S. HANNIFFY & ASSOCIATES CONSULTING ENGINEERS
COTTAGE, MAREE, ORANMORE, Co. GALWAY.
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16th August 2024

Planning Section,
Galway County Council,
Aras an Chontae,
Prospect Hill,
Galway.

Re: Design & detailing of existing foul sewers, storm sewers, attenuation, bypass separators, etc for proposed Planning Application for lake amenity enhancement project at Long Point, Loughrea.

Dear Sir/Madame

This report has been prepared to detail the Civil Works elements for the proposed Planning Application for lake amenity enhancement project at Long Point, Loughrea. This report details the foul & storm drainage design for the proposed development.

Foul Water Treatment

The foul sewage from the existing Changing Room facility on site is discharged to a foul sewer adjacent to the changing rooms. The foul sewage is discharged to a pumping station to the north east of the existing building and is pumped to the existing public sewer. It is proposed to install new foul sewers around the proposed storage/plant building and changing room/WC building as shown on drawing No. 24143-01. The new foul sewers will discharge to the existing pumping station and will be pumped to the public sewer.

Storm Water Drainage

We wish to advise that a sustainable drainage system (SuDS) has been designed in order to deal with the surface water from the existing/proposed development. We carried out infiltration tests on the site on Tuesday the 6th of August to determine the infiltration rate of the existing soil at locations shown on drawing No. 24143-01 enclosed herewith. We then carried out our design of the proposed storm water drainage system.

It is proposed to install 3No. Stormbreaker Water Attenuation, Infiltration & Soakaway systems to deal with the stormwater from the proposed buildings, carparks and roads, as shown on Drawing No. 24143-01 enclosed herewith. The stormwater from the 2No. proposed buildings, Carpark C and the road will discharge to Soakaway No. 1 which is a 149m^3 Stormbreaker Soakaway. The stormwater from Carpark A will discharge to Soakaway No. 2 which is a 98.40m^3 Stormbreaker Soakaway. The stormwater from Carpark B will discharge to Soakaway No. 3 which is a 136.90m^3 Stormbreaker Soakaway. Please find below a copy of the Soakaway Design calculations for the 3No. proposed Stormbreaker infiltration systems **(See Appendix A)**.

We have kept the surface water sewers and the Stormbreaker Soakaways as shallow as possible to negate the effect of flooding in the area. Due to these shallow depts, some of the

storm water sewers will be surrounded with concrete, as shown on Drawing No. 24143-02 (Storm Water Sewer Sections) enclosed herewith.

The Stormbreaker system is a world-leading solution for the attenuation, infiltration, soakaway & storage of surface water due to rainfall. The Stormbreaker forms an artificial underground reservoir where storm water can be stored and then released at a sustainable rate preventing flooding at the installation location and downstream in water courses and municipal sewers. Please find below a copy of the NSAI Agrement certificate for the Stormbreaker System (**See Appendix B**). The Stormbreaker systems have been designed in full compliance with the requirements of BRE Digest 365.

It is proposed to use permeable paving to deal with stormwater in the proposed Quayside area, as shown on drawing no. 24143-01. The use of Permeable Paving is a SuDS based permeable system which is designed to cater for the stormwater runoff from the Quayside area and discharge it into the sub-base and ground below this area. There is no requirement for a bypass separator in this area, as it is primarily for pedestrian use. The paths within the development will be finished with permeable resin bound gravel, which is self draining.

Bypass Interceptor & Silt Trap

The impervious areas of the proposed roofs, carpark and roadway will be discharged through 3No. Kingspan Klargester Bypass Seperators with silt traps prior to final discharge to the 3No. Stormbreaker Soakaway systems. It is proposed to install a Kingspan Klargester bypass interceptor model NSBP006 (or similar) on the storm water sewer prior to final discharge to the Stormbreaker Soakaway's 1 and 3 with a Kingspan Klargester bypass interceptor model NSBP004 (or similar) on the storm water sewer prior to final discharge to the Stormbreaker Soakaway 2 as shown on drawing No. 24143-01. Please find below a copy of the Kingspan Separators Declaration of Performance (**See Appendix C**). The Kingspan bypass Seperators have been designed to cater for the stormwater discharge from the entire development.

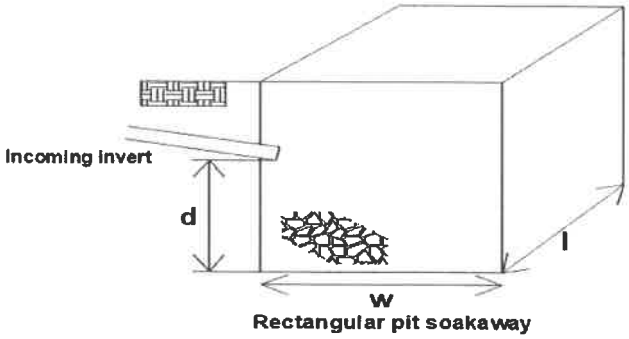
We trust that this is to your satisfaction.

Yours Faithfully

Shane Hanniffy

Shane Hanniffy BE CEng MIEI
S. Hanniffy & Associates

APPENDIX A



Rectangular pit soakaway

Project: Long Point Outdoor Amenity Enhancement Project, Loughrea (**Soakaway No.1** - Buildings, Carpark C & Road Soakaway Design)

Date: 08/08/2024

Soil *infiltration Rate (BRE Digest 365)*

Length of trial pit	l_{trial} =	0.3	m
Width of trial pit	b_{trial} =	0.3	m
Depth of trial pit (below invert)	d_{trial} =	0.4	m
Free volume (if fill used)	V_{trial} =	100	%
75% depth of pit	d_{75} = (d_{trial} × 0.75) =	0.3	m
50% depth of pit	d_{50} = (d_{trial} × 0.50) =	0.2	m
25% depth of pit	d_{25} = (d_{trial} × 0.25) =	0.1	m
Test 1 - time to fall from 75% depth to 25% depth	T1 =	208	min
Test 2 - time to fall from 75% depth to 25% depth	T2 =	110	min
Test 3 - time to fall from 75% depth to 25% depth	T3 =	172	min
Longest time to fall from 75% depth to 25% depth	t_{lg} = max(T1, T2, T3) =	208	min
Storage volume from 75% to 25% depth	V_{p75_25} = (l_{trial} × b_{trial} × (d_{75} – d_{25})) × V_{trial} =	0.018	m^3
Internal surface area to 50% depth	a_{p50} = ((l_{trial} × b_{trial}) + (l_{trial} + b_{trial}) × 2 × d_{50}) =	0.33	m^2
Surface area of soakaway to 50% storage depth	A_{s50} = 2 × (l_{trial} + b_{trial}) × d_{trial} / 2 =	0.240	m^2
Soil infiltration rate	f = V_{p75_25} / (a_{p50} × t_{lg}) =	0.00000437	m/s

Rectangular Pit Design

Pit length	l =	35	m	
Pit width	w =	10	m	
Pit depth below invert	d =	0.455	m	
Location of soakaway	Ireland			
Free volume	V_{free} =	94	%	BMS stormbreaker System
Return period		10	years	
Impermeable area	A =	2712	m^2	
Soil infiltration rate		0.00000437	m/s	
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l + b) \times d / 2$ =	20.475	m^2	
Outflow factor	$AF = A_{s50} \times f$ =	0.00008949	m^3/s	

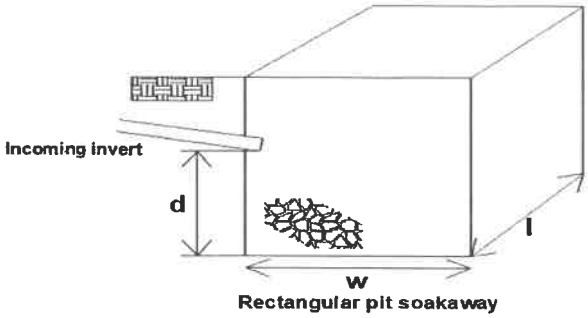
Duration	10 year rainfall (R) in mm taken from MET Eireann	Inflow (m3)	Outflow (m3)	Storage required (m3)
5 mins;	7.9	21.4248	0.03	21.40
10 mins;	11	29.832	0.05	29.78
15 mins;	12.9	34.9848	0.08	34.90
30 mins;	16.2	43.9344	0.16	43.77
1 hour;	20.3	55.0536	0.32	54.73
2 hours;	25.4	68.8848	0.64	68.24
4 hours;	31.8	86.2416	1.29	84.95
6 hours;	36.2	98.1744	1.93	96.24
9 hours;	41.3	112.0056	2.90	109.11
24 hours;	56.8	154.0416	7.73	146.31

