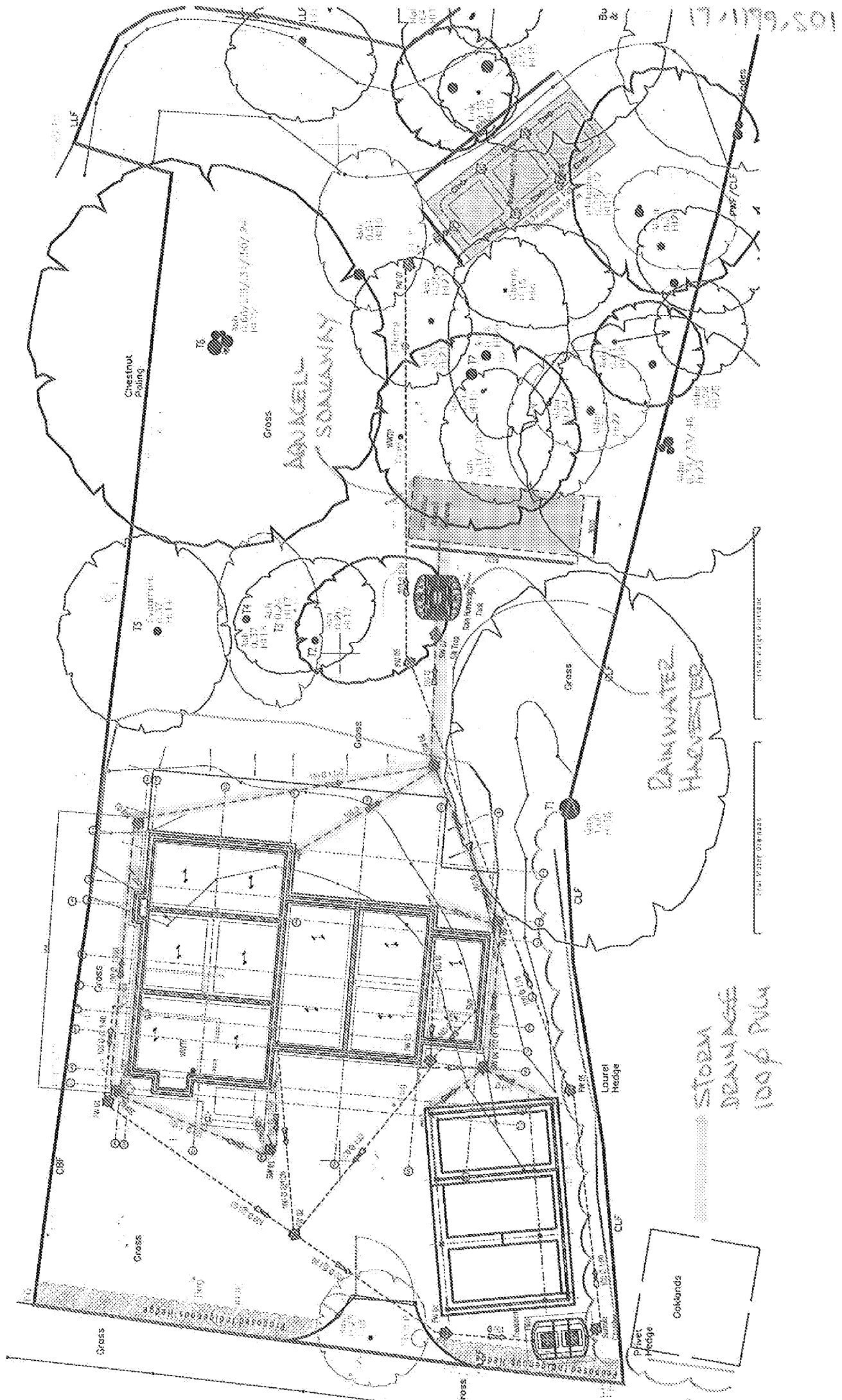




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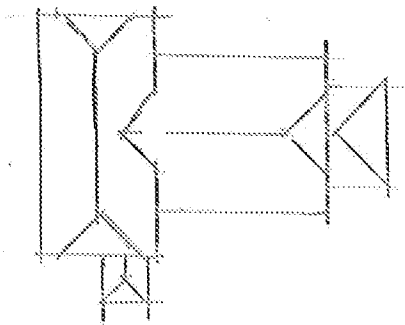
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Suite A Second Floor, Trinity Court 2-4 West Street, Fareham, Hampshire, PO16 0BH

Project: LAND TO SOUTH OF SUNDOWN	Project No.	Sheet No. S02
Item STORM SORAWAY		
Prepared	Date MAY 21	Checked
		Revision
		Date

CALCULATIONS

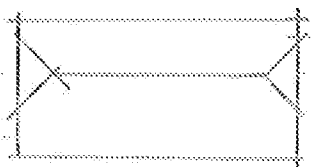
DWELLING Roof AREA. Roof Pitch = 40°



Roof AREA (SLOPE LENGTH)

$$(12.35 \times 5.0) + (7.5 \times 5.0) + (3.5 \times 6.5) + (1.5 \times 1.5) = \frac{234.5 \text{ m}^2}{(H)}$$

Garage Roof AREA. Roof Pitch = 40°



Roof AREA (SLOPE LENGTH)

$$10.4 \times 3.3 + 10.4 \times 5.1 = \frac{88 \text{ m}^2}{(G)}$$

$$\Sigma \text{ AREA} = H + G = 322.5 \text{ m}^2$$

$$\text{Allow 10\% VEDAM COVER} = 322.50 \times 1.1 = \underline{355 \text{ m}^2} \text{ DESIGN AREA}$$

