



**GEO ENVIRONMENTAL  
ASSESSMENT**

**FORMER HAPPY MAN  
PUBLIC HOUSE  
BERRY LANE  
RICKMANSWORTH  
HERTFORDSHIRE**

**22852-R01 (00)**

**TESCO STORES LTD**

**APRIL 2008**

CONFIDENTIAL



RSK Geoconsult Ltd  
19 Frogmore Road  
Hemel Hempstead  
Hertfordshire  
HP3 9RT  
United Kingdom

Telephone +44 (0) 1442 437500  
Fax +44 (0) 1442 437060  
www.rsk.co.uk

**GEO ENVIRONMENTAL ASSESSMENT  
FORMER HAPPY MAN PUBLIC HOUSE  
BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE**

**REPORT NO** : 22852R01-(00)

**Client** : **TESCO STORES LTD**  
**c/o STACE PROJECT MANAGEMENT**  
**273 High Street**  
**Epping**  
**Essex**  
**CM16 4DA**

**DOCUMENT ISSUE STATUS**

<b>Report Issue</b>	<b>FINAL</b>		
<b>Reference Number</b>	22852r01(00)		
<b>Title</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Author</b>	K Bissett		April 2008
<b>Project Manager</b>	G Cotton		April 2008
<b>Technical Reviewer</b>	J Pulsford		April 2008
	P Witherington		

This report is not to be used for contractual or engineering purposes unless the above is signed where indicated by the author, the project manager and the technical reviewer of the report, and the report is designated "FINAL"



INVESTOR IN PEOPLE

RSK Geoconsult Ltd  
Registered office  
21/22 Park Way - Newbury - Berkshire - RG14 1EE - UK  
Registered in England No. 2611785

www.rsk.co.uk

## TABLE OF CONTENTS

### EXECUTIVE SUMMARY

<b>1. INTRODUCTION</b> .....	<b>1</b>
1.1 Objectives .....	1
1.2 Scope .....	1
1.3 Limitations .....	2
1.4 Previous Report .....	2
<b>2. SITE DETAILS</b> .....	<b>3</b>
2.1 Site Location .....	3
2.2 Site Description .....	3
2.3 Future Development .....	3
2.4 Review of Previous Report.....	3
<b>3. PRELIMINARY RISK ASSESSMENT</b> .....	<b>4</b>
3.1 Geology.....	4
3.2 Radon.....	5
3.3 Hydrogeology.....	5
3.3.1 Source Protection Zone.....	5
3.3.2 Ground Water Abstractions .....	5
3.3.3 Soil Leaching Potential.....	5
3.4 Hydrology.....	5
3.4.1 Flooding .....	5
3.5 Sensitive Land Uses.....	6
3.6 Site History Review .....	6
3.6.1 Historic Maps .....	6
3.6.2 Database and Regulatory Information.....	7
3.6.3 Trade Directories.....	7
3.7 Site Walkover .....	7
3.7.1 Summary of Historic Potentially Contaminative Land Uses.....	7
3.8 Sensitive Receptors .....	8
3.9 Summary of Plausible Pathways.....	8
3.10 Data Gaps and Uncertainties .....	8
3.11 Outline Conceptual Model.....	8
3.12 Preliminary Risk Assessment Conclusions and Recommendations.....	10
<b>4. ENVIRONMENTAL SITE INVESTIGATION</b> .....	<b>10</b>
4.1 Sampling Strategy and Methodology.....	10
4.1.1 Investigation Locations.....	10
4.1.2 Gas and Groundwater Monitoring .....	11
4.1.3 Groundwater Sampling.....	11
4.2 Ground Conditions .....	11
4.2.1 Soil Stratigraphy .....	11
4.3 Refined Conceptual Model.....	12
4.4 Analytical Strategy and Methodology .....	13

<b>5. GENERIC QUANTITATIVE RISK ASSESSMENT</b> .....	<b>14</b>
5.1 Relevant Linkages for Assessment .....	14
5.2 Methodology and Results .....	15
5.2.1 Direct Contact and Indoor Air Vapour Inhalation by Future Residents (soil) .....	15
5.2.2 Vapour Inhalation from Indoor Air by Future Residents (water) .....	15
5.2.3 Uptake of Contaminants by Vegetation Potentially Inhibiting Plant Growth... ..	15
5.2.4 Permeation of Plastic Utilities.....	16
5.2.5 Leaching of Contaminants to Groundwater.....	16
5.2.6 Migration of Dissolved Phase Contaminants to Major Aquifer/SPZ's .....	16
5.2.7 Ground Gas.....	16
5.3 Environmental Assessment Conclusions .....	17
<b>6. WASTE</b> .....	<b>17</b>
6.1 Waste Classification .....	17
<b>7. GEOTECHNICAL SITE ASSESSMENT</b> .....	<b>18</b>
7.1 Intrusive Investigation Undertaken .....	18
7.1.1 Probeholes .....	18
7.1.2 Borehole.....	19
7.1.3 Laboratory Analysis.....	19
7.2 Foundation Design .....	19
7.3 Floors.....	20
7.4 Road Construction.....	20
7.5 Chemical Attack on Buried Concrete.....	21
7.6 Excavations.....	21
7.7 Soakaways.....	21
<b>8. REFERENCES</b> .....	<b>23</b>

## LIST OF TABLES WITHIN TEXT OF REPORT

Table 1: Historic Maps.....	6
Table 2: Preliminary Risk Assessment for Linkages in Outline Conceptual Model.....	9
Table 3: Investigation Locations.....	10
Table 4: Analytical Results.....	13
Table 5: Linkages for Generic Quantitative Risk Assessment.....	14

## LIST OF TABLES ATTACHED

Table 1a	Results of Gas and Groundwater Monitoring (31/03/08)
Table 2a	Results of Gas and Groundwater Monitoring (07/04/08)
Table 3a	Results of Gas and Groundwater Monitoring (15/04/08)
Table 4a	Results of Insitu Shear Strength Tests
Table 5a	Results of Mexecon Penetrometer Tests

## LIST OF FIGURES

Figure 1	Site Location Plan
Figure 2	Site Plan
Figure 3	Historical Map (1872)
Figure 4	Historical Map (1914)
Figure 5	Historical Map (1937)
Figure 6	Historical Map (1961)
Figure 7	Historical Map (1992)

## LIST OF APPENDICES

Appendix A	Summary of Legislation and Policy Relating to Contaminated Land
Appendix B	Service Constraints
Appendix C	Extracts of Delta-Simons Desk Study Report
Appendix D	Site Walkover Checklist
Appendix E	Methodology for Risk Assessment
Appendix F	Records of Probehole and Borehole Logs
Appendix G	<del>Environmental Test Results</del>
Appendix H	Human Health Generic Assessment Criteria
Appendix I	Generic Assessment Criteria for Phytotoxic Effects, Pipelines and Controlled Waters
Appendix J	Human Health 95 <sup>th</sup> Percentile Sheets/Screen
Appendix K	CAT-WASTE <sup>SOIL</sup> Results
Appendix L	Geotechnical Test Results
Appendix M	Environmental Reporting Requirement Checklists

## EXECUTIVE SUMMARY

On behalf of Tesco Stores Ltd, RSK Geoconsult Ltd (RSK) was commissioned by Stace Project Management Ltd to undertake a geo-environmental site investigation of the former Happy Man public house site located on Berry Lane, Rickmansworth. The public house has recently suffered from fire damage.

The site is being considered for a combined redevelopment with a Tesco Express store with residential above.

Historical research carried out by others indicates that before construction of the public house circa 1960 the site comprised open farmland.

Geological records indicate that the site is underlain by Chalk (major aquifer) locally overlain by superficial deposits comprising sand and gravel. The historical maps indicate both the chalk and sand/gravel have been extracted in the vicinity of the site.

The site is not located in an area at risk from flooding.

A ground investigation carried out by RSK revealed topsoil/made ground to a maximum of 1mbgl followed by natural clay including sand/gravel to about 6mbgl and then chalk. Perched groundwater was encountered at about 2.6m bgl.

The site assessment has not identified any pollutant linkages that could present an unacceptable risk to off-site receptors or pose a threat to the proposed end uses. However, a number of recommendations are made to ensure that potential liabilities are avoided and the proposed development can proceed safely. These are:

- Consultation with the Environment Agency/Local Authority over conclusions and recommendations of report;
- Consultation with water authority over specification for buried water pipes
- Type III Asbestos/Hazardous Building Materials Survey prior to demolition;
- Adoption of health and safety measures during proposed re-development works; and
- Chemical validation of imported backfill/subsoil/topsoil;

Any excavated made ground requiring disposal off site would be classified as non hazardous and it is probable that natural soils would be accepted by landfill sites as inert. However, under the duty of care for waste it is up to the 'producer' (in this case the contractor) to classify any waste generated and arrange disposal to an appropriately licensed site.

The proposed building may be supported on conventional strip or trench fill foundations placed in the natural clay at 0.9mbgl where an allowable net bearing pressure of 100kN/m<sup>2</sup> can be assumed. Foundations greater than 0.9m deep will be required in places where deeper made

ground is present and where there are foundations or substructure from the existing buildings are to be removed

A precast suspended ground floor slab with a 150mm void beneath should be adopted.

A California Bearing Ratio (CBR) in the range between 2 and 5 percent may be assumed with the inclusion of a geo-grid membrane recommended particularly within the location of PH1 and the proposed lorry park.

The Design Sulphate Class for the site as given as DS-1 with an Aggressive Chemical Environment for Concrete classification of AC-1.

Soakaway tests should be undertaken within gravel stratum to confirm potential storm water soakage characteristics. Consultation should be undertaken with the EA with respect to borehole soakaways within the chalk

## 1. INTRODUCTION

RSK Geoconsult Limited (RSK) was commissioned by Stace Project Management Limited (Stace) on behalf of Tesco Stores Ltd to carry out a geo-environmental assessment of the former Happy Man Public House site located on Berry Lane, Rickmansworth. Consideration is given to re-development of the site for a mixed commercial and residential end-use. The proposals include the construction of a Tesco Express convenience store with two-storey residential accommodation and associated infrastructure.

### 1.1 Objectives

The objectives of this assessment are as follows:

- To enable sufficient information regarding ground conditions to be obtained from which risks to end-users and the environment can be assessed; and
- To obtain sufficient information pertaining to ground conditions to assist in the design of foundations and infrastructure.

### 1.2 Scope

The scope of the investigation and layout of this report has been designed with CLR11<sup>(1)</sup> and guidance issued by the Environment Agency in July 2005 for land contamination reports<sup>(2)</sup>. A summary of relevant legislation and government policies applicable to land development is included in Appendix A.

The risk management process comprises up to three stages of risk assessment: preliminary, generic quantitative and detailed quantitative (PRA, GQRA and DQRA). The basis for the risk assessment is a conceptual model that is produced as part of the PRA and is updated throughout the risk management process.

The scope of works for the environmental assessment includes:

- A PRA involving the review of existing reports, utility location information, geological, hydro geological and hydrological information, a commercially available database, historical plans, correspondence with appropriate regulatory authorities and site walkover. This information is used to construct an outline conceptual model and consider any possible pollutant linkages (where a receptor may be connected to a source by a viable pathway) that may be present and design intrusive investigation if required;
- Where required, evaluation of possible pollutant linkages by intrusive investigation and laboratory analysis. This information is used to refine the conceptual model;
- GQRA (if required) to assess possible pollutant linkages identified in the PRA and enable outline conceptual model to be refined; and

- Provide recommendations for further works, DQRA and remedial actions of ground and groundwater (if deemed applicable).

The scope of works for the geotechnical assessment includes:

- Review of published geological data including a commercially available database with information pertaining to ground stability;
- Review of utility location information and site walkover;
- Coal mining search/solution features search/cavities search;
- Intrusive investigation and laboratory analysis to enable soil parameters for geotechnical purposes to be ascertained; and
- Interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundation, floor slabs and infrastructure design.

### 1.3 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater and ground gas levels may vary from those reported due to seasonal, or other, effects.

This report is subject to the RSK Geoconsult Limited service constraints given in Appendix B.

### 1.4 Previous Report

The following report was made available for review:

- Geo-environmental Desktop Review Report. The Happy Man Public House, Berry Lane, Rickmansworth, Hertfordshire, WD3 7HR, Delta-Simmons, Report ref 06-3042.01, 15 February 2006.

Where pertinent, information from the Delta-Simmons report has been included in this report and referenced accordingly.

## **2. SITE DETAILS**

The site location, description, historical information and future development are discussed below.

### **2.1 Site Location**

The site is situated at the corner of Berry Lane and Tudor Way at approximate National Grid reference 504510, 194630. The site is situated within a predominantly residential setting. A site location map is presented as Figure 1.

### **2.2 Site Description**

The site occupies approximately 0.15 hectares and is at an approximate elevation of 58.5m AOD. A Site Plan (including an overlay of the proposed development) is presented as Figure 2. At the time of the present study the site comprised a fire-damaged two storey former public house (The Happy Man) with vehicular access and parking and landscaped areas.

The site and surrounding areas slope gently down to the southeast.

The site contains a number of trees located on the southwestern and northwestern site boundaries.

The site is bounded by Berry Lane to the northeast, by Tudor Way to the southeast and by residential housing to the southwest and northwest.

It is not known if there is a basement cellar to the public house.

### **2.3 Future Development**

The site is to be developed with the construction of a Tesco Express store on the ground floor to the west of the site with two storey residential flats above. The remainder of the site is to be laid out almost exclusively to hard standing with areas demarked for customer parking and delivery areas to the store. The planned layout of the site is shown on Figure 3.

### **2.4 Review of Previous Report**

The desk study report (based on a site-centred Landmark Environmental Database Report<sup>(3)</sup>) by Delta-Simons (and also reviewed by RSK) has indicated that no significant potential sources of contamination have been identified, given its use as a public house since circa 1961. However, the potential local contamination sources were given as follows:

Fuels and chemicals associated with the public house;

Potential firewater used while extinguishing the fire at the property;  
Mobilisation of potential asbestos materials during the fire; and  
Potential ground gas associated with any potential made ground materials beneath the site.

It was also considered there was a low risk from potential land gas migration from the infilled gravel pits and landfill to the southeast and infilled chalk pits to the northwest of the site. Overall, the site was considered a low to medium environmental risk.

#### *Ownership Issues*

It was highlighted by Delta-Simons that the potential for Statutory Authority action in relation to the potential for "significant harm" and "pollution of controlled water" under Part II of the Environmental Protection Act 1990 was considered to be low. The potential for legal action from surrounding land owners from potential migration of contamination off site was considered low and the potential for contamination to impact the site from off site sources was considered to be also low.

#### *Geotechnical*

It was considered that based on the anticipated geology (made ground over chalk), that traditional strip and pad foundations of reinforced concrete to support the likely development would be required, or in the worst case that a piled foundation would be required.

Extracts of the previous Delta-Simmons desk study report are given in Appendix C.

### **3. PRELIMINARY RISK ASSESSMENT**

The following describes the results of the review of available information for the site and the findings from the site inspection. The information together with that presented in Section 2 has been used to identify potential contaminant sources and sensitive receptors, from which an outline conceptual model has been developed.

#### **3.1 Geology**

Published records<sup>14</sup> for the area indicate the geology beneath the site to comprise the Seaford and Newhaven Chalk Formation (SNCK). Superficial deposits comprising the Taplow Gravel Formation (TPGF) overlies the chalk immediately beyond the southeast boundary. The TPGF is described from associated BGS memoirs as sand and gravel, locally with lenses of silt, clay or peat.

It is also considered that potential made ground associated with development of the site, will be present overlying these natural deposits.

### 3.2 Radon

Information contained within the Landmark Report<sup>(3)</sup> for the site included within the Delta-Simons report indicates that no radon protective measures are necessary in the construction of new dwellings or extensions.

### 3.3 Hydrogeology

Information contained within the Landmark Report<sup>(3)</sup> for the site indicates the geology beneath the site to be classified as a major aquifer, defined as a highly permeable formations usually with a known or probable presence of significant fracturing. These may be highly productive and able to support large abstractions for public water supply and other purposes.

#### 3.3.1 Source Protection Zone

The Environment Agency has defined source protection zones (SPZ) for nearly 2,000 groundwater sources used for public drinking water supply. The SPZ provides an indication of the potential risk of pollution. Three zones (Inner, Outer and Total Catchment) are usually defined. Information within the Landmark Report<sup>(3)</sup> supplied to Delta-Simons indicates the site is situated within zone II (Outer Protection Zone) and zone III (Total Catchment) groundwater SPZ.

#### 3.3.2 Ground Water Abstractions

As mentioned within the Delta-Simons report there are sixteen groundwater abstractions between 1km and 2km of the site. The nearest groundwater abstraction (1215m SW) is for Three Valleys Water PLC at Mill End Pumping Station for potable water supply.

#### 3.3.3 Soil Leaching Potential

The soils beneath the site are classified within the Landmark Report<sup>(3)</sup> as having high leaching potential. It should be noted that soil information for urban areas is based on fewer observations than elsewhere, so a worst-case vulnerability classification is assumed until proven otherwise.

### 3.4 Hydrology

There are no surface water features on or in the immediate vicinity of the site. The nearest watercourse to the site as mentioned within the Delta-Simons Report, is the River Colne located approximately 670m to the southeast.

#### 3.4.1 Flooding

Information on the Environment Agency website<sup>(5)</sup> indicates the site is not located within a fluvial flood plain. The nearest is approximately 350m west. The location of the site indicates that a Flood Risk Assessment is therefore not required.

### 3.5 Sensitive Land Uses

It is indicated within the Landmark Report that the site is within a nitrate vulnerable zone for surface water.

### 3.6 Site History Review

A review of the site history has been carried out from the study of Ordnance Survey maps dating from the late 1800's including a review of database and regulatory information contained within the Landmark Report<sup>21</sup>. The review is designed to identify potential historic sources of contamination that may have impacted soil or groundwater quality beneath the site and to identify any potentially contaminative land uses in the area that may have impacted the site.

#### 3.6.1 Historic Maps

Development of the site has been researched from Historical maps dating from 1872 to 1992 provided within the Landmark Report. Selected maps are reproduced as Figures 3 to 7. These are not to scale, although all the evaluations in this report have been made from the scaled plans.

Table 1: Historic Maps

Date	On-site	Surrounding Area
1872 (Fig.3)	The map of 1872 indicates the site and wider area to be part of open farm land	Berry Lane is shown along the northeastern boundary. An excavation (chalk pit) is indicated approx. 230m to the northwest.
1914 (Fig.4)	The site remains unchanged.	A large gravel pit bounding either side of Berry Lane is indicated approx 120m to the southwest. The chalk pit to the northwest has been extended.
1937 (Fig.5)	The site remains unchanged.	Tudor Way with some associated housing is now shown bounding the site to the southeast. Some excavation and infilling of the gravel pit described earlier is now indicated.
1961 (Fig.6)	The map now resembles the present day site layout indicating the public house and associated infra structure.	High density housing is shown beyond all site boundaries. An isolated building (possible house) within a field is now indicated over the chalk pit (230m NW). The gravel pits to the SE are no longer highlighted and are replaced in part by a field and 'Highlands Water Garden'. It should be noted here that these former gravel pits are recorded as a historic landfill as listed within the landmark report <sup>21</sup> .

Date	On-site	Surrounding Area
1992 (Fig.7)	The site remains unchanged.	The gravel pits and landfill to the southeast have been replaced by fields. Several houses have now been added to the former chalk pit area to the NW.

### 3.6.2 Database and Regulatory Information

There were fourteen pollution incidents recorded within the Landmark Report<sup>(31)</sup> between 501m and 1km of the site with the nearest being 699m SE of the site involving oils with details on the catchment area, receiving water and cause of incident not given. The incident was classed as a "Category 3 - Minor incident".

### 3.6.3 Trade Directories

There were three trade directories listed within 250m of the site, nine between 251m and 500m and thirty between 501m and 1km. The nearest trade directory (47m E) was listed for 'Absolute Pest Control' (pest and vermin control) at 120 Tudor Way, Rickmansworth.

## 3.7 Site Walkover

The results of a site walkover undertaken during the investigation on 25/03/08 are presented as a checklist within in Appendix D.

### 3.7.1 Summary of Historic Potentially Contaminative Land Uses

The review of the site history did not indicate any significant potentially contaminative uses other than the site being used as a public house and the potential contaminative sources mentioned previously within the Delta Simons Desk Study comprising:

- Fuels and chemicals associated with the public house;
  - Potential contaminants and land gas within potential made ground; and
  - Asbestos containing materials associated with the fabric of the building.
- NB: An asbestos survey was outside the scope of the present investigation.

There is also the potential for the migration of land gas from offsite uses comprising the infilled gravel pits to the SE and the chalk pit (including migration of contaminants) approx. 230m to the northwest as mentioned within the Delta-Simons Report. However, the risk of migration is considered low given the distances and the resultant potential for dispersion and attenuation between the source and this site.

The public house has suffered from recent fire damage. Associated with this, is a potential for contaminants associated with fire water and the release of asbestos fibres from asbestos containing materials within the fabric of the building.

### 3.8 Sensitive Receptors

Potential receptors are considered to be:

- Future residents;
- Construction/Maintenance workers;
- Subsurface plastic water pipes;
- Major Aquifer;
- SPZ (Zone II Outer and Zone III Total Catchment);
- Groundwater abstractions (>1km from site); and
- River Colne approx. 670m to the southeast.;

### 3.9 Summary of Plausible Pathways

Potential pathways include:

- Inhalation of vapours on-site;
- Dermal contact and ingestion of potentially contaminated soil on-site;
- Groundwater migration from offsite and onsite sources;
- Leaching;
- Root uptake/phytotoxicity; and
- Permeation of plastic pipes.

### 3.10 Data Gaps and Uncertainties

A significant source of uncertainty in this assessment are the data gaps in the site historical maps. It is unknown what may have been built on-site or nearby off-site during intervening periods of time. An additional area of uncertainty is the nature of the filling of the gravel and chalk pits beyond the site. Both the waste types and the exact geographical/physical extent of the landfill are unknown.

### 3.11 Outline Conceptual Model

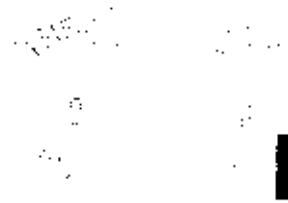
The information presented has been used to compile an Outline Conceptual Model. The identified potential contaminants and receptors have been considered together with possible pathways that may link them. The resulting pollutant linkages are summarised in the Table 2 below. The risk classification for each linkage has been estimated in accordance with information in Appendix E.

Table 2: Preliminary Risk Assessment for Linkages in Outline Conceptual Model

Potential Source	Potential Receptor	Possible Pathway	Likelihood	Severity	Risk
Made ground potentially contaminated with metals, hydrocarbons, PAHs, and asbestos.	Future on-site residents	Ingestion/Dermal Contact	Unlikely	Medium	Moderate - Future residents may come into contact with landscaped areas.
	Construction workers		Highly likely	Medium	High - Construction workers may come into contact with site soil.
	Maintenance workers		Unlikely	Medium	Low - Maintenance workers are unlikely to be in contact with site soils.
	Subsurface plastic water pipes	Permeation	Unlikely	Medium	Moderate - If shallow contamination exists it may impact plastic water supply pipes.
	Groundwater in Major Aquifer on-site & off-site and SPZ's II and III	Leaching	Low Likelihood	Medium	Low - Leaching is likely through soft landscaping areas although these areas are relatively small.
	Soft Landscaping on-site	Phytotoxicity/root uptake	Low Likelihood	Minor	Low - No evidence of phytotoxicity noted on-site.
Groundwater potentially contaminated with metals, hydrocarbons, and PAHs	Future on-site residents	Ingestion/Dermal Contact	Unlikely	Medium	Low - Future residents and off-site residents are not expected to come into contact with site groundwater.
	Off-site residents		Unlikely	Medium	
	Construction workers		Low Likelihood	Medium	Moderate/Low - Construction workers may not to come into contact with site groundwater.
	Maintenance workers		Unlikely	Medium	Low - Maintenance workers are unlikely to come into contact with site groundwater.
	Subsurface plastic water pipes	Permeation	Unlikely	Medium	Low - Groundwater depth expected to be below 1.5m bgl.
	Potable groundwater abstractions >1km	Lateral/Vertical Groundwater Migration	Unlikely	Medium	Low - Natural attenuation and degradation would occur over this distance to minimise the risk. Additionally groundwater flow direction expected to be to the north.
	Major Aquifer and Source Protections Zones II and III at the site		Unlikely	Medium	Moderate to High - Vertical migration may occur through Glacial Gravels although degradation of contaminants may occur over distances to major aquifer and SPZ reducing the risk.
River Colne	Unlikely		Medium	Low - The River Colne at 670m southeast is considered too remote to be of concern. At this distance, natural attenuation and dispersion will significantly dilute any on-site contaminants.	
Vapours associated with soil and groundwater (including offsite sources) contaminants and bulk ground gases	Future on-site residents	Migration along backfill around services, more permeable strata and inhalation	Low Likelihood	Medium	Moderate - Due to possible contamination, Made Ground, vapours and bulk gases may exist in sufficient quantities to produce a risk. Off-site residents are adjacent and may be affected.
	Off-site residents		Low Likelihood	Medium	
	Construction/Maintenance workers		Unlikely	Medium	High - If vapours and bulk gases exist on-site construction/maintenance workers in confined spaces may be affected.

The Conceptual Model has identified the following possible significant pollutant linkages:

- Residents and staff from the proposed development via ingestion and dermal contact with soil in the landscaped areas and through inhalation of vapours and gasses;



- Off-site residents via inhalation of vapours and gasses migrating off-site;
- Construction and maintenance workers exposed to the soils during development works. However, these would be mitigated through the adoption of good health & safety procedures and personal protective equipment. As these need to be task specific this receptor has not been carried through the risk assessment; and
- Leaching to the major aquifer and SPZs.

**3.12 Preliminary Risk Assessment Conclusions and Recommendations**

The review of information and the construction of the Outline Conceptual Model have highlighted possible pollutant linkages. In order to investigate any unacceptable risk presented by these an intrusive investigation has been carried out. The intrusive investigation will be able to provide further information on actual contaminants present and viable pathways to sensitive receptors.

**4. ENVIRONMENTAL SITE INVESTIGATION**

RSK carried out intrusive investigation work between 25 and 26 March 2008. Details of the scope of works are given in Section 7.1

**4.1 Sampling Strategy and Methodology**

Soil samples were selected at near surface from probehole locations positioned across the site to access the risks to the human health of site users, plant growth and building infrastructure. Samples were selected from potential contamination sources comprising contaminants associated with any made ground. Additionally, soil samples were selected from various strata to provide information on the risks to groundwater body contamination by the leaching of contaminants and subsequently groundwater was selected directly from the groundwater monitoring well (BH1).

Samples were collected and stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. Soil samples were also gathered by hand digging within areas inaccessible to the competitor drilling rig.

**4.1.1 Investigation Locations**

Table 3: Investigation Locations

Exploratory Location	Location and Rationale	Rationale for Installation
PH1	Positioned to cover the eastern area of the site and within potential made ground.	To provide information of groundwater quality, and ground gas.
PH2	Positioned to cover the northwest corner of the site and within potential made ground.	As in PH1.
PH3	Positioned to cover the northern corner of the site and within potential made ground.	As in PH1.

PH4	Positioned to cover the eastern area of the site and within potential made ground.	As in PH1.
PH5,6 and 7	Positioned to cover the southern area of the site and within potential made ground.	Installation within PH7 only to provide information of groundwater quality, and ground gas.
BH1	Positioned to cover the northeastern part of the site.	To provide information of groundwater quality, groundwater flow and ground gas within the chalk aquifer.
S1 and S2	Positions selected to cover localised topsoil areas within the western part. Shallow soils sampled by hand dug methods.	NA.

