REPORT

Civil Engineering Report for Residential Development at Harpurs Lane (Phase 2), Portlaoise, Co. Laois

September 2026

CONTENTS

1. INTRODUCTION 3
2. SURFACE WATER DRAINAGE 3
3. FOUL DRAINAGE..12
4. WATER SUPPLY...13
5. ROAD DESIGN...13
6. FLOOD RISK 14

Appendix A – Surface Water Calculations
Appendix B – Wastewater Calculations
Appendix C – Product Information
Appendix D – Confirmation of Feasibility

Description of change	Originator	Rev	Approval	Date
Initial Release	PC	0	PC	14/09/2026

1. INTRODUCTION

This report has been prepared to describe the proposed water and drainage services for the Phase 2 development of 44 no. residential units Harpur's Lane, Portlaoise, Co. Laois.

The proposed development consists of: (i) 8 no. house units, comprised of: 4 no. 3-Bed 2-storey end-terrace houses and 4 no. 2-bed 2-storey mid-terrace houses; (ii) 2 No. 3-storey apartment blocks comprising of 24 no. 2-bed own-door apartment units and 12 no. 1-bed own-door apartment units; (iii) continuation of existing access route from the adjoining residential development (namely Harpurs Crescent); (iv) 1 no. new pedestrian access point from the Knockmay Road and 1 no. new pedestrian access point from Harpurs Lane; (v) new foul sewer, storm water drainage, and water mains connection to existing public services; (vi) landscaping and boundary treatments; (vii) car parking and bicycle parking; (viii) public lighting; and (ix) all other associated site works.

This report should be read in conjunction with the engineering drawings along with all other elements of the Phase 2 planning package.

2. SURFACE WATER DRAINAGE

2.1. Surface Water Summary

The proposed surface water drainage and attenuation system has been designed to accommodate runoff generated by the proposed Phase 2 development, together with the existing Phase 1 development at Harpur's Lane, Portlaoise, which was previously granted planning permission under Planning Reference 19/580.

Due to the existing site topography and the availability of suitable green space within the development, a surface water attenuation system is proposed at the north-eastern corner of the Phase 2 development. The attenuation system will accommodate surface water runoff generated by Phase 2, together with the previously attenuated discharge from Phase 1.

Surface water runoff from Phase 1 is currently attenuated to a maximum discharge rate of 2.0 l/s. The proposed system will incorporate this flow with the attenuated runoff from Phase 2 prior to discharge to the existing surface water drainage network at the north-eastern corner of the development.

The combined discharge from both Phase 1 and Phase 2 will be restricted to the calculated overall greenfield runoff rate of 5.3 l/s prior to discharge to the existing surface water network.

2.2. Sustainable Urban Drainage System

SUDS addresses the water quality, water quantity, amenity and biodiversity by the management of surface water run off in a sequence of treatment processes along the drainage infrastructure network. Along with the nature based solutions described above the following SUDS features are included in the proposed development:

- Bioretention systems
- Tree pits
- Permeable paving
- Catchpit manhole
- Bypass interceptor
- Hydrobrake limiting flow to Qbar greenfield rates

- Attenuation tank

2.2.1. Bioretention Systems

Bioretention systems are proposed to be installed throughout the development at locations highlighted on the Storm and Foul Layout drawing C-1.02 enclosed. Bioretention systems are shallow, vegetated drainage features designed to receive and treat surface water runoff from roads, footpaths, and paved areas. Runoff is filtered through engineered soil and vegetation, which removes suspended solids and pollutants before infiltrating to ground or discharging to the surface water network. These systems provide flow attenuation, improve water quality, enhance local biodiversity, and integrate effectively within the public realm. Details of the biodiversity systems to be installed are shown on drawing C-2.01.

2.2.2. Tree Pits

Tree pits are proposed to be installed throughout the development at locations highlighted on the Storm and Foul Layout drawing C-1.02 enclosed. Tree pits are engineered planting zones that incorporate structural soils and subsurface storage to manage surface water runoff in addition to supporting tree growth. Runoff is directed into the tree pit, where it is temporarily stored, filtered through the soil profile, and either infiltrated to ground or discharged in a controlled manner. Tree pits provide both drainage and urban greening benefits, contributing to shading, air quality, biodiversity, and visual amenity. Details of the tree pits to be installed are shown on drawing C-2.01.

2.2.3. Permeable Paving

Private driveways and public parking areas will feature permeable paving allowing infiltration of storm water to ground. These provide a pavement suitable for lighter traffic movement while allowing rainwater to infiltrate through the surface into the structural layers beneath. The water is temporarily stored beneath the overlying surface before infiltration to the sub-surface or overflowing to the main drainage system where infiltration is not possible or not occurring. Treatment process that occur within the surface structure, the subsurface matrix (including soil layers) and the geotextile layers include filtration, adsorption, biodegradation and sedimentation. Refer to drawing C-1.02 for the private permeable paving locations.

The type of permeable paving proposed for the parking areas on this site is an Aquaflow ® paving system by Roadstone, or similar NSAI certified or equivalent (IAB or BBA cert) approved. To account for the variable infiltration rate of the soils and potential localised clogging of permeable paving areas if not adequately maintained, the overall area of the permeable paving has also been accounted for in the storm network and attenuation storage design, as per CIRIA SUDS manual guidance. Please refer to Drawing C-2.01 for details on the permeable paving installations.

2.2.4. Catchpit Manhole

Catchpit manholes are drainage chambers designed to intercept coarse solids and debris from surface water before it enters the wider drainage network. By trapping sediment and larger pollutants, catchpits reduce the risk of blockages in the system and contribute to improved water quality downstream. Regular maintenance of these manholes ensures continued efficiency and longevity of the drainage network. A catchpit manhole will be located upstream of the attenuation tank to act as a pre-treatment system. This will allow sediment and silt which was passed through the drainage system to settle out, thus reducing the risk of clogging.

2.2.5. Bypass Interceptor

A bypass interceptor is a treatment device installed in the drainage network to remove pollutants, such as hydrocarbons or sediments, from surface water runoff. It operates by directing the majority of flows through the interceptor while allowing excess flows to bypass during high-intensity storm events. This ensures the drainage network remains operational under peak conditions while still providing targeted water quality treatment. As noted above the bioretention systems, tree pits, catchpit manhole, stone layer of the permeable paving will be utilised on this project to reduce pollutants from runoff. In addition, a bypass interceptor is proposed to be installed on the outfall networks for removal of any petrol/ oil contaminants that may still remain in the drainage network.

The bypass interceptor proposed is Klargester Class 1 bypass interceptor, or similar approved, sized based on the outflow from each discharge location in the development. A typical example of the proposed interceptor is shown in Figure 1, with the location and size indicated on Drainage Drawing C-1.02.

Figure 1 – Proposed Interceptor

2.2.6. Hydrobrake Limiting Flow to Qbar Greenfield Rates

A Hydrobrake is a flow control device that restricts the discharge from the site to the greenfield runoff rate Qbar, ensuring that post-development flows do not exceed pre-development levels. By limiting peak discharge, the Hydrobrake mitigates downstream flooding risk and ensures compliance with sustainable drainage requirements. The hydrobrake is installed at the outlet of the attenuation tank as shown on drawing C-1.02. The Phase 2 greenfield runoff rate was determined as the Qbar of the gross area of the Phase 1 and 2 developments. The gross area of the overall site is 1.77 hectares resulting in a rate of 5.30 l/s, refer to the greenfield runoff rate estimation calculations within Appendix A.

