Report No. 5848/2
Date: May 2005

# QUANTITATIVE RISK ASSESSMENT

**of land at**

**BURTON ROAD, BARNSLEY**

**Prepared for**

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**FOREWORD (Geoenvironmental Investigation Report)**

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Encia Consulting Limited (Encia); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

The report presents observations and factual data obtained during our site investigation, and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Encia prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Encia cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in this report (including review of any third party reports) are based on information obtained from a variety of sources as detailed within this report, and which Encia believes are reliable. All reasonable care and skill has been applied in examining the information obtained. Nevertheless, Encia cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geo-environmental consultants. Encia does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Encia, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present and that houses will be of two storey construction. If this is not to be the case, then some modification to this report may be required.

It should be noted that the banning of the co-disposal of hazardous and non-hazardous waste was introduced in July 2004, as a result of the implementation within the UK of the Landfill Directive. This will considerably affect the current practices and procedures for the handling and disposal of wastes, in particular hazardous wastes. In addition, it will be a requirement for all wastes to be pre-treated and to comply with certain waste acceptance procedures prior to sending wastes to landfill. The full potential effects of these important changes are not known at this stage, but it is perceived that disposal costs will rise, particularly for hazardous wastes, and waste pre-treatment may, in some cases, become an 'additional' redevelopment cost with regard to the remediation of contaminated sites.

Should this report recommend that materials could be excavated and removed off site for landfill disposal, then it should be noted that the costs, timescales and implications of the pending changes to waste management legislation cannot be predicted at this stage. Encia Consulting Limited will not be responsible for changing practices, etc that may affect the viability of necessary remedial actions or of the implications of potential alternative treatment techniques.

Encia reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

# QUANTITATIVE RISK ASESSMENT

# of land at

# BURTON ROAD, BARNSLEY

## 1 INTRODUCTION

### 1.1 The Commission and Brief

1.1.1 Encia Consulting Limited (Encia), were commissioned by Ben Bailey Homes to carry out a a quantitative risk assessment of land off Burton Road, Barnsley.

1.1.2 Encia have previously undertaken a geoenvironmental appraisal of the site, this is presented in Report 5848/1 dated March 2004.

1.1.3 Correspondence regarding Encia's appointment, including the brief for this investigation, is included in Appendix E. The agreed scope of works included:

- A supplementary ground investigation comprising 13 trial pits and 9 boreholes
- a qualitative and quantitative assessment of contamination risks, with respect to potential receptors
- hazardous gas risk assessment

### 1.2 The Proposed Development

1.2.1 It is understood that consideration is being given to redevelopment of the site with 2 - 3 storey domestic dwellings, associated gardens, POS and adoptable roads and sewers.

### 1.3 Report Format and Limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting.
- Ground investigation fieldwork (including techniques, in-situ testing and sampling).
- Contamination Testing (including current guidance and notes about organics analyses).
- Hazardous Gas (including potential sources and notes about current guidance).

1.3.2 General notes and limitations relevant to all Encia geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

# 2 SITE DESCRIPTION

## 2.1 General

2.1.1 The site location is shown on Drawing Number 5848/10/1 presented in Appendix B to this report. Site details are summarised in the Table below.

| Detail | Remarks |
|---|---|
| Location | 4 km north east of Barnsley town centre |
| NGR | SE 377 087 |
| Area | 2.1ha (5.2 acres) |
| Known services | Raising main crosses southern half of site |

## 2.2 Site Features

2.2.1 Existing salient features are summarised in the Table below and shown on Drawing Number 5848/10/2 presented in Appendix B to this report.

| Feature | Remarks |
|---|---|
| Current Access | Off Burton Road |
| Topography | Relatively level |
| Approximate areas | 18500m$^2$ concrete hardstand<br>600m$^2$ buildings<br>1400m$^2$ grass/overgrown |
| Nature of boundaries | The eastern and western boundaries are formed by palisade or chain link fencing.<br>No physical boundaries are present in the north and south of the site. |
| Surrounding land uses | North – road with housing beyond<br>South – stream with housing beyond<br>West – open field<br>East – road, derelict land beyond |

2.2.2 Ground levels to the west are approximately 1 to 2m lower than the scrap yard, indicating that the ground within the scrap yard may have been raised to create a level area.

## 2.3 Site Operations

2.3.1 The site has been a metal recycling yard for numerous years, the site has recently been closed and is currently being cleared.

## 2.4 Japanese Knotweed

2.4.1 During the site walkover, we did not notice the presence of any Japanese Knotweed. However, it should be noted that we are not qualified ecologists and as such cannot be guarantee the absence of Knotweed or other invasive vegetation.

# 3 SITE HISTORY

3.1.1 The site history is presented in the initial geoenvironmental appraisal, Report 5848/1 dated March 2004. A short summary of the site history is presented below

3.1.2 The 1854 OS plan shows the site to be undeveloped. The 1955 plan shows several small buildings in Areas A and D. The 1973 and 1978 plans show Area D as a scrap metal yard.

# 4 ENVIRONMENTAL SETTING

## 4.1 General

4.1.1 The environmental setting of the site has been reviewed in the initial geoenvironmental appraisal, Report 5848/1 dated March 2004. This includes a review of responses received from the Coal Authority, Landmark, Barnsley Metropolitan District Council and the Environment Agency. A summary if the above is provided below.

| Issue | Data reviewed | Summary |
|---|---|---|
| Geology | 1:50,000 BGS map (Sheet 87)<br>1:10,000 BGS map (Sheet SE 30 NE) | Drift - Not present<br>Solid - undifferentiated Middle Coal Measures strata<br>Shallowest coal seam – unnamed thin seam at between 0 - 10m depth.<br>Strata Dip – not shown.<br>Faults - none. |
| Mining | Coal Authority Report<br>BGS maps | Past and present workings – deep workings at 150 - 560m depth.<br>Mine entries - none.<br>Opencast - none. |
| Quarrying | Local Authority search<br>Historical OS Plans | No quarrying shown within the site |
| Radon | BRE Report BR211<br>BGS Stage 2 Report | Basic measures required. |
| Hydrogeology | Environment Agency<br>Groundwater Vulnerability map (Sheet 11)<br>Landmark Report | Source Protection Zone - No.<br>Aquifer - Coal measures classed as a minor aquifer<br>Soil leaching potential - high leaching potential/urban.<br>Groundwater abstractions - No.<br>Pollution incidents - None. |
| Hydrology | Environment Agency<br>Landmark Report | Nearest watercourse(s) – EA indicate no main watercourses within 500m, though an unclassified stream does exist on the southern boundary.<br>Water quality – N/A.<br>Pollution incidents - no significant incidents<br>Abstractions – None.<br>Discharge consents- two discharge consent for a YW pumping station next to the site. |
| Flood Risk | Environment Agency | The EA indicate that the site is not affected by flooding |

## 4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

**Landfill Sites**

| Location | NGR (proximity to site) | Remarks | Source of data |
|---|---|---|---|
| Burton Road | SE 377 084, (150m west) | Licensed to take brick/rubble construction/soil. Site closed | EA/BMBC |
| Cudworth Landfill, Burton Road | SE 378 086 (25m NE) | Operated by Cleanaway Ltd, for clay, sub/topsoil, known to be producing landfill gas. Site closed | BMBC/ BGS |
| Bleach Farm Croft | SE 379 087 (250m NE) | Sand/solid no Haz/Construction/Demo Waste. Site Closed | EA/BMBC |
| Cudworth Railway Station | (250m S) | Inert/Demo/Construction Waste | EA |

4.2.2 Cudworth Landfill presents a potential gas risk to the site, as this landfill site is known to be producing landfill gas, see section 11.

# 5 PREVIOUS INVESTIGATION FINDINGS

## 5.1 General

5.1.2 Encia undertook a geoenvironmental investigation in December 2003, Report 5848/1, dated March 2004. This report included the investigation of five individual areas off Burton Road, with one area being this site.

## 5.2 Summary of Previous Work

5.2.1 The ground investigation works relating to this site comprised:

- 21 window sample holes (WSs 3 to 16 and WSs 101 to 107) drilled between 0.7 and 3.3m bgl.
- Monitoring wells were installed in WSs 9, 10, 16, 101 and 107, with response zones sealed in both made and natural ground.
- Geotechnical classification tests (Atterberg limits, pH, soluble sulphate etc).
- Chemical laboratory tests (including total and leachable metals, PAH, PCBs, TPH, asbestos and calorific value).
- Gas monitoring; 6 visits between 18th December 2003 and 11th March 2004.

## 5.3 Report Findings

***Ground conditions***

5.3.1 Made ground was encountered across this area and consisted of a reinforced concrete hardstand (average depth 0.2m) over granular fill underlain, by gravel and ash and clinker, generally to a depth between 1.0 and 2.0m.

5.3.2 Natural ground comprised firm gravelly clay (weathered mudstone).

***Contamination***

5.3.3 Within the made ground the most common contaminants were arsenic (4 samples), copper and zinc (3), chromium, lead and nickel (2) and cadmium (1). None of these samples were leachable.

5.3.4 Two elevated calorific values were recorded in ashy made ground.

5.3.5 Fourteen samples of made ground were contaminated with elevated concentrations of TPH. Natural ground did not contain any elevated TPH concentrations.

5.3.6 No elevated BTEX or GRO concentrations were detected within the made or natural ground.

5.3.7 Elevated PAH contamination was detected in one sample of made ground.

5.3.8 The shallow perched groundwater below the site is shown to be contaminated with arsenic, metals and PAH.

5.3.9 It was concluded that the made ground contains elevated TPH, metals and combustible materials (ash). Remediation could comprise complete removal of the contaminated made ground **or** ex-situ bioremediation of the contaminated fill with a soil cover of 500mm.

5.3.10 It was recommended that a detailed quantitative risk assessment should be undertaken to assess the risk to human health and groundwater.

***Hazardous Gas***

5.3.11 Due to the close proximity of a closed landfill site and filled ground, the risks associated with ground gas needs were assessed.

5.3.12 Elevated concentrations of methane gas were recorded in one well during the six monitoring visits. Based on these results, comprehensive gas protection measures would be required.

5.3.13 It was recommended that further gas monitoring be undertaken within the site.

## 6 GROUND INVESTIGATION DESIGN

### 6.1 Investigation Strategy

6.1.1 The initial site investigation identified that the made ground underlying the site is contaminated and requires remediation.

6.1.2 This supplementary investigation has been designed so that the site can be fully characterised to enable a robust risk assessment to be undertaken.

**Initial Ground Investigation Strategy**

| Exploratory holes | Purpose |
|---|---|
| TPs 101 to 114 | To determine the general nature of soils underlying the site, including the:<br>nature, distribution and thickness of made ground<br>nature, degree and extent of contamination |
| BHs 1 to 4 | Install monitoring wells within the made ground to determine groundwater levels and monitor for hazardous gas. |
| BHs 5 to 9 | Install monitoring wells within the natural ground to determine groundwater levels |

# 7 FIELDWORK

## 7.1 Scope of Works

7.1.1 Fieldwork was supervised by Encia between 21st and 23rd February 2005 and comprised the exploratory holes listed below.

***Scope of Ground Investigation Works***

| Technique | Exploratory holes | Final depth(s) | Remarks |
|---|---|---|---|
| *Trial pitting (machine dug)* | *TPs 101 to 114* | *0.4 to 3.2m* | *Vane tests in cohesive soils.* |
| Cable percussive boreholes | BHs 1 to 9 | 1.4 to 5m | Monitoring wells installed in all BHs except BH3. |

7.1.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

7.1.3 The locations of the exploratory holes are shown on Drawing 5848/10/3 in Appendix B to this report.

7.1.4 Exploratory hole logs are presented in Appendices D and E to this Report. These logs Include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing
- The monitoring wells installed

# 8 GROUND CONDITIONS

## 8.1 General

8.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices D and E. However, a summary of the ground conditions is provided below.

8.1.2 Typical ground conditions encountered in each of these areas are described below in *Sections 8.2 (made ground) and 8.3 (natural ground).*

## 8.2 Made Ground

8.2.1 Made ground was encountered all of the exploratory holes, and typically comprised reinforced concrete hardstand from ground level to 0.2m. This was underlain by a granular made ground comprising ash and clinker, demolition rubble, dolomite and sandy clay.

8.2.2 The depth of the granular made ground across the site varied between 0.8 and 2.43m *bgl, the average depth being 1.5m bgl.*

8.2.3 Whilst not encountered during this investigation, the possibility of asbestos sheeting, used as shuttering, and\or fragments of asbestos sheeting within the hardcore beneath concrete slabs, cannot be entirely discounted.

## 8.3 Natural Ground

8.3.1 Natural ground comprised firm orange brown clay, with an average thickness of 1m, underlain by weak brown mudstone.

## 8.4 Visual & Olfactory Evidence of Organic Contamination

8.4.1 Exploratory locations where evidence of significant organic contamination was noted are summarised below:

**Evidence of Organic Contamination**

| Expl. Locn(s) | Material | Depth m bgl | Observation |
|---|---|---|---|
| BH3 | MG: Ash and Clinker | 0.3 - 0.7 | Oily odour |
| BH6 | MG: Ash and Clinker<br>MG: Ash and Clinker | 0.4<br>1.4 | Slight diesel odour<br>Slight diesel odour |
| BH7 | MG: Gravelly Clay | 1.36 -2.32 | Oily odour |
| BH8 | MG: Ash and Clinker | 1.37 - 2.14 | Slight diesel odour |
| BH9 | MG: Ash and Clinker | 0.4 | Slight diesel odour |
| TP104 | MG: Ash and Clinker | 0.5 - 1.1 | Strong diesel odour |
| TP109 | MG: Ash and Clinker | 0.45 - 1.5 | Slight diesel odour |
| TP112 | MG: Sandy Gravel | 0.2 - 0.4 | Strong diesel odour |
| TP114 | MG: Ash and Clinker | 0.5 - 1.5 | Strong diesel odour |

8.4.2 Selected samples of potentially contaminated materials were scheduled for chemical testing to determine the nature and extent of the identified contamination, see Section 9.

## 8.5 Groundwater

8.5.1 Inflow of perched groundwater was encountered within the made ground in TP 102 (0.5m), and groundwater was also encountered at the base of the made ground in TP 107 (2.0m) and TP110 (2.0m).

8.5.2 Groundwater levels recorded in the monitoring wells are summarised below and plotted on Drawing 5848/10/5.

**Groundwater Levels**

| Exploratory Location | Response Zone (depth range & strata) | Typical standing water level // m bgl | Reduced groundwater level m(AOD) |
|---|---|---|---|
| BH1 | 1.0 - 1.8 (Made Ground) | 1.16 - 2.05 | 39.7 |
| BH2 | 0.5 - 2.4 (Made Ground) | 1.28 - 1.81 | 39.6 |
| BH4 | 1.0 - 1.9 (Made Ground) | 0.79 - 1.12 | 39.4 |
| BH5 | 1.0 - 1.9 (Made Ground) | 1.09 - 1.21 | 40.1 |
| BH6 | 2.0 - 4.0 (Clay and Mudstone) | 2.09 - 2.11 | 38.9 |
| BH7 | 3.0 - 5.0 (Clay and Mudstone) | 4.47 - 4.76 | 36.0 |
| BH8 | 3.0 - 5.0 (Clay) | 0.2 - 0.79 | 39.7 |
| BH9 | 2.0 - 4.0 (Clay and Mudstone) | 0.35 - 1.00 | 41.1 |

8.5.3 An Encia engineer visited the site on 9th March 2005 to obtain representative water samples from the groundwater monitoring wells.

8.5.4 In order to obtain a representative groundwater sample, it is generally considered necessary to purge each well by removing three times the volume of water standing within the HDPE well. Purging was undertaken wherever recharge rate allowed.

8.5.5 Purging of monitoring wells was carried out using a bailer.

8.5.6 The water samples obtained were labelled and placed in cool boxes and despatched the same day to Alcontrol's laboratory.

# 9 CONTAMINATION ANALYSIS

## 9.1 Testing Scheduled

9.1.1 The testing has been scheduled for the requirements of a quantitative risk assessment.

***Organic Determinands***

9.1.2 17 samples of made and natural ground were tested for TPH by US TPHCWG method.

9.1.3 26 samples of made and natural ground were tested for TPH by GC FID.

9.1.4 15 samples of made and natural ground were tested for speciated PAH.

9.1.5 5 samples of natural ground were tested for fraction of organic carbon.

9.1.6 10 samples of made ground samples for PCBs.

9.1.7 Eight samples of groundwater were tested for speciated PAH and TPH by US TPHCWG method.

9.1.8 Notes describing the various organics analyses are included in Appendix A to this report.

## Summary of Degree of Ground Contamination (Organics) in MADE GROUND at Burton Road, Barnsley.

| Sample Location & depth | Material | Contaminant Concentrations in mg/kg. Trigger Level Concentrations are shown in brackets | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Benzene | Toluene | Ethyl Benzene | Xylenes | PCB | PAH | TPH – $C_{10}$ to $C_{40}$ | | |
| | | (1)* | (50)* | (130)* | (25)* | (present?)# | (40)* | TPH $C_{10}$ to $C_{40}$ (500)** | DRO $C_{10}$ to $C_{26}$ (500)** | LRO $C_{26}$ to $C_{40}$ (500)** |
| BH2 – 1.0-2.0 | MG: Ash & Clinker | | | | | | 135 | 772 | 379 | 392 |
| BH3 – 0.3-0.7 | MG: Ash & Clinker | | | | | | 67 | 12,800 | 6,720 | 6,060 |
| BH4 – 0.4-1.0 | MG: Ash & Clinker | - | - | - | - | | | 2,269(+) | | |
| BH6 – 0.4-1.0 | MG: Ash & Clinker | - | - | - | - | | | 972(+) | | |
| BH7 – 1.5-2.0 | MG: Ashy Clay | | | | | | | - | - | - |
| BH8 – 1.5-2.0 | MG: Ash & Clinker | - | - | - | - | | | 926(+) | | |
| BH9 – 0.4-1.0 | MG: Ash & Clinker | | | | | | 1109 | 7,750 | 3,960 | 3,760 |
| TP101 – 0.4 | MG: Ash & Clinker | | | | | | 1210 | 7,620 | 3,380 | 4,220 |
| TP101 – 0.7 | MG: Sand & Gravel | - | - | - | - | 0.07 | 69 | 1,131 | | |
| TP103 – 0.6 | MG: Ash & Clinker | | | | | 0.92 | 92 | 6,005 | | |
| TP104 – 0.45 | MG: Sand & Gravel | | | | | | 45 | 1,291 | | |
| TP104 – 0.5 | MG: Sand & Gravel | | | | | 1.13 | | | | |
| TP104 – 0.6 | MG: Ash & Clinker | | | | | | 2,883 | 10,217 | | |
| TP105 – 0.4 | MG: Ash & Clinker | | | | | 0.37 | 781 | 6,910 | 2,640 | 4,240 |
| TP106 – 0.6 | MG: Rubble | | | | | 5.43 | - | 2,200 | 354 | 1,850 |
| TP107 – 1.0 | MG: Sand & Gravel | | | | | | - | - | | |
| TP107 – 1.6 | MG: Ash & Clinker | | | | | 0.15 | | - | | |
| TP108 – 0.6 | MG: Ashy Rubble | | | | | 1.13 | 114 | 3,080 | 882 | 2,200 |
| TP110 – 2.0 | MG: Ash & Clinker | | | | | 0.23 | - | - | | |
| TP111 – 0.5 | MG: Ashy Rubble | | | | | | 572 | 1,220 | 774 | 446 |
| TP112 – 0.3 | MG: Ashy Rubble | | | | | | - | 9,652 | | |
| TP113 – 0.8 | MG: Gravelly Sand | | | | | | 57 | 736 | 620 | 118 |
| TP114 – 0.4 | MG: Subbase | | | | | 0.05 | | | | |
| TP114 – 0.7 | MG: Ash & Clinker | | | | | | 388 | | | |
| TP114 – 1.45 | MG: Ash & Clinker | | | | | | 174 | 6,660 | 3,530 | 3,150 |

| Key | |
|---|---|
| - | Contaminant tested for but not found to be in excess of threshold concentration |
| | Contaminant not tested for |

| Source of Guidance Trigger Level | |
|---|---|
| * | Dutch E-3c Intervention Levels for Soil Remediation (1994) |
| ◊ | Conservative value – assumes all $C_6$ to $C_{10}$ is benzene |
| ** | Professional Judgement of Encia – based on requirements of regulators for remediation of hydrocarbons at other sites in the area and Dutch Intervention value for mineral oil |
| # | Professional Judgement of Encia |

## Summary of Degree of Ground Contamination (Organics) in NATURAL GROUND at Burton Road, Barnsley.

| Sample Location & depth | Material | Contaminant Concentrations in mg/kg. Trigger Level Concentrations are shown in brackets | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Benzene | Toluene | Ethyl Benzene | Xylenes | PCB | PAH | TPH – $C_{10}$ to $C_{40}$ | | |
| | | (1)* | (50)* | (130)* | (25)* | (present?)# | (40)* | TPH $C_{10}$ to $C_{40}$ (500)** | DRO $C_{10}$ to $C_{26}$ (500)** | LRO $C_{26}$ to $C_{40}$ (500)** |
| BH1 – 1.85-2.5 | CLAY | - | - | - | - | | - | 905(+) | | |
| BH1 – 3.2-4.0 | MUDSTONE | - | - | - | - | | - | - | | |
| BH2 – 2.5-3.5 | CLAY | - | - | - | - | | - | - | - | - |
| BH4 – 2.05-2.8 | CLAY | - | - | - | - | | | - | | |
| BH6 – 2.0-2.5 | CLAY | - | - | - | - | | | - | | |
| BH7 – 2.9-3.4 | CLAY | - | - | - | - | | | - | - | - |
| BH8 – 3.0-4.0 | CLAY | - | - | - | - | | | - | | |
| BH9 – 1.5-2.0 | CLAY | | | | | | | - | - | - |
| BH9 – 2.3-2.7 | CLAY | | | | | | | - | - | - |
| TP101 – 1.2 | CLAY | | | | | | - | - | - | - |
| TP103 – 1.7 | CLAY | | | | | | 43 | - | - | - |
| TP104 – 1.2 | CLAY | | | | | | - | - | - | - |
| TP105 – 1.75 | CLAY | | | | | | 83 | - | - | - |
| TP106 – 2.2 | CLAY | | | | | | - | - | - | - |
| TP107 – 2.3 | CLAY | | | | | | - | - | - | - |
| TP111 – 1.6 | CLAY | | | | | | - | - | - | - |
| TP113 – 1.8 | MUDSTONE | | | | | | 73 | - | - | - |
| TP114 – 1.7 | CLAY | | | | | | - | 508 | 147 | 361 |

| Key | |
|---|---|
| - | Contaminant tested for but not found to be in excess of *threshold concentration* |
| | Contaminant not tested for |

| Source of Guidance Trigger Level | |
|---|---|
| * | Dutch E-3c Intervention Levels for Soil Remediation (1994) |
| ◇ | Conservative value – assumes all $C_6$ to $C_{10}$ *is benzene* |

| | |
|---|---|
| * | Professional Judgement of Encia – based on requirements of regulators for remediation of |
| * | hydrocarbons at other sites in the area and Dutch Intervention value for mineral oil |
| # | Professional Judgement of Encia |

## Summary of Contamination in Perched Groundwater at Burton Road, Barnsley.

| Sample Location | Contaminant Concentrations in µg/l unless otherwise stated. Trigger Level Concentrations are Shown in Brackets | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Benzene | Toluene | Ethyl Benzene | Xylenes | Phenols | PAH | TPH – $C_{10}$ to $C_{40}$ | | |
| | (1)* | (1,000)#* | (150)#* | (70)#* | (0.5)* | (0.1)* | TPH $C_{10}$ to $C_{40}$ (600)## | DRO $C_{10}$ to $C_{20}$ (600)## | LRO $C_{20}$ to $C_{40}$ (600)## |
| BH1 - Perched | | | | | | 95 | 4,670 | 2,270 | 2,410 |
| BH2 - Perched | | | | | | 375 | - | - | - |
| BH4 - Perched | | | | | | 257 | 8,120 | 6,030 | 2,090 |
| BH5 - Perched | | | | | | 124 | - | - | - |

| Key | | Source of Guidance Trigger Level | |
|---|---|---|---|
| - | Parameter tested for but found not to be in excess of relevant trigger level concentration | * | Water Supply (Water Quality) Regulations 1989, as amended in 2000 |
| | Parameter not tested for | # | Dutch E-3.c Intervention Level for Soil Remediation (1994) |
| < LoD | Parameter concentration is below limit of detection (which is greater than trigger concentration | ## | Dutch E-3.c Intervention Level for mineral oil (1994) |

## 9.3 Soil/Fill Contamination Results

9.3.1 The soil/fill contamination test results are summarised in Tables on pages 13 to 15.

9.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix F to this report.

### *Organic Determinands*

9.3.3 In the absence of UK guidance values, these samples have been classified by comparison with risk-derived Dutch Intervention Values, which are based on both human and ecotoxicological data.

9.3.4 With respect to TPH ($C_{10}$ to $C_{40}$), the Dutch intervention level for mineral oil (broadly equivalent to TPH) is 5,000mg/kg. However, Encia typically give further consideration to results that are in excess of 500mg/kg, based on the experience of similar sites and the requirements of regulators.

9.3.5 This "Tier 1" TPH concentration is ten times lower than the Dutch intervention level and therefore considered conservative. With respect to remediation, a higher "target" concentration might be acceptable, but this would normally be subject to the results of a quantitative risk assessment.

9.3.6 The majority of the samples of made ground could be classified as contaminated, with the most common contaminant being petroleum hydrocarbons and PAHs. PCBs are present in half of the made ground samples.

9.3.7 Samples of natural ground were generally uncontaminated.

9.3.8 The average fraction of organic carbon result for the natural clay soils is 0.008%.

## 9.4 Water Contamination Results

9.4.1 The groundwater contamination test results are summarised in a table on page 16.

9.4.2 The significance of the results has been assessed by comparison with the Water Supply (Water Quality) Regulations 2000 and Dutch Groundwater Intervention Levels.

9.4.3 For ease of assessment, the groundwater results have been sub-divided into "perched" water and deeper groundwaters.

9.4.4 Perched water within the BHs 1, 2 and 4 is contaminated with petroleum hydrocarbons and PAHs. This contamination is consistent with contamination identified within the soils in this area.

# 10 CONTAMINATION (QUANTITATIVE RISK ASSESSMENT)

## 10.1 Introduction

10.1.1 This QRA is based on conservative assumptions and using site-specific data from this and previous reports relating to the site. The remedial target concentrations derived from this data are thus site specific for both the proposed site use and the type of contamination present. The QRA report assesses risks posed to future site users and controlled waters by contamination on-site.

10.1.2 A QRA was considered necessary to assess whether concentrations of petroleum hydrocarbons (TPH), PAHs and PCBs in made ground soils on-site have the potential to pose risks to future site residents or controlled waters. If risks are identified, Site Specific Target Levels will be derived, and clean-up to those values will mitigate potential risks.

## 10.2 Conceptual Ground Model

10.2.1 A schematic representation of a CSM for the site is included as Drawing Number 5848/10/4 in appendix B. The model draws upon the findings of the recent Encia investigation and previous works to identify pollutant linkages from sources to pathways to targets.

***Human Health***

10.2.2 For the purpose of this risk assessment, the proposed end use is residential with gardens areas, associated roads and parking. Considering this residential scenario two potential human receptor groups can be identified. These are:

- Construction workers (when the site is being redeveloped); and
- On-site residents

10.2.3 Construction workers are at the greatest risk as they are the most likely group of humans to come into direct contact with areas of contamination. Exposure pathways for workers are primarily direct dermal contact and indirect ingestion through the skin, mouth and nasal tracts.

