HERTS & ESSEX SITE INVESTIGATIONS

'THE OLD POST OFFICE', WELLPOND GREEN, STANDON, WARE, HERTS, SG11 1NJ
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GEOTECHNICAL ASSESSMENTS – ENVIRONMENTAL ASSESSMENT - DESKTOP STUDY – CONTAMINATED LAND

18th April 2022 Our ref : CSG/14617

Mr K Palmer
C/O Rampard Ltd
1 Alexandra Road,
London
N8 0PJ

For the attention of K.Palmer Esq.,

Dear Sir,

RE : Cuffley Motor Company, 71 Station Road, Cuffley. EN6 4HZ: Geotechnical Investigation

SECTION 1 INTRODUCTION

1.01 In accordance with your instructions, we visited the above site during February 2018.

1.02 The purpose of our visit was to carry out an investigation into the subsoil conditions in order to assess the suitability of the site for the proposed development which includes the demolition of the existing commercial property and removal of underground fuel tank farms in three locations and development of a new private residential property which includes a basement area.

1.03 The comments and opinions expressed are based purely on the conditions encountered and the subsequent laboratory testing. The location of the investigative works was based on the site conditions encountered and a historical search of the site.

1.04 Some special condition may be present on site that, to date, has not been encountered within the scope of the site investigation works and therefore will not have been taken into account within this report.

1.05 All ground water recordings or their absence relate to short term observations and do not allow for fluctuations due to seasonal or other effects.

SECTION 2 DESCRIPTION OF SITE

2.01 The site is located off Station Road and forms an existing commercial car showroom which has open space and canopy to the front and open parking to the sides and rear of the site. The main building is set centrally within the site and is a double height single storey unit. Three tank farms are located around the site being at the front side and rear areas.

2.02 The site forms a slopes from the rear to the front of the site with residential housing surrounding the site and commercial land to the south.

SECTION 3 FIELDWORK

3.01 Initial Investigation – February 2018

- 6No Competitor Rig boreholes sunk across the site to depths of 3.00 meters;
- 2No Shell & Auger Boreholes sunk within the site to assess geological profile at depth. Sunk to a depth of 20 meters;
- Installation of a standpipe to a depth of 8.00 meters within Borehole Two - Response zone between 1.00-8.00 meters;
- Chemical Sampling and Testing recovered from samples and sent to analytical chemist, (22nd February 2018).

3.02 The location of these works is indicated on the site plan-forming appendix one.

3.03 The various strata encountered were noted and are recorded on the borehole logs forming appendix two.

3.04 Full ranges of samples were recovered as noted and retained for subsequent laboratory testing.

SECTION 4 LABORATORY TESTING

4.01 All samples were tested in accordance with BS:1377:1990, methods for test for civil engineering purposes.

4.02 Selected samples were recovered to determine their Moisture Content, Particle Size Distribution, Atterberg Limits, Triaxial Strength and Soluble Sulphate value and pH.

4.03 The results of this laboratory testing are enclosed and form appendix three

SECTION 5 CONCLUSIONS

5.01 The site has been reviewed and we can confirm that the geology within the site is as follows :-

- ***Made Ground :*** has been identified within the site to depths of between 0.20-0.70 meters and generally forms a uniform FILL material;
- ***London Clay*** ; By examination of the geological profile, it would appear that London Clay encroaches on the site and is present within the upper geological profile of the site. This is identified as to depths of the close of all shallow boreholes and to depths of between 13.10-16.40 meters in the deep boreholes
- ***Lambeth Group :*** Has been identified to depths 13.10-16.40 meters and present to the close of the boreholes at 20 meters. This is identified as granular soils.
- ***Groundwater :*** Groundwater has not been identified within the scope of these works.

5.02 Laboratory testing has been undertaken in accordance with BS 1377:1990, (Methods for Tests for Soils for Civil Engineering Purposes), the results of which are enclosed.

5.03 Atterberg Limits tests proved the clay soil to be of low to very high plasticity, (PI=14-48%), which indicates a high susceptibility to movement associated with moisture content change.

5.04 Included within the laboratory testing was sulphate analysis, which can determine the use of sulphate resisting cement within the foundation design for the development. The results are enclosed and prove the classification in accordance with ACEC to be DS-2/AC-1S.

5.05 Laboratory testing has been undertaken on undisturbed samples recovered from the site works. From the information gathered, it is recorded that apparent cohesion values of between 37-118kN/m² were achieved. These can be converted to an allowable bearing capacity by multiplication of a the value by a shape factor and dividing that by a factor of safety. This can be crudely determined by a multiplication of 5 and divide by 3.

5.06 Particle Size Distribution testing has been undertaken on samples of granular material identified in the deeper boreholes. This has confirmed that where tested, the soils contain less than 35% fines and as such, can be considered non shrinkable due to any change in moisture content. The only exception to this being BH2 at 11.45m which confirm that 40% fines is in place and the soils at this depth will act as a likely low plasticity clay.

5.07 When considering the foundation proposals for the site, we make the following recommendations.

SECTION 6 FOUNDATION TECHNIQUE

6.01 A conventional foundation technique is traditionally founded at minimum depths of 0.90 meters below ground level in order to avoid the effects of weathering and to seat foundations within a uniform geotechnical stratum.