The depths of the exploratory holes, descriptions of strata encountered, comments on groundwater conditions, samples obtained and installation details are included on the exploratory hole records in Appendix F.

#### 4.1.2 Gas and Groundwater Monitoring

Return visits were made to site on the 31/03/08, 07/04/08, and 15/04/08 to monitor the borehole installations.

Concentrations of methane, carbon dioxide and oxygen were recorded using an Infra Red Gas Analyser. Atmospheric pressure, flow and groundwater were also recorded. The results of the gas monitoring are given in Tables 1a to 3a.

#### 4.1.3 Groundwater Sampling

A single groundwater sample was taken from BH1 using a disposable bailer. Prior to sampling, purging was undertaken involving the removal of three well volumes of groundwater by bailing.

The groundwater sample was collected in a variety of containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box.

### 4.2 Ground Conditions

The results of the onsite observations are detailed below.

#### 4.2.1 Soil Stratigraphy

The ground conditions encountered confirmed the published geological records in that the site is underlain by chalk. This is overlain by a clay stratum considered to be associated with the TPGR that is locally present. Made Ground and topsoil were found to locally overlie these natural deposits.

The ground conditions encountered are summarised as follows:

#### *Topsoil*

Topsoil of generally organic sandy/clayey silt composition was encountered during shallow soil sampling (hand dug methods) within the garden patio area to the rear of the public house. Sample locations (designated S1 and S2) are shown on Figure 2.

#### *Made Ground*

The made ground ranged in thickness between 0.3m and 1.0m and was variable in composition and comprised concrete/tarmac from hardstanding overlying sandy silty clay/gravel with a variable proportion of flint, brick and concrete fragments.

#### *Taplow Gravel Formation (TPGR)*

The unit was encountered within all locations with a proven thickness of 6.20m (BH1). The unit was slightly variable in composition and comprised stiff to very stiff sandy/silty clay with a variable proportion of flint. A very dense orange brown silty sandy gravel layer was encountered within BH1 from 3.50mbgl to 6.5mbgl.

#### *Chalk*

The unit extended to the full depth of the investigation and comprised structureless chalk becoming structured with depth.

#### *Groundwater*

Groundwater was encountered within the chalk from borehole (BH1) during the investigation at 12.95mbgl and during the return monitoring visits ranging between 12.86mbgl and 12.93mbgl. Given the distribution of the shallow clay soils encountered, it is considered that groundwater recorded during the return monitoring visits ranging between 2.61mbgl and 2.91mbgl within some of the well installations, was potentially perched.

#### *Contamination*

Contamination was not identified by visual or olfactory means during the investigation.

### **4.3 Refined Conceptual Model**

From the site investigation, it is considered that with respect to pollutant linkages the distribution of clay bearing soils encountered above the chalk, will potentially limit any soil leaching to groundwater (major aquifer). In addition, the groundwater table encountered within the chalk confirms the presence of the potential receptor and linkage outlined within the CSM.

A potential complete linkage identified in the Outline CSM that will no longer be carried through the Generic Quantitative Risk Assessment (GQRA) is:

- On-site migration of land gases and groundwater contamination from the infilled gravel pits and landfill to the SE and chalk pit to the NW.

#### 4.4 Analytical Strategy and Methodology

Soil samples were selected from the topsoil, made ground and natural soil strata to assess potential contaminants and their risks to site end-users, plant growth (phytotoxicity) and infrastructure (water pipes). Determinands comprised organics and inorganics including an asbestos screen of made ground. Metal leachates were also scheduled on soil samples to assess risks to controlled waters.

In addition a single groundwater sample was submitted for organics/inorganics to assess any direct impact from potential downward migration of potential leachate contaminants.

pH and water soluble sulphate were also selected on soil samples for assessment on attack on buried concrete with respect to foundation design. The results of the laboratory analyses are given in Appendix G.

Table 4: Analytical Results

Exploratory Hole No and depth (soil)	Primary Analyte(s)	Rationale
PH1 at 0.40m (made ground)	Organics/inorganics, metal leachates and asbestos.	Scheduled for the potential analytes within made ground used during development. Metal leachates scheduled for assessment of potential leaching of contaminants to aquifer beneath the site.
PH1 at 1.10m (natural soil)	Organics/inorganics.	Scheduled for background information and assessment from any leaching of metals within above made ground.
PH2 at 0.45m (natural soil)	Organics/inorganics.	As in PH1 at 1.10m.
PH3 at 0.40m (natural soil)	Organics/inorganics.	As in PH1 at 1.10m.
PH4 at 0.50m (natural soil)	Organics/inorganics.	As in PH1 at 1.10m.
PH5 at 0.40m (natural soil)	Organics/inorganics.	As in PH1 at 1.10m.
PH6 at 0.35m (natural soil)	Organics/inorganics.	As in PH1 at 1.10m.
PH7 at 0.20m (made ground)	Organics/inorganics, metal leachates and asbestos.	As in PH1 at 0.40m.

PH7 at 0.50m (natural soil)	Organics/inorganics	As in PH1 at 1.10m
S.1.	Organics/inorganics, metal leachates and asbestos	As in PH1 at 0.40m
S.2	Organics/inorganics, and metal leachates	As in PH1 at 0.40m
Exploratory Hole No and depth (water).	Primary Analyte(s)	Rationale
BH1	Organics/inorganics	Scheduled for assessment of impact to groundwater from migration of any potential analytes within the made ground.
Notes: pH and water soluble sulphate selected on soils from PH3 and BH1 for assessment on chemical attack on buried concrete with respect to foundation design. Total organic content selected on soils PH1, S.1. and S.2 for assessment of potential risks with respect to organics.		

## 5. GENERIC QUANTITATIVE RISK ASSESSMENT

In line with CLR11<sup>(1)</sup>, there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater and ground gas results with generic assessment criteria (GAC) that is appropriate to the linkage being assessed. The GAC used in this assessment are included in Appendix H for human health (together with details of their derivation) and in Appendix I for the assessment of phytotoxic effects, risks to plastic utilities and to controlled waters.

The site investigation work and subsequent refinement of the conceptual model indicates that there are relevant pollutant linkages at the site, which require further consideration.

### 5.1 Relevant Linkages for Assessment

The linkages for assessment are presented in Table 5 below.

**Table 5: Linkages for Generic Quantitative Risk Assessment**

Relevant Pollutant Linkage	GAC
Direct contact pathways to future residents	Human health GAC for a proposed residential end use without plant uptake since the private gardens since proposed end use includes landscaping areas (Appendix H)
Root uptake	Table A1 Appendix I.
Permeation to subsurface plastic water pipes	GAC for water supply piping (Appendix I)
Leaching and dissolved phase migration to major aquifer	Lowest of those recorded in Table 3 of Appendix I for major aquifers owing to linkages identified to both a major aquifer and a river upon which the GAC for major aquifers are based.

<p>Concentrations of methane and carbon dioxide in ground gas entering and accumulating in:</p> <ul style="list-style-type: none"> <li>• Depressions and excavations during any site works and development that could affect site workers; and</li> <li>• Enclosed spaces or small rooms in new buildings, which could affect future residents.</li> </ul> <p>In the case of methane, this could create a potentially explosive atmosphere, whilst death by asphyxiation could result from carbon dioxide.</p>	<p>Gas screening values (GSV) have been calculated using maximum methane and carbon dioxide concentrations with maximum flow rates recorded at the site. The GSV have been compared with the generic Traffic Lights, as presented within the NHBC ground gases guide<sup>7)</sup> and the aforementioned CIRIA Report 665 owing to the development comprising low-rise housing with suspended floors.</p>
--	---

## 5.2 Methodology and Results

In line with current UK guidance (CLR7<sup>(6)</sup> and 11<sup>(11)</sup>), soil data where appropriate have been statistically analysed to enable the identification of contaminant hotspots and to calculate the 95<sup>th</sup> percentile of the data. Where statistics are not appropriate (e.g. small data set), the laboratory analytical data have been compared directly with the GAC. The methodology and results of the generic quantitative risk assessment are presented for each relevant pollutant linkage in turn.

### 5.2.1 Direct Contact and Indoor Air Vapour Inhalation by Future Residents (soil)

The 95th percentile have been compared with the GAC presented in Appendix G for this linkage. The results of the statistical tests are presented in Appendix J. The results indicate that the upper 95 percentile for each determinand is below the GAC including the small data set for organic compounds comprising benzene, toluene, ethylbenzene and xylene (BTEX) when compared directly to the GAC. Therefore overall it is considered that there is no potential unacceptable risk to the health from site end users from this pathway.

### 5.2.2 Vapour Inhalation from Indoor Air by Future Residents (water)

Given the single data set for the analyses on the groundwater (BH1), the results have been assessed directly against the GAC (presented in Appendix I). The analysis indicates that contaminants have not exceeded the respective GAC's and therefore again, it is considered that there is no potential unacceptable risk to the human health of site end users from this pathway. Further assessment on ground gas is also highlighted within Section 5.2.7 of this report in respect to information gathered from ground gas monitoring visits.

### 5.2.3 Uptake of Contaminants by Vegetation Potentially Inhibiting Plant Growth

The results of the analyses have been compared with the GAC presented in Appendix I for this linkage and indicate no exceedances. Therefore, in the absence of a contaminant and the potential pathway and risk is no longer considered.

#### **5.2.4 Permeation of Plastic Utilities**

The results of the analyses have been compared with the threshold concentrations of potential contaminants in soils affecting material selection given in WRAS<sup>(12)</sup> an extract of which is included in Appendix I. Apart from a slight exceedance in Arsenic in PH7 at 0.5mbgl (14mg/kg), compared to the threshold value of 10mg/kg given in WRAS, all other determinands were below the threshold values indicated. On this basis, it is unlikely that enhanced protection will be required although it is recommended that the local water authority be consulted to confirm this.

#### **5.2.5 Leaching of Contaminants to Groundwater**

Soil samples were analysed for leachable metals. These concentrations have been compared with the GAC for major aquifers/SPZs included in Appendix I. These were considered the most appropriate GAC owing to the site's location on a major aquifer.

The results of the analysis indicated no contaminants above the respective GAC's therefore it is considered there are potentially no unacceptable risks from the leaching of metal contaminants to controlled waters. The distribution and thickness of clay will also likely retard any downward migration of any contaminants. In addition, the indicative distance to the groundwater table within the chalk(encountered during the investigation and monitoring ranging between 12.85mbgl and 12.95mbgl) will similarly allow for degradation of contaminants.

#### **5.2.6 Migration of Dissolved Phase Contaminants to Major Aquifer/SPZ's**

Owing to the single groundwater sample obtained, the laboratory data have been compared directly with the GAC rather than undertaking statistical analysis. The GAC used to assess this linkage are presented in Appendix I. These were considered the most appropriate GAC owing to the site's location on a major aquifer. The results of the analyses indicated no contaminants exceeding the respective limits. Together with the limited site history development, the ground conditions encountered and the results of the laboratory analysis it is considered that the potential pollutant linkage is not complete and therefore there is unlikely a potential unacceptable risk to pollution of controlled waters from this pathway.

---

#### **5.2.7 Ground Gas**

In order to assess the significance of ground gases at the site, measured concentrations and flow rates have been used to generate Gas Screening Values (GSVs). These have then been compared with the generic Traffic Lights, as presented within the NHBC ground gases guide and the aforementioned CIRIA Report 665<sup>(7)</sup>.

The GSV of 0.006 has been calculated based on the highest carbon dioxide concentration at 0.3 percent and a flow rate of 2.0 litres/hour.

Therefore for low rise housing (two storeys or less), the site has been characterised as a 'Green' classification, i.e. no gas precautions are considered potentially necessary for the developments apart from ensuring that any underfloor void should be well ventilated.

### 5.3 Environmental Assessment Conclusions

The results of the GQRA indicate that relevant pollutant linkages are absent and therefore the site is suitable for the proposed end-use. However following the assessment of the site we would recommend the following measures be implemented:

- Consultation with the Environment Agency and Environmental Health Department of the Local Borough Council to confirm that the conclusions and recommendations of this report are acceptable;
- Should any evidence of unexpected contamination be encountered during the site development, then further advice should be sought;
- Imported backfill/subsoil/topsoil material to be used during any redevelopment should be chemically validated at source to ensure that the material is suitable for use;
- It is considered unlikely that buried water pipes will require enhanced protection. Nevertheless, it is recommended that the local water authority be consulted with respect to the adoption of standard water pipe;
- A Type III Asbestos/Hazardous Building Materials Survey will be required prior to any demolition; and
- Adoption of health and safety measures during re development works on site e.g. provision of cleaning facilities, dust suppression measures, when required.

## 6. WASTE

### 6.1 Waste Classification

All excavated material and excess spoil must be classified for waste disposal purposes prior to disposal at landfill. Under the Landfill (England and Wales) Regulations 2002 (as amended) all wastes must be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous wastes prior to disposal. The Environment Agency guidance document WM2 (interpretation of the definition and classification of hazardous waste) outlines the methodology for classifying wastes.

**CAT-WASTE<sup>SOIL</sup> (CAT)** is a waste soils characterisation assessment tool, developed by Atkins and McArdles, which follows the guidance within WM2. The analytical results

have been run through this assessment tool for potential off-site disposal of materials during site development.

Any excavated made ground to be removed off site are initially indicated as non hazardous when passed through the soil CAT waste programme. The CAT-WASTE<sup>SOI</sup> results are presented in Appendix K. It is probable that excavated natural soils would be accepted at landfills as inert waste

Any waste as such must be disposed of at a suitably licensed landfill or taken to another site that has a valid exemption from the Waste Management Licensing Regulations 1994 (as amended) registered with the Environment Agency/Environmental Permitting (England and Wales) Regulations 20.

It will be the responsibility of the contractor to comply with the duty of care for any off-site shipment of waste

## **7. GEOTECHNICAL SITE ASSESSMENT**

As outlined in Section 1 it is proposed to redevelop the site for a mixed residential/commercial end use. The low rise building complex comprises a convenience store with residential units, vehicular parking/access and landscaping areas. The aim of the geotechnical investigation is to ascertain ground conditions at the site and provide sufficient data regarding the soil parameters to enable the design of foundations, floor slabs and infrastructure.

### **7.1 Intrusive Investigation Undertaken**

#### **7.1.1 Probeholes**

Seven probeholes (designated PH1 to PH7) were sunk by percussive means using drive in-sampling techniques. The shear strengths of the cohesive soils were determined using a Geonor hand vane and the results are given in Table 4a.

Standard penetration (and cone penetration in coarse grained deposits) tests where undertaken, were carried out to assess the relative density, consistency or hardness of the strata. The values of penetration resistance (N values) are given in the probehole records presented in Appendix F.

The California Bearing Ratio (CBR) values were determined at a number of locations limited to soft landscaping at the rear of the public house using a Mexecone penetrometer. These tests were commenced at existing ground level. The results are presented in Table 5a.

### 7.1.2 Borehole

A single borehole (designated BH1) was sunk by light cable percussion techniques. The depth of the borehole, descriptions of the strata encountered and comments on groundwater conditions are given in the borehole record presented in Appendix F.

100mm diameter undisturbed samples were taken in the cohesive soils and representative disturbed samples were taken throughout the full depth of boring. A selection of these samples were returned to the laboratory for examination and testing.

Standard penetration (and cone penetration in coarse grained deposits) tests were carried out to assess the relative density, consistency or hardness of the strata. The values of penetration resistance (N values) are given in the borehole record.

### 7.1.3 Laboratory Analysis

The geotechnical testing has generally been carried out in accordance with the methods given in BS 1377<sup>9</sup>.

The natural moisture contents and liquid and plastic limits of seven samples of the cohesive soils were determined and the particle size distributions of two samples of the granular soils were determined by wet sieve analysis. The results of these physical tests are given in Appendix L.

This assessment of the potential for chemical attack on buried concrete based on current BRE guidance<sup>(10)</sup> was carried out on six soil samples with results given in Appendix G.

## 7.2 Foundation Design

Based on the assessment of the soils encountered in the exploratory holes, it is considered that the proposed building may be supported on conventional strip or trench fill foundations taken down through any made ground and placed within the underlying clay. Such foundations may be designed to an allowable net bearing pressure of 100kN/m<sup>2</sup>. All formations should be inspected and if any pockets of soft or firm clay are found these should be excavated and the foundation locally deepened.

The results of the laboratory tests, given in Appendix L, indicate the clay to be of low volume shrinkage potential. Based upon the results of the moisture content determinations and the corresponding liquid and plastic limit values, it is considered that at the time of the investigation the clay soils were desiccated within PH1 at 1.50m, PH2 at 1.10m, PH3 and PH5 at 1.10m and PH7 at 1.60m.

Whilst for low volume shrinkage soil, a foundation depth of 0.75m is specified by NHBC Standards, Chapter 4.2, Building near Trees<sup>(10)</sup>, it is recommended that foundations be

founded 0.9m below final or existing ground level whichever is lower. Close to existing trees and shrubs or within influencing distance of new planting, the foundation depth would need to be increased to comply with the requirements of NHBC Standards<sup>(10)</sup> although unlikely up to 2.5mbgl depending upon such factors as the proximity and water demand of the tree.

Although cohesive soils were generally encountered above the chalk, where granular horizons are encountered within the footing surface it will be necessary to locally deepen shallow foundations for individual units until the clay is reached. Alternatively, if foundations span both soil types, it will be necessary to provide nominal reinforcement in both the top and bottom of the footings to 2m either side of the interface.

Where the new construction overlaps the footprints of the existing building, it will be necessary to break out any existing foundations where intersected by the excavations for the new, and place these on the underlying undisturbed material. This is likely to result in slightly deeper foundations locally. If the existing building has any basement/cellar, then the required depths of foundations will increase significantly. In this respect, it is recommended that a full building survey is undertaken before the building is demolished to ensure that any basements are identified and the precise extent delineated.

As for all sites underlain by chalk (at 4.0mbgl within BH1), consideration should be given to the possible existence of solution features. Although evidence of such feature was not observed during the investigation, their possible existence cannot be ruled out. Consequently, all excavations should be monitored carefully for any anomalous ground conditions and if encountered, further advice must be sought.

### 7.3 Floors

In view of the thickness of made ground on site, it is recommended that pre-cast suspended ground floor construction be adopted. In view of the slight potential for heave from the clay soils, the floor should be provided with a 150mm void beneath as specified by NHBC Standards Chapter 5.2<sup>(11)</sup>.

### 7.4 Road Construction

The proposed development includes for customer and residential car parking but also hard standing for lorry deliveries to the store.

The exploratory holes have revealed made ground typically comprising sandy/silty gravel with varying proportions of brick/concrete fragments to 0.4m depths although locally (PH1), slightly sandy, slightly gravelly clay was encountered to 1m depths. Beneath the made ground, the natural soils comprise stiff, slightly gravelly clay of low shrinkage potential.

The results of the Mexecon Penetrometer tests, given in Table 5a, indicate California Bearing Ratio (CBR) values typically in the range of 1 percent to 4 percent. Based on

these results and the ground conditions at the anticipated formation level, it is therefore recommended that road pavements be constructed upon the natural clay stratum where a CBR value in the range 2 and 5 percent may be assumed.

In the area of the lorry park, where made ground is up to 1m thick it would be prudent to design the pavement to a CBR of less than 2% and compact the formation with a heavy vibratory roller before construction

Any pockets of soft or loose material at formation level should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation including proof rolling throughout. The formation should not be left exposed for any period of time during inclement weather.

#### **7.5 Chemical Attack on Buried Concrete**

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance<sup>(9)</sup>. The desk study and site walkover indicate that, for the purposes of this assessment of the aggressive chemical environment, the site should be considered as site that has not been subject to previous industrial development and does not contain pyrite. A suite of chemical analyses appropriate to this site classification was carried on soil samples. The results of these analyses are given in Appendix G.

The mean of the highest two water-soluble sulphates content (0.041g/l and 0.021g/l) in soil of has been taken as the characteristic value i.e. mean being 0.031g/l. Based on Table C1 in the BRE guidance, the Design Sulphate Class for the site is DS-1.

From consideration of the characteristic pH value, and groundwater conditions, an Aggressive Chemical Environment for Concrete classification of AC-1 may be assumed.

#### **7.6 Excavations**

Based on the soil and groundwater conditions encountered, excavations for foundations and services should remain relatively stable for the short periods required for construction. However, side support must be provided where man entry is required into any excavations over 1.2m deep.

#### **7.7 Soakaways**

The shallow clay soils are considered unsuitable for the adoption of pit soakaways for the disposal of surface water due to its anticipated low infiltration characteristics. The gravel stratum encountered in the vicinity of BH1 between 3.5m and 6.5m bgl is considered suitable although, because it may only be present small lenses, this should be confirmed by carrying out soakaway tests.

Consideration could be given to the adoption of borehole soakaways taken down into the less weathered, blocky chalk. However, this approach may not be acceptable to the Environment Agency and their advice should be sought if this approach is to be considered.

## 8. REFERENCES

1. Environment Agency. Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 11 (CLR11). September 2004.
2. Environment Agency. Guidance on Requirements for Land Contamination Reports. Version 1, July 2005.
3. Landmark Information Group, Envirocheck Report 24232572\_1\_1.
4. British Geological Survey, Sheet 255, Beaconsfield 2005.
5. [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)
6. Environment Agency. Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 7 (CLR7). September 2004.
7. Wilson, S, et al. (2006) "CIRIA Report C659: Assessing Risks Posed By Hazardous Ground Gases To Buildings", Construction Industry Research and Information Association.
8. BS1377: British Standards Institution, 1990.
9. BRE Special Digest 1, Concrete in aggressive ground, Part 1: Assessing the aggressive chemical environment, BRE, Second Edition 2003.
10. NHBC Standards - Chapter 4.2, Building near Trees, National House Building Council, April 2003 edition (effective July 2003).
11. NHBC Standards - Chapter 5.2, Suspended Ground Floors, National House Building Council, Revised September 1999 (Effective January 2000).
12. WRAS. The selection of Materials for Water Supply Pipes to be Laid in Contaminated Land, Report Ref. 9-04-03, October 2002

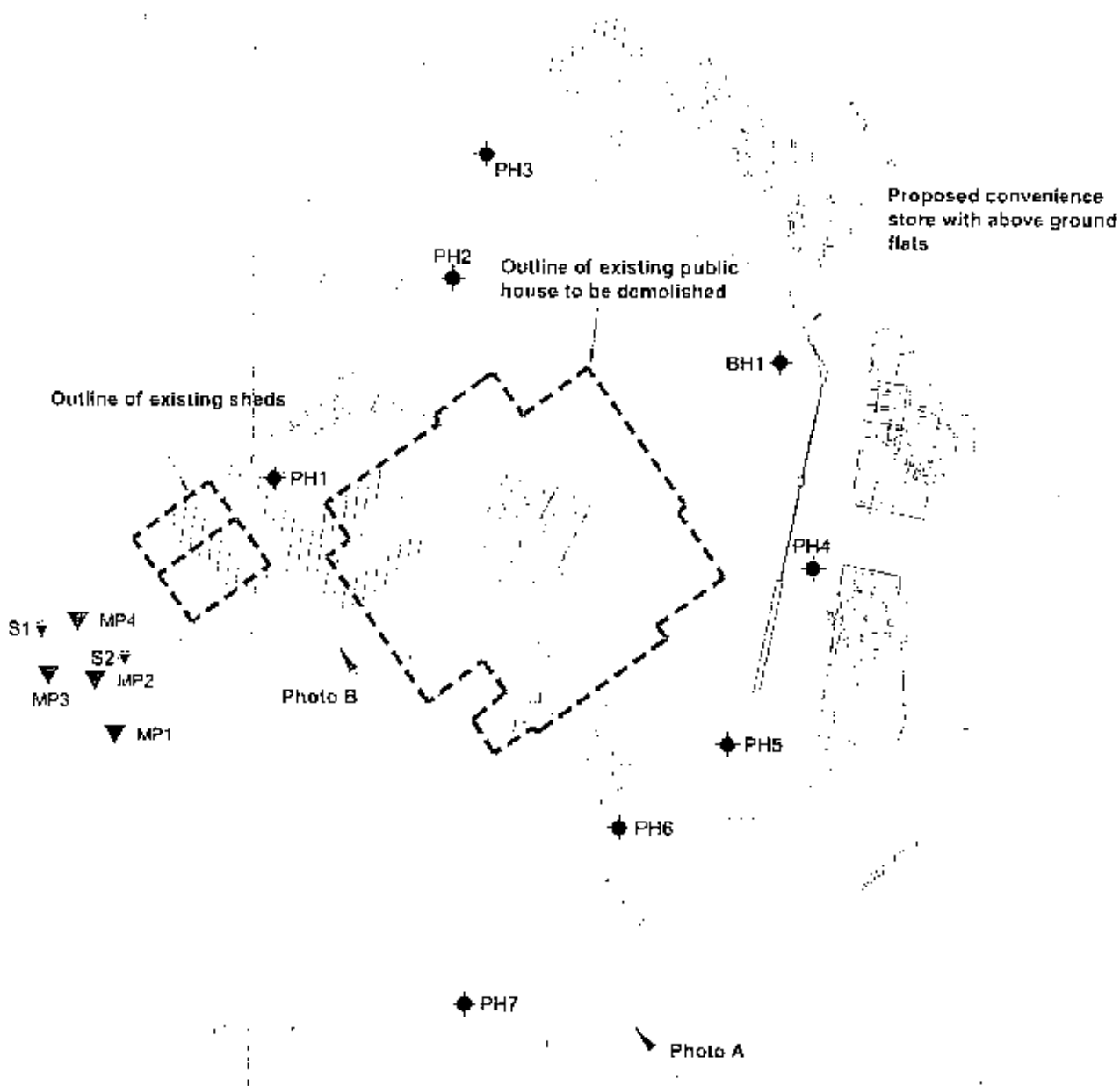
## FIGURES

---



Reproduced from the 2006 Ordnance Survey 1:50,000 Scale Landranger Map 176, OSGR - TQ 045 846  
with the permission of the Controller of Her Majesty's Stationery Office, Crown Copyright. Licence No. AL 52022A  
RSK Geospatial Limited, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 6RT.

