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BY EMAIL

Our Ref: PWS/01/L8/WW

14th March 2025

Dear Pam

Jill Lane, Mirfield
Ground Gas Risk Assessment

In accordance with our commission and following issue of the ARP Geotechnical Ltd (ARP) Intrusive Coal Mining Investigation (ref: PWS/01/L17/WW, dated 13th December 2024), we have now completed all six of the gas monitoring visits at the above site. A full set of gas monitoring results are appended and summarised below.

Background

During the coal mining investigation undertaken in (November & December 2024), three gas monitoring wells were installed in boreholes BH1, BH2 and BH3 (see location plan attached). Subsequent ground gas and water monitoring was undertaken by ARP Geotechnical Ltd. The wells were installed to a depth of 3.0m with the top 1.0m fitted with plain pipe and bentonite seal, and the bottom 2m with slotted pipe and gravel surround. All three wells were fitted with a lockable flush cover, bung and gas tap.

Monitoring Results

The ground gas investigation was undertaken in accordance with BS 8576: 2013 "Guidance on investigations for ground gas - Permanent gases and Volatile Organic Compounds (VOCs)". Ground gas risk assessment was carried out in accordance with BS 8485: 2015 + A1: 2019 “Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings".

The monitoring visits were carried out to record the levels of methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), groundwater level, and borehole gas flow rate in litres/hour (l/hr) within the wells. Six visits were made over a 11-week period. The visits were made between the 17th December 2024 and 04th March 2025. On the days of the visits, atmospheric pressures ranged between 978mb and 1,033mb.

The monitoring showed maximum concentrations, of CH_4 and CO_2, of 0.0%, and 1.9%, respectively, along with oxygen levels of a minimum of 17.3% (all results measured in percentage by volume). The detectable borehole flow rate was measured between 0.0l/hr and 0.5l/hr (the detection limit of 0.1l/hr is assumed where no flow was detected).

Risk Assessment

The British Standard, BS 8485: 2015 + A1: 2019, utilises the concept of borehole hazardous gas flow rates (Q_{hg}), in litres/hour (l/hr), which are obtained by multiplying flow rate by concentrations in the air stream of the particular gas being considered for each borehole. The Q_{hg} is used to derive a gas screening value (GSV), which is defined as the "flow rate of a specific hazardous gas representative of a site or zone, derived from assessment of borehole concentration and flow rate measurements and taking account of all other influencing factors, in accordance with a conceptual site model".

The table below allows the selection of the 'Characteristic Gas Situation' (CS) based on GSVs, using a numbering system of 1 to 6, where 1 equates to a very low hazard potential and 6 equates to a very high hazard potential.

A table showing the Characteristic Gas Situations is provided below:-

Characteristic Gas Situation (CS)	Hazard Potential	Gas Screening Value - l/hr - (GSV)	Additional Factors
1	Very Low	<0.07	Typically <1% CH_4 and <5% CO_2, otherwise consider an increased Characteristic Gas Regime
2	Low	>0.07 to <0.7	Typical Measured Flow Rate <70 l/hr, otherwise consider an increase to CS 3
3	Moderate	>0.7 to <3.5	
4	Moderate to high	>3.5 to <15	
5	High	>15 to <70	
6	Very High	>70	

Based on Table 2 of BS 8485: 2015 + A1: 2019

A summary of the results obtained from the ground gas monitoring investigation, together with the Q_{hg} for carbon dioxide and methane, is presented in the table on the following page:-

Borehole Ref.	Max Recorded Steady Flow (l/hr)	Max. CO_2 (% v/v)	Max CH_4 (% v/v)	Max BH Qhg (CO_2)	Max BH Qhg (CH_4)
BH1	0.3	0.4	0.0	0.001	0.000
BH2	0.4	1.9	0.0	0.008	0.000
BH3	0.5	1.5	0.0	0.008	0.000
Worst-credible Qhg (l/hr) *				0.008	0.000
Worst-possible Qhg (l/hr) +				0.010	0.000

* Based on maximum recorded concentration and maximum flow rate applicable to any individual borehole.

\+ Based on maximum recorded concentration and maximum flow rate across the whole site (any borehole)

The maximum recorded concentration of CH_4 and CO_2 is 0.0% v/v and 1.9% v/v, respectively. The worst credible gas regime identified on the site (based on the maximum recorded flow rate and concentration detected together within an individual borehole) is a Q_{hg} of 0.000 l/hr for CH_4 and 0.008 l/hr for CO_2. This equates to a Characteristic Situation of CS1, for CO_2 & CH_4.