6.02 Where Clay soils are in place, principles must be followed in order to avoid ongoing and future soil movements resulting from surrounding trees and vegetation and as such, a design guide must be followed :-

6.03 Any new foundations may be influenced by surrounding trees and vegetation and as such any new foundations should be taken to depths in excess of the influence of any surrounding trees or vegetation, (recently removed, existing or proposed). An assessment has been recorded as to the depth of the existing root system within the site. This cannot be utilized across the site due to limited observations and as such, a guideline should be used to determine the depth of foundations required in order to overcome the influence of any surrounding vegetation.

6.04 As a result, we would suggest that any new foundations should be taken to a minimum depth of 1.00m. The use of NHBC Chapter 4.2, (Building Near Trees), should be incorporated in the design of any foundations, which dictates species, clay type and, ultimately, foundation depth. This is only a guideline that should be implemented as a method of costing the substructure within the development. The depth of any root systems within the subsoil will dictate the actual in-situ depth of any foundations across the site. It is envisaged that NHBC Chapter 4.2 will provide a reasonable assessment of actual foundation depths.

6.05 Where trees are to be removed or have recently been removed from the site in order to provide new landscaping or to enable the development to take place, the existing height of the trees and vegetation to be/or that has been removed should be used in assessing the proposed foundation depths local to those specific trees.

6.06 Where trees are to remain and will undergo some degree of growth to reach maturity, the mature height of the tree should be used within NHBC Chapter 4.20m.

6.07 Taking foundations through any made ground soils will extend into the underlying clay soils and as such, the above ruling is in place and considering the presence of mature trees will be in place and foundations should extend to depth. It should also be noted that any new foundation should also extend to depths below tank farms which may be seated in excess of 3.00 meters.

6.08 Considering the potential for foundations to be used, we would suggest that a system of conventional foundations could be adopted following the guidance above, although, these will extend to depth based on the tree cover historically and currently across the site. An assessment of the proposed loadings of the proposed structures should be made through the use of a suitably qualified structural engineer with regard these loadings.

6.09 Based on the information gained, its I likely that the loadings of the proposed structure will exceed the support which a conventional or pad and beam foundation could be effectively design and as such, the likely foundation option for the site will form a system of piles and ground beams. The information contained within this report is sufficient for pile design and should be designed by a suitably qualified structural engineer in terms of the loading of the proposed structure and soil parameters defined within this report. It is possible that some piling companies will additionally complete this element of the design. This falls outside the scope of this report.

6.10 Any new foundations should be designed by a suitably qualified engineer with regard the loadings of the proposed structures and in the design of the anti heave precautions required.

I hope the foregoing is sufficient for your requirements, although please do not hesitate to contact us should require any further information regarding the above.

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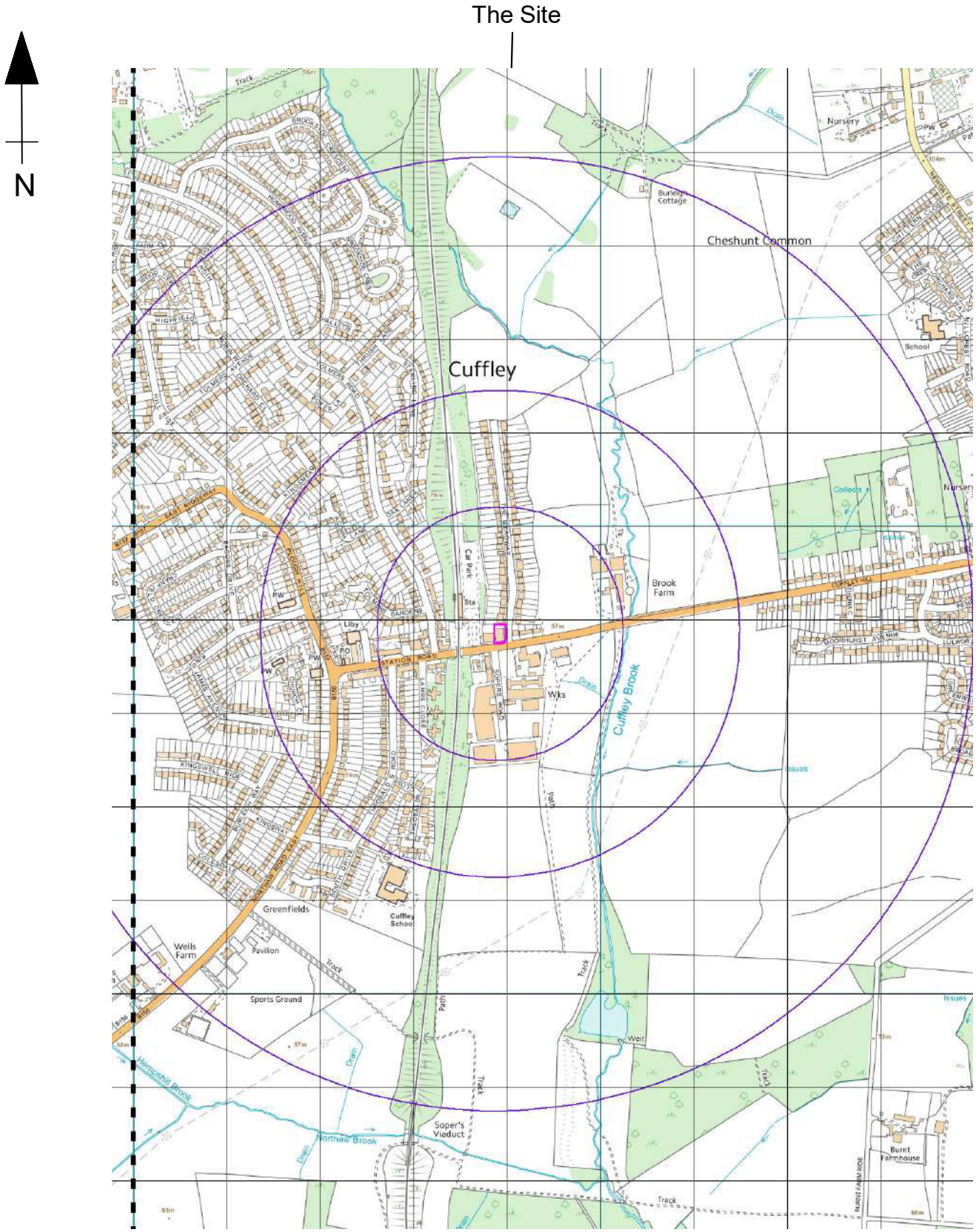
Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ

Location Plan



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Sketch No. : DTS / 14617 / 02 / 01

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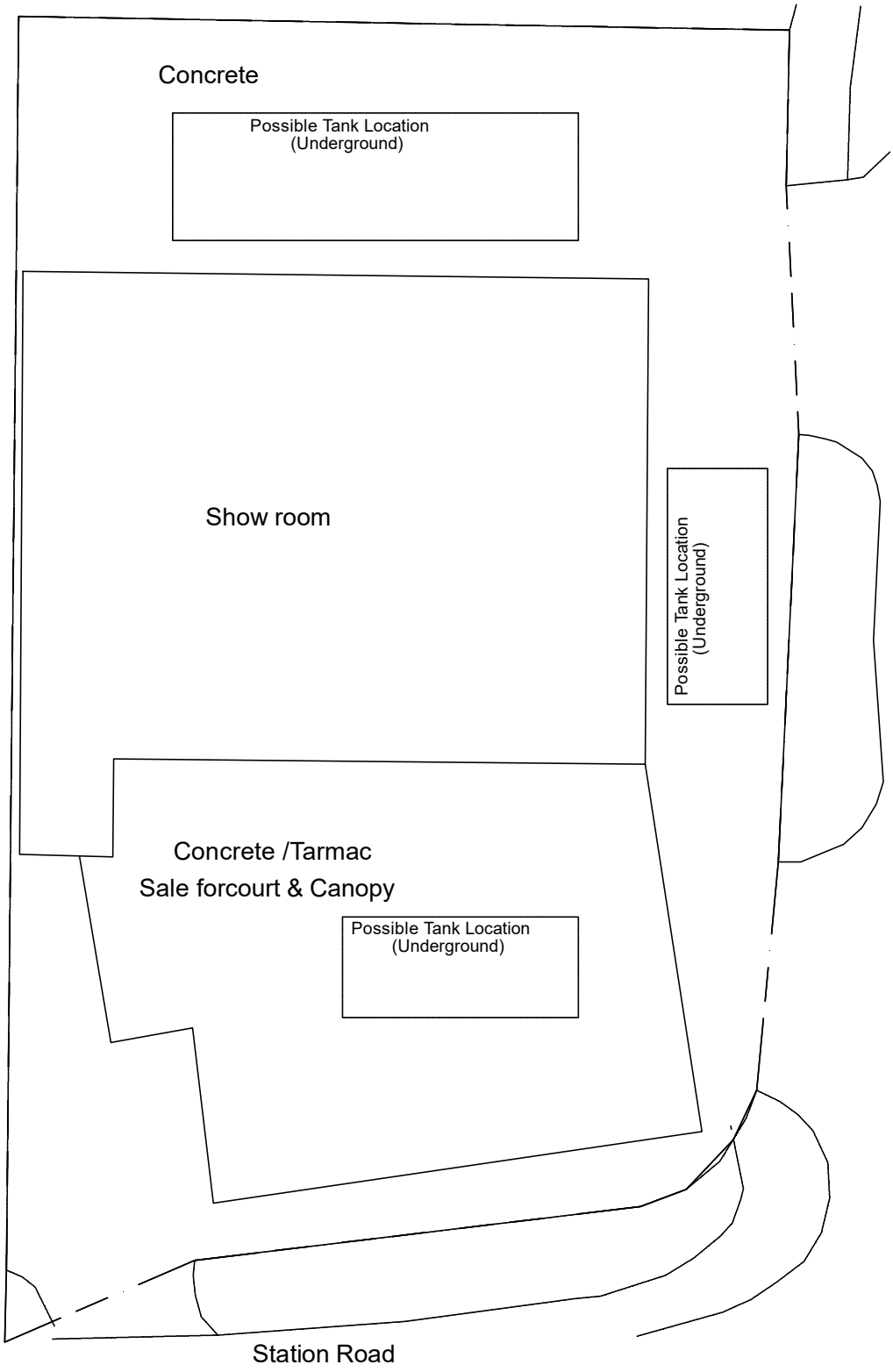
Existing Site Plan



