



RUSHBY|BREWSTER

CONSULTING CIVIL AND STRUCTURAL ENGINEERS

GREENOAKS, BARNHAM - SOUTHCOTT HOMES

Storm Drainage - Strategy & Design - Revised Scheme/May 2011

Technical

1. Attached revised drawing RBA 895-50/P6. This shows larger, shallower soakaways (as per the design sheet S/A-1 (20/01/11). The design for these has used the worst-case porosity figure of 5.9×10^{-8} throughout and is therefore 'safe' and gives a small margin of safety against the maximum water table level.
2. The roadway is, as before, porous paving throughout with an overflow for surge conditions, such as 1/100 year storm event. An extract from porous pavement design Manual is also attached to confirm suitability of the granular sump.
3. Also attached are the monitoring results from the groundwater regime. These indicate a general improvement once wetter periods have passed.
4. Storage figures for the 100 yr + 30% climate change are enclosed (RBA 895 S/A-2) and confirm that the soakaways provided are adequate to cover this extreme condition.

Supporting Comments

1. The land slope is such that no surface water from adjacent land is positively encouraged to increase the on-site rainfall and, further, the adjacent site will utilise the LPA approved system to mitigate any migration on to this site. As such, the site under consideration may be treated 'independently'.
2. To offer a long-stop to potential overflows, a french drain has been introduced at the low end of the site (see drawing RBA 895-50/P6). This will effectively remove potential overflow to neighbouring gardens.
3. Raising ground levels could be considered to improve the actual site drainage but it is considered imprudent to potentially increase flood risk to any adjoining land and property, and the current scheme retains existing ground levels.



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4. The soakaways are set to maximise the distance between their invert and the water table. In general circumstances this distance is in the order of a minimum of 600-800mm which does, under extreme conditions reduce to zero. The roadway itself is porous with its own inherent storage/dispersal system.
5. In order to reduce water inundation, rainwater harvesting could be employed but this will be subject to acceptance of usage as, often, such systems can involve maintenance issues, and affect flushing systems within drainage apparatus.

Enclosures

Drawings: RBA 895 – 50 P6

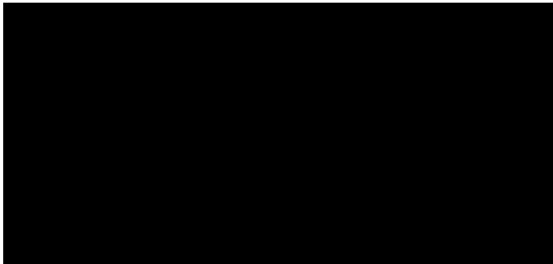
Calculations: RBA 895 – S/A 1 (1/10yr soakaway)

- S/A 2 (1/100yr soakaway, + 30% climate change)

Porosity Values: GESL letter 18.11.2009

Water Monitoring: GESL Layout and summary sheet

Porous Paving: Extracts from paving Manual (UK map & Table 5)

