

BVL Developments Ltd.

F.A.O. Ben Lutyens
Via email only: benlutyens@bvldevelopments.co.uk
Our ref.: 16695/LR
June 2018

Thomas Telford House
Sun Valley Business Park
Winnall Close
Winchester SO23 0LB

Dear Ben

RE: 1 Northfields Cottages, Fontwell Avenue, Eastergate, Chichester, West Sussex PO20 3RX

We are writing regarding the scheme of winter groundwater monitoring undertaken at the above-named site.

Brief

Soils Limited quotation reference Q19523, dated 15th December 2017, set the scope of the investigation. A scheme of winter groundwater monitoring was undertaken following intrusive works to install three groundwater monitoring wells via the drilling of windowless sampler boreholes. Groundwater monitoring visits were undertaken by the client under instruction by Soils Limited.

General

The site was located at 1 Northfields Cottages, Fontwell Avenue, Eastergate, Chichester, West Sussex PO20 3RX and had an O.S Land Ranger Grid Reference of SU 947 062.

The site comprised open pasture land with an equestrian sand school and tarmac car park in the south quarter of the site. The site was relatively flat with a gentle slope down to the south. Mature trees and vegetation occupied the east, north and west site boundaries. The site was surrounded by residential and pasture land to the north, residential to the east, residential to the south and pasture land to the west.

A site location plan has been included as Figure 2 **Error! Reference source not found.**

Anticipated Geology

1:50,000 BGS geology maps showed the site to be situated on bedrock of the Lambeth Group over undifferentiated Lewes Nodular, Seaford and Newhaven Chalk Formation, with superficial deposits of Head overlying.

Head deposit are drifts produced by solifluxion, the downslope movement of debris outwash during the periglacial period, and characteristically comprise poorly sorted sands gravels and chalk of local derivation

The Lambeth Group, formerly known as the Woolwich and Reading Beds, occurs in the London and Hampshire Basins, where it directly overlies the Chalk or Thanet Sand Formation, and is succeeded by the Harwich and London Clay Formations. Although generally less than 50

metres thick, it's lithological variability and position beneath much of London has concerned tunnelling engineers since the early 19th century.

Lewes Nodular Chalk Formation is composed of hard to very hard nodular chalks and hardgrounds (which resist scratching by finger-nail) with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks become more abundant towards the top. Nodular chalks are typically lumpy and iron-stained (usually marking sponges). Brash is rough and flaggy or rubbly, and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout.

Seaford Chalk Formation can be described as firm white chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known from the lowest beds. Some flint nodules are large to very large.

The Newhaven Chalk Formation is a soft white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments. At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and general solution. Weathering by frost action may extend to a depth of several metres.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually infilled with drift deposits, are found in the chalk. The features sometimes manifest themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

Site Works

On 24th November 2018, three windowless sampler boreholes were all drilled to a depth of 5.00m below ground level (bgl) at locations selected by Soils Limited.

All three windowless sampler boreholes were installed with groundwater monitoring wells comprising 33mm slotted standpipes surrounded by a response zone formed by siliceous 10mm gravel and sealed above with 1m 33mm plain standpipe with bentonite surround. The installations were completed with a cap and metal stopcock cover set in concrete.

A trial hole location plan has been included as Figure 3.

Groundwater monitoring visits were undertaken by the client within the period of 22nd December 2017 and 18th April 2018.

Ground Conditions

The ground conditions encountered during the site investigation have been summarised in Table 1.

Topsoil (TS)
Head (HEAD)

Lambeth Group (LMBE, not encountered)
Undifferentiated Lewes Nodular, Seaford and Newhaven Chalk Formation (WHCK)

Table 1 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
TS	Anthropocene	0.00	0.30 – 0.60	0.50	Turf over dark brown slightly gravelly silty CLAY with frequent roots and rootlets.
HEAD	Quaternary	0.30 – 0.60	1.35 – 2.50	1.40	Dark becoming light brown gravelly CLAY. Gravel is fine to coarse subangular to angular clasts of flint.
LMBE	Paleocene	Not encountered			
WHCK	L. Cretaceous	1.35 – 2.50	2.50 ¹	Not proven ²	Off white and brownish white weathered structureless CHALK recovered as fine gravel sized intact blocks of chalk within a sandy SILT calcareous matrix, with frequent fine to coarse gravel sized clasts of subrounded to angular flint.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered. 0.00 refers to ground level

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.

