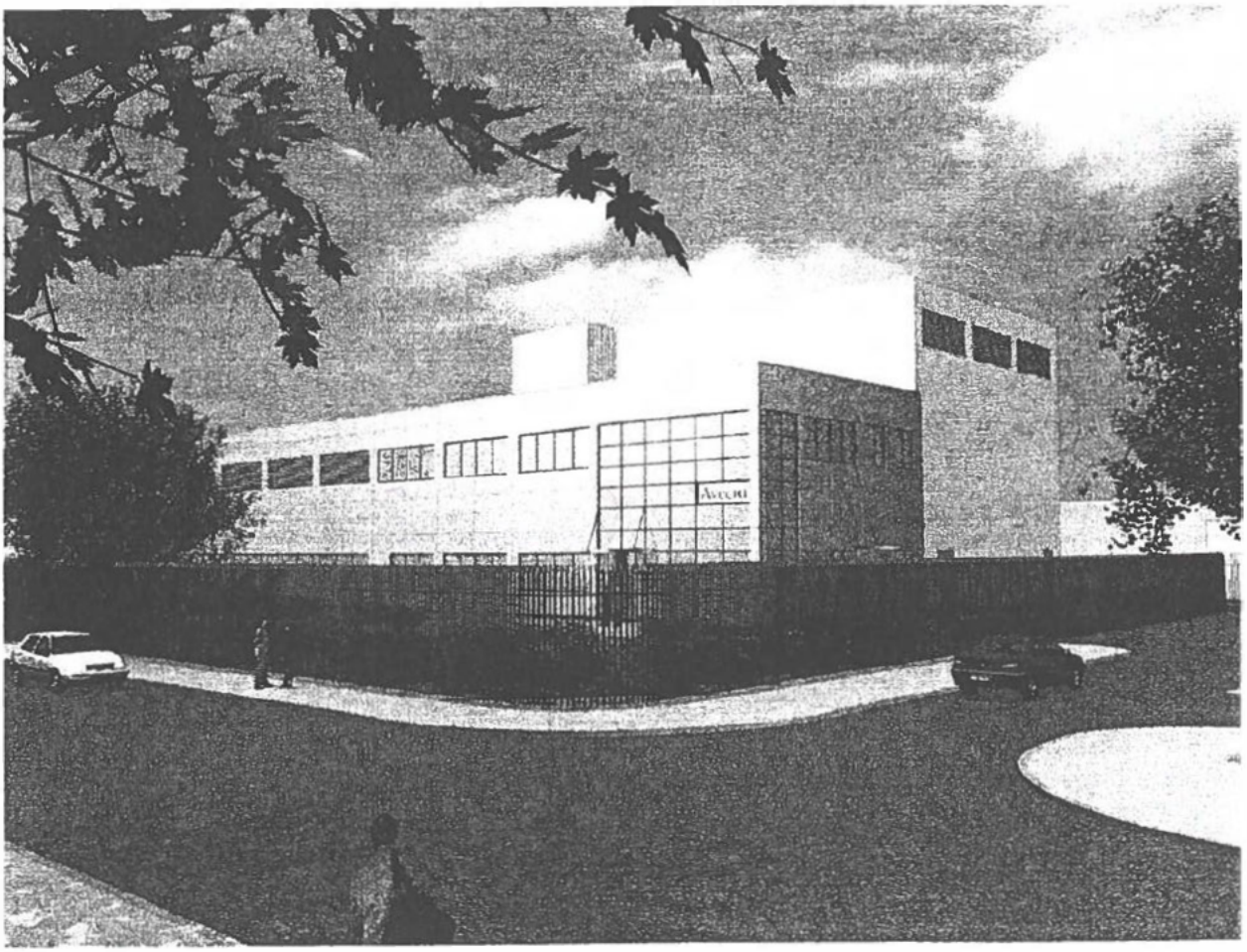
01/1664/P

Avecia

Chilton Site – Multiplex Development

Environmental Statement – Appendix 1 (Site Investigation)



AVECIA BIOTECHNOLOGY MULTIPLEX PROJECT

CONTENTS **PAGE**

APPENDICES

1. INTRODUCTION

Authorisation

At the request of Avecia Ltd, a ground investigation was carried out at Belasis Avenue Site, Billingham. The investigation consisted of the excavation of 3 shell and auger boreholes to depths of 15 metres and 6 trial pits. The site plan is shown in Appendix 1.

Aims and Objectives

The aims and objectives of the investigation were to:

- Investigate the ground conditions at the site and determine the chemical properties and contamination levels of the soils.
- Investigate the geotechnical properties of the ground beneath the site.

2 FIELDWORK

Fieldwork was carried out between the 9th and 11th of July 2001 and was generally in accordance with BS 5930: 1981 and the relevant Interdepartmental Committee for the Redevelopment of Contaminated Land (ICRCL) guidance. The location of the boreholes and trial pits were specified by Avecia based on the past knowledge of the site. The borehole records are included in Appendix 2.

Boreholes

The purpose of the boreholes amongst others was to determine the in-situ soil properties and the design parameters for use in pile design. After boring, the holes were backfilled arisings.

The trial pits were excavated to record ground conditions and take samples for chemical analysis.

Ground Conditions

A summary of the ground conditions encountered is given below:

Made Ground

The Made Ground sequence generally comprises the following, gravel in the order of 0.05m thick overlying locally a concrete slab up to 0.18m thick which in turn overlay a sandy fine to coarse gravel of brick and concrete with some ash and slag traces (rubble) in the order of 0.4m thick but up to 0.8m thick. In trial pits 5 and 6 a grey black sandy gravelly clay fill was encountered and further excavation revealed that the material had been backfilled within a basement/underground service run. In trial pit 3 ground conditions varied with a sandy gravel of slag, coke and ash to 0.55m instead of the brick rubble.

Laminated Clay

Underlying the Made Ground is a firm to stiff brown silty sandy clay in the order of 1m thick, locally soft to firm and turning soft to firm with depth which overlies a firm/firm to stiff brown indistinctly thinly laminated slightly sandy clay with occasional sand lenses turning soft to firm with depth and more laminated. The clay turns firm to stiff at depths ranging from 4.0 to 4.50m in boreholes 1 and 2 and firm by 1.50m in borehole 3.

Boulder Clay

Boulder clay was encountered in the three boreholes at depths ranging from 9.0 to 10.0m. The boulder clay can be described as a stiff brown sandy clay with some fine to medium gravel. The clay was described as stiff turning very stiff with depth.

3 TESTING

Laboratory geotechnical testing was undertaken in accordance with BS1377 (1990). The test results are included in Appendix 3.

Uniaxial undrained triaxial compression tests, bulk and dry densities, Atterberg limit determinations and moisture content tests were conducted on selected U100 samples.

Chemical testing was also conducted on selected samples in order to assess any potential contamination that may be present. The water-soluble sulphate content and pH was also determined in order to assess the aggressiveness of the soil to concrete

The chemical test results are included in Appendix 3.

4 GEOTECHNICAL RESULTS AND ASSESSMENT

A summary of the Atterberg limit test results performed on the samples is presented in Table 1 below.

Property	Minimum value	Maximum Value	Average Value	No. of tests
Liquid Limit %	31	53	44	5
Plastic Limit %	17	28	22	5
Plasticity Index	14	26	21	5

Table 1: *Summary of Atterberg Limit Results*

Based on the results above, the fine material (<425 μm) can be generally regarded as an inorganic clay of high plasticity according to BS5930: 1999 with occasional bands of low to intermediate plasticity. The results are typical for the laminated clays.

The moisture content of the clay varies from 11% to 32% with the lower results encountered within the higher strength boulder clays.

