

Our ref: 17-174.02L

FAO Mr William Cartwright  
Heritage Planning Design  
82 Park Road  
Bingley  
West Yorkshire  
BD16 4EJ

24<sup>th</sup> November 2017

Dear William,

**Re: Land north of Holme House, Oxford Road, Gomersal**

This report is an addendum to the Phase 2: Ground Investigation Report (GIR) (Project No.: 17-174, September 2017) undertaken for the proposed development at the above location.

Please find attached:

- Arc Environmental Ground Gas Monitoring Certificate

Based on the findings of the Phase 1: Desk Top Study and the Phase 2 intrusive ground investigation works, and in accordance with CIRIA Report C665, November 2007, BS8485:2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, and BS8576:2013: Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds, the risk assessment for this site would be based on the following limiting factors:

- The proposed residential development has been considered as *high* sensitivity (Tables 5.5a & 5.5b – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source is considered as *very low* (assessment based on the findings of the intrusive works).
- Monitoring over a minimum of *three* months with *six* recorded readings (Tables 5.5a & 5.5b – Typical /idealised frequency and period of monitoring after Wilson et al, 2005).
- No detectable concentrations of Methane or Carbon Dioxide have been recorded exceeding the action trigger levels of 1% & 5% respectively. (Table 8.5 – Modified Wilson & Card classification).
- *Negligible* (<0.1l/hr.) and slightly positive (up to 0.7l/hr) flow rates have been recorded during the monitoring period (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased programme of gas monitoring will be completed, which will obtain gas monitoring readings during varying atmospheric conditions, which covers the 'worst case' scenario for ground gas emissions to occur, particularly during rapid falls in atmospheric pressure (i.e. from c.1020mb and c.1010mb), and also during low atmospheric pressure events (i.e. c.1000mb and below).

A summary of the results for all 6 no. visits undertaken are presented in Table 1 on the following page, with a copy of the monitoring results attached with this report. Monitoring was undertaken using a Gas Data GFM 430/435 infra-red gas analyser with integral flow meter, and an electronic dipmeter.



Arc Environmental Ltd  
Solum House  
Unit 1 Elliott Court  
St. John's Road  
Meadowfield  
DH7 8PN

T: 0191 378 6380  
E: admin@arc-environmental.com  
W: www.arc-environmental.com  
Registered in England No. 05539784



**Re: Land north of Holme House, Oxford Road, Gomersal (Cont'd)**

**Table 1**

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH <sub>4</sub> (%v/v)	LEL (%v/v)	CO <sub>2</sub> (%v/v)	O <sub>2</sub> (%v/v)	Flow Rate (l/hr)
BH01	31/07/2017	998	1.82	0.0	0.0	2.4	13.2	<0.1
BH03		(trend - rising	1.44	0.0	0.0	1.5	14.7	<0.1
BH04		997-1009)	Dry	0.0	0.0	1.0	18.8	<0.1
BH01	21/08/2017	1020	1.86	0.0	0.0	0.5	19.5	0.6
BH03		(trend - steady	1.38	0.0	0.0	0.0	20.7	0.7
BH04		1022-1020)	1.42	0.0	0.0	1.0	18.2	0.5
BH01	15/09/2017	991-993	1.60	0.0	0.0	0.3	19.9	<0.1
BH03		(trend - rising	1.10	0.0	0.0	0.0	20.3	<0.1
BH04		981-1013)	1.34	0.0	0.0	0.0	20.5	<0.1
BH01	05/10/2017	999-1000	1.28	0.0	0.0	0.2	19.5	<0.1
BH03		(trend - Falling	0.67	0.0	0.0	1.7	15.0	<0.1
BH04		1020-1002)	0.64	0.0	0.0	0.7	19.9	<0.1
BH01	02/11/2017	991-993	1.38	0.0	0.0	0.1	20.3	<0.1
BH03		(trend - falling	0.88	0.0	0.0	0.2	20.4	<0.1
BH04		1031-1013)	0.92	0.0	0.0	0.0	20.6	<0.1
BH01	08/11/2017	1000-1002	1.67	0.0	0.0	0.1	19.9	<0.1
BH03		(trend - falling	1.59	0.0	0.0	0.2	20.0	<0.1
BH04		1023-1017)	1.54	0.0	0.0	0.1	20.2	<0.1

Note – Atmospheric trend taken from Wunderground for Leeds-Bradford Airport.

As can be seen from the results to date, no concentrations of detectable Methane (CH<sub>4</sub>) have been recorded. Concentrations of Carbon Dioxide (CO<sub>2</sub>) have currently been recorded up to a maximum of 2.4% v/v, with reduced Oxygen (O<sub>2</sub>) concentrations (minimum 13.2% v/v). Negligible (<0.1 l/hr.) and slightly positive (up to 0.7l/hr) flow rates have been recorded during the monitoring visits completed.

