

Mr Peter Taylor & Crayfern Homes

By email only

Our Ref: 17028/GWLR

May 2016

Dear Mr Taylor and Mr Wawman

RE: Groundwater Monitoring at Land North of Mayflower Way, off Roundstone Lane, Angmering, West Sussex.

We are writing regarding the intrusive investigation undertaken by Soils Limited at the above-named site on the 19th November 2015 and the subsequent groundwater monitoring which was undertaken between 30th November 2015 and 12th April 2016.

1.1 Brief

The brief was set out in Soils Limited Quotation Q17034, dated 10th October 2015, and comprised the drilling of three windowless sampler boreholes to depths of 5.00m bgl, and six dynamic probes to depths of 5.00m bgl at locations specified by Soils Limited. Groundwater monitoring wells were to be installed in three of the boreholes to facilitate a programme of groundwater monitoring. Groundwater monitoring was to be undertaken over a six-month period with measurements taken on a monthly basis.

At the time of the investigation it was understood that the proposed redevelopment of the site was to comprise 24 residential buildings, made up of semi-detached and terraced houses. The groundwater monitoring was intended to inform the design of the drainage strategy for the residential development.

1.2 General

The site was located at Land North of Mayflower Way, off Roundstone Lane, Angmering, and had an approximate OS Land Ranger Grid Reference of TQ 072033. At the time of the investigation the site comprised of open land used for the storage of building materials and equipment and stockpiles of aggregate and crushed material.

A site location plan is presented in Figure 1.

1.3 Ground Conditions

The site works were undertaken on the period 22nd November 2015 and comprised:

- 3No. Windowless sampler boreholes;

- 6No. Dynamic probes;
- 3No. Groundwater monitoring wells.

Trial hole locations were chosen by Soils Limited and are presented within Figure 2.

The ground conditions encountered in the site investigation have been summarised below:

**Made Ground
River Terrace Deposits
Pit Chalk Formation**

Table 1 Summary of Ground Conditions

Strata	Depth Encountered (m bgl)		Typical Description
	Top	Base	
Made Ground	0.00	0.40 -0.90	Very soft dark grey sandy silty CLAY and very gravelly SAND. Gravel comprised of fine to coarse, angular to sub angular brick, concrete, tarmacadam, glass and tile
River Terrace Deposits (Cohesive)	0.40 – 0.90	3.00 – 4.00	Soft brown slightly silty sandy occasionally gravelly CLAY. Sand was coarse. Gravel was fine to coarse angular to sub-angular flint. Occasional fine roots and rootlets.
River Terrace Deposits (Granular)	3.00 – 4.00	4.00 – 5.00 ¹	Light brown clayey gravelly SAND and light brown clayey sandy GRAVEL. Gravel comprised of fine to medium angular flint.
Pit Chalk Formation			Not encountered during the site investigation
Notes: ¹ encountered to base of trial hole			

Borehole logs including details of the well installations are provided in Appendix A.

1.4 Groundwater Strikes

No standing groundwater was encountered during the sinking of the exploratory holes.

1.5 Groundwater and Soil-Gas Monitoring

Groundwater monitoring was undertaken by Soils Limited comprising six visits over a six-month period between November 2015 and May 2016. Monitoring was undertaken by means of manual dipping of the wells. Dipping was undertaken at a monthly frequency. The results of the groundwater and soil gas monitoring have been presented in Table 2.

Table 2: Summary of Groundwater and Soil-Gas Monitoring

Date of visit	Trial Hole	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	CO (ppm)	LEL (%)	aP (mb)	Flow (l/h)	Dp	H ₂ O (m bgl)	VOC (ppm)
30/11/2015	WS1	0.0	4.0	16.7	0	0	0.0	1014	0.0	0	Dry	0
	WS2	0.0	2.3	18.3	0	0	0.0	1014	0.0	0	Dry	0
	WS3	0.0	4.6	15.5	0	0	0.0	1014	0.0	0	Dry	0
17/12/2016	WS1	0.0	6.2	12.5	0	0	0.0	1016	0.01	0	3.84	0
	WS2	0.0	2.4	17.5	0	0	0.0	1016	0.81	2	Dry	0
	WS3	0.0	6.3	11.6	0	0	0.0	1016	1.21	2	Dry	0
08/01/2016	WS1	0.0	0.2	19.7	0	0	0.0	996	0.4	0	3.85	0
	WS2	0.0	0.2	20.0	0	0	0.0	996	0.4	0	Dry	0
	WS3	0.0	0.2	20.1	0	0	0.0	996	0.3	0	Dry	0
12/02/2016	WS1	0.0	7.2	11.2	0.0	0	0.0	989	0.0	0	Dry	0
	WS2	0.0	0.6	20.2	0.0	0	0.0	989	0.0	0	Dry	0
	WS3	0.0	1.6	18.3	0.0	0	0.0	989	0.0	0	Dry	0
14/03/2016	WS1	0.0	7.9	9.9	0	0	0.0	1035	0.0	0	Dry	0
	WS2	0.0	0.0	21.4	0	0	0.0	1035	0.0	0	Dry	0
	WS3	0.0	2.6	16.3	0	0	0.0	1035	0.0	0	Dry	0
12/04/2016	WS1	0.0	4.5	13.9	0.0	0.0	0.0	1009	0.01	0.0	Dry	0
	WS2	0.0	0.0	20.9	0.0	0.0	0.0	1009	0.01	0.0	Dry	0
	WS3	0.0	4.1	15.0	0.0	0.0	0.0	1009	0.01	0.0	Dry	0