Thirty five samples were subjected to testing for the undrained compression test in order to measure the undrained shear strength of the clay. The results are presented in Appendix 3 and indicate firm laminated clays below an approximate depth of 4m turning firm to stiff circa 7.5m. The boulder clay is indicated to be stiff turning very stiff between 11.5 to 13.5m.

A summary geological model of the site is presented in Table 2 below:

Depth in metres	**Material**	**Properties**
0.6	Made Ground	Localised deeper areas within service areas.
1.5	Silty Clay	Cu 100kN/m² with softer areas present.
4.5	Laminated clay	Cu variable firm with softer areas present turns softer with depth.
9.5	Laminated clay	Cu 45kN/m² rising with depth in the order of 80kN/m². Plasticity index = 21.
To in excess of 15.0m	Boulder Clay	Cu = 100kN/m² rising to in excess of 150kN/m² with depth.

Table 2: *Geotechnical Model*

5 CHEMICAL RESULTS AND ASSESSMENT

Samples for chemical analysis were collected from the Made Ground. A total of 6 soil samples were tested for the following determinants

pH	Mercury	Sulphide	Cyanide
Arsenic	Copper	Sulphate	Sulphide
Cadmium	Nickel	Zinc	Phenol
Chromium	Lead	Boron	Selenium
Total Petroleum Hydrocarbons	Asbestos		

All chemical test results are included in Appendix 3.

The chemical analysis was undertaken by ECOS Laboratories, a UKAS (formerly NAMAS) accredited laboratory.

In order to interpret analytical results it is common practice to compare them with the various guidelines published across the UK and within Europe. These guidelines act as an aid and are by no means definitive and any judgement must be based on a source - pathway - target analysis. These guidelines include the UK Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) published in Guidance Note 59/83, UK Water Supply (Water Quality) Regulations (1989) and the soil and groundwater guidelines published by the Dutch authorities as the Dutch Intervention Levels.

The ICRCL values provide the most appropriate guidance in the UK and are primarily intended as a guide to site re-development. They were first published in 1983 and use the concept of 'trigger' and 'action' concentrations of contaminants in soil, which are related to the intended end use of the site. The concentrations are related to the sensitivity of the site. However ICRCL values relate to soil only and cover a limited range of contaminants. Therefore, it is common practice to use the Dutch values for the assessment of groundwater contamination and for assessing contaminants for which there are no ICRCL guidelines.

The Dutch Intervention Levels are based on a framework comprising two threshold values of increasing concentration, the 'desired/target' level and the 'action/intervention' level. These are defined as follows:

- The Target Level - Not considered as hazardous or posing significant risk when concentrations occur below this level.
- The Intervention Level - A threshold value above which remediation should be considered.

Metals

The results for the chemical analyses of the soil samples for metals are summarised in Table 3.

Parameter	Concentration Range (mg/kg)	ICRCL Threshold Concentration (mg/kg)	Number Exceeding Threshold	No. of Samples Tested
Heavy Metals				
Arsenic	8.7 to 25.8	40*	0	5
Cadmium	<0.2 to 3.4	15*	0	5
Chromium	14.6 to 27.7	1000*	0	5
Lead	22.1 to 481.8	2000*	0	5
Mercury	2.9 to 10.0	20*	0	5
Selenium	All <1.0	6*	0	5
Phytotoxic Metals				
Nickel	8.6 to 48.8	70**	0	5
Copper	24.4 to 136.4	130**	1	5
Zinc	147.6 to 692.5	300**	2	5

Table 3: *Summary of Metal Contamination Concentrations for Soil Samples*

* *ICRCL threshold value for Parks playing fields and open space*

** *ICRCL threshold value for any uses where plants are to be grown*

Apart from the phytotoxic metals copper and zinc, all results are below the relevant threshold value. The levels of zinc and copper are not considered significant with respect to the proposed development.

Inorganic substances

The results for the chemical analyses of the soil samples for inorganic compounds are summarised in Table 4.

Parameter	Concentration Range (mg/kg)	ICRCL Threshold Concentration (mg/kg)	Number Exceeding Threshold	No. of Samples Tested
Inorganic Compounds				
Boron	<0.50 to 0.8	3	0	5
Cyanide	All <2.0	100*	0	5
PH	7.7 to 10.4	Below pH 5	0	5
Sulphate	0.214 to 1.177	See text	Not applicable	5

Table 4: *Summary of Inorganic Compound Contamination Concentrations for Soil Samples*

* *ICRCL Threshold value for free cyanide for buildings and hard cover.*

Sulphate results assessed against the BRE Digest indicate all of the results are within a Class 1 site, however one result is close to a Class 2 site. pH values can be regarded as neutral to alkaline.

Levels of boron and cyanide are below the relevant threshold value.

Amosite (brown asbestos) was identified in one of the five samples.

Organic compounds

The results for the chemical analyses for organic compounds are summarised in Table 5.

Parameter	Concentration Range (mg/kg)	ICRCL Threshold Concentration (mg/kg)	Number Exceeding Threshold	No. of Samples Tested
Organic Compounds				
TPH (mineral oil)	1577 to 4157	5000*	0	5
Phenols	<1.0 to 2.0	5	0	5

Table 5: *Summary of Organic Compound Contamination Concentrations for Soil Samples*

* *Dutch Intervention value for mineral oil*

The samples analysed for the presence of hydrocarbons indicate all samples below the Dutch Intervention Value. However samples were slightly elevated particularly the black sample taken from trial pit 3 at 0.2 to 0.4m

All phenol results were below the relevant threshold value.

Water Analyses

Chemical testing was undertaken on one sample of water taken from trial pit 2. The results of the analyses are provided in full in Appendix 3, and summarised in Table 6.

Parameter	Concentration Value (µg/l)	Dutch Intervention Value (µg/l)	Intervention Value Exceeded
Heavy Metals			
Arsenic	<1.0	60	No
Cadmium	<0.1	6	No
Chromium	<10	30	No
Lead	<30	2	No
Mercury	0.2	75	No
Selenium	<1.0	-	No
Phytotoxic Metals			
Nickel	<10	75	No
Copper	<10	75	No
Zinc	10	800	No
Inorganic Compounds			
Boron	80	*	No
Sulphate (g/l)	0.068	No Level**	-
PH	7.4	<5	No
Organic Compounds			
Phenol	20	2000	No
Mineral Oil	<100	600	No

Table 6: *Summary of Contamination Concentrations for the Water Sample* (* see notes below)

Due to the lack of suitable criteria on which to compare measured concentrations from the water samples in terms of the risk posed, the following values were assigned:

* EEC 80/778/EEC (Drinking Water Guide)

No concentrations were above the Dutch Intervention Value of metal contaminants, inorganic and organic compounds.

6 CONCLUSIONS AND RECOMMENDATIONS

This ground investigation has revealed that a layer of Made Ground up to 0.8m thick comprising generally granular materials with occasional clay fill. Below the Made Ground is a firm to stiff silty sandy Clay locally soft to firm which in turn is underlain by a firm silty sandy thinly laminated clay turning soft to firm and firm/firm to stiff by 4.0 to 4.5m. The firm laminated clays are present to depths ranging from 9.0 to 10m. Below the laminated clay is a stiff boulder clay turning very stiff with depth.