2.2.7. SUDS Summary / Considerations:

SUDS Item	Description	Use	Reason
Rainwater Harvesting	Rainwater harvesting systems can be used to effectively drain roofs and	N	Not proposed in the development as there are other

SUDS Item	Description	Use	Reason
	provide both water supply and stormwater management benefits.		alternative SUDS available.
Bioretention Systems	Bioretention systems can be used to attenuate and treat roof runoff. Bioretention systems (either cells or linear systems) can be used for road or car park drainage where space allows.	Y	Bioretention systems to be installed in areas throughout the development.
Swales	Swales can be used for road or car park drainage where space allows. Under drained swales (ie with a subsurface gravel filled conveyance and treatment trench) can provide a more efficient solution for hydraulic control and water quality treatment. Swales can be used to convey roof water to other parts of the site.	N	Bioretention systems preferred and difficult to incorporate into dense urban landscape and
Filter Drains	Filter drains can replace conventional pipework as a conveyance system and can provide infiltration to ground and treatment of road runoff.	N	Bioretention systems are preferred.
Tree Pits	Tree pits can be used to attenuate and treat road runoff.	Y	Tree pits to be installed in areas throughout the development.
Detention Basins	Detention basins can be used in high density developments when effectively integrated within public open space areas. Detention basins can be used to attenuate and treat runoff.	N	Limited open space for detention basin. Bioretention systems and attenuation tank are preferred.
Ponds	Ponds can be used to attenuate and treat roof runoff. It is unlikely that a pond would be suitable for high density development, unless it is an integral amenity feature within the public open space area.	N	Limited open space for detention basin. Bioretention systems and attenuation tank are preferred.
Wetlands	Wetlands can be used to attenuate and treat roof runoff. It is unlikely that a wetland would be suitable for high density development, unless it is an integral amenity feature within the public open space area.	N	Limited open space for detention basin. Bioretention systems and attenuation tank are preferred.
Green Roofs	Green roofs can be designed to provide interception, management and treatment of rainfall up to specified rainfall depths. Green roofs can be implemented most cost-effectively on larger roofs. They provide a range of benefits in addition to stormwater management, including combatting the heat island effect, biodiversity and amenity functions.	N	Green roofs are not seen as an economically viable and architecturally acceptable solution for this development.

SUDS Item	Description	Use	Reason
Permeable Paving	Permeable paving can provide interception, attenuation and storage of surface waters. Permeable paving can be used to infiltrate surface water to ground.	Y	Permeable paving is provided at private driveways and public car parking spaces.
Proprietary Treatment Systems	Proprietary treatment systems may be appropriate to use particularly where there is no space for surface, vegetated treatment systems. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.	Y	Bypass separators are to be installed upstream of the attenuation tank
Flow Control Limiting Flows to Qbar	A Hydrobrake is a flow control device that restricts the discharge from the site to the greenfield runoff rate Qbar, ensuring that post-development flows do not exceed pre-development levels	Y	Hydrobrake to be installed to limit flows discharging to from site to Qbar.
Catchpit Manhole	Catchpit manholes are designed to intercept solids and debris from surface water before it enters the wider drainage network	Y	Catchpit manholes to be installed upstream of the attenuation tank

Table 1 – SUDS Summary / Considerations

Interception storage will be within the bioretention systems, tree pits and stone layers of the permeable paving. In accordance with GDSDS, the volume of interception storage provided is greater than that generated by 5mm of rainfall on the site and up to 10mm if possible.

Refer to Appendix C and drawings C-1.02, C2.01 and C2.02 for the drainage layouts and SUDS details.

2.3. Water Quality Protection

The water quality protection measures proposed for the drainage system are as follows;

- Bioretention systems and tree pits will treat road runoff prior to discharging to the drainage network.
- Road gullies on the road network will remove of initial heavy solids that can be washed into the drainage network – e.g. leaves, stones, heavy grit, etc;
- The permeable paving stone layers will treat road runoff by filtering pollutants from the surface water.
- Catchpit manholes proposed upstream of the attenuation tank will allow settlement of suspended solids washed into the pipe system.
- A Bypass interceptor is proposed downstream of the detention basins for removal of any petrol/ oil contaminants that may remain in the drainage network.

2.3.1. Pollution Hazard Indices Assessment:

A Pollution Hazard Indices Assessment was undertaken for the development based on the Simple Index Approach. The method used was guided by the land use and SuDS performance evidence. The design criteria for the Simple Index approach are for the

Total SuDS mitigation index (for each contaminant type) ≥ pollution hazard index (for each contaminant type).

Pollution hazard indices are presented in Table 26.2 of the CIRIA SuDS manual as provided below for ease of reference.

Use	Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways, and roads that have more than 300 traffic movements daily	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Table 2 - Pollution Hazard Indices for Different Land use Classifications

The proposed site consists of the following land uses:

- Residential roofs
- Individual property driveways, residential car parks, low traffic roads

Indicative SuDS mitigation indices are presented in Table 26.3 of the CIRIA SuDS manual and also provided below for ease of reference. These specify the mitigation index for each contaminant type for different types of SuDS measures.

	Mitigation Indices		
Type of SuDS Component	TSS	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention System	0.8	0.8	0.8
Permeable paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Propriety treatment system	Designed to address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 In 1 year return period event, for inflow concentrations relevant to the contributing drainage area		

Table 3 - Indicative SuDS mitigation indices for discharges to surface waters

The proposed SuDS measures for the development consist of bio retention systems / tree pits, permeable paving and propriety treatment system.

Each different SUDS train and associated mitigation measure has been assessed individually:

Residential Roofs via Detention Basin

Index	Type	TSS	Metals	Hydrocarbons
Hazard Index	Residential Roofs	0.2	0.2	0.05

Index	Type	TSS	Metals	Hydrocarbons
Mitigation Index 1	Propriety treatment system - class 1 bypass interceptors	Designed to address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 In 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 4 - Comparison of Hazard and Mitigation indices for Residential Roofs

Driveways/ Parking/ Roads via Bioretention Systems

Index	Type	TSS	Metals	Hydrocarbons
Hazard Index	Individual property driveways, residential car parks, low traffic roads	0.5	0.4	0.4
Mitigation Index 1	Bioretention Systems	0.5	0.5	0.6
Mitigation Index 2	Propriety treatment system (50% effective as placed in series)	Not required as Mitigation index 1 alone is greater than of the Hazard Index		
Total Mitigation Provided		**0.5**	**0.5**	**0.6**
Mitigation > Hazard		Yes	Yes	Yes

Table 5 - Comparison of Hazard and Mitigation indices Driveways/Parking/Roads

Driveways/ Parking/ Roads via Attenuation Tank

Index	Type	TSS	Metals	Hydrocarbons
Hazard Index	Individual property driveways, residential car parks, low traffic roads	0.5	0.4	0.4
Mitigation Index 1	Propriety treatment system - class 1 bypass interceptors	Designed to address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 In 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 6 - Comparison of Hazard and Mitigation indices Driveways/Parking/Roads

Based on the tables above, a proprietary treatment system is required for general surface water runoff from the development. A proprietary system is proposed as a measure to manage any potential oil or fuel spills that may occur.