Topsoil

Soils described as Topsoil were encountered in all three trial holes from ground level to depths ranging between 0.30m and 0.60m bgl.

The Topsoil typically comprised turf over dark brown slightly gravelly silty CLAY with frequent roots and rootlets. Gravel was fine to medium subangular clasts of flint.

Head

Soils described as Head were encountered in all three trial holes underlying the Topsoil and persisted to depths ranging between 1.35m and 2.50m bgl.

The Head typically comprised dark becoming light brown gravelly CLAY. Gravel was fine to coarse subangular to angular clasts of flint. The gravel content was observed to increase with depth.

Undifferentiated Lewes Nodular, Seaford and Newhaven Chalk Formation

Soils described as White Chalk Subgroup were encountered in all three trial holes underling deposits of Head and persisted to the full investigatory depth of 5.00m bgl.

The White Chalk Subgroup comprised off white and brownish white weathered structureless CHALK recovered as fine gravel sized intact fragments of chalk within a sandy SILT calcareous matrix, with frequent fine to coarse gravel sized clasts of subrounded to angular flint.

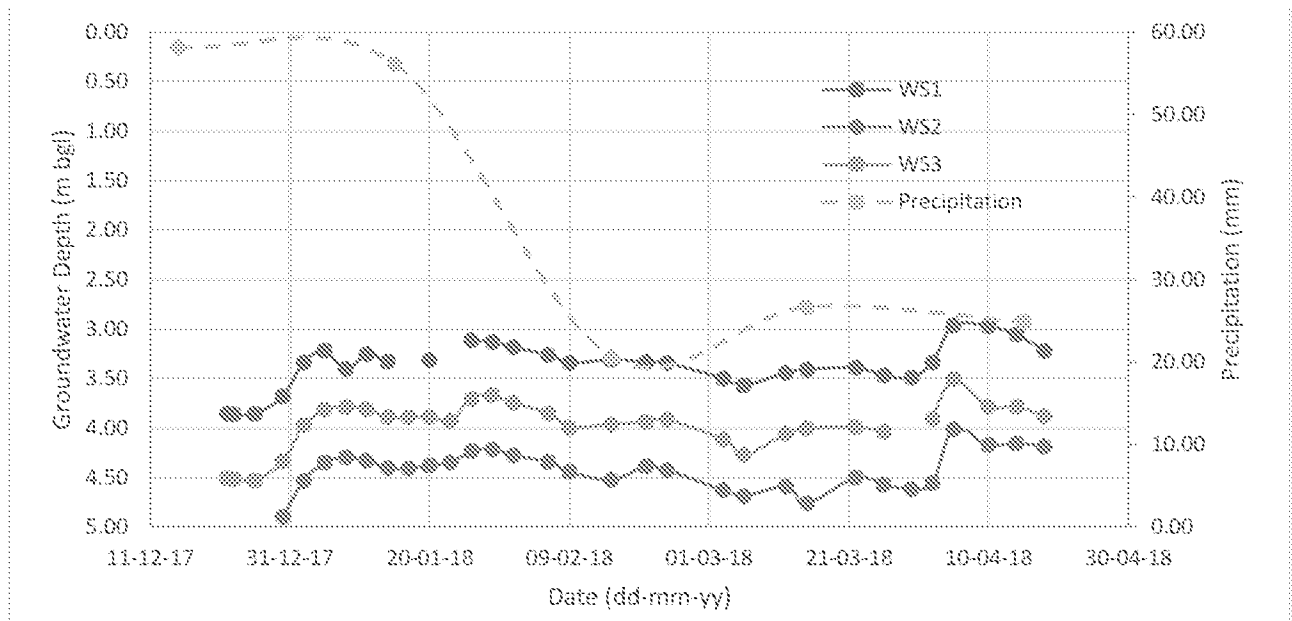
Winter Groundwater Monitoring

Groundwater was not encountered in any of the exploratory trial holes during construction of the groundwater monitoring wells. Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The drilling was conducted in December (2017), when

groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September.