It is also a requirement of the British Standard to check the very worst-case combination of the highest flow and highest detected concentrations, of any borehole, with values not necessarily from the same borehole. If the worst-case conditions indicate a higher hazard could reasonably exist, then this should be adopted as the GSV, unless further monitoring or other justification is provided for it not to be used. In this case, the worst-possible Q_{hg} is 0.000 l/hr for methane and 0.010 l/hr for carbon dioxide. This equates to a Characteristic Situation of CS1, for CO_2 & CH_4.

Coal Mine Gas Assessment

The Characteristic Situation is an empirical approach which was developed based on data from monitoring wells installed in soil-based sources. Coal mine related gas emissions involve flow through open voids and fractured rock which the method was not intended to be applied to. As such, GSV's are to be used with extreme caution and should not be used in isolation. A decision support tool for coal mine gas risk assessment is provided in Figure 13.1 of the CL:AIRE Good Practice for Risk Assessment for Coal Mine Gas Emissions dated October 2021. Using this support tool a multiple lines of evidence approach must be undertaken and is presented below.

<u>Mine Workings and Recorded Shaft</u>

A Coal Mining Risk Assessment was undertaken by ARP Geotechnical Ltd (reference PWS/01/JRjcl1), dated 4th September 2023. The report concluded that potential coal workings beneath the site pose a risk to ground stability, and a rotary borehole investigation was recommended to be carried out. In accordance with our commission, the recommended investigation was carried out on 28th November and 3rd December 2025, (ref: PWS/01/L17/WW), dated 13th December 2024.

Three boreholes were drilled, using rotary open hole water flush techniques. Three were drilled between the 28th November and 3rd December 2024 (numbered BH1 to BH3). The boreholes were taken to depths of between 12.0m and 28m bgl. Coal mine workings were identified across the site and generally do not

have sufficient rock cover. Stabilisation treatment by injection of grout into a grid of boreholes (known as drilling and grouting) has been recommended.

In addition to this The Mining Remediation Authority recorded mine entry referenced 421421-021 is recorded to be present on site from historic maps. An initial Shaft Investigation letter (reference PWS/01WWjcl3) dated 21st March 2024; followed by a Further Shaft Investigation Letter (Ref: PWS/01/WWjcl4), dated 17th June 2024 were produced and resulted in no mine shaft being identified within 90% of the error radius however 10% of the error radius remained unexamined.

Conclusions

Six rounds of gas monitoring have been undertaken on site. The maximum recorded concentration of CH_4 and CO_2 was 0.0% v/v and 1.9% v/v respectively. A flow of 0.5m (l/hr) was recorded. Atmospheric conditions at the time of the monitoring visits were generally high pressure conditions with three visits undertaken during falling conditions.

Coal mine workings were identified across the site during intrusive rotary drilling and generally do not have sufficient rock cover. Stabilisation treatment by injection of grout into a grid of boreholes is required before development can progress.

Mining Remediation Authority recorded mine entry referenced 421421-021 is recorded to be present on site from historic maps and has the potential to act as a pathway for hazardous mine gasses despite not being located within the mine shaft scrape searches. Mine shafts have the potential to be within 20m and 50m from the site.

Given the above lines of evidence approach, there is considered to be a high risk of mine gas emissions on site. Uncertainties exist regarding the potential for gas migration during the drill and grout process and due to the potential presence of an unlocated mineshaft on site and potential off-site shafts.

