

SUSTAINABLE DRAINAGE MANAGEMENT AND MAINTENANCE PLAN

Client: **Exemplar Health Care**

Site Address: **Proposed Care Home,
Irwell Str & Lower Bank Str,
Bury, BL9 0HD**

Project Number: **23389**

Reference (Revision): **MS01 (-)**

Date: **23/10/2024**

Author: George Dermentzoglou Date: 23/10/2024

Checker: Paul Brownlow Date: 23/10/2024



This document describes the Management and Maintenance Strategy for the SuDS components of the proposed privately owned and operated storm and foul water drainage system which is to be located at the former Bury Police Offices. This document is for the action of the Developer for submission to the Local Planning Authority and should be included in documentation in the sales of properties for the development and in the scheme's Operation and Maintenance Manual.

This document includes:

- Detail the management and maintenance plan for the lifetime of the development.
- The timetable for implementation is at the discretion of the Client and the contact details for the maintenance manager should be included at the rear of the document by the Client.
- Provide a typical maintenance proforma and log for the development
- Provide details of maintenance and inspection access for the sewers for the lifetime of the development
- Provide details of the design life of the various equipment and allowances for replacement of site equipment.

The extent of the drainage network and SuDS features for the development is shown on the drainage strategy drawings prepared and included in the appendices of this document.

Maintenance and suitable management of all drainage aspects is required to ensure that the SuDS methods are working affectively, ensure that the systems are operating correctly to ensure water quality and effluent quality and subsequently reducing the risk of flooding on the site.

The management and maintenance of the drainage networks; attenuation tank; vortex separator; and flow control chamber will be by a competent contractor appointed the owners / occupiers of the development.

Adopted chambers owned by the Water Authority (United Utilities) will be maintained by their respective contractors. Access into the site will be permitted for authorised personnel working on behalf of the LLFA of the Water Authority to inspect and undertake maintenance of their assets. The proposed combined manhole, labelled PROP. CW MH on the drawings, will be the responsibility of the Water Authority.

The maintenance management plan should commence prior to the occupation of the site to ensure that management arrangements are in place for the sustainable drainage system in order to manage the risk of flooding and pollution during the lifetime of the development

The drainage system is designed for a minimum life span of 50 years. The BBA Certificate in the appendices confirms the attenuation tank meets this requirement. Hydrobrake Units and the chambers specified normally have a minimum life span of 60 years, but it can be up to 120 years.



Required maintenance operations are as follows in accordance with the CIRIA SuDS Manual and Relevant Industry guidance documentation, and as per the manufacturers recommendations.

Pipe Network	
Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions.	Monthly for 3 months as a part of normal post completion monitoring, then biannually. If flooding is identified, take immediate action.
Debris removal from manholes (where may cause risk performance)	As required, but at least twice a year
Where rainfall into network from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually, or as required and after large storms

Flow Control	
Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions.	Monthly for 3 months as a part of normal post completion monitoring, then biannually
Debris removal from manholes (where may cause risk performance)	Monthly
Where rainfall into network from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Repair/check all inlets, outlets and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

Attenuation Tank	
Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthly
Debris removal from attenuation tank (where may cause risk performance)	As required, but at least twice a year



Attenuation Tank	
Operation	Frequency
Where rainfall into attenuation tank from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least twice a year
Remove sediment from upstream surface water network by jetting.	Annually or as required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed.	Annually and after large storms with remedials as required.
Survey inside of tank for sediment build up and remove if necessary.	Every 5 years.

Vortex Separator	
Operation	Frequency
Desludging and removal of debris	Every 3 months or as recommended by the Manufacturer
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for first half year of operation, then every six months, or as required by the Manufacturer.
Repair/check all inlets, outlets and overflow pipes	As required
Replace malfunctioning parts or structures	As required
Inspect filter media and establish appropriate replacement frequencies	Six monthly or as required by the Manufacturer.
Note – All Vortex Separators should be maintained and monitored under a Service Plan which is compatible with the Manufacturer's warranty and suited to the plant used.	

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance and should be managed with other maintenance activities. Regular inspection and monitoring of site conditions should be undertaken and recorded. Any issues noted should be reported to the Maintenance Manager. Logs of requests and maintenance activities need to be recorded on site for a minimum of 5 years.

Maintenance Manager Name: _____

Maintenance Manager Contact Information: _____

Property Maintenance Log

Name of Property		Property Management contact details:	
Address:		Date of purchase:	
Number:		Person responsible for property:	
		Date put into service:	

Date:	Type of Maintenance	Maintenance performed by:	Date of validation before put into service:	Validation performed by:	Next maintenance planned on (date):	Remarks:



DO NOT SCALE

DESIGNERS HAZARD IDENTIFICATION

IT IS ASSUMED THAT ALL WORKS WILL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. IN ADDITION TO THE HAZARDS TYPICALLY ASSOCIATED WITH THE TYPES OF CONSTRUCTION DETAILED ON THIS DRAWING, ANY KNOWN ABNORMAL HAZARDS SPECIFIC TO THIS SCHEME HAVE BEEN IDENTIFIED.



ABNORMAL
HAZARD
REFERENCE

NOTES

- DO NOT SCALE FROM THIS DRAWING.
- IF ANY DISCREPANCIES ARE FOUND IN THIS DRAWING, PLEASE REPORT TO DUDLEYS CONSULTING ENGINEERS.
- THIS DRAWING IS BASED ON THE FOLLOWING INFORMATION:
 - 60307MCLS-01A - TOPOGRAPHICAL SURVEY BY SURVEY SOLUTIONS DATED DECEMBER 2023
 - JS8468 - DRAINAGE INVESTIGATION SURVEY BY ENVIRONMENTAL DRAINAGE SOLUTIONS DATED DECEMBER 2023
 - IRVEL-WBA-SI-ZZ-DR-A-PL-003-P15 - PROPOSED SITE PLAN BY WATSON BATTY ARCHITECTS DATED JULY 2024.
 - IRVEL-WBA-NB-00-DR-A-20100 - GROUND FLOOR GA PLAN BY WATSON BATTY ARCHITECTS DATED MARCH 2024.
- ALL WORK TO BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT EDITION OF THE BUILDING REGULATIONS, AND SEWERAGE SECTOR CODES OF PRACTICE.
- THE SITE'S SURFACE WATER IS PROPOSED TO DISCHARGE INTO UNITED UTILITIES PUBLIC COMBINED SEWER IN IRWELL STREET AT A GREENFIELD RATE.
- THE TOTAL PROPOSED IMPERMEABLE AREA FOR SITE 1 IS 2,700m² / 0.270ha.

KEY

- OVERALL SITE BOUNDARY
- SITE 1 BOUNDARY
- SITE 2 BOUNDARY
- EXISTING PUBLIC COMBINED SEWER
- EXISTING PRIVATE COMBINED SEWER
- EXISTING COMBINED SEWER TO BE ABANDONED
- PROPOSED PRIVATE SURFACE WATER SEWER
- PROPOSED PRIVATE FOUL WATER SEWER
- PROPOSED PRIVATE COMBINED SEWER
- PROPOSED PRIVATE SW LINEAR DRAINAGE
- PROPOSED PRIVATE SW GULLY

14.08.24	DRAINAGE DESIGN REVISED TO SUIT AMENDED LAYOUT. TANK AND OUTFALL MH RELOCATED.	GD	PB	P03
21.06.24	INTERNAL DRAINAGE CONNECTIONS ADDED	JL	GD	P02
14.03.24	PRELIMINARY ISSUE	OB	GD	P01
DATE	REVISION DESCRIPTION	BY	CHK.	REV.

DUDLEYS
CONSULTING ENGINEERS

Tithe House
35 Town Street
Leeds, LS18 5UJ
0113 258 3611
info@dudleys.co.uk

PROJECT: EXEMPLAR HEALTH CARE
IRWELL STR. & LOWER BANK STR.
BURY, BL9 0HD

JOB-NO.:

TITLE: SITE 1 DRAINAGE STRATEGY

SCALE	PAPER	STATUS	REV.
1:200	A1	PRELIMINARY	
DRAWING NO.	23389-DCE-XX-XX-D-C-101		P03

Regency Chambers

SITE 1 ATTENUATION TANK
SDS GEOLIGHT 400 OR SIMILAR
TOTAL STORAGE VOLUME 189.6m³
19.0x7.0x1.5m - POROSITY:95%
CL: 91.300 - 91.000
SL: 90.400 - 90.310
IL: 88.900 - 88.810
0.60m MIN COVER ABOVE TANK

SITE 1 VORTEX
SEPARATOR
SDS AQUA SWIRL
OR SIMILAR
1.050 HDPE
CL:91.310
IL:88.810 2250

SW 1.08
SITE 1 FLOW CONTROL
HYDROBRAKE OR SIMILAR
FLOW:3.0l/s - HEAD:1.5m
1.5mØ PCC
CL:91.360
IL:88.800 3000 IN
IL:88.750 1500 OUT
CPIL:88.300

SITE 1 & 2
Vehicular Entry
EXTG CW MH
CL:90.940
IL:88.400 2250
IL:88.325 3000

PROP. CW MH
1.5mØ PCC
CL:91.340
IL:88.650 1500
IL:88.575 2250

2250 EXISTING PUBLIC SEWERS
SERVED THE FORMER POLICE
STATION BUILDINGS AND CAR
PARK, AND ARE NOT IN USE
SINCE c.2007 HENCE THEY ARE
PROPOSED TO BE ABANDONED
AND GRUBBED OUT FOLLOWING
A SECTION 116 SEWER CLOSURE
APPROVAL BY UNITED UTILITIES.

