

[REDACTED]

From: Robert Steventon [REDACTED]
Sent: 02 October 2019 16:38
To: Laura Gibbons <Laura.Gibbons@arun.gov.uk>
Cc: Paul Cann <Paul.Cann@arun.gov.uk>; Andrew Wood <Andrew.Wood@arun.gov.uk>;
[REDACTED] Wayne Stutchbury' [REDACTED] Kevin Lang'
Subject: RE: Planning Consultation on A/113/19/DOC - Angmering site

Laura,

Thanks for your responses, we have provided additional information in the enclosed letter.

Please call if you wish to discuss.

Kind regards,

Robert Steventon
Civil Engineer

[REDACTED]

From: Laura Gibbons <Laura.Gibbons@arun.gov.uk>
Sent: 17 September 2019 16:14
To: Robert Steventon [REDACTED]
Cc: Paul Cann <Paul.Cann@arun.gov.uk>; Andrew Wood <Andrew.Wood@arun.gov.uk>;
[REDACTED] Wayne Stutchbury' <wayne@countyoakhomes.co.uk>; Kevin Lang
Subject: RE: Planning Consultation on A/113/19/DOC - Angmering site

Hi Robert,

Comments below.

Key

Original comments

Your response

My response

1. Groundwater monitoring was undertaken and recorded groundwater to shallow depths of 0.43, 0.66 and 0.89mbgl. It is accepted that the results from WS1 and WS2 should be used for the surface water drainage design as they are relevant to the areas proposed for infiltration. It is not clear what the maximum recorded groundwater level was at each monitoring location respectively. Please can this be confirmed.

We enclose additional documents from Constructive Evaluation as part of their investigation. This provides full details of the groundwater monitoring. The highest and lowest groundwater levels at each location are as follows;

WS1 max = 1.48m bgl min = 1.69m bgl

WS2 max = 0.83m bgl min = 1.13m bgl

WS3 max = 0.43m bgl min = 1.04m bgl

2. Infiltration testing was completed at one location and gave rates of $5.13 \times 10^{-4} \text{ms}^{-1}$ at 0.9m depth. This is deeper than the highest recorded groundwater levels and the scarcity of infiltration testing is of significant concern. We would have expected at least one further infiltration test, ideally two further tests at the proposed location and depth of infiltrating structures.

The infiltration test was close to WS3 where the groundwater level is lower. The testing was in accordance with BRE365 and the location and depth close to the proposed filter drain. You state that testing was completed at WS3, maximum recorded groundwater level here was 0.43mbgl. Therefore, I stand by my comment that this was completed deeper than maximum recorded groundwater level. One test location is inadequate. The test location is also a long way from the proposed infiltrating structures.

3. Please can an impermeable areas plan be provided that clearly shows the impermeable areas draining to each surface water drainage feature. Please refer to enclosed drawing 191183/SK/04 for impermeable areas. This will likely need to be revised due to comment 9 below.
4. The filter drain is inadequate. Maximum modelled water depths are nearly 1m. This clearly will not be able to be contained above maximum recorded groundwater level. The groundwater monitoring found that the highest groundwater level in the vicinity of the filter drain was 1.48m below ground level. This has been shown on the filter drain long section 191183 2 Crete Nursery, Dappers Lane, Angmering, Bn16 4en11 September 2019 drawing 191183/520/02 and therefore the filter drain will be above the maximum groundwater level. As shown on the drawing, Filter Drain 1 is flat, and Filter Drain 2 is sloped, and this is correctly reflected in the MicroDrainage calculations. Location actually appears to be between WS1 and WS2. For clarity, please overlay monitoring locations onto drainage strategy drawing.
5. From looking at cross sections it also appears that the filter drain will be on a slope, please ensure this is accurately depicted within calculations.
6. Please provide evidence that a resin bound surface with open surface course asphalt is permeable. We have significant concerns over the permeability of this type of surface now and over the design lifetime. Please refer to the enclosed brochure for the Clearstone permeable resin bound surfacing. The brochure provides us with no confidence regarding this. Type 3 is not permeable. We would require independent evidence of permeability.
7. A permeable liner should fully wrap around the sub-base of the permeable paving areas. Please refer to drawing 191183/SD/01. Okay.
8. Please confirm material specification for filter drain. All sub-base material should be no fines. Please refer to drawing 191183/SD/01. Type 3 is not permeable.
9. Are diffusers to be used to disperse surface water into permeable paving subbases? Please provide construction details and locations of these if so. Diffusers should be located 5m from buildings, therefore the use of permeable patios to receive roof water is not acceptable. Diffusers have been added to the drawing. The patios have an impermeable surface so that rainwater runs off onto the grass and the subbase

is only infiltrating the roof runoff. As stated, diffusers should not be located within 5m of buildings. Permeable structures adjacent to buildings can receive water falling directly upon them, but should not receive concentrated rainwater within 5m of buildings.

10. Catchpits must be provided upstream of all connections to permeable paving. Please ensure the location of rwp, catchpits, and connections to permeable areas are clearly shown on plan. The discharge into the permeable paving is only taking roof runoff so will contain minimal silt/fines and it is considered excessive to provide catchpits on all connection to the patios and driveways. The rainwater down pipes will have access points to allow for maintenance. *Catchpits must be provided upstream of all connections to permeable paving, this is as per CIRIA C753. Think about how much debris sits in a standard gutter.*
11. Please provide invert levels and cover levels of all inspection chambers, manholes, filter drains, etc. Please also ensure that finish and formation level of permeable paving is clearly provided on plan. Please refer to drawing 191183/500/01. I will review further once GW and infiltration testing result acceptability has been agreed.

Kind Regards,

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: 37818 | External: +44 (0) 1903 737818 | Fax: +44 (0) 1903 716018 | E-mail: laura.gibbons@arun.gov.uk

Arun is Working in Partnership with Chichester District Council

Visit Arun's web site at <http://www.arun.gov.uk/> and www.chichester.gov.uk



Save the environment - think before you print.