Geotechnical Properties

A summary geotechnical model is presented as Table 7 with a summary presented below:

Depth in Metres	Material and Properties
To 0.8	Made Ground (locally deeper in and around service runs)
To 1.5	Firm to stiff silty sandy Clay locally soft to firm
To 4.5	Firm turning soft to firm laminated clay
15 to 20	Firm turning/firm to stiff laminated clay with Cu 45kN/m^2 rising circa 80kN/m^2.
15+	Stiff boulder clay with Cu 100kN/m^2 rising to in excess of 150kN/m^2 with depth

Of the various pile types available, both driven and percussion and augured bored and cast in place piles are considered suitable for the ground conditions at the site. Should driven piles be chosen then the boulder clay will mobilise considerable bearing resistance

Conventional percussion or augured piles may require to be extended deeper than the driven piles in view of the loosening process, which occurs as a result of the drilling.

For foundation design the competent piling contractor should take into account the possibility of negative skin friction as a result of the driving process and applied and dynamic loads. In addition the driving process may increase pore water pressures within cohesive deposits.

Chemical Properties

The materials were subjected to the standard suite of ICRCL tests, and in addition were tested for total petroleum hydrocarbons, total cyanide and polyaromatic hydrocarbons. From the results of the testing and subsequent analysis it is evident that the majority of the contaminants are below the relevant ICRCL threshold values. Only elevated copper and zinc. The cyanide value was below the action level.

Sulphate testing indicates a Class 1 site, however raised values suggest adopting a Class 2 site would be prudent.

Amosite (brown asbestos) was identified in one of the five samples. For site workers during redevelopment, reference should be made to CIRIA Report 132 "*A Guide for Safe Working on Contaminated Sites*".

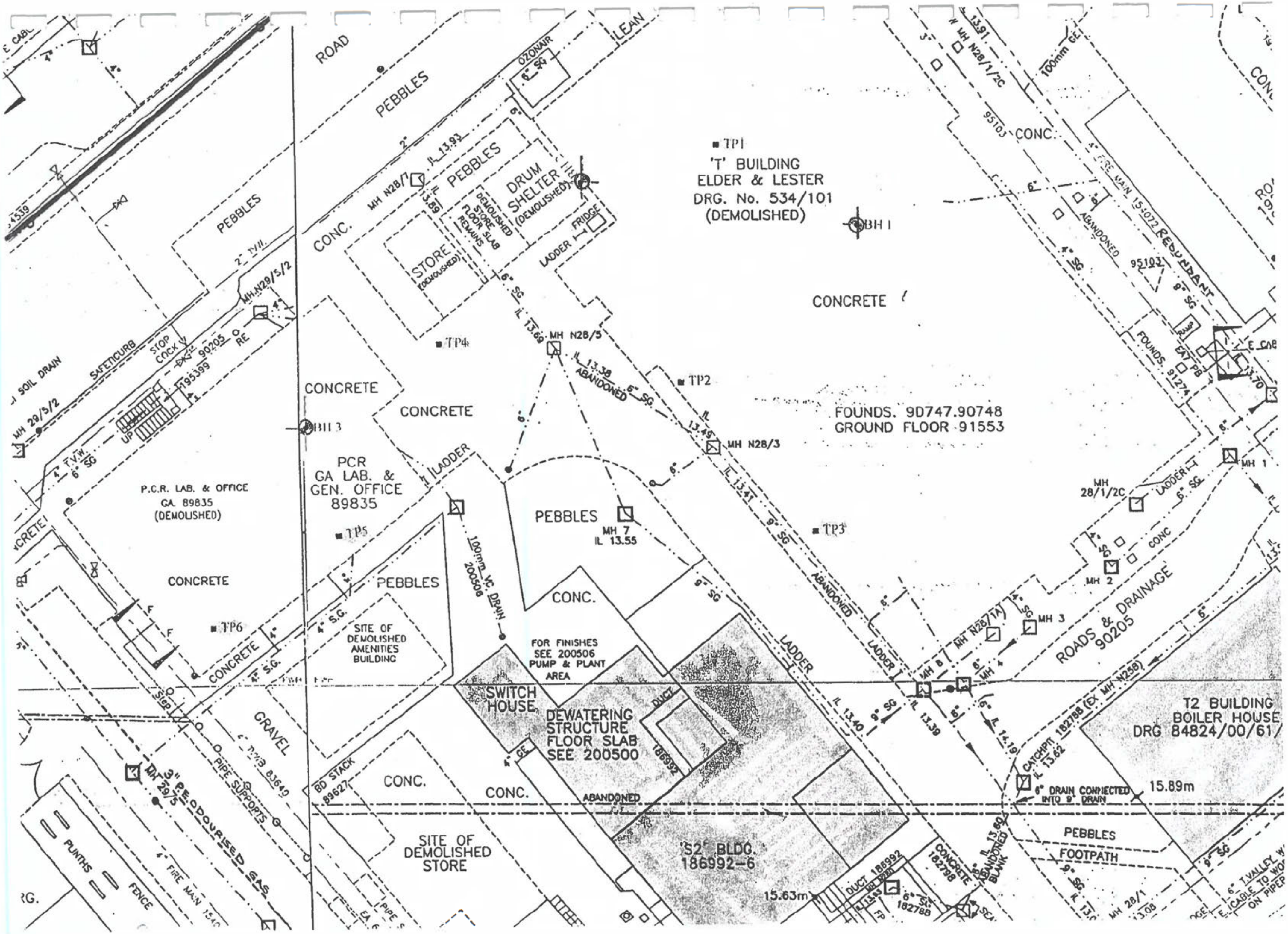
[redacted]
Gary Dresser, *HNC, MSc, Euro Pro Dip, FGS*

On behalf of J. T. Hymas Site Investigation Ltd

APPENDIX 1

FIGURES

FIGURE 1: SITE PLAN


ROAD
PEBBLES
CONC.
'T' BUILDING
ELDER & LESTER
DRG. No. 534/101
(DEMOLISHED)
TP1
BH1
CONCRETE
DRUM SHELTER (DEMOLISHED)
STORE (DEMOLISHED)
DEMOLISHED STORE FLOOR SLAB REMAINS
FRIDGE
LADDER
MH N28/1
MH N28/5
MH N28/3
MH 7
IL 13.55
TP2
TP3
TP4
TP5
TP6
BH3
FOUNDS. 90747.90748
GROUND FLOOR 91553
CONCRETE
PCR
GA LAB. &
GEN. OFFICE
89835
P.C.R. LAB. & OFFICE
GA 89835
(DEMOLISHED)
PEBBLES
SITE OF DEMOLISHED AMENITIES BUILDING
100mm V.C. DRAIN
200508
CONC.
FOR FINISHES SEE 200506 PUMP & PLANT AREA
SWITCH HOUSE
DEWATERING STRUCTURE FLOOR SLAB SEE 200500
DUCT
'S2' BLDG.
186992-6
15.63m
SITE OF DEMOLISHED STORE
CONC.
GRAVEL
PIPE SUPPORTS
3" DEODOURISED GAS
FIRE MAIN
FENCE
PLINTHS
SAFETICURB
STOP COCK
SOIL DRAIN
MH 29/5/2
MH N29/5/2
ROADS & DRAINAGE
90205
T2 BUILDING
BOILER HOUSE
DRG 84824/00/61/
CATCHPIT 182788 (EX MH N258)
6" DRAIN CONNECTED INTO 9" DRAIN
15.89m
PEBBLES
FOOTPATH
MH 28/1
MH 1
MH 2
MH 3
MH 4
MH 8
MH 28/1/2C
MH N28/1/2C
95103
REDUNDANT
FOUNDS. 91274
ABANDONED
100mm GE
OZONAIR
CONCRETE 182798
ABANDONED BLANK

APPENDIX 2

BOREHOLE AND TRIAL PIT RECORDS

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
TS18 3NA

Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.10-0.40	B					0.10	MADE GROUND: Concrete.		
						0.40	MADE GROUND: Black sandy fine to coarse gravel including brick and concrete rubble with some ash traces.		
0.50-0.95	U						Soft to firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
1.20-1.30	D					(1.60)			
1.50-1.90	B								
1.50-1.95	U					2.00			
2.00-2.45	U						Firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
2.70-2.80	D								
3.00-3.45	U					(2.50)	Soft to firm between 3.0 and 3.5m.		
3.70-3.80	D								
4.00-4.45	U					4.50			
4.70-4.80	D						Firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
5.00-5.45	U								
6.00-6.10	D								
6.50-6.95	U						Firm to stiff below 7m.		
						(5.50)			
7.50-7.60	D								
8.00-8.45	U								
9.00-9.10	D								
9.50-9.95	U					10.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Seepages at 1 80m and 3.50m. Chiselling at 12.7-13.0m (0.5hr) and 13.3-13.5m (0.5m). Borehole backfilled with arisings upon completion.