Required storage volume	S_{reqd} =	146.31	m^3
Soakaway storage volume	$S_{act} = l \times w \times d \times V_{free}$ =	149.7	m^3

Soakaway storage volume- OK

Time for emptying soakaway to half volume	$T_{s50} = S_{reqd} \times 0.5 / (A_{s50} \times f)$ =	817476.8762	s
		11:04:37	hrs:mins:secs

Soakaway discharge time - OK



Rectangular pit soakaway

Project: Long Point Outdoor Amenity Enhancement Project, Loughrea (**Soakaway No.2** - Carpark A Soakaway Design)

Date: 08/08/2024

Soil *infiltration Rate (BRE Digest 365)*

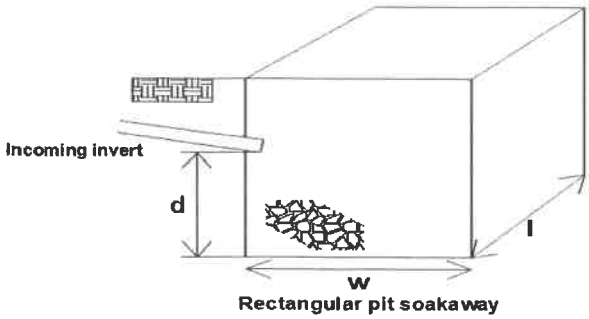
Length of trial pit	l_{trial} =	0.3	m
Width of trial pit	b_{trial} =	0.3	m
Depth of trial pit (below invert)	d_{trial} =	0.4	m
Free volume (if fill used)	V_{trial} =	100	%
75% depth of pit	$d_{75} = (d_{trial} \times 0.75)$ =	0.3	m
50% depth of pit	$d_{50} = (d_{trial} \times 0.50)$ =	0.2	m
25% depth of pit	$d_{25} = (d_{trial} \times 0.25)$ =	0.1	m
Test 1 - time to fall from 75% depth to 25% depth	T1 =	114	min
Test 2 - time to fall from 75% depth to 25% depth	T2 =	140	min
Test 3 - time to fall from 75% depth to 25% depth	T3 =	131	min
Longest time to fall from 75% depth to 25% depth	t_{lg} = max(T1, T2, T3) =	140	min
Storage volume from 75% to 25% depth	$V_{p75\_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial}$ =	0.018	m^3
Internal surface area to 50% depth	$a_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50})$ =	0.33	m^2
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2$ =	0.240	m^2
Soil infiltration rate	$f = V_{p75\_25} / (a_{p50} \times t_{lg})$ =	0.00000649	m/s

Rectangular Pit Design

Pit length	l =	23	m	
Pit width	w =	10	m	
Pit depth below invert	d =	0.455	m	
Location of soakaway	Ireland			
Free volume	V_{free} =	94	%	BMS stormbreaker System
Return period		10	years	
Impermeable area	A =	1823	m^2	
Soil infiltration rate		0.00000649	m/s	
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l + b) \times d / 2$ =	15.015	m^2	
Outflow factor	$AF = A_{s50} \times f$ =	0.00009750	m^3/s	

Duration	10 year rainfall (R) in mm taken from MET Eireann	Inflow (m3)	Outflow (m3)	Storage required (m3)
5 mins;	7.9	14.4017	0.03	14.37
10 mins;	11	20.053	0.06	19.99
15 mins;	12.9	23.5167	0.09	23.43
30 mins;	16.2	29.5326	0.18	29.36
1 hour;	20.3	37.0069	0.35	36.66
2 hours;	25.4	46.3042	0.70	45.60
4 hours;	31.8	57.9714	1.40	56.57
6 hours;	36.2	65.9926	2.11	63.89
9 hours;	41.3	75.2899	3.16	72.13
24 hours;	56.8	103.5464	8.42	95.12

Required storage volume	S_{reqd} =	95.12	m^3
Soakaway storage volume	$S_{act} = l \times w \times d \times V_{free}$ =	98.4	m^3
	Soakaway storage volume- OK		
Time for emptying soakaway to half volume	$T_{s50} = S_{reqd} \times 0.5 / (A_{s50} \times f)$ =	487807.1795	s
		15:30:07	hrs:mins:secs
	Soakaway discharge time - OK		



Rectangular pit soakaway

Project: Long Point Outdoor Amenity Enhancement Project, Loughrea (**Soakaway No.3** - Carpark B Soakaway Design)

Date: 08/08/2024

Soil *infiltration Rate (BRE Digest 365)*

Length of trial pit	l_{trial} =	0.3	m
Width of trial pit	b_{trial} =	0.3	m
Depth of trial pit (below invert)	d_{trial} =	0.4	m
Free volume (if fill used)	V_{trial} =	100	%
75% depth of pit	$d_{75} = (d_{trial} \times 0.75)$ =	0.3	m
50% depth of pit	$d_{50} = (d_{trial} \times 0.50)$ =	0.2	m
25% depth of pit	$d_{25} = (d_{trial} \times 0.25)$ =	0.1	m
Test 1 - time to fall from 75% depth to 25% depth	T1 =	125	min
Test 2 - time to fall from 75% depth to 25% depth	T2 =	137	min
Test 3 - time to fall from 75% depth to 25% depth	T3 =	119	min
Longest time to fall from 75% depth to 25% depth	t_{lg} = max(T1, T2, T3) =	137	min
Storage volume from 75% to 25% depth	$V_{p75\_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial}$ =	0.018	m^3
Internal surface area to 50% depth	$a_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50})$ =	0.33	m^2
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2$ =	0.240	m^2
Soil infiltration rate	$f = V_{p75\_25} / (a_{p50} \times t_{lg})$ =	0.00000664	m/s

Rectangular Pit Design

Pit length	l =	40	m	
Pit width	w =	8	m	
Pit depth below invert	d =	0.455	m	
Location of soakaway	Ireland			
Free volume	V_{free} =	94	%	BMS stormbreaker System
Return period		10	years	
Impermeable area	A =	2597	m^2	
Soil infiltration rate		0.00000664	m/s	
Surface area of soakaway to 50% storage depth	$A_{s50} = 2 \times (l + b) \times d / 2$ =	21.840	m^2	
Outflow factor	$AF = A_{s50} \times f$ =	0.00014492	m^3/s	

Duration	10 year rainfall (R) in mm taken from MET Eireann	Inflow (m3)	Outflow (m3)	Storage required (m3)
5 mins;	7.9	20.5163	0.04	20.47
10 mins;	11	28.567	0.09	28.48
15 mins;	12.9	33.5013	0.13	33.37
30 mins;	16.2	42.0714	0.26	41.81
1 hour;	20.3	52.7191	0.52	52.20
2 hours;	25.4	65.9638	1.04	64.92
4 hours;	31.8	82.5846	2.09	80.50
6 hours;	36.2	94.0114	3.13	90.88
9 hours;	41.3	107.2561	4.70	102.56
24 hours;	56.8	147.5096	12.52	134.99

Required storage volume	S_{reqd} =	134.99	m^3
Soakaway storage volume	$S_{act} = l \times w \times d \times V_{free}$ =	136.9	m^3
	Soakaway storage volume- OK		
Time for emptying soakaway to half volume	$T_{s50} = S_{reqd} \times 0.5 / (A_{s50} \times f)$ =	465721.6282	s
		09:22:02	hrs:mins:secs
	Soakaway discharge time - OK		

APPENDIX B

NSAI Agrément

IRISH AGRÉMENT BOARD
CERTIFICATE NO. 11/0356

Butler Manufacturing Services,
Strokestown Road, Longford, Ireland
Phone: +353 43 3326100
Fax: +353 43 3326285
Web site: www.butlerms.com E-mail: info@butlerms.com

BMS Stormbreaker™ System

Stürmen Sie Wasser Leitung System

NSAI Agrément (Irish Agrément Board) is designated by Government to issue 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 2009**.