**SITE LOCATION MAP**



- LEGEND**
- ◆ Borehole Location
  - Probehole Location
  - ▼ Shallow Soil Sample
  - ▼ Mexecone Penetrometer Location

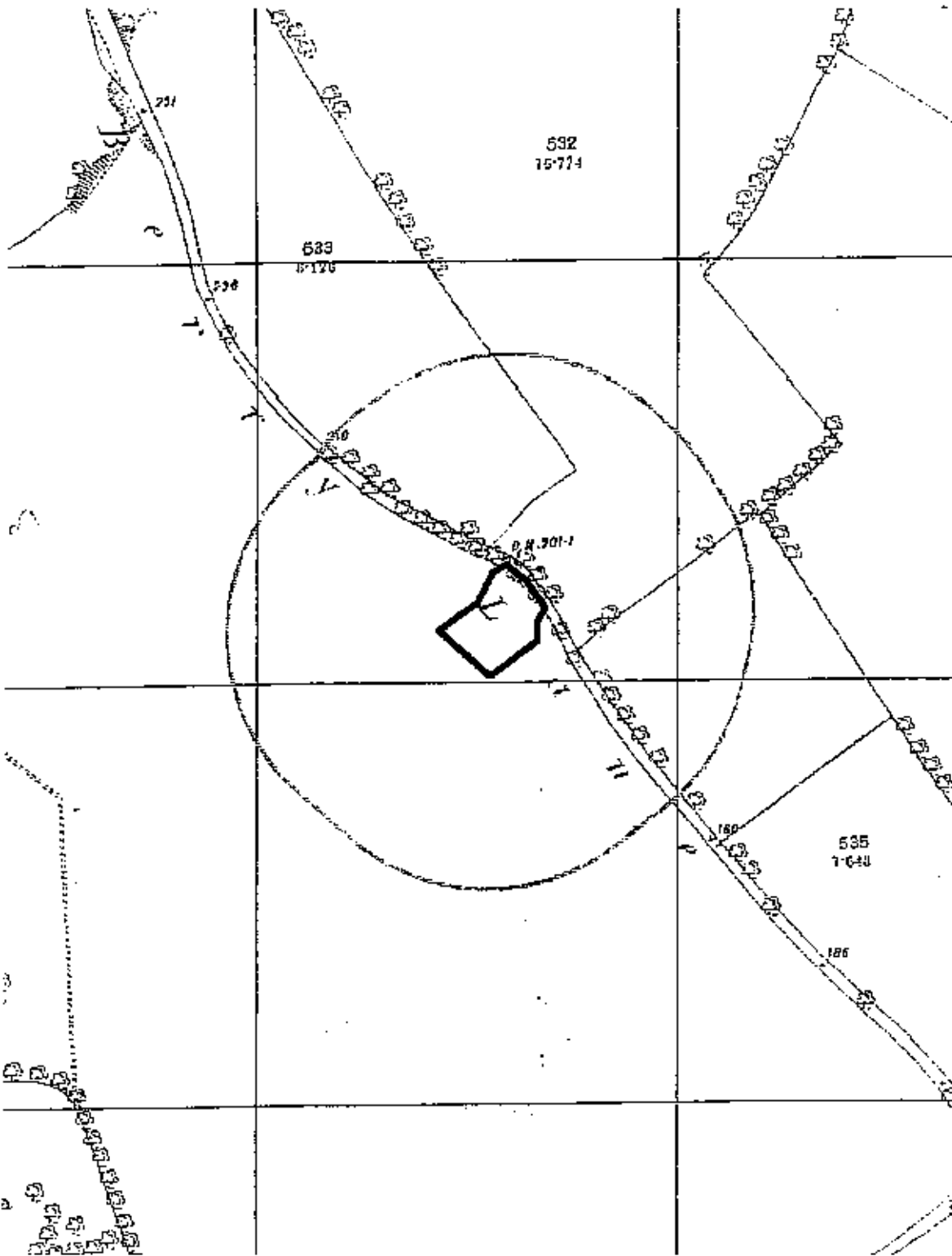


18 Frogmore Road  
Hemel Hempstead  
Hertfordshire  
HP3 9RT  
United Kingdom

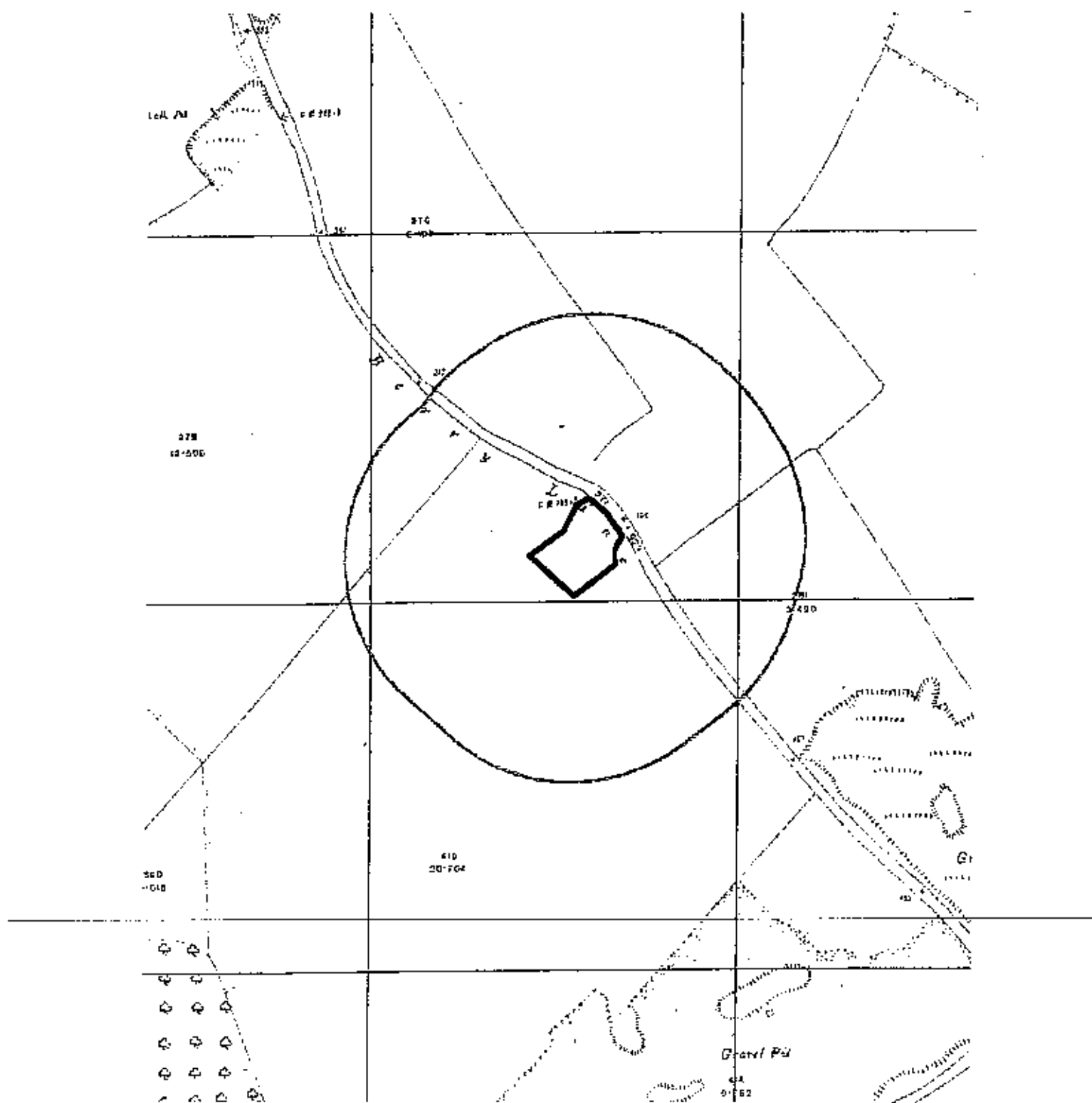
Tel: +44 (0) 1442 437500  
Fax: +44 (0) 1442 437550  
Email: info@rsk.co.uk  
Web: www.rsk.co.uk

Client	STACE PROJECT MANAGEMENT
Project Title	BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE
Drawing Title	PROPOSED SITE LAYOUT

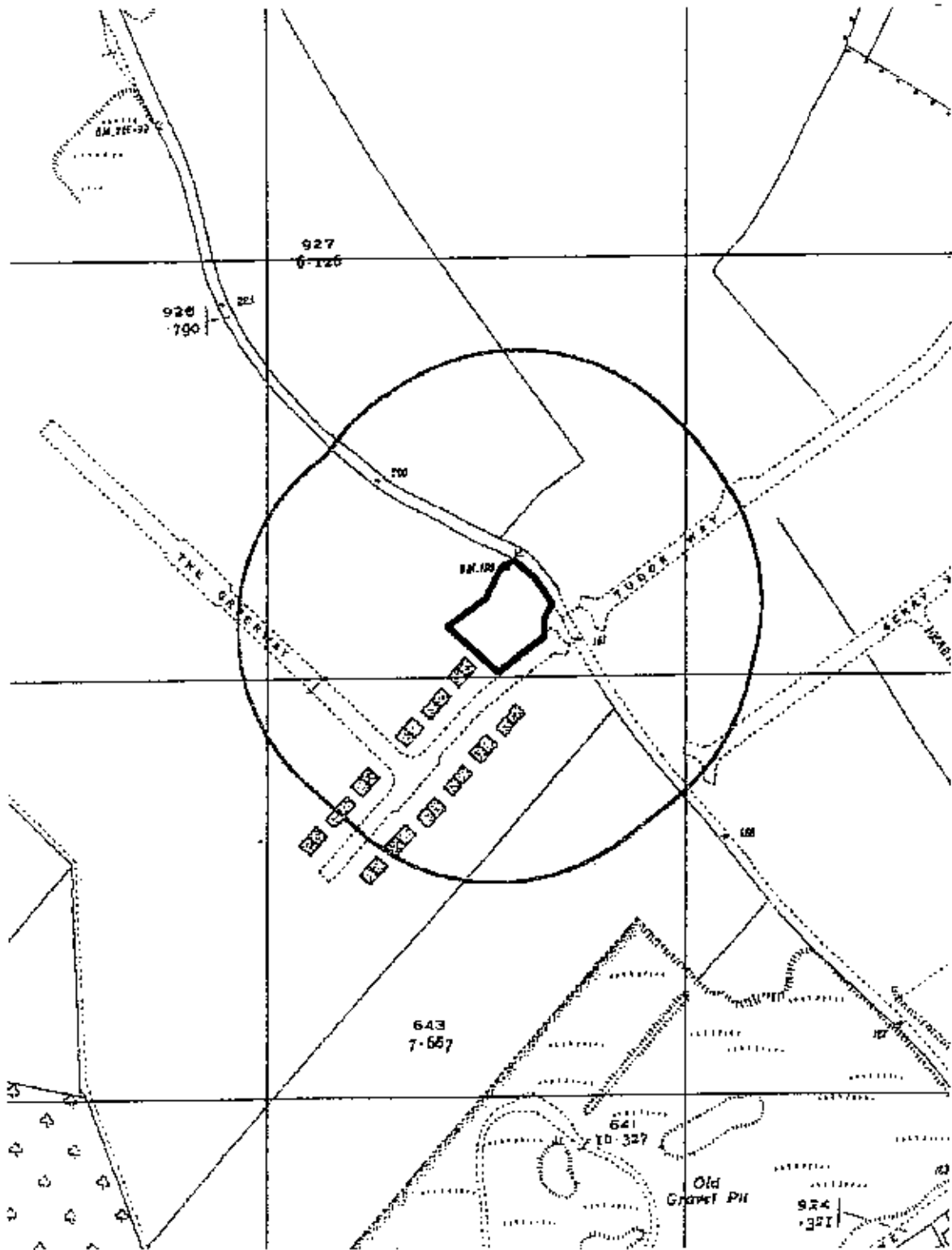
Drawn CPM	Date 01.04.08	Checked KB	Date 01.04.08	Approved KB	Date 01.04.08	Project No. 22852-1 (00)	Drawing File 22852 (R01-00).dwg
Scale NTS	Orig Size A4	Dimensions M	Drawing No FIGURE 2		Rev. P1		



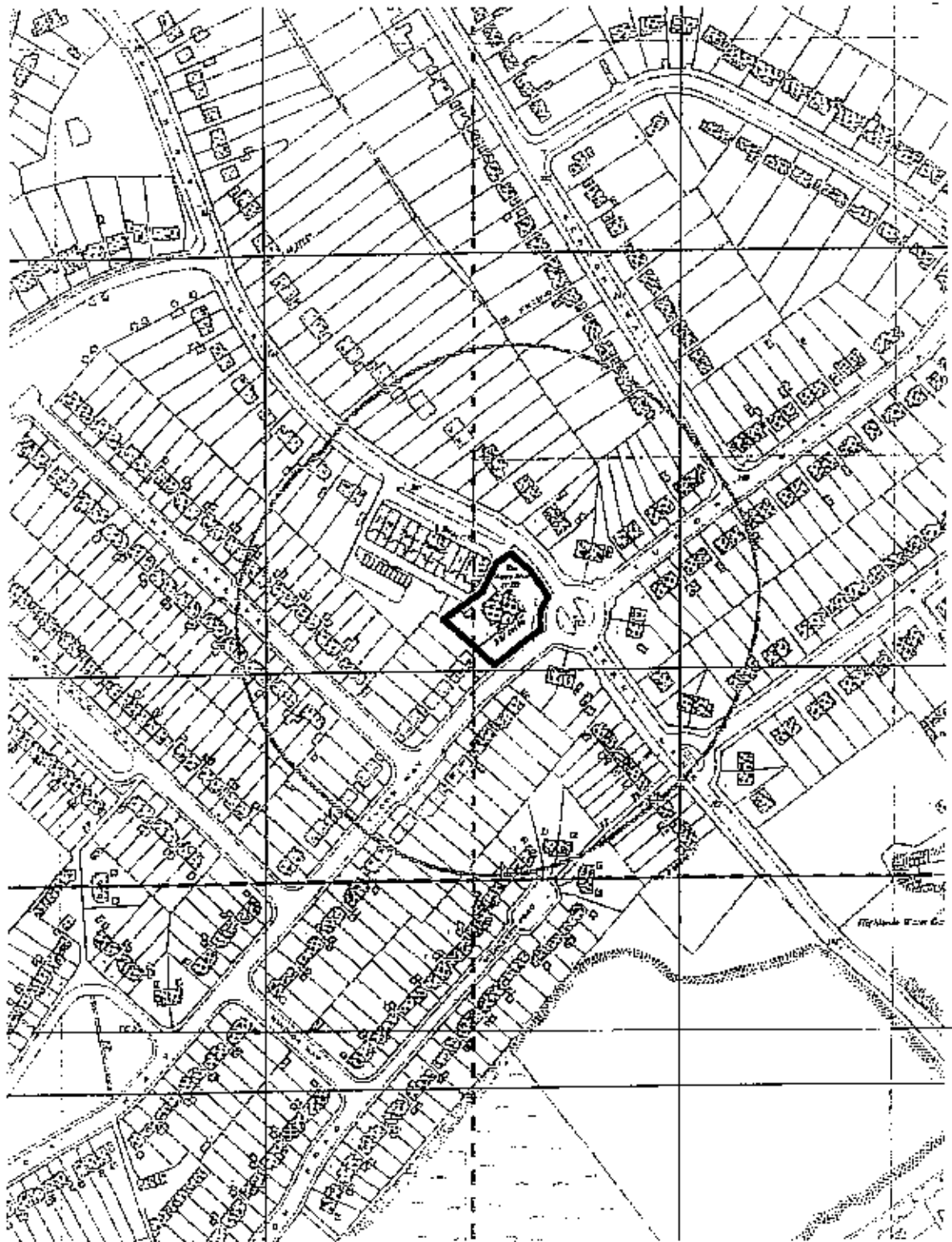
HISTORICAL MAP EXTRACT - 1872



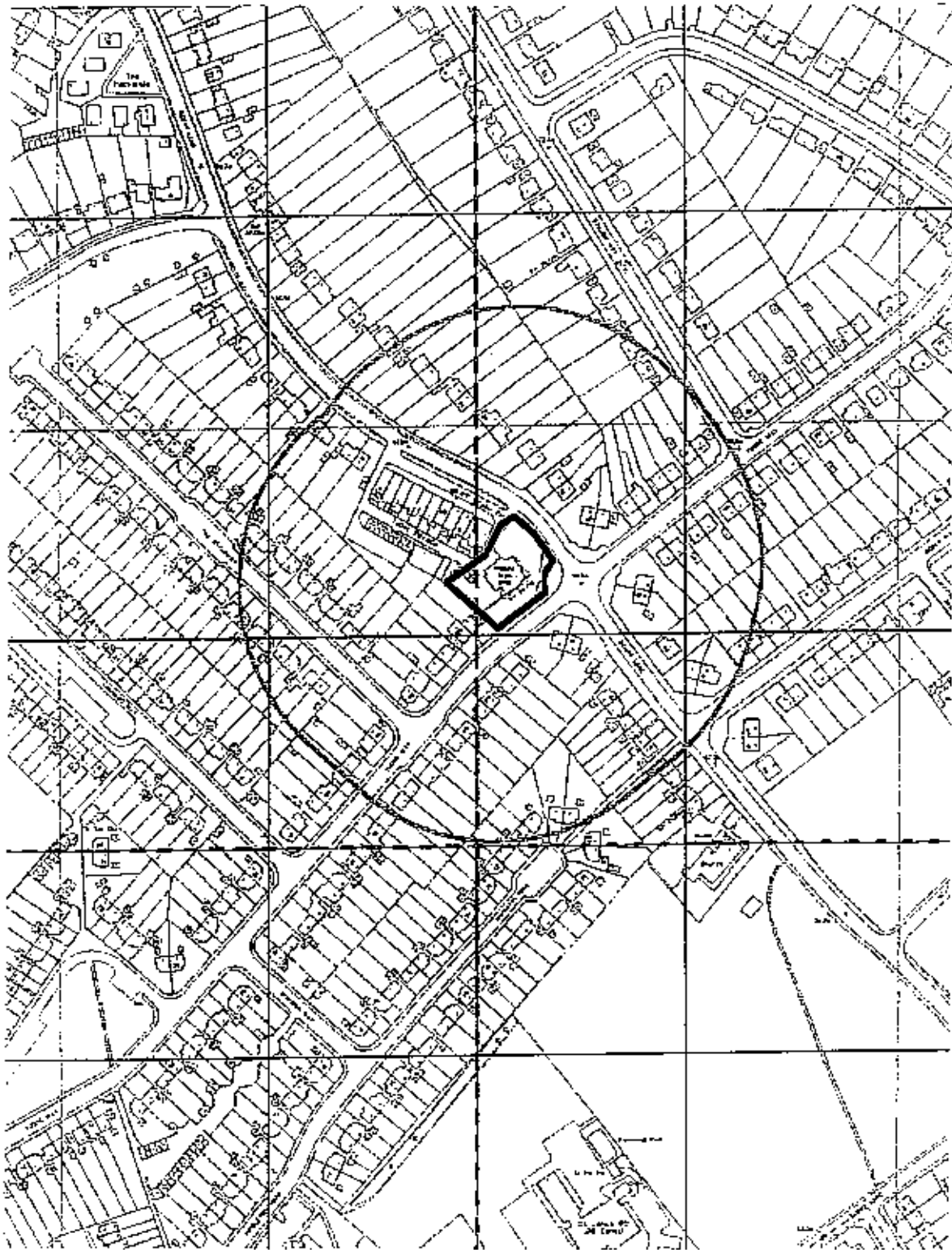
HISTORICAL MAP EXTRACT - 1914



HISTORICAL MAP EXTRACT - 1937



HISTORICAL MAP EXTRACT - 1961



HISTORICAL MAP EXTRACT - 1992



Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH1	30	<0.1	0.1	20.6	1007	0	14:35	0	Dry
	60	<0.1	0.1	20.5					
	90	<0.1	0.1	20.6					
	120	<0.1	0.2	20.6					
	150	<0.1	0.2	20.6					
	180	<0.1	0.2	20.6					
PH2	30	<0.1	0.1	20.6	1009	0	14:30	0	Dry
	60	<0.1	0.2	20.4					
	90	<0.1	0.2	20.4					
	120	<0.1	0.2	20.4					
	150	<0.1	0.2	20.4					
	180	<0.1	0.2	20.4					
PH3	30	<0.1	<0.1	20.8	1009	0	14:27	0	Dry
	60	<0.1	<0.1	20.8					
	90	<0.1	<0.1	20.8					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.8					
	180	<0.1	<0.1	20.8					
PH4	30	<0.1	<0.1	20.8	1008	0	14:20	0	Dry
	60	<0.1	<0.1	20.8					
	90	<0.1	<0.1	20.8					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.8					
	180	<0.1	<0.1	20.8					

Table 1a: Results of Gas and Groundwater Monitoring (31/03/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH7	30	<0.1	<0.1	20.7	1008	0	14:50	0	2.63
	60	<0.1	<0.1	20.7					
	90	<0.1	<0.1	20.6					
	120	<0.1	<0.1	20.6					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					
BH1	30	<0.1	<0.1	20.8	1008	0	14:24	0	12.86
	60	<0.1	<0.1	20.8					
	90	<0.1	<0.1	20.8					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.8					
	180	<0.1	<0.1	20.8					

Table 1a cont'd: Results of Gas and Groundwater Monitoring (31/03/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH1	30	<0.1	<0.1	20.6	996	0.0	11:05	0	Dry
	60	<0.1	<0.1	20.6					
	90	<0.1	<0.1	20.6					
	120	<0.1	<0.1	20.6					
	150	<0.1	<0.1	20.6					
	180	<0.1	<0.1	20.6					
PH2	30	<0.1	<0.1	20.6	996	0.0	10:55	0	Dry
	60	<0.1	<0.1	20.6					
	90	<0.1	<0.1	20.6					
	120	<0.1	<0.1	20.6					
	150	<0.1	<0.1	20.6					
	180	<0.1	<0.1	20.6					
PH3	30	<0.1	<0.1	20.7	996	0.0	10:50	0	Dry
	60	<0.1	<0.1	20.7					
	90	<0.1	<0.1	20.7					
	120	<0.1	<0.1	20.7					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					
PH4	30	<0.1	<0.1	20.7	996	0.0	10:40	0	Dry
	60	<0.1	<0.1	20.7					
	90	<0.1	<0.1	20.7					
	120	<0.1	<0.1	20.7					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					

Table 2a: Results of Gas and Groundwater Monitoring (07/04/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (m bgl)
PH7	30	<0.1	<0.1	20.6	996	0	10:35	0	2.61
	60	<0.1	<0.1	20.6					
	90	<0.1	<0.1	20.7					
	120	<0.1	<0.1	20.7					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					
BH1	30	<0.1	<0.1	18.2	996	(peak 0.3)	10:45	0	12.85
	60	<0.1	<0.1	18.1					
	90	<0.1	<0.1	18.1					
	120	<0.1	<0.1	18.1					
	150	<0.1	<0.1	18.0					
	180	<0.1	<0.1	18.0					

Table 2a cont'd: Results of Gas and Groundwater Monitoring (07/04/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH1	30	<0.1	<0.1	20.6	1014	0.1	14:11	0	Dry
	60	<0.1	<0.1	20.7					
	90	<0.1	<0.1	20.7					
	120	<0.1	<0.1	20.7					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					
PH2	30	<0.1	<0.1	20.9	1014	0.0	14:33	0	Dry
	60	<0.1	<0.1	20.8					
	90	<0.1	<0.1	20.9					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.8					
	180	<0.1	<0.1	20.8					
PH3	30	<0.1	<0.1	20.8	1014	0.0	13:51	0	2.91
	60	<0.1	<0.1	20.9					
	90	<0.1	<0.1	20.8					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.9					
	180	<0.1	<0.1	20.9					
PH4	30	<0.1	0.3	20.3	1013	0.0	13:31	0	Dry
	60	<0.1	<0.1	20.9					
	90	<0.1	0.1	20.7					
	120	<0.1	<0.1	21.0					
	150	<0.1	<0.1	21.0					
	180	<0.1	<0.1	21.0					

Table 3a: Results of Gas and Groundwater Monitoring (15/04/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH7	30	<0.1	<0.1	20.8	1013	0	13:22	0	Dry
	60	<0.1	0.1	20.7					
	90	<0.1	0.1	20.6					
	120	<0.1	0.1	20.6					
	150	<0.1	0.1	20.6					
	180	<0.1	0.1	20.5					
BH1	30	<0.1	<0.1	20.2	1014	0	13:39	0	12.93
	60	<0.1	<0.1	20.1					
	90	<0.1	<0.1	20.1					
	120	<0.1	<0.1	20.1					
	150	<0.1	<0.1	20.1					
	180	<0.1	<0.1	20.1					

Table 3a cont'd: Results of Gas and Groundwater Monitoring (15/04/08)

Location	Test Depth (m)	Shear Strength (kN/m <sup>2</sup> )
PH1	1.1	155
	1.6	160
	2.0	160
PH2	0.7	140
	1.2	145
	1.8	145
	2.4	130
	2.8	120
PH3	0.7	125
	1.2	130
	1.7	120
PH4	0.7	110
	1.2	140
	1.8	130
PH5	0.8	110
	1.5	120
	1.8	120
	2.5	150
PH6	1.0	120
	2.0	130
PH7	1.0	125
	2.0	130
	3.0	130

Table 4a: Results of In Situ Shear Strength Tests

Location	Depth at Start of Test (m)	CBR Value for 75mm Increments (%)							
		75	150	225	300	375	450	525	600
MP1	GL	1	1	1.5	1.5	4	5	>12	
MP2	GL	1	1	1	4	2	>12		
MP3	GL	1	2	2	4	>12			
MP4	GL	1	2	2.5	2	2	2.5	2	2

Table 5a: Results of Mexecone Penetrometer CBR Tests

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH1	30	<0.1	<0.1	20.8	1014	0.1	14:11	0	Dry
	60	<0.1	<0.1	20.7					
	90	<0.1	<0.1	20.7					
	120	<0.1	<0.1	20.7					
	150	<0.1	<0.1	20.7					
	180	<0.1	<0.1	20.7					
PH2	30	<0.1	<0.1	20.9	1014	0.0	14:33	0	Dry
	60	<0.1	<0.1	20.8					
	90	<0.1	<0.1	20.9					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.8					
	180	<0.1	<0.1	20.8					
PH3	30	<0.1	<0.1	20.8	1014	0.0	13:51	0	2.91
	60	<0.1	<0.1	20.9					
	90	<0.1	<0.1	20.8					
	120	<0.1	<0.1	20.8					
	150	<0.1	<0.1	20.9					
	180	<0.1	<0.1	20.9					
PH4	30	<0.1	0.3	20.3	1013	0.0	13:31	0	Dry
	60	<0.1	<0.1	20.9					
	90	<0.1	0.1	20.7					
	120	<0.1	<0.1	21.0					
	150	<0.1	<0.1	21.0					
	180	<0.1	<0.1	21.0					

Table 3a: Results of Gas and Groundwater Monitoring (15/04/08)

Probe Hole	Elapsed Time (sec)	Methane (% v/v)	Carbon Dioxide (% v/v)	Oxygen (% v/v)	Atmospheric Pressure (mb)	Steady Gas Flow (l/hr)	Time (24hrs)	LEL	Depth to Water (mbgl)
PH7	30	<0.1	<0.1	20.8	1013	0	13:22	0	Dry
	60	<0.1	0.1	20.7					
	90	<0.1	0.1	20.6					
	120	<0.1	0.1	20.6					
	150	<0.1	0.1	20.6					
	180	<0.1	0.1	20.5					
BH1	30	<0.1	<0.1	20.2	1014	0	13:39	0	12.93
	60	<0.1	<0.1	20.1					
	90	<0.1	<0.1	20.1					
	120	<0.1	<0.1	20.1					
	150	<0.1	<0.1	20.1					
	180	<0.1	<0.1	20.1					

Table 3a cont'd: Results of Gas and Groundwater Monitoring (15/04/08)

Location	Test Depth (m)	Shear Strength (kN/m <sup>2</sup> )
PH1	1.1	155
	1.6	160
	2.0	160
PH2	0.7	140
	1.2	145
	1.8	145
	2.4	130
	2.8	120
PH3	0.7	125
	1.2	130
	1.7	120
PH4	0.7	110
	1.2	140
	1.8	130
PH5	0.8	110
	1.5	120
	1.8	120
	2.5	150
PH6	1.0	120
	2.0	130
PH7	1.0	125
	2.0	130
	3.0	130

**Table 4a: Results of In Situ Shear Strength Tests**

Location	Depth at Start of Test (m)	CBR Value for 75mm Increments (%)							
		75	150	225	300	375	450	525	600
MP1	GL	1	1	1.5	1.5	4	5	>12	
MP2	GL	1	1	1	4	2	>12		
MP3	GL	1	2	2	4	>12			
MP4	GL	1	2	2.5	2	2	2.5	2	2

**Table 5a: Results of Mexecone Penetrometer CBR Tests**

## **APPENDIX A**

### **Summary of Legislation and Policy Relating to Contaminated Land**

### Summary of legislation and policy relating to contaminated land

Part IIA of the Environmental Protection Act (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, are the basis for the current regulatory framework and form the statutory regime for the identification and remediation of contaminated land.

Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters, defined by the Water Resources Act, are considered all groundwater, inland waters and estuaries.

The intention of the EPA 1990 Part IIA is to deal with contaminated land issues that are considered to cause significant harm, on land that is not undergoing development, (see circular 2-2000 for definitions of what is significant harm, website link - <http://www.defra.gov.uk/environment/land/contaminated/circ2-2000/index.htm>).

The Water Framework Directive 2000/60/EC (WFD) legislation aims to deliver long-term protection of the water environment and to improve the quality of all water bodies, including rivers, wetlands, coasts, estuaries, lakes, man-made structures and groundwater.

The Water Resources Act 1991 introduces an offence to cause or knowingly permit pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so. The Groundwater Regulations, 1998, aim to complement EPA 1990. These regulations give the Environment Agency the power to *prevent* the discharge of List I substances and *restrict* the discharge of List II substances to groundwater.

Contaminated land is often dealt with through planning because of land redevelopment. This approach is documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. The overall aim of the planning and pollution control policy is to promote the sustainable and beneficial use of land (in particular, encouraging reuse of previously developed land in preference to greenfield sites). Within this aim, polluting activities that are necessary for society and the economy should be so sited and planned, and subject to such planning conditions, that their adverse effects are minimised and contained to within acceptable limits.

**APPENDIX B**  
**Service Constraints**

## RSK GEOCONSULT LIMITED

### SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Geoconsult Limited (RSK) for Tesco Stores Ltd (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence or of the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK, save as otherwise provided in the terms of the contract between the client and RSK.
5. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters (as stipulated in the contract between the client and RSK) (based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

## **APPENDIX C**

### **Extracts of Delta-Simons Desk Study Report**



delta-simons  
environmental consultants

**GEO-ENVIRONMENTAL DESKTOP REVIEW REPORT**  
**THE HAPPY MAN PUBLIC HOUSE, BERRY LANE, RICKMANSWORTH,**  
**HERTFORDSHIRE, WD3 7HR**  
**DELTA-SIMONS PROJECT NUMBER: 08-3042.01**

<b>Current Site Status</b>	<p>The Site is located in the centre of Rickmansworth approximately 700 m to the east of the M25. The approximate National Grid Reference is 504510, 194630. It is understood that the Site is currently occupied by a recently burnt out building that was formerly used as a public house. From an aerial view of the Site, the main building is located in the centre and the majority of the surrounding area appears to be of hardstanding associated with car parking. In addition, there appears to be some limited landscaping along the northern and western boundaries of the Site.</p> <p>From the latest map edition, as provided in the Envirocheck report, the adjacent roads consist of Berry Lane to the east and Tudor Way to the south of the Site. The immediate surrounding area to the north, west and beyond the adjacent roads appear to be residential properties.</p>
<b>Development Proposal</b>	No development plan has been provided to Delta-Simons, however, It is understood that the Site is proposed to be acquired for redevelopment into a mixed residential and commercial end use.
<b>Development Type</b>	It is understood that the Site will be redeveloped by Tesco Stores Ltd.
<b>Geology</b>	Given the development at the Site, there will be some Made Ground present beneath the Site. From the British Geological Survey (BGS) map for the area (Sheet 255 for Beaconsfield), it appears that no superficial deposits are located beneath the Site and the solid geology comprises the Seaford and Newhaven Chalk Formations. It is noted, however, that the Taplow Gravels on the map are located adjacent to the south-east of the Site and, therefore, could be located in this area of the Site.
<b>Coal</b>	The Site is not located in an area where a Coal Authority Report is recommended.
<b>Radon</b>	From the Envirocheck report it is understood that less than 1% of homes are above the action level for radon and no radon protection measures are considered to be necessary in the construction of new dwellings.
<b>Hydrogeology</b>	The Site is classified as being located on a Major Aquifer associated with the Chalk. The soil leaching potential for the Site has not been classified due to being in an urban area and based on fewer observations than elsewhere; therefore, soils at the Site should be classified as high until proven otherwise. The Site is classified as being located in a Zone III (Total Catchment) Source Protection Zone associated with the Major Aquifer.
<b>Hydrology</b>	The nearest surface water feature to the Site is the River Colne located approximately 670 m to the south-east of the Site. The Site is not located in an area classified by the EA as being at risk from flooding.
<b>Topography</b>	No information on the topography of the Site has been provided to Delta-Simons, however, it is considered likely that topography of the Site will not vary significantly.
<b>Environmental Sensitivity</b>	The Site is located within a predominantly residential area, Site is directly underlain by Chalk which is classified as a Major Aquifer and the nearest water course is located approximately 670 m to the south-east of the Site. On this basis, the environmental sensitivity of the Site is considered to be medium to high.
<b>Key Historical Uses: Site</b>	The Site is undeveloped until the map edition of 1961, when the Site is in a similar layout as the current layout, with the building which is labelled as the Happy Man Public House.
<b>Surrounding Area</b>	There have been limited potentially contaminative historical features identified within the near surrounding area which comprise of several gravel pits located approximately 140 m to the south-east of the Site, from circa 1872, and expanded to approximately 80 m to the south of

	<p>the Site, from circa 1937, and are no longer present by 1979. Also, an old chalk pit is located approximately 140 m to the north-west of the Site, between circa 1898 and 1937. These may have been subsequently infilled.</p> <p>It is noted that there are some tanks located approximately 250 m to the south-east of the Site, between circa 1961 and 1992, however, these appear to be associated with a water gardens and are, therefore, not considered to be a potential off-Site source of contamination.</p>
<b>Regulatory Review</b>	An Envirocheck report has been obtained and reviewed and no key issues have been identified at the Site. Only one key potential off-Site source of contamination has been identified which is a historical landfill located approximately 130 m to the south-east of the Site. There are three contemporary trade directory entries within 250 m of the Site which include a pest and vermin control, hardware and domestic appliance services. Whilst any fuels and chemicals associated with these could represent potential off-Site sources of contamination, given their uses the risks are considered to be low.
<b>Summary of Contamination Issues</b>	No significant potential sources of contamination have been identified from the use of the Site, given that it has only been occupied by a building used as a public house since circa 1961. However, Delta-Simons cannot completely discount the potential for localised contamination from any fuels and chemicals that have been associated with the public house. In addition, the fire may have been caused or aided by accelerants and there would have been fire water, which could have caused ground contamination and the movement of asbestos fibres, should the building have contained any Asbestos Containing Materials (ACM's). There is the possibility for hazardous ground gases to be present at the Site associated with any Made Ground beneath the Site. Furthermore, there remains the potential for contamination and ground gases to migrate onto the Site from off-Site sources through the Major Aquifer, primarily from the infilled gravel and chalk pits and landfill to the south-east and north-west of the Site, however, it is considered that the risk of this is low.
<b>Environmental Risk</b>	From the available information and given the Site's history, including the fire, the Site is considered to present a low to medium environmental risk.
<b>Summary of Ground Condition Issues</b>	<p>The ground conditions at the location of the Site are likely to comprise a thin layer of Made Ground composed of mixed sand, clay, silt and gravel soil matrix with man-made items. If there are underground structures then the Made Ground will be locally deeper.</p> <p>Beneath the Made Ground, the soil is likely to comprise the weathered profile of the Chalk bedrock. Chalk is a white soft limestone which can have a complex weathered profile and disturbed upper layers through Glacial or post Glacial action. There are sometimes inclusions of sand, gravel and clay. There is a chance that the Taplow Gravel unit crops out on the Site and this comprises granular and cohesive soils.</p> <p>Groundwater could be present as a perched unit above shallow depth cohesive soils or within the Chalk aquifer.</p> <p>The geology at this location has the potential to develop dissolution stability hazards as identified in the Landmark report as a moderate risk. The moderate risk identified in the Landmark report appears to be appropriate because there are several listed items in the Natural and Mining Cavities database within 1,000 m of the Site combined with the presence of mineral extraction activities nearby.</p>
<b>Geotechnical Risk</b>	In the context of the proposed development, the expected underlying geology of the Site and anticipated ground conditions, the Site is considered to present a medium geotechnical risk due to dissolution stability hazards and possible mineral extraction.
<b>Ownership Issues: Statutory Liability</b>	The potential for Statutory Authority action based on the potential for "significant harm" and "pollution of controlled water", as defined by Part II of the Environmental Protection Act 1990, is considered to be low, given the historical use of the Site.
<b>Third Party Action</b>	The potential for legal action by surrounding landowners, based on the potential for contamination to migrate off-Site is considered to be low. The potential for contamination to impact the Site from off-Site sources is considered to be low, given the lack of off-Site sources of contamination.

Investment Impact	The potential for Site acquisition costs to be influenced by ground contamination issues is considered to be low.
Public Relations	The sensitivity of the local area and the significance of ground contamination issues to influence public relations are considered to be low to medium, given the recent fire at the Site.
Site Investigation Requirements	<p>Delta-Simons considers that a limited intrusive environmental assessment is warranted at the Site in order to assess the potential soil and groundwater contamination from the identified on-Site sources. This investigation would allow an assessment of potential ground gas issues at the Site and would provide preliminary waste classification data for any areas where any engineering cut is required.</p> <p>This investigation can be undertaken in conjunction with a geotechnical investigation. The costs for carrying out a Geo-environmental Assessment at the Site would be likely to be in the range £8,000 to £10,000 excl VAT, including intrusive investigation plant and equipment.</p> <p>Should significant contamination be identified, which is considered unlikely, the remediation options would be based upon the findings of a Quantitative Risk Assessment (QRA), which would determine Site-specific remediation criteria. The QRA would cost in the region of £12,000 to £20,000 excl VAT.</p>
Development Implications	There remains the potential that soil and groundwater remediation may be required prior to redevelopment of the Site. Disposal of any engineering arisings will incur elevated disposal costs. Due to the potential presence of hazardous ground gases, there is the possibility that ground gas protection measures will be required to be installed within the proposed building at the Site. In addition, the removal and disposal of ACMs from the Site buildings will incur elevated demolition costs.
Development Abnormals	<p>As with any development, additional costs for safe working practices, which will be performed by the construction workers, should be anticipated.</p> <p>A budget allowance of £25,000 should be made for the removal of ACMs from the Site and an asbestos survey will be required prior to demolition.</p> <p>Under the worst-case scenario, ground gas protection measures in the form of an upgraded damp proof membrane would be required.</p> <p>Local water authorities may require the upgrading of potable water and sprinkler pipes.</p> <p>Clean topsoil and subsoil is likely to be required in the location of any landscaped areas.</p>
Environmental Remediation Options	Consideration should be given to tax incentives, which may be available for the redevelopment of 'Brownfield' sites. On the basis of current Inland Revenue guidance, this may represent a Corporate Tax Credit to the value of 45% of the expenditure on environmental investigation and remediation.
	<p>It should be stated that the costs given below relate only to the potential costs arising from remediation at the Site. The potential costs arising from disposal of material for engineering purposes are included in a subsequent section. The costs of importing clean material following remediation works are not included.</p> <p>The Landfill Directive was implemented in July 2004. This has impacted the costs for disposal of waste, with an increase of up to 200%, depending upon the nature of the waste. As such, the following cost estimates reflect a range of disposal costs. It is stressed that these are estimates based on the limited information, which is currently available following the implementation of the Directive.</p> <p>The following costs can be revised once an intrusive investigation has been undertaken which will enable waste to be classified, and allow the feasibility of alternative technologies to be assessed. In addition, as mentioned above, the costs could be reconsidered further if</p>

	information pertaining to intrusive data and/or validation associated with the removal of the tanks at the Site can be provided.
<b>Best-Case Scenario</b>	Under the best-case scenario, following an intrusive assessment, the remediation of soils and groundwater would not be required. The total environmental remediation cost under this scenario is, therefore, likely to be Zero.
<b>Worst-Case Scenario</b>	Under the worst-case scenario, following an intrusive investigation and possible QRA, localised soils would have been impacted at the Site and would require remediation prior to redevelopment which would involve the removal of approximately 250 cubic m of soils. This volume, when bulked up by a factor of 1.2, would cost in the region of £45,000 to £80,000 to dispose of (based on an estimated disposal cost of £150 to £300 per cubic m). Removal may not be practical, however, this budget cost would allow for the use of alternative in-situ technologies. In addition, contamination at the Site may have impacted any shallow/perched groundwater within any Made Ground and the Taplow Gravel Formation beneath the Site. It is likely to require treatment or removal, which could cost in the region of £10,000 to £20,000. The total environmental remediation costs under this scenario are, therefore, likely to be in the range of £55,000 to £110,000.
<b>Likely-Case Scenario</b>	Under the likely-case scenario, following an intrusive investigation, very limited localised soils at the Site would have been impacted at the Site. A budget of £20,000 to £30,000 should be allowed for soil remediation prior to redevelopment. Under this scenario, no remediation of the groundwater would be required. The total environmental remediation cost under this scenario is, therefore, likely to be in the range of £20,000 to £30,000.
<b>Alternative Remediation Techniques</b>	Given the impacts of the Landfill Directive, alternative remediation technologies, such as on-Site remediation or pre-treatment of contaminated soils, may offer cost effective options for remediation. The opportunity for such techniques to be cost effective is considered to be low, given the low potential for contamination at the Site; however, the viability should be reviewed once a timescale for the development and the scale of the remediation are known following Site investigation. Options for 'pre-treatment' of waste materials should be considered.
<b>Waste Classification</b>	<p>Developers should consider the implications of the Landfill Directive, which was implemented in July 2004. The segregation of landfill sites between inert, non-hazardous and hazardous has impacted disposal costs of excavated materials. Whilst the impact on inert and non-hazardous waste is currently felt to be marginal, excavations that are designated as hazardous are likely to incur severe financial penalties. The disposal of soil from this Site for engineering purposes has the potential to incur abnormal costs, estimated as follows:</p> <ul style="list-style-type: none"> <li>△ Approximately £20 per cubic m for Inert materials;</li> <li>△ Between £150 and £300 per cubic m for Hazardous materials; and</li> <li>△ Between £60 and £100 per cubic m for Non-Hazardous materials.</li> </ul> <p>Limited engineering cut may be required for the redevelopment of the Site, and the materials may require off-Site disposal. In addition, the removal of soils may be required during the excavation of foundations and service trenches. For this material the following apportionment of disposal costs are considered to be appropriate:</p> <ul style="list-style-type: none"> <li>△ Inert – Made Ground in relatively shallow depths is expected across the majority of the Site and it is, therefore, considered that approximately 60% of material will be suitable for disposal at an Inert tip;</li> <li>△ Hazardous – Given that Made Ground is expected at the Site and the potential for on-Site sources of contamination, it is considered that approximately 5% of material will need to be disposed of at a Hazardous landfill site; and</li> <li>△ Non-Hazardous – Any remaining Made Ground material and possibly some natural ground will require disposal at a Non-Hazardous tip, at an estimated proportion of 35% of the total excavation.</li> </ul> <p>It must be stressed that this apportionment is based only on limited desk-top information and experience of similar Sites. A detailed waste classification exercise is required to confirm this apportionment and on the basis of such an exercise, it may be possible to reduce the</p>


	<p>proportion of materials designated as hazardous and non-hazardous.</p> <p>It is likely that landfill tax would not be charged for the disposal of any material from the Site for remediation purposes. However, it is likely that landfill tax, currently at a rate of £24 per tonne, which will rise to £32 per tonne in April 2008, will apply to materials removed for engineering purposes.</p>
<b>Geotechnical Solutions</b>	<p>Under a best-case scenario, the Made Ground would be shallow and the underlying natural ground would be chalk capable of supporting traditional strip and pad foundations of reinforced concrete to the type of structures envisaged for the Site. Groundwater levels might be perched and shallow, but foundations and service excavations may not require de-watering subject to detail of investigation and building design. The best-case scenario has a moderate chance of being realised accepting there may be areas of deeper made ground around underground structures.</p> <p>Under a worst-case scenario, the ground conditions could be complex with variable Made Ground and/or geology hazards such as dissolution features or mining. In these circumstances, the correct foundation for the proposed development would need to be determined following a detailed investigation of the ground conditions.</p> <p>A piled foundation is usually the most effective way of transferring structural loads to the solid geology. It is considered that this worst-case scenario has a medium risk of being realised.</p> <p>A carefully scoped site investigation should be sufficient to address the potential risks identified and this would include the following in a suitable density of sampling; boreholes to identify soil type, penetration testing to identify soil strength and variability, and standpipes for water level monitoring. Laboratory testing dependent on the findings and an interpretative report.</p>
<b>Consultancy Fees</b>	<p>It should be noted that the above costs do not include consultancy fees for overseeing any remediation, collecting validation samples, producing a validation report, carrying out monitoring, liaising with the regulatory authorities and undertaking waste classification works. Under the best-case scenario, costs would be in the region of £2,000 to £3,000 excl VAT. Under the likely-case scenario these costs are likely to be in the region of £5,000 to £10,000 excl VAT. Under the worst-case scenario, these costs would be £20,000 to £30,000 excl VAT.</p>
<b>Next Step Actions:</b> <b>Development Exec/</b>	Request and arrange access to Site for intrusive investigation.
<b>Value Manager</b> <b>Engineer/QS</b>	<p>Identify the extent of any Made Ground and the final development levels so that disposal costs can be considered further.</p> <p>The QS will also be required to undertake a review of costs following the intrusive investigation, and once a timescale for the redevelopment is known.</p>
<b>Environmental /</b> <b>Geotechnical</b>	Perform an intrusive investigation to assess the full extent of the potential soil and/or groundwater contamination, to confirm the ground gas regime at the Site and to undertake a preliminary waste classification exercise. If needed, perform a QRA to determine the extent of any remediation required and review feasibility of alternative remediation technologies.
<p>This Initial Environmental Review Report is intended as a summary of the assessment of the Site based on information received by Delta-Simons at the time of production. Recommendations are based on desk-top information with no Site inspection and are subject to confirmation by intrusive investigation works.</p>	

<b>DATE OF COMPLETION:</b>	15 <sup>th</sup> February 2008	
<b>COMPLETED BY:</b>	Jayne Pearson	Environmental Scientist
<b>REVIEWED BY:</b>	Mark Lunnon	Project Manager
<b>AUTHORISED BY:</b>	Alex Ferguson	Associate Director



PHOTOGRAPHIC LOG

<b>Photo No.</b> A	<b>Date:</b> 25/03/08	
<b>Direction Photo Taken:</b> Northwest from Tudor Way		
<b>Description:</b> The Happy Man public house		

<b>Photo No.</b> B	<b>Date:</b> 25/03/08	
<b>Direction Photo Taken:</b> Towards north-western boundary		
<b>Description:</b> Trees indicated close to northwestern boundary		

## WALKOVER SURVEY CHECKLIST

Features	Description
a) Describe surrounding properties/ land use	The site is located within a residential setting with housing extending beyond all site boundaries.
b) Describe present land use	The site was recently used as a public house, but now fire damaged. Surfaces comprise tarmac for vehicular access and parking. A paved garden area is located behind the public house to the southwest.  (see photo A)
c) Describe the site in terms of ground slopes and changes in slope.	The site and surrounding area slopes gently down to the southeast.
d) Describe the types and condition of surface vegetation.	Grassed areas as previously highlighted are located with the public house garden area at the rear.
e) Note the number, location, height and species of trees and hedges.	Trees are located along the southwestern boundary (and outside of), and along the northwestern boundary (and outside of) up to approx. to 12m to 15m in height.  (see photo B)

## WALKOVER SURVEY CHECKLIST Continued

Features	Description
f) Describe any damage to existing structures on site or adjacent to the site.	Fire damaged was observed within the public house. No indications of soil movement were observed from an outside inspection of the building walls. Given the age of the building it is considered that asbestos containing materials may be present.
g) Note any surface hollows.	None identified
h) Note the location of streams, ponds, seepages and sinks and signs of previous flooding.	None identified
i) Note any discoloured ground.	None identified
j) Identify any old structures, pipework etc wherever possible and, if safe, inspect for evidence of stored waste.	Services were noted within the paved areas comprising water.
k) Examine surrounding areas for evidence of contamination which could migrate onto the site.	None identified
l) Note the presence of any underground structures, services, mine workings, tunnels etc	None identified
m) Evidence of buried services (water, gas, electricity, telephone, cable, television, pipelines)	A buried gas line was indicated entering the northwestern face of the building from the north. A buried electricity service was indicated entering the building from Berry lane including a buried cable TV service line entering the northeast face of the building from Berry Lane. A series of manholes were indicated around the PH indicating a water service. Overhead cabling was noted on Berry Lane.

## APPENDIX E

### Methodology for Risk Assessment

## **Risk Assessment Methodology**

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: Preliminary, Generic Quantitative and Detailed Quantitative. An outline Conceptual Model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (source–pathway–receptor) and is used as the basis for design of the site investigation. The outline Conceptual Model is updated as further information becomes available, for example as a result of the site investigation.

Production of a Conceptual Model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- **Highly likely:** the event appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution;
- **Likely:** it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term;
- **Low likelihood:** circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term; and
- **Unlikely:** circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- **Severe:** short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);
- **Medium:** chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000);
- **Mild:** pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment; and

- Minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the likelihood of an event occurring and its severity has been classified, a risk category can be assigned the table below.

		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

Definitions of these risk categories are as follows together with an assessment of the further work that might be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability and urgent investigation and remediation are likely to be required;
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability and urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term;
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term;
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild; and
- Very Low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

## **APPENDIX F**

### **Records of Probehole and Borehole logs**



Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Boring Method: Competitor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level: -  
 Top of Casing Elevation (m): -

Record of: PH1  
 Sheet 1 of 1  
 Scale, 1:18

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0	0.0	Concrete (MADE GROUND).		
0.40 P, J 001			0.15	Firm orange brown slightly sandy silty clay with occasional fine to medium, rounded to angular flint and fine to coarse gravel size brick and concrete fragments (MADE GROUND).		
			(0.65)			
1.10 P, J 002	1.00m, SPT N=16 (5,6,4,4,4,4)		1.00.0	Very stiff orange brown slightly sandy silty CLAY with some fine to coarse, rounded to angular flint.		
1.50 P 003						
1.60 P 004						
	2.00m, SPT N=11 (2,2,2,3,3,3)		2.0			
			(2.45)			
	3.00m, SPT 53/150mm (10,13,17,36)		3.0			
			3.45	End of Borehole at 3.45 m		

**General Remarks:**  
 50mm diameter standpipe installed to 3.0m. Slotted from 3.0m to 1.0m and surrounded by sand. Bentonite from 1.0m to 0.10m. Flush cover and gas lap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From	To	Time	Borehole		Casing	
Σ	▽	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: STAGE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Boring Method: Competitor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level:  
 Top of Casing Elevation (m):

Record of: PH2  
 Sheet 1 of 1  
 Scale: 1:18

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0	0.0	Tarmac (MADE GROUND).		
			0.08	Moderately compact orange brown sandy fine to coarse gravel of brick and concrete fragments (MADE GROUND).		
0.45 P, J 001			0.30	Stiff orange brown silty CLAY with occasional fine to medium, subrounded to angular flint.		
	1.00m, SPT N=14 (2,2,3,4,3,4)		1.0			
1.10 P 002						
1.40 P 003						
			2.70			
			2.0			
			3.00	End of Borehole at 3.00 m		

General Remarks:  
 50mm diameter standpipe installed to 3.0m. Slotted from 3.0m to 1.0m and surrounded by sand. Bentonite from 1.0m to 0.10m. Flush cover and gas tap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From	To	Time	Borehole		Casing	
☐	▼	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Record of: PH3

Sheet 1 of 1  
 Scale, 1:18

Boring Method: Compellor rig

Date: 25/03/2008 - 25/03/2008

Driller: MB Drilling

Logged By: KMB

Ground Level: -

Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0	0.0	Tarmac (MADE GROUND).		
0.40 P, J 001			0.35	Moderately compact yellow brown and grey silty gravel of fine to medium brick and concrete fragments. Occasional silty clay lenses (MADE GROUND).		
1.10 P 002			1.0	Stiff orange brown silty CLAY with occasional fine to medium, rounded to angular flint		
1.30 P 003						
2.00 P 004			2.0			
2.50 P 005			2.5			
			3.000	End of Borehole at 3.00 m		

**General Remarks:**  
 50mm diameter standpipe installed to 3.0m. Slotted from 3.0m to 1.0m and surrounded by sand. Bentonite from 1.0m to 0.10m. Flush cover and gas tap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike ☒	Level ▼	From: (m)	To: (m)	Time: (hr's)	Borehole		Casing	
					Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

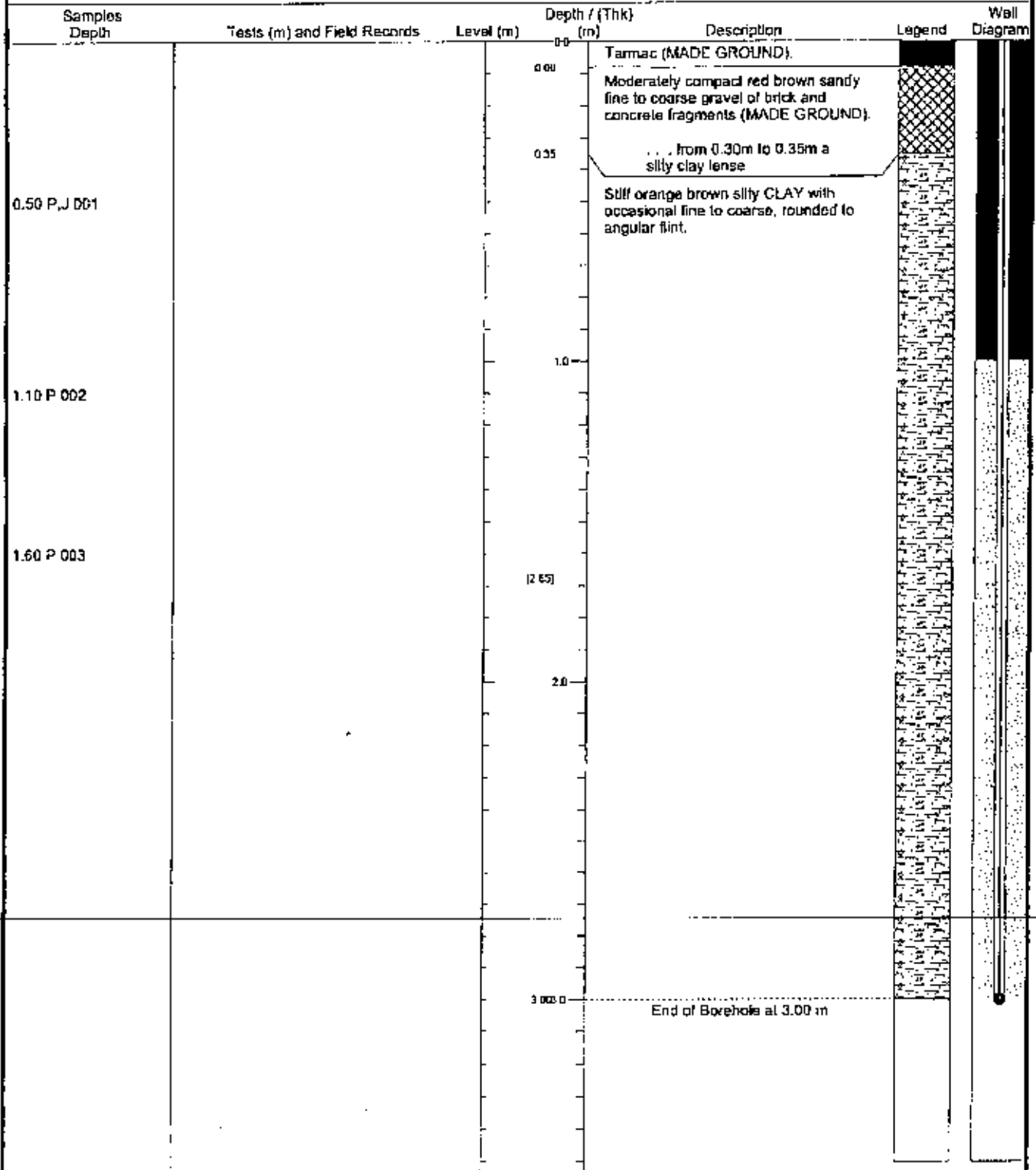
Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Boring Method: Competitor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level: -  
 Top of Casing Elevation (m): -

