   

REPORT

Civil Engineering Report for Residential Development at Speaker's Corner, Lower Carey's Rd, Limerick.

August 2022

Comhairle Cathrach & Contae Luimnigh
Limerick City & County Council

GARLAND
Concepts Realised

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Description of Change	Originator	Rev	Approval	Date
Draft Release	PC	1st	BL	04/05/21
Revised to FT comments and includes Irish Water agreements	PC	A	BL	26/05/21
Issued For Planning	PC	B	BL	17/06/2021
Revised for future LCCC development plan	PC	C	BL	27/06/2021

1. INTRODUCTION

This report has been prepared by GARLAND to describe the proposed water and drainage services for a residential development at Speaker's Corner, Lower Carey's Road, Limerick comprising of 36 No. apartments and associated site works. The associated site works include a wastewater and storm connection to the existing combined sewer at Lower Carey's Road and a water supply connection to the existing water network at Lower Carey's Road. A pedestrian access point together with proposed boundary treatments, landscaping, public lighting, ESB and telecommunication networks, bin storage & bicycle storage etc. to serve the development. The designs of the civil services described in this report allow for the above works.

2. SURFACE WATER DRAINAGE

It is proposed to provide a storm drainage system for the development which will discharge, following attenuation, to an existing combined sewer outside of the north east boundary of the site. The combined sewer is treated at Bunlickey wastewater treatment plant before discharging to the River Shannon. The main drainage scheme has the capacity to cater for future population growth and the Bunlickey wastewater treatment plant is operating below its design capacity of 130,000 population equivalents. Irish Water have accepted the proposal to discharge stormwater to the existing combined sewer refer to the Irish Water Confirmation of Feasibility in Appendix F.

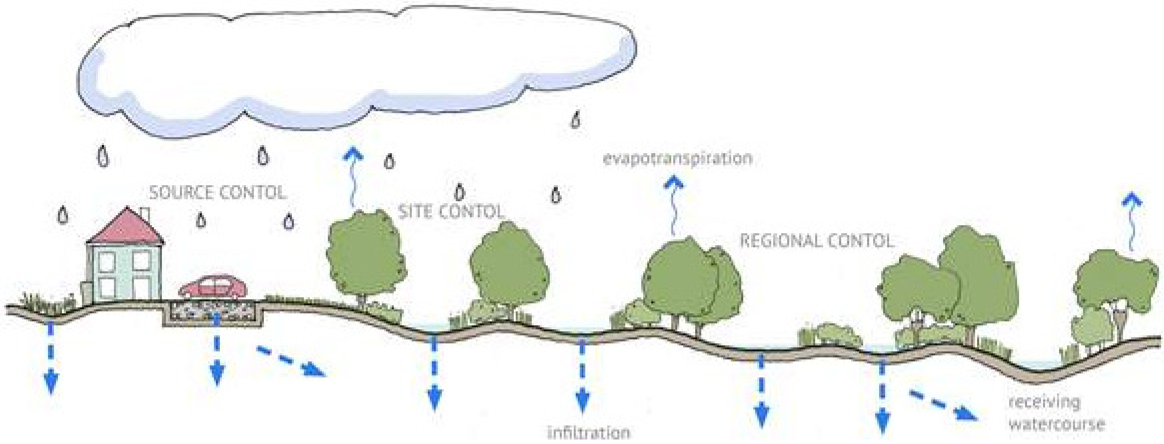
A sustainable urban drainage system (SUDS) to cater for storm runoff from the development has been designed in accordance with the CIRIA SUDS Manual 2015 and Greater Dublin Strategic Drainage Study (GDSDS). The proposed sustainable urban drainage system for this development is summarised hereafter and a detailed layout provided on GARLAND Drawing W0622-GAR-XX-XX-DR-C-0010;

2.1 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. Using the www.uksuds.com website, an assessment of the appropriate applicable SUDS features were evaluated. The appropriate SUDS features included in this proposal include the following:

- Green roof
- Catchpit manhole
- Attenuation tank
- Hydrobrake limiting flow to Qbar greenfield rates

The SUDS management train approach to designing the storm water network has been applied in this proposed development similar in principle to the figure below



2.1.1 Source Control

Source control aims to detain or infiltrate runoff as close as possible to the point origin.

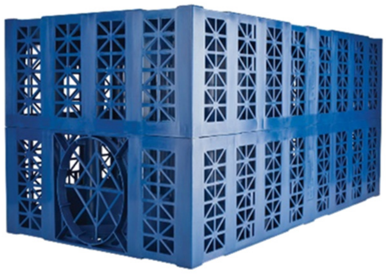
The opportunity to infiltrate to ground within this restricted site are limited however there is still scope to provide a level of interception storage, time delay and treatment as the surface water flows through a proposed green roof on the development. In accordance with the CIRIA SUDS Manual 2015, green roofs can be used to treat and attenuate runoff in their substrate and support root uptake of water with appropriate planting and are an integral part of source control on a site. Green roofs can increase the indigenous biodiversity and is an encouraging environmentally design strategy in accordance with the current and future Limerick City and County Council Development Plan.

A green roof is proposed for almost all of the flat roof area of the apartment block. The exact area of the green roof is to be coordinated with the location of the required heat pumps on the roof. Access to the green roof is to be facilitated via a staircore in the apartment block. A fall restraint system is to be included in the design of the roof. For structural reasons, a green roof suitable for use on lightweight roofs will be utilised. Refer to Appendix D for details of the proposed green roof.

2.1.2 Site Control

Site control involves the reduction in volume and rate of surface runoff while also providing some treatment of the runoff. The green roof will act as a site control as well as a source control as described above. The footpath surrounding the apartment block is to discharge to the grass area and infiltrate to ground.

As part of the overall control for the site it is proposed to use an attenuation tank and hydrobrake manhole to control the surface water runoff rate to the greenfield runoff rate. A greenfield runoff rate of 2l/s has been proposed for this site.



The attenuation system proposed is an underground geocellular type system, such as Wavin "Aqua Cell" type system, or similar approved, with 95% porosity. This type of system is proposed rather than an open detention basin, pond or a large concrete tank due to the very urban and restricted nature of the site to be developed.

The attenuation volume required was calculated based on the critical storm duration for the 100 year return period storm event inclusive of a 10% climate change allowance. The design was undertaken using hydraulic modelling software WinDes which allows for critical design storm duration analysis. The results of this analysis are provided in Appendix B.

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. Outflow from the attenuation tank within the site will be restricted to 2.0l/s using a vortex flow control device on the downstream manhole, namely a Hydrobrake® system, or similar approved.

2.1.3 Regional Control

Regional control comprises of treatment facilities to reduce pollutants from runoff and control the surface water runoff rate to the greenfield runoff rate. As noted above green roofs, flow control device, attenuation tanks will be utilised on this project to limit regional impact.

2.1.4 SUDS Summary / Considerations:

SUDS Item	Description	Use	Reason
Rainwater Harvesting	Rainwater harvesting systems can be used to effectively drain roofs	N	A communal water system is not proposed as part of the project.

SUDS Item	Description	Use	Reason
	and provide both water supply and stormwater management benefits.		
Swale	Swales can be used for road or car park drainage where space allows. Underdrained 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	There are no roads and car parks proposed for the project which has a limited site area
Trenches	Trenches can provide treatment and runoff control for road or car park drainage. Trenches can be used to convey roof water to other parts of the site.	N	
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	There is a very limited open space provided within the site. The level of which is higher than the building.
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	There is a very limited open space provided within the site. The level of which is higher than the building.
Wetlands	Wetlands can be used	N	There is a very limited

SUDS Item	Description	Use	Reason
	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.		open space provided within the site. The level of which is higher than the building.
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.	Y	A green roof for use with ligthtweight roofs are proposed for this project
Bioretention Systems	Bioretention systems can be used to attenuate and treat roof runoff. Biorention systems (either cells or linear systems) can be used for road or car park drainage where space allows.	N	There is a very limited open space provided within the site. The level of which is higher than the building.
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	N	This is not required as there are no roads and parking proposed and a green roof is being used.

SUDS Item	Description	Use	Reason
	so that they continue to function effectively.		
Subsurface Storage	Subsurface storage can be used to attenuate roof runoff. Subsurface storage of runoff is likely to be needed for high density developments. This can be implemented via a range of proprietary high void systems, or within gravels beneath permeable pavements which provide treatment as well. Sub-surface storage allows the land above the storage system to be used for car parking or public open space areas.	Y	An attenuation tank is proposed for the project.
Subsurface Conveyance Pipes	Subsurface conveyance systems may be an important means of connecting drainage components together and routing flows downstream. Space constraints in high density developments are likely to constrain the use of surface conveyance options	Y	There is a very limited open space provided within the site for the use of surface conveyance options.

The interception storage will be within the substrate of the green roof. 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. Calculations of the interception volume are shown in Appendix B. Replicating the natural characteristics and providing amenity/ biodiversity will be encouraged by creating the green roof.

The surface water runoff rate has been restricted to the greenfield runoff rate.

Refer to Appendix D and GARLAND drawing W0622-GAR-XX-XX-DR-C-0010 for the drainage layout and SUDS feature details.

In providing the above green roof, cathcpit manhole, attenuation storage, and greenfield run off vortex control it is proposed that the SUDS treatment of the surface runoff has been adequately provided.

2.2 Surface Water Pipe Network

Storm water from the greenroof will be collected using a pipe network. The pipe network will discharge via a catchpit manhole to an underground geocellular attenuation tank. From here via a controlled outlet to the proposed outfall points, thus mimicking the greenfield situation in so far as possible.

During construction treatment of unlikely events such as, hydro carbon spills or sediments / materials washed into the storm water network during heavy rainfall, will occur at the downstream Bunlickey wastewater treatment plant as the storm water discharges to the combined sewer.

The design of the storm water network and SUDS are based on the following conservative permeability factors for the developed site;

- Roofs; 100% runoff. (This is conservative as a green roof is being installed)
- Paths and hard landscaping/ paving; 100% runoff.
- Landscape area; 0% runoff.

The storm pipe network has been designed in accordance with IS EN 12056, IS EN 752 and the GDSDS. The design was completed using hydraulic modelling software WinDes 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:

$$Q = 3.61 \times Cv \times i \times Ai$$

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 network is shown on Garland Drawing W0622-GAR-XX-XX-DR-C-0010. The design calculations are provided in Appendix A.