The design criteria for the Simple Index approach are for the Total SuDS mitigation index (for each contaminant type) ≥ pollution hazard index (for each contaminant type). As shown above in all cases the mitigation index is greater than the pollution index for each contaminant type. As such the range of SuDS measures proposed satisfies the Simple index Approach and provides adequate mitigation for the site.

In providing the above bioretention systems, permeable paving, catchpit manholes and bypass separator, it is proposed that the treatment of the surface runoff has been adequately provided.

2.4. Design of Road Drainage Collection Network

The stormwater network and attenuation tank have been designed to cater for flows which would be generated by the proposed development.

The design of the storm water network and SUDS were based on the following permeability factors from the CIRIA SUDS Manual for the developed site;

- Roofs; 100% runoff.
- Roads and footpaths; 100% runoff.
- Green areas; 30% runoff.

The design of the storm water network and SUDS allow for 20% climate change.

This storm pipe network has been designed in accordance with IS EN 12056, IS EN 752 and the Greater Dublin Strategic Drainage Study. The design was completed using hydraulic modelling software Causeway Flow which uses the UK Modified Rational Method, in which the peak flow Q is determined for a storm of critical duration using the following equation:

Q = 3.61 x Cv x i x Ai

Cv = run-off coefficient (0.75), i = rainfall intensity, Ai = impermeable area

The following assumptions were made in the design:

- The maximum discharge of surface water (SW) from an area occurs when the duration of the storm is equal to the time of concentration (tc) of the area. tc = time of entry + (length of drain ÷ full bore velocity of flow).
- Time of entry (te) = 4 minutes.
- Colebrook-White effective roughness (Ks) = 0.6mm for Surface Water Sewers

The layout of the proposed drainage network is shown on Drawing C-1.02. The design calculations are provided in Appendix A. The water quality protection measures that are proposed are described above.

2.5. Finished Floor Level Freeboard Compliance

Section 6.3.2.1 of the Greater Dublin Strategic Drainage Study requires a minimum freeboard of 500 mm between storage pond flood levels and property finished floor levels for 100 year return period rainfall events.

The table below summarises the peak water levels recorded during critical stormwater events at nodes where detention basins provide attenuation storage.

Node	Attenuation System	Top Water Level m	Lowest Finished Floor Level m	Freeboard mm
MHS-2	Attenuation Tank	91.870	93.400	1530

Table 7 – Detention Basin Top Water Level Summary

As demonstrated above, a minimum freeboard of 500 mm is maintained between the maximum water level within the attenuation tank and the lowest finished floor level of the proposed development. The attenuation tank is designed to a top of tank level of 91.900 m, providing adequate freeboard and additional attenuation storage within the surface water management system.

3. FOUL DRAINAGE

A pre-connection enquiry was lodged with Uisce Eireann for the development outlining the proposed flows and loads which would be associated with the housing development. This application was undertaken to determine if there is adequate capacity in the existing public foul sewer network to cater for this development. The proposal was accepted as feasible in principle by Uisce Eireann and a copy of the confirmation of feasibility is attached in Appendix D.

It is proposed to provide a single gravity foul sewer system for this 72 no. residential unit development, discharging to the existing public wastewater network at the north east corner of the site.

Detailed design and further coordination with Uisce Éireann will be undertaken as part of the full connection application process, which will commence following receipt of planning permission.

The foul sewer network was designed in accordance with Irish Water Code of Practice July 2020 and to IS EN 12056/ IS EN 752, using hydraulic modelling software Causeway Flow, which uses the Colebrook White equation. These design calculations are included in Appendix B.

The following assumptions were made in the design:

- Colebrook-White effective roughness (Ks) = 1.5mm for Foul Sewers
- Minimum cover to pipes in non-trafficked areas = 900mm
- Minimum cover to pipes in trafficked areas = 1,200mm
- *Pipes with less cover than stated above shall be surrounded in concrete*
- Minimum pipe size to be 150mm diameter as per Irish Water Code of Practice (up to 20 no. houses).

3.1. Wastewater Output Calculation

Average Daily Demand = Residents No. 195 x 150 L/Day x 1.1 (For 10% infiltration (I)) = 32,175 L / Day
= 0.37 L/s

Design Flow = (Pf x P x G) + I + E, where:

Pf = Peaking factor Domestic = 6 (for a population of 0 to 750)
P = Population = 195 residents
G = Water Consumption / Capita = 150 l/person/day x 1.1 for unit consumption
I = Infiltration – Negligible for new wastewater system
E = Trade Flow – Not Applicable

Therefore, Design Flow = 6 x 195 x 150 l/day x 1.1
= 175,500 l/day
= 2.03 l/s

4. WATER SUPPLY

A pre-connection enquiry was lodged with Uisce Eireann for the development outlining the proposed water demands for the 72 no. residential unit development This application was undertaken to determine if adequate capacity is available in the existing public water network to service the development. The proposal was accepted as feasible in principle by Uisce Eireann and a copy of the confirmation of feasibility is attached in Appendix D.

It is proposed to provide a 110 mm OD watermain connection to the development from the existing 100 mm watermain within Phase 1, located along the southern boundary of the Phase 2 development. Hydrants will be provided throughout the development in accordance with the requirements of the Building Regulations.

The proposed water supply network layout is shown on Drawing C-1.03. New bulk water meters will be provided within the site boundary to serve the apartment blocks, subject to the agreement and approval of Uisce Eireann.

4.1. Water Supply Demand Calculations

The peak demand for sizing of the pipe network will normally be 5.0 times the average day/ peak week demand from Section 3.7.2 of the Uisce Eireann Water Code of Practice. The average day/peak week demand should be taken as 1.25 times the average daily domestic demand.

Average Daily Domestic Demand = 195 x 150 l/person/day
= 29,250 l/day
= 0.34 l/s

Average Day / Peak Week Demand = 0.34l/s x 1.25
= 0.425 l/s

5. ROAD DESIGN

This section provides an overview of the key design principles adopted in the road design for the development. The entrance to the development will be from the Phase 1 development planning reference 19/580 with the road network extending from Phase 1 into this development shown on drawing C-1.01.

Road markings and road signs are to in accordance with IS EN 1436 European Standard for Road Markings and in accordance with the Traffic Signs Manual, refer to drawing C-1.04. Internal pedestrian crossings, including dropped kerbs and tactile paving, are provided at pedestrian desire lines, refer to drawing C-1.04.

Adequate sightlines have been provided at junctions to ensure adequate forward visibility for drivers as indicated on drawing C-1.05. All road, footpath and car parking dimensions are indicated on drawing C-1.05 also. A vehicle tracking analysis has been carried out to confirm that the road network can be safely used by a refuse vehicle of 10m length. The results are detailed on drawing C-1.06. The internal road layout has been designed to ensure a simple and safe design in accordance with DMURS. The key aim of the design is to provide a self-regulating traffic environment in the estate through the use of suitable road widths and road curvature, with minimum signage and road markings within the development, other than at junctions. This is in line with the key principles of DMURS, which states that;

"*The implementation of a self-regulating street environment means that the reliance on signage or line marking to direct or instruct people is significantly reduced….there may also be traffic calming benefits of a 'less is more' approach to reinforce lower design speeds. For example, the removal of centre line markings has been found to reduce vehicle speeds and the number of accidents. With reduced signage drivers must navigate the street environment with full regard to their own behaviour and the behaviour of others around them. An emphasis on the values of place also requires the visual impact of signage to be considered in order to reduce visual clutter*."