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
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Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
							Stiff brown sandy CLAY with occasional gravel, predominantly fine to medium.		
10.50-10.60	D								
11.00-11.45	U						Very stiff below 12m.		
12.00-12.10	D								
12.50-12.95	U					(5.00)			
13.50-13.60	D								
14.00-14.45	U								
						15.00			
15.00	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Seepages at 1.80m and 3.50m. Chiselling at 12.7-13.0m (0.5hr) and 13.3-13.5m (0.5m). Borehole backfilled with arisings upon completion

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	10-07-01			
Contractor				Sheet
Groundquest				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.10-0.40	B					0.10	MADE GROUND: Concrete.		
						0.40	MADE GROUND: Black sandy fine to coarse gravel including brick and concrete rubble with some ash traces.		
0.50-0.95	U						Stiff brown silty sandy thinly laminated CLAY with occasional sand lenses.		
1.20-1.30	D					(1.50)	Firm below 1m.		
1.50-1.95	U					1.90			
2.20-2.30	D						Firm brown silty sandy thinly laminated CLAY with occasional sand lenses. Locally firm to stiff.		
2.50-2.95	U					(1.10)			
						3.00			
3.20-3.30	D						Soft to firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
3.50-3.95	U					(1.00)			
						4.00			
4.20-4.30	D						Firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
4.50-4.95	U								
5.20-5.30	D								
5.50-5.95	U						Firm to stiff below 7.5m.		
6.50-6.60	D					(5.50)			
7.00-7.45	U								
8.00-8.10	D								
8.50-8.95	U								
						9.50			
9.50-9.60	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia mm	Water Dpt	From	To	Hours	From	To	Seepage at 3.0m. Borehole backfilled with arisings upon completion.

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	10-07-01			
Contractor				Sheet
Groundquest				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
10.00-10.45	U						Stiff brown sandy CLAY with occasional gravel, predominantly fine to medium.		
11.00-11.10	D								
11.50-11.95	U					(5.50)	Very stiff below 13.5m. *(continued)*		
12.50-12.60	D								
13.00-13.45	U								
14.00-14.10	D								
14.50-14.95	U					15.00			
15.00	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Seepage at 3.0m. Borehole backfilled with arisings upon completion.

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				3
Job No	Date	Ground Level (m)	Co-Ordinates ( )	
15275	11-07-01			
Contractor				Sheet
Groundquest				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.10-0.40	B					0.40	MADE GROUND: Gravel over black sandy fine to coarse gravel including brick, concrete and slag with some ash traces.		
0.50-0.95	U					(1.10)	Stiff brown silty sandy thinly laminated CLAY with occasional sand lenses.		
1.20-1.30	D					1.50	Soft to firm below 1.0m.		
1.50-1.95	U						Firm brown silty sandy thinly laminated CLAY with occasional sand lenses.		
2.20-2.30	D								
2.50-2.95	U								
3.20-3.30	D								
3.50-3.95	U								
4.00-4.45	U								
4.70-4.80	D								
5.00-5.45	U					(7.50)	Firm to stiff below 6.5m.		
6.00-6.10	D								
6.50-6.95	U								
7.50-7.60	D								
8.00-8.45	U								
8.70-8.95	U					9.00			
9.60-9.70	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Borehole dry. Borehole backfilled with arisings upon completion.

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	11-07-01			
Contractor				Sheet
Groundquest				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
10.00-10.45	U						Stiff brown sandy CLAY with occasional gravel, predominantly fine to medium.		
11.00-11.10	D								
11.50-11.95	U					(6.00)	Very stiff below 11.5m. *(continued)*		
12.50-12.60	D								
13.00-13.45	U								
14.00-14.10	D								
14.50-14.95	U					15.00			
15.00	D								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Borehole dry. Borehole backfilled with arisings upon completion.

All dimensions in metres Scale 1:62.5	Client AVECIA	Method/ Plant Used	Logged By

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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.15	MADE GROUND: Concrete.		
0.15-0.40	D					(0.25) 0.40	MADE GROUND: Pink grey sandy fine to coarse gravel of brick and concrete.		
						(0.60) 1.00	Firm stiff light brown sandy CLAY.		
1.00-1.20	D					(0.50) 1.50	Soft to firm grey brown silty sandy CLAY. Turns orange brown and firm by 1.3m. Wet sand and silt layers below 1.4m.		
						(1.10) 2.60	Firm to stiff brown with grey veins slightly silty sandy indistinctly thinly laminated CLAY. Turns more silty and laminated with depth.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Trial pit backfilled with arisings upon completion. Trial pit dry.

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
TS18 3NA

Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.18	MADE GROUND: Gravel overlying Concrete.		
0.18-0.80	D					(0.62) 0.80	MADE GROUND: Pink grey sandy fine to coarse gravel of brick and concrete with occasional slag. Clay pipe 150mm diameter at 0.18m depth.		
0.80	W					(0.80) 1.60	Firm stiff light brown sandy CLAY. Black organic silty clayey pocket at 1.0 to 1.20m on north face, possibly associated with service run.		
1.00-1.20	D					(0.60) 2.20	Firm to stiff brown with grey veins slightly silty sandy indistinctly thinly laminated CLAY. Turns more silty and laminated with depth.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Trial pit backfilled with arisings upon completion. Water within gravel layer at 0.7m.

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
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Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						(0.25) 0.25	MADE GROUND: Gravel overlying Concrete.		
0.20-0.40	D					(0.30) 0.55	MADE GROUND: Black sandy fine to coarse gravel of slag, coke and ash.		
0.50-0.70	D					(0.65) 1.20	Firm stiff brown sandy CLAY. Turns light brown with depth. Clay pipe 100mm diameter at 1.2m depth.		
						(1.30) 2.50	Firm to stiff brown with grey veins slightly silty sandy indistinctly thinly laminated CLAY. Turns more silty and laminated with depth.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Trial pit backfilled with arisings upon completion. Water seepage at 1.2m.

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
TS18 3NA

Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP4
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.05-0.45	D					0.05	MADE GROUND: Gravel overlying concrete.		
						(0.40)	MADE GROUND: Pink grey sandy fine to coarse gravel of brick, concrete and a little ash.		
						0.45			
0.50-0.60	D						Soft to firm grey sandy CLAY with some rootlets. Possible Made Ground to 1.0m as some suspect small gravel appears fill.		
						(1.15)			
						1.60			
							Firm to stiff brown with grey veins slightly silty slightly sandy indistinctly thinly laminated CLAY.		
							Turns more silty and laminated with depth.		
						(1.00)	Firm by 1.9m.		
						2.60			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Trial pit backfilled with arisings upon completion. Trial pit dry.