3. FOUL DRAINAGE

A pre-connection enquiry was lodged with Irish Water for this development outlining the proposed flows and loads which would be associated with the residential 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 Irish Water and a copy of the confirmation of feasibility is attached in Appendix F.

It is proposed to provide a single gravity foul sewer system around the apartment block for discharging to the existing combined sewer network below Lower Carey's Road, at the north east boundary of the site. The combined sewer is treated at Bunlickey wastewater treatment plant before discharging to the River Shannon. The current and future Limerick Development Plan states that the main drainage scheme has the capacity to cater for future population growth; ''Irish Water's current wastewater treatment capacity register for County Limerick dated March 2022, states that there is capacity available in 41 no. of the 53 no. wastewater treatment plants (WWTPs). These include Bunlicky and Castletroy WWTPs, which serve the Limerick City Metropolitan Municipal District. These WWTPs require some upgrading and it is envisaged by Irish Water that with the completion of these upgrades, there will be sufficient spare capacity to accommodate the projected growth in Limerick City and Suburbs (in Limerick).''

The proposed foul sewer network layout for this development is shown on GARLAND Drawings W0622-GAR-XX-XX-DR-C-0010. The foul sewer network was designed in accordance with Irish Water Code of Practice July 2020 and to IS EN 12056 and IS EN 752, using hydraulic modelling software WinDes, which uses the Colebrook White equation. These design calculations are included in Appendix C.

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).

4. WATER SUPPLY

A pre-connection enquiry was lodged with Irish Water for this development outlining the proposed water demands for the residential 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 Irish Water and a copy of the confirmation of feasibility is attached in Appendix F. We note that an upgrade of approximately 23m of water pipe is required. We will discuss this further with Irish Water during the full connection application process.

The proposed internal water supply network for the development has been designed in accordance with Irish Water Code of Practice July 2020. The proposed water supply network layout for the development is shown on GARLAND Drawing W0622-GAR-XX-XX-DR-C-0010. It is proposed to connect the development, to the existing water network main that runs below Lower Carey's Road. A bulk meter has been provided at the connection point to the apartment block in compliance with Irish Water Code of Practice. Individual water meters for each unit will be provided within the building.

5. FLOOD RISK

Based on the OPW CFRAMs Map, refer to Appendix E, the site is located outside Flood Risk Zones A and B, therefore located in Flood Risk Zone C. Existing site levels within the development lands are between 11.0 m and 12.5 m AOD above the 1:1000 year flood level of 5.17m in the region. 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.

6. OUTLINE CONSTRUCTION PROGRAMME / METHODOLOGY

The following outline construction programme is envisaged for the project at this stage. We note that a number of factors including further detailed design and the contractor selected will result in the on-going development of the programme and construction methodology. It is proposed that a construction plan will be submitted to the Council in advance of commencement of the works which will include further detail of the construction methodology and sequencing.

Item	Duration (Months)											
Site Establishment												
Reduce Site Levels												
Foundations Excavation												
Construction of Foundations												

Below Ground Rising Elements												
Ground Floor												
Superstructure												
Façade / Water Tight Elements												
Mechanical Installation												
Electrical Installation												
Lift Installation												
Site works including attenuation tank, lighting, services ducts												
Internal Finishes												
Electrical Connection												
Sewer Connection												
Water Connection												
Telecoms Connection												

Signed:

BRIAN LAHIFF
CHARTERED ENGINEER

Date: 27th June 2022

APPENDIX A
Storm Network Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes Irish Manhole Sizes Precast

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	15.000	Add Flow / Climate Change (%)	10
Ratio R	0.300	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	250	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall MHSATT-TANK (pipe S-1.000)

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.101	4-8	0.000

Total Area Contributing (ha) = 0.101

Total Pipe Volume (m³) = 0.056

Time Area Diagram at outfall MHS (pipe S-2.002)

Time (mins)	**Area (ha)**
0-4	0.000

Total Area Contributing (ha) = 0.000

Total Pipe Volume (m³) = 1.382

Network Design Table for Storm

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**
S-1.000	1.416	0.014	100.0	0.101	4.00	0.0	0.600	o	225	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)**
S-1.000	63.59	4.02	9.860	0.101	0.0	0.0	1.7	1.31	52.0	19.2

Network Design Table for Storm

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
S-2.000	10.930	0.064	170.0	0.000	4.00	2.0	0.600	o	225	Pipe/Conduit	
S-2.001	21.926	0.129	170.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-2.002	1.903	0.011	170.0	0.000	0.00	0.0	0.600	o	225	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)
S-2.000	62.72	4.18	9.800	0.000	2.0	0.0	0.2	1.00	39.8	2.2
S-2.001	60.87	4.55	9.736	0.000	2.0	0.0	0.2	1.00	39.8	2.2
S-2.002	60.72	4.58	9.607	0.000	2.0	0.0	0.2	1.00	39.8	2.2

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S-1.000	MHSATT-TANK	11.200	9.846	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S-2.002	MHS	11.200	9.596	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.000	Storm Duration (mins)	30
Ratio R	0.300		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: MHS3, DS/PN: S-2.000, Volume (m^3): 1.7

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	9.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Storage Structures for Storm

Cellular Storage Manhole: MHS3, DS/PN: S-2.000

Invert Level (m) 9.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	32.0	0.0	0.801	0.0	0.0
0.800	32.0	0.0			

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region Scotland and Ireland Cv (Summer) 0.750
M5-60 (mm) 15.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 50.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 30, 100
Climate Change (%) 10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S-1.000	MHS4	120 Winter	30	+10%	30/15 Winter				10.283
ATT TANK		120 Winter	30	+10%	30/15 Summer				10.282
S-2.000	MHS3	120 Winter	30	+10%	30/15 Summer				10.281
S-2.001	MHS2	360 Summer	30	+10%					9.769
S-2.002	MHS1	600 Summer	30	+10%					9.645

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S-1.000	MHS4	0.198	0.000	0.29		8.6	SURCHARGED	
ATT TANK		0.211	0.000	0.30		8.4	SURCHARGED	
S-2.000	MHS3	0.256	0.000	0.06		2.0	SURCHARGED	
S-2.001	MHS2	-0.191	0.000	0.05		2.0	OK	
S-2.002	MHS1	-0.187	0.000	0.07		2.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region Scotland and Ireland Cv (Summer) 0.750
M5-60 (mm) 15.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 50.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 30, 100
Climate Change (%) 10, 10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S-1.000	MHS4	120 Winter	100	+10%	30/15 Winter				10.482
ATT TANK		120 Winter	100	+10%	30/15 Summer				10.482
S-2.000	MHS3	120 Winter	100	+10%	30/15 Summer				10.480
S-2.001	MHS2	120 Summer	100	+10%					9.769
S-2.002	MHS1	600 Summer	100	+10%					9.645

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S-1.000	MHS4	0.397	0.000	0.37		11.1	SURCHARGED	
ATT TANK		0.411	0.000	0.39		10.8	SURCHARGED	
S-2.000	MHS3	0.455	0.000	0.06		2.0	SURCHARGED	
S-2.001	MHS2	-0.191	0.000	0.05		2.0	OK	
S-2.002	MHS1	-0.187	0.000	0.07		2.0	OK	

APPENDIX B
Attenuation Calculations

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 104 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.212	0.412	0.0	2.0	2.0	12.5	O K
30 min Summer	10.344	0.544	0.0	2.0	2.0	16.5	O K
60 min Summer	10.440	0.640	0.0	2.0	2.0	19.4	O K
120 min Summer	10.474	0.674	0.0	2.0	2.0	20.5	O K
180 min Summer	10.472	0.672	0.0	2.0	2.0	20.4	O K
240 min Summer	10.459	0.659	0.0	2.0	2.0	20.0	O K
360 min Summer	10.422	0.622	0.0	2.0	2.0	18.9	O K
480 min Summer	10.378	0.578	0.0	2.0	2.0	17.6	O K
600 min Summer	10.330	0.530	0.0	2.0	2.0	16.1	O K
720 min Summer	10.270	0.470	0.0	2.0	2.0	14.3	O K
960 min Summer	10.168	0.368	0.0	2.0	2.0	11.2	O K
1440 min Summer	10.027	0.227	0.0	2.0	2.0	6.9	O K
2160 min Summer	9.926	0.126	0.0	1.9	1.9	3.8	O K
2880 min Summer	9.889	0.089	0.0	1.7	1.7	2.7	O K
4320 min Summer	9.866	0.066	0.0	1.3	1.3	2.0	O K
5760 min Summer	9.856	0.056	0.0	1.0	1.0	1.7	O K
7200 min Summer	9.850	0.050	0.0	0.9	0.9	1.5	O K
8640 min Summer	9.846	0.046	0.0	0.8	0.8	1.4	O K
10080 min Summer	9.843	0.043	0.0	0.7	0.7	1.3	O K
15 min Winter	10.267	0.467	0.0	2.0	2.0	14.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	73.683	0.0	14.0	18
30 min Summer	50.453	0.0	19.1	32
60 min Summer	32.616	0.0	24.7	60
120 min Summer	20.379	0.0	30.9	100
180 min Summer	15.355	0.0	35.0	134
240 min Summer	12.524	0.0	38.0	168
360 min Summer	9.378	0.0	42.7	238
480 min Summer	7.626	0.0	46.3	308
600 min Summer	6.491	0.0	49.3	378
720 min Summer	5.689	0.0	51.8	440
960 min Summer	4.617	0.0	56.1	558
1440 min Summer	3.437	0.0	62.6	792
2160 min Summer	2.558	0.0	69.9	1124
2880 min Summer	2.075	0.0	75.6	1468
4320 min Summer	1.542	0.0	84.3	2200
5760 min Summer	1.249	0.0	91.0	2936
7200 min Summer	1.060	0.0	96.5	3672
8640 min Summer	0.926	0.0	101.3	4304
10080 min Summer	0.827	0.0	105.4	5104
15 min Winter	73.683	0.0	15.6	18

