300	
S08	200.080	1.392	Open Manhole	1200	1.007	198.688	300	1.006	198.688	300	
S10	199.710	1.425	Open Manhole	1200	2.000	198.285	300				
S11	199.710	1.564	Open Manhole	1200	2.001	198.146	300	2.000	198.146	300	
S12	199.710	1.584	Open Manhole	1200	2.002	198.126	300	2.001	198.126	300	
S13	199.705	1.671	Open Manhole	1200	2.003	198.034	300	2.002	198.034	300	
S17	199.975	1.425	Open Manhole	1200	3.000	198.550	300				
S18	200.065	1.696	Open Manhole	1200	3.001	198.369	300	3.000	198.369	300	
S14	199.705	1.763	Open Manhole	1200	2.004	197.942	300	2.003	197.942	300	
								3.001	198.255	300	313
S15	199.645	1.730	Open Manhole	1200	2.005	197.915	300	2.004	197.915	300	
S16	199.645	1.794	Open Manhole	1200	2.006	197.851	300	2.005	197.851	300	
S09	199.645	1.933	Open Manhole	1350	1.008	197.712	375	1.007	198.652	300	865
								2.006	197.787	300	
T MH	199.645	1.945	Open Manhole	1350	1.009	197.700	375	1.008	197.700	375	
PI	199.645	2.073	Open Manhole	1350	1.010	197.572	375	1.009	197.672	375	100
INF	199.645	2.130	Open Manhole	1350	1.011	197.515	375	1.010	197.515	375	
	199.645	2.181	Open Manhole	0		OUTFALL		1.011	197.464	375	

Manhole Schedules for Storm 2 - Upper site

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S01	697530.188	713195.095	697530.188	713195.095	Required	
S02	697541.962	713217.044	697541.962	713217.044	Required	
S03	697552.389	713241.309	697552.389	713241.309	Required	
S04	697562.817	713265.573	697562.817	713265.573	Required	
S05	697569.392	713280.899	697569.392	713280.899	Required	
S06	697630.054	713260.775	697630.054	713260.775	Required	
S07	697622.269	713234.977	697622.269	713234.977	Required	
S08	697614.484	713209.178	697614.484	713209.178	Required	
S10	697788.950	713212.566	697788.950	713212.566	Required	
S11	697776.044	713173.682	697776.044	713173.682	Required	
S12	697769.473	713168.369	697769.473	713168.369	Required	

Manhole Schedules for Storm 2 - Upper site

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S13	697731.539	713180.273	697731.539	713180.273	Required	
S17	697759.087	713222.842	697759.087	713222.842	Required	
S18	697708.399	713239.223	697708.399	713239.223	Required	
S14	697693.606	713192.176	697693.606	713192.176	Required	
S15	697682.497	713189.184	697682.497	713189.184	Required	
S16	697655.952	713196.934	697655.952	713196.934	Required	
S09	697629.407	713204.685	697629.407	713204.685	Required	
T MH	697631.133	713210.330	697631.133	713210.330	Required	
PI	697633.021	713217.103	697633.021	713217.103	Required	
INF	697646.645	713221.221	697646.645	713221.221	Required	
	697659.154	713218.279			No Entry	

Area Summary for Storm 2 - Upper site

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	Pitched Roof	90	0.007	0.006	0.006
	Classification	Permeable Pavement	60	0.020	0.012	0.018
1.001	Classification	Pitched Roof	90	0.010	0.009	0.009
	Classification	Permeable Pavement	60	0.012	0.007	0.016
1.002	Classification	Pitched Roof	90	0.012	0.011	0.011
	Classification	Permeable Pavement	60	0.013	0.008	0.019
1.003	Classification	Pitched Roof	90	0.012	0.011	0.011
	Classification	Permeable Pavement	60	0.024	0.014	0.025
1.004	Classification	Flat Roof	90	0.013	0.012	0.012
	Classification	pavement	75	0.008	0.006	0.018
1.005	Classification	Permeable Pavement	60	0.013	0.008	0.008
	Classification	Flat Roof	90	0.013	0.012	0.020
	Classification	pavement	75	0.036	0.027	0.046
1.006	Classification	Permeable Pavement	60	0.013	0.008	0.008
	Classification	pavement	75	0.021	0.015	0.024
	Classification	Pitched Roof	90	0.008	0.007	0.031
1.007	Classification	Permeable Pavement	60	0.016	0.009	0.009
	Classification	pavement	75	0.015	0.011	0.021
	Classification	Pitched Roof	90	0.009	0.008	0.028
2.000	Classification	Pitched Roof	90	0.008	0.008	0.008
	Classification	Flat Roof	90	0.007	0.006	0.014
	Classification	pavement	75	0.024	0.018	0.032
	Classification	Permeable Pavement	60	0.013	0.008	0.039
2.001	Classification	Permeable Pavement	60	0.009	0.006	0.006
	Classification	pavement	75	0.018	0.014	0.019
2.002	Classification	Permeable Pavement	60	0.018	0.011	0.011
	Classification	Permeable Pavement	60	0.014	0.008	0.019
2.003	Classification	pavement	75	0.026	0.020	0.020
	Classification	Pitched Roof	90	0.018	0.016	0.036
	Classification	Pitched Roof	90	0.013	0.012	0.048
	Classification	Permeable Pavement	60	0.017	0.010	0.058
	Classification	Permeable Pavement	60	0.013	0.008	0.066
3.000	Classification	Pitched Roof	90	0.010	0.009	0.009
3.001	Classification	Flat Roof	90	0.007	0.006	0.006
	Classification	Pitched Roof	90	0.010	0.009	0.015

Area Summary for Storm 2 - Upper site

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	Classification	pavement	75	0.023	0.017	0.032
2.004	Classification	pavement	75	0.024	0.018	0.018
	Classification	Permeable Pavement	60	0.013	0.008	0.026
	Classification	pavement	75	0.002	0.002	0.027
	Classification	Permeable Pavement	60	0.011	0.006	0.034
	Classification	pavement	75	0.006	0.004	0.038
	Classification	Flat Roof	90	0.007	0.006	0.044
2.005	-	-	100	0.000	0.000	0.000
2.006	Classification	pavement	75	0.032	0.024	0.024
	Classification	Permeable Pavement	60	0.040	0.024	0.048
	Classification	Pitched Roof	90	0.008	0.007	0.055
1.008	Classification	Flat Roof	90	0.013	0.012	0.012
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.677	0.496	0.496

Free Flowing Outfall Details for Storm 2 - Upper site

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011		199.645	197.464	0.000	0	0

Simulation Criteria for Storm 2 - Upper site

Volumetric Runoff Coeff	1.000	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	16.400	Cv (Summer)	1.000
Return Period (years)	100	Ratio R	0.215	Cv (Winter)	1.000
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Storage Structures for Storm 2 - Upper site

Infiltration Basin Manhole: INF, DS/PN: 1.011

Invert Level (m) 196.650 Infiltration Coefficient Side (m/hr) 0.15700 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.15700 Safety Factor 5.0

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	371.2	0.800	371.2	0.801	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm 2 - Upper site

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 16.500 Cv (Summer) 1.000
Region Scotland and Ireland Ratio R 0.233 Cv (Winter) 1.000

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S01	30 minute 100 year Summer I+20%		201.290	199.957	-0.208	0.000	0.14	0.099	5.331		8.3	OK
1.001	S02	15 minute 100 year Summer I+20%		201.620	199.926	-0.154	0.000	0.31	0.665	7.005		14.9	OK
1.002	S03	15 minute 100 year Summer I+20%		202.400	199.899	-0.120	0.000	0.46	1.057	10.794		21.8	OK
1.003	S04	15 minute 100 year Summer I+20%		202.500	199.868	-0.090	0.000	0.77	1.301	15.896		31.0	OK
1.004	S05	15 minute 100 year Summer I+20%		202.570	199.817	-0.102	0.000	0.75	0.824	19.522		37.9	OK
1.005	S06	30 minute 100 year Summer I+20%		201.385	199.225	0.054	0.000	0.79	0.395	41.298		52.4	SURCHARGED
1.006	S07	30 minute 100 year Summer I+20%		200.945	199.145	0.094	0.000	1.31	2.226	50.247		62.7	SURCHARGED
1.007	S08	30 minute 100 year Summer I+20%		200.080	199.034	0.046	0.000	1.89	2.138	58.468		71.8	SURCHARGED
2.000	S10	30 minute 100 year Summer I+20%		199.710	198.740	0.155	0.000	0.25	0.509	11.469		14.9	SURCHARGED
2.001	S11	30 minute 100 year Summer I+20%		199.710	198.720	0.274	0.000	0.58	3.455	17.079		20.0	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm 2 - Upper site

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.002	S12	30 minute 100 year Summer I+20%		199.710	198.708	0.282	0.000	0.49	1.166	22.602		24.0	SURCHARGED
2.003	S13	30 minute 100 year Summer I+20%		199.705	198.674	0.340	0.000	0.86	3.443	41.826		42.4	SURCHARGED
3.000	S17	30 minute 100 year Summer I+20%		199.975	198.625	-0.225	0.000	0.06	0.080	2.611		3.9	OK
3.001	S18	30 minute 100 year Summer I+20%		200.065	198.618	-0.051	0.000	0.32	2.156	11.913		16.1	OK
2.004	S14	30 minute 100 year Summer I+20%		199.705	198.605	0.363	0.000	1.69	6.592	66.573		60.7	SURCHARGED
2.005	S15	30 minute 100 year Summer I+20%		199.645	198.552	0.337	0.000	1.28	1.443	66.567		61.2	SURCHARGED
2.006	S16	30 minute 100 year Summer I+20%		199.645	198.454	0.303	0.000	1.49	2.546	82.544		71.5	SURCHARGED
1.008	S09	30 minute 100 year Summer I+20%		199.645	198.306	0.219	0.000	1.96	2.707	144.427		145.7	SURCHARGED
1.009	T MH	30 minute 100 year Summer I+20%		199.645	198.166	0.091	0.000	1.71	1.159	144.440		145.5	SURCHARGED
1.010	PI	30 minute 100 year Summer I+20%		199.645	198.010	0.063	0.000	1.45	1.135	144.455		145.1	SURCHARGED
1.011	INF	600 minute 100 year Winter I+20%		199.645	197.579	-0.311	0.000	0.06	283.635	12.781	860	6.0	OK

Appendix C

Surface Water Infiltration Design Output and Sizing

- **SHB3-BLN-CS-RPS-CA-002 – Infiltration Design Calculations – Lower Catchment**
- **SHB3-BLN-CS-RPS-CA-002 – Infiltration Design Calculations – Upper Catchment**

