

ATTENUATION TANK ON HUB SITE

Management System

**MORGAN
SINDALL**
CONSTRUCTION

CHECKSHEET

Drainage and Manholes

Contract:	GORTON COMMUNITY HUB	Contract no.:	13W009	Serial no.:	
Inspection details					
ITP ref. no.:		Element heading:			
Element subheading:					
Description:	ATTENUATION TANK ON HUB SITE				
Check sheet details					
Drawing references used:	92002(C09), 92003(C01), 0001(C02), 0002(C03)				
Has setting out check sheet been signed off? Yes ☐ Check sheet - SET serial no.:					
Details of drainage and manholes to be installed:					
Material:	POLYSTORM MODULAR CELLS		Size:	17m x 7m x 1.6m	
Excavation support method:	STEPPED SIDES				
Concrete grade where applicable	GEN3 N / mm2				
Where special installation instructions are to be followed, particularly for interceptors, give brief details. :					
All materials and plant available on site? Yes ☐					
Area released for construction:	Initials:	G/G	Date:	08.03.22	
Drainage pipes laid to correct depth and gradient? ☒					
Correct P Gravel installed as per specification? ☒					
Concrete base installed to specification? Yes ☐ N/A ☒					
Channels / branches / haunching to specification? Yes ☐ N/A ☒					
M/H rings / concrete surround or poly chamber or brickwork to specification? Yes ☐ N/A ☒					
Step irons / ladder rung irons / ladder to specification? Yes ☐ N/A ☒					
Water test carried out to specification? Yes ☐ No ☒					
If yes, give brief details and refer to relevant test record:					
Manhole / chamber / interceptor correctly backfilled? Yes ☒ N/A ☐					
Actual installed position recorded for as-built drawing? Yes ☒ N/A ☐					
Manhole / chamber / interceptor clean and cover(s) installed at correct level? Yes ☐ N/A ☒					
Area released for next activity:					
This check sheet has been issued with the purpose to progress 'the works'. All work is subject to a final inspection and customer approval at the date of project handover. This checklist is flexible to allow full checking process by all parties.					
Drainage and Manholes checked, approved and released for next activity:					
PRINT NAME	COMPANY NAME (to differentiate whether subcontractor, Morgan Sindall, client or third party):	PRINT JOB TITLE:	SIGNATURE:	DATE:	
G. GAFFNEY	MORGAN SINDALL	SITE ENGINEER	G. Gaffney	21.03.22	

TEST REPORT

Client Chartrange Ltd

Address Wharf Street
Dukinfield
Cheshire
SK16 4NJ

Contract Gorton Community Hub, Garrat Way
Gorton M18 8LD

Job Number MRN 4238/32
Date of Issue 18 March 2022
Pages 1 of 2

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



-

REFERENCE DRAWINGS:

- FOR INFORMATION, SEE PAGE 27.
SUNNY & SHINE BUILDING PRODUCTS LTD. (SUNNY BUILDING OF LANS) AT
CUSTOMER COMPANY HAS, CURRENTLY, MANUFACTURED, WITH NO
TRADING REFERENCE: 3172847

LEGEND:

- COATING PRIMER FOR WATER-BASED
COATING RESIN GLAZE
WATER-BASED
COATING PRIMER FOR WATER-BASED
COATING RESIN GLAZE
WATER-BASED

- 
 NORMAL SPERMATOCYTE
 AFTER CANNOT BE ASSASSINATED

- ATTORNEY GENERAL
JAMES C. HARRIS

- UPPER ORANGE VALLEY CHAMPS
 100 - ALL-STAR SOFT
 100 - ALL-STAR SOFT
 100 - ALL-STAR SOFT

-

- STAFF REPORT CARD
GILB' WOLFE REPORT CARD

- DECEMBER 2012

- | | | | |
|------|---------------|--------------------|--------|
| DATE | RECEIVED FROM | CONTRIBUTOR'S NAME | AMOUNT |
|------|---------------|--------------------|--------|

- [illegible]

- | | | | |
|------|--|----------|----|
| 0000 | 2. SUBJECT TO NO COMMENTS, APPROVED FOR
FILING FOLLOWING REVISIONS. | 10/20/01 | AM |
| 0000 | NO COMMENTS. 178001. PACE. 00000001. | 11/08/01 | AM |
| 0000 | ALtered 1780. 10. 0001. PACE. 000000. 00. 000. | 10/00/01 | AM |
| 0000 | 000000. 00. 0001. 00. 0000. 00. 0000. 00. 0000. 00. | | |

- | Buy | Description | Date | By | Q |
|---------|-------------|---------|---------|---------|
| 10/1/01 | 10/1/01 | 10/1/01 | 10/1/01 | 10/1/01 |

- Gcurtains**

- blows, risk increased. However, "total force" (a combination of impact and frequency) had little effect. "Older people with a history of falling" were at greatest risk, other factors were less important.

- MORGAN**

- MCC GORTON COMMUNITY HUB

- ### PROPOSED DRAINAGE LAYOUT

- | | | | | |
|-------------------|------------------|-----------------|--------------------|----------------|
| Patient No | Date | Drugs In | Expenditure | C month |
| M | M 07 2011 | 2.86 | 32.8 | A.9 |
| Total | 2.23 | | | |

- GC# - CLR - XX - XX - DR - C - 52002

DRAINAGE NOTES

- [illegible]

- [illegible]

- SCALE 1300

CULTURE DRAINAGE STRATEGY

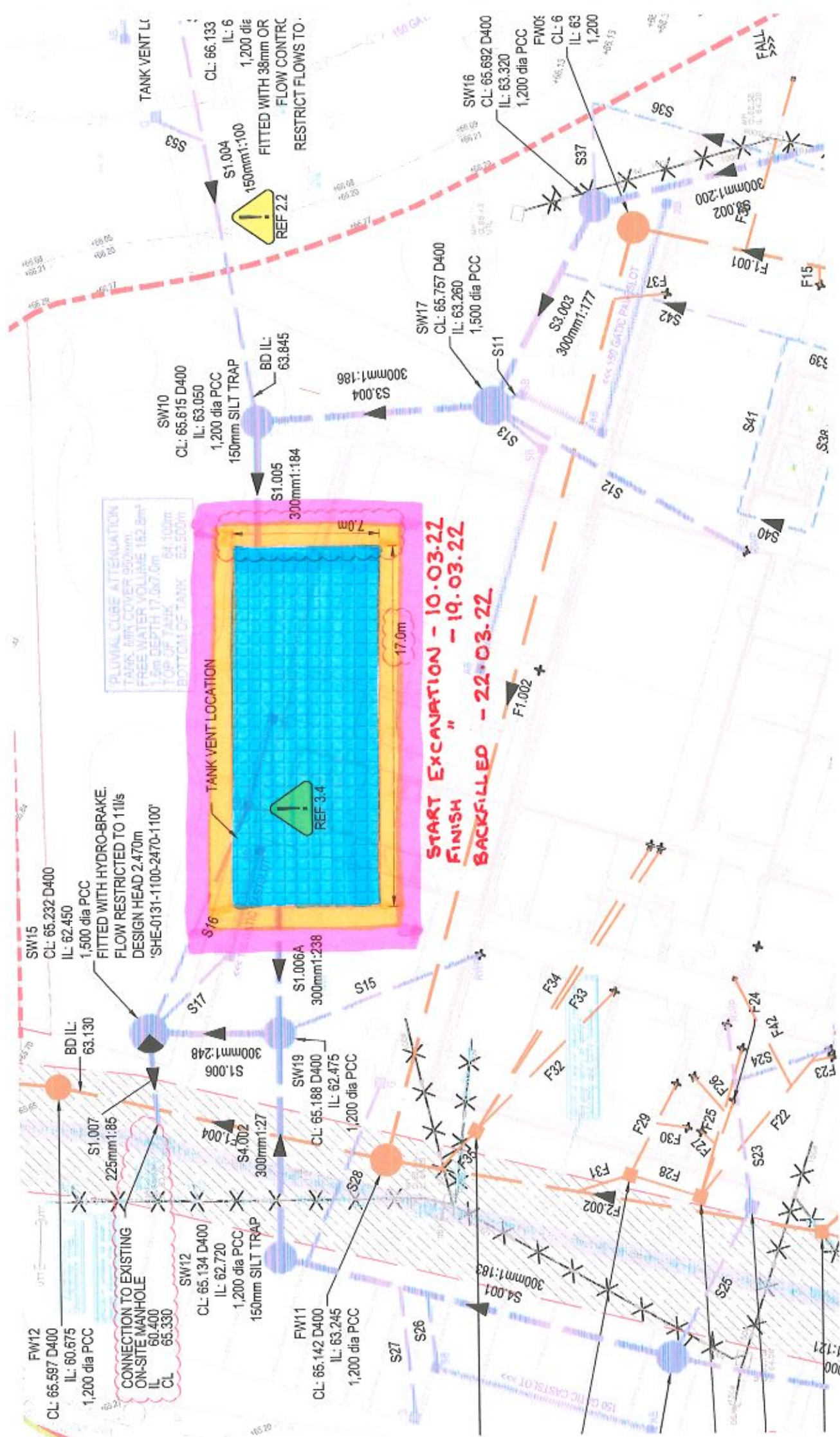
-

RESIDUAL HAZARD REGISTER

- [illegible]

- | | | |
|---|--|--|
|  | BARRIER SURPASSAGE WARNING
ATTENTION! "AHEAD" | MAXIMUM CLEARANCE LIMIT OF
6' 6" OVER THE POST FRAME IS
10' 1" (2550 mm) |
|---|--|--|

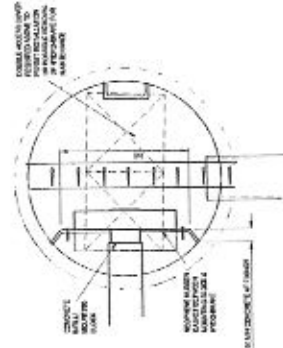
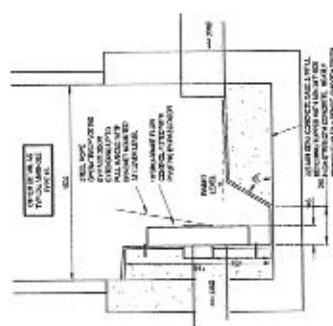




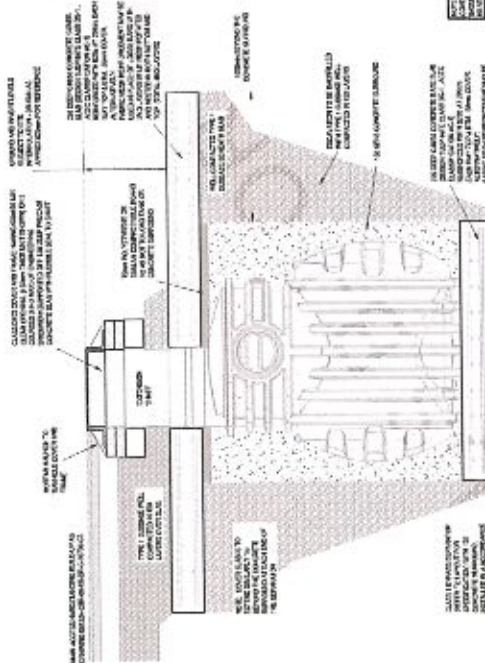
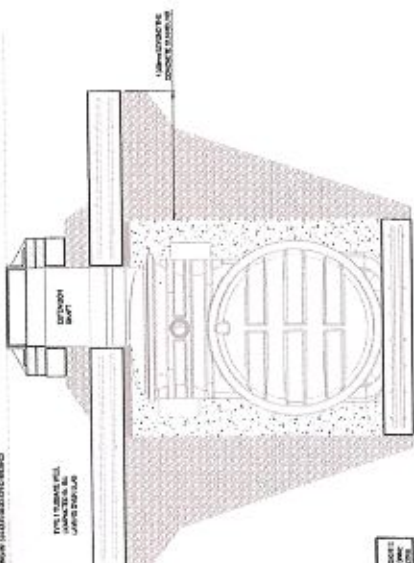
[illegible]

