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Our Ref: 8948G/TPB/SCS

23rd January 2020

Dear Madam

Dob Brook Close, Failsworth

Further to the issue of the Phase 2 report, the ground gas monitoring has been completed. This letter report provides an updated ground gas risk assessment associated with the proposed residential redevelopment.

Updated Ground Gas Risk Assessment

Methodology

Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents, namely:

- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2015 & A1:2019); and
- Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).

The assessment presented herein is primarily based on the BS8485 document.

Hazardous ground gas qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be assessed based on knowledge of the conceptual model and a measure of hazardous gas concentration and gas flow at the site within monitoring standpipes.

Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Q_{hg}) can be derived for each monitoring point, from which the "site characteristic hazardous gas flow rate" (Q_{hgs}), and then the "Characteristic Situation" (CS) can be determined.

BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation and the proposed development based on building type as outlined in Table 3.

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Table 3 - Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ Public, possible multiple	Commercial / Public	Commercial / Industrial
Control (Change of use)	None	Some but not all	Full	Full
Room Sizes	Small	Small/ medium	Small to Large	Large Industrial/ Retail Park

The proposed development is indicated to comprise the construction of **Type B** buildings, the definition of which is provided in BS8485:2015 as:

- *Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout the ground floor.*

Ground Gas Conceptual Model

The site is not located in an area where radon protection measures are required.

There are no current or historic landfills within influencing distance of the site.

Made ground from historical in-filling has been encountered beneath the site up to 3.80m in thickness. This was not found to contain any significant volumes of organic materials which could be considered a significant source of ground gas. However, a relatively thin horizon of peaty clay was encountered within WS5 between 2.40m and 2.90mbgl. Notwithstanding this, due to the age of infilling, the potential for the made ground to generate ground gas in significant volumes is considered low.

With the exception of localised recent deposits (WS4 2.30m to 3.00mbgl) which included some decayed roots, no evidence a significant thickness of natural organic material was encountered in the exploratory holes within the area of the infilled brook.

The presence of ground gas resulting from shallow unrecorded mine workings can be discounted.

However, it has been considered prudent to undertake ground gas monitoring, primarily for methane and carbon dioxide, with associated flow rates, on six occasions between 17th September and 4th December 2019.

Results and Recommendations

The results indicate concentrations of methane not exceeding 0.1% by volume in air (v/v). Peak and steady state carbon dioxide concentrations generally range from 0.1% to 8.1%.

A maximum positive steady state flow of 1.5l/hr was recorded in WS4 on the fifth visit.

No detectable concentrations of hexane were recorded during any of the visits.

The results for each individual standpipe have been assessed with reference to guidance provided in BS8485:2015. Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Q_{hg}) have been derived for each monitoring point, from which an individual "Characteristic Situation" (CS) has been determined, in accordance with Table 2 of BS8485:2015. The

determined CS for each standpipe, for both methane and carbon dioxide per visit, is presented on the ground gas monitoring sheets within Appendix 02.

The individual results give a maximum Qhg value of <0.021l/hr and indicate the site to classify as 'Characteristic Situation (CS) 1 – Very Low Gas Risk'.

However, due to the elevated concentrations of carbon dioxide on a number of occasions it would be prudent to classify the site as Characteristic Situation (CS) 2 – 'Low Gas Risk'.

This would require new structures to incorporate ground gas protection measures to provide a score of 3.5 in accordance with Table 4 of BS8485:2015.

This could include the following:-

- Passive sub-floor dispersal (minimum 150mm clear void) with cross ventilation to internal sleeper walls of very good performance which meets all criteria out in Paragraph B.6 of BS 8485:2015.
- Sub-slab ventilation, swan neck pipes connected to external airbrick, at maximum 1500mm centres to at least opposing sides of the structure.
- Lapped and taped gas resistant membranes (tested to BS8485), in the floor slab construction which meets all the criteria as set out in Table 7 of BS 8485:2015 and installed to reasonable levels of workmanship in line with current good practice.
- Membrane to be sealed around all penetrations and to damp proof course and taken over cavity walls.