6. FLOOD RISK

The site is not subject to an OPW CFRAMs Map as it lies outside of an identified flood risk zone, therefore placing this development in Flood Risk Zone C. Existing site levels within the development lands are between 67.0 m and 62.0 m AOD. Therefore due to its location in Flood Risk Zone C and its elevation, the site is suitable for the development of housing in accordance with the Flood Risk Management Guidelines. A site specific flood risk assessment is therefore not necessary for this development.

Signed: Paul Clune

Paul Clune
Chartered Engineer

Date: 14 September 2026

Appendix A
Surface Water Calculations

Greenfield runoff rate estimation tool

hr wallingford

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

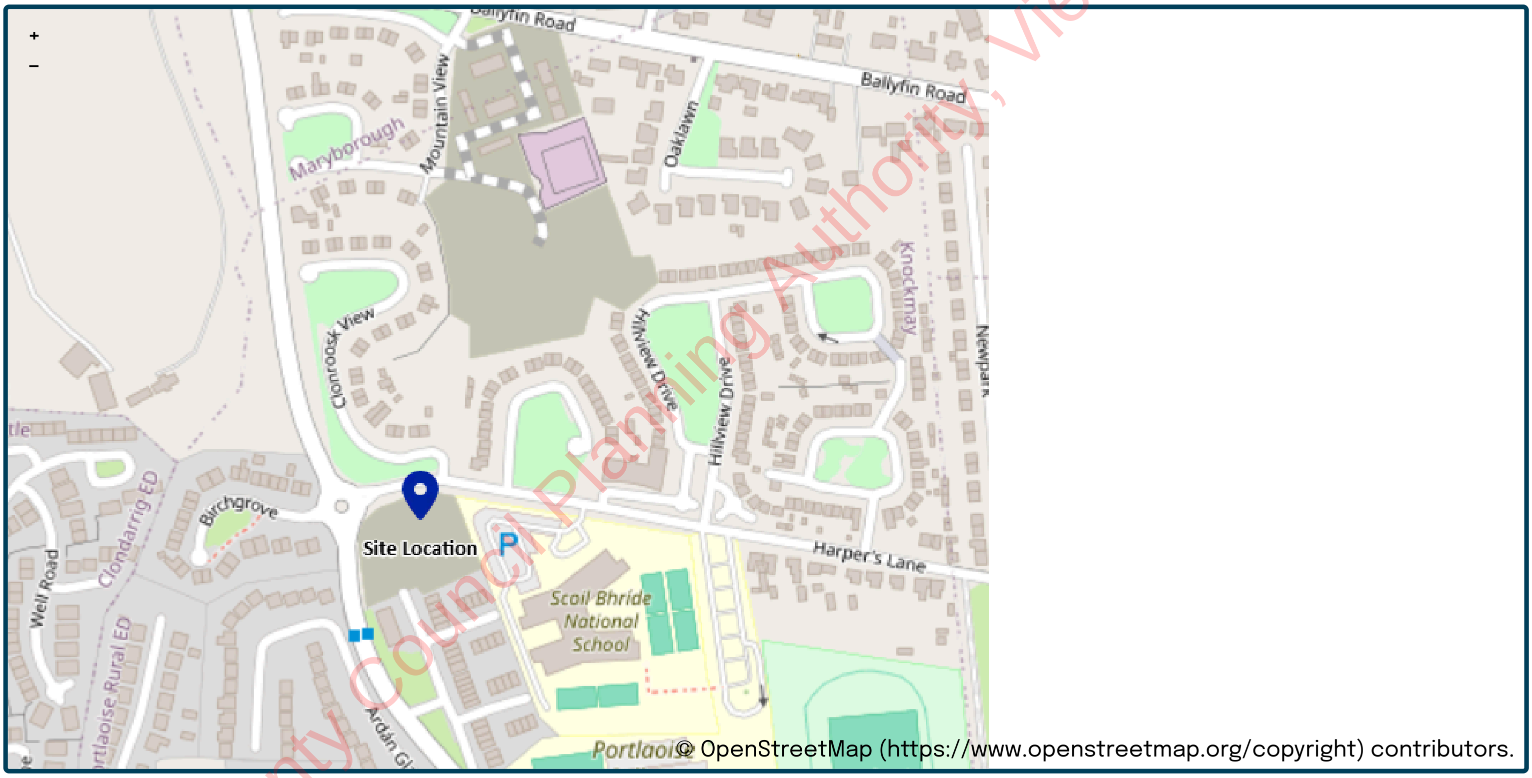
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	28/08/2026
Calculated by	Paul Clune
Reference	Harpurs Lane Portlaoise
Model version	2.2.3

Location

Site name	Phase 2 Harpurs Lane
Site location	Portlaoise, Laois



Site easting (Irish Grid)	245911
Site northing (Irish Grid)	198741
Site easting (Irish Transverse Mercator)	645851
Site northing (Irish Transverse Mercator)	698776

Site details

Total site area (ha)	1.77 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	1072 mm		1072
How should SPR be derived?	WRAP soil type		
WRAP soil type	2		2
SPR	0.3		
QBar (IH124) (l/s)	5.3 l/s		

Growth curve factors

	My value		Map value
Hydrological region	13		13
1 year growth factor	0.85		
2 year growth factor	0.95		
10 year growth factor	1.4		
30 year growth factor	1.65		
100 year growth factor	1.95		
200 year growth factor	2.15		

Results

Method	IH124
Flow rate 1 year (l/s)	4.5 l/s
Flow rate 2 year (l/s)	5.0 l/s
Flow rate 10 years (l/s)	7.4 l/s
Flow rate 30 years (l/s)	8.8 l/s
Flow rate 100 years (l/s)	10.4 l/s
Flow rate 200 years (l/s)	11.4 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	250.0
Additional Flow (%)	20	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	16.500	Minimum Backdrop Height (m)	0.000
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	10.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
EXMHS2-4	0.140	10.00	95.650	1350	645841.779	698734.977	4.260	91.390
5.1	0.046	10.00	95.150	1200	645825.308	698771.036	1.750	93.400
5	0.044	10.00	94.650	1350	645841.326	698772.273	3.412	91.238
3.1	0.075	10.00	93.130	1200	645888.182	698775.895	1.735	91.395
4			93.500	1350	645868.687	698774.388	2.423	91.077
2			93.150	1350	645878.903	698791.989	2.450	90.700
1			93.000	1200	645881.355	698792.970	2.316	90.684
4.1	0.071	10.00	93.350	1200	645867.454	698790.401	1.700	91.650
PH1-3	0.673	10.00	96.700	1350	645861.874	698660.066	4.100	92.600
PH1-2			95.800	1350	645850.082	698690.865	3.750	92.050
PH1-1			95.600	1350	645842.887	698732.481	3.722	91.878
3			93.290	1350	645880.195	698775.278	2.281	91.009