Infiltration Design Calculations – Lower Catchment

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1241 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	196.479	0.220	1.4	52.3	O K
30 min Summer	196.573	0.314	1.5	74.5	O K
60 min Summer	196.675	0.416	1.5	98.8	O K
120 min Summer	196.787	0.528	1.5	125.4	O K
180 min Summer	196.856	0.597	1.6	141.8	O K
240 min Summer	196.905	0.646	1.6	153.4	O K
360 min Summer	196.972	0.713	1.6	169.4	O K
480 min Summer	197.016	0.757	1.6	179.8	O K
600 min Summer	197.046	0.787	1.6	186.8	O K
720 min Summer	197.066	0.807	1.6	191.7	O K
960 min Summer	197.089	0.830	1.6	197.1	O K
1440 min Summer	197.109	0.850	1.6	201.9	O K
2160 min Summer	197.114	0.855	1.6	203.1	O K
2880 min Summer	197.108	0.849	1.6	201.7	O K
4320 min Summer	197.079	0.820	1.6	194.8	O K
5760 min Summer	197.040	0.781	1.6	185.5	O K
7200 min Summer	196.996	0.737	1.6	175.0	O K
8640 min Summer	196.951	0.692	1.6	164.3	O K
10080 min Summer	196.906	0.647	1.6	153.6	O K
15 min Winter	196.506	0.247	1.5	58.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	80.285	0.0	22
30 min Summer	57.512	0.0	37
60 min Summer	38.681	0.0	66
120 min Summer	25.203	0.0	126
180 min Summer	19.445	0.0	184
240 min Summer	16.136	0.0	244
360 min Summer	12.374	0.0	364
480 min Summer	10.236	0.0	482
600 min Summer	8.831	0.0	602
720 min Summer	7.825	0.0	720
960 min Summer	6.466	0.0	932
1440 min Summer	4.937	0.0	1170
2160 min Summer	3.761	0.0	1560
2880 min Summer	3.098	0.0	1988
4320 min Summer	2.353	0.0	2812
5760 min Summer	1.936	0.0	3640
7200 min Summer	1.664	0.0	4472
8640 min Summer	1.471	0.0	5272
10080 min Summer	1.326	0.0	6056
15 min Winter	80.285	0.0	22

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	196.612	0.353	1.5	83.7	O K
60 min Winter	196.727	0.468	1.5	111.2	O K
120 min Winter	196.855	0.596	1.6	141.6	O K
180 min Winter	196.935	0.676	1.6	160.6	O K
240 min Winter	196.993	0.734	1.6	174.2	O K
360 min Winter	197.073	0.814	1.6	193.3	O K
480 min Winter	197.127	0.868	1.6	206.2	O K
600 min Winter	197.166	0.907	1.7	215.4	O K
720 min Winter	197.194	0.935	1.7	222.1	O K
960 min Winter	197.231	0.972	1.7	230.7	O K
1440 min Winter	197.256	0.997	1.7	236.8	O K
2160 min Winter	197.257	0.998	1.7	237.0	O K
2880 min Winter	197.241	0.982	1.7	233.3	O K
4320 min Winter	197.184	0.925	1.7	219.8	O K
5760 min Winter	197.112	0.853	1.6	202.7	O K
7200 min Winter	197.036	0.777	1.6	184.5	O K
8640 min Winter	196.960	0.701	1.6	166.4	O K
10080 min Winter	196.886	0.627	1.6	148.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	57.512	0.0	36
60 min Winter	38.681	0.0	66
120 min Winter	25.203	0.0	124
180 min Winter	19.445	0.0	182
240 min Winter	16.136	0.0	240
360 min Winter	12.374	0.0	356
480 min Winter	10.236	0.0	472
600 min Winter	8.831	0.0	588
720 min Winter	7.825	0.0	700
960 min Winter	6.466	0.0	924
1440 min Winter	4.937	0.0	1340
2160 min Winter	3.761	0.0	1672
2880 min Winter	3.098	0.0	2140
4320 min Winter	2.353	0.0	3072
5760 min Winter	1.936	0.0	3976
7200 min Winter	1.664	0.0	4824
8640 min Winter	1.471	0.0	5624
10080 min Winter	1.326	0.0	6456

Model Details

Storage is Online Cover Level (m) 199.100

Infiltration Basin Structure

Invert Level (m) 196.259 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.09900 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.09900

Depth (m)	Area (m^2)	Depth (m)	Area (m^2)	Depth (m)	Area (m^2)
0.000	250.0	1.200	250.0	1.201	0.0

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 651 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	196.855	0.205	3.4	72.2	O K
30 min Summer	196.943	0.293	3.4	103.2	O K
60 min Summer	197.037	0.387	3.5	136.4	O K
120 min Summer	197.136	0.486	3.5	171.4	O K
180 min Summer	197.193	0.543	3.6	191.5	O K
240 min Summer	197.231	0.581	3.6	204.9	O K
360 min Summer	197.276	0.626	3.6	220.9	O K
480 min Summer	197.299	0.649	3.6	228.9	O K
600 min Summer	197.312	0.662	3.6	233.5	O K
720 min Summer	197.321	0.671	3.6	236.6	O K
960 min Summer	197.331	0.681	3.6	240.1	O K
1440 min Summer	197.334	0.684	3.6	241.1	O K
2160 min Summer	197.318	0.668	3.6	235.7	O K
2880 min Summer	197.292	0.642	3.6	226.4	O K
4320 min Summer	197.226	0.576	3.6	203.2	O K
5760 min Summer	197.157	0.507	3.5	178.7	O K
7200 min Summer	197.090	0.440	3.5	155.0	O K
8640 min Summer	197.027	0.377	3.5	133.1	O K
10080 min Summer	196.971	0.321	3.4	113.3	O K
15 min Winter	196.880	0.230	3.4	81.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	81.129	0.0	23
30 min Summer	58.507	0.0	37
60 min Summer	39.558	0.0	66
120 min Summer	25.933	0.0	126
180 min Summer	20.082	0.0	186
240 min Summer	16.709	0.0	244
360 min Summer	12.862	0.0	362
480 min Summer	10.668	0.0	478
600 min Summer	9.224	0.0	530
720 min Summer	8.189	0.0	600
960 min Summer	6.787	0.0	732
1440 min Summer	5.199	0.0	1008
2160 min Summer	3.974	0.0	1428
2880 min Summer	3.281	0.0	1848
4320 min Summer	2.502	0.0	2644
5760 min Summer	2.064	0.0	3456
7200 min Summer	1.779	0.0	4184
8640 min Summer	1.577	0.0	4936
10080 min Summer	1.425	0.0	5656
15 min Winter	81.129	0.0	23

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	196.980	0.330	3.4	116.2	O K
60 min Winter	197.087	0.437	3.5	154.1	O K
120 min Winter	197.202	0.552	3.6	194.6	O K
180 min Winter	197.270	0.620	3.6	218.6	O K
240 min Winter	197.316	0.666	3.6	234.9	O K
360 min Winter	197.375	0.725	3.7	255.7	O K
480 min Winter	197.409	0.759	3.7	267.5	O K
600 min Winter	197.428	0.778	3.7	274.2	O K
720 min Winter	197.438	0.788	3.7	277.8	O K
960 min Winter	197.445	0.795	3.7	280.4	O K
1440 min Winter	197.443	0.793	3.7	279.6	O K
2160 min Winter	197.408	0.758	3.7	267.2	O K
2880 min Winter	197.357	0.707	3.7	249.3	O K
4320 min Winter	197.241	0.591	3.6	208.4	O K
5760 min Winter	197.126	0.476	3.5	167.7	O K
7200 min Winter	197.020	0.370	3.5	130.3	O K
8640 min Winter	196.926	0.276	3.4	97.3	O K
10080 min Winter	196.846	0.196	3.4	69.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	58.507	0.0	37
60 min Winter	39.558	0.0	66
120 min Winter	25.933	0.0	124
180 min Winter	20.082	0.0	182
240 min Winter	16.709	0.0	240
360 min Winter	12.862	0.0	354
480 min Winter	10.668	0.0	466
600 min Winter	9.224	0.0	574
720 min Winter	8.189	0.0	678
960 min Winter	6.787	0.0	778
1440 min Winter	5.199	0.0	1086
2160 min Winter	3.974	0.0	1556
2880 min Winter	3.281	0.0	1996
4320 min Winter	2.502	0.0	2856
5760 min Winter	2.064	0.0	3688
7200 min Winter	1.779	0.0	4464
8640 min Winter	1.577	0.0	5184
10080 min Winter	1.425	0.0	5848

Model Details

Storage is Online Cover Level (m) 199.645

Infiltration Basin Structure

Invert Level (m) 196.650 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.15700 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.15700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	371.2	0.800	371.2	0.801	0.0

Infiltration Design Calculations – Upper Catchment

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 651 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	196.855	0.205	3.4	72.2	O K
30 min Summer	196.943	0.293	3.4	103.2	O K
60 min Summer	197.037	0.387	3.5	136.4	O K
120 min Summer	197.136	0.486	3.5	171.4	O K
180 min Summer	197.193	0.543	3.6	191.5	O K
240 min Summer	197.231	0.581	3.6	204.9	O K
360 min Summer	197.276	0.626	3.6	220.9	O K
480 min Summer	197.299	0.649	3.6	228.9	O K
600 min Summer	197.312	0.662	3.6	233.5	O K
720 min Summer	197.321	0.671	3.6	236.6	O K
960 min Summer	197.331	0.681	3.6	240.1	O K
1440 min Summer	197.334	0.684	3.6	241.1	O K
2160 min Summer	197.318	0.668	3.6	235.7	O K
2880 min Summer	197.292	0.642	3.6	226.4	O K
4320 min Summer	197.226	0.576	3.6	203.2	O K
5760 min Summer	197.157	0.507	3.5	178.7	O K
7200 min Summer	197.090	0.440	3.5	155.0	O K
8640 min Summer	197.027	0.377	3.5	133.1	O K
10080 min Summer	196.971	0.321	3.4	113.3	O K
15 min Winter	196.880	0.230	3.4	81.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	81.129	0.0	23
30 min Summer	58.507	0.0	37
60 min Summer	39.558	0.0	66
120 min Summer	25.933	0.0	126
180 min Summer	20.082	0.0	186
240 min Summer	16.709	0.0	244
360 min Summer	12.862	0.0	362
480 min Summer	10.668	0.0	478
600 min Summer	9.224	0.0	530
720 min Summer	8.189	0.0	600
960 min Summer	6.787	0.0	732
1440 min Summer	5.199	0.0	1008
2160 min Summer	3.974	0.0	1428
2880 min Summer	3.281	0.0	1848
4320 min Summer	2.502	0.0	2644
5760 min Summer	2.064	0.0	3456
7200 min Summer	1.779	0.0	4184
8640 min Summer	1.577	0.0	4936
10080 min Summer	1.425	0.0	5656
15 min Winter	81.129	0.0	23

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
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180 min Winter	197.270	0.620	3.6	218.6	O K
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360 min Winter	197.375	0.725	3.7	255.7	O K
480 min Winter	197.409	0.759	3.7	267.5	O K
600 min Winter	197.428	0.778	3.7	274.2	O K
720 min Winter	197.438	0.788	3.7	277.8	O K
960 min Winter	197.445	0.795	3.7	280.4	O K
1440 min Winter	197.443	0.793	3.7	279.6	O K
2160 min Winter	197.408	0.758	3.7	267.2	O K
2880 min Winter	197.357	0.707	3.7	249.3	O K
4320 min Winter	197.241	0.591	3.6	208.4	O K
5760 min Winter	197.126	0.476	3.5	167.7	O K
7200 min Winter	197.020	0.370	3.5	130.3	O K
8640 min Winter	196.926	0.276	3.4	97.3	O K
10080 min Winter	196.846	0.196	3.4	69.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	58.507	0.0	37
60 min Winter	39.558	0.0	66
120 min Winter	25.933	0.0	124
180 min Winter	20.082	0.0	182
240 min Winter	16.709	0.0	240
360 min Winter	12.862	0.0	354
480 min Winter	10.668	0.0	466
600 min Winter	9.224	0.0	574
720 min Winter	8.189	0.0	678
960 min Winter	6.787	0.0	778
1440 min Winter	5.199	0.0	1086
2160 min Winter	3.974	0.0	1556
2880 min Winter	3.281	0.0	1996
4320 min Winter	2.502	0.0	2856
5760 min Winter	2.064	0.0	3688
7200 min Winter	1.779	0.0	4464
8640 min Winter	1.577	0.0	5184
10080 min Winter	1.425	0.0	5848

