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Drainage Strategy Report

The Curlew,

Petersfield Road,

Havant, PO9 2HU

Prepared B[redacted].
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Table of Contents

1.0 Introduction 4

2.0 Government Policy on Flood Risk and Drainage of Development 5

3.0 Development Site 7

4.0 Development Proposals 9

5.0 Flood risks 10

6.0 Surface Water Drainage Strategy 12

7.0 Foul Water Drainage Strategy 15

8.0 Maintenance 16

9.0 Summary 21

Appendices

Appendix 1

Aerial Site Photograph

Appendix 2

Southern Water sewer map

Appendix 3

Proposed Site Plan

Appendix 4

Microdrainage Calculations

Appendix 5

Soakaway Test Results

1.0 Introduction

1.1 Scott White and Hookins have been instructed by Fortitudo Ltd to provide a drainage strategy as part of the planning submission for the proposed residential development on the site of the former The Curlew public house, Petersfield Road, Havant.

1.2 This report considers the flood risk to the proposed development and the impact that the development will have in relation to flooding of adjacent areas and watercourses. It considers any limits relating to flooding that are likely to be imposed to allow the development to be undertaken. The report also provides a foul and surface water drainage strategy to cater for the proposed development using sustainable drainage techniques where possible. This report addresses the requirements of an outline drainage strategy report as required by the Lead Local Flood Authority for a major development.

1.3 This report is based on information received from the Environment Agency, Southern Water, in addition to a desk top study to assess the existing conditions on site. Scott White and Hookins cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

1.4 This report is for the private and confidential use of Fortitudo Ltd and its agents and may not be copied in whole or in part without the written permission of Scott White and Hookins.

2.0 Government Policy on Flood Risk and Drainage of Development

2.1 The frequency and severity of river flooding is perceived to have increased in recent years and in an attempt to mitigate the flood risk the Government published Planning Policy Statement Note 25: Development and Flood Risk (PPS25) in December 2006. PPS25 details the importance of the effective management and reduction of flood risk in the land use planning process and attempts to address the issue of climate change. This has since been updated and is set out in The National Planning Policy Framework and the supporting technical guidance.

2.2 Traditionally surface water run off from developments has been conveyed by pipe systems to the nearest watercourse or sewer. This tends to increase the rate and volume of the run off often leading to flooding downstream of the new development. Latest policy promotes the use of sustainable urban drainage systems (SUDS) whereby the control of run off is to be as close to source as possible. This can be achieved by utilizing techniques which mimic the natural drainage processes, the use of direct infiltration for example. The Environment Agency will, in general, seek to restrict the allowable discharge from a new development to that previously expected from the undeveloped land.

2.3 The requirements of the revised Building Regulations which came into force on 1st April 2002 are that adequate provision should be made for dealing with rainwater from the roofs of buildings and certain paved areas providing access to the buildings. Run off from such drainage systems are to be discharged to one of the following systems listed in order of priority:-

- A soakaway or other infiltration system
- A watercourse
- A sewer or drain

2.4 The revised Building Regulations were drafted to reinforce the requirements for SUDS wherever possible.

2.5 The Requirements of a Flood Risk Assessment

2.5.1 A Flood Risk Assessment is required in order to ascertain whether a development will exacerbate the risk of flooding elsewhere in the catchment or is at risk of flooding itself.

3.0 Development Site

3.1 The proposed development is to be located on the site of the Curlew public house on Petersfield Road, Havant. The site is broadly triangular with the top of the triangle pointing in a northerly direction.

3.2 On the existing site, the Curlew public house is located in the centre of the site with a large parking area to the east and soft landscaped garden to the west with a prominent Weeping Willow. The main access is from Petersfield Road on the northern side of the site although there is a second access from Leigh Road on the south-east corner of the site. There is currently a car wash business located within the car park area.

3.3 The site is bounded by Petersfield Road to the north, residential properties to the south and the Parkway Centre medical centre on the eastern boundary. See Appendix 1 for site aerial photographs.

3.4 The nearest watercourse to the site is a tributary which ultimately flows into Chichester Harbour and is located approximately 200m to the east of the site.

3.5 The pre-development site consists of a mix of impermeable tarmac hardstanding, existing buildings, and soft landscaping. The overall site area is 3740m^2 with the existing building comprising an area of 450m^2 and the existing hardstanding surrounding the existing public house and the link road comprises approximately 1450m^2.

3.6 From Southern Water sewer maps there is an existing 675mm diameter public foul water sewer flowing east to west across the southern half of the site. The sewer records indicate the invert is approximately 3.6m below ground level. There is a 225mm diameter public foul sewer in the adjacent Petersfield Road and Leigh Road, and the residential properties to the south of the site are served by public foul and surface water sewers of unknown depth.

3.7 The existing building roof appears to collect surface water via downpipes however these appear to discharge on to the surrounding hardstanding. From the topographical survey there are a limited number of gullies noted to the existing car park.

3.8 From a site CCTV survey, it shows that the surface water drains to multiple soakaways on site. It should be noted that the original planning submission for the car wash service was submitted in 2011 and shows the drainage being connected to an existing foul water chamber on site.

3.9 Ground Conditions

3.9.1 The geology of the area is shown on British Geological Survey map which indicates the site is underlain by bedrock geology of clay, silt and sand of the London Clay formation with superficial deposits of clay, silt and sand of the River Terrace Deposits. Nearby borehole records from the opposite side of Petersfield Road confirm the presence of stiff clay with flints and gravel all underlain by sand at approximately 4m depth.

3.9.2 The boreholes in the local area have identified the presence of groundwater at approximately 2.4m below ground level. The use of traditional deep soakaways is unlikely to be suitable due to the historic groundwater table although this should be investigated further on site. Whilst the cohesive nature of the clay geology would normally restrict the use of infiltration devices, the presence of gravels and flints within the geology may provide some scope to use a shallow solution.

4.0 Development Proposals

4.1 The proposed development involves the demolition of the existing building on site and construction of a new three storey residential block, providing 31 new apartments with parking at the rear of the site and soft landscaping surrounding the new building. Main vehicular access to the site will be from Leigh Road on the south-east corner of the site. A separate bin store and cycle store are to be provided within the new car park. See Appendix 3 for proposed site plans.

4.2 The existing building is to be demolished and the new building is to be located over the footprint of the existing building and hardstanding. The area of the proposed building is 675m^2 and the new car park and access to Leigh Road is 1200m^2 resulting in an overall developed area of 1875m^2 compared to the pre-development area of 1900m^2. It is proposed that the new car park will be constructed from permeable paving with block paved finish over a stone sub-base to provide attenuation and infiltration. The soft landscaping and the existing Weeping Willow on the western side of the site are to be retained.

4.3 With reference to National Planning Policy Framework (NPPF): Table 2, as residential buildings used for dwellings, the flood risk vulnerability classification will be 'More Vulnerable'.

5.0 Flood risks

5.1 River Catchment and Flooding

5.1.1 Based on the Environment Agency flood map the site is located in Flood Zone 1 which indicates this area has an annual probability of river flooding of less than 1 in 1000 (<0.1%).

