

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
Planning Ref: A/104/19/RES

11 September 2019

Dear Laura,

CRETE NURSERY, DAPPERS LANE, ANGMERING, BN16 4EN

Following your consultation on the above planning application we are writing to respond to your comments on the proposed drainage. Also, since the initial submission a CCTV survey of the culvert has been undertaken and this has allowed the proposed foul pumping station to be removed, the design drawings have been updated to reflect this.

We respond to your comments as follows;

- 1 & 2 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
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.
- 3 Please refer to enclosed drawing 191183/SK/04 for impermeable areas.
- 4 & 5 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

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.

- 6 Please refer to the enclosed brochure for the Clearstone permeable resin bound surfacing.
- 7 & 8 Please refer to drawing 191183/SD/01.
- 9 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.
- 10 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.
- 11 Please refer to drawing 191183/500/01.

We trust the enclosed is acceptable and you are now able to recommend the application for approval. Please call if you have any queries.

Yours sincerely

Robert Steventon

Enclosed: Winter Groundwater Monitoring and Soil Infiltration Rates
191183/SK/04
Clearstone Resin Bound Surfacing Brochure



Date: 04/04/2019
Our Ref: 18.1157

Crete Nurseries,
Dappers Lane,
Angmering,
West Sussex,
BN16 4EN

Dear Ms. Frampton, on behalf of Country Oak Homes Ltd

RE: Winter Groundwater Monitoring and Soil Infiltration Rates at Crete Nurseries

Introduction

I write further to the completion of soakaway/soil infiltration testing and winter groundwater monitoring carried out at Crete Nurseries, Dappers Lane, Angmering, West Sussex, BN16 4EN (hereafter referred to as the 'site'), as instructed by yourself, and Country Oak Homes Ltd – the client (EQ12972, September 2018).

This letter report provides copies of the test data, observations made during works and stratigraphic logs.

The site currently comprises a two-storey residential dwelling with front and rear garden, together with horse stables with an associated paddock and training ground. The entire site area is approximately 0.58Ha. Access can be afforded via a private driveway directly off from Dappers Lane.

The area highlighted for the investigation specifically includes the horse paddock making up approximately 0.29Ha. The paddock is entirely laid to soft-standing as turfed grass.

Scope

The scope of works were undertaken in respect of Condition 9.0 within the associated planning application (Ref: A/178/17/OUT), and after correspondence between Constructive Evaluation Ltd and the Client.

The purposes of this investigation were to establish highest annual groundwater levels as well as to calculate infiltration rate values in order to ascertain drainage characteristics of the underlying soils for soakaway design.



Fieldworks

The following site works were completed over a single day operation on 4th December 2018, supervised by an Engineer from CE. The investigation was undertaken in relation to statutory guidance BS5930: 1999 *Code of Practice for Site Investigations (Amendment 3: 2015)*, and in general accordance with BRE365; approved methods by ADC (Arun District Council). A site plan with indicative locations of the tests is enclosed.

- Prior to excavations taking place a Cable Avoidance Tool (CAT) was used to check for the position of any underlying electrical services; accessible manhole covers were lifted to confirm the direction of underlying drainage.
- 3no. windowless sample boreholes (WS1, WS2 and WS3) were completed through the base of their respective starter trial pits, to a maximum depth of 2.50mbgl (metres below ground level), using a tracked dynamic sampling rig. On completion all three boreholes were installed with groundwater monitoring wells, constructed with 50mm diameter HDPE plain and slotted pipe. A filter pack of washed gravel was placed in each well annulus to approximately just above the screen section, and the annulus sealed with bentonite. The monitoring wells were finished with a secure raised steel barrel cover.
- 1no. machine excavated trial pit (TP1) was completed to allow for a soakaway infiltration test, in accordance with BRE365, to provide information for soakaway design. The pit was excavated using an 8 tonne excavator to a depth of approximately 0.90mbgl, with dimensions approximately consistent from top to bottom. Following which the pit was rapidly filled with potable water. Measurements were taken to monitor the drop in water level over time. On completion the trial pit was backfilled with arisings and reinstated at the surface (as best as practically possible) in respect of existing conditions.
- All intrusive locations were logged and any visual or olfactory evidence of contamination noted in accordance with current protocol.
- Following installation, monitoring wells were developed on 12th December 2018 using either disposable bailers. Development enabled the removal of materials that may have entered the well during drilling and installation. Additionally, the development allows settlement of the gravel surround and ensures free flow of liquids through the well screen. Development continued until at least three well volumes had been removed.