1.6 Groundwater Monitoring

Groundwater was recorded in the shallowest monitoring well, WS1 on two occasions 17/12/2015 and 08/01/2016 during the monitoring period. No groundwater was recorded in the deeper monitoring wells situated in WS2 or WS3 during the monitoring period.

1.7 Soil-Gas Monitoring

The elevated concentrations of carbon dioxide (CO₂), greater than 5.0% v/v were recorded within WS1 and WS3 on 17/12/2015 (WS1:6.2% v/v and WS3:6.3% v/v), and within WS1 on 12/02/2016 (7.2% v/v) and 14/03/2016 (7.9% v/v). No methane was recorded during the monitoring period. A maximum flow rate of 1.21 l/h.

If requested, a full Soil-Gas Risk Assessment can be provided as part of the Phase II Ground Investigation report, which is to be undertaken at a later date.

1.8 Conclusions

Groundwater levels appear to be at depths greater than 3.85m bgl in the area of WS1 and greater than 5.00m bgl in the areas of WS2 and WS3. The difference in groundwater levels may be accounted for by a change in ground levels, with the area of WS3 being situated at a lower elevation relative to WS1 and WS2. It is recommended that the hole locations are levelled to enable an accurate groundwater elevation to be established.

The results of the groundwater monitoring programme suggest that groundwater should not present a problem for the construction of conventional shallow footings or other shallow trenches such as service runs etc, providing that site levels are to remain similar to the levels encountered at the time of the investigation.

In line with Environment Agency guidance any soakaway drainage system considered for the proposed development must ensure that the base of such soakaways are a minimum of 1.00m above the highest annual groundwater level.

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

Figure 1. Site Location Plan

Figure 2. Trial Hole Location Plan

Appendix A. Field Data

Should you have any further questions please do not hesitate to contact the undersigned.