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	EXMHS2-4	5	37.299	0.600	91.390	91.238	0.152	245.0	375	11.67	44.4
1.000	PH1-3	PH1-2	32.979	0.600	92.600	92.465	0.135	244.3	375	10.48	46.9
2.000	5.1	5	16.066	0.600	93.400	92.998	0.402	40.0	225	10.13	47.6
1.001	PH1-2	PH1-1	42.233	0.600	92.050	91.878	0.172	245.0	375	11.09	45.6
1.004	5	4	27.443	0.600	91.238	91.077	0.161	170.0	375	12.00	43.8
1.002	PH1-1	EXMHS2-4	2.731	0.600	91.878	91.867	0.011	245.0	375	11.13	45.5
3.000	4.1	4	16.060	0.600	91.650	91.248	0.402	40.0	225	10.13	47.6
1.005	4	3	11.542	0.600	91.077	91.009	0.068	170.0	375	12.13	43.6
4.000	3.1	3	8.011	0.600	91.395	91.166	0.229	35.0	225	10.06	47.8
1.006	3	2	16.761	0.600	91.009	90.897	0.112	150.0	375	12.32	43.2
1.007	2	1	2.641	0.600	90.700	90.684	0.016	170.0	225	12.37	43.1

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.003	1.153	127.3	117.6	3.885	3.037	0.813	0.0	286	1.301
1.000	1.155	127.5	102.6	3.725	2.960	0.673	0.0	256	1.279
2.000	2.074	82.5	7.1	1.525	1.427	0.046	0.0	44	1.280
1.001	1.153	127.3	99.8	3.375	3.347	0.673	0.0	251	1.271
1.004	1.386	153.1	128.7	3.037	2.048	0.903	0.0	265	1.546
1.002	1.153	127.3	99.6	3.347	3.408	0.673	0.0	251	1.271
3.000	2.075	82.5	11.0	1.475	2.027	0.071	0.0	55	1.449
1.005	1.386	153.1	138.1	2.048	1.906	0.975	0.0	280	1.561
4.000	2.219	88.2	11.7	1.510	1.899	0.075	0.0	55	1.549
1.006	1.477	163.1	147.6	1.906	1.878	1.050	0.0	281	1.663
1.007	1.000	39.7	147.3	2.225	2.091	1.050	0.0	225	1.018

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.003	37.299	245.0	375	PVC S	95.650	91.390	3.885	94.650	91.238	3.037
1.000	32.979	244.3	375	PVC S	96.700	92.600	3.725	95.800	92.465	2.960
2.000	16.066	40.0	225	PVC S	95.150	93.400	1.525	94.650	92.998	1.427
1.001	42.233	245.0	375	PVC S	95.800	92.050	3.375	95.600	91.878	3.347
1.004	27.443	170.0	375	PVC S	94.650	91.238	3.037	93.500	91.077	2.048
1.002	2.731	245.0	375	PVC S	95.600	91.878	3.347	95.650	91.867	3.408
3.000	16.060	40.0	225	PVC S	93.350	91.650	1.475	93.500	91.248	2.027
1.005	11.542	170.0	375	PVC S	93.500	91.077	2.048	93.290	91.009	1.906
4.000	8.011	35.0	225	PVC S	93.130	91.395	1.510	93.290	91.166	1.899
1.006	16.761	150.0	375	PVC S	93.290	91.009	1.906	93.150	90.897	1.878
1.007	2.641	170.0	225	PVC S	93.150	90.700	2.225	93.000	90.684	2.091

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.003	EXMHS2-4	1350	Manhole	SMH	5	1350	Manhole	SMH
1.000	PH1-3	1350	Manhole	SMH	PH1-2	1350	Manhole	SMH
2.000	5.1	1200	Manhole	SMH	5	1350	Manhole	SMH
1.001	PH1-2	1350	Manhole	SMH	PH1-1	1350	Manhole	SMH
1.004	5	1350	Manhole	SMH	4	1350	Manhole	SMH
1.002	PH1-1	1350	Manhole	SMH	EXMHS2-4	1350	Manhole	SMH
3.000	4.1	1200	Manhole	SMH	4	1350	Manhole	SMH
1.005	4	1350	Manhole	SMH	3	1350	Manhole	SMH
4.000	3.1	1200	Manhole	SMH	3	1350	Manhole	SMH
1.006	3	1350	Manhole	SMH	2	1350	Manhole	SMH
1.007	2	1350	Manhole	SMH	1	1200	Manhole	SMH

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	360
Rainfall Events	Singular	Additional Storage (m³/ha)	0.0
FSR Region	Scotland and Ireland	Starting Level (m)	
M5-60 (mm)	16.500	Check Discharge Rate(s)	✓
Ratio-R	0.300	5 year (l/s)	44.9
Summer CV	0.750	30 year (l/s)	61.7
Winter CV	0.840	100 year (l/s)	73.3
Analysis Speed	Detailed	Check Discharge Volume	✓
Skip Steady State	x	100 year +20% 360 minute (m³)	3312

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.65
Greenfield Method	IH124	Growth Factor 100 year	1.96
Positively Drained Area (ha)	11.420	Betterment (%)	0
SAAR (mm)	1155	QBar	37.4
Soil Index	2	Q 5 year (l/s)	44.9
SPR	0.30	Q 30 year (l/s)	61.7
Region	11	Q 100 year (l/s)	73.3
Growth Factor 5 year	1.20		

Pre-development Discharge Volume

Site Makeup	Greenfield	CWI	125.388
Greenfield Method	FSR/FEH	Return Period (years)	100
Positively Drained Area (ha)	11.420	Climate Change (%)	20
Soil Index	2	Storm Duration (mins)	360
SPR	0.30	Betterment (%)	0

Pre-development Discharge Volume

PR	0.361	Runoff Volume (m³)	3312

Node PH1-1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	91.878	Product Number	CTL-SHE-0057-2000-2010-2000
Design Depth (m)	2.010	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	90.700	Product Number	CTL-SHE-0106-5300-1200-5300
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.3	Min Node Diameter (mm)	1200

Node PH1-2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	92.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	460.0	460.0	1.350	460.0	562.6	1.351	0.0	562.6

Node 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	90.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	120.0	1.200	120.0	166.6	1.201	0.0	166.6

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.88%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	EXMHS2-4	344	91.568	0.178	8.3	0.2543	0.0000	OK
15 minute winter	5.1	13	93.454	0.054	9.7	0.0608	0.0000	OK
360 minute winter	5	344	91.568	0.330	12.8	0.4718	0.0000	OK
360 minute winter	3.1	344	91.568	0.173	3.8	0.1952	0.0000	OK
360 minute winter	4	344	91.568	0.491	16.4	0.7021	0.0000	SURCHARGED
360 minute winter	2	344	91.567	0.867	18.9	100.1281	0.0000	SURCHARGED
120 minute winter	1	64	90.739	0.055	5.3	0.0000	0.0000	OK
30 minute winter	4.1	20	91.718	0.068	15.1	0.0768	0.0000	OK
15 minute winter	PH1-3	13	92.965	0.365	142.4	0.5229	0.0000	OK
2160 minute winter	PH1-2	2040	92.820	0.770	9.6	337.7899	0.0000	SURCHARGED
2160 minute winter	PH1-1	2040	92.820	0.942	1.4	1.3486	0.0000	SURCHARGED
360 minute winter	3	344	91.568	0.559	19.7	0.7993	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	EXMHS2-4	1.003	5	8.3	0.609	0.065	2.8737	
15 minute winter	5.1	2.000	5	9.7	1.369	0.118	0.1138	
360 minute winter	5	1.004	4	12.8	0.735	0.084	2.9223	
360 minute winter	3.1	4.000	3	3.8	1.085	0.043	0.2902	
360 minute winter	4	1.005	3	16.0	0.814	0.104	1.2730	
360 minute winter	2	1.007	1	5.3	0.661	0.133	0.0212	183.9
30 minute winter	4.1	3.000	4	15.0	1.542	0.182	0.1567	
15 minute winter	PH1-3	1.000	PH1-2	142.3	1.414	1.116	3.2530	
2160 minute winter	PH1-2	1.001	PH1-1	1.4	0.098	0.011	4.6582	
2160 minute winter	PH1-1	1.002	EXMHS2-4	1.4	0.403	0.011	0.0095	
360 minute winter	3	1.006	2	18.9	0.882	0.116	1.8487	

