

EG Fontwell - SW Drainage Infiltration Drainage System July 2018



Quality Management

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Location	Fontwell		
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Prepared by 1	J M White	Signature (for file)	
Checked by	Paul Pennington	Signature (for file)	
Authorised by	J M White	Signature (for file)	

Revision Status / History

Rev	Date	Issue / Purpose/ Comment	Prepared	Checked	Authorised
P01	23.07.18	Issued for Approval	JMW	PP	JMW
P02	03.08.18	Issued for Approval Additional details added	JMW	PP	JMW

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1. Background

1.1 Site

The site is the former Little Chef Restaurant Arundel Road BN18 0SB.

The Grid Ref. for the site is 495128E, 107121N, (SU9512807121)

1.2 Proposals

The proposals were submitted to Arun District Council Planning Department under Planning Application reference WA/88/17/PL.

The work consists primarily of refitting the existing building but there are also external works to be undertaken.

These works consist of additional hard paving for car parking spaces and the provision of a drive-thru lane to the site.

These external works increase the extent of hardstanding at the site and were the subject of a planning condition.

The decision note was issued on 10th May 2018 granting permission subject to conditions.

1.3 Appointment

Capita Real Estate & Infrastructure were appointed by Euro Garages to review the requirements of the decision notice specifically regarding Condition 6 which states:

Development shall not commence until full details of the proposed surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority.

The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SUDS Manual produced by CIRIA.

Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage.

No building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.

2. Work Scope

2.1 Site Visit

As the condition required winter monitoring it was determined that the first course of action would be to undertake summer testing.

This was to determine whether infiltration was a feasible option for the site, the intent either to discount the possibility and liaise with Arun DC on alternative course of action. Or, if feasible to determine a strategy to monitor / test going forward.

To this end a soakaway test was organised on for the 27th June 2018. The methodology for the test can be found in Appendix A.

During the test it became apparent that infiltration was not going to be an issue. A bullet point of the testing is as follows:

- Hole was excavated to the dimensions in Appendix A;
- A dip pipe and stone were added to the hole;
- A water tanker with 500 gallons of water, approximately 2200litres, began to fill the hole;
- After approximately 10 minutes the full 500 gallons had been emptied into the hole and the water had not reached to the top of the stone;
- Timings were taken, see Appendix A, and the hole was dry again within 30minutes;
- It was also noted that there is a bottom of embankment at the site boundary which is 2m below the ground level where the soakaway is situated;
- This bottom of embankment is part of the Highways England A27 and contains a land drain;

2.2 Post Site Visit

Capita reviewed the BGS website for information relating to boreholes in the location and spoke with Arundel DC Drainage team.

The drainage team provided planning reference numbers relating to other sites in the area that had also undertaken investigation works and monitoring.

It was agreed that monitoring would not be required as the groundwater will not reach a level affecting the proposals.

Refer to Appendix B for correspondence.

2.3 Design

Capita undertook the design using the following criteria:

- BRE 365 infiltration design, due to the nature of the site 4 separate infiltration trenches for four areas were selected – Note in line with standard practise for this design method no factor of safety is applied, inherent factors are deemed applicable;
- Capita used Tekla TEDDS to undertake the designs;
- The design criterion is as follows:

- 10year design plus 40% climate change to meet BRE365 requirements of half drainage time within 24 hours and adequate storage volume below the inlet pipe, at 400mm above pit base;
 - 100year design plus 40% climate change to be retained below ground. The depth of the pit is increased to 550mm in the calculations to allow full use of the geocellular units storage volume.
- A check of Area A using MicroDrainage and the Ciria method is included in Appendix C. This design included a FoS of 3; the 100yr +40% design criteria; full use of the geocell storage facility (0.55m deep) for below ground storage; 0.4m infiltration depth to allow for the pipe connection. This confirms that Area A meets the Ciria method.
- Note that Area D has been given a 50% increase in area in the calculations to allow for overflow from the existing areas.
- The infiltration rate for the site was calculated, see Appendix C, and determined to be 77×10^{-6} m/s during the summer investigation. However, it was agreed with the local authority that a 40×10^{-6} m/s should be used within the designs to allow for the winter scenario;
- The design for a 10year with 40% climate change was the first undertaken, but due to the ground infiltration rate the below ground storage requirements for larger storms is the determining factor. These calculations are within Appendix C;
- The 100year with 40% climate change was used as the below ground storage criteria. This volume utilized the area above the inlet pipes within the cellular tanks to retain the water underground;
- It was determined during the initial design process that the use of a stone filled system, with a 30% void ratio, was not a suitable solution due to the amount of volume required for the storage. A larger void ratio was necessary, and the use of a geo-cellular option was selected to provide the storage required below ground. The designs were re-run using a 90% void ratio for the Geocellular units;
- The use of heavy duty Geocell units helps the depth of the infiltration systems to be as shallow as possible.
- Geo-cellular units generally have a greater than 90% void ratio so there is some spare capacity with the tanks;
- Linear drainage channels have been used in the design due to the nature of the site and the need to keep the drainage as high as possible.
- All calculations are within Appendix C.
- Drawings showing the proposals are within Appendix D. These consist of:
 - Layout showing the areas and location of the tanks and channels;
 - The layout includes levels based on topographical survey information supplied by others;
 - General details of the Geocellular tank; and
 - Typical construction details of the linear drainage channel and pipes.

Appendix A - Testing Method

Testing Method

Job Title:



Job No:

Date:

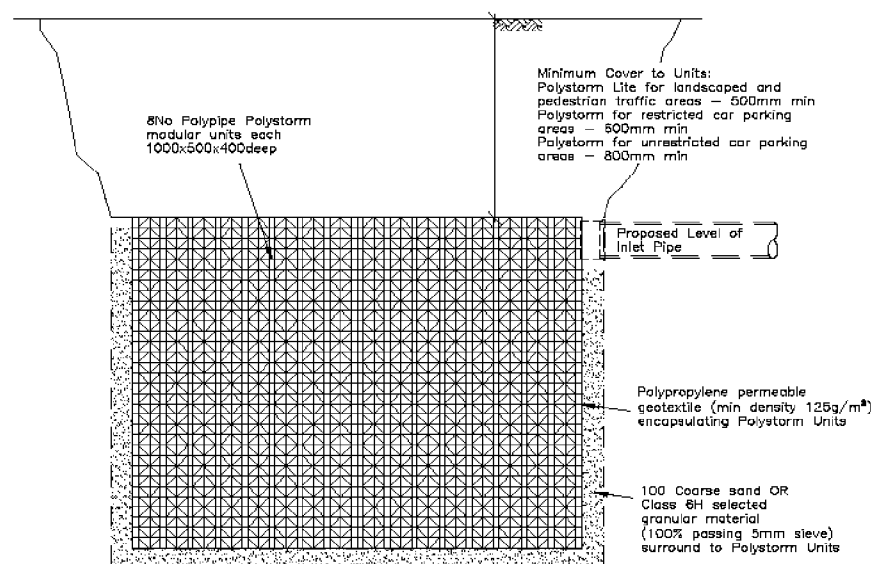
Made By: JAS

Checked By:

PERCOLATION TEST METHOD - BRE Digest 365

Applicable to soakaways draining greater than 25m²

1. Excavate test pit at proposed discharge point to each soakaway trench. Trial pit to be approximately 2m long by 0.6m wide.
2. Depth of pit to be 1.5m below proposed invert level of drain discharging to soakaway.
- 3a. Neatly trim sides, square and vertical, measure and record finished pit dimensions. Fill pit with 1.5m deep, clean un-compacted 75mm single-sized granular material with a void ratio of 30% leaving a full height, vertical 150mm diameter perforated observation pipe, positioned centrally within the pit, neatly trimmed above the granular material.
- 3b. Alternatively, infill using 8No Polypipe Polystorm modular units with (each 1m by 0.5m by 0.4m deep) as per sketch below.
4. Rapidly fill each pit to top of infill and record time.
5. NOTE – each filling will take at least 120 gallons per pit based on suggested dimensions if using stone infill and 350 gallons if using Polystorm units, therefore a water tanker vehicle is suggested!
6. Complete accompanying booking sheet recording depth of water remaining in pit at time intervals noted until pit is empty.
7. The test must be repeated twice more per pit
8. **The three tests are to be on the same or consecutive days**



Percolation Test Pit

Job Title:



Job No:

Date:

Made By: JAS

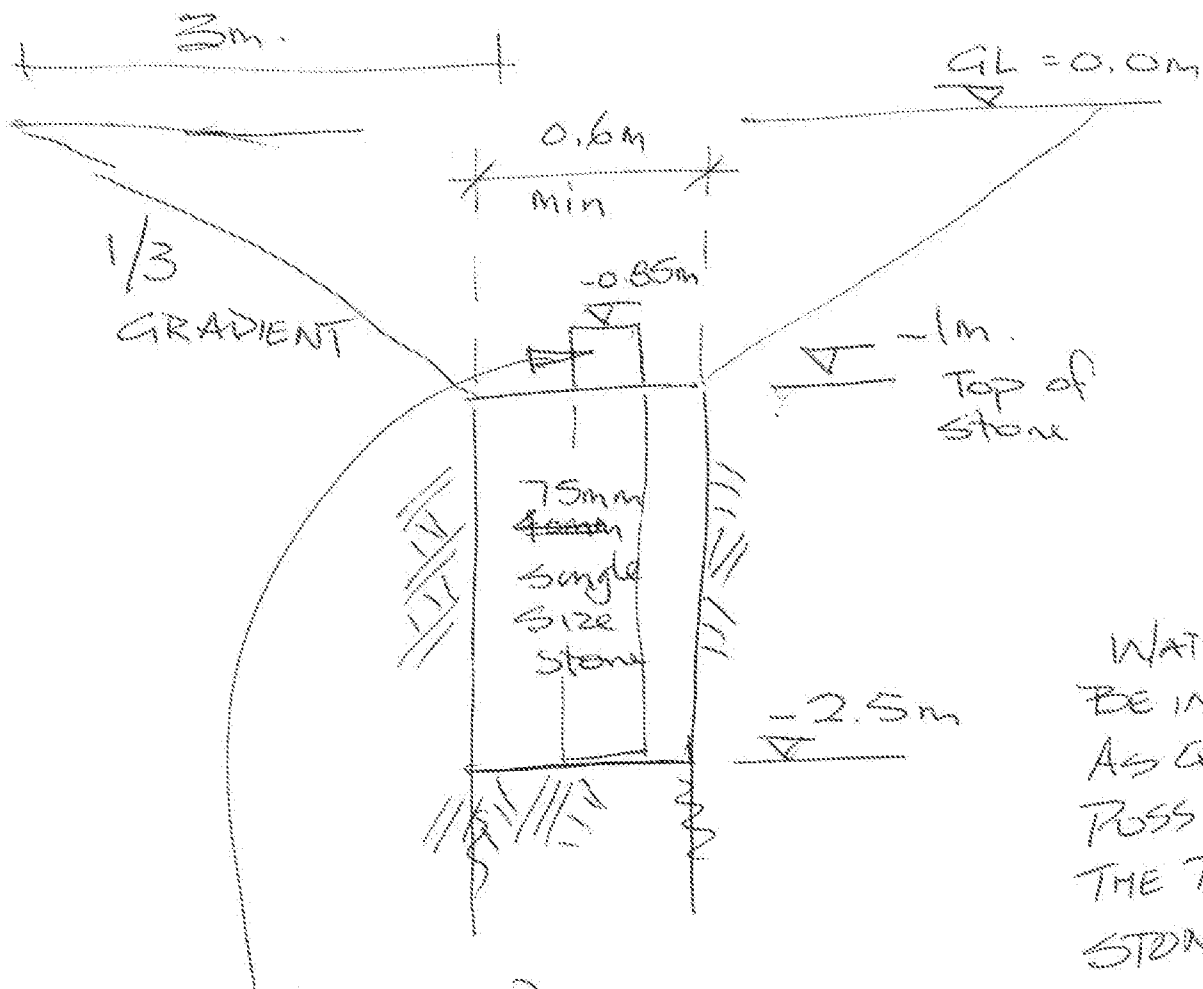
Checked By:

PERCOLATION TEST - BRE Digest 365

pit no =
pit length = m
pit width = m
pit depth = m
effective depth = m (depth of stone/water fill)
Void ratio of stone infill = %

Insitu test results:

Date:			
Start Time:			
Time lapsed (mins)	Test 1	Test 2	Test 3
	Depth of Water Remaining		
0			
15			
30			
45			
60 (1hr)			
75			
90			
105			
120 (2hr)			
135			
150			
165			
180 (3hr)			
210			
240 (4hr)			
270			
300 (5hr)			
330			
360 (6hr)			
390			
420 (7hr)			
450			
480 (8hr)			
510			
540 (9hr)			
570			
600 (10hr)			



CENTRALLY POSITIONED
225mm ϕ PERFORATED
PIPE FROM BASE
OF TEST PIT TO
150mm ABOVE STONE

WATER IS TO
BE INFILLED
AS QUICKLY AS
POSSIBLE TO
THE TOP OF THE
STONE

USE OF ~~B~~
BOWSER WITH
LARGE HOSE OR
GULLY SUCKER
TO DISCHARGE
CLEAN WATER

ARUN DISTRICT COUNCIL WA/85/18/DOC

TRAVELODGE

LANDSCAPE

PAVEMENT

EXISTING
BURGER
'KING'

EXISTING LITTLE
CHEF

PAVEMENT

EXISTING RAMP FROM TRAVELODGE

2m x 0.6m
scavengery
pit (min)
2 1/2 m deep

51 EXISTING
PARKING SLOTS



LANDSCAPE

Appendix B - Post-site correspondence

Post-site Correspondence

White, John (Capita)

From: White, John (Capita)
Sent: 24 July 2018 16:25
To: 'Laura Gibbons'
Cc: Natalie Ternent; Anita Gardner
Subject: RE: EG Fontwell - Little Chef Fontwell

Laura,

See comments below.

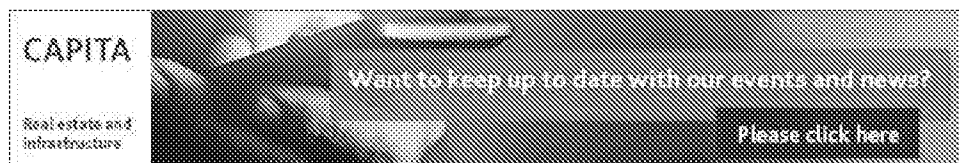
I'll ask some questions of the client with regard some of the comments

Please note that when we re-evaluate the designs as neither SUDS or BRE 365 require the 100yr plus cc to be below the level of the inlet pipe(s) we will revise the calcs for the 100yr designs so that the full 0.55m depth of the tanks is used for storage for the 100ye designs, the water will be kept below ground but the inlets are surcharge, which is permitted under all design codes. The 10yr+40%cc will have the depth set at 0.4m as the inlet is required to be free flowing. You will notice this difference between the revised calculation sheets when resubmitted.

Regards

John M White GMICE
Associate - Infrastructure Projects
Real Estate & Infrastructure

Capita 5th Floor Churchgate House Oxford Street Manchester M1 6EU
capitaproperty.co.uk



Advance notice of leave: 28th – 31st July 2018

From: Laura Gibbons [REDACTED]
Sent: 24 July 2018 15:14
To: White, John (Capita) [REDACTED]
Cc: Natalie Ternent [REDACTED] Anita Gardner [REDACTED]
Subject: RE: EG Fontwell - Little Chef Fontwell

Hi John,

I have reviewed the information you have sent over. I have the following comments:

- The proposal increase roof area. Where is this roof water going? It is not shown on your plans, nor does it seem to have been taken account of in calculations. [JMW] I will check but I was under the impression that the building, including the roof, is remaining untouched. The work was a fit-out and externals as shown.
- Please provide a drainage layout plan showing all levels and dimensions. I.e. cover levels and invert levels of the infiltration trenches. Pipe diameters and levels. [JMW] We will need to check with the client whether the levels have been designed as it was not part of our remit, hence not able provide at present
- We will require the linear drainage channel details prior to DOC being discharged. [JMW] Understood
- Please provide construction details of silt traps and gullies. [JMW] Understood
- There is no evidence in your calculations that a factor of safety of 3 has been applied as requested. Outflow volumes and your calculations are based on a factor of safety of 1. I have completed calculations myself to check yours, and if a factor of safety of 3 is applied there is currently insufficient storage volume provided.

Please re-evaluate design. *[JMW]* We have used BRE 365 which has in built FOS. A FOS is only applicable when doing a Ciria design. Table 25.2 of C753 does state that FOS not relevant to BRE method. The BRE assumes that the base is impermeable due to silting, Ciria don't which is one reason they include a FOS

- * The infiltration rates you found are better than on neighbouring sites, likely a result of your tests being completed in summer. As stated previously please apply infiltration rates from neighbouring developments to your design. I.e. use 4×10^{-5} which is in line with the ground investigation immediately south of your site that was conducted in the winter. *[JMW]* We will change the calculations to use a 4×10^{-5}

I will complete a further review when the design is revised and further information provided.

Thanks,

Laura Gibbons, MEng, GMICE
Engineer (Drainage & Coastal)

Laura Gibbons | Engineer (Drainage & Coastal), Engineering Services, Arun District Council | Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: [REDACTED] | External: [REDACTED] | Fax: [REDACTED] | E-mail: [REDACTED]
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From: White, John (Capita) [REDACTED]
Sent: 24 July 2018 10:58 [REDACTED]
To: Laura Gibbons
Cc: Natalie Ternent; Anita Gardner
Subject: EG Fontwell - Little Chef Fontwell

Laura,

Please find attached the report in connection with the SW drainage for the proposals to the Fontwell site under Planning Application WA/88/17/PL

As previously discussed we had agreed there is no need for monitoring during winter due to the depth anticipated to the groundwater and the Highways England bottom of embankment drainage dewatering around the site.