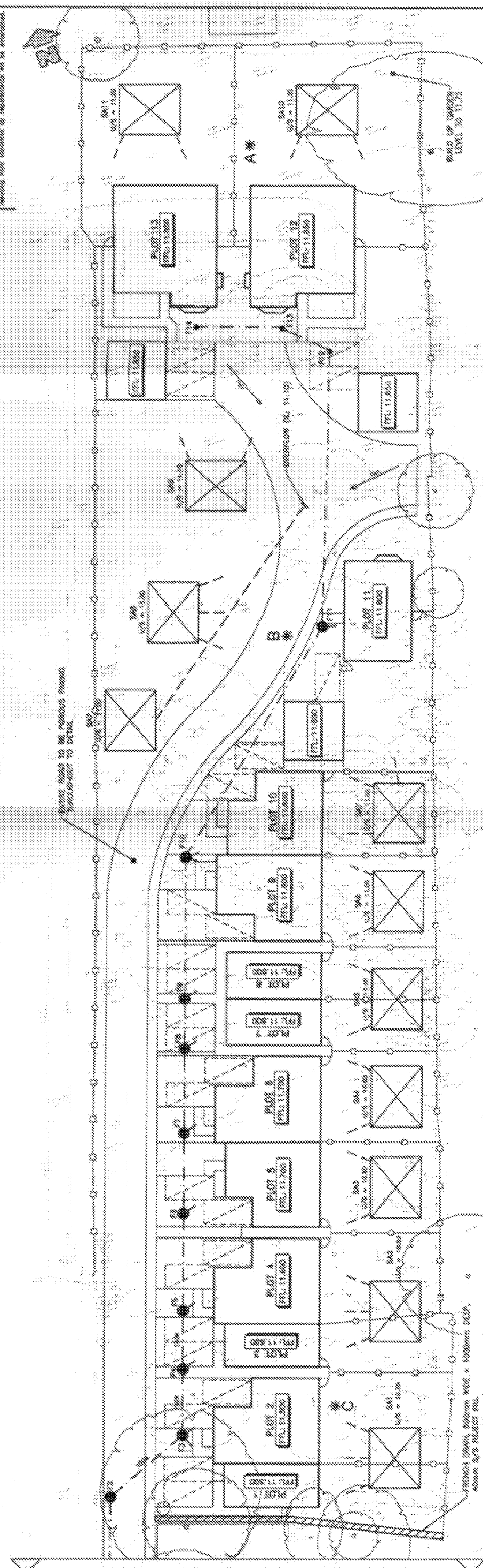


RBA 895/17.05.11

DRAWINGS

RBA 895 - 50 P8

RBA 895/17.05.11

[illegible][illegible][illegible]

SCHEMATIC FOUL AND STORM WATER		DATE	5.8
SIZE 1-200	SHEET NO. 50	SCALE 1/4" = 1'-0"	NO. 1000000

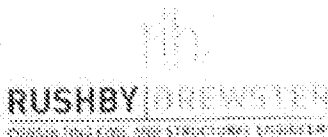
CALCULATIONS

RBA 895 – S/A 1 (1/10 yr soakaway)

&

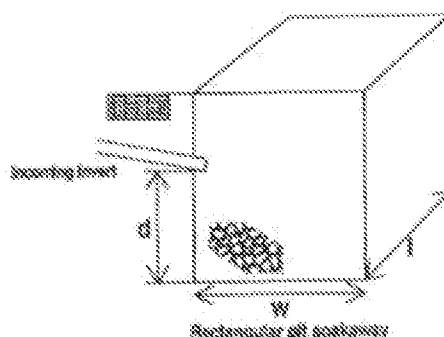
RBA 895 – S/A2 (1/100 yr soakaway + 30% climate change)

RBA 895/21.01.11

 RUSHBY DREWSTER CONSULTING ENGINEERS AND STRUCTURAL ENGINEERS	Project			Job Ref.	
	Greenocks Barnham			RBA895	
	Decision			Sheet no./rev.	
	Soakaways 1/10 year			S/A - 1	
Calc. by	Date	Chk'd by	Date	App'd by	Date
SB	20/01/2011				

SOAKAWAY DESIGN - BRE DIGEST 365

TEDOS calculation version 1.0.01



Rectangular Pit Design

Pit length	$l = 6000 \text{ mm}$	Pit width	$w = 5000 \text{ mm}$
Pit depth below invert	$d = 400 \text{ mm}$	Free volume	$V_{\text{free}} = 100.0 \%$
Location of soakaway	England and Wales	Return period	10 years
Ratio of 60 minute to 2 day rainfalls of 5 year return period (BRE digest 365 - fig 1)		$r = 0.35$	
Impermeable area	$A = 75.0 \text{ m}^2$	Soil infiltration rate	$f = 0.0000055 \text{ m/s}$
Surface area of soakaway to 50% storage depth			

$$A_{\text{tot}} = 2 \times (l + w) \times d / 2 = 4.400 \text{ m}^2$$

Outflow factor $AF = A_{\text{tot}} \times f = 26.0 \times 10^{-4} \text{ m}^3/\text{s}$

M5 rainfalls are calculated from table 1 BRE digest 365 using Factor Z1

Duration	M5 rainfalls	Growth factor Z2	10 year rainfall	Inflow	Outflow	Storage required
5 mins	7.1 mm	1.20	8.8 mm	0.6 m ³	0.0 m ³	0.6 m ³
10 mins	10.1 mm	1.22	12.4 mm	0.9 m ³	0.0 m ³	0.9 m ³
15 mins	12.3 mm	1.23	15.2 mm	1.1 m ³	0.0 m ³	1.1 m ³
30 mins	16.7 mm	1.24	19.5 mm	1.5 m ³	0.0 m ³	1.4 m ³
1 hour	20.0 mm	1.24	24.8 mm	1.9 m ³	0.1 m ³	1.8 m ³
2 hours	24.5 mm	1.24	30.3 mm	2.3 m ³	0.2 m ³	2.1 m ³
4 hours	29.9 mm	1.22	36.5 mm	2.7 m ³	0.4 m ³	2.4 m ³
6 hours	33.8 mm	1.21	40.9 mm	3.1 m ³	0.6 m ³	2.5 m ³
10 hours	38.9 mm	1.19	46.5 mm	3.5 m ³	0.9 m ³	2.6 m ³
24 hours	49.6 mm	1.17	58.1 mm	4.4 m ³	2.2 m ³	2.1 m ³