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.417	0.617	0.0	2.0	2.0	18.8	O K
60 min Winter	10.532	0.732	0.0	2.0	2.0	22.3	O K
120 min Winter	10.578	0.778	0.0	2.0	2.0	23.7	O K
180 min Winter	10.572	0.772	0.0	2.0	2.0	23.5	O K
240 min Winter	10.551	0.751	0.0	2.0	2.0	22.8	O K
360 min Winter	10.489	0.689	0.0	2.0	2.0	20.9	O K
480 min Winter	10.418	0.618	0.0	2.0	2.0	18.8	O K
600 min Winter	10.340	0.540	0.0	2.0	2.0	16.4	O K
720 min Winter	10.240	0.440	0.0	2.0	2.0	13.4	O K
960 min Winter	10.091	0.291	0.0	2.0	2.0	8.8	O K
1440 min Winter	9.935	0.135	0.0	1.9	1.9	4.1	O K
2160 min Winter	9.879	0.079	0.0	1.5	1.5	2.4	O K
2880 min Winter	9.865	0.065	0.0	1.2	1.2	2.0	O K
4320 min Winter	9.852	0.052	0.0	0.9	0.9	1.6	O K
5760 min Winter	9.845	0.045	0.0	0.8	0.8	1.4	O K
7200 min Winter	9.841	0.041	0.0	0.6	0.6	1.2	O K
8640 min Winter	9.838	0.038	0.0	0.6	0.6	1.1	O K
10080 min Winter	9.835	0.035	0.0	0.5	0.5	1.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	50.453	0.0	21.4	32
60 min Winter	32.616	0.0	27.7	60
120 min Winter	20.379	0.0	34.6	112
180 min Winter	15.355	0.0	39.2	142
240 min Winter	12.524	0.0	42.6	180
360 min Winter	9.378	0.0	47.8	258
480 min Winter	7.626	0.0	51.9	334
600 min Winter	6.491	0.0	55.2	410
720 min Winter	5.689	0.0	58.0	470
960 min Winter	4.617	0.0	62.8	578
1440 min Winter	3.437	0.0	70.1	792
2160 min Winter	2.558	0.0	78.3	1104
2880 min Winter	2.075	0.0	84.7	1468
4320 min Winter	1.542	0.0	94.4	2200
5760 min Winter	1.249	0.0	101.9	2944
7200 min Winter	1.060	0.0	108.1	3584
8640 min Winter	0.926	0.0	113.4	4344
10080 min Winter	0.827	0.0	118.1	5048

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.101

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.100	4	8	0.001

Model Details

Storage is Online Cover Level (m) 11.400

Cellular Storage Structure

Invert Level (m) 9.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	32.0	0.0	0.801	0.0	0.0
0.800	32.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	9.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

APPENDIX C
Foul Sewer Network Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes Irish Manhole Sizes Precast

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	10
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	0.000
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	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
F-1.000	7.540	0.038	200.0	0.000	36	2.0	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)
F-1.000	9.500	0.000	2.0	36	0.4	54	0.55	0.81	32.2	4.0

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)
F-1.000	MHF-	11.000	9.462	0.000	0	0

APPENDIX D
Product Information

CI/SfB | (29) | |

IRISH AGRÉMENT BOARD
CERTIFICATE NO. 18/0401

Alderburgh Ltd,
Solution House, Dane Street
Rochdale, OL11 4EZ
Tel: +44(0)1706 374416 Fax: 01706376785
Email: info@alderburgh.com

Pluvial Cube Attenuation and Infiltration Systems

Stürmen Sie Wasser Leitung System

NSAI Agrément (Irish Agrément Board) is designated by Government to carry out European Technical Approvals.

NSAI Agrément Certificates establish proof that the certified products are **'proper materials'** suitable for their intended use under Irish site conditions and in accordance with the **Building Regulations 1997 to 2017.**

PRODUCT DESCRIPTION:
This Certificate relates to the Pluvial Cube attenuation and infiltration system which comprises of modular polypropylene units which, in conjunction with a satisfactory civil engineering design, will act as either an attenuation or infiltration vessel as part of a sustainable drainage system.

The Pluvial Cube system consists of modular polypropylene units, low flow maintenance and self-cleaning channels.

USE:
The product is used as a subsurface stormwater management system, used for sub-surface water storage or as a soakaway to manage rain water run-off from impermeable surfaces. Subject to site conditions and restraints, the Pluvial Cube system modules can be built up to create the volumetric capacity required for

- Attenuation system
- Infiltration system.
- Or a combined attenuation/infiltration system.

MANUFACTURE AND MARKETING:
The product is manufactured and marketed by:

Alderburgh Ltd.
Solution House,
Dane Street,
Rochdale,
OL11 4EZ.
Tel: +44(0)1706 374416 Fax: 01706376785
Email:info@alderburgh.com

1.1 ASSESSMENT

In the opinion of NSAI Agrément, the Pluvial Cube system, if used in accordance with this Certificate, meets the requirements of the Building Regulations 1997 - 2017 as indicated in Section 1.2 of this Certificate.

1.2 BUILDING REGULATIONS 1997 to 2017

REQUIREMENT:

Part A – Structure

A1 - The Pluvial Cube system, as certified in this Certificate, can be designed to ensure that the combined dead and imposed loads are sustained and transmitted to the ground in compliance with CIRIA C737 *Structural and geotechnical design of modular geocellular drainage systems*.

Part D - Materials & Workmanship

D3 – The Pluvial Cube system, as certified in this Certificate, is comprised of proper materials fit for their intended use (See Part 4 of this Certificate).

D1 – The Pluvial Cube system, as certified in this Certificate, meets the requirements of the building regulations for workmanship.

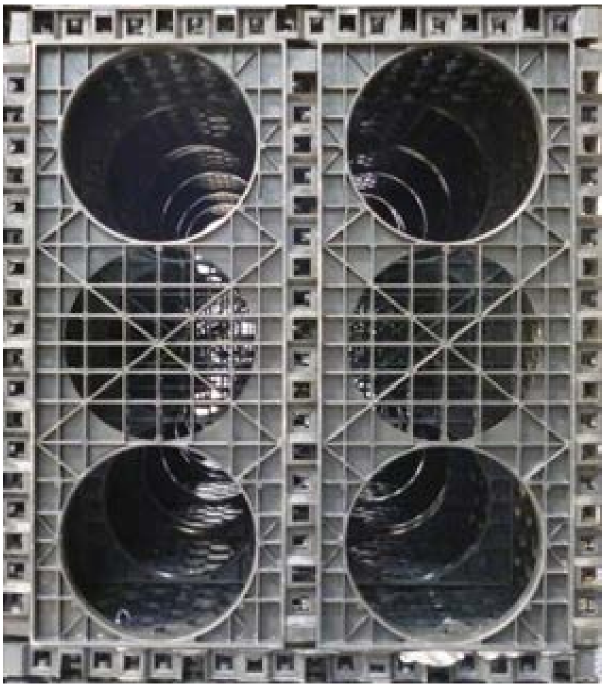
Part H – Drainage and waste water disposal.

H1 - The Pluvial Cube system, as certified in this Certificate, meets the requirements of the building regulations for the adequate disposal of surface water from the building.

2.1 Production Description

This Certificate relates to the Pluvial Cube system a subsurface Stormwater Management System. The modular units are manufactured from black polypropylene. The units are assembled on either a permeable geotextile when used for infiltration or on an impermeable geomembrane when used for attenuation.

The units, which have a high void ratio, are assembled to form an underground structure which can be used for storage of surface water or as a soakaway to form part of a sub-surface water management system.



500(L) x 500(W) x 550(D)
Figure 1 - Pluvial Module

The Pluvial Cube module incorporates six 160mm diameter opes in one orientation, four of which are open, and these extend through the module. These opes can accommodate semi-circular distribution pipes or linear access channels. These channels can assist the passage of silt through the system during period of low flow.

Larger diameter distribution pipes up to 360 mm can be accommodate in the perpendicular orientation by forming openings through the side and central walls of the Pluvial Cube module. Larger opening are not suitable for semi-circular pipes but can accommodate perforated circular pipes which can fully support the modified Pluvial Cube module. When it is necessary to accommodate a larger opening than the preformed 160mm diameter opening, guidance from the certificate holder must be followed.

160mm Ø Open Channel
Figure 2 - Pluvial Cube Module

This certificate does not cover collection or disposal of the surface water. Information relating to this matter can be obtained from the Certificate holder. The Pluvial Cube system is suitable for use as an integral part of an overall surface water drainage scheme and can perform the function of either an attenuation tank or and infiltration/soakaway or a combination of both.

2.1.1 Ancillary Items

The Pluvial Cube units are installed with the aid of several ancillary items as outlined hereunder [(§)]

- Geotextiles
- Geomembranes - Impermeable Membrane
- Pipe distribution network
- Inlet manhole
- Outlet Manhole
- Hydrobrake flow control device
- Vent pipes
- Fittings/adaptors
- Petrol/oil interceptor

2.2 Manufacture

The units are manufactured from recycled polypropylene by an injection moulding process.

[§] Outside the scope of this Certificate.

Pluvial Cube Module Dimensions (mm) (l x w x h)	Module Configuration	Units per m³	Module Volume (m³)
500 x 500 x 550	Single	7.27	0.1375
500 x 500 x 1075	Double	3.72	0.2688
500 x 500 x 1600	Triple	2.5	0.4

Table 1 - Physical properties

Product Data	Pluvial Cube Module		Units
	Vertical	Lateral	
Compressive Strength	400	225	kN/m^2
Creep Rupture Test	317	201	kN/m^2
Design strength	176	110	kN/m^2
Average Weight - single module	8		kg
Void Ratio	96		%
Surface Void Ratio	Greater than 90		%
Minimum Backfill Cover#	450		mm
Maximum Backfill Cover	7500		mm
#Any cover less than 450 mm - contact ESS design department			

Table 2 - Product Data

Certified raw materials are supplied to the manufacturer to an agreed specification. The manufacturer carries out quality control checks on incoming raw materials, before manufacture of the Pluvial Cube modules commence.

As part of the assessment process an audit of the manufacturing process was carried out by NSAI. The manufactures quality control procedures and product testing was assessed along with product traceability and satisfactory controls were in place at the time of the audit to meet these requirements.

The manufacturer demonstrated that satisfactory processes were in place to manage nonconformities and complains should they arise.

The manufacturers testing laboratory was inspected and the equipment used to carry out quality control checks on the manufactured product were found to be properly tested, calibrated and operated by trained personnel.

The manufacture has undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

The management system of Alderburgh has been assessed and registered as meeting the requirements of EN ISO 9001 and ISO 14001.

