STATS

Specialist Engineering, Materials and Environmental Consultants

06 '2110 HOT

Report for

Heinz and Simone Ackerman

Commissioned by

Jane Wernick Associates

Geotechnical Report

Ackerman Glass House, Richmond

January 2006

STATS Report No. 34961/01

Site Ref:	Ackerman Glass House, 53 Mount Ararat, Richmond, TW10 6PL					
Client:	Jane Wernick Associates Limited	Invoice Ref:	35439		Date	27-Jan-06

Item	Description	Quantity	Unit	Rate	Amount (£)
1	***Phase One Investigation***				
1a	Historical Map Search (Results presented in final report)	1	Sum	150.00	150.00
1b	Technical research and appraisal (Results presented in final report)		Sum	300.00	not included
1c	Walkover survey		Sum	350.00	included
	Phase One Investigation Sub-total				*150.00*
2	***Drilling Costs (Modular light cable percussive drilling rig)***				
2a	Mobilise drilling rig, 12m of casing, equipment, and personnel to and from site		sum	425.00	
2b	Mobilise additional casing		sum	270.00	
2c	Provision of water bowser		wk	130.00	
2d	Provision of a pallet truck		sum	65.00	
2e	Set drilling rig up at borehole position (max four hours)		nr	192.00	
2f	Excavate 1.2m service pit by hand		hr	48.00	
2g	Drill from ground level to a depth of 10m (150mm dia casing)		m	22.75	
2h	Drill from 10m to a depth of 20m (150mm dia casing)		m	27.00	
2i	Chiselling obstructions including rock, boulders, dry gravel etc		hr	34.00	Rate Only
2j	Standing time incurred on site when rig and crew available for work - Note: If excessive standing time (4 or more hours in any one day) is incurred, STATS reserves the right to charge a minimum day rate of £600 per crew per day.		hr	48.00	Rate Only
2k	Dayworks (gaining access, winching, tidying up, soakage tests etc)		hr	48.00	Rate Only
2l	Take undisturbed (U100) sample or perform SPT - Up to 20m depth		nr	18.75	
2m	Take bulk disturbed sample		nr	4.00	
2n	Take small disturbed sample	5	nr	2.00	10.00
2o	Record rise in water strike levels (0.5hr) and take ground water sample		nr	24.00	
2p	Reinstatement of boreholes		nr	17.60	
	Drilling Costs (Standard light cable percussive drilling rig) Sub-total				*10.00*
3	***Borehole Installations***				
3a	19mm dia. standpipe including shingle/sand		m	14.00	
3b	50mm dia. Dual purpose gas/groundwater standpipe including shingle/sand		m	19.00	
3c	Bentonite seal		m	17.00	
3d	Provision of gas valve		No.	15.00	
3e	Provision of stopcock cover		No.	48.00	
3f	Groundwater/gas monitoring visit		Sum	250.00	
	Borehole Installations Sub-total				
4	***Trial pitting,drive in sampling and other tests***				
4a	Provide 'JCB' with buckets based on a minimum 9 hour day		day	300.00	
4b	Provide breaker attachment for 'JCB'		day	85.00	
4c	Provide technician to excavate trial pits by hand	2	day	250.00	500.00
4d	Provision of shoring for pits below 1.2m depth if not excavated from surface		day	250.00	
4e	Provide drive-in sampler, crew and undertake boreholes, including sampling	1	day	600.00	600.00
4f	Provide dynamic probe, crew and undertake probing		day	720.00	
4g	Diamond coring of hardstanding		day	400.00	
4h	In situ CBR determination using DCP test apparatus		nr	7.50	
	Trial pitting,drive in sampling and other tests Sub-total				*1,100.00*
5	***Laboratory Testing and Logging***				
5a	Geotechnical Testing (Provisional sum - see Schedule 2)				267.75
5b	Contamination Testing (Provisional sum - see Schedule 3)				174.50
5c	Logging borehole samples and preparation of borehole logs	5	m	5.00	25.00
	Laboratory Testing and Logging Sub-total				*467.25*
6	***Administration, Supervision, Reporting and Consultancy***				
6a	Mobilisation and administration of resources	1	Sum	100.00	100.00
6b	On-site engineer supervision	1	day	350.00	350.00
6c	Preparation of factual/interpretive report (1 copy)	1	Sum	600.00	600.00
6d	Additional copies of report (£25 each before issue, £55 each after issue)	2	nr	25.00	50.00
	Administration, Reporting and Consultancy Sub-total				*1,100.00*
	Total (exclusive of VAT)				**2,827.25**