SITE 2
40 Red Home
3 abode:
2733m² - 68m² per resident



Regency Chambers

DO NOT SCALE

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- ALL WORK TO BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT EDITION OF THE BUILDING REGULATIONS, AND SEWERAGE SECTOR CODES OF PRACTICE.
- THE SITE'S SURFACE WATER IS PROPOSED TO DISCHARGE INTO UNITED UTILITIES PUBLIC COMBINED SEWER IN IRWELL STREET AT A GREENFIELD RATE.
- THE TOTAL PROPOSED IMPERMEABLE AREA FOR SITE 2 IS 1,820m² / 0.182ha.

- OVERALL SITE BOUNDARY
- SITE 1 BOUNDARY
- SITE 2 BOUNDARY
- EXISTING PUBLIC COMBINED SEWER
- EXISTING PRIVATE COMBINED SEWER
- EXISTING COMBINED SEWER TO BE ABANDONED
- PROPOSED PRIVATE SURFACE WATER SEWER
- PROPOSED PRIVATE FOUL WATER SEWER
- PROPOSED PRIVATE COMBINED SEWER
- PROPOSED PRIVATE SW LINEAR DRAINAGE
- PROPOSED PRIVATE SW GULLY

2250 EXISTING PUBLIC SEWERS SERVED THE FORMER POLICE STATION BUILDINGS AND CAR PARK, AND ARE NOT IN USE SINCE c.2007 HENCE THEY ARE PROPOSED TO BE ABANDONED AND GRUBBED OUT FOLLOWING A SECTION 116 SEWER CLOSURE APPROVAL BY UNITED UTILITIES.

SW 3.04
SITE 2 FLOW CONTROL
HYDROBRAKE OR SIMILAR
FLOW: 2.4l/s - HEAD: 1.5m
1.2mØ PCC
CL: 91.375
IL: 89.200 3000 IN
IL: 89.150 1500 OUT
CPL: 88.700

SW 3.03
1.5Ø PCC
CL: 91.450
IL: 89.450 1500
IL: 89.300 3000

SITE 2 ATTENUATION TANK
SDS GEOLIGHT 400 OR SIMILAR
TOTAL STORAGE VOLUME 114.0m³
20.0x4.0x1.5m DEEP - POROSITY: 95%
CL: 91.875 - 91.530
SL: 90.965 - 90.830
IL: 89.465 - 89.330
0.70m MIN COVER ABOVE TANK

SITE 2
40 Bed Home
3 enbrs
2733m² - 68m² per resident

FFL 92.000

FW 4.04
0.45Ø PPIC
CL: 91.975
IL: 90.840

FW 4.02
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CL: 91.975
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IL: 91.190

FW 3.02
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CL: 91.975
IL: 91.250

FW 4.01
0.45Ø PPIC
CL: 91.975
IL: 91.190

FW 3.02
0.45Ø PPIC
CL: 91.975
IL: 91.030

SW 4.00
0.45Ø PPIC
CL: 91.950
IL: 91.350 1500

SW 3.00
0.45Ø PPIC
CL: 91.950
IL: 90.950 1500

FW

Hydro International Ltd

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website: www.hydro-int.com



Agrément Certificate

08/4596

Product Sheet 1

HYDRO INTERNATIONAL HYDRO-BRAKE FLOW CONTROLS

S-RANGE HYDRO-BRAKE OPTIMUM FLOW CONTROLS

This Agrément Certificate Product Sheet⁽¹⁾ relates to S-Range Hydro-Brake Optimum Flow Controls⁽²⁾, a range of units to control the discharge outlet flow in surface/storm water management systems.

(1) Hereinafter referred to as 'Certificate'.

(2) Hydro-Brake, Hydro-Brake Optimum, Flush-Flo and Kick-Flo are trademarks of Hydro International Ltd.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

Flow characteristics — the performance characteristics of the flow controls have been assessed (see section 6).

Strength — the ability of the flow controls to withstand characteristic loads has been assessed (see section 8).

Durability — under normal service conditions, the flow controls will have a service life in excess of 60 years (see section 10).



The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Fifth issue: 25 May 2021

Originally certificated on 18 October 2008

Hardy Giesler
Chief Executive Officer

The BBA is a UKAS accredited certification body – Number 113.

*The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.*

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

British Board of Agrément

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Page 1 of 13

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Regulations

In the opinion of the BBA, S-Range Hydro-Brake Optimum Flow Controls, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	H3(3)	Rainwater drainage
Comment:		The products can be used in a construction to satisfy this Requirement. See section 6 of this Certificate.
Requirement:	7(1)	Materials and workmanship
Comment:		The products are acceptable. See section 10 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The products are acceptable. See sections 9 and 10 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.6(a)(b)	Surface water drainage
Comment:		The products can be used in a construction to satisfy this Standard, with reference to clauses 3.6.1 ⁽¹⁾⁽²⁾ to 3.6.5 ⁽¹⁾⁽²⁾ . See section 6 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The products can contribute to satisfying the relevant requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		All comments given for the products under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ .
		(1) Technical Handbook (Domestic).
		(2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i)(iii)(b)	Fitness of materials and workmanship
Comment:		The products are acceptable. See section 10 and the <i>Installation</i> part of this Certificate.
Regulation:	82	Rain-water drainage
Comment:		The products can be used in a construction to satisfy this Regulation. See section 6 of this Certificate.

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: 3 *Delivery and site handling* (3.3) and 12 *General* (12.1) of this Certificate.

1 Description

1.1 S-Range Hydro-Brake Optimum Flow Controls are vortex flow controls manufactured from 3, 5 or 8 mm thick grade 1.4301/1.4307 stainless steel to BS EN 10088-4 : 2009. Alternative material thicknesses and grades are available depending on the application, but are outside the scope of this Certificate. The Certificate holder should be contacted for further details.

1.2 Each unit is designed and manufactured to meet specific hydraulic requirements (see section 7). The configuration of the inlet, volute and outlet is varied to achieve the required discharge control characteristics. The units may be fitted with a fixed inlet or an adjustable inlet gate to allow for post-installation adjustment of the discharge flow rate by up to 20% (see Figure 1).

Figure 1 Fixed and adjustable inlet arrangements



1.3 The units are available in a range of sizes to give design flow rates from 0.7 to 250 l·s⁻¹, suitable for use in surface/stormwater management applications. A summary of technical information is given in Table 1.

Table 1 Summary of technical information

Characteristic (unit)	Typical range of values
Design flow rate (l·s ⁻¹)	0.7 to 250
Design head (m)	0.4 to 4
Maximum lateral dimension (mm)	
Lug mounted units	180 to 2000
Backplate mounted units	Dependent on discharge pipe size
Push-fit units	180 to 2000
Mass (kg) excluding packaging	
Lug mounted units	6 to 680
Backplate mounted units	Dependent on discharge pipe size
Push-fit units	6 to 680

1.4 Each unit is supplied fully assembled including:

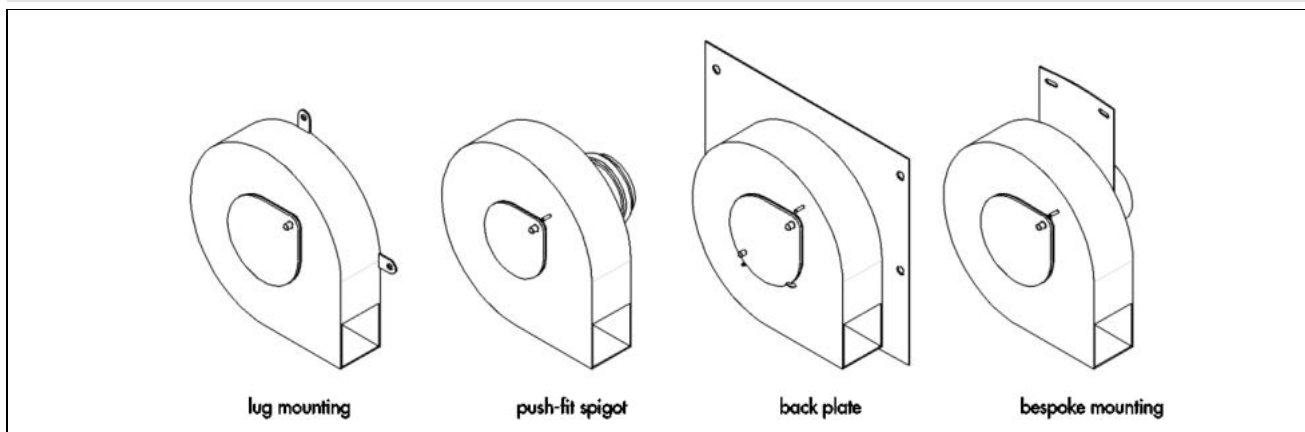
- an S-Range Hydro-Brake Optimum Flow Control with integral bypass door on the front face of the unit, outlet pipe location spigot and mounting face gasket or push-fit sealing rings

- wire rope to allow remote operation of the pivoting bypass door (3 mm diameter rope consisting of 7 x 7 strand elements of 0.018 mm diameter) and stainless steel wire rope attachment brackets
- mounting anchor bolts (A4 316 stainless steel). The performance and suitability of the mounting bolts is outside the scope of this Certificate; the Certificate holder should be contacted for advice on the most appropriate fixings for individual projects.

1.5 The flow controls are available with various types of mounting arrangement (see Figure 2):

- lug mounting — lugs are provided at points around the perimeter of the flow control mounting face. This is appropriate for the majority of applications where the outlet diameter of the installation structure is approximately 0.5 times the flow control body diameter or less
- push-fit spigot — a push-fit spigot with rubber sealing rings is provided. A single lug may also be provided on the outside perimeter of the mounting face to prevent rotation of the flow control in service. Precise specification of the outlet pipe is essential for push-fit mounting, in order to ensure a watertight seal
- backplate mounting — a rectangular mounting plate is provided to allow fixing to the outlet of the installation structure where lug mounting is not appropriate. If a flat surface is not available, the mounting plate may also be provided curved to the same radius as the chamber in which it is to be fitted.