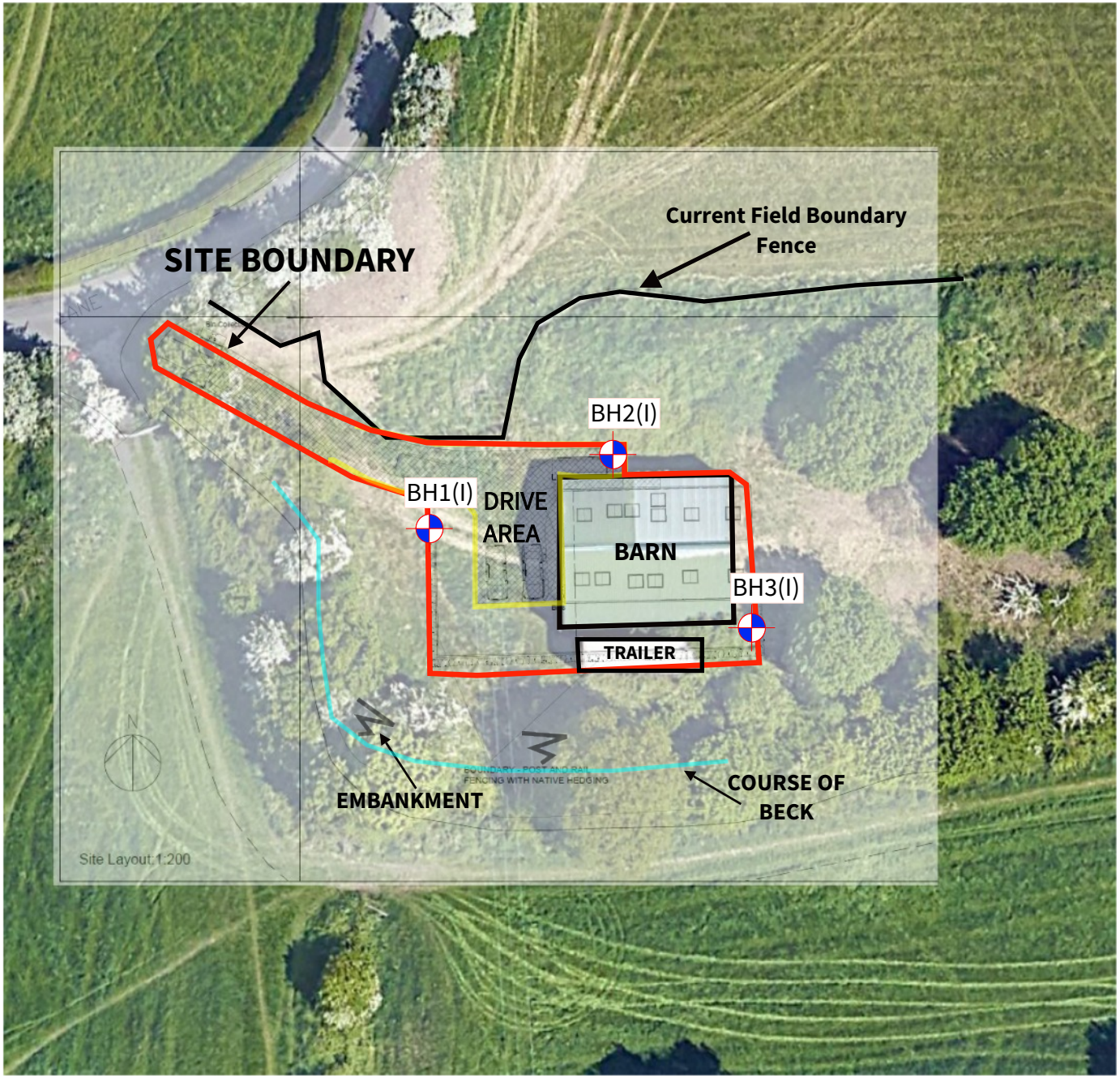
As a result, it is considered that gas protection measures are required on site to mitigate the identified risks and lower them to the moderate risk zone. Foundations should be designed with a vented sub-floor void and a gas membrane resistant to CO_2 and CH_4 should be installed within the property on site.

We trust the above is sufficient for your requirements. However, should you have any queries, or wish to discuss the matter further, please do not hesitate to contact us at your convenience.

Yours sincerely
for ARP GEOTECHNICAL LTD

William Watkins
BSc(Hons) MSc FGS

Encs



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KEY

ARP ROTARY BOREHOLE LOCATION.

(I) - MONITORING INSTALL.