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Consulting Structural Engineers

Suite A Second Floor, Trinity Court 2-4 West Street, Fareham, Hampshire. PO16 0BH

Project: LAND TO SOUTH OF SANDOWN	Project No.	Sheet No. S03
Item STORM SOAKAWAY		
Prepared	Date MAY 21	Checked
		Revision
		Date

CALCULATIONS

DESIGN DATA

IMPERMEABLE AREA $355m^2$ (INCL 10% VERBAL GROUND)

INFILTRATION RATE $4.0 \times 10^{-5} m/sec$ (INCL F.O.S. 2)

$\phi = 0.35$ (ADC PROVES)

CLIMATE CHANGE 40% (INCL IN RAINFALLS MM)

DESIGN BASED ON 1:100yr (M100-D) [BASELINE M10-D]

SOAKAWAY FILL - AGGREGATE BY WATIN (OR EQUAL APPROVED)
VOID RATIO 95%.

CRATES $1.0 \times 0.5 \times 0.2$ Dg EACH.

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Suite A 2nd Floor Trinity Court
2-4 West Street Fareham

Land to South of Sundown

Revision

Job No:

17-1197

Page:

SW-04

Section:

Main Soakaway House & Garage (FOS 2.0 on 'f')

Prepared By:

PH

Date:

17/03/2022

ALTERNATIVE SOAKAWAY SIZES

	trench soakaways			
	width of trench [mm]	2000	2500	3000
required trench length [m]		10.78	9.00	7.69
	ring soakaways			
	diameter of ring [mm]	1050	1350	1500
required pit diameter [m]		2.59	2.99	2.99

* Based on effective depth and number of pits as in Soakaway Data table

SUMMARY OF CALCULATIONS

critical design rainfall duration ' t_{crit} '	=	240	min
required storage volume ' V_{req} '	=	21.37	m ³
provided storage volume ' V_{prov} '	=	24.23	m ³
utilisation factor	=	0.88	.OK
required time to discharge 50% ' t_{50} '	=	6.10	hours
utilisation factor	=	0.25	.OK

GENERAL DATA

site location:	England and Wales
soakaway type:	geocellular units
impermeable area drained to soakaway 'A' [m ²]	= 355
60 min rainfall depth of 5 year return period 'R' [mm]	= 20
M5-60 to M5-2d rainfall ratio 'Y'	= 0.36
allowance for climate change:	40%

SOAKAWAY DATA

soakaway width 'W' [m]	= 3.00
soakaway length 'L' [m]	= 8.50
total depth from ground level 'D _g ' [m]	= 1.50
depth to drain invert level 'D _d ' [m]	= 0.50
soakaway effective depth 'D _{eff} ' [m]	= 1.00
free volume in infill aggregate [%]	= 95

SOIL INFILTRATION DATA

allowance for infiltration through soakaway base:	No
available on-site infiltration test results:	☐ Yes ☒ No
soil infiltration rate 'f' [m/s]	= 4.80E-05

BELOW
IL INVERT

(incl F.O.S. 2.0)

DESIGN
CASE

REQUIRED STORAGE CAPACITY PER RAINFALL DURATION

rainfall duration [min]	rainfall factor Z1	M5-D rainfalls [mm]	M10-D			M100-D			Ignore			outflow from soakaway [m ³]	required storage [m ³]
			Z2	rainfalls [mm]	inflow [m ³]	Z2	rainfalls [mm]	inflow [m ³]	Z2	rainfalls [mm]	inflow [m ³]		
5	0.36	7.13	1.20	12.01	4.26	1.84	18.39	6.53				0.17	6.36
10	0.51	10.13	1.22	17.32	6.15	1.91	27.13	9.63				0.33	9.30
15	0.62	12.33	1.23	21.23	7.54	1.95	33.62	11.84				0.50	11.44
30	0.79	15.73	1.24	27.31	9.70	2.00	43.95	15.81				0.98	14.81
60	1.00	20.00	1.24	34.72	12.33	2.03	56.84	20.18				1.99	18.19
120	1.22	24.47	1.24	42.47	15.08	2.01	68.92	24.47				3.97	20.49
240	1.50	29.93	1.22	51.14	18.16	1.97	82.58	29.32				7.95	21.37
360	1.69	33.80	1.21	57.19	20.30	1.94	91.78	32.58				11.92	20.68
600	1.95	38.93	1.19	65.04	23.09	1.90	103.48	36.74				19.87	16.88
1440	2.48	49.60	1.17	81.30	28.86	1.81	125.91	44.70				47.69	0.00

* Z2 is growth factor from M5 rainfalls

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Project: <u>LAND TO SOUTH OF SUNDOWN</u>	Project No. <u>17/1179</u>	Sheet No. <u>S 05</u>
Item: <u>STORM DRAINAGE</u>		
Prepared: <u>[REDACTED]</u>	Date: <u>08/21</u>	Checked: <u></u>
	Revision: <u></u>	Date: <u></u>

CALCULATIONS

STORM DRAINAGE 100 Ø @ 1:100 GRADIENT (VNS)