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	EXMHS2-4	344	91.871	0.481	10.2	0.6877	0.0000	SURCHARGED
30 minute winter	5.1	20	93.462	0.062	12.7	0.0700	0.0000	OK
360 minute winter	5	344	91.870	0.632	16.0	0.9051	0.0000	SURCHARGED
360 minute winter	3.1	344	91.870	0.475	4.9	0.5376	0.0000	SURCHARGED
360 minute winter	4	344	91.870	0.793	19.8	1.1353	0.0000	SURCHARGED
360 minute winter	2	344	91.870	1.170	22.2	135.0658	0.0000	SURCHARGED
15 minute winter	1	95	90.739	0.055	5.3	0.0000	0.0000	OK
360 minute winter	4.1	344	91.870	0.220	4.6	0.2493	0.0000	OK
30 minute winter	PH1-3	20	93.126	0.526	186.0	0.7523	0.0000	SURCHARGED
2160 minute winter	PH1-2	2100	93.057	1.007	11.9	441.6462	0.0000	SURCHARGED
2160 minute winter	PH1-1	2100	93.057	1.179	1.6	1.6876	0.0000	SURCHARGED
360 minute winter	3	344	91.870	0.861	23.3	1.2325	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	EXMHS2-4	1.003	5	10.2	0.637	0.080	4.1140	
30 minute winter	5.1	2.000	5	12.7	1.472	0.153	0.1382	
360 minute winter	5	1.004	4	15.4	0.736	0.100	3.0269	
360 minute winter	3.1	4.000	3	4.9	1.132	0.056	0.3186	
360 minute winter	4	1.005	3	18.6	0.821	0.121	1.2730	
360 minute winter	2	1.007	1	5.3	0.661	0.133	0.0212	185.6
360 minute winter	4.1	3.000	4	4.6	1.095	0.056	0.6369	
30 minute winter	PH1-3	1.000	PH1-2	185.3	1.695	1.453	3.4471	
2160 minute winter	PH1-2	1.001	PH1-1	1.6	0.102	0.012	4.6582	
2160 minute winter	PH1-1	1.002	EXMHS2-4	1.6	0.411	0.012	0.0103	
360 minute winter	3	1.006	2	22.2	0.905	0.136	1.8487	

Appendix B
Wastewater Calculations

Design Settings

Frequency of use (kDU)	0.00	Minimum Velocity (m/s)	1.00
Flow per dwelling per day (l/day)	4000	Connection Type	Level Soffits
Domestic Flow (l/s/ha)	0.0	Minimum Backdrop Height (m)	0.200
Industrial Flow (l/s/ha)	0.0	Preferred Cover Depth (m)	1.200
Additional Flow (%)	0	Include Intermediate Ground	✓

Nodes

Name	Units	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
EX-4	50.0	95.600	1200	645843.533	698734.525	3.953	91.647
5.1	12.0	95.400	1200	645832.421	698762.363	2.400	93.000
5		95.000	1200	645842.987	698762.744	3.494	91.506
4		94.700	1200	645842.829	698770.986	3.235	91.465
3.1	4.0	93.170	1200	645888.185	698774.491	1.470	91.700
2.1	24.0	93.550	1200	645861.495	698787.667	2.140	91.410
1		93.250	1200	645878.724	698794.257	2.056	91.194
3		93.500	1200	645870.440	698773.119	2.173	91.327
2		93.180	1200	645869.236	698788.697	1.931	91.249

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)
1.000	EX-4	5	28.224	1.500	91.647	91.506	0.141	200.0	225
2.000	5.1	5	10.573	1.500	93.000	92.930	0.070	150.0	150
1.001	5	4	8.244	1.500	91.506	91.465	0.041	200.0	225
1.002	4	3	27.693	1.500	91.465	91.327	0.138	200.0	225
3.000	3.1	3	17.798	1.500	91.700	91.403	0.297	60.0	150
1.003	3	2	15.624	1.500	91.327	91.249	0.078	200.0	225
4.000	2.1	2	7.809	1.500	91.410	91.254	0.156	50.0	225
1.004	2	1	10.997	1.500	91.249	91.194	0.055	200.0	225

Name	Pro Vel @ 1/3 Q (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Dwellings (ha)	Σ Units (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.000	0.810	32.2	0.0	3.728	3.269	0.000	0	50.0	0.0	0	0.000
2.000	0.000	0.714	12.6	0.0	2.250	1.920	0.000	0	12.0	0.0	0	0.000
1.001	0.000	0.810	32.2	0.0	3.269	3.010	0.000	0	62.0	0.0	0	0.000
1.002	0.000	0.810	32.2	0.0	3.010	1.948	0.000	0	62.0	0.0	0	0.000
3.000	0.000	1.132	20.0	0.0	1.320	1.947	0.000	0	4.0	0.0	0	0.000
1.003	0.000	0.810	32.2	0.0	1.948	1.706	0.000	0	66.0	0.0	0	0.000
4.000	0.000	1.625	64.6	0.0	1.915	1.701	0.000	0	24.0	0.0	0	0.000
1.004	0.000	0.810	32.2	0.0	1.706	1.831	0.000	0	90.0	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	28.224	200.0	225	PVC F	95.600	91.647	3.728	95.000	91.506	3.269
2.000	10.573	150.0	150	PVC F	95.400	93.000	2.250	95.000	92.930	1.920
1.001	8.244	200.0	225	PVC F	95.000	91.506	3.269	94.700	91.465	3.010
1.002	27.693	200.0	225	PVC F	94.700	91.465	3.010	93.500	91.327	1.948
3.000	17.798	60.0	150	PVC F	93.170	91.700	1.320	93.500	91.403	1.947
1.003	15.624	200.0	225	PVC F	93.500	91.327	1.948	93.180	91.249	1.706
4.000	7.809	50.0	225	PVC F	93.550	91.410	1.915	93.180	91.254	1.701

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX-4	1200	Manhole	FMH	5	1200	Manhole	FMH
2.000	5.1	1200	Manhole	FMH	5	1200	Manhole	FMH
1.001	5	1200	Manhole	FMH	4	1200	Manhole	FMH
1.002	4	1200	Manhole	FMH	3	1200	Manhole	FMH
3.000	3.1	1200	Manhole	FMH	3	1200	Manhole	FMH
1.003	3	1200	Manhole	FMH	2	1200	Manhole	FMH
4.000	2.1	1200	Manhole	FMH	2	1200	Manhole	FMH