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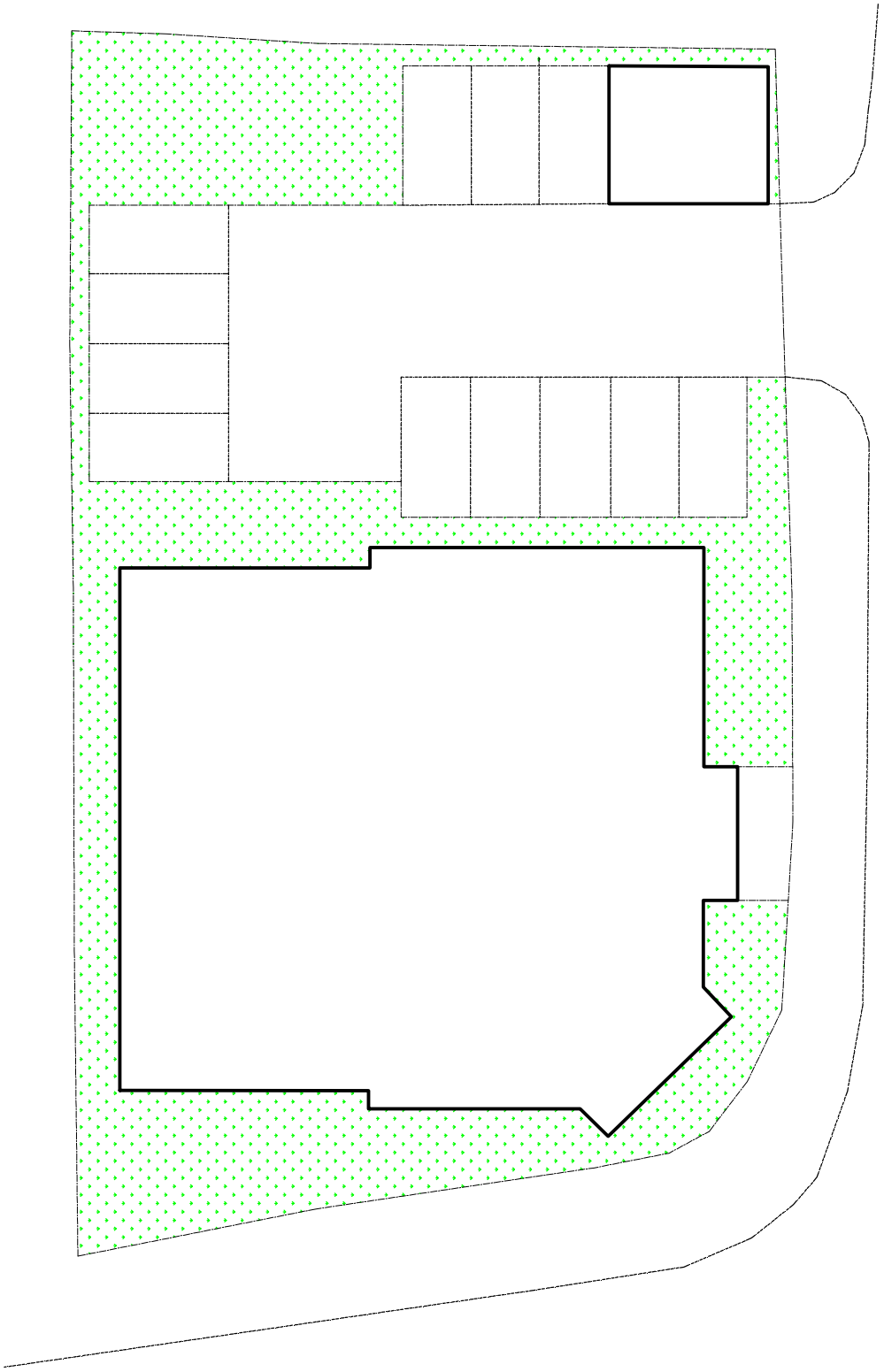
Proposed Site Plan



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Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ

Window Sampler One

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Concrete			0.30		1	U	GL–1.00				
		0.30									
Firm to stiff orange brown mottled grey brown slightly to moderately silty CLAY			1.20		2	U	1.00–2.00				1.00
		1.50									
Firm to stiff orange brown slighly silty CLAY			1.50		3	U	2.00–3.00				
		3.00									
Borehole closed at 3.00m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Window Sampler Two

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Concrete		0.30	0.30		1	U	GL–1.00				
Firm to stiff orange brown mottled grey brown slightly to moderately silty CLAY		1.00	0.70								1.00
Firm to stiff orange brown slighly silty CLAY			2.00		2	U	1.00–2.00				
		3.00			3	U	2.00–3.00				
Borehole closed at 3.00m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Window Sampler Three

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Concrete		0.20	0.20		1	U	GL–1.00				
Firm to stiff orange brown slightly mottled grey slighly silty CLAY					2	U	1.00–2.00				1.00
			2.80								
					3	U	2.00–3.00				
		3.00									
Borehole closed at 3.00m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Window Sampler Four

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Tarmac (0.03) over concrete			0.30		1	U	GL–1.00				
		0.30									
Firm to stiff orange brown slighly silty CLAY											1.00
					2	U	1.00–2.00				
			2.70								
					3	U	2.00–3.00				
		3.00									
Borehole closed at 3.00m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Window Sampler Five

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Tarmac (0.03m) over Concrete		0.30	0.30		1	U	GL–0.70				
Cruched Concrete FILL		0.70	0.40								
Borehole closed at 0.70m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ

Window Sampler Six

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Concrete		0.20	0.20		1	U	GL–1.00				
Loose brown reworked clay FILL		0.30	0.10								
Concrete		0.50	0.20								
Firm to stiff orange brown mottled grey brown slightly to moderately silty CLAY with occasional flint gravel		1.00	0.50								1.00
Firm to stiff orange brown slighly silty CLAY		2.50	1.50		2	U	1.00–2.00				
					3	U	2.00–3.00				
Firm to stiff orange brown slighly silty CLAY occasional rounded gravel		3.00	0.50								
Borehole closed at 3.00m											