FOR MORE INFORMATION

FOR MORE INFORMATION



© 2007 The Authors
Journal compilation © 2007 Blackwell Publishing Ltd



NAME _____
 ADDRESS _____
 PHONE NO. _____
 CITY _____

UNDER PUMP WITH SPAM WITH A REFRIGERATOR BASE & COVER

11 SEP 2010

5:24M 5:27P

FOR THE RECORD

158

Curtins

APPROVED AND

ACCEPTED - STAGES
MORGAN

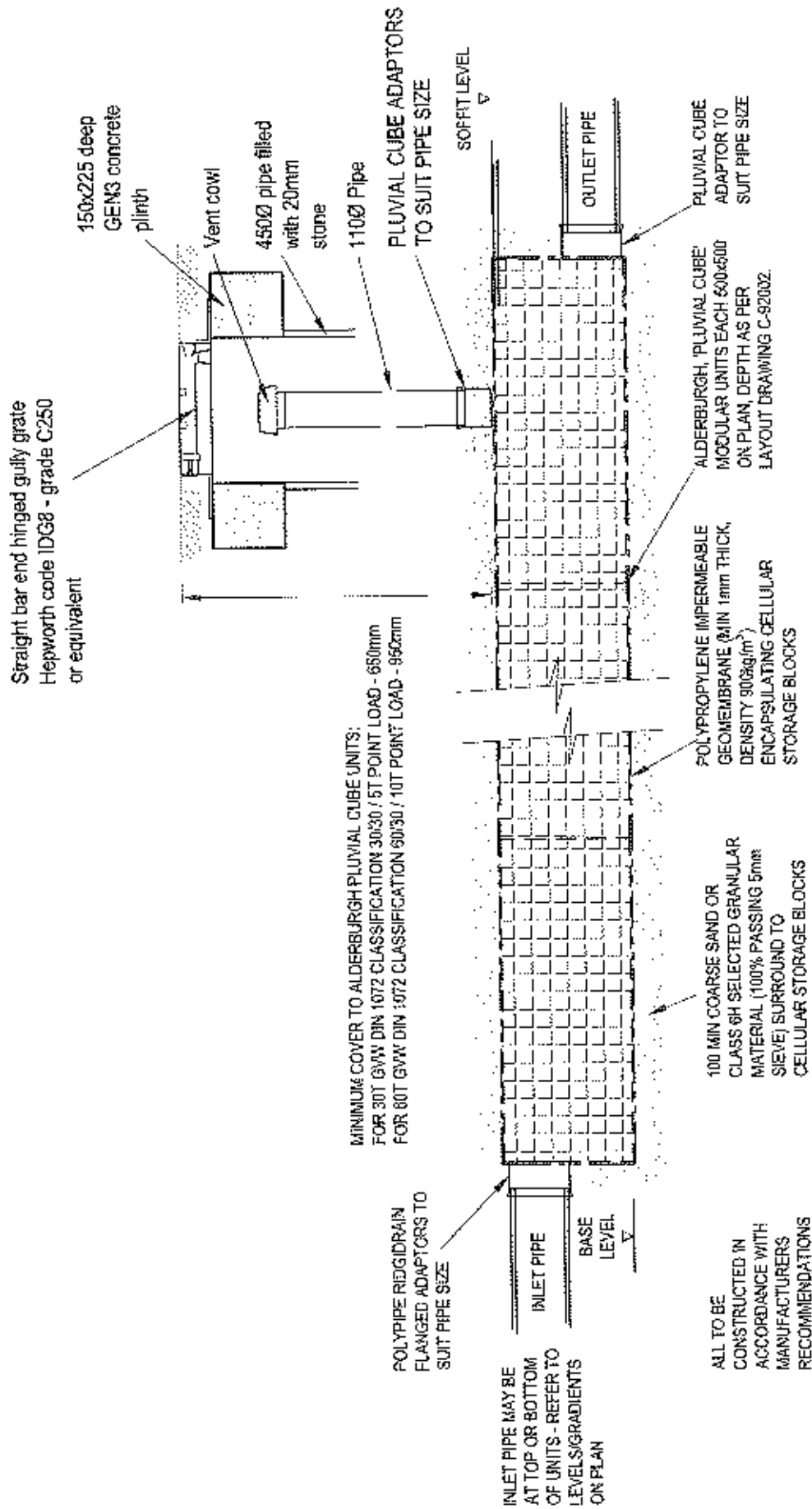
SINDALL

MCC GORTON COMMUNITY HUB

DRAINAGE DETAILS SHEET 1

Page No.	Date	Roll	Section	Examiner's Bk.	Control No.
62417	11	1001012015		1998	21

GCN - CUR - XX - XX - DR - C - 92'03 - D11



SINGLE 550 DEEP LAYER SHOWN FOR REFERENCE
REFER TO PLAN FOR OVERALL TANK SIZE & DEPTH

ATTENUATION TANK

VENT / ACCESS

OUTLET PIPE TO SW19
(LEVEL TO SUIT
DESIGN REQUIREMENTS)

64.100m

62.500m

INLET PIPE FROM SW10
SIZE AND LEVEL TO
ENGINEER REQUIREMENTS

17000 mm

1600 mm

DIAGRAMMATIC TANK LAYOUT (N.T.S.)

ATTENUATION TANK 1
17m x 7m x 1.6m DEEP = 190.4m³ GROSS
182.78m³ NETT (96% VOID RATIO)
(LEVELS TO THE ENGINEER REQUIREMENTS
PLEASE REFER TO THE LATEST DRAINAGE
LAYOUT PRIOR TO INSTALLATION)

1. ALL STORAGE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. THE CONSTRUCTION OF THE TANKS MUST BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
2. THE LOCATION, SIZE AND DEPTH OF ALL TANKS MUST BE DETERMINED BY THE ENGINEER PRIOR TO THE CONSTRUCTION OF THE TANKS. THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
3. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
4. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
5. ALL LEVELS AND DIMENSIONS SHALL BE VERIFIED BY THE ENGINEER PRIOR TO THE CONSTRUCTION OF THE TANKS. THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
6. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
7. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
8. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
9. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.
10. THE CONTRACTOR SHALL ALLOW FOR THE CONSTRUCTION OF THE TANKS TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.

NOTES: (1) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (2) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (3) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (4) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (5) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (6) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (7) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (8) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (9) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY. (10) THE TANKS MUST BE CONSTRUCTED TO THE REQUIREMENTS OF THE ENVIRONMENTAL AGENCY.



ENVIRONMENTAL AGENCY
SOUTH WEST
DANCE STREET
BATH
BA1 1BE
TEL: 01225 374400
FAX: 01225 374401
EMAIL: info@environmental-agency.gov.uk

SCALE: 1:100
N.E. SECTION COMPLETION: 10/10/2010
ATTENUATION TANK 1 - LAYOUT

DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD
DATE	16/07/2003	BY	MD	CD

Method Statement For: ATTENUATION TANK EXCAVATION AND INSTALLATION

Document Produced by: DENYS BUTKO

Original Issue Date:

14.03.22

AUTHORISATION

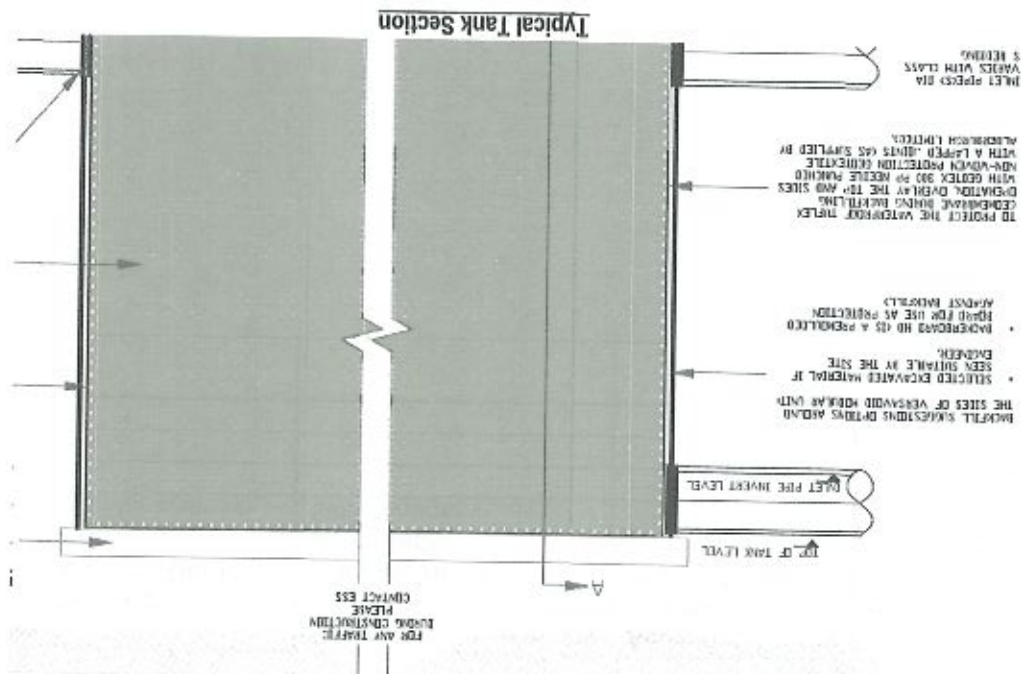
Rev Nº	Prepared or Reviewed by: (Name & Job Title)	Accepted for use by Project Manager/Nominee	Accepted Employer required)	by (if	Date
0	David Keating	Denys Butko			14.03.22
	Contract Manager	Site Manager			

Issue Date	Revision No		Page 1 of 6

2	Location of Work		
Gorton Community Hub, Garratt Way, Gorton, M188LD			
Start Date		14.03.22	Duration
		2 WEEKS	
Description of Work			

Introduction

The attenuation tank comprises the following components:



- Prefabricated Pluvial module units'
- Impermeable membrane wraps to entire tank
- Geotextile protection fleece to bottom and sides
- 2nr pipe connection flanges to outlets and inlets
- 2 nr vent flanges to the main tank

Dimensions

The overall tank dimensions are 17m long, 7m wide and 1.6m depth.

Excavation

The tank inverts and cover levels and location are shown on drawing GCH-CUR-XX-XX-DR-C-92002-C08-Proposed Drainage Layout.

The section as shown on the attached sketch will be the 7m wide section. The dimensions will be set out to ensure safe pedestrian access between the manhole working area fencing and the top of the batter to the tank excavation.

The plan area of the tank (top of batter) will be marked out by the engineer.

The area will be CAT scanned and Permit to Excavate issued if confirmed clear of services.

The tank will be constructed in a stepped and battered side excavation to a formation some 100mm below tank base level. The excavator will work from the upstream face into the excavation, side casting arisings to stockpile or to wagon for export. The excavation to the batters will be set at 1:1 initially however will be monitored during the works and slopes reduced if the material/slopes are not stable. The base of the excavation shall be 8m wide providing a 500mm working edge to the tank base.

Access and egress

The excavator will access the works from the end of the dig, by lowering the batter to form a ramp suitable for the machine, and a ride on roller to gain access. Operatives will access the excavation via battered ramps.

Edge Protection

Pedestrian barriers will be located around the perimeter of the excavation, set 1m back from the top of batter.

Control of groundwater

Perched ground water has been observed in the excavations for the pile mat. A sump pump will be available during the excavation and will be deployed when necessary. The water will be pumped to a localised bunded lagoon adjacent to the tank dig.

Preparation of Formation

The design criteria for the formation is 3% CBR

The base will be excavated to 50mm above formation. The surface will be inspected for any clear hard obstructions or soft or deleterious material. Any obstructions or soft spots will be removed and backfilled with 6F2. The formation will then be proof rolled and subject to plate testing.

The formation then will be blinded with a layer of sharp sand. The sand will be placed using the excavator from top of the batter

Issue Date	Revision No		Page 3 of 6

Issue Date		Page 4 of 6
Revision No		

Printed copies of this document are uncontrolled

3	Supervision	Competency	Yes	No
	Name of Supervisor in Charge	Denys Bulko	X	
	Name of deputy / relief supervisor	David Keating	X	
		SMSSTS	X	
		SMSSTS/First Aid	X	

And raked finished, level checked and signed off.

Tank Installation

The Polystorm Cube standard installation guide is appended to this MS. This describes the way base plates, end plates the modular units and top plates are connected. The following describes the way the whole installation is assembled.

PIPE FLANGES

1. There are 1 inlet and 1 outlet a pipe flange for each pipe connection is required
2. When you order we need to know the O.D. for each pipe, as many manufacturers have different dimensions
3. The pipe flanges are attached using the super adhesive double-sided tape on the square section of the "top hat"
4. When attached check that the Geotex and Tuflex membrane is completely removed inside the pipe flange

Installation of the modular units

The sections are to be assembled in the lay down area and lowered into the excavation by sling. The boxes will be installed working from the end of the tank in staged and staggered lifts with no more than 0.5m high steps.

The panels shall not be assembled to more than 1.6m in height, at which point the textile and membrane shall be gathered and pulled into the tank. The annulus if the tank shall then be backfilled with selected excavated material and compacted in accordance with the earthwork's specification.

On completion of the module installation the tank membrane will be closed as described in the section above.

The tank can then be backfilled in accordance with the Earthworks specification and associated RAMs.

4 Risk Assessment					
Hazard Identification	Yes	No	Hazard Identification	Yes	No
Slips and Trips	X		COSHH		X
Manual handling	X		Noise		X
Hand tools		X	Work at Height	X	
Excavations	X		Dust/Fumes	X	
Machinery/Lifting equipment	X		Lighting		X
Fire		X	3rd party (Contractor)		
Fall of material		X	Environmental		X
Electrical		X	Other		

Potential severity of injury or illness	First Aid	LTI	Major	Fatal
Tick Box	X			
Number of workers exposed to hazard	1 - 5	6 - 10	11+	
Tick Box	X			
Probability of injury or illness	Rare	Annually	Occasional	Regular
Tick Box	X			

5 Control Measures to Reduce the Risks		(use additional sheet if necessary)
1.	ACCESS /EGRESS SET UP AND MONITORED DAILY	
2.	ASSESS LIFT WEIGHT AND SIZE (IF NECESSARY TWO MAN LIFT)	
3.	EXCAVATION AREA FENCED OFF AND ONLY BANKSMAN PRESENT WHILST WORKS TAKE PLACE	
4.	ONLY TRAINED OPS AND TESTED PLANT AND EQUIPMENT TO BE USED	
5.	EDGE PROTECTION TO BE USED AT HIGH LEVELS	
6.	WATER SUPPRESSION TO BE USED AS NECESSARY	
7.		

Permits to be used	Yes	No	Assessments Required (Attach if "Yes")	Yes	No
Hot works		X	COSHH		X
Working at height	X		Noise		X
Excavation	X		Manual handling	X	
Confined space entry		X	Vibration		X
Crane / Excavator check list	X		Other (state)		
Electrical		X			
Demolition	X				

Other control measures	
1.	
2.	