From: Robert Steventon [REDACTED]
Sent: 11 September 2019 15:15
To: Laura Gibbons <Laura.Gibbons@arun.gov.uk>
Cc: Paul Cann <Paul.Cann@arun.gov.uk>; Andrew Wood <Andrew.Wood@arun.gov.uk>; [REDACTED] Wayne Stutchbury' [REDACTED]; Kevin Lang
Subject: FW: Planning Consultation on A/113/19/DOC - Angmering site

Laura,

Further to your comments below we enclose a letter providing responses and the updated engineering drawings for the development.

The aim of the surface water strategy is to discharge all runoff to ground in accordance with the SuDS hierarchy. Due to the high groundwater table the use of soakaways is not viable, so runoff is discharged via permeable paving. If this strategy is not acceptable then the only alternative is to provide an attenuation tank with a discharge to the culvert, which we are trying to avoid.

Please call if you have any queries.

Kind regards,

Robert Steventon
Civil Engineer



[REDACTED]

From: Mark Goodchild <[REDACTED]>
Sent: 06 September 2019 16:07
To: [REDACTED]
Cc: 'Wayne Stutchbury' <[REDACTED]>; Richard Sloman <[REDACTED]>
Daniel Burton <[REDACTED]>
Subject: FW: Planning Consultation on A/113/19/DOC - Angmering site

Dear Robert,

Please see below for an email from the local authorities drainage consultant.

Regards

Mark Goodchild

Architect & Director

The logo for Nye Saunders chartered architects. The name 'Nye saunders' is in a large, stylized, lowercase font. Below it, 'chartered architects' is written in a smaller, cursive script.

[REDACTED]

Please Note: The information contained in this email is confidential and may be legally privileged. If you are not the intended recipient, you must not read, use or disseminate this information. If this email has been sent to you in error, please delete all copies and any attachments and please also inform us by return email and we will ensure that your details are removed as applicable. Although this email and its attachments are believed to be free of any virus or any other defect which might affect any computer or IT system into which they are received and opened, it is the responsibility of the recipient to ensure that they are virus free and no responsibility is accepted by Nye Saunders Ltd for any loss or damage arising in any way from receipt thereof.

From: Admin Dept. <[REDACTED]>
Sent: 06 September 2019 13:28
To: Mark Goodchild <[REDACTED]>; Richard Sloman <[REDACTED]>
Cc: Daniel Burton <[REDACTED]> Admin Dept. <[REDACTED]>
Subject: FW: Planning Consultation on A/113/19/DOC - Angmering site

From: Andrew Wood <Andrew.Wood@arun.gov.uk>
Sent: 06 September 2019 11:03
To: Admin Dept. <[REDACTED]>
Subject: FW: Planning Consultation on A/113/19/DOC

Attention Richard Sloman,

Please see additional information request. Please do negotiate directly with Laura Gibbons ADC Drainage Engineer. Contact details below. Thank you,

Andrew Wood

Andrew Wood MRTPI | Senior Planning Officer, Planning Department, Arun District Council |
Location: 1st Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
Internal: 37768 | External: +44 (0) 1903 737768 | E-mail: andrew.wood@arun.gov.uk

Visit Arun's web site at www.arun.gov.uk



Save the environment - think before you print.

From: Laura Gibbons <Laura.Gibbons@arun.gov.uk>

Sent: 05 September 2019 10:37

To: Planning.Responses <Planning.Responses@arun.gov.uk>

Cc: Andrew Wood <Andrew.Wood@arun.gov.uk>

Subject: RE: Planning Consultation on A/113/19/DOC

Engineers Comments Regarding Condition 9- surface water drainage design

1. Groundwater monitoring was undertaken and recorded groundwater to shallow depths of 0.43, 0.66 and 0.89mbgl. It is accepted that the results from WS1 and WS2 should be used for the surface water drainage design as they are relevant to the areas proposed for infiltration. It is not clear what the maximum recorded groundwater level was at each monitoring location respectively. Please can this be confirmed.
2. Infiltration testing was completed at one location and gave rates of $5.13 \times 10^{-4} \text{ms}^{-1}$ at 0.9m depth. This is deeper than the highest recorded groundwater levels and the scarcity of infiltration testing is of significant concern. We would have expected at least one further infiltration test, ideally two further tests at the proposed location and depth of infiltrating structures.
3. Please can an impermeable areas plan be provided that clearly shows the impermeable areas draining to each surface water drainage feature.
4. The filter drain is inadequate. Maximum modelled water depths are nearly 1m. This clearly will not be able to be contained above maximum recorded groundwater level.
5. From looking at cross sections it also appears that the filter drain will be on a slope, please ensure this is accurately depicted within calculations.
6. Please provide evidence that a resin bound surface with open surface course asphalt is permeable. We have significant concerns over the permeability of this type of surface now and over the design lifetime.
7. A permeable liner should fully wrap around the sub-base of the permeable paving areas.
8. Please confirm material specification for filter drain. All sub-base material should be no fines.
9. Are diffusers to be used to disperse surface water into permeable paving subbases? Please provide construction details and locations of these if so. Diffusers should be located 5m from buildings, therefore the use of permeable patios to receive roof water is not acceptable.
10. Catchpits must be provided upstream of all connections to permeable paving. Please ensure the location of rwp, catchpits, and connections to permeable areas are clearly shown on plan.
11. Please provide invert levels and cover levels of all inspection chambers, manholes, filter drains, etc. Please also ensure that finish and formation level of permeable paving is clearly provided on plan.

Comments Regarding condition 10- discharge of flows to watercourse

It would not be appropriate to approve condition 10 whilst the surface water drainage design is still being revised.

Comments Regarding condition 11- SuDS maintenance manual

It would not be appropriate to review the adequacy of the maintenance manual whilst the surface water drainage design is still being revised. I will provide comments once the details of condition 9 are agreed.

Regards,

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: 37818 | External: +44 (0) 1903 737818 | Fax: +44 (0) 1903 716018 | E-mail: laura.gibbons@arun.gov.uk
Arun is Working in Partnership with Chichester District Council
Visit Arun's web site at <http://www.arun.gov.uk/> and www.chichester.gov.uk



Save the environment - think before you print.