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
TS18 3NA

Tel 01642 607083
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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP5
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.03	MADE GROUND: Gravel.		
						(0.37)	MADE GROUND: Pink grey sandy fine to coarse gravel of brick and concrete.		
						0.40			
0.40-0.60	D					(0.70)	MADE GROUND: Firm grey black brown sandy CLAY with some fine to coarse gravel of slag and sandy ash. Concrete floor at 0.8m depth.		
						1.10			
						1.20	Firm to stiff brown with grey veins slightly silty slightly sandy indistinctly thinly laminated CLAY.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Trial pit backfilled with arisings upon completion. Trial pit dry. Concrete floor at 0.8m with brick sides. Trial pit extended past floor in one corner only.

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

J. T. Hymas (Site Investigation) Ltd.
12 Yarm Road, Stockton on Tees
TS18 3NA

Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				TP6
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	09-07-01			
Contractor				Sheet
Groundquest				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.05	MADE GROUND: Gravel.		
0.40-0.60	D					(0.75)	MADE GROUND: Soft to firm brown sandy CLAY with some fine to coarse gravel of brick and concrete and occasional black ash and coke areas. Coke areas damp. Concrete floor at 0.8m depth.		
						0.80			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Trial pit backfilled with arisings upon completion. Trial pit dry. Concrete floor at 0.8m with brick sides

All dimensions in metres Scale 1:25	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 08/08/01

APPENDIX 3

LABORATORY RECORDS

0618
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What's so special about a UKAS report or certificate?
- Accreditation of testing is granted by the United Kingdom Accreditation Service (UKAS).
- It's your assurance that the work has been carried out to the highest standards.
- The laboratory issuing the test report has been stringently assessed by independent experts.
- You are assured that the agreed or specified methods and procedures have been followed.
- Measurements are traceable to national and international standards.

Comments:
Tests marked † in this report are not included in the UKAS Accreditation Schedule for the testing laboratory. However, with the continuing development of our QC protocols, these tests will be included in the near future.
Any opinions and interpretations expressed herein are outside the scope of the testing laboratory's UKAS Accreditation.
The Coefficient of Variation CV_T (where CV_T = standard deviation/mean*100) is better than 15%
All analysis carried out using ECoS standard methods unless otherwise agreed
The test results in this report refer only to the actual samples on which testing has been performed.
This test report shall not be reproduced, except in full, without written approval of ECoS Environmental.

Date submitted for analysis : 17/07/01

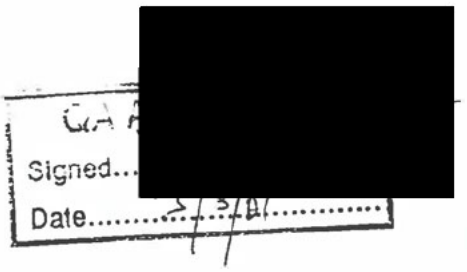
Your Job/Order Number : 10703

Analyst(s) : NB NSP SPA JS DS ELD MRH

Approved signatories: J R Brown, G Ewbank, E Dewell

Signature : [redacted]

Report date : 3 August 2001



SOIL

ANALYTE	METHOD OF DETECTION	LIMIT OF DETECTION
Arsenic	ICP-OES	1.0 mg/kg
Cadmium	ICP-OES	0.2 mg/kg
Chromium (total)	ICP-OES	0.2 mg/kg
Lead	ICP-OES	0.5 mg/kg
Mercury	ICP-OES	1.0 mg/kg
Selenium	ICP-OES	1.0 mg/kg
Boron (water soluble)	Colorimetry	0.5 mg/kg
Copper	ICP-OES	0.2 mg/kg
Nickel	ICP-OES	0.2 mg/kg
Zinc	ICP-OES	0.2 mg/kg
TPH (screen)	Infra-red	1 mg/kg
Phenols	Colorimetry	1.0 mg/kg
Cyanide (total)	HPLC-PED	2.0 mg/kg
Sulphate (water soluble)	HPLC-IC	0.001 g/l
pH	Aqualyser	N/A

Details of Asbestos analysis contained in report RO12383a (appended).
Y - Asbestos detected
N - Asbestos not detected

WATER

ANALYTE	METHOD OF DETECTION	LIMIT OF DETECTION
Arsenic	AAS-HYDRIDE	1.0 ug/l
Cadmium	GF-AAS	0.1 ug/l
Chromium	ICP-OES	0.01 mg/l
Lead	ICP-OES	0.03 mg/l
Mercury	AAS-HYDRIDE	0.1 ug/l
Selenium	AAS-HYDRIDE	1.0 ug/l
Boron	ICP-OES	0.01 mg/l
Copper	ICP-OES	0.01 mg/l
Nickel	ICP-OES	0.01 mg/l
Zinc	ICP-OES	0.01 mg/l
Phenols	Colorimetry	0.01 mg/l
Cyanide (total)	Colorimetry	0.01 mg/l
Sulphate	HPLC-IC	1 mg/l
pH	Aqualyser	N/A
TPH (screen)	Infra-red	0.1 mg/l

Summary Of Results
GeoEnvironmental Investigation Ltd. - Avecia, Billingham

ANALYTES	UNITS	TP1 (0.15 - 0.40m)	TP2 (0.18 - 0.80m)	TP3 (0.20 - 0.40m)	TP4 (0.05 - 0.45m)	TP6 (0.40m)							
		S0122217	S0122218	S0122219	S0122220	S0122222							
Arsenic	mg/kg	13.7	8.7	25.8	16.1	14.7	#	#	#	#	#	#	#
Cadmium	mg/kg	1.0	0.2	<0.2	3.4	0.8	#	#	#	#	#	#	#
Chromium (total)	mg/kg	23.2	14.6	27.7	21.7	19.0	#	#	#	#	#	#	#
Lead	mg/kg	109.2	22.1	131.4	138.7	481.8	#	#	#	#	#	#	#
Mercury	mg/kg	4.8	7.4	8.0	10.0	2.9	#	#	#	#	#	#	#
Selenium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	#	#	#	#	#	#	#
Boron (water soluble)	mg/kg	<0.5	0.5	0.8	0.8	0.5	#	#	#	#	#	#	#
Copper	mg/kg	25.9	26.7	136.4	35.8	24.4	#	#	#	#	#	#	#
Nickel	mg/kg	19.6	8.6	48.8	22.5	17.0	#	#	#	#	#	#	#
Zinc	mg/kg	169.1	147.6	281.0	683.5	692.5	#	#	#	#	#	#	#
TPH (screen)	mg/kg	1674	1577	4157	2125	1672	#	#	#	#	#	#	#
Phenols	mg/kg	<1.0	<1.0	2.2	<1.0	<1.0	#	#	#	#	#	#	#
Cyanide (total)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	#	#	#	#	#	#	#
Sulphate (water soluble)	g/l	1.031	0.214	0.818	1.177	0.613	#	#	#	#	#	#	#
pH	N/A	10.4	8.6	9.5	10.0	7.7	#	#	#	#	#	#	# †
Asbestos	N/A	N	N	Y	N	N	#	#	#	#	#	#	#