Additional PPE requirements	Yes	No		Yes	No
Full Body Safety Harness			Fall Restraint Lanyard		
Hearing protection			Welding Mask/Gauntlets		
Full Face Shield			Other [state]		

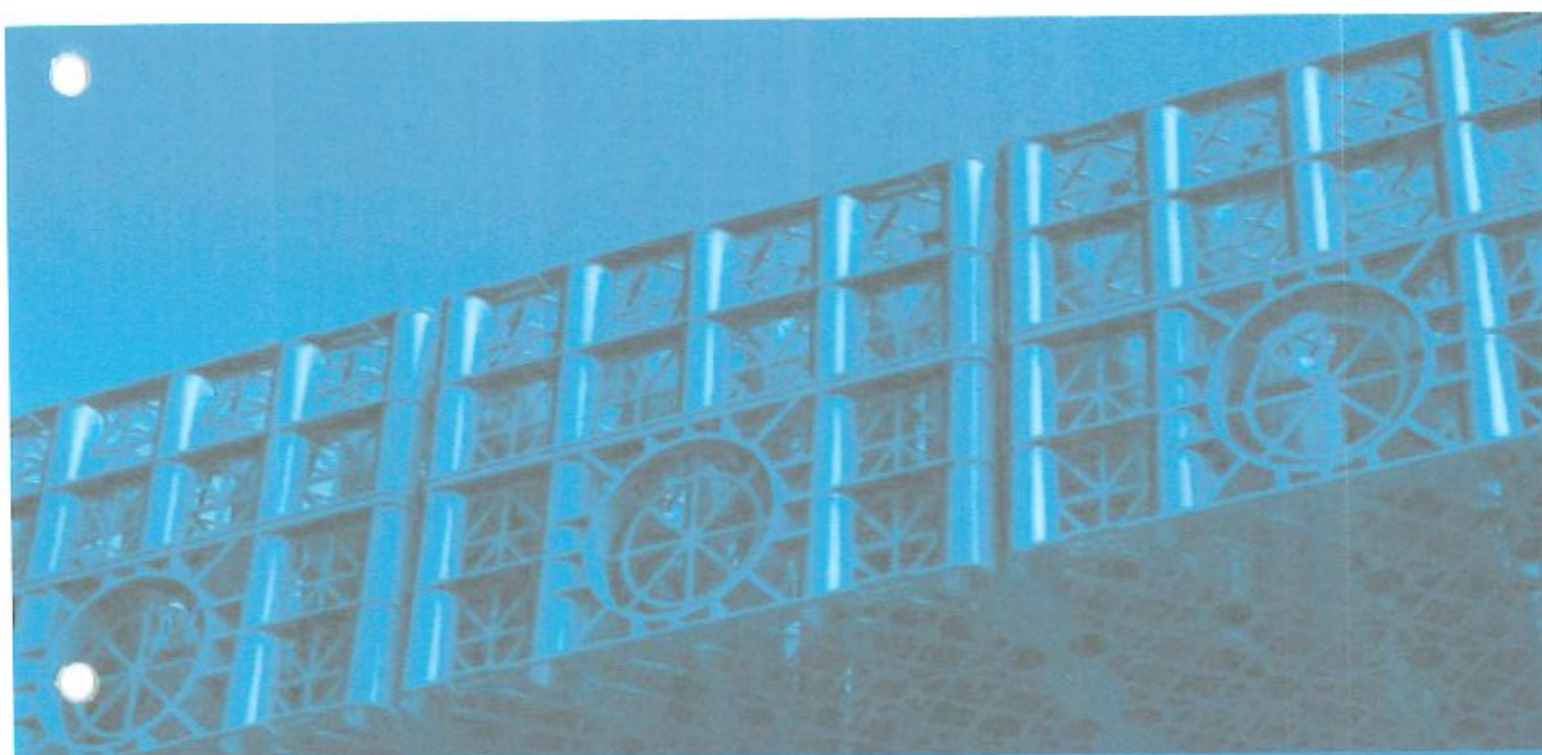
OVERALL Assessment of Risk after the implementation of Control Measures (Highlight as inapplicable)			
Low	Moderate	Substantial	High

Issue Date	Revision No		Page 5 of 6

Resources						Maximum Number of Personnel	6
Competencies Required							
CSCS [general]	X	No	PASMA [mobile scaffolding]	Yes	No	X	
CPCS [plant]	X		FASET / IRATA [nets & rope access]			X	
CISRS [scaffolding]	X		IPEAF(MEWP/ Scissor lift)			X	
Confined Spaces	X		Telerehandler			X	
List any Subcontractors to be used							
1.		Method Statement approved?	Yes No	Method Statement attached?	Yes No		
2.							
3.							
Equipment To Be Used							
Excavator for lifting duties	X	No	Task Lighting	Yes	No		
Lifting - slings / chains / beams / etc.	x		Welder/Angle Grinder/Cutting Torch		x		
Mechanical hoist, winches, pulleys, etc.			Hand tools	x			
Scaffolding			Mechanical tools	x			
Mobile elevating working platform			Ventilation/Extraction Equipment	x			
Mobile Tower Scaffolding			CAT Scan	x			
Ladders/Step ladders/ Podium			Test Equipment	x			
Telerehandler			Excavator	x			
Emergency Arrangements							
First Aid Provision Required							
As per site requirements							
Rescue Plan Required Y/N (if yes attach Rescue plan)							
Amendments to Current Systems (Yes/No) [If yes indicate what?]							
Traffic routes	x		Re-route pedestrian and traffic access and egress				
Emergency arrangements		x					
Exclusion zones		x					
Services		x					
8 Amendments to Current Systems (Yes/No) [If yes indicate what?]							
9 Communication							
Confirmation of briefing from Persons Carrying out the Work							
Print Name	Signature			Print Name		Signature	
1.							
2.							
3.							
4.							
5.							
Customer Permission to Proceed							
Customer Supervisor/Manager							
Name:				Name:			
Signature:				Signature:			

Polystorm & Polystorm Lite

Technical Guide



Water Management Solutions

Design, planning, specification and installation guidelines

Water Management Solutions

Modular Cell Systems

Design, planning, specification and installation guidelines

From the **technical specialists**, Polypipe Water Management Solutions, the Polystorm range of products and solutions for **attenuation and soakaway** applications.

This document describes the products from Polypipe Water Management Solutions for implementing a **stormwater management** system that meets the requirements for **Sustainable Drainage Systems (SUDS)**.

Purpose of this document

This document provides full technical details of Polypipe WMS Polystorm products and explains how to:

- select products to provide the best solution for your specific stormwater requirements
- incorporate products into your project's design
- install products on-site

Other relevant documents from Polypipe WMS

- Rodgidrain/Biogreener and Polysaver Design and Installation Manuals
- Forms for specifying your requirements for Catchpits and Stormwater Chambers

Contents

Section	Page
Index	4 - 7
Overview	1 8 - 13
Products	2 14 - 23
Testing & Certification	3 24 - 29
Design Protocol	4 30 - 49
Installation	5 50 - 63
Associated Products	6 64 - 73
Project Solutions	7 74 - 79
The Company	8 80 - 91

Index - how this document is organised



The document is presented in clearly marked sections to help you navigate and find the information you require quickly and easily.

Section 1 - provides an overview of SUDS.

Section 2 - provides guidance on drainage design and helps you select which product to use for managing a site's stormwater run-off.

Section 3 - provides testing and certification information.

Section 4 & 5 - describe design protocol, installation and maintenance.

Section 6 - provides information on associated products.

Section 7 - shows project solutions.

Section 8 - company overview.

Description	Section	Page
Overview	1	8 - 13
SUDS best practice & legislation	1.1	10 - 11
Drainage design and planning	1.2	12 - 13
Products	2	14 - 23
Modular cell system overview	2.1	18 - 17
Polystorm Lite	2.2	18 - 19
Polystorm	2.3	20 - 21
Polystorm Hybrid construction	2.4	22 - 23
Testing & Certification	3	24 - 29
Testing and certification	3.1	26 - 27
Summary of test results	3.2	28 - 29
Design Protocol	4	30 - 49
Detail design protocol	4.1	32 - 35
Distributed loads	4.2	36
Lateral loading calculation example	4.3	37 - 38
Maximum burial depths	4.4	39
Special measures	4.5	40
Hydraulic design	4.6	41
Hydrological rainfall	4.7	42 - 43
Sewerage design	4.8	44 - 47
General layouts	4.9	48 - 49
Installation	5	50 - 63
Health and safety	5.1	52 - 55
Connections	5.2	56 - 57
Ventilation	5.3	58 - 60
Typical installation procedure - sewerage	5.4	61 - 62
Maintenance	5.5	63
Associated Products	6	64 - 73
Stormcheck	6.1	66 - 67
Storm-X4	6.2	68 - 71
Pearlcatons	6.3	72 - 73
Project Solutions	7	74 - 79
Polystorm case studies	7.1	76
Polystorm Lite case study	7.2	77
Hybrid solutions case study	7.3	78 - 79
The Company	8	80 - 91
Manufacture	8.1	82 - 83
Innovation, research & development	8.2	84 - 85
Health, safety & environmental policies	8.3	86 - 87
Sustainability	8.4	88 - 89
Support: information	8.5	90 - 91

Index - illustrations and tables

Description	Section	Table	Illustrations*	Page
Products				
Polystorm Lite - technical specification overview	2	1		18
Polystorm Lite cell dimensions	2		Figure 1	18
Polystorm Lite - product codes and pack quantities	2	2		19
Polystorm Lite maximum burial depths	2		Figure 2	19
Polystorm technical specification overview	2	3		20
Polystorm cell dimensions	2		Figure 3	20
Polystorm - product codes and pack quantities	2	4		21
Polystorm maximum burial depths	2		Figure 4	21
Polystorm Lite burial depths	2		Figure 5	22
Polystorm burial depths	2		Figure 6	22
Hydra solution burial depths	2		Figure 7	23
Testing & Certification				
Compression test rig	3		Figure 8	26
Unit axis, direction of applied load	3		Figure 9	27
Position of load platens; point load resistance	3		*Figure 10	27
Creep test rig	3		Figure 11	27
Dimensions of Polystorm Lite cell	3		Figure 12	28
Dimensions of Polystorm cell	3		Figure 13	28
Technical data of Polystorm Lite and Polystorm cells	3	5		29
Design Protocol				
Structural design	4		Figure 14	32
Partial material factors of safety: Polystorm Lite & Polystorm	4	6		34
Partial factors of safety for applied loads	4	7		35
Distributed loads - design against collapse	4		Figure 15	36
Lateral loading - load from wheels	4		Figure 16	37
Lateral loading - from earth, water pressure and surcharge above cell	4		Figure 17	37
Lateral loading - design against flotation	4		Figure 18	38
Polystorm Lite - maximum depth of installation	4	8		39
Polystorm - maximum depth of installation	4	9		39
Polystorm & Polystorm Lite - minimum cover levels	4	10		39
Reducing lateral pressure - building out layers	4		Figure 19	40
Reducing lateral pressure - using reinforced soil backfill	4		Figure 20	40
Reducing lateral pressure - mass concrete backfill	4		Figure 21	40
Attenuation storage volume	4		Figure 22	41
Required attenuation storage	4	11		42
Hydrological rainfall zones for the UK	4		Figure 23	42
Long term storage volumes	4	12		43
Typical silt trap	4		Figure 24	43
Percolation test for designing a soakaway system	4		Figure 25	44
Guidance on soakaway for single house development	4		Figure 26	45
Volume of data per linear metre for one cell wide trench configuration	4	14		46
Volume of data for 3D usage - two cells high	4	15		47
Concrete Ring Connection	4	16		47
Polystorm structures and manifolds - typical arrangement	4		*Figure 27	48
Cross section view of typical arrangement	4		*Figure 28	48
Example of offline solution	4		*Figure 29	49
Example of offline solution 2	4		*Figure 30	49

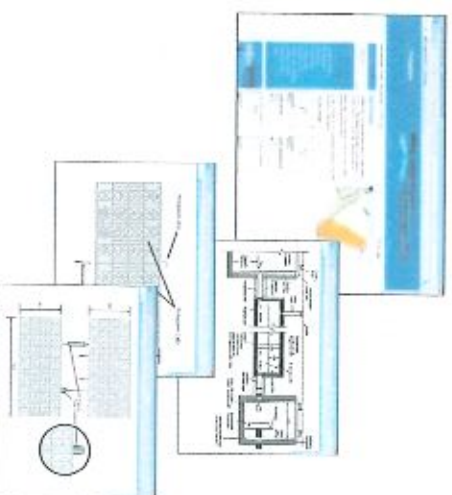
Index - illustrations & tables

Description	Section	Table	Illustrations*	Page
Installation				
Impermeable geomembrane properties	5	17		53
C/P connectors	5		*Figure 31	54
Shear connectors	5		*Figure 32	54
Location of points for clips and shears	5		*Figure 33	54
Shear connector installation	5		*Figure 34	55
Clip connector installation	5		*Figure 35	55
160-110mm invert level reducer	5		*Figure 36	56
160mm diameter adaptor	5		*Figure 37	56
Polystorm cell 160mm diameter knock out	5		*Figure 38	56
Fabricated Polystorm cell allowing 225mm diameter pipe connection	5		*Figure 39	56
Fabricated Polystorm cell allowing 300mm diameter pipe connection	5		*Figure 40	56
Typical Polystorm 450mm inlet manifold detail	5		*Figure 41	57
Typical Polystorm 450mm inlet manifold detail	5		*Figure 42	57
Typical Polystorm manifold detail	5		*Figure 43	57
Typical Polystorm 600mm inlet manifold detail	5		*Figure 44	57
Vertical vent pipe with rowl	5		*Figure 45	58
Horizontal vent pipe	5		*Figure 46	58
Permeable geotextile properties	5	18		61
Silt trap	5		Figure 47	63
Associated Products				
Manual bypass design	6		Figure 48	67
Auto bypass design	6		Figure 49	67
Capabilities of Storm-X4 19 reduce chemical pollutants	6	19		71

* Please note:

Illustrations shown within this publication are available as downloadable CAD drawings from

www.polypipewms.co.uk



1.0 Overview

Polypipe Water Management Solutions

Part of the overall Polypipe Civils business, the Polypipe Water Management Solutions (WMS) team includes some of the most talented Civil Engineers and Water Management Specialists within the industry to provide dedicated knowledge, support and technical expertise for a wide range of sustainable drainage systems (SUDS) and water management projects.

Today, the concept of sustainable water management is a major driver in the UK construction industry. Planning Policy Statement 25 (PPS25) requires local planning authorities to institute policies that enforce, wherever possible, the use of Sustainable Drainage Systems or SUDS. Combine this with the Floods and Water Management Act and it becomes obvious that specifying the correct sustainable drainage solution is vital.



Polypipe WMS are totally dedicated to focusing on the legislative drivers and industry developments in order to provide innovative, future proof sustainable Water Management Solutions to our customers and the UK construction industry.

Overview

Contents

		Page
SUDS best practise & legislation	1.1	10 - 11
Drainage design - planning, cost effective techniques, site evaluation, adoption and future maintenance	1.2	12 - 13

1.1 SUDS - sustainable drainage best practise and building regulations

Sustainable drainage systems are an alternative to the traditional approach of collecting stormwater in pipes and discharging it into treatment works or watercourses. SUDS best practice limits the flow of rainwater which runs off a site or is piped away, protects local watercourses from the contamination carried in surface run-off, encourages natural groundwater recharge (where appropriate) and reduces the likelihood of downstream flooding.



