

**STONE CONSULTING
ENGINEERS LTD.**

**CONSULTING CIVIL, STRUCTURAL AND
FOUNDATION ENGINEERS**

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PO21 4ED

Job No. 1904

Date: Mar 2019

QA INFORMATION

CLIENT:	Lynes
JOB ID:	Little Glebe
SCOPE OF WORK:	Soakaway Design
DESIGN CODES AND REFERENCES:	BRE 365
SOFTWARE:	MS EXCEL
SUB-SOIL/ FOUNDATION DATA:	N/A

MATERIAL DATA

CONCRETE:	
REINFORCEMENT:	
STEELWORK:	
TIMBER:	
OTHER:	Field observation by others

OTHER INFORMATION / NOTES

Rev A	First issue
Rev B	superceeded
Rev C	BRE 365 with factor of safety of 3 on infiltration rate
Rec D	Front soakawy sized

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Project:	Little Glebe	Date:	Mar 2019	Made by:	KS	Sheet No.	1
CALCULATION SHEET		Job No.	1904	Chkd:	-	Rev.	D

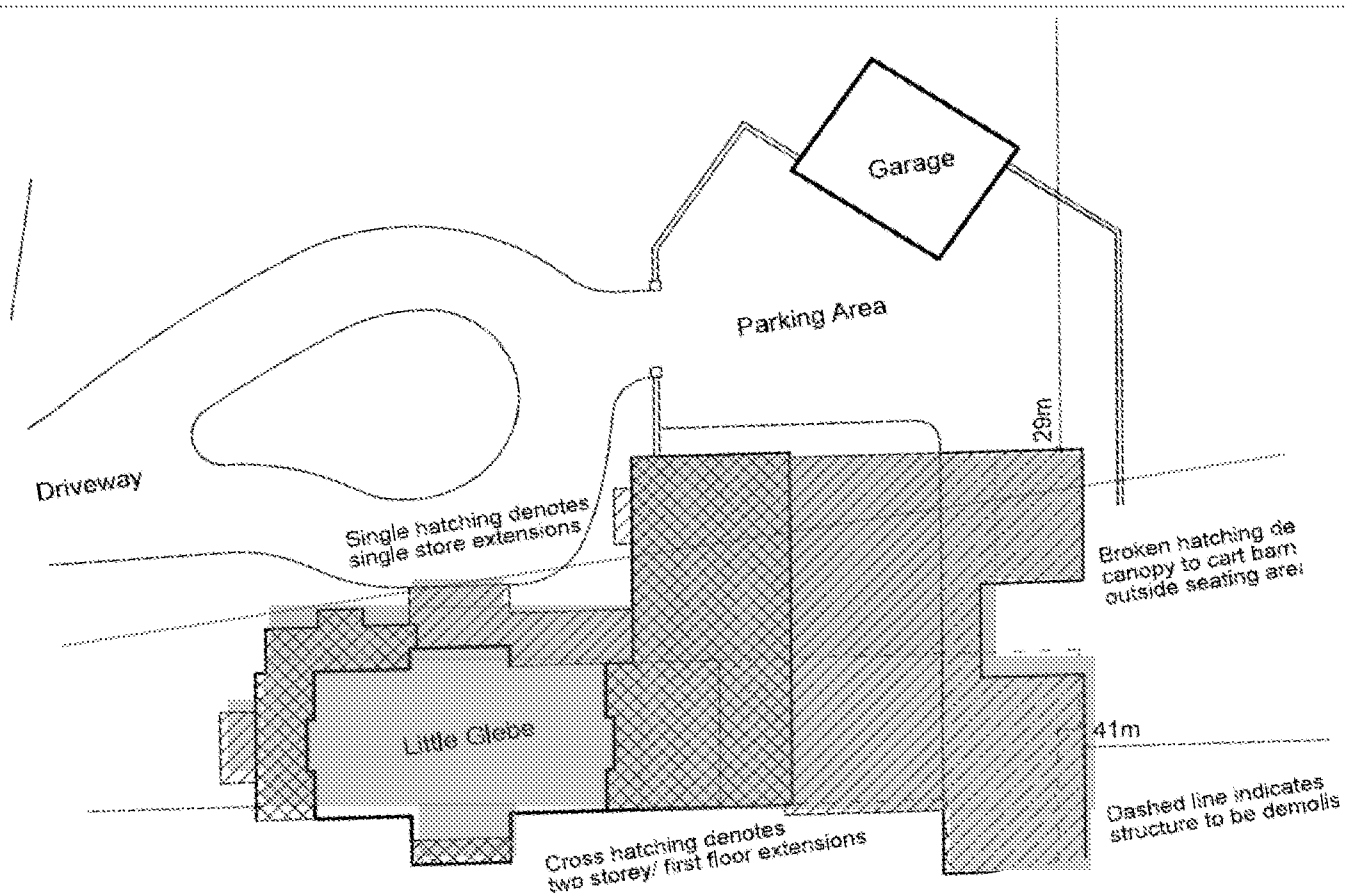
SUMMARY:

The calculation is based on a 100 year return period with a 40% allowance for Climate Change.

Soakaways located to the front and rear of the property are required to attenuate and discharge surface water.

The infiltration rate has been derived from infiltration testing at site in general accordance with BRE 365.

The site is confirmed suitable for the use of soakaways.



Roof areas draining into soakaways to

Front (blue) = 206.00 m2

Rear (red) = 253.00 m2

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Project: Little Glebe	Date: Mar 2019	Made by: KS	Sheet No. 2
CALCULATION SHEET	JobNo. 1904	Chkd: -	Rev. D

SOAKAWAY DESIGN TO BRE(1991)

SOAKAWAY DETAILS

Ring		Pit/crates	
Soakaway size, Ds =	2.50 m	Length =	4.5 m
Depth of below invert, Hs =	1.50 m	Width =	4.5 m
		Depth below invert =	1.2 m
Free volume, S =	7.36 m ³	=	24.30 m ³
Rubble filled volume, S' =	2.21 m ³	=	8.02 m ³

INITIAL SOAKAWAY SIZING

Drained area to soakaway = ~~253.00~~ m²
 Climate change allowance = 40 %

INFLOW

Inflow, I = (run off area) x (design rainfall)
 = A x (M10-D)

DESIGN RAINFALL

Return period = 100 yrs
 Ratio of 60 min to 2-Day rainfalls of 5 year return period, r = 0.35 BRE(1991) Fig 1.

M5 rainfalls are calculated from table 1 (BRE 365) using Z1 factor

Storm duration (mins)	Z1	M5-D (mm)	Z2 M10 (cor. Fac)	M10-D* rainfall	Z2 M100 Design	100 yr + 40%	
5	0.38	7.5	1.19	12.50	1.84	rainfall	
10	0.53	10.5	1.22	17.93	1.92	19.32	
15	0.64	12.7	1.23	21.87	1.96	28.22	
30	0.81	16.1	1.22	27.50	2.00	34.85	
60	1.00	20	1.24	34.72	2.03	45.08	
120	1.21	24.1	1.24	41.84	2.01	56.84	
240	1.45	28.9	1.22	49.36	1.97	67.82	
360	1.61	32.1	1.21	54.38	1.94	79.71	
600	1.80	35.9	1.2	60.31	1.90	87.18	
1440	2.24	44.8	1.18	74.01	1.81	95.49	
						113.52	

* including 40% for climate change

OUTFLOW

Soil infiltration rate, f = 3.23E-05 m/sec
 Factor of safety on infiltration rate FS = 3.00
 effective storage depth, a(50) = H x .5 = 0.75 m (ring)
 Outflow /sec = 3.142 x Dia x a(50) x (f/FS) = 6.33E-05 m3/sec (ring)
 effective storage depth, a(50) = H x .5 = 0.6 m (pit)
 Outflow /sec = 2(L + W) x a(50) x (f/FS) = 1.16E-04 m3/sec (pit)