Figure 2 Standard mounting arrangements



1.6 The units may be supplied for installation in purpose-built or existing structural housings on site. These must have adequate strength to resist the loads imposed by the unit. The design of these structures is outside the scope of this Certificate but the performance and durability of the flow control will be unaffected, provided it is installed in accordance with the recommendations of this Certificate.

1.7 The units may also be supplied ready-fitted to purpose-built reinforced concrete or plastic manhole chambers ready for installation into the ground. The performance of these chambers is outside the scope of this Certificate.

2 Manufacture

2.1 The products are manufactured from austenitic stainless steel sheet which is cut, rolled and welded to the required dimensions.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- 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.

2.3 The management system of Hydro International Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by Lloyd's Register Quality Assurance Limited (Certificate LRQ 4002211).

3 Delivery and site handling

3.1 S-Range Hydro-Brake Optimum Flow Controls are supplied wrapped in polythene and plywood packaging for small units and on a pallet for large units. They should be handled and stored appropriately to avoid being dropped or receiving impacts, eg from construction plant.

3.2 Each unit is stamped with the Certificate holder's unique project reference number and carries a label bearing the Certificate holder's contact information and advice on orientation. The packaging also bears details of the package weight and client details.

3.3 Care should be taken handling the units and when lowering into position for installation. Where appropriate, larger units should be lifted via the fitted lugs using mechanical lifting/lowering equipment.

Assessment and Technical Investigations

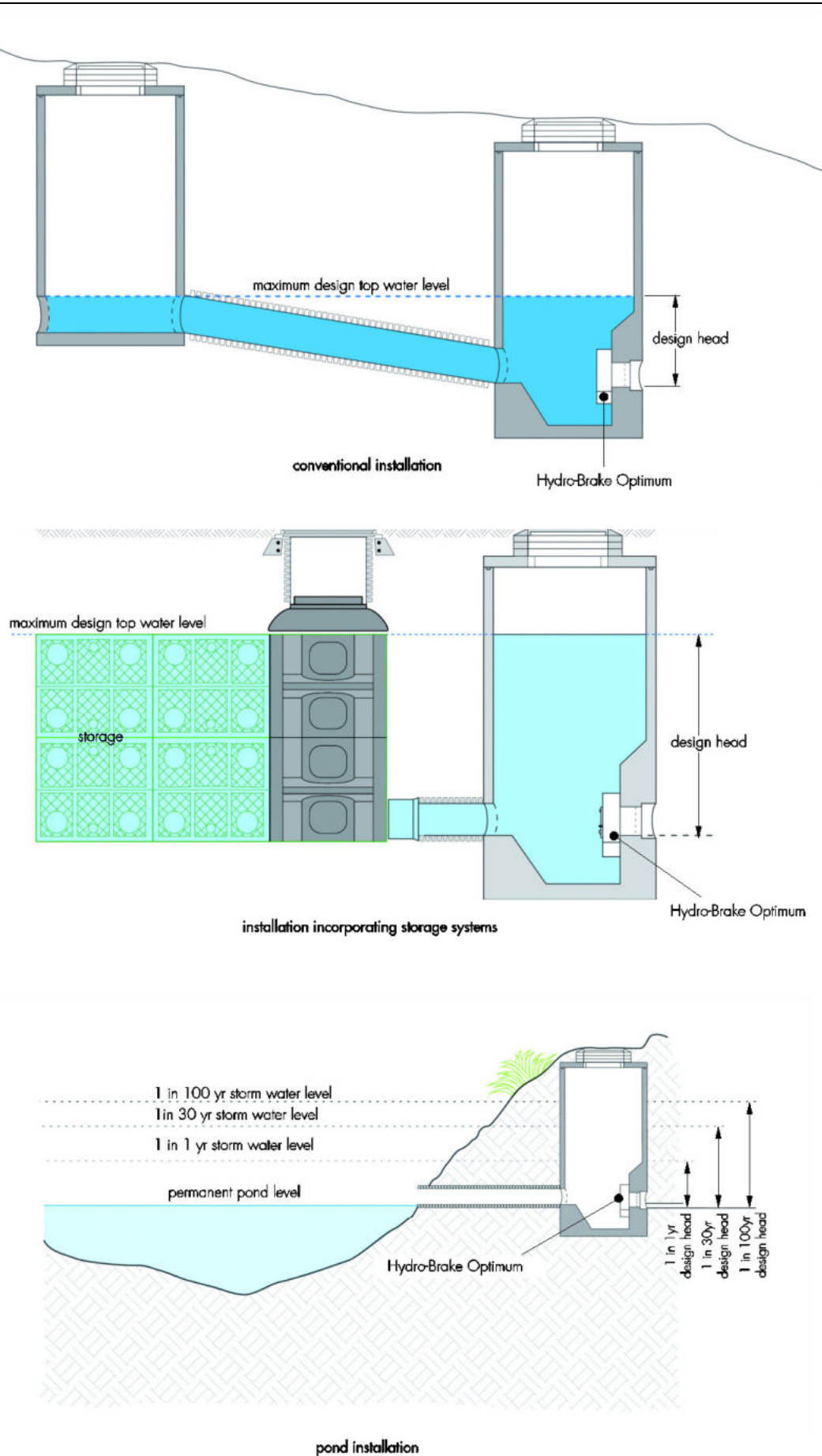
The following is a summary of the assessment and technical investigations carried out on S-Range Hydro-Brake Optimum Flow Controls.

Design Considerations

4 Use

4.1 S-Range Hydro-Brake Optimum Flow Controls are intended to restrict the outlet flow from a surface/storm water management system by increasing back pressure, achieved by inducing a vortex flow pattern in the water passing through the device. In these applications, the units are often used in conjunction with storage facilities, including geocellular storage systems, concrete tanks, oversized pipes and ponds. The performance of these items is outside the scope of this Certificate. Guidance on design of sustainable drainage systems is given in Flood risk and coastal change Guidance and CIRIA C753 : 2015. Typical installation details are shown in Figure 3.

Figure 3 Typical applications and design head



4.2 The units are self-activating without any moving parts and do not, therefore, require external power.

4.3 As a matter of good design practice, measures should be taken to remove silt sediment and debris from the surface water at an early stage to prevent problems further downstream.

4.4 It is recommended to maintain a minimum clear opening of 75 mm in a surface water drainage system. In some cases, it may be necessary to use a flow control with a smaller minimum opening. In which case, the installation of screens or debris removal systems upstream of the device is recommended.

5 Practicability of installation

The products are designed to be installed by a competent contractor, experienced with these types of products.

6 Flow characteristics



6.1 Owing to the 'S'-shaped head-flow characteristic, the units are able to pass greater volume flow rates at lower heads, whilst still limiting the flow at the duty/design point to an acceptable level. A typical head versus flow characteristic for the units is given in Figures 4, 5 and 6.

6.2 The units have a hydraulic characteristic, comprising three distinct stages corresponding to different phases of operation (see Figures 4, 5 and 6):

- pre-initiation phase — at low heads, the flow control provides similar performance to an orifice plate with equivalent size to its outlet⁽¹⁾. Flow rate accuracy of $\pm 5\%$ of the ultimate duty/design flow is typically achievable in this region
- vortex initiation phase — as the head increases, vortex motion will start to develop inside the unit, starting to restrict the flow⁽¹⁾. Flow rate accuracy of -5% of flow to $+5\%$ of phase peak is typically achievable in this region
- post-initiation/design phase — following vortex initiation, the flow control characteristic stabilises, providing hydraulic performance equivalent to a substantially smaller orifice plate than the unit's outlet. The units can be specified to give a duty/design point in any part of this region, though in most practical cases specification will be at flow rates above the initiation phase peak (corresponding to the Flush-Flo point). Flow rate accuracy of $\pm 5\%$ of flow is typically achievable in this region.

As the water level subsides and water in the device drains, the energy within the flow reduces and the vortex collapses. Air is drawn into the volute and the unit returns to operating in a similar manner to an orifice of the same cross sectional area. This drains the system quickly so that the upstream network is ready for the next event.

(1) Although a flow control would not usually be selected with the duty/design point in this region, this part of the characteristic will have implications to overall drainage system operation.