From: planning.responses@arun.gov.uk <planning.responses@arun.gov.uk>

Sent: 02 September 2019 11:06

To: Land Drainage <Land.Drainage@arun.gov.uk>

Subject: Planning Consultation on A/113/19/DOC

To: **Engineers (Drainage)**

NOTIFICATION FROM ARUN DISTRICT COUNCIL

TOWN AND COUNTRY PLANNING ACT 1990

APPLICATION NO: A/113/19/DOC

Registered: 22-AUG-19

Site Address: Crete Nursery Dappers Lane Angmering BN16 4EN

Description of Works: Approval of details reserved by condition imposed under ref A/178/17/OUT relating to Condition Nos 4 - external lighting, 5 - construction management plan, 6 - road safety audit, 7 - visibility splays, 8 - footway, 9 - proposed surface water drainage, 10 - discharge flows to watercourses, 11 - SuDs system and 13 - future access & management of any watercourse or culvert.

The Council have received the above application to discharge conditions. I shall be pleased to receive any observations you may wish to make in respect of those conditions relating to your field of expertise.

[Click here to view the Discharge of Condition application](#)

[Click here to view conditions on original application - click on decision tab](#)

Should you have any comments to make, these should be sent by replying to this email by 16th September 2019.

www.arun.gov.uk/planning

Please be aware that any comments you may make will be available on our website so please do not insert personal details or signatures on your reply.

In the absence of a reply within the period stated, I shall assume that you have no observations to make.

The officer dealing with this application is Andrew Wood who can be contacted on telephone number 01903 737768.

Thanking you in anticipation

Planning Case Officer
Arun District Council

post_con_email

<http://www.arun.gov.uk>

DX 57406 Littlehampton

You can view Arun District Council's Privacy Policy from <https://www.arun.gov.uk/privacy-policy>

Important Notice This e-mail is intended exclusively for the addressee and may contain information that is confidential and/or privileged. If you are not the intended recipient (or authorised to receive it for the addressee), please notify the sender and delete the e-mail immediately; using, copying, or disclosing it to anyone else, is strictly prohibited and may be unlawful. Any views, opinions or options presented are solely those of the author and do not necessarily represent those of Arun District Council. The information in this e-mail may be subject to public disclosure under the Freedom of Information Act 2000, therefore we cannot guarantee that we will not provide the whole or part of this e-mail to a third party. The Council reserves the right to monitor e-mails in accordance with relevant legislation. Whilst outgoing e-mails are checked for viruses, we cannot guarantee this e-mail is virus-free or has not been intercepted or changed and we do not accept liability for any damage caused. Any reference to "e-mail" in this disclaimer includes any attachments.

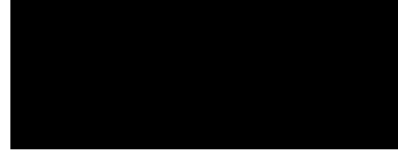
<http://www.arun.gov.uk>

DX 57406 Littlehampton

You can view Arun District Council's Privacy Policy from <https://www.arun.gov.uk/privacy-policy>

Important Notice This e-mail is intended exclusively for the addressee and may contain information that is confidential and/or privileged. If you are not the intended recipient (or authorised to receive it for the addressee), please notify the sender and delete the e-mail immediately; using, copying, or disclosing it to anyone else, is strictly prohibited and may be unlawful. Any views, opinions or options presented are solely those of the author and do not necessarily represent those of Arun District Council. The information in this e-mail may be subject to public disclosure under the Freedom of Information Act 2000, therefore we cannot guarantee that we will not provide the whole or part of this e-mail to a third party. The Council reserves the right to monitor e-mails in accordance with relevant legislation. Whilst outgoing e-mails are checked for viruses, we cannot guarantee this e-mail is virus-free or has not been intercepted or changed and we do not accept liability for any damage caused. Any reference to "e-mail" in this disclaimer includes any attachments.

Thorogood House
34 Tolworth Close
Surbiton
Surrey
KT6 7EW



Laura Gibbons
Arun District Council
First Floor
Arun Civic Centre
Maltravers Road
Littlehampton
BN17 5LF

Our Ref: 191183

02 October 2019

Dear Laura,

CRETE NURSERY, DAPPERS LANE, ANGMERING, BN16 4EN

Thank you for your response to our letter, we have considered these items and have provided further responses below.

1, 2, 4 Having reviewed the information previously provided to you, it appears we may have provided some misleading information in respect of the location of the infiltration testing. We previously referred to the infiltration testing being carried out close to WS3, when we should have stated WS1. In actual fact, the infiltration test was carried out in TP1, as identified on the attached location plan; apologies for any confusion this may have created. With this in mind, we are confident that the on-site testing, supports the detailed design we have prepared.

During the on-site soil investigation, the geotechnical engineers found the ground conditions to be consistent across the site. Accordingly, they took the informed decision to only undertake one percolation test. As the soakage test was undertaken adjacent to the proposed filter drain, this procedure is fully in accordance with BRE365. In this scenario and on a site of this size, it is not uncommon for one soakage to be undertaken.

6, 8 We are slightly confused as to why you believe Type 3 sub-base is not a permeable material. Type 3 (DfT Type 3) material is commonly recognised and used as a permeable sub-base within SuDS compliant designs. It is listed as a suitable material for permeable paving sub-base in CIRIA C753 Table 20.13, as well as being referenced as a suitable sub-base by the

MCHW Clause 805. With this in mind, we would be grateful if this could now be confirmed as an acceptable sub-base.

We have enclosed BBA Agreement Certificate 18/5548 for the resin bound surfacing proposed. The British Board of Agreement are accredited as the industry leaders in independent testing and we would hope that the attached, detailed certificate will provide you with the reassurance you require to accept this material.

- 9 CIRIA report C753 does not state that diffusers must be 5m from a building. Susdrain / CIRIA have published guidance on the use of SuDS close to buildings, copy enclosed. The guidance recommends a ratio of impermeable area to base area of less than 10:1. For the proposed permeable paving the ratios are between 1.5:1 and 2.6:1. The maximum depth of water in the sub-base is between 50mm and 182mm which again is less than the 300mm in this guidance. Therefore, we consider the proposed permeable paving with diffusers, in the locations shown, to be acceptable in this situation and ask that you reconsider your position on this issue.