Model Details

Storage is Online Cover Level (m) 199.645

Infiltration Basin Structure

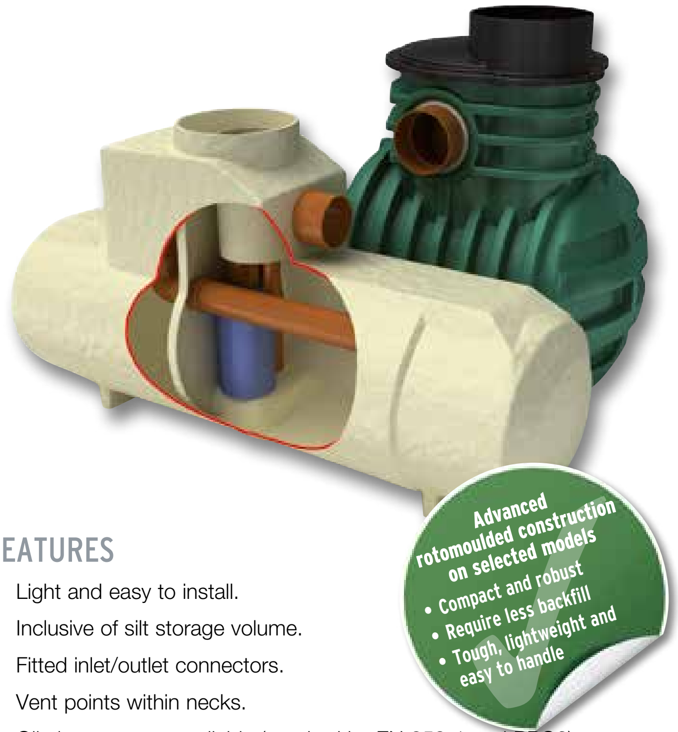
Invert Level (m) 196.650 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.15700 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.15700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	371.2	0.800	371.2	0.801	0.0

Appendix D

Hydrocarbon Interceptor – Brochure

Bypass NSB RANGE



APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Kingspan Klargester Bypass separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Oil storage volume.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m^2)	STORAGE CAPACITY (litres)		UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA.
				SILT	OIL								
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Rotomoulded chamber construction GRP chamber construction * Some units have more than one access shaft – diameter of largest shown.

Appendix E

Confirmation of Feasibility – Irish Water

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Avril Hill
County Buildings
Station Road
Wicklow
A67FW9

22 October 2019

Dear Avril Hill,

Re: Connection Reference No CDS19007276 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 100 units at Burgage More, Blessington, Wicklow.

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Burgage More, Blessington, Wicklow.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the network(s), as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water network(s) can be facilitated.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

A. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services.

B. You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed and appropriate connection fee paid at a later date.

Water

A section of the existing 80mm water network adjacent to the site will have to be upsized to 150mm in order to facilitate the development. The specifics of the connection would be assessed at connection application stage. Irish Water does not currently have any plans to carry out the works required to provide the necessary upgrades. Should you wish to have such upgrade works progressed, Irish Water will require you to provide a contribution of a relevant portion of the costs for the required upgrades, please contact Irish Water to discuss this further.

Wastewater

In order to accommodate the proposed wastewater connection at the development, upgrade works are required to increase the capacity of the Blessington Wastewater Treatment Plant. Irish Water currently has a project on our current investment plan, which received planning permission in Q2 2019, which will provide the necessary upgrade and capacity. The proposed upgrade works will increase the capacity to accommodate 9,000 PE. This upgrade project is scheduled to be completed by Q4 2020 (this may be subject to change) and the proposed connection could be completed as soon as possibly practicable after this date.

Please note that it will be necessary to comply with Irish Water's wayleave and diversion requirements in relation to any assets located within the subject site. Any proposed infrastructure located on third party lands will require a wayleave in favour of Irish Water.

All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details. A design proposal for the water and/or wastewater infrastructure should be submitted to Irish Water for assessment. Prior to submitting your planning application, you are required to submit these detailed design proposals to Irish Water for review.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact Fionán Ginty from the design team on 01 89 25734 or email fginty@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix F

Hydrant Testing Results – SES Water Management

Hydrant Testing Report

Social Housing Bundle 3 Lot 1, Blessington, Co. Wicklow

Client:	RPS
Site Contact:	Desmond Keane
Project:	Hydrant Testing Social Housing Bundle 3 Lot 1, Blessington, Co. Wicklow
Engineer:	Conor Malone
Technician:	James Curran
Start/Finish of Survey	August 2021

Contents

1 Scope of Works

SES Water Management was requested by RPS Consulting Engineers to carryout flow and pressure testing on hydrants for the Social Housing Bundle 3 Lot 1 project location in Blessington, Co. Wicklow.

Pressure logging of the hydrants was carried out over a 7-day period. Flow testing was then carried out using a digital flow meter with static and residual pressures also being recorded.

2 Hydrant Specifications & Flow Requirements

2.1 Guidelines for Fire Flow Requirement

Housing Developments
Housing Developments with units of detached or semi-detached houses of not more than two floors should have a supply capable of delivering a minimum of 8 l/s (480 l/min) OR multi occupied developments with units of more than 2 floors should have a water supply capable of delivering a minimum of 20 to 35 l/s (1,200 to 2,100 Litres/minute).

Village Hall or the like
Should have a water supply capable of delivering 15 Litres per second (900 Litres/minute) through any single hydrant on the development.

Primary School and/or Single Story Health Centre or the like should have a water supply capable of delivering 20 Litres per second (1,200 Litres/minute) through any single hydrant on the development.

Secondary Schools, Colleges, Large Health & Community Facilities or the like
Should have a water supply capable of delivering 35 Litres per second (2,100 Litres/minute) through any single hydrant on the development.

Industry
Up to one hectare, facility should have 20 Litres per second (1,200 Litres/minute)
Between one and two hectares, facility should have 35 Litres per second (2,100 Litres/minute)

2.2 Key Aspects of Fire Hydrant Specification

SURFACE:
Hydrants should be located in the footpath or grass margin adjoining the roadway. Where it is located in the grass, the periphery of the box should be concreted.
The surface box and concrete surround should be kept over the level of the adjoining surface to prevent polluted water from entering the hydrant pit.

FRAME:
Hydrant chambers should have a cast iron surface box. The surface box should be bedded in mortar on the chamber walls, and if the hydrants are located other than on a footway or roadway, they should be surrounded by 150mm concrete of 100mm in depth.

COVER:
The hydrant cover should provide a 375mm x 225mm clear opening and should be placed centrally over the hydrant to permit freedom of affixing stand-pipe and valve key.

PIT:
The hydrant pit / chamber should provide not less than 75mm clearance around the hydrant body. Hydrant pits should be constructed to be self-draining. The pit should be clean and free of all debris.

OUTLET DEPTH:
The depth of the hydrant outlet should not exceed 350mm below finished ground level, with the top of the spindle being 75mm minimum to 225mm maximum below finished surface to footpath.

MARKER:
A hydrant indicator plate should be fitted on a wall or marker post at 450mm over ground level. They should show the diameter of the water main and the distance in metres of the hydrant from the marker.

TESTING:
Fire hydrants should be tested on an annual basis. The Fire Hydrant condition should be assessed to ensure it meets the required criteria. The flow and pressure should be recorded and reported in writing. Calibration certificates must be available for all test Equipment used.

3 Fire Hyrdant Condition Survery

There are 4 Hydrants on the school grounds and all were reviewed to assess that they meet the standards in accordance with the BS5360 / BS9990.

Appendix A provides full details of the condition survey which was completed on site.
The items below are the main findings of the fire hydrant condition survey;

- FH1 is missing the spindle
- FH1 & FH2 exceed the outlet depth specification but both hydrants are easily accessible
- FH1 & FH3 have no marker plates to help identify/locate the hydrants
- All 4 hydrants are bayonet LUG connections
- All frames, covers and pits are in good condition
- All hydrants were operable.

Figure 1: Condition Photos

4 Fire Hydrant Flow & Pressure Testing

4.1 7-Day Pressure Logging

Pressure loggers were deployed on the Fire Hydrants on 16th August 2021 to record pressure over a 7-day logging period. The graph below shows the pressure logging results which show the day night variation in pressure.

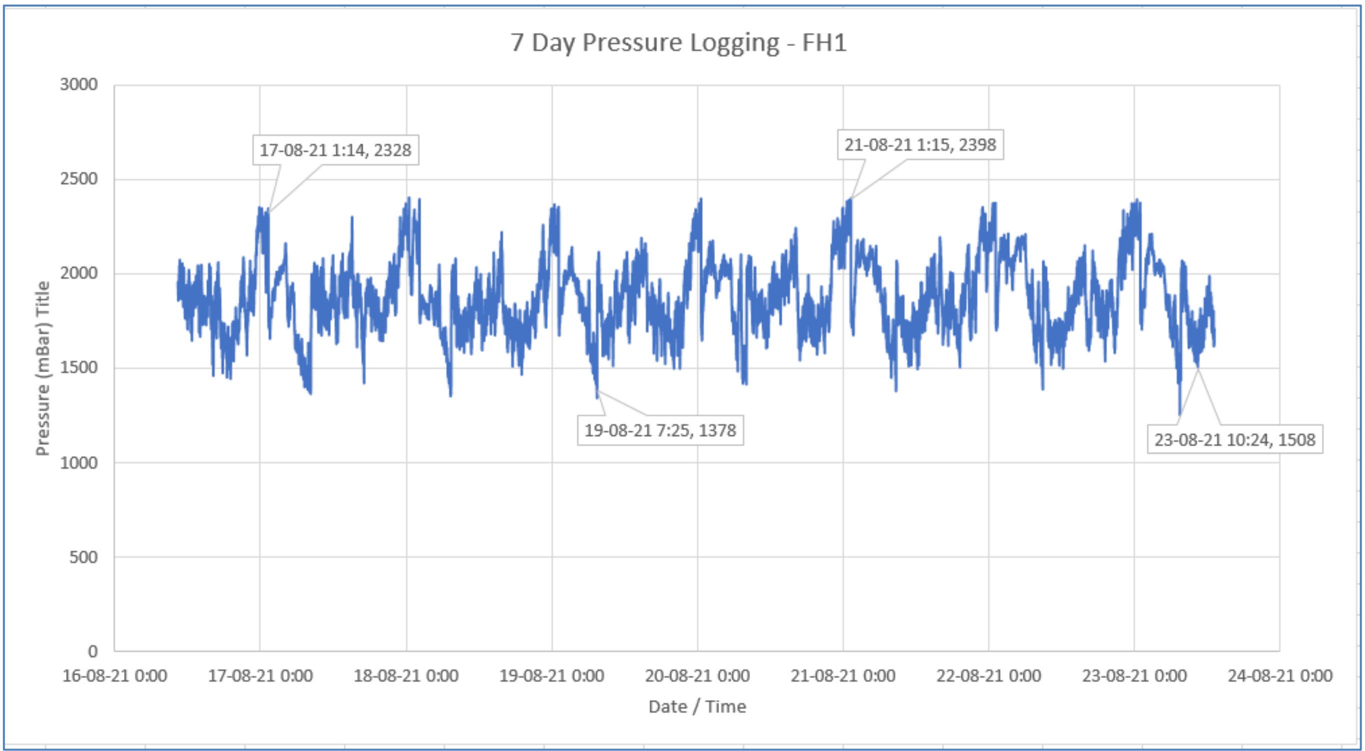


Figure 2: 7-Day Static Pressure Logging Results

Based on the downloaded pressure data, the static pressure varies from 1.3 bar at night to 2.4 bar during the day. For the purposes of hydrant testing, the time/duration of the minimum static pressure is between 07:30hrs to 18:00hrs.