5.1.2 With reference to Section 4 and NPPF: Table 3, a development classified as 'More Vulnerable' within Flood Zone 1 is deemed appropriate.

5.2 Overland flow

5.2.1 The existing site has been visually assessed for overland flows. Due to the nature and relatively flat topography of the existing site and building, although not calculated, the depth of potential flow across the site is thought likely to be very small, and the general velocity over the ground will be minor.

5.2.2 The Environment Agency surface water modelling demonstrates the site is at low risk of surface water flooding from overland flow although there are areas of high and medium risk along Petersfield Road. Based upon the modelled flow paths, it appears that the route of overland flow occurs from surface water on Petersfield Road which overflows through the main entrance and across the site. The surface water flows around the building and onto the soft landscaping to the west and along the tarmac access road onto Leigh Road. Generally the depth of water is modelled as less than 300mm however there are isolated locations where the depth exceeds 300mm. These flows paths are based upon a surface water flood event in excess of 1 in 100 year (1% annual exceedance probability).

5.2.3 The proposed development represents a slight reduction in impermeable area and with the introduction of permeable paving to the car park the overall surface water drainage strategy for the site will be improved. Therefore it is considered that any risk from overland flow will be reduced by the proposed development and overall the

situation will be improved. The proposed surface water drainage strategy is discussed further in section 6.

5.3 Local flooding of surface water sewer

5.3.1 The PUSH Strategic Flood Risk Assessment identifies that the site is located in an area of low risk of sewer flooding, and there are no incidents recorded in the area of the development site. The proposed development will replicate the existing situation, and should an existing connection to public surface water sewer be found, the development will incorporate suitable attenuation to ensure the proposed development does not increase the flow to the public surface water sewers. Therefore the proposed development does not increase the risk of flooding to the site or surrounding areas.

5.4 Groundwater flooding

5.4.1 The PUSH SFRA map illustrates instances of groundwater flooding events occurring, however these are not within the vicinity of the site. Whilst the local ground conditions indicate a standing water level at around 2.5m below ground level, this level is unlikely to fluctuate significantly within the underlying soil and therefore we would conclude that the site is at low risk of groundwater flooding.

6.0 Surface Water Drainage Strategy

6.1 In the document 'Control of Run-off from New Development' the Environment Agency state that their run-off policy seeks to sustain the natural process within catchments. Surface water drainage should seek to replicate the existing condition where possible such that run off is discharged from site by one of the following systems listed in order of priority; soakaway or other infiltration system, a watercourse or finally a sewer or drain.

6.2 It has been shown that the site is currently connected to soakaways and therefore testing has been undertaken to prove the infiltration rates. These are included in Appendix 5.

6.3 Soakaway tests were undertaken at three locations on site. These have shown a very consistent infiltration rate across the development area. Based on the findings we will adopt the worst case infiltration rate of 9.83×10^{-5} m/s.

6.4 Based on the above, it is proposed the car park will be constructed as permeable paving to allow shallow infiltration.

6.5 Therefore it is therefore proposed that the building will partly drain to a crate soakaway for the drainage of the front section of proposed building, with the rear section of the building draining directly into the permeable paving.

6.6 To achieve these aims it is recommended that source control and Sustainable Drainage Systems (SuDS) are implemented, where practical constraints allow. This will also ensure that flood risk to the surrounding area is minimised.

6.7 Permeable paving car park

6.7.1 The proposed car park comprises an overall area of 1200m². Permeable paving construction typically comprises a surface layer of block paviours which allow rainwater to percolate between the blocks. The blocks are laid on a 50mm layer of

sand bedding which is laid on a 100mm layer of 5-20mm granular stone, with a single layer of geotextile providing a silt barrier over a sub-base comprising 10-63mm sized angular stone at a depth to suit the water storage requirements.

6.7.2 With reference to the Microdrainage calculations provided in Appendix 4, it is proposed to combine the whole of the parking area (1200m^2) plus half of the proposed building (400m^2) and the bike store (70m^2), and drain this into the 1200m2 permeable parking area. The calculations demonstrate this can be achieved and all storms up to and including 1 in 100 year plus 40% allowance for climate change can be accommodated. It is recommended that a minimum 250mm deep sub-base is provided to achieve adequate hydraulic and primarily structural performance. Final construction depths will need confirming following undertaking site CBR tests.

6.7.3 The building will be connected into the permeable paving via rainwater pipes, through distribution boxes as required by the permeable paving manufacturer, directly into the sub-base of the system.

6.8 Building drainage

6.8.1 As discussed previously the building will be split to drain partially to the permeable car park, and partially to a specific crate soakaway located in the soft to the south of the building.

6.8.2 With reference to the Microdrainage calculations provided in Appendix 4, assuming the infiltration rate of 9.83×10^{-5} m/s for a catchment area of 400m2 from the front half of the proposed building, a crate soakaway of 6m x 5m x 0.5m deep will provide suitable capacity for all storms up to and including 1 in 100 year plus 40% allowance for climate change.

6.9 Considering the effect of exceedance flows, the investigations have shown that the site has a good ability to infiltrate water. Therefore any exceedance will be accommodated in the provided systems, or directly into the ground utilising the infiltration available on site.

6.10 In accordance with the Ciria SUDS manual, the proposed car park should be constructed with a permeable surfacing and sub-base in order to provide initial treatment stage at source. The permeable sub-base should be wrapped in permeable membrane with an appropriate discharge to the proposed attenuation tank.

6.11 Based on the extent of the works and proposed SUDs system on the development site, we would therefore conclude the site is at low risk of flooding due to overland flow.

7.0 Foul Water Drainage Strategy

7.1 It will be proposed to discharge foul water via the existing drainage connection on site. The final discharge point of the private manholes serving the public house should be determined in order undertake a preliminary capacity check with Southern Water. The final connection should be confirmed on site during detailed design stage.

7.2 Southern Water should be consulted during detailed design stage to confirm there is adequate capacity within the foul network to accommodate the flow. The existing dry weather flow for the existing public house can be calculated assuming 150 litres per seat within the pub, and 270 litres per seat within the restaurant. For example, if there are 30 seats in the pub and 30 seats within the restaurant, the existing dry weather flow equates to (150 x 30) + (270 x 30) = 12600 litres per day or 0.146 litres per second over a 24 hour period or 0.88 litres per second as a peak flow.

7.3 The dry weather flow (DWF) rate in litres per second for the proposed foul water is calculated on the basis of 150 litres of discharge per person per day. British Water 'Flows and Loads' document states the design flow per property is based upon the number of beds. Two bed apartments should be designed for 4 persons, with 31 no. apartments the number of persons at full occupancy is 124.

7.4 Based upon a rate of 150 litres of discharge per person per day, the total flow from the site is 150 x 124 = 18600 litres per day. To calculate the DWF take 18600/(24x60x60) = 0.215 litres per second as an average flow or 1.3 litres per second as a peak flow.

