



**Quiet Waters
Roundstone Lane
Angmering
West Sussex**

In Situ Soil Infiltration Testing Report

Report Beneficiary:

Bedaro Ltd
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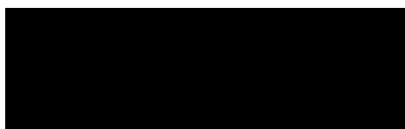
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1. INTRODUCTION

It is proposed to construct 23 no. new dwellings on land located at Roundstone Lane, Angmering, West Sussex. The development proposals also allow for the provision of a new surface water drainage system.

Ashdown Site Investigation Limited was requested to provide an estimate for carrying out in situ soil infiltration testing at the site by Bedaro Ltd, Northern Office, Suite 9, Beech House, Padgate Business Park, Green Lane, Warrington, WA1 4JN. The scope of the works allowed for and the terms and conditions under which the works were to be undertaken were set out within the offer letter Q18-7569, dated 27th July 2018. The instruction to proceed was received from the client, Bedaro Ltd., in an email dated 1st August 2018.

The objectives of the works were to:

- a) Investigate the shallow ground and groundwater conditions at the test locations specified by the client; and
- b) Provide calculated soil infiltration rates to assist others in finalising the design of infiltration systems.

2. SITE WORKS

The site works comprised the drilling of six boreholes to depths of between 3.00m and 5.00m below ground level, together with associated in situ soil infiltration testing. The fieldwork was carried out on 3rd and 9th August 2018. The exploratory hole locations are shown on Figure 1.

The boreholes were formed by a series of 1.0m long, open ended, hollow steel tubes of up to 100mm diameter, each containing a removable plastic liner. The tubes, progressively reducing in diameter, were driven into the ground by means of a track-mounted drop weight. Each tube was extracted from the ground using a hydraulically operated jack and the enclosed sample was recovered in its plastic liner.

Descriptions of the strata encountered and comments on groundwater conditions are shown in the exploratory hole records that are appended to this report. Notes to assist interpretation of the records are also appended.

3. GROUND CONDITIONS

3.1 Stratigraphy

3.1.1 *Surface Covering*

In general, the boreholes were excavated through a surface cover of topsoil some 100mm to 150mm in thickness.

3.1.2 *Made Ground*

Made ground, generally comprising reworked gravelly sandy silty clay, was recorded to depths of between 0.35m and 1.50m below ground level at each of the borehole positions. The gravel fraction comprised variable quantities of flint, brick and charcoal-like material.

3.1.3 *River Terrace Deposits*

Underlying the made ground, the investigation progressed into clay deposits with variable proportions of sand and gravel. The clay deposits were recorded to contain localised pockets of flint gravel to depths of around 3.00m below ground level, below which depth the stratum was generally noted to become increasingly gravelly.

These soils, which were recorded to the full depth of the investigation, are considered to be representative of the River Terrace Deposits indicated to be present beneath the site on the published geological map.

3.2 Stability

Each of the boreholes was recorded to be stable on completion of drilling.

3.3 Groundwater Conditions

All of the boreholes remained dry throughout the duration of the drilling works.

4. STORMWATER INFILTRATION SYSTEMS

In-situ infiltration testing¹ was undertaken in boreholes WS02, WS04, WS05 and WS06. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

Non-standard falling head infiltration testing was also carried out in the uncased dynamic sampler boreholes WS01 and WS03. From the test results calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the soils within the test zone. The soil infiltration rate has been calculated by dividing the volume of water lost during the test by the product of the average surface area of the sides in contact with water during the test period and the test duration in seconds.

The infiltration rates derived from the tests are summarised in the following table.