The final protection measures should also be confirmed with the local authority Environmental Health / Building Control Officer prior to any building design being finalised.

We trust this provides you with the information required at this time. However, please do not hesitate to contact us if you have any queries.

Yours sincerely



S C Seddon

For WML CONSULTING

**Appendix 01
Drawings**



Station	Easting	Northing	Level
1	388361.508	400715.560	88.568
2	388307.208	400695.132	88.311

GENERAL NOTES

- DO NOT SCALE FROM THIS DRAWING WORK TO FIGURED DIMENSIONS ONLY.
- NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS ALLOWED WITHOUT PRIOR PERMISSION IN WRITING.
- ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
- THE CONTRACTOR SHALL INCORPORATE ALL THE REQUIREMENTS OF THE PRE-TENDER STAGE HEALTH & SAFETY PLAN.

KEY

- SITE BOUNDARY
- ⊕ WS1 WINDOW SAMPLE PROBEHOLES
- ⊞ TP1 WINDOW SAMPLE PROBEHOLES
- ▨ AREA OF KNOWN JAPANESE KNOTWEED

P1	FIRST PRELIMINARY ISSUE	AUG '19	SCS	PGD
Rev.	Amendment	Date	By	Chkd

Project	DOB BROOK CLOSE
Client	THE GUINNESS PARTNERSHIP
Title	EXPLORATORY HOLE LOCATION PLAN

Drawn	Checked	Date	Scale
SCS	PGD	2210-19	1:200

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Job No.	8949G	Drawing No.	SK-01
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Appendix 02
Gas Monitoring Results

WMLCONSULTING

Atmospheric Pressure
Start:- 1016mb
End:- 1015mb
Trend:- Rising

Operator:- P Hobson

[illegible]

Additional Comments

WMLCONSULTING

Atmospheric Pressure
Start:- 1000mb
End:- 999mb
Trend:- Rising

Operator:- P Hobson

[illegible]

Additional Comments

WMLCONSULTING

Atmospheric Pressure
Start:- 1010mb
End:- 1010mb
Trend:- Rising

Operator:- P Hobson

[illegible]

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Dob Brook Close
Project No:- 8948G
Client:- The Guinness Partnership

Date:- 04/11/2019
Start Time:- 09:30
End Time:- 09:50
Ground Conditions:- Wet
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 970mb
End:- 970mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS1	<0.1	0	0	0.0	0.0	0.0000	4.4	3.5	0.0000	13.5	0	0	0.000	1.90	2.70
WS2	<0.1	0	0	0.0	0.0	0.0000	3.2	3.2	0.0000	15.2	0	0	0.000	1.40	3.00
WS4	<0.1	0	0	0.0	0.0	0.0000	4.1	2.1	0.0000	12.1	0	0	0.000	2.80	3.00

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Dob Brook Close
Project No:- 8948G
Client:- The Guinness Partnership

Date:- 15/11/2019
Start Time:- 10:30
End Time:- 11:10
Ground Conditions:- Wet
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 990mb
End:- 998mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS1	<0.1	0	0	0.0	0.0	0.0000	5.4	5.4	0.0000	6.3	0	0	0.000	1.88	2.70
WS2	<0.1	0	0	0.0	0.0	0.0000	3.4	3.4	0.0000	13.2	0	0	0.000	1.30	3.00
WS4	2.4	1.5	8	0.0	0.0	0.0000	1.9	1.4	0.0210	16.0	0	0	0.000	1.30	3.00

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Dob Brook Close
Project No:- 8948G
Client:- The Guinness Partnership

Date:- 04/12/2019
Start Time:- 08:10
End Time:- 08:35
Ground Conditions:- Frozen
Weather Conditions:- Sunny

Atmospheric Pressure
Start:- 1007mb
End:- 1006mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS1	<0.1	0	0	0.0	0.0	0.0000	4.1	1.1	0.0000	17.9	0	0	0.000	2.50	2.70
WS2	<0.1	0	0	0.0	0.0	0.0000	4.1	4.1	0.0000	11.5	0	0	0.000	1.50	3.00
WS4	<0.1	0	0	0.0	0.0	0.0000	2.9	2.0	0.0000	12.8	0	0	0.000	2.90	3.00