7.5 It will be necessary to carry out a detailed check of existing pipe gradients and levels; however it is anticipated the existing private drains on site will be adequate for the proposed flow. Southern Water should be consulted to determine if there is capacity in the public system and it will be necessary to submit a formal connection application.

8.0 Maintenance

8.1 This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system. This work is to be undertaken by a private maintenance company.

8.2 All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.

8.3 The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

8.4 There are three types of maintenance activities associated with surface water drainage systems.

The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – *'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'*
- Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'*
- Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'*

Operation and Maintenance Activity	SuDs Component		
	Piped Network / Inspection Chambers	Cellular / Modular Storage	Permeable Pavement
Regular Maintenance			
Inspection	■	■	■
Litter and debris removal	■	□	■
Grass cutting		□	□
Weed and invasive plant control			□
Occasional Maintenance			
Sediment management	■	■	■
Vacuum sweeping and brushing			■
Remedial Maintenance			
Structure rehabilitation/ repair	□	□	□
Infiltration surface reconditioning			□
■ **Will be required** □ **May be required**			
Extract from The SuDs Manual Table 32.1 : Typical key SuDs components operation and maintenance activities			

Piped Network/Chambers Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed	Annually and after large storm events
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Permeable Pavement Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over the whole surface). Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material if present. Any lost material should be replaced.	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturers' recommendations – pay particular attention to areas where water runs from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weed or management using glyphosate applied directly to the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements
Remedial Maintenance	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structured performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 year or as required (if infiltration and filtration performance is reduced due to significant clogging)

Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and / or weed growth - If required, take remedial action.	Three-monthly, forty-eight hours after large rainfall events in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually
The SuDS Manual Table 20.15: Operation and maintenance requirements for pervious pavements		

Cellular Storage Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then annually.
	Remove debris from catchment surface (where may cause risks to performance)	Monthly
	Remove debris from catchment surface (where may cause risks to performance)	Annually or as required
Remedial Maintenance	Repair / rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storm events
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of storage units is required.	As required
The SuDS Manual Table 21.3: Operation and maintenance requirements for attenuation storage tanks		

9.0 Summary

9.1 Based on the Environment Agency map the proposed development lies in Flood Zone 1 which is outside a flood risk area and is considered to not be at risk from nearby watercourses.

9.2 With reference to section 5.1.2, the proposed development is considered appropriate for Flood Zone 1.

9.3 The proposed works will connect to the existing foul drainage on site. Therefore an application will need to be made to Southern Water once the design is to be developed in order to connect the new proposed properties to the existing drainage on site.

9.4 The proposed development results in a reduction of impermeable area, thus providing an improvement on the existing situation.

9.5 The proposed development is to incorporate permeable paving and soakaways mirroring the current site operation, and will be designed and installed in accordance with CIRIA 753. This will ensure the risk of flooding from the site is low.

Appendix 1

Photograph 1:

Aerial View of Site

Appendix 2

Southern Water sewer maps

Southern Water

Scott-White & Hookins
Harman House
Andover Road
Winchester
Hampshire
SO23 7BS

Your ref	W01651
Our ref	247293
Date	07 June 2017
Contact	searches@southernwater.co.uk Tel 0845 272 0845 0330 303 0276 Fax 01634 844514

Attention: Ian Llewellyn

Dear Customer

Re: Provision of public sewer record extract

Location: The Curlew, Petersfield Road, Havant, PO9 2HU

Thank you for your order regarding the provision of extracts of our sewer and/or water main records. Please find enclosed the extracts from Southern Water's records for the above location.

We confirm payment of your fee in the sum of £49.92 and enclose a VAT receipt for your records.

Customers should be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Actual positions of the disclosed (and any undisclosed) infrastructure should therefore be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan. Accordingly it should not be considered to be a definitive document.

Should you require any further assistance regarding this matter, please contact the LandSearch team.

Yours faithfully

LandSearch

VAT receipt

Ordered by:

Scott-White & Hookins
Andover Road
Winchester
Hampshire
SO23 7BS

VAT registration number: 813 0378 56
Order reference: 247293
Your reference: W01651

Receipt for provision of an extract from the public sewer and/or water main records.

Location	Costs
The Curlew Petersfield Road Havant PO9 2HU	£41.60
Net total	£41.60
VAT	£8.32
Total	£49.92
Paid	**Paid in full**

Thank you for your payment:

Received on: 31 May 2017

For enquiries regarding the information provided in this receipt, please contact the LandSearch team:

Tel: 0845 270 0212
0330 303 0276 (individual consumers)