Yours sincerely

Geo-Environmental Engineer

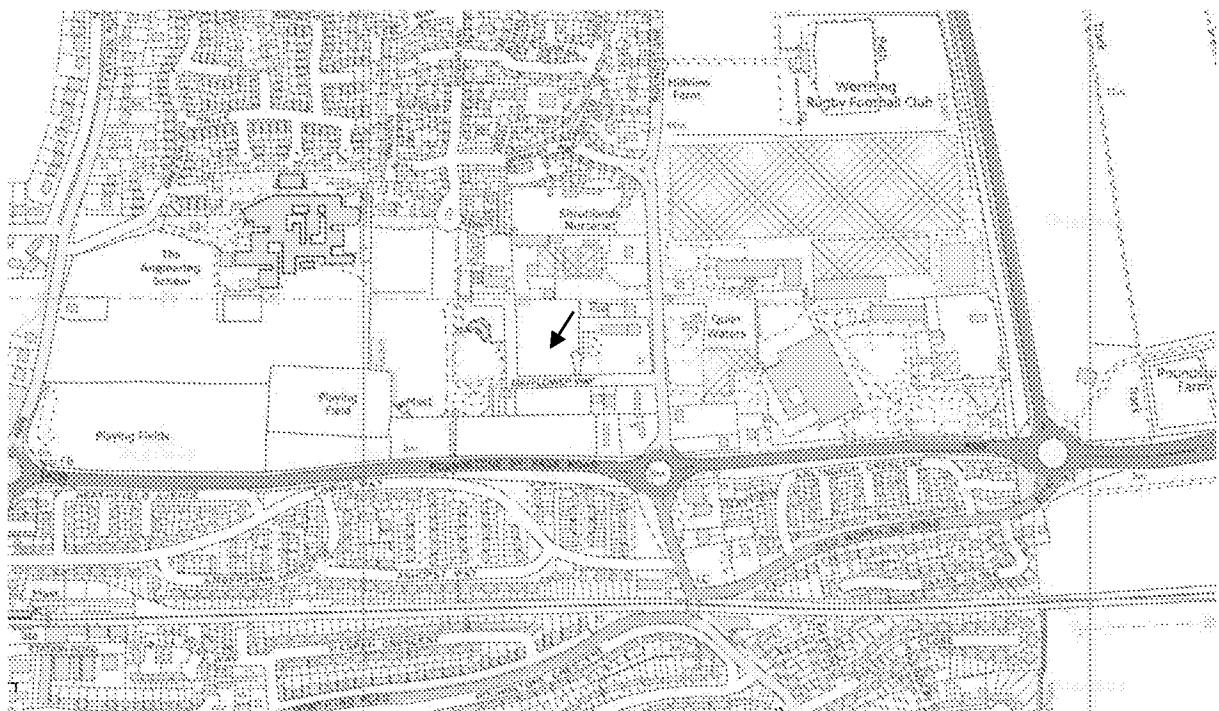


Figure 1 - Site Location Plan



Project
Land North of Mayflower Way

Date
May 2016

Client
Mr. Peter Taylor and Crayfern Homes

Job Number
17028

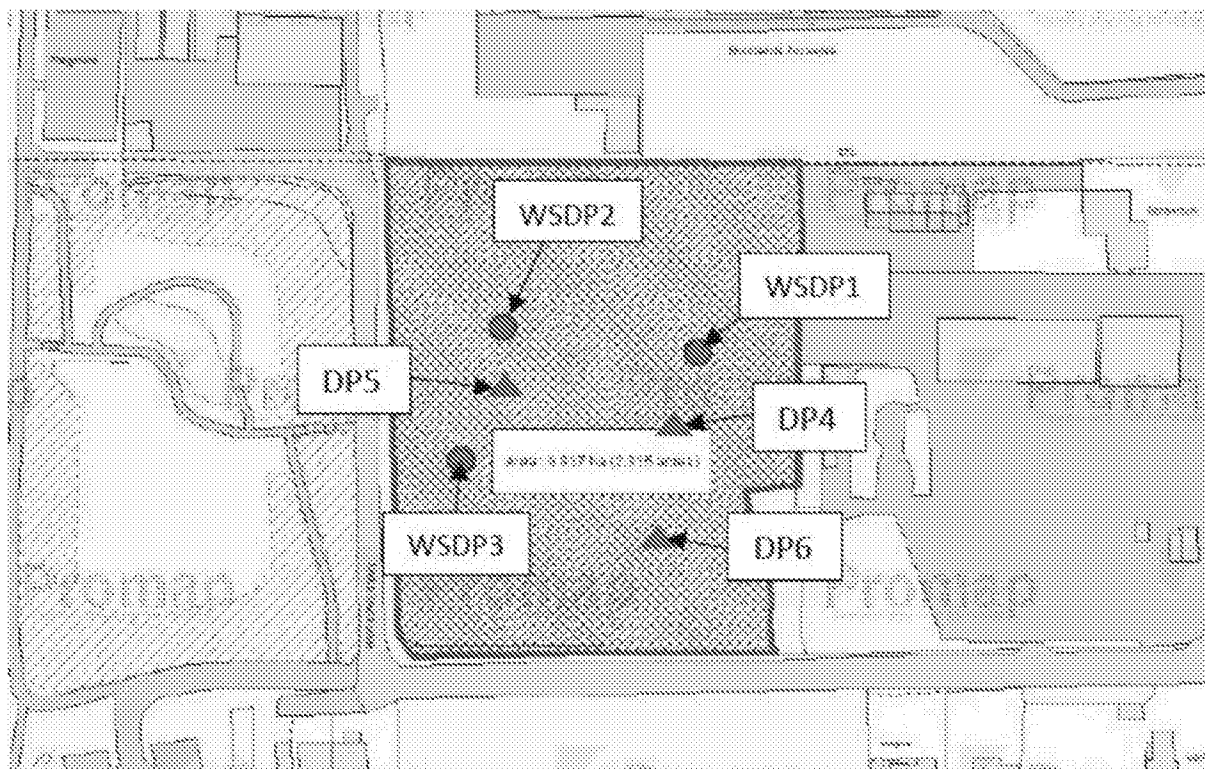


Figure 2 – Trial Hole Location Plan



Project
Land North of Mayflower Way

Date
May 2016

Client
Mr. Peter Taylor and Crayfern Homes

Job Number
17028

Appendix A – Field Data

Project Name: Land North of Mayflower Way

Project No.: 17028

Co-ords:

Hole Type

WS

Location: Angmering, West Sussex BN14 4AY

Level:

Scale

1:50

Client: Mr. Peter Taylor and Crayfern Homes

Dates: 05-01-2016

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			Very soft dark grey sandy silty CLAY. Sand is fine to medium. Occasional fine to medium sub-angular flint gravels. Occasional fine to medium brick tile and glass fragments. Occasional carbonated material. MADE GROUND.	
								Saturated sample	
								Soft brown slightly sandy silty CLAY becoming light brown at 3.0 to 4.0. Sand is fine. Occasional fine to medium sub-angular flint gravels becoming rare fine at 0.4 to 0.80. A fine piece of plastic wire at 0.60.	1
								~70% recovery	
								~60% recovery	2
					3.00			Light brown clayey sandy fine to coarse sub-angular flint GRAVEL. Sand is fine to coarse.	3
								~20% recovery	
					4.00			End of Borehole at 4.00m	4
									5
									6
									7
									8
									9
									10

General Remarks:

Fine roots and rootlets to 1.0.

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: Land [REDACTED] ds:

Hole Type
WS

Location: Angmering, West Sussex BN14 4AY

Level:

Scale
1:50

Client: Mr. Peter Taylor and Crayfern Homes

Dates: 05-01-2016

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Multicoloured very gravelly fine to coarse SAND. Gravel is fine to cobble sized flint brick concrete and tarmac. Frequent sharp sand. Occasional fine roots and rootlets. MADE GROUND.	
					0.90			Saturated sample	
								Soft brown slightly sandy silty CLAY. Sand is fine. Occasional fine to medium sub-angular flint gravels. A pocket of grey gravelly fine to coarse SAND at 1.5 to 1.8. Sand is fine to coarse. Gravel is fine to coarse sub-angular flint brick and concrete. A grey possible hydrocarbon staining at 1 to 1.30. Rare fine roots and rootlets. MADE GROUND.	1
					2.00			Hydrocarbon type odour	
								Soft light brown slightly sandy silty CLAY. Sand is fine.	2
								70% recovery	
					3.00				
								Light brown clayey fine SAND. Occasional fine to medium angular flint gravels.	3
								70% recovery	
					4.00				
								Light brown clayey gravelly fine SAND. Gravel is fine to medium angular flint.	4
					5.00				
								End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

General Remarks:

Fine roots and rootlets to 2.0.

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: Land North of Mayfield Way

Hole Type
WS

Location: Angmering, West Sussex BN14 4AY

Level:

Scale
1:50

Client: Mr. Peter Taylor and Crayfern Homes

Dates: 05-01-2016

Logged By

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.60			Very soft grey and dark grey mixed gravelly sandy silty CLAY. Sand is fine to medium. Gravel is fine to coarse sub-angular flint brick and concrete. Occasional carbonated material. Occasional fine roots and rootlets. MADE GROUND. <u>Saturated sample</u>	
								Soft light brown slightly sandy silty CLAY. Sand is fine. Occasional black staining. A grey possible hydrocarbon staining at 1.0 to 1.30. MADE GROUND. <u>Hydrocarbon type odour</u> <u>~70% recovery</u>	1
					3.00			Stiff light brown slightly sandy silty CLAY. Sand is fine. Rare fine to medium angular flint gravels. A pocket of fine to medium angular flint gravels at 2.90 to 3.0. Occasional black staining. <u>No sample received</u>	3
					4.00			Light brown clayey fine SAND.	4
					5.00			End of Borehole at 5.00m	5
									6
									7
									8
									9
									10

General Remarks:

Fine roots and rootlets to 1.0.

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



OAKLAND
site investigation

Job Reference:

Site Address:

Client:

15306

Mayflower Way, Angmering

Soils Limited

Probe No:

DP1

Probe Type

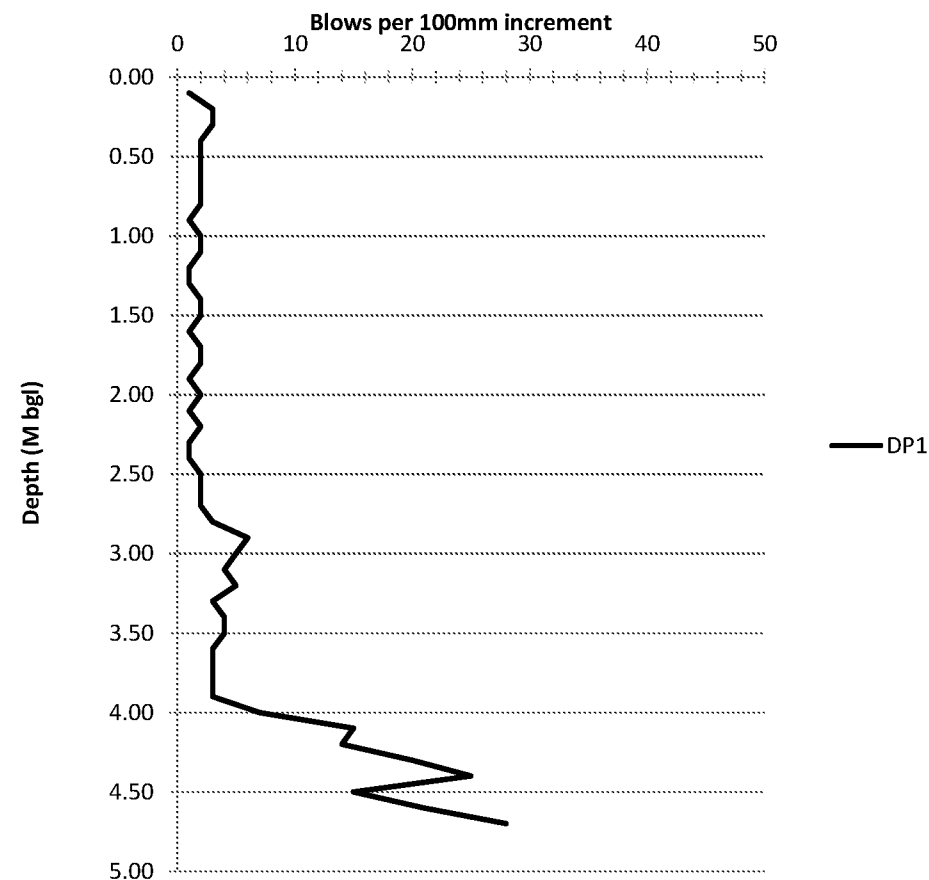
DPSH

Operator

JN

DP1

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	1	3	3	2	2	2	2	2	1	2	
1 - 2m	2	1	1	2	2	1	2	2	1	2	
2 - 3m	1	2	1	1	2	2	2	3	6	5	
3 - 4m	4	5	3	4	4	3	3	3	3	7	
4 - 5m	15	14	20	25	15	21	28				
5 - 6m											
6 - 7m											
7 - 8m											
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11 - 12m											
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16 - 17m											
17 - 18m											
18 - 19m											
19 - 20m											



Oakland Site Investigation

Registered Office Address: Unit 4, Ashway



OAKLAND
site investigation

Job Reference:
Site Address:
Client:

15306
Mayflower Way, Angmering
Soils Limited

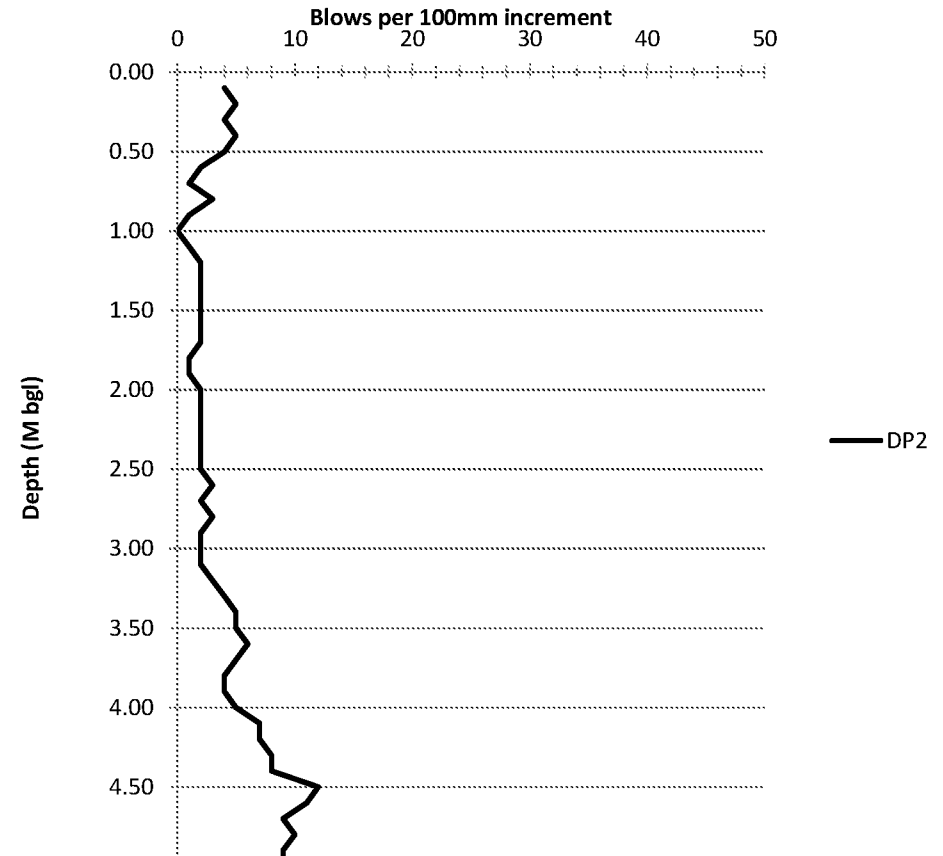
Probe No:
DP2

Probe Type
Operator

DPSH
JN

DP2

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	4	5	4	5	4	2	1	3	1	0	
1 - 2m	1	2	2	2	2	2	2	1	1	2	
2 - 3m	2	2	2	2	2	3	2	3	2	2	
3 - 4m	2	3	4	5	5	6	5	4	4	5	
4 - 5m	7	7	8	8	12	11	9	10	9	9	
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17 - 18m											
18 - 19m											
19 - 20m											