2.3 Delivery, Storage and Marking

The system is supplied to site on pallets, secured with shrink wrap and banding to enable placing and movement by a forklift truck. Each pallet contains a label bearing the Pluvial Cube type, date of manufacture, operator's name, pallet no., and quality control check.

Labels are attached to pallets which display the NSAI Agrément Logo and Certificate number.

The polypropylene chambers are sensitive to UV radiation and as a result exposure to sunlight for prolonged periods must be avoided.

Individual chambers may be carried by one person; normal manual handling precautions should be taken. The mass of one unit/module is given in Table 2.

2.4 Installation

2.4.1 General

Prior to commencing site installation, a full site investigation and design as outlined in section 3.0 of this certificate must be completed by a Chartered Engineer or suitable qualified person.

Once a location has been specified and invert levels checked, the entire area should be checked for buried cables and utilities. Designers and/or project managers' design stage (PMDS), as part of their assessment of Health and Safety, must consider all aspects of the site installation.

Designers should consider the following non-exhaustive Health and Safety issues

- access for plant such as excavators
- embankment angle of excavations
- installation of temporary works if necessary for deep excavations.
- reducing local water table levels if necessary
- floatation concerns both during and post installation

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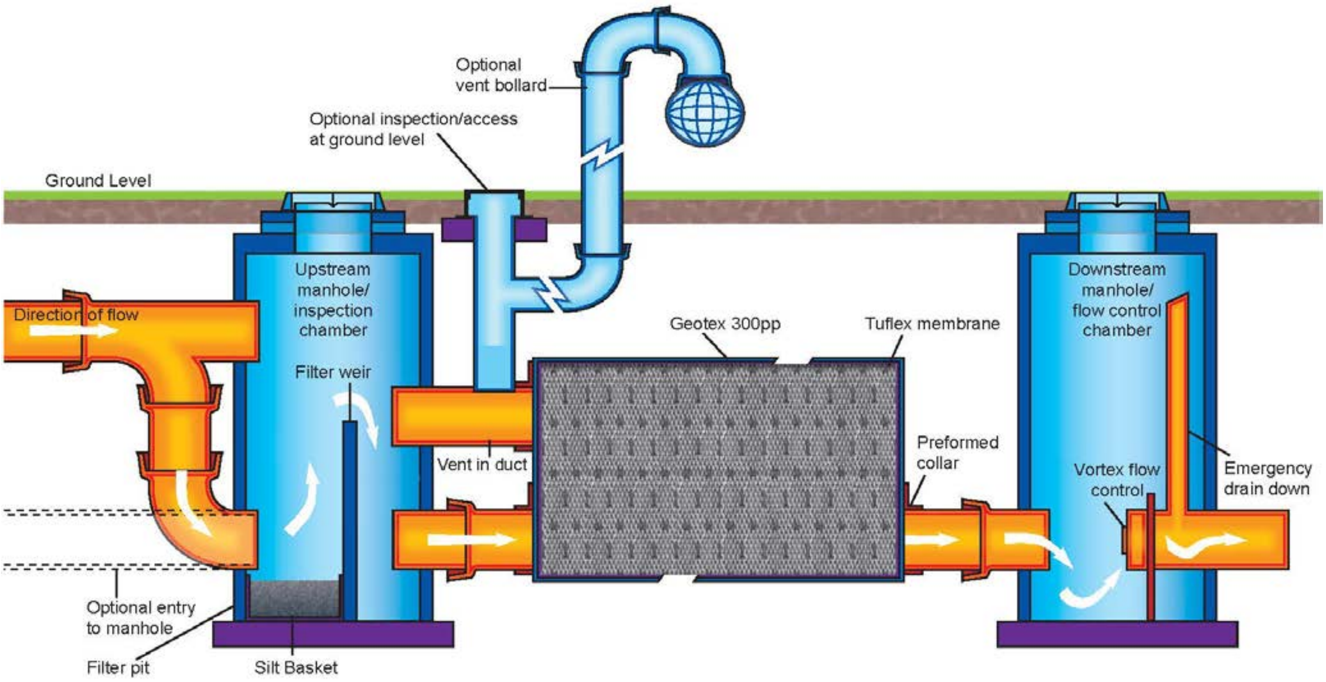

Figure 3 - Typical layout

2.4.2 Installation Procedure

A trench is excavated to the required depth, dimensions and formation levels. The plan area should be sufficient to allow compaction plant access around the sides of the excavation to place and compact backfill material. The base must be smooth and level without sharp drops or humps. Slopes must be cut to a safe angle or adequately supported and safe access must be provided to allow personnel to enter the excavation.

The formation level must be inspected for soft spots and if present, soft spots are excavated out and replaced with compacted granular fill material.

In general, a California bearing ratio (CBR) of 5% is required at formation level for trafficked areas and 3% for green areas.

A 100mm thick, blinding layer of graded stone, sand or quarry dust is laid on the compacted base of the excavation.

The geotextile (and geomembrane, if an attenuation system) is laid over the blinding layer and up the sides of the excavation. When using a geomembrane, it must always be protected by a layer of geotextile. The geomembrane is inspected for damage and all welds are tested as required. Joints between adjacent sheets of impermeable membranes should be sealed correctly using proprietary welding techniques with a minimum lap of 120mm. Outer protective geotextiles must have a minimum overlap of 150mm.

The Pluvial Cube units are installed in the orientation outline on the site-specific design drawings.

Drainage connections are made to the installation using proprietary adaptors. It is recommended by the certificate holder that all connections and air vent installations, in attenuation applications, are made with a flange adaptor, using thermal welding, adhesive cement or double-sided tape to form a seal.

Once the modular units are placed they are then wrapped with the geotextile filter fabric or geomembrane, which is brought up around the sides and lapped over the top of the structure.

The Main Contractor is to indicate outside pipe diameters and the position of all inlet and outlet pipes. Generally, pipes need to be no larger than 450 mm while using a 550 mm deep modular unit (contact manufacturer for information while using other types of modular units). Also, pipes should be positioned at 90° to the structure.

The installation is backfilled with 100mm of Type B material (Gas permeable unbound granular fill) as defined in SR21 Guidance on the use of I.S. EN 13242:2007+A1:2007, or similarly approved specification. The backfill is compacted in 150mm layers and should be free from partials exceeding 40mm in diameter.

3.1 Design General
The Pluvial Cube Stormwater Management System must be designed in accordance with the Certificate holder's instructions. Guidance on the application of sustainable drainage systems (SUDS) for new developments can be found in the TII publication DN-DNG03072 *Design of Soakaways* and the 2015 SUDS Manual C753 published by the Construction Industry Research and Information Association (CIRIA).

3.2 Design options
The system can be used for the control of run-off from impermeable surfaces in three main ways:

- **Infiltration** — water is collected in the units during rainfall and allowed to drain away by soaking into the surrounding ground over a period of time
- **Attenuation** — water is collected in the units during rainfall and released at a reduced flow rate through a flow control device into an appropriate outfall. This reduces peak flows in the watercourse, thereby minimising the risk of flooding
- **Combined** — a combination of the above two systems.

3.3 Site Investigation
Design of the appropriate system for a specific project must always be preceded by a detailed audit of the proposed site to establish:

- Existing factors and considerations applicable to the site
- Predicted factors relating to the site's use following the planned development, and the parameters within which the installation will be required to function
- The type of function of application suggested by this audit.

3.4 Drainage system selection
The following non- exhaustive list of factors must to be considered in any systems design and these factors will influence the final design solution.

- The area to be drained
- The area available to accommodate the Pluvial Cube Stormwater Management System
- Proximity of adjoining buildings must be > 5m
- Site levels
- Elevation of downstream drainage systems
- The rainfall intensity
- Provision of upstream silt traps
- Site topography and stability
- Existing water table
- Seasonal groundwater levels
- Soil properties, e.g. CBR value, stiffness, infiltration potential, etc.
- Future upstream developments from drainage basin if required.

3.5 Drainage system design.
Once the project criteria have been established from the site audit, there are two main parts to the design procedure: hydraulic design (Clause 3.6) and structural design (Clause 3.12).

The design selection flow chart in Figure 4 can be followed to establish the optimum stormwater management design solution.

3.6 Hydraulic Design
3.6.1 Infiltration
There are two approaches, either of which may be adopted:
- the Construction Industry Research and Information Association (CIRIA) Report 156 *Infiltration Drainage — Manual of Good Practice*
- BRE Digest 365, Soakaway design

Further information on the design of Sustainable Drainage Systems (SuDS) may be obtained from CIRIA Report C753 which is the SuDS Manual 2015.

3.6.2 Simplified Infiltration Design
A simplified approximate approach can be used on a small site (i.e. a single-house development), where detailed site infiltration rate information may not be required nor available (see Table 3). A storage volume equal to the area to be drained multiplied by 10 mm, for areas up to 25 m^2 is allowed.

Beyond this size, design should be carried out in accordance with I.S. EN 752:2017 or BRE Digest 365. It is suggested in I.S. EN 752:2017 that a storage volume equal to 20 mm multiplied by the area to be drained may be used.

The method shown above for areas up to 25 m^2 has been used to calculate the Soakaway storage volumes below in Table 3.

Simplified soakaway design for single-house development [1]		
Number of units	Storage volume (m^3)	Maximum area to be drained (m^2)
1	0.132	13.2[2]
2	0.258	25.0[2]
4	0.547	28.5[3]
6	0.768	40.0[3]
[1] When doubt exists over suitability of ground for infiltration permeability, figures should be derived by test (see BRE Digest 365). [2] In accordance with TGD Part H. [3] In accordance with I.S. EN 752:2017		

Table 3

Data for use in hydraulic design - one-unit wide trench configuration			
Number of units high	System volume (m^3)	Vertical surface area around sides and ends of tank (m^2)	Surface area beneath base of tank (m^2)
1	0.132	1.1	0.25
2	0.258	2.15	0.25

Table 4

Data for use in hydraulic design - Three-dimensional system, two units high									
System length (Two units long) (1 m side)	2 units long x 2 units wide x 2 units high (1m x 1m x 1.075m)			4 units long x 2 units wide x 2 units high (2m x 1m x 1.075m)			8 units long & 2 units wide x 2 units high (4m x 1m x 1.075)		
	Volume (m^3)	Side area (m^2)	Base area (m^2)	Volume (m^3)	Side (m^2)	Base (m^2)	Volume (m^3)	Side (m^2)	Base (m^2)
1	1.075	1.075	1.0	2.15	6.45	2.0	4.30	10.75	4.0
2	2.15	6.45	2.0	4.30	8.6	4.0	8.60	12.90	8.0
4	4.30	10.75	4.0	8.60	12.9	8.0	17.2	17.20	16.0
8	8.6	19.35	8.0	17.2	21.5	16.0	34.4	25.80	32.0
10	10.75	23.65	10.0	21.5	25.8	20.0	43.0	30.10	40.0
100	107.5	217.15	100.0	215.0	219.3	200.0	430.0	223.6	400.0

Table 5

3.6.3 Detailed Infiltration Design

When the BRE 365 or CIRIA 156 approach is used, the design volumes and areas for trench or cuboid type installations can be found in Table 4 and Table 5 of this certificate.