Email: searches@southernwater.co.uk

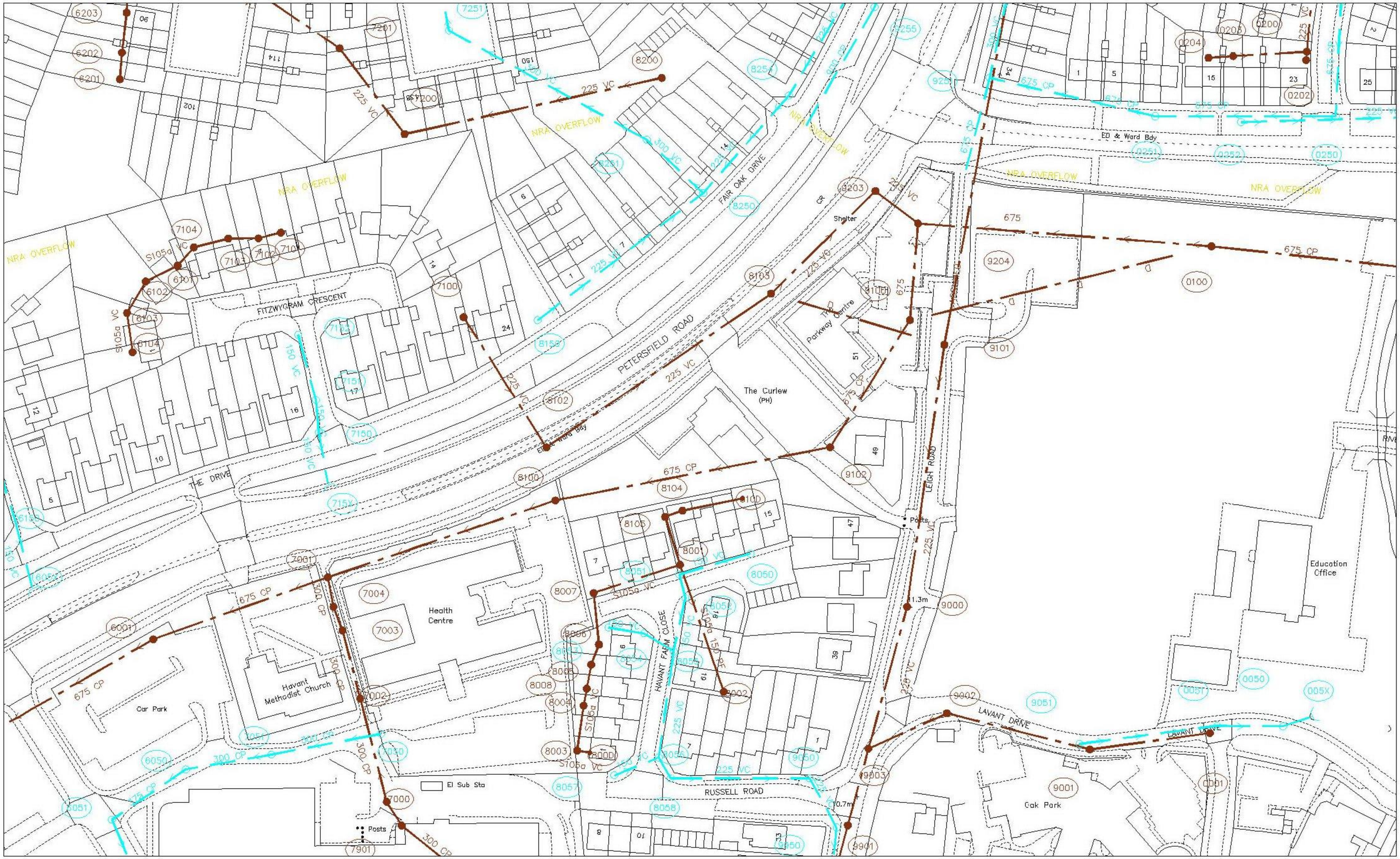
Web: www.southernwater.co.uk

LandSearch
Southern Water Services
Southern House
Capstone Road
Chatham
Kent
ME5 7QA

Southern Water

SEWER RECORDS PAGE 1 OF 2

107277



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O.S. REF. SU7107SE	Drawn by: chowdha	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determnined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement
	Scale: 1:1250	
Title: 247293_The Curlew, Petersfield	Date: 07/06/2017	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.

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Southern Water

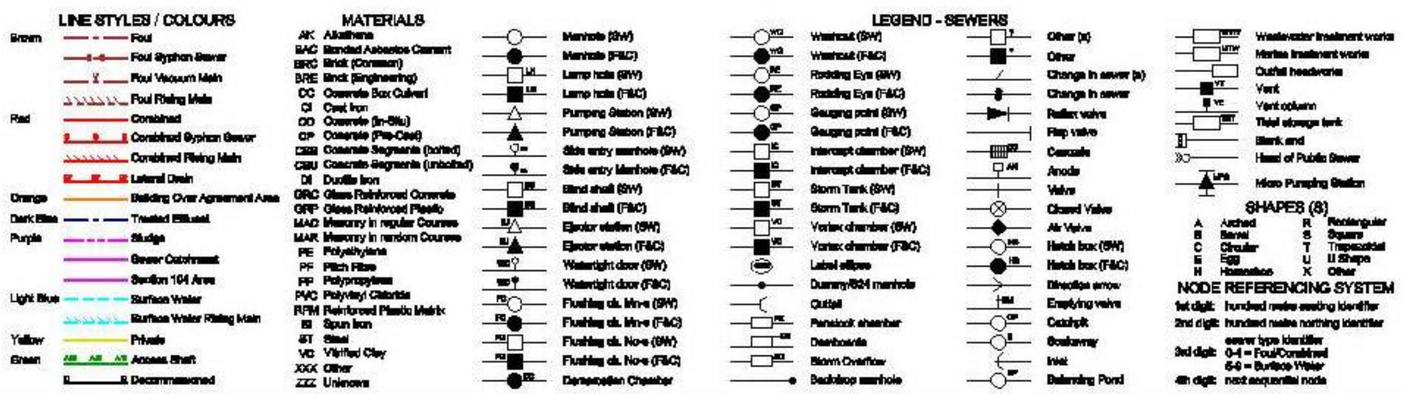
SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape
0001X	11.97	10.6	150	UNK	CIRC
0050X	12.46	10.55	450	UNK	CIRC
0051Y	12	10.66	450	UNK	CIRC
0100X	13.09		675	UNK	CIRC
0200X	13.7	12.45	225	VC	CIRC
0202X			225	VC	CIRC
0203X			UNK	UNK	CIRC
0204X			UNK	UNK	CIRC
0250X	13.48	11.68	675	CP	CIRC
0251X	13.99	11.44	675	CP	CIRC
0252X	13.83	12.73	225	VC	CIRC
6001X	12.87	8.85	675	CP	CIRC
6050X	11.83	9.33	375	CP	CIRC
6051X	12		225	UNK	CIRC
6101X			UNK	VC	CIRC
6102X			UNK	VC	CIRC
6103X			UNK	VC	CIRC
6150X	13.47	12.7	150	VC	CIRC
6201X			UNK	UNK	CIRC
6202X			UNK	UNK	CIRC
6203X			UNK	UNK	CIRC
7000X	11.49	9.79	300	CP	CIRC
7001X	12.82	8.52	675	CP	CIRC
7002X	11.78	9.36	300	CP	CIRC
7003X	12.2	9.3	300	CP	CIRC
7004X	12.8	9.3	300	CP	CIRC
7050X	11.43	10.29	300	CP	CIRC
7051X	11.68	10.03	300	CP	CIRC
7100X	13.59	11.56	225	VC	CIRC
7101X			UNK	VC	CIRC
7102X			UNK	VC	CIRC
7103X			UNK	VC	CIRC
7104X			UNK	VC	CIRC
7150X	13.66	12.71	150	VC	CIRC
7151X	13.87	12.92	150	VC	CIRC
7152X	14.14	13.38	150	VC	CIRC
7200X	14.98	12.98	225	VC	CIRC
7201X	14.7	12.6	225	VC	CIRC
7251X	14.88	11.43	300	VC	CIRC
7901X			UNK	UNK	UNK
8001X			150	PF	CIRC
8003X			UNK	VC	CIRC
8004X			UNK	VC	CIRC
8005X			UNK	VC	CIRC
8006X			UNK	VC	CIRC
8007X			UNK	VC	CIRC
8008X			UNK	UNK	CIRC
800DX			UNK	VC	CIRC
8050X	12.88	11.66	150	VC	CIRC
8051X	12.65	11.49	150	VC	CIRC
8052X	12.62	11.44	150	VC	CIRC
8053X	12.59	11.57	150	VC	CIRC
8054X	12.57	11.38	150	VC	CIRC
8055X	12.37	11.15	225	VC	CIRC
8056X	12.37	10.83	225	VC	CIRC
8057X	12.39	11.02	150	VC	CIRC
8058X	12.49	10.7	225	VC	CIRC
8100X	12.29		UNK	UNK	CIRC
8102X	13.77	12.52	225	VC	CIRC
8103Y	13.77	11.28	225	VC	CIRC
8104X			UNK	UNK	CIRC
8105X			UNK	UNK	CIRC
810DX			UNK	UNK	CIRC
8150X	13.77	12.44	225	VC	CIRC
8200X	14.53	13.14	225	VC	CIRC