Table 1. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
WS01	0.00	3.00	River Terrace Deposits (slightly gravelly sandy clay)	Negligible – the water fell only 200mm in 90 minutes	
WS02 test 1	2.00	3.00	River Terrace Deposits (gravelly sandy clay)	6.9 x 10 ⁻⁵	1.0
WS02 test 2	2.00	3.00	River Terrace Deposits (gravelly sandy clay)	8.6 x 10 ⁻⁵	1.0 or 2.0
WS02 test 3	2.00	3.00	River Terrace Deposits (gravelly sandy clay)	7.3 x 10 ⁻⁵	1.0 or 2.0
WS03	0.55	3.00	River Terrace Deposits (slightly to very gravelly clay)	1.5 x 10 ⁻⁶	-
WS04	4.00	5.00	River Terrace Deposits (slightly to very gravelly clay)	8.9 x 10 ⁻⁶	1.0
WS05 test 1	3.00	5.00	River Terrace Deposits (very gravelly clay)	3.3 x 10 ⁻³	1.0 or 2.0
WS05 test 2	3.00	5.00	River Terrace Deposits (very gravelly clay)	7.8 x 10 ⁻⁴	1.0
				1.8 x 10 ⁻³	2.0
WS05 test 3	3.00	5.00	River Terrace Deposits (very gravelly clay)	1.8 x 10 ⁻³	1.0 or 2.0
				5.6 x 10 ⁻³	3.0
WS06	3.00	5.00	River Terrace Deposits (slightly gravelly clay)	Negligible – the water fell only 100mm in 151 minutes	

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests indicate that the River Terrace Deposits possess negligible to good infiltration characteristics, with the highest infiltration rates yielded within the soils with higher gravel content. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system. Given the variable infiltration rates recorded

¹ Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

it may be prudent to undertake larger scale testing within machine excavated pits once the depths and locations of proposed soakaways are known.

To comply with building regulations², point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

Designers should consider the need to undertake monitoring of groundwater levels during the worst annual case (wetter periods), which is often a requirement from the Local Authority and suggested by the BRE365 guidance, prior to designing the infiltration systems.

In the event that discharge to ground via infiltration systems is proposed, it is recommended that designers of the system provide for the prevention of pollution of groundwater. In this regard due consideration should be given to guidance provided within BRE 365 and by the Environment Agency. Appropriate consideration should also be given to whether there is a need for inclusion of interceptors and oil separators. The Local Authority and/or relevant water company should be consulted in relation to consent for discharge of water from rooftops, areas of hardstanding and roadways to drains.

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² The Building Regulations 2010; Part H; Drainage and Waste Disposal