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STORAGE CAPACITY

$$\text{Storage capacity, } S = \text{Inflow} - \text{Outflow}$$

$$= I - O = [A \times (M10-D)] - O$$

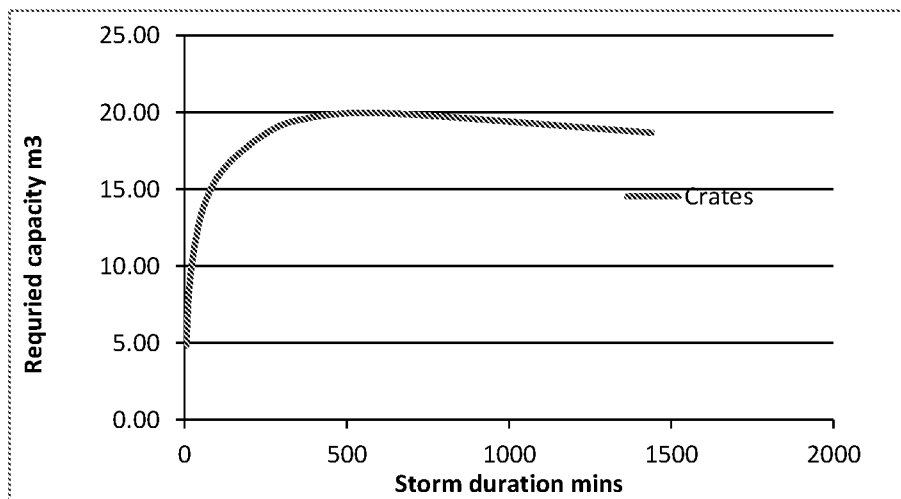
Ring soakaway				Pit/crates soakaway	
Storm duration (mins)	Inflow S(1) m ³	Outflow Max m ³	Required capacity m ³	Outflow Max m ³	Required capacity m ³
5	4.89	0.02	4.87	0.03	4.85
10	7.14	0.04	7.10	0.07	7.07
15	8.82	0.06	8.76	0.10	8.71
30	11.41	0.11	11.29	0.21	11.20
60	14.38	0.23	14.15	0.42	13.96
120	17.16	0.46	16.70	0.84	16.32
240	20.17	0.91	19.26	1.67	18.49
360	22.06	1.37	20.69	2.51	19.55
600	24.16	2.28	21.88	4.18	19.98
1440	28.72	5.47	23.25	10.03	18.69
Max required capacity =			23.25	= 19.98	
Max ring capacity =			7.36	Free volume =	24.30 OK
Rubble filled volume =			2.91	Rubble filled volume =	8.02 FAIL

Storage volume

Ring soakaway				Status
Diameter	2.50	m	Unfilled	FAIL
Depth below invert =	1.50	m	Filled	FAIL

Pit or trench

Length = 4.50 m
Width = 4.50 m
Depth below invert = 1.2 m



Select pit/crate soakaway Discharge time

Unfilled pit	
Required soakaway storage volume =	19.98
effective discharge area =	10.80 m ²
Infiltration rate (factored)=	1.08E-05
Time for emptying soakaway to 50% volume	8.60E+04 sec
	23 hrs
	54 mins

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Project: Little Glebe	Date: Mar 2019	Made by: KS	Sheet No. 4
CALCULATION SHEET	JobNo. 1904	Chkd: -	Rev. D

FRONT SOAKAWAY

SOAKAWAY DETAILS

Ring		Pit/crates	
Soakaway size, Ds =	2.50 m	Length =	4.5 m
Depth of below invert, Hs =	1.50 m	Width =	2 m
		Depth below invert =	1.2 m
Free volume, S =	7.36 m ³		= 16.20 m ³
Rubble filled volume, S' =	2.21 m ³		= 5.35 m ³

INITIAL SOAKAWAY SIZING

Drained area to soakaway = 206.00 m²
 Climate change allowance = 40 %

INFLOW

Inflow, I = (run off area) x (design rainfall)
 = A x (M10-D)

DESIGN RAINFALL

Return period = 100 yrs
 Ratio of 60 min to 2-Day rainfalls of 5 year return period, r = 0.35 BRE(1991) Fig 1.

M5 rainfalls are calculated from table 1 (BRE 365) using Z1 factor

Storm duration (mins)	Z1	M5-D (mm)	Z2 M10 (cor. Fac)	M10-D* rainfall	Z2 M100 Design	100 yr + 40%	
5	0.38	7.5	1.19	12.50	1.84	rainfall	
10	0.53	10.5	1.22	17.93	1.92	19.32	
15	0.64	12.7	1.23	21.87	1.96	28.22	
30	0.81	16.1	1.22	27.50	2.00	34.85	
60	1.00	20	1.24	34.72	2.03	45.08	
120	1.21	24.1	1.24	41.84	2.01	56.84	
240	1.45	28.9	1.22	49.36	1.97	67.82	
360	1.61	32.1	1.21	54.38	1.94	79.71	
600	1.80	35.9	1.2	60.31	1.90	87.18	
1440	2.24	44.8	1.18	74.01	1.81	95.49	
						113.52	