Instead we have done the following in the attached:

- Separated proposals into 4 areas with their own infiltration trenches;
- BRE 365 Design
- 100year +40% cc contained below the level of the inlet
- Volume is taken 0.15m below the top of the geocell tank so there is an additional 0.15m capacity for water storage, if we have a surcharged inlet;
- Underside of tanks to in the region of 1.1m – 1.2m below ground level
- Infiltration rate calculated at 77×10^{-6} for the calculations we have used 70×10^{-6} ;
- Multiple inlets from drainage system to disperse the water within the trench;
- Due to volume requirements a Geo-Cell system has been selected. We have specified 90% void ratio in calculations. This provides for alternate products to the Pluvial Cube suggested (98%) with a lower void ratio.

I believe our client will ask their planning consultant to undertake a formal request for discharge of the condition based on this report. Hopefully you're happy with the measures we have used and would appreciate your feedback in the meantime.

Any queries etc please feel free to ask

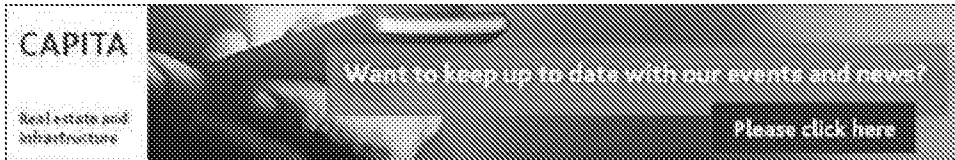
John

Regards

John M White GMICE

Associate - Infrastructure Projects
Real Estate & Infrastructure

Capita 5th Floor Churchgate House Oxford Street Manchester M1 6EU
capitaproperty.co.uk



Advance notice of leave: 28th – 31st July 2018

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White, John (Capita)

From: Laura Gibbons [REDACTED]
Sent: 05 July 2018 16:03
To: White, John (Capita)
Cc: Anita Gardner
Subject: Little Chef fontwell
Attachments: groundwater monitoring from FRA.PDF; Soakaway Results from FRA.PDF

Hi John,

Thank you for the phone call earlier. As discussed I think it is sensible in this instance to use infiltration rates and groundwater monitoring results from nearby developments to inform your design, I would recommend you look at the following applications: WA/22/15/OUT (see attachments), WA/37/18/DOC, and possibly others.

To ensure that we apply a belt and braces approach in lieu of any winter testing at your site, I would ideally like to see the base of your infiltrations structures kept not much lower (preferably above) 1-1.5m below ground level. And a factor of safety of 3 applied to design.

If you have any queries regarding this please get in contact.

Kind Regards,

Laura Gibbons, MEng, GMICE
Engineer (Drainage & Coastal)



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Appendix C - Calculations

Calculations

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
 Impermeable area drained to the system $A = 230.0 \text{ m}^2$
 Return period Period = 10 yr
 Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
 5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
 Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 400 \text{ mm}$
 Width of pit $w = 1000 \text{ mm}$
 Length of pit $l = 24000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 90 \%$
 Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 10000000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M10 \times A$
 Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
 Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.22;	12.2;	2.80;	0.12;	2.68
10	0.51;	14.2;	1.24;	17.5;	4.04;	0.24;	3.80
15	0.62;	17.3;	1.24;	21.4;	4.92;	0.36;	4.56
30	0.79;	22.0;	1.24;	27.3;	6.28;	0.72;	5.56
60	1.00;	28.0;	1.23;	34.4;	7.91;	1.44;	6.47
120	1.22;	34.3;	1.21;	41.4;	9.51;	2.88;	6.63
240	1.50;	41.9;	1.19;	49.7;	11.43;	5.76;	5.67
360	1.69;	47.3;	1.18;	55.6;	12.79;	8.64;	4.15
600	1.95;	54.5;	1.16;	63.5;	14.60;	14.40;	0.20
1440	2.48;	69.4;	1.15;	79.6;	18.31;	34.56;	0.00

Required storage volume $S_{\text{req}} = 6.63 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 8.64 \text{ m}^3$ **PASS - Soakaway storage volume**Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 18\text{min } 8\text{s}$ **PASS - Soakaway discharge time less than or equal to 24 hours**

Project Euro Garages - Fontwell				Job no. CS/096094	
Calcs for				Start page no./Revision 1	
Calcs by JW	Calcs date 10/07/2018	Checked by	Checked date	Approved by	Approved date

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area	Brighton	Imp area drained to soakaway	$A = 100.0 \text{ m}^2$
Return period	Period = 10 yr	Ratio r	$r = 0.350$
5-yr rtn period rainfall 60 min	M5_60min = 20.0 mm	Increase for global warming	$p_{\text{climate}} = 0 \%$

Soakaway / infiltration trench details

Soakaway type	Rectangular		
Depth of pit	$d = 550 \text{ mm}$	Width of pit	$w = 800 \text{ mm}$
Length of pit	$l = 4500 \text{ mm}$	Percentage free volume	$V_{\text{free}} = 90 \%$

Soil infiltration rate (BRE digest 365)

Length of trial pit	$l_{\text{trial}} = 2500 \text{ mm}$	Width of trial pit	$b_{\text{trial}} = 600 \text{ mm}$
Depth of trial pit (below invert)	$d_{\text{trial}} = 865 \text{ mm}$	Free volume (if fill used)	$V_{\text{trial}} = 30 \%$
75% depth of pit	$d_{75} = 648.75 \text{ mm}$	50% depth of pit	$d_{50} = 432.50 \text{ mm}$
25% depth of pit	$d_{25} = 216.25 \text{ mm}$	Test 1 - 75% to 25% depth	$T1 = 10 \text{ min}$
Test 2 - 75% to 25% depth	$T2 = 10 \text{ min}$	Test 3 - 75% to 25% depth	$T3 = 10 \text{ min}$
Longest test time	$t_{\text{lg}} = 10 \text{ min}$	Storage volume 75% to 25%	$V_{p75_25} = 0.19 \text{ m}^3$
Internal surface area to 50%	$a_{p50} = 4.18 \text{ m}^2$	Surface area to 50% depth	$A_{s50} = 2.682 \text{ m}^2$
Soil infiltration rate	$f = 77.6 \times 10^{-6} \text{ m/s}$		
Wetted area of pit 50% full	$a_{s50} = 2915000 \text{ mm}^2$		

Table equations

Inflow	$I = M10 \times A$	Outflow	$O = a_{s50} \times f \times D$
Storage	$S = I - O$		

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	7.1;	1.20;	8.6;	0.86;	0.07;	0.79
10	0.51;	10.1;	1.22;	12.4;	1.24;	0.14;	1.10
15	0.62;	12.3;	1.23;	15.2;	1.52;	0.20;	1.31
30	0.79;	15.7;	1.24;	19.5;	1.95;	0.41;	1.54
60	1.00;	20.0;	1.24;	24.8;	2.48;	0.81;	1.67
120	1.22;	24.5;	1.24;	30.3;	3.03;	1.63;	1.41
240	1.50;	29.9;	1.22;	36.5;	3.65;	3.26;	0.40
360	1.69;	33.8;	1.21;	40.9;	4.09;	4.88;	0.00
600	1.95;	38.9;	1.19;	46.5;	4.65;	8.14;	0.00
1440	2.48;	49.6;	1.17;	58.1;	5.81;	19.54;	0.00

Required storage volume $S_{\text{req}} = 1.67 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = 1.78 \text{ m}^3$

PASS - Soakaway storage volume

Time to empty half soakaway $t_{s50} = 1 \text{ hr } 1 \text{ min } 33 \text{ s}$

PASS - Soakaway discharge time less than or equal to 24 hours

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
 Impermeable area drained to the system $A = 230.0 \text{ m}^2$
 Return period Period = 100 yr
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 5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
 Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 550 \text{ mm}$
 Width of pit $w = 1000 \text{ mm}$
 Length of pit $l = 24000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 90 \%$
 Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 13750000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M100 \times A$
 Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
 Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.91;	19.1;	4.39;	0.17;	4.22
10	0.51;	14.2;	1.98;	28.0;	6.45;	0.33;	6.12
15	0.62;	17.3;	2.01;	34.7;	7.97;	0.50;	7.48
30	0.79;	22.0;	2.02;	44.5;	10.24;	0.99;	9.25
60	1.00;	28.0;	1.99;	55.6;	12.79;	1.98;	10.81
120	1.22;	34.3;	1.94;	66.3;	15.25;	3.96;	11.29
240	1.50;	41.9;	1.87;	78.6;	18.07;	7.92;	10.15
360	1.69;	47.3;	1.83;	86.7;	19.93;	11.88;	8.05
600	1.95;	54.5;	1.78;	97.0;	22.31;	19.80;	2.51
1440	2.48;	69.4;	1.68;	116.5;	26.80;	47.52;	0.00

Required storage volume $S_{\text{req}} = 11.29 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 11.88 \text{ m}^3$ **PASS - Soakaway storage volume**Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 51\text{min } 4\text{s}$ **PASS - Soakaway discharge time less than or equal to 24 hours**

Project Euro Garages - Fontwell				Job no. CS/096094	
Calcs for Area B Infiltration - 10year				Start page no./Revision B10- 1 P02	
Calcs by JW	Calcs date 25/07/2018	Checked by PP	Checked date 25/07/2018	Approved by JMW	Approved date 25/07/2018