10.2.4 However, whilst transient risks from contamination to site workers during redevelopment or other construction works may be significant, such risks are within the remit of the Health and Safety Executive and are dealt with under the Health and Safety at Work Act 1974 and regulations made under the Act including the COSHH Regulations (Reference EA/DEFRA R & D Publication CLR 7). As such, these potential risks will not be considered further. The remaining target group is therefore future on-site residents.

10.2.5 The critical receptor in the residential scenario is a female child up to the age of six years. The human health model has therefore assessed potential risks from volatilisation of vapours to indoor air and outdoor air in a garden area. It is assumed that the entire site is to be capped with at least 1000mm of cover, which will incorporate 300mm layer of low permeability clay. As such, potential pollutant linkages associated with direct contact (ingestion, dermal contact) will be eliminated, as will generation of contaminated dust or uptake of contaminants by home grown produce.

***Controlled Waters***

10.2.6 The conceptual site model also presents a ***potential*** pollutant linkage to controlled waters, namely the adjacent stream and the underlying minor aquifer. The potential

exists for made ground impacted with hydrocarbons to leach to underlying shallow groundwater. The shallow groundwater has the potential to act as a pathway to link the source on-site to the adjacent watercourse. However,the supplementary investigation proved firm clay underlying the made ground across the entire site. This low permeability layer offers the minor aquifer protection, hence removing the risk to the aquifer.

10.2.7 Groundwater monitoring has been undertaken within boreholes installed in both the made ground and the shallow natural ground. Groundwater contours have been plotted on Drawing 5848/10/5 presented in Appendix B.

**Groundwater Levels**

| Borehole Location | Response Zone (depth range & strata) | Reduced Groundwater Level m(AOD) | Comments |
|---|---|---|---|
| BH1 | 1.0 - 1.8 (Made Ground) | 39.7 | Perched groundwater - no consistent flow direction identified |
| BH2 | 0.5 - 2.4 (Made Ground) | 39.6 | Perched groundwater - no consistent flow direction identified |
| BH4 | 1.0 - 1.9 (Made Ground) | 39.3 | Perched groundwater - no consistent flow direction identified |
| BH5 | 1.0 - 1.9 (Made Ground) | 40.1 | Perched groundwater - no consistent flow direction identified |
| BH6 | 2.0 - 4.0 (Weathered Coal Measures) | 38.9 | Groundwater in coal measures minor aquifer - flow direction towards stream at SE boundary |
| BH7 | 3.0 - 5.0 (Weathered Coal Measures) | 36.0 | Groundwater in coal measures minor aquifer - flow direction towards stream at SE boundary |
| BH8 | 3.0 - 5.0 (Weathered Coal Measures) | 39.7 | Groundwater in coal measures minor aquifer - flow direction towards stream at SE boundary |
| BH9 | 2.0 - 4.0 (Weathered Coal Measures) | 41.1 | Groundwater in coal measures minor aquifer - flow direction towards stream at SE boundary |

10.2.8 The water levels recorded in the made ground are higher than those recorded in the shallow groundwater. Additionally, there appears to be no consistent gradient towards the south east of the site, which confirms that the shallow groundwater in the made ground is perched on the relatively impermeable clay layer and is not in continuity with the groundwater in the minor aquifer or the stream.

10.2.9 It is concluded that there is no pollutant linkage between the perched groundwater and the stream or minor aquifer. The focus of the QRA is therefore on Human Health.

10.2.10 Water levels recorded in the deeper weathered coal measures show a consistent gradient towards the stream in the southeast and are considered to be representative of the coal measures minor aquifer. However given that the aquifer is protected by a low permeability clay layer, there is not considered to be a pollutant linkage.

## 10.3 Contaminants of Concern

10.3.1 Due to the former use of the site as a scrap yard, the analytical suite tested at the site investigation stage included PAHs, PCBs and petroleum hydrocarbons, speciated into BTEX compounds, petrol range and diesel range hydrocarbons. In addition a suite of inorganic analysis was also undertaken. Within the entire development, the capping layer will be 1000mm due to potential combustibility of the ashy made ground. This capping will effectively break the potential pollutant linkages to human health other than by potential vapour migration. As such, the focus of this QRA is upon the organic

hydrocarbons rather that inorganic compounds in soils.

10.3.2 The Dutch "target" and "intervention" values for mineral oils are 50 mg/kg and 5000 mg/kg respectively. Based on professional judgement and Encia Consulting Limited's experience, TPH concentrations greater than 500 mg/kg, can often be regarded as indicative of contamination. Therefore, a concentration for mineral oils of 500mg/kg has been adopted as a TPH screening concentration.

10.3.3 Should the Tier 1 criteria be exceeded then two courses of action are available. The first is to "break" the pollutant linkage by recommending an appropriate level of remedial action – removal of contaminated material for example. The alternative approach is to carry out more detailed (Tier 2, Tier 3, etc) risk assessments in order to determine whether a contamination risk actually exists.

10.3.4 The maximum-recorded concentrations of TPH in soils on-site exceed the tier 1 screening concentrations. As the objective of the risk assessment is to calculate a concentration for residual impact in soils which does not pose a risk, additional tiers of assessment have been conducted to derive risk based remedial target concentrations for the contaminants identified at the site.

***Assessment of TPH***

10.3.5 Numerical risk assessment models cannot be used to calculate remedial target levels from a laboratory derived "TPH" value. This is because "TPH" as defined by laboratory analysis is not a single element or compound possessing known physiochemical properties. Instead "TPH" is a mixture of many hydrocarbon molecules, generally ranging from 5-carbon chain to 35-carbon chain molecules. The behaviour of each carbon chain molecule in the environment and their respective toxicity varies from species to species. In addition, the relative proportion of each carbon chain compound also varies between the type of hydrocarbon product (for example, petrol and lubricating oil) and the degree of weathering a product is subjected to (for example, a fresh diesel spill compared to a historic diesel spill).

10.3.6 As a consequence it is not scientifically defensible to directly calculate a "TPH" remedial target concentration for laboratory derived "TPH" values in the way that a remedial target for a single compound or element can be calculated. This is because the abundance of each fraction within the TPH is not known. As such a laboratory derived "TPH" value may represent a banding of relatively environmentally immobile carbon chain molecules or, alternatively a band of carbon chain molecules, which are particularly environmentally mobile.

10.3.7 To address this problem the US Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) have broken down "TPH" into thirteen representative constituent fractions or "EC Bandings". EC Bandings are based around *Equivalent Carbon* numbers and the TPHCWG have derived a series of physiochemical and toxicological parameters for each of the thirteen EC bandings. The methodology for the derivation of these banding-specific properties is outlined in the TPHCWG series volumes 1-4. From the physiochemical data presented for each EC banding, a RBSL can be derived for each active exposure pathway.

10.3.8 The TPH fractions present on-site are 'medium to heavy end' and predominantly aliphatic (C10 –C12, C12-C16, C16 - C21 and C21 – C35).

10.3.9 This QRA will be used to derive remedial target concentrations, protective of human health, for each of the Equivalent Carbon bands of Petroleum Hydrocarbons present on site.

***Assessment of PAH***

10.3.10 PAH cannot be assessed as a single "total" value using a numerical model, as each

individual PAH compound has different toxicity and mobility in the environment. In order to determine the potential risks posed to future site users from PAH impact, speciated analysis for PAH has been conducted.

10.3.11 This risk assessment has been conducted by considering the human health effects of two "representative" PAH compounds present in the made ground beneath the site based on toxicity and mobility.

10.3.12 The UK Government has published toxicity data for the PAH compound benzo(a)pyrene in the form of DEFRA/Environment Agency R&D Publication Tox 2 (2002) "Contamination in Soil: Collation of Toxicological Data and Intake Values for Humans. Benzo(a)pyrene". As such it is considered that benzo(a)pyrene should be one of the individual PAH compounds considered in this assessment. In addition, Benzo (a) Pyrene is considered potentially the most toxic of the PAHs and is therefore a key risk driver.

10.3.13 Naphthalene will also be considered as part of the risk assessment, as it is relatively environmentally mobile and is considered the most volatile of the PAHs, which is important given volatilisation is the pathway modelled in this assessment.

10.3.14 As a further conservative measure this risk assessment will assume that all the PAH (ie sum of the 16 compounds) is one or other of the worst-case compounds (i.e. Benzo (a) Pyrene or Naphthalene), whichever yields the most onerous clean-up target concentration.

10.3.15 If actual concentrations of PAH do not exceed the derived clean-up criteria then clearly no risk to human health exists. If actual concentrations of PAH do exceed the derived criteria, then clean-up to the target concentration will mitigate potential risks from all 16 PAH compounds.

## 10.4 Human Health Risk Assessment

### *Introduction*

10.4.1 The RBCA Tier 2 human health risk assessment process essentially involves the estimation of chemical doses to potentially exposed human receptors. The Tier 2 assessment calculates Site Specific Target Levels (SSTLs) for soil cleanup, which are determined on the basis of site-specific information and/or points of exposure. Simple analytical models are applied in conjunction with site data to calculate Tier 2 SSTL values.

10.4.2 The exposure pathways considered using the RBCA Tier 2 assessment include inhalation of indoor and outdoor soil vapours by on-site residents. The proposed development assumes a cover thickness of 1000mm across the entire site. Off site residents have not been considered as part of this assessment as any measures designed to be protective of on site residents will be, by default, protective of off site residents.

### *Methodology & Model Set Up*

10.4.3 The Groundwater Services Inc "RBCA Toolkit for Chemical Releases" V1.3b model has been used for the purpose of this risk assessment, given that volatilisation is the pathway considered. The model has been run using site specific data where possible and exposure assumptions and other relevant 'default' values presented in the UK Contaminated Land Exposure Assessment (CLEA) model have also been used within the RBCA framework where appropriate (ref: DEFRA/Environment Agency R&D Publication CLR10 2002).

10.4.4 The RBCA model has been run in the "backwards" mode, which means that a maximum permissible target concentration has been calculated under site-specific conditions without the need for a "maximum recorded site hydrocarbon

concentration". Details of the input parameters for the model including a contaminant inventory, assumptions and uncertainties are included in Appendix A.

10.4.5 Human exposure assumptions and the physical parameters (such as building volume, air exchange rate, average wind speed, air mixing heights etc) have been based upon "defaults" outlined in the EA/DEFRA R & D publication CLR10 "*The Contaminated Land Exposure Assessment Model: technical basis and algorithms*" 2002 and, where appropriate, RBCA defaults. A summary of the inputs and justifications for their use is included in Appendix A.

10.4.6 It is not possible within the RBCA model to adjust the air intake breathing rate to match the daily volume for a child suggested in CLR 10 ($5m^3$/day). The default value within the RBCA model is for an adult at $15m^3$/day. In order to match this input parameter which is important for the volatilisation pathway, the exposure duration has been reduced from 365 days to 121 days.

***Human Health Risk Assessment Results***

10.4.7 This section provides a summary of the results of the RBCA Human Health risk assessment, which are presented in full in Appendix G. The results are briefly summarised below.

10.4.8 Under the proposed residential site use, the SSTLs for the soil volatilisation to indoor and outdoor air receptors for each contaminant of concern are presented overleaf.

**RBCA Toolkit SSTL Soil Volatilisation to Indoor and Outdoor Air**

| Determinand | Outdoor air SSTL (mg/kg) | Indoor air SSTL (mg/kg) |
|---|---|---|
| PCBs | 12 | 8.8 |
| Benzo (a) Pyrene | >16 | >16 |
| Napthalene | >620 | >620 |
| C10 - C12 Aliphatic Hydrocarbons | >86 | >86 |
| C12 - C16 Aliphatic Hydrocarbons | >38 | >38 |
| C16 - C21 Aliphatic Hydrocarbons | >16 | >16 |
| C21 - C35 Aliphatic Hydrocarbons | >16 | >16 |
| C12 - C16Aromatic Hydrocarbons | >29 | >29 |
| C16 - C21 Aromatic Hydrocarbons | >10 | >10 |
| C21 - C35 Aromatic Hydrocarbons | >8.3 | >8.3 |

10.4.9 Many of the SSTLs for soil volatilisation to indoor and outdoor air receptors have been predicted to be greater than the constituent residual saturation value.

10.4.10 Prior to saturation, as the concentration of a contaminant in soil or groundwater increases, so does the concentration of the same contaminant in the associated vapour phase. However, once saturation is reached, the concentration of contaminant in the vapour phase remains constant (for any given atmospheric conditions – temperature and pressure).

10.4.11 For example, the concentration of Naphthalene in the soil atmosphere will increase as the concentration of Benzo (a) Pyrene in soil increases from 0 to 16mg/kg (at $20^0$C and 1 atmosphere). However, the concentration of Benzo (a) Pyrene in the soil atmosphere is the same whether the soil concentration is 16 or 160mg/kg.

10.4.12 After migration through the 1.0m thick cover of "clean" soil, the RBCA model predicts that the saturated vapours, for most of the contaminants listed above present no risk to the sensitive receptor (a child resident) inhaling indoor or outdoor air.

10.4.13 Potential risks from both inhalation of outdoor and indoor air were identified from PCBs and site specific target values were derived. These remedial target values are taken forward to the remedial strategy.

10.4.14 For the remaining compounds, the actual soil concentrations of, for example, naphthalene or C12-C16 aromatic hydrocarbons are irrelevant with respect to the volatilisation pathways considered and no remedial action is considered necessary with respect to these compounds.

## 11 HAZARDOUS GAS

### 11.1 General

11.1.1 As detailed in Section 4.2, an actively gassing landfill is located within close proximity of the site.

11.1.2 Therefore, eight gas monitoring wells have been installed in boreholes across the site. Details of the installations are given on the borehole logs presented in Appendix E to this the report.

### 11.2 Scope Of Works

11.2.1 To date, the wells have been monitored on one occasion for groundwater levels and soils-gases. A further 5 visits are proposed over the next 2 months, and will be discussed in a supplementary letter report to issued in June 2005.

11.2.2 Notes outlining the standard gas monitoring procedure are included in Appendix A.

### 11.3 Monitoring Results

11.3.1 The results of the monitoring completed to date are summarised below.

**Summary of Gas Monitoring Results**

| Well | Methane Concentrations (%v/v) | Carbon Dioxide Concentrations (%v/v) | Positive Flow Rates (litre/hour) |
|---|---|---|---|
| BH1 | 1.3 | 0.6 | 0 |
| BH2 | 0.0 | 3.5 | 0 |
| BH4 | 0.0 | 0.0 | 0 |
| BH5 | 0.0 | 0.0 | 0 |
| BH6 | 0.0 | 1.8 | 0 |
| BH7 | Borehole Flooded | | |
| BH8 | Borehole Flooded | | |
| BH9 | 3.5 | 0.0 | 0 |

### 11.4 Discussion

11.4.1 Elevated methane gas has been recorded in two wells, BH9 and BH1, both these wells are located in the north of the site, nearest to the adjacent landfill site. Slightly elevated carbon dioxide has also been recorded in two other boreholes in the site. No gas flows were recorded from any of the boreholes.

11.4.2 A full hazardous gas risk assessment report incorporating all of the results will be issued on completion of monitoring in June 2005.

11.4.3 As a minimum basic gas protection measures are required for radon gas, these may need upgrading to include the following:

- ventilation of confined spaces within buildings.
- well constructed ground slab.
- *passive venting to building - suspended floor with vented void. The recommended* minimum area of ventilation for a sub-floor void is 1,500mm$^2$ per metre-run of wall or 500mm$^2$ per square metre of floor area, whichever gives the greater area of opening. The void should be well cross-ventilated and there should be plenty of air gaps in sleeper walls to ensure that there will be no pockets of still air where gas could accumulate. Air should be allowed to flow freely through the air bricks and they should not be covered up by further construction around the building.
- gas retardant membrane (eg. Callenders Alumite/Bitite). This membrane should extend across any wall cavities and should be installed in accordance with the manufacturer's instructions.
- minimum penetration of ground slab by services. Where services enter the building they should be suitably sealed.

# 12 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

## 12.1 Contamination & Remediation

12.1.1 The results of the qualitative risk assessment (i.e. source-pathway-target assessment) show that the site does not pose a risk to controlled waters.

12.1.2 The human health quantitative risk assessment shows that if the site is capped with 1000mm of soil, including a 300mm layer of clay, then no risks are posed to human health from PAH or TPH compounds in the made ground.

12.1.3 A site specific target level of 8.8mg/kg has been calculated for PCBs within the made ground. This value should be taken forward to the remedial action plan. Soil sample results undertaken to-date do not exceed this site specific target level for PCBs. A more rigorous testing regime, on a grid network, is recommended to analyse for PCBs in made ground. If concentrations exceed the risk based target level derived from PCBs, appropriate action should be undertaken, such as removal of impacted soils from site, or treatment.

## 12.2 Hazardous Gas

12.2.1 A comprehensive gas risk assessment will be issued in a supplementary letter report on completion of the gas monitoring in June. In the meantime, based on the results obtained to date, it is considered likely that gas protection measures will be of a higher specification than those required simply to provide protection against radon.

# APPENDIX A
# GENERAL NOTES

# Generic Notes – Encia Geoenvironmental Investigations

## 1. Environmental Setting

### General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence Appendix of this Geoenvironmental Report.

### Geology, Mining & Quarrying

In order to establish the geological setting of a site, Encia refer to BGS maps for the area, and the relevant geological memoir.

A coal mining report is obtained from the Coal Authority. Further information is sourced from the Local Authority and by reference to current and historical OS plans.

### Landfills

Encia obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

### Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Encia refer to BRE Report BR211, 1999: "*Radon: guidance on protective measures for new dwellings*".

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often necessary to request a Stage 2 Protective Measures Site Report from the BGS.

The level of protection needed is site-specific and is determined by reference to the radon potential map for the area followed by a geological assessment of the site. This information is contained in the Annexes of BR211.

Annex A – derived from statistical analysis of radon measurements in existing houses carried out by the NRPB and grouped on a 5km grid.

Annex B - based on an assessment of the same radon measurements grouped by geological units. The maps show the 5km grid squares underlain completely or in part, by geological units which potentially exceed the action levels for radon protective measures. The grid squares are coded according to the highest potential within the square. In many cases the actual geological radon potential varies considerably within a grid square.

Encia adopt the following procedure when assessing risk associated with radon.

Firstly, Annex A maps are reviewed to see whether the site requires full, basic or no measures. If the site is in a dark brown square, full radon protection measures are required. If the site is in a light brown square, reference should be made to Annex B.

Secondly, Annex B maps are reviewed to see whether a further geological assessment is required which may result in upgrading the result from Annex A. If a site lies within a shaded square, it may require radon protection, and Encia request a Stage 2 Protective Measures Site Report from the BGS.

If the site is in a square that is not coloured or shaded in either set of maps then no radon protection is needed and therefore a BGS Report is not normally necessary.

The BGS geological assessment involves checking whether the site is on or close to a geological unit that has statistically been found to have elevated radon potential. The geological assessment is based on either 1:50,000 or the 1:250,000 scale data. The search area specified as part of the request is increased by 50m in areas where 1:50,000 data is available and by 500m in areas with 1:250,000 scale data to allow for potential inaccuracies in the position of boundaries. The BGS report indicates the highest level of protection required within the search area and its buffer zone.

When requesting a BGS report, Encia select the search radius carefully, since too large a search radius may result in the inclusion of areas underlain by geological units of a higher radon potential, thereby giving rise to recommending too high a level of protection.

The report also includes (where available), a list of the geological units included in the assessment. Encia check that these actually underlie the site, rather than the buffer zone only.

On the basis of radon measurements in dwellings and on their geological interpretation, the BGS report stipulates the level of protective measures required for the proposed development site, and this could be:

1. no measures,
2. basic measures, or
3. full measures.

Details of these measures are provided in the Hazardous Gas section of this Geoenvironmental Report.

**Hydrogeology**

Encia obtain information from the Environment Agency (EA) and the Landmark Information Group with respect to:

- groundwater quality
- recorded pollution incidents
- licensed groundwater abstractions

Reference is also made to the EA document *"Policy and Practice for the Protection of Groundwater"* (1998) and the relevant Groundwater Vulnerability Map.

Bedrock and any overlying granular Drift deposits are classified by the EA:-

- **Major aquifers:** *"Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public water supply and other purposes".*

- **Minor aquifers**: *"Fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers will seldom produce large quantities of water for abstractions, they are important both for local supplies and in supplying base flow to rivers".*
- **Non-aquifers**: *"Formations which are generally regarded as containing insignificant quantities of groundwater. However groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use".*

Groundwater vulnerability is determined by 4 variables:

1. The presence and nature of overlying soil (the weathered zone affected by living organisms; soil in the UK can extend up to 2m in depth). Physical properties of the soil affect the downward passage of water and it's ability to attenuate pollutants. The EA make reference to a three-fold classification of soil types:-

   - Soils of **low** leaching potential are defined as *"soils in which the pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants".*
   - Soils of **intermediate** leaching potential are defined as *"soils which have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer".*
   - Soils of **high** leaching potential are defined as *"soils with little ability to attenuate diffuse source pollutants and in which non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater".*

   In urban areas and restored mineral workings the soil information is based on fewer observations than elsewhere. A worst-case vulnerability (H) is therefore assumed for these areas and for current mineral workings by the EA. All are given a designation of **HU** unless proved otherwise.

2. The presence and nature of Drift, which often overlies bedrock. Where Drift is of substantial thickness and low permeability, it can provide an effective barrier to surface pollutant migration. Permeable Drift is classified as a Minor Aquifer except where it is in probable hydraulic continuity with a Major Aquifer, where it is regarded as part of the Major Aquifer unless proven otherwise by site investigation.

3. The nature of the geological strata (bedrock). Rocks that contain groundwater in exploitable quantities are called aquifers.

4. The depth of the unsaturated zone; ie that part of the aquifer which lies above the water table

The EA have also designated Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

**Hydrology**

Encia obtain information from the Environment Agency and the Landmark Information Group with *respect to:*

- surface water quality
- recorded pollution incidents
- licensed abstractions (groundwater & surface waters)
- licensed discharge consents
- site susceptibility to flooding

The EA have set water quality targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are six GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to flooding is assessed by reference to the Environment Agency's Indicative Floodplain Maps which provide a general overview of areas of land in natural floodplains and therefore potentially at risk of flooding from rivers or the sea. The maps use the best information currently available, based on historical flood records and geographical models. They indicate where flooding from rivers, streams, watercourses or the sea is possible. However the maps do not show flood defences which offer vital protection in many areas.

For flooding from rivers the maps indicate the extent of flooding for a one in one hundred (or a one per cent) chance of flooding each year, for flooding from the sea and tidal estuaries, the maps show a one in two hundred (or 0.5 per cent) chance of flooding each year.

It should also be noted that as the floodplain shown is the 1 in 100 year (or 1 in 200 year as appropriate), areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within the indicative floodplain, it is recommended that a flood survey be undertaken by a specialist consultant who can advise on appropriate mitigating measures; ie raising slab levels, provision of storage etc.

**COMAH & Explosive Sites**

Encia obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. Encia's report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise it's emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH

site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

**Preliminary Conceptual Ground Model**

The site's environmental setting (and proposed end use) is used by Encia to assess the significance of any contamination encountered during the subsequent ground investigation

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential targets.

Potential pollutant linkages are shown on a preliminary conceptual site model, presented as a Drawing in an Appendix to this Geoenvironmental Report. The preliminary model is revised in light of data arising from the subsequent ground investigation.

**Generic Notes – Encia Geoenvironmental Investigations**

## 2. Ground Investigation Fieldwork

### General

Encia Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:1999 *"Code of practice for site investigation"*
- BS10175:2001 *"Code of practice for the identification of potentially contaminated sites"*.
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 *"Sampling strategies for contaminated land"*
- *"Guidance on the protection of housing on contaminated land"* – NHBC & EA R&D Publication 66 (2000)
- *"Development of appropriate soil sampling strategies for land contamination"* – EA R&D Technical Report P5-066/TR (2001)
- AGS: 1996 *"Guide to the selection of Geotechnical Soil Laboratory Testing"*

Exploratory hole logs are presented in Appendices to this Geoenvironmental Report. These logs include details of the:

- Investigation technique adopted
- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of any in-situ testing
- Any gas\groundwater monitoring well installed

### Exploratory Hole Locations

Exploratory hole locations are selected by Encia, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

### Investigation Techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 1999 and BS1377: 1990. Techniques most commonly used by Encia include:

- Machine excavated trial pits, usually equipped with a backactor and a 0.6m wide bucket.
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing.
- Window or Windowless Sampling boreholes. Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in

areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).

- Rotary percussive open-hole probeholes are typically drilled using a tricone rock roller bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse.

Where installed, gas\groundwater monitoring wells typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete.

Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

**In-situ Testing**

Where relative densities of granular materials given on the trial pit and window sample logs are based on visual inspection only, they do not relate to any specific bearing capacities. However, wherever possible Encia employ a Mackintosh probe to assess relative density. Mackintosh probe results can be related to approximate allowable bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x.

The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

**Sampling**

Representative soil/fill samples are taken at regular intervals from the exploratory holes to assist in description of the ground and to allow selected laboratory testing to be performed. The type of sample taken is dependent on the nature of the stratum and the purpose of the analysis.

Where the soils encountered contain a significant proportion of coarse grained material, truly representative samples are not typically obtained - only the finer fraction is placed in sample containers. However, a visual estimate of the amount of coarse material is made on site.

NB: Coarse constituents not sampled are defined as: coarse gravel, cobble and boulder. (i.e. any 'particles' with an average diameter greater than 20mm).

Occasionally, unrepresentative 'spot' samples are also taken from some exploratory locations for contaminant analysis, typically where unusual, localised pockets of materials are encountered.

Samples of soil for chemical testing are placed into 1 litre plastic tubs prior to delivery to the selected laboratory. Samples of water are taken in one litre, brown glass bottles and stored in

cool boxes, at a temperature of approximately 4°C, until delivery to the selected laboratory. Soil\fill samples for organic analysis are also stored in cool boxes.

**Groundwater**

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

**Description of Strata**

The soils encountered during an Encia ground investigation are described (logged) in general accordance with BS 5930. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text.

The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

**Key to Exploratory Hole Logs**

Keys to logs are presented in the Appendix(ces) containing the logs. There are two Keys - Symbols & Legends and Terms & Definitions.

## Generic Notes – Encia Geoenvironmental Investigations

### 4. Contamination Laboratory Analysis & Interpretation

#### General

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "*Potential contaminants for the assessment of land*" and the relevant DETR Industry Profile(s).

#### Common Inorganic Contaminants

These include:

- metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc.
- semi-metals, most notably arsenic, selenium, and (water soluble) boron
- non-metals, most notably sulphur
- inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates.

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction.

Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to uv digestion for determination of both free and total CN.

*Thiocyanate (SCN) is a different species combined with sulphur.*

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates ($SO_4$), sulphides etc

*There are 2 forms of chromium (Cr), chromium VI and chromium III. chromium VI is the more* toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

#### Common Organic Contaminants

*Petroleum hydrocarbons* are a mixture of hydrocarbons produced from the distillation of crude oil. They include aliphatics (alkanes, alkenes and cycloalkanes), aromatics (single or multi benzene ringed compounds) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen.

Petroleum hydrocarbons can be grouped based on the carbon number range:-

GRO - Gasoline Range Organics (typically $C_6$ to $C_{10}$). Also referred to as PRO - Petroleum Range Organics
DRO - Diesel Range Organics (typically $C_{10}$ to $C_{28}$)
LRO - Lubricating Oil Range Organics (typically $C_{28}$ to $C_{40}$)
MRO - Mineral Oil Range Organics (typically $C_{18}$ to $C_{44}$)

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies.

*Total Petroleum Hydrocarbons (TPH)* is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from $C_5$-$C_{40}$, whereas other define TPH as $C_{10}$-$C_{30}$.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

*Gasoline* contains light aliphatic hydrocarbons rapidly (especially within the C4 to C5 range) that will evaporate. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polyaromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present.

*Diesel and light fuel oils* have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

*Heavy Fuel Oils* are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar NSO compounds are also present.

*Lubricating Oils* are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

*Polycyclic Aromatic Hydrocarbons* (PAHs) have more than two fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (Benzo(a)pyrene) and\or mobile in the environment (naphthalene).