Error Radius

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Project	JILL LANE, MIRFIELD
Client	PAMELA DEWS
Title	COAL MINING INVESTIGATION PLAN
Date	DECEMBER 2024
Drawn: WW	Scale: AS SHOWN
Job No.	PWS/01

ARP GEOTECHNICAL BOREHOLE MONITORING RESULTS

JOB NO. PWS/01 **CLIENT:** Pam Dews

SITE: Jill Lane, Mirfield

BAROMETRIC PRESSURES

Monitor Date	Weather on Day	Pressure on Day (mb)*	Pressure on day before (mb)*	Pressure 2 days before (mb)*	Pressure 3 days before (mb)*	3 Day Trend*
17/12/2024	Overcast, mild	1019	1024	1021	1019	Stable
07/01/2025	Overcast, Cold	994	978	986	1013	Rising
21/01/2025	Overcast, Cold	1010	1015	1017	1027	Falling
04/02/2025	Overcast cold	1012	1020	1019	1026	Falling
18/02/2025	Overcast cold	1022	1022	1021	1017	Stable
04/02/2025	Sunny mild	1023	1027	1032	1033	Falling

Check dates. Monitoring should be carried out over 3 months

*Pressures at midday (EGNM) corrected to sea level.

https://www.timeanddate.com/weather/uk/leeds/historic

ARP GEOTECHNICAL BOREHOLE MONITORING RESULTS

JOB NO: PWS/01 **CLIENT:** Pam Dews

SITE: Jill Lane, Mirfield

BH: BH1

Date	BH Steady Flow Rate (l/hr)*	Peak CH_4 %	Qhg CH_4 (l/hr)	Peak CO_2 %	Qhg CO_2 (l/hr)	Min. O_2 %	Depth to G Water (m)	Comment
17/12/2024	N/A	N/A	#VALUE!	N/A	#VALUE!	N/A	1.9	Monitoring Valve Broken
07/01/2025	0.1	0.0	0.000	0.1	0.000	19.8	1.85	Monitoring Valve Installed
21/01/2025	0.3	0.0	0.000	0.0	0.000	19.7	1.76	
04/02/2025	0.1	0.0	0.000	0.4	0.000	19.2	1.78	
18/02/2025	0.1	0.0	0.000	0.3	0.000	19.3	1.80	
04/02/2025	0.1	0.0	0.000	0.1	0.000	19.5	1.84	

* Where no flow is detected, detection limit of 0.1l/hr should be inserted

Qhg = Hazardous gas flow rate, in accordance with BS8485:2007

ARP GEOTECHNICAL BOREHOLE MONITORING RESULTS

JOB NO: PWS/01 **CLIENT:** Pam Dews

SITE: Jill Lane, Mirfield

BH: BH2

Date	BH Steady Flow Rate (l/hr)*	Peak CH_4 %	Qhg CH_4 (l/hr)	Peak CO_2 %	Qhg CO_2 (l/hr)	Min. O_2 %	Depth to G Water (m)	Comment
17/12/2024	0.1	0.0	0.000	1.6	0.002	17.8	1.24	
07/01/2025	0.1	0.0	0.000	1.9	0.002	17.7	1.10	
21/01/2025	0.3	0.0	0.000	0.0	0.000	19.7	1.08	
04/02/2025	0.4	0.0	0.000	0.0	0.000	19.5	1.13	
18/02/2025	0.2	0.0	0.000	1.7	0.003	18.5	1.30	
04/02/2025	0.2	0.0	0.000	0.2	0.000	19.2	1.35	

* Where no flow is detected, detection limit of 0.1l/hr should be inserted

Qhg = Hazardous gas flow rate, in accordance with BS8485:2007

ARP GEOTECHNICAL BOREHOLE MONITORING RESULTS

JOB NO: PWS/01 **CLIENT:** Pam Dews

SITE: Jill Lane, Mirfield

BH: BH3

Date	BH Steady Flow Rate (l/hr)*	Peak CH_4 %	Qhg CH_4 (l/hr)	Peak CO_2 %	Qhg CO_2 (l/hr)	Min. O_2 %	Depth to G Water (m)	Comment
17/12/2024	0.1	0.0	0.000	1.5	0.002	17.3	1.20	
07/01/2025	0.1	0.0	0.000	1.2	0.001	17.3	1.10	
21/01/2025	0.5	0.0	0.000	0.0	0.000	19.5	1.17	
04/02/2025	0.5	0.0	0.000	0.1	0.001	19.3	1.30	
18/02/2024	0.2	0.0	0.000	0.9	0.002	18.7	1.38	
04/02/2025	0.3	0.0	0.000	0.1	0.000	19.4	1.49	

* Where no flow is detected, detection limit of 0.1l/hr should be inserted

Qhg = Hazardous gas flow rate, in accordance with BS8485:2007