

GEOTECHNICAL SOIL SURVEY

Copeland Yussuf LLP

**Pavilion Café,
Horley**



Client:

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GEOTECHNICAL SOIL SURVEY

**Pavilion Café,
Horley**

A report prepared on behalf of *Soil Environment Services* by:



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1. SCOPE OF WORKS

Soil Environment Services Ltd was instructed to conduct a factual ground investigation at:

Pavilion Café,
Horley

(Drawing 1)

...to determine the ground conditions for a proposed commercial development.

The planned works include soil survey and testing to provide a factual geotechnical assessment of soil conditions for the required ground-works and/or building construction in general accordance with EC7, BS5930 and BS1377.

The site investigation was carried out on the 3rd May 2018.

The planned scope of works detailed and specified within the agreed quotation comprised:

- 3 x Boreholes to a maximum depth of 4 m or as dictated by ground conditions
- 3 x Dynamic probing or SPT and/ or Shear vane reading
- pH and sulphate analysis
- Atterberg limits analysis (plastic index)
- 1 x Factual report in general accordance with EC7 and BS5930

Variation to the above scope of works may be needed and beneficial given the ground conditions encountered during the site investigation. This will be detailed in **Section 3.1 – Completed Works**.

The accuracy of the geotechnical report is restricted to the initial scope of works and then the completed works. Also, variation in soil strength and composition may subsequently be encountered across the site during site works operations and/or ground preparation.

2. SITE SETTING

The site assessed for this investigation (Drawing 1) is a grassed area on the east side of a public park. Mature trees are located to the east of the site.

Topographically the site is relatively level with a slight slope to the south west towards the river.

2.1 Surface conditions

The surface comprised a grassed level parkland.

2.2 BGS/Soil survey mapped Geology and drift

The site is mapped by the BGS (1:50 000) as being located on:

Superficial:

1:50 000 scale superficial deposits description: River Terrace Deposits (undifferentiated) - Sand And Gravel. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers (U).

Bedrock:

1:50 000 scale bedrock geology description: *Weald Clay Formation - Mudstone. Sedimentary Bedrock formed approximately 126 to 134 million years ago in the Cretaceous Period. Local environment previously dominated by swamps, estuaries and deltas.*

Nearby BGS listed borehole logs in the same strata as the site is located on detail gravelly clay with high N values at 1 m depth plus and occasional ironstone at shallow depths.

2.3 Drainage and hydrogeology

Surface water is expected to runoff to the south west and to the road drainage.

The ground conditions encountered during the investigation were typically described as gravelly clay and hence may restrict initial infiltration and drainage to depth.

Perched water was noted at around 1 m bgl.

3. GEOTECHNICAL SOIL SURVEY

3.1 Completed works

Site works

Boreholes with LDPs were located as in Drawing 1 and drilled to around 2 m depth maximum.

3.2 General strata descriptions (full borehole log/s in Appendix A)

Made ground topsoil was encountered to a maximum depth of 0.2 m overlying sandy gravelly clay over extremely stiff clay at around 2 m depth when drill rod refusal was encountered (See Appendix A).

3.3 In-situ testing

Shear Vane readings

Shear vane readings were not undertaken as part of this investigation due to the gravel in the soils.

Light Dynamic Probe (LDP)

LDPs were undertaken and data plots are listed below.

Light dynamic probe data sheet						DIN 4094
Hole ref: BH 1		Water depth (m)		1.1		
Depth	Blow count	Torque	Torque adj. blows		SPT-N Eqv	Depth
m bgl	N 10	N/m	N 10	N 30		m bgl
0.0	0		0			0.0
0.1	0		0			0.1
0.2	0		0			0.2
0.3	0		0			0.3
0.4	3		3			0.4
0.5	4		4			0.5
0.6	5		4	11	4	0.6
0.7	13		11	19	7	0.7
0.8	21		19	34	12	0.8
0.9	28		26	57	20	0.9
1.0	45	12	43	88	31	1.0
1.1	100		97	166	59	1.1
1.2						1.2
1.3						1.3
1.4						1.4
1.5						1.5
1.6						1.6
1.7						1.7
1.8						1.8
1.9						1.9
2.0		54				2.0
2.1						2.1
2.2						2.2
2.3						2.3
2.4						2.4
2.5						2.5
2.6						2.6
2.7						2.7
2.8						2.8
2.9						2.9
3.0						3.0
3.1						3.1
3.2						3.2
3.3						3.3
3.4						3.4
3.5						3.5
3.6						3.6
3.7						3.7
3.8						3.8
3.9						3.9
4.0						4.0
4.1						4.1
4.2						4.2
4.3						4.3
4.4						4.4
4.5						4.5
4.6						4.6
4.7						4.7
4.8						4.8
4.9						4.9
5.0						5.0
Notes						
SPT N Eqv.						
0 20 40 60 80 100						