Figure 4 Pre-initiation phase

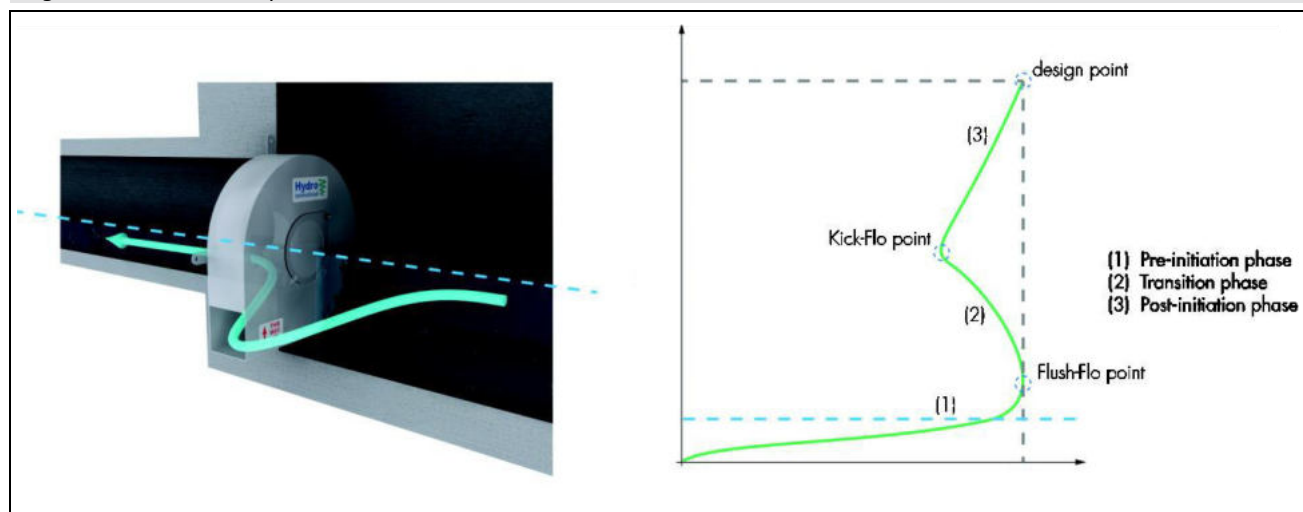


Figure 5 Vortex initiation phase

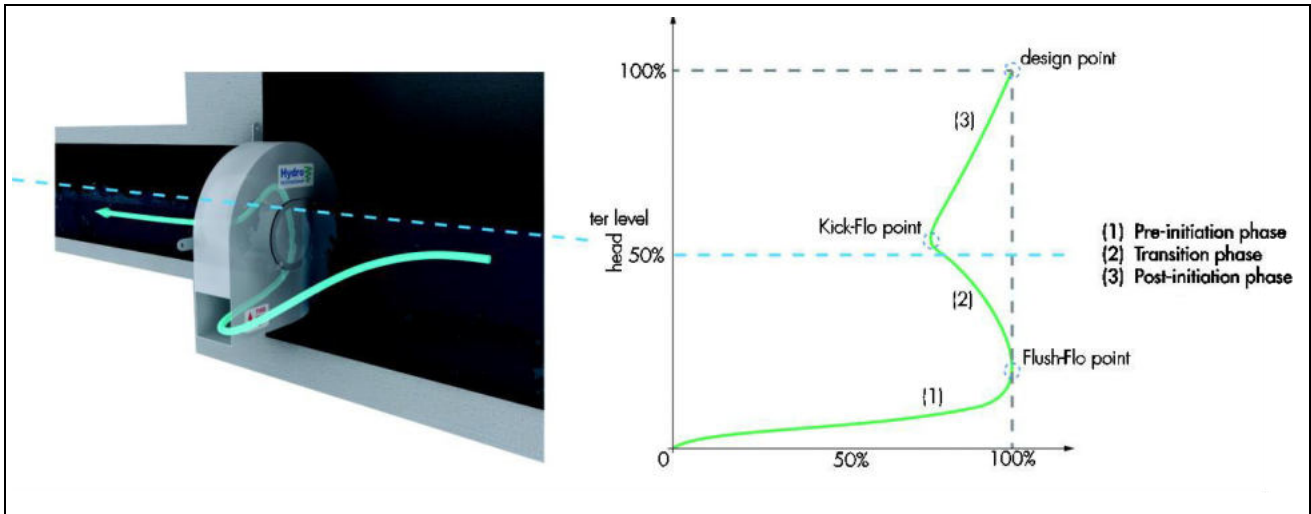
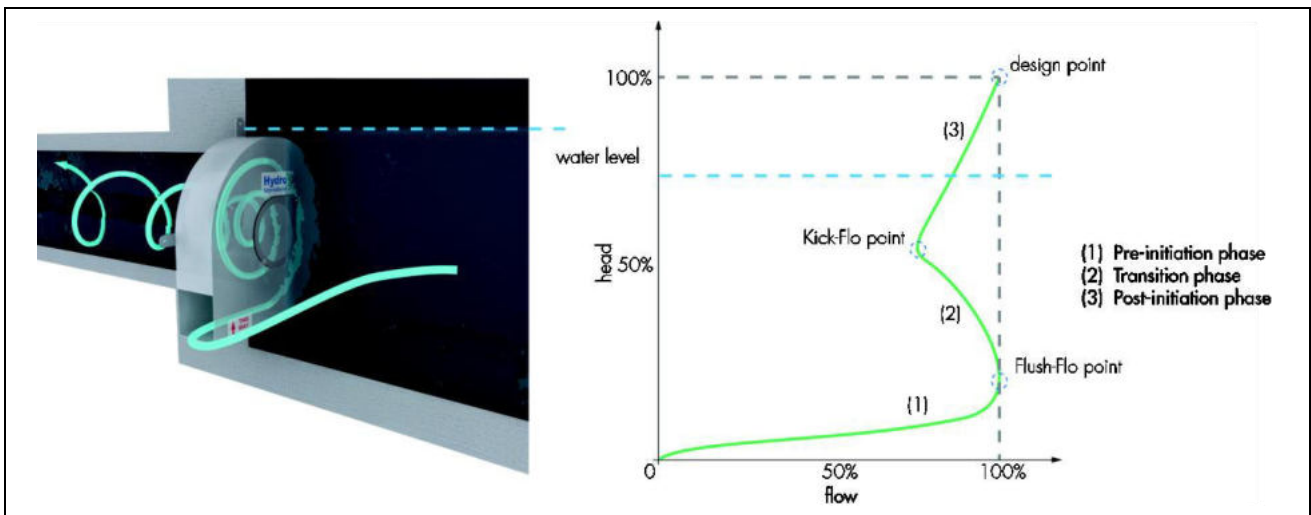


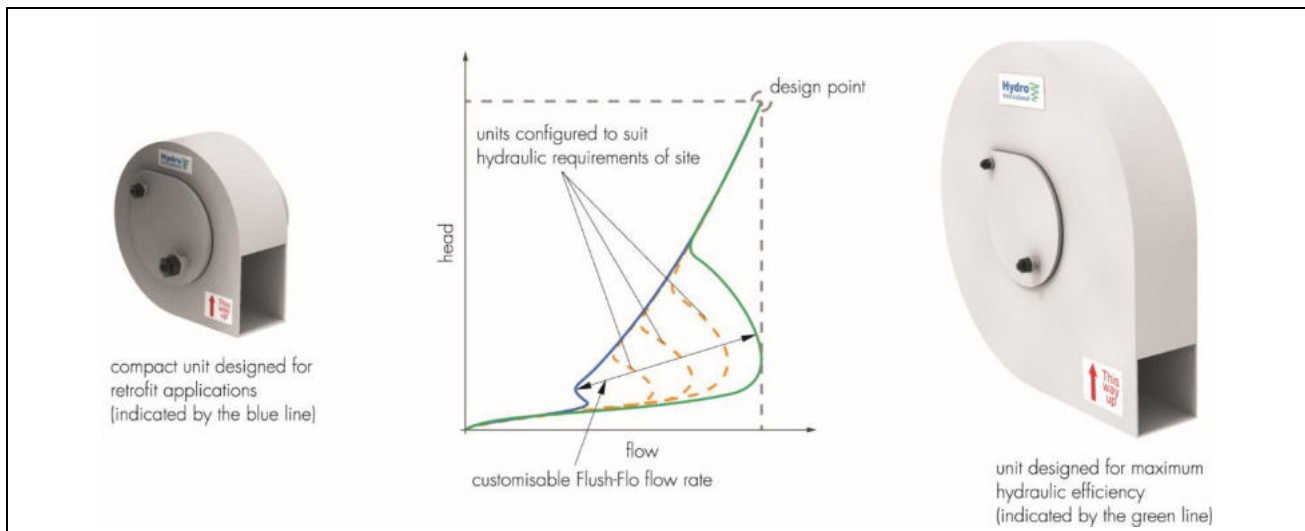
Figure 6 Post-initiation phase



6.3 S-Range Hydro-Brake Optimum Flow Controls allow the inlet, volute and outlet to be individually configured to suit the application, enabling the system to be designed to provide the appropriate hydraulic performance or to suit constant discharge, multi-stage discharge or risk-based network designs (see Figure 7). Individual configuration of the inlet, volute and outlet also allows the system designer to adjust the physical dimensions of the unit in order to:

- maximise the internal clearances
- comply with minimum outlet guidelines
- retrofit to existing infrastructure.

Figure 7 Application-based design



6.4 The units are specified and supplied to meet individual application requirements. Though the characteristics are incorporated into a number of commercially available hydraulic modelling packages, the Certificate holder should be contacted directly for advice on correct selection. The following information should be provided:

- operating head — depth from the unit's outlet invert to the design water level(s) (see Figure 3)
- flow — required discharge at the given head(s)
- manhole details or control chamber proposals, including outlet size
- information on any 'special' conditions, for example if the unit is expected to be subjected to downstream surcharging or possible siphoning effects.

6.5 In most cases the downstream drainage system will be designed to allow the unit a free discharge. However, this is not always possible and in certain cases it will be necessary to design the flow control to surcharge conditions. Surcharging of the flow control will affect the hydraulic performance, and advice should be sought from the Certificate holder. Installations where the outlet is surcharged are outside the scope of this Certificate.

6.6 Where a drainage system has been designed and hydraulically modelled based on the use of a S-Range Hydro-Brake Optimum Flow Control, it is essential to ensure that the same flow control, or a flow control that has been confirmed to provide an equivalent hydraulic performance across the whole design head range, is used in the final installation.

7 Hydraulic design

7.1 The units are typically used to control flows across a site or to limit the rate of discharge from a site. Where used to limit the rate of discharge from a site, the allowable discharge rate to an appropriate outfall will generally be set by the Environmental Regulator, local Planning Authorities or the Sewer Undertaker.

7.2 The allowable discharge rate will often be calculated in respect of the greenfield equivalent run-off rate for the undeveloped site. Advice on calculating the greenfield equivalent run-off rate can be found in the *Interim Code of Practice for Sustainable Drainage Systems*. Where a site is being redeveloped, the allowable discharge rate may be determined based on the discharge rate prior to the redevelopment. The design head acting on the upstream side of the S-Range Hydro-Brake Optimum Flow Control will generally be determined by the maximum design top water level within the storage volume. The design head is illustrated in Figure 3.