PRODUCT DESCRIPTION:
This Certificate relates to the BMS Stormbreaker™ system which comprises primarily of interlocking 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 system consisting of individual units manufactured from black polypropylene and assembled on polypropylene bases. The units when assembled are wrapped in membrane and buried below ground. The assemblies can be used for attenuation applications (temporary storage of storm water) or for infiltration/soakaway tanks to store storm water which in turn will seep back into suitable ground over time.

When the modules are used for infiltration they are wrapped in a permeable geotextile membrane. When used for attenuation purposes an additional impermeable geomembrane is required. Flange adaptors are used for connecting the modules to PVC pipe work. The Stormbreaker™ can be designed for use in green field, light and heavy trafficked areas.

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, the BMS Stormbreaker™ system is designed as interlocking modules and 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:
Butler Manufacturing Services,
Strokestown Road,
Longford,
Ireland
Phone: +353 43 3326100
Fax: +353 43 3326285
Web site: www.butlerms.com
E-mail: info@butlerms.com

Part One / Certification 1

1.1 ASSESSMENT

In the opinion of NSAI Agrément, the BMS Stormbreaker™ system, if used in accordance with this Certificate, meets the requirements of the Building Regulations 1997 - 2009 as indicated in Section 1.2 of this Certificate.

1.2 BUILDING REGULATIONS 1997 to 2009

REQUIREMENT:

Part A – Structure

A1 - The BMS Stormbreaker™ system, as certified in this Certificate, can be designed so as to ensure that the combined dead and imposed loads are sustained and transmitted to the ground.

Part D - Materials & Workmanship

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

D1 – The BMS Stormbreaker™ system, as certified in this Certificate, meets the requirements of the building regulations for workmanship.

Part H – Drainage and waste water disposal.

H1 - The BMS Stormbreaker™ 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 BMS Stormbreaker™ a subsurface Stormwater Management System, consisting of interlocking polypropylene chambers or units. The modular units manufactured from black polypropylene are assembled on to polypropylene bases (eight bases per unit). Subsequent modular units are then added in an interlocking arrangement until the desired height is achieved.

The units, which have a high voids 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.

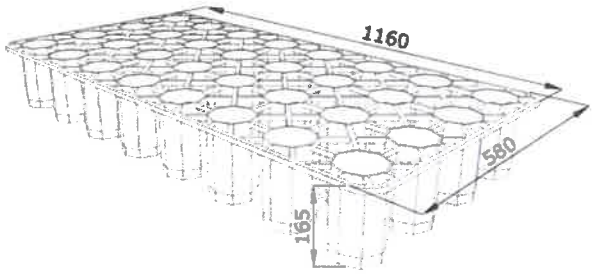


Figure 1 - Stormbreaker™ Module

The system does not cover collection or disposal of the surface water. Information relating to this matter can be obtained from the Certificate holder. The BMS Stormbreaker™ 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.

The BMS Stormbreaker™ is a registered trademark of Butler Manufacturing Services Ltd.

2.1.1 Ancillary Items

The BMS Stormbreaker™ units are installed with the aid of a number of ancillary items as outlined hereunder (§)

- Geotextiles
- Geomembranes - Impermeable Membrane
- Pipe distribution network
- Inlet manhole
- Outlet Manhole
- Stormbrake (Hydrobrake)
- Vent pipes
- Fittings/adaptors
- Petrol/oil interceptor

§ Outside the scope of this Certificate.

2.2 Product Range

The Stormbreaker™ system is designed as interlocking modules and can be built up to create the volumetric capacity required. The interlocking nature of the modular units lends itself to producing a stable monolithic arrangement.

The modular unit, which measures 1160mm x 580mm on plan, consists of thirty-two cylindrical columns, each with an octagonal cross section, which provide load bearing capacity and rigidity.

The unit depth of each module is 165mm (see figure 1). Each unit has an arched rib design for load bearing and the cylindrical columns are rebated to interlock with each successive layer. The rebate results in a net layer depth of 145mm.

BMS Stormbreaker™ units are manufactured from both **Virgin** and **Reprocessed** polypropylene granulates (as distinct from recycled polypropylene). Characteristics for both formulations are given in Table 1 and further technical information can be found in section 4 of this certificate.

The bases units are manufactured from polypropylene. Each base unit supports four cylindrical columns which results in eight bases per unit (see figure 2). The base unit helps redistribute vertical load from the cylindrical columns uniformly to the ground and in doing so affords protection to the rebated end of the Stormbreaker™ unit.

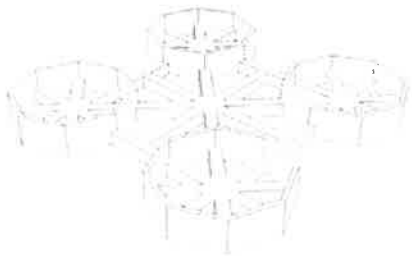


Figure 2 - Base units

2.3 Delivery, Storage and Marking

The Stormbreaker™ units are supplied to site in packs of 52 (13 layers of four) units, stacked on a pallet and shrink wrapped. Each pack of 52 units carries a label bearing the product name and quantity. Stormbreaker™ units can be purchased and supplied pre-assembled if required.

Characteristics of modular unit			
Element		**Value**	**Units**
Unit dimensions (nom)		1160x580x165	mm
Unit volume (nom)		0.11	m^3
Storage volume (nom)		0.1034	m^3
Porosity (void ratio)		94	%
Ultimate compressive strength at yield			
vertical loading on top face	single unit single unit *f* 3-column arrangement	753 756 458	kN/m^2
lateral loading on side face (1)	2x2 unrestrained 3 full units restrained *f*	77 128	kN/m^2
Short-term deflection (2)			
vertical loading	single unit 3-column arrangement	1 per 200 1 per 55	$mm/kN/m^2$
lateral loading on side face		1 per 40	$mm/kN/m^2$
Estimated long-term deflection (3) (4)		1.65	mm

(1) Referance to section 4.2 for variation in test set-up
(2) Applied load.
(3) at up to 10 years at 20°C with applied loading of $30.7kN/m^2$
(4) deflection (d) in mm {d = 0.2384Ln(t) + 2.2572} t =Time in hours
f denotes reprocessed polypropylene granulates where as all other value represent virgin polypropylene granulates.

Table 1

The Stormbreaker™ units are clearly marked as either virgin or reprocessed polypropylene. Palletised Stormbreaker™ units interstack and as a result they occupy approximately half their final insitu volume for ease of transport. Labels are attached to pallets which display the IAB 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.

Base plates are packed in polyethylene bags. The packs of units should be carefully placed on level ground.

Individual chambers may be carried by one person; normal manual handling precautions should be taken. The mass of the unit is 6Kg.

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 of excavations
- installation of temporary works if necessary for deep excavations.
- reducing local water table levels if necessary
- floatation both during and post installation

2.4.2 Installation Procedure

2.4.2.1 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.

2.4.2.2 The base or formation is compacted and an adequate gradient built in to achieve self cleansing. The base or formation level must be inspected for soft spots— any present must be excavated and replaced with suitable compacted granular fill material.