4.2 Fire Hydrant Flow & Pressure Testing

Flow testing includes measuring the static pressure at the test hydrant before the flow testing is carried out. A digital hydrant flow meter is then connected to the hydrant to record flow rates in litres per minute over a 5-minute period. The flow rates detailed below, is the average maximum sustainable flow based on the 5-minute flow test.

Flow testing was carried out on 23rd August 2021 at 10:10am and the results are detailed below.

FH No.	Flow Rate L/Min	Static Pressure (bar)	Residual Pressure (bar)
FH1	862	2.0	1.1 At FH2

Table 1: Fire Hydrant Flow & Pressure Test Results

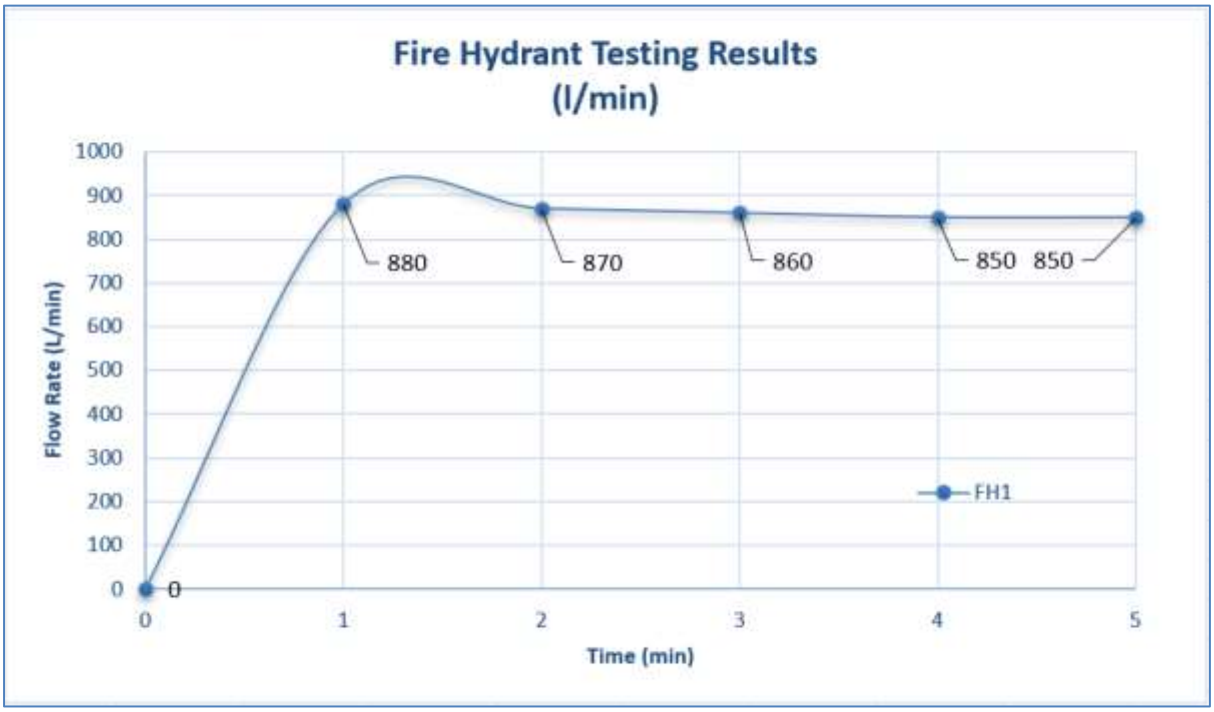


Figure 1: Fire Hydrant Flow Test Results

As can be seen from the results the hydrants have a flow rate from 880 l/min to 850 l/min.

5 Fire Hydrant Location Plan

Appendices

Appendix A - Fire Hydrant Condition Survey

FH No.	Surface	Cover/ Frame	Pit	Type	Depth (mm)	Marker/ Plate	Canary Yellow	Spindle	Operating	Comment
1	Road	Good	Poor	LRT	150	No	No	Good	Yes	
2	Concrete	Good	Poor	Lugs	500	Yes	No	Good	Yes	

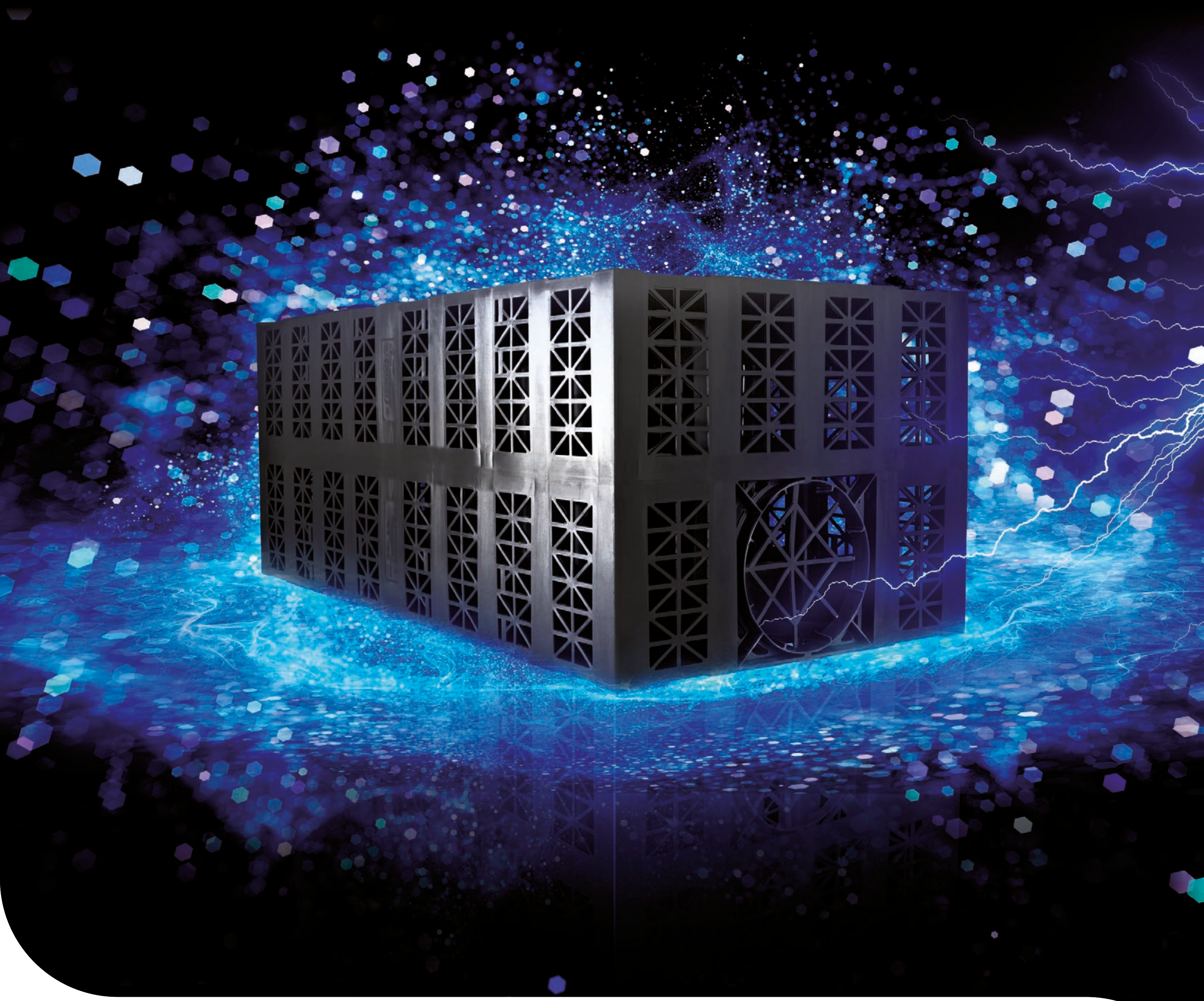
Appendix G

Aquacell – Cellular Storage System

WATER MANAGEMENT

AquaCell systems

Product and installation manual



Introduction to SuDS

Continuing urban development, a changing climate and the consequences of increased rainfall are all increasingly prominent issues on the political and environmental agenda and all drive the need to actively manage excessive rainfall across new and existing developments through the use of Sustainable Drainage Systems (SuDS).
Designed correctly drainage systems can assist in delivering sustainable development whilst improving the spaces where we live, work and play.
The SuDS approach to managing water takes account not just of how water quantity is managed but also considers how improvements to water quality can be delivered as well as the creation of habitats promoting biodiversity and amenity for the community.
Good SuDS aim to mimic nature and manage rainfall close to where it falls. They are designed to move and attenuate water within the development before it is released into water courses. Water is stored within the development where is allowed to infiltrate into the ground or is released at a controlled rate to prevent issues downstream.
The CIRIA SuDS Manual gives guidance on all areas of SuDS and focuses on the cost-effective planning, design, construction, operation and maintenance of SuDS.

Which SuDS components are best?

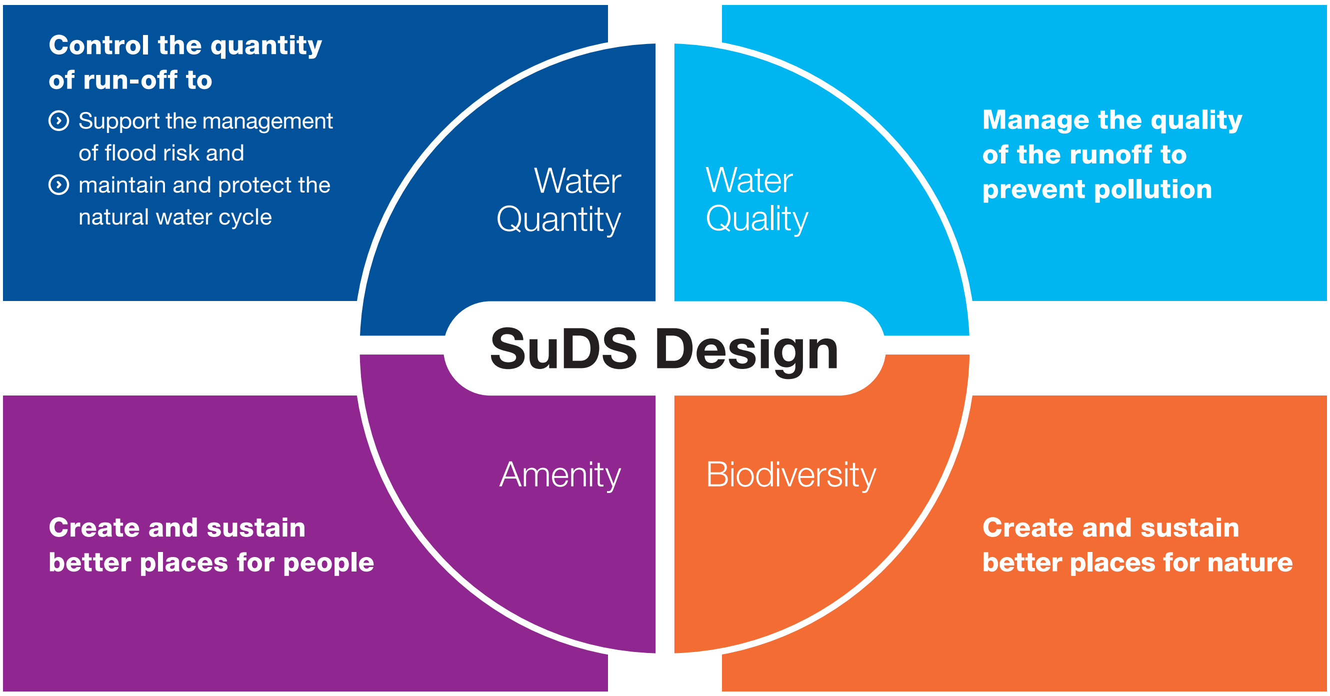
SuDS should help maximise amenity and biodiversity, whilst also delivering key objectives to manage flood risk and water quality For any given site, SuDS should be considered as sequence of components designed to efficiently drain surface water whilst minimising pollution.
Selection of which SuDS components is best for each development is dependent on the site specific requirements.