A site plan indicating intrusive positions is enclosed.

Ground Conditions

The following strata conditions were encountered during both stages of works:

Stratum	Depth Range Encountered	Detail Description
Topsoil	Ground level to max 0.20m	Dark brown slightly sandy Silt with abundant roots and rootlets, and occasional gravels of flint
Made Ground	Exclusive to TP1 from 0.15m to 0.30mbgl	Brown silty slightly gravelly Clay, with gravels of flint and rarely concrete. Abundant roots and rootlets were also recorded
Silty CLAY / Clayey SILT	0.15m to 0.75mbgl	Soft to firm dark brown sometimes brown mottled silty CLAY / clayey SILT, with abundant roots and rootlets, and occasional gravels of flint
Head Deposit	0.30m to 2.00mbgl	Predominantly dense light brown and light grey slightly silty slightly sandy GRAVEL of flint, with rare cobbles and boulders of flint
London Clay	Exclusive to WS2 from 1.60m to 2.50mbgl	Firm to stiff brown mottled grey silty CLAY, with occasional gravels of flint and rare rootlets

During intrusive works groundwater was encountered ranging depths of 0.50m to 1.80mbgl, and shallowest within WS3. A winter groundwater monitoring regime was completed cooperatively by CE and the client over the winter of 2018-2019. This is detailed in subsequent report sections. Other than the anthropogenic material recorded within the Made Ground soils, no other visual and olfactory evidence of contamination was encountered.

Groundwater Monitoring

A total of 25no groundwater gauging rounds were completed within the winter period of October to March, the first reading being taken upon installation of standpipes on 10th December 2018, and the last on the 29th March 2019. Readings were taken monthly from December to January, then approximately twice per week between January and March. All gauge rounds involved the dipping of wells with an interceptor probe.

In general, groundwater levels in all locations were found to slightly decline between December and mid-January (from 0.66-1.61mbgl to 0.89-1.67mbgl), then rise relatively rapidly until early February (0.43-1.48mbgl). Levels were noted to relatively rapidly decline again until the end of February (0.94-1.68mbgl). At the beginning of March, levels were seen to steeply rise once more for the first week (up to 0.67-1.51mbgl), then remain relatively consistent until mid-March, before gradually declining to levels akin to those observed at the end of February (1.04-1.69mbgl).

Highest (shallowest) groundwater levels were almost ubiquitously observed in standpipe WS3 (north east corner of site), with a minimum depth recorded as 0.43mbgl on 10th February 2019.

Levels in WS2 (north west corner of site) were recorded as generally 0.20-0.40m lower than those in WS3, and recorded the lowest (deepest) groundwater level in the northern section of the site as 1.13mbgl on 20th January 2019.

Lowest (deepest) groundwater depths were consistently recorded within WS1 (south west corner of site), with a minimum of 1.48mbgl on 7th – 10th February 2019 and maximum of 1.69mbgl on 27th – 29th March 2019.

There is a drainage ditch noted running along the western boundary of the site; this considered likely to have an influence on groundwater levels across the site, and may explain shallowest groundwater depths having been recorded in the north east of the site (WS3).

Soil Infiltration Testing

Infiltration testing in general accordance with BRE 365 was conducted in location TP1, the test comprised the excavation of the trial pit to a depth of 0.90mbgl, the squaring of the excavation sides and the subsequent rapid filling of the pits using potable water. The subsequent fall in water level within each pit was monitored over a nominal period. The soil infiltration rate is calculated by the rate of outflow from 75% to 25% effective fill depth. The table below summarises the results.