For calculations, the size and volume of the units are given in Table 1. The total areas of the base and sides are required as water is absorbed through the geotextile soil interface. Storage volume is 96% of the total volume.

As an example, using Table 5, for a typical system 1 m wide (two units) linear trench 10 m long and two units high, the volume is 1.075m x 1m x 10m = 10.75 m^3 and the side area 1.075m x (10m x 2 + 1m x 2) = 23.65 m^2.

3.6.4 Attenuation Calculation principles

The anticipated total run-off volume from the site is estimated. The most commonly-used method for evaluating storm rainfall events is the Wallingford Procedure by which the total rainfall level of storms over defined time periods ranging from five minutes up to 48 hours is assessed.

The allowable discharge rate from the site to an appropriate outfall is established, which will normally be set by the Environment Agency or Planning Authorities. The volume to be stored underground in the system is then determined and the number of units needed to contain this volume is calculated on the basis that the storage volume is equal to 96% of the total volume of the system.

In some situations when looking at a 1 in 100-year return period designers can be asked to increase storage capacity by 20% to allow for climate change.

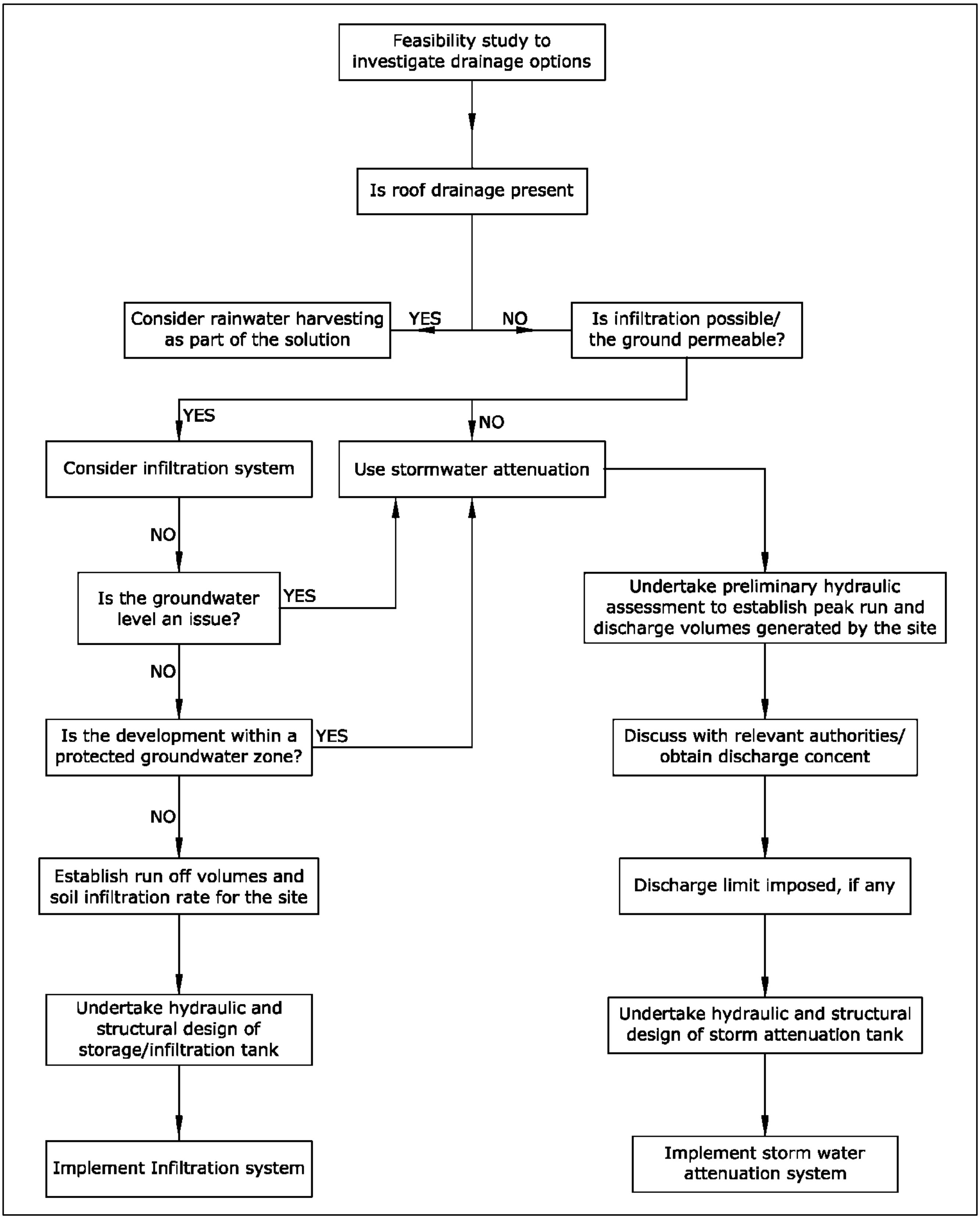

Figure 4 - Design flow chart

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Maximum installation depths (m) (to base of system)					
Typical soil type	Soil weight (kN/m³)	Angle of internal friction	Maximum installation depth (from base) (m)		
			Small Domestic gardens/Landscaped areas (adjacent to drives or roads)	Car Park Without barriers Traffic (LM3)	HGV Parks Traffic (LM1)
Over consolidated stiff clay	20	24°	5.5	5.25	5.00
Silty sandy clay	19	26°	6.0	5.75	5.50
Loose sand and gravel	18	30°	6.5	6.25	6.00
Medium-dense sand and gravel	19	35°	7.0	6.75	6.50
Dense sand and gravel	20	38°	7.5	7.25	7.00

(1) Trafficked areas vehicles up to gross vehicle weight (GVW), defined in CIRIA C737, Load models LS, LM3 and LM1.

(2) Non-trafficked areas taken as small gardens or landscaped areas where no vehicles are used, defined in CIRIA C737, Table 5.6.

(3) Depth to invert with high groundwater is depending on the groundwater level

(4) Soil Unit weights Table 5.4/ Angle of Friction Table 5.5 CIRIA C737

Table 6

Minimum cover depths over Pluvial Cube				
Live load conditions	Landscaped area[1]	Trafficked		
		Small domestic gardens/Landscaped areas (adjacent to drives or roads)	Car Park Without barriers Traffic (LM3)	HGV Parks Traffic (LM1)
Minimum cover depth 450 over system to prevent accidental damage (mm)	450	600	600	900

(1) Landscaped areas taken as small gardens or landscaped areas where no vehicles are used, defined in CIRIA C737, Table 5.6.
(2) Trafficked (Car Parks) Loading Model LM3 defined in CIRIA C737, Table 5.6.
(3) Trafficked (HGV Parks and Loading Bays) Loading Model LM1 defined in CIRIA C737, Table 5.6.

Notes:

- Assumes angle of friction of the surrounding soil of 35° and a soil weight of 20 kN/m³.
- The load spread through asphaltic surfaces (for trafficked areas) is assumed to be 26.5°.
- The load spread through landscaped areas is assumed to be 26.5°.
- Ground surface is horizontal.
- Shear planes or other weaknesses are not present within the structure of the soil.
- Calculations based on there being no groundwater present.
- Accidental loading is not considered.
- Partial load and material factors shall be as defined in Table 5.9.

Table 7

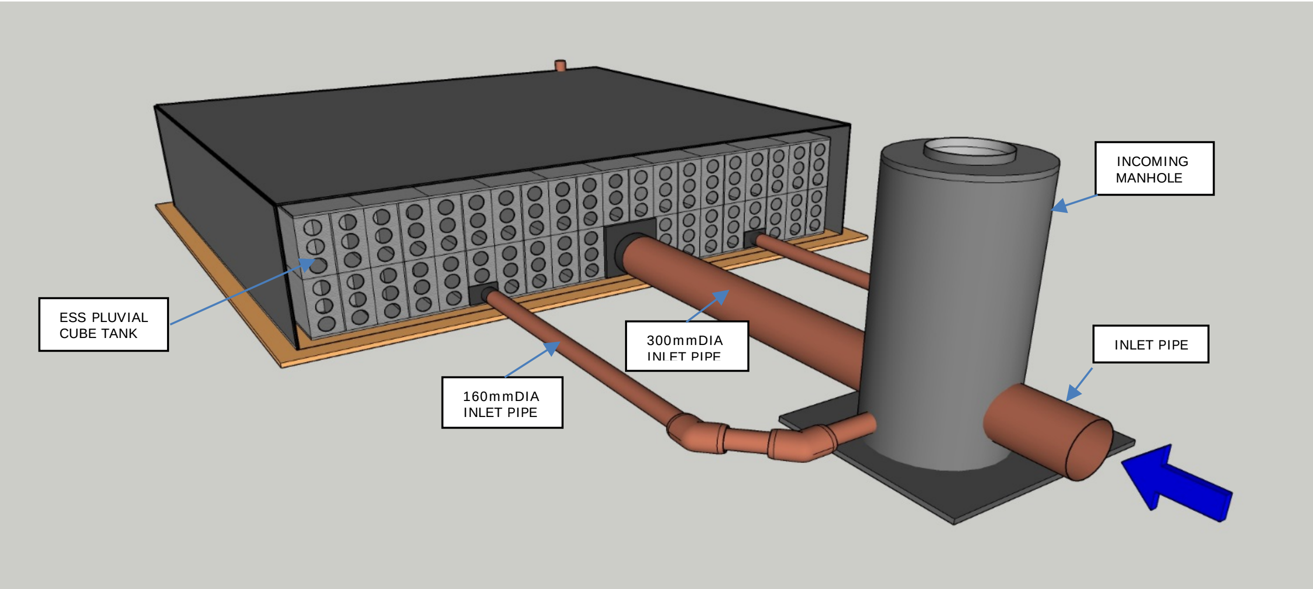

Figure 5 - Typical manifold design

3.7 Outlet Connections
The outlet of detention systems should incorporate a flow control device. The flow control device and the connecting pipe work are not covered by the scope of this Certificate. It is recommended that all connections out of storage applications (using a geomembrane) are made using a flange adaptor. Adhesive cement or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

3.8 Inlet Connections
Any inlets, etc., should be installed flush (i.e. 'butted up') to the tank and are to be surrounded in concrete to the specification of the engineer. The geotextile filter fabric shall be cut to enable hydraulic continuity at the inlet and outlets and secured around the pipe using a suitable coupling prior to the application or the concrete surround to ensure a secure seal. A similar procedure shall occur in respect to the venting pipes.