Record of : PH4  
 Sheet 1 of 1  
 Scale, 1:18



**General Remarks:**  
 50mm diameter standpipe installed to 3.0m. Slotted from 3.0m to 1.0m and surrounded by sand. Bentonite from 1.0m to 0.10m. Flush cover and gas tap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From:	To:	Time:	Borehole		Casing	
Σ	▼	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								



Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE



Project No: 22852

Record of: PH5

Boring Method: Compellor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level:

Sheet 1 of 1

Top of Casing Elevation (m):

Scale, 1:18

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0	0.0	Tarmac (MADE GROUND).		
			0.10	Moderately compact orange brown sandy fine to coarse gravel of brick and concrete fragments (MADE GROUND).		
			0.40	... from 0.3m to 0.4m some sandy silty clay pockets		
0.40 P, J 001				Stiff orange brown silty CLAY with occasional fine to coarse, rounded to angular yellow and grey flint		
			1.0			
1.10 P, J 002						
			2.00			
1.50 P 003						
			2.70	at 2.70m occasional thin sandy clay beds		
			3.000	End of Borehole at 3.00 m		

General Remarks:  
 Backfilled with arisings to surface

Water Strikes		Chiselling			Borehole and Casing Details			
Strike Σ	Level x	From: (m)	To: (m)	Time: (hr's)	Borehole		Casing	
					Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

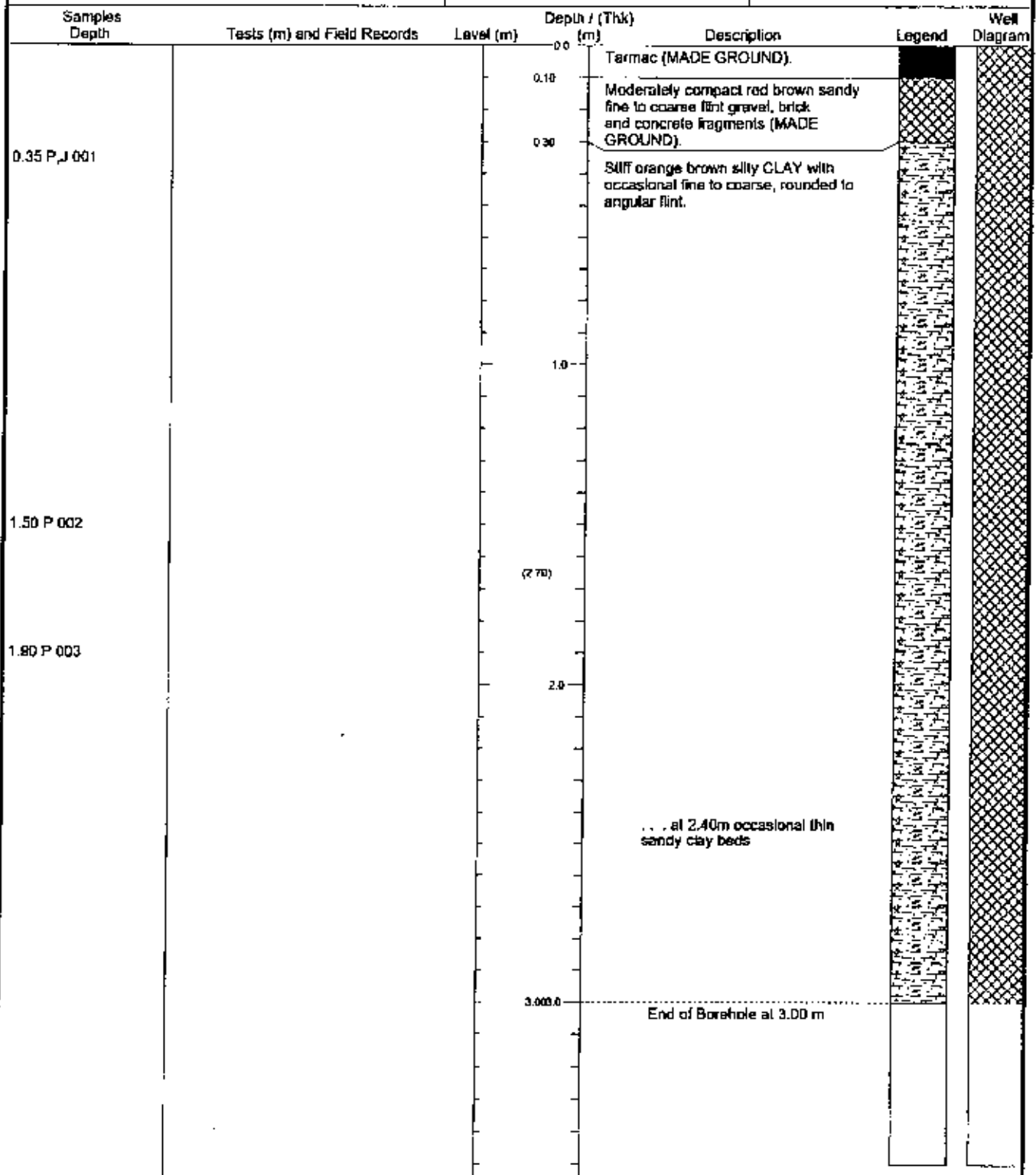
Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Boring Method: Compelitor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level: -  
 Top of Casing Elevation (m): -

Record of : PH6  
 Sheet 1 of 1  
 Scale, 1:18



General Remarks:  
 Backfilled with arisings to surface.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From:	To:	Time:	Borehole		Casing	
☒	☒	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No Groundwater Encountered								

Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE



Project No: 22852

Record of: PH7

Boring Method: Compeltor rig  
 Date: 25/03/2008 - 25/03/2008  
 Driller: MB Drilling  
 Logged By: KMB

Ground Level: -

Sheet 1 of 1

Top of Casing Elevation (m):

Scale, 1:18

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
		0.0	0.0	Tarmac (MADE GROUND).		
0.20 P,J 001		0.10	0.10	Moderately compact yellow brown and dark grey sandy fine to coarse stone gravel (MADE GROUND).		
0.50 P,J 002		0.30	0.30	Stiff orange brown silty CLAY with occasional fine to coarse rounded to angular flint.		
1.30 P 003		1.0				
1.60 P 004		(2.70)				
		2.0		... at 2.0m becomes slightly sandy		
		3.00		End of Borehole at 3.00 m		

**General Remarks:**  
 50mm diameter standpipe installed to 3.0m. Slotted from 3.0m to 1.0m and surrounded by sand. Bentonite from 1.0m to D.10m. Flush cover and gas tap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From:	To:	Time:	Borehole		Casing	
Σ	▼	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
No	Groundwater	Encountered						

Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Record of: BH1

Sheet 1 of 2  
 Scale, 1:50

Boring Method: Cable Percussion

Date: 26/03/2008 - 26/03/2008

Driller: MB Drilling

Logged By: KMB

Ground Level: -

Top of Casing Elevation (m): -

Samples Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
0.00-0.05 D 001 0.20 D 002			0.10 0.20	Tarmac (MADE GROUND). Moderately compact yellow brown and dark grey sandy fine to coarse stone gravel (MADE GROUND).		
1.00 D 003 1.20 U 002 1.60 D 004			1.0	Stiff orange brown silty CLAY with occasional fine to medium, rounded to angular flint		
	2.00m, CPT N=14 (2,2,3,3,4,4)		2.00			
	3.00m, CPT N=74 (4,8,10,18,20,26)		3.0			
4.00 D 005	4.00m, CPT N=53 (5,6,9,11,18,15)		3.50 4.0	Very dense orange brown sandy clayey fine to coarse rounded to angular flint GRAVEL.		
5.00 D 006	5.00m, CPT N=20 (3,3,5,5,4,6)		5.00 5.00			
6.50 D 007	6.50m, SPT N=14 (2,2,3,4,3,4)		6.50 7.0	Structureless CHALK comprised of an off white clayey silt with fine to medium subrounded highly weathered very weak chalk fragments.		
8.00 U 003 8.45 D 008			8.00 (2.50)			
9.50 D 009	9.50m, SPT N=23 (3,3,3,7,7,6)		9.00 9.00	Structureless CHALK comprised of an off white clayey silt with fine to medium subrounded highly weathered very weak chalk fragments. White highly weathered very weak white		
			10.0	Continued next sheet		

**General Remarks:**  
 50mm diameter standpipe installed to 15m. Slotted from 11m to 15m and surrounded by sand. Bentonite from 11m to 0.10m. Flush cover and gas tap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From:	To:	Time:	Borehole		Casing	
☼	▼	(m)	(m)	(hr's)	Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)

Client: STACE PROJECT MANAGEMENT LIMITED  
 Site: BERRY LANE, RICKMANSWORTH, HERTFORDSHIRE  
 Project No: 22852



Record of : BH1

Sheet 2 of 2  
 Scale, 1:50

Boring Method: Cable Percussion

Date: 26/03/2008 - 26/03/2008

Driller: MB Drilling

Logged By: KMB

Ground Level: -

Top of Casing Elevation (m): -

Sample Depth	Tests (m) and Field Records	Level (m)	Depth / (Thk) (m)	Description	Legend	Well Diagram
11.00 D 010	11.0m, SPT N=22 (2,3,4,6,6,6)		10.0	structured CHALK. Occasional black and white coated medium to coarse, subangular flint.		
12.50 U 004			11.0			
12.95 D 011	GW - 12.95m -		13.0			
14.00 D 012	14.0m, SPT N=26 (3,3,5,6,9,6)		14.0			
			15.00.0			
			16.0	End of Borehole at 15.00 m		
			17.0			
			18.0			
			19.0			
			20.0			

**General Remarks:**  
 50mm diameter sandpipe installed to 15m. Slotted from 11m to 15m and surrounded by sand. Bentonite from 11m to 0.10m. Flush cover and gas lap fitted.

Water Strikes		Chiselling			Borehole and Casing Details			
Strike	Level	From: (m)	To: (m)	Time: (hr's)	Borehole		Casing	
☒	▼				Depth (m)	Diam. (mm)	Depth (m)	Diam. (mm)
12.95								

## **APPENDIX G**

### **Environmental Test Results**





Validated   
 Preliminary

## ALcontrol Laboratories Analytical Services Table Of Results

\* ISO 17025 accredited  
 N MCERTS accredited  
 † Subcontracted test  
 ‡ Shown on prev. report

Job Number: 08/06430/02/01  
 Client: Envirolab  
 Client Ref. No.: 22852-4107

Matrix: SOLID  
 Location: TUDOR WAY  
 Client Contact: Envirolab Data

Sample Identity	81640 S1	81641 S2	81642 BHI D6	81643 BHI D9	81644 BHI D12	81645 BHI D14					Method Code	LoD/Units
Depth (m)	0.05	0.05	3.00	6.50	11.00	14.00						
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID						
Sampled Date	T	T										
Sample Received Date	02.04.08	02.04.08	02.04.08	02.04.08	02.04.08	02.04.08						
Batch	1	1	1	1	1	1						
Sample Number(s)	10	11	12	15	13	14						
Total Sulphate	850	590	-	-	-	-					TM129 <sup>u</sup>	<100 mg/kg
Arsenic	7	14	-	-	-	-					TM129 <sup>u</sup>	<3.0 mg/kg
Cadmium	0.5	0.4	-	-	-	-					TM129	<0.3 mg/kg
Chromium	21	24	-	-	-	-					TM129 <sup>u</sup>	<4.5 mg/kg
Copper	23	35	-	-	-	-					TM129 <sup>u</sup>	<6 mg/kg
Lead	160	74	-	-	-	-					TM129 <sup>u</sup>	<3 mg/kg
Mercury	<0.6	<0.6	-	-	-	-					TM129 <sup>u</sup>	<0.6 mg/kg
Nickel	16	15	-	-	-	-					TM129 <sup>u</sup>	<0.9 mg/kg
Selenium	<3	<3	-	-	-	-					TM129 <sup>u</sup>	<3 mg/kg
Zinc	180	150	-	-	-	-					TM129 <sup>u</sup>	<2.5 mg/kg
Water Soluble Sulphate as SO4 2- (Extract)	<0.003	0.021	-	-	-	-					TM098 <sup>u</sup>	<0.003 g/l
Total Organic Carbon	3.0	2.0	-	-	-	-					TM132 <sup>u</sup>	<0.2 %
Asbestos Presence Screen	No Green detected	-	-	-	-	-					TM001	NONE
pH Value	6.94	7.48	8.37	8.60	8.60	8.44					TM133 <sup>u</sup>	<1.00 pH Units
Soluble Sulphate 2:1 Extract as SO4 DRF	-	-	0.012	0.018	0.021	0.012					TM098 <sup>u</sup>	<0.003 g/l

All results expressed on a dry weight basis.

Date 11.04.2008









## ALcontrol Laboratories Analytical Services Table Of Results - Appendix

Job Number: 08/06430/02/01  
 Client: Envirolab  
 Client Ref. No.: 22852-4107

### Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10<sup>-7</sup>

NDP	No Determination Possible	*	Subcontracted test
NFD	No Fibres Detected	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
PFD	Possible Fibres Detected	EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

### Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample <sup>1</sup>	Surrogate Corrected
TM001	In - house Method	Screening of Soils for Fibres			WET	
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690, Part 109 1984	Determination of alkalinity in aqueous samples			NA	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser	✓		DRY	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser	✓	✓	DRY	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer			DRY	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓		DRY	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓	✓	DRY	
TM132	In - house Method	ELTRA CS800 Operators Guide	✓	✓	DRY	
TM133	BS 1377: Part 3 1990	Determination of pH in Soil and Water using the GLpH pH Meter	✓	✓	WET	

<sup>1</sup> Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.





Date: 09 April 2008  
Your Ref: 22852  
Our Ref: 22852-(4107)-010  
Project Manager: Karl Bissett  
Report to: Karl Bissett

Envirolab  
Units 7 & 8  
Sandpits Business Park  
Mottram Road  
Hyde  
Cheshire  
SK14 3AR

## Interim Test Report

Sample(s) of Soil from Tudor Way,  
Received from RSK Group plc  
18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT

Date of receipt 31 March 2008  
Date of analysis 31 March 2008

---

### Method Statement

Speciated TPH analysis is performed in accordance with procedures A-T-022 using GC-MS with Head Space & A-T-023 using GC-FID.

PAH analysis is performed in accordance with procedure A-T-019.

Loss on drying analysis is performed in accordance with procedure A-T-020.

Subcontract analysis was submitted to a laboratory on Envirolab's approved vendors list.

Prepared by:

Approved by:

Thi McNabb  
Reporting Analytical Chemist

Louise Adams  
Associate Director - Operations



Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.  
Tests marked "" in this report are not included in the UKAS Accreditation Schedule for Envirolab.  
Analytical results reflect the quality of the sample at the time of analysis only.



Report No. 22852-010-(4107)  
Site Name: Tudor Way  
Date: 09/04/2008

Initial

Page 1 of 5

EnviroLab Ref.	PROCEDURE	ISO17025	NCERTS	B1631	B1632	B1634	B1635	B1637	B1638	B1639			
Location				PH1	PH1	PH3	PH4	PH6	PH7	PH7			
Depth (m)				0.40	1.10	0.40	0.50	0.35	0.20	0.50			
MTBE <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Benzene <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Toluene <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Ethyl Benzene <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
m & p Xylene <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
o Xylene <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics C5-C8 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C8-C8 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C8-C10 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aliphatics >C10-C12 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	7.6	1.9			
Aliphatics >C12-C16 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	11.6	5.7			
Aliphatics >C16-C21 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	29.5	17.9			
Aliphatics >C21-C36 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	61.9	14.1			
Total Aliphatics		Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	110.80	39.60			
Aromatics >C5-C8 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >C8-C8 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >C8-C10 <sub>n</sub>	A-T-022	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Aromatics >C10-C12 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >C12-C16 <sub>n</sub>	A-T-023	Y	N	3.3	<0.1	<0.1	<0.1	<0.1	19.4	16.9			
Aromatics >C16-C21 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Aromatics >C21-C36 <sub>n</sub>	A-T-023	Y	N	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Total Aromatics		Y	N	3.30	<0.1	<0.1	<0.1	<0.1	19.40	18.90			
TPH (Aliphatics & Aromatics)		Y	N	3.30	<0.1	<0.1	<0.1	<0.1	130.20	58.50			

Table 1 - Soil Speciated TPH Results (mg/kg)

Envirolab Ref.	PROBIDURE	ISO17025	MCERTS	B1638 -	B1638 -								
Location				PH7	PH7								
Depth (m)				0.20	0.50								
Naphthalene <sub>n</sub>	A-T-019	Y	N	0.01	<0.01								
Acenaphthylene <sub>n</sub>	A-T-019	Y	N	<0.01	<0.01								
Acenaphthene <sub>n</sub>	A-T-019	Y	N	0.01	<0.01								
Fluorene <sub>n</sub>	A-T-019	Y	N	<0.01	<0.01								
Phenanthrene <sub>n</sub>	A-T-019	Y	N	0.17	<0.01								
Anthracene <sub>n</sub>	A-T-019	Y	N	0.11	<0.01								
Fluoranthene <sub>n</sub>	A-T-019	Y	N	0.54	<0.01								
Pyrene <sub>n</sub>	A-T-019	Y	N	0.41	<0.01								
Benzo [a] anthracene <sub>n</sub>	A-T-019	Y	N	0.09	0.01								
Chrysene <sub>n</sub>	A-T-019	Y	N	0.25	<0.01								
Benzo [b] fluoranthene <sub>n</sub> Benzo [k] fluoranthene # <sub>n</sub>	A-T-019	Y	N	0.50	<0.01								
Benzo [a] pyrene <sub>n</sub>	A-T-019	Y	N	0.18	<0.01								
Indeno [1,23-cd] pyrene <sub>n</sub>	A-T-019	Y	N	<0.01	<0.01								
Dibenz [ah] anthracene <sub>n</sub>	A-T-019	Y	N	<0.01	<0.01								
Benzo [ghi] perylene <sub>n</sub>	A-T-019	Y	N	0.04	<0.01								
Total 16 PAH Reported		Y	N	2.29	0.01								

# Due to colution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 2 - Soil PAH Results (mg/kg, expressed on a dry weight basis)

- Samples not MCERTS - See Note 5.-

Envirolab Ref.	PROCEDURE	ISO 17024	MCERTS	B1631	B1632	B1633	B1634	B1635	B1636	B1637			
Location				PH1	PH1	PH2	PH3	PH4	PH5	PH6			
Depth (m)				0.40	1.10	0.45	0.40	0.50	0.40	0.35			
Naphthalene <sub>n</sub>	A-T-019	Y	Y	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Acenaphthylene <sub>n</sub>	A-T-019	Y	N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Acenaphthene <sub>n</sub>	A-T-019	Y	Y	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01			
Fluorene <sub>n</sub>	A-T-019	Y	Y	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Phenanthrene <sub>n</sub>	A-T-019	Y	Y	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Anthracene <sub>n</sub>	A-T-019	Y	Y	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01			
Fluoranthene <sub>n</sub>	A-T-019	Y	Y	0.03	<0.01	<0.01	0.01	<0.01	<0.01	0.01			
Pyrene <sub>n</sub>	A-T-019	Y	Y	0.04	0.01	<0.01	0.02	<0.01	<0.01	0.01			
Benzo [a] anthracene <sub>n</sub>	A-T-019	Y	Y	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01			
Chrysene <sub>n</sub>	A-T-019	Y	Y	0.05	<0.01	<0.01	0.01	0.01	0.01	0.01			
Benzo [b] fluoranthene <sub>n</sub> Benzo [k] fluoranthene <sub>n</sub>	A-T-019	Y	Y	0.07	0.04	<0.01	<0.01	<0.01	<0.01	<0.01			
Benzo [a] pyrene <sub>n</sub>	A-T-019	Y	Y	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Indeno [123-cd] pyrene <sub>n</sub>	A-T-019	Y	Y	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Dibenz [ah] anthracene <sub>n</sub>	A-T-019	Y	Y	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Benzo [ghi] perylene <sub>n</sub>	A-T-019	Y	Y	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			
Total 16 PAH Reported		Y	N	0.31	0.05	0.01	0.04	0.03	0.01	0.04			

\* Due to co-elution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 2 - Soil PAH Results (mg/kg, expressed on a dry weight basis)

Subcontract results to follow.

#### Notes

1. For detailed matrix description please see attached sheet.
2. Analysis suffixed "d" were performed on the sample air dried at <30°C
3. Analysis suffixed "n" were performed on the sample as received. Where results are expressed on a dry weight basis, the samples were oven dried at 95°C.
4. Natural stones and debris are excluded from analyses.
5. Coarse granular material such as concrete, gravel & brick are not MCERTS accredited if they comprise the major part of the sample.

Envirolab Ref.	81631	81632	81633	81634	81635	81636	81637	81638	81639	
Location	PH1	PH1	PH3	PH3	PH4	PH5	PH6	PH7	PH7	
Depth (m)	0.40	1.10	0.45	0.40	0.50	0.40	0.35	0.20	0.50	
Type	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Made Ground	Made Ground	
Colour	Brown	Brown	Brown	Brown	Light Brown	Light Brown	Light Brown	Mixed	Mixed	
Consistency	Firm	Very Firm	Stiff	Firm	Firm	Very Firm	Firm	Loose	Loose	
Some Stones	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
>50 Stones	No	No	No	No	No	No	No	Yes	Yes	
Some Vegetation	No	No	No	No	No	No	No	No	No	
Very Wet	No	No	No	No	No	No	No	No	No	
Strong Odour	No	No	No	No	No	No	No	No	No	

Table 3 - Soil Matrix Table









Date: 09 April 2008  
Your Ref: 22852  
Our Ref: 22852-(4036)-020  
Project Manager: Karl Bissett  
Report To: Karl Bissett

Envirolab  
Units 7 & 8  
Sandpits Business Park  
Mottram Road  
Hyde  
Cheshire  
SK14 3AR

## Final Test Report

Sample(s) of Water from Tudor Way.  
Received from RSK Group plc  
18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT

Date of receipt 02 April 2008  
Date of analysis 02 April 2008

### Method Statement

Specialised TPH analysis is performed in accordance with procedures A-T-022 using GC-MS with Head Space & A-T-023 using GC-FID.

PAH analysis is performed in accordance with procedure A-T-019.

Subcontract analysis was submitted to a laboratory on Envirolab's approved vendors list.

A copy of the report is attached, accreditation status is detailed on the report.

Prepared by:

Approved by:

Thi McNabb  
Reporting Analytical Chemist

Louise Adams  
Associate Director - Operations



Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.  
Tests marked "" in this report are not included in the UKAS Accreditation Schedule for Envirolab.  
Analytical results reflect the quality of the sample at the time of analysis only.

Report No. 22852-020-(4036)  
Site Name: Tudor Way  
Date: 15/04/2008

Initial

Page 1 of 3

Envirolab Ref.	PROCEDURE	ISO17020	H11513										
Location			BH1										
MTBE <sub>n</sub>	A-T-022	Y	<1										
Benzene <sub>n</sub>	A-T-022	Y	<1										
Toluene <sub>n</sub>	A-T-022	Y	<1										
Ethyl Benzene <sub>n</sub>	A-T-022	Y	<1										
m & p Xylene <sub>n</sub>	A-T-022	Y	<1										
o Xylene <sub>n</sub>	A-T-022	Y	<1										
Aliphatics >C5-C6 <sub>n</sub>	A-T-022	Y	<1										
Aliphatics >C6-C8 <sub>n</sub>	A-T-022	Y	<1										
Aliphatics >C8-C10 <sub>n</sub>	A-T-022	Y	<1										
Aliphatics >C10-C12 <sub>n</sub>	A-T-023	Y	<5										
Aliphatics >C12-C16 <sub>n</sub>	A-T-023	Y	<5										
Aliphatics >C16-C21 <sub>n</sub>	A-T-023	Y	<5										
Aliphatics >C21-C36 <sub>n</sub>	A-T-023	Y	<5										
Total Aliphatics		Y	<5										
Aromatics >C5-C6 <sub>p</sub>	A-T-022	Y	<1										
Aromatics >C6-C8 <sub>p</sub>	A-T-022	Y	<1										
Aromatics >C8-C10 <sub>p</sub>	A-T-022	Y	<1										
Aromatics >C10-C12 <sub>p</sub>	A-T-023	Y	<5										
Aromatics >C12-C16 <sub>p</sub>	A-T-023	Y	<5										
Aromatics >C16-C21 <sub>p</sub>	A-T-023	Y	<5										
Aromatics >C21-C36 <sub>p</sub>	A-T-023	Y	<5										
Total Aromatics		Y	<5										
TPH (Aliphatics & Aromatics)		Y	<5										

Table 1 - Water Speciated TPH Results (µg/l)

EnviroLab Ref.	PROCEDURE	ISO17025	H11513									
Location			BH1									
Naphthalene <sub>n</sub>	A-T-018	Y	<0.01									
Acenaphthylene <sub>n</sub>	A-T-019	Y	<0.01									
Acenaphthene <sub>n</sub>	A-T-019	Y	<0.01									
Fluorene <sub>n</sub>	A-T-019	Y	<0.01									
Phenanthrene <sub>n</sub>	A-T-019	Y	<0.01									
Anthracene <sub>n</sub>	A-T-019	Y	<0.01									
Fluoranthene <sub>n</sub>	A-T-019	Y	0.01									
Pyrene <sub>n</sub>	A-T-018	Y	0.01									
Benz [a] anthracene <sub>n</sub>	A-T-018	Y	<0.01									
Chrysene <sub>n</sub>	A-T-018	Y	<0.01									
Benzo [b] fluoranthene <sub>n</sub> Benzo [k] fluoranthene <sub>n</sub>	A-T-018	Y	<0.01									
Benzo [a] pyrene <sub>n</sub>	A-T-018	Y	<0.01									
Indeno [123-cd] pyrene <sub>n</sub>	A-T-019	Y	<0.01									
Dibenz [ah] anthracene <sub>n</sub>	A-T-019	Y	<0.01									
Benzo [ghi] perylene <sub>n</sub>	A-T-019	Y	<0.01									
Total 16 PAH Reported		Y	0.02									

\* Due to co-elution Benzo [b] fluoranthene and Benzo [k] fluoranthene are reported as one value.

Table 2 - Water PAH Results (µg/l)

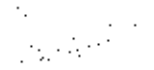
Notes

1. Analyses suffixed "R" were performed on the sample 'as received'.
2. Analyses suffixed "F" were performed on the filtered sample.