Results for soil samples expressed as dry weight
: Analyte not requested

Summary Of Results
GeoEnvironmental Investigation Ltd. - Avecia, Billingham

ANALYTES	UNITS	TP2											
		S0122225											
Arsenic	ug/l	<1.0	#	#	#	#	#	#	#	#	#	#	#
Cadmium	ug/l	<0.1	#	#	#	#	#	#	#	#	#	#	#
Chromium	mg/l	<0.01	#	#	#	#	#	#	#	#	#	#	#
Lead	mg/l	<0.03	#	#	#	#	#	#	#	#	#	#	#
Mercury	ug/l	0.2	#	#	#	#	#	#	#	#	#	#	#
Selenium	ug/l	<1.0	#	#	#	#	#	#	#	#	#	#	#
Boron	mg/l	0.08	#	#	#	#	#	#	#	#	#	#	#
Copper	mg/l	<0.01	#	#	#	#	#	#	#	#	#	#	#
Nickel	mg/l	<0.01	#	#	#	#	#	#	#	#	#	#	#
Zinc	mg/l	0.01	#	#	#	#	#	#	#	#	#	#	#
Phenols	mg/l	0.02	#	#	#	#	#	#	#	#	#	#	#
Cyanide (total)	mg/l	<0.01	#	#	#	#	#	#	#	#	#	#	#
Sulphate	mg/l	68	#	#	#	#	#	#	#	#	#	#	#
pH	N/A	7.4	#	#	#	#	#	#	#	#	#	#	# †
TPH (screen)	mg/l	<0.1	#	#	#	#	#	#	#	#	#	#	#

Water samples analysed as received
: Analyte not requested

UKAS TESTING
0618
0618 SI

ECOS ENVIRONMENTAL

Low Moor Business Park
Common Road
Bradford
BD12 0NB

Our ref: RW/CB

30 July, 2001

[redacted]
GeoEnvironmental Investigation Ltd.
12 Yarm Road
Stockton on Tees
TS18 3NA

Dear [redacted]

Herewith report on analysis of bulk material submitted for examination on 25th July 2001.
Samples taken by GeoEnvironmental Investigation Ltd. personnel and analysed by ECOS Environmental, Bradford.

ASBESTOS BULK MATERIAL ANALYSIS

Samples analysed using polarised light optical microscopy with dispersion staining in accordance with a documented in-house procedure based on HSE Method MDHS 77 - Asbestos in Bulk Materials.

The standard analytical method used for asbestos identification cannot give an accurate quantitative value for percentage asbestos content. The following values however may be used to assess the approximate quantity of asbestos present in the sample as submitted to the laboratory.

None Detected - no fibres detected (based on a detection limit of 0.01% by volume)
1 - more than 0.01% but less than 1% by volume
2 - more than 1% but less than 50% by volume
3 - more than 50% by volume

SAMPLE REF:	TYPE OF ASBESTOS FIBRE DETECTED				
	CHRYSOTILE (WHITE)	AMOSITE (BROWN)	CROCIDOLITE (BLUE)	OTHER AMPHIBOLE ASBESTOS FIBRES	NON-ASBESTOS FIBRES
TP1 (0.15-0.40M) ECOS ref: S0122217	None Detected	None Detected	None Detected	None Detected	Present
TP2 (0.18-0.80M) ECOS ref: S0122218	None Detected	None Detected	None Detected	None Detected	None Detected

SAMPLE REF:	TYPE OF ASBESTOS FIBRE DETECTED				
	CHRYSOTILE (WHITE)	AMOSITE (BROWN)	CROCIDOLITE (BLUE)	OTHER AMPHIBOLE ASBESTOS FIBRES	NON-ASBESTOS FIBRES
TP3 (0.20-0.40M) ECOS ref: S0122219	None Detected	Present[1]	None Detected	None Detected	None Detected
TP4 (0.05-0.45M) ECOS ref: S0122220	None Detected	None Detected	None Detected	None Detected	Present
TP6 (0.40M) ECOS ref: S0122222	None Detected	None Detected	None Detected	None Detected	None Detected

Yours sincerely,

[redacted]

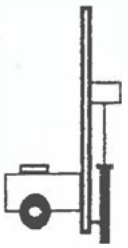
Note: (i) The identification of non-asbestos fibres is outside the scope of the laboratorys UKAS accreditation.

(ii) The laboratory cannot be held responsible for the condition or suitability of samples submitted for testing by a third party or for the competency of personnel other than its own staff.

(iii) Any opinions or interpretation of test results expressed herein are not within the scope of UKAS accreditation.

RJH Geo Drilling Ltd

Company Registered Number:3835513
VAT Registration No:722 1282 71



Business Address:
12 Yarm Road
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Cleveland
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Fax: 01642 612355

SITE Avecia

TEST : Triaxial Compression Test

TEST METHOD : BS1377, 1990

DATE 1/08/01

U38 SAMPLES

RESULTS

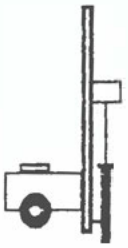
Borehole and depth	Undrained Shear Strength	Moisture	Density in Kg/m^3
BH3 @ 0.9m	128kN/m^2	25%	1983
BH3 @ 1.5m	88kN/m^2	25%	1956
BH3 @ 2.5m	82kN/m^2	21%	2040
BH3 @ 4.0m	66kN/m^2	26%	1965
BH3 @ 5.0m	61kN/m^2	29%	1890
BH3 @ 6.5m	91kN/m^2	26%	1915
BH3 @ 8.0m	77kN/m^2	25%	1910
BH3 @ 8.7m	75kN/m^2	26%	1905
BH3 @ 10.0m	169kN/m^2	13%	2090
BH3 @ 11.5m	172kN/m^2	15%	2100
BH3 @ 13.0m	274kN/m^2	11%	2215
BH3 @ 14.5m	260kN/m^2	15%	2150

[redacted] .....

On behalf of RJH Geo Drilling Ltd

RJH Geo Drilling Ltd

Company Registered Number:3835513
VAT Registration No:722 1282 71



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SITE Avecia

TEST : Triaxial Compression Test

TEST METHOD : BS1377, 1990

DATE 1/08/01

U38 SAMPLES

RESULTS

Borehole and depth	Undrained Shear Strength	Moisture	Density in Kg/m^3
BH2 @ 0.5m	102kN/m^2	24%	1985
BH2 @ 1.5m	68kN/m^2	17%	1945
BH2 @ 2.5m	85kN/m^2	23%	1940
BH2 @ 3.5m	28kN/m^2	30%	1810
BH2 @ 4.5m	52kN/m^2	30%	1900
BH2 @ 5.5m	53kN/m^2	30%	1915
BH2 @ 7.0m	64kN/m^2	32%	1860
BH2 @ 8.5m	102kN/m^2	25%	1980
BH2 @ 10.0m	87kN/m^2	17%	2100
BH2 @ 11.5m	139kN/m^2	16%	2090
BH2 @ 13.0m	131kN/m^2	15%	2154
BH2 @ 14.5m	174kN/m^2	17%	2119

[redacted] .....

On behalf of RJH Geo Drilling Ltd

JH Geo Drilling Ltd

pany Registered Number:3835513
AT Registration No:722 1282 71

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Fax: 01642 612355

SITE Avecia

TEST : Triaxial Compression Test

TEST METHOD : BS1377, 1990

DATE 1/08/01

U38 SAMPLES

RESULTS

Borehole and depth	Undrained Shear Strength	Moisture	Density in Kg/m^3
BH1 @ 0.5m	30kN/m^2	25%	1836
BH1 @ 2.0m	49kN/m^2	27%	1851
BH1 @ 3.0m	28kN/m^2	23%	1896
BH1 @ 4.0m	43kN/m^2	29%	1842
BH1 @ 5.0m	47kN/m^2	32%	1835
BH1 @ 6.5m	65kN/m^2	29%	1885
BH1 @ 8.0m	141kN/m^2	14%	2100
BH1 @ 9.5m	112kN/m^2	25%	1920
BH1 @ 11.0m	177kN/m^2	21%	1990
BH1 @ 12.5m	239kN/m^2	14%	2095
BH1 @ 14.0m	208kN/m^2	13%	2005

[redacted] .....