Site Ref:	Ackerman Glass House, 53 Mount Ararat, Richmond, TW10 6PL				
Client:	Jane Wernick Associates Limited	Invoice Ref:	35439	Date	27-Jan-06

Item	Description	Quantity	Unit	Rate	Cost (£)
Laboratory Tests for Civil Engineering Purposes (BS1377) U - denotes UKAS Accredited Test					
1	Moisture content (U)	5	nr	5.35	26.75
2	Liquid and Plastic Limit; Plasticity Index - Standard prep, 1 point LL (U)		nr	25.50	
3	Liquid and Plastic Limit; Plasticity Index - Washed prep, 1 point LL (U)	5	nr	29.00	145.00
4	Wet sieving prep/non-plastic status (U)		nr	17.50	
5	Soil suction test (filter paper method) (U)		nr	40.00	
6	Intact dry density of chalk (U)		nr	26.00	
7	Saturation moisture content of chalk (U)		nr	19.00	
8	Chalk crushing value (per point) (U)		nr	35.00	
9	Particle size distribution by wet sieving (U)		nr	32.00	
10	Unconsolidated undrained triaxial test on single 38mm or 102mm specimens (U)		nr	21.50	
11	Density and moisture content only		nr	6.00	
12	Organic Matter Content (U)		nr	70.00	
13	Sulphate and pH	12	nr	8.00	96.00
14	BRE SD1 Suite - pH, sol sulphate, acid sol sulphate, total sulphur, Mg,amm N2, nitrate, chloride		nr	37.50	
	Sub-Total Carried to Summary (Excluding VAT)				**267.75**

	Environmental Analysis of Samples (by UKAS accredited laboratory)				
Soil samples					
1	**Metals Suite** - As Cd tCr Pb Hg Se wsB Cu Ni Zn pH		nr	17.50	
2	**CLEA Metals Suite** - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, V, Be, WSB, Se, Ba	6	nr	17.00	102.00
3	**Organic Suite** - Speciated PAH EPA16 (GC-FID (0.05mg/kg)), TPH (GRO/EPH), including BTEX & MTBE by GC-FID (GRO-0.01mg/kg, EPH 1mg/kg),		nr	63.00	
4	**Asbestos analysis**	2	nr	25.00	50.00
Water samples					
5	**Standard GW Suite** - pH EC, NH4,Cl, SO4, tCN, H2S, Phenols, Detailed hydrocarbons, Speciated PAH (GC/MS), As,Cd,Cr, Cu, Hg, Pb, Ni, Se, Zn, alkalinity.		nr	110.00	
6	**Metals suite** - As, Cd, tCr, Pb, Hg, Se, B, Cu, Ni, Zn, pH to DWS		nr	12.00	
7	**CLEA Metals Suite** - As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, V, Be, WSB, Se, Ba		nr	18.90	
8	**Near Surface Waters** - TOC, BOD, COD,		nr	20.50	
Analysis of soils/water samples for organics					
9	Soils - Hydrocarbon screen by GC EZ Flash with PRO/C10-C40 split (10mg/kg)		nr	16.50	
10	Soils/Waters - Mineral Oil (aliphatics) by GC-FID (C10-40) Following solvent extraction and column clean up (1mg/kg/10ug/l)		nr	26.00	
11	Soils/Waters - TPH (GRO/EPH), including BTEX & MTBE by GC-FID (GRO-0.01mg/kg / 10ug/l, EPH 1mg/kg 10ug/l)		nr	43.00	
12	Soils - Speciated PAH EPA16 by GC-FID (0.05mg/kg)		nr	20.00	
13	Soils/Waters VOCs (volatile organic compounds)- target list (Includes BTEX) by GC/MS (0.001mg/kg / 1ug/l)		nr	33.00	
14	Soils/Waters SVOCs (semi-volatile organic compounds) -target list Inc PAHs and phenols by GC/MS (0.001mg/kg / 1ug/l)		nr	38.00	
15	Soils/Waters - Total PCB (Total Aroclors) 0.001mg/kg		nr	44.00	
Other tests					
16	Total organic carbon & Fraction of Carbon	3	nr	7.50	22.50
17	Unallocated allowance for extra analysis		sum		
	Sub-Total Carried to Summary (Excluding VAT)				**174.50**