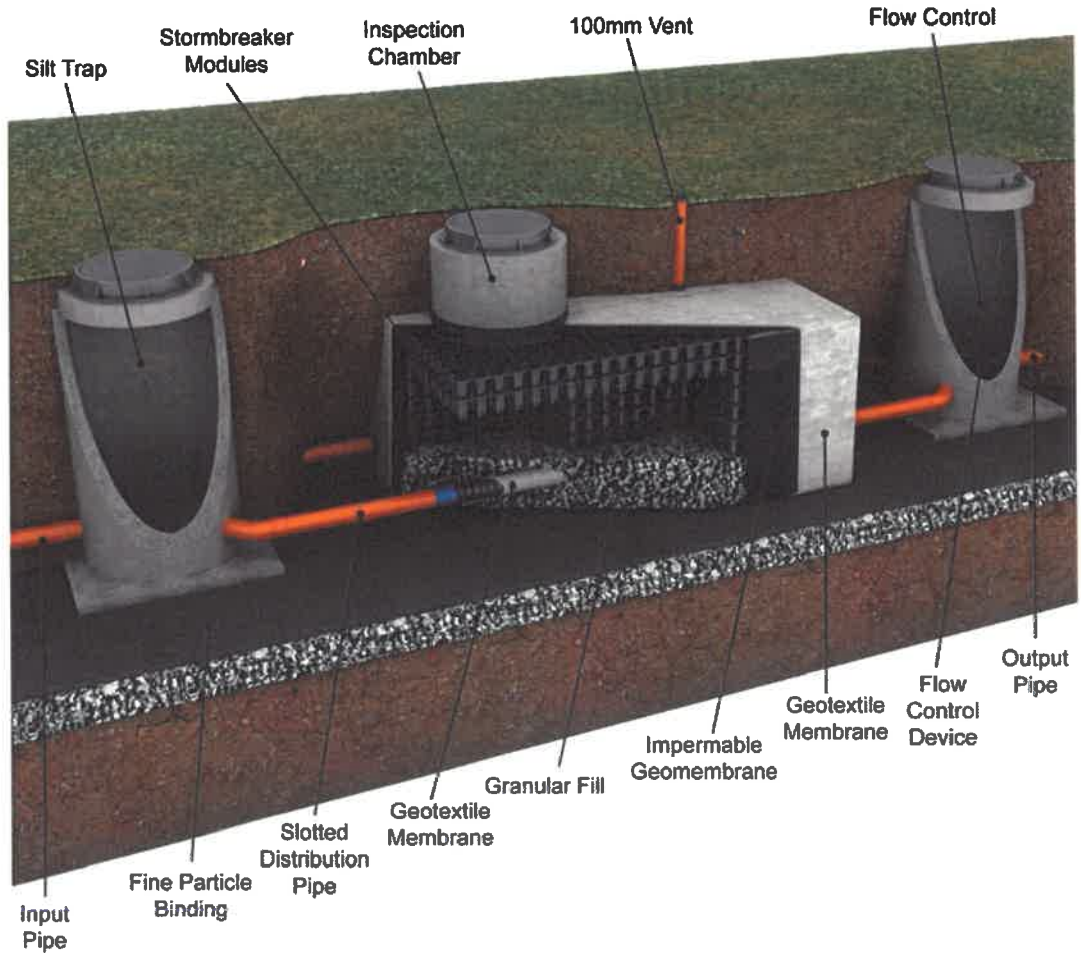


Figure 3 - Typical layout

Slopes are cut to a safe angle or adequately supported and safe access is provided to allow personnel to enter the excavation.

2.4.2.3 A 100mm thick, blinding layer of coarse sand is laid on the compacted base of the excavation.

2.4.2.4 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 membrane should be sealed correctly using proprietary techniques with a minimum lap of 50mm.

2.4.2.5 The position of the distribution pipe(s) should be established initially. Install 300mm filtration base of 25mm Round Clean Stone on top of the geomembrane. The distribution pipe is wrapped in a permeable geotextile, bedded and backfilled.

2.4.2.6 The units are installed in accordance with the installation schedule for correct orientation. Wherever possible, continuous vertical joints should be avoided and adjacent layers placed perpendicular to one another.

2.4.2.7 The units are placed in an interlocking manner and pressed down to connect units together which form a solid connection. The internal column design allowed for units above and below to integrally clip together without any additional clips or ties.

2.4.2.8 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 or double-sided tape to form a seal.

2.4.2.9 The geotextile or geomembrane encapsulation to base and sides (including protective geotextile) is completed. Geomembranes when spliced or jointed on site are welded with double seams. The geomembrane is inspected for damage and all welds are tested as required.

2.4.2.10 Inspection chambers are installed as per design requirements. When placed over the Stormbreaker™ units, the inspection chamber

are sealed to the geomembrane with a flange adaptor, using thermal welding, adhesive or double-sided tape to form a watertight seal.

2.4.2.11 The installation is backfilled with Type 1 or 2 sub-base or Class 6P (side fill only) selected granular material in accordance with the MCHW, Volume 1. The backfill is compacted in 150mm thick layers.

2.4.2.12 A protection layer of coarse sand 100mm thick should be placed over the top of the units that are wrapped in either a geotextile (infiltration system) or a geomembrane with protective geotextile (attenuation system). Backfilling is continued with:

- trafficked areas (e.g. car parks) — Type 1 or 2 sub-base material compacted in 150 mm layers in accordance with the MCHW, Volume 1. Compaction plant must not be allowed over the top of blocks until a minimum cover of 400 mm has been placed and, in any case, the load must not exceed 2300 kg per meter width.
- landscaped and non-trafficked areas — selected as-dug material with size of pieces less than 75mm compacted to 90% maximum dry density. Compaction plant over top of system must not to exceed a load of 2300 kg per meter width.

2.4.2.13 The pavement construction or landscaping is completed over the system.

3.1 Design General

The BMS Stormbreaker™ system design must be in accordance with the Certificate holder's instructions. Guidance on the application of sustainable drainage systems (SUDS) for new developments, such as the Subsurface Stormwater Management System, can also be found in the Planning Policy Statement PPS25 Development and Flood Risk.

3.2 Design options

The system is suitable for the control of storm water run-off from impermeable surfaces. It can be utilised in three ways:-

- Infiltration (recharge/soakaway) — water is collected in the units during rainfall and allowed to drain away by soaking into the surrounding ground over a substantial period of time after the rain has stopped.
- Attenuation (detention) — 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 and, therefore, minimizes the risk of flooding.
- Combination system — water is collected in the units during rainfall and able to flow out of the tank via infiltration and through an outlet flow control device into an appropriate outfall.

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 is required to function
- the type of function of application suggested by this audit.

3.4 Drainage system selection and design.

Once the project criteria have been established from the site audit, there are two main parts to the design procedure: system design (Cl 3.5) and structural design (Cl 3.6). The design selection flow chart in Figure 4 can be followed to establish the optimum stormwater management design solution.

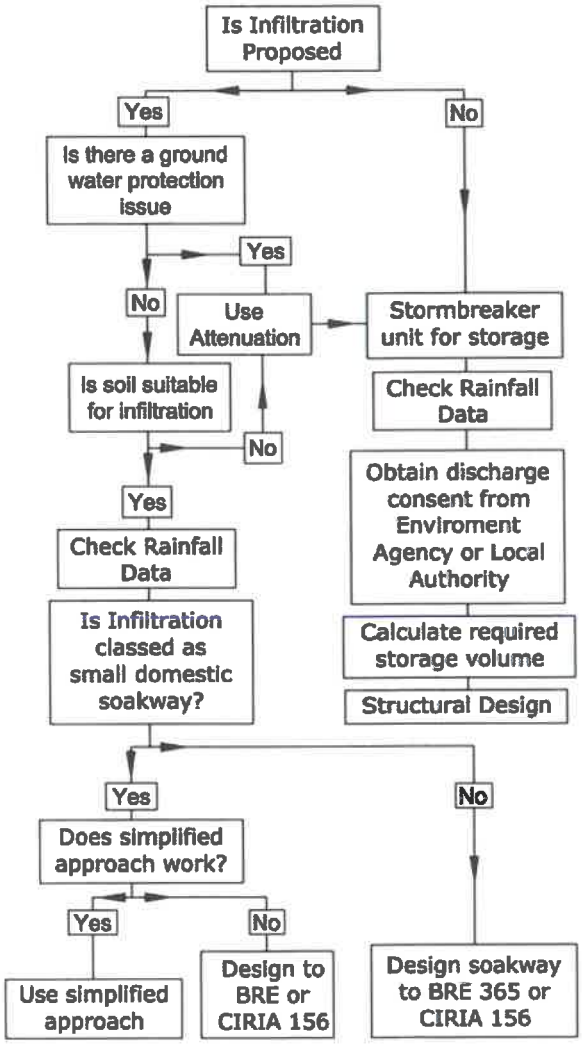


Figure 4 - Design flow chart

3.5 System Design

3.5.1 Infiltration

There are two design approaches, either of which may be adopted:

- the Construction Industry Research and Information Association (CIRIA) Report 156 *Infiltration Drainage — Manual of Good Practice*
- or BRE Digest 365 Soakaway Design. †

† Further information on the design of sustainable urban drainage systems (SUDS) may be obtained from The SUDS manual (C697) published by CIRIA.