8 Strength

8.1 The units are manufactured from stainless steel of a sufficient strength and thickness to ensure that the products remain fit for purpose throughout their design life.

8.2 Under normal operation, the units will deflect by no more than the thickness of the material used for manufacture. This ensures that the volume of the unit available for water flow is not compromised during operation and therefore the hydraulic operation of the unit is not adversely affected by deformation of the unit.

9 Maintenance



9.1 Access should be allowed for clearing debris from the chamber housing the flow control. In the event that the inlet to the unit becomes blocked, the pivoting bypass door may be operated by pulling the wire rope attached upwards to drain down the chamber and provide access for maintenance. The pivoting bypass door must be returned to the closed position following drain down of the chamber and clearance of the blockage.

9.2 Regular inspections should be carried out to ensure that debris that may obstruct the inlet to the flow control is not present in the chamber. The frequency of inspection will depend on the location of the unit but must be at least once per year.

9.3 The units can be jetted from downstream, in accordance with standard sewer jetting procedures without affecting the hydraulic performance of the system.

10 Durability



The units are made from materials that will not be adversely affected by contaminants likely to be found in surface water systems in the UK. In the opinion of the BBA, the units will have a service life in excess of 60 years when installed in surface water systems.

11 Reuse and recyclability

The units consist of stainless steel which is readily recyclable.

Installation

12 General

12.1 S-Range Hydro-Brake Optimum Flow Controls must be installed in accordance with the Certificate holder's instructions. In many cases the installation will be in a confined space and all appropriate measures must be taken to ensure the safety of operatives working in such areas.

12.2 Dimensioned drawings for each installation are provided by the Certificate holder. It is important that the flow control chamber is constructed to the drawing. Other than where a curved backplate is supplied, this should incorporate a flat mounting surface on the inside face of the chamber wall at the outlet pipe. Ensure that the sump has sufficient width and depth below the invert of the outlet pipe to accommodate the unit.

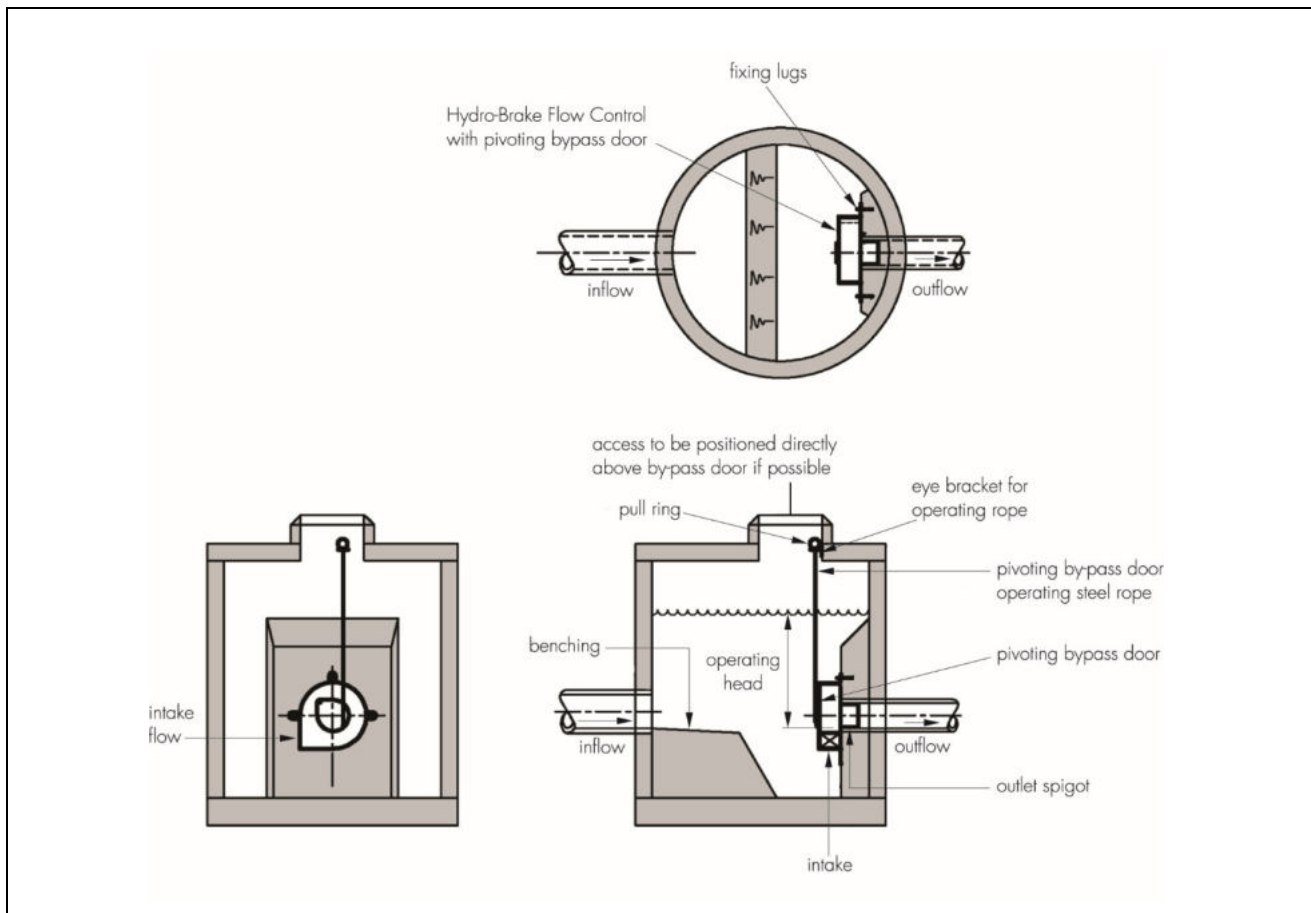
12.3 The benching must be formed as indicated on the installation drawing.

12.4 Where an adjustable inlet gate is provided, the factory set position must not be adjusted without prior consultation with the Certificate holder.

13 Procedure

13.1 The unit is offered up to the chamber outlet wall until the spigot projects into the outlet pipe with its invert seated to the outlet pipe invert and with the unit in the correct orientation (see Figure 8).

Figure 8 Typical installation details



13.2 With the unit in position, the position of the required number of bolt holes is marked and drilled through the fixing lugs or plate mount (depending on specification).

13.3 Ensuring that the supplied rubber gasket is suitably positioned over the outlet spigot of the flow control, the fixings are inserted and tightened until moderate compression of the gasket is achieved.

13.4 The supplied eye brackets on the pivoting bypass door operating rope are fixed to the soffit of the roof slab using masonry bolts, to achieve a direct vertical line of pull from over the chamber access cover to the pivoting bypass door. It should be arranged that the rope is taut when held in the upper eye bracket. Where it is not possible to attain a direct vertical line of pull, additional eye brackets can be used to account for the change of direction.

13.5 The rope stop should be positioned to ensure that, when the pivoting bypass door is open, the rope stop can be clipped to the uppermost bracket. Once positioned, the stop attachment grub screws should be tightened.

Technical Investigations

14 Tests

Tests were carried out and the results assessed to determine:

- dimensional accuracy of the units
- the hydraulic performance of the units.

15 Investigations

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

15.2 A site visit was made to assess the practicability and ease of installation.

15.3 An assessment of computational fluid dynamic (CFD) modelling used to predict the hydraulic performance of the units was made.

15.4 An assessment of the Certificate holder's predicted characteristics was made against the results of hydraulic performance tests.

15.5 An assessment was made of the structural adequacy of the units under loads that they are expected to resist.

15.6 An evaluation of existing data was made to assess durability.

Bibliography

BS EN 10088-4 : 2009 *Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

CIRIA C753 : 2015 *The SUDS manual*

Flood risk and coastal change Guidance - National Planning Policy Framework

16 Conditions

16.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

16.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

16.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

16.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

16.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

16.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

Sustainable Drainage Systems Ltd

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Tel: 01934 751303 Fax: 01934 751304
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website: www.sdslimited.com



Agrément Certificate
11/4877
Product Sheet 1

GEOLIGHT STORMWATER MANAGEMENT SYSTEMS

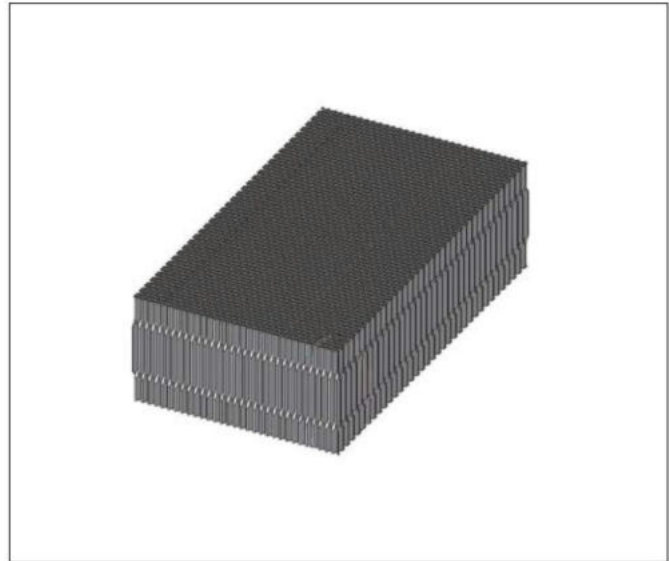
GEOLIGHT 400 STORMWATER BLOCKS

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to GEOLight 400 Stormwater Blocks, for use as sub-surface water storage or as a soakaway to manage run-off from impermeable surfaces.

AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.



KEY FACTORS ASSESSED

System design — the Certificate provides data to assist in the design of a sub-surface water management system incorporating the stormwater blocks (see section 6).