SPOT IL @ RWP BY GRID EG : -0.4m IL : 37.000

GR'D LV'L ADOPTED 37.400

HOUSE F.F.L = 37.550

SW01 CL. 37.400

Le $\rightarrow$ RWP (EG) = 3.6m $\therefore$ FALL = 0.040m IL = 36.960

SW 02 CL 37.400

Le FROM SW01 = 8.8m $\therefore$ FALL = 0.088m IL = 36.880

SW03 CL 37.400

Le FROM SW02 = 13.2m $\therefore$ FALL = 0.132m IL = 36.748

SW 06 CL 36.00

Le FROM SW03 = 14.9m $\therefore$ FALL = 0.166m IL = 35.550

SW07 CL 35.400

Le FROM SW06 = 6.4m ADOPT A DEPTH TO IL OF -0.45m
 $\therefore$ IL = 34.95

GRADIENT FROM SW06

= 0.6m FALL $\therefore$ = 1:10

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Suite A Second Floor, Trinity Court 2-4 West Street, Fareham, Hampshire. PO16 0BH

Project:	LAND TO SOUTH OF SOUNDOWN	Project No.	17/1179	Sheet No.	S06
Item	STORM DRAINAGE				
Prepared		Date	09/21	Checked	
				Revision	
				Date	

CALCULATIONS

STORM DRAINAGE RWP GRID G8

DOE TO FOUL RUN STORM UNDER FOUL BY FWO3 (IL 36.900)

∴ MIN STREET IL @ G8 = 36.750 (-0.65m)

SW04 CL 37.250 [SPOT POINT]

L_e FROM RWP G8 = 3.5m ∴ FALL = 0.035 IL 36.715

SW05 CL 37.400 (SIMILAR TO DECK LV'L)

L_e FROM SW04 = 7.2m ∴ FALL = 0.07m IL 36.645

SW06 CL 36.000 (@ BASE OF EMBANKMENT)

MAIN FALL FROM SW03 (SEE SHEET S06)

L_e FROM SW05 = 8.3m ∴ IL @ SW06 = 35.550

Q/A FALL = 1.095m ∴ GRADIENT = 1:8 (DUE TO TOPOGRAPHY)

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Suite A Second Floor, Trinity Court 2-4 West Street, Fareham, Hampshire. PO16 0BH

Project:	LAND TO SOUTH OF SUNDOWN	Project No.	17/1175	Sheet No.	S07
Item	STORM DRAINAGE				
Prepared		Date	OCT 21	Checked	
				Revision	
				Date	

CALCULATIONS

OXFORD STORM WATER TANK (3000L TANK)

IL @ 0.630 FROM BASE OF TANK (DIFFERENCE 0.055)
 OL @ 0.575 FROM BASE OF TANK

FORMATION LV'L (MIN DPTH (1/4 HT) 2.710M

GR'D LV'L APPROX 35.400

∴ BASED ON IL = 34.900 (INLET)
 OL = 34.845 (OUTLET)

* LV'LS TO BE REVIEWED ON SITE DUE TO
 NEW EMBANKMENT & DECK EXTENT.