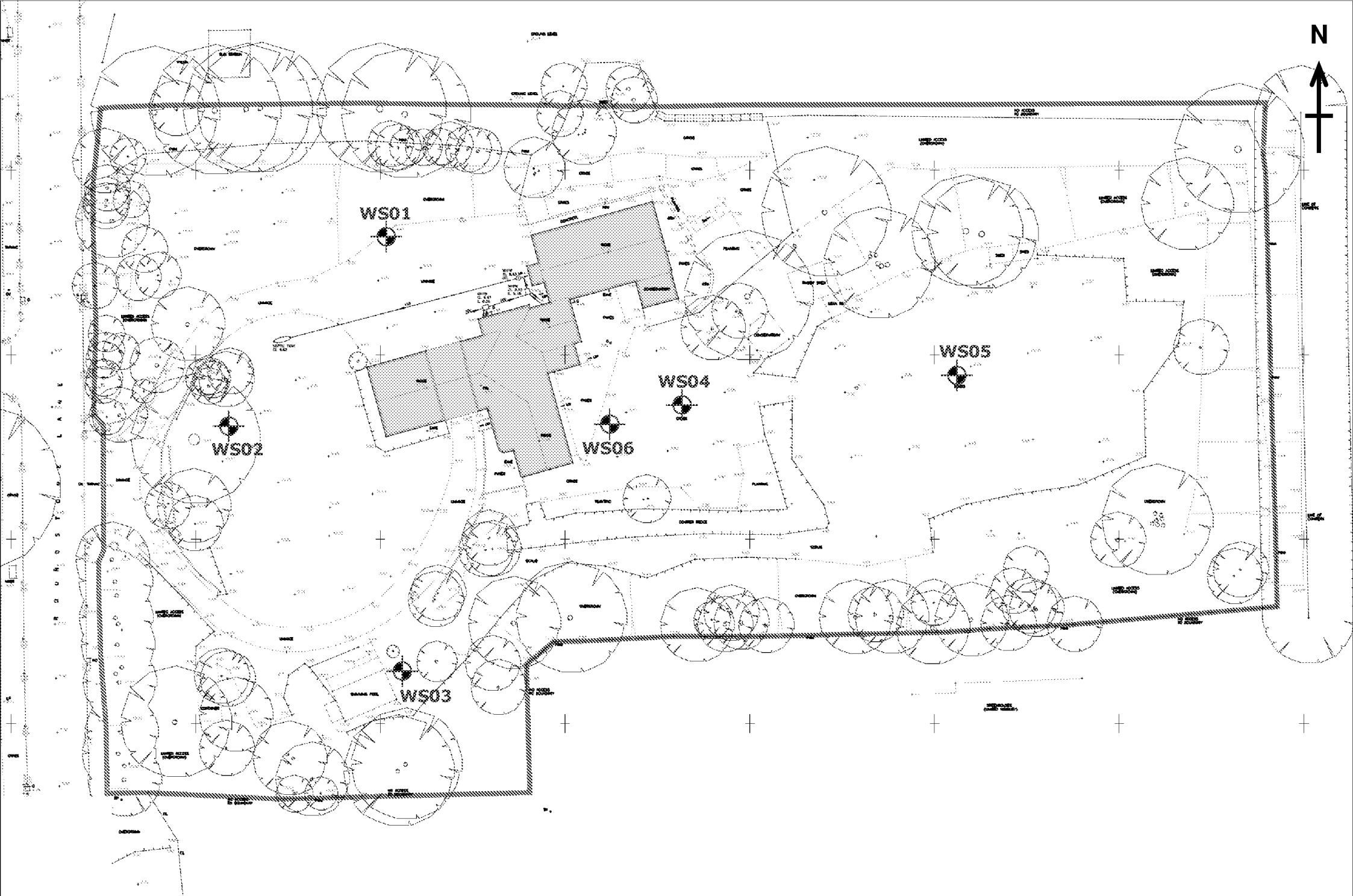
FIGURES AND APPENDICES

Figure 1 Site Plan

Exploratory Hole Notes

Exploratory Hole Records

Summary of Borehole Falling Head Soakage Test Results



NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U	'Undisturbed' Sample: - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo	Sample not obtained.
U*	Full penetration of sample not obtained.
Pi	Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D	Disturbed Sample.
R	Root Sample.
B	Bulk Disturbed Sample.
W	Water Sample.
J	Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T	Tub Sample
Vi	Vial Sample

In situ Testing

S	Standard penetration test (SPT): Using the split spoon sampler.
C	Standard Penetration Test (SPT): using a solid cone instead of the sampler - conducted usually in coarse grained soils or weak rocks.
V	Shear Vane Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
H	Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
P	Perth Penetrometer Test: Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column.

Excavation Method

CP	Cable Percussion Borehole
WLS	Dynamic Sampler Borehole using windowless sampler tubes
WS	Dynamic Sampler Borehole using window sampler tubes
TP	Trial Pit excavated using mechanic excavator
HDP	Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004+A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003) as well as the BS5930:2015 code of Practice for Ground Investigations.

4 Chalk Description

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.