## **APPENDIX H**

### **Human Health Generic Assessment Criteria**



Generic Assessment Criteria for Human Health  
Residential Scenario – Private Gardens

1. Model Selection

The Generic Assessment Criteria (GAC) were calculated using Risk-Based Corrective Action (RBCA) and Risk-Integrated Software for Clean-ups (RISC). RBCA was chosen for two reasons. Firstly, it uses the Johnson and Ettinger (J&E) model, which has been incorporated into the current beta version of the UK Contaminated Land Exposure Assessment (CLEA) model and secondly, RBCA accounts for differential pressure in the indoor air inhalation pathway from both soil and groundwater. RISC only accounts for differential pressure for indoor air inhalation from soil. However, it is the only model available to generate values for the vegetable ingestion pathway and was used for this pathway. One disadvantage is that the model only accounts for dissolved phase hydrocarbons. CLEA was not used following the Environment Agency's Frequently Asked Question Number 26 regarding the suitability of the Briggs et al algorithm for chemicals with a log Kow >5.

2. Pathway Selection

Pathways considered in the residential end use include indoor air inhalation from soil and groundwater, ingestion of soil/indoor dust, dermal contact with soil and ingestion of vegetables. CLEA also includes the outdoor air inhalation and soil attached to vegetables pathways. Outdoor air inhalation was not modelled, as the indoor air pathway is typically more conservative. Soil attached to vegetables was not included owing to a calculation method not being available within RISC. A conceptual model illustrating the linkages modelled is included in Figure 1.

Within the model, the solubility limit of the determinant limits the extent of volatilisation, which in turn drives the indoor air inhalation pathway. In cases where the contaminant solubility is exceeded, a reliable method to derive GAC has not been determined, and the values calculated for the soil ingestion and dermal contact pathways are selected as the GAC.

3. Input Selection

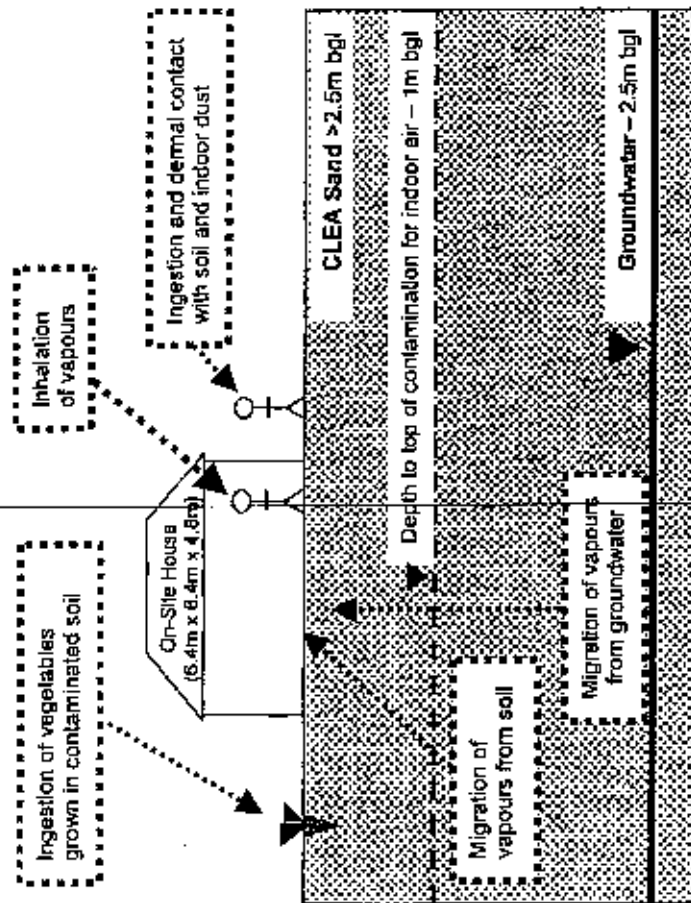
Where available, the published UK toxicity data has been used. For compounds where Tolerable Daily Soil Intakes (TDSI) for both a child and an adult are published, the value for the child was used in line with CLEA. For Total Petroleum Hydrocarbons (TPH), toxicity and chemical specific parameters from the TPH Criteria Working Group (TPHCWG) were used. Due to the lack of UK-specific data, default information in the RBCA model was used to evaluate MTBE. No published UK toxicity data was available for 1,2,4- and 1,3,5-trimethylbenzene. Data was collected from Syracuse Research Corporation database (<http://www.syrres.com/esc/physdemo.htm>) and the Risk Assessment Information System (<http://risk.lsd.ornl.gov/cgi-bin/tox/>). Toxicity reports have been generated by RSK in line with guidance in CLR9 for 14 of the 16 USEPA Polycyclic Aromatic Hydrocarbons (PAHs). The chemical and toxicity data used to generate the GAC was derived from these reports.

Building size, particularly height, is a sensitive parameter when considering the indoor air pathway. Building parameters for a CLEA house (two floors) and a sand soil type were used in line with published SGVs. An average groundwater depth of 2.5m was assumed based on typical UK conditions. This is also a sensitive parameter for the indoor air pathway. If groundwater is shallower than 2.0m bgl or deeper than 3.0m bgl, the GAC should be used with caution since they could be over or under conservative.

4. GAC

The GAC were produced using the input parameters in Tables 1 to 3 and the GAC are presented by pathway in Table 4. The final selected GAC are presented in Table 5.

Figure 1  
Conceptual Model for Residential Scenario – Private Gardens



Note: Exposure parameters shown on Table 1.

Table 1  
Exposure Assessment Parameters for Residential Scenario - Private Gardens – Inputs for RBCA Model

Parameter	Value	Justification
Averaging time	6 years	Equals exposure duration for residential use in line with Table 3.2, CLR10
Body weight	14.5kg	Average 0-6 year old female child in line with Table 5.6, CLR10 for residential use
Exposure frequency	365 days	In line with Tables 3.2, 4.3, 4.4, CLR10 for a residential end use.
Exposure duration	6 years	
Ingestion rate for soil	100mg/day	Table 6.1, CLR10 value for a 0-6 year old ingesting soil and indoor dust. Equation: Total skin area (6157cm <sup>2</sup> ) x max fraction skin exposed outdoors (0.265)
Total exposed skin surface area	1634cm <sup>2</sup>	Mean of total skin area for 0-6 year old female, calculated from Appendix 1, BN 1 and mean of max fraction for outdoor exposure of a 0-6 year old female taken from Table 2, BN 1.  Indoor exposure fraction is 0.33 but was not selected since a lower adherence factor is relevant for indoor exposure. This value is within the range of indoor and just above that for outdoor exposed skin in Appendix 1, BN1 and therefore is considered appropriate for use.
Soil/skin adherence factor	1mg/cm <sup>2</sup>	In line with recommendations for a child resident for outdoor exposure, Table 3, BN1. Note indoor adherence factor is 0.06mg/cm <sup>2</sup> but 1mg/cm <sup>2</sup> is considered more conservative.

Note: Existing Notes (BN) are CLEA publications: BN1, Version 1.1, (March 2005).

**GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH**  
**Residential Scenario – Private Gardens**



**Table 2**  
**Additional Exposure Parameters used in the RISC Model – Ingestion of Vegetable Pathway**

Parameter	Value	Justification
Exposure frequency	365 No.	In line with paragraph 4.34, CLR10 for a residential end use.
Ingestion rate for root veg	61.7g/day	In line with CLR10 for a 1–4 year old, averaged for 1–4 year old age from Tables 6.3 and 5.6 as the 1–4 year age group is nearest to 0–6 year old used in CLEA to assess residential end use.
Ingestion rate for above ground veg	16.5g/day	
Fraction of veg grown in contaminated soil	0.28 [-]	Average home-grown fraction calculated from Table 6.4, CLR10.
Fraction of organic carbon	0.0058 [-]	Published SGVs use a soil organic matter of 1%. This is the equivalent of 0.58% TOC.

Note: Fraction of vegetables grown in contaminated soil is taken from CLR10 that CLAN06 recognises as being overly conservative.

**Table 3**  
**Additional Parameters for Residential Scenario - Private Gardens - Inputs for RBCA Model**

Parameter	Value	Justification
Depth to water bearing unit	2.5m	Assumed typical depth to groundwater based on RSK experience.
Depth to top of affected soil	1m	Default from BN 2 for the depth to impacted soil.
Depth to base of affected soil	2.5m	Taken equal to depth to water-bearing unit to reflect unsaturated zone thickness.
Affected soil area	40.96m <sup>2</sup>	Taken equal to foundation area (6.4m x 6.4m) of CLEA house. BN 3.
<b>Soil type – Sand in line with CLEA</b>		
Total porosity	0.46 [-]	CLEA sand from Table 3, BN2 as this is the most permeable CLEA soil and was used to produce the published SGVs.
Volumetric water content	0.15 [-]	
Dry bulk density	1.6	
Vertical hydraulic conductivity	5.6m/d	
Vapour permeability	7.20E-12m <sup>2</sup>	Calculated for a CLEA sand using equations in Appendix 2, BN 2.
Capillary zone thickness	0.05m	Default value for sand from RBCA as RBCA sand is similar to CLEA sand and value is not included in BN 2.
Fraction of organic carbon	0.0058	Modeling used 1% SOM (0.58% TOC) in line with the published CLEA SGVs.
Soil/water pH	6.8	Taken as model default, which is considered reasonably conservative for UK.
Groundwater plume width at source	6.4m	Equal to width of CLEA house (6.4m x 6.4m). Appendix 1, BN 3.
Foundation area	40.96m <sup>2</sup>	CLEA house dimensions used (6.4m x 6.4m). Appendix 1, BN 3.
Foundation perimeter	25.6m	
Building volume/area ratio	4.8m	CLEA house. Appendix 1, BN 3.
Building air exchange rate	12 No./day	CLEA BN 3 for a residential property.
Depth to slab base	0.15m	CLEA house. Appendix 1, BN 3 for foundation or slab thickness.
Foundation crack fraction	0.00125	Calculated using building perimeter and foundation area in line with last paragraph of BN 3 (0.002m x perimeter/area).
Volumetric air content of cracks	0.31 [-]	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Discussion for Equation 6 - BN 2. Underlying soil is assumed to be CLEA sand.
Volumetric water content of cracks	0.15 [-]	
Indoor/outdoor differential pressure	30g/cm <sup>2</sup>	CLEA house. Appendix 1, BN 3.

Note: Briefing Notes (BN) are CLEA publications. BN2, Version 1.1 (July 2004). BN3, Version 1.1 (July 2004).

**GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH  
Residential - Private Gardens**

**Table 4  
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens**

Compound	GAC for Inhalation of Indoor Air from Groundwater (e) (mg/l)	Soil Ingestion/ Dermal Contact (mg/kg)	SSV Appropriate to Pathway Inhalation of Indoor Air (mg/kg)	SSV for Vegetable Uptake (b) (mg/kg)	Selected SSV for Soil with Vegetable Uptake (c) (mg/kg)
<b>Metals</b>					
Argenic	-	NC	NC	NC	2.00E+01 (d)
Cadmium (pH 6 - see note k)	-	NC	NC	NC	1.00E+00 (d)
Chromium (total)	-	NC	NC	NC	1.30E+02 (d)
Copper	(b)	5.40E+03	-	4.40E+02	4.40E+02
Lead	-	NC	NC	NC	4.50E+02 (d)
Mercury	-	NC	NC	NC	8.00E+00 (d)
Nickel	-	NC	NC	NC	5.00E+01 (d)
Selenium	-	NC	NC	NC	3.50E+01 (d)
Zinc	(b)	4.40E+04	-	8.80E+02	8.80E+02
<b>Volatile Organic Compounds (f)</b>					
Benzene	7.30E-02	1.60E+01	1.87E-01	2.00E+00	1.87E-01
Toluene (1% SOM - see note e)	5.15E+00	NC	NC	NC	3.00E+00 (d)
Ethylbenzene (1% SOM - see note e)	1.16E+01	NC	NC	NC	9.00E+00 (d)
Xylene	3.50E+00	9.80E+03	1.10E+01	2.50E+03	1.10E+01
Methyl t-Butyl ether	3.86E+02	4.77E+02	1.80E+02	1.80E+01	1.90E+01
Trichloroethane	2.20E-01	2.80E+02	9.57E-01	4.30E+01	9.57E-01
1,4-Dichlorobenzene	1.41E+00	7.71E+02	1.21E+01	1.40E+02	1.21E+01
1,1,1-Trichloroethane	1.75E+01	8.49E+03	1.09E+02	5.80E+03	1.09E+02
1,1,1,2,2-Tetrachloroethane	1.11E+01	8.17E+01	8.94E+00	5.20E+01	6.84E+00
Carbon Tetrachloride	4.18E-02	2.21E+01	3.66E-01	1.70E+01	3.68E-01
1,2-Dichloroethane	4.40E-02	1.90E+00	2.21E-02	4.00E-01	2.21E-02
Vinyl Chloride	4.03E-03	2.21E-01	5.52E-02	6.80E-02	4.80E-02
1,2,4-Trimethylbenzene	8.07E-02	2.75E+03	3.13E-01	8.70E+02	3.13E-01
1,3,5-Trimethylbenzene	5.93E-02	2.75E+03	3.13E-01	8.00E+02	3.13E-01
<b>Semi-Volatile Organic Compounds (f)</b>					
Acenaphthene	7.69E-01	9.28E+02	1.53E+01	1.00E+03	1.53E+01
Acenaphthylene	1.08E-01	9.28E+01	1.27E+00	7.00E+01	1.27E+00
Anthracene	ND	5.11E+04	ND	9.50E+04	5.11E+04
Benzo(a)anthracene	ND	9.28E+00	ND	8.00E+01	9.28E+00
Benzo(b)fluoranthene	ND	9.28E+00	ND	4.40E+01	9.28E+00
Benzo(g,h,i)perylene	ND	1.99E+03	ND	1.70E+03	1.99E+03
Benzo(k)fluoranthene	ND	9.28E+00	ND	6.70E+01	9.28E+00
Chrysene	ND	9.28E+01	ND	5.40E+00	5.40E+00
Diene(1,2,3,4)anthracene	ND	9.28E+01	ND	6.40E+00	9.28E+01
Fluoranthene	ND	9.28E+01	ND	2.40E+02	9.28E+01
Fluorans	ND	6.45E+03	ND	9.10E+03	8.45E+03
Indeno(1,2,3-cd)pyrene	ND	9.28E+00	ND	6.80E+01	9.28E+00
Phenanthrene	ND	1.95E+03	ND	2.90E+03	1.95E+03
Pyrene	ND	9.28E+02	ND	2.40E+03	9.28E+02
Benzo(a)pyrene	ND	1.10E+00	ND	2.40E+03	9.28E+02
Naphthalene	(f)	1.10E+03	ND	5.50E+00	1.10E+00
Phenol	(d)	-	NC	4.70E+02	6.56E+00

**GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH  
Residential - Private Gardens**

**Table 4  
Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens**

Compound	GAC for Inhalation of Indoor Air from Groundwater (g) (mg/l)	Soil Ingestion/Dermal Contact (mg/kg)	SSV Appropriate to Pathway		Selected SSV for Soil with Vegetable Uptake (c) (mg/kg)
			Inhalation of Indoor Air (mg/kg)	SSV for Vegetable Uptake (b) (mg/kg)	
<b>Table 4 Continued</b>					
<b>Total Petroleum Hydrocarbons (h)</b>					
Aliphatic Hydrocarbons >EC <sub>7</sub> -EC <sub>8</sub>	1.36E+00	2.76E+06	ND	9.30E+04	9.30E+04
Aliphatic Hydrocarbons >EC <sub>9</sub> -EC <sub>14</sub>	9.99E-01	2.76E+06	ND	1.70E+05	1.70E+05
Aliphatic Hydrocarbons >EC <sub>15</sub> -EC <sub>18</sub>	3.13E-02	5.50E+03	9.26E+01	7.30E+03	5.28E+01
Aliphatic Hydrocarbons >EC <sub>19</sub> -EC <sub>22</sub>	2.01E-02	5.50E+03	ND	1.50E+04	5.50E+03
Aliphatic Hydrocarbons >EC <sub>23</sub> -EC <sub>28</sub>	ND	5.50E+03	ND	3.90E+04	5.50E+03
Aliphatic Hydrocarbons >EC <sub>29</sub> -EC <sub>31</sub>	-	1.10E+05	-	-	1.10E+05
Aliphatic Hydrocarbons >EC <sub>32</sub> -EC <sub>33</sub>	-	1.10E+05	-	-	1.10E+05
Aromatic Hydrocarbons >EC <sub>34</sub> -EC <sub>37</sub>	6.20E-02	1.85E+02	3.13E-01	1.20E+03	3.13E-01
Aromatic Hydrocarbons >EC <sub>38</sub> -EC <sub>41</sub>	3.64E+00	1.10E+04	2.10E+01	2.10E+03	2.10E+01
Aromatic Hydrocarbons >EC <sub>42</sub> -EC <sub>44</sub>	1.02E+00	2.20E+03	1.05E+01	9.80E+02	1.05E+01
Aromatic Hydrocarbons >EC <sub>45</sub> -EC <sub>48</sub>	3.63E+00	2.20E+03	3.07E+01	1.30E+03	3.07E+01
Aromatic Hydrocarbons >EC <sub>49</sub> -EC <sub>51</sub>	ND	2.20E+03	1.81E+02	1.70E+03	1.61E+02
Aromatic Hydrocarbons >EC <sub>52</sub> -EC <sub>53</sub>	-	1.85E+03	-	1.40E+03	1.40E+03
Aromatic Hydrocarbons >EC <sub>54</sub> -EC <sub>58</sub>	-	1.85E+03	-	3.70E+04	1.65E+03

**Notes:**  
 \* - GAC or SSV not calculated owing to low volatility of substance and therefore an absence of toxicity data for this pathway.  
 EC - Equivalent Carbons.  
 GAC - Generic Assessment Criteria.  
 ND - Not determined. Calculated screening value exceeded the solubility limit used in RBCA. Alternatively, these compounds could not dissolve into a solution with high enough concentrations to pose a risk as the actual limit is exceeded and the RBCA model cannot consider these plants.  
 RBCA - Risk-Based Corrective Action model, Version 1.3a (2000). (ASTM, 1988).  
 RISC - Risk-Integrated Software for Clean-ups, Version 4.03a (BP, 2003).  
 SSV - Soil Screening Values.  
 SSV - Soil Screening Values.  
 (a) Unless otherwise noted, values were calculated by the RBCA model using default values shown in Table 1, Table 2 and Table 3 of this Appendix.  
 (b) Toxicity data taken from the RISC model.  
 (c) Value selected is the lowest calculation from the soil ingestion/dermal contact, ingestion of indoor air and vegetable uptake pathways.  
 (d) GAC limits are published residential with plant uptake SSV.  
 (e) The SSVs for toluene and ethylbenzene are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.684. 1% SOM is 0.58% TOC. DL Rowell Soil Science Methods and Applications, Longmans, 1984.  
 (f) Unless otherwise noted toxicity intermediates and chemical parameters obtained from Environmental Agency publications.  
 (g) Child values for Total Daily Soil Intake were used for both the oral and inhalation pathways (oral values substituted for dermal pathway in absence of dermal values).  
 (h) RBCA default values used for MTBE and hydrocarbon fractions. Hydrocarbons consistent with TPH Criteria Working Group (TPHCWG).  
 (i) No UK data available, see Input Selection section for references.  
 (j) Unless otherwise noted RSK toxicity values used. These were derived following the CLRa hierarchy in absence of UK data. Toxicity reports available upon request.  
 (k) Cadmium is dependent on soil pH. 1 mg/kg in the SSV at a pH of 6. 2 mg/kg in the SSV at a pH of 7. 8 mg/kg in the SSV at a pH of 8.

Table 5  
Selected Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GAC for Groundwater (a) (mg/l)	GAC for Soils (a) (mg/kg)
<b>Metals</b>		
Arsenic	-	20
Cadmium (pH 6, 7, 8)	-	1.28
Chromium (total)	-	130
Copper	-	440
Lead	-	450
Mercury	-	8
Selenium	-	35
Nickel	-	50
Zinc	-	880
<b>Volatile Organic Compounds</b>		
Benzene	0.074	0.17
Toluene (SDM 1%, 2.5%, 5%)	5.2	3.0, 7.0, 14
Ethylbenzene (SDM 1%, 2.5%, 5%)	12	8.0, 21, 41
Xylene	3.5	11
Methyl t-Butyl ether	370	19
Trichloroethene	0.22	0.98
Tetrachloroethene	1.4	12
1,1,1-Trichloroethane	18	110
1,1,1,2 & 1,1,2,2-Tetrachloroethane	11	8.6
Carbon Tetrachloride	0.042	0.37
1,2-Dichloroethane	0.044	0.022
Vinyl Chloride	0.0040	0.048
1,2,4-Trimethylbenzene	0.081	0.31
1,3,5-Trimethylbenzene	0.059	0.31
<b>Semi-Volatile Organic Compounds</b>		
Acenaphthene	0.76	15
Acenaphthylene	0.11	1.3
Anthracene	ND	51,000
Benzo(a)anthracene	ND	9.3
Benzo(b)fluoranthene	ND	9.3
Benzo(g,h,i)perylene	ND	1,400
Benzo(k)fluoranthene	ND	9.3
Chrysene	ND	5.4
Dibenzo(a,h)anthracene	ND	0.93
Fluorene	ND	93
Fluorene	ND	6,500
Indeno(1,2,3-cd)pyrene	ND	9.3
Phenanthrene	ND	1,900
Pyrene	ND	930
Benzo(a)pyrene	ND	1.1
Naphthalene	1.7	8.8
Phenol	-	78
<b>Total Petroleum Hydrocarbons</b>		
Aliphatic Hydrocarbons EC <sub>5</sub> -EC <sub>8</sub>	1.4	93,000
Aliphatic Hydrocarbons >EC <sub>9</sub> -EC <sub>9</sub>	0.9	170,000
Aliphatic Hydrocarbons >EC <sub>11</sub> -EC <sub>10</sub>	0.031	53
Aliphatic Hydrocarbons >EC <sub>10</sub> -EC <sub>12</sub>	0.020	5,500
Aliphatic Hydrocarbons >EC <sub>12</sub> -EC <sub>16</sub>	ND	5,500
Aliphatic Hydrocarbons >EC <sub>16</sub> -EC <sub>21</sub>	-	110,000
Aliphatic Hydrocarbons >EC <sub>21</sub> -EC <sub>35</sub>	-	110,000
Aromatic Hydrocarbons EC <sub>5</sub> -EC <sub>7</sub>	0.083	0.31
Aromatic Hydrocarbons >EC <sub>7</sub> -EC <sub>9</sub>	3.5	21
Aromatic Hydrocarbons >EC <sub>9</sub> -EC <sub>10</sub>	1.0	11
Aromatic Hydrocarbons >EC <sub>10</sub> -EC <sub>12</sub>	3.6	31
Aromatic Hydrocarbons >EC <sub>12</sub> -EC <sub>16</sub>	ND	160
Aromatic Hydrocarbons >EC <sub>16</sub> -EC <sub>21</sub>	-	1,400
Aromatic Hydrocarbons >EC <sub>21</sub> -EC <sub>35</sub>	-	1,700

Notes:  
 -? Value not applicable due to low volatility of substance. No value in table as groundwater ingestion not considered a plausible pathway.  
 GAC - Generic Assessment Criteria  
 ND - Not determined. Value exceeded solubility limit used in RBCA. Theoretically these compounds could not dissolve into a solution with high enough concentrations to pose a risk, as solubility limit is exceeded the potential pathway is incomplete.  
 RBCA - Risk-Based Corrective Action model, Version 1.3b (2020), (ASTM, 1998)  
 (a) See Table 4 for calculation notes, values shown rounded to two significant figures

## **APPENDIX I**

### **Generic Assessment Criteria for Phototoxic Effects, Pipelines and Controlled Waters**

## **GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS, PIPELINES AND CONTROLLED WATERS**

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to:

- Vegetation via the uptake of phytotoxic determinands through plant roots;
- Water supply pipes constructed using conventional pipe materials, i.e. polyethylene; and
- Controlled waters.

The GAC for each of these receptors is discussed in turn.

### **PHYTOTOXIC DETERMINANDS TO INHIBIT HEALTHY PLANT GROWTH**

Copper and zinc can inhibit plant growth but are not normally hazardous to human health. The GAC for this pollutant linkage have been taken from Department of the Environment Publication, Code of Practice for Agricultural Use of Sewage Sludge, 1996. The GAC for the phytotoxic determinands are presented in Table A1. The table also includes nickel since this is also phytotoxic determinand and the Soil Guideline Value (SGV which is protective of human health) for a commercial (5000mg/kg) or residential without plant uptake (75mg/kg) is greater than the GAC to protect plant growth in acidic soil. Therefore, the SGV may not be suitably protective of the phytotoxic effects pathway.

**Table A1: Generic Assessment Criteria for Phytotoxic Determinands**

Determinand	Generic Assessment Criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	250	300	450
Copper	80	100	135	200
Nickel	50	60	75	110

### **WATER SUPPLY PIPES**

Risks to water supply pipes have been assessed in accordance with the Water Regulations Advisory Scheme Information and Guidance Note 9-04-03, dated October 2002 and the flow chart included as Figure A1 in this appendix.

The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supplier has a statutory duty to enforce the regulations. Therefore, this assessment is a guide, the results of which should be checked with the water supplier.

Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used providing the strata is the same as that in which water supply pipes are likely to be located.

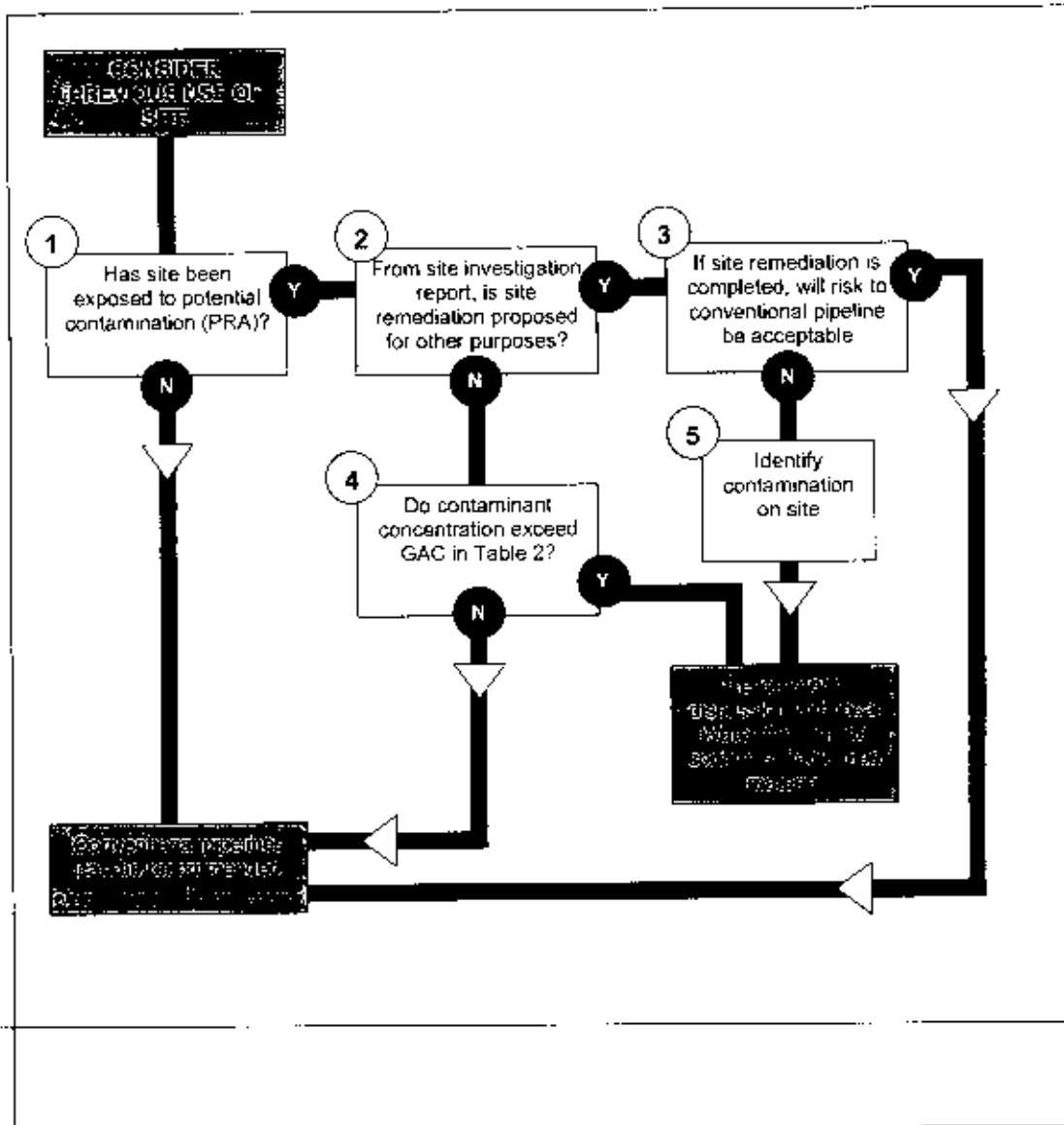
The GAC for this linkage are recorded in Table A2 and are based on recommendations of the 'Foundation for Water Research Guidance Note, FR0448: Laying Potable Water Pipelines in Contaminated Ground, 1994'. Owing to the number of caveats and lack of research into contaminants that could affect water supply, the water industry has undertaken research on a project entitled 'Pipe Materials Selection and Specification for use in Contaminated Land'. This document will be used to update the GAC for this pathway once available.