Light dynamic probe data sheet						DIN 4094
Hole ref: BH 2		Water depth (m)		1.1		
Depth	Blow count	Torque	Torque adj. blows		SPT-N Eqv	Depth
m bgl	N 10	N/m	N 10	N 30		m bgl
0.0	0		0			0.0
0.1	0		0			0.1
0.2	0		0			0.2
0.3	0		0			0.3
0.4	4		4			0.4
0.5	6		6			0.5
0.6	5		4	14	5	0.6
0.7	11		10	19	7	0.7
0.8	22		20	34	12	0.8
0.9	33		31	61	22	0.9
1.0	29	11	27	79	28	1.0
1.1	67		64	123	44	1.1
1.2	100		97	188	67	1.2
1.3						1.3
1.4						1.4
1.5						1.5
1.6						1.6
1.7						1.7
1.8						1.8
1.9						1.9
2.0		45				2.0
2.1						2.1
2.2						2.2
2.3						2.3
2.4						2.4
2.5						2.5
2.6						2.6
2.7						2.7
2.8						2.8
2.9						2.9
3.0						3.0
3.1						3.1
3.2						3.2
3.3						3.3
3.4						3.4
3.5						3.5
3.6						3.6
3.7						3.7
3.8						3.8
3.9						3.9
4.0						4.0
4.1						4.1
4.2						4.2
4.3						4.3
4.4						4.4
4.5						4.5
4.6						4.6
4.7						4.7
4.8						4.8
4.9						4.9
5.0						5.0
Notes						
SPT N Eqv.						
0 20 40 60 80 100						

Light dynamic probe data sheet						DIN 4094	
Hole ref:		BH 3		Water depth (m)		1.1	
Depth	Blow count	Torque	Torque adj. blows		SPT-N Eqv*	SPT N Eqv.	
m bgl	N 10	N/m	N 10	N 30		m bgl	
0.0	0		0			0.0	
0.1	0		0			0.1	
0.2	0		0			0.2	
0.3	0		0			0.3	
0.4	2		2			0.4	
0.5	2		2			0.5	
0.6	8		7	11	4	0.6	
0.7	19		18	27	10	0.7	
0.8	22		21	45	16	0.8	
0.9	29		27	66	23	0.9	
1.0	39	10	37	85	30	1.0	
1.1	56		53	118	42	1.1	
1.2	77		74	164	59	1.2	
1.3	100		96	223	80	1.3	
1.4						1.4	
1.5						1.5	
1.6						1.6	
1.7						1.7	
1.8						1.8	
1.9						1.9	
2.0		50				2.0	
2.1						2.1	
2.2						2.2	
2.3						2.3	
2.4						2.4	
2.5						2.5	
2.6						2.6	
2.7						2.7	
2.8						2.8	
2.9						2.9	
3.0						3.0	
3.1						3.1	
3.2						3.2	
3.3						3.3	
3.4						3.4	
3.5						3.5	
3.6						3.6	
3.7						3.7	
3.8						3.8	
3.9						3.9	
4.0						4.0	
4.1						4.1	
4.2						4.2	
4.3						4.3	
4.4						4.4	
4.5						4.5	
4.6						4.6	
4.7						4.7	
4.8						4.8	
4.9						4.9	
5.0						5.0	
Notes							

No readings taken in top 0.30 m bgl

SPT N Eqv.

0 20 40 60 80 100

3.3.1 Ground bearing

The allowable bearing capacities are as detailed in Table 1.