SINKAWAY AREA

GR'D LV'L LOCAL TO SINKAWAY = 35.34

SINKAWAY UNITS AQUACELL ECO WITH MINIMUM
 GR'D COVER @ 500mm

" AQUACELL TOP LV'L = 34.84 @ START
 WITH 1" INLET IL = -0.20

IL 34.64

ALLOWING FOR GR'D LV'L VARIATIONS POSITION

THE INLET IL @ 34.500

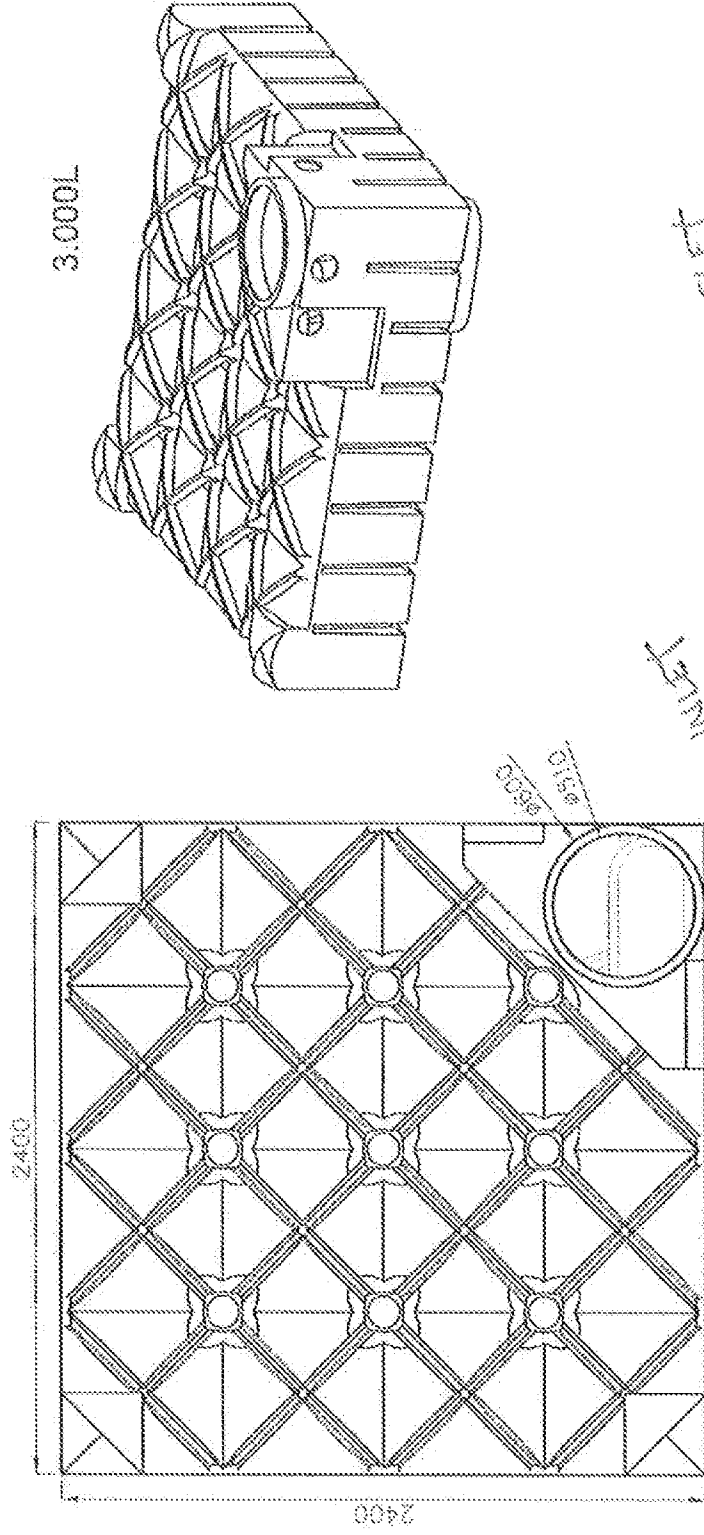
START OF SINKAWAY

17-1179-S08



SMART RAINWATER
SYSTEMS

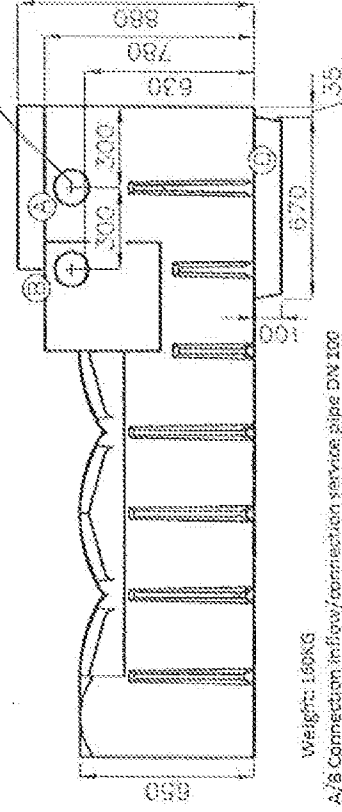
ROOF STORMWATER
TANK WITH DL
TO SOAKAWAY.



3.000L

INLET

OUTLET

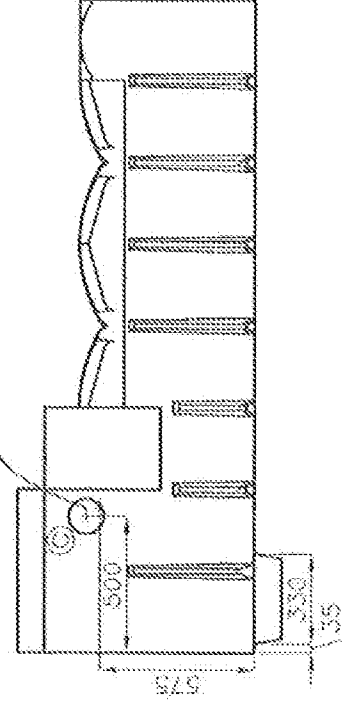


Weight: 150KG

A/B Connection inflow/overflow service pipe DN 100

C. connection overflow DN 100

D pump basin



For Technical Assistance Call: 01844 877 030

AquaCell Eco

Application

AquaCell Eco is manufactured from specially reformulated, recycled material and has been specifically designed for shallow, non-trafficked, landscaped applications. AquaCell Eco is **NOT** suitable for locations subject to high water tables.

AquaCell Eco is typically suitable for installations to a maximum depth of 2.68 metres, to the base of the units from ground level, with a minimum cover depth of 0.3 metres, (CIRIA's recommendation, is to allow a cover depth of 0.5 metres in applications where a ride on mower may be used).

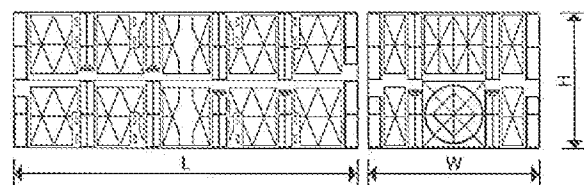
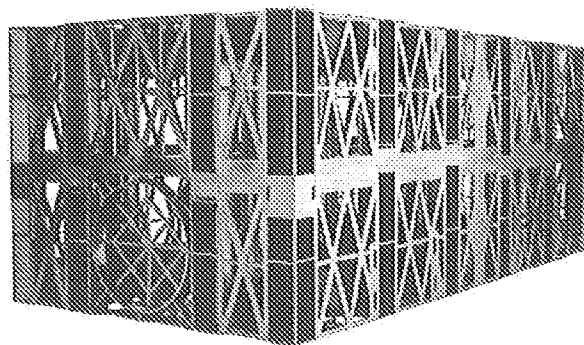
Any installation using AquaCell Eco must **NOT** be subjected to additional loading at any time. Trafficking by construction plant on site, including mechanical equipment, must be avoided.

If trafficking of the buried tank by construction plant or, other vehicles is unavoidable, the installation should be constructed using AquaCell Core-R units (see page 9).