Although, we do not believe that the proposed roof finishes will generate a silt run-off that would necessitates the use of catchpits, we are happy to provide them to alleviate your concerns and will add these to the drawings.

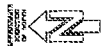
Given our responses above, please could you confirm that the proposed filter drain, Type 3 material and diffuser boxes within 5m of a building are all acceptable and we will update our drawings with the other items.

Please call if you have any queries.

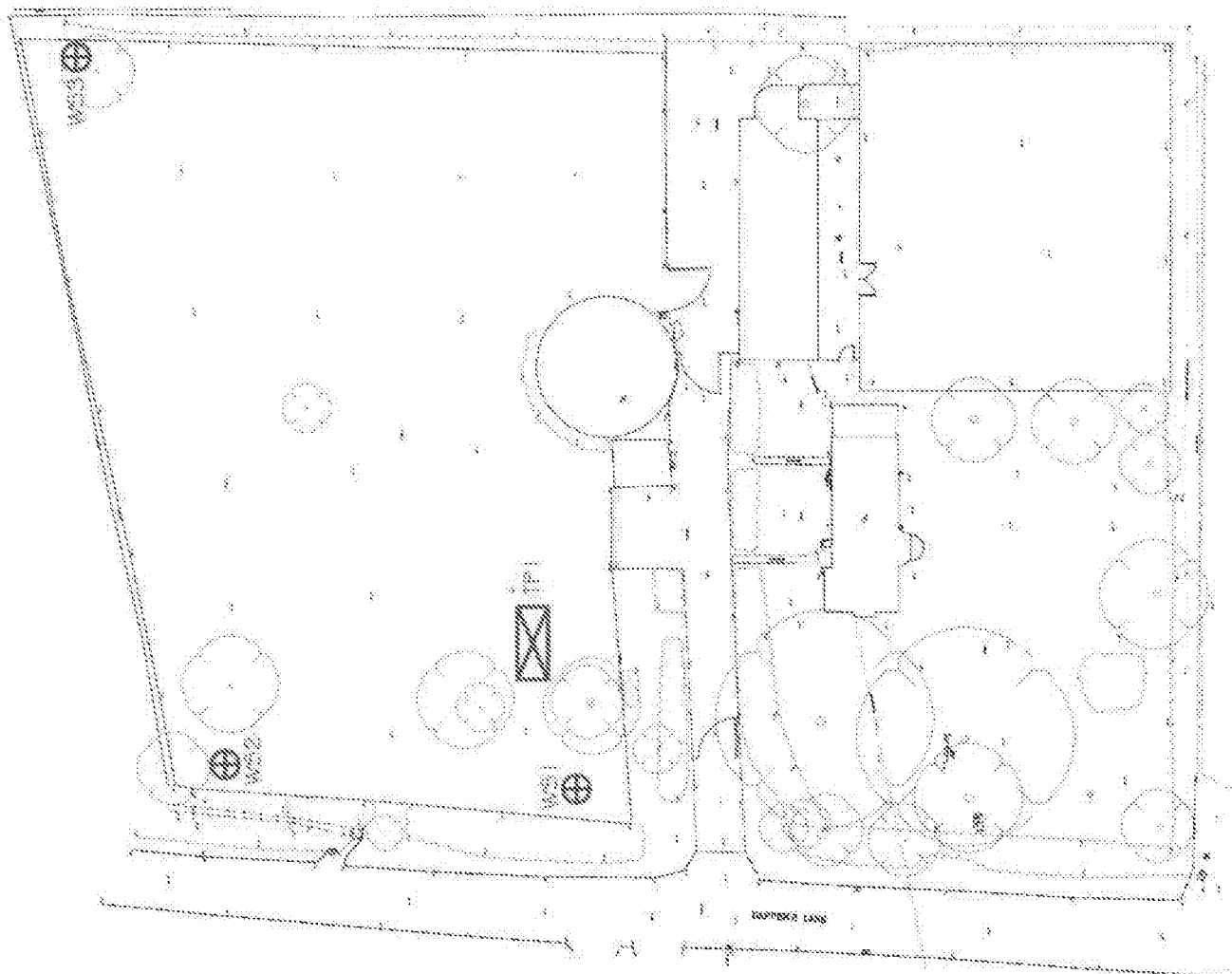
Yours sincerely

Robert Steventon

Enclosed: Site Investigation Plan
BBA Certificate 18/5548
Using SuDS close to buildings



ADJOINING PROPERTIES



- NOTES
1. Do not scale from this drawing.
 2. All dimensions are in metres.
 3. All dimensions are to be taken from the centre of the road.
 4. The drawing is the property of the Council and is not to be reproduced without written permission.

date	checked	drawn
------	---------	-------

evaluation

client	10/11/18
--------	----------

project	10/11/18
---------	----------

drawing	10/11/18
---------	----------

date	checked	drawn
------	---------	-------

Clearstone Paving Ltd

Unit 5A, Valley Farm Business Park
Reeds Lane
Sayers Common
West Sussex BN6 9JQ



Agrément Certificate

18/5548

Product Sheet 1

CLEARSTONE RESIN BOUND SURFACING

CLEARBOUND

This Agrément Certificate Product Sheet⁽¹⁾ relates to Clearbound, a resin bound aggregate surfacing system with enhanced UV resistance, for use as a surface course in landscaping domestic driveways, patios, tree pits, pedestrian areas, lightly trafficked car-parks, low speed access roads and lightly trafficked areas.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Strength and stability — the system has satisfactory resistance to the loads associated with vehicle and pedestrian traffic conditions for which it is designed (see section 6).

Surface characteristics — the system has satisfactory slip and skid resistance and is resistant to wear (see section 7).

Rainwater drainage — the system can be designed to have sufficient rainwater drainage properties to eliminate surface ponding (see section 8).