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	10.997	200.0	225	PVC F	93.180	91.249	1.706	93.250	91.194	1.831

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	2	1200	Manhole	FMH	1	1200	Manhole	FMH

Simulation Settings

Analysis Speed	Detailed	Drain Down Time (mins)	360
Skip Steady State	x	Foul Event Duration (mins)	

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.65
Greenfield Method	IH124	Growth Factor 100 year	1.96
Positively Drained Area (ha)	11.420	Betterment (%)	0
SAAR (mm)	1155	QBar	37.4
Soil Index	2	Q 5 year (l/s)	44.9
SPR	0.30	Q 30 year (l/s)	61.7
Region	11	Q 100 year (l/s)	73.3
Growth Factor 5 year	1.20		

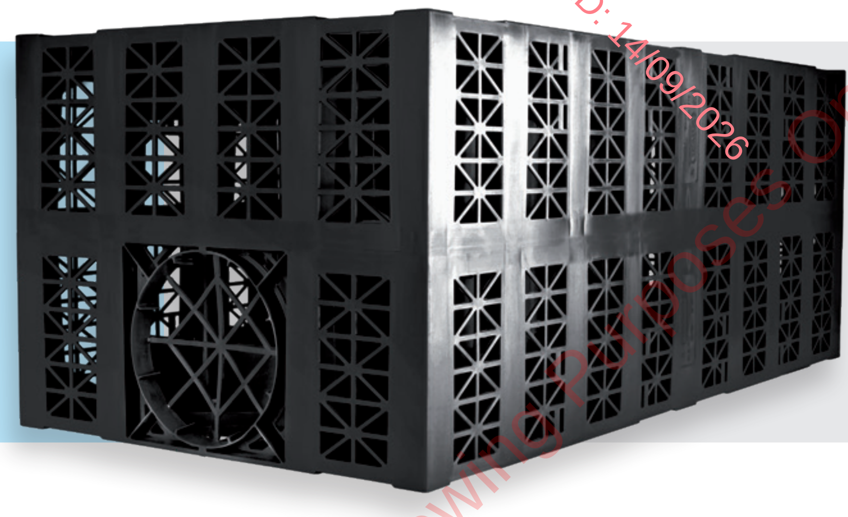
Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	20
Positively Drained Area (ha)	11.420	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.30	PR	0.361
CWI	125.388	Runoff Volume (m³)	3312

Appendix C
Product Information

Product Datasheet

AquaCell Core-R



Product description

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 in both landscaped and deep soakaway applications.

Technical specification

Product code / SAP code	6LB150 / 4064830	**Void ratio**	95%
Colour	Black	**Material**	Recycled PP
Dimensions	1m x 0.5m x 0.4m	**Vertical loading**	66.9 tonnes/m² (669 kN/m²)
Weight	11.5kg	**Lateral loading**	12.3 tonnes/m² (123 kN/m²)
Storage volume	190 litres	**BBA approval**	Certificate 03/4018

Maximum installation depths

Typical soil type	**Maximum depth of installation – to base of units (m)[1]**				
	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

Minimum cover depths

	Landscaped areas	**Car parks with vehicle mass <3 tonnes[5]**	**Car parks with vehicle mass <9 tonnes**	**Car parks with vehicle mass <12 tonnes**	**Low speed roads with vehicle mass <60 tonnes**
Minimum cover depth (m)	0.30	0.50	0.60	0.70	1.11

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

Wavin Ireland Ltd | Balbriggan | Co Dublin | K32 K840
Tel 01 8020200 | **Email** info.ie@wavin.com | **Website** www.wavin.ie

June 2021

Design Data

Hydro-Brake® Optimum

Vortex Flow Control Valve

Inspired by nature and engineered to deliver the perfect curve, the Hydro-Brake® Optimum is the most advanced vortex flow control valve available. There is no equivalent to the Hydro-Brake® Optimum when it comes to delivering the best possible hydraulic performance with a passive flow control.

With a wide range of configurations and options available, the Hydro-Brake® Optimum is able to provide precision flow control to suit the vast majority of applications.

Figure 1 - The Hydro-Brake® Optimum is designed and manufactured to deliver precise, repeatable flow control.

Precision Engineered Vortex Flow Controls

Each Hydro-Brake® Optimum is custom configured to suit the application and is manufactured under strict quality assurance procedures to deliver precise flow control to exacting requirements.

Every unit is backed by significant R&D investment to fine-tune the performance, meaning that the Hydro-Brake® Optimum is the only vortex flow control to have been independently certified by the BBA and WRc.

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4598

WRc Approved PT/329/0412

Benefits

- Manufactured from high grade stainless steel.
- Future proof – adjustable or replaceable inlet plates available to alter flow rates post-installation.
- Configurations available to suit a wide variety of installations.
- Large cross sectional area at all heads.
- Simple installation.
- Self-activating.
- No moving parts or external power requirement.

Versatile and Flexible

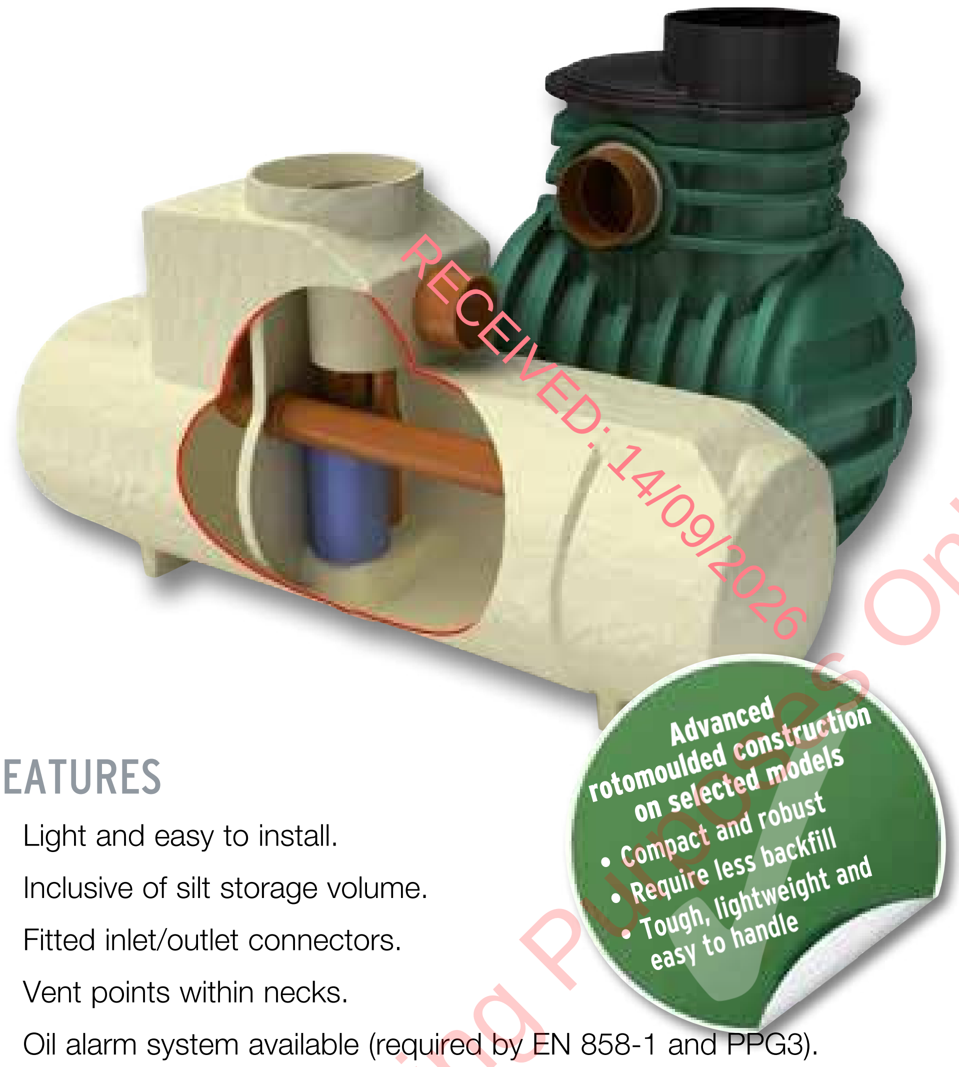
At Hydro International, we pride ourselves on providing solutions that meet your requirements, rather than providing a standard solution and asking you to compromize on your project needs.