Oakland Site Investigation
Registered Office Address: Unit 4, Ashwyn



OAKLAND
site investigation

Job Reference:

Site Address:

Client:

15306

Mayflower Way, Angmering

Soils Limited

Probe No:

DP3

Probe Type

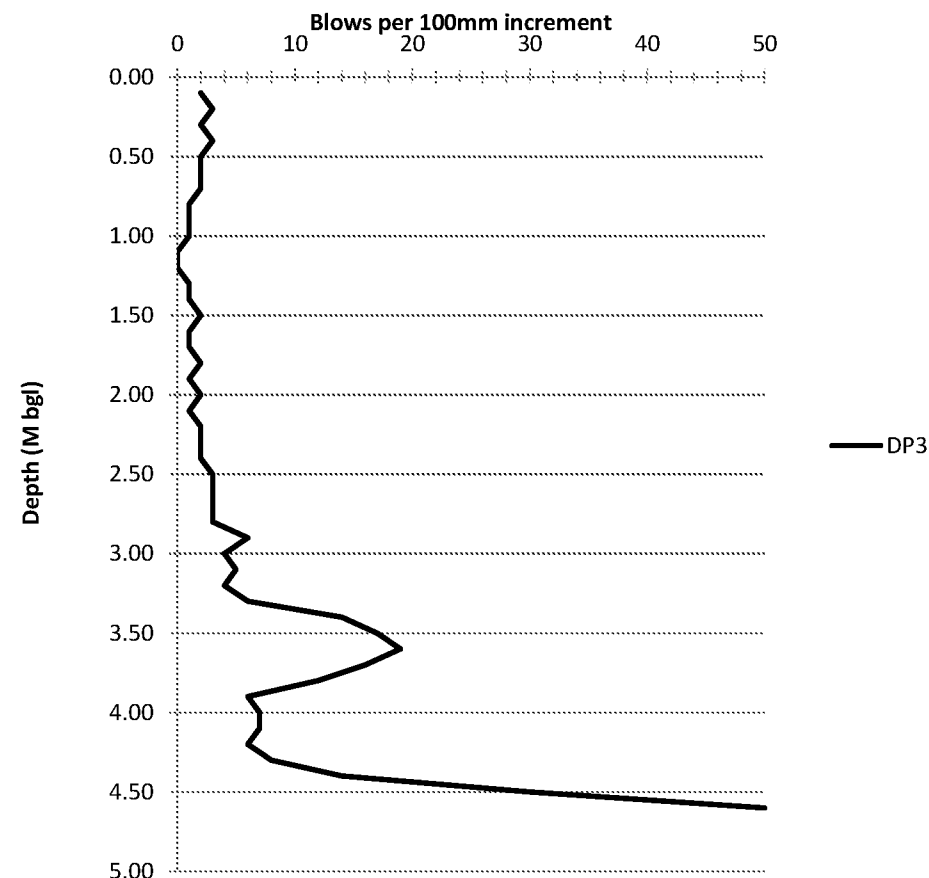
DPSH

Operator

JN

DP3

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	2	3	2	3	2	2	2	1	1	1	
1 - 2m	0	0	1	1	2	1	1	2	1	2	
2 - 3m	1	2	2	2	3	3	3	3	6	4	
3 - 4m	5	4	6	14	17	19	16	12	6	7	
4 - 5m	7	6	8	14	30	50					
5 - 6m											
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Job Reference:

Site Address:

Client:

15306

Mayflower Way, Angmering

Soils Limited

Probe No:

DP4

Probe Type

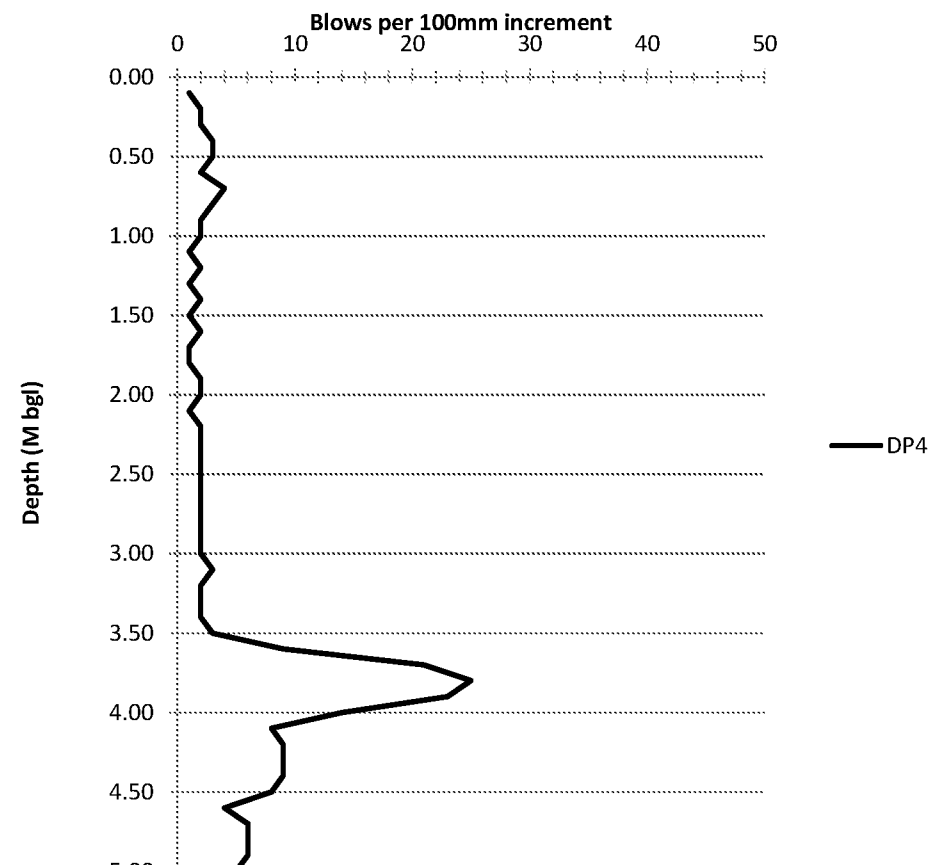
DPSH

Operator

JN

DP4

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	1	2	2	3	3	2	4	3	2	2	
1 - 2m	1	2	1	2	1	2	1	1	2	2	
2 - 3m	1	2	2	2	2	2	2	2	2	2	
3 - 4m	3	2	2	2	3	9	21	25	23	14	
4 - 5m	8	9	9	9	8	4	6	6	6	5	
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19 - 20m											



Oakland Site Investigation

Registered Office Address: Unit 4, Ashwyn Bu



OAKLAND
site investigation

Job Reference:

Site Address:

Client:

15306

Mayflower Way, Angmering

Soils Limited

Probe No:

DP5

Probe Type

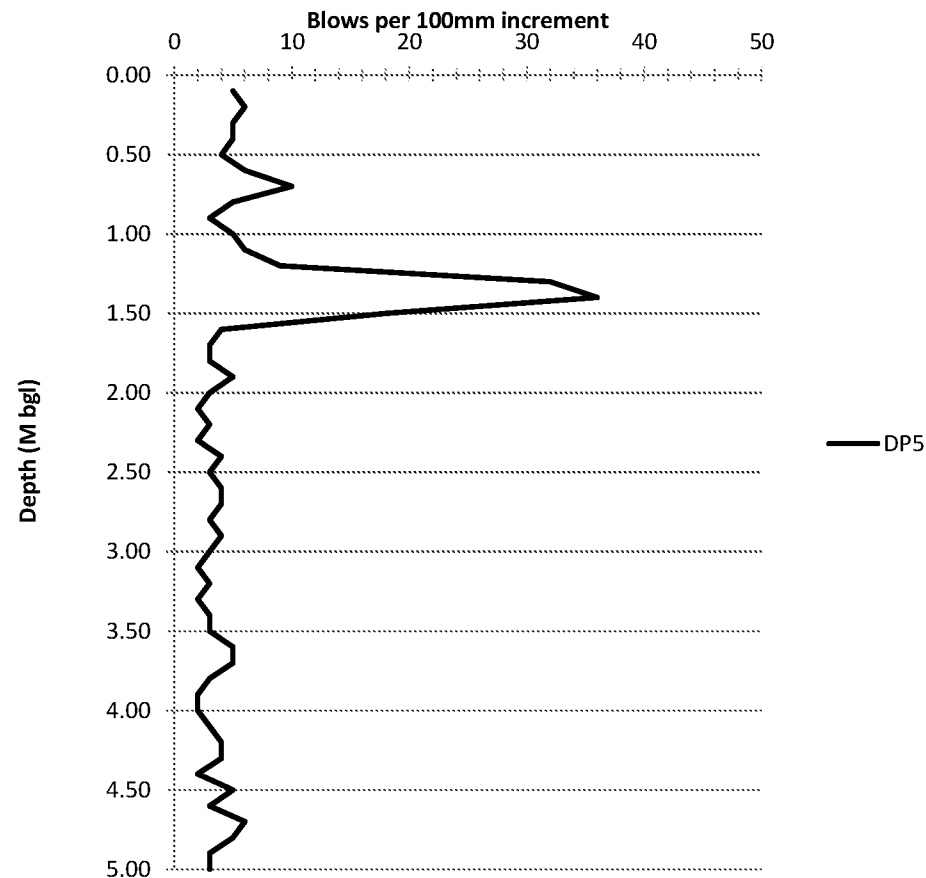
DPSH

Operator

JN

DP5

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	5	6	5	5	4	6	10	5	3	5	
1 - 2m	6	9	32	36	18	4	3	3	5	3	
2 - 3m	2	3	2	4	3	4	4	3	4	3	
3 - 4m	2	3	2	3	3	5	5	3	2	2	
4 - 5m	3	4	4	2	5	3	6	5	3	3	
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19 - 20m											



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Registered Office Address: Unit 4, As



OAKLAND
site investigation

Job Reference:

Site Address:

Client:

15306

Mayflower Way, Angmering

Soils Limited

Probe No:

DP6

Probe Type

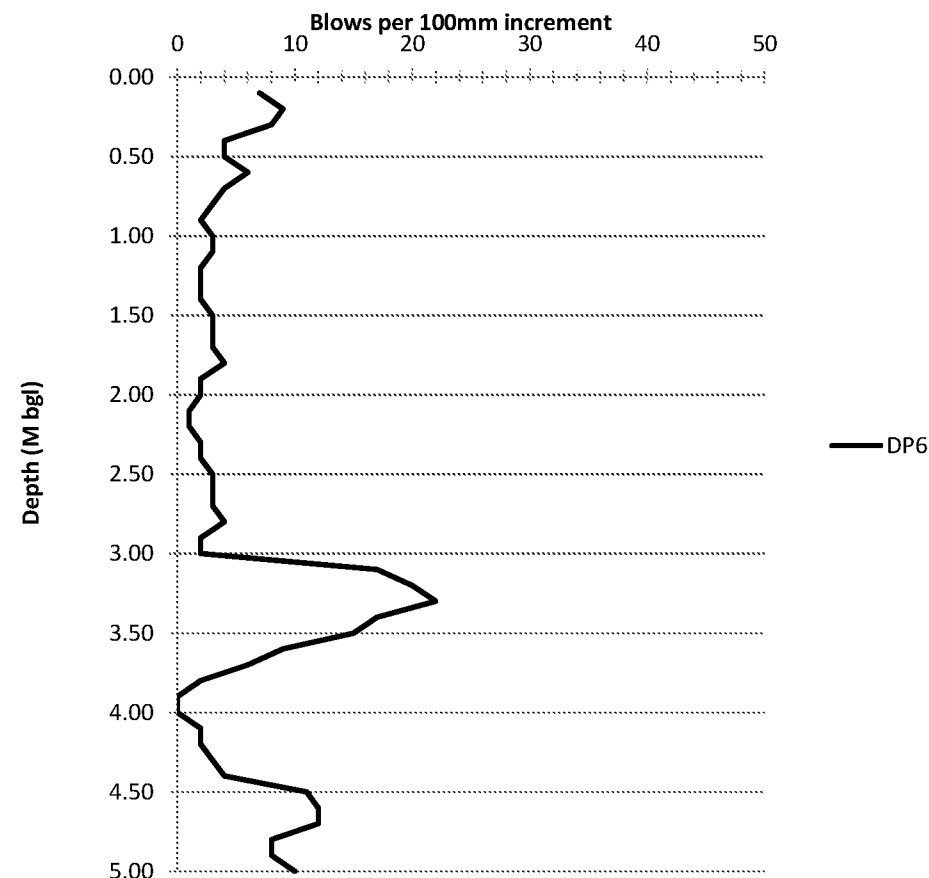
DPSH

Operator

JN

DP6

	+0.1	+0.2	+0.3	+0.4	+0.5	+0.6	+0.7	+0.8	+0.9	+1.0	Torque
0 - 1m	7	9	8	4	4	6	4	3	2	3	
1 - 2m	3	2	2	2	3	3	3	4	2	2	
2 - 3m	1	1	2	2	3	3	3	4	2	2	
3 - 4m	17	20	22	17	15	9	6	2	0	0	
4 - 5m	2	2	3	4	11	12	12	8	8	10	
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