Durability — when used in the applications described in this Certificate, the system will retain its integrity and have a service life in excess of that of a traditional asphalt surface course. Rainwater drainage can be maintained provided that a maintenance schedule, including regular suction cleaning and sweeping, is implemented (see section 10).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 28 August 2018

Paul Valentine

Technical Excellence Director

Claire Curtis-Thomas

Chief Executive

The BBA is a UKAS accredited certification body – Number 113.

The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk. Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

British Board of Agrément

Bucknalls Lane

Watford

Herts WD25 9BA

©2018

Regulations

In the opinion of the BBA, Clearbound, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	H3(2)	Drainage of paved areas
Comment:		The system can contribute to the dissipation of rainwater from pavement areas and minimise the risk of ponding. See section 8 of this Certificate.
Requirement:	M1	Access to and use of buildings other than dwellings (Volume 2)
Requirement:	M2	Access to extensions to buildings other than dwellings
Requirement:	M4(1)(2)(3)	Access to and use of buildings Volume 1: Dwellings
Comment:		The system is suitable for use as a surface course in car parks and on approach routes, providing external access to dwellings and buildings other than dwellings. See section 4.1 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system is acceptable. See section 10 and the <i>Installation</i> part of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The system can contribute to a construction satisfying this Regulation. See sections 9 and 10 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	2.12	Fire and rescue service access
Comment:		The system will contribute to satisfying the relevant requirements of this Standard, with reference to clauses 2.12.0 ⁽¹⁾⁽²⁾ , 2.12.2 ⁽¹⁾⁽²⁾ and 2.12.3 ⁽¹⁾⁽²⁾ . See section 4.1 of this Certificate.
Standard:	3.6	Surface water drainage
Comment:		The system will contribute to satisfying the relevant requirements for rainwater drainage in this Standard, with reference to clauses 3.6.2 ⁽¹⁾⁽²⁾ , 3.6.3 ⁽¹⁾⁽²⁾ , 3.6.4 ⁽¹⁾⁽²⁾ and 3.6.6 ⁽¹⁾⁽²⁾ . See section 8 of this Certificate.
Standard:	4.1	Access to Buildings
Comment:		Use of the system will contribute towards compliance with this Standard, with reference to clause 4.1.4 ⁽¹⁾⁽²⁾ . See section 4.1 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The system can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	Building standards applicable to conversions
Comment:		All comments given for the system under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i-iv)(b)(i)	Fitness of materials and workmanship
Comment:		The system is acceptable. See section 10 and the <i>Installation</i> part of this Certificate.
Regulation:	82(a)(b)	Rainwater drainage
Comment:		The system will contribute to the dissipation of rainwater from pavement areas and minimise the risk of ponding. See section 8 of this Certificate.
Regulation:	37	Facilities and access for the Fire and Rescue Service
Regulation:	91	Access and use
Regulation:	92	Access to extensions
Comment:		The system will contribute to satisfying the relevant requirements for vehicular and non-vehicular access routes and hardstanding areas in these Regulations. See section 4.1 of this Certificate.

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: 3 *Delivery and site handling* of this Certificate.

Additional Information

NHBC Standards 2018

In the opinion of the BBA, Clearbound, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards, Chapter 10.2 Drives, paths and landscaping*.

Technical Specification

1 Description

1.1 Clearbound is a resin bound surface course system comprising a two-component, solvent-free, cold-applied polyurethane binder, and fine and coarse 5 and 10 mm sized aggregates.

1.2 Other components which may be used with the system, but which are outside the scope of this Certificate, are:

- glass grit, broadcast onto surfaces where additional skid/slip resistance may be required
- catalyst which may be mixed with the binder to reduce curing times, if necessary.

2 Manufacture

2.1 The binder components are manufactured using a batch process.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

The Certificate holder has taken the responsibility of classifying and labelling the binder components under the *CLP Regulation (EC) No 1272 / 2008 on the classification, labelling and packaging of substances and mixtures*. Users must refer to the relevant Safety Data Sheet(s).

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Clearbound.

Design Considerations

4 Use



4.1 Clearbound is satisfactory for use as a surface course system with enhanced UV resistance, for domestic driveways, patios, tree pits, pedestrian areas, lightly trafficked car-parks, low speed access roads and lightly trafficked areas.

4.2 Clearbound is designed incorporating a blend of fine aggregate, and either a 5 mm coarse aggregate or 10 mm (for tree pit use only). The choice of aggregate type will depend on site-specific details, including location and contractual requirements for polished stone value (PSV), texture depth, colour, porosity and any other properties.

4.3 The system can be applied to a bituminous or concrete substrate provided the underlying layers of the pavement are stable and have sufficient load-spreading capabilities to support the imposed loading of the surfacing during installation and the expected service life.

4.4 The system can be used as part of new or maintenance pavement construction.

5 Practicability of installation

The system is to be installed only by contractors approved by the Certificate holder, using conventional equipment for the mixing and application of the system (see the *Installation* part of this Certificate).

6 Strength and stability

Resistance to permanent deformation

6.1 The system has a resistance to rut rate and rut depth that is classified as Type 2 in accordance with PD 6691 : 2015, Appendix D, Table D.2. It is suitable for heavily stressed sites requiring very high rut resistance.

Tensile bond strength

6.2 A visual inspection of existing sites confirmed no significant defects that could be related to de-bonding. In addition, laboratory testing to TRL Report 176, Appendix J, on a control set, and after heat ageing and water soak, confirmed satisfactory tensile bond strength to both asphalt and concrete when installed in accordance with the provisions of this Certificate.

Erosion index

6.3 A visual inspection of sites confirmed no significant defects that could be related to wear such as fretting and ravelling of aggregates from the surface. In addition, laboratory testing in accordance with the BBA HAPAS *Guidelines for Assessment and Certification of High Friction Surfacing* for scuffing at 45°C resulted in an erosion index of less than 4.0.

Chemical resistance

6.4 When tested in accordance with BS 5284 : 1993, the system has a good resistance to chemicals likely to be spilt on road surfaces or parking areas, such as oil or petrol. Any spillages must be removed as soon as possible to avoid staining and contamination due to the permeable nature of the surface.