Volumetric data per unit (0.58m) for single width trench applications				
No. of units high	Volume (m^3)		Side Area (m^2) Perimeter x H	Base Area (m^2)
	Gross	Nett*		
Base	0.0135	0.0126	0.0696	0.6728
1	0.0976	0.0917	0.5046	
2	0.1951	0.1834	1.0092	
3	0.2927	0.2751	1.5138	
* Nett storage volume are based on a voids ratio of 94%				

Table 2

Stormbreaker™ unit									
Volumetric data for cuboid installation (Storage volume V's internal side surface area)									
No. Of units high	2 x 2 units Area = 2.691m^2			4 x 4 units Area = 10.765m^2			8 x 8 units Area = 43.059m^2		
	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)
2	0.784	1.079	0.539	3.137	2.158	1.079	12.547	4.315	2.158
4	1.518	2.088	1.044	6.071	4.176	2.088	24.285	8.352	4.176
6	2.251	3.097	1.549	9.006	6.194	3.097	36.023	12.389	6.194
8	2.985	4.106	2.053	11.940	8.213	4.106	47.761	16.426	8.213
10	3.719	5.116	2.558	14.875	10.231	5.116	59.499	20.462	10.231
No. Of units high	2 x 4 units Area = 5.382m^2			2 x 8 units Area = 10.765m^2			2 x 10 units Area = 13.456m^2		
	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)
2	1.568	1.438	0.719	3.137	2.158	1.079	3.921	2.517	1.259
4	3.036	2.784	1.392	6.071	4.176	2.088	7.589	4.872	2.436
6	4.503	4.130	2.065	9.006	6.194	3.097	11.257	7.227	3.613
8	5.970	5.475	2.738	11.940	8.213	4.106	14.925	9.582	4.791
10	7.437	6.821	3.410	14.875	10.231	5.116	18.594	11.936	5.968
No. Of units high	4 x 6 units Area = 16.147m^2			4 x 8 units Area = 21.530m^2			4 x 10 units Area = 26.912m^2		
	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)	Vol (m^3)	Side (m^2)	a_{s50} (m^2)
2	4.705	2.517	1.259	6.274	2.877	1.438	7.842	3.236	1.618
4	9.107	4.872	2.436	12.143	5.568	2.784	15.178	6.264	3.132
6	13.509	7.227	3.613	18.012	8.259	4.130	22.515	9.292	4.646
8	17.910	9.582	4.791	23.881	10.950	5.475	29.851	12.319	6.160
10	22.312	11.936	5.968	29.750	13.642	6.821	37.187	15.347	7.673
All volumes are net storage volumes i.e. 94% of overall volume. All units AxBxC = Length x Width x Number of units high a_{s50} (m^2) = internal surface area of the soakaway to 50% effective depth.									

Table 3

3.5.1.1 Design should be carried out in accordance with IS EN 752-4: 1998 *Drain and sewer systems outside buildings - Part4: Hydraulic design and environmental considerations* or BRE Digest 365. It is suggested in IS EN 752-4: 1998 that a storage volume equal to 20 mm multiplied by the area to be drained may be used.

Prior to selection of infiltration system, designers are required to assess the suitability of soil for infiltration. Designers must assess if infiltration could wash fines from adjoining soil leading to voids and ultimately settlement or collapse. Designer should refer to CIRIA Report 156 for further guidance of design section and considerations.

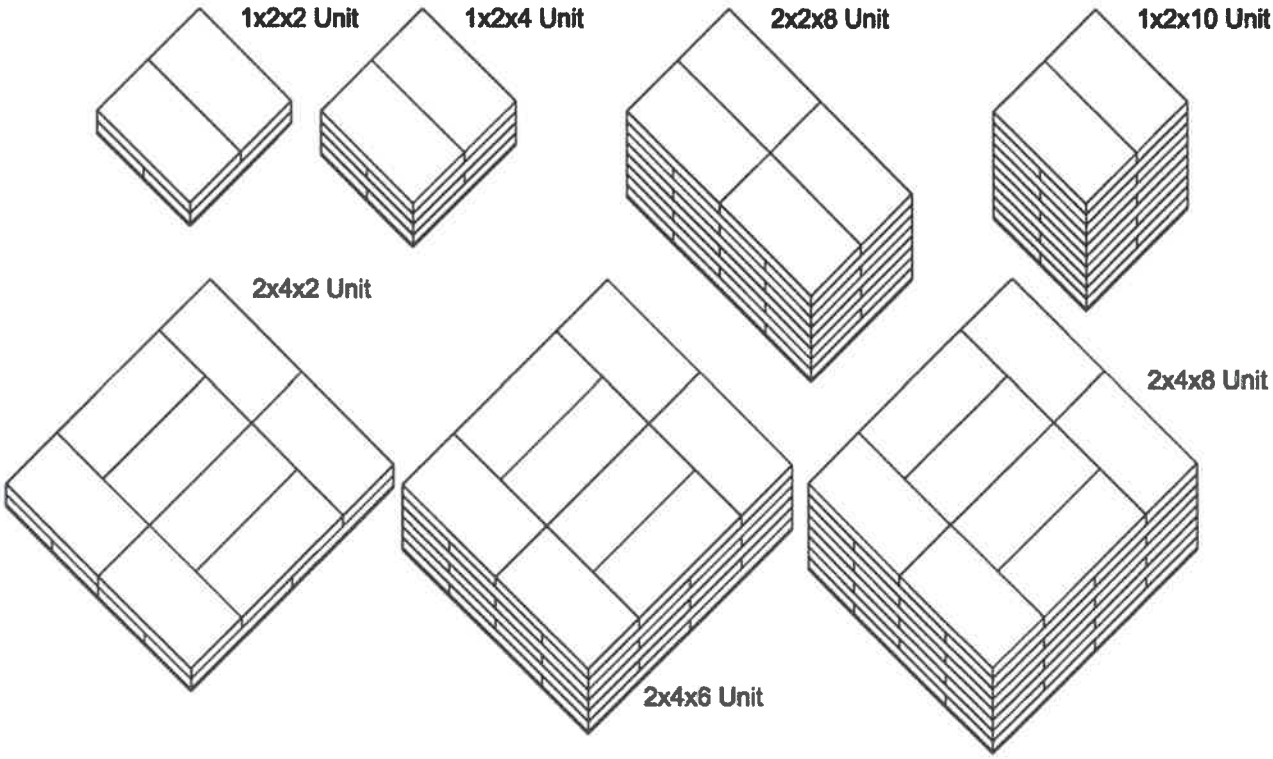


Figure 4 - Sample Stormbreaker™ configurations.

When doubt exists over suitability of ground for infiltration, permeability figures should be derived by test (see BRE Digest 365).

3.5.1.2 When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found from Tables 2 and 3.

3.5.1.3 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 94% of the total volume. As an example, using Table 3, for a typical trench 2 units long and 2 units wide by 8 units deep, the net storage volume is 2.985m^3, the total side area 4.106m^2 or the internal surface area of the soakaway to 50% effective depth is 2.053m^2.

3.5.2 Attenuation

The design approach for attenuation systems should follow the principles outlined in the CIRIA C697 Suds Manual & the Greater Dublin Strategic Drainage Study (GDSDS).

The anticipated run-off volume (A) from a site must be calculated using the Wallingford Procedure. The rainfall event duration which generates the highest rate of run-off is determined. This is termed the critical rainfall event. To do this the drainage system needs to be tested for a range of storm durations for each return period, from 15 minutes up to and possibly exceeding 48 hours. This is done by using the Flood Studies Report (FSR) methods.

The design return period is usually 30 or 100 years but can vary between local authorities. The critical rainfall event is then used in the Wallingford Procedure to determine the development's run-off volume (A). The allowable discharge rate from the site to an appropriate outfall is established but will normally be set by the Environment Agency or Planning Authorities.

The outflow volume (B) to be discharged at this rate is calculated using the critical storm duration and subtracted from the run off volume (A–B).

This defines the excess volume (C) to be stored in units constructed as an underground tank. The number of units needed to contain this excess is calculated on the basis that the storage volume is equal to 94% of the total volume of the tank.

Due allowance can be made for distribution pipes that may run within the tank sub-structure, the porosity of the hardcore formation retained within the geomembrane and above the outlet level of the distribution pipe.