Remarks:

Scale 1:25

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ

Borehole One

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Tarmac over Concrete		0.20	0.20								
Soft bluish grey mottled brown slightly silty CLAY		1.55	1.25		1	U	1.10				
Firm brown slightly silty CLAY		6.95	5.40	3.50	2 3 4 5 6	U U U U U	2.00 3.00 4.00 5.00 6.50				
Firm to stiff grey slightly silty sandy CLAY		8.70	1.75		7	U	8.00				
Stiff brown very sandy silty CLAY			3.40		8	U	9.40				

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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Borehole One .... Continued

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
As above			3.40		9	U	11.00				
		12.10			11	D	12.00	N=50+			
Dense light brown SAND			4.30		12	D	13.50	N=50+			
					13	D	15.00	N=50+			
		16.40									
Dense orange brown SAND with rounded GRAVEL			3.60		14	U	16.50	N=50+			
					1	B	18.00	N=50+			
					15	D	19.50	N=50+			19.50
Borehoel closed at 20.00m		20.00									

Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼–Water Struck D –Disturbed Sample ▽–Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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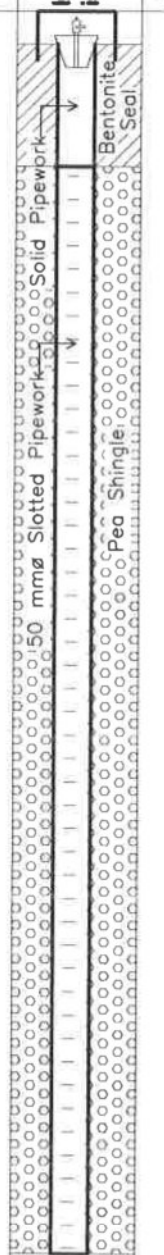
Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ

Borehole Two

Description of Strata	Legend	Depth	Thickness (m)	Water Level	Samples No.	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC (ppm)	Installation installed	Casing Depth(m)
Tarmac over reinforced concrete		0.25	0.25								
Soft dark grey gravelly sandy slightly silty CLAY		1.50	1.25								
Soft to firm brown mottled grey slightly silty sandy CLAY		2.20	0.70		1	U	1.60				
Soft to firm brown sandy slightly silty CLAY		2.90	0.70	2.50	2	U	2.30				
Firm to stiff brown claybound GRAVEL		3.90	1.00				2.90	N=22			
Stiff brown slightly silty sandy CLAY		4.35	0.45		3	U	3.90				
Stiff grey brown mottled slightly silty CLAY		4.80	0.45								
Stiff grey silty silty CLAY		8.60	4.00		4 5 6	U U U	5.00 6.50 8.00				
Stiff brown sandy silty CLAY becoming very sandy from 9.40			4.30		7	U	9.50				



Remarks:

Scale 1:50

Key : U–Undisturbed Sample (100mm diameter) B –Bulk Sample ▼ –Water Struck D –Disturbed Sample ▽ –Water Standing W–Water Sample T–Chemical Tub N–S.P.T. N–Value V–Vane Strength (kN/m²)

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LOCATION *Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ*

TRIAXIAL TEST RESULTS

Window Sampler No	Depth (m)	Sample	Natural Moisture Content (%)	Bulk Density (Mg/m^3)	Lateral Pressure (kN/m^2)	Deviator Stress (kN/m^2)	Apparent Cohesion (kN/m^2)	Angle of Shearing resistance (degrees)	Remarks
BH1	1.10	U	34	1.98	22	84	42	-	
	2.00	U	28	1.96	40	94	47	-	
	3.00	U	30	1.99	60	128	64	-	
	4.00	U	32	2.00	80	153	76	-	
	5.00	U	32	2.03	100	143	71	-	
	6.50	U	29	2.02	130	177	89	-	
	8.00	U	25	2.02	160	197	99	-	
	9.40	U	19	2.05	188	237	118	-	
	11.00	U	16	2.04	220	227	113	-	
BH2	1.60	U	27	1.95	32	74	37	-	
	2.30	U	21	1.97	46	89	44	-	
	3.90	U	33	2.00	78	133	67	-	
	5.00	U	31	2.03	100	148	74	-	
	6.50	U	26	2.01	130	182	91	-	
	8.00	U	24	2.05	160	222	111	-	
	9.50	U	41	2.02	190	84	42	-	

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LOCATION *Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ*

ATTERBERG LIMITS TEST

Borehole	Depth (m)	Sample	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Group Symbol	Ammended Plasticity Index (%)	Roots Present	Desiccation Profile	Percentage Retained on 425 Micron Sieve (%)
BH1	1.10	U	34	74	29	45	CV	45			0
	2.00	U	28								
	3.00	U	30	65	26	39	CH	39			0
	4.00	U	32								
	5.00	U	32								
	6.50	U	29								
	8.00	U	25	65	25	40	CH	40			0
	9.40	U	19								
	11.00	U	16	48	22	26	CI	26			0
BH2	1.60	U	27	49	22	27	CI	27			0
	2.30	U	21	32	15	17	CL	14			20
	3.90	U	33	73	28	45	CV	45			0
	5.00	U	31								
	6.50	U	26	78	30	48	CV	48			0
	8.00	U	24								
	9.50	U	41	78	31	47	CV	47			0