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
 Impermeable area drained to the system $A = 100.0 \text{ m}^2$
 Return period Period = 10 yr
 Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
 5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
 Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 400 \text{ mm}$
 Width of pit $w = 1000 \text{ mm}$
 Length of pit $l = 10000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 90 \%$
 Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 4400000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M10 \times A$
 Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
 Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.22;	12.2;	1.22;	0.05;	1.17
10	0.51;	14.2;	1.24;	17.5;	1.75;	0.11;	1.65
15	0.62;	17.3;	1.24;	21.4;	2.14;	0.16;	1.98
30	0.79;	22.0;	1.24;	27.3;	2.73;	0.32;	2.41
60	1.00;	28.0;	1.23;	34.4;	3.44;	0.63;	2.80
120	1.22;	34.3;	1.21;	41.4;	4.14;	1.27;	2.87
240	1.50;	41.9;	1.19;	49.7;	4.97;	2.53;	2.44
360	1.69;	47.3;	1.18;	55.6;	5.56;	3.80;	1.76
600	1.95;	54.5;	1.16;	63.5;	6.35;	6.34;	0.01
1440	2.48;	69.4;	1.15;	79.6;	7.96;	15.21;	0.00

Required storage volume $S_{\text{req}} = 2.87 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 3.60 \text{ m}^3$ **PASS - Soakaway storage volume**Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 15\text{min } 54\text{s}$ **PASS - Soakaway discharge time less than or equal to 24 hours**

Project Euro Garages - Fontwell				Job no. CS/096094	
Calcs for Area B Infiltration - 100 year				Start page no./Revision B100- 1 P02	
Calcs by JW	Calcs date 25/07/2018	Checked by PP	Checked date 25/07/2018	Approved by JMW	Approved date 25/07/2018

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
 Impermeable area drained to the system $A = 100.0 \text{ m}^2$
 Return period Period = 100 yr
 Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
 5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
 Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 550 \text{ mm}$
 Width of pit $w = 1000 \text{ mm}$
 Length of pit $l = 10000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 90 \%$
 Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 6050000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M100 \times A$
 Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
 Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.91;	19.1;	1.91;	0.07;	1.83
10	0.51;	14.2;	1.98;	28.0;	2.80;	0.15;	2.66
15	0.62;	17.3;	2.01;	34.7;	3.47;	0.22;	3.25
30	0.79;	22.0;	2.02;	44.5;	4.45;	0.44;	4.02
60	1.00;	28.0;	1.99;	55.6;	5.56;	0.87;	4.69
120	1.22;	34.3;	1.94;	66.3;	6.63;	1.74;	4.89
240	1.50;	41.9;	1.87;	78.6;	7.86;	3.48;	4.37
360	1.69;	47.3;	1.83;	86.7;	8.67;	5.23;	3.44
600	1.95;	54.5;	1.78;	97.0;	9.70;	8.71;	0.99
1440	2.48;	69.4;	1.68;	116.5;	11.65;	20.91;	0.00

Required storage volume $S_{\text{req}} = 4.89 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 4.95 \text{ m}^3$ **PASS - Soakaway storage volume**Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 48\text{min } 24\text{s}$ **PASS - Soakaway discharge time less than or equal to 24 hours**

Project Euro Garages - Fontwell				Job no. CS/096094	
Calcs for Area C Infiltration - 10year				Start page no./Revision C10- 1 P02	
Calcs by JW	Calcs date 25/07/2018	Checked by PP	Checked date 25/07/2018	Approved by JMW	Approved date 25/07/2018

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
Impermeable area drained to the system $A = 170.0 \text{ m}^2$
Return period Period = 10 yr
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
Minimum depth of pit (below incoming invert) $d = 400 \text{ mm}$
Width of pit $w = 2000 \text{ mm}$
Length of pit $l = 10000 \text{ mm}$
Percentage free volume $V_{\text{free}} = 90 \%$
Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 4800000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M10 \times A$
Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.22;	12.2;	2.07;	0.06;	2.01
10	0.51;	14.2;	1.24;	17.5;	2.98;	0.12;	2.87
15	0.62;	17.3;	1.24;	21.4;	3.64;	0.17;	3.47
30	0.79;	22.0;	1.24;	27.3;	4.64;	0.35;	4.30
60	1.00;	28.0;	1.23;	34.4;	5.85;	0.69;	5.15
120	1.22;	34.3;	1.21;	41.4;	7.03;	1.38;	5.65
240	1.50;	41.9;	1.19;	49.7;	8.45;	2.76;	5.69
360	1.69;	47.3;	1.18;	55.6;	9.46;	4.15;	5.31
600	1.95;	54.5;	1.16;	63.5;	10.79;	6.91;	3.88
1440	2.48;	69.4;	1.15;	79.6;	13.54;	16.59;	0.00

Required storage volume $S_{\text{req}} = 5.69 \text{ m}^3$

Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 7.20 \text{ m}^3$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 4\text{hr } 6\text{min } 58\text{s}$

PASS - Soakaway discharge time less than or equal to 24 hours

Project Euro Garages - Fontwell				Job no. CS/096094	
Calcs for Area C Infiltration - 100 year				Start page no./Revision C100- 1 P02	
Calcs by JW	Calcs date 25/07/2018	Checked by PP	Checked date 25/07/2018	Approved by JMW	Approved date 25/07/2018

SOAKAWAY DESIGN**In accordance with BRE Digest 365 - Soakaway design**

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
 Impermeable area drained to the system $A = 170.0 \text{ m}^2$
 Return period Period = 100 yr
 Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
 5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
 Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
 Minimum depth of pit (below incoming invert) $d = 550 \text{ mm}$
 Width of pit $w = 2000 \text{ mm}$
 Length of pit $l = 10000 \text{ mm}$
 Percentage free volume $V_{\text{free}} = 90 \%$
 Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
 Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 6600000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M100 \times A$
 Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
 Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.91;	19.1;	3.24;	0.08;	3.16
10	0.51;	14.2;	1.98;	28.0;	4.77;	0.16;	4.61
15	0.62;	17.3;	2.01;	34.7;	5.89;	0.24;	5.66
30	0.79;	22.0;	2.02;	44.5;	7.57;	0.48;	7.10
60	1.00;	28.0;	1.99;	55.6;	9.45;	0.95;	8.50
120	1.22;	34.3;	1.94;	66.3;	11.27;	1.90;	9.37
240	1.50;	41.9;	1.87;	78.6;	13.36;	3.80;	9.55
360	1.69;	47.3;	1.83;	86.7;	14.73;	5.70;	9.03
600	1.95;	54.5;	1.78;	97.0;	16.49;	9.50;	6.98
1440	2.48;	69.4;	1.68;	116.5;	19.81;	22.81;	0.00

Required storage volume $S_{\text{req}} = 9.55 \text{ m}^3$ Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 9.90 \text{ m}^3$ **PASS - Soakaway storage volume**Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 5\text{hr } 1\text{min } 28\text{s}$ **PASS - Soakaway discharge time less than or equal to 24 hours**

Churchgate House Oxford Street Manchester M1 6EU	Project Euro Garages - Fontwell				Job no. CS/096094	
	Calcs for Area D Infiltration - 10year				Start page no./Revision D10- 1 P02	
	Calcs by JW	Calcs date 03/09/2018	Checked by PP	Checked date 03/09/2018	Approved by JMW	Approved date 03/09/2018

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
Impermeable area drained to the system $A = 90.0 \text{ m}^2$
Return period Period = **10 yr**
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
Minimum depth of pit (below incoming invert) $d = 400 \text{ mm}$
Width of pit $w = 1000 \text{ mm}$
Length of pit $l = 9000 \text{ mm}$
Percentage free volume $V_{\text{free}} = 90 \%$
Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 4000000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M10 \times A$
Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	10 year rainfall, M10 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.22;	12.2;	1.10;	0.05;	1.05
10	0.51;	14.2;	1.24;	17.5;	1.58;	0.10;	1.48
15	0.62;	17.3;	1.24;	21.4;	1.93;	0.14;	1.78
30	0.79;	22.0;	1.24;	27.3;	2.46;	0.29;	2.17
60	1.00;	28.0;	1.23;	34.4;	3.09;	0.58;	2.52
120	1.22;	34.3;	1.21;	41.4;	3.72;	1.15;	2.57
240	1.50;	41.9;	1.19;	49.7;	4.47;	2.30;	2.17
360	1.69;	47.3;	1.18;	55.6;	5.01;	3.46;	1.55
600	1.95;	54.5;	1.16;	63.5;	5.71;	5.76;	0.00
1440	2.48;	69.4;	1.15;	79.6;	7.17;	13.82;	0.00

Required storage volume $S_{\text{req}} = 2.57 \text{ m}^3$

Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 3.24 \text{ m}^3$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 13\text{min } 52\text{s}$

PASS - Soakaway discharge time less than or equal to 24 hours

Churchgate House Oxford Street Manchester M1 6EU	Project Euro Garages - Fontwell				Job no. CS/096094	
	Calcs for Area D Infiltration - 100 year				Start page no./Revision D100- 1 P02	
	Calcs by JW	Calcs date 03/09/2018	Checked by PP	Checked date 03/09/2018	Approved by JMW	Approved date 03/09/2018