Trial Hole ID	Test	Pit Depth (m)	Time at 75% (mins)	Time at 25% (mins)	Permeability Coefficient (m/s)	Drainage Conditions
TP1	1	0.90	0.35	1.90	8.96×10^{-4}	Good
	2	0.90	1.10	3.20	5.50×10^{-4}	Good
	3	0.90	0.80	2.70	5.13×10^{-4}	Good

The infiltration results calculated from the tests completed indicate an initial rate of 8.96×10^{-4} m/s. During subsequent second and third tests (saturated conditions), rates of 5.50×10^{-4} m/s to 5.13×10^{-4} m/s are calculated. The results calculated correspond to low end of 'good' drainage conditions, or alternatively clean sands and gravel mixtures (Ref: Soil Mechanics in Engineering practice by Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri; Table 14.1 Permeability and drainage characteristics of soils (after casagrande and Fadum 1940)).

I trust the above information is sufficient for your requirements in this matter, should you have any queries please do not hesitate to contact the undersigned.

Kind regards,
Spencer Robinson BSc



Graduate Geo-Environmental Scientist

Constructive Evaluation Limited

Enclosed: Site Plan
 Groundwater Gauging Results
 Infiltration Testing Records
 Soil Logs

CRETE

DAPPER'S LANE

4.41 10.000



ARUN DISTRICT COUNCIL A/113/19/DOC

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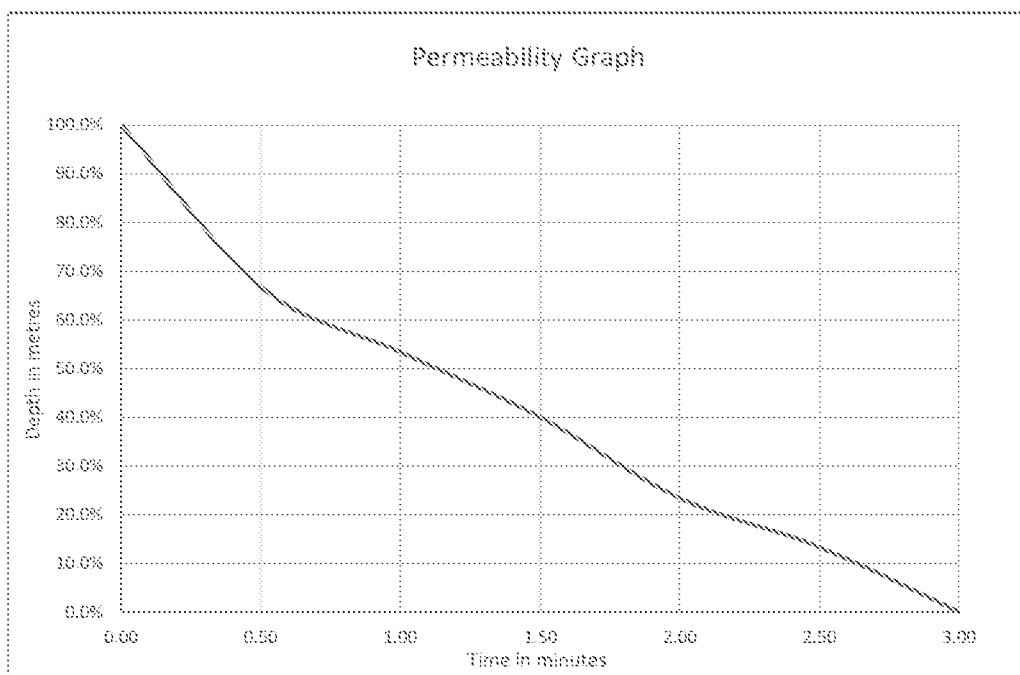
INFILTRATION CALCULATED FROM 75%-25% WATER DEPTH RANGE

Pit Size		Time in mins	
Length	1.50	0.35	75%
Width	0.50	1.9	25%
Depth	0.50		

Infiltration Rate

from 75%-25%

8.96E-04



[illegible]