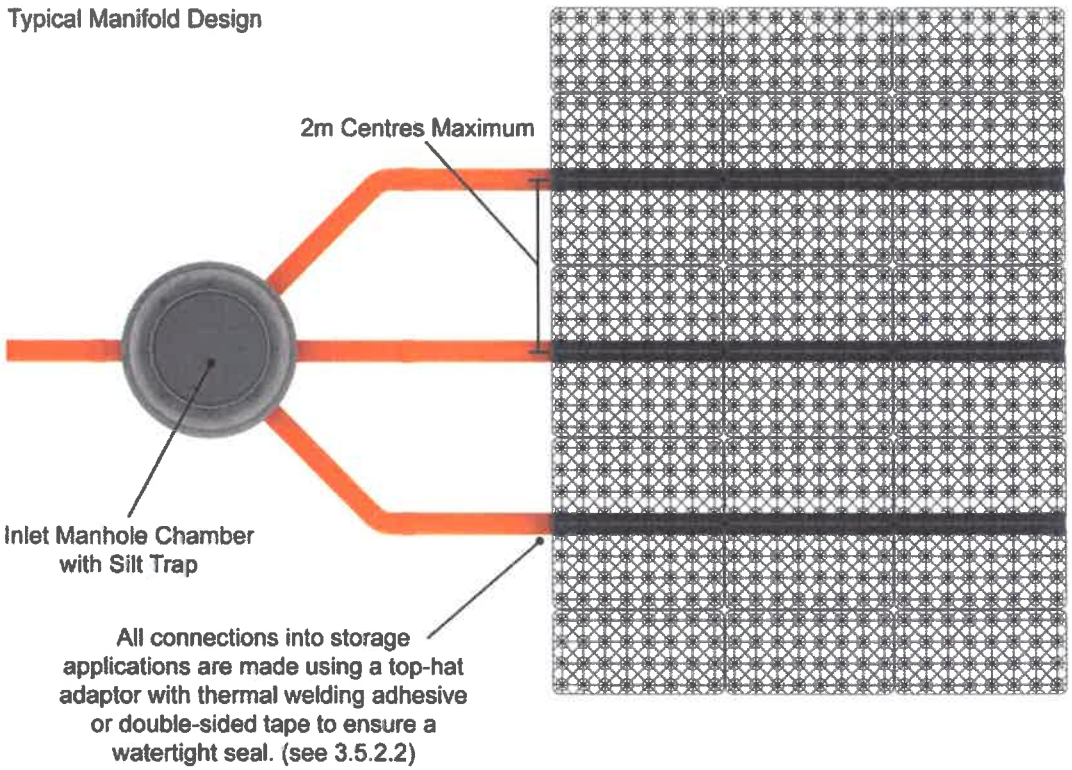


Figure 5

3.5.2.1 Outlet Connections
The outlet of detention systems should incorporate a flow control device. The flow control device (stormbrake) 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 or double sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

3.5.2.2 Inlet Connections
Typically, a half-slotted distribution pipe running through the tank's formation hardcore is used to convey inlet and outlet (where appropriate) flow. The lower half of the distribution pipe is smooth and un-perforated to reduce the build up of silt and assist with self cleansing.

It is recommended that all connections into storage applications (using a geomembrane) are made using a top-hat adaptor. Thermal welding, adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

A petrol/oil interceptor may also need to be incorporated where there is a likelihood of contamination or the discharge site is particularly sensitive.

3.5.2.3 Manifold design
The capacity of the inlet pipe must be sufficient for the anticipated flow load. The flow load may be split between a number of pipes from the inlet manhole chamber. It is the recommended by the certificate holder that the maximum spacing of distribution pipes be not greater than 2.0m centre to centre. The maximum number of uPVC pipes from a single inlet chamber is recommended to be three. Where distribution pipe change direction, provided long radius bends to ensure the system can be adequately rodded. In cases where the Stormbreaker™ system exceeds a width of 6m then additional inlet and outlet chambers should be provided. It is recommended that there should be an inlet / outlet chamber for every 6m of width. For larger installations guidance on manifold design should be sought from the certificate holder.

3.5.2.4 Flow control
The outflow from the tank must be controlled to comply with the discharge rate consent for the site. Comparative features and benefits of these various control flow devices should be considered before selection. However, these devices are outside the scope of this Certificate.

3.5.2.5 Outflow and head calculations
The invert level of the outflow pipe should allow the tank to drain. As the tank fills, a depth of

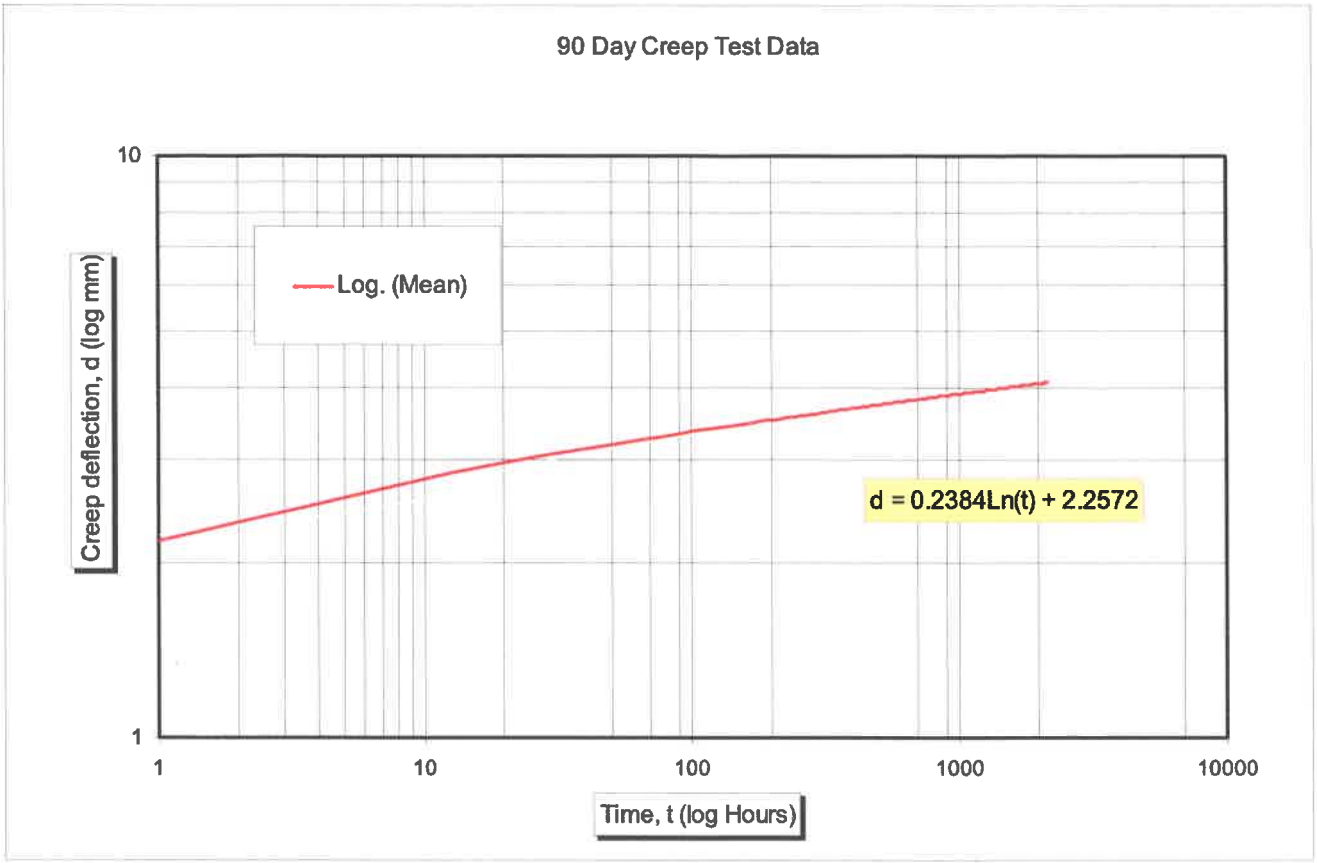


Figure 6 - Compressive creep test result for Virgin polypropylene units only

water develops on the upstream side of the outflow control, 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 centre line of the outflow device.

3.6 Structural Performance

3.6.1 General

Chambers 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. Design parameters and estimated loads should be used to determine the maximum depth of installation and the maximum and minimum cover depths. Guidance on this is given in Structural design of modular geocellular drainage tanks (CIRIA C680).