1.1.1 Building regulations

The Building Regulations Approved Document A2, Rainwater Drainage, which came into effect on 1st April 2002, prioritises drainage requirements. In short, it requires that rainwater from the roof of a building or from a paved area may either be gathered for re-use in a rainwater tank or be discharged into one of the following, listed in order:

- (a) an adequate soakaway or some other adequate infiltration system, or, where that is not reasonably practical,
- (b) a watercourse; or, where that is not reasonably practical,
- (c) a sewer.

In other words, the traditionally preferred method of rainwater disposal, i.e. totally discharging to a sewer, may now only be considered after other forms of re-use or drainage have been considered.

1.1.2 SUDS Best Practice CRIA C697

The SUDS Manual, published by CEMA 2007 (CRIA C697) defines that a sustainable urban drainage system should consider certain basic requirements, including:

- Runoff from a developed area should be no greater than the runoff prior to development
- Runoff from a developed area should not result in any down-grading of downstream watercourses or habitat
- Consideration should be given as to the development feasibility stage to water resource management and control in the development area
- Runoff should replicate as far as possible the natural response of the site to rainfall

SUDS best practice limits the flow of rainwater which runs off a site or is piped away, protects local watercourses from contamination carried in surface run-off, encourages natural groundwater recharge (where appropriate) and reduces the likelihood of downstream flooding.

1.1.3 The Code for Sustainable Homes

The Building Regulations also provide guidance on the construction of rainwater harvesting systems for the first time. The newly published Guidance Document entitled 'The Code for Sustainable Homes' reflects the Government's intentions to further drive developers towards building sustainable homes.

As well as covering energy efficiency, water usage and waste, the Code also proposes a minimum standard for surface water management. This minimum standard will require peak run-off rates or annual run-off volumes of surface water to be no more than the original conditions of the site.

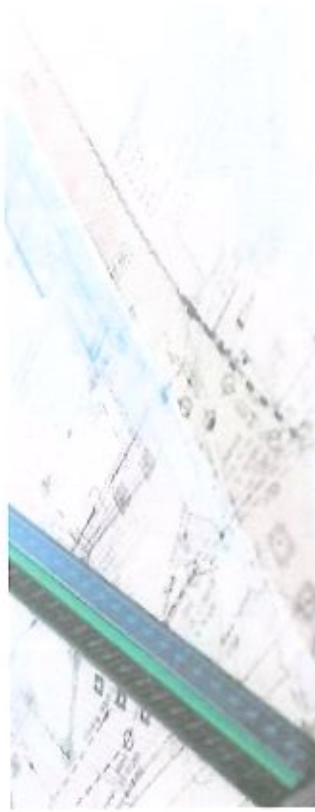
The challenge for developers lies in both greenfield and brownfield developments is what to do with the excess run-off generated by a development which has to be retained in and around the site.



Polypipe WMS

provide the developer with both large and small, with flexible value engineered solutions which cater for almost any site conditions and restraints.

1.2 Drainage design - planning, cost effective techniques, site evaluation, adoption and future maintenance



Many authorities will expect planning applications, whether outline or detailed, to demonstrate how a more sustainable approach to drainage is to be incorporated into development proposals.



Step 4 requires planners to use SUDS as a form of control for surface water.

1.2.1 Key elements of Planning Policy Statement 25 (PPS25)

- Covers all types of flooding
- Flooding considered at all stages of the planning process
- Risk based sequential approach
- Safe development of sustainable communities

1.2.2 Planning

Planning authorities will set a limit to the rate of stormwater flow from a site via sewers as a condition of planning consent. In recognition of this, Local Planning increasingly state that all applications should, in the first instance, aim to incorporate SUDS into development proposals. SUDS are also considered suitable for mitigating adverse impacts and supporting water conservation objectives.



1.2.3 Cost effective techniques

SUDS incorporate cost-effective techniques that are applicable to a wide range of schemes, from small developments to major residential, leisure, commercial or industrial operations with large roof spaces and large hardstanding areas. They can also be successfully retro-fitted to existing developments. Planning policy guidance on development and flood risk emphasizes the role of SUDS and introduces a general presumption that they will be used.

1.2.4 Site evaluation

As with other key considerations in the planning process - transport, landscape, heritage and nature conservation - incorporating SUDS needs to be considered early in the site evaluation and planning process, as well as at the detailed design stage.



1.2.5 Floods & Water Management Act

Sir Michael Pitt completed his independent review of the 2007 flooding emergency in June 2008, forming the catalyst for major legislative changes. The report proposed 52 recommendations to improve UK surface water management and has called for significant investment from the Government in sustainable drainage techniques and flood management strategy.

The Floods and Water Management Act sets out a more joined-up approach to flood risk prevention and management and has been developed to implement the majority of the recommendations set out in the Pitt Review. It gives local authorities the lead role in managing local flood risk, as well as the responsibility for adopting and maintaining sustainable drainage schemes. This will then enable the Environment Agency to adopt a strategic overview role for all forms of flood risk, including groundwater and surface water.

1.2.6 Adoption and future maintenance

In the early stages of design, consideration should be given to the arrangements for adoption and future maintenance of the system. This is likely to influence the design just as much as technical considerations. For private, or non-adopted systems, maintenance will be the responsibility of the owner and future developments may be affected by covenants. For systems serving more than one residential property it is recommended that maintenance should be the responsibility of a publicly accountable body, which will often necessitate the payment of a committed sum or a legal agreement, possibly backed by the deposit of a financial bond. The adopting organisation should approve the design before construction.



2.0 Polystorm modular cell system attenuation and soakaway solutions

Average UK temperatures are expected to rise by up to 3/5°C by 2080,

resulting in a dramatic change in the seasonal distribution of rainfall and subsequent

weather patterns. The flooding witnessed during recent years is a clear indication

that climate change is causing more frequent and extreme weather events and

innovative solutions are required to cope with increased pressure on our existing

drainage and water management networks.

Planning Policy Statement 25 - Development and flood risk

Planning Policy Statement 25 (PPS25) sets our Government policy on

development and flood risk. Its aim is to ensure that flood risk is taken into

account at all stages in the planning process to avoid inappropriate

development in areas at risk of flooding and to direct development away from

areas of highest risk. Where new development is exceptionally necessary in

such areas, policy aims to make it safe, without increasing flood risk elsewhere

and where possible, reducing flood risk overall.

Planning Policy Statement 25: Development and Flood Risk (PPS25) published in June 2006.

Polystorm modular solution

The Polystorm range of modular cells are designed to address the above

legislation on minimising flood risk. The cells retain large volumes of water

and fit together to create a modular underground water tank. The tank can

then be modified to be either an attenuation or soakaway solution.



Products

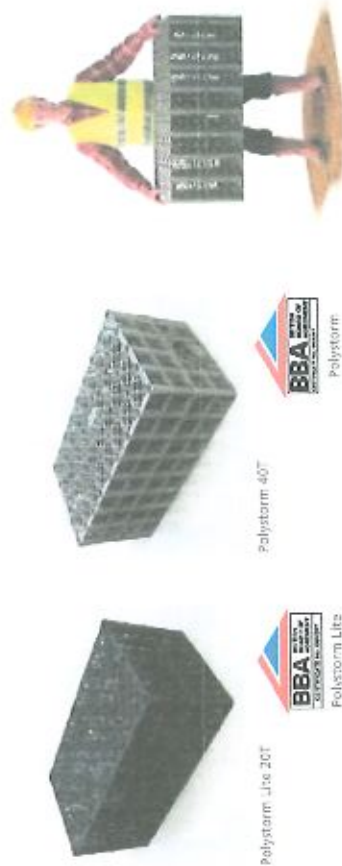
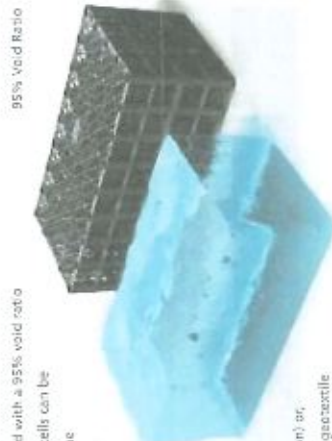
Contents

	Page
Polystorm modular cell system overview	2.1 16 - 17
Polystorm Lite	2.2 18 - 19
Polystorm	2.3 20 - 21
Polystorm hybrid construction	2.4 22 - 23

2.1 Polystorm modular cell system - three types of Polystorm cells

2.1.1 The Polystorm principles

The Polystorm range of modular cell systems are designed with a 95% void ratio to retain large volumes of water run-off. The Polystorm cells can be designed and built to a specific size to a total void volume requirement dependent upon the water run-off volumes required on a particular project (i.e. car park, road or building). The Polystorm range of water storage cells are structurally strong, individual modular cells which can be built up to form a structure of any shape or size. The structure is wrapped in a non permeable, geomembrane which can receive rainwater collected from the roof gutter system or surface drains and either releases the water within set discharge limits (attenuation) or, where soil conditions allow, be wrapped in a permeable geotextile and slowly release the water back into the surrounding soil (soakaway).



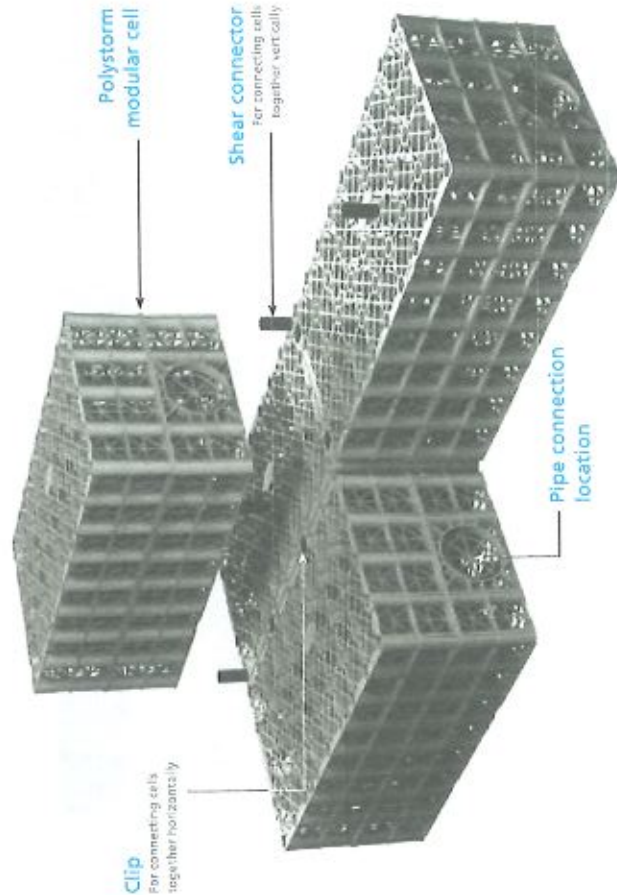
There are three different types of Polystorm cells which are Polystorm Lite, Polystorm and Polystorm Xtra. Each Polystorm cell type has a different surface based specification.

- Polystorm Lite is designed for use in landscaped pedestrian or other non-loaded applications
- Polystorm is designed for use in light trafficked and loaded applications

The Polystorm Technical Manual is available to download at:
www.polystorm.co.uk/downloads

Key benefits

- **95% void ratio:** Providing greater water storage capacity and reduced excavation and disposal costs
- **Modular units:** Allow flexibility of design - ideal for shallow excavation systems, narrow strips or use in restricted areas
- **Light weight yet robust:** Excellent Health and Safety and installation benefits
- **Easy to handle:** Unique rounded corners for ease of handling and reduces likelihood of punctures to membranes
- **Cost effective:** Especially when used as a hybrid, value engineered system
- **Recyclable:** 100% - recyclable at the end of its useful life
- **Range:** Spans from 20 tonnes per square metre load bearing capacity up to a maximum of 80 tonnes per square metre load bearing capacity
- The range can be designed for non-trafficked, trafficked or heavy trafficked applications
- Suitable for both attenuation and soakaway systems
- 50 year design life
- BBA Approved
- Hybrid Solutions



2.2 Polystorm Lite

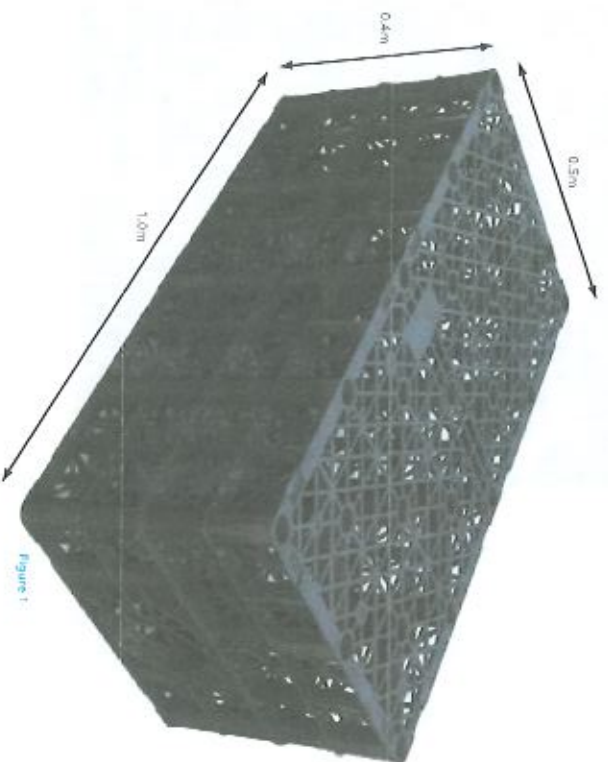


Figure 1

Designed for use in landscaped, pedestrian or other non-loaded applications with a load bearing capacity of:

20 tonnes

Technical specification overview

Unit type	Polystorm Lite
Product code	PSM2*
Dimensions	1m x 0.5m x 0.4m high
Total volume	0.2m per cubic
Unit weight	7kg**
Cube storage volume	0.19m ³ (190 litres)
Surface area	55% perforated
Compressive strength	Maximum 20 tonnes per sq metre
Maximum burial depth	2.5m***

* Each unit weighs a cube and 2 x cover connection. Please note that back-burns connection may be required at additional cost.