A schedule of other testing can be provided on request

CONTENTS

STATS

Specialist Engineering, Materials and Environmental Consultants

STATS Limited

Porterswood House
Porters Wood
St Albans
Hertfordshire, AL3 6PQ
United Kingdom

Tel: +44 (0) 1727 833261
Fax: +44 (0) 1727 835682
Email: info@stats.co.uk
Website: www.stats.co.uk

Offices also at
Coventry and Swansea

- ☐ Environment
- ☐ Geophysics
- ☐ Geotechnics
- ☐ Land Quality & Remediation
- ☐ Materials
- ☐ Structures
- ☐ Asbestos & Water Management
- ☐ Inspection & Quality Assurance
- ☐ UKAS Laboratory

DOCUMENT CONTROL

Document Title: Geotechnical Report for Ackerman Glass House, 53 Mount Ararat Road, Richmond, TW10 6PL

The Client: Heinz and Simone Ackerman

STATS Ground Engineering, a division of STATS Limited (STATS), has prepared this report in accordance with the instructions of Jane Wernick Associates on behalf of Heinz and Simone Ackerman ("the Client") by email of 1st December 2005 under the terms of appointment for site investigation services. This report is for the sole and specific use of the Client, and STATS shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. Should the Client require to pass copies of the report to other parties for information, the whole of the report should be so copied, but no professional liability or warranty shall be extended to other parties by STATS in this connection without the explicit written agreement thereto by STATS.

Report prepared by:		Report approved by:	
Name:	Frances Russell	Name:	Jon Bailey
Designation:	Graduate Geotechnical Engineer	Designation:	Principal Geotechnical Engineer
Signed:		Signed:	
Date:	27th January 2006	Date:	27th January 2006

Report Reference	34961/01
Status of Report:	Final
Date of Issue:	January 2005
Page No.	3 of 16

Registered in England No. 2833839

GEOTECHNICAL REPORT FOR SITE AT 53 MOUNT ARARAT ROAD, RICHMOND, TW10 6PL

1. INTRODUCTION

1.1 Purpose of Investigation

On the instructions of Jane Wernick Associates Consulting Engineers on behalf of Heinz and Simone Ackerman, STATS Geotechnical has carried out a site investigation of 53 Mount Ararat Road, Richmond. The project was commissioned in order to obtain information on the ground conditions in relation to the proposed development of a glass house on the site.

1.2 Project Brief

The project was carried out to an agreed brief, as set out in Jane Wernick Associates invite to tender and STATS proposal letter of 22nd November 2005, and has included the following tasks:

Desk Study

- A site walk-over reconnaissance survey, undertaken during the site work.
- A study of local geology and hydrogeology.
- The history of development and industry on the site, including a study of archival Ordnance Survey mapping.
- The identification of potential geological hazards.

Site Investigation

- Sinking of 1No. drive-in window sampler borehole to a maximum of 5m depth.
- Excavation of 3No. trial pits.
- Associated sampling and on-site testing.
- Laboratory chemical testing of 6No. soil samples for common contaminants.
- Laboratory screening of 2 samples of made ground for the presence of asbestos fibres.
- Laboratory geotechnical testing of soil samples for classification purposes.
- Interpretative reporting

1.3 Limitations

The opinions and recommendations expressed in this report are based on the ground conditions encountered during the site work, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site, therefore other conditions may prevail at the site which have not been revealed by this investigation.

The results of STATS laboratory tests are covered by UKAS accreditation, but opinions and interpretations expressed in the report and on the site work records are outside the scope of this accreditation. Where laboratory testing has been carried out at a sub-contractor laboratory, this laboratory is an approved sub-contractor in accordance with the requirements of STATS' quality management system and is UKAS accredited for the relevant range of tests undertaken.

2. SITE DETAILS

2.1 Site Location and Description

The site, which may be located by National Grid reference TQ183745, is situated at 53 Mount Ararat Road, Richmond. An extract of the 1:50 000 Ordnance Survey map showing the location of the site is included in Figure 1.

The site currently comprises a residential dwelling with the associated garden and terrace. The area around the site is the urbanised historic flood plain of the River Thames.

The characteristics of the site observed during the site reconnaissance visit and obtained from current Ordnance Survey maps are summarised in Table 2.1.