* including 40% for climate change

OUTFLOW

Soil infiltration rate, f = 3.23E-05 m/sec
 Factor of safety on infiltration rate FS = 3.00
 effective storage depth, a(50) = H x .5 = 0.75 m (ring)
 Outflow /sec = 3.142 x Dia x a(50) x (f/FS) = 6.33E-05 m³/sec (ring)
 effective storage depth, a(50) = H x .5 = 0.6 m (pit)
 Outflow /sec = 2(L + W) x a(50) x (f/FS) = 9.68E-05 m³/sec (pit)

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Project: Little Glebe	Date: Mar 2019	Made by: KS	Sheet No. 5
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STORAGE CAPACITY

$$\text{Storage capacity, } S = \text{Inflow} - \text{Outflow} \\ = I - O = [A \times (M10-D)] - O$$

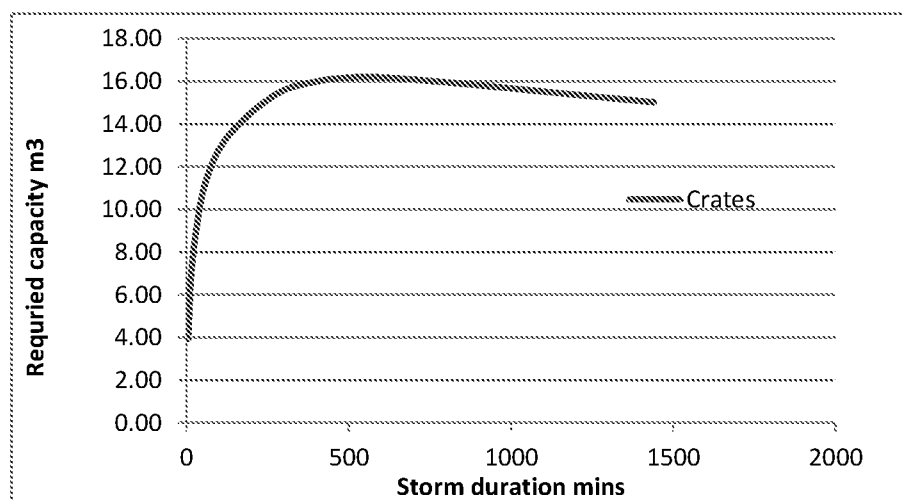
Ring soakaway				Pit/crates soakaway	
Storm duration (mins)	Inflow S(1) m ³	Outflow Max m ³	Required capacity m ³	Outflow Max m ³	Required capacity m ³
5	3.98	0.02	3.96	0.03	3.95
10	5.81	0.04	5.78	0.06	5.76
15	7.18	0.06	7.12	0.09	7.09
30	9.29	0.11	9.17	0.17	9.11
60	11.71	0.23	11.48	0.35	11.36
120	13.97	0.46	13.51	0.70	13.27
240	16.42	0.91	15.51	1.39	15.03
360	17.96	1.37	16.59	2.09	15.87
600	19.67	2.28	17.39	3.48	16.19
1440	23.39	5.47	17.91	8.36	15.02
Max required capacity =			17.91	= 16.19	
Max ring capacity =			7.36	Free volume =	16.20 OK
Rubble filled volume =			2.91	Rubble filled volume =	5.35 FAIL

Storage volume

Ring soakaway				Status
Diameter	2.50	m	Unfilled	FAIL
Depth below invert =	1.50	m	Filled	FAIL

Pit or trench

Length = 4.50 m
Width = 3.00 m
Depth below invert = 1.2 m



Select pit/crate soakaway Discharge time

Unfilled pit	
Required soakaway storage volume =	16.19
effective discharge area =	9.00 m ²
Infiltration rate (factored)=	1.08E-05
Time for emptying soakaway to 50% volume	8.36E+04 sec
	23 hrs
	14 mins

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Project: Little Glebe	Date: Mar 2019	Made by: KS	Sheet No. 6
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Estimation of infiltration rate

Site conditions : Permeable silty GRAVEL

Soakage test data

Test hole A

Depth of water at start of test = 0.5 m
Length of pit = 1.5 m
Width of pit = 0.4 m

Water level drop of 0.50 m in 100 mins

Total volume out = 0.3 m³

Mean area sides = 0.95 m² (50% of water depth)

Area base = 0.6 m²

Total outflow area = 1.55 m²

Infiltration rate = **3.23E-05** m/sec

Depth to water table

It should be noted that the water table was not encountered in a trial excavation to a depth of 2.5m.