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.

The Certificate holder does not vary the installation recommendations for lightly loaded scenarios, but instead recommends that all installations be designed to withstand vehicle traffic.

Short-term loading design parameters for the units have been derived from independent test data (see Table 7). The short-term and estimated long-term deflections are given in Table 1.

Typical creep results for virgin polypropylene unit (see Figure 6) enable a long-term rate of deflection to be estimated and long-term deformations for periods up to 20 years forecast. In locations where settlement is not of concern, then designs up to 50 years can be undertaken.

Partial factors of safety for materials take account of factors such as variations during manufacture, variability and uncertainties in material strength damage during installation and environmental effects. A partial factor safety for materials, fm, of 2.75 for ultimate limit state and 1.5 for serviceability limit state, should be applied to these values for a design life of 20 years.

3.6.2 For small-scale application such as soakaways for individual house roof drainage, the BMS Stormbreaker™ units are typically located below a garden a minimum of 5 m from the building. In this case there are no traffic loads.

3.6.3 The criteria provided in Tables 5 and 6 can be used to design the Stormbreaker™ units for installation below trafficked areas.

Loading design parameters for Stormbreaker™ Units		
	Vertical loading kN/m²	Lateral loading kN/m²
Compressive Strength at Yield (3 units)	458	128
Note - A partial factor safety for materials, fm, of 2.75 for ultimate limit state and 1.5 for serviceability limit state, should be applied to these values for a design life of 20 years.		

Table 4

3.6.4 These design tables are only applicable in temperate climate conditions such as those found in Ireland. The installer must ensure that the ground-bearing capacity at the formation level is sufficient for the proposed operational loads. In areas of weak or compressible soils advice on allowable ground bearing pressures should be sought from a Geotechnical Engineer. The Stormbreaker™ units can be used for areas where greater loads are anticipated but these applications are outside the scope of this Certificate and specific advice should be sought from the Certificate holder.

Maximum Installation Depths (to base of units) (2)				
Bulk unit weight soil (1) kN/m²	Maximum Depth on Installation (to base of units) (m)			
	Landscape Area	30/30 Road	60/30 Road	Main Road
16 kN/m² e.g. Very loose drained granular soil	18.57	18.56	18.56	18.56
22 kN/m² e.g. Undrained Stiff Clays	13.5	13.49	13.49	13.49
1) Bulk unit weight soil to be confirmed by a Chartered Geotechnical Engineer. 2) Maximum installation depths above determined directly from compressive strength at yield derived during vertical compression testing on 3 stacked units.				

Table 5

3.6.5 All foundation and infill stone to 150mm above the crown of the chambers shall be nominal 200mm to 400mm, clean, crushed stone in accordance with IS EN 13242:2002 *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*, sizes 20/40 or 20/32. Recycled crushed concrete may be an acceptable fill material but its use is outside the scope of this Certificate. Further details may be obtained from the Certificate holder.

3.6.6 For lightly-loaded applications, the bearing capacity of the underlying soils, typically, should not be exceeded by the system. Therefore, settlement of the underlying soils should be negligible. On weak or compressible soils, the bearing capacity and settlement characteristics should be confirmed by a Geotechnical Engineer.

3.6.7 Care should be taken when the system is 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.

Minimum Cover Depths over top of Stormbreaker™ Unit	
Location	Minimum Cover Depth (m)
Non trafficked areas, e.g. landscaping	0.5
Car Parks, vehicle up to 2500kg gross mass	0.6
Roadways (30/30, 60/30 or main road)(1)	0.6
1) DIN1072 Classification for road loadings	

Table 6

3.6.8 Where a slotted distribution pipe is installed within the tank structure, the guidance given in CIRIA publication C680 *Structural design of modular geocellular drainage tanks* should be followed and the design engineer must be satisfied that the deflection of the pipe will not be excessive under design load cases. Calculations should be carried out in accordance with IS EN 1295-1: 1998 *Structural design of buried pipelines under various conditions of loading - Part 1: General requirements,* to verify that this is the case.

3.7 Geotextile and Geomembrane.

3.7.1 A **Geotextile** is wrapped around the system in infiltration applications to:

- prevent soil and fine clay particles from washing into and clogging the stone surround to the distribution pipe network and the units themselves
- prevent soil entering the units and in storage applications to give added protection to the geomembrane (when specified).

3.7.2 The selection of an appropriate geotextile for a specific infiltration installation should be considered carefully, with particular reference to

the surrounding soil properties and required performance. Points to consider are:

- pore size — should be designed and specified to assist infiltration and prevent migration of fine soil particles
- permeability and breakthrough head — the geotextile should not limit flow of water in the system, and should have a similar or greater permeability than the surrounding materials
- puncture resistance — the geotextile must be able to resist the punching stresses caused by loading on sharp points of contact
- tensile strength — the geotextile should have sufficient strength to resist the imposed forces (e.g. from traffic).

3.7.3 The geotextile should be selected according to specific site conditions. However, typically a 110g non-woven material will be suitable for most situations. Specialist advice shall be sought if surrounding soil characteristics exhibit a high degree of fines/low infiltration capacity and/or there is risk of damage from ground contaminants.

3.7.4 A **Geomembrane** is wrapped around the system in attenuation/storage applications where infiltration is not possible or permitted. The function of the geomembrane is to:

- prevent release of attenuated/stored water to surrounding ground
- prevent inflow of pollutants from contaminated subsoil into the storage reservoir.

3.7.5 The specification and selection of the impermeable geomembrane must be correct for the installation envisaged, to ensure it performs to the level required. It is essential that the specified material:

- withstands the rigours of installation
- resists puncture
- resists multi-axial elongation stress and strains associated with settlement
- resists environmental stress cracking
- resists damage from ground contaminants and remains intact for the full design life of the drainage system

3.7.6 To ensure total impermeability, joints between adjacent sheets of impermeable geomembranes should be sealed correctly using proprietary welding techniques.

3.8 Venting

For most chamber applications, venting back through the inlet piping is sufficient. However some applications, where inlet piping may be submerged, require additional vent capacity. A typical detail to achieve additional venting is to provide a vent pipe or a perforated manhole/inspection cover. (See figure 3)

3.8.1 It is the certificate holder's recommendation that one 110mm diameter air vent per 7500 m^2 of impermeable catchment area to be drained is generally sufficient.

3.9 Resistance To Chemicals

The components of the system are suitable for use in contact with the chemicals likely to be found in rainwater.

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

3.10 Maintenance

The owner of the structure is responsible for maintenance.

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

3.10.2 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.

3.10.3 When constructed in accordance to BMS installation guidance document, soakaways and attenuation systems are self cleansing. In the unlikely event where debris or blockages occur it is prudent at design stage to provide access (via a manhole or similar) in order to clear blockages and allow for jetting clear silt build ups.

3.10.4 When inlet manholes incorporate silt-traps, owners should carry out frequent maintenance of these silt-trap manholes in order to minimize the risk of silts and other suspended partials entering the distribution pipe network.

3.11 Durability

The structural properties of polypropylene used in the components of the system will deteriorate with time and should be taken into account at the design stage by the application of suitable safety factors. In the opinion of the IAB, the BMS Stormwater units, when used in accordance with this Certificate, will have a life in excess of 50 years.

3.12 Installation

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

4.1 Vertical Compression Test

4.1.1 Single column specimen.

The BMS Stormbreaker™ system was tested to establish its behaviour under compressive loading in the vertical direction. The test method used followed the principals outlined in ASTM Standard D 1621 – 00 – *Standard Test method for Compressive Properties of Rigid Cellular Plastics* which is technically equivalent to I.S. EN ISO 844:2009 *Rigid cellular plastics — Determination of compression properties*.

A series of single column specimen manufactured from virgin polypropylene were subjected to a vertical compressive load and the ultimate compressive strength was determined at the yield point.

Using the average failure load at the yield point of 16.11kN, for a single column, the total load required to cause yielding in a single Stormbreaker™ unit was calculated as 515.52kN. Hence the ultimate compressive strength of a single Stormbreaker™ unit is 753.24kN/m^2. A partial factor of safety as appropriate should be applied to this value for design (see section 3.6.1).