The Hydro-Brake® Optimum offers designers options to precision-engineer a vortex flow control to:

- Minimize upstream storage volumes.
- Maximize internal (inlet & outlet) cross sectional areas to prevent blockages.
- Build-in a climate change factor to allow for future changes in flow rate.

Further, if you need to retrofit a flow control, our dedicated team of engineers can assist with providing a customized Hydro-Brake® Optimum suitable for installation into existing infrastructure.

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.
- Oil storage volume.
- Silt storage capacity.
- 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) SILT	OIL	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.
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 D
Confirmation of Feasibility

CONFIRMATION OF FEASIBILITY

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

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Paul Clune

Brasswood Limited
10th Floor, Riverpoint
Lower Mallow Street
Limerick City
V94 WC6A

22 July 2026

Our Ref: CDS26005077 Pre-Connection Enquiry
Harpurs Lane, Knockmay, Portlaoise, Co. Laois

Dear Applicant/Agent,

We have completed the review of the Pre-Connection Enquiry.

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 44 unit(s) at Harpurs Lane, Knockmay, Portlaoise, Co. Laois, (the **Development**).

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection** - Feasible without infrastructure upgrade by Uisce Éireann
- **Wastewater Connection** - Feasible Subject to upgrades

It is noted from the proposals that a sewer diversion is proposed as part of the Development. It will not be permitted to build over any Uisce Éireann infrastructure. The layout of the development must ensure that this pipe is protected and adequate separation distances are provided between Uisce Éireann infrastructure and any structures on site. You will be required to enter into a diversion agreement for the diversion of infrastructure to accommodate your development. Please make contact with Uisce Éireann Diversions team at Diversions@water.ie in order to agree the diversion proposals. It will be necessary to provide a wayleave over this pipe to the benefit of Uisce Éireann and ensure that it is accessible for maintenance.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Uisce Éireann's Network(s)

This letter is issued to provide information about the current feasibility of the proposed connection(s) to Uisce Éireann's network(s). This is not a connection offer and capacity in Uisce Éireann's network(s) may only be secured by entering into a connection agreement with Uisce Éireann.

For any further information, visit **www.water.ie/connections**, **email newconnections@water.ie** or contact 1800 278 278**.**

Yours sincerely,

Dermot Phelan

Dermot Phelan
Connections and Developer Services

Section A - What is important to know?

What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Uisce Éireann's network(s). • Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.
When should I submit a Connection Application?	• A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	• Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works
Fire flow Requirements	• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine. • **What to do?** - Contact the relevant Local Fire Authority
Plan for disposal of storm water	• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. • **What to do?** - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Uisce Éireann's network(s)?	• Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie

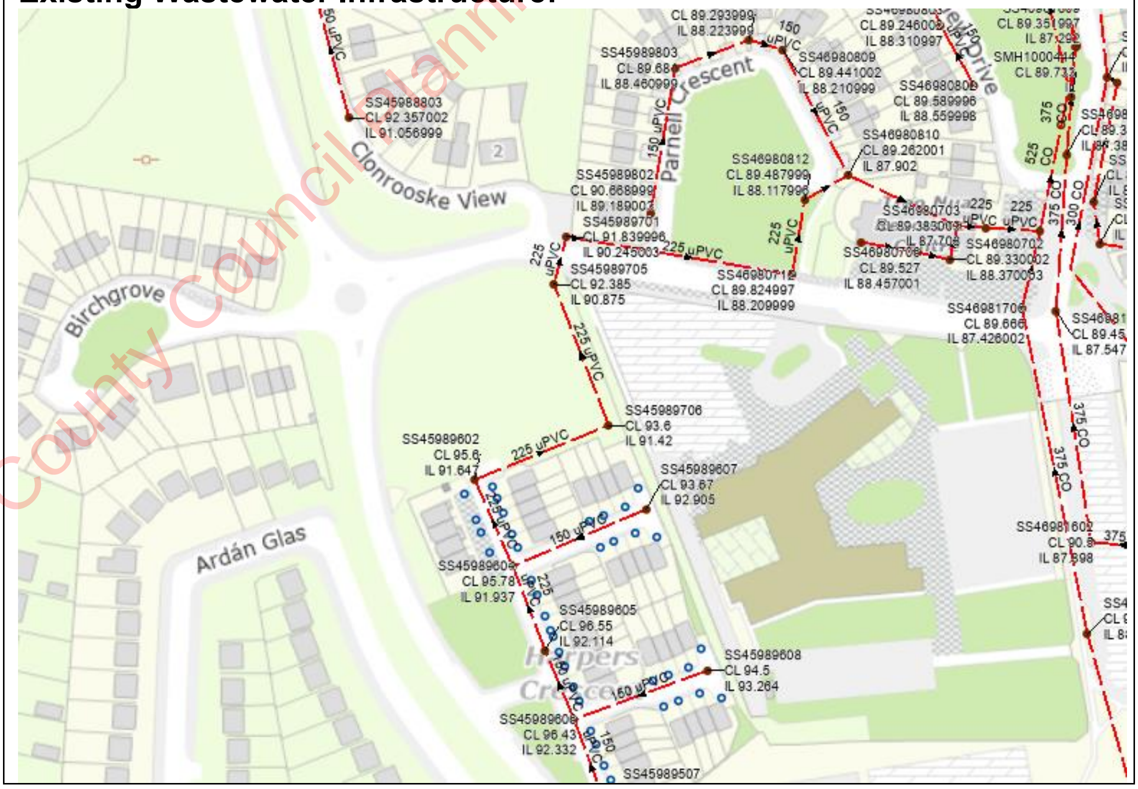
What are the design requirements for the connection(s)?	• The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with ***the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice,*** available at www.water.ie/connections
Trade Effluent Licensing	• Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended). • More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Section B – Details of Uisce Éireann's Network(s)

The map included below outlines the current Uisce Éireann infrastructure adjacent the Development: To access Uisce Éireann Maps email datarequests@water.ie

Existing Water Infrastructure:

Existing Wastewater Infrastructure:



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Note: The information provided on the included maps as to the position of Uisce Éireann's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann's network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann's underground network(s) is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.