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LOCATION *Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ*

SULPHATE ANALYSIS TEST RESULTS

Borehole	Depth (m)	Sample	Concentrations of Soluble Sulphate			Classification	pH
			Soil		Groundwater		
			Total SO_4 (%)	SO_4 in 2:1 Water:soil (g/l)			
BH1	3.00	U		0.51		DS-2 / AC-1s	8.2
BH2	9.50	U		0.36		DS-1 / AC-1s	8.6

HERTS & ESSEX SITE INVESTIGATIONS

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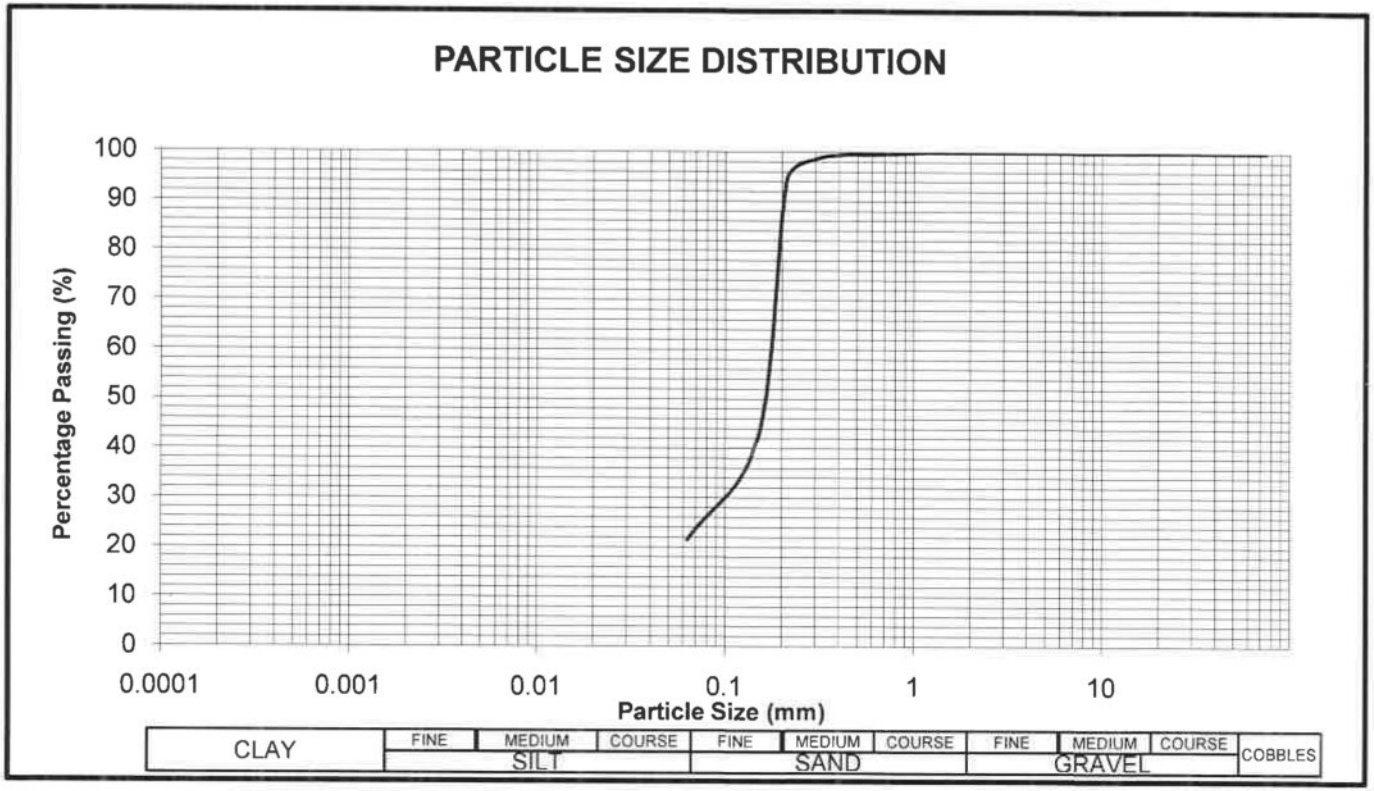
Appendix No. 3
Sheet No. 4
Job No. 14617
Date 27 2 18

Site Address: **Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ**

Borehole **BH1** Depth : **12** Sampe No: **B**

Initial Mass: 200 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00		0	100
20.00		0	100
14.00		0	100
10.00		0	100
6.30		0	100
5.00		0	100
3.35		0	100
2.00	0	0	100
1.180	0	0	100
0.600	1	1	100
0.425	0	0	100
0.300	2	1	99
0.212	8	4	95
0.150	104	52	43
0.063	42	21	22



Fines (%) = **22** Sands (%) = **79** Gravels = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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Appendix No. 3
Sheet No. 5
Job No. 14617
Date 27 2 18

Site Address: **Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ**

Borehole **1** Depth : **18** Sampe No: **B**

Initial Mass: 300 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00		0	100
20.00	31	10	90
14.00	54	18	72
10.00	15	5	67
6.30	20	7	60
5.00	5	2	58
3.35	8	3	56
2.00	9	3	53
1.180	6	2	51
0.600	6	2	49
0.425	3	1	48
0.300	18	6	42
0.212	32	11	31
0.150	48	16	15
0.063	23	8	7