Structural performance — the product has adequate strength and stiffness to resist long- and short-term loads when used in accordance with this Certificate (see section 7).

Durability — the product will have a service life in excess of 50 years when installed in accordance with this Certificate (see section 12).

The BBA has awarded this Agrément Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 23 November 2011

Brian Chamberlain

Head of Approvals — Engineering

Greg Cooper

Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

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website: www.bbacerts.co.uk

Regulations

In the opinion of the BBA, GEOLight 400 Stormwater Blocks, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



The Building Regulations 2010 (England and Wales)

Requirement:	H3(3)	Rainwater drainage
Comment:		The blocks can be used in a construction to meet this Requirement. See sections 6.1 to 6.10 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The system components are acceptable. See section 12 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Fitness and durability of materials and workmanship
Comment:		The system components are acceptable. See sections 11.1 to 11.7 and 12 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards — construction
Standard:	3.6(a)	Surface water drainage
Comment:		The blocks can be used in a construction to satisfy this Standard, with reference to clauses 3.6.1 ⁽¹⁾⁽²⁾ to 3.6.5 ⁽¹⁾⁽²⁾ . See sections 6.1 to 6.10 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The product can contribute to meeting the relevant Requirements of Regulation 9, Standards 1 to 6, and, therefore, will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	Fitness of materials and workmanship
Comment:		The system components are acceptable. See section 12 and the <i>Installation</i> part of this Certificate.
Regulation:	B3(2)	Suitability of certain materials
Comment:		The system components are acceptable. See sections 11.1 to 11.7 of this Certificate.
Regulation:	N5	Rain-water drainage
Comment:		The blocks can be used in a construction to satisfy this Regulation. See sections 6.1 to 6.10 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 1 *Description* (1.1), 3 *Delivery and site handling* (3.1 and 3.2) and 14 *Procedure* (14.1) of this Certificate.

Additional Information

NHBC Standards 2011

In the opinion of the BBA, the use of GEOLight 400 Stormwater Blocks, in relation to this Certificate, is not subject to the requirements of these Standards.

1 Description

1.1 GEOLight 400 Stormwater Blocks are manufactured from dark-grey, recycled, rigid polyvinyl-chloride (PVC) sheet which is corrugated and bonded to form a cellular structure (see Figure 1). The main characteristics are detailed in Table 1.

Figure 1 GEOLight 400 block

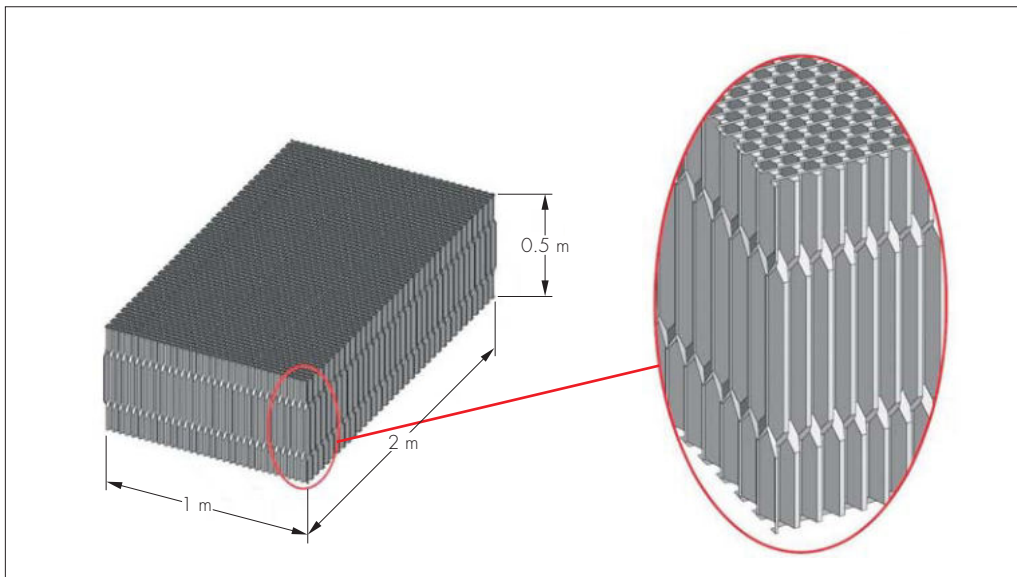


Table 1 Characteristics of blocks

Element (unit)	Value
Dimension ⁽¹⁾ (m)	2 x 1 x 0.5
Dry weight (kg)	55
Volume (nominal) (m ³)	1
Storage volume (nominal) (m ³)	0.95
Porosity (void ratio) (%)	95
Ultimate compression strength at yield (kN·m ⁻²):	
vertical loading on top face	420
lateral loading on side face	34
Estimated long-term deflection ⁽²⁾ (Ln) ⁽³⁾ (mm)	0.5885
Short-term deflection (mm per kN·m ⁻²):	
vertical loading on top face	1 per 21
lateral loading on side face	1 per 1

(1) Other sizes are available on request from the Certificate holder.

(2) At up to 12 years at 20°C with an applied load of 215 kN·m⁻².

(3) Time in hours.

(4) Applied load.

1.2 The blocks can be used in systems to control stormwater run-off from impermeable surfaces by:

- infiltration — soakaways to infiltrate water back into the ground, or
- attenuation — temporary storage for excess flows and limiting outflow to streams and rivers, or
- a combination of infiltration and attenuation.

1.3 Inlet and outlet pipes and connecting pipework for use with this system are not covered by the scope of this Certificate. Geotextiles and geomembranes for use with this system are not covered by the scope of this Certificate. Information on the required specification of the geotextile and/or geomembrane can be obtained from the Certificate holder.

1.4 A slotted distribution pipe is used to allow water to enter and/or exit the GEOLight structure. The pipe should be a slotted twinwall pipe of minimum stiffness class SN8 with third-party approval, eg BBA Agrément Certificate. The bedding and backfill around this pipe must be in accordance with type H or type I filter drain trench and bedding details as described in the *Manual of Contract Documents for Highway Works (MCHW)*, Volume 3, section 1, drawing F2.

1.5 Each assembly is wrapped in either a permeable geotextile, when used for infiltration, or an impermeable geomembrane, when used for storage (attenuation).

1.6 Adequate venting must be provided to the structure using an air vent. One vent is required per 1250 square metres of impermeable catchment area to be drained. Air vent connections and pipework for use with this system are outside the scope of this Certificate.

1.7 Water collected in the structure may be used to supply a rainwater harvesting system. The design of this system and the suitability of the water stored are beyond the scope of this Certificate but the structural and storage properties of the units published will remain valid providing the design of the structure follows the guidance given in this Certificate.

2 Manufacture

2.1 Profiled sheets of PVC are welded together to form the blocks.

2.2 To ensure product quality is consistently maintained to the required specifications, the BBA has assessed the manufacturer's documented factory production control procedure, its implementation and the production process.

2.3 Management system checks include monitoring of equipment for proper testing and calibration, assessment of product conformity and that non-conforming products are managed accordingly. Production control checks on the products are carried out on the incoming materials, during production and on the finished products.

2.4 For continued compliance, the quality control procedures and tests to be adopted have been agreed with manufacturer and regular surveillance audits of the factory are undertaken.

3 Delivery and site handling

3.1 The blocks are supplied to site in packs of 12 m³ secured with plastic banding on a wooden pallet to enable placing and movement by fork-lift truck. Each pack carries a label bearing the product name, order number and date of manufacture.

3.2 The packs should be carefully placed on level ground and should not be stacked on site. Loose individual blocks should not be stored more than two high; each block has a dry weight of 55 kg.

3.3 The blocks contain an inhibitor to resist the effects of ultraviolet light. However, prolonged storage in direct sunlight should be avoided.

3.4 The blocks should not be stored near fuel bowzers, fuel tanks or other solvents.

3.5 The blocks are resistant to damage likely to be caused during normal handling, but should be stored in locations where impacts from vehicles and other construction plant will be avoided.

Assessment and Technical Investigations

The following parts of the Certificate give a summary of the assessment and technical investigations carried out on GEOLight 400 Stormwater Blocks.

Features in Certificate



The presence of a UK map and blue tint indicates that the subject is related to the Building Regulations in the region(s) depicted.

GEOLight is a registered trademark of Sustainable Drainage Systems Ltd.

General

This Certificate does not cover the surface water collection or disposal systems that may be used to transfer water to and from the GEOLight tank — further information on these systems can be obtained from the Certificate holder.

Design Considerations

4 General

4.1 The GEOLight 400 Stormwater Blocks design must be in accordance with the Certificate holder's instructions. Guidance on the application of sustainable drainage systems (SUDS), such as the GEOLight range of stormwater blocks, for new developments, can also be found in the Government's Planning Policy Statement PPS25 *Development and Flood Risk* and *The SUDS Manual C697* published by CIRIA⁽¹⁾.

(1) Construction Industry Research and Information Association.

4.2 A system incorporating the blocks is suitable for the control of stormwater run-off from impermeable surfaces. It can be utilised in three main ways:

- Infiltration — water is collected in the blocks 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 — water is collected in the blocks 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, minimises the risk of flooding.
- Combination system — water is collected in the blocks during rainfall and able to flow out of the tank via infiltration and through an outlet flow control device into an appropriate outfall.

4.3 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.

4.4 Once the project criteria have been established from the site audit, there are two main parts to the design procedure: system design and structural design (see sections 6 and 7).

5 Practicability of installation

The product is designed to be installed by a competent general builder, or a contractor, experienced with this type of product.

6 System design

Infiltration

Calculation principles

6.1 There are two approaches, either of which may be adopted: the CIRIA Report 156 *Infiltration Drainage — Manual of Good Practice* or BRE Digest 365 *Soakaway Design*.