Required storage volume $S_{\text{reqd}} = 2.6 \text{ m}^3$

Soakaway storage volume $S_{\text{tot}} = l \times d \times w \times V_{\text{free}} = 12.0 \text{ m}^3$

Soakaway storage volume - OK

Time for emptying soakaway to half volume

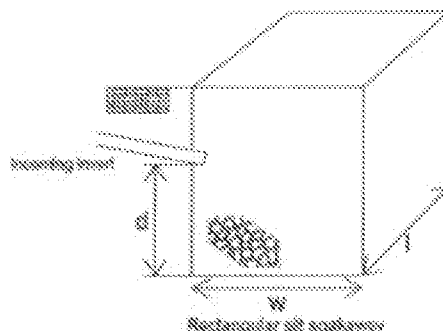
$$T_{\text{tot}} = S_{\text{reqd}} \times 0.5 / (AF) = 13 \text{ hr } 38 \text{ min } 26 \text{ s}$$

Soakaway discharge time - OK

RUSHBY Rural Drainage Design Software	Project Greenoaks Barnham		Site Ref RBA805	
	Section Soakaways 1/100 year		Sheet no./rev. S/A - 2	
	Calc. by SB	Date 20/01/2011	Chkd by	Date
		Appl'd by	Date	

SOAKAWAY DESIGN -- BRE DIGEST 365

TEC005 calculation version 1.0.01



Rectangular Pit Design

Pit length	$l = 6000 \text{ mm}$	Pit width	$w = 5000 \text{ mm}$
Pit depth below invert	$d = 400 \text{ mm}$	Free volume	$V_{\text{free}} = 100.0 \%$
Location of soakaway	England and Wales	Return period	100 years
Ratio of 60 minute to 2 day rainfalls of 5 year return period (BRE digest 365 - fig 1)		$r = 0.35$	
Impermeable area	$A = 75.0 \text{ m}^2$	Soil infiltration rate	$f = 0.0000088 \text{ m/s}$
Surface area of soakaway to 50% storage depth			

$$A_{50} = 2 \times (l + w) \times d / 2 = 4.400 \text{ m}^2$$

Outflow factor $AF = A_{50} \times f = 26.0 \times 10^{-6} \text{ m}^3/\text{s}$

MS rainfalls are calculated from table 1 BRE digest 365 using Factor Z1

Duration	MS rainfalls	Growth factor Z2	100 year rainfall	Inflow	Outflow	Storage required
5 mins	7.1 mm	1.84	13.1 mm	1.0 m ³	0.0 m ³	1.0 m ³
10 mins	10.1 mm	1.91	19.4 mm	1.5 m ³	0.0 m ³	1.4 m ³
15 mins	12.3 mm	1.95	24.0 mm	1.8 m ³	0.0 m ³	1.8 m ³
30 mins	15.7 mm	2.00	31.4 mm	2.4 m ³	0.0 m ³	2.3 m ³
1 hour	20.0 mm	2.03	40.6 mm	3.0 m ³	0.1 m ³	3.0 m ³
2 hours	24.5 mm	2.01	49.2 mm	3.7 m ³	0.2 m ³	3.5 m ³
4 hours	29.9 mm	1.97	59.0 mm	4.4 m ³	0.4 m ³	4.1 m ³
6 hours	33.8 mm	1.94	65.5 mm	4.9 m ³	0.5 m ³	4.4 m ³
10 hours	38.9 mm	1.90	73.9 mm	5.5 m ³	0.8 m ³	4.8 m ³
24 hours	49.6 mm	1.81	89.9 mm	6.7 m ³	2.2 m ³	4.5 m ³

Required storage volume $S_{\text{req}} = 4.8 \text{ m}^3$

Soakaway storage volume $S_{\text{sw}} = l \times d \times w \times V_{\text{free}} = 12.0 \text{ m}^3$