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.03

Design rainfall intensity

Location of catchment area Brighton
Impermeable area drained to the system $A = 90.0 \text{ m}^2$
Return period Period = **100 yr**
Ratio 60 min to 2 day rainfall of 5 yr return period $r = 0.350$
5-year return period rainfall of 60 minutes duration $M5_{60\text{min}} = 20.0 \text{ mm}$
Increase of rainfall intensity due to global warming $p_{\text{climate}} = 40 \%$

Soakaway / infiltration trench details

Soakaway type Rectangular
Minimum depth of pit (below incoming invert) $d = 550 \text{ mm}$
Width of pit $w = 1000 \text{ mm}$
Length of pit $l = 9000 \text{ mm}$
Percentage free volume $V_{\text{free}} = 90 \%$
Soil infiltration rate $f = 40.0 \times 10^{-6} \text{ m/s}$
Wetted area of pit 50% full $a_{s50} = l \times d + w \times d = 5500000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1) $I = M100 \times A$
Outflow (cl.3.3.2) $O = a_{s50} \times f \times D$
Storage (cl.3.3.3) $S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.0;	1.91;	19.1;	1.72;	0.07;	1.65
10	0.51;	14.2;	1.98;	28.0;	2.52;	0.13;	2.39
15	0.62;	17.3;	2.01;	34.7;	3.12;	0.20;	2.92
30	0.79;	22.0;	2.02;	44.5;	4.01;	0.40;	3.61
60	1.00;	28.0;	1.99;	55.6;	5.00;	0.79;	4.21
120	1.22;	34.3;	1.94;	66.3;	5.97;	1.58;	4.38
240	1.50;	41.9;	1.87;	78.6;	7.07;	3.17;	3.90
360	1.69;	47.3;	1.83;	86.7;	7.80;	4.75;	3.05
600	1.95;	54.5;	1.78;	97.0;	8.73;	7.92;	0.81
1440	2.48;	69.4;	1.68;	116.5;	10.49;	19.01;	0.00

Required storage volume $S_{\text{req}} = 4.38 \text{ m}^3$

Soakaway storage volume $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 4.46 \text{ m}^3$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = 2\text{hr } 45\text{min } 55\text{s}$

PASS - Soakaway discharge time less than or equal to 24 hours

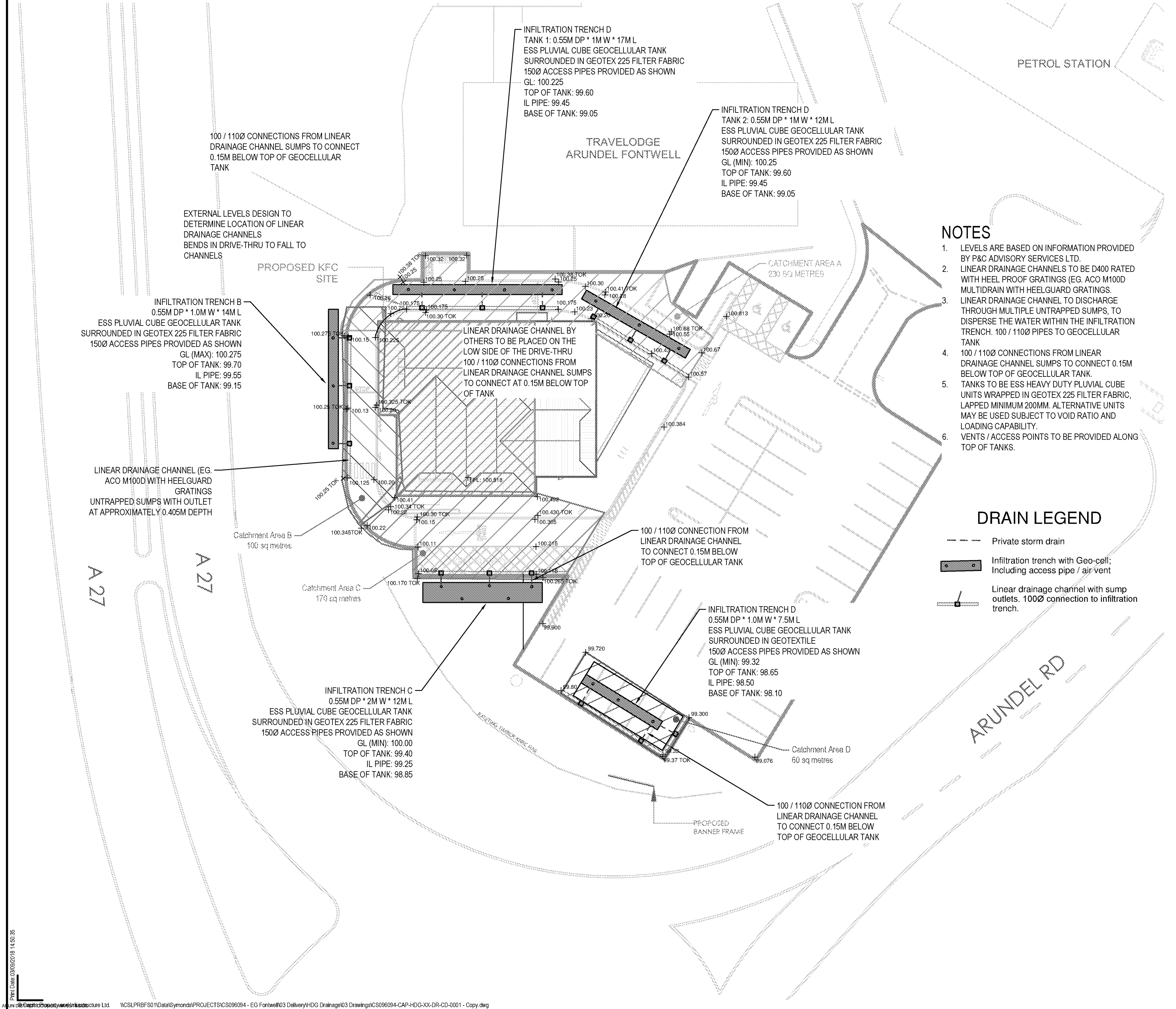
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<p><u>Summary of Results for 100 year Return Period (+40%)</u></p> <p>Half Drain Time : 165 minutes.</p> <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>98.947</td><td>0.247</td><td>0.5</td><td>5.3</td><td>O K</td></tr><tr><td>30 min Summer</td><td>99.021</td><td>0.321</td><td>0.5</td><td>6.9</td><td>O K</td></tr><tr><td>60 min Summer</td><td>99.085</td><td>0.385</td><td>0.6</td><td>8.3</td><td>O K</td></tr><tr><td>120 min Summer</td><td>99.119</td><td>0.419</td><td>0.6</td><td>9.1</td><td>O K</td></tr><tr><td>180 min Summer</td><td>99.123</td><td>0.423</td><td>0.6</td><td>9.1</td><td>O K</td></tr><tr><td>240 min Summer</td><td>99.117</td><td>0.417</td><td>0.6</td><td>9.0</td><td>O K</td></tr><tr><td>360 min Summer</td><td>99.102</td><td>0.402</td><td>0.6</td><td>8.7</td><td>O K</td></tr><tr><td>480 min Summer</td><td>99.084</td><td>0.384</td><td>0.6</td><td>8.3</td><td>O K</td></tr><tr><td>600 min Summer</td><td>99.065</td><td>0.365</td><td>0.6</td><td>7.9</td><td>O K</td></tr><tr><td>720 min Summer</td><td>99.047</td><td>0.347</td><td>0.6</td><td>7.5</td><td>O K</td></tr><tr><td>960 min Summer</td><td>99.012</td><td>0.312</td><td>0.5</td><td>6.7</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>98.952</td><td>0.252</td><td>0.5</td><td>5.4</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>98.882</td><td>0.182</td><td>0.4</td><td>3.9</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>98.830</td><td>0.130</td><td>0.4</td><td>2.8</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>98.767</td><td>0.067</td><td>0.4</td><td>1.5</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>98.746</td><td>0.046</td><td>0.3</td><td>1.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>98.739</td><td>0.039</td><td>0.3</td><td>0.8</td><td>O K</td></tr><tr><td>8640 min 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Summer</td><td>10.402</td><td>0.0</td><td>382</td></tr><tr><td>720 min Summer</td><td>9.042</td><td>0.0</td><td>450</td></tr><tr><td>960 min Summer</td><td>7.241</td><td>0.0</td><td>580</td></tr><tr><td>1440 min Summer</td><td>5.284</td><td>0.0</td><td>838</td></tr><tr><td>2160 min Summer</td><td>3.848</td><td>0.0</td><td>1212</td></tr><tr><td>2880 min Summer</td><td>3.068</td><td>0.0</td><td>1560</td></tr><tr><td>4320 min Summer</td><td>2.226</td><td>0.0</td><td>2248</td></tr><tr><td>5760 min Summer</td><td>1.771</td><td>0.0</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>1.483</td><td>0.0</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.284</td><td>0.0</td><td>4392</td></tr><tr><td>10080 min Summer</td><td>1.137</td><td>0.0</td><td>5080</td></tr><tr><td>15 min Winter</td><td>131.851</td><td>0.0</td><td>18</td></tr></table>			Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	98.947	0.247	0.5	5.3	O K	30 min Summer	99.021	0.321	0.5	6.9	O K	60 min Summer	99.085	0.385	0.6	8.3	O K	120 min Summer	99.119	0.419	0.6	9.1	O K	180 min Summer	99.123	0.423	0.6	9.1	O K	240 min Summer	99.117	0.417	0.6	9.0	O K	360 min Summer	99.102	0.402	0.6	8.7	O K	480 min Summer	99.084	0.384	0.6	8.3	O K	600 min Summer	99.065	0.365	0.6	7.9	O K	720 min Summer	99.047	0.347	0.6	7.5	O K	960 min Summer	99.012	0.312	0.5	6.7	O K	1440 min Summer	98.952	0.252	0.5	5.4	O K	2160 min Summer	98.882	0.182	0.4	3.9	O K	2880 min Summer	98.830	0.130	0.4	2.8	O K	4320 min Summer	98.767	0.067	0.4	1.5	O K	5760 min Summer	98.746	0.046	0.3	1.0	O K	7200 min Summer	98.739	0.039	0.3	0.8	O K	8640 min Summer	98.734	0.034	0.2	0.7	O K	10080 min Summer	98.730	0.030	0.2	0.6	O K	15 min Winter	98.978	0.278	0.5	6.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	131.851	0.0	18	30 min Summer	88.566	0.0	32	60 min Summer	56.713	0.0	62	120 min Summer	35.004	0.0	114	180 min Summer	25.973	0.0	144	240 min Summer	20.877	0.0	176	360 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5th Floor Churchgate House 56 Oxford Street Manchester, M1 6EU	Fontwell A 100yr +40%				
Date P01 File Fontwell.srcx	Designed by JMW Checked by				
Micro Drainage					
Source Control 2015.1					
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	99.062	0.362	0.6	7.8	O K
60 min Winter	99.137	0.437	0.6	9.4	O K
120 min Winter	99.186	0.486	0.6	10.5	O K
180 min Winter	99.189	0.489	0.6	10.6	O K
240 min Winter	99.181	0.481	0.6	10.4	O K
360 min Winter	99.158	0.458	0.6	9.9	O K
480 min Winter	99.129	0.429	0.6	9.3	O K
600 min Winter	99.099	0.399	0.6	8.6	O K
720 min Winter	99.071	0.371	0.6	8.0	O K
960 min Winter	99.020	0.320	0.5	6.9	O K
1440 min Winter	98.935	0.235	0.5	5.1	O K
2160 min Winter	98.842	0.142	0.4	3.1	O K
2880 min Winter	98.779	0.079	0.4	1.7	O K
4320 min Winter	98.743	0.043	0.3	0.9	O K
5760 min Winter	98.734	0.034	0.2	0.7	O K
7200 min Winter	98.729	0.029	0.2	0.6	O K
8640 min Winter	98.725	0.025	0.2	0.5	O K
10080 min Winter	98.722	0.022	0.2	0.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)		
30 min Winter	88.566	0.0	32		
60 min Winter	56.713	0.0	60		
120 min Winter	35.004	0.0	116		
180 min Winter	25.973	0.0	168		
240 min Winter	20.877	0.0	190		
360 min Winter	15.365	0.0	266		
480 min Winter	12.341	0.0	340		
600 min Winter	10.402	0.0	412		
720 min Winter	9.042	0.0	484		
960 min Winter	7.241	0.0	624		
1440 min Winter	5.284	0.0	884		
2160 min Winter	3.848	0.0	1256		
2880 min Winter	3.068	0.0	1588		
4320 min Winter	2.226	0.0	2200		
5760 min Winter	1.771	0.0	2944		
7200 min Winter	1.483	0.0	3680		
8640 min Winter	1.284	0.0	4376		
10080 min Winter	1.137	0.0	5144		
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5th Floor Churchgate House 56 Oxford Street Manchester, M1 6EU	Fontwell A 100yr +40%																																		
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<p style="text-align: center;"><u>Model Details</u></p> <p style="text-align: center;">Storage is Online Cover Level (m) 100.000</p> <p style="text-align: center;"><u>Infiltration Trench Structure</u></p> <table> <tr> <td>Infiltration Coefficient Base (m/hr)</td> <td>0.14400</td> <td>Trench Width (m)</td> <td>1.0</td> </tr> <tr> <td>Infiltration Coefficient Side (m/hr)</td> <td>0.14400</td> <td>Trench Length (m)</td> <td>24.0</td> </tr> <tr> <td>Safety Factor</td> <td>3.0</td> <td>Slope (1:X)</td> <td>0.0</td> </tr> <tr> <td>Porosity</td> <td>0.90</td> <td>Cap Volume Depth (m)</td> <td>0.550</td> </tr> <tr> <td>Invert Level (m)</td> <td>98.700</td> <td>Cap Infiltration Depth (m)</td> <td>0.400</td> </tr> </table>			Infiltration Coefficient Base (m/hr)	0.14400	Trench Width (m)	1.0	Infiltration Coefficient Side (m/hr)	0.14400	Trench Length (m)	24.0	Safety Factor	3.0	Slope (1:X)	0.0	Porosity	0.90	Cap Volume Depth (m)	0.550	Invert Level (m)	98.700	Cap Infiltration Depth (m)	0.400
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Appendix D - Drawings