Table 1. Ground bearing for trench/strip footings (kN/m²)

Depth (m bgl)	BH1		BH2		BH3	
	SPT-N	Bearing*	SPT-N	Bearing*	SPT-N	Bearing*
0.6	4	415.8	5	467.0	4	415.8
1.2	59	754.9	67	831.7	59	754.9
		R		R		R

* Method: – Bowles after Meyerhof 1976 for 25 mm settlement – 0.6 m width.

R - refusal of drill

** 1.1 for BH1

Notes on bearing capacity calculations

The bearing value information constitutes an element of interpretation of the factual data as recorded on site. This requires choice of methods and formulae which are open to interpretation.

Soil Environment Services uses NovoSPT, a widely accepted software package, using typical formulae for these calculations. Appropriate formulae have been used given the soil type/s and data input into the software adjusted to site specific conditions.

Shear Failure safety factor	3 or 25 mm settlement
Soil type/s	CLAY
Unit weight/s	18 kN/m ³
Groundwater depth	1.1 m bgl
Shallow footing width	0.6 m
Preferred depth	0.9 m bgl
Pile diameter	0.4 m
Borehole diameter	65 mm
Overburden correction	Liao & Whitman 1986

A number of interpretations of the factual data may be selected within the software and results offered for comparison. This will typically be either shallow and deep foundation options and different formulae for each of these options.

NovoSPT is a computer program for interpretation of Standard Penetration Test (SPT/ DCPT) and correlating blow counts (N) to soil properties based on more than 270 formulas. Novo Tech Software Ltd. #4188 Hoskins Road, North Vancouver, British Columbia, Canada. Soil Environment Services accept no responsibility for errors within NovoSPT software.

3.4 Groundwater

Water (perched) was encountered within the boreholes at 1.1 m bgl.

4. LABORATORY TESTING

4.1 Chemical testing

Samples obtained at depth indicated no concern with regards to pH or sulphates (Appendix B) and it is therefore recommended in accordance with BRE Special Digest 1 (2005) that the on site Design Sulphate Class is classified as DS-1. Subsequently all concrete specification should be of DS-1 ACEC AC-1s with respect to the chemical environment for concrete.

4.2 Mechanical testing

The clay soils below 0.9 m depth are classified as low to medium modified plasticity and low to medium volume change potential. With reference to NHBC Chapter 4.2, *Building near trees*, the following applies with tree type and location:

Table 2. Foundation depth in relation to existing trees

BH/ location	Volume change potential	Tree type	Tree water demand	Potential distance from foundations (m)	Max tree height (m)	DH	Foundation depth (m)*
1	Med	Hawthorn	High	12	10	1.2	1.0
2	Low	Hawthorn	High	6	10	0.75	1.45
3	Low	Hawthorn	High	4	10	0.40	1.95

*-The foundation depths are based on the soil volume change potential noted in the borehole, the estimated distance between the nearest foundation and specific tree in relation to that borehole and the status of the trees in terms of removal, maximum growth allowed or limited height with respect to some hedge types. Hence, apart from soil volume change potential and tree type identification (although some estimation may occur during the winter) other factors may be subject to some variation if information is not supplied by the client or not obvious from site observations. It is expected that hedges will not exceed the legal max height.

R = To be removed

Foundations depths are required to be placed at a maximum depth 1.95 m bgl due to low volume change potential soils and proximity to trees. As this depth occurs nearest to BH3 and a hawthorn tree, foundations could be stepped to shallower locations.

5. SUMMARY AND CONCLUSIONS

5.1 General ground conditions

- The soils encountered comprised silty clay over gravelly clay to 1.2 m over extremely stiff silty clay to 2.0 m depth when drill refusal was encountered. Little significant difference between the boreholes was noted.
- Perched water was encountered at 0.9 m depth.
- Chemical testing indicates no concern with regards to pH or sulphates (Appendix B). Concrete specification should be of DS-1 ACEC AC-1s with respect to the chemical environment for concrete.
- Allowable bearing capacity is upwards of 415 kN/m² at 1.0 m foundation depth.
- Foundations depths are required to be placed at a maximum of 1.95 m bgl due to low volume change potential soils and proximity to trees. As this depth occurs nearest to BH3 and a hawthorn tree, foundations could be stepped to shallower locations.