Table 2.1 – Site description

Feature	Description
Physical characteristics	
Area of site	Approximately 0.07 hectares.
Ground levels	The site is essentially level, but the access pathway slopes upwards when joining the garden.
Depressions in the ground surface	None observed.
Waterlogged or marshy ground	None observed.
Surface water	There are no streams or drainage ditches on or adjacent to the site.
Flood risk	The indicative floodplain map for the area, published by the Environment Agency, shows that the site does not lie within the predicted (1 in 100 year) flood plain of the River Thames. Therefore the site is not considered to be susceptible to fluvial flooding.
Trees and hedges	Large mature trees present at north and east boundary. Small trees are present on site as shown on the site plan in Figure 2.
Existing land-use on site	The site contains 53 Mount Ararat Road, and its associated garden and terrace.
Basements on site	No evidence of existing or infilled basements was observed.
External hardstanding	There are no roads or areas of external hardstanding on site.
Retaining walls on or close to site boundary	Three walls retain the entire garden. The site level at the far end of the garden is 0.70m above the adjoining land.
Made ground, earthworks and quarrying	None observed.
Potentially unstable slopes on or close to site	None observed.
Buried services present	None observed.

2.2 Site History

The history of the site's land-use and development from Victorian times onwards is summarised in Table 2.2 and has been researched from the succession of historical County Series and Ordnance Survey maps listed in the table. Extracts of the maps and plans referred to are presented in Figures 3 to 9.

Reference to historical maps provides invaluable information regarding the land-use history of the site, but historical evidence will be incomplete for the period pre-dating the first edition and between successive maps.

2.2.1 Summary of Site History

The earliest historical map was published in 1866 and portrays the land use of the site as being an agricultural field. Number 53 Mount Ararat Road was built between 1866 and 1894, along with vast housing and infrastructure developments in the local area, which replaced all the previous agricultural land use. A second phase of building occurred between 1894 and 1911, where further terrace housing was constructed immediately adjacent to the northern part of the site. Since 1911, there has been little change to either the site or the surrounding area in terms of land use. It appears that 53 Mount Ararat Road already accommodated a glass house or outbuilding from at least 1894 to 1982, at the south-western end of the garden close to today's proposed plans.

Table 2.2 Summary of Historical Development

Date	Land Use / Features on Site	Land Use / Features in Vicinity of Site (of relevance to the assessment)	Source / Figure Number
1866	➢ The site in 1866 was a field 140 x 40m, it appears to be lined with trees / hedges along every border. ➢ The northern most edge of the field is the same as the northernmost border of today's site. ➢ Mount Ararat Lane is shown to be running north-west to south-east, directly alongside the north-eastern edge of the site.	➢ Mount Ararat House and gardens were situated adjacent to the northern border of the site; the gardens were covered in trees and were probably landscaped. A fountain was situated 50 metres to the north-west of the site. ➢ More fields occupied the ground surrounding the site to the south-east and north-east, some of which were also lined with trees. ➢ A further area of landscaped gardens was situated 75 metres to the south-west. ➢ Housing developments were in existence 250 metres to the north, 150 metres to the west and 200 metres to the south and south-east.	3
1894 - 1898	➢ 53 Mount Ararat Road was built between 1866 and 1898. The size and shape of the house and garden is the same as the present day. ➢ A glass house or outbuilding was situated at the end of the garden, covering the entire width of the plot. The dimensions appear to be approximately 2.5 x 10m. ➢ Mount Ararat Lane is now labelled Mount Ararat Road.	➢ There was extensive housing and infrastructural development between 1866 and 1894 in the local area surrounding the site. The entire area was devoid of any agricultural fields by 1894, and in their place residential dwellings were constructed. ➢ Neighbouring houses along Mount Ararat Road were also built prior to 1894. Three glass houses were located next to the site within the gardens of 55 Mount Ararat Road. ➢ Mount Ararat House still stood in 1894, but the gardens appear to have been converted into a tree-lined walkway. No other landscaping features are shown, including the aforementioned fountain. ➢ The landscaped gardens appearing in 1866 to the south-west of the site have since been converted into housing.	4
1911 - 1913	➢ The site's land use remained unchanged between 1894 and 1911.	➢ By 1911, Mount Ararat House was demolished, and further terrace housing was built in its place. The tree-lined avenue became Onslow Avenue by 1911, which was also lined with terrace housing, directly adjacent to the site.	5
1933 - 1934	➢ The site's land use remained unchanged between 1911 and 1933.	➢ The land use of the local area surrounding the site appears not to have changed between 1911 and 1933.	6