How can Wavin help with SuDS projects?

Wavin is well qualified to advise on how to comply with current and emerging regulation. We can aid specifiers, developers and contractors in responding to legislative demands as they pertain to flooding, sewage, urban drainage and sustainable resources use.
In particular, the proven qualities and performance of AquaCell systems not only support the achievement of SuDS, they can also help reinforce and enhance planning applications and enable development to proceed.

CIRIA SuDS Design

Source: The SuDS Manual (CIRIA)



Keeping you on top of legislation

Flood and Water Management Act 2010

The Flood and Water Management Act was designed to reduce the risk of flooding and its consequences by providing for better, more comprehensive and co-ordinated water management, embracing groundwater, surface water and coastal erosion risk. Schedule 3 of the act gives DEFRA responsibility for establishing national standards for sustainable drainage and empowers local authorities to manage local flood risk by adopting and maintaining sustainable drainage schemes. In January 2019 Schedule 3 was implemented by the Welsh Government. This legislation effectively makes the use of SuDS mandatory on new developments with the aim of reducing flood risk and improving water quality. The new standards for Wales support the 'four pillars' of SuDS.

Sewers for Adoption

In England the framework for the delivery of SuDS in the absence of Schedule 3 is through a revision to Sewers for Adoption to include some SuDS components as adoptable by the Water and Sewage Companies. The document, currently with Ofwat for approval, is expected to be introduced early 2020. When it comes into force it will be the only guide to the standards that sewers must meet if they are to be adoptable by WaSCs in England. The new document will, for the first time, offer guidance on SuDS components (although not all) that can be adopted by Water and Sewerage Companies with standards on the flood risk performance that is expected.

The Water Environment and Water Services (WEWS) (Scotland) Act 2003

In Scotland WEWS makes Scottish Water responsible for SuDS that deal with the run-off from roofs and any paved ground surface within the property boundary. In order to deliver this SuDS need to be designed to Scottish Water's specifications as set out in their manual, Sewers for Scotland v4.0. In addition, the law makes the use of SuDS obligatory when dealing with surface water drainage from all new developments.

The EU Water Framework Directive

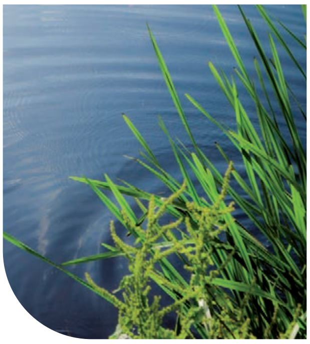
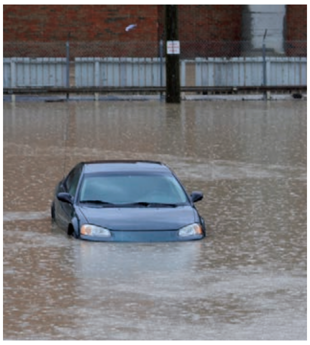
Nearly half the EU population lives in 'water-stressed' countries, caused by high extraction from freshwater sources, and demand is growing all the time. The EU Water Framework Directive introduces a new legislative approach designed to better manage and protect water resources, based not on national orpolitical boundaries but on the natural catchment of river basins.

Building Regulation Part H (Drainage and Waste Disposal)

Building Regulation Part H embraces the guidelines for drainage and waste disposal that must be met in the UK. Although Part H extends to rainwater drainage and solid waste storage, waste drainage issues are to the fore. The Building Regulations are designed to ensure that all foul water is properly disposed of to maintain a decent level of sanitation, promoting both personal and environmental health. The regulations also highlight the importance of pollution prevention, working sewage infrastructure and sewage maintenance. With regards to stormwater, Building Regulations Approved Document H3 stipulates that adequate provision should be made for rainwater to be carried from the roof of a building to either a soakaway, water course or sewer.

National Planning Policy Framework

Section 14 of the National Planning Policy Framework sets out policy to ensure that flood risk is taken into account at all stages of the planning process and that inappropriate development in areas at risk of flooding is avoided. The policy directs development away from areas of highest risk and where new development is, exceptionally necessary in such areas, aims to make it safe without creating an increase in flood risk elsewhere and, where possible, reduce flood risk overall. It also states developments should only be allowed in an area of flood risk if it incorporates sustainable drainage systems, unless there is clear evidence that these would be inappropriate.

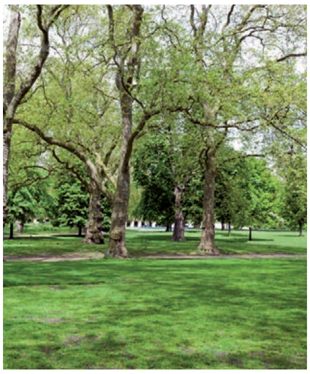



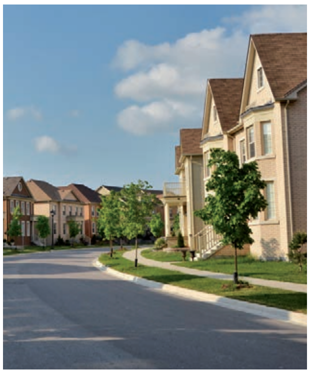
Overview

The AquaCell range of geocellular systems are a fully tried and tested, BBA approved, modular technique for managing excessive rainfall.

Applications

The AquaCell range can be used as either a temporary storage tank or as a soakaway, and is suitable for applications including:
- Landscaped areas
- Parks
- Domestic gardens
- Residential developments
- Car parks & roads
- Industrial/commercial areas



The AquaCell range

There are three types of AquaCell unit. Each can be used as a standalone system or different unit types can be mixed and matched together in layers to value engineer the most cost effective solution.

All AquaCell units have identical dimensions (1m x 0.5m x 0.4m), but they are manufactured to perform differently. The type of unit, or combination of units required will depend on factors such as the load application, overall installation depth and site conditions.

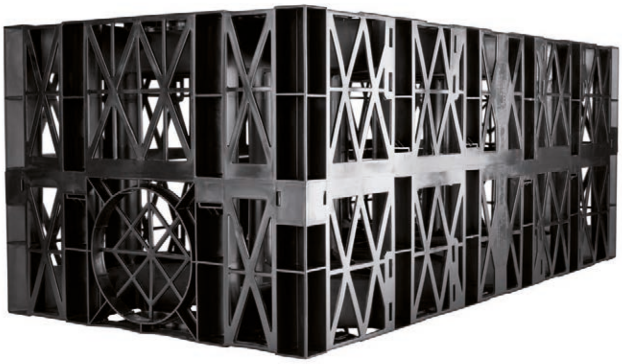
Features and benefits

The following are applicable to all AquaCell units:
- BBA Approved – certificate No. 03/4018
- Modular, lightweight and versatile
- Easy to handle and quick to install
- Proven clip and peg connection system
- 95% void (each unit holds 190 litres of water)
- Can be brick-bonded for extra stability
- Units can be mixed and matched together for optimum performance
- Full range of ancillaries
- Can be used as integral part of a SuDS scheme

Environmental benefits

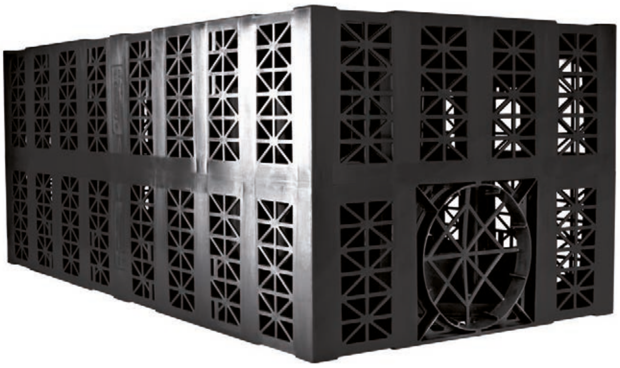
In addition, the AquaCell range can also offer the following environmental benefits:
- Reduced flooding risk
- Controlled release of stormwater into watercourses or, where permitted, existing sewer systems
- Recharging of local groundwater (if infiltration/soakaway application)
- Aerobic purification to improve water run-off quality
- Sustainable, cost effective management of the water environment

Eco



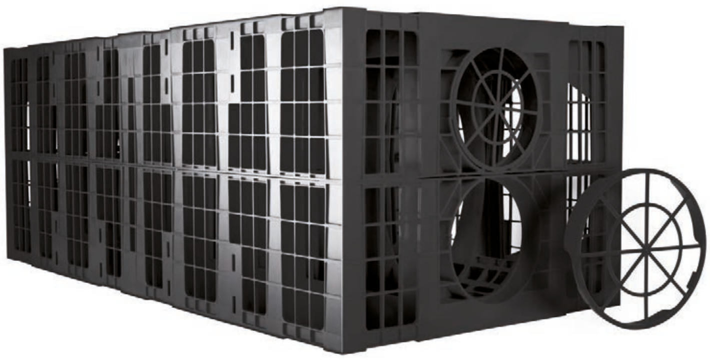
Eco is manufactured from specially reformulated, recycled material and has been designed for shallow, non-trafficked, landscape applications.

Core-R



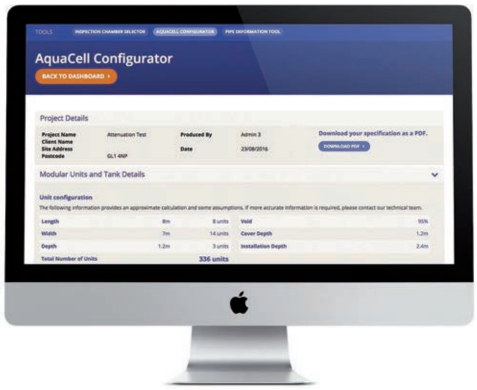
Core-R has been designed for use in deep applications, subject to both regular and heavy traffic loadings, such as cars and HGV's.

Plus-R



Plus-R has been designed primarily for use in applications where inspectability is required, and is suitable for use in all applications from landscaped areas to heavily trafficked areas including HGV.

AquaCell Configurator Tool



Optimise tank and soakaway designs with the AquaCell Configurator Tool

The AquaCell Configurator tool aids and speeds the efficient design of stormwater tank or soakaway solutions. The tool guides users through a step-by-step specification process and, based on responses, will recommend the optimum design, based on the loadings, depths and site conditions of each project.