The width of an AquaCell Eco installation should not exceed 12 metres to allow for mechanical backfilling without loading. There is no limit to the length of the installation.

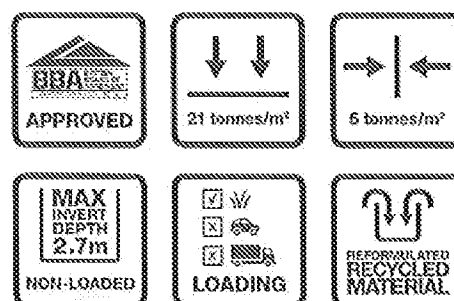
Features and benefits

- ⊙ Manufactured from specially reformulated, recycled material
- ⊙ Suitable for both soakaway and attenuation applications
- ⊙ Proven vertical loading capacity of: 21.3 tonnes/m² (213kN/m²)
- ⊙ Proven lateral loading capacity of: 5.2 tonnes/m² (52kN/m²)
- ⊙ Integral "hand holds" for ease of carrying/handling
- ⊙ BBA approved – Certificate No 03/4018



Material: Reformulated polypropylene

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB025	500	400	1000



Maximum installation depths – to base of units (m)⁽¹⁾

Typical soil type	Soil weight (kN/m ³)	Angle of internal friction ϕ (degrees) ⁽²⁾	Landscaped areas
Over-consolidated stiff clay	20	24	1.53
Silty sandy clay	19	26	1.68
Loose sand and gravel	18	30	2.08
Medium dense sand and gravel	19	34	2.35
Dense sand and gravel	20	38	2.68

(1) These values relate to installations where the groundwater is a minimum of one metre below the base of the excavation.

(2) AquaCell Eco units should not be used where groundwater is present.

(3) 0.5m cover is required where a ride-on mower may be used.

Assumptions made: ⊙ Ground surface is horizontal

⊙ Shear planes or other weaknesses are not present within the structure of the soil.

Source: BBA

Design guidance

Hydraulic design

All AquaCell units have identical dimensions: 1m x 0.4m x 0.5m, have a nominal void ratio of 95% and each holds 190 litres of water. Hydraulic calculations are accordingly the same for AquaCell Eco, Core-R and Plus-R.

Structural design however, requires careful consideration of loading factors specific to each location – see CIRIA C680 or CIRIA C737 for further guidance (we recommend using the BPF Guide Designing Geocellular Drainage Systems to CIRIA Report C737 alongside.)

Structural design – installation and cover depths

Each AquaCell unit has been designed to have specific loading capacities (see pages 8-10) that define the maximum depth parameters for which they are suitable.

Minimum depth of cover varies according to whether or not the installation will be subject to trafficking by cars/HGVs.

However, in some situations, installations may have to be located with greater cover depths. Reasons may include:

- ① Deep-running drainage network
- ② Other buried services running above tank location
- ③ Installation into banked/ sloping ground
- ④ Upper layer of clay preventing infiltration

The table shows a summary of typical cover depths and installation depths as a guide.

Typical minimum cover depths and maximum installation depths

Location type	Minimum cover depths (m)		
	AquaCell Eco	AquaCell Core-R	AquaCell Plus-R
Landscaped/non-trafficked areas²	0.30	0.30	0.30
Car parks, vehicle mass up to 9 tonnes¹	n/a	0.60	0.69
HA/HGV loading up to 60 tonnes	n/a	1.11	1.30
	Maximum installation depths (m)³		
Maximum depth to base of unit (Landscaped)	2.68	6.68	7.82
Maximum depth to base of unit – vehicle mass up to 9 tonnes	n/a	6.43	7.57
Maximum depth to base of unit – vehicle mass up to 44 tonnes	n/a	6.18	7.30