Site Name: Quiet Waters, Roundstone Lane, Angmering, West Sussex	
Job Number: R18-13139	
Start Date: 03/08/2018	Borehole Number: WS01
End Date: 03/08/2018	

Samples and In Situ Testing					Legend	Depth	Stratum Description
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
	D	0.20				0.00	MADE GROUND: Dark brown gravelly sandy silty clay. Gravel is angular to subrounded fine to coarse flint and crystalline rock.
	D	0.80				0.40	Brown slightly gravelly sandy CLAY. Gravel is angular to subangular fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
	D	1.50					
	D	2.50					becoming very gravelly below 2.00m depth.
						3.00	End of borehole at 3.00m

Remarks Groundwater: Borehole dry on completion. Stability: Borehole stable on completion. Notes: n/a	Excavation Method: WLS
	Borehole Diameter: Various
	Made By: RJ



Site Name: Quiet Waters, Roundstone Lane, Angmering, West Sussex

Job Number: R18-13139

Start Date: 03/08/2018

End Date: 03/08/2018

Borehole Number: **WS02**

Sheet 1 of 1

Samples and In Situ Testing					Legend	Depth	Stratum Description
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
	D	0.50				0.00 0.10	Topsoil. MADE GROUND/ Reworked: Brown slightly gravelly sandy silty clay. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse.
	D	1.50				0.80	Orange brown gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
	D	2.50				2.80	becoming very gravelly below 2.60m depth. Gravel is coarse flint with occasional cobbles.
							End of borehole at 2.80m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: No further progress below 2.80m depth - too dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

End Date: 03/08/2018

WS03

Sheet 1 of 1

Remarks Groundwater: Borehole dry on completion. Stability: Borehole stable on completion. Notes: n/a	Excavation Method: WLS
	Borehole Diameter: Various
	Made By: RJ



Site Name: Quiet Waters, Roundstone Lane, Angmering, West Sussex

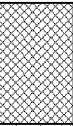
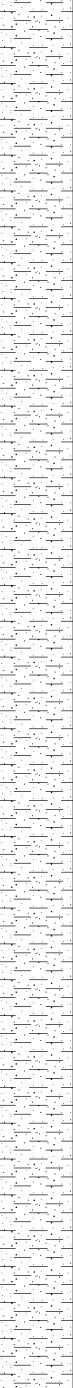
Job Number: R18-13139

Start Date: 03/08/2018

End Date: 03/08/2018

Borehole Number: **WS04**

Sheet 1 of 1

Samples and In Situ Testing					Legend	Depth	Stratum Description
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
	D	0.20				0.00	Topsoil over, MADE GROUND/ Reworked: Brown gravelly slightly sandy clay. Gravel is angular to rounded fine to medium flint and occasional charcoal-like material. Sand is fine to coarse.
	D	0.80				0.40	Orange brown slightly gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
	D	1.20					
	D	1.80					
	D	2.20					
	D	2.80					becoming very gravelly below 2.60m depth.
	D	3.50					becoming slightly gravelly between 3.00m and 4.00m depth.
	D	4.50					becoming very gravelly below 4.00m depth.
						5.00	End of borehole at 5.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ



Site Name: Quiet Waters, Roundstone Lane, Angmering, West Sussex

Job Number: R18-13139

Start Date: 03/08/2018

End Date: 03/08/2018

Borehole Number: WS05

Sheet 1 of 1

Samples and In Situ Testing					Legend	Depth	Stratum Description
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
	D	0.50				0.00	Topsoil over, MADE GROUND: Dark brown and brown gravelly sandy silty clay. Gravel is angular to subrounded fine to coarse brick and flint with occasional charcoal-like material. Sand is fine to coarse.
	D	1.80				1.50	Orange brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
	D	2.50					becoming slightly gravelly between 2.00m and 2.80m depth.
	D	3.50					becoming very gravelly below 3.00m depth.
	D	4.50				5.00	End of borehole at 5.00m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