*Polychlorinated Biphenyls (PCBs)*

*Volatile Organic Compounds (VOCs)*

*Semi-Volatile Organic Compounds (sVOCs)*

*Phenols*

*Solvents, pesticides, herbicides*

*Dioxins & furans*

**Methods of Analysis (Organic Compounds)**

**Toluene Extractable Matter** (TEM) results provide a screening test for organic contamination. The sample is air dried at 30$^0$C and ground prior to addition of the solvent (toluene). The solvent extraction is aggressive and most organic compounds (fuels, oils, tars, humic material, animal fats and vegetable oil) are dissolved, as are some other inorganic contaminants such as sulphur. However, the volatiles (lighter fuel fraction etc) are lost during evaporation of the solvent.

**Total Petroleum Hydrocarbon (TPH) by IR** (also known as mineral oil by some testing laboratories) is undertaken on "as received" samples. Tetrachloroethylene is the solvent, and fluoroscil is used to remove humic material, animal fats and vegetable oil. Consequently this

analysis detects a wide range of "mineral" organics from volatiles (BTEX and gasoline), through diesel and oils to tars (including the very heavy, stable tars such as asphalt and bitumen).

**TPH by GC-FID** is a more refined analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range $C_{10}$ to $C_{40}$ (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a breakdown of the TPH results into diesel range organics (**DRO**) and heavier lubricating oil range organics (**LRO**).

**GRO (PRO) by GC-FID** analysis detects the more volatile $C_6$-$C_9$ hydrocarbons (aliphatic and aromatic), including those organic compounds present in petrol.

**Speciated VOC (by GC-MS)** analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

**Speciated sVOC by (GC-MS)** analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH. by GC-FID. Naphthalene (the lightest PAH) is also one of the 58 US EPA VOCs.

***Speciated TPH by GC-FID*** *provides a "banded" TPH, initially split into aromatic and aliphatic* fractions and then further divided into fraction specific carbon bandings based upon behavioural characteristics.

*Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.*

*If the relative proportion of each carbon banding within the "TPH" impact at a site is known, the risks posed by each individual fraction can be assessed and a simple back calculation applied to calculate an overall "TPH" screening value based upon the percentage weight fraction of each banding present in the "TPH". Specialised analytical techniques and data interpretation skills are required to identify each carbon banding.*

**Current Guidance**

The UK approach to the consideration of contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of so called source⇨pathway⇨target principles in order to establish the presence, or potential presence, of a pollutant linkage.

Encia Consulting Ltd adopts a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate guidance levels, intervention levels or remedial targets.

In March 2002 DEFRA and the Environment Agency published a series of technical research papers (R & D Publications CLR 7, 8, 9 and 10) introducing the UK approach to the assessment of risk to **human health** from land contamination. This methodology and approach represents current scientific knowledge and thinking. The overall methodology also included the Contaminated Land Exposure Model (CLEA) and some Soil Guideline Values (SGV's).

At the time of writing this report, these guidelines only address seven contaminants and the development of both the CLEA model and additional SGV's is ongoing. Where published, SGV's have been utilised as intervention values for the purpose of an initial Tier 1 assessment.

Where SGV's were not published at the time of writing this report, appropriate Tier 1 human health related assessments have been based upon information that was best available at the time of the study.

With respect to the assessment of potential **phytotoxic effects** of contaminants, Encia refer to "*The Soil Code*" (MAFF, 1998) for copper and zinc. The CLEA SGV is adopted for nickel.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Sulphate and Acid Resistance of Concrete in the Ground', 2001.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that:

"*In general.....it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate concentrations with the appropriate water quality standard. Depending upon the specific characteristics and environmental setting of the site the appropriate standard is likely to be one of the following:

- Water Supply (Water Quality) Regulations 1989
- Environmental Quality Standards (for Freshwater)
- The Surface Waters (Abstraction for Drinking Water) Regulations

The tier 1 risk assessment of **landfill gas** is undertaken through reference to the following documents:

- Approved Document C, Building Regulations 1991
- CIRIA Report 149, "Protecting Development from Methane", 1995

Should any Tier 1 criteria be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

- Undertake further statistical analysis following the approach set out in Appendix A of CLR 7 in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
- Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.
- Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.

**Generic Notes – Encia Geoenvironmental Investigations**

## 5. Hazardous Gas

### General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency).

In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 1. – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey.

Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

### Sources

Potential sources of hazardous gas are:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal-bearing strata and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas.
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

### Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

### Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and

permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

**Current Guidance**

Guidance on landfill gas monitoring control at landfill sites is given in two technical memoranda, Waste Management Paper Nos. 26 and 27, published by the Department of the Environment.

Waste Management Paper 27, 1991 recommends that no dwellings should be constructed within 50m of any landfill that has the capacity to produce large volumes of landfill gas. No garden should extend to within 10m of the landfilled waste. However, development closer to landfill has been permitted where a comprehensive gas risk assessment has been completed (typically based on a minimum of 6 to 12 month monitoring programme) and appropriate gas exclusion measures designed.

The current advice with regard to monitoring for landfill gas is that if the trigger value of 1% volume (20% LEL) for methane and 1.5% volume for carbon dioxide is exceeded then remedial/control measures will be required.

It should be noted that the guideline limit for carbon dioxide of 1.5% volume recommended in Waste Management paper No. 27 is the short term (10 minute) occupational exposure limit for carbon dioxide quoted by the Health and Safety Executive in their publication, EH40. The long-term (8 hour) occupational exposure limit for carbon dioxide is 0.5% volume.

Approved Document C to the Department of the Environment's Building Regulations 1992, requires that where there may be gaseous contamination of the ground but the level of methane is unlikely to exceed 1% by volume, the ground floor of any house or similar small building shall be constructed of suspended concrete and ventilated as described in BRE Digest Report "Construction of New Buildings on Gas Contaminated Land". The document also requires specific design measures to be taken if a level of 5% volume carbon dioxide exists or is exceeded within the ground.

Although the above guidance is still relevant it has been more recently updated with the following documents published by the Construction Industry Research and Information Association (CIRIA).

CIRIA Report 149 'Protecting Development from Methane' (1995)
CIRIA Report 150 'Methane Investigation Strategies' (1995)
CIRIA Report 151 'Interpreting Measurement of Gas in the Ground' (1995)
CIRIA Report 152 'Risk Assessment for Methane and other gases from the ground (1995)

The above documents are intended to provide advice on how to investigate and deal with gas contaminated ground with respect to development.

CIRIA report 149 characterised sites based on the recorded methane / carbon dioxide concentration and emission rates recorded during a suitable gas investigation. Characteristic situation 1 is deemed to be the lowest risk scenario with the risk rating increasing up to 6. The characteristic situations are classified as follows:

| Gassing regime in ground | | | |
|---|---|---|---|
| **Methane (% by volume in air)** | **Carbon dioxide (% by volume in air)** | **Emission rate [1] (m/s)** | **Characteristic situation [2]** |
| **<0.1** | **<1.5** | **Not detected** | **1** |
| **>0.1 - 1** | **>1.5 - 5** | **Not detected** | **2** |
| **>1 -5** | **<5** | **Not detected** | **3** |
| **>5 - 20** | **<20** | **<0.01** | **4** |
| **>20** | **>20** | **>0.01 - 0.05** | **5** |
| **>20** | **>20** | **>0.05** | **6** |

Notes:
1. Emission rate values measured as equivalent total gas flow velocity from a 50mm diameter borehole; for methods of measurement see Crowhurst and Manchester (1992).
2. Highest measured parameter used as determining factor.

CIRIA Report 151 (1995) identified that there is currently inadequate guidance on trigger concentrations for ground gases. The current emphasis on using gas concentrations for trigger values particularly in Waste Management Paper 27 and the Building Regulations, should be revised to consider gas pressures, borehole flow rates and estimated surface emission rates.

It was concluded that the most important aspect of relating the gas regime below or adjacent to a site, to the risk it poses to any development, is the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. This is considered further in the DETR Partners in Technology Report ' Passive venting of soil gases beneath buildings' (September 1997).

CIRIA Report 149 (1995), reference Table 28, reviewed over 100 case studies of development affected by gas to establish current UK practices for gas control. The report classified the gassing regimes found within 6 Characteristic Situations. The highest measured parameter, either methane or carbon dioxide concentration and/or emission rate were used to define the Characteristic Situation for each case history site. The report then related the typical range of mitigation measures that had been adopted at each study site to the characteristic gas situation.

To achieve a more consistent design of protection measures Table 28 of CIRIA 149 was rewritten (Wilson and Card, 1999) in terms of borehole gas volume flow rate and gas concentrations, as reproduced in the Table below. This was done to reflect the importance of recognising the gas surface emission rate.

**Characteristic Situations based on Gas Flux**

| Characteristic Situation | Limiting $CH_4$ Concentration (% v/v) | Limiting $CO_2$ Concentration (% v/v) | Limiting Borehole Flow Velocity (m/s) | Limiting Borehole Gas Volume Flow (litre/hour) | |
|---|---|---|---|---|---|
| | | | | $CH_4$ | $CO_2$ |
| 1 | <0.1 | <0.1 | <0.005 | <0.035 | <0.035 |
| 2 | <1.0 | <1.5 | <0.005 | <0.35 | <0.5 |
| 3 | <5.0 | <5.0 | <0.005 | <1.75 | <1.75 |
| 4 | <20 | <20 | <0.01 | <14 | <14 |
| 5 | >20 | >20 | <0.05 | <70 | <70 |
| 6 | >20 | >20 | <0.05 | >70 | >70 |

Notes:
Borehole flow velocity measured in 50 mm diameter standpipe
Table 28, CIRIA 149 - not detected: has been replaced with assumed flow velocity of 0.005 m/s.

**Gas Monitoring Procedure**

Encia adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

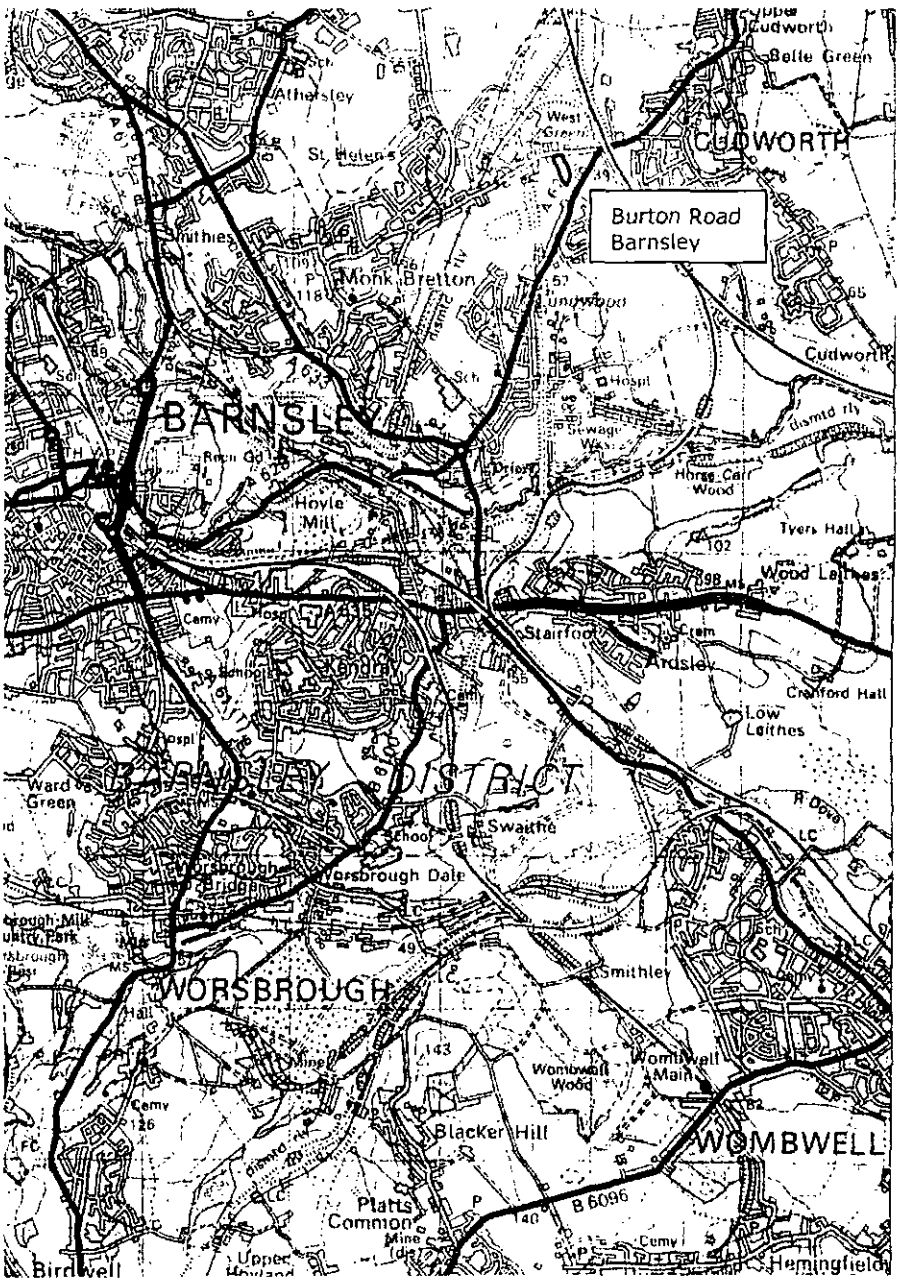
- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring.
- Gas emission rate.
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser.
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism.

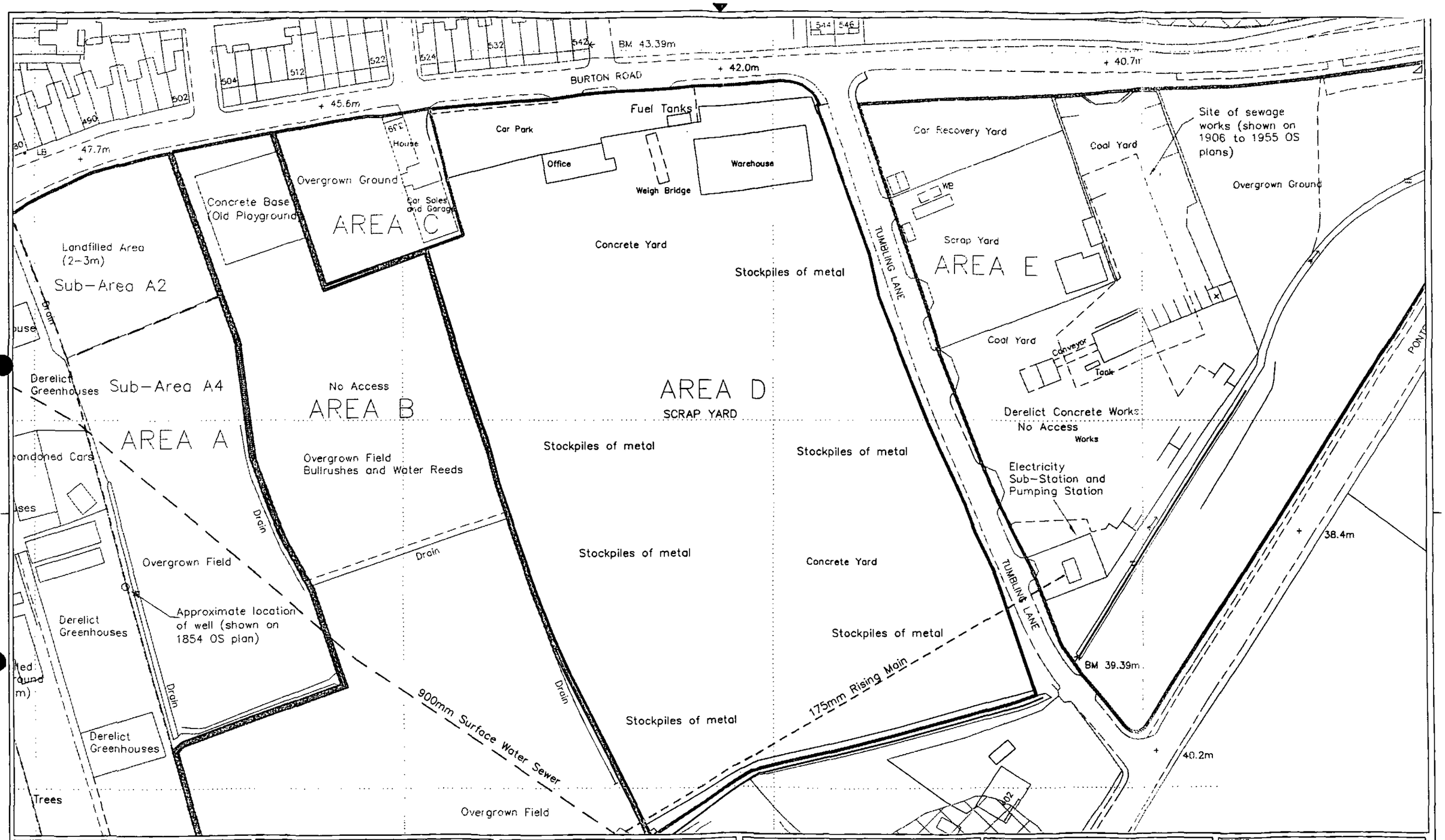
Where samples of gas are required for laboratory analysis, Gresham Tubes are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

**APPENDIX B**
**DRAWINGS**

ENCIA CONSULTING LTD ENCIA HOUSE AUDBY LANE WETHERBY W.YORSHIRE LS22 7RD TEL: 01937 589955 FAX: 01937 589944




| | | | | |
|---|---|---|---|---|
| CLIENT: **Ben Bailey Homes** | | | | |
| JOB TITLE: **Burton Road, Barnsley** | | | | |
| DRAWING TITLE: ***Site Location Plan*** | | | | |
| DRAWN BY: **JWH** | SIGNATURE: | DATE: **29/04/05** | STATUS: **Final** | |
| APPROVED: **RLM** | SIGNATURE: | DATE: **29/04/05** | SCALE: **1:50,000** | DRG NO.: **5848/10/1** |




ENCIA CONSULTING LIMITED
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WETHERBY, WEST YORKSHIRE
TEL: – 01937 589955 FAX: – 01937 589944

CLIENT: **BEN BAILEY HOMES LTD**

JOB TITLE: **BURTON ROAD BARNSLEY**

DRAWING TITLE: **SITE FEATURES PLAN**

NOTES

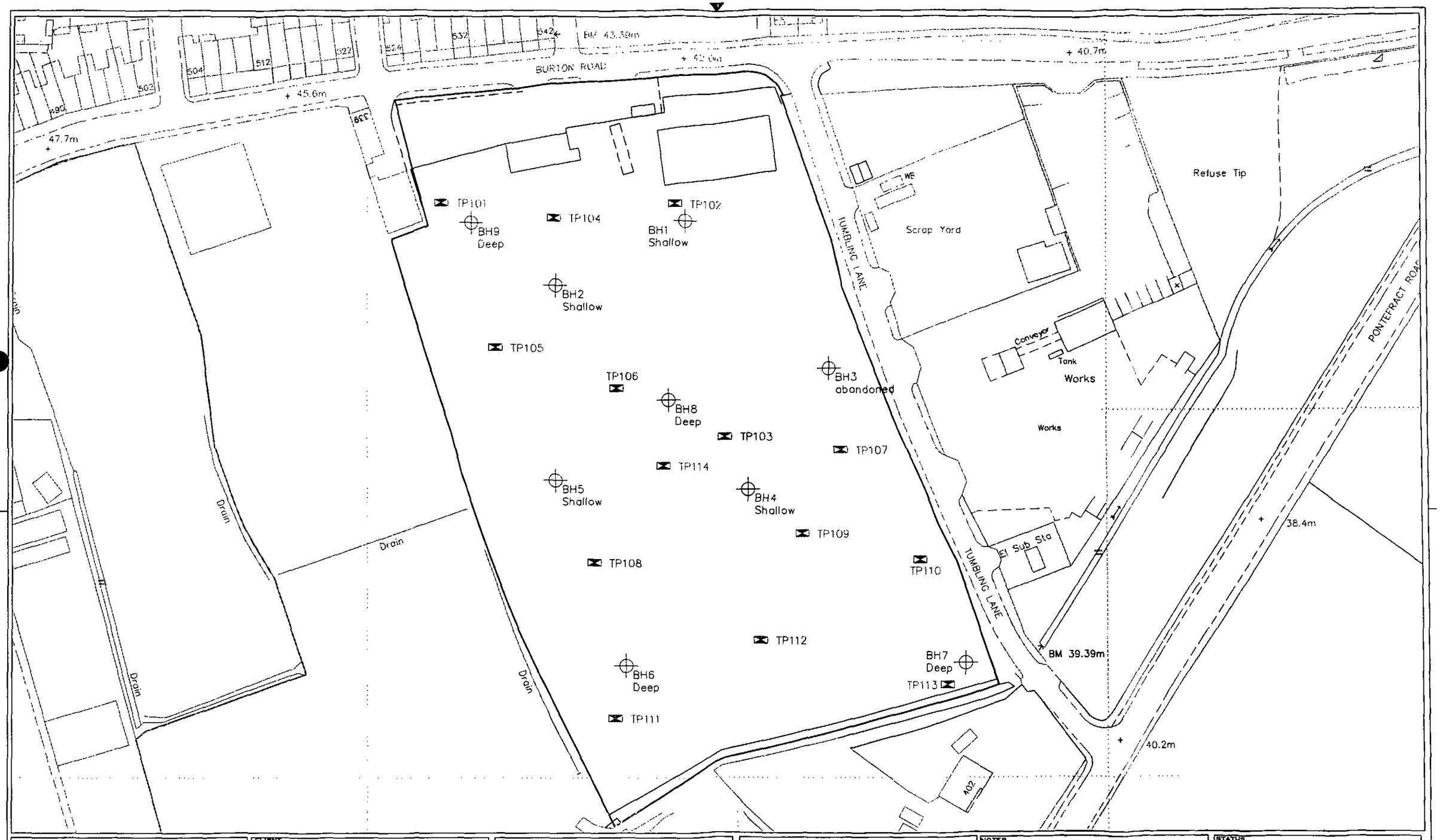
| REV. | DESCRIPTION | DATE |
|---|---|---|

STATUS: FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☑

| | SIGNITURE | DATE |
|---|---|---|
| DRAWN: JWH | | 29/04/05 |
| APPROVED: RLM | | 29/04/05 |

SCALE: 1:1000 SHEET: A3

DRAWING NO.: 5848/10/2 REVISION:




ENCIA
CONSULTING
LIMITED
ENCIA HOUSE, AUDBY LANE
WETHERBY, WEST YORKSHIRE
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CLIENT
**BEN BAILEY HOMES LTD**

JOB TITLE
**BURTON ROAD BARNSLEY**

DRAWING TITLE
**EXPLORATORY HOLE LOCATION PLAN**

NOTES
BOREHOLE
TRIAL PIT

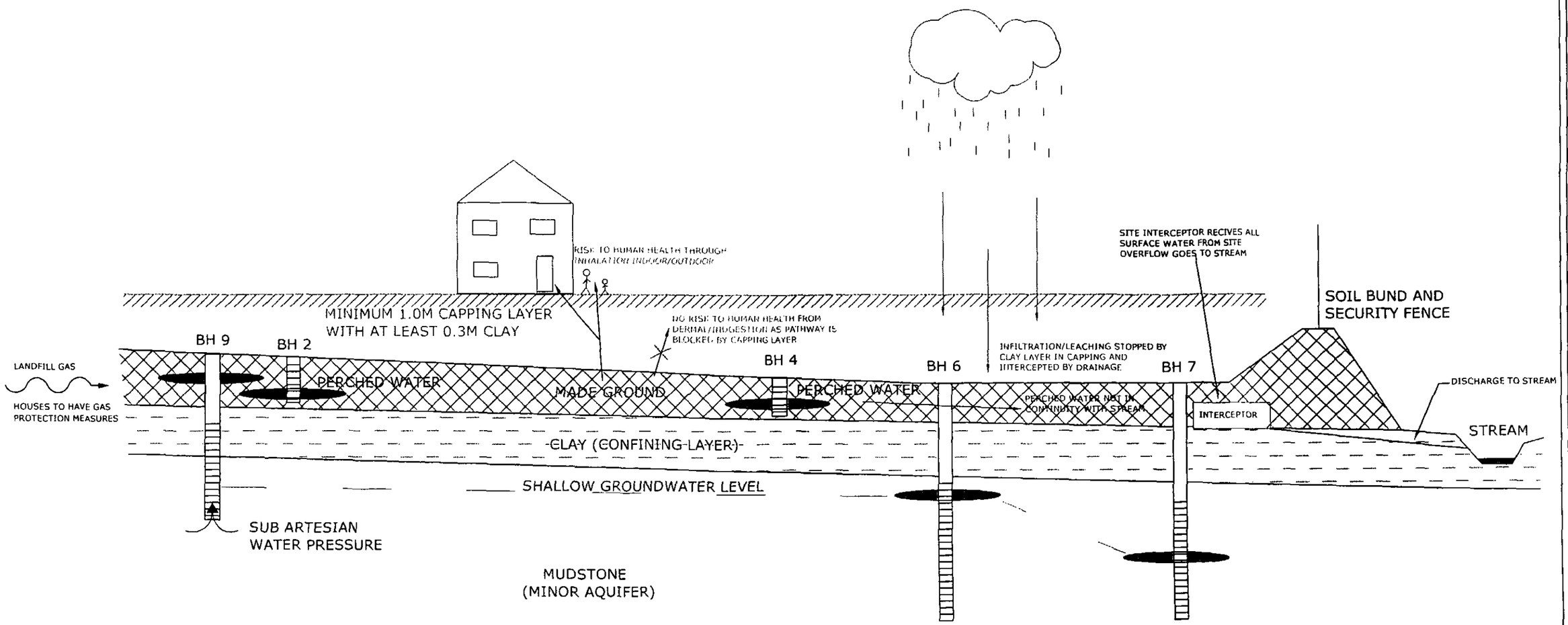
| REV. | DESCRIPTION | DATE |
|---|---|---|