Now 30% CLIMATE CHANGE

$$Vol = 4.6 \times 1.3 = 6.0 < 12.0$$

Soakaway storage volume- OK

Time for emptying soakaway to half volume

$$T_{50} = S_{\text{req}} \times 0.5 / (A_{50} \times f) = 24 \text{ hr } 39 \text{ min } 34 \text{ s}$$

Soakaway discharge time inadequate

POROSITY VALUES

GESL Letter 18.11.2009

RBA 895/21.01.11

18 November 2009

Our ref: GE7217

Southcott Homes
Bramble House
Furzehall Farm
112 Wickham Road
Fareham
PO16 7JH



For the Attention of: Mr. Darren Harman

Dear Sirs,

RE: 'GREENOAKS' BARNHAM ROAD, BARNHAM – SOAKAGE TESTS

Further to our investigative works at the above site, please find enclosed the results of the soakage tests, together with a test location plan and trial pit logs.

The trial pits were prematurely terminated in the range of 1.60m – 1.90m bgl as groundwater was encountered at these depths.

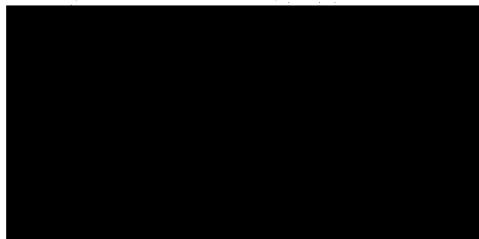
The result of the soakage tests are presented as BRE365 printouts for a wetted area of 200m². The infiltration rates were moderate but the results for each of the trial pits required extrapolation to calculate the soakage rate. Designs are given for trench and ring soakaways for SA1 (5.9×10^{-6} m/s), SA2 (6.3×10^{-6} m/s) and TP3 (3.5×10^{-6} m/s).

Please note these are preliminary designs for guidance only and final designs should be made by your drainage Engineers.

We trust that we have interpreted your instructions correctly, and please do not hesitate to contact us should you have any queries.

May we take this opportunity to thank you for your instruction, and we look forward to working with you again on further projects.