NOTES

1. LEVELS ARE BASED ON INFORMATION PROVIDED BY P&C ADVISORY SERVICES LTD.
2. LINEAR DRAINAGE CHANNELS TO BE D400 RATED WITH HEEL PROOF GRATINGS (EG. ACO M100D MULTIDRAIN WITH HEELGUARD GRATINGS).
3. LINEAR DRAINAGE CHANNEL TO DISCHARGE THROUGH MULTIPLE UNTRAPPED SUMPS, TO DISPERSE THE WATER WITHIN THE INFILTRATION TRENCH. 100 / 1100 PIPES TO GEOCELLULAR TANK
4. 100 / 1100 CONNECTIONS FROM LINEAR DRAINAGE CHANNEL SUMPS TO CONNECT 0.15M BELOW TOP OF GEOCELLULAR TANK.
5. TANKS TO BE ESS HEAVY DUTY PLUVIAL CUBE UNITS WRAPPED IN GEOTEX 225 FILTER FABRIC, LAPPED MINIMUM 200MM. ALTERNATIVE UNITS MAY BE USED SUBJECT TO VOID RATIO AND LOADING CAPABILITY.
6. VENTS / ACCESS POINTS TO BE PROVIDED ALONG TOP OF TANKS.

DRAIN LEGEND

- Private storm drain
- Infiltration trench with Geo-cell; Including access pipe / air vent
- Linear drainage channel with sump outlets. 1000 connection to infiltration trench.

P02 JMW JMW JMW ISSUED FOR APPROVAL 03/08/18

P01 JMW PP JMW ISSUED FOR APPROVAL 23/07/2018

Rev	Drawn	Checked	Appr	Description	Date
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Purpose of Issue

FOR APPROVAL

Classification

COMMERCIAL IN CONFIDENCE

Client

EURO GARAGES

Project

FONTWELL

Drawing

SURFACE WATER
DRAINAGE PROPOSALS

Scale @ A2	Drawn	Checked	Approved
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1:250	JMW	PP	JMW
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Project No.	Date
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CS096094	JULY 2018
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Drawing Identifier BS1192 Compliant

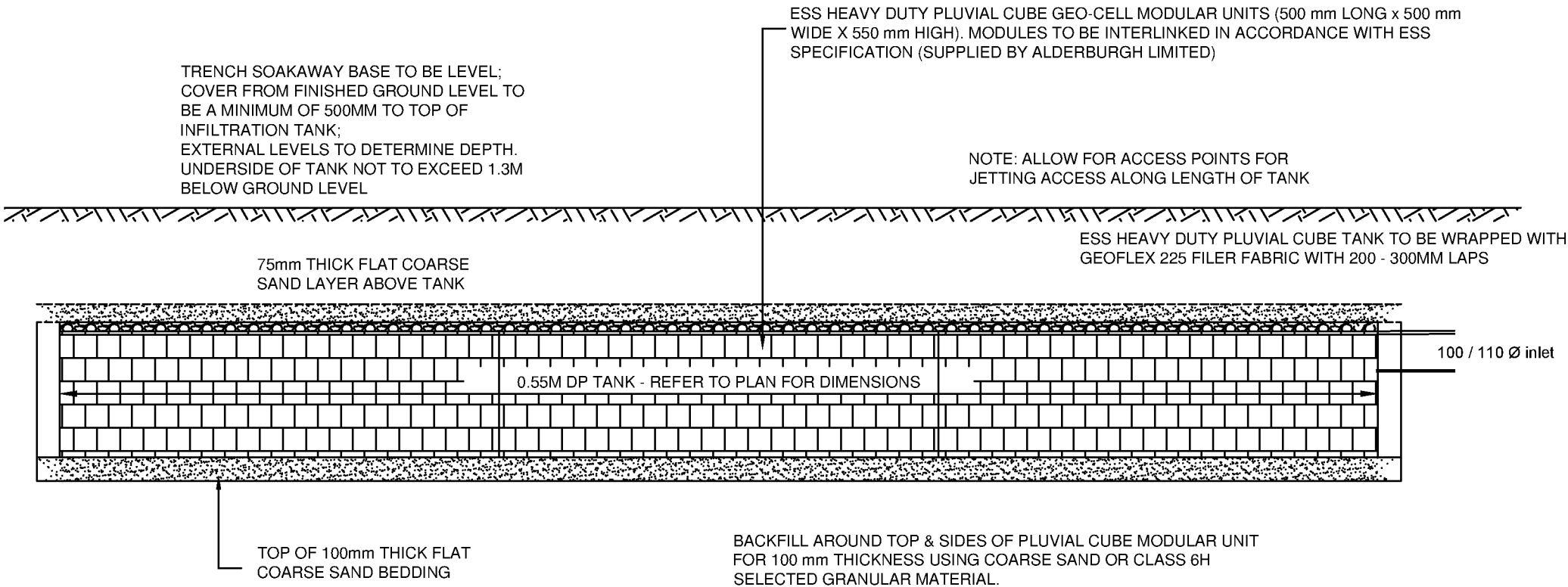
Project - Originator - Zone - Level - File Type - Role - Number rev