STATUS
FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☑

| DRAWN | SIGNITURE | DATE |
|---|---|---|
| JWH | | 29/04/05 |
| APPROVED | SIGNITURE | DATE |
| RLM | | 29/04/05 |

| SCALE | SHEET |
|---|---|
| 1:1000 | A3 |

| DRAWING NO. | REVISION |
|---|---|
| 5848/10/3 | |




ENCIA
CONSULTING
LIMITED
ENCIA HOUSE, AUDBY LANE
WETHERBY, WEST YORKSHIRE
TEL: - 01937 589955 FAX: - 01937 589944

CLIENT: **BEN BAILEY HOMES LTD**

JOB TITLE: **BURTON ROAD BARNSLEY**

DRAWING TITLE: **CONCEPTUAL SITE MODEL**

NOTES

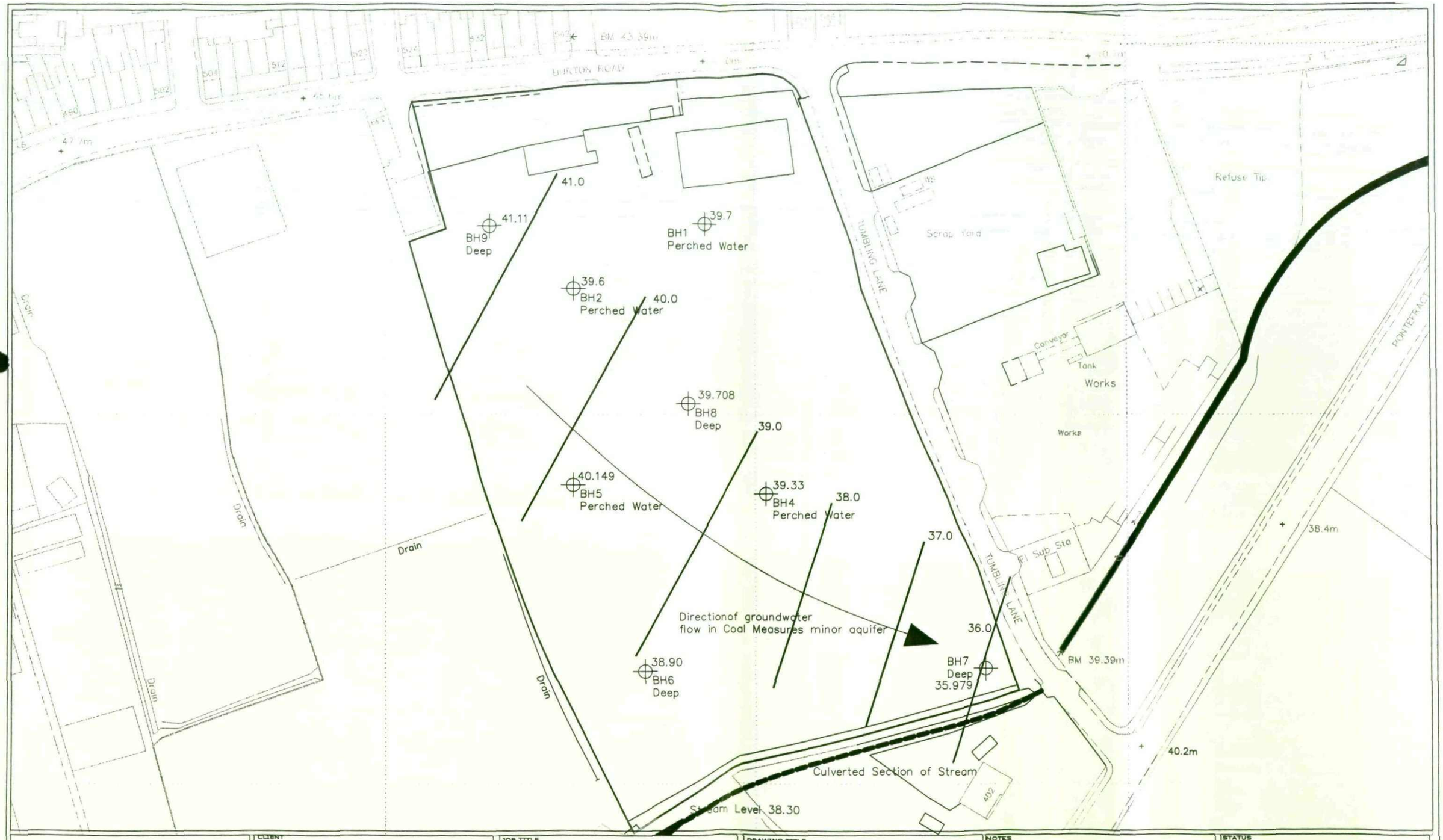
| REV. | DESCRIPTION | DATE |
|---|---|---|

STATUS: FOR COMMENT ☑ FOR APPROVAL ☐ DRAFT ☐ FINAL ☐

| | | |
|---|---|---|
| DRAWN: JWH | SIGNITURE: | DATE: 28/04/05 |
| APPROVED: RLM | SIGNITURE: | DATE: 28/04/05 |

SCALE: NTS SHEET: A3

DRAWING NO.: 5848/10/4 REVISION:




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|---|---|---|---|---|---|
| **ENCIA** CONSULTING LIMITED<br>ENCIA HOUSE, AUDBY LANE<br>WETHERBY, WEST YORKSHIRE<br>TEL: – 01937 589955 FAX: – 01937 589944 | CLIENT<br>**BEN BAILEY HOMES LTD** | JOB TITLE<br>**BURTON ROAD BARNSLEY** | DRAWING TITLE<br>**PERCHED AND GROUNDWATER LEVELS WITH COUNTOURS** | NOTES<br>Groundwater Contour<br>Perched Water Contour<br>REV. DESCRIPTION DATE | STATUS: FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☑<br>DRAWN JWH SIGNITURE DATE 29/04/05<br>APPROVED RLM SIGNITURE DATE 29/04/05<br>SCALE 1:1000 SHEET A3<br>DRAWING NO. 5848/10/5 REVISION |

**APPENDIX C**
**COMMISSION**

5848/JWH

9th February 2005

Mr P Barringer
Ben Bailey Homes
Elizabeth House
Cliff Street
Mexborough
South Yorkshire
S64 9HQ

Dear Phillip

**Burton Road, Barnsley**

**Introduction**

Further to the initial quantative risk assessment for Area D, letter dated 28th May 2004, it was recommended that additional SI should be undertaken in order to fully assess risks to controlled waters from the contamination within Area D. On completion a detailed quantative risk assessment would be issued to Barnsley Metropolitan Borough Council.

It is understood that the scrap yard which occupies Area D is in the process of being cleared and that full access to the site will be available towards the end of February.

The purpose of detailed quantitative risk assessment would be to determine site-specific remediation target concentrations for the contaminants of concern. The assessment would consider *both* controlled waters and human health, and on completion, it should be possible to determine:

- whether some\all of this material can be left untreated on site, subject to an agreed cover thickness and possibly a cut-off wall to protect the culverted watercourse
- the approximate volume of material requiring treatment\removal
- the most appropriate remedial strategy

Our fee estimate for this work is £15,935.00, a detailed breakdown is enclosed.

These fees allow for:

- fieldwork and laboratory testing
- the necessary computer modelling,
- preparation of interpretative reports,
- submission to regulators (on your instruction) and initial liaison with regulators (i.e. response to any comments made).

During the initial site investigation elevated ground gas was encountered within the north eastern area of Area D, this area being the closest to an actively gassing landfill on the opposite side of Burton Road. Therefore we have also allowed for the installation of gas monitoring wells and a gas risk assessment.

With respect to timescales, fieldwork will take 1 week, testing 2 weeks and reporting including risk assessment a further 2 weeks. Therefore, a final risk assessment report would be available within 5 weeks of receipt of your written instruction to proceed.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

Richard Meredith
**For and on behalf of**
**ENCIA CONSULTING LIMITED**

Ben Bailey HOMES
STYLED for LIFE
Elizabeth House, Cliff Street, Mexborough,
South Yorkshire. S64 9HQ
Telephone: 01709 586261 Fax: 01709 570006
www.ben-bailey.co.uk

# FACSIMILE

DATE: 10 February, 2005

FAX NO: 01937 589944

TO: Richard Meredith

COMPANY: ENCIA

FROM: Andy Roberts

NO OF PAGES: 1

**Burton Road, Barnsley**

In response to your letter regarding the detailed quantitative risk assessment on the above site please accept this fax as your official instruction to undertake the works agreed on your letter to the timescales agreed with Phil Barringer.

If you require any further information please do not hesitate to get in contact.

Regards

Andrew Roberts
Land & Planning Executive

# APPENDIX D
# TRIAL PIT LOGS

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP101**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | In-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.30 | | MADE GROUND: (Loose) dark brown black sandy ash with much fine to coarse gravel sub-angular of clinker, brick and concrete. (ASH & CLINKER) | | | | |
| 2D | 0.40 | | | | | | |
| 3D | 0.60 | | | 0.60 | | | |
| 4D | 0.70 | | MADE GROUND: (Loose) grey brown sand and gravel. Gravel fine to coarse rounded to sub-rounded of various stone. (GRANULAR MADE GROUND) | 0.80 | | | |
| | | | Stiff orange brown mottled grey slightly sandy CLAY, becoming friable from 2.50m, with some litho relics fine to coarse sub angular of mudstone. (WEATHERED COAL MEASURES) | | | | |
| 5D | 1.20 | V = 80 kPa | Stiff from 1.50m | | | | |
| | | | | 2.90 | | | |
| 6D | 2.95 | | (Weak) brown MUDSTONE. (COAL MEASURES) | 3.00 | | | |
| | | | End of trial pit at 3.00 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP102**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | MADE GROUND: (Dense) black fine to coarse sub-angular gravel of tarmac. (GRANULAR MADE GROUND) | 0.20 | | | |
| 1D | 0.50 | | MADE GROUND: (Dense) black sandy fine to coarse sub-angular gravel of clinker, brick, concrete, ash and tar. Occasional cobbles and boulders up to 30cm diameter sub angular of brick and concrete. (ASH & CLINKER) | 0.50 | | | |
| 2D | 0.90 | | Discoloured water inflow at 0.50m<br>Many bricks at 0.70m | | | | |
| | | | End of trial pit at 1.00 m | 1.00 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Seepage of groundwater at 0.50m.
4. On completion the trial pit was backfilled with materials arising.
5. Concrete slab encountered at 1.00, TP terminated.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP103**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| | | | MADE GROUND: (Dense) dark brown black sandy ash with much fine to coarse gravel sub-angular of clinker, glass, brick and plastic. Occasional bricks and sub-angular concrete boulders. (ASH & CLINKER) | | | | |
| 1D | 0.50 | | | | | | |
| 2D | 0.60 | | | | | | |
| | | | Many large brick fragments up to 30cm diameter from 0.90m | | | | |
| 3D | 1.60 | | | 1.60 | | | |
| 4D | 1.70 | | (Firm) dark brown mottled black slightly sandy CLAY with occasional black organic fibrous material. (WEATHERED COAL MEASURES) | | | | |
| 5D | 1.85 | | | 1.80 | | | |
| | | | Stiff orange brown mottled grey slightly sandy CLAY. (WEATHERED COAL MEASURES) | | | | |
| 6D | 2.10 | | | | | | |
| | | V = 90 kPa | | | | | |
| | | | End of trial pit at 3.00 m | 3.00 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP104**

DATE 21/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | MADE GROUND: (Loose) grey brown gravelly sand. Gravel is fine to coarse sub-angular of concrete and stone, occasionally cemented. (GRANULAR MADE GROUND) | 0.20 | | | |
| 1D | 0.40 | | | | | | |
| 2D | 0.45 | | | | | | |
| 3D | 0.50 | | | 0.50 | | | |
| 4D | 0.60 | | MADE GROUND: (Loose) brown black sandy fine to coarse angular gravel of ash and clinker with some brick. (ASH & CLINKER) Strong diesel odour | | | | |
| 5D | 1.10 | | | 1.10 | | | |
| 6D | 1.20 | | (Firm) grey brown mottled orange and black slightly sandy CLAY. | | | | |
| 7D | 1.60 | | Stiff, orange brown from 1.50m | | | | |
| 8D | 2.50 | | Fibrous plastic black PEAT. (PEAT) | 2.50 | | | |
| 9D | 2.60 | | | 2.70 | | | |
| | | | (Firm) grey mottled orange friable CLAY, with occasional litho relics fine to coarse angular to sub angular of mudstone. (WEATHERED COAL MEASURES) | | | | |
| | | | End of trial pit at 3.20 m | 3.20 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP105**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.30 | | MADE GROUND: (Loose) dark grey black sandy ash with much fine to coarse gravel sub-angular of clinker. (ASH & CLINKER) | | | | |
| 2D | 0.40 | | | 0.50 | | | |
| | | | MADE GROUND: (Loose) dark grey sandy fine to coarse sub-rounded gravel of various stone. (GRANULAR MADE GROUND) | | | | |
| | | | From 0.80m becoming increasingly cemented | | | | |
| | | | | 1.50 | | | |
| | | | (Firm) orange brown mottled grey slightly sandy CLAY. (WEATHERED COAL MEASURES) | | | | |
| 3D | 1.70 | | | | | | |
| 4D | 1.75 | | | | | | |
| | | V = 100 kPa | From 2.00m becoming stiff. | | | | |
| | | | | 2.65 | | | |
| | | | (Moderately weak) thinly laminated grey brown MUDSTONE. (COAL MEASURES) | 2.75 | | | |
| | | | End of trial pit at 2.75 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP106**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.50 | | MADE GROUND: (Loose) brown sandy brick and rubble fill with much fine to coarse gravel and cobbles sub angular of clinker, brick ( 50% of material ), metal fragments, wood, plastic pipe. Occasional boulders up to 1.00m diameter of concrete. (RUBBLE) | | | | |
| 2D | 0.60 | | Damp from 0.60m | | | | |
| | | | From 1.00m with occasional reworked clay | | | | |
| | | | Pipe at 1.60m, 600mm diameter, E-W | | | | |
| | | | | 2.00 | | | |
| 3D | 2.10 | | Firm grey thinly laminated CLAY, with occasional coal lenses up to 10mm thick. (WEATHERED COAL MEASURES) | | | | |
| 4D | 2.20 | V = 70 kPa | | | | | |
| | | | | 2.90 | | | |
| | | | (Weak) orange brown friable WEATHERED MUDSTONE. (COAL MEASURES) | 3.00 | | | |
| | | | End of trial pit at 3.00 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit were unstable below 0.30m.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP107**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | MADE GROUND: (Loose) orange brown sand and gravel. Gravel fine to coarse sub-angular of clinker and sandstone. (GRANULAR MADE GROUND) | 0.20 | | | |
| 1D | 1.00 | | | | | | |
| 2D | 1.60 | | MADE GROUND: (Loose) black clayey gravel. Gravel fine to coarse sub-angular of clinker. (ASH & CLINKER) | 1.50 | | | |
| | | | (Firm) grey brown mottled green and black slightly sandy CLAY with occasional organic fibrous material. (WEATHERED COAL MEASURES) | 2.00 | | | |
| 3D | 2.30 | | | | | | |
| | | | End of trial pit at 3.00 m | 3.00 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. There was a small inflow of water at 2.00 during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP108**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.50 | | MADE GROUND: (Loose) brown sand and gravel. Gravel fine to coarse angular to sub angular of clinker, concrete, glass, ceramic, ash, plastic, wire metal. Occasional cobbles and boulders angular to sub-angular of sandstone, metal sheeting, brick, wood, plastic pipe. (GRANULAR MADE GROUND) Large metal chain 5m long at 0.5mbgl Many metal wires at 0.70mbgl | | | | |
| 2D | 0.60 | | | | | | |
| 3D | 1.70 | | | 1.70 | | | |
| 4D | 1.90 | | Firm orange brown mottled grey and black slightly sandy CLAY. (WEATHERED COAL MEASURES) | | | | |
| | | V = 65 kPa | | | | | |
| | | | | 3.00 | | | |
| | | | End of trial pit at 3.00 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit were unstable from 0.00m to 1.00m during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP109**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | MADE GROUND: (Dense) dark grey fine to coarse sub-angular gravel of limestone . (HARDCORE) | 0.20 | | | |
| | | | MADE GROUND: (Medium dense) dark brown and black sandy ash with much fine to coarse gravel sub-angular of clinker, wood, metal wire and brick. Occasional bricks (15%). (ASH & CLINKER) Diesel odour Damp with an oily sheen from 0.70m | 0.45 | | | |
| 1D | 0.60 | | | | | | |
| 2D | 0.70 | | | | | | |
| 3D | 1.50 | | (Firm) dark brown mottled black slightly sandy CLAY with occasional black organic fibrous material. (WEATHERED COAL MEASURES) | 1.50 | | | |
| 4D | 1.60 | | | | | | |
| 5D | 1.70 | | Stiff orange brown mottled grey slightly sandy CLAY. (WEATHERED COAL MEASURES) | 1.70 | | | |
| 6D | 1.90 | V = 110 kPa | Friable from 2.70m | | | | |
| | | | End of trial pit at 3.00 m | 3.00 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP110**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.50 | | MADE GROUND: (Loose) orange brown gravelly sand with occasional rootlets. Gravel is fine to coarse sub-angular of brick, clinker and sandstone. Occasional cobbles of sandstone. (GRANULAR MADE GROUND) | | | | |
| | | | Many cobbles and boulders up to 50cm diameter sub angular of concrete from 1.00mbgl. | | | | |
| 2D | 1.50 | | | | | | |
| | | | Damp, slightly clayey from 1.80m | | | | |
| | | | | 1.95 | | | |
| 3D | 2.00 | | MADE GROUND: (Dense) black clayey gravel. Gravel fine to coarse sub-angular of clinker. (ASH & CLINKER) Fragment of pipe at 1.95m | 2.00 | | | |
| | | | End of trial pit at 2.00 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit were unstable below 0.30m during excavation.
3. There was a water inflow at 2.00m.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP111**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.50 | | MADE GROUND: (Loose) dark brown slightly clayey slightly sandy gravel. Gravel fine to coarse sub-angular of clinker, metal wire, stone and cement. Occasional cobbles and boulders up to 1.00m diameter sub-angular of concrete, brick, tarmac and metal sheeting. (GRANULAR MADE GROUND) | | | | |
| | | | Car tyre at 1.10m | | | | |
| | | | Becoming clayey from 1.30m | | | | |
| | | | | 1.50 | | | |
| 2D | 1.60 | | Stiff orange mottled grey slightly sandy CLAY. (WEATHERED COAL MEASURES) | | | | |
| | | V = 85 kPa | | | | | |
| | | | | 2.50 | | | |
| | | | End of trial pit at 2.50 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Fast water inflow at 2.00m, possible drainage pipe.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP112**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| 1D | 0.30 | | MADE GROUND: (Loose) dark brown damp slightly sandy gravel. Gravel fine to coarse angular to sub-angular of clinker, metal wire, stone and wood. (GRANULAR MADE GROUND) Diesel odour and oily sheen | 0.20 | | | |
| | | | End of trial pit at 0.40 m | 0.40 | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.
5. TP terminated at 0.40m due to obstruction.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP113**

DATE 23/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| | | | MADE GROUND: (Loose) light brown sand and gravel. Gravel fine to coarse sub-angular of limestone. (GRANULAR MADE GROUND) | | | | |
| 1D | 0.40 | | | | | | |
| | | | | 0.70 | | | |
| 2D | 0.80 | | MADE GROUND: (Loose) dark orange brown slightly clayey slightly gravelly sand. Gravel is fine to coarse sub-angular of clinker and sandstone. Occasional cobbles and boulders up to 40cm diameter of sandstone. (GRANULAR MADE GROUND) | | | | |
| | | | | 1.50 | | | |
| | | | MADE GROUND: (Loose) black sandy soil with some fine to coarse gravel sub-angular of clinker. Occasional rootlets. (SUBSOIL) | 1.55 | | | |
| 3D | 1.80 | | (Moderately weak) thinly laminated grey MUDSTONE. (COAL MEASURES) | | | | |
| | | | | 2.50 | | | |
| | | | End of trial pit at 2.50 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# TRIAL PIT LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**TP114**

DATE 22/02/2005 Co-ords Sheet 1 of 1

Ground Level Scale 1:25

| sample no & type | depth (m) | in-situ test | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|
| | | | MADE GROUND: Reinforced concrete. | | | | |
| | | | | 0.20 | | | |
| 1D | 0.30 | | MADE GROUND: (Loose) grey sandy gravel. Gravel fine to coarse sub-angular of stone and cement. (GRANULAR MADE GROUND) | | | | |
| 2D | 0.40 | | | | | | |
| | | | | 0.50 | | | |
| 3D | 0.60 | | MADE GROUND: (Loose) black sandy ash with much fine to coarse gravel sub-angular of clinker, glass, brick and concrete. Occasional bricks and timber fragments (ASH & CLINKER) Strong diesel odour | | | | |
| 4D | 0.70 | | | | | | |
| 5D | 1.40 | | | | | | |
| 6D | 1.45 | | From 1.40m, damp, slightly clayey with an oily sheen | | | | |
| | | | | 1.50 | | | |
| 7D | 1.60 | | Firm orange brown mottled grey CLAY. (WEATHERED COAL MEASURES) | | | | |
| 8D | 1.70 | | | | | | |
| | | V = 68 kPa | | | | | |
| | | | | 3.00 | | | |
| | | | End of trial pit at 3.00 m | | | | |

Remarks

1. Prior to excavation a Cable Avoidance Tool survey was carried out.
2. The sides of the trial pit remained stable during excavation.
3. Groundwater was not apparent during excavation.
4. On completion the trial pit was backfilled with materials arising.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| JCB 3CX with 0.6m wide tooth bucket and hydraulic breaker. | SAH | 5848 | |

# APPENDIX E
# BOREHOLE LOGS

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH1**

DATE 23/02/2005 to 23/02/2005

Co-ords

Ground Level 41.2 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 40.95 | | |
| 1D | 0.40-0.50 | | | | MADE GROUND: (Dense) yellow sandy medium angular gravel of dolomite (SUBBASE) | 0.32 | 40.83 | | |
| | | | | | MADE GROUND: (Dense) grey fine angular gravel of ash and clinker with occasional brick and concrete (ASH & CLINKER) | 0.50 | 40.65 | | |
| | | | | | MADE GROUND: Obstruction, no recovery | 1.70 | 39.45 | | |
| 2D | 1.85-2.50 | | | | MADE GROUND: (Dense) grey fine angular gravel of ash and clinker with occasional brick and concrete (ASH & CLINKER) | 1.84 | 39.31 | | |
| | | | | | (Firm) orange brown mottled CLAY *(WEATHERED COAL MEASURES)* | 2.93 | 38.22 | | |
| 3D | 3.20-4.00 | | | | Weak brown MUDSTONE: Recovered as: grey brown slightly sandy clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | | | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 37.15 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH2**

DATE 21/02/2005 to 21/02/2005

Co-ords

Ground Level 41.4 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 41.21 | | |
| 1D | 0.60-1.00 | | | | MADE GROUND: (Dense) yellow sandy medium angular gravel of dolomite (SUB-BASE) | 0.48 | 40.93 | | |
| 2D | 1.00-2.00 | | | | MADE GROUND: (Dense) grey clayey sand and gravel of ash, clinker and brick (ASH & CLINKER) | | | | |
| 3D | 2.10-2.43 | | | | MADE GROUND: (Firm) brown clay with a little broken brick and clinker (COHESIVE MADE GROUND) | 2.07 | 39.34 | | |
| 4D | 2.50-3.50 | | | | (Firm) orange brown mottled CLAY (WEATHERED COAL MEASURES) | 2.43 | 38.98 | | |
| | | | | | Weak brown MUDSTONE: Recovered as: grey brown clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 3.50 | 37.91 | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 37.41 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH3**

DATE 22/02/2005 to 22/02/2005

Co-ords

Ground Level

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: *Reinforced concrete.* | | | | |
| 1D | 0.30-0.70 | | | | MADE GROUND: (Loose) brown silty sand with much fine to coarse angular to subrounded gravel of brick and concrete some ash and clinker. Some odour of oil (ASH & CLINKER) | 0.30 | | | |
| | | | | | MADE GROUND: Obstruction | 0.70 | | | |
| | | | | | *End of borehole at 1.47 m* | 1.47 | | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Balley Homes Limited

SITE *Burton Road, Barnsley*

**BH4**

DATE 22/02/2005 to 22/02/2005

Co-ords

Ground Level 40.5 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 40.25 | | |
| 1D | 0.40-1.00 | | | | MADE GROUND: (Dense) yellow sandy medium angular gravel of dolomite (SUBBASE) | 0.36 | 40.09 | | |
| | | | | | MADE GROUND: (Dense) grey fine angular gravel of ash and clinker with occasional brick and concrete (ASH & CLINKER) | 1.12 | 39.33 | | |
| | | | | | MADE GROUND: Obstruction, no recovery | | | | |
| 2D | 2.05-2.80 | | | | (Firm) orange brown mottled CLAY (WEATHERED COAL MEASURES) | 1.98 | 38.47 | | |
| 3D | 3.00-4.00 | | | | Weak brown MUDSTONE: Recovered as: grey brown slightly sandy clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 2.96 | 37.49 | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 36.45 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH5**

DATE 21/02/2005 to 21/02/2005

Co-ords

Ground Level 41.4 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 41.16 | | |
| 1D | 0.50-1.20 | | | | MADE GROUND: (Dense) yellow sandy medium angular gravel of dolomite (SUBBASE) | | | | |
| 2D | 1.20-1.95 | | | | | | | | |
| 3D | 2.00-3.00 | | | | (Firm) orange brown mottled CLAY *(WEATHERED COAL MEASURES)* | 1.96 | 39.40 | | |
| 4D | 3.30-4.00 | | | | Weak brown MUDSTONE: Recovered as: grey brown clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 3.03 | 38.33 | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 37.36 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH6**

DATE 22/02/2005 to 22/02/2005

Co-ords

Ground Level 41.0 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 40.79 | | |
| 1D | 0.40-1.00 | | | | MADE GROUND: (Firm) grey gravelly clay with ash, clinker, brick and slate. Odour of oil. (ASH & CLINKER) slight diesel odour at 0.4m | | | | |
| 2D | 1.40-1.90 | | | | MADE GROUND: (Firm) greyish brown sandy clay with a little brick, ash and clinker (ASH & CLINKER) diesel odour at 1.4m | 1.38<br>1.47 | 39.61<br>39.52 | | |
| 3D | 2.00-2.50 | | | | (Firm) orange brown mottled CLAY (WEATHERED COAL MEASURES) | | | | |
| 4D | 3.20-4.00 | | | | Weak brown MUDSTONE: Recovered as: grey brown clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 2.83 | 38.16 | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 36.99 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH7**

DATE 22/02/2005 to 22/02/2005

Co-ords

Ground Level 40.5 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 40.25 | | |
| 1D | 0.40-1.00 | | | | MADE GROUND: (Dense) yellow sandy medium angular gravel of dolomite (SUBBASE) | | | | |
| 2D | 1.50-2.00 | | | | MADE GROUND: (Firm) grey gravelly clay with ash, clinker, brick and slate. Odour of oil. (COHESIVE MADE GROUND) | 1.36 | 39.09 | | |
| 3D | 2.35-2.80 | | | | MADE GROUND: (Firm) greyish brown sandy clay with a little brick, ash and clinker (COHESIVE MADE GROUND) | 2.32 | 38.13 | | |
| 4D | 2.90-3.40 | | | | (Firm) orange brown mottled CLAY (WEATHERED COAL MEASURES) | 2.84 | 37.61 | | |
| 5D | 4.00-5.00 | | | | Weak brown MUDSTONE: Recovered as: grey brown clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 3.64 | 36.81 | | |
| | | | | | *End of borehole at 5.00 m* | 5.00 | 35.45 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | JWH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH8**

DATE 21/02/2005 to 21/02/2005

Co-ords

Ground Level 40.5 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 40.30 | | |
| 1D | 0.40-1.00 | | | | MADE GROUND: Dark grey brown sandy fine to coarse angular gravel of ash and clinker with some brick. (ASH & CLINKER) | | | | |
| 2D | 1.50-2.00 | | | | MADE GROUND: Dark grey brown mottled black slightly clayey sand and gravel. Gravel is fine to coarse sub-angular of clinker, brick and stone. Occasional cobbles sub-angular of brick. (ASH & CLINKER) | 1.37 | 39.13 | | |
| 3D | 2.30-2.70 | | | | Slight diesel odour | 2.14 | 38.36 | | |
| | | | | | MADE GROUND: Brown mottled black and orange *slightly sandy slightly gravelly clay. Gravel fine to* coarse sub-angular of clinker and mudstone. (COHESIVE MADE GROUND) | 2.45 | 38.05 | | |
| 4D | 3.00-4.00 | | | | (Firm) thinly laminated friable grey CLAY with much litho relics fine to coarse angular of mudstone (WEATHERED COAL MEASURES) | | | | |
| | | | | | No laminations from 4.00m | | | | |
| | | | | | *End of borehole at 5.00 m* | 5.00 | 35.50 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | SAH | 5848 | |

# BOREHOLE LOG

ENCIA CONSULTING LIMITED

CLIENT Ben Bailey Homes Limited

SITE Burton Road, Barnsley

**BH9**

DATE 23/02/2005 to 23/02/2005

Co-ords

Ground Level 42.1 mAOD

Sheet 1 of 1

Scale 1:50

| sample no & type | depth (m) | casing depth (m) | Vane SPT & N value | well/ backfill | description | depth (m) | level (m) | ground water | legend |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MADE GROUND: Reinforced concrete. | 0.20 | 41.91 | | |
| 1D | 0.40-1.00 | | | | MADE GROUND: Black slightly sandy gravel. Gravel fine to coarse angular of ash, clinker and sandstone. (ASH & CLINKER) Slight diesel odour at 0.40m | | | | |
| | | | | | | 1.17 | 40.94 | | |
| 2D | 1.50-2.00 | | | | MADE GROUND: Brown mottled grey and black slightly sandy slightly gravelly clay. Gravel fine to coarse angular of ash, clinker and brick. (COHESIVE MADE GROUND) | 1.48 | 40.63 | | |
| 3D | 2.30-2.70 | | | | (Firm) brown mottled orange sandy CLAY. (WEATHERED COAL MEASURES) | | | | |
| | | | | | Weak brown MUDSTONE: Recovered as: grey brown slightly sandy clay with much fine to coarse subangular gravel litho relics of mudstone. (COAL MEASURES) | 2.86 | 39.25 | | |
| | | | | | *End of borehole at 4.00 m* | 4.00 | 38.11 | | |

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out.
2. Groundwater was not apparent during drilling.

| Equipment/Methods | Logged by | JOB | FIGURE |
|---|---|---|---|
| Cable percussion boring rig equipped with 150mm diameter tools and casing. | SAH | 5848 | |

## APPENDIX F
## LABORATORY TEST CERTIFICATES

ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

Received - 1 APR 2005 22236

Mr J Harrison
Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

30/03/2005

Dear Mr J Harrison

**Your Ref and Description :**

**Site Name :** **Burton Road,Barnsley**

**SDG Number :** ***SDG05005846***

*Please find enclosed the test reports for the samples received on* 25 Feb 2005.