Yours sincerely
For and on Behalf of GESL



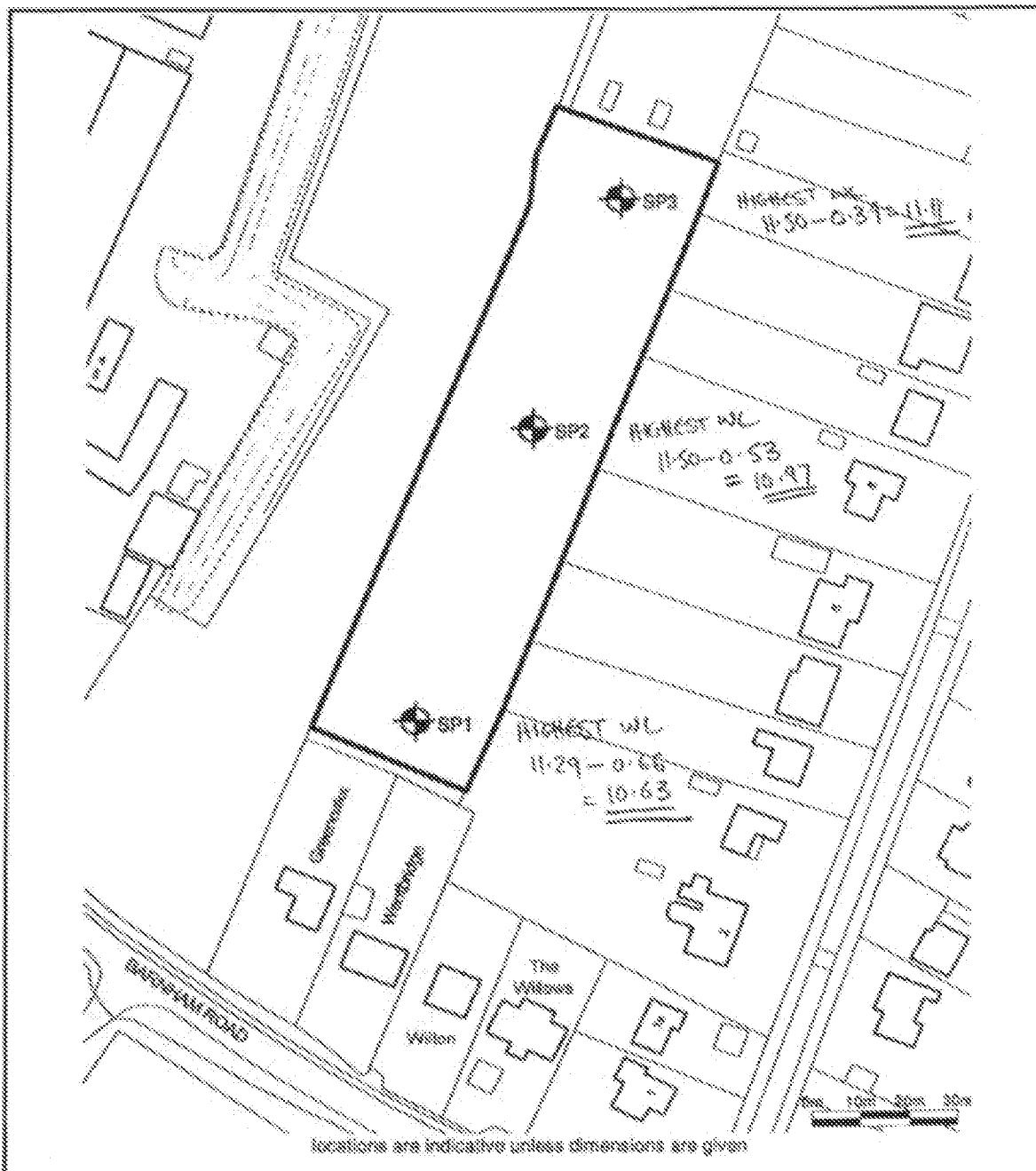
WATER MONITORING

GESL Layout & Summary sheet

RBA 895/21.01.11



Geo-Environmental



Project:	Greenoaks Barnham Road, Barnham, West Sussex			Title	Standpipe Location Plan
Client:	Southcott Homes			Geo-Environmental Services Ltd	
Ref No:	GE7236	Revision:	0	28 Crescent Road, Brighton, BN2 3RP	
Drawn:	EGMN	Date:	March 2010	T: 01273 699 399 F: 01273 699 388	
Figures:	1	Scale:	Not To Scale	E: mail@gesl.net W: www.gesl.net	

Steve BrewsterRU-895

From: ed [ed@geel.net]

Sent: 10 March 2010 16:28

To: darren harman; steve.b@rushbybrewster.co.uk

Subject: RE: Greenpaks Barnham Your ref - GE7217

Darren

Further to our telephone conversation this afternoon, please find tabulated below the groundwater monitoring results for the above site.

	SP1m bgl	SP2m bgl	SP3m bgl
19/1/2010	0.702	0.581	0.453
3/2/2010	0.948	0.945	0.973
17/2/2010	1.105	0.990	0.844
3/3/2010	0.660	0.530	0.390
14/3/2010	1.16	1.33	1.42
24/3/2010	1.03	1.21	1.36