The tool generates a PDF of the design for easy download and can store the data online for future reference. To start using the tool or to learn more visit: **myportal.wavin.co.uk/tools**

AquaCell Eco

Application

AquaCell Eco is manufactured from specially reformulated, recycled material and has been specifically designed for shallow, non-trafficked, landscaped applications. AquaCell Eco is **NOT** suitable for locations subject to high water tables.

AquaCell Eco is typically suitable for installations to a maximum depth of 2.68 metres, to the base of the units from ground level, with a minimum cover depth of 0.3 metres, (CIRIA's recommendation, is to allow a cover depth of 0.5 metres in applications where a ride on mower may be used).

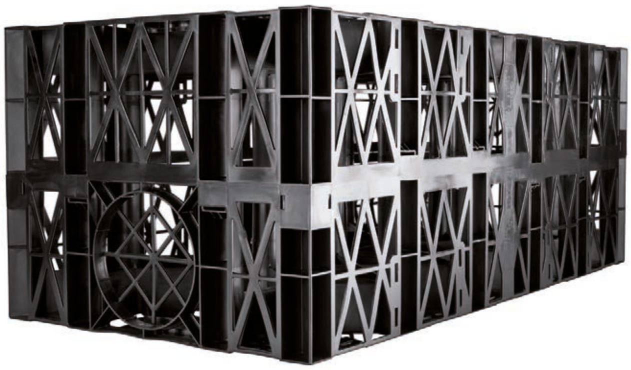
Any installation using AquaCell Eco must **NOT** be subjected to additional loading at any time. Trafficking by construction plant on site, including mechanical equipment, must be avoided.

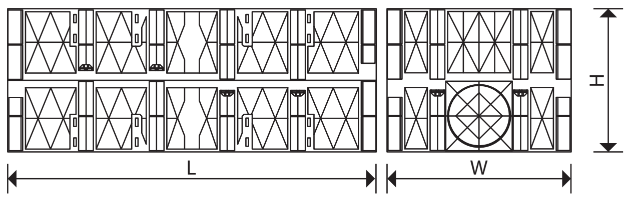
If trafficking of the buried tank by construction plant or, other vehicles is unavoidable, the installation should be constructed using AquaCell Core-R units (see page 9).

The width of an AquaCell Eco installation should not exceed 12 metres to allow for mechanical backfilling without loading. There is no limit to the length of the installation.

Features and benefits

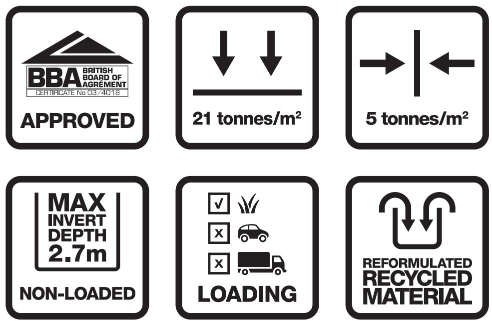
- Manufactured from specially reformulated, recycled material
- Suitable for both soakaway and attenuation applications
- Proven vertical loading capacity of: 21.3 tonnes/m² (213kN/m²)
- Proven lateral loading capacity of: 5.2 tonnes/m² (52kN/m²)
- Integral "hand holds" for ease of carrying/handling
- BBA approved – Certificate No 03/4018





Material: Reformulated polypropylene

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB025	500	400	1000



Maximum installation depths – to base of units (m)[1]

Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas
Over-consolidated stiff clay	20	24	1.53
Silty sandy clay	19	26	1.68
Loose sand and gravel	18	30	2.08
Medium dense sand and gravel	19	34	2.35
Dense sand and gravel	20	38	2.68

(1) These values relate to installations where the groundwater is a minimum of one metre below the base of the excavation.
(2) AquaCell Eco units should not be used where groundwater is present.
(3) 0.5m cover is required where a ride-on mower may be used.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

Source: BBA

AquaCell Core-R

Application

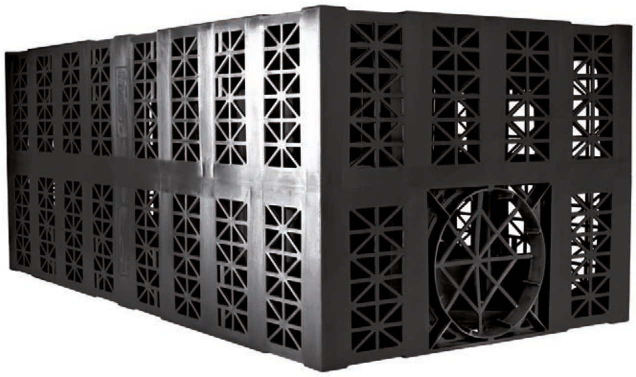
AquaCell Core-R has been designed for use in deep applications, subject to regular and heavy traffic loadings, e.g. cars and HGV's. AquaCell Core-R can also be used for deep soakaways and landscaped applications.

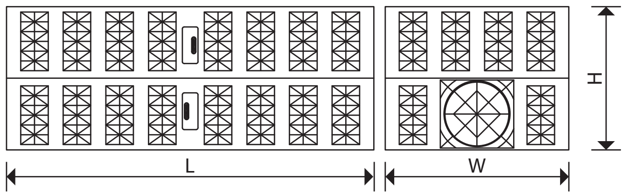
Typically for use down to depths of 6.68m in landscaped areas (6.43m trafficked by cars) to the base of the units from ground level, in best soil conditions.

Trafficking by heavy construction plant on site, including mechanical equipment, must be avoided until the minimum cover depth of 1.11 metres is in place.

Features and benefits

- Suitable for regular and heavy traffic loadings
- Proven vertical loading capacity of: 66.9 tonnes/m² (669 kN/m²)
- Proven lateral loading capacity of: 12.3 tonnes/m² (123kN/m²)
- BBA approved – Certificate No 03/4018
- Ideal for all types of shallow and deep projects including major attenuation and infiltration schemes





Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB150	500	400	1000

Maximum installation depths – to base of units (m)[1]

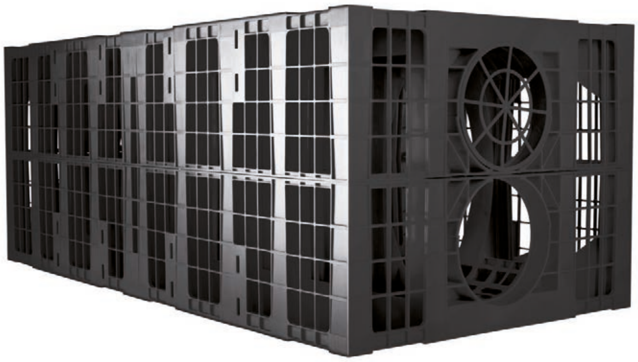
Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas	Vehicle mass <9 tonnes[4, 5]	Vehicle mass <44 tonnes
Over-consolidated stiff clay	20	24	3.85	3.61	3.36
Silty sandy clay	19	26	4.35	4.09	3.83
Loose sand and gravel	18	30	5.34	5.06	4.78
Medium dense sand and gravel	19	34	5.94	5.68	5.41
Dense sand and gravel	20	38	6.68	6.43	6.18

(1) Without groundwater present below base of units – AquaCell Core-R may be used where groundwater is present, contact Wavin for technical advice.
(2) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of φ.
(3) The design is very sensitive to small changes in the assumed value of φ, therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
(4) Applicable for car parks or other areas trafficked only by cars or occasional refuse collection trucks or similar vehicles (typically one per week).
(5) This category should be used when considering landscaped areas that may be trafficked by ride on mowers.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

Source: BBA

AquaCell Plus-R

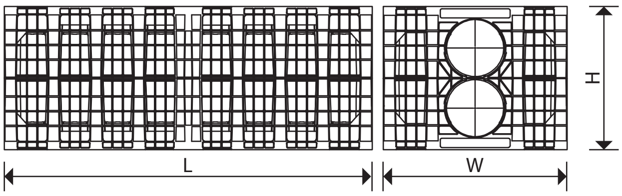


Application

AquaCell Plus-R has been designed primarily for use in applications where inspection is required. It is suitable for use in all applications from landscaped areas to heavily trafficked areas (for vehicles up to 44 tonnes). The units can be used in combination with AquaCell Core-R (and Eco if there is at least one layer of Core-R in between the Plus-R and Eco layer).

Extra lateral loading capacity allows installation at greater depths. Integral inspection channels in each unit combine to create viewing channels for the full length of the installed structure.

Typically for use down to depths of 7.82m in landscaped areas (7.57m trafficked by cars and 7.3m trafficked by HGV's) to the base of the units from ground level, in best soil conditions. Trafficking by heavy construction plant on site, including mechanical equipment, must be avoided until the minimum cover depth of 1.30 metres is in place.

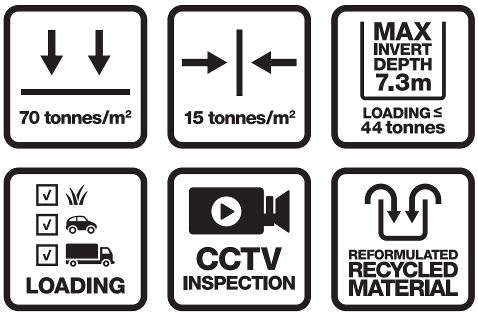


Material: Polypropylene

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB200	500	400	1000

Features and benefits

- Suitable for extra deep installations
- Inspectable (supplied with end cap for use when an inspection channel is not required)
- Proven vertical loading capacity of: 70.2 tonnes/m² (702 kN/m²)
- Proven lateral loading capacity of: 15.1 tonnes/m² (151 kN/m²)



Maximum installation depths – to base of units (m)[1]

Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas	Vehicle mass <9 tonnes[4, 5]	Vehicle mass <44 tonnes
Over-consolidated stiff clay	20	24	4.67	4.42	4.17
Silty sandy clay	19	26	5.03	4.78	4.53
Loose sand and gravel	18	30	5.86	5.61	5.36
Medium dense sand and gravel	19	34	6.87	6.62	6.37
Dense sand and gravel	20	38	7.82	7.57	7.30

(1) Without groundwater present below base of units – AquaCell Plus-R may be used where groundwater is present, contact Wavin for technical advice.
(2) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of φ.
(3) The design is very sensitive to small changes in the assumed value of φ, therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
(4) Applicable for car parks or other areas trafficked only by cars or occasional refuse collection trucks or similar vehicles (typically one per week).
(5) This category should be used when considering landscaped areas that may be trafficked by ride on mowers.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

AquaCell Plus-R: for inspectability

By aligning AquaCell Plus-R units end-to-end, full length viewing channels can be created – allowing for CCTV inspection if required. These are created in the bottom layer of an AquaCell tank installation.

The units can be used in combination with AquaCell Core-R (and with Eco if there is at least one layer of AquaCell Core-R in between the Plus-R and Eco layer).

NOTE: For any AquaCell Plus-R units on the perimeter of a structure that are NOT required for inspection access, the open ends of the integral inspection tunnels should be fitted with the end caps provided.

Inspection chambers

An inspection chamber should precede the inlet pipework for the AquaCell structure.

A silt trap or hydro-dynamic separator prior to the inspection chamber is also recommended.

For on-line installations the following Chambers are recommended:
— Down to 3m Wavin Non-Entry Inspection Chambers
— Down to 5m Wavin Range 600 Inspection Chambers, or a traditional manhole*

**where inlet pipework is replaced by AquaCell units acting as flow conduit.*

For off-line installations:
— Manhole with in-built flow control

Recommendation: If installing any Wavin Non-Entry Inspection Chamber, deeper than 1.2 metres, ensure that the cover and frame includes a 350mm restrictor to prevent man entry.