Further groundwater monitoring was conducted within the standpipes installed on site following completion of site works and the results have been graphed in Figure 1 **Error! Reference source not found.** The groundwater monitoring period included the winter seasons from December (2017) to April (2018). Raw data provided by the client have been presented in Appendix B.

Figure 1 Winter Groundwater Monitoring Graph



Note: Precipitation data obtained from Shoreham weather station. www.wunderground.com. Two anomalous readings from WS1 and one from WS3 have been omitted in production of the graph.

Over the monitoring period, which included the winter months where groundwater levels are typically at their highest, groundwater was recorded at shallowest depths of 2.96m, 4.01m and 3.51m bgl in the area of WS1, WS2 and WS3 respectively. The difference in groundwater levels across the site may be accounted for by change in ground elevation. The topography was noted to slope down to the south.

The following attachments make up the remainder of this letter report.

Figure 2 – Site Location Plan

Figure 3 – Trial Hole Location Plan

Appendix A – Engineering Borehole Logs

Appendix B – Raw Groundwater Monitoring Data

Should you have any queries, please do not hesitate to contact the undersigned.

Yours sincerely

A large black rectangular redaction box covering the signature of Tim Rudkin.

Tim Rudkin BSc. (Hons.), MSc., FGS.

Graduate Geo-Environmental Engineer

A black rectangular redaction box covering contact information.

For and on behalf of Soils Limited.



Figure 2 - Site Location Plan

Project
1 Northfields Cottages

Date
June 2018

Client
BVL Developments Ltd.

Job Number
16695



Figure 3 – Trial Hole Location Plan

Project
I Northfields Cottages

Date
June 2018

Client
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Job Number
16695

Appendix A – Engineering Borehole Logs

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Borehole Log

Borehole No.

WS1

Sheet 1 of 1

Project Name: 1 Northfields Cottages

Project No.: 16695

Co-ords:

Hole Type
WS

Location: Fontwell Avenue, Eastergate, Chichester, West Sussex PO20 3RX

Level:

Scale
1:50

Client: BVL Developments Ltd.

Dates: 21-12-2017

Logged By
AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		0.30			Turf over dark brown slightly gravelly silty CLAY with frequent roots and rootlets. Gravel is fine to medium subangular clasts of flint.	
		0.80	D					TOPSOIL	
								Light brown gravelly CLAY. Gravel was fine to coarse subangular clasts of flint. HEAD	
								Percentage gravel increasing with depth	1
		1.50	D		1.35			Light yellow and light brown weathered structureless CHALK recovered as fine gravel sized fragments of intact chalk within a sandy SILT calcareous matrix. WHITE CHALK SUBGROUP	2
		2.50	D					Off white weathered structureless CHALK recovered as fine to medium gravel sized fragments intact chalk within a clayey SILT comminuted calcareous matrix. WHITE CHALK SUBGROUP	4
		3.50	D		4.10			Off white weathered structureless CHALK recovered as fine to medium gravel sized fragments intact chalk within a clayey SILT comminuted calcareous matrix. WHITE CHALK SUBGROUP	4
		4.50	D		5.00			Off white weathered structureless CHALK recovered as fine to medium gravel sized fragments intact chalk within a clayey SILT comminuted calcareous matrix. WHITE CHALK SUBGROUP	5
								End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

General Remarks:

Roots to 1.20m bgl. No groundwater encountered.

Groundwater Remarks:**Borehole Type**

CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types

D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing

SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test

Project Name: 1 Northfields Cottages

Project No.: 16695

Co-ords:

 Hole Type
WS

Location: Fontwell Avenue, Eastergate, Chichester, West Sussex PO20 3RX

Level:

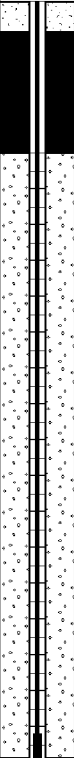
Scale

1:50

Client: BVL Developments Ltd.