Node	Cover	Invert	Size	Material	Shape
8250X	14.16	11.98	300	VC	CIRC
8251X	14.57	11.73	300	VC	CIRC
8254X	14.7	12.61	225	VC	CIRC
9000X	11.35		225	VC	CIRC
9001X	12.44	10.34	150	UNK	CIRC
9002X	12.13	9.98	150	UNK	CIRC
9003X	11.098		225	VC	CIRC
9050X	12.07		225	VC	CIRC
9051X	12.25	11.08	300	UNK	CIRC
9100X	13.317		675	CP	CIRC
9101X	12.81	10.71	225	VC	CIRC
9102X	12.94	9.34	675	CP	CIRC
9203X	14.365	10.808	225	VC	CIRC
9204X	13.8	9.53	675	UNK	CIRC
9251X	14.24		675	CP	CIRC
9255X	14.92		900	CP	CIRC
9901X			UNK	UNK	CIRC
9950X	10.79	10.33	225	CP	CIRC

Node	Cover	Invert	Size	Material	Shape

Node	Cover	Invert	Size	Material	Shape



Drawn by: chowdha	Southern Water
Title: 247293_The Curlew, Petersfield	
Date: 07/06/2017	

Appendix 3

Proposed Site Plan

SOAKAWAY CALCULATION

983.5 X 0.018 = 17.70M³

(CRATE AREA - 1.0M (HEIGHT) X 0.5M (WIDTH) X 0.4M (HEIGHT) = 0.190M³

17.07M³ (ROOF AREA) / 0.190M³ (CRATE AREA) = 93 CRATES

SUDS PLAN : BASED ON TOPOGRAPHICAL SURVEY INFORMATION
SCALE 1:250

10m @ 1:100

NOTES

1 The contents of this drawing are copyright.

2 Do not scale. Figured dimensions only to be used.

3 Contractors must verify all dimensions and report any discrepancies before putting work in hand or making any shop drawings.

4 All flat roofs to be fitted with a man safe system.

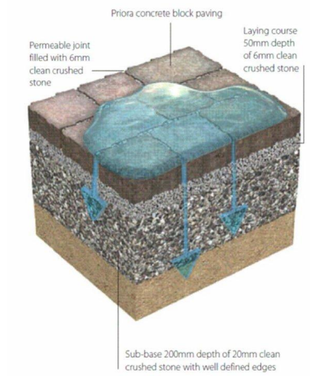
5 Please note a domestic sprinkler system maybe required

6 Fixed shut fire safety glass windows may be required where windows are in close proximity to boundaries (subject to building regulations)

LEGEND

SITE BOUNDARY

PARKING CONSTRUCTION



SITE AREA: 0.374 HECTARES / 0.924 ACRES
32 CYCLE SPACES 40 PARKING SPACES

No.	Revision.	date	by
C.	Revised building shown.	04.04.17	JA
B.	Parking spaces 11,12 & 13 moved back 200mm following transport planners comments.	29.03.17	WD
A.	Boundary treatment revised & proposed trees added.	07.03.17	WD

PROPOSED DEVELOPMENT
THE CURLEW, PETERSFIELD ROAD
HAVANT
HAMPSHIRE
PO9 2HU

SUDS PLAN

scale	AS SHOWN @ A1	checked	//
date	FEBRUARY 2017	drawn	WD

FB 5728 / 104

A. B. C.

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Christchurch, Dorset, BH23 1EP

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E-mail: enquiries@andersrobertscheer.co.uk
Web: www.andersrobertscheer.co.uk

Appendix 4

Microdrainage calculations

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 3 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	99.555	0.055	59.0	12.7	O K
30 min Summer	99.556	0.056	59.0	12.9	O K
60 min Summer	99.546	0.046	54.6	9.5	O K
120 min Summer	99.538	0.038	42.0	6.3	O K
180 min Summer	99.533	0.033	32.6	4.9	O K
240 min Summer	99.530	0.030	26.1	4.1	O K
360 min Summer	99.526	0.026	19.6	3.0	O K
480 min Summer	99.523	0.023	15.9	2.5	O K
600 min Summer	99.522	0.022	14.0	2.1	O K
720 min Summer	99.520	0.020	12.1	1.8	O K
960 min Summer	99.518	0.018	9.8	1.5	O K
1440 min Summer	99.516	0.016	7.3	1.1	O K
2160 min Summer	99.513	0.013	5.2	0.8	O K
2880 min Summer	99.512	0.012	4.1	0.6	O K
4320 min Summer	99.510	0.010	3.1	0.5	O K
5760 min Summer	99.509	0.009	2.5	0.4	O K
7200 min Summer	99.508	0.008	2.0	0.3	O K
8640 min Summer	99.508	0.008	1.8	0.3	O K
10080 min Summer	99.507	0.007	1.6	0.3	O K
15 min Winter	99.559	0.059	59.0	14.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	126.074	0.0	12
30 min Summer	84.745	0.0	20
60 min Summer	54.368	0.0	34
120 min Summer	33.674	0.0	64
180 min Summer	25.065	0.0	94
240 min Summer	20.180	0.0	124
360 min Summer	14.839	0.0	186
480 min Summer	11.923	0.0	246
600 min Summer	10.054	0.0	308
720 min Summer	8.741	0.0	362
960 min Summer	7.003	0.0	480
1440 min Summer	5.114	0.0	722
2160 min Summer	3.727	0.0	1076
2880 min Summer	2.973	0.0	1428
4320 min Summer	2.159	0.0	2132
5760 min Summer	1.718	0.0	2864
7200 min Summer	1.438	0.0	3648
8640 min Summer	1.245	0.0	4416
10080 min Summer	1.102	0.0	5040
15 min Winter	126.074	0.0	12

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	99.554	0.054	59.0	12.2	O K
60 min Winter	99.541	0.041	48.7	7.7	O K
120 min Winter	99.533	0.033	32.6	4.9	O K
180 min Winter	99.529	0.029	24.4	3.7	O K
240 min Winter	99.526	0.026	19.6	3.0	O K
360 min Winter	99.522	0.022	14.6	2.2	O K
480 min Winter	99.520	0.020	12.1	1.8	O K
600 min Winter	99.518	0.018	9.8	1.5	O K
720 min Winter	99.517	0.017	8.8	1.3	O K
960 min Winter	99.515	0.015	6.9	1.0	O K
1440 min Winter	99.513	0.013	5.2	0.8	O K
2160 min Winter	99.511	0.011	3.7	0.6	O K
2880 min Winter	99.510	0.010	3.1	0.5	O K
4320 min Winter	99.509	0.009	2.3	0.3	O K
5760 min Winter	99.508	0.008	1.8	0.3	O K
7200 min Winter	99.507	0.007	1.6	0.2	O K
8640 min Winter	99.507	0.007	1.3	0.2	O K
10080 min Winter	99.506	0.006	1.2	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	84.745	0.0	20
60 min Winter	54.368	0.0	34
120 min Winter	33.674	0.0	64
180 min Winter	25.065	0.0	94
240 min Winter	20.180	0.0	126
360 min Winter	14.839	0.0	180
480 min Winter	11.923	0.0	244
600 min Winter	10.054	0.0	308
720 min Winter	8.741	0.0	358
960 min Winter	7.003	0.0	494
1440 min Winter	5.114	0.0	720
2160 min Winter	3.727	0.0	1100
2880 min Winter	2.973	0.0	1400
4320 min Winter	2.159	0.0	2224
5760 min Winter	1.718	0.0	3096
7200 min Winter	1.438	0.0	3544
8640 min Winter	1.245	0.0	4352
10080 min Winter	1.102	0.0	4824

