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2500/1/RLM

5th January 2005

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

Dear Phil

Development at Goldthorpe Colliery

This letter, which should be read in conjunction with Report No 2500/1, provides an assessment of the soil-gas risk present and makes appropriate recommendations in light of redevelopment of the site.

1. Background

The site is situated approximately 11km west of Barnsley town centre, South Yorkshire. The whole site covers an area of approximately 27 hectares and can be divided into two main areas:

- **Area 1:** The former main colliery site, with outline planning for residential development (c. 11.5 ha)
- **Area 2:** Includes the former main colliery spoil tip (Spoil Tip No.1)

Historical Ordnance Survey plans indicate the site to have been occupied by a colliery.

Ground conditions at the site generally comprise a variable cover of made ground over firm and stiff clay or dense sand and gravel, over Middle Coal Measures and Ackworth Rock bedrock.

Although the site does not lie within the statutory consultation zone of a former landfill site, there is a potential for coal/mine gas migration into the site from both mine workings and colliery spoil tips on the site.

Based on the above, it was considered that hazardous gas posed a potential risk to the proposed development. Monitoring wells were therefore installed in ten probeholes; details of the individual installations are provided in Report No. 2500/1.

2. Scope of Works

The wells have been monitored on ten occasions between 25th April and 15th November 2002 for groundwater levels and soils-gases. A standard procedure was followed in accordance with CIRIA guidance; this procedure involved measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration on site immediately prior to and on completion of monitoring.

- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data LMSx infra-red gas analyser.
- Standing water level using a dipmeter.

3. Gas Monitoring Results

The results of the gas monitoring are enclosed and summarised in Table 1 below.

Table 1 - Summary of gas monitoring results

Monitoring Well	Methane Concentrations (% v/v)	Range of Carbon Dioxide Concentrations (% v/v)	Range of Positive Flow Rates (litre/hour)
PH101	0.0	0.0 - 8.7	0.0 - 0.8
PH102	0.0	0.0 - 4.4	0.0 - 0.8
PH103	0.0	0.3 - 1.2	0.0 - 0.1
PH104	0.0	0.0 - 13.0	0.0 - 1.1
PH105	0.0	0.1 - 5.1	0.0 - 0.2
PH106	0.0	0.0 - 5.8	0.0 - 0.4
PH107	0.0	0.0 - 4.7	0.0 - 1.0
PH108	0.0	1.9 - 4.7	0.0 - 0.3
PH109	0.0	0.2 - 3.3	0.0 - 0.3
PH110	0.0	0.1 - 2.0	0.0 - 0.4

No methane was recorded during the monitoring period. Carbon dioxide concentrations in excess of 1.5% by volume (v/v) were recorded in all but one location, PH 103, whilst concentrations in excess of 5% by volume (v/v) were recorded in PH's 101, 104, 105 and 106.

Elevated concentrations of carbon dioxide were encountered within the wells to a maximum of 13% v/v. The monitoring was undertaken over a range of barometric pressures from 986 to 1016 mb.

Low gas flow rates were recorded throughout the monitoring period from each of the ten wells, with a maximum of 1.1 litre/hour.

4. Current Guidance

Guidance in 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. However, development closer to landfill has been permitted where appropriate gas exclusion measures have been satisfactorily installed.

CIRIA Report 151 (1995)¹ 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 27² and the Building Regulations³,

¹ Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151

² DoE (1989a). Waste Management Paper No. 27. The control of landfill gas. Department of the Environment, HMSO, London

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.

CIRIA Report 149 (1995)⁴, 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)⁵ in terms of borehole gas volume flow rate and gas concentrations. This was done to reflect the importance of recognising the gas surface emission rate.

5. Current Gas Regime

According to the Building Regulations, Document C, consideration should be given to installation of gas protection measures where the concentration of carbon dioxide is greater than 5% by volume (v/v). The maximum recorded during the monitoring period was 13% v/v.

Site classification should generally be based on results obtained over a prolonged period, usually in excess of 6 months (and in excess of 12 months if significant concentrations and flows of methane are recorded). However, no methane has been recorded in any of the wells installed at the site.

The worse-case borehole gas volume flow for carbon dioxide is less than 0.0408 litres/hour, although the worse-case concentration of carbon dioxide of 13% would place the site in Characteristic Situation 2.

Based on this assessment it is considered that the elevated concentrations of carbon dioxide should not prohibit development of the site. However, gas protection measures as outlined below will need to be incorporated into new housing. These measures are, however, subject to the approval of NHBC, EA and the Environmental Health Department of Barnsley Metropolitan Council, who may request that data be collected over an extended period (say 6 months to 1 year).

6. Conclusions

Monitored soil-gas concentrations across the site are considered to be significant. Observed concentrations to date indicate the presence of a maximum concentration of 13% v/v of carbon dioxide.