For the purposes of the proposed residential development, the site is characterised based on the limiting borehole gas volume flow for Methane and Carbon Dioxide known as the Gas Screening Value (GSV) which in turn determines the level of protection required. Therefore, in order to complete the risk assessment, the maximum GSV (Gas Screening Value) for the CH<sub>4</sub> and CO<sub>2</sub> levels recorded have been determined as follows:

- Methane (CH<sub>4</sub>) – Due to the lack of Methane no GSV can be calculated.
- Carbon Dioxide (CO<sub>2</sub>) - multiplying the maximum concentration recorded (taken as 2.4%) by the maximum flow rate (taken as 0.7 l/hr.) which gives a GSV of 0.01 l/hr. (calculated from 0.024 x 0.7 l/hr. maximum flow rate).

From the above assessment, it can be seen that the presence of hazardous ground gases does not exceed the GSV assessment values of 0.07 l/hr. (Characteristic Situation 1) or 0.78 l/hr. (Green Classification – NHBC Traffic light system), indicating that no gas protection measures are required for the proposed residential development.

We trust the above and attachments are to your satisfaction, however if you require any further information or clarification please do not hesitate to contact us.



Yours sincerely  
For and on behalf of Arc Environmental Ltd

A handwritten signature in black ink, appearing to read 'Richard Stripp', written over a horizontal line.

.....  
Richard Stripp *BSc. (Hons) MSc. FGS*  
Associate

# Arc Environmental Ground Gas & Groundwater Monitoring Certificate



<b>Site:</b>	Land adj. Holme House, Oxford Road, Gomersal
<b>Ref:</b>	17 - 174

Visit	Date	Time	Equipment	Weather	Initials	Comments	Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Atmospheric Pressure Trend	Methane (% v/v)		Methane (% LEL)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Hydrocarbons (GFM 435 only)		Other Gases (PPM)			Depth to Water (m bgl)				
											Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Hex %	PID Cf	PID (Isobutylene)	H <sub>2</sub> S	CO					
1	31/07/2017	9.45am	GFM435	Sunny	KC		1	<0.1	988	Rising 997-1009	0.0	0.0	2.4	13.2										1.82				
							3	<0.1	988	Rising 997-1009	0.0	0.0	1.5	14.7												1.44		
							4	<0.1	986	Rising 997-1009	0.0	0.0	1.0	18.8														2.12 DRY
2	21/08/2017	11.40am	GFM435	Overcast , Dry	KC		1	0.6	1000	Steady 1022-1020	0.0	0.0	0.5	19.5											1.86			
							3	0.7	1002	Steady 1022-1020	0.0	0.0	0.0	20.7													1.38	
							4	0.5	1002	Steady 1022-1020	0.0	0.0	1.0	18.2														1.42
3	15/09/2017	11.05am	GFM435	Sunny, and partly overcast	KC		1	<0.1	991	Rising 981-1013	0.0	0.0	0.3	19.9											1.60			
							3	<0.1	993	Rising 981-1013	0.0	0.0	0.0	20.3													1.10	
							4	<0.1	991	Rising 981-1013	0.0	0.0	0.0	20.5														1.34
4	05/10/2017	11.55am	gfm430	Sunny	KC	BH 3 and BH 4 bailed	1	<0.1	999	Falling 1020-1002	0.0	0.0	0.2	19.5											1.28			
							3	<0.1	1000	Falling 1020-1002	0.0	0.0	1.7	15.0													0.67	
							4	<0.1	1000	Falling 1020-1002	0.0	0.0	0.7	19.9														0.64
5	02/11/2017	1.35PM	GFM430	Sunny	KC	BH 3 and 4 Bailed	1	<0.1	993	Falling 1031-1013	0.0	0.0	0.1	20.3											1.38			
							3	<0.1	992	Falling 1031-1013	0.0	0.0	0.2	20.4													0.88	
							4	<0.1	991	Falling 1031-1013	0.0	0.0	0.0	20.6														0.92
6	08/11/2017	11.35am	GFM430	Sunny	KC		1	<0.1	1000	Falling 1023-1017	0.0	0.0	0.1	19.9											1.67			
							3	<0.1	1001	Falling 1023-1017	0.0	0.0	0.2	20.0													1.59	
							4	<0.1	1002	Falling 1023-1017	0.0	0.0	0.1	20.2														1.54

Notes:  
 Atmospheric pressure trend taken from www.wunderground.com for Leeds-Bradford Airport  
 Detection limits - Methane = 0.0%, Carbon Dioxide = 0.0%, LEL = 0.0%, Oxygen = 0.0%, Flow = 0.1l/hr  
 Monitoring order is from **Left to Right** across table  
 Monitoring should be for **Not Less** than 3 minutes. However, if high concentrations of gasses initially recorded, monitoring should be for up to 10 minutes  
 N/A = Not applicable >>> = Off the scale

Cf = PID compensation Factor (1-10) - Must be used to multiply the PID reading to give an accurate measure of the total hydrocarbons in the borehole when methane is present  
 Hex = Hexane (Valid and in range up to 2.000%) - Recorded when abnormally high methane is present.  
 PID = Photo Ionisation Detector (Calibrated to Isobutylene)