7 Surface characteristics

Skid and slip resistance

7.1 The initial skid resistance (prior to trafficking) measured in accordance with TRL Report 176, Appendix E (pendulum test using sliders applicable to both vehicular and foot traffic), indicates that initial measurements of greater than 30 can be achieved, this can increase to 40 depending on the aggregate and design of the system (see section 7.2). The system is considered suitable in applications where this is required.

7.2 Retained skid resistance is affected by the aggregate type and expected trafficking. Appropriate aggregate selection must therefore be considered in areas where risk of slipping by foot, or skidding by vehicles, is high.

Surface texture

7.3 The initial texture depth measured in accordance with BS EN 13036-1 : 2010 indicates that texture depth is dependent on the aggregate size of the mix. The texture depth for 5 mm aggregate is ≥ 0.7 mm. The system is considered suitable for use in applications where these texture depths are required.

7.4 Retained texture depth is affected by the aggregate type and expected trafficking levels. Therefore appropriate aggregate selection must be considered in areas where retained texture depths are required.

8 Rainwater drainage



Results of vertical and horizontal permeability tests conducted in accordance with BS EN 12697-19 : 2004 indicate that the water will drain through the surface course into the pavement substrate, thereby reducing or eliminating surface ponding (see Table 1).

Table 1 Vertical and horizontal permeability

Test	Method	Parameter measured	Results	
			5 mm	10 mm
Permeability	BS EN 12697-19 : 2004	Permeability ⁽¹⁾ ($10^{-3} \cdot \text{m} \cdot \text{s}$)		
		Vertical	0.402	0.483
		Horizontal	0.193	0.296

(1) Mean of two results. Tests were carried out on 100 mm diameter cores.

9 Maintenance



In order to maintain the permeability of the surface it must be cleaned periodically using a pressure washer or a sweeper fitted with water jetting and vacuuming equipment.

10 Durability



The system has been in use since 1998 and visits to existing sites 2 years old indicate that the system is performing satisfactorily. When used in domestic driveways, patios, tree pits, pedestrian areas, lightly trafficked car-parks, low speed access roads and lightly trafficked areas, the system will have a service life in excess of conventional asphalt surfacing.

Installation

11 General

11.1 Ambient and pavement surface temperatures, along with relative humidity, should be recorded at the start and, if the weather is variable, during the installation process. Installation should not proceed if:

- the relative humidity is outside the range of 30 to 85%
- the surface temperature is less than 3°C above the dew point of the measured air temperature and relative humidity
- the operating temperature and road surface temperature and/or air temperature is outside the range 10 to 30°C.

11.2 The Certificate holder is responsible for training and monitoring their approved contractors to ensure the system is installed in accordance with the BBA Agreed Method Statement and this Certificate.

11.3 The Certificate holder must be consulted on the structural design and suitability of the pavement structure. The base and binder course layers must take into account the anticipated rainfall, traffic loading, ground conditions and the key factors assessed and identified in this Certificate.

11.4 Rates of spread will be dictated by the required installed depths and the aggregate size. The minimum nominal installation depth for the 5 mm aggregate is 16 mm and for the 10 mm tree pit is 30 mm.

12 Preparation

12.1 All imperfections in the substrate not acceptable to the Installer must be reinstated with a material approved by the Purchaser in consultation with the Installer.

12.2 The substrate must be clean, dry and free from ice, frost, loose aggregate, oil, grease, road salt and other loose matter which may impair the adhesion of the system.

12.3 When used on a concrete surface, Apollo A1408 primer must be applied in accordance with the manufacturers instruction.

13 Application

13.1 The binder components and catalyst are supplied in pre-weighed packs. Parts A and B are mixed together using a slow-speed, high-torque drill and paddle for a minimum of 60 seconds, until a homogeneous mix is achieved. A catalyst may be added depending on the weather conditions. The Certificate holder provides details of appropriate quantities relative to temperature.

13.2 The mixed resin must then be added immediately to the pre-mixed aggregate and placed in a mechanical mixer and mixed for a minimum of 2 minutes, or until homogeneous.

13.3 The mixed material is immediately spread evenly across the surface to the required depth using a screed box or hand trowel.

13.4 The surface is finished with a hand trowel or lightweight powered finishing tool.

13.5 Glass grit is broadcast onto the surface at this stage at a minimum spread rate of 100 g·m².

14 Aftercare

The system must be allowed to cure. During the curing period no disturbance or trafficking is permitted.

15 Repair

Any damaged area must be cut back to firmly-bound material and replaced with material mixed and installed in accordance with this Certificate.

Technical Investigations

16 Tests

Tests were conducted on samples of Clearbound, including the resin, and the results were assessed to determine:

- tensile characteristics
 - control
 - uv exposure (400 mj · m⁻² at 50°C, 10 years equivalence)
 - heat aged at 70°C for 28 days
 - water soak at 23°C for 7 days (including chlorinated water)
- scuffing resistance
- skid and slip resistance
- texture depth
- erosion index
- resistance to permanent deformation at 60°C

- tensile adhesion
 - control
 - heat aged at 70°C for 28 days
 - water soak at 23°C for 7 and 28 days
- hardness test
 - control
 - 1 and 7 day exposure to:
 - petrol
 - diesel
 - hydraulic fluid
 - antifreeze
 - engine oil
 - battery acid
- permeability
- flexural strength
- colour stability after uv exposure (400 mj·m⁻² at 50°C, 10 years equivalence).

17 Investigations

17.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

17.2 An installation trial was carried out to assess the practicability of the installation and on-site quality control procedures. A visual inspection of the site concluded that it was free from significant abnormalities.

17.3 A user/specifier survey relating to existing sites up to and including three years in service was carried out to confirm the system's performance in use. The visual condition survey carried out by the BBA inspection marked all sites as good to excellent condition with no significant defects.