6.2 A simplified approximate approach can be used on a very small site (ie a single-house development) where detailed site infiltration rate information may not be required nor available (see Table 2). From Approved Document H of the England and Wales Building Regulations, for areas up to 25 m², a storage volume equal to the area to be drained multiplied by 10 mm may be used. Beyond this size, design should be carried out in accordance with BS EN 752 : 2008 or BRE Digest 365. It is suggested in BS EN 752 : 2008 that a storage volume equal to 20 mm multiplied by the area to be drained may be used. In Scotland, guidance for the design of single-house soakaways is given in Mandatory Standard 3.6, clause 3.6.5⁽¹⁾.

(1) Technical Handbook (Domestic).

Table 2 Simplified soakaway design for single-house development⁽¹⁾

Number of units	Storage volume (m ³)	Maximum area to be drained ⁽²⁾ (m ²)
1	1.0	47.5
2	1.9	95
3	2.9	142.5

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

(2) In accordance with BS EN 752 : 2008, clause NA 4.4.8.

6.3 When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installations can be found from Tables 3 and 4.

Table 3 Volumetric data per linear metre for single-width (1 m) trench applications

Number of units long	Volume (m ³)	Side area (m ²)	Base area (m ²)	End area (m ²)
1	0.5	1.0	1.0	1.0
2	1.0	2.0	1.0	2.0
3	1.4	3.0	1.0	3.0

Table 4 Volumetric data for cuboid installations two units high

No of units long	Two units wide			Four units wide			Eight units wide		
	Volume (m ³)	Base (m ²)	Side + end (m ²)	Volume (m ³)	Base (m ²)	Side + end (m ²)	Volume (m ³)	Base (m ²)	Side + end (m ²)
1	3.8	1.3	8.0	7.6	2.6	12.0	15.2	5.1	20.0
2	7.6	2.6	12.0	15.2	5.1	16.0	30.4	10.2	24.0
5	19.0	24.0	24.0	38.0	12.8	28.0	76.0	25.6	36.0
10	38.0	12.8	44.0	76.0	25.6	48.0	152.0	51.2	56.0
25	95.0	104.0	104.0	190.0	64.0	108.0	380.0	128.0	116.0

6.4 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 95% of the total volume of the blocks. As an example, using Table 3, for a typical linear trench 48 m long and two units deep, the storage volume is 48 m³ and the side area is 96 m². The area of the ends of the trench should also be taken into account; in the example the end area will be 2 m². The storage capacity of the slotted distribution pipe and its surrounding backfill will need to be calculated separately.

Attenuation

Calculation principles

6.5 The anticipated run-off volume (A) from the site must be estimated. The most commonly used method for evaluating storm rainfall events in the UK is the Wallingford Procedure by which the total rainfall level of storms over defined time periods ranging from five minutes up to 48 hours are assessed. The depth of water (mm) found can be multiplied by the catchment area to assess the size of attenuation systems and is normally based upon a two-hour storm of a return period appropriate for the catchment. 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 over the two-hour period is calculated and subtracted from the run-off volume (A-B). This defines the excess volume (C) to be stored in GEOLight blocks 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 95% of the total volume of the tank with due allowance made for distribution pipes that may run within the tank structure.

Connection

6.6 Typically, a slotted distribution pipe running through the tank is used to convey inlet and outlet (where appropriate) flow.

6.7 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.

Manifold design

6.8 The tank can be designed to accommodate multi-pipe entry if the capacity of a single input pipe is insufficient for the anticipated flow load. This allows the flow load to be split between a number of pipes from the adjacent manhole.

Flow control

6.9 The outflow from the tank must be controlled to comply with the discharge rate consent of the site. There are a number of methods to achieve outflow control. Comparative features and benefits of the various control flow devices should be considered prior to selection. These devices are not within the scope of this Certificate.

Outflow positioning and head calculations

6.10 The invert level of the outflow pipe should be flush with or below the bottom of the lowest unit to allow the tank to drain. As the tank fills, a depth of water develops on the upstream side of the outflow control. For a tank with two layers of GEOLight 400 blocks, this depth is 1 m (nominal) 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 centre line of the outflow device.

7 Structural performance

7.1 The blocks can be placed under a wide variety of landscaped or lightly-trafficked areas. Design procedures for heavily-trafficked applications are not within the scope of this Certificate. If the proposed application of the product is in areas subject to high-intensity traffic, commercial vehicles or other heavy loads, advice should be sought from the Certificate holder. Typical installation details are shown in Figure 2.

7.2 Short-term loading design parameters for the blocks have been derived from test data (see Table 5). The short- and long-term deflection is given in Table 1.

Table 5 Loading design parameters⁽¹⁾

Characteristic	Vertical loading on top face	Lateral loading on side face
Short-term ultimate compressive strength at yield (kN·m ⁻²)	420	34 ⁽²⁾

(1) A partial safety factor for materials (f_m) should be applied to these values depending on the application and design life required for a particular project. The Certificate holder suggests values of 1.5 for ultimate limit state and 1.4 for serviceability limit state for a design life of 12 years.

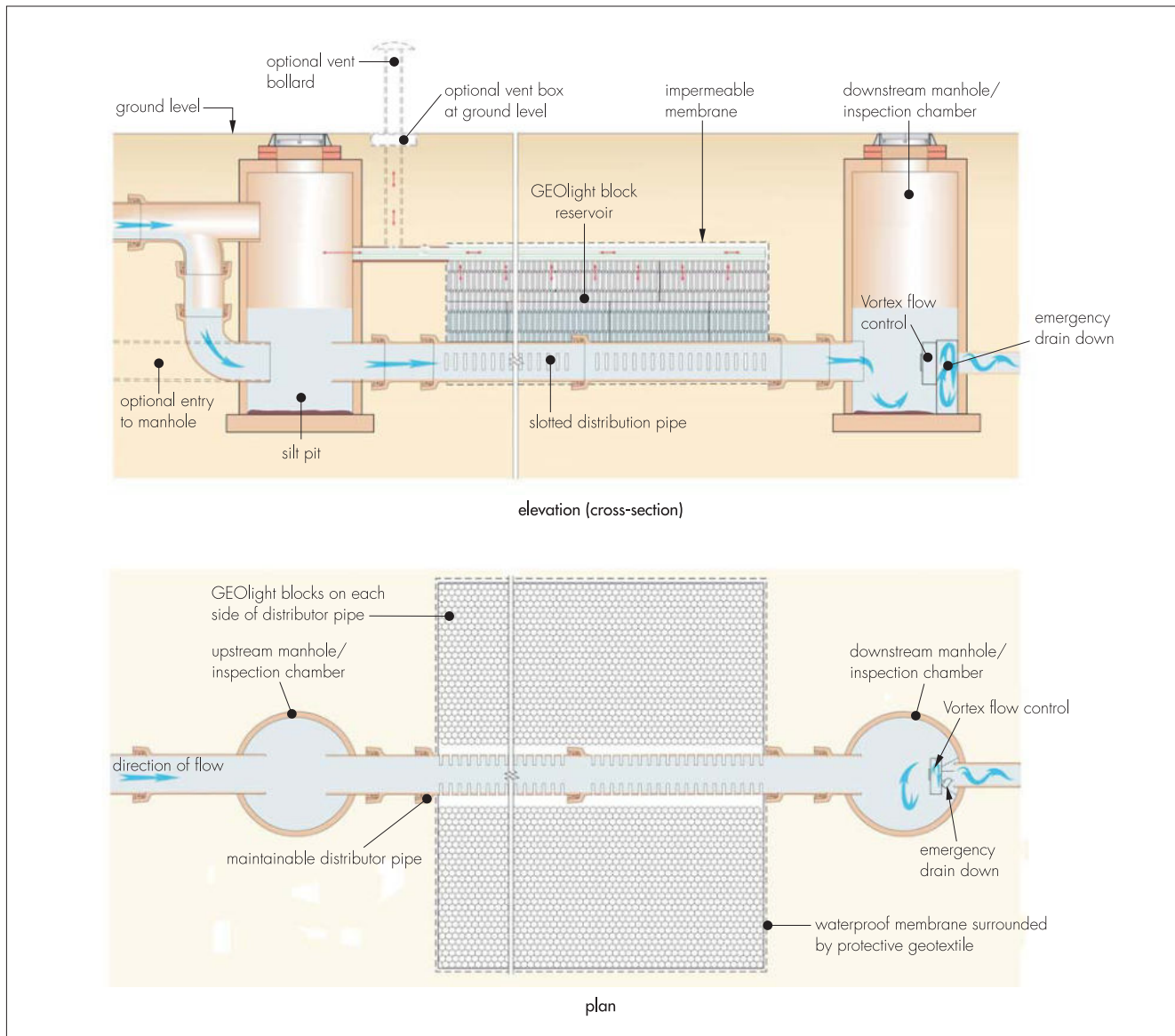
(2) A minimum surrounding soil modulus of 3 MN·m⁻² is assumed.

7.3 From creep tests⁽¹⁾, it is suggested that the long-term rate of deflection may be estimated from the expression below. This will be valid for loads up to 215 kN·m⁻² and durations of up to 12 years at 20°C. In locations where settlement is not of concern, designs up to 50 years can be undertaken:

$$\text{Deflection (mm)} = 0.5885 \cdot \ln(\text{time in hours}) + 1.1759$$

(1) Creep tests were carried out with a load equivalent to a pressure of 215 kN·m⁻² for a period of 10000 hours.

Figure 2 Typical installation



7.4 For small-scale application such as soakaways for individual house roof drainage, the blocks are typically located below a garden a minimum of 5 m from the building (see Table 6). In this case there are no traffic loads.