Date	Land Use / Features on Site	Land Use / Features in Vicinity of Site (of relevance to the assessment)	Source / Figure Number
1959 - 1982	➢ The glass house or outbuilding on the site at 53 Mount Ararat Road appears smaller, now approximately 2.5 x 3 metres. ➢ The rest of the land-use on site remains unchanged.	➢ Glass house positions on the adjacent property (number 55) have changed, there is now just one glasshouse or outbuilding in the middle of the garden. ➢ The rest of the land use in the surrounding area remains largely unchanged between 1933 and 1982.	7-8
1996	➢ The glasshouse or outbuilding on the site appears to have been removed between 1982 and 1996.	➢ The land use in the surrounding area remains unchanged between 1982 and 1996.	9

3. GROUND INVESTIGATION

3.1 Site Work

The site work was carried out on 16th and 21st December 2005 and comprised the activities summarised in Table 3.1. The exploratory hole logs and other site work records, as listed in the Contents, are presented in Appendix A.

Table 3.1 Summary of ground investigation site work activities

Investigation Type	Number	Location/ Designation
Boreholes – by drive-in-sampler	1	BH1
Trial Pits – excavated by hand	3	TP1 to TP3

The investigation points were located approximately by reference to physical features present on the site at the time of investigation.

3.2 Laboratory Testing

A programme of geotechnical and chemical laboratory testing, scheduled by STATS, was carried out on selected samples taken from various strata. The laboratory results, as listed in the Contents, are presented in Appendices B and C, respectively.

4. GEOTECHNICAL GROUND CONDITIONS

4.1 Published Geology and Hydrogeology

The published 1:50,000 scale geological map of the area (Sheet No 270) indicates that the site is underlain by London Clay, with River Terrace Deposits situated within 250 metres to the north and south.

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of a non-aquifer comprising the London Clay.

4.2 Findings of Ground Investigation

4.2.1 General Succession of Strata

The exploratory holes revealed that the site is underlain by a superficial thickness of made ground over London Clay. This appears to confirm the stratigraphical succession suggested by the published geological records. For the purpose of discussion, the ground conditions are summarised in Table 4.1 below.

Table 4.1 General succession of strata encountered

Brief Description	Depth to top of stratum m.bgl	Thickness (m)
Made Ground	0	0.95 – 1.40
Reworked London Clay	0.95	1.75
London Clay	2.70	Proved to 5.00

4.2.2 Made Ground

The exploratory holes encountered a variable thickness of Made Ground across the site ranging from 0.95m in the borehole to in excess of 1.40m in the trial pits excavated up against the existing garden walls. The maximum thickness of made ground is typically encountered at TP2.

In general the Made Ground comprises dark brown sandy gravelly CLAY, with fine to coarse sub-angular to sub-rounded gravel of flint, brick, ceramic and glass. The presence of rootlets was noted in each of the exploratory holes.

The measured and inferred soil parameters for the stratum are listed in Table 4.2 below.

Table 4.2 Summary of soil parameters for Made Ground

Soil Parameters	Range	Results
Liquid Limit (%)	36	Appendix B1
Plastic Limit (%)	18	Appendix B1
Plastic Index (%)	18	Appendix B1
Modified Plasticity Index (%)	12.78	-
Plasticity Term	Intermediate	Figure 11
Moisture Content (%)	16	Figure 10
Volume Change Potential (NHBC)	Low	-

4.2.3 Reworked London Clay

The Reworked London Clay typically comprised firm light brown to orange slightly silty, sandy, gravelly CLAY. The gravel fraction consisted of medium to coarse, rounded to sub-rounded flint.

The measured and inferred soil parameters for the stratum are listed in Table 4.3 below.

Table 4.3 Summary of soil parameters for Weathered London Clay

Soil Parameters	Range	Results
Liquid Limit (%)	78-79	Appendix B1
Plastic Limit (%)	27-28	Appendix B1
Plastic Index (%)	51	Appendix B1
Plasticity Term	Very High	Figure 11
Moisture Content (%)	30-37	Figure 10
Volume Change Potential (NHBC)	High	-

4.2.4 London Clay

The London Clay typically comprised of, firm becoming stiff at depth, light brown to orange CLAY.

The measured and inferred soil parameters for the stratum are listed in Table 4.4 below.