On behalf of RJH Geo Drilling Ltd

RJH Geo Drilling Ltd

Company Registered Number:3835513
VAT Registration No:722 1282 71

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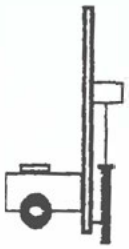

SITE Avecia

TEST : Sulphate Analysis

TEST METHOD : BS1377, 1990

DATE 31/07/01

Position	Depth in m	SO_3 g/L	SO_4 g/L	pH
BH1	2.0	0.08	0.096	11.2
BH1	5.0	0.072	0.086	10.0
BH2	2.5	0.104	0.125	10.1
BH2	4.5	0.072	0.086	10.9
BH3	0.5	0.08	0.096	9.9
BH3	4.0	0.08	0.096	9.7

Signed [redacted] .....

On behalf of RJH Geo Drilling Ltd

RJH Geo Drilling Ltd

Company Registered Number:3835513
VAT Registration No:722 1282 71

Business Address:
12 Yarm Road
Stockton-on-Tees
Cleveland
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SITE		AVECIA
TEST	:	Atterberg Limit
TEST METHOD	:	BS1377, 1990
DATE		28/07/01

RESULTS

Position	Liquid Limit	Plastic Limit	Plastic Index	Classification
BH1 @ 2.0m	35	19	16	CL/CI
BH1 @ 5.0m	31	17	14	CL
BH2 @ 4.5m	50	25	25	CI/CH
BH3 @ 0.5m	53	28	25	CH
BH3 @ 4.0m	53	21	26	CH

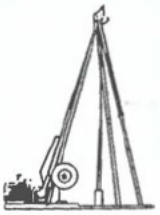
Signed .. [redacted] .....

On behalf of RJH Geo Drilling Ltd

J. T. HYMAS (Site Investigation) LTD.

Registered Number
899169

VAT Registration No.
258 6654 18



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AVECIA BIOTECHNOLOGY MULTIPLEX PROJECT

REPORT NO. 15275/01

ADDENDUM - SEPTEMBER 2001

INTRODUCTION

Following the completion of the geotechnical and environmental report no. 15275/01 in August 2001 Avecia Ltd extended the scope of the investigation by adding two further boreholes in the existing car park area situated to the north west of the initial site investigation.

SITE WORKS

The two further boreholes nos. 4 and 5 were drilled to depths of 15.00m and 20.00m, respectively. Their locations are shown on a site plan attached to this addendum.

The drilling sampling and testing methoeds used were similar to those described in the initial report.

STRATA

Both boreholes encountered hard concrete below a topsoil surface. These initial deposits including hardcore are, however, less than 1.00m thick lying on to a natural cohesive horizon.

Both boreholes were advanced through the cohesive strata showing a similar sequence of laminated clay overlying boulder clay as seen in borehole 1 to 3.

However, approaching the 15.00m target depth variations in strata were recorded. In borehole 4 dense sand lies below the boulder clay and in borehole 5 a further deposit of laminated clay lies below the boulder clay.

Borehole 5 was advanced below 15.00m depth in the laminated clay finding further stiff boulder clay below 18.00m and terminating in this material at 20.00m.

GEOTECHNICAL TESTS

Undrained triaxial compression tests were carried out on all undisturbed samples recovered from the boreholes. Selected samples were also tested for atterburg limits and water soluble sulphates.

The results are shown on sheets attached to this report. These confirm soft increasing to firm and then to stiff cohesive strata of medium to high plasticity. The water soluble sulphate levels are within acceptable limits.

CONCLUSIONS AND RECOMMENDATIONS

The investigation was conducted on the understanding that a piled foundation solution would be employed. The geotechnical information in the initial and later reports give sufficient information for a competent piling consultant/contractor to design a piling system to support the intended development.

Some shallow foundation design is being considered for the development. Reviewing the strata strength values at around 1.00m, 2.00m and 3.00m depth in each of the five boreholes.

The following range of results is noted:-

Depth of Test	Range of Cu kN/m²		
1.00m	30.0	to	128.9
2.00m	49.0	to	58.4
3.00m	23.5	to	82.5

The results are variable but show the laminated clay material to be of a soft nature between 1.00m and 3.00m.

These soft deposits therefore limit the design bearing capacity from shallow foundations to only 60.0kN/m². In addition, for large independent foundations i.e. in excess of 2.00m x 2.00m, there is a risk of some post construction foundation settlement due to consolidation of the laminated clay under imposed loading. The settlement would not be excessive, probably in the order of 10mm to 20mm over a period of 24 months. Any differential movements between piled and non-piled construction may, however, be of concern in pipework connections.

[redacted]

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SITE : Avecia

TEST : Triaxial Compression Test

TEST METHOD : BS 1377, 1990

DATE : 26.09.01

U38 SAMPLES

RESULTS

Boreholes and Depth	Undrained Shear Strength	Moisture	Density in Kg/m³
BH4 @ 0.85m	90.0kN/m²	23	1870
BH4 @ 2.0m	49.2kN/m²	20	1890
BH4 @ 3.0m	37.2kN/m²	27	1735
BH4 @ 4.0m	39.2kN/m²	25	1750
BH4 @ 5.5m	73.9kN/m²	23	1970
BH4 @ 7.0m	62.1kN/m²	23	1885
BH4 @ 8.5m	107.4kN/m²	15	2010
BH4 @ 10.0m	147.3kN/m²	14	2075
BH4 @ 11.5m	94.5kN/m²	17	2080

Signed .....
On behalf of J T Hymas (Site Investigation) Ltd

JMM/MOC/15275/01

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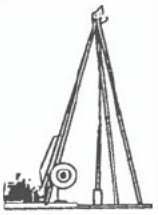

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SITE : Avecia

TEST : Triaxial Compression Test

TEST METHOD : BS 1377, 1990

DATE : 26.09.01

U38 SAMPLES

RESULTS

Boreholes and Depth	Undrained Shear Strength	Moisture	Density in Kg/m³
BH5 @ 1.0m	31.2kN/m²	21	1930
BH5 @ 2.1m	58.4kN/m²	15	1985
BH5 @ 3.0m	23.5kN/m²	23	1925
BH5 @ 4.0m	29.3kN/m²	23	1835
BH5 @ 5.5m	38.4kN/m²	27	1785
BH5 @ 7.0m	42.7kN/m²	27	1780
BH5 @ 8.5m	39.5kN/m²	26	1875
BH5 @ 10.0m	81.9kN/m²	14	2030
BH5 @ 11.5m	102.9kN/m²	15	2005
BH5 @ 13.0m	77.4kN/m²	22	1905
BH5 @ 14.5m	64.8kN/m²	26	1870
BH5 @ 16.0m	48.9kN/m²	26	1830
BH5 @ 17.5m	41.9kN/m²	30	1800
BH5 @ 19.5m	111.1kN/m²	14	2010

Signed .....[redacted]

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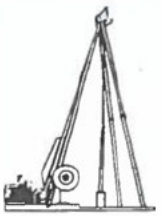

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SITE : Avecia

TEST : Atterberg Limit

TEST METHOD : BS 1377, 1990

DATE : 26.09.01

RESULTS

Position	Liquid Limit	Plastic Limit	Plastic Index	Classification
BH4 @ 2.0m	38	21	17	CI
BH4 @ 5.5m	49	23	26	CL
BH5 @ 5.5m	52	26	27	CH
BH5 @ 8.5m	56	24	22	CH

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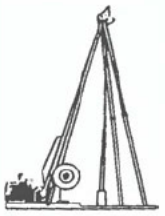