** Rules weight depends upon water quantity and transport type.

*** Please work only on conditions the maximum burial depth is 2.5 metres. Polystorm Lite should not be installed below the water table.

Table 1

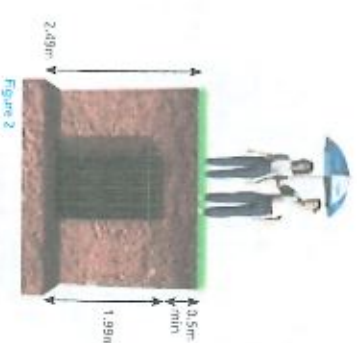


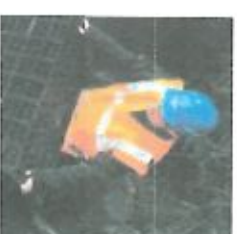
Figure 2

Polystorm Lite has been specifically designed for non-re-fitted applications. With a 20 tonne per square metre compressive strength it will however take general maintenance vehicles such as grass cutters. Polystorm Lite can be used for both attenuation and soakaway applications. The modular structure receives rainwater collected from roofs or surface drains ready to release within a set drainage limit. Polystorm Lite can be used typically for landscaped areas, pedestrian or public open spaces such as underground playgrounds.

Polystorm Lite

Description	Code	Peak quantity
Polystorm Lite cell 1000 x 500 x 400mm	PSM2	13
Polystorm Lite flow control unit	PSMFC160/30	1
Brick bond shear connector	PSM89SC	30
Clips	PSMCLIP	80
Shear connector	PSMSC	30
EN 1401 flange adaptor - 110mm	PSMAFA110	1
Rigidflange flange adaptor - 150mm	PSMFA150	1
EN1401 flange adaptor - 160mm	PSMFA160	1
Basic silt trap	PSMST160	1
Advanced silt trap - 15 litres/sec	PSMASTA150/15	1
Mini silt trap for Polystorm Lite	PSMAST110	1
Cover & frame (round)	UG501	1
Cover & frame (square)	UG502	1
450mm silt trap lid & frame	UG512	1
480mm lockable plastic cover & frame	UG511	1
Polypropylene cover & frame	ICDCT	1
Chamber riser section	ICDRT	1
Silt trap sealing ring	UG488	1

Table 2



When Minimum cover and burial depths may vary depending on soil and ground conditions. Please consult Sapienpe VMS for further information. All grades of Polystorm Lite may be used in situations outside of those mentioned above, through the use of the appropriate protective measures designed to reduce the impact leading on the product Polystorm must not.

2.3 Polystorm

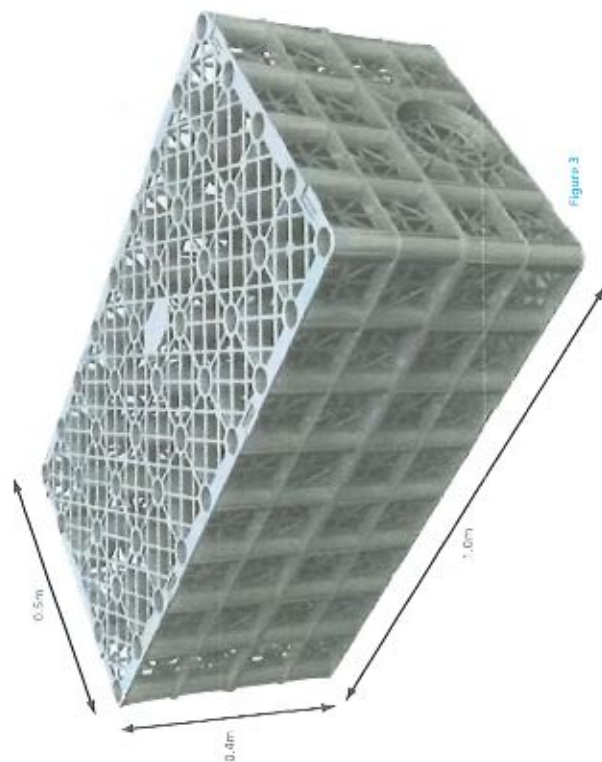


Figure 3

Designed for use in trafficked and loaded applications with a load bearing capacity of:

40 tonnes

Technical specification overview

Unit type	Polystorm
Product code	PSM1*
Dimensions	1m x 0.5m x 0.4m high
Total volume	0.2m per cube
Unit weight	9kg**
Cube storage volume	0.29m ³ (130 litres)
Surface area	48% perforated
Compressive strength	Maximum 40 tonnes per sq metre
Maximum burial depth	3.7 metres***

* Each unit includes 4 clips and 2 shear connectors. Please note rear link band connector may be required at additional cost.

** Packet weight dependent upon order quantity and transport type

*** In waste clay soil conditions the maximum burial depth is reduced, please consult Polystorm 2045 Technical Team on 01509 6 5100

Table 3



Figure 4

Polystorm features individual modular cells that can be built up to form a load-bearing tank structure of any shape or size to receive rainwater collected from the gutter system or surface drains ready to release within a set discharge limit. Polystorm has a 40 tonne per square metre compressive strength and is ideally suited for light trafficked and loaded applications. Polystorm can be used for both attenuation and overflow applications and typically for housing developments, small car parks and light commercial developments.

Polystorm	Description	Code	Pack quantity
Polystorm cell 1000 x 500 x 400mm	PSM1		15
Polystorm cell with 225mm connector	PSM/C/D225		1
Polystorm cell with 300mm connector	PSM/C/D300		1
Brick bond shear connector	PSM/BESC		30
Clips	PSM/CLIP		60
Shear connector	PSM/SC		30
EN1421 Flange adaptor - 110mm	PSM/FA110		1
Reguldrain Flange adaptor - 150mm	PSM/FA150		1
EN1401 Flange adaptor - 160mm	PSM/FA160		1
Basic silt trap	PSM/ST160		1
Advanced silt trap - 15 litres/sec	PSM/STA160**5		1
Cover & frame (round)	UG301		1
Cover & frame (square)	UG502		1
450mm silt top lid & frame	UG512		1
480mm leachable plastic cover & frame	UG511		1
Polypropylene cover & frame	ICDC1		1
Chamber riser section	ICDK1		1
Silt trap sealing ring	UG488		1

Table 4

Note: Minimum cover and build depths may vary depending on base and ground conditions. Please consult Polystorm 2045 for further information. All grades of Polystorm units may be used in situations outside of those recommended above, through the use of the adaptor and protective areas are designed to reduce the imposed loading on the supported Polystorm modules.



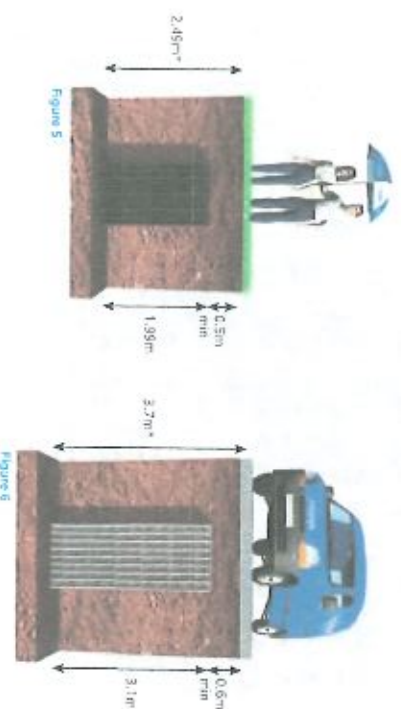
2.4 Hybrid - Polystorm range of modular cells creating a cost-effective hybrid construction

The following illustrations indicate maximum burial depths for Polystorm Lite and Polystorm modular cell systems.

Polystorm Lite and Polystorm

POLYSTORM Lite
20 tonnes
Pedestrian

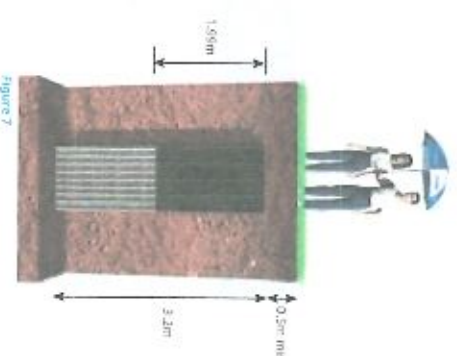
POLYSTORM
40 tonnes
Light Traffic



Note: • Based on ground conditions being dense sand and gravel.
When an cover and burial depths may vary depending on local and ground conditions.
Please contact Polystorm W&S for further information. All grades of Polystorm units may be used in situations outside of those recommended above, through the use of the appropriate protective measures designed to reduce the imposed loading on the proposed Polystorm structures.

Hybrid Solution VALUE ENGINEERED STRUCTURES

POLYSTORM Lite
POLYSTORM
Pedestrian



Value engineered structures

Polystorm are the only manufacturer who can offer a complete value engineered hybrid system utilising Polystorm Lite or Polystorm cells to create a bespoke solution based on the load requirements and burial depths for any given project.

When integrated as a hybrid structure, a complete value engineered solution can be adapted for any given project. To ensure costs, it's possible to construct a hybrid tank, which contains all types of cells, the stronger Polystorm cells at the bottom and Polystorm Lite cells at the top. For further details contact Polystorm W&S technical support team. Refer to tables 8, 9 and 10 (page 35) for burial depths in different soil conditions.

3.0 Testing and certification - laboratory testing and protocol

At Polypipe WMS we pride ourselves on providing a consistently high level of product quality. All our products undergo stringent testing and quality control and where possible, are covered by third party certification. Our manufacturing processes are also accredited to ISO 9001:2008. There are two quality control labs in operation 12 hours a day.



Testing and certification

Contents

		Page
Testing and certification	3.1	26 - 27
Summary of test results	3.2	28 - 29

3.1 Testing and certification

As a manufacturer of plastic below-ground water management products, Polytype WMS invests heavily in British Board of Agreement (BBA) approval and is a supporter of the criteria used to assess each product. By achieving BBA approval, Polytype WMS can pass on to our customers confidence in the performance of all our products.



Figure 8 Compression test rig

Increasingly new products are being introduced within the UK water management markets with no independent approval. This can create potential issues for product specifications unsupported by independent testing and assessment and may not correlate with the performance parameters of the product. BBA approved products offer our customers a safety net and further reassurances that the product will perform in-line with our claims when installed in accordance with the BBA certificate.

3.1.1 Laboratory testing

Laboratory testing to determine the structural performance of the Polytype cells were carried out in accordance with the laboratory protocol provided by the British Board of Agreement (BBA) for products of this type. Direct compression tests were conducted at Polytype's research and development laboratory in accordance with ISO 9001:2008 to determine the vertical and lateral strength of the polypropylene cells. Vertical creep tests were undertaken at the UKAS accredited Berry and Hayward laboratory.

3.1.2 Test protocol

Laboratory testing to determine the structural performance of the Polytype cells has followed the protocol agreed with the British Board of Agreement (BBA). Direct bearing tests were carried out on single cells. Individual cells were load tested until failure (i.e. the point at which they could not sustain further load).

Tests were carried out along two axes (Figure 9).

- Vertical compression test: with load applied down the y-axis, via a 300mm x 300mm at two positions (Figure 10).
- Vertical compression test: with load applied down the y-axis, via a platen covering the full area of the cellular unit (0.5 x 1.0m).
- Lateral compression test: with load applied along the x-axis via a platen covering the full area of cellular unit (0.4 x 1.0m). A simultaneous restraining load, representing the vertical load that may be expected at the unit's recommended maximum burial depth, was also applied.

Creep tests were carried out on single Polytype cells for a minimum period of 56 days.

- Vertical creep test: with a constant load applied down the y-axis, via a 300mm x 300mm platen at position 1 (Figure 9). The applied test load was equivalent to 75% of the vertical compressive design load, with the design load calculated by applying an appropriate material factor of safety (2.75 recommended by CEN) to the lowest vertical compressive yield test result.

Polytype cell, direction of applied load and platen location

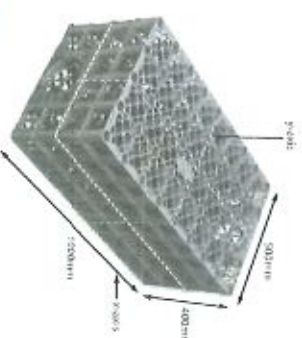


Figure 9 Unit axis direction of applied load

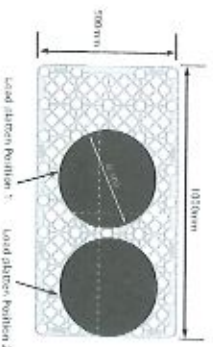


Figure 10 Position of load platens, point load resistance



Figure 11 Creep test rig

3.2 Summary of test results

3.2.1 Unit specifications

Figure 12 shows the dimensions of Polystorm Lite cells.

Figure 13 shows the dimensions of the Polystorm cells.

Table 5 shows the technical data for Polystorm Lite and Polystorm cells.