Inspection and maintenance

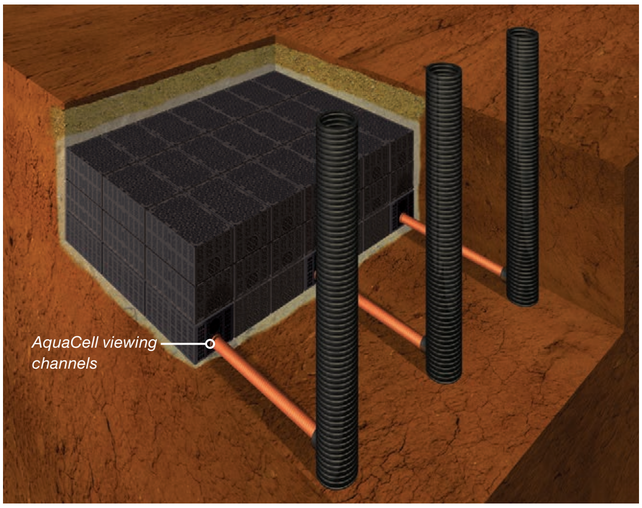
CCTV inspection at every inspection point is recommended:
— after every major storm
— at regular intervals according to the specific maintenance plan for the site

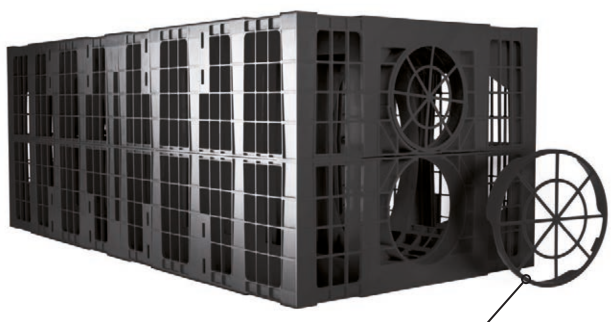
Silt traps prior to inlet pipework should be routinely inspected and cleaned out to minimise debris reaching the tank.
It is important to prevent construction silt from entering the AquaCell structure.

Inspectability scenarios

AquaCell Plus-R viewing channel

Trafficked tank installation with inspection chambers





End cap for when an inspection channel is not required

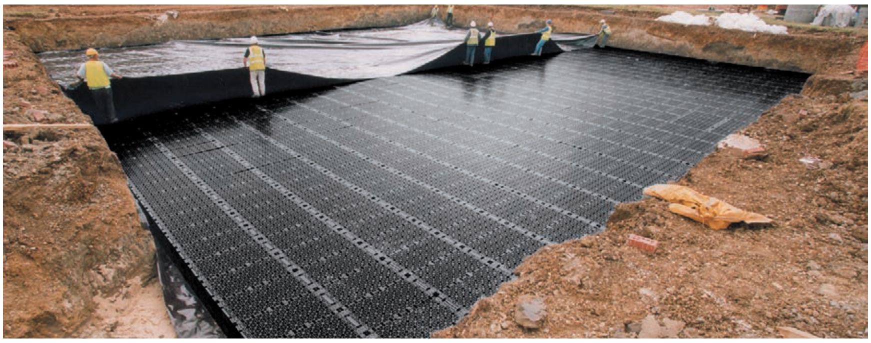
Design guidance

Infiltration or attenuation?

The AquaCell range can be used either as:

- A soakaway whereby the units will be installed in suitable pervious soils so the units can be wrapped in a geotextile to allow infiltration of the stormwater into the surrounding ground, or
- As an attenuation tank in impervious ground (e.g. clay) where infiltration is not possible, here the units are encapsulated in a geomembrane (which is in turn wrapped in a protective geotextile layer) so that the structure can hold the stormwater temporarily until local drainage flows can accept it for normal disposal at a permissible outflow rate.

Large scale AquaCell Core-R storage tank



Domestic AquaCell Core-R soakaway

Site assessment

Ground conditions may be established as part of a geotechnical assessment. This may include tests for infiltration and ground water level.

If there is no confirmation that such assessments have been conducted, or resulting conclusions are unavailable, a trial pit will be required in accordance with BRE 365.

For further information and guidance, please contact the Wavin Technical Design Team.

Infiltration (soakaways)

According to the principals of SuDS, wherever possible stormwater should be drained back into the ground via a soakaway as the first priority. A site must meet BOTH of the following criteria for infiltration to be possible:

- The underlying soil surrounding the proposed installation is sufficiently permeable
- The seasonally high water table is a minimum of 1 metre below the base of the proposed installation

If either of these criteria is not met, or cannot be confirmed for any reason, a soakaway system may not be suitable for the application, in which case a storage tank must be used.

Attenuation (storage tanks)

A storage tank may be designed to be online or offline (see pages 26-31 for typical details). However, if the site is subject to groundwater or a high water table, it is important to ensure that the tank is not vulnerable to flotation. Sufficient weight from soil, or other covering placed over the AquaCell units, must be sufficient to counter any buoyancy uplift force from the rising groundwater level.

Important design considerations for geocellular structures

Rising rainfall levels and increased focus on SuDS compliance, have led to an increase in the use of modular units to create underground structures for infiltration or the temporary storage of stormwater.

However, not all currently available systems have the proven performance characteristics necessary to meet the wide range of complex underground geocellular applications.

The Wavin range of AquaCell units provide assured performance, since all strength and hydraulic capabilities have been verified by independent testing and all units are fully BBA approved.

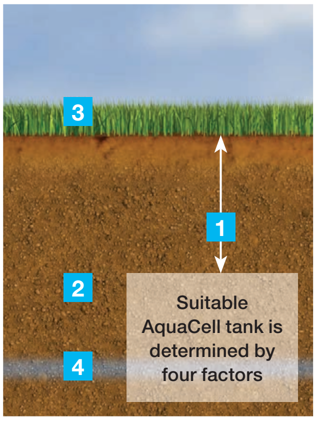
To guarantee the structural integrity of an engineered drainage system, any underground structure must be strong enough to support the loads to which it will be subjected without any unacceptable deflection.

The correct choice of geocellular unit must have appropriate proven top (vertical) and side (lateral) load bearing capacity and deflection characteristics to suit site conditions.

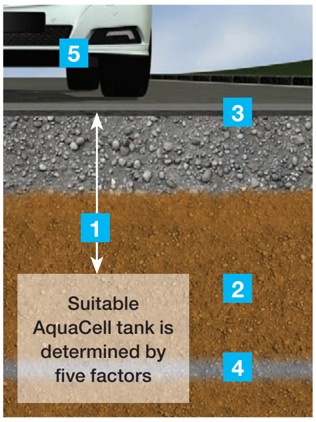
The five key site considerations to be noted when designing a geocellular structure are:

1. Depth of cover (See page 14)
2. Soil type
3. Surface finishing
4. Presence of groundwater
5. Type of traffic/loading

A: Non-trafficked



B: Trafficked



The combination of these 5 factors effectively means that the required characteristics of a geocellular structure to be installed under a trafficked location (for example) will be very different from that under a landscaped/low-loaded location.

Two typical examples are given below.

Example A: Landscaped/non-trafficked location and 0.3m cover depth. Typically requires minimum vertical strength of 17.5 tonnes/m²

Example B: Car park with occasional light delivery traffic and between 0.5 – 0.7m cover depth. Typically requires minimum vertical strength of 40 tonnes/m²

Design guidance

Hydraulic design

All AquaCell units have identical dimensions: 1m x 0.4m x 0.5m, have a nominal void ratio of 95% and each holds 190 litres of water. Hydraulic calculations are accordingly the same for AquaCell Eco, Core-R and Plus-R.

Structural design however, requires careful consideration of loading factors specific to each location – see CIRIA C680 or CIRIA C737 for further guidance (we recommend using the BPF Guide Designing Geocellular Drainage Systems to CIRIA Report C737 alongside.)

Structural design – installation and cover depths

Each AquaCell unit has been designed to have specific loading capacities (see pages 8-10) that define the maximum depth parameters for which they are suitable.

Minimum depth of cover varies according to whether or not the installation will be subject to trafficking by cars/HGVs.

However, in some situations, installations may have to be located with greater cover depths. Reasons may include:

- Deep-running drainage network
- Other buried services running above tank location
- Installation into banked/ sloping ground
- Upper layer of clay preventing infiltration

The table shows a summary of typical cover depths and installation depths as a guide.

Typical minimum cover depths and maximum installation depths

Location type	Minimum cover depths (m)		
	AquaCell Eco	**AquaCell Core-R**	**AquaCell Plus-R**
Landscaped/non-trafficked areas[2]	0.30	0.30	0.30
Car parks, vehicle mass up to 9 tonnes[1]	n/a	0.60	0.69
HA/HGV loading up to 60 tonnes	n/a	1.11	1.30
	Maximum installation depths (m)[3]		
Maximum depth to base of unit (Landscaped)	2.68	6.68	7.82
Maximum depth to base of unit – vehicle mass up to 9 tonnes	n/a	6.43	7.57
Maximum depth to base of unit – vehicle mass up to 44 tonnes	n/a	6.18	7.30

(1) For specific advice on cover depths for heavier loadings/HGV applications, contact Wavin Technical Design on 0844 856 5165.

(2) 0.30m is minimum depth for AquaCell in landscaped applications. 0.5m cover is recommended in applications where ride-on mowers may be used. If construction plant is to be used on site, extra protection may be needed.