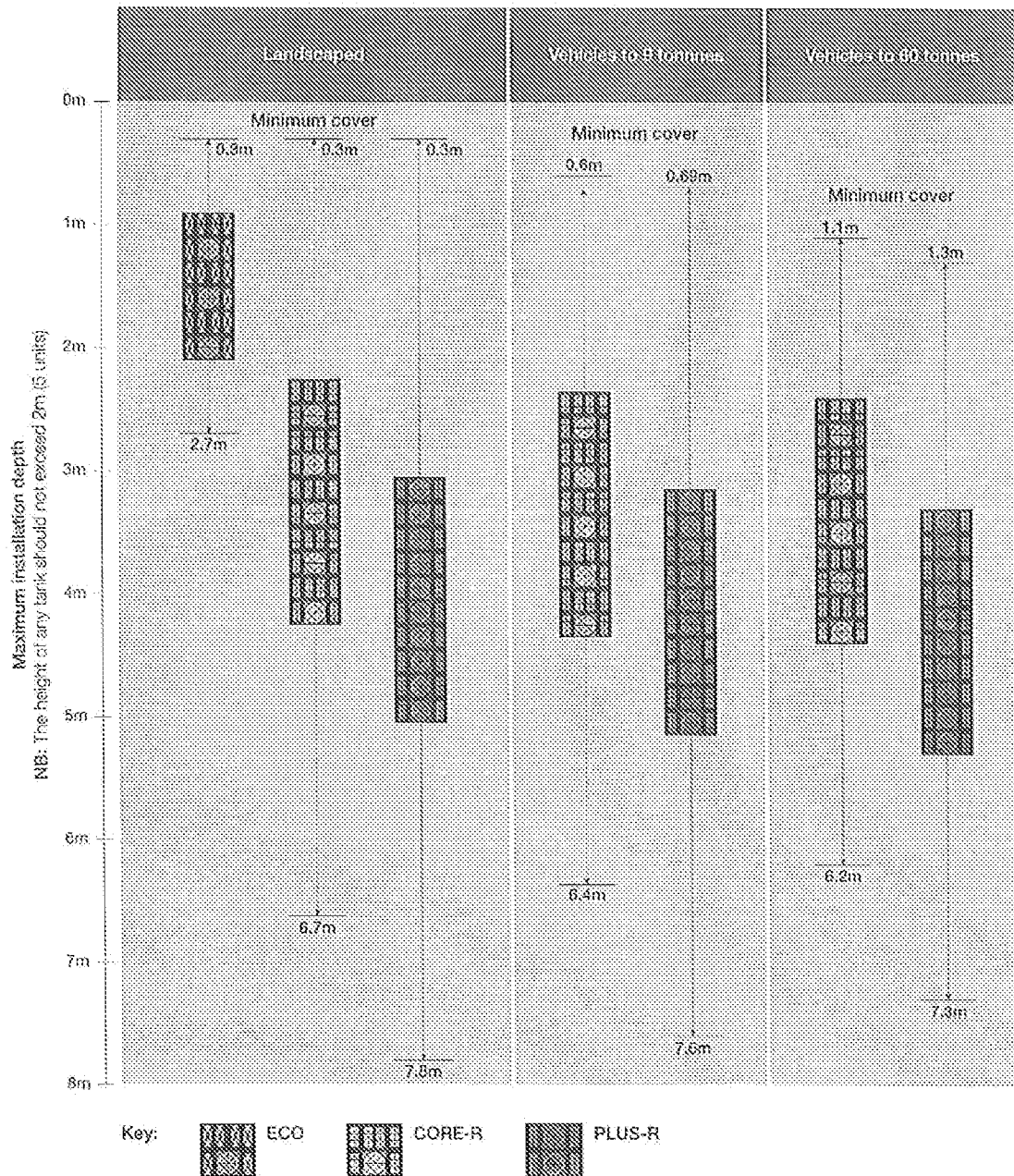
- (1) For specific advice on cover depths for heavier loadings/HGV applications, contact Wavin Technical Design on 0844 856 5165.
- (2) 0.30m is minimum depth for AquaCell in landscaped applications. 0.5m cover is recommended in applications where ride-on mowers may be used. If construction plant is to be used on site, extra protection may be needed.
- (3) Allowable maximum depth to base of bottom layer of units is dependent on soil type, angle of shearing resistance, loadings, and groundwater level. The above depths are based on 38° angle of shearing resistance and no groundwater.

In trafficked applications it is recommended that the height of any tank should not exceed 2m (5 units). If you require a tank that exceeds this, please contact Wavin Technical Design for guidance:

T: 0844 856 5165 E: technical.design@wavin.co.uk

Minimum cover and maximum installation depths to base of units from ground level, in best soil conditions

This chart shows how deep each unit can be used for different applications in best soil conditions.



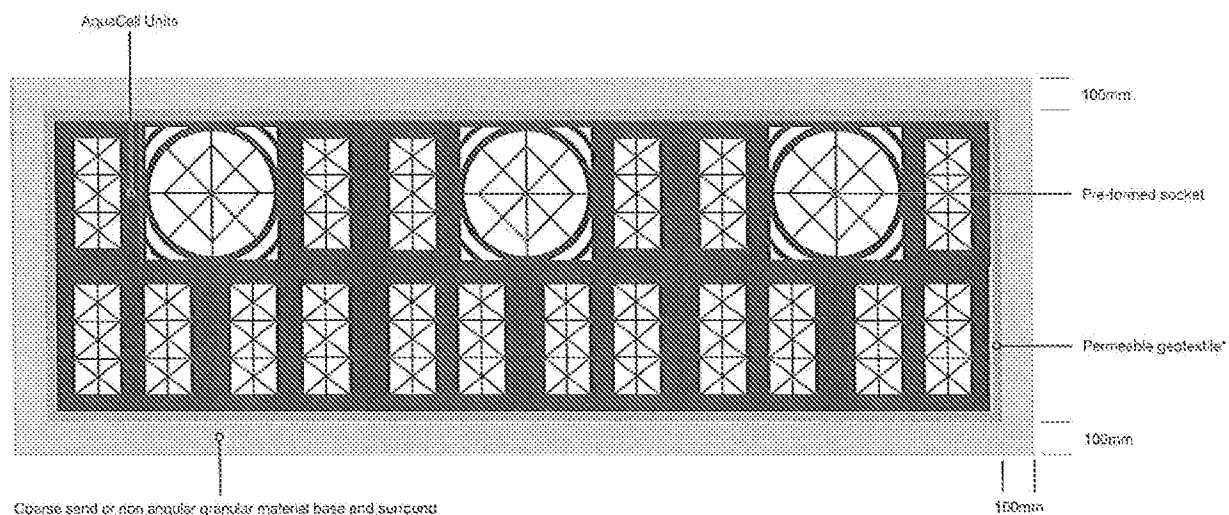
Note: The AquaCell units can also be used in combination with each other, see page 16 for details.