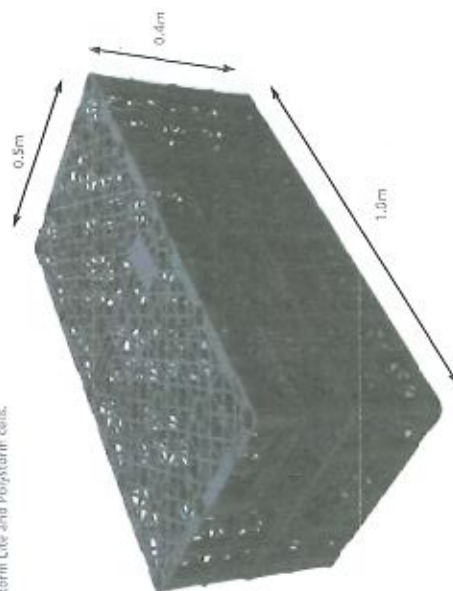


Figure 12 Dimensions of Polystorm Lite cell

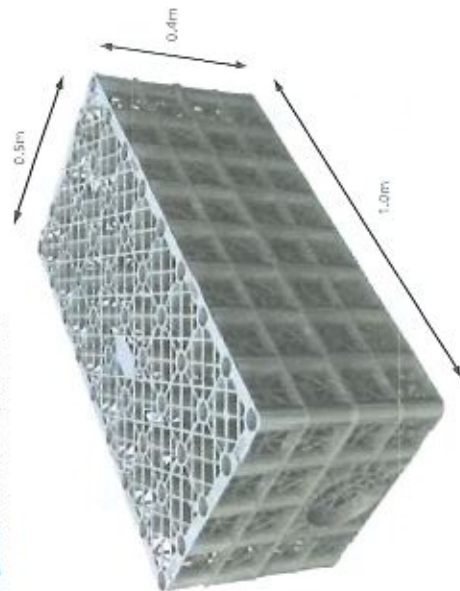


Figure 13 Dimensions of Polystorm cell

Technical data of Polystorm Lite and Polystorm cells	
	Polystorm Lite
Unit dimensions (mm)	1000 x 500 x 400
Unit volume (norm) (m³)	0.2
Storage volume (norm) (m³)	0.19
Porosity (void ratio) (%)	95
Perforation of surface area (%)	55
Weight (kg)	7
Ultimate compressive strength at yield (kN/m²)	200
Vertical loading on top face (kN/m²)	40
Lateral loading on side face (kN/m²)	1 per 43
Short vertical loading on top edge face (kN/m²)	1 per 83
Estimated long-term deflection ²⁾ (mm)	0.2773
Max burial depth (m)	2.5m

1) = Applied load 12 = At least 25 years @ 20°C @ 120kN/m² load (Polystorm); 2) = Time to failure 3) = At least 25 years @ 20°C @ 120kN/m² load (Polystorm Lite)

* Maximum burial depth dependent upon soil conditions, see page 39 for further details.

Table 5

3.2.2 Durability

When installed in accordance with Polyipe WMS recommendations, the design life of Polystorm Lite and Polystorm cells exceeds 50 years. Please refer to BBA certificate.

3.2.3 Chemical resistance

Polystorm Lite and Polystorm cells are suitable for use in contact with chemicals likely to be found in rainwater. They are also resistant to all compounds occurring naturally in soils. For guidance on using Polystorm cells in contaminated ground, contact Polyipe WMS technical support team.



4.1.5 Material factors

4.1.5 Material factors

The ultimate compressive strength of the Polystorm cells has been obtained from laboratory testing on samples. To take account of other factors such as variations due to manufacturing processes, variability and uncertainties in design strength (e.g. due to extrapolation of test), a design strength is derived by dividing the test's characteristic strength by a material partial factor of safety (f_{m1}), appropriate to the material and limit state. There is no guidance on the choice of material factors for plastic storage tanks.

Partial material factors of safety: Polystorm Lite & Polystorm

Limit state	f_{m1}
Ultimate limit state	2.75
Servicability limit state	1.5

Table 6

The partial factor f_{m1} is made up of several components:

f_{m11}

This is applied to the characteristic strength of Polystorm. It covers possible reductions in strength from the control test specimen and 'uncertainties in the assessment of the resistance of a structural element resulting from modelling errors. For tightly controlled Polystorm production, f_{m11} would normally be between 1.05 and 1.1. Because a limited number of compression tests have been undertaken on the Polystorm cells in addition to this property not being measured as part of the quality control program, a conservative value has been adopted. Compression tests were undertaken at points judged by inspection to be the weakest however the cell is a complex three dimensional structure, therefore an allowance must be made for this. In view of the preceding factors and the conservative choice of design parameters already undertaken, a value of f_{m11} is 1.20 has been adopted for the ULS and 1.1 for the SLS. This can be reviewed if the compressive strength is measured as part of the manufacturing quality control procedure.

f_{m12}

This is applied to take account of the extrapolation of creep test data. It is also used in the case of the Polystorm cells to allow for the absence of fatigue testing. A suggested value of f_{m12} is given by Ingold $\log(t_{test}/t_{design})$ where t_{test} is the duration of creep test. This gives a value for the ULS, with a design life of 20 years, of $f_{m12} = 1.9$. Although the cells will be under compressive loads and appear to fall in compression at the internal columns, they are complex structures. Some of the elements will be acting in tension and where polystyrene is subject to creep under long term tensile loads it can lose strength over time. Therefore the values taken from reinforced earth applications are considered reasonable. For serviceability, which is not so critical, a value of 1.25 is adopted.

f_{m21}

This is applied to take account of damage during installation. The Polystorm cells are robust and not particularly susceptible to damage and therefore, in the absence of specific damaged strength testing, a factor of 1.1 for the ULS and 1.0 for the SLS has been used.

f_{m22}

This is applied to take account of environmental conditions. The polystyrene used in the manufacture of the Polystorm units is resistant to all contaminants that are naturally found in soil and rainwater. No specific test results are available and so a value of f_{m22} for both ULS and SLS of 1.1 has been adopted, which is the minimum value recommended for reinforced earth applications by Ingold. With the total value of $f_{m1} = f_{m11} \times f_{m12} \times f_{m21} \times f_{m22}$

Therefore, for the following limit state, f_{m1} will equate to:

Ultimate limit state: $1.2 \times 1.9 \times 1.1 \times 1.1 = 2.75$

Servicability limit state: $1.1 \times 1.25 \times 1.0 \times 1.1 = 1.5$

The use of conservative factors also allows for synergistic effects (i.e. the combined effect of construction damage, environmental effects and lower than expected cell strength) that may result in a greater combined effect than the three factors acting individually. These factors are only applicable for temperate climate conditions such as in the UK. Although the strength of polystyrene varies with temperature, this will not be significant for installation in the UK where the temperature in the ground (at the typical depth of installation) remains between 0°C and 20°C with a mean value of around 10°C.



4.1.6 Applied loads and load factors

4.1.6 Applied loads and load factors

Loads that may be imposed on a cellular storage structure such as Polystorm, can be broken down into the following types:

- **Dead loads**
Permanent loads applied to the cells, including the weight of back-fill material placed over the top and lateral (horizontal) earth and water pressure loads acting on the side of the system.
- **Live loads**
Loads due to pedestrian, vehicle and construction traffic that are not permanent. Traffic wheel loads are normally given as static loads, with a factor applied to allow for dynamic effects in moving wheel will impose more force on the ground than a static one.

A design load is obtained by applying a partial factor of safety to the estimated characteristic load. This allows for unforeseen variations of loading and also the severity of the consequences of the limit state occurring. The loads on cellular units will be similar to loads applied in the design of structures using rigid materials such as concrete and therefore the partial safety factors for loads that are appropriate to the design of plastic storage systems are taken from British Standard BS 8110.

Partial factors of safety for applied loads

Limit state	Imposed vertical dead load f_{m1}	Imposed earth pressure dead load f_{m1}	Imposed live load f_{m1}
Ultimate limit state	1.40	1.40	1.60
Servicability limit state (Polystorm only)	1.0	1.0	1.0

Table 7

Thermal expansion of the cells will be negligible because temperature variations that are likely to occur in the ground should not be significant. These loads are therefore not considered in this design.

4.2 Distributed loads

4.2.1 Example of calculation methods

The structural design of the cells needs to consider a number of different loads and their effects.

What load is applied to the tank?

1. Dead (permanent) loads such as the weight of soil placed over the top of the cells or long term stockpiles of containers or materials, anything that will be applying load for a lengthy period of time).
2. Surcharge loads. From stored materials or to allow for traffic.

How is this analysed?

The weight of the fill material is calculated from the depth of soil and its self weight. The traffic loads that are typically used are: Car Parks - 2.5kPa, HGV loading - 10kPa.

Example: 1.5m cover depth over the top of Polystorm - Car Park.

Design against collapse (ultimate limit state)

Weight of soil = $1.5\text{m} \times 20\text{kN/m}^3$.

Partial factor of safety = 1.4.

Surcharge = 2.5 kPa, Partial factor of safety = 1.6.

Total design load = $(1.5 \times 20 \times 1.4) + (2.5 \times 1.6) = 48\text{kPa}$.

Polystorm ultimate compressive strength at yield = 40kPa.

Partial factor of safety = 2.75.

Design strength of Polystorm = $40/2.75 = 14.5\text{kPa}$.

Design strength is greater than factored loads so the design is ok.

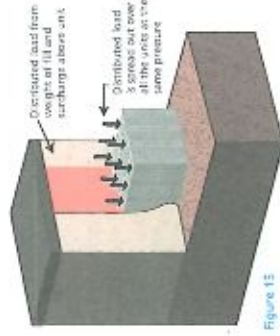


Figure 15

Check deflection (serviceability limit state)

Partial factor on load = 1.0.

Partial load = $(1.5 \times 20 \times 1.0) + (2.5 \times 1.0) = 32.5\text{kPa}$.

Deflection of Polystorm = 1mm per 33kPa load.

Partial factor of safety = 1.5.

So elastic deflection of Polystorm = $32.5 \times 1.5/33 = 0.6\text{mm}$.

Most of the deflection is due to the permanent load and so it will be acceptable.

4.3 Lateral loading - calculation example

4.3.1 Check deflection (serviceability limit state)

In this case we are interested in the continuous and repeated deflections under wheel loads only.

Partial factor on load = 1.0.

Applied pressure from wheel (above) = 26.6kPa.

Design pressure = $26.6 \times 1.0 = 26.6\text{kPa}$.

Deflection of Polystorm = 1mm per 33kPa load.

Partial factor of safety = 1.5.

So elastic deflection of Polystorm = $26.6 \times 1.5/33 = 0.5\text{mm}$.

This will be repeated each time a wheel passes over the tank. This is acceptable for an asphalt pavement.

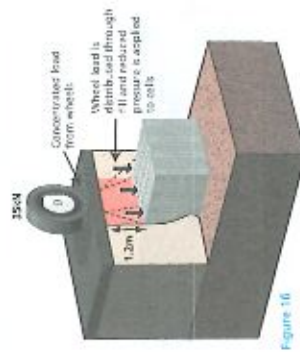


Figure 16

What load is applied to the tank?

4. Earth and groundwater pressure from the surrounding ground. Note that account must be taken of sloping ground, pre-existing near planes and groundwater. If in doubt, obtain expert advice from PolyPipe WVS technical support team.

How is this analysed?

The earth pressure applied to the side of the tank by the soil and groundwater. The weaker the soil the greater the pressure it applies to the side of the tank. Water also applies pressure to the side of a tank. The calculations are based on standard earth pressure theory.

Example

The bottom of a modular tank is located 2.5m below ground level. The excavation is surrounded by medium dense sand and gravel with an angle of friction of 34° .

The groundwater is below the base of the tank. Allow for a 10kN/m^2 surcharge.

To allow for load distribution on the side of the tank, the design uses the earth pressure at a depth of 0.25m above the base of the tank.

Therefore, Design depth = $2.5 - 0.25 = 2.25\text{m}$.

For an angle of friction of 34° the coefficient of active earth pressure is 0.282.

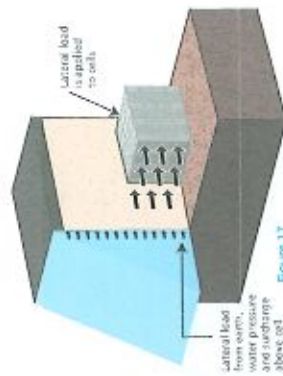


Figure 17

Design against collapse (ultimate limit state)

Partial factor of safety for earth pressure = 1.35.

Partial factor of safety for earth pressure = 1.3.

The applied pressure from the soil is given by:

Applied pressure =

$0.282 \times 2.25\text{m} \times 20\text{kN/m}^3 \times 1.35 = 0.262 \times 10\text{kN/m}^2 \times 1.5$.

Applied pressure = 21.4kN/m².

Polystorm ultimate strength at yield for lateral

loading = 63kN/m².

Material partial factor of safety = 2.75.

Design strength = $63/2.75 = 22.9\text{kN/m}^2$.

This is greater than the applied load and so it is acceptable.

Deflections can be estimated using the same approach as for the vertical loads with a partial load factor of 1.0 in all cases.

Note: Where groundwater is present the submerged density must be used to calculate the earth pressure on the side of the tank from the soil below the groundwater table.

4.3 Lateral loading - calculation example



What load is applied to the tank?

5. Uplift pressure from groundwater of the tank is constructed below the groundwater table:

How is this analysed?

A tank is constructed 1m below the groundwater table and has a soil cover over the top of 0.8m.

Will uplift occur?

Design against floatation

Uplift pressure equals weight of water displaced by tank.

Partial factor safety on uplift force = 1.5.

Uplift pressure = $1 \times 10 \times 1.5 = 15\text{ kN/m}^2$.

Weight of soil resisting uplift:

Partial factor of safety = 0.95.

Weight = $0.8 \times 20 \times 0.95 = 15.2\text{ kN/m}^2$.

The weight of soil is sufficient to prevent uplift.

Note: An assessment would need to be made of the risk of ground levels being reduced or groundwater levels rising after completion of construction.

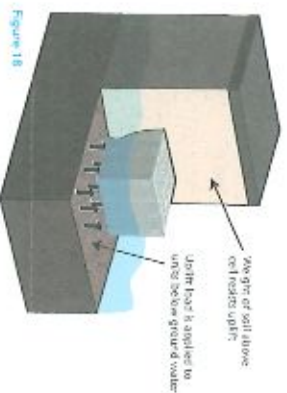


Figure 18

4.4.1 Recommended maximum installation depths

Polystorm Lite and Polystorm cells can be buried to the maximum depths detailed below. Actual maximum burial depths will depend on soil conditions applicable, however in some circumstances both Polystorm Lite and Polystorm can be buried to greater depths when special measures are carried out. For examples of such measures please refer to page 46.