The samples were given Lab numbers 050021983 - 050022009. Please quote these numbers should you have any queries about the enclosed test reports. Also enclosed are brief descriptions of the techniques employed to analyse these samples.

Where appropriate, all liquid and solid samples are retained for 10 working days from the report date. After that date the samples will be discarded.

If you wish to extend the period for which a sample is to be retained, please call 01709 841096. A cost of 20p per sample per container per day will apply for this extended storage service.

Should you have any queries about the enclosed report or if you have any comments to make about the service you have received, please contact the Customer Services Team at the address, telephone number or email address given above.

Yours sincerely

Samantha Duke
Customer Services

0995
0996
2330

ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

## Accredited Test Procedures

| Method Ref. | Technique |
|---|---|
| R2.21 | Colorimetric |
| R2.3.2/S2.3 | Colorimetric |
| R2.4.2/S2.4 | Colorimetric |
| R2.5 | Colorimetric |
| R2.6.1/S2.6 | Colorimetric |
| R2.7.3/S2.7 | Colorimetric |
| R2.8.2/S2.8 | Colorimetric |
| R3.2/S3.2 | Titrimetric |
| R3.3/S3.3 | Electrochemical |
| R3.4.1/A | Ion Selective Electrode |
| R3.5.1 | Ion Selective Electrode |
| R3.6/S3.6.2 | Ion Selective Electrode |
| R3.7.1/S3.7.1 | Gravimetric |
| R3.8/S3.8 | Gravimetric |
| R4.1/R4.2/S4.1 | Titrimetric |
| R5.1/S5.1 | Electrochemical (dissolved oxygen probe) |
| R5.2/S5.2 | Dichromate oxidation / colorimetric |
| R5.5 | Ion Chromatography |
| R6.13 | Colorimetric |
| R7.2 | Infra-red spectrometry |
| R7.22 | Gas chromatography - flame ionisation detector |
| R7.25 | Gas chromatography - flame ionisation detector |
| R7.31 | Gas chromatography - mass spectrometry |
| R7.41 | Gas chromatography - mass spectrometry |
| R7.4.1 | Gravimetric |
| R7.6 | HPLC |
| R7.7 | Gas chromatography - mass spectrometry |
| R7.9 | Gas chromatography - mass spectrometry |
| R8B | Inductively coupled plasma |
| R9A | Atomic fluorescence spectrometry |
| R9B | Atomic fluorescense spectrometry |
| R11.1 | Gravimetric |
| R11.2 | Gravimetric |
| R11.3 | Gravimetric |
| R11.7 | Gravimetric |
| R12.1 | Respiration inhibition |
| R12.2.1a | Nitrification inhibition |
| R12.3 | Microtox |

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ALcontrol Laboratories

Rotherham Laboratory : Templeborough House, Mill Close, Rotherham S60 1BZ (UKAS Lab No 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF. (UKAS Lab No 0995)
Telephone 01709 841096 Fax 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021983 | | 050021984 | | 050021985 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP101 0.4m | | TP101 0.7m | | TP101 1.2m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | | | 0.727 | mg/kg | | |
| Acenaphthylene | R7.7 | | | <0.36 | mg/kg | | |
| Benzo (a) Anthracene | R7.7 | | | 4.57 | mg/kg | | |
| Chrysene | R7.7 | | | 3.99 | mg/kg | | |
| Dibenzo (a,h) Anthracene | R7.7 | | | 0.842 | mg/kg | | |
| Fluoranthene | R7.7 | | | 13.9 | mg/kg | | |
| Fluorene | R7.7 | | | 0.742 | mg/kg | | |
| Phenanthrene | R7.7 | | | 6.14 | mg/kg | | |
| Pyrene | R7.7 | | | 13.8 | mg/kg | | |
| Benzo (a) Pyrene | R7.7 | | | 6.28 | mg/kg | | |
| Benzo (g,h,i) Perylene | R7.7 | | | 2.91 | mg/kg | | |
| Indeno (1,2,3-cd) pyrene | R7.7 | | | 3.55 | mg/kg | | |
| Anthracene | R7.7 | | | 1.99 | mg/kg | | |
| Naphthalene | R7.7 | | | <0.36 | mg/kg | | |
| Benzo (b&k) Fluoranthene | R7.7 | | | 9.63 | mg/kg | | |
| PAH Total (EPA 16) | R7.7 | | | 69.431 | mg/kg | | |
| PCB 28 | R7.41 | | | 15.8 | ug/kg | | |
| PCB 52 | R7.41 | | | 9.79 | ug/kg | | |
| PCB 101 | R7.41 | | | 12.1 | ug/kg | | |
| PCB 118 | R7.41 | | | 8.21 | ug/kg | | |
| PCB 138 | R7.41 | | | 10.5 | ug/kg | | |
| PCB 153 | R7.41 | | | 7.70 | ug/kg | | |
| PCB 180 | R7.41 | | | 4.13 | ug/kg | | |
| Diesel range organics (C10 - C26) | R7.25 | 3380 | mg/kg | | | 25.2 | mg/kg |
| Lubricating oil range organics (C26 - C40) | R7.25 | 4220 | mg/kg | | | 49.0 | mg/kg |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 7620 | mg/kg | | | 74.2 | mg/kg |
| PAH (FID screen) | R7.22 | 1210 | mg/kg | | | 5.26 | mg/kg |
| Air Dried Solids | R1.1 | 91.90 | % | 92.20 | % | 79.40 | % |
| Stones > 10mm | R1.1 | 31.90 | % | 46.10 | % | 0.00 | % |
| Calorific Value | R*6.16.X | 6930 | kJ/kg | | | | |
| TPH (Aliphatic/Aromatic Split) | *$ | | | See Separate Report | | | |

Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

SDG Number : SDG05005846
Certificate ID : 101786


0995
0996
2300

*Methods marked * in this report are not in the UKAS Accreditation Schedule for our Laboratory. Methods marked $ are subcontracted, those prefixed R are performed at the Rotherham Lab & those prefixed S are performed at the Bellshill Lab Comments, opinions & interpretations expressed herein are outside the scope of UKAS Accreditation Details of the methods used and their performance characteristics are available on request Unless otherwise stated, sampling was not carried out by ALcontrol Laboratories. < = less than; > = greater than; DSB = dry solids basis*

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ALcontrol Laboratories

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Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF. (UKAS Lab No 0995)
Telephone 01709 841096 Fax 01709 841079 E-mail : customer services@alcontrol co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021986 | | 050021987 | | 050021988 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP103 0.6m | | TP103 1.7m | | TP104 0.45m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | 2.37 | mg/kg | | | 0.32 | mg/kg |
| Acenaphthylene | R7.7 | 0.378 | mg/kg | | | <0.32 | mg/kg |
| Benzo (a) Anthracene | R7.7 | 5.29 | mg/kg | | | 3.30 | mg/kg |
| Chrysene | R7.7 | 4.80 | mg/kg | | | 2.89 | mg/kg |
| Dibenzo (a,h) Anthracene | R7.7 | 0.831 | mg/kg | | | 0.41 | mg/kg |
| Fluoranthene | R7.7 | 18.3 | mg/kg | | | 10.3 | mg/kg |
| Fluorene | R7.7 | 3.14 | mg/kg | | | 0.339 | mg/kg |
| Phenanthrene | R7.7 | 12.6 | mg/kg | | | 4.20 | mg/kg |
| Pyrene | R7.7 | 18.0 | mg/kg | | | 11.3 | mg/kg |
| Benzo (a) Pyrene | R7.7 | 5.94 | mg/kg | | | 2.86 | mg/kg |
| Benzo (g,h,i) Perylene | R7.7 | 2.96 | mg/kg | | | 1.46 | mg/kg |
| Indeno (1,2,3-cd) pyrene | R7.7 | 3.73 | mg/kg | | | 1.88 | mg/kg |
| Anthracene | R7.7 | 3.46 | mg/kg | | | 1.29 | mg/kg |
| Naphthalene | R7.7 | 0.632 | mg/kg | | | <0.32 | mg/kg |
| Benzo (b&k) Fluoranthene | R7.7 | 9.29 | mg/kg | | | 5.00 | mg/kg |
| PAH Total (EPA 16) | R7.7 | 91.721 | mg/kg | | | 45.869 | mg/kg |
| PCB 28 | R7.41 | 349 | ug/kg | | | | |
| PCB 52 | R7.41 | 194 | ug/kg | | | | |
| PCB 101 | R7.41 | 136 | ug/kg | | | | |
| PCB 118 | R7.41 | 80.6 | ug/kg | | | | |
| PCB 138 | R7.41 | 74.4 | ug/kg | | | | |
| PCB 153 | R7.41 | 53.9 | ug/kg | | | | |
| PCB 180 | R7.41 | 34.7 | ug/kg | | | | |
| Diesel range organics (C10 - C26) | R7.25 | | | 98.0 | mg/kg | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | | | 116 | mg/kg | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | | | 214 | mg/kg | | |
| PAH (FID screen) | R7.22 | | | 43.3 | mg/kg | | |
| Air Dried Solids | R1.1 | 88.90 | % | 76.40 | % | 90.00 | % |
| Stones > 10mm | R1.1 | 25.60 | % | 0.00 | % | 39.00 | % |
| Calorific Value | R*6.16.X | <100 | kJ/kg | | | | |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | | | See Separate Report | |

Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

SDG Number : SDG05005846
Certificate ID : 101786


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ALcontrol Laboratories

Rotherham Laboratory : Templeborough House, Mill Close, Rotherham S60 1BZ (UKAS Lab No. 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF. (UKAS Lab No 0995)
Telephone 01709 841096 Fax: 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021989 | | 050021990 | | 050021991 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP104 0.5m | | TP104 0.6m | | TP104 1.2m | |
| *Sampled On* | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | | | 89.0 | mg/kg | | |
| Acenaphthylene | R7.7 | | | <3.2 | mg/kg | | |
| Benzo (a) Anthracene | R7.7 | | | 224 | mg/kg | | |
| Chrysene | R7.7 | | | 18.3 | mg/kg | | |
| Dibenzo (a,h) Anthracene | R7.7 | | | 27.6 | mg/kg | | |
| Fluoranthene | R7.7 | | | 559 | mg/kg | | |
| Fluorene | R7.7 | | | 64.5 | mg/kg | | |
| Phenanthrene | R7.7 | | | 446 | mg/kg | | |
| Pyrene | R7.7 | | | 539 | mg/kg | | |
| Benzo (a) Pyrene | R7.7 | | | 221 | mg/kg | | |
| Benzo (g,h,i) Perylene | R7.7 | | | 93.9 | mg/kg | | |
| Indeno (1,2,3-cd) pyrene | R7.7 | | | 117 | mg/kg | | |
| Anthracene | R7.7 | | | 120 | mg/kg | | |
| Naphthalene | R7.7 | | | 11.0 | mg/kg | | |
| Benzo (b&k) Fluoranthene | R7.7 | | | 352 | mg/kg | | |
| PAH Total (EPA 16) | R7.7 | | | 2883.9 | mg/kg | | |
| PCB 28 | R7.41 | 223 | ug/kg | | | | |
| PCB 52 | R7.41 | 150 | ug/kg | | | | |
| PCB 101 | R7.41 | 203 | ug/kg | | | | |
| PCB 118 | R7.41 | 177 | ug/kg | | | | |
| PCB 138 | R7.41 | 181 | ug/kg | | | | |
| PCB 153 | R7.41 | 119 | ug/kg | | | | |
| PCB 180 | R7.41 | 73.5 | ug/kg | | | | |
| Diesel range organics (C10 - C26) | R7.25 | | | | | <19.5 | mg/kg |
| Lubricating oil range organics (C26 - C40) | R7.25 | | | | | <19.5 | mg/kg |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | | | | | <40 | mg/kg |
| PAH (FID screen) | R7.22 | | | | | <5 | mg/kg |
| Air Dried Solids | R1.1 | 88.40 | % | 92.40 | % | 80.10 | % |
| Stones > 10mm | R1.1 | 28.10 | % | 32.70 | % | 0.00 | % |
| Calorific Value | R*6.16.X | | | 6440 | kJ/kg | | |
| TPH (Aliphatic/Aromatic Split) | *$ | | | See Separate Report | | | |

Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

SDG Number : SDG05005846
Certificate ID : 101786


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ALcontrol Laboratories

Rotherham Laboratory : Templeborough House, Mill Close, Rotherham S60 1BZ (UKAS Lab No 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF (UKAS Lab No 0965)
Telephone 01709 841096 Fax 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021992 | | 050021993 | | 050021994 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP105 0.4m | | TP105 1.75m | | TP106 0.6m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| PCB 28 | R7.41 | 32.4 | ug/kg | | | 14.2 | ug/kg |
| PCB 52 | R7.41 | 72.3 | ug/kg | | | 19.9 | ug/kg |
| PCB 101 | R7.41 | 110 | ug/kg | | | 48.9 | ug/kg |
| PCB 118 | R7.41 | 37.2 | ug/kg | | | 20.5 | ug/kg |
| PCB 138 | R7.41 | 61.8 | ug/kg | | | 133 | ug/kg |
| PCB 153 | R7.41 | 40.6 | ug/kg | | | 917 | ug/kg |
| PCB 180 | R7.41 | 12.6 | ug/kg | | | 4280 | ug/kg |
| Diesel range organics (C10 - C26) | R7.25 | 2640 | mg/kg | <15.5 | mg/kg | 354 | mg/kg |
| Lubricating oil range organics (C26 - C40) | R7.25 | 4240 | mg/kg | <15.5 | mg/kg | 1850 | mg/kg |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 6910 | mg/kg | <40 | mg/kg | 2200 | mg/kg |
| PAH (FID screen) | R7.22 | 781 | mg/kg | <5 | mg/kg | 16.0 | mg/kg |
| Air Dried Solids | R1.1 | 93.50 | % | 83.30 | % | 87.60 | % |
| Stones > 10mm | R1.1 | 52.40 | % | 0.00 | % | 58.80 | % |
| Calorific Value | R*6.16.X | 5470 | kJ/kg | | | | |

SDG Number : SDG05005846
Certificate ID : 101786


Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

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ALcontrol Laboratories

*Rotherham Laboratory* : *Templeborough House, Mill Close, Rotherham S60 1BZ* *(UKAS Lab No 0995)*
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill, ML4 3BF. (UKAS Lab No 0995)
Telephone 01709 841096 Fax 01709 841079 E-mail customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021995 | | 050021996 | | 050021997 | |
|---|---|---|---|---|---|---|---|
| *Your Ref* | | *TP106 2.2m* | | *TP107 1.0m* | | *TP107 1.6m* | |
| *Sampled On* | | *02/03/2005* | | *02/03/2005* | | *02/03/2005* | |
| | Method | | | | | | |
| *Acenaphthene* | R7.7 | | | <0.31 | mg/kg | | |
| Acenaphthylene | R7.7 | | | <0.31 | mg/kg | | |
| *Benzo (a) Anthracene* | R7.7 | | | 0.725 | mg/kg | | |
| Chrysene | R7.7 | | | <0.31 | mg/kg | | |
| *Dibenzo (a,h) Anthracene* | R7.7 | | | <0.31 | mg/kg | | |
| Fluoranthene | R7.7 | | | 1.23 | mg/kg | | |
| *Fluorene* | R7.7 | | | <0.31 | mg/kg | | |
| Phenanthrene | R7.7 | | | 0.887 | mg/kg | | |
| Pyrene | R7.7 | | | 1.10 | mg/kg | | |
| Benzo (a) Pyrene | R7.7 | | | <0.31 | mg/kg | | |
| Benzo (g,h,i) Perylene | R7.7 | | | <0.31 | mg/kg | | |
| Indeno (1,2,3-cd) pyrene | R7.7 | | | <0.31 | mg/kg | | |
| Anthracene | R7.7 | | | <0.31 | mg/kg | | |
| Naphthalene | R7.7 | | | <0.31 | mg/kg | | |
| Benzo (b&k) Fluoranthene | R7.7 | | | 0.546 | mg/kg | | |
| PAH Total (EPA 16) | R7.7 | | | 6.038 | mg/kg | | |
| PCB 28 | R7.41 | | | | | 211 | ug/kg |
| PCB 52 | R7.41 | | | | | 94.0 | ug/kg |
| PCB 101 | R7.41 | | | | | 26.7 | ug/kg |
| PCB 118 | R7.41 | | | | | <1.16 | ug/kg |
| PCB 138 | R7.41 | | | | | <1.16 | ug/kg |
| PCB 153 | R7.41 | | | | | 3.71 | ug/kg |
| PCB 180 | R7.41 | | | | | <1.16 | ug/kg |
| Diesel range organics (C10 - C26) | R7.25 | 157 | mg/kg | | | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | 192 | mg/kg | | | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 349 | mg/kg | | | | |
| PAH (FID screen) | R7.22 | <5 | mg/kg | | | | |
| Air Dried Solids | R1.1 | 81.90 | % | 88.80 | % | 95.90 | % |
| Stones > 10mm | R1.1 | 0.00 | % | 26.10 | % | 0.00 | % |
| Calorific Value | R*6.16.X | | | | | 6610 | kJ/kg |
| TPH (Aliphatic/Aromatic Split) | *$ | | | See Separate Report | | | |

Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

**SDG Number : SDG05005846**
**Certificate ID : 101786**


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Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF (UKAS Lab No 0995)
Telephone: 01709 841066 Fax: 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050021998 | | 050021999 | | 050022000 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP107 2.3m | | TP108 0.6m | | TP110 2.0m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | | | | | 0.587 | mg/kg |
| Acenaphthylene | R7.7 | | | | | <0.33 | mg/kg |
| Benzo (a) Anthracene | R7.7 | | | | | 2.66 | mg/kg |
| Chrysene | R7.7 | | | | | <0.33 | mg/kg |
| Dibenzo (a,h) Anthracene | R7.7 | | | | | <0.33 | mg/kg |
| Fluoranthene | R7.7 | | | | | 4.97 | mg/kg |
| Fluorene | R7.7 | | | | | <0.33 | mg/kg |
| Phenanthrene | R7.7 | | | | | 2.96 | mg/kg |
| Pyrene | R7.7 | | | | | 6.88 | mg/kg |
| Benzo (a) Pyrene | R7.7 | | | | | 2.55 | mg/kg |
| Benzo (g,h,i) Perylene | R7.7 | | | | | 1.23 | mg/kg |
| Indeno (1,2,3-cd) pyrene | R7.7 | | | | | 1.01 | mg/kg |
| Anthracene | R7.7 | | | | | <0.33 | mg/kg |
| Naphthalene | R7.7 | | | | | <0.33 | mg/kg |
| Benzo (b&k) Fluoranthene | R7.7 | | | | | 3.25 | mg/kg |
| PAH Total (EPA 16) | R7.7 | | | | | 27.087 | mg/kg |
| PCB 28 | R7.41 | | | 168 | ug/kg | 83.8 | ug/kg |
| PCB 52 | R7.41 | | | 334 | ug/kg | 20.5 | ug/kg |
| PCB 101 | R7.41 | | | 295 | ug/kg | <13.2 | ug/kg |
| PCB 118 | R7.41 | | | 143 | ug/kg | <13.2 | ug/kg |
| PCB 138 | R7.41 | | | 101 | ug/kg | 29.1 | ug/kg |
| PCB 153 | R7.41 | | | 67.4 | ug/kg | 33.9 | ug/kg |
| PCB 180 | R7.41 | | | 25.0 | ug/kg | 40.1 | ug/kg |
| Diesel range organics (C10 - C26) | R7.25 | <15 | mg/kg | 882 | mg/kg | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | <15 | mg/kg | 2200 | mg/kg | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | <40 | mg/kg | 3080 | mg/kg | | |
| PAH (FID screen) | R7.22 | <5 | mg/kg | 114 | mg/kg | | |
| Air Dried Solids | R1.1 | 80.80 | % | 93.20 | % | 94.20 | % |
| Stones > 10mm | R1.1 | 0.00 | % | 60.70 | % | 0.00 | % |
| Calorific Value | R*6.16.X | | | | | 7410 | kJ/kg |
| TPH (Aliphatic/Aromatic Split) | *$ | | | | | See Separate Report | |

SDG Number : SDG05005846
Certificate ID : 101786


Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

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2300

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Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050022001 | | 050022002 | | 050022003 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP111 0.5m | | TP111 1.6m | | TP112 0.3m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | | | | | 0.422 | mg/kg |
| Acenaphthylene | R7.7 | | | | | <0.33 | mg/kg |
| Benzo (a) Anthracene | R7.7 | | | | | 2.07 | mg/kg |
| Chrysene | R7.7 | | | | | 1.46 | mg/kg |
| Dibenzo (a,h) Anthracene | R7.7 | | | | | <0.33 | mg/kg |
| Fluoranthene | R7.7 | | | | | 6.14 | mg/kg |
| Fluorene | R7.7 | | | | | 1.21 | mg/kg |
| Phenanthrene | R7.7 | | | | | 4.07 | mg/kg |
| Pyrene | R7.7 | | | | | 6.29 | mg/kg |
| Benzo (a) Pyrene | R7.7 | | | | | 1.50 | mg/kg |
| Benzo (g,h,i) Perylene | R7.7 | | | | | 1.11 | mg/kg |
| Indeno (1,2,3-cd) pyrene | R7.7 | | | | | 1.42 | mg/kg |
| Anthracene | R7.7 | | | | | 1.37 | mg/kg |
| Naphthalene | R7.7 | | | | | 0.409 | mg/kg |
| Benzo (b&k) Fluoranthene | R7.7 | | | | | 3.87 | mg/kg |
| PAH Total (EPA 16) | R7.7 | | | | | 31.671 | mg/kg |
| Diesel range organics (C10 - C26) | R7.25 | 774 | mg/kg | <16 | mg/kg | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | 446 | mg/kg | <16 | mg/kg | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 1220 | mg/kg | <40 | mg/kg | | |
| PAH (FID screen) | R7.22 | 572 | mg/kg | <5 | mg/kg | | |
| Air Dried Solids | R1.1 | 90.90 | % | 81.50 | % | 84.70 | % |
| Stones > 10mm | R1.1 | 57.30 | % | 0.00 | % | 45.70 | % |
| TPH (Aliphatic/Aromatic Split) | *$ | | | | | See Separate Report | |

SDG Number : SDG05005846
Certificate ID : 101786


Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

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Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| *Our Ref* | | 050022004 | | 050022005 | | 050022006 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP113 0.8m | | TP113 1.8m | | TP114 0.4m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| PCB 28 | R7.41 | | | | | 16.8 | ug/kg |
| PCB 52 | R7.41 | | | | | 8.77 | ug/kg |
| PCB 101 | R7.41 | | | | | 5.02 | ug/kg |
| PCB 118 | R7.41 | | | | | 5.34 | ug/kg |
| PCB 138 | R7.41 | | | | | 4.71 | ug/kg |
| PCB 153 | R7.41 | | | | | 3.62 | ug/kg |
| PCB 180 | R7.41 | | | | | 2.94 | ug/kg |
| Diesel range organics (C10 - C26) | R7.25 | 620 | mg/kg | 188 | mg/kg | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | 118 | mg/kg | 31.7 | mg/kg | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 736 | mg/kg | 220 | mg/kg | | |
| PAH (FID screen) | R7.22 | 57.0 | mg/kg | 73.4 | mg/kg | | |
| Air Dried Solids | R1.1 | 88.80 | % | 95.70 | % | 89.60 | % |
| Stones > 10mm | R1.1 | 44.60 | % | 0.00 | % | 64.70 | % |

Approved by: Steve Scott (Operations Manager)
*Reported : 30/03/2005 16:13:26*

SDG Number : SDG05005846
Certificate ID : 101786


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*Methods marked * in this report are not in the UKAS Accreditation Schedule for our Laboratory. Methods marked $ are subcontracted, those prefixed R are performed at the Rotherham Lab & those prefixed S are performed at the Bellshill Lab Comments, opinions & interpretations expressed herein are outside the scope of UKAS Accreditation Details of the methods used and their performance characteristics are available on request. Unless otherwise stated, sampling was not carried out by ALcontrol Laboratories < = less than; > = greater than, DSB = dry solids basis*

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ALcontrol Laboratories

Rotherham Laboratory : Templeborough House, Mill Close, Rotherham S60 1BZ (UKAS Lab No 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF (UKAS Lab No 0995)
Telephone. 01709 841096 Fax 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 30/03/2005 13:58:51
Site Name : Burton Road,Barnsley

Your PO No : None Supplied

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050022007 | | 050022008 | | 050022009 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | TP114 0.7m | | TP114 1.45m | | TP114 1.7m | |
| Sampled On | | 02/03/2005 | | 02/03/2005 | | 02/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | 4.07 | mg/kg | | | | |
| Acenaphthylene | R7.7 | 0.422 | mg/kg | | | | |
| Benzo (a) Anthracene | R7.7 | 29.3 | mg/kg | | | | |
| Chrysene | R7.7 | 31.6 | mg/kg | | | | |
| Dibenzo (a,h) Anthracene | R7.7 | <0.32 | mg/kg | | | | |
| Fluoranthene | R7.7 | 74.8 | mg/kg | | | | |
| Fluorene | R7.7 | 4.63 | mg/kg | | | | |
| Phenanthrene | R7.7 | 31.0 | mg/kg | | | | |
| Pyrene | R7.7 | 72.7 | mg/kg | | | | |
| Benzo (a) Pyrene | R7.7 | 34.9 | mg/kg | | | | |
| Benzo (g,h,i) Perylene | R7.7 | 19.0 | mg/kg | | | | |
| Indeno (1,2,3-cd) pyrene | R7.7 | 21.6 | mg/kg | | | | |
| Anthracene | R7.7 | 14.2 | mg/kg | | | | |
| Naphthalene | R7.7 | 0.55 | mg/kg | | | | |
| Benzo (b&k) Fluoranthene | R7.7 | 49.4 | mg/kg | | | | |
| PAH Total (EPA 16) | R7.7 | 388.332 | mg/kg | | | | |
| Diesel range organics (C10 - C26) | R7.25 | | | 3530 | mg/kg | 147 | mg/kg |
| Lubricating oil range organics (C26 - C40) | R7.25 | | | 3150 | mg/kg | 361 | mg/kg |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | | | 6660 | mg/kg | 508 | mg/kg |
| PAH (FID screen) | R7.22 | | | 174 | mg/kg | <5 | mg/kg |
| Air Dried Solids | R1.1 | 87.90 | % | 85.30 | % | 76.80 | % |
| Stones > 10mm | R1.1 | 50.00 | % | 62.50 | % | 0.00 | % |
| Calorific Value | R*6.16.X | 8370 | kJ/kg | | | | |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | | | | |

SDG Number : SDG05005846
Certificate ID : 101786


Approved by: Steve Scott (Operations Manager)
Reported : 30/03/2005 16:13:26

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# ALcontrol Geochem Analytical Services
# Sample Descriptions

**Job Number:** 05/03774/02/01
**Client:** Alcontrol UK
**Client Ref :** ALC W 7559

**Grain sizes**

| | |
|---|---|
| <0.063mm | Very Fine |
| 0.1mm - 0.063mm | Fine |
| 0.1mm - 2mm | Medium |
| 2mm - 10mm | Coarse |
| >10mm | Very Coarse |

| Sample Identity | Depth (m) | Colour | Grain Size | Description | Batch |
|---|---|---|---|---|---|
| 050021984-011 | TP101 0.7m | Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050021986-013 | TP103 0.6m | Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050021988-009 | TP104 0.45 | Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050021990-011 | TP104 0.6m | Dark Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050021996-009 | TP107 1.0m | Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050022000-013 | TP110 2.0m | Brown | 0.1mm - 0.063mm | Silty Clay with some Stones | 1 |
| 050022003-009 | TP112 0.3m | Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |
| 050022007-011 | TP114 0.7m | Dark Brown | 0.1mm - 2mm | Sandy Clay with some Stones | 1 |

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated ☑
Preliminary ☐

# ALcontrol Geochem Analytical Services
## Table Of Results

' ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

**Job Number:** 05/03774/02/01 **Matrix:** SOLID
**Client:** Encia **Location:** Not Specified
**Client Ref. No.:** Burton Rd, Barnsley **Client Contact:** John Harrison

| Sample Identity | 050021984-011 | 050021986-013 | 050021988-009 | 050021990-011 | 050021996-009 | 050022000-013 | 050022003-009 | 050022007-011 | | Method Code | LoD/Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | TP101 0.7m | TP103 0.6m | TP104 0.45 | TP104 0.6M | TP107 1.0m | TP110 2.0m | TP112 0.3m | TP114 0.7m | | | |
| Sample Type | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | | | |
| Sampled Date | | | | | | | | | | | |
| Sample Received Date | 09.03.05 | 09.03.05 | 09.03.05 | 09.03.05 | 09.03.05 | 09.03.05 | 09.03.05 | 09.03.05 | | | |
| Batch | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Sample Number(s) | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | | |
| EPH (DRO) (C10-C40) | 1131 | 6005 | 1291 | 10217 | 151 | 175 | 9652 | 4990 | | TM061'M | <1 mg/kg |
| GRO (C4-C10) | <10 | 787 | <10 | 123 | <10 | <10 | 3793 | <10 | | TM089'M | <10 ug/kg |
| GRO (C10-C12) | <10 | 2846 | <10 | 74 | <10 | <10 | <10 | <10 | | TM089'M | <10 ug/kg |
| Benzene | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | | TM089'M | <10 ug/kg |
| Toluene | <10 | <10 | <10 | <10 | <10 | <10 | 286 | <10 | | TM089'M | <10 ug/kg |
| [redacted]enzene | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | | TM089'M | <10 ug/kg |
| m & p Xylene | <10 | <10 | <10 | <10 | <10 | <10 | 84 | <10 | | TM089'M | <10 ug/kg |
| o Xylene | <10 | <10 | <10 | <10 | <10 | <10 | 70 | <10 | | TM089'M | <10 ug/kg |
| MTBE | <10 | <10 | <10 | <10 | <10 | <10 | 270 | <10 | | TM089' | <10 ug/kg |

All results expressed on a dry weight basis.