Additional Comments

Appendix 03
Gas Monitoring Methodology and Calibration Certificates

GAS MONITORING METHODOLOGY

1. The following are recorded upon arrival or at each location as the monitoring progresses:-
 - Operator name;
 - Instrumentation name i.e. Gas Data - GFM436;
 - Atmospheric pressure;
 - Time of commencement of the monitoring visit;
 - Ground conditions e.g. wet, dry waterlogged etc.;
 - General weather conditions, as the prevailing conditions may affect the results; and
 - Condition of the monitoring point e.g. damaged, covered etc.
2. The background oxygen concentration in the vicinity of the monitoring point is recorded to ensure that the instrument is zeroed.
3. Where appropriate, both the flow and pressure differential are recorded at each monitoring point prior to obtaining the gas concentrations.
4. Concentrations of light hydrocarbon gas, comprising methane (%v/v), carbon dioxide (%v/v), oxygen (%v/v), hydrogen sulphide (ppm), carbon monoxide (ppm) and hexane % are monitored continuously over a 90 seconds period. The highest concentrations of methane, carbon dioxide, carbon monoxide and hydrogen sulphide and the lowest concentration of oxygen are then recorded.
5. If/where concentrations stabilise after 90 seconds, the steady-state concentrations are recorded. If concentrations are still varying, monitoring is continued until steady-state conditions are attained and concentrations then recorded. The accuracy for light hydrocarbon gases is :-
 - Methane - +/-0.2% at 5%.
 - Carbon dioxide - +/-0.1% at 10%.
6. Depth to water level and base of installation are recorded as the movement of groundwater can affect gas migration and migration pathways to monitoring points.
7. The above steps are to be repeated at each monitoring point.
8. The following are then recorded upon completion of the monitoring process:-
 - Atmospheric pressure;
 - Time of completion of the monitoring visit.

Key For Gas Monitoring Records

BH/WS	- Readings taken from gas valve within borehole or window sample probehole.	PD	- Pressure differential measured in millibars
Flow	- Gas flow measured in litres per hour	%	- Percentage
<0.1	- Where flows are less than 0.1/hr are recorded	ppm	- Parts Per Million
CO ₂	- Carbon Dioxide	l/hr	- Litres per hour
O ₂	- Oxygen	CH ₄	- Methane
H ₂ S	- Hydrogen Sulphide	mbgl	- Metres below ground level
CO	- Carbon Monoxide	GSV	- Gas Screening Value

TEST DATE AND CONDITIONS			
Date		14/08/19	
Atmospheric Pressure		993	mB
Ambient Temperature		21.9	°C
EnviroNics Serial No.		5089	

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311

Fax 02476307711



Customer	WML Consulting Ltd
Certificate Number	121220
Order Number	323564

Serial Number	12969
Software Version	G436-00.0027/0010

Recalibration DUE Date
14/08/20

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	60	60	40	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
Zero Reading 100% N ₂	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	0	0	0	0	0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H ₂ S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1000	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects								
Applied Gas (ppm)		Instrument Readings (ppm)						
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX	
H2S	1500	1500		0		0		
CO	1000	40		1000		0		
Hexane	2.0%	0		0		1.99		

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		993	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200mb	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.3	Accept ± 3.0	-556	-570	Accept ± 50
-3	-3	Accept ± 1.0	-23	-22	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	17	17	Accept ± 3.0
30	30	Accept ± 3.0	385	384	Accept ± 50
60	60	Accept ± 6.0	1192	1193	Accept ± 130
90	90.4	Accept ± 9.0	2362	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading °C	
Applied Temperature °C		
-10	-10	Accept ± 2.0
0	0	Accept ± 1.0
30	30	Accept ± 1.0
60	60	Accept ± 1.0
100	100	Accept ± 1.0

Technician:
<i>Jack Rutland</i>

Date Tested:
<i>15/08/19</i>

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.