Polystorm Lite - maximum depth of installation (to base of cells) (m)				
Typical soil type	Typical angle of shearing resistance ϕ	Without groundwater (below base of cells) nominal case	Non-traffic	With groundwater at 1m below ground level and units wrapped in geotextile
Stiff over consolidated clay e.g. London Clay	24	1.49	1.47	
Normally consolidated silty sandy clay e.g. Alluvium, Moat Circum	25	1.50	1.48	
Loose sand and gravel	30	1.77	1.60	
Medium dense sand and gravel	33	2.05	1.59	
Dense sand and gravel	38	2.49	1.83	

Table 8

Polystorm - maximum depth of installation (to base of cells) (m)				
Typical soil type	Typical angle of shearing resistance ϕ	Without groundwater (below base of cells) nominal case	Trafficked (cars only)	Non-traffic
Stiff over consolidated clay e.g. London Clay	24	2.1	2.2	1.5
Normally consolidated silty sandy clay e.g. Alluvium, Moat Ground	25	2.3	2.4	1.5
Loose sand and gravel	30	2.5	2.7	1.6
Medium dense sand and gravel	33	3.0	3.1	1.7
Dense sand and gravel	38	3.7	3.8	1.8

Table 9

Polystorm Lite & Polystorm - minimum cover levels (to top of cells) (m)			
Live load conditions	Head	Light trafficking (Polystorm only)	Car park with occasional vehicle mass <2500kg
Minimum cover depth required (m)	0.50	0.50	0.80

Table 10

Please note that the maximum burial depths above are based on the partial factors at safety derived during consultation with the British Board of Agrement (BSA) prior to the publication of CIRIA C680. The BSA has used higher partial factors of safety than CIRIA C680. For further information of the design method detailed in CIRIA C680 please contact our technical support.

4.5 Special measures - relieving earth pressure for deeper installations

4.5.1 Special measures

The earth pressure at the design depth for the tank may exceed the lateral strength of Polystorm Lite and Polystorm cells (once it has been factored down). If this is the case there are a number of solutions:

1. Redesign the drainage system to make the invert of the tank shallower.
2. Place the cells in a stepped configuration where the tank gets wider from the base to the top (Figure 19).
3. Reinforce the lower part of the backfill with geogrids (Figure 20).
4. Use mass concrete backfill in the lower part of the backfill (Figure 21).

Reducing lateral pressure on a Polystorm Tank



Figure 19



Figure 20



Figure 21

4.6 Hydraulic design

4.6.1 Hydraulic design

Hydraulic design calculations provide the storage volume required on any particular site that is required to reduce the speed, frequency and volume of rainfall run-off into rivers or sewers. The required volume depends on the site location, the size of the area being drained, the soil infiltration rate (for soakaways) or allowable discharge rate (for attenuation systems).

The design of SUDS should follow the requirements in the CIRIA Report C 897 The SUDS Manual.

This identifies three types of storage that are required:

- **Interception storage** - this is not actually storage - the aim is to reduce the frequency of run-off and prevent run-off from sites for rainfall events up to 5mm in order to simulate the behaviour of greenfield catchments more closely. This is achieved using infiltration or source control methods where evapotranspiration can reduce the volume of run-off.
- **Attenuation storage** - used to reduce the peak discharge rate from a site (i.e. how fast water flows off the site) and is used to store excess water where the rate of discharge is limited to greenfield run-off rates (or other agreed rates). It is designed to operate for a range of annual probabilities typically 1 in 30 years and 1 in 100 years.
- **Long term storage** - used to reduce the additional volume of run-off caused by developments. Stores excess water that is the difference in total volume of run-off between the developed and greenfield site for a 1 in 100 year 6 hour rainfall event. Outflow from the long term storage should be to either infiltration or to a water course or sewer at 2 l/s/ha or less.

Polystorm can be used to provide attenuation, long term storage and can be designed into systems that provide interception storage (e.g. soakaways or sallow swales or infiltration basins). The SUDS manual also requires treatment of pollution in run-off and Polystorm can help these treatment systems work more effectively by controlling the flow of water through them (for example by providing attenuation storage upstream of a wetland). The exact design requirements for any site should be agreed with the Environment Agency.

4.6.2 Design of attenuation storage

The volume of Polystorm required for attenuation storage is typically calculated using drainage design software based on the Wellingford Procedure. The volume of temporary run-off storage required is shown in Figure 22 and is simply the difference between the volume of run-off that enters the tank during a design storm and the volume of water that is allowed to flow out in the same period (which is governed by the discharge rate allowed by the regulators). In this way Polystorm can be used to limit the peak rate of run-off from a site (usually to the greenfield run-off rate). The calculations are completed for a range of return periods and durations.

Attenuation storage volume

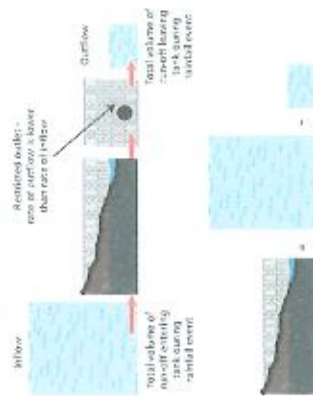


Figure 22

4.7 Hydrological rainfall

4.7.1 Hydrological rainfall zones for the UK

(HR Wallingford. Use of SUDS in high density developments, defining hydraulic performance criteria, Report SR 602, December 2003).

The table below can be used to size a Polystorm tank. The tables are based on the hydrological rainfall regions shown on the map.

The tables are based on the following assumptions:

- Storage is provided for development: design events of 1 in 30 years, 1 in 100 years and 1 in 100 years plus 20% increase for climate change but the grassfield runoff rate is always considered to be 5 l/s/ha
- Time of entry and time of concentration within the drainage system is not considered
- 100% run-off is assumed

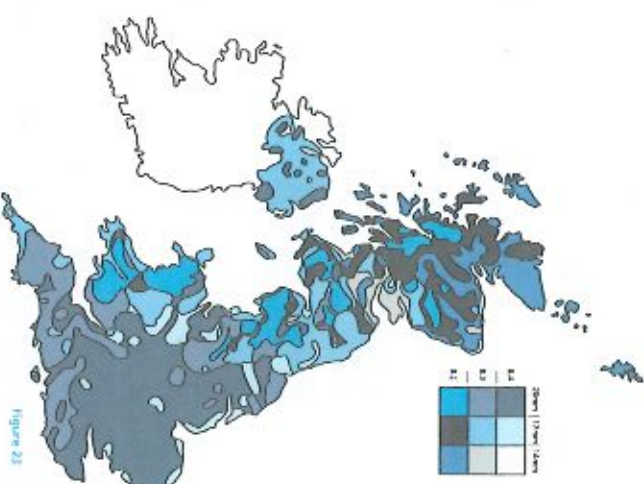


Figure 23

Required attenuation storage (m³ of storage per Ha of impermeable area)

	1 in 30 year design event	1 in 100 year event	1 in 100 year event plus 20% climate change
M<60 = 20mm	0.4	357	516
	0.3	413	583
	0.2	556	778
M=50 = 17mm	0.4	293	419
	0.3	335	483
	0.2	444	637
M=50 = 40mm	0.3	258	383
	0.2	335	500

Table 11

Notes: Volumes include allowance for 95% void ratio of Polystorm. Polystorm has a void ratio of 95% (i.e. for every 1m³ there is 0.95m³ of space available for water storage). The volume at Polystorm required is therefore calculated by dividing the required storage volume by 0.95. This factor is allowed for in the design table.

Example of Polystorm sizing for attenuation storage site in London has an impermeable area as follows:

- 1200m² roof area
- 1475m² car park and other areas

Therefore the total impermeable area = 2675m².

Assume the required return period for the drainage design is 1 in 100 years as agreed with the Environment Agency.

From Table 11: London is in the region where

M<60=20mm and $\alpha=0.4$.

Therefore from the table the volume of the Polystorm tank required is 516m³/ha.

Required attenuation storage on this site = $516 \times 2675/10000 = 136.4m³$.

Design of long term storage

Long term storage can be designed using the volumes in CIRIA C697 The SUDS manual and these are summarised in the table below.

Long term storage volumes (CIRIA C697)

Soil type (from maps in Wallingford Procedure for Europe of Flood Studies Report)	Storage volume (m³/ha)
1	320
2	180
3	130
4	60
5	20

Table 12

The discharge rate for the long term storage is 2 l/s/ha or to infiltration (soakaway).

The long term storage is part of the attenuation storage but it is normally located in a separate tank that is restricted to an outflow of 2 l/s/ha. Alternatively one large tank can be fitted with an outlet control that achieves the different discharge criteria for the different storage volumes.

Example of Polystorm sizing for long term storage

As for the previous example consider a site in London which has an impermeable area as follows:

- 1200m² roof area
- 1475m² car park and other areas

Therefore the total impermeable area = 2675m²

The attenuation storage is provided by Polystorm that has a volume of 88m³ and the flow out of it is restricted to 2 l/s/ha.

Assume the site is over Soil type 3.

From Table 12 the long term storage required is 130m³

So required long term storage on this site = $130 \times 2675/10000 = 34.7m³$

Redistribution of storage requirements gives:

Attenuation storage tank = $136.4 - 34.7$

= 101.7m³ with an outflow of 1.2 l/s

Long term storage tank = 34.7m³ with an outflow of 0.4 l/s

4.7.2 Siltation

The drainage system upstream of polystorm tanks should be designed so that silt and other debris is removed from the run-off and is prevented from entering the tank. This can be achieved using silt traps, permeable pavement or other methods. Polystorm can be used below basins and swales to provide under-drainage. This has the advantage of preventing silt entering the tank but also makes the swale more effective at removing pollution and makes it more aesthetically pleasing by keeping the base dry. If silt does enter the Polystorm tanks it may be difficult to remove. However after a site is completed the level of silt entering the tank is relatively small on most sites. It is suitable to make an allowance for loss of storage due to siltation and the tank can be over designed by the amount typically a 10% increase in tank size will deal with any siltation over a 50 year period. Off line tanks are less prone to siltation because the low flow which contain most of the silt bypass the tank. Soakaways are very prone to siltation if upstream treatment is not provided to remove silt. It is critical that silt from the construction site is not allowed to enter the Polystorm tank.

Typical silt trap

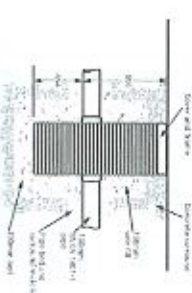


Figure 24

4.8 Soakaway design

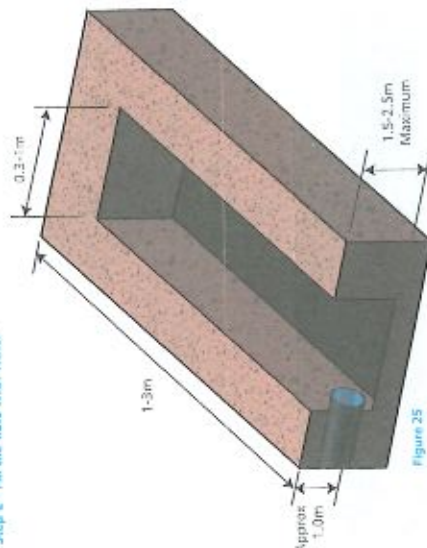
4.8.1 Percolation test for designing a soakaway system

This percolation test follows the procedures laid out by the BRE Digest 365

Step 1 - Dig a trial hole

- The base of the trial hole should be approximately the same depth as anticipated in the full size soakaway
- Overall excavation depth is typically: 1.5m-2.5m for areas <100m²
- The test hole should be typically 0.3m-1m wide and 1m-3m long (make a record of the test hole dimensions)

Step 2 - Fill the hole with water



- Fill trial hole with water - this needs to be done rapidly to mimic a real storm event
- Record the time taken for the water level to fall within the trial hole from 75% to 25% full
- Repeat 3 times, allowing the trial hole to drain between tests
- Best practice for soakaways larger than 25m is to perform a second percolation test at a different location to that of the 1st test site

Step 3 - The results - Soil infiltration rate

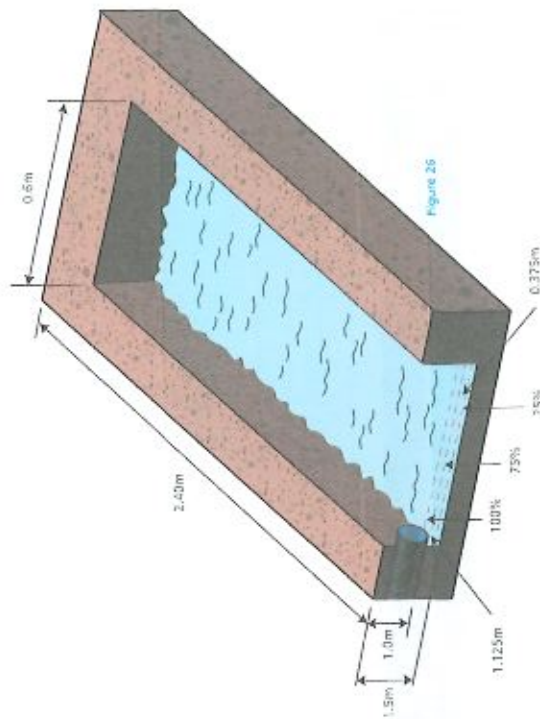
$$f = \frac{V_{100-25}}{A_{100-25} \times t_{100-25}} = \frac{\text{Volume of the hole from 25% to 75% depth}}{\text{Internal surface area of the hole up to 50% of the depth and including the base area}}$$

$$t_{100-25} = \text{The time for the hole to drain from 75% to 25% full in seconds}$$

- Contact the Polypipe VMS technical support team and advise them of the dimensions of the test hole and overall timed result (in minutes)
- Polypipe VMS will take this data and estimate the soakaway size required

Worked example

Invert of the discharge drain - 1.0m below the surface. When deemed suitable the test hole was 2.51m deep, 2.40m long and 0.60m wide. An effective storage depth of 1.5m therefore selected.