Table 4.4 Summary of soil parameters for London Clay

Soil Parameters	Range	Results
Liquid Limit (%)	78-79	Appendix B1
Plastic Limit (%)	29-31	Appendix B1
Plastic Index (%)	48-49	Appendix B1
Plasticity Term	Very High	Figure 11
Moisture Content (%)	32-35	Figure 10
Volume Change Potential (NHBC)	High	-

4.2.5 Comparison of Measured Moisture Contents with those from Driscoll's Criteria

An assessment of the state of desiccation of a soil can be made by comparison of measured moisture contents with those calculated using Driscoll's Criteria based on soil index properties. Using Driscoll's Criteria the soil can be said to be significantly desiccated when the natural moisture content drops below 40% of its liquid limit.

Assessing the available laboratory index test results against the above Criteria indicates the signs of significant desiccation at a depth of 2.25m at the time of sampling. However, no significant roots were found in the clay soils recovered from the borehole.

4.3 Groundwater Results

No groundwater was encountered during this investigation.

5. GROUND CONTAMINATION CONDITIONS

5.1 Chemical Analysis of Soil Samples

Chemical analyses have been performed on a total of 6 no. Made Ground samples down to a maximum depth of 0.75m below existing ground level.

In addition to the chemical analyses, a total of 2 no. samples of the made ground were screened in the laboratory for the presence of asbestos fibres. All soil samples received at the laboratory are also inspected visually for the presence of materials potentially containing asbestos, e.g. fragments of asbestos-cement products.

The results have been assessed with respect to human health, plant phytotoxicity and the performance of construction materials in Tables 5.1 to 5.3, respectively.

5.1.1 Summary of soil results with respect to human health effects

Table 5.1 Summary of soil results with respect to human health effects

Substances present at or above CLEA published Soil Guideline Values[1] or STATS screening values[2] (maximum concentrations in mg/kg)		
Substance	**Residential - with plant uptake**	**Residential - without plant uptake**
Metals and arsenic[1]	Arsenic (28mg/kg in TP3 @0.5m) Lead (817mg/kg in TP3 @0.5m)	Arsenic (28mg/kg in TP3 @0.5m) Lead (817mg/kg in TP3 @0.5m)

1. Substances assessed against CLEA SGV's comprise: Arsenic, Cadmium, Chromium, Lead, Mercury, Selenium and Nickel.
2. Where no CLEA SGV's are available STATS has derived values from the CLEA published toxicity data for naphthalene, benzo-a-pyrene, free cyanide, benzene.
3. Where no SGV's or TOX report is available STATS has derived values from published toxicity data

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground.

5.1.2 Summary of soil results with respect to plant phytotoxicity effects

Table 5.2 Summary of soil results with respect to plant phytotoxicity effects

Substance	Assessment value adopted (mg/kg) from The Soil Code (1998)				Maximum concentration where in excess of assessment value (mg/kg)
	pH <5.5	pH 5.5-6	pH 6-7	pH >7	
Boron	3	4	5	6	None in excess
Copper	250	250	250	250	None in excess
Nickel	50	60	75	110	None in excess
Zinc	200	200	300	300	436mg/kg in TP3 @0.5m

5.1.3 Summary of soil results with respect to performance of building materials

Table 5.3 Summary of soil results with respect to performance of building materials

Category of substance	Receptor at risk	Assessment value adopted (mg/kg)	Maximum concentration where in excess of assessment value (mg/kg)
Sulfates	Concrete[1]	500mg/l (WS as SO_4)	1476mg/l
Phenols	Potable water in plastic pipes	5	NA
TPH	Plastics and fresh concrete	1000[2]	NA

1. Where sulfates are present follow BRE Special Digest 1: 2001 *Concrete in aggressive ground* design guidelines.
2. General guideline value for petrol and diesel type products (C6-C35).

5.1.4 Summary of Soil Results

In summary, the limited chemical analyses undertaken have indicated that the samples tested are generally uncontaminated, with the exception of elevated arsenic, lead and zinc in a single sample of made ground tested from TP3 at a depth of 0.5m. The made ground encountered in TP3 is unlikely to be disturbed during the construction of the proposed glass house and in consideration of the overlying topsoil thickness of 0.35m at this location, the requirement for any further action does not appear justified.

Elevated concentrations of water soluble sulfate were detected in five of the soil samples tested and the implications with respect to concrete design are discussed in Section 6.4.