Bibliography

BS 5284 : 1993 *Methods of sampling and testing mastic asphalt used in building and civil engineering*

BS EN 12697-19 : 2004 *Bituminous mixtures — Test methods for hot mix asphalt — Permeability of specimen*

BS EN 13036-1 : 2010 *Road and airfield surface characteristics — Test methods — Measurement of pavement surface macrotexture depth using a volumetric patch technique*

BBA HAPAS *Guidelines for Assessment and Certification of High Friction Surfacing*

PD 6691 : 2015 *Guidance on the use of BS EN 13108, Bituminous mixtures — Material specifications*

TRL Report 176 *Laboratory tests on high friction surfaces for highways*

Conditions of Certification

18 Conditions

18.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

18.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

18.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

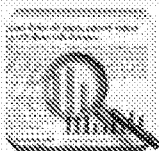
18.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

18.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

18.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

Using SuDS close to buildings



In this fact sheet Steve Wilson summarises the role of the designer in overcoming any potential challenges related to using SuDS components that rely on infiltration close to buildings.

The author

Steve Wilson is a Chartered Civil Engineer with 30 years' experience of geotechnical engineering. He has a Masters Degree in geotechnical engineering and has wide experience of foundation design and construction. Steve provided advice to the former Commission for New Towns on subsidence and settlement issues with their housing stock in the south east and this often involved in the investigation and assessment of subsidence and heave caused by trees in clay soils (especially London Clay). He has extensive experience in the design and construction of infiltration drainage and has investigated many soakaway failures. He has also provided advice on settlement of foundations caused by water consolidation of loose sand infill to Chalk solution features.

Introduction

Permeable pavements are a widely used SuDS approach that can allow water to infiltrate into the ground. They allow source control to be included in dense developments. Similarly rain gardens are one of the simplest ways of retrofitting SuDS to existing buildings. However space constraints mean that both approaches often need to allow water to soak into the ground near to building foundations.

The Building Regulations state that "Infiltration devices should not be built within 5m of a building or road or in areas of unstable land". This is to prevent water that soaks into the

of foundations. Complying with this guidance means that it often proves difficult for designers to locate permeable pavements, small basins and similar infiltration systems close to buildings and the benefits of allowing water to soak into the ground are lost (groundwater recharge, water availability to nearby trees, etc). Some SuDS methods such as rain gardens do not have to rely on infiltration to work, but will allow some water to soak into the ground if they are not lined. Similarly shallow tanks and permeable pavements may be designed as leaky or partial infiltration systems even on clayey soils.



Unlined rain garden close to building foundations (deliberately filled for research)

Many designers do not realise it is possible to override the crude rule of thumb in the Building Regulations with appropriate geotechnical assessment. In some instances SuDS infiltration systems and unlined storage systems (such as rain gardens) can even be

located immediately next to buildings. This is useful if disconnecting downpipes as it makes the process easier and less costly.

However, allowing water to soak into the ground close to foundations should always be done in consultation with a Geotechnical Adviser or Registered Ground Engineering Professional¹.

The “5m rule” in the Building Regulations was originally devised as a rule of thumb to be applied to traditional soakaways that are relatively deep in relation to foundations and concentrate runoff into a quite small area of ground. Many SuDS methods differ to the traditional soakaway in that they are shallow and act as a blanket or plane infiltration system. They keep infiltrating water spread out over a wider area, unlike traditional solutions. Also remember that in some areas of the UK a traditional soakaway at 5m may be too close to foundations, for example where solution features are present in Chalk (CIRIA 2002).

The Building Regulations – what is the objective of the 5m rule

In 2002, as part of a research project by CIRIA, advice was sought from the Department for Transport, Local Government and the Regions (DTLR) Building Regulations Division (now Communities and Local Government) regarding the statement in the Building Regulations that soakaways should be located at least 5m from buildings. They provided the following statement in relation to permeable pavements that allow dispersed infiltration and evaporation of rainwater:

“As pervious paving permits dispersed absorption of rainfall it should not create any problems with concentrated outflow of water gathered over an area but discharged at a single point as in the case of soakaways. If the paving is combined with a storage system the outlet must be at a sufficient distance to ensure that discharged water does not impair the stability of any building. 5 metres is given as a guideline, if foundation details and

geotechnical data are available to show that a shorter distance is safe then it can be used.”

It is clear that the “5m rule” was intended to be a guideline and that infiltration or unlined attenuation can be allowed closer to building foundations if it can be demonstrated that it is safe to do so.



Permeable pavement with infiltration close to house foundations

Further evidence that rainwater can be allowed to soak into the ground close to building foundations is given in a response to an appeal made by an applicant against the enforcement of Requirement H3 in the Building Regulations. The Department for Communities and Local Government considered the possible effects of rainwater in foundations and concluded that distributed rainwater soaking into the ground will reduce the risk of saturation and erosion (Appeal against refusal in respect of a 5 bay aircraft hangar port –DETR, 1998 Reference 45/3/125). As part of this assessment they also considered the risk of collapse without warning of the structure. Where there is the potential for this (eg where solution features could develop unnoticed below the surface) a rigorous geotechnical assessment would be required even a normal soakaway located 5m from a building.

Comparison of SuDS to traditional soakaways

Well-designed shallow SuDS that are at or close to the ground surface are quite different from traditional soakaway drainage. They are designed on the principle of source control

and the roof area draining to these SuDS features (or area of hardstanding) should not be that large compared to the infiltration area.

A traditional soakaway will typically drain between 30m² and 300m² of impermeable area to every 1m² area in the base of the soakaway (ie a ratio of between 30:1 and 300:1). SuDS features close to buildings should normally be designed with a ratio of impermeable area to base area of less than 10:1 and the depth of the stored water should not be greater than 300mm. Thus the flow of water from the base of the SuDS features is much less concentrated than in a normal soakaway.

A traditional soakaway will have a ratio at the higher end of scale where it drains a road or several houses. Therefore it is a concentrated point source of water in the ground and the height of these types of soakaways means that water also flows out sideways. As a result the risk of water affecting the soils under shallow foundations can be quite high if the soakaway is located close to buildings. Because infiltration from a plane feature is much more dispersed, has a shallow height and has a short retention time there is less potential for flow to occur laterally in any significant quantities.

It is possible to analyse water flow into the ground using computer programmes. This is known as numerical modelling. A model of water flow from a SuDS permeable pavement that was constructed close to foundations is shown in Figure 1. The water flows vertically (shown by the black arrows) and the velocity is low until it meets the groundwater table just below the foundations.

How can infiltrating water cause problems?

