

31th March 2020

Our ref: GE18965/LD01/200331

Christian O'Brien
Dandara Limited (Southern)
Roman House
South Hampshire Industrial Estate
Eddystone Road
Totton
SO40 3SA



Dear Christian,

RE: Land at Stakers Farm, North End Road, Yapton, Arundel, West Sussex, BN18 0DU – BRE 365 Soakage Testing

We are pleased to present the results of the soakage testing undertaken at the above site. The soakage tests were undertaken in accordance with BRE Digest 365 'Soakaway Design' BRE, 2016.

The intrusive investigation was undertaken between 24th and 26th March 2020 with the works supervised by a Geo-Environmental Engineer and Geo-Environmental Technician.

A total of eight BRE365 soakage tests within eight separate trial pits and one cable percussive borehole were undertaken at locations specified by the Client's Drainage Engineer, which targeted the proposed locations of the soakaways. The locations of the exploratory holes are presented in Figure 2.

Background

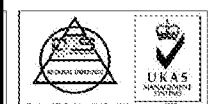
Following a technical review and consultation with Arun District Council (ADC) and their Drainage Engineer as well as the Client's Drainage Engineer, it is understood that further infiltration testing in a deep borehole and supplementary full scale soakage testing in accordance with BRE 365 was required to inform the drainage strategy for the site. The locations and depths of tests were directed by the Client's Drainage Engineer.

A total of three previous ground investigations have been undertaken within the boundaries of the site and are summarised below.

WYG (May 2019)

The first ground investigation was undertaken by WYG Environment Planning Transport Ltd (WYG) on behalf of Dandara Ltd, dated 28th May 2019 entitled 'Land at Stakers Farm, Yapton. Ground Investigation Interpretative Report', reference no: A112666. The investigation comprised twenty exploratory holes with a maximum depth of 6.0m bgl. The investigation encountered Topsoil to depths in the range of 0.05m to 0.50m. Where encountered Topsoil was generally described as brown slightly gravelly sandy clay with frequent rootlets. Firm to stiff orange brown clay with varying sand and gravel content was encountered thereafter (River Terrace Deposits) overlying the White Chalk. The White Chalk was described as weathered structureless (Grade Dm) White Chalk generally recovered as silty chalk gravel with occasional flint.

Geo-Environmental Services Ltd
Unit 7 Danworth Farm, Cuckfield Road, Hurstpierspoint, West Sussex BN6 9GI



Geo-Environmental Services (November 2019)

The second ground investigation was undertaken by Geo-Environmental Services Ltd (Geo-Environmental) on behalf of Dandara Ltd, dated November 2019 entitled 'Land at Stakers Farm, Northern End Road (B2132), Yapton. Ground Investigation Report', reference no: GE18621/GIR/NOV19.

Geo-Environmental Services (February 2020)

The third ground investigation was undertaken by Geo-Environmental Services Ltd (Geo-Environmental) on behalf of Dandara Ltd, dated February 2020 entitled '*Land at Stakers Farm, Northern End Road (B2132), Yapton. Soakage Testing Letter Report*' reference no: GE18875/LD01/200228. The investigations comprised eight machine excavated trial pits to a maximum depth of 0.8m bgl. As part of the fieldworks, eight soakage tests were undertaken in accordance with BRE Digest 365 Soakaway Design. The soakage testing results indicated that the infiltration rates were in the range of 2.1×10^{-5} to 9.8×10^{-6} m/s during the intrusive investigation, however two locations (FEB-TP1 and FEB-TP8) did not record a sufficient fall in head of water to calculate a rate of infiltration.

Reference should be made to the original reports and documents for further details.

Ground Conditions

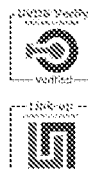
With reference to British Geological Survey (BGS) mapping, the geology of the site was anticipated to comprise sand, silt and clay of the River Terrace Deposits overlying chalk of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated). A mantle of Topsoil was assumed to be present over the subsoil and bedrock strata. In addition, given the close proximity of developed areas within the surrounding area of the site (e.g. Northern End Road, a primary school, residential properties, a farm house and farm outbuildings to the immediate southeast), there is the potential for a thickness of Made Ground to be present near to the boundaries of the site. In addition, Made Ground may have been introduced onto the site through other historic activities.

The ground conditions encountered within the exploratory holes were broadly consisted with those anticipated, i.e. a thickness of Topsoil overlying cohesive and granular soils of the River Terrace Deposits overlying the chalk.

For a more detailed description of the ground conditions encountered during this phase of investigation, reference should be made to the logs in Appendix A.