4.1.2 Three column high specimen.

Further testing on a three column high assembly, manufactured from virgin polypropylene, was carried out to establish the ultimate compressive load for a number of Stormbreaker™ units stacked on top of each other as this would be more likely to reflect an actual installation as it would occur out on site.

In the 3-column arrangement, the deformation observed consisted of a single column being pushed into another adjacent column at their interface. As a result, this deformation is characterised by a lower deformation force than that established when testing a single column-retainer assembly.

Using the average failure load at the yield point of 9.80kN, for a three column arrangement, the total load required to cause yielding in complete units of the Stormbreaker™ product stacked three high was calculated as 313.60kN. Hence the ultimate compressive strength of three Stormbreaker™ units when stacked on each other is 458.21kN/m^{2††}. A partial factor of safety as appropriate should be applied to this value for design.

†† This value should be used for all design purposes.

4.1.3 Single column specimen Reprocessed

In order to establish a suitable correlation between virgin and reprocessed polypropylene, vertical compression testing was carried out on a single column specimen of reprocessed polypropylene. Again the test method used followed the principals outlined in ASTM Standard D 1621 – 00 – *Standard Test method for Compressive Properties of Rigid Cellular Plastics* which is technically equivalent to I.S. EN ISO 844:2009 *Rigid cellular plastics — Determination of compression properties*.

The ultimate compressive strength of the Stormbreaker™ product in the vertical direction was determined as 756.51kN/m^2. A partial factor of safety as appropriate should be applied to this value for design (see section 3.6.1).

4.2 Lateral Compression Strength

A direct lateral compression loading test was carried out on polypropylene samples as outlined hereunder to determine the lateral compressive strength of the assembled units.

a) a 2 x 2 column specimen with end bearing moulded retainer attached (see figure 2) cut from a full Stormbreaker™ unit manufactured from virgin polypropylene.
b) An assembly of 3 Stormbreaker™ units of reprocessed polypropylene were clamped together clamped together using bracing tie rods to ensure that the test loading did not cause separation of the units during the test.

Testing was carried out in accordance with ASTM Standard D 1621 – 00 – *Standard Test method for Compressive Properties of Rigid Cellular Plastics* which is technically equivalent to I.S. EN ISO 844:2009 *Rigid cellular plastics — Determination of compression properties*.

A series of specimens were tested for both arrangement a) and b) to establish the ultimate compressive strength at the yield point.

For arrangement a), a 2 x 2 column specimen cut from the unit, the total lateral load required to cause yielding in a single Stormbreaker™ unit was calculated giving an ultimate lateral compressive strength of the Stormbreaker™ unit of 77kN/m^2. For arrangement b) the total lateral compressive strength at 10% lateral deformation was calculated giving an ultimate lateral compressive strength of the Stormbreaker™ unit of 128kN/m^2. A partial factor of safety as

appropriate should be applied to this value for design (see section 3.6.1).

4.3 Short Term Deflection

A cyclic compressive loading test was carried out to assess the performance of the units under repeated cyclic loads (e.g. pedestrian and vehicular traffic). The cyclic loading test was carried out according to guidelines published in *CIRIA C680 London, 2008 - Structural design of modular geocellular drainage tanks, The Environmental Protection Group Ltd.*

Results were obtained for both a single unit and a three stacked high arrangements. The short term deflections as outlined in ASTM D 1621 – 00 – *Standard Test method for Compressive Properties of Rigid Cellular Plastics* were estimated as outlined in Table 7.

Short-Term Deflection		
Short-term deflection - Single unit		
vertical loading on top face	1 per 200	mm/kN/m^2
lateral loading on side face	1 per 40	mm/kN/m^2
Short-term deflection - Three stacked units		
vertical loading on top face	1 per 55	mm/kN/m^2

Table 7

4.4 Creep Test

Typical creep results (see Figure 4) enable a long-term rate of deflection to be estimated and long-term deformations for periods up to 20 years forecast. In locations where settlement is not of concern, then designs up to 50 years can be undertaken.

The BMS Stormbreaker™ system manufactured from virgin polypropylene was tested to establish its compressive creep characteristics in accordance with the international standard ISO 7850:1986 *Cellular plastics – rigid – Determination of compressive creep.* The formula $d = 0.2384\ln(t) + 2.2572$ as shown in figure 4 of this certificate, derived from the data, can be used to estimate the creep deflection, d in millimetres after a time period of t hours.

4.5 Civil Engineering Report

As part of the assessment process Butler manufacturing constructed a trial system at their manufacturing plant in Longford. The aim of the tests was to evaluate whether the Stormbreaker unit was suitable for attenuation and assess its performance in a working environment.

The key aspects assessed under the supervision of third party consultant civil Engineers were

- Attenuation – Replicate storm event
- Siltation – Assess self cleansing parameters
- Flushing – Replicate construction sedimentation and assess flush / self cleansing
- Maintenance – Assess ability to clean silt trap and jet clean system
- Water Holding – Assess the impermeability of the system with a standing water test.

The results of these full scale trials demonstrated that system performed as a stormwater attenuation structure and achieved adequate self cleansing. In addition the Stormbreaker™ attenuation system performed favourably as an impermeable attenuation system

4.6 Other Investigations

4.6.1 Existing data on product properties in relation to mechanical strength/stability and durability were assessed.

4.6.2 The manufacturing process was examined including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

4.6.3 Special building details were assessed and approved for use in conjunction with this Certificate.

4.6.4 Site visits were conducted to assess the practicability of installation the history of performance in use of the product.

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 2009 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.

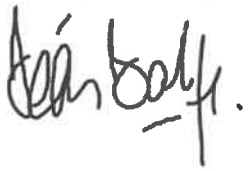
5.7 Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is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

NSAI Agrément

NSAI Agrément

This Certificate No. **11/0356** is accordingly granted by the NSAI to Butler Manufacturing Services Ltd. on behalf of NSAI Agrément.

Date of Issue: **March 2011**

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

APPENDIX C

NS PLASTIC BYPASS SEPARATORS - DECLARATION OF PERFORMANCE

kingspan-klargester-nsbp-003-006-dop-en-oct2021-v1

1.Unique identification code of the product-type:

Separator Systems for Light Liquids, Plastic Construction
NSBP003, NSBP004 & NSBP006

2. Type, batch or serial number or any other element allowing identification of the construction product as required under Article 11(4) of the CPR:

Serial Number/Works Order Number printed on the Product Information Label & affixed to product

3. Intended use/es of the product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer:

To be used for Collection & Separation of Light Liquids from Wastewater by means of gravity and/or coalescence

4. Manufacturer name, registered trade name or registered trade mark and contact address as required under Article 11(5):

Kingspan Water & Energy Ltd
College Rd North
Aston Clinton, Aylesbury, Buckinghamshire
HP22 5EW

5. Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2):

N/A

6. System/s of assessment and verification of constancy of performance (AVCP) of the product as set out in CPR, Annex V:

4

7. In case of the declaration of performance concerning a construction product covered by a harmonised standard:

EN:858-1:2002

Notified body/ bodies:

Notified Body No: 1739 + PIA Prüfinstitut für Abwassertechnik GmbH

Document date:	Document version no:	ECN no:
12/10/2021	V1.	1587

Kingspan

8. Declared performance/s:

Essential characteristics		Performance			Harmonised technical specification
Crushing Resistance (vertical load test)		Pass (also wet conditions)			EN:858-1:2002
Structural Behaviour		Pass			
Reaction to fire		Class E			
Water Tightness (water test)		Pass			
Material Durability		MFR (190/2,16) = 3.0± 1g/10 min (ISO 1133)			
		Density ≥ 930 kg/m³ (ISO 1872)			
		Yield Stress ≥ 19 Mpa (ISO 527-2)			
		Pressure A1 = 1 (EN1778)			
		Pressure A2K = 1 (EN1778)			
Treatment Efficiency	Sample	Specified Maximum Light Liquid (mg/l)	Actual Light Liquid (mg/l)		
	1	≤10	0.37	Pass	
	2	≤10	0.22	Pass	
	3	≤10	0.35	Pass	
	4	≤10	0.23	Pass	
	5	≤10	0.35	Pass	
	Average	≤5	0.30	Pass	
Electrical Consumption		n/a			

9. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 8. This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

David Anderson – Water Business Unit Director

At Portadown on 22 September 2021