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.167

Time (mins) From:	To:	Area (ha)
0	4	0.167

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Model Details

Storage is Online Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.35400	Width (m)	30.0
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	333.3	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.500	Membrane Depth (m)	0

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Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 64 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	98.784	0.284	1.8	8.1	O K
30 min Summer	98.853	0.353	1.9	10.1	O K
60 min Summer	98.890	0.390	1.9	11.1	O K
120 min Summer	98.892	0.392	1.9	11.2	O K
180 min Summer	98.872	0.372	1.9	10.6	O K
240 min Summer	98.847	0.347	1.9	9.9	O K
360 min Summer	98.796	0.296	1.8	8.4	O K
480 min Summer	98.750	0.250	1.8	7.1	O K
600 min Summer	98.709	0.209	1.7	6.0	O K
720 min Summer	98.673	0.173	1.7	4.9	O K
960 min Summer	98.617	0.117	1.6	3.3	O K
1440 min Summer	98.555	0.055	1.6	1.6	O K
2160 min Summer	98.539	0.039	1.2	1.1	O K
2880 min Summer	98.531	0.031	1.0	0.9	O K
4320 min Summer	98.523	0.023	0.7	0.6	O K
5760 min Summer	98.518	0.018	0.6	0.5	O K
7200 min Summer	98.515	0.015	0.5	0.4	O K
8640 min Summer	98.513	0.013	0.4	0.4	O K
10080 min Summer	98.512	0.012	0.4	0.3	O K
15 min Winter	98.823	0.323	1.8	9.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	126.074	0.0	17
30 min Summer	84.745	0.0	31
60 min Summer	54.368	0.0	52
120 min Summer	33.674	0.0	86
180 min Summer	25.065	0.0	120
240 min Summer	20.180	0.0	154
360 min Summer	14.839	0.0	220
480 min Summer	11.923	0.0	286
600 min Summer	10.054	0.0	348
720 min Summer	8.741	0.0	408
960 min Summer	7.003	0.0	522
1440 min Summer	5.114	0.0	738
2160 min Summer	3.727	0.0	1100
2880 min Summer	2.973	0.0	1468
4320 min Summer	2.159	0.0	2200
5760 min Summer	1.718	0.0	2888
7200 min Summer	1.438	0.0	3656
8640 min Summer	1.245	0.0	4304
10080 min Summer	1.102	0.0	5120
15 min Winter	126.074	0.0	17

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	98.905	0.405	1.9	11.5	O K
60 min Winter	98.952	0.452	2.0	12.9	O K
120 min Winter	98.950	0.450	2.0	12.8	O K
180 min Winter	98.918	0.418	1.9	11.9	O K
240 min Winter	98.878	0.378	1.9	10.8	O K
360 min Winter	98.801	0.301	1.8	8.6	O K
480 min Winter	98.732	0.232	1.7	6.6	O K
600 min Winter	98.673	0.173	1.7	4.9	O K
720 min Winter	98.624	0.124	1.6	3.5	O K
960 min Winter	98.558	0.058	1.6	1.7	O K
1440 min Winter	98.539	0.039	1.2	1.1	O K
2160 min Winter	98.528	0.028	0.9	0.8	O K
2880 min Winter	98.523	0.023	0.7	0.6	O K
4320 min Winter	98.517	0.017	0.5	0.5	O K
5760 min Winter	98.513	0.013	0.4	0.4	O K
7200 min Winter	98.511	0.011	0.3	0.3	O K
8640 min Winter	98.510	0.010	0.3	0.3	O K
10080 min Winter	98.509	0.009	0.3	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	84.745	0.0	31
60 min Winter	54.368	0.0	58
120 min Winter	33.674	0.0	92
180 min Winter	25.065	0.0	130
240 min Winter	20.180	0.0	168
360 min Winter	14.839	0.0	236
480 min Winter	11.923	0.0	302
600 min Winter	10.054	0.0	364
720 min Winter	8.741	0.0	420
960 min Winter	7.003	0.0	518
1440 min Winter	5.114	0.0	736
2160 min Winter	3.727	0.0	1104
2880 min Winter	2.973	0.0	1444
4320 min Winter	2.159	0.0	2148
5760 min Winter	1.718	0.0	2896
7200 min Winter	1.438	0.0	3552
8640 min Winter	1.245	0.0	4200
10080 min Winter	1.102	0.0	5112

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.040

Time (mins) From:	To:	Area (ha)
0	4	0.040

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Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.35800 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.35800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	30.0	0.600	0.0	41.0
0.500	30.0	41.0			