POROUS PAVING

Extracts from paving Manual (UK map & Tables

RBA 895/21.01.11

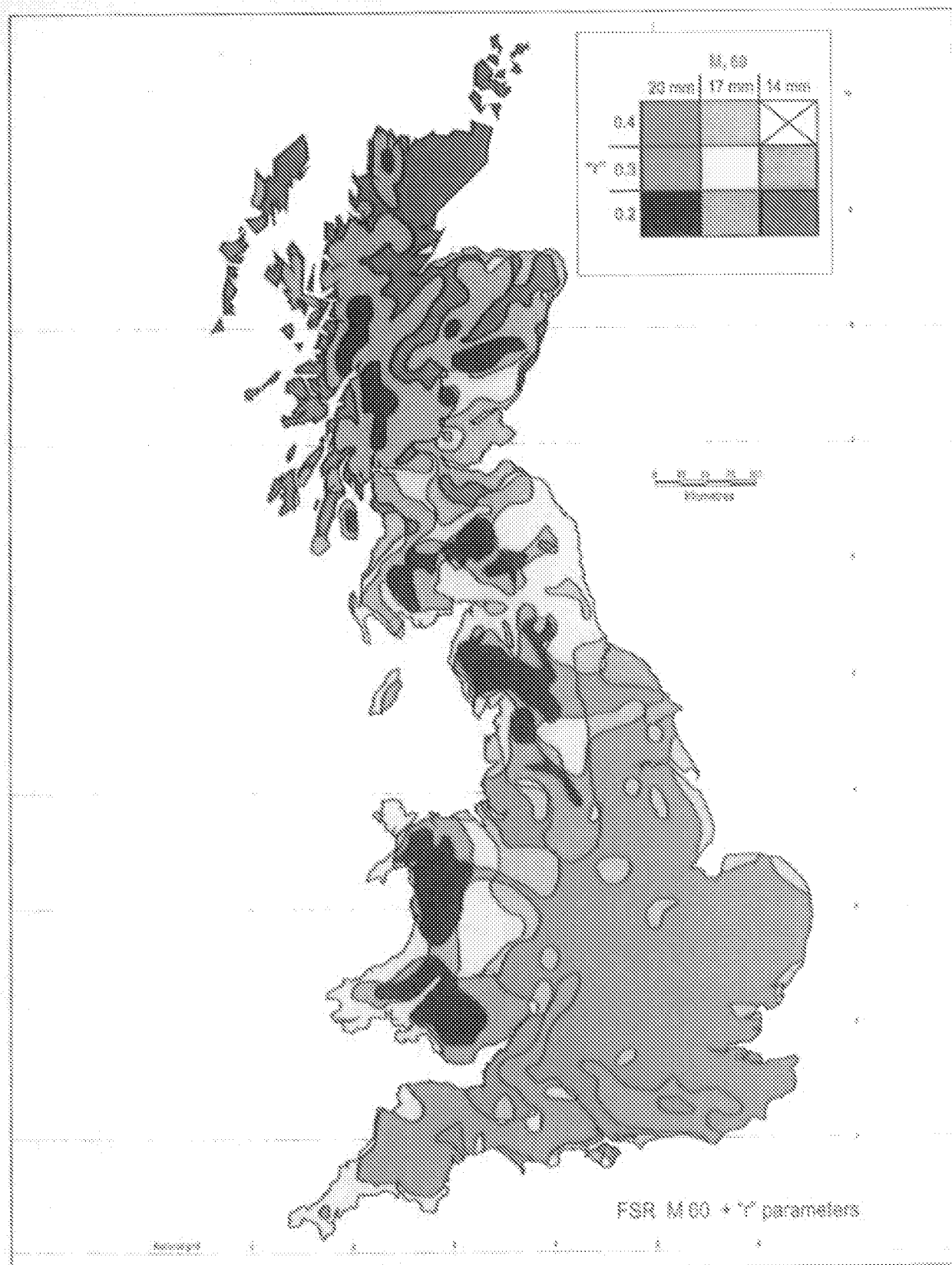


Figure 20:

- $M_60 - 60$ is the 1 in 5 year, 60 minute duration rainfall
- Y is the rainfall ratio (Ratio of 60 minute to 2 day rainfall for a 5 year return period)

Reproduced with permission from H.B. Wallingford.

Required = 350 mm

> 210

180

OK!

Table 5: Permeable sub-base thickness for attenuation storage (Systems A and C)

Rainfall data	r	Required permeable sub-base thickness (mm)		
		1 in 30 year design event	1 in 100 year event	1 in 100 year event plus 20% climate change
$M_{x-60} = 20\text{mm}$	0.4	120	160	210
	0.3	140	190	240
	0.2	180	250	310
$M_{x-60} = 17\text{mm}$	0.4	100	140	180
	0.3	110	160	210
	0.2	150	210	270
$M_{x-60} = 14\text{mm}$	0.4			
	0.3	90	130	170
	0.2	110	160	220

Note: Thickness assumes permeable sub-base has a voids ratio of 30%.
 Limited discharge rate 7 l/s/ha. For System A infiltration rate greater than 1×10^{-4} m/s.
 Factor of safety on infiltration rate for System A = 1.5 (based on CIREA Report 156).
 Assumes level site. Factor of safety on outflow for System C = 1. Assumes level site.

Table 5 is based on the following generally conservative assumptions:

- Storage is provided for development design rainfall events of 1 in 30 yr, 1 in 100 yr and 1 in 100 yr plus 20% increase for climate change but the greenfield runoff rate is always considered to be 7 l/s/ha.
- 100% runoff from the permeable pavement is assumed.

The calculations have been carried out for a range of rainfall durations up to 24 hours and the maximum depth is provided in the tables (ie the depth at the critical duration). The tables also assume that there is no impermeable area draining onto or into the permeable pavement. It is also important that permeable pavements empty relatively quickly (subject to requirements for long term storage) and the main attenuation storage volume should half empty within 24 hours after the rainfall event. This requirement was originally intended for systems designed up to a return period of 1 in 10 years and is quite onerous when applied to systems that are designed to a 1 in 100 year return period.