Site Name: Quiet Waters, Roundstone Lane, Angmering, West Sussex

Job Number: R18-13139

Start Date: 09/08/2018

End Date: 09/08/2018

Borehole Number: **WS06**

Sheet 1 of 1

Samples and In Situ Testing							Stratum Description	
Standpipe	Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth		
	V	0.00				0.00	Topsoil.	
						0.15	MADE GROUND: Brown slightly gravelly silty clay. Gravel is angular to subrounded fine to coarse flint, charcoal-like material and clinker-like material.	
	H	0.50		>250		0.40	Brown and orange brown silty CLAY. (River Terrace Deposits)	
	H	0.80		155				
	H	1.20		60				
	H	1.50		60				
	H	1.80		35				
	H	2.20		35		2.00	Brown and orange brown slightly gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. (River Terrace Deposits)	
	H	2.50		35				
	H	2.80		35				
	H	3.20		35				
	H	3.50		35				
	H	3.80		<35				
	H	4.20		35				
	H	4.50		90				
						5.00	End of borehole at 5.00m	

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: n/a

Excavation Method: WLS

Borehole Diameter: Various

Made By: MR

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Site: Quiet Waters, Roundstone Lane, Angmering, West
Sussex

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS01	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.08
2	0.11
3	0.12
6	0.13
10	0.14
15	0.15
20	0.16
30	0.18
40	0.18
60	0.19
80	0.20
90	0.20
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	n/a
Borehole Diameter (mm)	88.00
Casing Diameter (mm)	n/a

Notes: bgl – below ground level.

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Site: Quiet Waters, Roundstone Lane, Angmering, West
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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS02 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.25
1	0.35
2	0.98
4	1.26
6	1.53
8	1.83
10	2.05
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS02 (Test 2)	
Time (mins)	Depth to water (m bgl)
0	0.10
1	0.25
2	0.45
4	0.66
5	0.92
8	1.40
10	1.81
12	1.95
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS02 (Test 3)	
Time (mins)	Depth to water (m bgl)
0	0.05
1	0.38
2	0.59
3	0.67
5	0.80
8	1.30
10	1.75
13	1.90
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Quiet Waters, Roundstone Lane, Angmering, West
Sussex

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS03	
Time (mins)	Depth to water (m bgl)
0	0.55
1	0.56
2	0.58
4	0.59
8	0.80
10	1.10
30	1.15
40	1.20
60	1.23
75	1.25
80	1.25
Borehole Depth (m bgl)	3.00
Casing Depth (m bgl)	n/a
Borehole Diameter (mm)	88.00
Casing Diameter (mm)	n/a

Notes: bgl – below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Quiet Waters, Roundstone Lane, Angmering, West
Sussex

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS04	
Time (mins)	Depth to water (m bgl)
0	0.00
2	0.03
3	0.06
5	0.08
7	0.10
17	0.21
27	0.40
42	0.72
52	1.35
82	1.88
97	2.60
127	2.90
172	3.70
Borehole Depth (m bgl)	5.00
Casing Depth (m bgl)	4.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Quiet Waters, Roundstone Lane, Angmering, West
Sussex

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS05 (Test 1)	
Time (secs)	Depth to water (m bgl)
0	0.30
5	1.20
10	1.50
20	3.10
Borehole Depth (m bgl)	5.00
Casing Depth (m bgl)	3.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS05 (Test 2)	
Time (secs)	Depth to water (m bgl)
0	0.55
5	0.92
10	1.50
15	2.20
35	3.40
Borehole Depth (m bgl)	5.00
Casing Depth (m bgl)	3.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS05 (Test 3)	
Time (secs)	Depth to water (m bgl)
0	0.50
5	0.80
10	1.70
20	2.80
Borehole Depth (m bgl)	5.00
Casing Depth (m bgl)	3.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level

ASHDOWN SITE INVESTIGATION LIMITED

Site: Quiet Waters, Roundstone Lane, Angmering, West
Sussex

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SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS06	
Time (mins)	Depth to water (m bgl)
0	0.00
1	0.00
3	0.01
9	0.01
17	0.01
25	0.02
33	0.03
151	0.10
Borehole Depth (m bgl)	5.00
Casing Depth (m bgl)	3.00
Borehole Diameter (mm)	75.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.