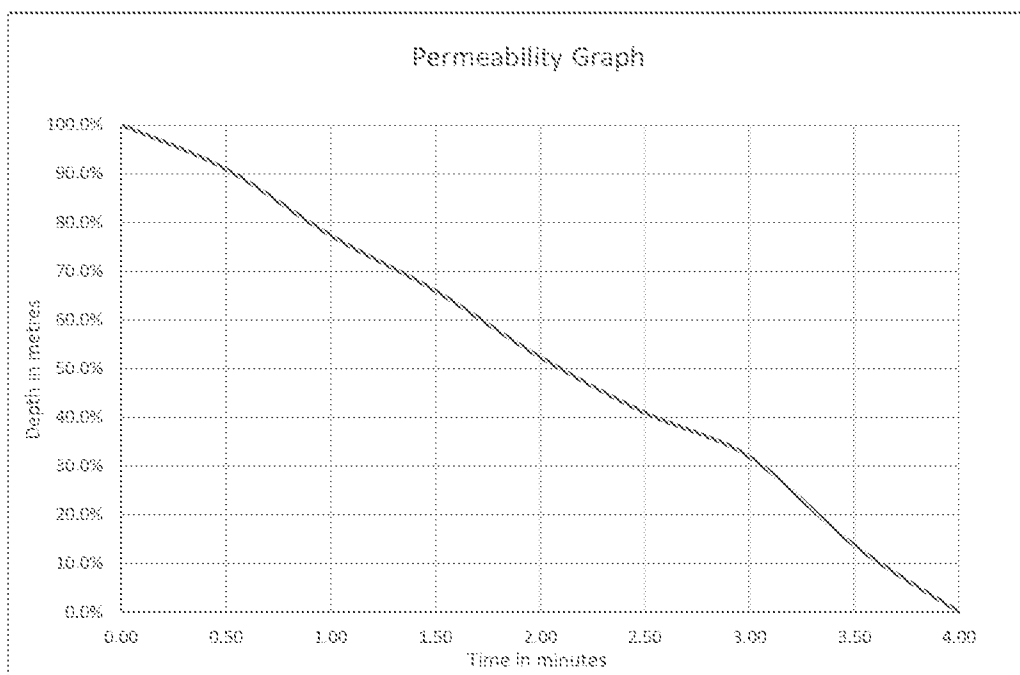
INFILTRATION CALCULATED FROM 75%-25% WATER DEPTH RANGE

Pit Size		Time in mins	
Length	1.50	1.1	75%
Width	0.50	3.2	25%
Depth	0.90		

Infiltration Rate

from 75%-25%

5.50E-04





constructiveevaluation
site investigation & building pathology

Site: Crete Nurseries

Job No: 18.1157

Trial Hole: TP1

Test 3

[illegible]

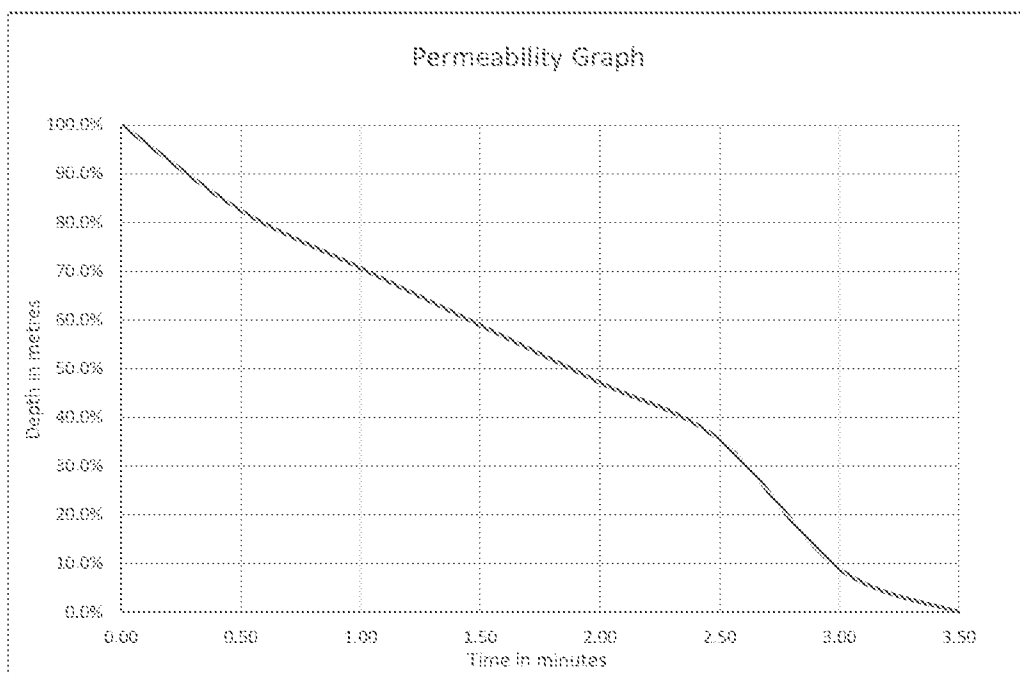
INFILTRATION CALCULATED FROM 75%-25% WATER DEPTH RANGE