CS096094-CAP-HDG-XX-DR-CD-0001	P02
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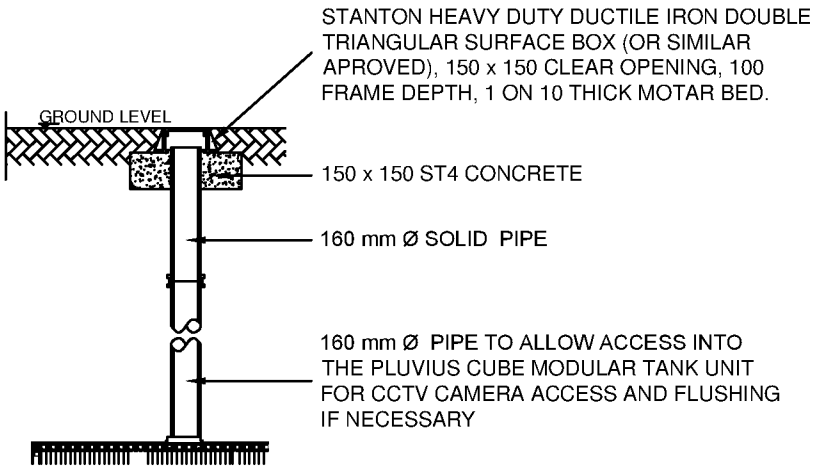
CAPITA CIVILS

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01254 273000
www.capitaproperty.co.uk
Capita Property and Infrastructure Ltd.

Print Date: 23/07/2018 14:35:10



TYPICAL SECTION THROUGH PLUVIAL CUBE GEOCELLULAR SOAKAWAY TRENCH
PLUVIAL HEAVY DUTY UNITS



TYPICAL 150 / 160 mm Ø VENT PIPE /
ACCESS CONNECTION

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Rev	Drwn	Chkd	App'd	Description	Date
P01	JMW	PP	JMW	ISSUED FOR APPROVAL	23.07.2018

CAPITA

Civil

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- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL
OTHER RELEVANT DRAWINGS, ANY DISCREPANCIES,
ERRORS OR OMISSIONS TO BE BROUGHT TO THE
ATTENTION OF CAPITA.
- ALL DIMENSIONS TO BE CHECKED BEFORE
COMMENCEMENT OF WORK ON SITE.
- ALL DIMENSIONS IN METRES UNLESS OTHERWISE STATED

Client
EURO GARAGES

Project
Fontwell

Drawing
Typical SW drainage
Infiltration trench details

Purpose of Issue
Issued for Approval

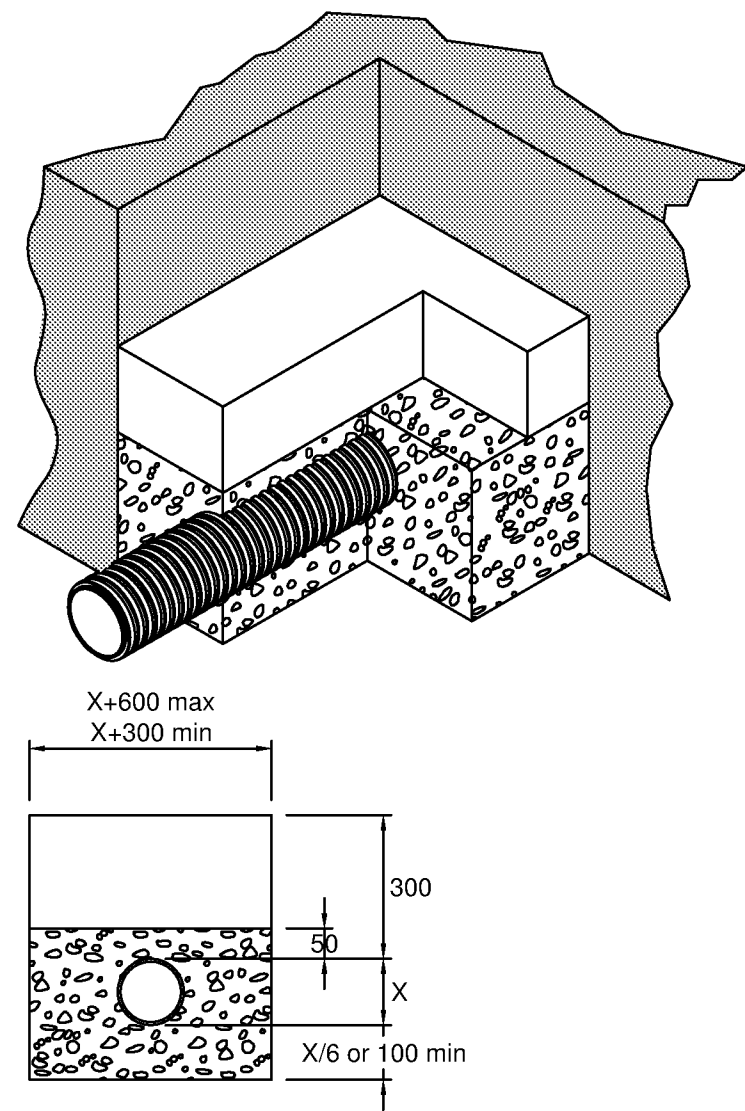
Classification
Commercial in Confidence

Scale @ A3	Drawn	Checked	Approved
NTS	JMW	PP	JMW

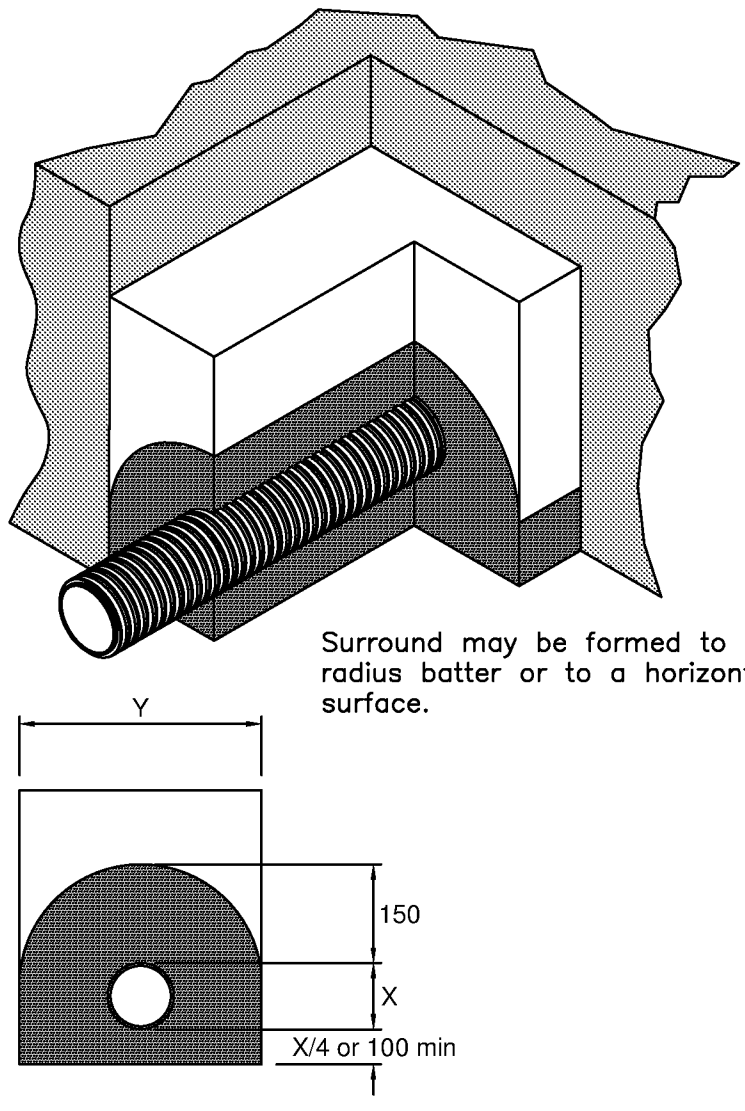
Project No.	Date
CS/096094	July 18

Drawing Identifier	BS1192 Compliant
Project - Originator - Zone - Level - File Type - Role - Number	revision
CS096094-CAP-HDG-XX-DR-CD-0100	P01