Date 29.03.2005

# ALcontrol Geochem

## Extractable Petroleum Hydrocarbons (EPH) By GC-FID

### Carbon Range C10-C40

**Job Number : 05/03774/02/01**
**Client : Encia**
**Client Ref : Burton Road, Barnsley**
**Matrix [Units] : SOLID [mg/kg]**

**All results expressed on a dry weight basis.**

| Sample No | Sample Identity | Depth | EPH | Interpretation |
|---|---|---|---|---|
| 4 | 050021984-011 | TP101 0.7m | 1131 | Heavy Oil |
| 5 | 050021986-013 | TP103 0.6m | 6005 | Heavy Oil |
| 6 | 050021988-009 | TP104 0.45 | 1291 | Heavy Oil |
| 7 | 050021990-011 | TP104 0.6m | 10217 | Heavy Oil |
| 8 | 050021996-009 | TP107 1.0m | 151 | PAHs/Humic Acids |
| 9 | 050022000-013 | TP110 2.0m | 175 | Biodegraded Diesel/Humic Acids |
| 10 | 050022003-009 | TP112 0.3m | 9652 | Electrical Oil |
| 11 | 050022007-011 | TP114 0.7m | 4990 | Heavy Oil |

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

RM7 – EH – KLM.

ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

RECEIVED 24 MAR 2005

22165

Mr J Harrison
Encia Group Ltd
Remediation Office
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

22/03/2005

Dear Mr J Harrison

**Your Ref and Description :** **5848/10**

**Site Name :** **Burton Rd, Barnsley**

**SDG Number :** **SDG05006395**

*Please find enclosed the test reports for the samples received on 25 Feb 2005.*

*The samples were given Lab numbers 050024245 - 050024260. Please quote these numbers should you have any queries about the enclosed test reports. Also enclosed are brief descriptions of the techniques employed to analyse these samples.*

Where appropriate, all liquid and solid samples are retained for 10 working days from the report date. After that date the samples will be discarded.

If you wish to extend the period for which a sample is to be retained, please call 01709 841096. A cost of 20p per sample per container per day will apply for this extended storage service.

Should you have any queries about the enclosed report or if you have any comments to make about the service you have received, please contact the Customer Services Team at the address, telephone number or email address given above.

Yours sincerely

Samantha Duke
Customer Services

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ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

## Accredited Test Procedures

| Method Ref. | Technique |
|---|---|
| R2.21 | Colorimetric |
| R2.3.2/S2.3 | Colorimetric |
| R2.4.2/S2.4 | Colorimetric |
| R2.5 | Colorimetric |
| R2.6.1/S2.6 | Colorimetric |
| R2.7.3/S2.7 | Colorimetric |
| R2.8.2/S2.8 | Colorimetric |
| R3.2/S3.2 | Titrimetric |
| R3.3/S3.3 | Electrochemical |
| R3.4.1/A | Ion Selective Electrode |
| R3.5.1 | Ion Selective Electrode |
| R3.6/S3.6.2 | Ion Selective Electrode |
| R3.7.1/S3.7.1 | Gravimetric |
| R3.8/S3.8 | Gravimetric |
| R4.1/R4.2/S4.1 | Titrimetric |
| R5.1/S5.1 | Electrochemical (dissolved oxygen probe) |
| R5.2/S5.2 | Dichromate oxidation / colorimetric |
| R5.5 | Ion Chromatography |
| R6.13 | Colorimetric |
| R7.2 | Infra-red spectrometry |
| R7.22 | Gas chromatography - flame ionisation detector |
| R7.25 | Gas chromatography - flame ionisation detector |
| R7.31 | Gas chromatography - mass spectrometry |
| R7.41 | Gas chromatography - mass spectrometry |
| R7.4.1 | Gravimetric |
| R7.6 | HPLC |
| R7.7 | Gas chromatography - mass spectrometry |
| R7.9 | Gas chromatography - mass spectrometry |
| R8B | Inductively coupled plasma |
| R9A | Atomic fluorescence spectrometry |
| R9B | Atomic fluorescense spectrometry |
| R11.1 | Gravimetric |
| R11.2 | Gravimetric |
| R11.3 | Gravimetric |
| R11.7 | Gravimetric |
| R12.1 | Respiration inhibition |
| R12.2.1a | Nitrification inhibition |
| R12.3 | Microtox |

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ALcontrol Laboratories

Rotherham Laboratory . Templeborough House, Mill Close, Rotherham. S60 1BZ (UKAS Lab No 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF (UKAS Lab No 0996)
Telephone 01709 841096 Fax 01709 841079 E-mail customer services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 22/03/2005 10:41:28
Site Name : Burton Rd, Barnsley

Your PO No : None Supplied

Encia Group Ltd
Remediation Office
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050024245 | | 050024246 | | 050024247 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | BH1 1.85-2.50m | | BH1 3.20-4.00m | | BH2 1.00-2.00m | |
| Sampled On | | 04/03/2005 | | 04/03/2005 | | 04/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | 0.333 | mg/kg | <0.3 | mg/kg | 3.11 | mg/kg |
| Acenaphthylene | R7.7 | <0.32 | mg/kg | <0.3 | mg/kg | <0.27 | mg/kg |
| Benzo (a) Anthracene | R7.7 | 1.81 | mg/kg | 0.69 | mg/kg | 9.23 | mg/kg |
| Chrysene | R7.7 | 0.954 | mg/kg | <0.3 | mg/kg | 7.32 | mg/kg |
| Dibenzo (a,h) Anthracene | R7.7 | <0.32 | mg/kg | <0.3 | mg/kg | 1.21 | mg/kg |
| Fluoranthene | R7.7 | 3.79 | mg/kg | <0.3 | mg/kg | 26.5 | mg/kg |
| Fluorene | R7.7 | 0.493 | mg/kg | <0.3 | mg/kg | 2.89 | mg/kg |
| Phenanthrene | R7.7 | 3.08 | mg/kg | <0.3 | mg/kg | 20.2 | mg/kg |
| Pyrene | R7.7 | 3.42 | mg/kg | <0.3 | mg/kg | 25.3 | mg/kg |
| Benzo (a) Pyrene | R7.7 | 0.998 | mg/kg | <0.3 | mg/kg | 8.73 | mg/kg |
| Benzo (g,h,i) Perylene | R7.7 | 0.614 | mg/kg | <0.3 | mg/kg | 4.66 | mg/kg |
| Indeno (1,2,3-cd) pyrene | R7.7 | 0.621 | mg/kg | <0.3 | mg/kg | 4.65 | mg/kg |
| Anthracene | R7.7 | 1.00 | mg/kg | <0.3 | mg/kg | 5.59 | mg/kg |
| Naphthalene | R7.7 | <0.32 | mg/kg | <0.3 | mg/kg | 0.821 | mg/kg |
| Benzo (b&k) Fluoranthene | R7.7 | 1.93 | mg/kg | <0.3 | mg/kg | 14.9 | mg/kg |
| PAH Total (EPA 16) | R7.7 | 19.523 | mg/kg | <4.5 | mg/kg | 135.446 | mg/kg |
| Diesel range organics (C10 - C26) | R7.25 | | | | | 379 | mg/kg |
| Lubricating oil range organics (C26 - C40) | R7.25 | | | | | 392 | mg/kg |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | | | | | 772 | mg/kg |
| Air Dried Solids | R1.1 | 79.40 | % | 84.70 | % | 78.50 | % |
| Stones > 10mm | R1.1 | 0.00 | % | 0.00 | % | 0.00 | % |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | See Separate Report | | | |
| FOC | *$ | | | 0.008 | | | |

Approved by: Steve Scott (Operations Manager)
Reported : 22/03/2005 11:12:57

SDG Number : SDG05006395
Certificate ID : 100766


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ALcontrol Laboratories

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Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF. (UKAS Lab No 0996)
Telephone 01709 841096 Fax 01709 841079 E-mail customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 25/02/2005
Analysis Completed : 22/03/2005 10:41:28
Site Name : Burton Rd, Barnsley

Your PO No : None Supplied

Encia Group Ltd
Remediation Office
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050024248 | | 050024249 | | 050024250 |
|---|---|---|---|---|---|---|
| Your Ref | | BH2 2.50-3.50m | | BH3 0.30-0.70m | | BH4 0.40-1.00m |
| Sampled On | | 04/03/2005 | | 04/03/2005 | | 04/03/2005 |
| | Method | | | | | |
| Acenaphthene | R7.7 | <0.33 | mg/kg | 1.58 | mg/kg | |
| Acenaphthylene | R7.7 | <0.33 | mg/kg | 0.342 | mg/kg | |
| Benzo (a) Anthracene | R7.7 | 1.24 | mg/kg | 3.93 | mg/kg | |
| Chrysene | R7.7 | 0.515 | mg/kg | 3.35 | mg/kg | |
| Dibenzo (a,h) Anthracene | R7.7 | <0.33 | mg/kg | 0.57 | mg/kg | |
| Fluoranthene | R7.7 | 1.75 | mg/kg | 13.1 | mg/kg | |
| Fluorene | R7.7 | <0.33 | mg/kg | 2.48 | mg/kg | |
| Phenanthrene | R7.7 | 1.04 | mg/kg | 11.2 | mg/kg | |
| Pyrene | R7.7 | 1.77 | mg/kg | 12.7 | mg/kg | |
| Benzo (a) Pyrene | R7.7 | 0.515 | mg/kg | 3.24 | mg/kg | |
| Benzo (g,h,i) Perylene | R7.7 | 0.337 | mg/kg | 2.07 | mg/kg | |
| Indeno (1,2,3-cd) pyrene | R7.7 | 0.35 | mg/kg | 2.09 | mg/kg | |
| Anthracene | R7.7 | <0.33 | mg/kg | 3.37 | mg/kg | |
| Naphthalene | R7.7 | <0.33 | mg/kg | 1.41 | mg/kg | |
| Benzo (b&k) Fluoranthene | R7.7 | 1.11 | mg/kg | 5.79 | mg/kg | |
| PAH Total (EPA 16) | R7.7 | 9.617 | mg/kg | 67.222 | mg/kg | |
| Diesel range organics (C10 - C26) | R7.25 | 51.0 | mg/kg | 6720 | mg/kg | |
| Lubricating oil range organics (C26 - C40) | R7.25 | 48.6 | mg/kg | 6060 | mg/kg | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 99.7 | mg/kg | 12800 | mg/kg | |
| Air Dried Solids | R1.1 | 81.90 | % | 81.70 | % | |
| Stones > 10mm | R1.1 | 0.00 | % | 42.80 | % | |
| TPH (Aliphatic/Aromatic Split) | *$ | | | | | See Separate Report |
| FOC | *$ | 0.01 | | | | |

| Our Ref | | 050024251 | 050024252 | 050024253 |
|---|---|---|---|---|
| Your Ref | | BH4 2.05-2.80m | BH6 0.40-1.00m | BH6 2.00-2.50m |
| Sampled On | | 04/03/2005 | 04/03/2005 | 04/03/2005 |
| | Method | | | |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | See Separate Report | See Separate Report |
| FOC | *$ | 0.01 | | |

Approved by: Steve Scott (Operations Manager)
Reported : 22/03/2005 11:12:57

SDG Number : SDG05006395
Certificate ID : 100766


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# ALcontrol Geochem Analytical Services
# Sample Descriptions

**Job Number:** 05/03721/02/01
**Client:** Alcontrol UK
**Client Ref :**

**Grain sizes**

| | |
|---|---|
| <0.063mm | Very Fine |
| 0.1mm - 0.063mm | Fine |
| 0.1mm - 2mm | Medium |
| 2mm - 10mm | Coarse |
| >10mm | Very Coarse |

| Sample Identity | Depth (m) | Colour | Grain Size | Description | Batch |
|---|---|---|---|---|---|
| 050024245 | | Brown | <0.063mm | Clay | 1 |
| 050024246 | | Brown | 0.1mm - 0.063mm | Silty Clay | 1 |
| 050024248 | | Brown | <0.063mm | Clay | 1 |
| 050024250 | | Dark Brown | <0.063mm | Clay with some Stones | 1 |
| 050024251 | | Brown | <0.063mm | Clay | 1 |
| 050024252 | | Dark Brown | <0.063mm | Clay with some Stones | 1 |
| 050024253 | | Brown | <0.063mm | Clay | 1 |
| 050024255 | | Brown | <0.063mm | Clay with some Stones | 1 |
| 050024256 | | Dark Grey | <0.063mm | Clay with some Stones | 1 |
| 050024257 | | Grey | <0.063mm | Clay | 1 |

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Validated ☑
Preliminary ☐

# ALcontrol Geochem Analytical Services
## Table Of Results

\# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

**Job Number:** 05/03721/02/01 **Matrix:** SOLID
**Client:** Alcontrol UK **Location:** ALC7563
**Client Ref. No.:** **Client Contact:** Water Reception

| Sample Identity | | | | | | 050024245 | 050024246 | 050024248 | 050024250 | Method Code | LoD/Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | | | | | | BH1 1.85-2.50 | BH1 3.2-4.0 | BH2 2.5-3.5 | BH4 0.4-1.0 | | |
| Sample Type | | | | | | SOIL | SOIL | SOIL | SOIL | | |
| Sampled Date | | | | | | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | | |
| Sample Received Date | | | | | | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | | |
| Batch | | | | | | 1 | 1 | 1 | 1 | | |
| Sample Number(s) | | | | | | 1 | 2-3 | 5 | 6 | | |
| Total Organic Carbon | | | | | | - | - | - | - | TM050# | <0.01 % |
| Fraction of Organic Carbon | | | | | | - | 0.008 | 0.010 | - | TM050# | <0.001 NONE |

All results expressed on a dry weight basis.

Date 22.03.2005

Validated ✓
Preliminary

# ALcontrol Geochem Analytical Services
## Table Of Results

* ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

**Job Number:** 05/03721/02/01 **Matrix:** SOLID
**Client:** Alcontrol UK **Location:** ALC7563
**Client Ref. No.:** **Client Contact:** Water Reception

| Sample Identity | | | | | | 050024245 BH1 | 050024246 BH1 | 050024248 BH2 | 050024250 BH4 | Method Code | LoD/Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | | | | | | 1.85-2.50 | 3.1-4.0 | 2.5-3.5 | 0.4-1.0 | | |
| Sample Type | | | | | | SOIL | SOIL | SOIL | SOIL | | |
| Sampled Date | | | | | | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | | |
| Sample Received Date | | | | | | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | | |
| Batch | | | | | | 1 | 1 | 1 | 1 | | |
| Sample Number(s) | | | | | | 1 | 2-3 | 5 | 6 | | |
| GRO (C4-C12) | - | - | - | - | - | <10 | <10 | - | 791 | TM089#M | <10 ug/kg |
| MTBE | - | - | - | - | - | <10 | <10 | - | <10 | TM089# | <10 ug/kg |
| Benzene | - | - | - | - | - | <10 | <10 | - | 15 | TM089#M | <10 ug/kg |
| Toluene | - | - | - | - | - | <10 | <10 | - | 27 | TM089#M | <10 ug/kg |
| Ethyl benzene | - | - | - | - | - | <10 | <10 | - | 12 | TM089#M | <10 ug/kg |
| m & p Xylene | - | - | - | - | - | <10 | <10 | - | 58 | TM089#M | <10 ug/kg |
| o Xylene | - | - | - | - | - | <10 | <10 | - | 24 | TM089#M | <10 ug/kg |
| Aliphatics C5-C6 | - | - | - | - | - | <10 | <10 | - | 58 | TM089#M | <10 ug/kg |
| Aliphatics >C6-C8 | - | - | - | - | - | <10 | <10 | - | 206 | TM089#M | <10 ug/kg |
| Aliphatics >C8-C10 | - | - | - | - | - | <10 | <10 | - | 98 | TM089#M | <10 ug/kg |
| Aliphatics >C10-C12 | - | - | - | - | - | <10 | <10 | - | 59 | TM089#M | <10 ug/kg |
| Aliphatics >C12-C16 | - | - | - | - | - | 37646 | 3861 | - | 36428 | TM061#M | <100 ug/kg |
| Aliphatics >C16-C21 | - | - | - | - | - | 144849 | 12577 | - | 311192 | TM061#M | <100 ug/kg |
| Aliphatics >C21-C35 | - | - | - | - | - | 628171 | 33802 | - | 1792372 | TM061#M | <100 ug/kg |
| Total Aliphatics C5-C35 | - | - | - | - | - | 810666 | 50240 | - | 2140413 | TM61/89#M | <100 ug/kg |
| Aromatics C6-C7 | - | - | - | - | - | <10 | <10 | - | 15 | TM089#M | <10 ug/kg |
| Aromatics >C7-C8 | - | - | - | - | - | <10 | <10 | - | 27 | TM089#M | <10 ug/kg |
| Aromatics >EC8-EC10 | - | - | - | - | - | <10 | <10 | - | 240 | TM089#M | <10 ug/kg |
| Aromatics >EC10-EC12 | - | - | - | - | - | <10 | <10 | - | 88 | TM089#M | <10 ug/kg |
| Aromatics >EC12-EC16 | - | - | - | - | - | 2666 | 401 | - | 2616 | TM061#M | <100 ug/kg |
| Aromatics >EC16-EC21 | - | - | - | - | - | 16748 | 876 | - | 16695 | TM061#M | <100 ug/kg |
| Aromatics >EC21-EC35 | - | - | - | - | - | 75224 | 3161 | - | 109566 | TM061#M | <100 ug/kg |
| Total Aromatics C6-C35 | - | - | - | - | - | 94638 | 4438 | - | 129247 | TM61/89#M | <100 ug/kg |
| TPH (Aliphatics and Aromatics C5-C35) | - | - | - | - | - | 905304 | 54678 | - | 2269660 | TM61/89#M | <100 ug/kg |

**All results expressed on a dry weight basis.**

Date 22.03.2005

Validated ☑
Preliminary ☐

# ALcontrol Geochem Analytical Services
## Table Of Results

* ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

**Job Number:** 05/03721/02/01 **Matrix:** SOLID
**Client:** Alcontrol UK **Location:** ALC7563
**Client Ref. No.:** **Client Contact:** Water Reception

| Sample Identity | 050024251 BH4 | 050024252 BH6 | 050024253 BH6 | 050024255 BH7 | 050024256 BH8 | 050024257 BH8 | | | | Method Code | LoD/Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | 2.05-2.8 | 0.4-1.0 | 2.0-2.5 | 2.9-3.4 | 1.5-2.0 | 3-4 | | | | | |
| Sample Type | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | | | | | |
| Sampled Date | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | | | | | |
| Sample Received Date | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | | | | | |
| Batch | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| Sample Number(s) | 7-8 | 9 | 4 | 10 | 11 | 12-13 | | | | | |
| Total Organic Carbon | - | - | - | - | - | - | | | | TM050* | <0.01 % |
| Fraction of Organic Carbon | 0.010 | - | - | 0.008 | - | 0.005 | | | | TM050* | <0.001 NONE |

All results expressed on a dry weight basis.

Date 22.03.2005

Validated ☑
Preliminary ☐

# ALcontrol Geochem Analytical Services
## Table Of Results

# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

**Job Number:** 05/03721/02/01 **Matrix:** SOLID
**Client:** Alcontrol UK **Location:** ALC7563
**Client Ref. No.:** **Client Contact:** Water Reception

| Sample Identity | 050024251 BH4 | 050024252 BH6 | 050024253 BH6 | 050024255 BH7 | 050024256 BH8 | 050024257 BH8 | | | | Method Code | LoD/Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | 2.05-2.8 | 0.4-1.0 | 2.0-2.5 | 2.9-3.4 | 1.5-2.0 | 3.0-4.0 | | | | | |
| Sample Type | SOIL | SOIL | SOIL | SOIL | SOIL | SOIL | | | | | |
| Sampled Date | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | 17.03.05 | | | | | |
| Sample Received Date | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | 12.03.05 | | | | | |
| Batch | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
| Sample Number(s) | 7-8 | 9 | 4 | 10 | 11 | 12-13 | | | | | |
| GRO (C4-C12) | <10 | 6418 | <10 | - | 585 | 39 | | | | TM089#M | <10 ug/kg |
| MTBE | <10 | 53 | <10 | - | 15 | <10 | | | | TM089# | <10 ug/kg |
| Benzene | <10 | 14 | <10 | - | <10 | <10 | | | | TM089#M | <10 ug/kg |
| Toluene | <10 | 151 | <10 | - | 22 | <10 | | | | TM089#M | <10 ug/kg |
| Ethyl benzene | <10 | 19 | <10 | - | <10 | <10 | | | | TM089#M | <10 ug/kg |
| m & p Xylene | <10 | 468 | <10 | - | 83 | 23 | | | | TM089#M | <10 ug/kg |
| o Xylene | <10 | 320 | <10 | - | 29 | 16 | | | | TM089#M | <10 ug/kg |
| Aliphatics C5-C6 | <10 | 88 | <10 | - | 17 | <10 | | | | TM089#M | <10 ug/kg |
| Aliphatics >C6-C8 | <10 | 1470 | <10 | - | 193 | <10 | | | | TM089#M | <10 ug/kg |
| Aliphatics >C8-C10 | <10 | 846 | <10 | - | 47 | <10 | | | | TM089#M | <10 ug/kg |
| Aliphatics >C10-C12 | <10 | 688 | <10 | - | 44 | <10 | | | | TM089#M | <10 ug/kg |
| Aliphatics >C12-C16 | 3744 | 8284 | 353 | - | 4130 | 450 | | | | TM061#M | <100 ug/kg |
| Aliphatics >C16-C21 | 74313 | 52659 | 1096 | - | 29107 | 286 | | | | TM061#M | <100 ug/kg |
| Aliphatics >C21-C35 | 178487 | 298220 | 2810 | - | 609493 | 436 | | | | TM061#M | <100 ug/kg |
| Total Aliphatics C5-C35 | 256544 | 362255 | 4259 | - | 643031 | 1172 | | | | TM61/89#M | <100 ug/kg |
| Aromatics C6-C7 | <10 | 14 | <10 | - | <10 | <10 | | | | TM089#M | <10 ug/kg |
| Aromatics >C7-C8 | <10 | 151 | <10 | - | 22 | <10 | | | | TM089#M | <10 ug/kg |
| Aromatics >EC8-EC10 | <10 | 2077 | <10 | - | 182 | 39 | | | | TM089#M | <10 ug/kg |
| Aromatics >EC10-EC12 | <10 | 1031 | <10 | - | 65 | <10 | | | | TM089#M | <10 ug/kg |
| Aromatics >EC12-EC16 | 528 | 19968 | <100 | - | 2701 | 127 | | | | TM061#M | <100 ug/kg |
| Aromatics >EC16-EC21 | 4781 | 134164 | 1515 | - | 6683 | <100 | | | | TM061#M | <100 ug/kg |
| Aromatics >EC21-EC35 | 29358 | 452946 | 3863 | - | 273890 | <100 | | | | TM061#M | <100 ug/kg |
| Total Aromatics C6-C35 | 34667 | 610351 | 5378 | - | 283543 | 166 | | | | TM61/89#M | <100 ug/kg |
| TPH (Aliphatics and Aromatics C5-C35) | 291211 | 972606 | 9637 | - | 926574 | 1338 | | | | TM61/89#M | <100 ug/kg |

**All results expressed on a dry weight basis.**

Date 22.03.2005

# ALcontrol Geochem Analytical Services
# Table Of Results - Appendix

**Job Number:** 05/03721/02/01
**Client:** Alcontrol UK
**Client Ref. No.:**

## Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to $1.03 \times 10^{-7}$

| | | | |
|---|---|---|---|
| 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 [1] | Surrogate Corrected |
|---|---|---|---|---|---|---|
| TM050 | Method 5310B, AWWA/APHA, 20th Ed., *1999 / DIN EN 13137* | Total Organic Carbon determination by combustion method | ✓ | | DRY | |
| TM061 | Method for the Determination of *EPH,Massachusetts Dept.of EP, 1998* | Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40) | ✓ | ✓ | DRY | |
| TM089 | Modified: US EPA Methods 8020 & 602 | Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12) | ✓ | | WET | |
| TM089 | Modified: US EPA Methods 8020 & 602 | Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12) | ✓ | ✓ | WET | |
| TM61/89 | | see TM061 and TM089 for details | ✓ | ✓ | WET | |
| | | | | | | |
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| | | | | | | |

[1] Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.