Installation

Typical soakaway installation method

Typical installation procedure

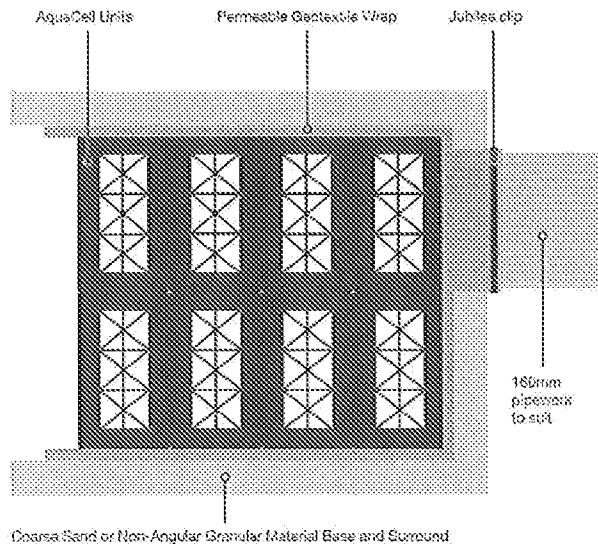
1. Excavate the trench to the required depth ensuring that the plan area is slightly greater than that of the AquaCell units.
2. Lay 100mm bed of coarse sand or non angular granular material, level and compact.
3. Lay the geotextile* over the base and up the sides of the trench.
4. Lay the AquaCell units parallel with each other. In multiple layer applications, wherever possible, continuous vertical joints should be avoided. AquaCell units can be laid in a 'brick bonded' formation (i.e. to overlap the joints below) – see page 16. For single layer applications use the AquaCell Clips and for multi layers use the AquaCell Shear Connectors (vertical rods).
5. Fix the Adaptors to the AquaCell units as required and connect pipework.
6. In order to prevent silt from entering the tank, clogging inlet pipework and reducing storage capacity, it is recommended that the Domestic Silt Trap (6LB300) or one of the standard Silt Traps (6LB600, 6LB625, 6LB630) is installed prior to the inlet pipework – see page 24 for installation guidelines.
7. Wrap and overlap the geotextile covering the entire AquaCell structure.
8. Lay 100mm of coarse sand or non angular granular material between the trench walls and the AquaCell structure and compact.
9. Lay 100mm of coarse sand or non angular granular material over the geotextile and compact.
10. Backfill with suitable material.
11. Rainwater from roof areas may discharge directly into the soakaway but rainwater from car parks must discharge through a catchpit manhole and/or a petrol interceptor.



Example shows the use of AquaCell Eco. However, a soakaway can also be installed as shown using either of the other versions of AquaCell units (Core-R or Plus-R) as appropriate.

**The geotextile should be selected according to specific site conditions. Specialist advice should be sought if surrounding soil characteristics exhibit a high degree of fines/slow infiltration capacity and/or there is a high risk of damage from ground contaminants.*

Connections

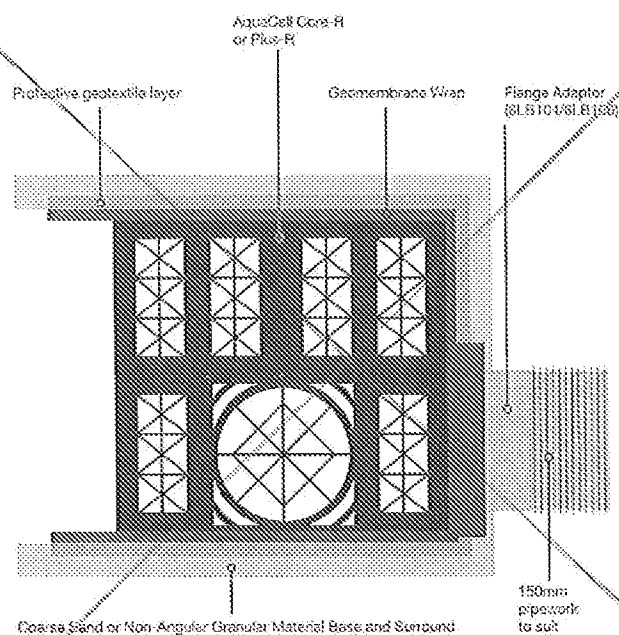


Connections to AquaCell units

Connection for soakaway application using either the pre-formed socket (as shown below) or standard adaptors into pre-formed socket*.

*NOTE: For pipework other than 150mm OsmaDrain, these adaptors can be used to connect to the following:

- ① 6TW141: TwinWall S/S Adaptor connects to 150mm TwinWall
- ① 6D099: OsmaDrain Adaptor connects to 110mm OsmaDrain
- ① 6UR141: UltraRib S/S Adaptor connects to 150mm UltraRib
- ① SA15/2: Double Spigot Adaptor connects 150mm OsmaDrain to 150mm Superslave Clay



Connection for storage application using Flange Adaptor at points other than pre-formed socket, (for AquaCell Core-R or Plus-R).

Installation procedure

1. Fix Flange Adaptor to the AquaCell unit with self tapping screws.
2. Cut through the geomembrane.
3. Insert pipework into Flange Adaptor.