Tank requires ventilation units to ensure proper hydraulic performance. Number of vent pipes depends on the size of the tank (contact manufacturer for details). Vents are often installed using a 90° elbow etc. with PVC pipe into soft landscape area with 'u' bend or venting bollard to inhibit the ingress of debris, etc., and secure using suitable solvent bonded or mechanical couplings. Alternatively, a ground level ventilated concrete/steel cover can be fixed to suit.

3.9 Manifold design and silt control system
The units are manufactured to allow a connection to be formed by insertion of 160 to 360 mm diameter pipes into the knock-out section incorporated in each cell. The capacity of a 160mm pipe is limited and may be insufficient for the anticipated design flow. The flow may be split amongst a number of 160 to 360 mm pipes connected to a manifold to provide increased hydraulic capacity. To control the build-up of sediment, the Pluvial Cube system incorporates self-cleaning low flow channels. These are usually located at inlet/outlet pipes locations that receive sediments in storm water and are configured with an upstream manhole and pipe access for inspection and removal of sediments, it is also possible to enclose the inlet/outlet channel in a filter fabric (Geotex 225 FF which removes the passage of TSS to 40 micron) to catch sediments in this channel only allowing clean water to enter the rest of the tank. The system designer should ensure the pipework connecting the Pluvial Cube units to the drainage system has sufficient capacity to cope with the design flow.

3.10 Flow control
The outflow from the system must be controlled to comply with the discharge rate consent of the site. The main methods to achieve outflow control are: orifice plate, vortex control or small pipe. Comparative features and benefits of these various control flow devices should be considered prior to selection.

3.11 Outflow and head calculations
The invert level of the outflow pipe should be flush with the bottom of the lowest unit to allow

the system to drain. As the system fills, a depth of water develops on the upstream side of the outflow control. For a system with two layers of units, this depth is 1.075 m when the units are full, creating a driving head to push the flow through the control device. For design purposes, the head used in calculations is taken as that at the invert line of the outflow device.

3.12 Structural Performance

3.12.1 General

The system may be placed under a wide variety of landscaped or trafficked areas and must be designed to carry all loads that will be applied, including dead and imposed loads.

The certificate holder provides a site specific structural design for each project which follows the design methodology outlined in CIRIA C737 *Structural and geotechnical design of modular geocellular drainage systems.* As part of that design, a site investigation report will form an integral part of the structural design.

When used for infiltration below trafficked areas and close to structures. It is important to ensure that the infiltrating water will not soften the soils or cause loss of fines and settlement.

In addition to dead and live loads, designers must consider flotation due to high surrounding water tables in times when the tank is empty. When flotation is likely to occur, sufficient overburden should be provided.

3.12.2 Structural Design Inputs

The certificate holder will carry out a structural design to comply with CIRIA C737. Prior to commencing the structural design, a geotechnical site investigation will be carried out to acquire information on the site history, the site geology and the ground and groundwater conditions likely to be encountered at the site.

As part of the design process, the certificate holder uses the "*Design and construction classification and check proforma*" from Annex A1 of CIRIA C737. The principle aim of the scoring system is to identify projects with high intrinsic complexity and/or where the consequences of failure are severe.

3.12.3 Design strength of units

The design strength of the Pluvial Cube is the characteristic strength modified by the appropriate material partial factor.

$$P_d = {}^{P_{ck}}/_{\gamma_m}$$

Where:
P_d = design strength
P_{ck} = characteristic strength (at design life)
γ_m = material partial factor

The characteristic strength is derived from load test data. The material partial factor needs to take account of a wide range of factors including:

1. Manufacturing process, and geocellular unit variability.
2. Extrapolation of test data, between test durations and design life and other selected key design periods.
3. Differences between strengths mobilised under different loading scenarios (e.g. laboratory compared with buried units).
4. Susceptibility to damage during construction, in particular how the units are backfilled, including compaction pressures.
5. The global behaviour of the units, especially when multiple units are stacked together.
6. Environmental effects, exposure to chemicals, UV light, extreme temperatures etc.

The characteristic strength of the Pluvial Cube units has been derived from a combination of compressive load tests and creep rupture tests as described in CIRIA C737. The derivation of unit strength given in CIRIA C737 allows the designer to extrapolate a characteristic design strength for a specified design life (50 years) based on a series of creep rupture test data results.

The design strength and calculated characteristic strength for the 50-year design life are given in Table 8.

Design Strength of Pluvial Cube		
	Vertical loading kN/m^2	Lateral loading kN/m^2
Characteristic strength (P_{ck})	317	201
Design strength (P_d)	176	110
§ A material partial factor (γ_m) of 1.8 has been applied based on - Factory production: with independent audited - Extrapolation of 5000 hr creep rupture test data to 50-year value - Only laboratory test data - Only laboratory data on single units - Allowance for Damage during construction		

Table 8

Load factors for ultimate and serviceability limit state checks (γ_{LF})				
Persistent and transient design situations	Permanent actions		Variable action (unfavourable)[1]	Accidental action
	Unfavourable	Favourable		
ULS				
Vertical loads	1.35	1.0	1.5	1.0
Lateral loads – Combination 1 in EC7[2]	1.35	1.0	1.5	1.0
Lateral loads – Combination 2 in EC7[2]	1.0	1.0	1.3	1.0
Uplift	1.0	0.95	1.5	1.0
SLS				
All loads	1.0	1.0	1.0	N/A

Notes
Any variable favourable loads should be taken as zero, i.e. partial factor applied = 0.
Combination 2 in EC7 is an assessment of overall stability in the ground and should only be considered when assessing overall slope stability or overall stability of the units (i.e. overturning). Combination 1 in EC7 should be used to check the ability of the units to withstand the applied lateral loads.

- Persistent design situations = permanent works.
- Transient design situations = temporary works.
- Permanent actions = dead loads, such as earth pressure, weight of overburden above unit.
- Variable action = live loads, such as car or HGV loads.
- Unfavourable = destabilising. Favourable = stabilising.
- ULS = stability or collapse checks.
- SLS = checks against excessive deformation, settlement etc.
- Partial factors on loads are multipliers.

Table 9

Cover to geocellular unit (m)	Dynamic load factor
0.5	1.25
1.0	1.2
1.5	1.1
2.0	1.0

Table 10

3.12.4 Derivation of design loads

The characteristic loads are an estimate of the load to be placed on a structure during its design life. The characteristic loads derived for the permanent and temporary works need to be factored to allow for possible variations, in order to calculate the design loads, (Q_d), in accordance with CIRIA C737 Equation 5.12:

Design Loads, $Q_d = \sum(Q_{ck} \times \gamma_{LF} \times \gamma_{df} \times \gamma_{sf})$

Where:
Q_{ck} = characteristic loads
γ_{LF} = load factor
γ_{df} = dynamic factor
γ_{sf} = site factor

The partial load factors given in Eurocode 0 (EC0) and EC7 are summarised in table 5.9 of CIRIA C737 and Table 9 above.

Dynamic factors are outlined in table 5.10 of CIRIA C737 and Table 10 above, and Table 5.11 of CIRIA C737 summarises the site importance factors.

The load and site importance factors are applied to characteristic permanent and variable loads (actions).

The dynamic factors are applied to variable loads (actions) generated by road traffic, for any situation (including accidental load cases) where the geocellular units are within the zone of influence outlined in Clause 3.4 of CIRIA C737.

3.12.5 Zone of influence

The zone of influence is defined in Clause 3.4 of CIRIA C737 and takes account for proximity of adjacent structures and slopes, embankments or soil heaps/stockpiles and retaining walls. It should be noted that an installation does not have to be directly beneath a particular loaded surface or area such as a road or railway for the imposed loading to affect the design.