Pit Size		Time in mins
Length	1.50	0.8 75%
Width	0.50	2.7 25%
Depth	0.90	

Infiltration Rate

from 75%-25%

5.13E-04



				Trial Pit Log				Trialpit No TP1 Sheet 1 of 1	
Project Name: Crete Nurseries				Project No. 18.1157		Co-ords: - Level:		Date 04/12/2018	
Location: Dappers Lane, Angmering, BN16 4EN						Dimensions (m): 0.5 1.5		Scale 1:20	
Client: Mrs Claire Frampton / Country Oak Homes Ltd						Depth 0.90		Logged RG	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.15			Turfed grass over TOPSOIL: Dark brown slightly sandy Silt. Sand is fine and medium. Abundant roots and rootlets. Occasional sub-angular and sub-rounded fine and medium Gravel of flint. MADE GROUND: Brown silty slightly gravelly Clay. Gravel is sub-angular to rounded fine and medium flint. Abundant roots and rootlets. Rare angular to sub-rounded medium Gravel of concrete. Light brown speckled light grey slightly silty slightly sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. Occasional cobbles of flint. Rare boulders of flint. (HEAD DEPOSIT).		
				0.30					
	0.40	B		0.90					
							End of pit at 0.90 m		
Remarks: CAT scanned prior to excavation. Groundwater not encountered.									
Stability: Somewhat unstable from 0.30m to 0.90mbgl.									

1

2

3

4



Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: Crete Nurseries

Project No.
18.1157

Co-ords:

Hole Type
WLS

Location: Dappers Lane, Angmering, BN16 4EN

Level:

Scale
1:20

Client: Mrs Claire Frampton / Country Oak Homes Ltd

Dates: 04/12/2018

Logged By
RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Turfed grass over TOPSOIL: Dark brown slightly sandy Silt. Sand is fine and medium. Abundant roots and rootlets.	
					0.70			Soft to firm dark brown and brown mottled silty CLAY / clayey SILT. Abundant roots and rootlets. Occasional sub-angular and sub-rounded fine and medium Gravel of flint.	
		1.00 1.00	D SPT	N=32 (8,7/9,9,6,8)	1.10			Dense light brown speckled light grey slightly silty slightly sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. (HEAD DEPOSIT).	1
					1.70			Dense light grey sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is medium and coarse. (HEAD DEPOSIT).	
		2.00 2.00	D SPT	N=45 (7,9/11,11,11,12)	2.00			Dense brown silty slightly sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. Locally clayey. (HEAD DEPOSIT).	2
								End of Borehole at 2.000m	3
									4

Remarks

CAT scanned prior to excavation. Buried service clearance pit hand-dug to ~1.00mbgl. Borehole advanced using a tracked dynamic windowless drilling rig. Groundwater strike at 1.80m, rising to 1.70mbgl after a period of 20 minutes.





Borehole Log

Borehole No.