³ DoE (1992). Building Regulations, Approved Document C. HMSO, London.

⁴ Card GB (1995). Protecting Development from Methane. CIRIA Report 149

⁵ Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.

To enable safe redevelopment of the site, bearing in mind the aforementioned comments, it is recommended that the following mitigation measures be allowed for in **all** new dwellings at the site.

- well constructed suspended floor slab
- 1200 gauge membrane incorporated in the slab and sealed with top hats around service entries. The membrane should be sealed to the manufactures specification;
- passively ventilated sub-space and wall cavities;
- *minimum penetration of floor slab by services and minimum number of confined spaces such as cupboards above the slab. Any confined spaces should be ventilated;*

The passively ventilated sub-space should be of the following design to provide sufficient air flow to maintain gas concentrations in the void space to well below target concentrations:

- minimum clear open void depth of 200 mm;
- cross ventilation on two opposite faces of the open void;
- ventilation set at a minimum of 2652 mm²/m run of wall;

An essential factor to ensure the efficacy of the proposed mitigation measures is to provide a high standard of supervision and quality assurance checking throughout the duration of installing gas mitigation measures and associated remedial works. Independent validation should be carried out by specialist personnel and a Completion Report prepared to detail the implemented measures.

We trust the above is sufficient for you present needs, but should you have any queries, please contact the undersigned.

Yours sincerely



Richard Meredith
for and on behalf of
ENCIA CONSULTANTS LTD

Enc.



Consultants

Checked: _____ Approved: _____



Gas Monitoring Results

Consultants

Job Title:				Goldthorpe Colliery, Goldthorpe		Job No:		2500	
Client:						Sheet :			
						1 of 1			
Date:		13-Jun-02		Arr		Dep		Operator:	
(Visit 3)		Time:		10:15		Time:		11:30	
						Gareth Shaw			

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH ₄ : 0.0	CO ₂ : 0.0	O ₂ : 21.2
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[illegible]

Notes

Equipment Used:	Calibration	Key
Gas Data LMSX Infra red analyser	Last date	POS - Positive Flow
Gentechical Instruments Dipmeter	01.02.01	NEG - Negative Flow
		ND - None Detected
		NR - Not Recorded

Barometric Pressure Trend: Rising

Start of Visit:	1005mb	End of Visit:	1004mb	Intermediate Readings:	NR
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Weather Conditions:	Cool, overcast, breeze
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Surface Ground Conditions:	Dry	Temp:	NR
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Remarks:

PH101 cap could not be removed so no ground water level was taken.

Checked:	Approved:
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Gas Monitoring Results

Consultants

Job Title:				Job No:	
Goldthorpe Colliery, Goldthorpe				2500	
Client:				Sheet :	
				1 of 1	
Date:	08-Aug-02	Arr	Dep	Operator:	
	(Visit 5)	Time: 10:00	Time: 11:15	Gareth Shaw	

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH ₄ :	0.0	CO ₂ :	0.0	O ₂ :	20.8
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[illegible]

Notes

Equipment Used:	Calibration	Key
Gas Data LMSX Infra red analyser	Last date	POS - Positive Flow
Geotechnical Instruments Dipmeter	01.02.01	NEG - Negative Flow
		ND - None Detected
		NR - Not Recorded

Barometric Pressure Trend:		Steady	
Start of Visit:	1004mb	End of Visit:	1003mb
Weather Conditions:		Intermediate Readings: NR	
Weather Conditions:		Warm, sunny, breeze	
Surface Ground Conditions:		Damp	Temp: NR

Remarks:

PH101 cap could not be removed so no ground water level was taken.

Checked:	Approved:
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Gas Monitoring Results

Consultants

Job Title: Goldthorpe Colliery, Goldthorpe				Job No: 2500	
Client:				Sheet : 1 of 1	
Date: 03-Sep-02 (Visit 7)		Arr Time: 14:05		Dep Time: 16:00	
				Operator: Lynda Owen	

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH ₄ :	0.0	CO ₂ :	0.0	O ₂ :	20.9
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[illegible]

Notes

Equipment Used:	Calibration	Key
Gas Data LMSX Infra red analyser	Last date	POS - Positive Flow
Geotechnical Instruments Dipmeter	30.08.02	NEG - Negative Flow
		ND - None Detected
		NR - Not Recorded

Barometric Pressure Trend:

Start of Visit:	1009mb	End of Visit:	1008mb	Intermediate Readings:	NR
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Weather Conditions:	Cool, cloudy, breezy and warm.
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Surface Ground Conditions:	Dry	Temp:	NR
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Remarks:

PH101, Cap could not be removed, therefore no record taken for Ground Water Level.

Checked:	Approved:
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Checked:	Approved:
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