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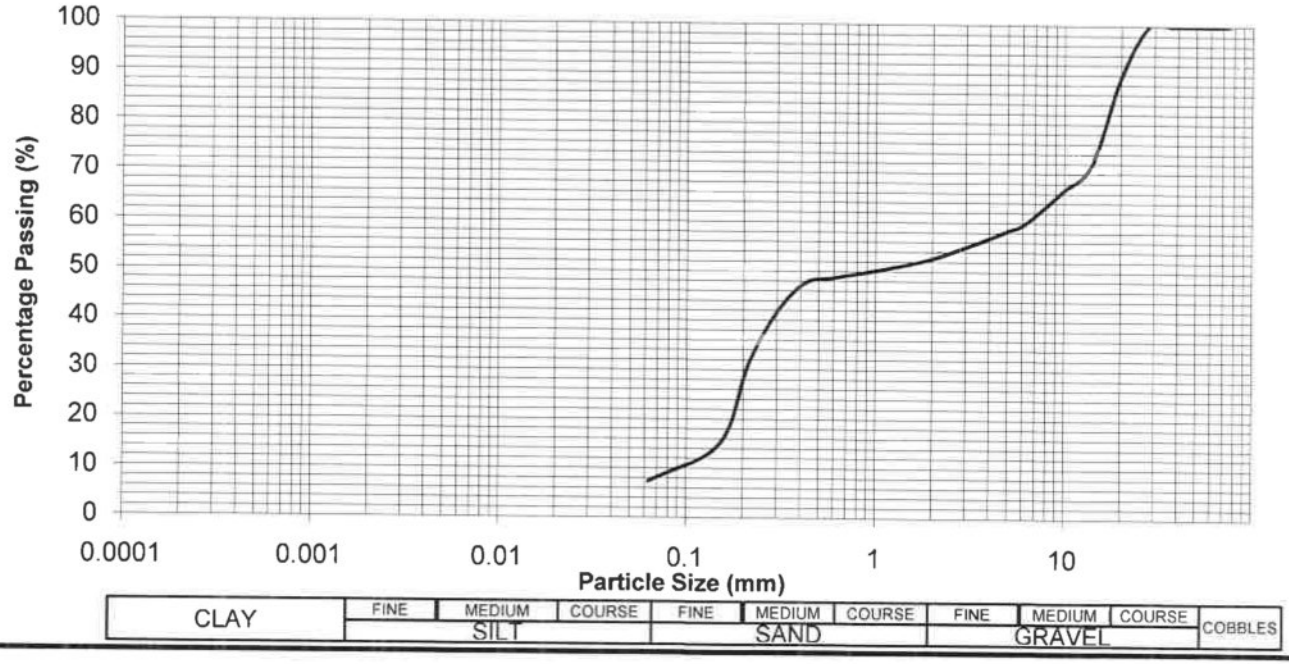
PARTICLE SIZE DISTRIBUTION



Fines (%) = **7** Sands (%) = **45** Gravels = **47**

British Standard Sieve Test 5930:1990 as Per Test 7a

HERTS & ESSEX SITE INVESTIGATIONS

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Appendix No. 3
Sheet No. 6
Job No. 14617
Date 27 2 18

Site Address: **Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ**

Borehole **2** Depth : **11.45** Sampe No: **B**

Initial Mass: 200 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00		0	100
20.00		0	100
14.00		0	100
10.00		0	100
6.30		0	100
5.00		0	100
3.35		0	100
2.00		0	100
1.180	2	1	99
0.600	2	1	98
0.425	1	1	98
0.300	4	2	96
0.212	6	3	93
0.150	8	4	89
0.063	98	49	40

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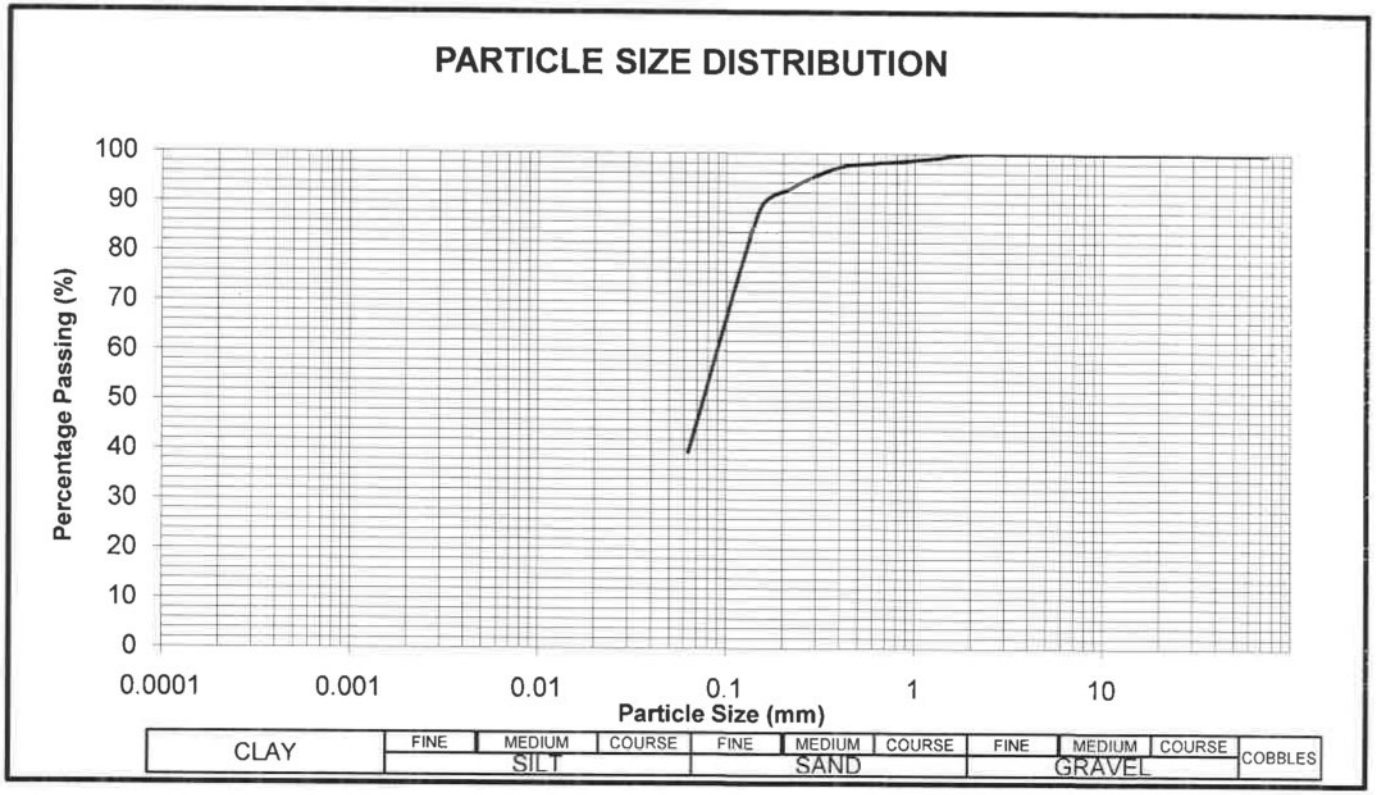