Drawing 1

Borehole Locations

NOTES:



Borehole and LDP

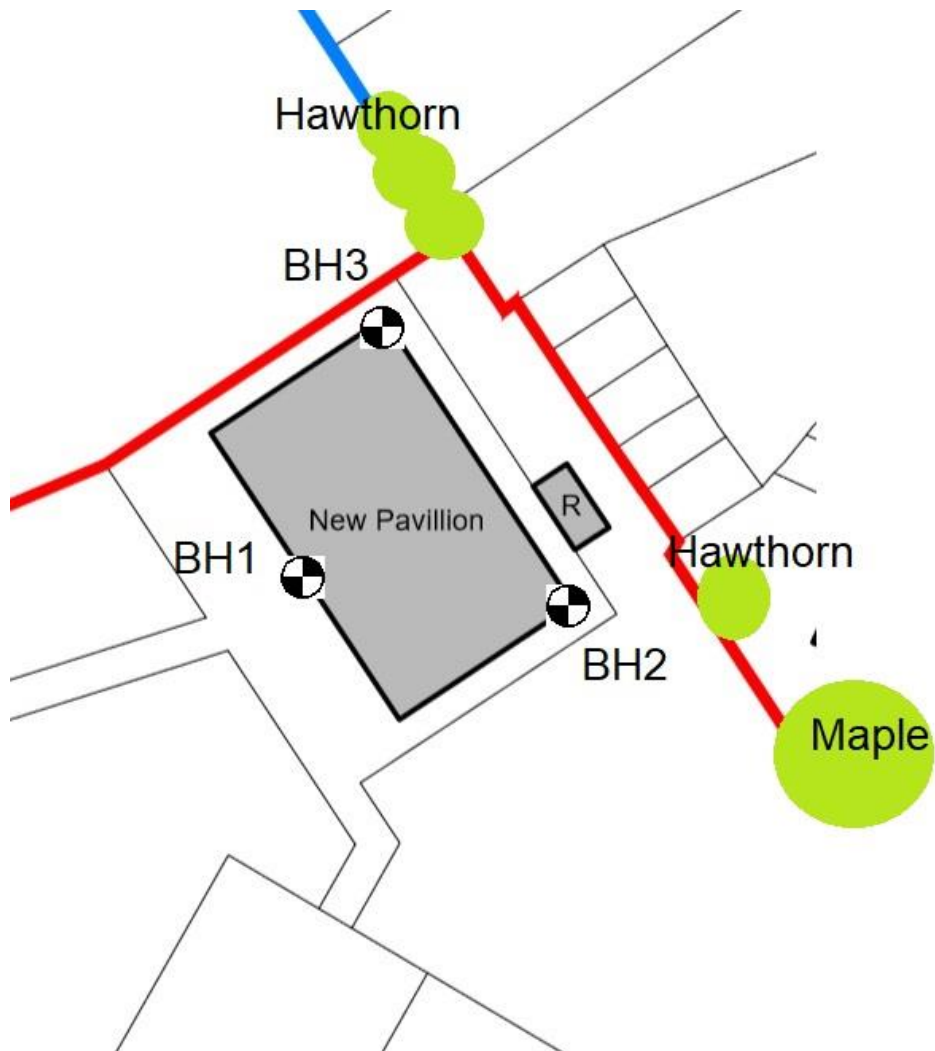
Soil Environment Services

Drawing Title: Borehole locations

Drawing No.: 1

Scale: na

Date: 2nd May 2018



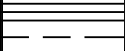
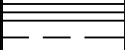
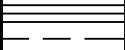
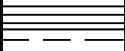
APPENDIX A

Engineer's Borehole Logs

Borehole/ Testpit Log		Excavation type and method: Borehole/Window Sampler	Date
BH/Pit Ref.	BH 1		02/05/2018

Surface elevation

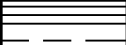
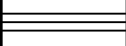
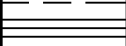
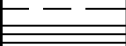
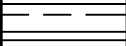
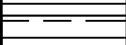
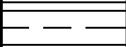
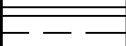
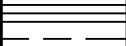
Site ref: 0 m