Soakage Testing

Soakage tests were undertaken at eight locations (MAR-TP1 to MAR-TP8) in accordance with BRE Digest 365, with the depth and locations of the tests being specified by the Client's Drainage Engineer. Three soakage runs were undertaken within each position were commenced on the 24th March 2020 with testing completed on the 26th March 2020. There was insufficient fall in head to calculate an infiltration rate within MAR-TP2 and MAR-TP5 with insufficient fall in head over a three day period to calculate a rate of infiltration. Table 1 summarises the soakage rates, which were calculated based on the results of the soakage testing.



Reference	Calculated Infiltration Rates (m/s)		
	1 st Cycle	2 nd Cycle	3 rd Cycle
MAR-TP1	2.4X10 ⁻⁶	1.9X10 ⁻⁶	N/D
MAR-TP2	N/D	N/D	N/D
MAR-TP3	4.9X10 ⁻⁶	2.0X10 ⁻⁶	1.9X10 ⁻⁶
MAR-TP4	1.8X10 ⁻⁶	1.7X10 ⁻⁶	1.7X10 ⁻⁶
MAR-TP5	N/D	N/D	N/D
MAR-TP6	1.2X10 ⁻⁶	1.5X10 ⁻⁶	1.6X10 ⁻⁶
MAR-TP7	2.1X10 ⁻⁶	2.2X10 ⁻⁶	2.3X10 ⁻⁶
MAR-TP8	2.0X10 ⁻⁶	1.9X10 ⁻⁶	1.9X10 ⁻⁶
N/D: Not determined due to insufficient fall in head over three day period			

Table 1 Summary of Soakage Test Results

In addition, as part of the investigation, one cable percussive borehole (MAR-BH01) was drilled to a depth of 9.0m bgl. Upon completion of the borehole, a constant head permeability testing could not be undertaken due to the presence of shallow groundwater and fast groundwater ingress at depths of 3.18m and 9.00m. bgl. However, two falling head permeability tests were attempted within the borehole. Table 2 summarises the falling head permeability tests results.

Reference	Depth Range of Test (m)	Calculated Infiltration Rates (m/s)
MAR-BH01	0.11 – 1.80	N/D
	3.18 – 7.60	N/D
N/D: Not determined due to insufficient fall in head.		

Table 2 Summary of Falling Head Test Results

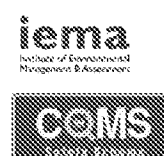
Conclusions

Based on the above results and ground conditions encountered on site, it is considered that conventional soakaways may locally be suitable for discharging storm water run-off to the ground. However, the storage capacity of any soakaway may be limited by the presence of groundwater, particularly during the wetter winter months, and it is likely that some allowance for on-site storage and attenuation of peak storm flow with discharge to the drainage ditch network, possible at greenfield run-off rate would be required, under an extension of riparian rights.

In addition, disposal of stormwater via a deep borehole soakaway is unlikely to be effective.

Closure

We trust we have interpreted your request correctly and provided sufficient information for your current requirements. If you have any questions or queries in relation the information provided at this stage please do not hesitate to contact the undersigned.



Yours sincerely
For and on Behalf of Geo-Environmental

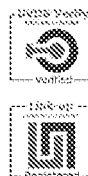
Prepared by

Reviewed by

LEVENT DOGAN BSc, MSc, PGDip, CEng MCIHT, AMICE
Senior Consulting Engineer

SHAUN ARMITAGE BSc (Hons), FGS
Senior Consulting Engineer

Enc Figure 1 – Locations Plan
 Figure 2 – Exploratory Hole Locations Plan
 Appendix A – Exploratory Hole Logs



FIGURES





t IX#d#	[L9] L# {A# C# I#b IX#9 Ib wIXp=Q#X#I# C#bT# T#			□□□	{C# [IX]IX#I# I#II	
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wIXbIX#	D935	wI#IX#	れ			
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C#C#I#	3	{L#I#	bIX#IX#I#			

APPENDIX A

Exploratory Hole Logs



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GI		Borehole Log				Borehole No. MAR-BH01 Sheet 1 of 1	
Project Name: GE18965 Land at Stakers Farm - Borehole Soakage		Project No. GE18965		Co-ords:		Hole Type CP	
Location: Land at Stakers Farm, Yapton				Level:		Scale 1:50	
Client: Dandara Ltd				Dates:		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.05 0.20		 Grass over brown silty Clay with frequent rootlets.  TOPSOIL  Soft to firm brown silty Clay with frequent rootlets.  RIVER TERRACE DEPOSITS  Firm to stiff silty sandy CLAY.  RIVER TERRACE DEPOSITS	1	
		1.45	S	N=5 (1,1/1,1,1,2)				2	
		2.45	S	N=2 (1,0/1,0,1,0)				3	
		3.45	S	N=7 (1,1/1,1,2,3)	3.40		 Recovered as off-white structureless putty CHALK with scattered intact white chalk gravel and flints. Gravel is fine to coarse and sub-angular to sub-rounded intact chalk. Occasional bands of very soft silty fine to medium sandy CLAY.  SEAFORD CHALK FORMATION	4	
		4.45	S	N=17 (2,1/2,4,5,6)				5	
		5.45	S	N=9 (1,3/2,3,2,2)				6	
		6.95	S	N=13 (1,2/2,4,3,4)				7	
	8.45	S	N=20 (2,2/4,5,5,6)	9.00			8		
							End of Borehole at 9.00m	9	
								10	