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SITE : Avecia

TEST : Sulphate Analysis

TEST METHOD : BS 1377, 1990

DATE : 26.09.01

RESULTS

Position	Depth in m	SO_3 g/L	SO_4 g/L	pH
BH4	2.0	0.080	0.096	9.4
BH5	4.0	0.080	0.096	9.0

Signed .....[redacted].....
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JMM/MOC/15275/01

TS18 3NA

Tel 01642 607083
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BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				4
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	04-09-01			
Contractor				Sheet
Groundquest				1 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						0.40	MADE GROUND: topsoil		
						0.60	MADE GROUND: dolomite		
						0.75	MADE GROUND: concrete		
0.85	U	M(23%) Cu(90.0)				0.85	MADE GROUND: brick Firm to soft light brown sandy silty CLAY		
						(1.35)			
2.00	U	M(20%) Cu(49.2)				2.20	Soft light brown laminated CLAY		
						(1.30)			
3.00	U	M27%) Cu(37.2)				3.50	Firm laminated CLAY		
4.00	U	M(25%) Cu(39.3)							
						(3.70)			
5.50	U	M(23%) Cu(73.9)							
7.00	U	M(23%) Cu(67.1)				7.20	Firm to stiff boulder CLAY		
8.50	U	M(15%) Cu(107.4				(3.30)			
10.00	U	M(14%) Cu(147.3				10.50			
						10.60	Small gravel Boulder CLAY		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Water @ 3.500m Standing @ 2.600m (20mins) Trial pit backfilled with arisings upon completion. Trial pit dry. Concrete floor at 0.8m with brick sides

All dimensions in metres Scale 1:68.75	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 19/09/01

TS18 3NA

Tel 01642 607083
Fax 01642 612355

BOREHOLE LOG

Project				BOREHOLE No
AVECIA, Billingham				4
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	04-09-01			
Contractor				Sheet
Groundquest				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
11.50	U	M(17%) Cu(94.5)				(1.90) 12.50	Boulder CLAY *(continued)*		
13.00	SPT	50 blows				(1.05) 13.55	SAND		
13.50	SPT	50 blows							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Water @ 3.500m Standing @ 2.600m (20mins) Trial pit backfilled with arisings upon completion. Trial pit dry. Concrete floor at 0.8m with brick sides

All dimensions in metres Scale 1:68.75	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 19/09/01

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BOREHOLE LOG

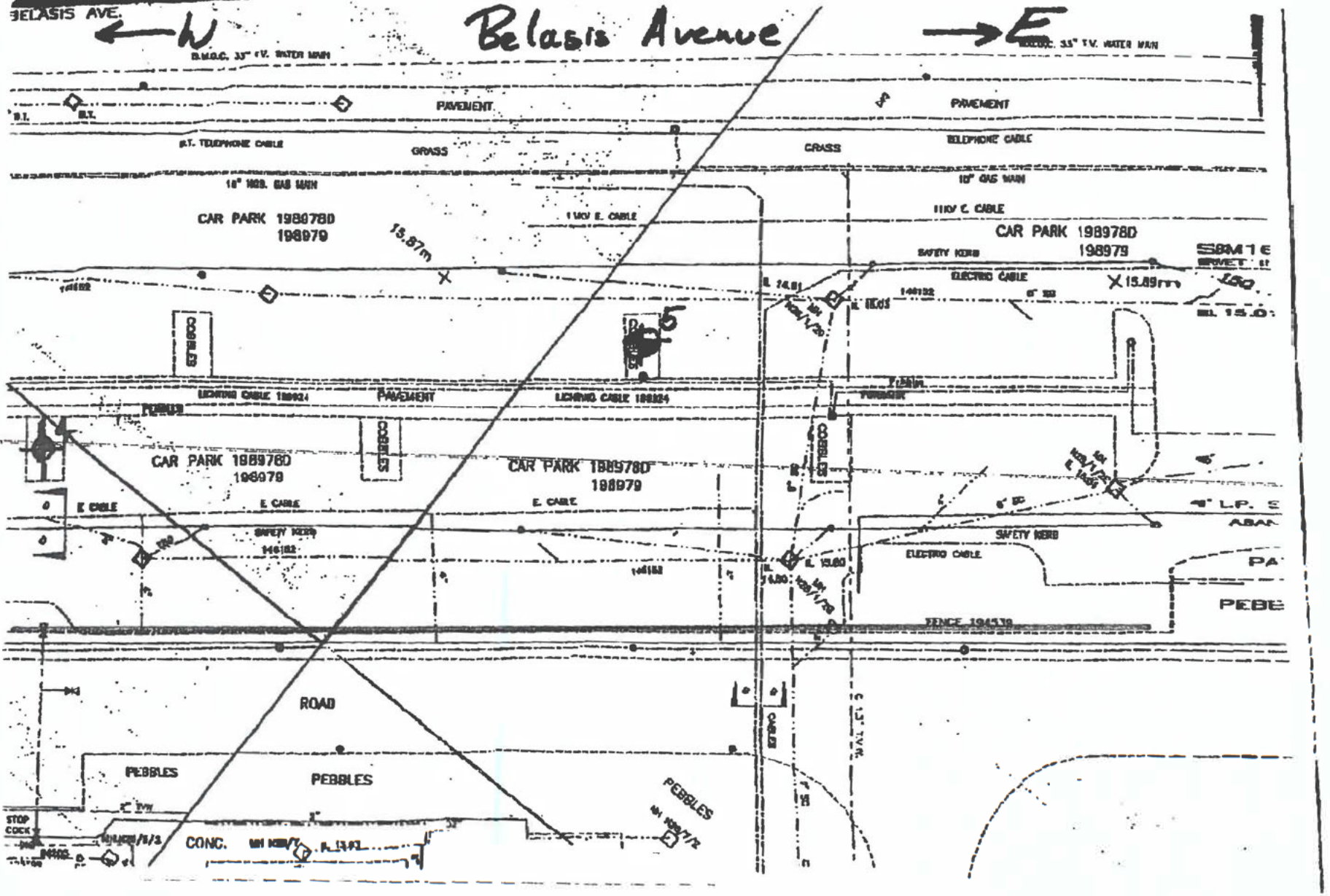
Project				BOREHOLE No
AVECIA, Billingham				5
Job No	Date	Ground Level (m)	Co-Ordinates ()	
15275	04-09-01			
Contractor				Sheet
Groundquest				2 of 2

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
11.50	U	M(15%) Cu(102.9				(4.40)	Firm to stiff Boulder CLAY *(continued)*		
13.00	U	M(22%) Cu(77.4)				13.40			
							Firm laminated CLAY		
14.50	U	M(26%) Cu(64.8)				(3.60)			
16.00	U	M(26%) Cu(48.9)				17.00			
							Stiff boulder CLAY		
17.50	U	M(30%) Cu(41.9)				(3.00)			
19.50	U	M(14%) Cu(111.1				20.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Water @ 3.000m Standing @ 3.000m (20min) Trial pit backfilled with arisings upon completion. Trial pit dry. Concrete floor at 0.8m with brick sides

All dimensions in metres Scale 1:68.75	Client AVECIA	Method/ Plant Used	Logged By

HYMASLOG 15275.GPJ JTHYMAS.GDT 19/09/01


BELASIS AVE.
Belasis Avenue
PAVEMENT
GRASS
CAR PARK 1989780
198979
PAVEMENT
CAR PARK 1989780
198979
CAR PARK 1989780
198979
CAR PARK 1989780
198979
ROAD
PEBBLES
PEBBLES
PEBBLES
CONC.
FENCE 194539