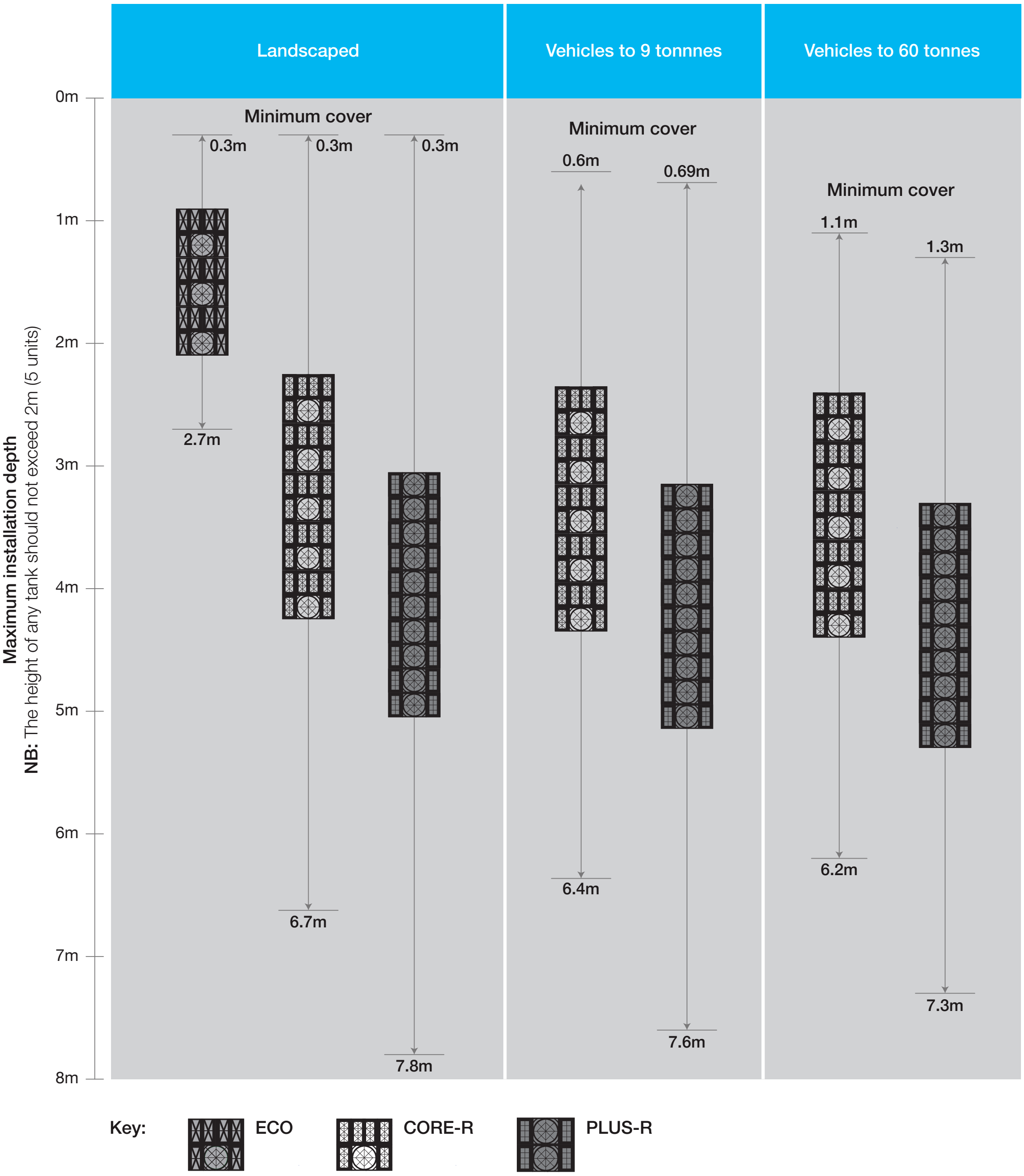
(3) Allowable maximum depth to base of bottom layer of units is dependent on soil type, angle of shearing resistance, loadings, and groundwater level. The above depths are based on 38° angle of shearing resistance and no groundwater.

In trafficked applications it is recommended that the height of any tank should not exceed 2m (5 units). If you require a tank that exceeds this, please contact Wavin Technical Design for guidance:

T: 0844 856 5165 E: technical.design@wavin.co.uk

Minimum cover and maximum installation depths to base of units from ground level, in best soil conditions

This chart shows how deep each unit can be used for different applications in best soil conditions.



Note: The AquaCell units can also be used in combination with each other, see page 16 for details.

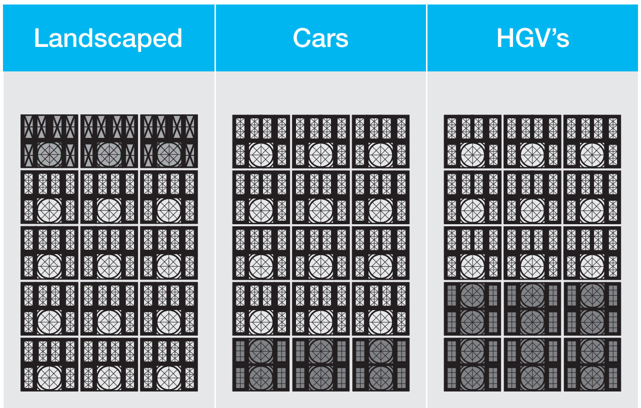
Design guidance

Mix and match

Although all AquaCell units have identical dimensions, and a high nominal void ratio of 95%, they are manufactured to perform at a range of depths, dependent on soil type, angle of shearing resistance, loading and ground water levels. For optimum performance the units can be mixed and matched (in layers) to value engineer the most effective design (in cost and performance terms) for each installation. For example, in a landscaped application if you needed to install a tank or soakaway that is deeper than 2.7m, you could install layers of AquaCell Core-R underneath the AquaCell Eco. See below illustrations showing examples of how the AquaCell units can be mix and matched together. For advice on how to optimise a tank or soakaway design using more than one type of AquaCell please contact Wavin Technical Design.

Note: AquaCell Eco cannot be used directly with AquaCell Plus-R therefore there must be a layer of AquaCell Core-R between them.

Typical examples of mix and match with AquaCell



Key: ECO CORE-R PLUS-R

Brick bonding – for extra stability

When assembling a geocellular structure that comprises two or more layers, it is recommended that AquaCell units are placed in a 'brick-bonded' configuration for extra stability.

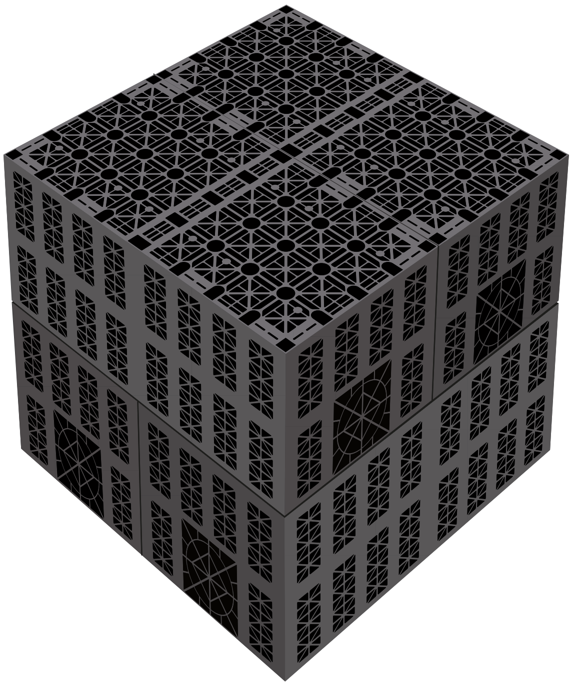
This helps minimise continuous vertical joints in the assembly, and gives the structure extra stability.

A significant advantage of AquaCell unit design is that brick bonding placement does not require extra connectors.

All three AquaCell units may be placed in this way, unless inspection channels and cleaning access are required using AquaCell Plus-R.

AquaCell Plus-R units incorporate integral inspection channels. These are designed for combined alignment to create viewing tunnels at the base of an assembled structure (see page 11).

Example of AquaCell being brick bonded



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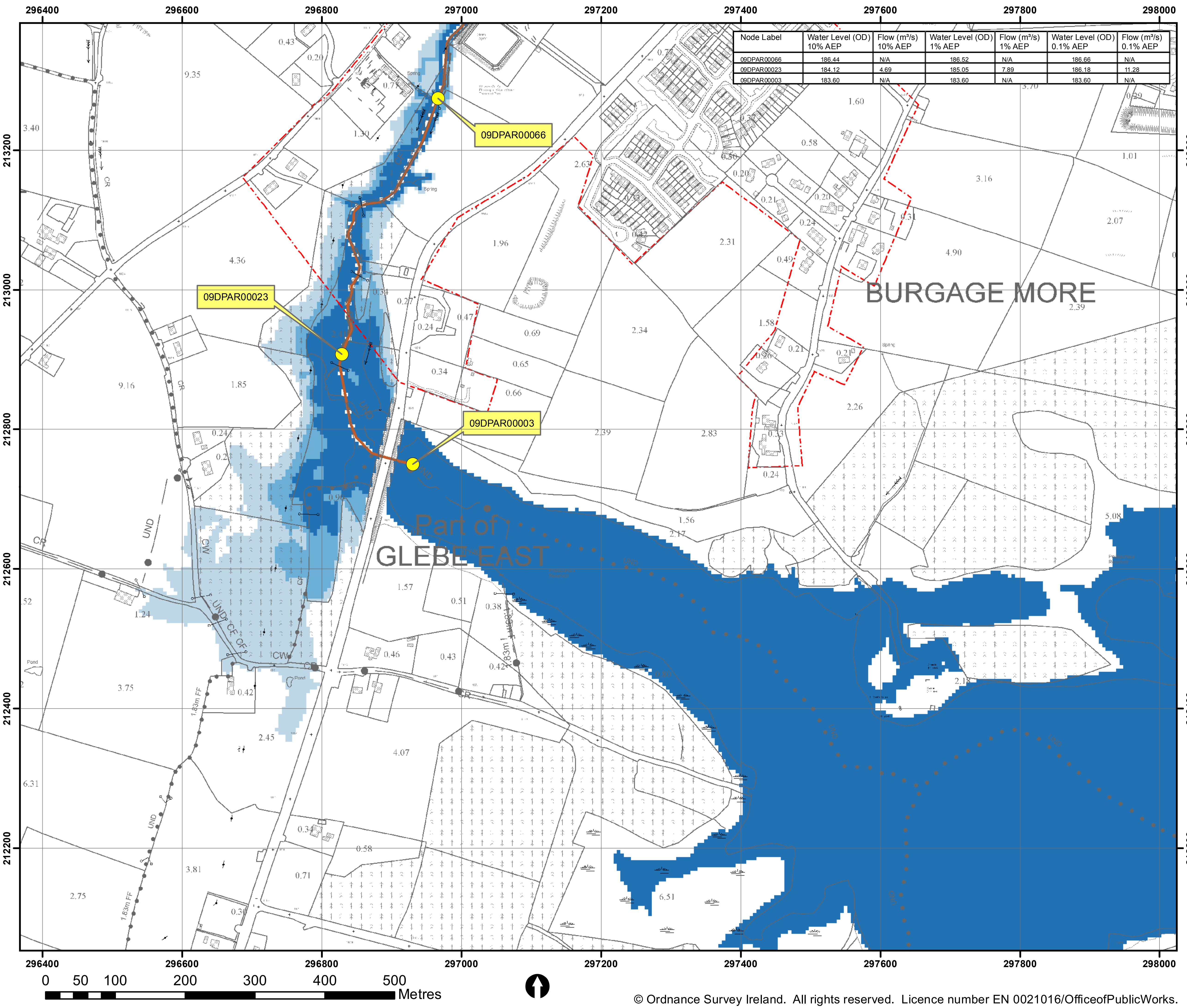
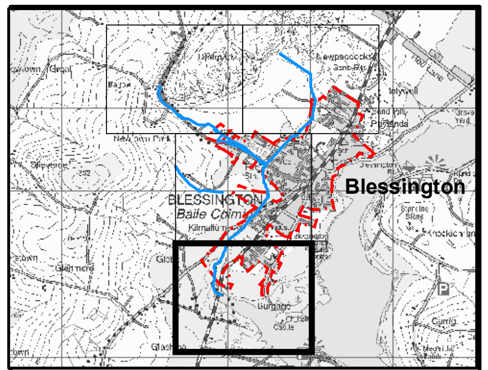
WM424 - January 2020

Appendix H

CFRAM Mapping

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09DPAR00066	186.44	N/A	186.52	N/A	186.66	N/A
09DPAR00023	184.12	4.69	185.05	7.89	186.18	11.28
09DPAR00003	183.60	N/A	183.60	N/A	183.60	N/A





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

Legend

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

FINAL

REV:	NOTE:	DATE:

EASTERN CFRAM STUDY
CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT

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Map:
Blessington Fluvial Flood Extent Maps

Map Type: EXTENT
Source: FLUVIAL
Map Area: HPW
Scenario: CURRENT
Drawn By : F.M.C. **Date :** 26 July 2016
Checked By : T.D. **Date :** 26 July 2016
Approved By : S.P. **Date :** 26 July 2016
Drawing No. :
E09BLE_EXFCD_F0_03
Map Series : 3 of 4
Drawing Scale : 1:5,000 @A3