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
		3.40	1.80			1. Inspection pit hand dug to 1.0m depth 2. Water strike at 3.4m, rising to 1.8m after 20minutes. 3. Temporary casing installed to 8.0m depth 4. Unable to progress 150mm diameter casing below 9.0m due to constant moderate groundwater ingress below 7.8m depth. 5. 50mm. dia. monitoring well upstanding protective cover installed to 9.0m depth on completion. 6. Borehole backfilled with gravel backfill-bentonite-concrete on completion.
		7.80	4.00			





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental

Trial Pit Log

Trial Pit No
MAR-TP01

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm - Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions (m):

1.30

Depth
0.75

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			Grass over brown silty Clay with frequent rootlets. TOPSOIL
				0.75			Firm brown silty CLAY with frequent rootlets and occasional medium to coarse flint gravel. RIVER TERRACE DEPOSITS
							End of Pit at 0.75m

Depth Strike	Water Strike

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environment

Trial Pit Log

Trial Pit No
MAR-TP02

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm - Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions (m):

1.35

Depth
0.70

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.15			Grass over brown silty Clay with frequent rootlets. TOPSOIL
				0.70			Brown slightly sandy silty CLAY with occasional rootlets. RIVER TERRACE DEPOSITS
							End of Pit at 0.70m

Water Strike	
Depth Strike	Notes to (relog)

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Trial Pit Log

Trial Pit No
MAR-TP03

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm -
Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions
(m):

1.20

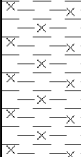
Depth
0.70

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over brown silty Clay with frequent rootlets. TOPSOIL
							Firm light brown silty CLAY with frequent rootlets. RIVER TERRACE DEPOSITS
				0.70			End of Pit at 0.70m

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9CJ

Geo-Environmental Services Ltd

Trial Pit Log

Trial Pit No
MAR-TP04

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm - Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions (m):

1.12

Depth
0.70

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over brown silty Clay with frequent rootlets. TOPSOIL
							Light brown silty CLAY with with frequent rootlets. RIVER TERRACE DEPOSITS
				0.70			End of Pit at 0.70m

Water Strike	
Depth Strike	Notes to (relog)

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environment

Trial Pit Log

Trial Pit No
MAR-TP05

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm - Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions (m):

1.20

Depth
0.70

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over brown silty Clay with frequent rootlets.. TOPSOIL
				0.70			Light brown slightly sandy silty CLAY with occasional rootlets. RIVER TERRACE DEPOSITS
							End of Pit at 0.70m

Depth Strike	Water Strike	Remarks
		1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.
		Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental

Trial Pit Log

Trial Pit No
MAR-TP06

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm -
Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions
(m):

1.30

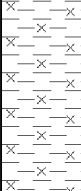
Depth
0.78

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over brown silty Clay with frequent rootlets. TOPSOIL
							Firm brown silty CLAY. RIVER TERRACE DEPOSITS
				0.78			End of Pit at 0.78m

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental

Trial Pit Log

Trial Pit No
MAR-TP07
Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm - Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions (m):

1.15

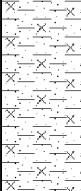
Depth
0.80

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over brown silty Clay with frequent rootlets. TOPSOIL
				0.80			Light brown slightly sandy silty CLAY with frequent rootlets rare flint gravel. RIVER TERRACE DEPOSITS
							End of Pit at 0.80m

Water Strike	
Depth Strike	Notes to (relog)

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability





Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL

Geo-Environmental

Trial Pit Log

Trial Pit No
MAR-TP08

Sheet 1 of 1

Project Name: GE18965 Land at Stakers Farm -
Borehole Soakage

Project No.
GE18965

Co-ords: -
Level:

Date

Location: Land at Stakers Farm, Yapton

Dimensions
(m):

1.30

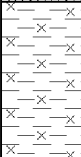
Depth
0.70

0.45

Scale
1:25

Logged
LH

Client: Dandara Ltd

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.15			Grass over brown silty Clay with frequent rootlets. TOPSOIL
							Firm brown silty CLAY with frequent rootlets. RIVER TERRACE DEPOSITS
				0.70			End of Pit at 0.70m

Water Strike	
Depth Strike	Notes to (relog)

Remarks 1. BRE 365 Soakage testing undertaken 2. Pit backfilled with arisings on completion.

Stability