WS2

Sheet 1 of 1

Project Name: Crete Nurseries

Project No.
18.1157

Co-ords:

Hole Type
WLS

Location: Dappers Lane, Angmering, BN16 4EN

Level:

Scale
1:20

Client: Mrs Claire Frampton / Country Oak Homes Ltd

Dates: 04/12/2018

Logged By
RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15			Turfed grass over TOPSOIL: Dark brown slightly sandy Silt. Sand is fine and medium. Abundant roots and rootlets.	
		0.50	D					Soft to firm brown silty CLAY / clayey SILT. Abundant roots and rootlets to 0.50mbgl. Occasional angular to sub-rounded fine and medium Gravel of flint.	
					0.75				
		1.00	D					Medium dense light brown speckled light grey slightly silty slightly sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. (HEAD DEPOSIT).	1
		1.00	SPT	N=19 (4,7/6,5,4,4)					
					1.50				
		1.55	D					Medium dense brown clayey slightly sandy angular to sub-rounded fine to coarse GRAVEL of flint. Sand is fine to coarse.	
					1.60			Firm to stiff brown mottled grey silty CLAY. Occasional angular medium Gravel of flint. Rare rootlets. (LONDON CLAY FORMATION).	
									2
		2.00	D						
		2.00	SPT	N=15 (1,2/3,4,4,4)					
					2.50			End of Borehole at 2.500m	
									3
									4

Remarks

CAT scanned prior to excavation. Buried service clearance pit hand-dug to ~1.00mbgl. Borehole advanced using a tracked dynamic windowless drilling rig. Groundwater seepage at 0.90mbgl.





Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: Crete Nurseries

Project No.
18.1157

Co-ords:

Hole Type
WLS

Location: Dappers Lane, Angmering, BN16 4EN

Level:

Scale
1:50

Client: Mrs Claire Frampton / Country Oak Homes Ltd

Dates: 04/12/2018

Logged By
RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			Turfed grass over TOPSOIL: Dark brown slightly sandy Silt. Sand is fine and medium. Abundant roots and rootlets. Occasional sub-angular and sub-rounded fine and medium Gravel of flint.	
					0.50			Firm dark brown silty CLAY. Abundant roots and rootlets.	
		1.00	D						1
		1.00	SPT	N=50 (2,9/50 for 260mm)					
		1.50	D						
		2.00	D		2.00			2	
		2.00	SPT	N=37 (1,4/8,7,9,13)					
End of Borehole at 2.000m									3
									4
									5
									6
									7
									8
									9
									10