*NOTE: When using the 6LB104: For pipework other than 150mm UltraRib these adaptors can be used to connect to the following:

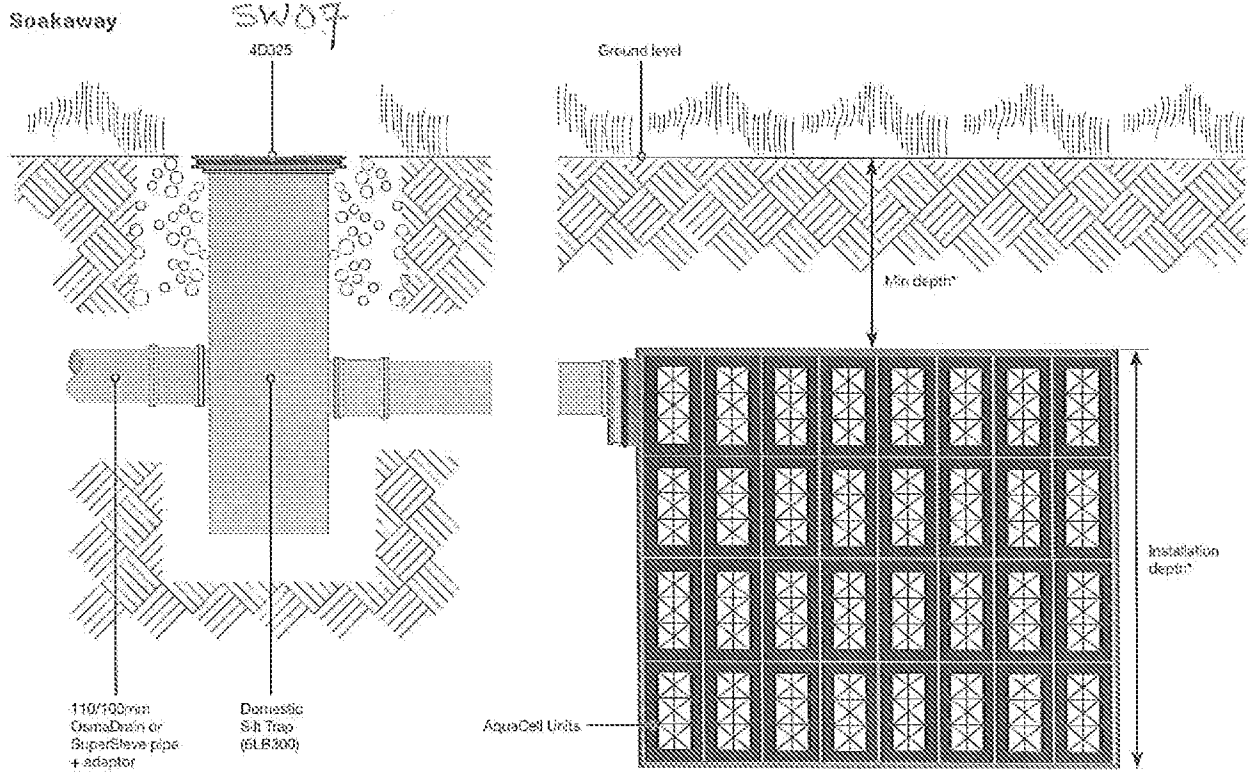
- ① 6UR099: S/S Level Invert Reducer to 110mm OsmaDrain
- ① 6UR143: UltraRib 150mm Spigot Adaptor connects to 150mm OsmaDrain
- ① 6TW145: UltraRib 150mm Spigot Adaptor connects to 150mm Twinwall
- ① TA/2: UltraRib 150mm Spigot Adaptor connects to 150mm Superslave Clay

When using the 6LB106: For pipework other than 225mm UltraRib these adaptors can be used to connect to the following:

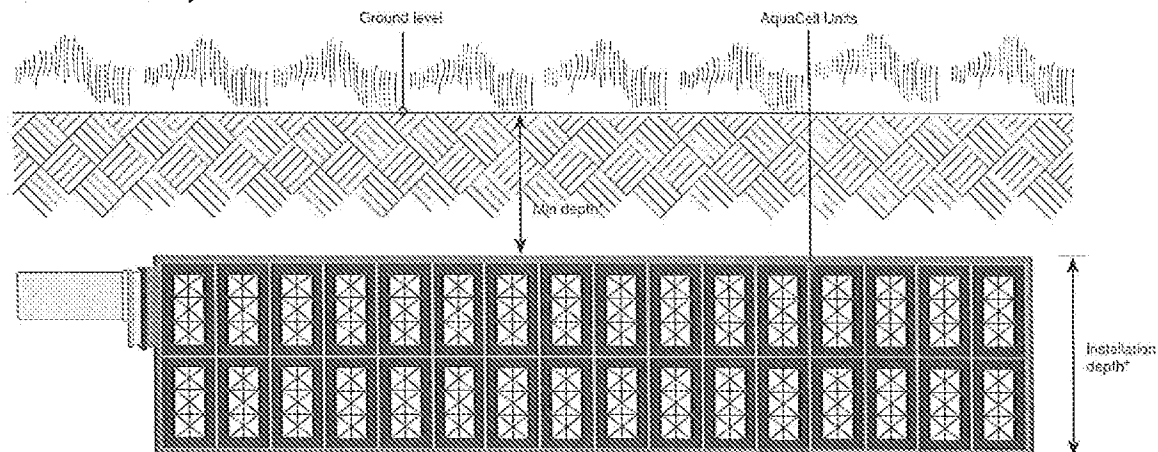
- ① 9TW145: UltraRib 225mm Spigot Adaptor connects to 225mm Twinwall
- ① TA/4: UltraRib 225mm Spigot Adaptor connects to 225mm Superslave Clay

Soakaways

Soakaway – non-traffic loading



Trench soakaway



Notes

1. Soakaways should be sited at least 5m away from the building (Ref BS EN 752-4).
2. The exact size and shape of the soakaways are to be determined once all the necessary calculations have been produced.
*For information regarding cover depths and installation depths, see page 15.