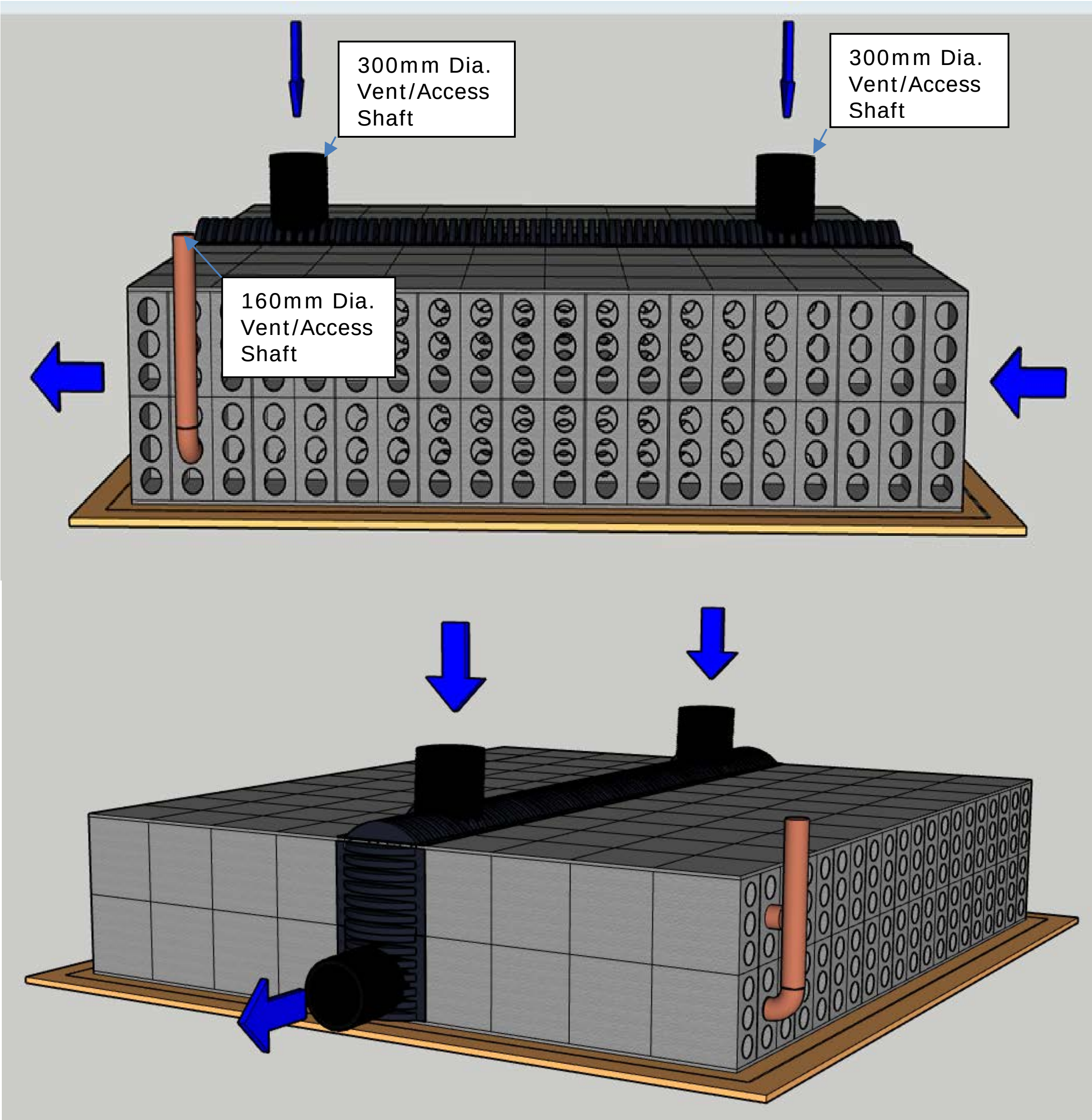

Figure 6 - Typical venting details

3.13 Venting

Adequate venting must be provided to the structure using an air vent. One 160 mm diameter air vent is required per 7500m^2 of impermeable catchment area to be drained or for each 200m^3 of storage volume. At the location where the vent pipe penetrates the impermeable membrane, it is recommended that integrity of the membrane is restored after installation of the vent pipe. This can be achieved using a welded flange adaptor, double-sided adhesive tape or adhesive cement/solvent welding.

3.14 Resistance to Chemicals

An assessment indicates that the components of the system are suitable for use in contact with the chemicals likely to be found in rainwater.

An assessment of the suitability for use of Pluvial Cube units on brownfield sites should be made only after a suitable site investigation to determine the possibility for chemical attack. Care must be taken where acids and organic solvents are present at high concentrations. Further information can be obtained from the Certificate holder.

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3.15 Maintenance
The customer is responsible for maintenance. Recommendations for maintenance of SUDS systems are given in CIRIA C697.

3.15.1 For soakaways to individual houses, the only necessary maintenance is to keep gullies clear of debris such as leaves.

3.15.2 For large installations or where the receiving waters are environmentally sensitive, a system of regular inspections should be established to prevent the accumulation of silt in the system which, if allowed to develop, would reduce effectiveness. They should also be inspected after every major storm event.

3.15.3 It is recommended that a silt trap is incorporated into the pipework at the inlet to the tank. There must be a maintenance plan that ensures regular cleaning of the trap to ensure correct performance. Silt traps for use with this system are outside the scope of this Certificate.

3.15.4 For all flow control devices, it is sensible to incorporate access (via a manhole or similar) to the location of the pipe entry, orifice or vortex control. This will enable easy removal of any blockage. The orifice itself may be protected by a debris screen.

3.15.5 Paved surface areas above an installation should be inspected at the same time to ensure the units continue to provide the required structural support.

3.15.6 The open design of the Pluvial Cube module allows inspection of the inside of the structure provided adequate access is available. Each module has a preformed socket from 160 mm up to 360 mm to provide an inspection channel. One inspection channel for each Inlet/outlet row is recommended.

3.16 Durability
The polypropylene used to manufacture the module units will not deteriorate significantly over the life of the structure and will remain chemically stable under exposure to contaminants normally found in a storm-water environment and will not be susceptible to environmental stress cracking.

In common with all thermoplastic structures, the module units will creep with time. This is taken into account in long-term design by the use of a 50-year modulus for the material to allow for accumulated strain under a dead load. The system when used and installed in accordance with this Certificate will have a life in excess of 50 years.

3.17 Installation
The Subsurface Stormwater Management System should be installed in accordance with the Certificate holder's installation instructions.

Installations are generally carried out by the certificate holders approved contractors under their supervision.

Part Four / Technical Investigations 4

4.1 Tests
Tests were carried out on the system to determine:
- short-term resistance to vertical and horizontal loading
- long-term resistance to vertical and horizontal loading
- Volumetric capacity.

4.2 Investigations
The manufacturing process was examined including the method adopted for quality control, and details obtained on the quality and composition of the material used.

An assessment of the system was made in relation to:
- Material properties
- Design procedures.

Site visit was made to assess the practicability and ease of installation and connection.

4.3 Bibliography

- CIRIA Report C737 Structural design of modular geocellular drainage tanks
- BRE Digest 365 Soakaway Design.
- BS 6031:2009 Code of practice for earthworks
- I.S. EN 752:2017 Drain and sewer systems outside buildings - Sewer system management
- I.S. EN 1401-1:2009 Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinylchloride) (PVC-U) — Specifications for pipes, fittings and the system
- I.S. EN ISO 9001:2000 Quality management systems — Requirements

- CIRIA Report 156 Infiltration drainage — Manual of good practice
- CIRIA Report C753 The SuDS Manual 2015
- CIRIA Report SP124:1996 Barriers, liners and cover systems for containment and control of land contamination
- Manual of Contract Documents for Highway Works, Volume 1 Specification for Highway Works
- Manual of Contract Documents for Highway Works, Volume 2 Notes for Guidance on the Specification for Highway Works
- TII publication DN-DNG03072 Design of Soakaways
- PPS25, Development and Flood Risk.

Part Five / Conditions of Certification 5

5.1 National Standards Authority of Ireland ("NSAI") following consultation with NSAI Agrément has assessed the performance and method of installation of the product/process and the quality of the materials used in its manufacture and certifies the product/process to be fit for the use for which it is certified provided that it is manufactured, installed, used and maintained in accordance with the descriptions and specifications set out in this Certificate and in accordance with the manufacturer's instructions and usual trade practice. This Certificate shall remain valid for five years from date of issue so long as:

(a) the specification of the product is unchanged.

(b) the Building Regulations 1997 to 2017 and any other regulation or standard applicable to the product/process, its use or installation remains unchanged.

(c) the product continues to be assessed for the quality of its manufacture and marking by NSAI.

(d) no new information becomes available which in the opinion of the NSAI, would preclude the granting of the Certificate.

(e) the product or process continues to be manufactured, installed, used and maintained in accordance with the description, specifications and safety recommendations set out in this certificate.

(f) the registration and/or surveillance fees due to NSAI Agrément are paid.

5.2 The NSAI Agrément mark and certification number may only be used on or in relation to product/processes in respect of which a valid Certificate exists. If the Certificate becomes invalid the Certificate holder must not use the NSAI Agrément mark and certification number and must remove them from the products already marked.

5.3 In granting Certification, the NSAI makes no representation as to;

(a) the absence or presence of patent rights subsisting in the product/process; or

(b) the legal right of the Certificate holder to market, install or maintain the product/process; or
(c) whether individual products have been manufactured or installed by the Certificate holder in accordance with the descriptions and specifications set out in this Certificate.

5.4 This Certificate does not comprise installation instructions and does not replace the manufacturer's directions or any professional or trade advice relating to use and installation which may be appropriate.

5.5 Any recommendations contained in this Certificate relating to the safe use of the certified product/process are preconditions to the validity of the Certificate. However, the NSAI does not certify that the manufacture or installation of the certified product or process in accordance with the descriptions and specifications set out in this Certificate will satisfy the requirements of the Safety, Health and Welfare at Work Act 2005, or of any other current or future common law duty of care owed by the manufacturer or by the Certificate holder.

5.6 The NSAI is not responsible to any person or body for loss or damage including personal injury arising as a direct or indirect result of the use of this product or process.

5.7 Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is in force at the date of this Certification.

NSAI Agrément

NSAI Agrément

This Certificate No. **18/0401** is accordingly granted by the NSAI to Alderburgh Ltd. on behalf of NSAI Agrément.

Date of Issue: **16th July 2018**

Signed

Seán Balfe
Director of NSAI Agrément

Readers may check that the status of this Certificate has not changed by contacting NSAI Agrément, NSAI, 1 Swift Square, Northwood, Santry, Dublin 9, Ireland.
Telephone: (01) 807 3800. Fax: (01) 807 3842. www.nsai.ie

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.

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.