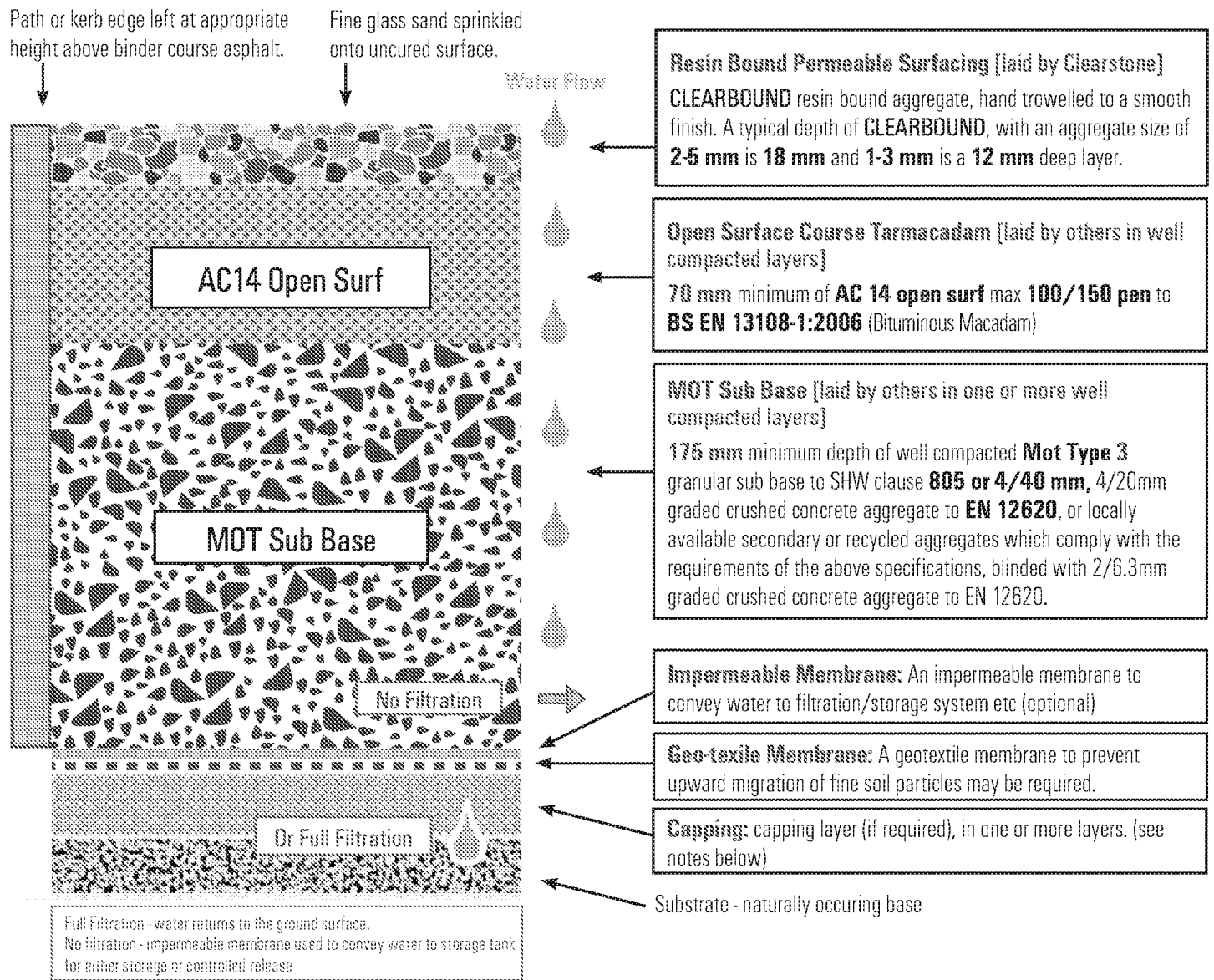
Remarks

CAT scanned prior to excavation. Buried service clearance pit hand-dug to ~1.00mbgl. Borehole advanced using a tracked dynamic windowless drilling rig. Groundwater strike at 0.80m, rising to 0.50mbgl after a period of 20 minutes.





Permeable Private Driveway - suitable for medium vehicle use & SuDS compliant



***** Please note: New asphalt and concrete surfaces need a minimum of two weeks curing time, before resin bound paving can be laid upon it *****

Planning Permission SuDS: Resin bound surfacing creates an attractive, permeable and durable surface which avoids the need for planning permission under the 2008 SuDS Planning Order 1998 on the paving of front gardens. **Notes:**

- If there is a probability of standing water, then this may soften the substrate, therefore a nominal fall to an out-fall or soakaway should be considered.
- If water recycling is a requirement then an impermeable membrane should be used in conjunction with a water harvesting system
- Areas that could be trafficked by heavy vehicles should have layers designed according to Highways Agency requirements.
- If the substrate is silty, then this may need to be stabilised or partially removed and replaced with sub-base/granular capping, in accordance with Highways Agency design manual for roads and bridges.
- The maximum deviation of the binder course should not exceed 3mm under a 1m straight edge.
- Total sub-base thickness will be dependant on expected loading, water storage capacity, and sub-base strength.
- This specification is based on normal good practice for resin bound surfacing, and does not absolve the specifier from designing a base construction suitable for the expected loadings of traffic and ground conditions existing on a given site.

Updated September 2018 v7



Disclaimer: Whilst Clearstone Paving Ltd. endeavours to ensure that advice, specifications, recommendations and information given is correct, it cannot have control over how substrates constructed by others are done and will not accept liability, directly or indirectly, arising from poor workmanship.

Any advice, recommendation or information given by Clearstone Paving Ltd. is based on practical experience and is believed to be accurate at the time of publication, no liability or responsibility of any kind including liability for negligence is accepted in this respect by the company.

The figures quoted do not constitute a specification, they represent typical values obtained for the substrate of the product.

Product design and specifications are subject to change without further notice.

Accreditations & Memberships