Fines (%) = **40** Sands (%) = **61** Gravels = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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Appendix No. 3
Sheet No. 7
Job No. 14617
Date 27 2 18

Site Address: **Cuffley Motor Company Ltd, 71 Station Road, Cuffley. Herts. EN6 4HZ**

Borehole **2** Depth : **18** Sampe No: **B**

Initial Mass: 300 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00		0	100
20.00	60	20	80
14.00	16	5	75
10.00	30	10	65
6.30	17	6	59
5.00	4	1	58
3.35	5	2	56
2.00	4	1	55
1.180	3	1	54
0.600	3	1	53
0.425	1	0	52
0.300	13	4	48
0.212	35	12	36
0.150	39	13	23
0.063	19	6	17

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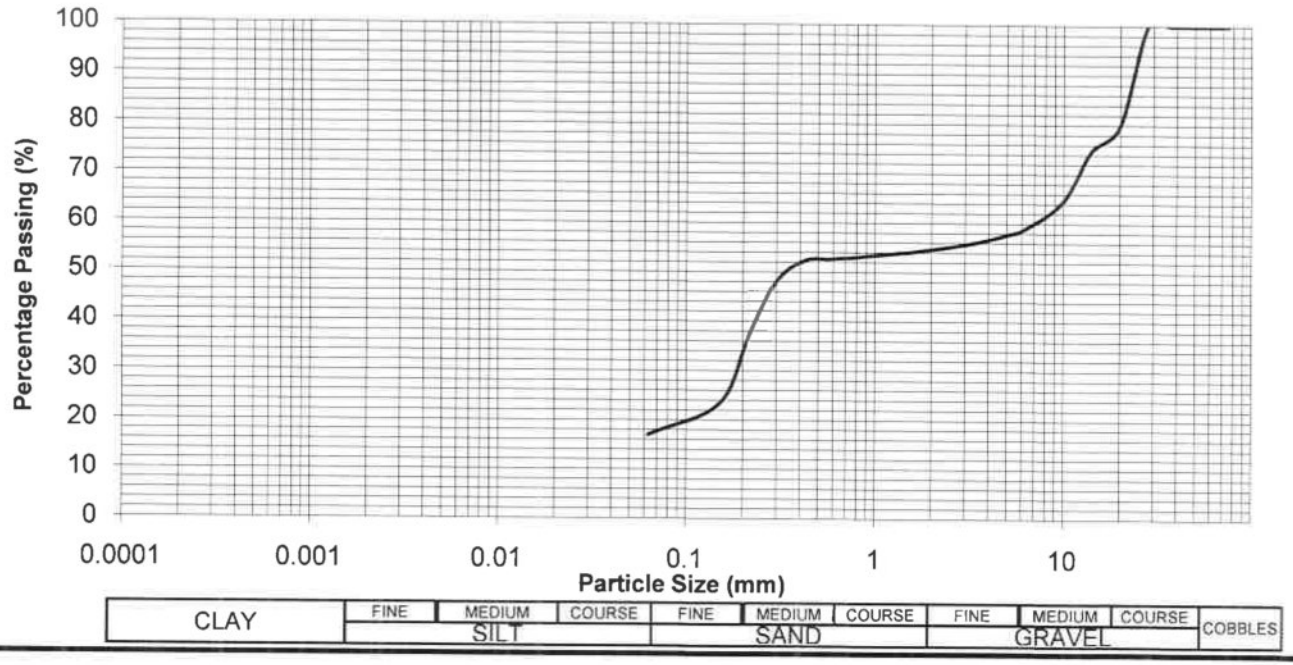
PARTICLE SIZE DISTRIBUTION



Fines (%) = **17** Sands (%) = **38** Gravels = **45**

British Standard Sieve Test 5930:1990 as Per Test 7a