Table 6 Design criteria for use of the blocks as a soakaway for an individual house

Criterion	Value
Maximum depth to base ⁽¹⁾ (m)	2.62
Minimum cover depth over units (to prevent accidental damage) (m)	0.5
Maximum cover depth for single-layer installation (m)	2.12
Maximum cover depth for double-layer installation (m)	1.62

(1) Assumptions applying are:

- minimum angle of shearing resistance of surrounding soil is 29° (to be confirmed by site survey).
- ground water at least one metre below base of blocks
- there is no possibility of any surcharge being applied.

7.5 The blocks used for large-scale storage or infiltration 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.

7.6 The criteria provided in Tables 7 and 8 can be used to design the blocks for installation below lightly- and non-trafficked areas⁽¹⁾. These design tables are only applicable in temperate climate conditions such as those found in the UK. The partial safety factors applied were:

ultimate limit state

- vertical dead load (F_{dl}) 1.35
- earth pressure (horizontal) dead load (F_{ep}) 1.35
- imposed live load (F_{ll}) 1.50
- materials (F_m) 1.50

serviceability limit state

- vertical dead load (F_{dl}) 1.00
- earth pressure (horizontal) dead load (F_{ep}) 1.00
- imposed live load (F_{ll}) 1.00
- materials (F_m) 1.40

(1) The blocks 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.

Table 7 Maximum installation depths (to base of units)⁽¹⁾

Typical soil type	Typical angle of shearing resistance ⁽¹⁾⁽²⁾ (ϕ)	Maximum depth of installation (to base of blocks) (m)	
		Without groundwater (below base of blocks) wrapped in geomembrane	
		Trafficked area (cars only)	Non-trafficked
Stiff over consolidated clay (eg London clay)	24°	1.91	2.19
Normally consolidated silty, sandy clay (eg alluvium, made ground)	27°	2.16	2.44
Loose sand and gravel	30°	2.44	2.72
Medium dense sand and gravel	35°	3.02	3.30
Dense sand and gravel	40°	3.79	4.06

- (1) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of ϕ .
- (2) The design is very sensitive to small changes in the assumed value of ϕ , therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
- (3) Applicable for car parks or other areas trafficked only by cars, based on DIN 1072 : 1988, load case 6/6. Assumptions made are:
- ground surface is horizontal
 - shear planes or other weaknesses are not present within the structure of the soil.

Table 8 Minimum cover depths over top of blocks⁽¹⁾

Location	Minimum cover depth (m)
Non-trafficked areas (eg landscaping)	0.5
Car parks, vehicle up to 2500 kg mass (gross)	0.5

(1) Assumes 27° load distribution through fill material and overlying surface of asphalt or block paving, and trafficking by cars and light vans as DIN 1072 : 1988, load case 6/6.

7.7 For lightly-loaded applications, the bearing capacity of the underlying soils, typically, should not be exceeded by the installation. 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.

7.8 Care should be taken when the blocks are 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.

7.9 When the blocks are wrapped in geomembrane and placed below the groundwater table, flotation may occur. To prevent this, the weight of the soil over the top of the blocks must be greater than the uplift force caused by the block's buoyancy in the water. This can be achieved with most types of fill if the depth of cover fill is equal to, or greater than, the depth of penetration of the blocks below groundwater level.

7.10 Where a slotted distribution pipe, or pipes, are installed within the tank it is bedded on and surrounded by an appropriate aggregate. The surrounding fill must be a sufficient thickness to provide adequate support to the pipe and finish level with the top of the adjacent GEOlight units. Structural calculations should be carried out in accordance with BS EN 1295-1 : 1997 to verify that the deflection of the pipe(s) will not be excessive under the anticipated design loads.

8 Geotextiles and geomembranes

Geotextiles

8.1 In infiltration applications, a geotextile is wrapped around the block installation⁽¹⁾ to prevent clogging of the soil which surrounds the unit with silt present in run-off, and soil entering the units. In storage applications, a geotextile is placed either side of the geomembrane to protect it from damage.

(1) A geotextile is also wrapped around the slotted distribution pipe where used, to prevent silt entering the tank structure.

8.2 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
- tensile strength — the geotextile should have sufficient strength to resist the imposed forces (eg from traffic).

8.3 The geotextile should be selected according to specific site conditions. However, typically a 300 g non-woven material will be suitable for most situations. Specialist advice should 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.

Geomembranes

8.4 A geomembrane is wrapped around the block installation in attenuation/storage applications where infiltration is not possible or permitted and functions to:

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

8.5 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
- remains intact for the full design life.

8.6 Geomembranes of less than 400 g.m⁻² are unlikely to meet these criteria⁽¹⁾, and are not recommended for use with the blocks⁽²⁾.

(1) Except in shallow, domestic installations.

(2) Further details are available from the Certificate holder.

8.7 To ensure total impermeability, joints between adjacent sheets of impermeable geomembranes should be sealed correctly using proprietary welding techniques. The integrity of joints should be demonstrated by non-destructive testing⁽¹⁾.

(1) Advice on seam testing is given in CIRIA SP124 *Barriers, liners and cover systems for containment and control of land contamination*.

9 Venting

9.1 Adequate venting must be provided to the block structure. One 20 mm by 150 mm air vent is required per 1250 square metres of impermeable catchment area to be drained (see Figure 2).

9.2 A typical air vent arrangement is shown in Figure 2. It is recommended that all air vent installations in storage applications (using a geomembrane) are made using a flange adaptor. Thermal welding, adhesive or double-sided tape should be used between the geomembrane and flange adaptor to ensure a watertight seal.

10 Resistance to chemicals

10.1 An assessment by the BBA indicates that the components of the system are suitable for use in contact with the chemicals likely to be found in rainwater, ground water and surface water run-off.

10.2 An assessment of the suitability for use of the blocks 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 in high concentrations. Further information should be sought from the Certificate holder.

11 Maintenance



11.1 The owner of the structure is responsible for maintenance.

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

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

11.4 It is recommended that a silt trap is incorporated into the pipework at the inlet to the tank (see Figure 2). 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.

11.5 Any silt finding its way into the structure should remain in the slotted distribution pipe which should be provided with sufficient access to allow flushing as part of a planned maintenance programme; the frequency required will vary between projects.

11.6 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.

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

12 Durability



The structural properties of PVC 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 BBA, the blocks, when used in accordance with this Certificate, will have a life in excess of 50 years.

Installation

13 General

The system should be installed in accordance with the Certificate holder's *Installation method statement*.

14 Procedure

14.1 The hole or trench is excavated to the required depth, dimensions and levels. It must be ensured that the plan area is sufficient to allow compaction plant access around sides to compact backfill material (500 mm minimum). 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.

14.2 The base should be compacted with a single pass of a smooth-wheeled roller with a mass per metre width of roller not less than 2100 kg, a vibratory roller with a mass per metre width of roller not less than 700 kg or a vibrating plate compactor having a mass per square metre of not less than 1400 kg. The base must be inspected for soft spots in the formation — any present must be excavated and replaced with compacted granular fill material.

14.3 A 50 mm thick, blinding layer of coarse sand is laid on the base of the excavation.

14.4 The geotextile (and geomembrane, if in an attenuation system) is laid over the blinding layer and up the sides of the excavation with lapped joints as per the geotextile manufacturer's recommendations. When using a geomembrane it must always be protected on the outer side 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 welding techniques with a minimum lap of 50 mm. Jointing with tape is not recommended as this places reliance on the mechanical properties of the tape to maintain the integrity of the system.

14.5 The blocks are installed in accordance with the installation schedule for correct orientation. The bottom layer is placed such that the horizontal filling channels are perpendicular to the distribution pipe and subsequent layers are placed perpendicular to one another. The position of the distribution pipe(s) should be established initially and the units placed around the pipes. The distribution pipe should be bedded and backfilled in accordance with the MCHW, Volume 3, section 1, drawing F2 for filter drain trenches type H or I. The backfill should be compacted in 150 mm layers. A layer of geotextile is placed below the pipe and up the side of the adjacent blocks overlapping the first layer of blocks by at least 1 m to prevent the aggregate backfill around the pipe migrating into the tank structure.

14.6 Adjacent blocks should be placed tightly against one another with the horizontal filling channels aligned across each layer.

14.7 The geotextile or geomembrane encapsulation to base, sides and top of installation, including protective geotextile is completed. Geomembranes should be welded with double seams. The geomembrane is inspected for damage and all welds tested as required.

14.8 Drainage connections are made to the installation using proprietary adaptors. It is recommended 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.

14.9 The installation is backfilled with selected granular material in accordance with the MCHW, Volume 1, appropriate to the tank design [typically Type 1 or Type 2 sub-base or Class 6P (side fill only) are used]. The backfill is compacted in layers of thickness appropriate to the fill type (typically 150 mm).

14.10 Backfilling is continued with:

- trafficked areas (eg car parks) — Type 1 or Type 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 metre width.
- landscaped and non-trafficked areas — selected as-dug material with size of pieces less than 75 mm compacted to 90% maximum dry density. 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, must not exceed a load of 2300 kg per metre width.

14.11 The pavement construction or landscaping is completed over the installation.

15 Tests

Tests were carried out on the system to determine:

- long-term and short-term resistance to loading
- volumetric capacity.

16 Investigations

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

16.2 An assessment of the system was made in relation to:

- material properties
- design procedures
- geotextile and geomembrane specifications.

16.3 A site visit was made to assess the practicability and ease of installation and connection.

Bibliography

BS EN 752 : 2008 *Drain and sewer systems outside buildings*

BS EN 1295-1 : 1997 *Structural design of buried pipelines under various conditions of loading — General requirements*

DIN 1072 : 1985 *Road and foot bridges; design roads*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*

Manual of Contract Documents for Highway Works, Volume 3 *Highway Construction Details*

17 Conditions

17.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

17.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

17.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

17.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

17.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

17.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.