Test hole volume between 75% and 25% effective depth:

$$V_{\text{test}} = 2.40 \times 0.60 \times (1.125 - 0.375) = 1.08 \text{ m}^3$$

The mean surface area through which outflow occurs:

$$A_{\text{test}} = 0.75[(2.40 + 0.6)] + (2.4 \times 0.6) = 0.75(6) + 1.44 = 5.94 \text{ m}^2$$

taken to be the hole sides at 50% effective depth, including the base of the pit:

The time taken for water to drain from 75% to 25% full:

$$t_{\text{test}} = 102 - 11 = 91 \text{ minutes}$$

$$\text{Soil infiltration rate} = \frac{1.08}{5.94 \times (91 \times 60)} = 3.33 \times 10^{-5} \text{ m/sec}$$

$$\text{Number of minutes to drain from 75% to 25% depth} = \frac{1.08}{3.33 \times 10^{-5}} = 3245 \text{ minutes}$$

4.8 Soakaway design

4.8.2 Infiltration

Calculation principles

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

A simplified approximate approach can be used on a very small site (i.e. a single house development) where detailed site information may not be required nor available (see table below). Approved document H3 (refer to 1.1, page 10), allows a storage volume equal to the area to be drained multiplied by 1mm for areas up to 25m². Beyond this size, design should be carried out in accordance with BS EN 752-4 : 1998 or BRE Digest 365. BS EN 752-4 : 1998 suggests a storage volume equal to 20mm multiplied by the area to be drained.

Guidance on soakaway for single house development ⁽¹⁾

Number of units	Storage volume (m ³)	Max area to be drained (m ²)
1	0.19	19.0 m ²
2	0.38	38.0 m ²
3	0.57	57.0 m ²
4	0.76	76.0 m ²
5	0.95	95.0 m ²
6	1.14	114.0 m ²

Table 13

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

(2) In accordance with Approved Document H3 (refer to 1.1 page 10).

(3) In accordance with BS EN 752-4 : 1998, Clause NG 2.4.

When the BRE or CIRIA approach is used, the design volumes and areas for trench or cuboid type installers can be found from Tables 14 and 15.

Volumetric data per linear metre for one cell (0.5m) wide

Trench configuration			
Number of cells high	Storage volume (m ³)	Side area (m ²)	Base area (m ²)
1	0.19	0.8	0.5
2	0.38	1.6	0.5
3	0.57	2.4	0.5

Table 14

Volumetric data for 3D usage - two cells high

Cells long (1m side)	2 wide (0.5m side)			4 wide (0.5m side)			6 wide (0.5m side)		
	Vol m ³	Side m ²	Base m ²	Vol m ³	Side m ²	Base m ²	Vol m ³	Side m ²	Base m ²
1	0.76	3.2	1.0	1.52	4.8	2.0	3.04	8.0	4.0
2	1.52	4.8	2.0	3.04	5.4	4.0	6.08	9.6	8.0
4	3.04	8.0	4.0	6.08	9.6	8.0	12.16	12.8	16.0
6	4.56	11.2	6.0	9.12	14.4	12.0	18.24	19.2	24.0
10	7.60	17.6	10.0	15.20	19.2	20.0	30.40	22.4	40.0
100	76.00	161.6	100.0	152.00	163.2	200.0	304.00	166.4	400.0

Table 15

Concrete ring converter

Table 16 enables the conversion of a specified nominal diameter pre-cast concrete ring soakaway volume into the equivalent number of Polystorm Lite and Polystorm cells.

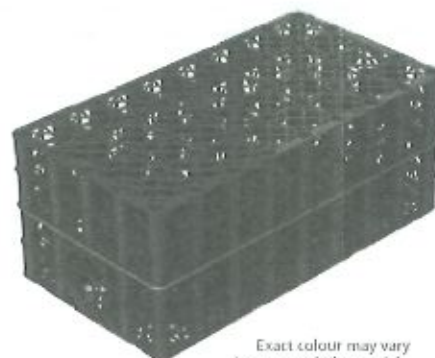
Concrete Ring conversion									
Depth of soakaway	900	1050	1200	1350	1500	1650	1800	1950	2100
0.25	1	2	2	2	3	3	4	4	5
0.50	2	3	4	4	5	6	7	8	9
0.75	3	4	5	6	8	9	11	12	14
1.00	4	5	7	8	10	12	14	16	19
1.25	5	6	8	10	12	15	18	21	25
1.50	6	8	10	12	15	18	22	26	31
1.75	7	9	11	14	17	21	26	31	37
2.00	7	10	13	16	20	24	29	35	42
2.25	8	10	13	16	20	24	29	35	42
2.50	8	11	14	18	22	27	33	40	48
2.75	9	12	16	20	24	30	36	44	53
3.00	11	14	18	21	26	32	39	48	58

Table 16

Product code: PSM1A

The Polystorm-R modular cell is ideally suited for loaded applications at greater depths, such as housing, commercial and infrastructure projects and has a compressive strength of up to 61 tonnes/m². It offers all the proven performance of the Polystorm cell, with the added benefits of being manufactured from over 90% recycled material content.

Wherever performance criteria and standards allow, we will always maximise the sustainability of our products by using post consumer plastics in their manufacture. By sourcing and carefully controlling the quality of the recycled material we use our precision injection moulding. Therefore we are able to guarantee consistent quality in our recycled plastic, giving you the confidence and the performance levels you expect from the market leader.



Exact colour may vary due to recycled materials.

Key Benefits

- Made from specially selected and controlled recycled materials
- Environmentally friendly, sustainable solution
- Has undergone stringent testing to ensure product performance
- Compressive strength of 61 tonnes/m²
- Ideal for retention, attenuation and infiltration applications with a suitable geomembrane or geotextile
- BBA approved
- Allow flexibility of shape - ideal for shallow excavation systems, narrow strips or use in restricted areas
- Can be used as part of a value engineered hybrid system with Polystorm, Polystorm Lite and Polystorm Xtra
- Integrated inlet and outlet
- 3D flow throughout the structure
- 95% void ratio
- Light weight yet robust - excellent Health and Safety and installation benefits
- 60 years creep limited life expectancy

Technical Support

Detailed guidance and assistance is available.

For further information, please contact our Technical Team on +44 (0) 1509 615100 or email civils@polypipe.com



ELEMENT	
PHYSICAL PROPERTIES	
Length	1m
Width	0.5m
Depth	0.4m
Total volume	0.2m ³
Unit weight	9kg (approx)
Unit storage volume	0.19m ³ (190 litres)
Void ratio	95%
SHORT TERM COMPRESSIVE STRENGTH	
Vertical	610 kN/m ² **
Lateral	63 kN/m ² **
SHORT TERM DEFLECTION	
Short-term vertical deflection	60 kN/m ² per mm
LONG TERM DEFLECTION	
Estimated long term vertical deflection (creep)	0.2798 Ln (design life in hrs) +0.485 [Based on an applied test load = 162 kN/m ²] Creep data limit 60 years
Estimated long term lateral deflection (creep)	1.0192 Ln (design life in hrs) -3.864 [Based on an applied test load = 30.8 kN/m ²] Creep data limit 60 years

Note: Polystorm-R is ideal for use in trafficked and pedestrian applications subject to a structural design check and suitable installation conditions

* Each unit includes 4 Clips and 2 Shear Connectors.

** Compressive strength at yield, maximum recommended value for design purposes.

RECOMMENDED MAXIMUM DEPTH OF INSTALLATION (to cell invert) [m]

TYPICAL SOIL TYPE	TYPICAL ANGLE OF SHEAR	SOIL WEIGHT KN/m ²	WITHOUT GROUNDWATER (below base of cells)		WITH GROUNDWATER AT 1M BELOW GROUND LEVEL AND UNITS WRAPPED IN GEOMEMBRANE	
			Trafficked (cars) <3000kg GVW	Pedestrian	Trafficked (cars) <3000kg GVW	Pedestrian
Stiff over consolidated clay e.g. London clay	24	20.0	2.2	1.9	1.6	1.8
Normally consolidated silty sandy clay e.g. alluvium, made ground	26	19.0	2.4	2.2	1.7	1.9
Loose sand and gravel	30	18.0	3.0	2.7	1.9	2.0
Medium dense sand and gravel	33	19.0	3.2	2.9	1.9	2.0
Dense sand and gravel	38	20.0	3.7	3.5	2.0	2.1

Note:

1) Stated depths based on the calculation methodology detailed within CIRIA C680 (2008)

2) Assuming water density = 10.0kN/m³

3) Assumed ultimate limit state (ULS) partial factor of safety applied to: Material = 2.75 Lateral pressure = 1.35

Durability

The polymer material used in the manufacture of the Polystorm-R unit has an adequate resistance to attack from the type and quantities of chemicals that may be expected to naturally occur in uncontaminated soils and rainwater runoff. When installed in accordance with our recommendations, it is expected that the Polystorm-R unit will have a design life in excess of 60 years*. The installer of a proposed geocellular structure should ensure that an appropriate design check has been undertaken, in accordance with the recommended methodology and factors of safety given in CIRIA C680 (2008). Structural Design of Modular Geocellular Drainage Tanks, prior to the commencement of construction activities.

* Derived from long term extrapolated creep testing

Notes

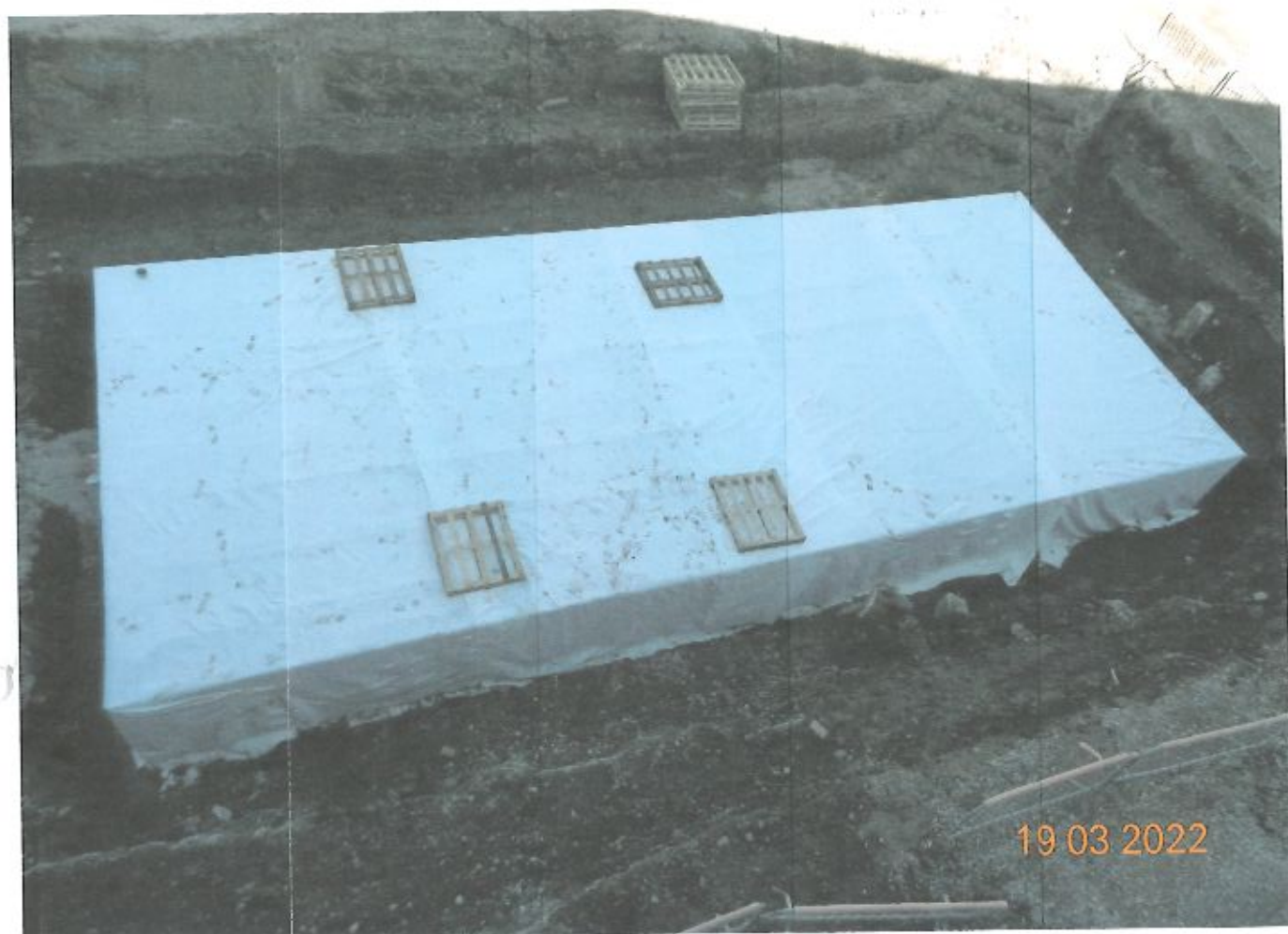
1. Unless stated, all values are nominal and may vary within normal production tolerances.
2. The characteristic unit parameters stated have been based on Polypipe BBA certificate N° 06/4297, sheet 3.
3. Polypipe reserve the right to change product specifications without prior notice.
4. This document is uncontrolled and updates will not be issued automatically.

All descriptions and illustrations in this publication are intended for guidance only and shall not constitute a 'sale by description'. All dimensions given are nominal and Polypipe may modify and change the information, products and specifications from time to time for a variety of reasons, without prior notice. The information in this publication is provided 'as is' on September 2017. Updates will not be issued automatically. This information is not intended to have any legal effect, whether by way of advice, representation or warranty (express or implied). We accept no liability whatsoever (to the extent permitted by law) if you place any reliance on this publication you must do so at your own risk. All rights reserved. Copyright in this publication belongs to Polypipe and all such copyright may not be used, sold, copied or reproduced in whole or part in any manner in any media to any person without prior consent. Polypipe is a registered trademark of Polypipe. All Polypipe products are protected by Design Right under CDPA 1988. Copyright © 2016 Polypipe. All rights reserved.

















16 03 2022



15 03 2022







Polypipe

LOUGHBOROUGH TEL: (01509) 615100



DESCRIPTION: **POLYSTORM - R STORMWATER
MANAGEMENT SYSTEM CELL**

CODE:

PSM1A



SIZE: 1000mmx500mmx400mm

COLOUR: BLACK

QUANTITY: **15**

PALLET No: **99**

WEIGHT
APPROX
175"J

DATE: 25/02/2022

JOB No: 1029874

LINE No: PSM1A

OPERATOR: 012

14 03 2022



14 03 2022

14 03 2022



11 03 2022







10.03.2022