SUMMARY:

Soakaway design is governed by discharge time using a factor of three on infiltration rate

FRONT soakaway of 4.5 x 3.0 x 1.2m deep

REAR soakaway of 4.5 x 4.5 x 1.2m deep

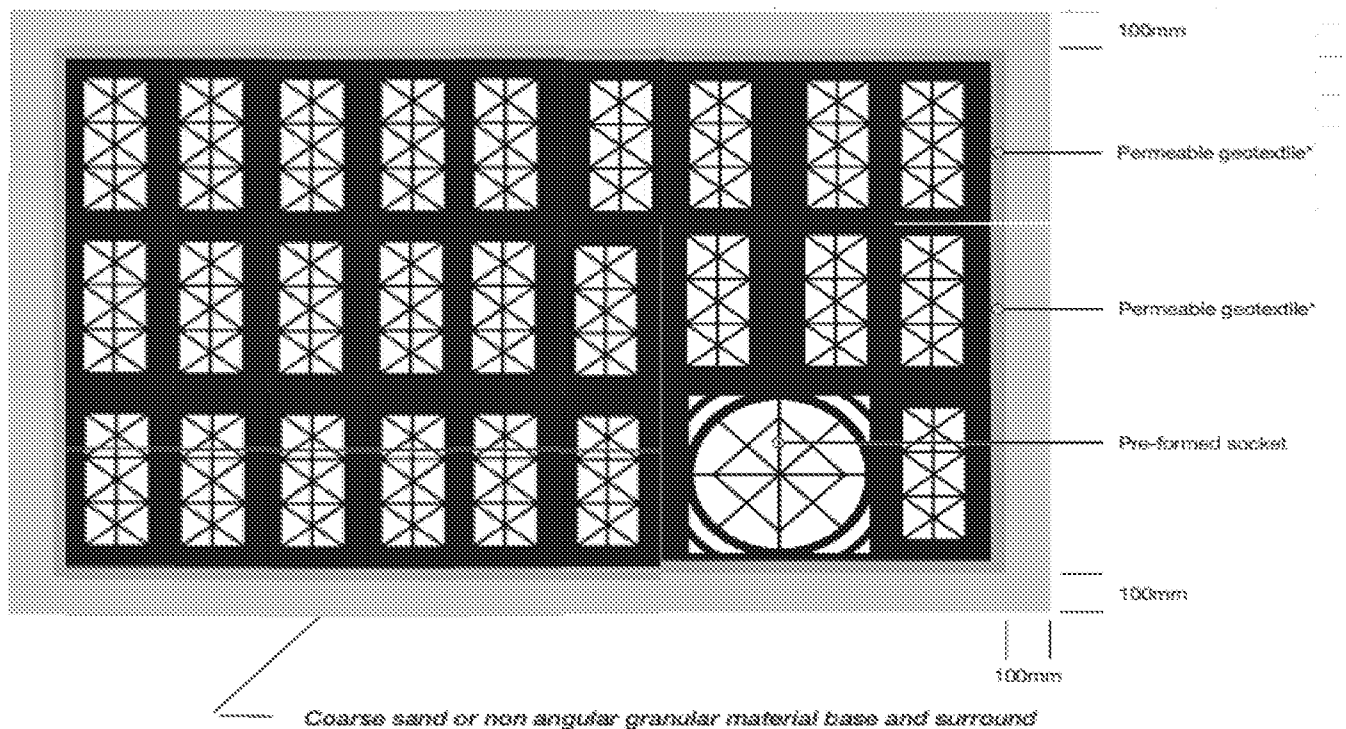
Soakaways would be formed using Wavin AquaCell or similar crates of 1 x 0.5 x 0.4(high) installed in accordance with manufacturers recommendations.

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Typical installation procedure for AquaCell Eco (or similar) crated

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). For single layer applications use the AquaCell Clips and for multi layers use the AquaCell Clips and 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 (SLB300) or the standard Silt Trap (SLB600) is installed prior to the inlet pipework.
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.



- Notes:**
1. Crates installed in 3 layers to give 1.2m depth below invert level
 2. Modular crate size 1m x 0.5 x 0.4m
 3. AquaCell Prime or silmiar product to be used in areas subject to traffic such as below driveways.
 4. Any arrangement to of single or multiple soakaways to provide similar storage volume is satisfactory