**Table A2: Generic Assessment Criteria for Water Supply Pipes**

CONTAMINANT	GAC (mg/kg dried soil)
<b>Corrosion</b>	
Sulphate (SO <sub>4</sub> )	2000
Sulphur (S)	5000
Sulphide	250
pH	Less than pH5 Greater than pH8
<b>Toxic Substances</b>	
Antimony (Sb)	10
Arsenic (As)	10*
Cadmium (Cd)	3
Chromium (hexavalent) (Cr)	25
Chromium (total) (Cr)	600
Cyanide (free) (CN)	25*
Cyanide (complexed) (CN)	250*
Lead (Pb)	500
Mercury (Hg)	1
Selenium (Se)	3
Thiocyanate (SCN)	50
<b>Organic Contaminants</b>	
Coal Tar	50
Cyclohexane extractable	50
Phenol	5
Polycyclic Aromatic Hydrocarbons	50
Toluene extractable	50
Petroleum Hydrocarbons	50
Notes: * denotes 'it is not recommended that water pipes should be laid in sites where these substances are identified or suspected'.	

FIGURE A1

FLOW CHART FOR WATER SUPPLY PIPELINE ASSESSMENT ADOPTED FROM  
GUIDANCE NOTE 9-04-03



### CONTROLLED WATERS

The GAC for controlled waters are presented in Table A3. In line with the Environment Agency's Remedial Targets Methodology dated December 2006, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- Whether the substance is classified as List I or List II substance by the EU under the Groundwater Directive 80/68/EEC;
- Background concentrations in the aquifer; and
- Published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2001 that are protective of drinking water.

A list of target concentrations considered suitable to assess risks to major aquifers and minor aquifers are presented in Table A3. Those for a major aquifer are taken from the UK Water Supply (Water Quality) Standards where possible owing to the possibility of a drinking water supply being within an influencing distance from the site or the possibility of one being installed. The target concentrations for a minor aquifer are generally taken as the freshwater Environmental Quality Standards where available owing to groundwater in minor aquifers commonly providing base flow to surface watercourses.

**Table A3: Target Concentrations for Controlled Waters**

Determinand	Target Concentrations (mg/l)	
	Major Aquifer/Source Protection Zone	Minor Aquifer/Surface Watercourse
<b>Metals</b>		
Arsenic	0.01 <sup>(1)</sup>	0.05 <sup>(7)</sup>
Cadmium	0.005 <sup>(1)</sup>	0.005 <sup>(7)</sup>
Chromium (total)	0.05 <sup>(1)</sup>	0.005, 0.01, 0.02, 0.02, 0.05, 0.05 <sup>(8)</sup>
Copper	2.0 <sup>(7)</sup>	0.001, 0.006, 0.01, 0.01, 0.01, 0.02 <sup>(8)</sup>
Lead	0.025 <sup>(1)</sup>	0.004, 0.01, 0.01, 0.02, 0.02, 0.02 <sup>(8)</sup>
Mercury	0.001 <sup>(1)</sup>	0.001 <sup>(7)</sup>
Selenium	0.01 <sup>(1)</sup>	0.01 <sup>(1,12)</sup>
Nickel	0.02 <sup>(1)</sup>	0.05, 0.1, 0.15, 0.15, 0.2, 0.2 <sup>(9)</sup>
Zinc	5 <sup>(2)</sup>	0.008, 0.05, 0.075, 0.075, 0.075, 0.125 <sup>(6)</sup>
<b>Chlorinated Solvents</b>		
Trichloroethene	0.01 <sup>(1)</sup>	0.01 <sup>(7)</sup>
Tetrachloroethene		0.01 <sup>(7)</sup>

1,1,1-Trichloroethane	0.0001 <sup>(2)</sup>	0.1 <sup>(7)</sup>
1,1,2-Trichloroethane	0.0001 <sup>(3)</sup>	0.4 <sup>(7)</sup>
Carbon Tetrachloride	0.0001 <sup>(3)</sup>	0.0001 <sup>(3,12)</sup>
1,2-Dichloroethane	0.003 <sup>(1)</sup>	0.01 <sup>(7)</sup>
Vinyl Chloride	0.0005 <sup>(1)</sup>	0.0005 <sup>(1,12)</sup>
Tetrachloromethane	0.003 <sup>(1)</sup>	0.012 <sup>(7)</sup>
Trihalomethanes	0.1 <sup>(4)</sup>	0.1 <sup>(4,12)</sup>
Chloroform	-	0.012 <sup>(7)</sup>
<b>Polycyclic Aromatic Hydrocarbons</b>		
Acenaphthene	0.0058 <sup>(9,13)</sup>	0.0058 <sup>(9)</sup>
Acenaphthylene	0.0058 <sup>(9,13)</sup>	0.0058 <sup>(9)</sup>
Anthracene	0.000012 <sup>(9,13)</sup>	0.000012 <sup>(9)</sup>
Benzo(a)anthracene	0.000018 <sup>(9,13)</sup>	0.000018 <sup>(9)</sup>
Benzo(b)fluoranthene	0.0001 <sup>(1)</sup>	0.000014 <sup>(9)</sup>
Benzo(k)fluoranthene		0.000014 <sup>(9)</sup>
Benzo(g,h,i)perylene		0.00002 <sup>(9)</sup>
Indeno(1,2,3-cd)pyrene		No data <sup>(9)</sup>
Chrysene	0.00001 <sup>(9,13)</sup>	0.00001 <sup>(9)</sup>
Dibenzo(a,h)anthracene	0.00001 <sup>(9,13)</sup>	0.00001 <sup>(9)</sup>
Fluoranthene	0.00001 <sup>(9,13)</sup>	0.00001 <sup>(9)</sup>
Fluorene	0.0021 <sup>(9,13)</sup>	0.0021 <sup>(9)</sup>
Phenanthrene	0.003 <sup>(9,13)</sup>	0.003 <sup>(9)</sup>
Pyrene	0.00004 <sup>(9,13)</sup>	0.00004 <sup>(9)</sup>
Benzo(a)pyrene	0.00001 <sup>(1)</sup>	0.000015 <sup>(9)</sup>
Naphthalene	0.01 <sup>(9,13)</sup>	0.01 <sup>(7)</sup>
<b>Petroleum Hydrocarbons</b>		
Total Petroleum Hydrocarbons	0.01 <sup>(2)</sup>	0.01 <sup>(2,10)</sup>
Benzene	0.001 <sup>(1)</sup>	0.03 <sup>(7)</sup>
Toluene	0.004 <sup>(6)</sup>	0.05 <sup>(7)</sup>
Ethylbenzene	0.02 <sup>(9,13)</sup>	0.02 <sup>(8)</sup>
Xylene	0.003 <sup>(3)</sup>	0.03 <sup>(7)</sup>
Methyl t-Butyl ether	0.015 <sup>(6)</sup>	0.015 <sup>(6,12)</sup>
<b>Pesticides and Herbicides</b>		
Aldrin	0.00003 <sup>(7)</sup>	0.00001 <sup>(7)</sup>
Dieldrin	0.00003 <sup>(1)</sup>	0.00003 <sup>(1,12)</sup>
Heptachlor	0.00003 <sup>(1)</sup>	0.00003 <sup>(1,12)</sup>
Heptachlor epoxide	0.00003 <sup>(1)</sup>	0.00003 <sup>(1,12)</sup>
Other pesticides	0.0001 <sup>(1)</sup>	0.0001 <sup>(1,12)</sup>
Total pesticides	0.0005 <sup>(1)</sup>	0.0005 <sup>(1,12)</sup>
Endrin	0.000005 <sup>(7,13)</sup>	0.000005 <sup>(7)</sup>
Total DDT	0.000025 <sup>(7,13)</sup>	0.000025 <sup>(7)</sup>
Azinphos - methyl	0.00001 <sup>(7,12)</sup>	0.00001 <sup>(7)</sup>
Cyfluthrin	0.000001 <sup>(7,13)</sup>	0.000001 <sup>(7)</sup>
Demeton	0.0005 <sup>(7,13)</sup>	0.0005 <sup>(7)</sup>

Dichlorvos	0.000001 <sup>(7,13)</sup>	0.000001 <sup>(7)</sup>
Dimethoate	0.001 <sup>(7,13)</sup>	0.001 <sup>(7)</sup>
Endosulphan	0.000003 <sup>(7,13)</sup>	0.000003 <sup>(7)</sup>
Fenitrothion	0.000001 <sup>(7,13)</sup>	0.000001 <sup>(7)</sup>
Flucifuron	0.001 <sup>(7,13)</sup>	0.001 <sup>(7)</sup>
Malathion	0.00001 <sup>(7,13)</sup>	0.00001 <sup>(7)</sup>
Mevinphos	0.00002 <sup>(7,13)</sup>	0.00002 <sup>(7)</sup>
Omethoate	0.00001 <sup>(7,13)</sup>	0.00001 <sup>(7)</sup>
PCSDs	0.00005 <sup>(7,13)</sup>	0.00005 <sup>(7)</sup>
Permethrin	0.00001 <sup>(7,13)</sup>	0.00001 <sup>(7)</sup>
Sulcofuron	0.025 <sup>(7,13)</sup>	0.025 <sup>(7)</sup>
Triazaphos	0.000005 <sup>(7,13)</sup>	0.000005 <sup>(7)</sup>
Atrazine & Simazine	0.002 <sup>(7,13)</sup>	0.002 <sup>(7)</sup>
Bentazone	0.5 <sup>(7,13)</sup>	0.5 <sup>(7)</sup>
Linuron	0.002 <sup>(7,13)</sup>	0.002 <sup>(7)</sup>
Mecoprop	0.02 <sup>(7,13)</sup>	0.02 <sup>(7)</sup>
Trifluralin	0.0001 <sup>(7,13)</sup>	0.0001 <sup>(7)</sup>
<b>Miscellaneous</b>		
Cyanide	0.05 <sup>(1)</sup>	0.05 <sup>(1,12)</sup>
Phenol	0.0001 <sup>(2)</sup>	0.03 <sup>(7)</sup>
Sodium	200 <sup>(1)</sup>	170 <sup>(7)</sup>
Chloride	250 <sup>(1)</sup>	250 <sup>(7)</sup>
Ammonium (as NH <sub>4</sub> <sup>+</sup> )	0.5 <sup>(1)</sup>	0.5 <sup>(1,12)</sup>
Ammonia (NH <sub>3</sub> as N)	0.015 <sup>(7,13)</sup>	0.015 <sup>(7)</sup>
Sulphate	250 <sup>(1)</sup>	400 <sup>(7)</sup>
Iron	0.20 <sup>(1)</sup>	1 <sup>(7)</sup>
Manganese	0.05 <sup>(1)</sup>	0.05 <sup>(1,12)</sup>
Aluminium	0.2 <sup>(1)</sup>	0.2 <sup>(1,12)</sup>
Nitrate (as NO <sub>3</sub> )	50 <sup>(1)</sup>	50 <sup>(1,12)</sup>
Nitrite (as NO <sub>2</sub> )	0.5 <sup>(1)</sup>	0.5 <sup>(1,12)</sup>

#### Notes

1. Statutory Instrument 2000 No 3184. The Water Supply (Water Quality) Regulations.
2. Statutory Instrument 1989 No 1147. The Water Supply (Water Quality) Regulations, 1989.
3. Environment Agency. Minimum Reporting Values listed in Appendix 7 of Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control and Trigger Levels. LFTGN01. Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
4. Statutory Instrument 1989 No 3184. The Water Supply (Water Quality) Regulations, 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
5. Target concentration for Major Aquifer receptor taken as equal to target concentration for Minor Aquifer owing to absence of published guidance for PAH compounds other than those which are carcinogenic.
6. Environment Agency MTBE Guidance.
7. Freshwater Environmental Quality Standards
8. Freshwater Environmental Quality Standards for all fish life (including game) and dependent upon hardness range. Hardness ranges are: 0-50mg/l CaCO<sub>3</sub>, 50-100 mg/l CaCO<sub>3</sub>, 100-150 mg/l CaCO<sub>3</sub>, 150-200 mg/l CaCO<sub>3</sub>, 200-250 mg/l CaCO<sub>3</sub> and >250 mg/l CaCO<sub>3</sub>. The target concentrations included in Table 3 are listed in order of increasing calcium carbonate concentrations.
9. Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development, WRc Plc, R&D Technical Report P45, 2002. Where Predicted No-Effect Concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(a,h)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
10. Owing to hydrocarbons being List I substances, 0.01mg/l (DWS) should be used in the first instance against the total of the hydrocarbon bands. However, if the hydrocarbon concentrations measured in groundwater exceed this value, an alternative value of 0.05mg/l could be used providing it is justified based on the type of aquifer and distance to secondary receptors such as a stream. The value is taken as the lowest concentration in Statutory Instrument 1996 No. 3001 titled The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations, 1996.
11. Value for ethylbenzene taken from R&D Technical Report P2-115/TR4 – Proposed Environmental Quality Standards for Ethylbenzene in Water.
12. Where a published target concentration considered suitable for use with a minor aquifer could not be found for certain substances such as selenium, the target concentration used for the major aquifer has been adopted.
13. Where a published target concentration considered suitable for use with a major aquifer could not be found for certain substances such as ethylbenzene, the target concentration used for the minor aquifer has been adopted.

∴ A target concentration for chloroform for a major aquifer is absent since it is one of the trihalomethane compounds. See note 4 above.

**APPENDIX J**

**Human Health 95<sup>th</sup> Percentile Sheets/Screen**

STATISTICAL TESTS FOR CONTAMINATED LAND EXPOSURE ASSESSMENT MODEL (CLEA)

**SITE DETAILS**

MEAN VALUE TEST

PROJECT TITLE:

PROJECT NUMBER:

SAMPLING DATE:

DATE ENTERED BY:

DATE:

**INORGANIC CONTAMINANTS**

Sample ID	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Selenium mg/kg	Copper mg/kg	Zinc mg/kg
PH1 AT 0.4M N	10	0.3	30	10	0.0	19	3	11	37
PH1 AT 1.0M N	9	0.3	39	14	0.0	23	3	14	45
PH2 AT 0.4M N	7	0.3	26	9	0.0	16	3	9	36
PH2 AT 1.0M N	6	0.3	23	13	0.0	13	3	9	31
PH3 AT 0.4M N	8	0.3	26	14	0.0	21	3	12	45
PH3 AT 1.0M N	5	0.3	19	12	0.0	12	3	7	24
PH7 AT 0.2M N									
PH7 AT 0.5M N	14	0.3	33	20	0.0	24	3	13	38
S1 AT 0.2M T									
S2 AT 0.5M T									

**MEAN VALUE TESTS**

Sampling check for mean value test:  Residential with plant uptake

Upper skin permeability:  Residential with plant uptake

Comparison with GAC:  Residential with plant uptake

Source of GAC:  Residential with plant uptake

Sampling check for max value test:  Residential with plant uptake

Maximum Value Test Report:  Residential with plant uptake











**APPENDIX K**  
**CAT-WASTE<sup>SOIL</sup> RESULTS**

---

**CAT-WASTE SOIL**

Classification Assessment Tool of Soil Wastes - Hazard Summary Sheet

Site Name	Former Happy Man Public House
Location	Berry Lane, Rickmansworth
Site ID	22852
Job Number	22852
Date	4/14/2008 1:16:48 PM
User Name	neulin@rsk.co.uk
Company Name	RSK ENSR



PH	Sample Depth	H1	H2	H3A	H3B	H4	H5	H6	H7	H8
PH1	0.4m	N	False	False	False	False	False	False	False	False
PH1	1.1m	N	False	False	False	False	False	False	False	False
PH2	0.45m	N	False	False	False	False	False	False	False	False
PH3	0.4m	N	False	False	False	False	False	False	False	False
PH4	0.5m	N	False	False	False	False	False	False	False	False
PH5	0.4m	N	False	False	False	False	False	False	False	False
PH6	0.35m	N	False	False	False	False	False	False	False	False
PH7	0.2m	N	False	False	False	False	False	False	False	False
PH7	0.5m	N	False	False	False	False	False	False	False	False
S1	0.05m	N	False	False	False	False	False	False	False	False
S2	0.05m	N	False	False	False	False	False	False	False	False
PH	Sample Depth	H1	H2	H3A	H3B	H4	H5	H6	H7	H8
PH1	0.4m	N	False	False	False	False	False	False	False	False
PH1	1.1m	N	False	False	False	False	False	False	False	False
PH2	0.45m	N	False	False	False	False	False	False	False	False
PH3	0.4m	N	False	False	False	False	False	False	False	False
PH4	0.5m	N	False	False	False	False	False	False	False	False
PH5	0.4m	N	False	False	False	False	False	False	False	False
PH6	0.35m	N	False	False	False	False	False	False	False	False
PH7	0.2m	N	False	False	False	False	False	False	False	False
PH7	0.5m	N	False	False	False	False	False	False	False	False
S1	0.05m	N	False	False	False	False	False	False	False	False
S2	0.05m	N	False	False	False	False	False	False	False	False

Classification Assessment Tool of Soil Wastes - Individual Compound Information



Site Name	Happy Man
Location	Rickmansworth
SiteID	22852
Job Number	22852
Date	4/14/2008 1:16:48 PM
User Name	neusling@risk.co.uk
Company Name	RSK ENSR

Hole ID	Sample Depth	Contaminant	Contaminant Concentration (%)	Hazardous Waste Y/N	Hazard Class	Risk Phrases Exceeded	Additional Risk Phrases (see notes section)
PH1	0.4m	Benzene	1E-06	N			R11 test
PH1	0.4m	Toluene	1E-06	N			R11 test
PH1	0.4m	Ethylbenzene	1E-06	N			R11 test
PH1	0.4m	m,p-xylene	1E-06	N			R10 test flash point
PH1	0.4m	o-xylene	1E-06	N			R10 test flash point
PH1	0.4m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH1	0.4m	Chromium (Total)	0.00336159	N			R43 see comment
PH1	0.4m	Nickel	0.003954853	N			R42 see comment, R43 see comment
PH1	1.1m	Benzene	1E-06	N			R11 test
PH1	1.1m	Toluene	1E-06	N			R11 test
PH1	1.1m	Ethylbenzene	1E-06	N			R11 test
PH1	1.1m	m,p-xylene	1E-06	N			R10 test flash point
PH1	1.1m	o-xylene	1E-06	N			R10 test flash point
PH1	1.1m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH1	1.1m	Chromium (Total)	0.004384683	N			R43 see comment
PH1	1.1m	Nickel	0.005009227	N			R42 see comment, R43 see comment
PH2	0.45m	Chromium (Total)	0.00526162	N			R43 see comment
PH2	0.45m	Nickel	0.006063802	N			R42 see comment, R43 see comment
PH3	0.4m	Benzene	1E-06	N			R11 test
PH3	0.4m	Toluene	1E-06	N			R11 test
PH3	0.4m	Ethylbenzene	1E-06	N			R11 test
PH3	0.4m	m,p-xylene	1E-06	N			R10 test flash point
PH3	0.4m	o-xylene	1E-06	N			R10 test flash point
PH3	0.4m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH3	0.4m	Chromium (Total)	0.003900059	N			R43 see comment
PH3	0.4m	Nickel	0.004216297	N			R42 see comment, R43 see comment
PH4	0.5m	Benzene	1E-06	N			R11 test
PH4	0.5m	Toluene	1E-06	N			R11 test
PH4	0.5m	Ethylbenzene	1E-06	N			R11 test
PH4	0.5m	m,p-xylene	1E-06	N			R10 test flash point
PH4	0.5m	o-xylene	1E-06	N			R10 test flash point
PH4	0.5m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH4	0.5m	Chromium (Total)	0.00336159	N			R43 see comment
PH4	0.5m	Nickel	0.003427306	N			R42 see comment, R43 see comment
PH5	0.4m	Chromium (Total)	0.004238527	N			R43 see comment



Classification Assessment Tool of Soil Wastes - Individual Compound Information



Site Name	Happy Man
Location	Rickmansworth
Site ID	22652
Job Number	22652
Date	4/19/2008 1:18:48 PM
User Name	nauslin@atkins.co.uk
Company Name	RSK ENSR

Hole ID	Sample Depth	Contaminant	Concentration (%)	Hazardous Waste Y/N	Hazard Class	Risk Phrases Exceeded	Additional Risk Phrases (see notes section)
PH5	0.4m	Nickel	0.005538515	N			R42 see comment, R43 see comment
PH8	0.35m	Benzene	1E-08	N			R11 test
PH8	0.35m	Toluene	1E-08	N			R11 test
PH6	0.35m	Ethylbenzene	1E-06	N			R11 test
PH6	0.35m	m,p-xylene	1E-06	N			R10 test flash point
PH8	0.35m	o-xylene	1E-06	N			R10 test flash point
PH8	0.35m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH8	0.35m	Chromium (Total)	0.002776966	N			R43 see comment
PH6	0.35m	Nickel	0.003163723	N			R42 see comment, R43 see comment
PH7	0.2m	Benzene	1E-06	N			R11 test
PH7	0.2m	Toluene	1E-06	N			R11 test
PH7	0.2m	Ethylbenzene	1E-06	N			R11 test
PH7	0.2m	m,p-xylene	1E-06	N			R10 test flash point
PH7	0.2m	o-xylene	1E-06	N			R10 test flash point
PH7	0.2m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH7	0.2m	Chromium (Total)	0.001481561	N			R43 see comment
PH7	0.2m	Nickel	0.001768412	N			R42 see comment, R43 see comment
PH7	0.5m	Benzene	1E-06	N			R11 test
PH7	0.5m	Toluene	1E-06	N			R11 test
PH7	0.5m	Ethylbenzene	1E-06	N			R11 test
PH7	0.5m	m,p-xylene	1E-06	N			R10 test flash point
PH7	0.5m	o-xylene	1E-06	N			R10 test flash point
PH7	0.5m	Methyl-tert-butyl ether	1E-06	N			R11 test
PH7	0.5m	Chromium (Total)	0.004823151	N			R43 see comment
PH7	0.5m	Nickel	0.006327445	N			R42 see comment, R43 see comment
S1	0.05m	Chromium (Total)	0.003058276	N			R43 see comment
S1	0.05m	Nickel	0.004218287	N			R42 see comment, R43 see comment
S2	0.05m	Chromium (Total)	0.003507745	N			R43 see comment
S2	0.05m	Nickel	0.003954653	N			R42 see comment, R43 see comment

Notes - Additional Information on Risk Phrases

R1 to R8	Test for explosives except when the waste is covered by the Explosives Act 1875	Test to establish whether a substance or preparation presents a danger of explosion when submitted to the effect of a flame (thermal sensitivity), impact or friction. Undertake Test Method A14 from EC Directive 92/62/EEC
R7, R8 and R9	Test/calculation for oxidises	Applicable to solid compounds that are not explosive, highly flammable, organic peroxides or combustible. A test for the compounds oxidising properties as described in Directive 92/69/EEC, Test Method A17. For organic peroxides calculate the available oxygen content (%). For liquids and oxidising materials not covered by those previously listed no testing available.
R10	R10 test flash point	Flashpoint test as per Directive 92/62/EEC, Test Method A9
R11	R11 test flash point	For liquid substances, undertake the flashpoint test as per Directive 92/62/EEC, Test Method A8. For solid substances undertake flammability test as per directive 92/62/EEC, Test Method A10
R12	R12 test flammability	Flammability of passes test as per Directive 92/62/EEC, Test Method A11.
R15	R15 test flammability	To test the flammability of a substance when in contact with water test as per Directive 92/62/EEC, Test Method A12.
R16	R16 test for explosives	Test to establish whether a substance or preparation present a danger of explosion when submitted to the effect of a flame (thermal sensitivity), impact or friction. Undertake Test Method A14 from EC Directive 92/62/EEC
R17	R17 pyrophoric test	To test the pyrophoric properties of solids and liquids test as per Directive 92/62/EEC, Test Method A13.
R18	R18 test for flammable explosive vapour air mixture	Test to establish whether a substance or preparation presents a danger of explosion when submitted to the effect of a flame (thermal sensitivity), impact or friction. Undertake Test Method A14 from EC Directive 92/62/EEC
R19	R19 test for flammable explosive peroxides	Test to establish whether a substance or preparation present a danger of explosion when submitted to the effect of a flame (thermal sensitivity), impact or friction. Undertake Test Method A14 from EC Directive 92/62/EEC
R29	R29 test or calculation	Undertake test as per Directive 92/62/EEC, Test Method A12.
R31	R31 test or calculation	Undertake testing as per Directive 92/62/EEC, Test Method A12 modified to replace water with an acid which will not cause a displacement reaction to occur. Method to measure SO2 evolved when a waste is in contact with an acid (see Environment Agency SWEN 065).
R32	R32 test or calculation	Undertake testing as per Directive 92/62/EEC, Test Method A12 modified to replace water with an acid which will not cause a displacement reaction to occur.
R42 and R43	No test available	No test available for sensitisation
R44	R44 test for explosives	Test to establish whether a substance or preparation present a danger of explosion when submitted to the effect of a flame (thermal sensitivity), impact or friction. Undertake Test Method A14 from EC Directive 92/62/EEC
R54 to R58	see comment	Classification of waste as ecotoxic (on the basis of terrestrial non-aquatic toxicity) is not applicable due to the lack of detailed information. Until more data becomes available R54 to R58 should not be considered when assessing the ecotoxic hazard of wastes and classifications should be based upon aquatic toxicity data. Where there is reason to believe that a waste contains substances that only have effects on the terrestrial environment, guidance on the appropriate test method should be obtained from the Environment Agency.