6. ENGINEERING CONSIDERATIONS

6.1 Details of Proposed Development

It is understood that the proposed development will comprise a glass house with plan dimensions of 4m wide by 8m long. The total loading associated with the structure is indicated to be in the order of 640kN, with a resulting uniformly distributed load over the plan area of the structure of 20kN/m^2.

6.2 Geotechnical Hazards

A summary of commonly occurring geotechnical hazards is given in Table 6.1 together with an assessment of whether the site may be affected by each of the stated hazards.

Table 6.1 Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	**Hazard status** based on investigation findings and proposed development			**Engineering considerations if** hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions			✓	Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	✓	London Clay – high potential		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)			✓	Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions	✓	London Clay		Likely to affect ground engineering and foundation design and construction
Karstic dissolution features (including 'swallow holes' in Chalk terrain)			✓	May affect ground engineering and foundation design and construction
Evaporite dissolution features and/or subsidence			✓	May affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides			✓	Likely to require special stabilisation measures
Ground subject to peri-glacial valley cambering with gulls possibly present			✓	Likely to affect ground engineering and foundation design and construction
Ground subject to or at risk from coastal or river erosion			✓	Likely to require special protection/stabilisation measures
High groundwater table (including waterlogged ground)			✓	May affect temporary and permanent works
Rising groundwater table due to diminishing abstraction in urban area			✓	May affect deep foundations, basements and tunnels
Underground mining			✓	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)			✓	Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	✓	Made ground 0.95m thick		Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)	✓	Elevated sulphates see Section 6.4.		May affect ground engineering and foundation design and construction

Note: Seismicity is not included in the above Table as this is not normally a design consideration in the UK.

6.3 Foundations

6.3.1 General Suitability

The ground conditions beneath the proposed glass house comprise 0.95m of made ground overlying firm, becoming stiff with depth, clays (London Clay) of high volume change potential. The clay sub-soils are therefore highly susceptible to swelling and shrinkage movement resulting from seasonal changes in moisture content and the effect of trees.

In view of the above, combined with the presence of substantial mature trees at the boundary of the site and the apparent signs of significant desiccation detected in the clay soils, the chosen foundation solution will either need to be able to accommodate resulting ground movements or negate them. In respect to the proposed glass house a stiff raft foundation is considered the most suitable foundation solution.

6.3.2 Raft Foundations

The recommendations for the design and construction of raft foundations in relation to the ground conditions are set out in Table 6.2.

Table 6.2 Design and construction of raft foundations

Design/construction considerations	Design/construction recommendations
Founding stratum	Firm clay - London Clay
Depth	Foundations should be taken to a minimum depth of 0.5m below finished ground level and at least 0.1m into the founding stratum below any overlying made ground. The raft should be constructed on well-compacted granular infill which should be not be less than 50% of the foundation depth and not greater than 1.25m.
Bearing capacity	A raft foundation with a width of up to 4m and constructed on the firm clay may be designed using a net allowable bearing pressure of 40kN/m^2. The allowable bearing capacity includes an overall factor of safety of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.
Construction considerations	All foundation excavations should be inspected and any made ground, soft, organic or otherwise unsuitable materials removed and replaced with mass concrete or well-compacted granular fill. The proposed founding stratum is a relatively silt-rich soil, hence susceptible to rapid softening once exposed. Hence all foundation excavations should immediately be blinded with concrete or the full foundation constructed.

6.4 Chemical Attack on Buried Concrete

The results of chemical tests carried out on soil samples indicate 2:1 water soil extract sulphate contents of up to 1476mg/l with generally near neutral pH values.

These results indicate that, in accordance with BRE Special Digest 1: 2005 *Concrete in aggressive ground*, the Aggressive Chemical Environment for Concrete (ACEC) Classification is ***AC-1s*** with a Design Sulfate Class for the site of ***DS-2***. This assumes nominally static

groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures.

If significantly disturbed clay is likely to come into contact with concrete foundations or structures it will be necessary to carry out additional tests on the soil to investigate its total potential sulphate content. This will facilitate a revaluation of the ACEC Classification and Design Sulfate Class for the material, to take into consideration potential oxidation of available sulphides (e.g. pyrite), as defined in Table C1 (natural ground sites) or C2 (brownfield sites) BRE Special Digest 1: 2005.

6.5 Soakaways

The ground conditions do not appear suitable from a geotechnical viewpoint for the use of pit soakaways to discharge surface run-off water into the London Clay.