Type S - Surface Water Carrier Drains



Type Z - Surface Water Carrier Drains

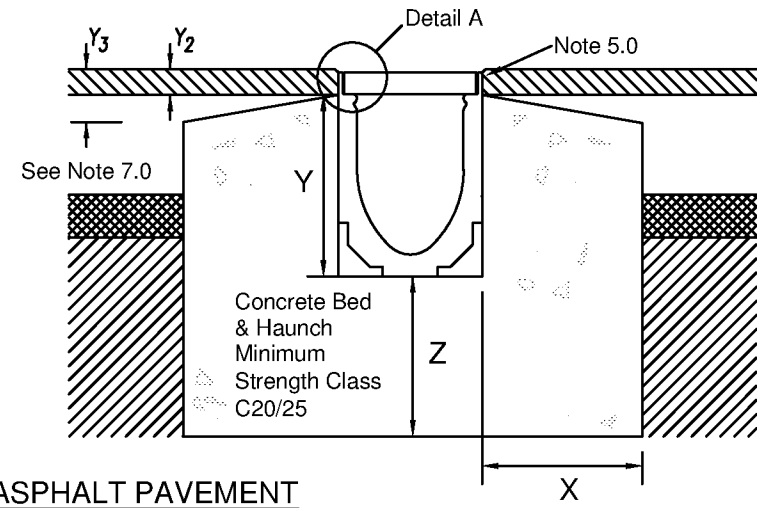


- Type S is the preferred granular bed and surround detail
- Type Z is recommended where depths of cover are less than 1.2metres. Joint filler board shall be placed in contact with the end of the socket at the pipe joint and shall extend through the full thickness of the concrete in contact with the pipe. These should be placed at each pipe joint.

- Class 8 material to S.H.W Clause 503.3 (iv)
- Concrete to S.H.W Clause 503.3 (iii)
- Granular material to S.H.W Clause 503.3 (i)
- Material to S.H.W Clause 503.3 (ii)
- In situ soil

S.H.W = Specification for Highway Works 2001 Edition

FLEXIBLE PIPE SYSTEM



ASPHALT PAVEMENT

1.0 GROUND CONDITIONS: The customer should ensure that the minimum dimensions shown are suitable for the existing ground conditions. Engineering advice may be necessary.

2.0 BLOCK PAVEMENTS: ~~THE CHANNEL MUST BE SUPPORTED~~ ~~LATERALLY~~ and therefore blocks must be restrained from movement by bedding securely. e.g. by using an Epoxy or Polymer Modified Mortar for bed and perpendicular joints. (for example RONAFIX Mortar Mix C or similar: From Ronacrete Tel 01279 638700). Engineering advice may be required.

3.0 SURFACE CRACKS: Alternate crack control and movement joints transversely within bed and haunch may reduce unsightly surface cracking. Engineering advice may be required.

4.0 JOINT SEALANT: Where ACO Drain channel joints and fittings are to be sealed (where used in foul water applications or where impermeability is required, for example) contact a sealant specialist for guidance on the most appropriate sealing compound to use.

5.0 SURFACE PROTECTION: In asphalt pavements avoid contact between compaction equipment and channel/grating. This may be achieved by ensuring that the finished surface level lies above the grating level (by at least 3mm). Stones should be removed from grating prior to laying/rolling wearing course.

6.0 GENERAL INSTALLATION NOTES: See drawing for general notes on installation.

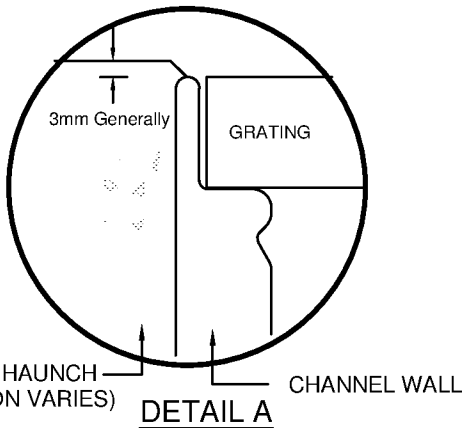
7.0 Minimum Dimensions of Concrete Surround

Load Class	A15	B125	C250	D400*
Minimum Dimensions (mm)	X 100	Y 150	Z 150	Y2 200
	Y Full Channel Height (Less Y2 where necessary)			
Maximum Dimensions (mm)	Y1 100	Y2 35	Y3 35	Y4 60

* e.g. parking areas for all types of road vehicle.
Not suitable for carriageway of roads or industrial areas.
Note dashed line printed on edge rails 35mm below top.

8.0 GRATING SECURITY LOCKS
All the gratings are held in the channel units by the Drainlock™ fixing. In addition, gratings type 23405, 23161 & 23221 (Cast Iron) and 12680/12682 (Composite) can be locked in place with an optional security locking kit. See installation notes.

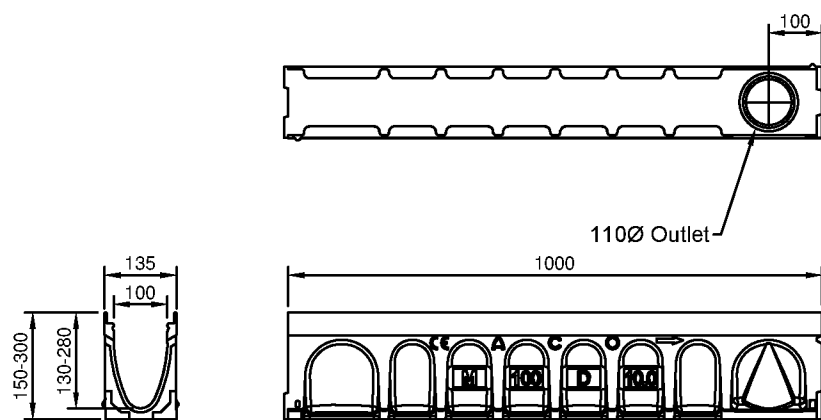
9.0 CONCRETE CLASS
All concrete FND4Z



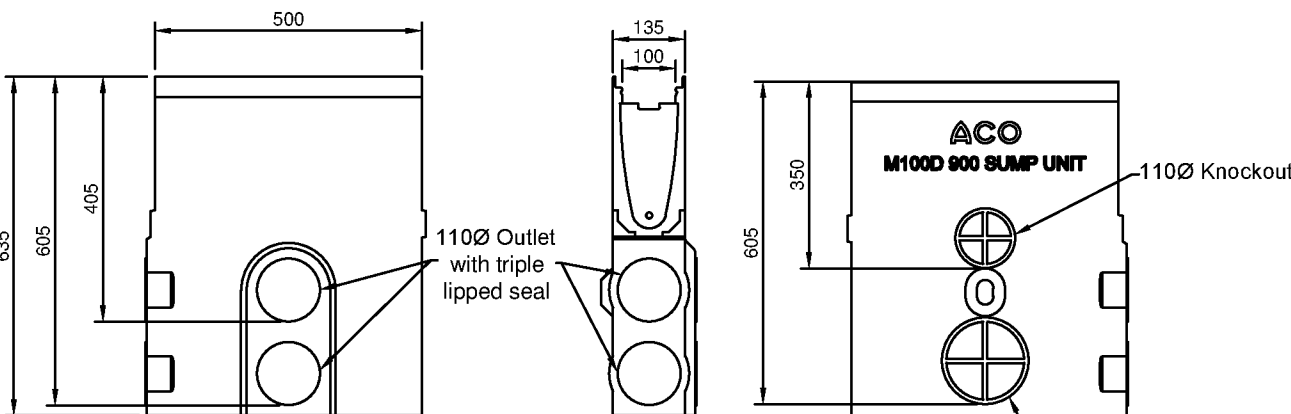
PAVEMENT OR HAUNCH (CONSTRUCTION VARIES) DETAIL A CHANNEL WALL

TRENCH WIDTHS

PIPE I.D	OVERALL TRENCH WIDTH
100	550
150	600
225	700
300	850
375	1050
450	1150
525	1200
600	1350
675	1450
750	1500
825	1600
900	1900
1050	2100
1200	2300
1350	2500
1500	2700
1800	3100



ACO MULTIDRAIN M100D CHANNEL WITH ULTRASTEEL GALVANISED EDGE RAIL



ACO MULTIDRAIN M100D SUMP UNIT WITH ULTRASTEEL GALVANISED EDGE RAIL

INSTALLATION DETAILS FOR ACO MULTIDRAIN M100D DRAINAGE CHANNEL WITH ULTRASTEEL GALVANISED EDGE RAIL

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING
NO SHE HAZARD IDENTIFIED
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT

Rev	Drawn	Checked	Approved	Description	Date
				Purpose of Issue	
				For Approval	
				Classification	
				Commercial in Confidence	
				Client	
				EURO GARAGES	

Project
FONTWELL

Drawing TYPICAL DRAINAGE DETAILS SHEET 2

Scale @ A1	Drawn	Checked	Approved
NTS	JMW	JMW	JMW
Project No.		Date	
CS/096094		Aug. 2018	

Drawing Identifier	BS1192 Compliant
Project - Originator - Zone - Level - File Type - Role - Number	revision
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