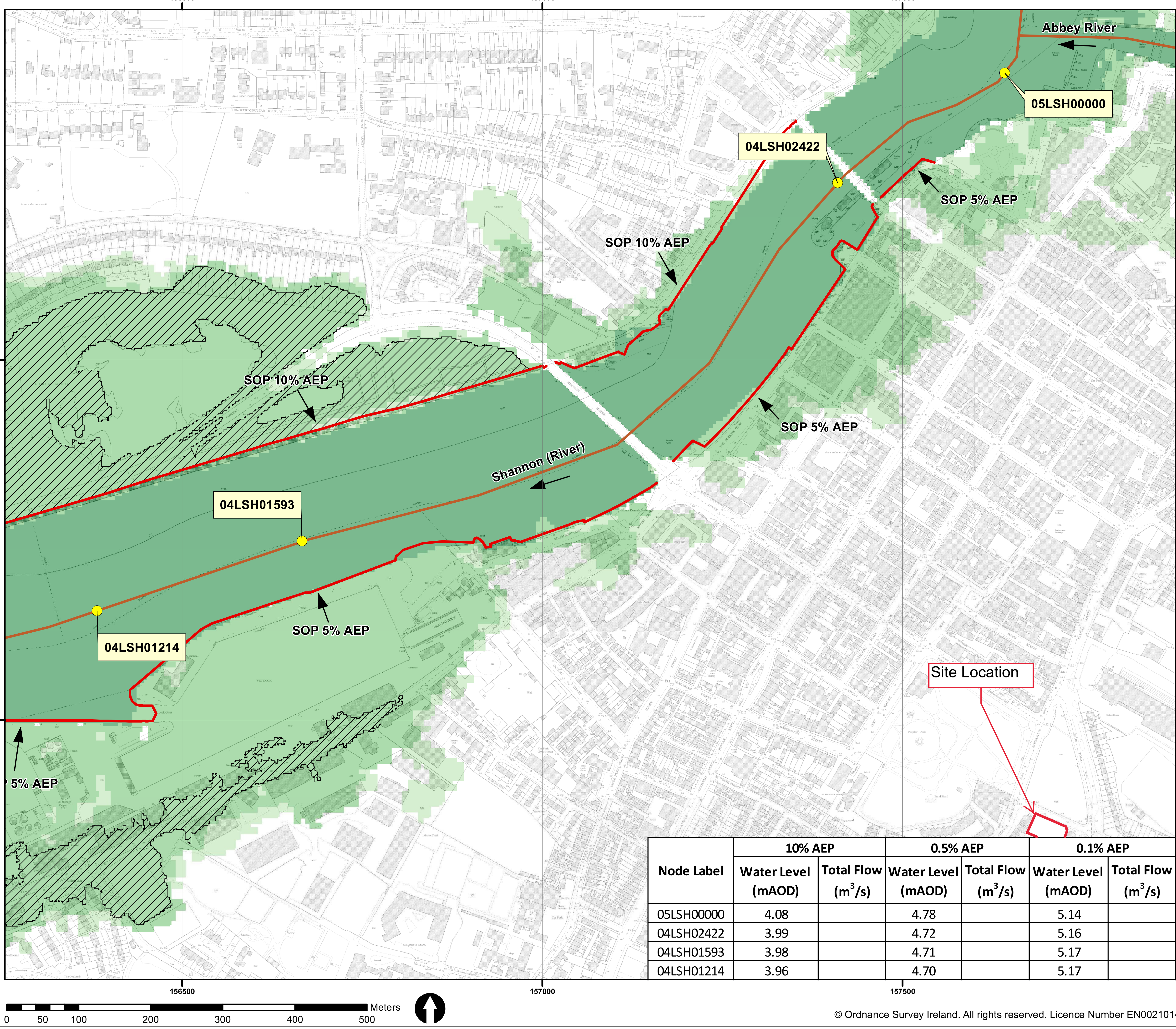
The Hydro-Brake® Optimum offers designers options to precision-engineer a vortex flow control to:

- 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.

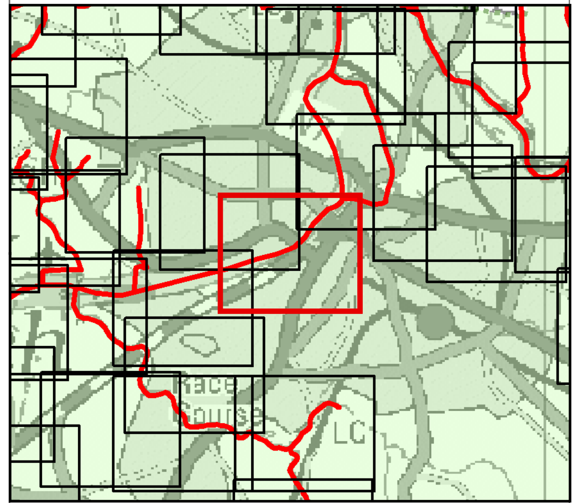
GARLAND
Concepts Realised

APPENDIX E
OPW CFRAMS Map



Node Label	10% AEP		0.5% AEP		0.1% AEP	
	Water Level (mAOD)	Total Flow (m^3/s)	Water Level (mAOD)	Total Flow (m^3/s)	Water Level (mAOD)	Total Flow (m^3/s)
05LSH00000	4.08		4.78		5.14	
04LSH02422	3.99		4.72		5.16	
04LSH01593	3.98		4.71		5.17	
04LSH01214	3.96		4.70		5.17	

Location Plan:



Legend:

- Nodes
- Model Reach
- AFA Boundary
- Flood Defence: Wall
- Flood Defence: Embankment
- Defended Area

10% AEP Coastal Flood Extent
(1 in 10 chance in any given year)

0.5% AEP Coastal Flood Extent
(1 in 200 chance in any given year)

0.1% AEP Coastal Flood Extent
(1 in 1000 chance in any given year)

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

The Office of Public Works
Jonathan Swift Street
Trim
Co. Meath
C15 NX36

Merrion House
Merrion Road
Dublin 4
D04 R2C5

Project:	SHANNON CFRAM STUDY
Map Type:	EXTENT
Source:	COASTAL - TIDAL
Area:	LIMERICK
Scenario:	EXISTING
Drawn by: EH	Date: June 2016
Checked by: KM	Date: June 2016
Reviewed by: MC	Date: June 2016
Approved by: PS	Date: June 2016
Map No.:	S2526LIK_EXCCD_F1_25
Sheet: 25 of 65	Revision: 0
Map Scale: 1: 5000	Plot Scale: 1:1 @ A3

APPENDIX F
Irish Water Confirmation of Feasibility

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

Brian Lahiff,

Riverfront,

Howley's Quay,

Limerick

25 May 2021

Re: CDS21001850 pre-connection enquiry - Subject to contract | Contract denied

Connection for Housing Development of 39 unit(s) at Carey's Road, Limerick, Co. Limerick

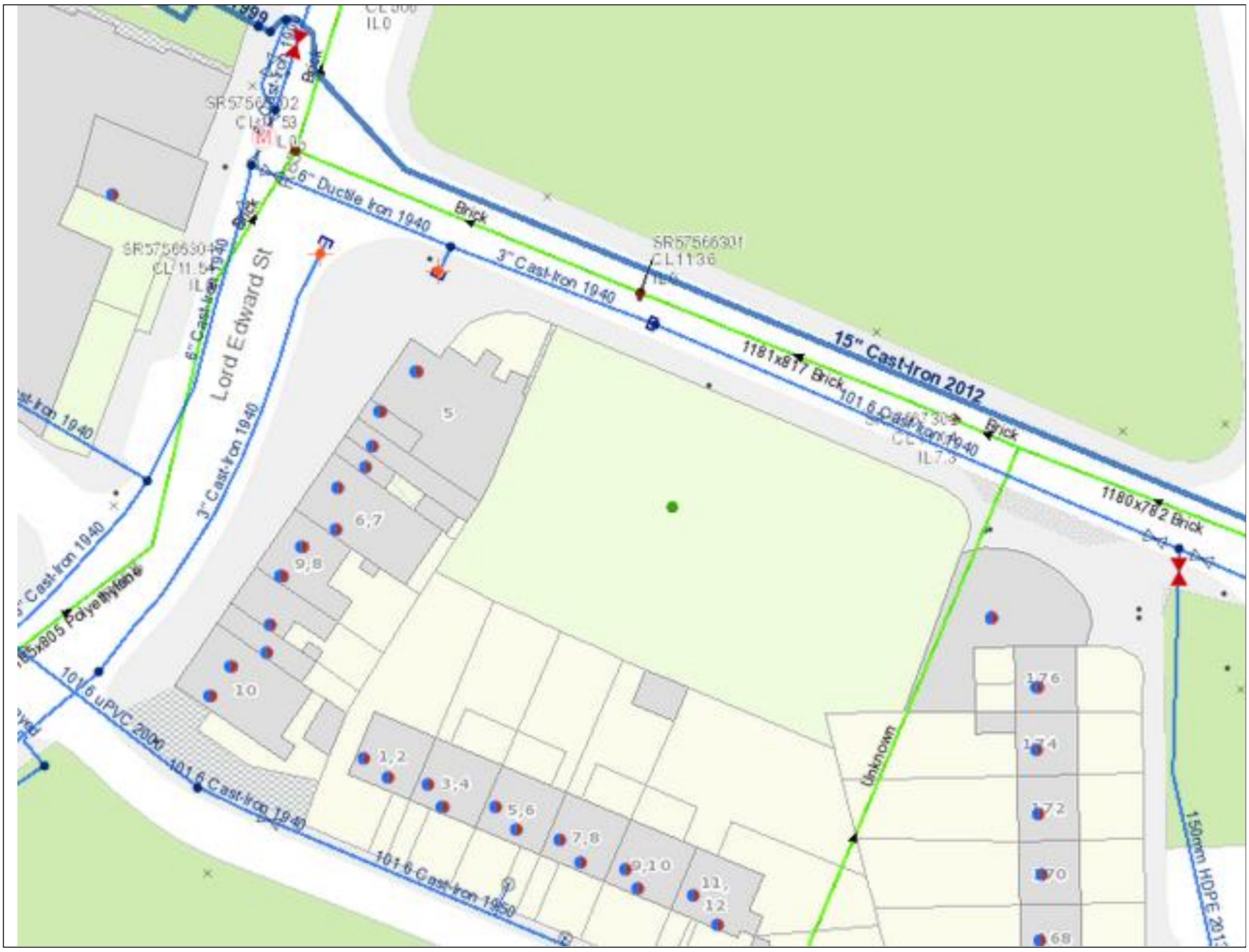
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Carey's Road, Limerick, Co. Limerick (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible Subject to upgrades
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Water Connection	In order to complete the proposed connection at the Premises, the Irish Water wastewater network will have to be upsized from 75mm diameter to 100mm diameter for a length of approximately 23m. Irish Water currently does not have any plans to upgrade its network in this area. Should you wish to consider upgrading the water network infrastructure, please contact Irish Water. This Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. In order to determine the potential flow that could be delivered during normal operational conditions, an on site assessment of the existing network is required. Please note that Irish Water cannot guarantee a flow rate to meet fire flow requirements and in order to guarantee a

	flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development.
Wastewater Connection	The applicant shall submit further details to Irish Water in respect of the proposals for management and discharge of stormwater discharges to the public wastewater network for Irish Water acceptance.
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

The map included below outlines the current Irish Water infrastructure adjacent to your site:



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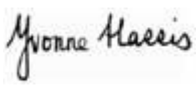
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network 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.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact John Hennessy from the design team on 022 52256 /0870959296 or email jhennessy@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



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