# ALcontrol Geochem Analytical Services
# Table Of Results - Appendix

**Job Number:** 05/03721/02/01
**Client:** Alcontrol UK
**Client Ref. No.:**

Summary of Coolbox temperatures

| Batch No. | Coolbox Temperature (°C) |
|---|---|
| 1 | 8 |
| | |
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RECEIVED - 4 APR 2005 22259

ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

Mr J Harrison
Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

01/04/2005

Dear Mr J Harrison

**Your Ref and Description : 33160/5848/10 5848**

**Site Name : Burton Road, Barnsley**

***SDG Number : SDG05007085***

*Please find enclosed the test reports for the samples received on 09 Mar 2005.*

The samples were given Lab numbers 050026784 - 050026790. Please quote these numbers should you have any queries about the enclosed test reports. Also enclosed are brief descriptions of the techniques employed to analyse these samples.

*Where appropriate, all liquid and solid samples are retained for 10 working days from the report date. After that* date the samples will be discarded.

If you wish to extend the period for which a sample is to be retained, please call 01709 841096. A cost of 20p per sample per container per day will apply for this extended storage service.

Should you have any queries about the enclosed report or if you have any comments to make about the service you have received, please contact the Customer Services Team at the address, telephone number or email address given above.

*Yours sincerely*

Andrew Timms
Customer Services

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0996
2330

ALcontrol Laboratories

Templeborough House, Mill Close,
Rotherham, S60 1BZ
Tel : 01709 841096
Fax : 01709 841079
customer.services@alcontrol.co.uk

## Accredited Test Procedures

| Method Ref. | Technique |
|---|---|
| R2.21 | Colorimetric |
| R2.3.2/S2.3 | Colorimetric |
| R2.4.2/S2.4 | Colorimetric |
| R2.5 | Colorimetric |
| R2.6.1/S2.6 | Colorimetric |
| R2.7.3/S2.7 | Colorimetric |
| R2.8.2/S2.8 | Colorimetric |
| R3.2/S3.2 | Titrimetric |
| R3.3/S3.3 | Electrochemical |
| R3.4.1/A | Ion Selective Electrode |
| R3.5.1 | Ion Selective Electrode |
| R3.6/S3.6.2 | Ion Selective Electrode |
| R3.7.1/S3.7.1 | Gravimetric |
| R3.8/S3.8 | Gravimetric |
| R4.1/R4.2/S4.1 | Titrimetric |
| R5.1/S5.1 | Electrochemical (dissolved oxygen probe) |
| R5.2/S5.2 | Dichromate oxidation / colorimetric |
| R5.5 | Ion Chromatography |
| R6.13 | Colorimetric |
| R7.2 | Infra-red spectrometry |
| R7.22 | Gas chromatography - flame ionisation detector |
| R7.25 | Gas chromatography - flame ionisation detector |
| R7.31 | Gas chromatography - mass spectrometry |
| R7.41 | Gas chromatography - mass spectrometry |
| R7.4.1 | Gravimetric |
| R7.6 | HPLC |
| R7.7 | Gas chromatography - mass spectrometry |
| R7.9 | Gas chromatography - mass spectrometry |
| R8B | Inductively coupled plasma |
| R9A | Atomic fluorescence spectrometry |
| R9B | Atomic fluorescense spectrometry |
| R11.1 | Gravimetric |
| R11.2 | Gravimetric |
| R11.3 | Gravimetric |
| R11.7 | Gravimetric |
| R12.1 | Respiration inhibition |
| R12.2.1a | Nitrification inhibition |
| R12.3 | Microtox |

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ALcontrol Laboratories

Rotherham Laboratory : Templeborough House, Mill Close, Rotherham S60 1BZ (UKAS Lab No 0995)
Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill, ML4 3BF. (UKAS Lab No 0995)
Telephone. 01709 841096 Fax 01709 841079 E-mail : customer services@alcontrol co uk

# Certificate of Analysis

Sample Received : 09/03/2005
Analysis Completed : 01/04/2005 10:31:36
Site Name : Burton Road, Barnsley

Your PO No : 33160/5848/10

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050026784 | | 050026785 | | 050026786 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | BH1 | | BH2 | | BH4 | |
| Sampled On | | 09/03/2005 | | 09/03/2005 | | 09/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | 4.50 | ug/l | 6.12 | ug/l | 5.44 | ug/l |
| Acenaphthylene | R7.7 | 0.70 | ug/l | 0.65 | ug/l | 0.57 | ug/l |
| Benzo (a) Anthracene | R7.7 | 6.32 | ug/l | 25.9 | ug/l | 17.9 | ug/l |
| Chrysene | R7.7 | <0.5 | ug/l | 23.5 | ug/l | 14.4 | ug/l |
| Dibenzo (a,h) Anthracene | R7.7 | <0.5 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Fluoranthene | R7.7 | 20.4 | ug/l | 70.8 | ug/l | 49.3 | ug/l |
| Fluorene | R7.7 | 2.11 | ug/l | 3.65 | ug/l | 5.06 | ug/l |
| Phenanthrene | R7.7 | 6.89 | ug/l | 19.8 | ug/l | 23.1 | ug/l |
| Pyrene | R7.7 | 18.9 | ug/l | 70.1 | ug/l | 44.9 | ug/l |
| Benzo (a) Pyrene | R7.7 | 7.92 | ug/l | 37.7 | ug/l | 21.8 | ug/l |
| Benzo (g,h,i) Perylene | R7.7 | 5.46 | ug/l | 23.1 | ug/l | 12.6 | ug/l |
| Indeno (1,2,3-cd) pyrene | R7.7 | 5.88 | ug/l | 25.3 | ug/l | 15.1 | ug/l |
| Anthracene | R7.7 | 4.53 | ug/l | 8.31 | ug/l | 10.3 | ug/l |
| Naphthalene | R7.7 | <0.5 | ug/l | 1.12 | ug/l | 3.30 | ug/l |
| Benzo (b&k) Fluoranthene | R7.7 | 11.0 | ug/l | 59.0 | ug/l | 33.2 | ug/l |
| PAH (sum of EPA 16) | R7.7 | 95.36 | ug/l | 375.3 | ug/l | 257.22 | ug/l |
| Diesel range organics (C10 - C26) | R7.25 | 2.27 | mg/l | 0.259 | mg/l | 6.03 | mg/l |
| Lubricating oil range organics (C26 - C40) | R7.25 | 2.41 | mg/l | 0.278 | mg/l | 2.09 | mg/l |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 4.67 | mg/l | 0.538 | mg/l | 8.12 | mg/l |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | See Separate Report | | See Separate Report | |

Approved by: Steve Scott (Operations Manager)
Reported : 01/04/2005 11:04:09

SDG Number : SDG05007085
Certificate ID : 102208


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Methods marked * in this report are not in the UKAS Accreditation Schedule for our Laboratory. Methods marked $ are subcontracted, those prefixed R are performed at the Rotherham Lab & those prefixed S are performed at the Bellshill Lab. Comments, opinions & interpretations expressed herein are outside the scope of UKAS Accreditation. Details of the methods used and their performance characteristics are available on request. Unless otherwise stated, sampling was not carried out by ALcontrol Laboratories. < = less than; > = greater than; DSB = dry solids basis

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ALcontrol Laboratories

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Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill, ML4 3BF. (UKAS Lab No 0995)
Telephone 01709 841096 Fax: 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 09/03/2005
Analysis Completed : 01/04/2005 10:31:36
Site Name : Burton Road, Barnsley

Your PO No : 33160/5848/10

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050026787 | | 050026788 | | 050026789 | |
|---|---|---|---|---|---|---|---|
| Your Ref | | BH5 | | BH6 | | BH8 | |
| Sampled On | | 09/03/2005 | | 09/03/2005 | | 09/03/2005 | |
| | Method | | | | | | |
| Acenaphthene | R7.7 | 4.03 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Acenaphthylene | R7.7 | <0.5 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Benzo (a) Anthracene | R7.7 | 6.37 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Chrysene | R7.7 | 7.24 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Dibenzo (a,h) Anthracene | R7.7 | 1.29 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Fluoranthene | R7.7 | 21.6 | ug/l | <0.5 | ug/l | 0.86 | ug/l |
| Fluorene | R7.7 | 2.32 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Phenanthrene | R7.7 | 11.3 | ug/l | <0.5 | ug/l | 0.82 | ug/l |
| Pyrene | R7.7 | 21.7 | ug/l | <0.5 | ug/l | 0.93 | ug/l |
| Benzo (a) Pyrene | R7.7 | 11.1 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Benzo (g,h,i) Perylene | R7.7 | 6.25 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Indeno (1,2,3-cd) pyrene | R7.7 | 7.12 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Anthracene | R7.7 | 3.29 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Naphthalene | R7.7 | 3.86 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| Benzo (b&k) Fluoranthene | R7.7 | 16.9 | ug/l | <0.5 | ug/l | <0.5 | ug/l |
| PAH (sum of EPA 16) | R7.7 | 124.62 | ug/l | <7.5 | ug/l | <7.5 | ug/l |
| Diesel range organics (C10 - C26) | R7.25 | 0.0717 | mg/l | <0.0625 | mg/l | 1.11 | mg/l |
| Lubricating oil range organics (C26 - C40) | R7.25 | 0.151 | mg/l | <0.0625 | mg/l | 0.818 | mg/l |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | 0.224 | mg/l | <0.125 | mg/l | 1.92 | mg/l |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | See Separate Report | | See Separate Report | |

SDG Number : SDG05007085
Certificate ID : 102208


Approved by: Steve Scott (Operations Manager)
Reported : 01/04/2005 11:04:09

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*Methods marked * in this report are not in the UKAS Accreditation Schedule for our Laboratory. Methods marked $ are subcontracted, those prefixed R are performed at the Rotherham Lab & those prefixed S are performed at the Bellshill Lab. Comments, opinions & interpretations expressed herein are outside the scope of UKAS Accreditation. Details of the methods used and their performance characteristics are available on request. Unless otherwise stated, sampling was not carried out by ALcontrol Laboratories. < = less than; > = greater than, DSB = dry solids basis*

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ALcontrol Laboratories

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Bellshill Laboratory : 2 Mallard Way, Strathclyde Business Park, Bellshill ML4 3BF (UKAS Lab No 0995)
Telephone 01709 841096 Fax 01709 841079 E-mail : customer.services@alcontrol.co.uk

# Certificate of Analysis

Sample Received : 09/03/2005
Analysis Completed : 01/04/2005 10:31:36
Site Name : Burton Road, Barnsley

Your PO No : 33160/5848/10

Encia Group Ltd
Encia House
Audby Lane
Wetherby
West Yorkshire
LS22 7RD

| Our Ref | | 050026790 | | | |
|---|---|---|---|---|---|
| Your Ref | | BH9 | | | |
| Sampled On | | 09/03/2005 | | | |
| | Method | | | | |
| Acenaphthene | R7.7 | <0.5 | ug/l | | |
| Acenaphthylene | R7.7 | <0.5 | ug/l | | |
| Benzo (a) Anthracene | R7.7 | 0.93 | ug/l | | |
| Chrysene | R7.7 | 0.93 | ug/l | | |
| Dibenzo (a,h) Anthracene | R7.7 | <0.5 | ug/l | | |
| Fluoranthene | R7.7 | 2.27 | ug/l | | |
| Fluorene | R7.7 | <0.5 | ug/l | | |
| Phenanthrene | R7.7 | 0.68 | ug/l | | |
| Pyrene | R7.7 | 2.49 | ug/l | | |
| Benzo (a) Pyrene | R7.7 | 1.06 | ug/l | | |
| Benzo (g,h,i) Perylene | R7.7 | 0.64 | ug/l | | |
| Indeno (1,2,3-cd) pyrene | R7.7 | 0.64 | ug/l | | |
| Anthracene | R7.7 | <0.5 | ug/l | | |
| Naphthalene | R7.7 | <0.5 | ug/l | | |
| Benzo (b&k) Fluoranthene | R7.7 | 1.78 | ug/l | | |
| PAH (sum of EPA 16) | R7.7 | 12.92 | ug/l | | |
| Diesel range organics (C10 - C26) | R7.25 | <0.0588 | mg/l | | |
| Lubricating oil range organics (C26 - C40) | R7.25 | <0.0588 | mg/l | | |
| Total petroleum hydrocarbons (C10 - C40) | R7.25 | <0.1176 | mg/l | | |
| TPH (Aliphatic/Aromatic Split) | *$ | See Separate Report | | | |

Approved by: Steve Scott (Operations Manager)
Reported : 01/04/2005 11:04:09

SDG Number : SDG05007085
Certificate ID : 102208


0995
0996
2300

*Methods marked * in this report are not in the UKAS Accreditation Schedule for our Laboratory. Methods marked $ are subcontracted, those prefixed R are performed at the Rotherham Lab & those prefixed S are performed at the Bellshill Lab. Comments, opinions & interpretations expressed herein are outside the scope of UKAS Accreditation. Details of the methods used and their performance characteristics are available on request. Unless otherwise stated, sampling was not carried out by ALcontrol Laboratories. < = less than; > = greater than; DSB = dry solids basis.*

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# APPENDIX G
# HUMAN HEALTH RISK ASSESSMENT

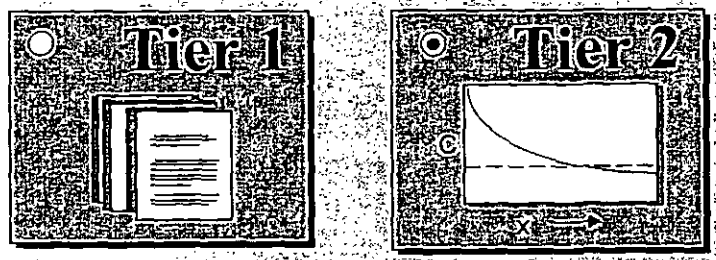
# Main Screen

RBCA Tool Kit for Chemical Releases
Version 1.3b © 2000

## 1. Project Information

| | | | |
|---|---|---|---|
| Site Name: | Burton Road | | |
| Location: | Barnsley | | |
| Compl. By: | JWH | | |
| Date: | 28-Apr-05 | Job ID: | 5848/10 |

## 2. Which Type of RBCA Analysis? (?)




○ Generic Values — On-Site Exposure

◉ Site-Specific Values — On- or Off-Site Exposure

## 3. Calculation Options (?)

*Affects which input data are required*

☐ ***Baseline Risks (Forward mode)***

☑ ***RBCA Cleanup Standards (Backward mode)***

## 4. RBCA Evaluation Process

### *Prepare Input Data*

Data Complete? ( ■= yes, ■= no)

- ■□ Exposure Pathways
- ■□ Constituents of Concern (COCs)
- ■□ Transport Models
- ■□ Soil Parameters
- ■□ GW Parameters
- ■□ Air Parameters

### *Review Output*

- Exposure Flowchart
- COC Chem. Parameters
- Input Data Summary
- User-Spec. COC Data...
- Transient Domenico Analysis...
- Baseline Risks...
- Cleanup Standards...

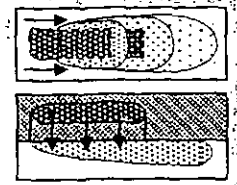
## 5. Commands and Options

| | | | |
|---|---|---|---|
| New Site | Load Data... | Save Data As... | Quit |
| Print Sheet | Set Units | Custom Chem. Data... | *Help* |

# Exposure Pathway Identification

Site Name: Burton Road
Location: Barnsley
Compl. By: JWH
Job ID: 5848/10 Date: 28-Apr-05

## 1. Groundwater Exposure



*Groundwater Ingestion/ Surface Water Impact*

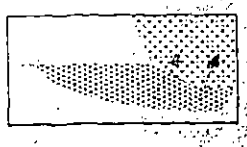
| Receptor Type: | None / On-site | None / Off-site1 | None / Off-site2 |
|---|---|---|---|

Source Media:

Distance to GW receptors

| | On-site | Off-site1 | Off-site2 | |
|---|---|---|---|---|
| ☐ Affected Groundwater | 0 | 0 | 0 | (m) |
| ☐ Affected Soils Leaching to Groundwater | 0 | 0 | 0 | (m) |

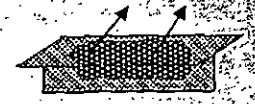
*GW Discharge to Surface Water Exposure*



☐ Swimming
☐ Fish Consumption
☐ Aquatic Life Protection
Enter ALP Criteria

## 2. Surface Soil Exposure

*Direct Ingestion and Dermal Contact*

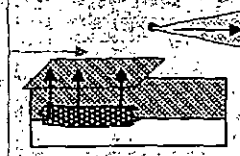


| Receptor Type: | None / On-site | No off-site receptors |
|---|---|---|

Construction Worker ☐

## 3. Air Exposure

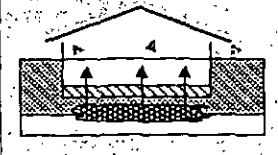
*Volatilization and Particulates to Outdoor Air Inhalation*



| Receptor Type: | Res. / On-site | None / Off-site1 | None / Off-site2 |
|---|---|---|---|
| | 0 | 0 | 0 (m) |

Construction worker ☐

☑ Affected Soils--Volatilization to Ambient Outdoor Air
☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



*Volatilization to Indoor Air Inhalation*

| Receptor Type: | Res. / On-site | No off-site receptors |
|---|---|---|

☑ Affected Soils--Volatilization to Enclosed Space
☐ Affected Groundwater--Volatilization to Enclosed Space

## 4. Commands and Options

Main Screen | Print Sheet | Set Units | Help

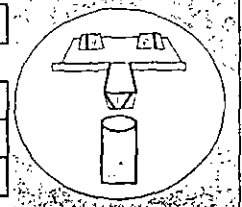
Exposure Factors & Target Risks | Exposure Flowchart

# Exposure Factors and Target Risk Limits

Site Name: Burton Road
Location: Barnsley
Compl. By: JWH
Job ID: 5848/10 Date: 28-Apr-05

## 1. Exposure Parameters

| | Age Adjustment? | Residential Adult | Residential (Age 0-6) | Residential (Age 0-16) | Commercial Chronic | Commercial Construc |
|---|---|---|---|---|---|---|
| Averaging time, carcinogens (yr) | | 6 | | | | |
| Averaging time, non-carcinogens (yr) | | 6 | | | 0 | 0 |
| Body weight (kg) | | 14.5 | 14.5 | 14.5 | 0 | |
| Exposure duration (yr) | | 6 | 6 | 6 | 0 | 0 |
| Exposure frequency (days/yr) | | 97 | | | 0 | 0 |
| Dermal exposure frequency (days/yr) | | 365 | | | 0 | |
| Skin surface area, soil contact ($cm^2$) | ☐ | 6167 | | 6167 | 0 | 0 |
| Soil dermal adherence factor ($mg/cm^2/day$) | | 0.06 | | | | |
| Water ingestion rate (L/day) | | 2 | | | 0 | |
| Soil ingestion rate (mg/day) | ☐ | 100 | 200 | | 0 | 0 |
| Swimming exposure time (hr/event) | | 0 | | | | |
| Swimming event frequency (events/yr) | | 0 | 0 | 0 | | |
| Swimming water ingestion rate (L/hr) | ☐ | 0 | 0 | | | |
| *Skin surface area, swimming ($cm^2$)* | ☐ | 0 | | 0 | | |
| Fish consumption rate (kg/day) | | 0 | | | | |
| Contaminated fish fraction (unitless) | | 0 | | | | |



## 2. Risk Goal Calculation Options

- ○ Individual Constituent Risk Goals Only
- ◉ Individual and Cumulative Risk Goals

## 3. Target Health Risk Limits

| | Individual | Cumulative |
|---|---|---|
| Target Risk (Class A/B carcins.) | 1.0E-6 | 1.0E-5 |
| Target Risk (Class C carcinogens) | 1.0E-5 | |
| Target Hazard Quotient | 1.0E+0 | |
| Target Hazard Index | | 1.0E+0 |

## 4. Commands and Options

Return to Exposure Pathways

Use Default Values

Print Sheet

*Help*

Site Name: Burton Road | Job ID: 5848/10
Location: Barnsley | Date: 28-Apr-05
Compl. By: JWH

**Commands and Options**

Main Screen | Print Sheet | *Help*

# Source Media Constituents of Concern (COCs)

Apply Raoult's Law ?

## Selected COCs

COC Select: | Sort List: ?

Add/Insert | Top | MoveUp
Delete | Bottom | MoveDown

## Representative COC Concentration ?

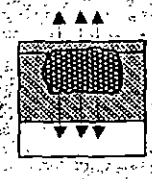
| Selected COCs | Groundwater Source Zone | | Soil Source Zone | | Mole Fraction in Source Material |
|---|---|---|---|---|---|
| | Calculate | Enter Site Data | Calculate | Enter Site Data | |
| | (mg/L) | note | (mg/kg) | note | (-) |
| Benzo(a)Pyrene Tox2 CLR* | | | | | |
| Naphthalene | | | | | |
| PCBs | | | | | |
| TPH - Aliph >C10-C12 | | | | | |
| TPH - Aliph >C12-C16 | | | | | |
| TPH - Aliph >C16-C21* | | | | | |
| TPH Aliphatic >C21-C35* | | | | | |
| TPH - Arom >C12-C16 | | | | | |
| TPH - Arom >C16-C21* | | | | | |
| TPH - Arom >C21-C35* | | | | | |

*=Chemical with user-specified data

# Transport Modeling Options

Site Name: Burton Road | Job ID: 5848/10
Location: Barnsley | Date: 28-Apr-05
Compl. By: JWH

## 1. Vertical Transport, Surface Soil Column



***Outdoor Air Volatilization Factors*** (?)

- ○ Surface soil volatilization model only
- ◉ Combination surface soil/Johnson & Ettinger models
  - Thickness of surface soil zone: 1 (m)
- ○ User-specified VF from other model — Enter VF Values

***Indoor Air Volatilization Factors*** (?)

- ◉ Johnson & Ettinger model
- ○ User-specified VF from other model — Enter VF Values

***Soil-to-Groundwater Leaching Factor*** (?)

- ○ ASTM Model
  - ☐ Apply Soil Attenuation Model (SAM) — Enter Decay Rates
  - ☐ Allow first-order biodecay — Enter LF Values
- ○ User-specified LF from other model

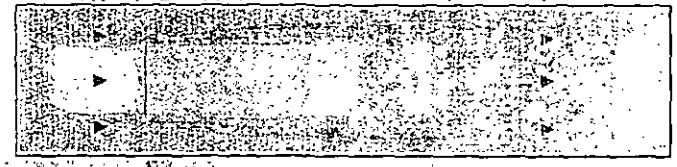
## 2. Lateral Air Dispersion Factor




(?)

- ○ 3-D Gaussian dispersion model — Off-site 1: 1.00E+0 | Off-site 2: 1.00E+0 (-)
- ○ User-Specified ADF

## 3. Groundwater Dilution Attenuation Factor



***Calculate DAF using Domenico Model*** (?)

- ○ Domenico equation with dispersion only (no biodegradation)
- ○ Domenico equation first-order decay — Enter Decay Rates
- ○ Modified Domenico equation using electron acceptor superposition — Enter Site Data

Enter Directly: Biodegradation Capacity: NC (mg/L)

— or —

***User-Specified DAF Values***

- ○ DAF values from other model or site data — Enter DAF Values

## 4. Commands and Options

Main Screen | Print Sheet | Help

# Site-Specific Soil Parameters

Site Name: Burton Road | Job ID: 5848/10
Location: Barnsley | Date: 28-Apr-05
Compl. By: JWH

## 1. Soil Source Zone Characteristics

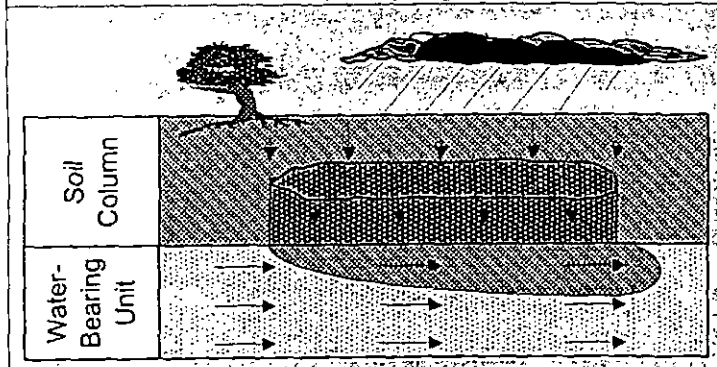
### Hydrogeology

General Case Construction

| | | | |
|---|---|---|---|
| Depth to water-bearing unit | 3 | | (m) |
| Capillary zone thickness | 0.05 | | (m) |
| Soil column thickness | 2.95 | | (m) |

### Affected Soil Zone

| | | | |
|---|---|---|---|
| Depth to top of affected soils | 1 | | (m) |
| Depth to base of affected soils | 3 | | (m) |
| Affected soil area | 19800 | 19800 | (m^2) |
| Length of affected soil parallel to assumed wind direction | 200 | 200 | (m) |
| Length of affected soil parallel to assumed GW flow direction | | | (m) |




## 2. Surface Soil Column

Vadose Zone | Capillary Fringe

### Predominant USCS Soil Type

SW/SP: Sand

or Enter Directly

| | Vadose Zone | Capillary Fringe | |
|---|---|---|---|
| Total porosity | 0.41 | | (-) |
| Volumetric water content | 0.08 | 0.369 | (-) |
| Volumetric air content | 0.33 | 0.041 | (-) |
| Dry bulk density | 1.7 | | (kg/L) |
| Vertical hydraulic conductivity | 8.6E+2 | | (cm/d) |
| Vapor permeability | 1.0E-12 | | (m^2) |
| Capillary zone thickness | 5.0E-2 | | (m) |

### Net Rainfall Infiltration

Net infiltration estimate: (cm/yr)

or

Average annual precipitation: (cm/yr)

### Partitioning Parameters

| | | |
|---|---|---|
| Fraction organic carbon | 0.01 | (-) |
| Soil/water pH | 6.8 | (-) |

## 3. Commands and Options

Main Screen | Use Default Values | Print Sheet
Set Units | | Help

# Site-Specific Air Parameters

Site Name: Burton Road | Job ID: 5848/10
Location: Barnsley | Date: 28-Apr-05
Compl. By: JWH

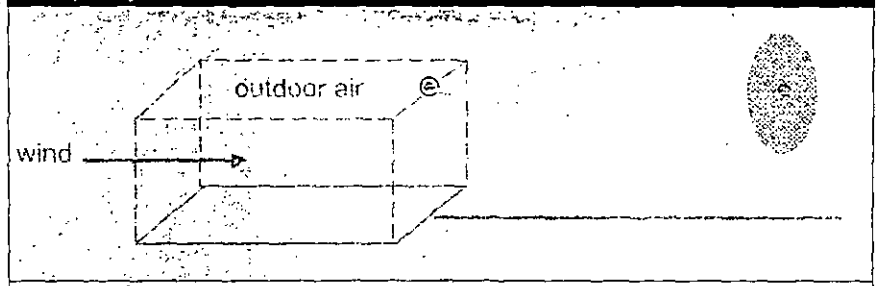
## 1. Outdoor Air Pathway

### Dispersion in Air

| | Off-site 1 | Off-site 2 | |
|---|---|---|---|
| Distance to offsite air receptor | | | (m) |
| or NA | ↓ | or ↓ | |
| Horizontal dispersivity | | | (m) |
| Vertical dispersivity | | | (m) |

### Air Source Zone

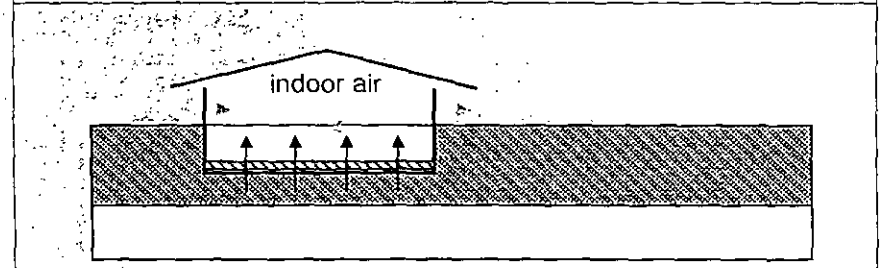
| | | |
|---|---|---|
| Air mixing zone height | 2 | (m) |
| Ambient air velocity in mixing zone | 2.25 | (m/s) |
| Areal particulate emission flux | 6.9E-14 | (g/cm^2/s) |