Notes:

Testing of compounds which would be classified under H14 should only be undertaken where the hazards cannot be adequately identified. (i.e. where the waste contains a substance/s for which there is no aquatic toxicity data and/or where the waste is an uncharacterised mixture and/or there is the potential that the waste may contain unknown substances or breakdown products.  
Aquatic toxicity testing should be undertaken in accordance with the Environmental Health and Safety Publication, series on Testing and Assessment No. 23 ENV/JM/MONO(2000) 6 June 2000

**APPENDIX L**

**Geotechnical Test Results**



No 2652



Karl Bissett  
18 Frogmore Road  
Hemel Hempstead  
Hertfordshire  
HP3 9RT

**STRUCTURAL  
SOILS LTD**

10<sup>th</sup> April 2008

**TESTING REPORT**

—  
SITE INVESTIGATION  
—

—  
SOIL, ROCK &  
MATERIAL TESTING  
—

—  
GEOTECHNICAL  
CONSULTANCY  
—

—  
CONTAMINATED  
LAND ASSESSMENT  
—

YOUR REF: 22852

SITE: TUDOR WAY

CERTIFICATE NUMBER: 580345

DATE SAMPLES RECEIVED: 28<sup>th</sup> March 2008  
DATE TESTING COMMENCED: 2<sup>nd</sup> April 2008

DATE OF SAMPLE DISPOSAL: 10<sup>th</sup> May 2008

INSTRUCTIONS: Please carry out Moisture Content, Atterberg Limit, Sieve Analysis and Saturated Moisture Content tests on samples provided.

Dear Mr Bissett,

I have pleasure in enclosing the test report for the above project that you submitted to us for testing.

Yours sincerely

*P Kent*

P Kent  
Laboratory Manager

Enc.

18 FROGMORE ROAD  
HEMEL HEMPSTEAD  
HERTS  
HP3 9RT  
TEL: 01442 262 323  
FAX: 01442 262 585  
hemel@soils.co.uk  
www.soils.co.uk

HEAD OFFICE:  
Bristol

BRANCH OFFICE:  
Castleford  
West Yorkshire

Date: 10/04/2008

Drawn by: SC

Template Issue: 4

Filename: 580345 / 01\_SD.XLS

Borehole	Depth (m)	Moisture Content (%)	Sample Description
PH1	1.50	17	Dark brown gravelly (fine to coarse) CLAY with fine to medium flint fragments, some pockets of fine to medium sand and traces of rootlets.
PH2	1.10	14	Dark orangey brown CLAY with fine to coarse gravel and flint fragments and occasional pockets of fine to medium sand.
PH2	1.40	12	Dark brown sandy, gravelly (fine to medium) CLAY with pockets of fine to medium sand.
PH3	1.10	14	Dark orangey brown very gravelly (fine to coarse), slightly silty CLAY with fine to coarse flint fragments.
PH3	2.00	15	Dark orangey brown slightly silty, gravelly (fine to coarse) CLAY.
PH3	2.50	20	Orangey brown slightly silty, sandy CLAY with occasional fine to medium gravel.
PH4	1.10	20	Orangey brown CLAY with fine to medium gravel and some pockets of fine to medium sand.
PH4	1.60	21	Orangey brown slightly silty CLAY with some fine to medium gravel.
PH5	1.10	12	Dark brown very gravelly (fine to coarse) CLAY.
PH5	1.50	20	Bright orangey brown slightly silty CLAY with occasional fine to medium gravel.

Moisture contents tested in accordance with BS 1377: Part 2: 1990: Clause 3

Key to Gravel Sizes:      fine      -      2 to 5mm  
    medium    -      5 to 20mm  
    coarse    -      20 to 60mm

### SUMMARY OF SAMPLE DESCRIPTIONS AND MOISTURE CONTENT



Date: 10/04/2003

Drawn by: SC

Template Issue: 4

Filename: 580345 / 02\_SD.XLS

Borehole	Depth (m)	Moisture Content (%)	Sample Description
PH7	1.30	16	Bright orangey brown slightly silty, slightly gravelly (fine to medium) CLAY with occasional fine to medium flint fragments.
PH7	1.60	14	Bright orangey brown slightly silty, slightly gravelly (fine to medium) CLAY with occasional fine to medium flint fragments.
BH1	4.00	-	Orangey brown gravelly (fine to medium), fine to medium SAND.
BH1	5.00	-	Dark orangey brown very gravelly (fine to medium) SAND.
BH1 / U2	8.80	24	Light grey putty chalk with frequent fine to coarse gravel and chalk fragments.
BH1 / U3	12.50	26	Light grey putty chalk with frequent fine to coarse gravel and chalk fragments.

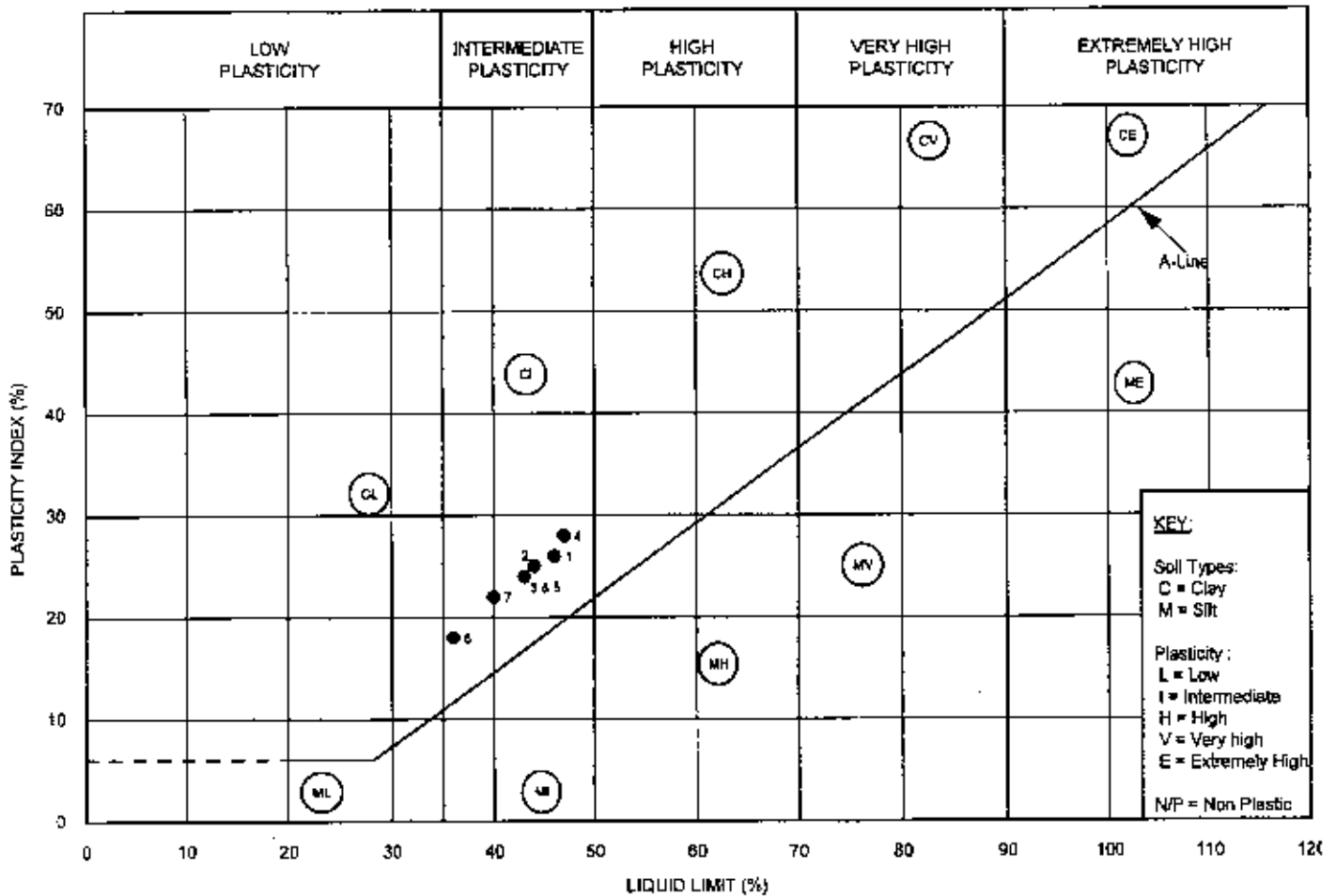
Moisture contents tested in accordance with BS 1377: Part 2: 1990: Clause 3

Key to Gravel Sizes:      fine      -      2 to 6mm  
    medium    -      6 to 20mm  
    coarse    -      20 to 60mm

**SUMMARY OF SAMPLE DESCRIPTIONS AND MOISTURE CONTENT**

Date : 10/04/2002

Drawn by: SC



Plot Number	Borehole	Sample	Depth (m)	BS Test Method*	Preparation Method †	% Passing 425 micron Sieve	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
1	P-H1	-	1.50	4.4/5.3/5.4	4.2.4	46	46	20	26
2	P-H2	-	1.10	4.4/5.3/5.4	4.2.4	40	44	19	25
3	P-H3	-	1.10	4.4/5.3/5.4	4.2.4	56	43	19	24
4	P-H4	-	1.10	4.4/5.3/5.4	4.2.4	65	47	19	28
5	P-H5	-	1.10	4.4/5.3/5.4	4.2.4	33	43	19	24
6	P-H7	-	1.30	4.4/5.3/5.4	4.2.4	70	36	18	18
7	P-H7	-	1.80	4.4/5.3/5.4	4.2.4	52	40	18	22

\*Tested in accordance with the following clauses of BS 1377 Part 2:1990:  
4.3 - Cone Penetrometer Method  
4.4 - One point Cone Penetrometer Method  
4.2 - Casagrande Method  
4.6 - One point Casagrande Method  
5.3 - Plastic Limit Method  
5.4 - Plasticity Index

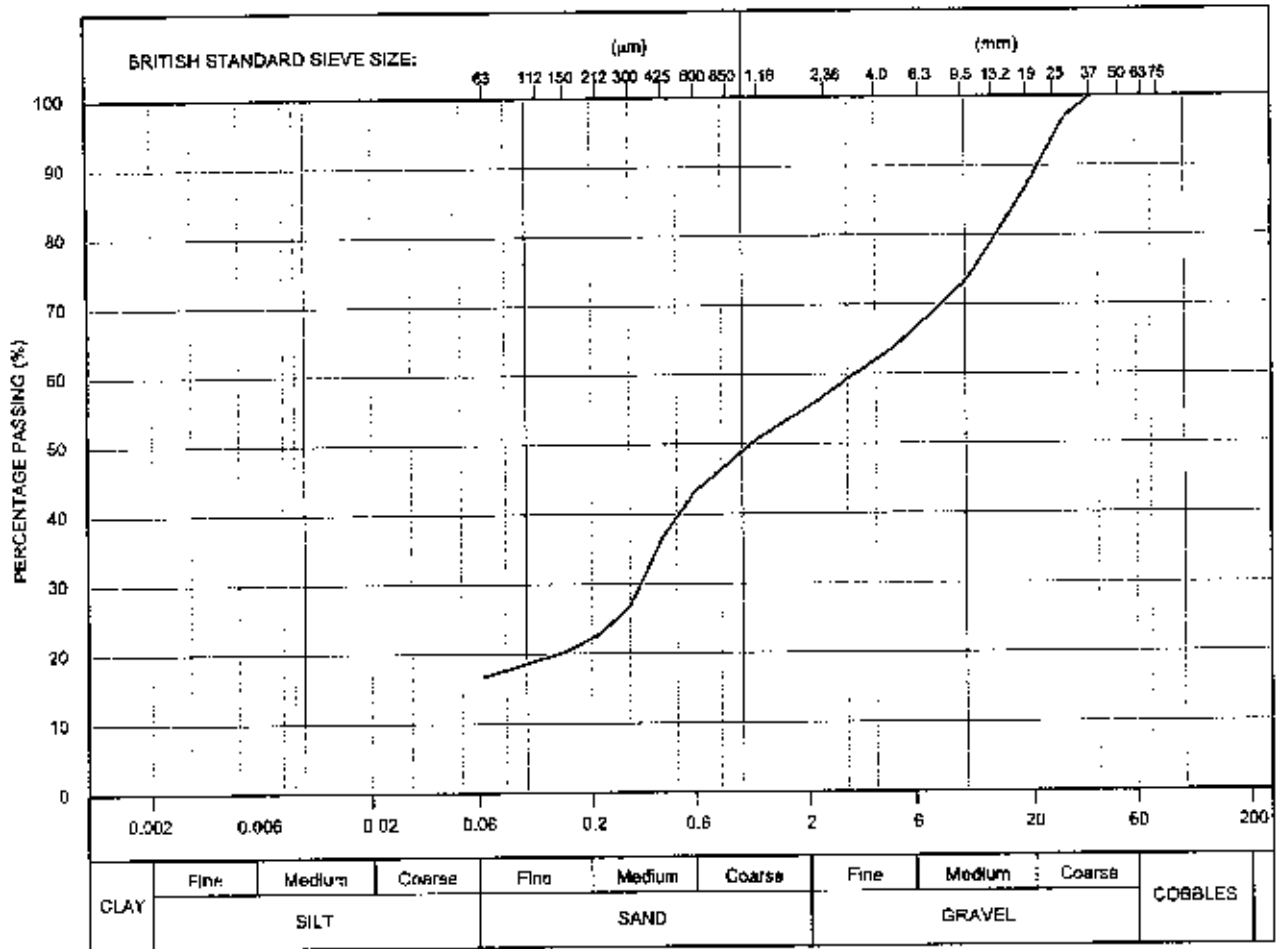
†Tested in accordance with the following clauses of BS 1377 Part 2:1990:  
4.2.2 - Natural Soil  
4.2.4 - Sieved Specimen

### ATTERBERG LIMITS TEST RESULTS



Date: 10/04/2006

Drawn by: SC



Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt **	Sand	Gravel	Cobbles
1	BH1	-	4.00	9.2	Sodium Hex.	-	17	38	45	-

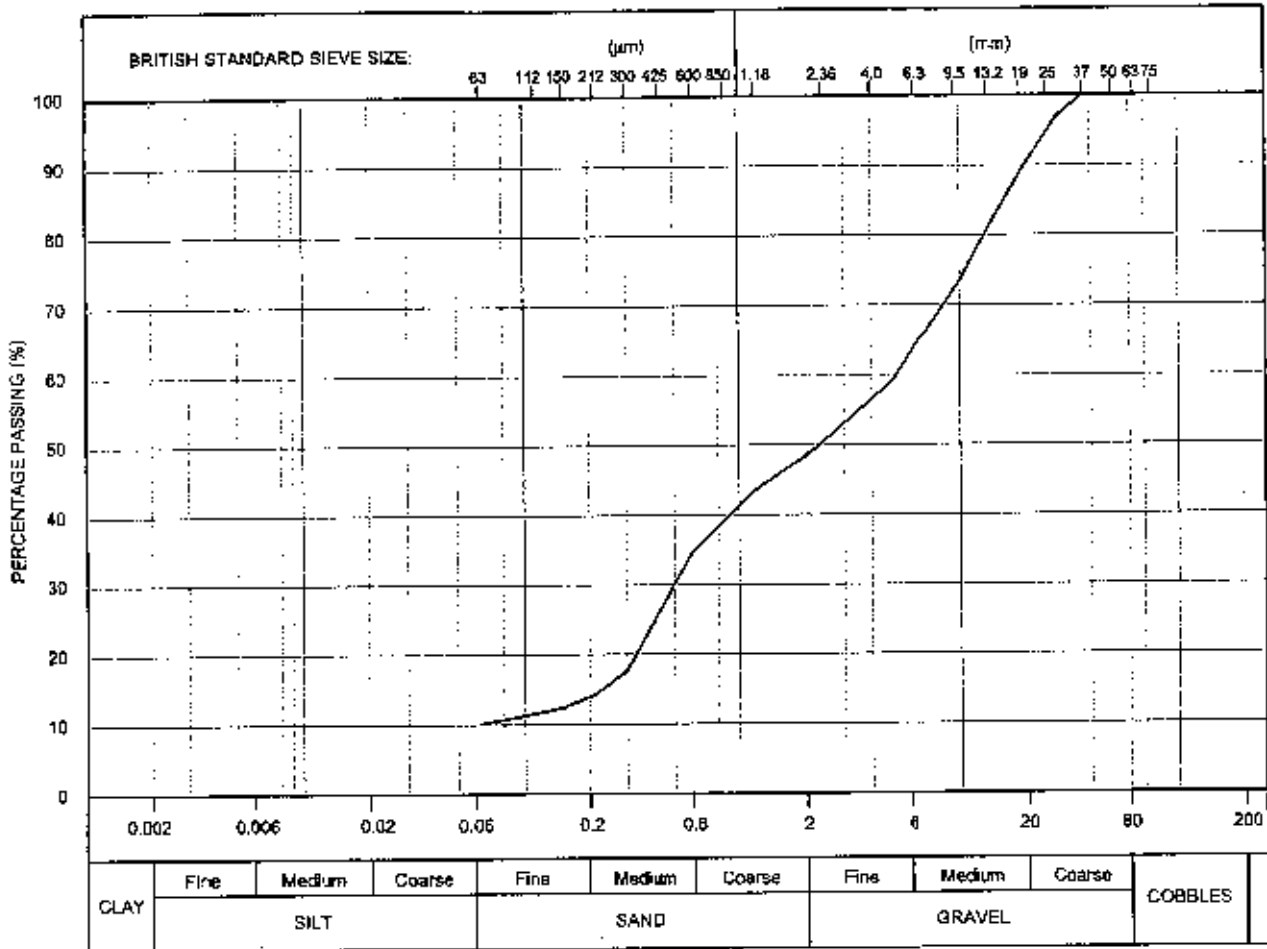
**Notes:**  
 \* Tested in accordance with the following clauses of BS 1377: Part 2: 1990  
 9.2 Wet sieve                      9.4 Sedimentation by pipette  
 9.3 Dry sieve                        9.5 Sedimentation by hydrometer  
 \*\* Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

**PARTICLE SIZE DISTRIBUTION TEST RESULTS**



Date: 10/04/2008

Drawn by: SC



Curve	Borehole	Sample	Depth (m)	BS Test * Method	Pretreatment Method	Percentage soil types				
						Clay	Silt **	Sand	Gravel	Cobbles
1	BH1	-	5.00	9.2	Sodium Hex.	-	10	36	52	-

**Notes:**  
 \* Tested in accordance with the following clauses of BS 1377: Part 2: 1990  
 9.2 Wet sieve                      9.4 Sedimentation by pipette  
 9.3 Dry sieve                        9.5 Sedimentation by hydrometer  
 \*\* Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

**PARTICLE SIZE DISTRIBUTION TEST RESULTS**

Date: 10/04/2008

Drawn by: SC

Template Issue: 2

Filename: 580345 / CLASS / 01\_SMC.XLS

Borehole	Sample	Depth (m)	Bulk Density mg/m <sup>3</sup>	Dry Density mg/m <sup>3</sup>	Saturated Moisture Content (%)
BH1	U2	8.80	1.95	1.57	27
BH1	U3	12.5	1.91	1.51	29

Tested in accordance with BS1377: Part 2: 1990: Clause 3

### SUMMARY OF SATURATED MOISTURE CONTENT TEST RESULTS

Certificate No: 580345

Page 7 of 7

## **APPENDIX M**

### **Environmental Reporting Requirement Checklists**

<b>PRELIMINARY RISK ASSESSMENT REPORTING REQUIREMENTS</b>	<b>Provided?</b>	<b>Reference / Comment</b>
<b>Contents:</b>		
Report objectives	Yes / No	Section 1.1
Site location map and National Grid Reference	Yes / No	Section 2.1
Site layout plans *	Yes / No	Section 2.3
Site area in hectares	Yes / No	Section 2.3
Description of site and surroundings	Yes / No	Section 2.2
Details of desk study researches undertaken	Yes / No	Sections 2.4 and 3.0 excluding 3.7
Information on past and current activities at the site	Yes / No	Sections 2.2 and 3.6
Details of intended future use of the site	Yes / No	Section 1, Site Plan (Figure 2).
Unique references for all relevant planning applications or permissions at the site	Yes / No	Not applicable
Historical Ordnance Survey maps* and site plans* and if available, aerial photographs	Yes / No	Figures 2 to 7. No aerial photographs attached or reviewed.
Superficial deposits and solid geology	Yes / No	Section 3.1
Hydrology	Yes / No	Section 3.4
Hydrogeology (including the interaction between all relevant shallow and deep groundwater and how they flow to potential receptors)	Yes / No	Section 3.3
Location and status of relevant surface water and groundwater receptors, including all abstracted uses and natural discharge such as springs, river baseflow and wetlands.	Yes / No	Section(s) 3.3, 3.4, 3.9
Ecological receptors	Yes / No	Not applicable
Human Health receptors	Yes / No	Section(s) 3.8
Information on site drainage and other man-made potential pollutant pathways, e.g. underground services	Yes / No	Section(s) 3.11.

<b>PRELIMINARY RISK ASSESSMENT REPORTING REQUIREMENTS</b>  <b>Contents:</b>	<b>Provided?</b>	<b>Reference / Comment</b>
Identification of potential contaminants of concern and source areas	Yes / No	Sections 3.7.1, Table 2 within text
Consultations with the local authority	Yes / No	Not applicable
Consultations with the Environment Agency	Yes / No	Not applicable
Consultations with other appropriate bodies	Yes / No	Not applicable
Review and summary of previous report, with report references	Yes / No	Sections 1.4 and 1.4.
Outline conceptual model with nature and location of receptors clearly identified	Yes / No	Section 3.11
Description of possible pollutant linkages	Yes / No	Section(s) 3.11
Identification of potentially unacceptable risks to receptors including criteria used to identify these risks	Yes / No	Section 5.1
Discussion of uncertainties and gaps in information	Yes / No	Section 3.10
Description and justification of next steps proposed at the site, e.g. carry out site investigation and quantitative risk assessment	Yes / No	Section 3.12

<b>SITE INVESTIGATION REPORTING REQUIREMENTS</b>	<b>Provided?</b>	<b>Reference / Comment</b>
<b>Contents</b>		
Report objectives	Yes / No	Section 1.1
Site location map and National Grid Reference	Yes / No	Section 2.1
Site layout plan	Yes / No	Figure 2
Review and summary of previous reports, with report references	Yes / No	Sections 1.4 and 2.4
Outline conceptual model	Yes / No	Section 3.11
Results of preliminary risk assessment	Yes / No	Section 3.12
Details of any preparatory enabling works e.g. moving mounds of waste, breaking out concrete	Yes / No	Not applicable
Investigation objectives	Yes / No	Section 4
Summary of work done	Yes / No	Section 4.1
Rationale for investigation	Yes / No	Sections 4.1, 4.1.1
Methods used for forming exploratory holes e.g. borcholes, window samples	Yes / No	Sections 7.1.1 and 7.1.2
Details of any borehole sampling undertaken	Yes / No	Sections 4.1.2 and Appendix F
Methods used for collecting, preserving and transporting samples to the analytical laboratory	Yes / No	Section 4.1
Rationale for sampling strategy	Yes / No	Section 4.4
Description and explanation of monitoring programmes for groundwater and, if encountered, surface waters (upstream and downstream conditions should be represented)	Yes / No	Section 4.1.2 and Tables 1a, 2a and 3a
Monitoring and sampling locations, depths (metres below ground and AOD) and frequencies	Yes / No	Section 4.1.2
Rationale for selection of analytical parameters	Yes / No	Section 4.4
Selection of samples for leachability testing	Yes / No	Section 4.4

<p align="center"><b>SITE INVESTIGATION REPORTING REQUIREMENTS</b></p> <p align="center"><b>Contents</b></p>	<p align="center"><b>Provided?</b></p>	<p align="center"><b>Reference / Comment</b></p>
Description of chemical analyses, in accordance with the MBERTS performance standard for soils	Yes / No	See Laboratory Certificates
Quality assurance and quality control requirements for laboratory analyses	Yes / No	See Laboratory Certificates
Plan showing monitoring and sample point locations*	Yes / No	Site Plan (Figure 2)
Details of <i>in situ</i> tests and geotechnical tests required to provide data for quantitative risk assessment	Yes / No	Sections 7.1.1, 7.1.2 and 7.1.3
Description of site works and on-site observations	Yes / No	Section 7.1
Measures undertaken to prevent pollution of controlled waters as a consequence of site investigation methods used	Yes / No	Not applicable
Presentation and interpretation of investigation results	Yes / No	Appendix L and Section 7
Description of ground conditions encountered at the site, including groundwater regime and surface water features	Yes / No	Sections 4.2 and 4.2.1
Cross-sections showing site strata and shallow and deep groundwater levels	Yes / No	Not applicable. Groundwater levels given on logs within Appendix F.
Summary tables of chemical analyses, site monitoring and geotechnical test	Yes / No	Site groundwater and ground gas information given in Table 1a to 3a attached. Geotechnical test results given in Appendix L. Summary tables of chemical analyses not given- See Appendix G.
Description of type, nature and spatial distribution of contamination, with plans where appropriate*	Yes / No	Not applicable
Evaluation of site investigation results against the outline conceptual model	Yes / No	Refer to Section 5.
Append exploratory hole logs including grid co-ordinates and ground elevation (logged by suitably qualified professionals)	Yes / No	Appendix F. Grid co-ordinates and ground elevation not given.
Append construction details for monitoring boreholes or other type of monitoring installation e.g. response zone, method of sealing borehole annulus	Yes / No	Appendix F
Append monitoring results	Yes / No	Tables 1a to 3a attached
Append groundwater levels	Yes / No	Appendix F and Tables 1a to 3a attached

<b>SITE INVESTIGATION REPORTING REQUIREMENTS</b>  <b>Contents</b>	<b>Provided?</b>	<b>Reference / Comment</b>
Appendix description of samples submitted for analysis	Yes / <del>No</del>	Appendix G
Appendix laboratory analytical reports, completed in accordance with the MDERTS performance standard for soils	Yes / <del>No</del>	Appendices G
Appendix chain of custody records	Yes / No	These can be provided upon request.

<b>QUANTITATIVE RISK ASSESSMENT REPORTING REQUIREMENTS</b>  <b>Contents</b>	<b>Provided?</b>	<b>Reference / Comment</b>
Risk assessment objectives	Yes / No	Section 1.1
Description of proposed development	Yes / No	Section 1.1
Conceptual model, revised following site investigation, with nature and location of controlled waters receptors clearly identified	Yes / No	Sections 4.3 and 5.1
Rationale for the chosen risk assessment approach and explanation for why it is valid for the site	Yes / No	Section 5.1
Discussion of relevant exposure scenarios	Yes / No	Section 5.2
Assessment criteria selected for the site, with justification for all criteria used	Yes / No	Appendix H and I
Description of model, if used, and:	Yes / No	Appendix H
• input parameters	Yes / No	Appendix H
• safety factors	Yes / No	Appendix H
• assumptions	Yes / No	Appendix H
• any sensitivity analysis undertaken	Yes / No	Not applicable
Calculation worksheets provided	Yes / No	Not applicable
Constraints and limitations relating to data quality and risk assessment method	Yes / No	Appendix H
Identification of pollutant linkages that present an unacceptable risk of pollution to controlled waters	Yes / No	Not applicable
Discussion of uncertainties and their impact on the outcome of the risk assessment	Yes / No	Not applicable
Results of risk estimation if detailed quantitative risk assessment is undertaken	Yes / No	No DQRA included
Evaluation of unacceptable risks to controlled waters taking into account both the current use of the site and details of the proposed development, e.g. foundation design, surface drainage and foul water disposal	Yes / No	Section 7.7
Description of evaluation method and criteria used	Yes / No	Section 5.2.6 and Appendix I

10/10/2010

<b>QUANTITATIVE RISK ASSESSMENT REPORTING REQUIREMENTS</b>  <b>Contents</b>	<b>Provided?</b>	<b>Reference / Comment</b>
Description and justification of next steps proposed at the site.	Yes / No	Section 5.3