Freeman et al (2002) identified the most common causes of settlement or subsidence to buildings. Those that can be associated with infiltrating water are listed below:

- Erosion - soil can be washed by infiltrating water into open features such as broken pipes, gullies, joints, solution features or faults. Water flow through the ground on its own does not wash soil particles out – the particles need somewhere to go. SUDS will not cause erosion if there is nowhere to wash soil particles out to.

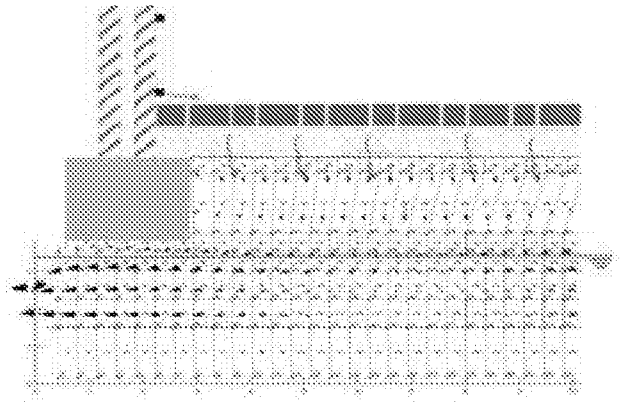


Figure 1 Numerical model of water flow from a SuDS permeable pavement

- Settlement of filled or loose ground by water flow (made ground or infill to solution features¹). This is most likely in low density material with high void ratios. It is less likely to occur in well compacted or dense fill, especially where infiltrating water is spread out.
- Collapse of mine workings and natural cavities – this can be caused by infiltrating water.
- Soil softening - clays in particular that can be softened leading to reduced strength and increased settlement. The effects on slope stability may also need to be assessed if the foundations are close to the top of a slope. Softening of clay soils will occur if the moisture content increases. Clay has a very low permeability and in normal circumstances the softening caused by water does not extend to a great depth. For example this normally occurs for 200mm to 300mm or so below the surface of clay with a perched water table above it.

Softening of clay soils next to broken drainage pipes has been reported. However in these cases the pipe has been located very close to the foundations and most of the runoff from every rainfall event from a large drained area (typically at least half of the roof of a house) has been collecting and standing in contact with the clay for a long period of time. This is different to shallow plane infiltration where the water is soaking into the ground at around 300mm to 400mm depth and the foundations are typically at least 1m below that. Most of the rainfall in a correctly designed plane infiltration or attenuation system will be held in the shallow surface soils or blocks and will evaporate. Thus there will be limited softening of clay at depth and it is not likely to affect the foundations.

- Variations in groundwater level – this relates to a loss of bearing capacity in granular soils where the groundwater level increases. Groundwater mounding (an increase in water level) can occur below soakaways. This rarely happens to any great degree under normal small soakaways and is even less likely to occur below shallow plane SuDS, again because of the dispersed nature of the water storage and the effects of evapotranspiration.
- Shrinkage and heave - clay soils that are desiccated (dried out) can heave when the moisture content is increased or the soils can be dried out by trees for example and cause subsidence. Heave is generally only a problem where trees are removed prior to construction of buildings.
- Swelling occurs when a clay soil has a suction in the soil pores that draws water into the soil and it increases in volume. Swelling only occurs in response to suction pressure, ie the clay must be dry and below its equilibrium moisture content, or where soil overburden has been removed (eg heave in basement

excavations). Clay at its natural equilibrium moisture content will not swell significantly. Heave is normally a major problem when trees have been removed from a site prior to constructing a building.

Thus water from small rain gardens or similar features will not cause swelling over and above that which occurs over the natural cycle. The water from shallow plane SuDS will actually reduce the soil moisture deficit caused by trees and potentially reduce the adverse effects. Where rain gardens are located in areas already affected by trees they may reverse some of the shrinkage that has occurred. This may cause some heave of the foundations, but again because of the dispersed nature of the water the effects will not be concentrated locally at one point. Instead any effect will be uniformly distributed over a wide area. This reduces the risk of cracks occurring in the building due to localised differential ground movement.

For adverse effects to occur as a result of water soaking into the ground, the foundations also need to be of a form that can be affected (for example piled foundations are likely to be far less susceptible to any adverse impacts of infiltrating water, if at all). Permeable paving that only collects and drains rainwater falling directly on it can be used against any building providing there is no point source of water from any other impermeable surfaces connected into it.

Conclusion

The “5m rule” in the Building Regulations is a guideline and many designers do not realise it is possible to override the crude rule of thumb when using shallow SuDS infiltration systems and unlined storage systems (such as rain gardens). The problems caused by large volumes of water from relatively deep point soakaways are not likely to occur with shallow SuDS draining small areas and with appropriate design and assessment they can

be located closer to buildings than 5m. This is useful if disconnecting downpipes as it makes the process easier and less costly.

References

DETR (1998). Requirement H3: Appeal against refusal in respect of a 5 bay aircraft hangar port (Ref: 45/3/125)

Freeman TJ, Driscoll RMC and Littlejohn GS (2002). Has your house got cracks? Second Edition. BRE and ICE, Thomas Telford Publishing, London.

Her Majesty's Government, (2010). The Building Regulations. Approved Document H. Drainage and waste disposal DTLR, London

CIRIA (2002). Engineering in Chalk, CIRIA Report C574.

ⁱⁱ A Geotechnical Adviser is defined by the Site Investigation Steering Group as a Chartered Engineer or Geologist with a minimum of 10 years post charter experience in geotechnical engineering (5 years acting as a geotechnical specialist).

The Register of Ground Engineering Professionals is administered by The Institution of Civil Engineers.

ⁱⁱ Solution features are common phenomena within Chalk areas. They are formed by dissolution of the Chalk as a result of chemical weathering, probably during the Quaternary period. This results in sinkholes in the chalk surface or pipes within the chalk mass. These features are often infilled with soft or loose materials. (For more information see CIRIA, 2002).

For further information on designing SuDS schemes close to buildings please contact Steve Wilson, Technical Director, EPG Ltd on: 07971 277889 or email: stevewilson@epg-ltd.co.uk