## 2. Indoor Air Pathway

### Building Parameters

| | Residential | Commercial | |
|---|---|---|---|
| Building volume/area ratio | 2 | 3 | (m) |
| Foundation area | 70 | 70 | (m^2) |
| Foundation perimeter | 34 | 34 | (m) |
| Building air exchange rate | 1.4E-4 | 2.3E-4 | (1/s) |
| Depth to bottom of foundation slab | 0.15 | 0.15 | (m) |
| Convective air flow through cracks | 0.0E+0 | 0.0E+0 | (m^3/s) |
| Foundation thickness | 0.15 | | (m) |
| Foundation crack fraction | 0.005 | | (-) |
| Volumetric water content of cracks | 0.12 | | (-) |
| Volumetric air content of cracks | 0.26 | | (-) |
| Indoor/Outdoor differential pressure | 0 | | (g/cm/s^2) |

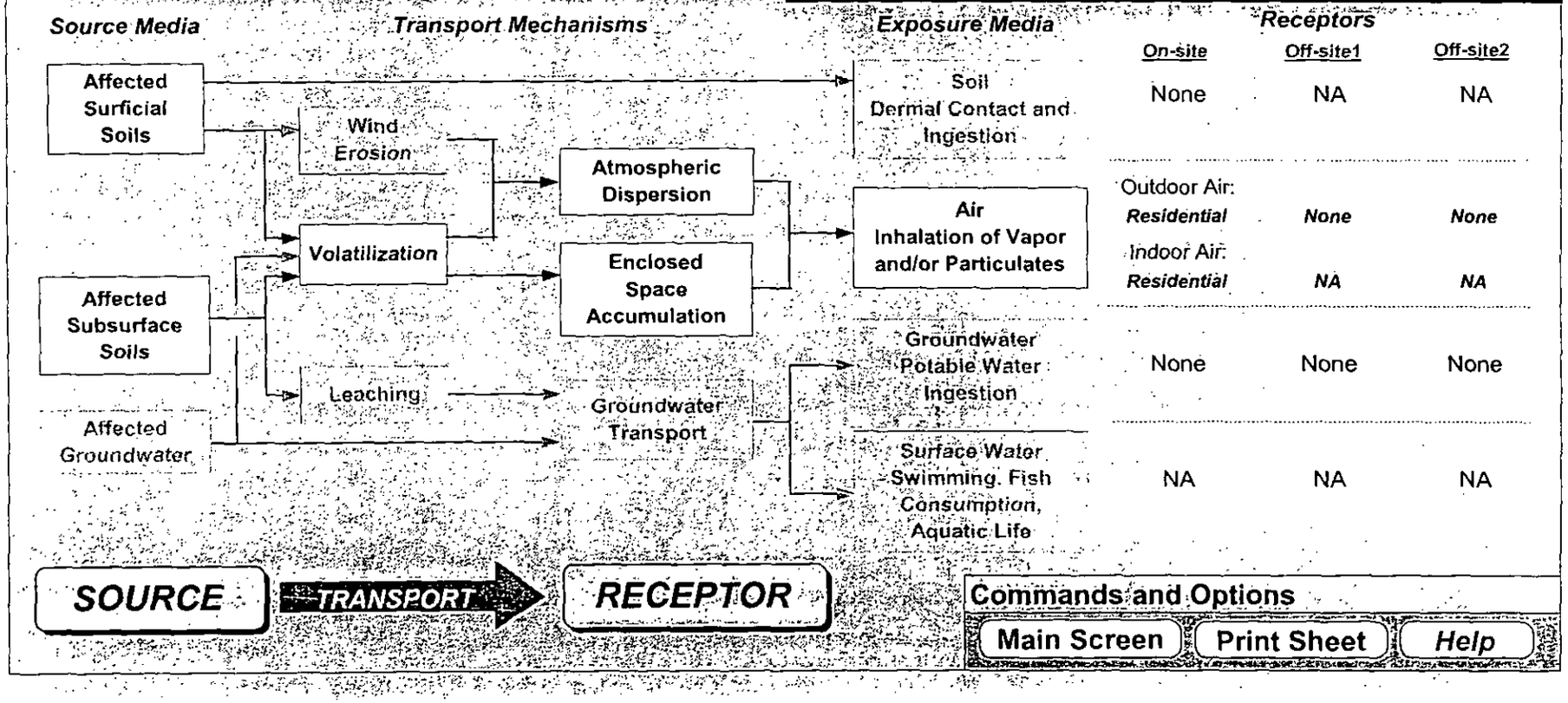



## 3. Commands and Options

Main Screen | Use Default Values | Print Sheet
Set Units | | Help

# Exposure Pathway Flowchart

Site Name: Burton Road | Job ID: 5848/10
Location: Barnsley | Date: 28-Apr-05
Compl. By: JWH




Commands and Options

Main Screen | Print Sheet | Help

## CHEMICAL DATA FOR SELECTED COCs

**Physical Property Data**

| Constituent | CAS Number | type | Molecular Weight (g/mole) MW | ref | Diffusion Coefficients: In air (cm2/s) Dair | ref | In water (cm2/s) Dwat | ref | log (Koc) or log(Kd) (@ 20 - 25 C) log(L/kg) partition | | ref | Henry's Law Constant (@ 20 - 25 C) (atm-m3/mol) | (unitless) | ref | Vapor Pressure (@ 20 - 25 C) (mm Hg) | ref | Solubility (@ 20 - 25 C) (mg/L) | ref | acid pKa | base pKb | ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Pyrene Tox2 CLR* | 0-00-0 | PAH | 400 | - | 1.00E-01 | - | 1.00E-05 | - | 8.80 | Koc | - | 1.76E+02 | 7.26E+03 | - | 8.36E-04 | - | 2.50E-06 | - | - | - | - |
| Naphthalene | 91-20-3 | PAH | 128.2 | PS | 5.90E-02 | PS | 7.50E-06 | PS | 3.30 | Koc | PS | 4.83E-04 | 1.99E-02 | PS | 2.30E-01 | PS | 3.10E+01 | PS | - | - | - |
| PCBs | 1336-36-3 | PCB | 290 | 4 | 1.04E-01 | 4 | 1.00E-05 | 4 | 5.21 | Koc | 11 | 2.94E-04 | 1.21E-02 | 4 | 0.00E+00 | 4 | 2.00E-01 | 5 | - | - | - |
| TPH - Aliph >C10-C12 | 0-00-0 | T | 160 | T | 1.00E-01 | T | 1.00E-05 | T | 5.40 | Koc | T | 2.96E+00 | 1.22E+02 | T | 4.79E-01 | - | 3.40E-02 | T | - | - | - |
| TPH - Aliph >C12-C16 | 0-00-0 | T | 200 | T | 1.00E-01 | T | 1.00E-05 | T | 6.70 | Koc | T | 1.26E+01 | 5.21E+02 | T | 3.65E-02 | - | 7.60E-04 | T | - | - | - |
| TPH - Aliph >C16-C21* | 0-00-0 | T | 270 | T | 1.00E-01 | T | 1.00E-05 | T | 8.80 | Koc | T | 1.19E+02 | 4.90E+03 | T | 8.36E-04 | - | 2.50E-06 | T | - | - | - |
| TPH Aliphatic >C21-C35* | 0-00-0 | T | 400 | - | 1.00E-01 | - | 1.00E-05 | - | 8.80 | Koc | - | 1.76E+02 | 7.26E+03 | - | 8.36E-04 | - | 2.50E-06 | - | - | - | - |
| TPH - Arom >C12-C16 | 0-00-0 | T | 150 | T | 1.00E-01 | T | 1.00E-05 | T | 3.70 | Koc | T | 1.24E-03 | 5.12E-02 | T | 3.65E-02 | - | 5.80E+00 | T | - | - | - |
| TPH - Arom >C16-C21* | 0-00-0 | T | 190 | T | 1.00E-01 | T | 1.00E-05 | T | 4.20 | Koc | T | 3.22E-04 | 1.33E-02 | T | 8.36E-04 | - | 6.50E-01 | T | - | - | - |
| TPH - Arom >C21-C35* | 0-00-0 | T | 240 | T | 1.00E-01 | T | 1.00E-05 | T | 5.10 | Koc | T | 1.60E-05 | 6.60E-04 | T | 3.34E-07 | - | 6.60E-03 | T | - | - | - |

* = Chemical with user-specified data

Site Name: Burton Road

Site Location: Barnsley

Completed By: JWH

Date Completed: 28-Apr-05

Job ID: 5848/10

## CHEMICAL DATA FOR SELECTED COCs

*Toxicity Data*

| Constituent | Reference Dose (mg/kg/day) Oral RfD_oral | ref | Reference Dose (mg/kg/day) Dermal RfD_dermal | ref | Reference Conc. (mg/m3) Inhalation RfC_inhal | ref | Slope Factors 1/(mg/kg/day) Oral SF_oral | ref | Slope Factors 1/(mg/kg/day) Dermal SF_dermal | ref | Unit Risk Factor 1/(µg/m3) Inhalation URF_inhal | ref | EPA Weight of Evidence | Is Constituent Carcinogenic ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Pyrene Tox2 CLR* | 1.38E-06 | - | - | - | 1.00E+00 | - | - | - | - | - | - | - | D | FALSE |
| Naphthalene | 4.00E-01 | PS | 3.56E-01 | TX | 1.40E+00 | PS | - | - | - | - | - | - | D | FALSE |
| PCBs | 7.00E-05 | R | - | - | - | - | 2.00E+00 | R | 2.15E+00 | TX | 6.00E-04 | R | B2 | TRUE |
| TPH - Aliph >C10-C12 | 1.00E-01 | T | - | - | 1.00E+00 | T | - | - | - | - | - | - | D | FALSE |
| TPH - Aliph >C12-C16 | 1.00E-01 | T | - | - | 1.00E+00 | T | - | - | - | - | - | - | D | FALSE |
| TPH - Aliph >C16-C21* | 2.00E+00 | T | - | - | 1.00E+00 | T | - | - | - | - | - | - | D | FALSE |
| TPH Aliphatic >C21-C35* | 2.00E+00 | T | - | - | 1.00E+00 | T | - | - | - | - | - | - | D | FALSE |
| TPH - Arom >C12-C16 | 4.00E-02 | T | - | - | 2.00E-01 | T | - | - | - | - | - | - | D | FALSE |
| TPH - Arom >C16-C21* | 3.00E-02 | T | - | - | 2.00E-01 | T | - | - | - | - | - | - | D | FALSE |
| TPH - Arom >C21-C35* | 3.00E-02 | T | - | - | 2.00E-01 | T | - | - | - | - | - | - | D | FALSE |

* = Chemical with user-specified

*Site Name: Burton Road*

Site Location: Barnsley

## Miscellaneous Chemical Data

| Constituent | Maximum Contaminant Level MCL (mg/L) | ref | Time-Weighted Average Workplace Criteria TWA (mg/m3) | ref | Aquatic Life Prot. Criteria AQL (mg/L) | ref | Biocon-centration Factor (L-wat/kg-fish) |
|---|---|---|---|---|---|---|---|
| Benzo(a)Pyrene Tox2 CLR* | - | - | - | - | - | - | 1 |
| Naphthalene | - | - | 5.00E+01 | PS | - | - | 430 |
| PCBs | 5.00E-04 | 56 FR 3526 (30 Jan 91) | - | - | - | - | 100000 |
| TPH - Aliph >C10-C12 | - | - | - | - | - | - | 1 |
| TPH - Aliph >C12-C16 | - | - | - | - | - | - | 1 |
| TPH - Aliph >C16-C21* | - | - | - | - | - | - | 1 |
| TPH Aliphatic >C21-C35* | - | - | - | - | - | - | 1 |
| TPH - Arom >C12-C16 | - | - | - | - | - | - | 1 |
| TPH - Arom >C16-C21* | - | - | - | - | - | - | 1 |
| TPH - Arom >C21-C35* | - | - | - | - | - | - | 1 |

* = Chemical with user-specified

Site Name: Burton Road

Site Location: Barnsley

## CHEMICAL DATA FOR SELECTED COCs

Miscellaneous Chemical Data

| Constituent | Dermal Relative Absorp. Factor (unitless) | Water Dermal Permeability Data: Dermal Permeability Coeff. (cm/hr) | Lag time for Dermal Exposure (hr) | Critical Exposure Time (hr) | Relative Contr of Derm Perm Coeff (unitless) | Water/Skin Derm Adsorp Factor (cm/event) | ref | Detection Limits: Groundwater (mg/L) | ref | Soil (mg/kg) | ref | Half Life (First-Order Decay) (days): Saturated | Unsaturated | ref |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Pyrene Tox2 CLR* | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Naphthalene | 0.05 | 0.069 | 0.53 | 2.2 | 0.2 | 0.0E+0 | D | 0.01 | 32 | 0.01 | 32 | 258 | 258 | H |
| PCBs | 0.05 | - | - | - | - | - | - | 0.05 | S | - | - | - | - | - |
| TPH - Aliph >C10-C12 | 0.5 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH - Aliph >C12-C16 | 0.5 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH - Aliph >C16-C21* | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH Aliphatic >C21-C35* | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH - Arom >C12-C16 | 0.5 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH - Arom >C16-C21* | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TPH - Arom >C21-C35* | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |

* = Chemical with user-specified

Site Name: Burton Road

Site Location: Barnsley

# RBCA SITE ASSESSMENT

## Input Parameter Summary

Site Name: Burton Road
Site Location: Barnsley

Completed By: JWH
Date Completed: 28-Apr-05

Job ID: 5848/10



| Exposure Parameters | | Residential | | | Commercial/Industrial | |
|---|---|---|---|---|---|---|
| | | Adult | (1-6yrs) | (1-16 yrs) | Chronic | Construc. |
| $AT_c$ | Averaging time for carcinogens (yr) | 6 | | | | |
| $AT_n$ | Averaging time for non-carcinogens (yr) | 6 | | | 0 | 0 |
| BW | Body weight (kg) | 14.5 | 14.5 | 14.5 | 0 | |
| ED | Exposure duration (yr) | 6 | 6 | 6 | 0 | 0 |
| t | Averaging time for vapor flux (yr) | 6 | | | 0 | 0 |
| EF | Exposure frequency (days/yr) | 97 | | | 0 | 0 |
| $EF_D$ | Exposure frequency for dermal exposure | 365 | | | 0 | |
| $IR_w$ | Ingestion rate of water (L/day) | 2 | | | 0 | |
| $IR_s$ | Ingestion rate of soil (mg/day) | 100 | 200 | | 0 | 0 |
| SA | Skin surface area (dermal) (cm^2) | 6167 | | 6167 | 0 | 0 |
| M | Soil to skin adherence factor | 0.06 | | | | |
| $ET_{swim}$ | Swimming exposure time (hr/event) | 0 | | | | |
| $EV_{swim}$ | Swimming event frequency (events/yr) | 0 | 0 | 0 | | |
| $IR_{swim}$ | Water ingestion while swimming (L/hr) | 0 | 0 | | | |
| $SA_{swim}$ | Skin surface area for swimming (cm^2) | 0 | | 0 | | |
| $IR_{fish}$ | Ingestion rate of fish (kg/yr) | 0 | | | | |
| $FI_{fish}$ | Contaminated fish fraction (unitless) | 0 | | | | |

| Complete Exposure Pathways and Receptors | On-site | Off-site 1 | Off-site 2 |
|---|---|---|---|
| Groundwater: | | | |
| Groundwater Ingestion | None | None | None |
| Soil Leaching to Groundwater Ingestion | None | None | None |
| Applicable Surface Water Exposure Routes: | | | |
| Swimming | | | NA |
| Fish Consumption | | | NA |
| Aquatic Life Protection | | | NA |
| Soil: | | | |
| Direct Ingestion and Dermal Contact | None | | |
| Outdoor Air: | | | |
| Particulates from Surface Soils | None | None | None |
| Volatilization from Soils | Residential | None | None |
| Volatilization from Groundwater | None | None | None |
| Indoor Air: | | | |
| Volatilization from Subsurface Soils | Residential | NA | NA |
| Volatilization from Groundwater | None | NA | NA |

| Receptor Distance from Source Media | On-site | Off-site 1 | Off-site 2 | (Units) |
|---|---|---|---|---|
| Groundwater receptor | NA | NA | NA | (m) |
| Soil leaching to groundwater receptor | NA | NA | NA | (m) |
| Outdoor air inhalation receptor | 0 | NA | NA | (m) |

| Target Health Risk Values | | Individual | Cumulative |
|---|---|---|---|
| $TR_{ab}$ | Target Risk (class A&B carcinogens) | 1.0E-6 | 1.0E-5 |
| $TR_c$ | Target Risk (class C carcinogens) | 1.0E-5 | |
| THQ | Target Hazard Quotient (non-carcinogenic risk) | 1.0E+0 | 1.0E+0 |

| Modeling Options | |
|---|---|
| RBCA tier | Tier 2 |
| Outdoor air volatilization model | Surface & subsurface models |
| Indoor air volatilization model | Johnson & Ettinger model |
| Soil leaching model | NA |
| Use soil attenuation model (SAM) for leachate? | NA |
| Air dilution factor | NA |
| Groundwater dilution-attenuation factor | NA |

NOTE: NA = Not applicable

| Surface Parameters | | General | Construction | (Units) |
|---|---|---|---|---|
| A | Source zone area | 2.0E+4 | NA | (m^2) |
| W | Length of source-zone area parallel to wind | 2.0E+2 | NA | (m) |
| $W_{gw}$ | Length of source-zone area parallel to GW flow | NA | | (m) |
| $U_{air}$ | Ambient air velocity in mixing zone | 2.3E+0 | | (m/s) |
| $\delta_{air}$ | Air mixing zone height | 2.0E+0 | | (m) |
| $P_a$ | Areal particulate emission rate | NA | | (g/cm^2/s) |
| $L_{ss}$ | Thickness of affected surface soils | 1.0E+0 | | (m) |

| Surface Soil Column Parameters | | Value | | | (Units) |
|---|---|---|---|---|---|
| $h_{cap}$ | Capillary zone thickness | NA | | | (m) |
| $h_v$ | Vadose zone thickness | NA | | | (m) |
| $\rho_b$ | Soil bulk density | 1.7E+0 | | | (g/cm^3) |
| $f_{oc}$ | Fraction organic carbon | 1.0E-2 | | | (-) |
| $\theta_T$ | Soil total porosity | 4.1E-1 | | | (-) |
| $K_{sv}$ | Vertical hydraulic conductivity | 8.6E+2 | | | (cm/d) |
| $k_v$ | Vapor permeability | 1.0E-12 | | | (m^2) |
| $L_{gw}$ | Depth to groundwater | NA | | | (m) |
| $L_s$ | Depth to top of affected soils | 1.0E+0 | | | (m) |
| $L_{base}$ | Depth to base of affected soils | 3.0E+0 | | | (m) |
| $L_{subs}$ | Thickness of affected soils | 2.0E+0 | | | (m) |
| pH | Soil/groundwater pH | 6.8E+0 | | | (-) |
| | | capillary | vadose | foundation | |
| $\theta_w$ | Volumetric water content | 0.369 | 0.08 | 0.12 | (-) |
| $\theta_a$ | Volumetric air content | 0.041 | 0.33 | 0.26 | (-) |

| Building Parameters | | Residential | Commercial | (Units) |
|---|---|---|---|---|
| $L_b$ | Building volume/area ratio | 2.00E+0 | NA | (m) |
| $A_b$ | Foundation area | 7.00E+1 | NA | (m^2) |
| $X_{crack}$ | Foundation perimeter | 3.40E+1 | NA | (m) |
| ER | Building air exchange rate | 1.40E-4 | NA | (1/s) |
| $L_{crack}$ | Foundation thickness | 1.50E-1 | NA | (m) |
| $Z_{crack}$ | Depth to bottom of foundation slab | 1.50E-1 | NA | (m) |
| $\eta$ | Foundation crack fraction | 5.00E-3 | NA | (-) |
| dP | Indoor/outdoor differential pressure | 0.00E+0 | NA | (g/cm/s^2) |
| $Q_s$ | Convective air flow through slab | 0.00E+0 | NA | (m^3/s) |

| Groundwater Parameters | | Value | (Units) |
|---|---|---|---|
| $\delta_{gw}$ | Groundwater mixing zone depth | NA | (m) |
| $I_f$ | Net groundwater infiltration rate | NA | (cm/yr) |
| $U_{gw}$ | Groundwater Darcy velocity | NA | (cm/d) |
| $V_{gw}$ | Groundwater seepage velocity | NA | (cm/d) |
| $K_s$ | Saturated hydraulic conductivity | NA | (cm/d) |
| i | Groundwater gradient | NA | (-) |
| $S_w$ | Width of groundwater source zone | NA | (m) |
| $S_d$ | Depth of groundwater source zone | NA | (m) |
| $\theta_{ef}$ | Effective porosity in water-bearing unit | NA | (-) |
| $f_{oc-sat}$ | Fraction organic carbon in water-bearing unit | NA | (-) |
| $pH_{sat}$ | Groundwater pH | NA | (-) |
| | Biodegradation considered? | NA | |

| Transport Parameters | | Off-site 1 | Off-site 2 | Off-site 1 | Off-site 2 | (Units) |
|---|---|---|---|---|---|---|
| Lateral Groundwater Transport | | Groundwater Ingestion | | Soil Leaching to GW | | |
| $\alpha_x$ | Longitudinal dispersivity | NA | NA | NA | NA | (m) |
| $\alpha_y$ | Transverse dispersivity | NA | NA | NA | NA | (m) |
| $\alpha_z$ | Vertical dispersivity | NA | NA | NA | NA | (m) |
| Lateral Outdoor Air Transport | | Soil to Outdoor Air Inhal. | | GW to Outdoor Air Inhal. | | |
| $\sigma_y$ | Transverse dispersion coefficient | NA | NA | NA | NA | (m) |
| $\sigma_z$ | Vertical dispersion coefficient | NA | NA | NA | NA | (m) |
| ADF | Air dispersion factor | NA | NA | NA | NA | (-) |

| Surface Water Parameters | | Off-site 2 | (Units) |
|---|---|---|---|
| $Q_{sw}$ | Surface water flowrate | NA | (m^3/s) |
| $W_{gw}$ | Width of GW plume at SW discharge | NA | (m) |
| $\delta_{gw}$ | Thickness of GW plume at SW discharge | NA | (m) |
| $DF_{sw}$ | Groundwater-to-surface water dilution factor | NA | (-) |

## RBCA SITE ASSESSMENT

Site Name: Burton Road | Completed By: JWH | Job ID: 5848/10

Site Location: Barnsley | Date Completed: 28-Apr-05 | 1 OF 1

### SOIL (1 - 3 m) SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

Groundwater DAF Option

SSTL Results For Complete Exposure Pathways ("X" If Complete)

| CONSTITUENTS OF CONCERN | | Representative Concentration | Soil Leaching to Groundwater Ingestion / Discharge to Surface Water | | | X Soil Vol. to Indoor Air | X Soil Volatilization to Outdoor Air | | | | Surface Soil Inhalation, Ingestion, Dermal Contact | | Applicable SSTL | SSTL Exceeded ? | Required CRF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | On-site (0 m) | Off-site 1 (0 m) | Off-site 2 (0 m) | On-site (0 m) | On-site (0 m) | | Off-site 1 (0 m) | Off-site 2 (0 m) | On-site (0 m) | | | | Only if "yes" left |
| CAS No. | Name | (mg/kg) | None | None | None | Residential | Residential | Construction Worker | None | None | None | Construction Worker | (mg/kg) | "■" if yes | |
| 0-00-0 | Benzo(a)Pyrene Tox2 CLR* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 91-20-3 | Naphthalene | | NA | NA | NA | >6.2E+2 | >6.2E+2 | NA | NA | NA | NA | NA | >6.2E+2 | ☐ | NA |
| 1336-36-3 | PCBs | | NA | NA | NA | 8.8E+0 | 1.2E+1 | NA | NA | NA | NA | NA | 8.8E+0 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C10-C12 | | NA | NA | NA | >8.6E+1 | >8.6E+1 | NA | NA | NA | NA | NA | >8.6E+1 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C12-C16 | | NA | NA | NA | >3.8E+1 | >3.8E+1 | NA | NA | NA | NA | NA | >3.8E+1 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C16-C21* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 0-00-0 | TPH Aliphatic >C21-C35* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 0-00-0 | TPH - Arom >C12-C16 | | NA | NA | NA | >2.9E+2 | >2.9E+2 | NA | NA | NA | NA | NA | >2.9E+2 | ☐ | NA |
| 0-00-0 | TPH - Arom >C16-C21* | | NA | NA | NA | >1.0E+2 | >1.0E+2 | NA | NA | NA | NA | NA | >1.0E+2 | ☐ | NA |
| 0-00-0 | TPH - Arom >C21-C35* | | NA | NA | NA | >8.3E+0 | >8.3E+0 | NA | NA | NA | NA | NA | >8.3E+0 | ☐ | NA |

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.

## RBCA SITE ASSESSMENT

Site Name: Burton Road | Completed By: JWH | Job ID: 5848/10

Site Location: Barnsley | Date Completed: 28-Apr-05 | 1 OF 1

### SOIL (1 - 3 m) SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

Groundwater DAF Option:

SSTL Results For Complete Exposure Pathways ("X" If Complete)

| CONSTITUENTS OF CONCERN | | Representative Concentration | Soil Leaching to Groundwater Ingestion / Discharge to Surface Water | | | X Soil Vol. to Indoor Air | X Soil Volatilization to Outdoor Air | | | | Surface Soil Inhalation, Ingestion,Dermal Contact | | Applicable SSTL | SSTL Exceeded ? | Required CRF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | On-site (0 m) | Off-site 1 (0 m) | Off-site 2 (0 m) | On-site (0 m) | On-site (0 m) | | Off-site 1 (0 m) | Off-site 2 (0 m) | On-site (0 m) | | | | Only if "yes" left |
| CAS No. | Name | (mg/kg) | None | None | None | Residential | Residential | Construction Worker | None | None | None | Construction Worker | (mg/kg) | "■" if yes | |
| 0-00-0 | Benzo(a)Pyrene Tox2 CLR* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 91-20-3 | Naphthalene | | NA | NA | NA | >6.2E+2 | >6.2E+2 | NA | NA | NA | NA | NA | >6.2E+2 | ☐ | NA |
| 1336-36-3 | PCBs | | NA | NA | NA | 8.8E+0 | 1.2E+1 | NA | NA | NA | NA | NA | 8.8E+0 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C10-C12 | | NA | NA | NA | >8.6E+1 | >8.6E+1 | NA | NA | NA | NA | NA | >8.6E+1 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C12-C16 | | NA | NA | NA | >3.8E+1 | >3.8E+1 | NA | NA | NA | NA | NA | >3.8E+1 | ☐ | NA |
| 0-00-0 | TPH - Aliph >C16-C21* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 0-00-0 | TPH Aliphatic >C21-C35* | | NA | NA | NA | >1.6E+1 | >1.6E+1 | NA | NA | NA | NA | NA | >1.6E+1 | ☐ | NA |
| 0-00-0 | TPH - Arom >C12-C16 | | NA | NA | NA | >2.9E+2 | >2.9E+2 | NA | NA | NA | NA | NA | >2.9E+2 | ☐ | NA |
| 0-00-0 | TPH - Arom >C16-C21* | | NA | NA | NA | >1.0E+2 | >1.0E+2 | NA | NA | NA | NA | NA | >1.0E+2 | ☐ | NA |
| 0-00-0 | TPH - Arom >C21-C35* | | NA | NA | NA | >8.3E+0 | >8.3E+0 | NA | NA | NA | NA | NA | >8.3E+0 | ☐ | NA |

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable NC = Not calculated.