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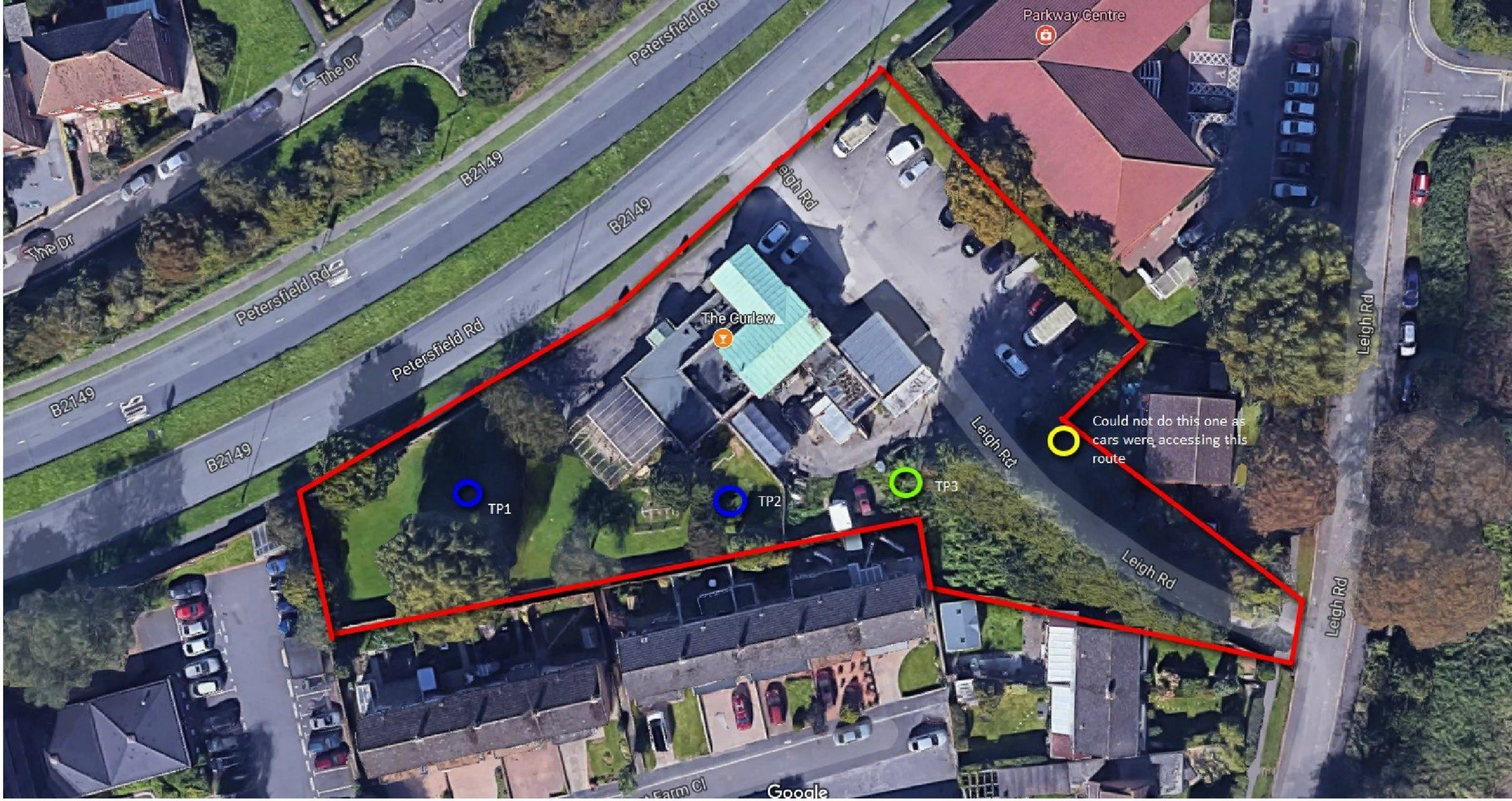
Appendix 5

Soakaway Test results


Parkway Centre
Petersfield Rd
The Dr
B2149
Leigh Rd
The Curlew
TP1
TP2
TP3
Could not do this one as cars were accessing this route
Google

Combined Services DW ltd @ THE CURLEW, PETERSFIELD ROAD, HAVANT, PO9 2HU	Infiltration testing to determine soil capability		Revision	
	Job No:	GR1	Page:	C/01
Section: Infiltration/percolation Test hole 1 -	Prepared By:	DJH	Date:	18/08/2017

SUMMARY OF CALCULATIONS		
critical design rainfall duration 't_{crit}' =	60	*min*
required storage volume 'V_{req}' =	5.99	m^3
provided storage volume 'V_{prov}' =	6.70	m^3
utilisation factor =	**0.89**	***.OK***
required time to discharge 50% 't_{50}' =	1.32	*hours*
utilisation factor =	**0.06**	***.OK***

GENERAL DATA	
site location:	**England and Wales**
soakaway type:	**perforated concrete ring**
pit shape:	**square pit around ring**
impermeable area drained to soakaway 'A' *[m^2]* =	**150**
60 min rainfall depth of 5 year return period 'R' *[mm]* =	**20**
M5-60 to M5-2d rainfall ratio 'r' =	**0.35**
allowance for climate change:	**40%**

SOAKAWAY DATA	
number of ring soakaways:	**1**
square pit side length 'L' [m] =	**2.50**
soakaway ring internal diameter 'D_{int}' *[mm]* =	**1500**
total depth from ground level 'D_b' *[m]* =	**1.50**
depth to drain invert level 'D_d' *[m]* =	**0.30**
soakaway effective depth 'D_{eff}' *[m]* =	1.20
free volume in infill aggregate *[%]* =	**90**

SOIL INFILTRATION DATA	
allowance for infiltration through soakaway base:	**No**
available on-site infiltration test results:	◉ Yes ○ No
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	5.76
storage volume between 75-25% 'V_p' [m^3] =	0.89
time for water to fall from 75-25% 't_p' [min] =	21.95
soil infiltration rate 'f' [m/s] =	1.17E-04

SOAKAGE TRIAL PIT DATA	
soakage trial pit width 'W_t' *[m]* =	**0.60**
soakage trial pit length 'L_t' *[m]* =	**3.00**
total depth from ground level 'D_{tb}' *[m]* =	**1.50**
depth to pipe invert level 'D_{tp}' *[m]* =	**0.40**
soakage trial pit effective depth 'D_{teff}' *[m]* =	1.10
free volume in infill aggregate *[%]* =	**90**

NOTE: faces of excavation assumed to be vertical

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	1.80	1.84	18.39	2.76				0.21	2.55
10	0.51	10.13	1.22	17.32	2.60	1.91	27.13	4.07				0.42	3.65
15	0.62	12.33	1.23	21.23	3.18	1.95	33.62	5.04				0.63	4.41
30	0.79	15.73	1.24	27.31	4.10	2.00	43.96	6.59				1.27	5.33
60	1.00	20.00	1.24	34.72	5.21	2.03	56.84	8.53				2.54	**5.99**
120	1.22	24.47	1.24	42.47	6.37	2.01	68.92	10.34				5.07	5.26
240	1.50	29.93	1.22	51.14	7.67	1.97	82.58	12.39				10.15	2.24
360	1.69	33.80	1.21	57.19	8.58	1.94	91.78	13.77				15.22	0.00
600	1.95	38.93	1.19	65.04	9.76	1.90	103.48	15.52				25.37	0.00
1440	2.48	49.60	1.17	81.30	12.20	1.81	125.91	18.89				60.89	0.00

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	10	15	20	25	30	35	40	45	50	55	60								
	depth to water *[m]* =	0.50	0.56	0.61	0.73	0.82	0.92	1.19	1.29	1.36	1.42	1.48								
Soakage Trial 2	time *[min]* =	10	15	20	25	30	35	40	45	50	55									
	depth to water *[m]* =	0.50	0.61	0.72	0.76	0.89	0.97	1.23	1.32	1.40	1.49									
Soakage Trial 3	time *[min]* =																			
	depth to water *[m]* =																			

Combined Services DW ltd @ THE CURLEW, PETERSFIELD ROAD, HAVANT, PO9 2HU	Infiltration testing to determine soil capability		Revision	
	Job No:	GR1	Page:	C/01
Section: Infiltration/percolation Test hole 2 -	Prepared By:	DJH	Date:	18/08/2017

SUMMARY OF CALCULATIONS		
critical design rainfall duration 't_{crit}' =	60	*min*
required storage volume 'V_{req}' =	6.40	m^3
provided storage volume 'V_{prov}' =	6.70	m^3
utilisation factor =	**0.96**	***.OK***
required time to discharge 50% 't_{50}' =	1.58	*hours*
utilisation factor =	**0.07**	***.OK***