Dates: 21-12-2017

 Logged By
AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		0.50			Turf over dark brown slightly gravelly silty CLAY with frequent roots and rootlets. Gravel is fine to medium subangular clasts of flint. TOPSOIL	
		0.80	D		0.90			Soft light brown gravelly CLAY. Gravel is fine to medium sub-angular clasts of flint. HEAD	
		1.50	D					Dark brown very gravelly CLAY. Gravel is fine to coarse angular clasts of flint. HEAD	1
		2.50	D		2.50			Light brown and off white weathered structureless CHALK recovered as fine gravel sized fragments of intact chalk within a sandy SILT calcareous matrix. WHITE CHALK SUBGROUP	2
		3.50	D						3
		4.50	D						4
					5.00			End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

General Remarks:

Roots to 0.50m bgl. No groundwater encountered.

Groundwater Remarks:
Borehole Type

 CP: Cable Percussive
 WS: Windowless Sampler
 RC: Rotary Cored

Sample Types

 D: Disturbed
 B: Bulk
 J: Jar
 W: Water
 U: Undisturbed

In-Situ Testing

 SPT: Split spoon - Standard Penetration Test
 CPT: Cone - Standard Penetration Test

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Borehole Log

Borehole No.

WS3

Sheet 1 of 1

Project Name: 1 Northfields Cottages

Project No.: 16695

Co-ords:

Hole Type

WS

Location: Fontwell Avenue, Eastergate, Chichester, West Sussex PO20 3RX

Level:

Scale

1:50

Client: BVL Developments Ltd.

Dates: 21-12-2017

Logged By

AP

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	D		0.60			Turf over dark brown slightly gravelly silty CLAY with frequent roots and rootlets. Gravel is fine to medium subangular clasts of flint. TOPSOIL	
		0.80	D					Light brown becoming light brown very gravelly CLAY. Gravel is fine to coarse angular clasts of flint. HEAD Percentage gravel increasing with depth	1
		1.50	D		1.90			light brown and off white weathered structureless CHALK recovered as fine gravel sized fragments of intact chalk within a sandy SILT calcareous matrix. WHITE CHALK SUBGROUP	2
		2.50	D						3
		3.50	D						4
		4.50	D						5
					5.00			End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

General Remarks:

Roots to 0.60m bgl. No groundwater encountered.

Groundwater Remarks:**Borehole Type**

CP: Cable Percussive
WS: Windowless Sampler
RC: Rotary Cored

Sample Types

D: Disturbed
B: Bulk
J: Jar
W: Water
U: Undisturbed

In-Situ Testing

SPT: Split spoon - Standard Penetration Test
CPT: Cone - Standard Penetration Test

Appendix B – Raw Groundwater Monitoring Data

Date of reading	Depth to Water (m bgl)		
	WS1	WS2	WS3
22-12-17	3.85	DRY	4.51
23-12-17	3.86	DRY	4.52
26-12-17	3.86	DRY	4.53
30-12-17	3.68	4.89	4.34
02-01-18	3.33	4.54	3.97
05-01-18	3.22	4.35	3.82
08-01-18	3.40	4.30	3.79
11-01-18	3.26	4.33	3.81
14-01-18	3.33	4.40	3.89
17-01-18	3.81	4.41	3.89
20-01-18	3.31	4.38	3.89
23-01-18	3.80	4.35	3.93
26-01-18	3.11	4.23	3.70
29-01-18	3.13	4.22	3.67
01-02-18	3.19	4.28	3.74
06-02-18	3.26	4.34	3.85
09-02-18	3.34	4.44	3.99
15-02-18	3.31	4.52	3.96
20-02-18	3.33	4.39	3.94
23-02-18	3.34	4.43	3.92
03-03-18	3.50	4.63	4.11
06-03-18	3.57	4.69	4.27
12-03-18	3.44	4.59	4.06
15-03-18	3.41	4.76	4.00
22-03-18	3.39	4.50	3.99
26-03-18	3.47	4.57	4.04
30-03-18	3.49	4.62	4.36
02-04-18	3.34	4.55	3.90
05-04-18	2.96	4.01	3.51
10-04-18	2.97	4.17	3.78
14-04-18	3.06	4.15	3.78
18-04-18	3.22	4.19	3.88
Depth of well (m bgl)	5.00	5.00	5.00