Depth (m BGL)	Symbol	Description	Notes
		Made ground - brown silty clay topsoil	Perched water at 1.1 m bgl
		Pale brown/ orange brown stiff silty CLAY.	
1.0		Reddish brown (iron pan) with gravelly stiff silty CLAY.	
		Pale grey/ yellow brown extremely stiff silty CLAY.	
2.0		Drill rod refusal at 2 m bgl in ext stiff ground.	
3.0			
4.0			

Borehole/ Testpit Log		Excavation type and method: Borehole/Window Sampler	Date
BH/Pit Ref.	BH 2		02/05/2018

Surface elevation

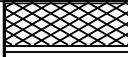
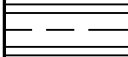
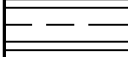
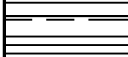
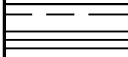
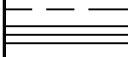
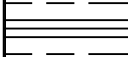
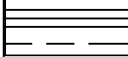
Site ref: 0 m

Depth (m BGL)	Symbol	Description	Notes
		Made ground - brown silty clay topsoil	Perched water at 1.1 m bgl
		Pale brown/ orange brown stiff silty CLAY.	
		Reddish brown (iron pan) with gravelly stiff silty CLAY.	
1.0		Pale grey/ yellow brown extremely stiff silty CLAY.	
			
			
			
			
2.0			
			
		Drill rod refusal at 2 m bgl in ext stiff ground.	
3.0			
4.0			

Borehole/ Testpit Log		Excavation type and method: Borehole/Window Sampler	Date 02/05/2018
BH/Pit Ref.	BH 3		

Surface elevation

Site ref: -0.25 m

Depth (m BGL)	Symbol	Description	Notes
		Made ground - brown silty clay topsoil	Perched water at 1.1 m bgl
		Pale brown/ orange brown stiff silty CLAY.	
		Reddish brown (iron pan) with gravelly stiff silty CLAY.	
1.0		Pale grey/ yellow brown extremely stiff silty CLAY.	
			
			
			
			
2.0			
			
		Drill rod refusal at 2 m bgl in ext stiff ground.	
3.0			
4.0			

APPENDIX B

Laboratory Results

Summary of Classification Tests		Solmek 12-16 Yarm Road, Stockton on Tees, TS18 3NA 01642 607083 lab@solmek.com	
Site name	Job number		
Horley	71632		

Hole	Depth		Type	w %	Oven temp. °C	w _a %	P _a %	Pr %	w _L %	w _P %	IP %	IL	Plasticity class	Preparation method
	Top m	Base m												
BH1	0.20	0.90	D	35	105	35	100	0	66-f	31	35	0.114	CH	Tested in natural condition
BH1	1.10	1.50	D	24	105	24	100	0	44-f	18	26	0.231	CI	Tested in natural condition
BH2	0.20	0.90	D	37	105	37	100	0	73-f	34	39	0.077	MV	Tested in natural condition
BH2	1.10	2.00	D	28	105	28	100	0	37-f	23	14	0.357	CI	Tested in natural condition
BH3	0.20	0.90	D	37	105	40	93	7	79-f	34	45	0.133	CV	Tested after >425µm removed by hand
BH3	1.00	1.50	D	18	105	18	100	0	41-f	23	18	-0.278	CI	Tested in natural condition

Chemtech Environmental Limited

SOILS

Lab number			71632-1	71632-2	71632-3	71632-4	71632-5	71632-6
Sample id			BH1	BH1	BH1	BH2	BH2	BH2
Depth (m)			0.20-0.90	0.90-1.10	1.10-1.50	0.20-0.90	0.90-1.10	1.10-2.00
Date sampled			03/05/2018	03/05/2018	03/05/2018	03/05/2018	03/05/2018	03/05/2018
Test	Method	Units						
pH	CE004 ^M	units	6.2	6.6	7.0	5.2	6.1	6.7
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄	89	48	30	16	80	29

Chemtech Environmental Limited

SOILS

Lab number			71632-7	71632-8	71632-9
Sample id			BH3	BH3	BH3
Depth (m)			0.20-0.70	0.80-0.90	1.00-1.50
Date sampled			03/05/2018	03/05/2018	03/05/2018
Test	Method	Units			
pH	CE004 ^M	units	6.2	6.6	6.9
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄	46	242	50