GENERAL DATA	
site location:	**England and Wales**
soakaway type:	**perforated concrete ring**
pit shape:	**square pit around ring**
impermeable area drained to soakaway 'A' *[m^2]* =	**150**
60 min rainfall depth of 5 year return period 'R' *[mm]* =	**20**
M5-60 to M5-2d rainfall ratio 'r' =	**0.35**
allowance for climate change:	**40%**

SOAKAWAY DATA	
number of ring soakaways:	**1**
square pit side length 'L' [m] =	**2.50**
soakaway ring internal diameter 'D_{int}' *[mm]* =	**1500**
total depth from ground level 'D_b' *[m]* =	**1.50**
depth to drain invert level 'D_d' *[m]* =	**0.30**
soakaway effective depth 'D_{eff}' *[m]* =	1.20
free volume in infill aggregate *[%]* =	**90**

SOIL INFILTRATION DATA	
allowance for infiltration through soakaway base:	**No**
available on-site infiltration test results:	◉ Yes ○ No
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	1.40
storage volume between 75-25% 'V_p' [m^3] =	0.14
time for water to fall from 75-25% 't_p' [min] =	16.34
soil infiltration rate 'f' [m/s] =	9.83E-05

SOAKAGE TRIAL PIT DATA	
soakage trial pit width 'W_t' *[m]* =	**0.60**
soakage trial pit length 'L_t' *[m]* =	**1.00**
total depth from ground level 'D_{tb}' *[m]* =	**0.50**
depth to pipe invert level 'D_{tp}' *[m]* =	**0.00**
soakage trial pit effective depth 'D_{teff}' *[m]* =	0.50
free volume in infill aggregate *[%]* =	**90**

NOTE: faces of excavation assumed to be vertical

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	1.80	1.84	18.39	2.76				0.18	2.58
10	0.51	10.13	1.22	17.32	2.60	1.91	27.13	4.07				0.35	3.72
15	0.62	12.33	1.23	21.23	3.18	1.95	33.62	5.04				0.53	4.51
30	0.79	15.73	1.24	27.31	4.10	2.00	43.96	6.59				1.06	5.53
60	1.00	20.00	1.24	34.72	5.21	2.03	56.84	8.53				2.12	6.40
120	1.22	24.47	1.24	42.47	6.37	2.01	68.92	10.34				4.25	6.09
240	1.50	29.93	1.22	51.14	7.67	1.97	82.58	12.39				8.50	3.89
360	1.69	33.80	1.21	57.19	8.58	1.94	91.78	13.77				12.74	1.02
600	1.95	38.93	1.19	65.04	9.76	1.90	103.48	15.52				21.24	0.00
1440	2.48	49.60	1.17	81.30	12.20	1.81	125.91	18.89				50.98	0.00

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	10	15	20	25	30	35													
	depth to water *[m]* =	0.00	0.12	0.22	0.29	0.38	0.48													
Soakage Trial 2	time *[min]* =	10	15	20	25	30	35													
	depth to water *[m]* =	0.00	0.10	1.19	0.26	0.34	0.46													
Soakage Trial 3	time *[min]* =																			
	depth to water *[m]* =																			

Combined Services DW ltd @ THE CURLEW, PETERSFIELD ROAD, HAVANT, PO9 2HU	Infiltration testing to determine soil capability		Revision	
	Job No:	GR1	Page:	C/01
Section: Infiltration/percolation Test hole 3 -	Prepared By:	DJH	Date:	18/08/2017

SUMMARY OF CALCULATIONS		
critical design rainfall duration 't_{crit}' =	60	*min*
required storage volume 'V_{req}' =	5.40	m^3
provided storage volume 'V_{prov}' =	6.70	m^3
utilisation factor =	**0.81**	***.OK***
required time to discharge 50% 't_{50}' =	1.07	*hours*
utilisation factor =	**0.04**	***.OK***

GENERAL DATA	
site location:	**England and Wales**
soakaway type:	**perforated concrete ring**
pit shape:	**square pit around ring**
impermeable area drained to soakaway 'A' *[m^2]* =	**150**
60 min rainfall depth of 5 year return period 'R' *[mm]* =	**20**
M5-60 to M5-2d rainfall ratio 'r' =	**0.35**
allowance for climate change:	**40%**

SOAKAWAY DATA	
number of ring soakaways:	**1**
square pit side length 'L' [m] =	**2.50**
soakaway ring internal diameter 'D_{int}' *[mm]* =	**1500**
total depth from ground level 'D_b' *[m]* =	**1.50**
depth to drain invert level 'D_d' *[m]* =	**0.30**
soakaway effective depth 'D_{eff}' *[m]* =	1.20
free volume in infill aggregate *[%]* =	**90**

SOIL INFILTRATION DATA	
allowance for infiltration through soakaway base:	**No**
available on-site infiltration test results:	◉ Yes ○ No
use soakage trial pit table below	
internal surface area of trial pit 'a_{p50}' [m^2] =	1.40
storage volume between 75-25% 'V_p' [m^3] =	0.14
time for water to fall from 75-25% 't_p' [min] =	11.12
soil infiltration rate 'f' [m/s] =	1.45E-04

SOAKAGE TRIAL PIT DATA	
soakage trial pit width 'W_t' *[m]* =	**0.60**
soakage trial pit length 'L_t' *[m]* =	**1.00**
total depth from ground level 'D_{tb}' *[m]* =	**0.50**
depth to pipe invert level 'D_{tp}' *[m]* =	**0.00**
soakage trial pit effective depth 'D_{teff}' *[m]* =	0.50
free volume in infill aggregate *[%]* =	**90**

NOTE: faces of excavation assumed to be vertical

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	1.80	1.84	18.39	2.76				0.26	2.50
10	0.51	10.13	1.22	17.32	2.60	1.91	27.13	4.07				0.52	3.55
15	0.62	12.33	1.23	21.23	3.18	1.95	33.62	5.04				0.78	4.26
30	0.79	15.73	1.24	27.31	4.10	2.00	43.96	6.59				1.56	5.03
60	1.00	20.00	1.24	34.72	5.21	2.03	56.84	8.53				3.12	**5.40**
120	1.22	24.47	1.24	42.47	6.37	2.01	68.92	10.34				6.25	4.09
240	1.50	29.93	1.22	51.14	7.67	1.97	82.58	12.39				12.49	0.00
360	1.69	33.80	1.21	57.19	8.58	1.94	91.78	13.77				18.74	0.00
600	1.95	38.93	1.19	65.04	9.76	1.90	103.48	15.52				31.23	0.00
1440	2.48	49.60	1.17	81.30	12.20	1.81	125.91	18.89				74.96	0.00

** Z2 is a growth factor from M5 rainfalls*

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	water level measurement N°:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Soakage Trial 1	time *[min]* =	10	15	20	25	30														
	depth to water *[m]* =	0.00	0.13	0.28	0.39	0.47														
Soakage Trial 2	time *[min]* =	10	15	20	25	30														
	depth to water *[m]* =	0.00	0.17	0.26	0.38	0.46														
Soakage Trial 3	time *[min]* =																			
	depth to water *[m]* =																			