



Mr S Tranter
Fallbrook House
Falhouse Lane
Whitley
WF12 0NJ

BY E-MAIL

Our Ref: TRN/01/DMBnmI5

24th June 2021

Dear Shaun

Land at Falhouse Lane, Whitley
Ground Gas Risk Assessment

In accordance with our commission, and following issue of the ARP Geotechnical Ltd (ARP) Stage 2 Geo-environmental Report, reference TRN/01r2a, dated 28th January 2021 and the Intrusive Coal Mining Investigation Report, reference TRN/01/OGnml4, dated 19th April 2021, we have now completed all six of the gas monitoring visits at the above site. A full set of gas monitoring results is appended, and summarised below.

Background

During the Intrusive Coal Mining Investigation, which was undertaken in April 2021, three gas monitoring wells were installed in BH1, BH3 and BH4. The wells were installed to a depth of 3m, with the upper 1m comprising plain pipe with bentonite seal and the bottom 2m comprising slotted pipe with gravel surround. A rubber bung and gas valve was placed in the top of the pipe and the well was sealed with a lockable flush cover.

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)". A ground gas risk assessment was carried out in accordance with BS 8485: 2015 "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 (CH₄), carbon dioxide (CO₂), oxygen (O₂), groundwater level, and borehole gas flow rate in litres/hour (l/hr) within the wells. Six visits were made over a 10 week period. The visits were made between the 15th April 2021 and 22nd June 2021, during a variety of atmospheric pressures, including three visits during falling pressure, with one of the falling visits below 1,000mb. The atmospheric pressure, at the time of the visits, ranged between 993mb and 1,034mb.

The monitoring showed maximum concentrations, of CH₄ and CO₂, of 0.0% v/v and 10.5% v/v, respectively, along with a maximum steady state borehole gas flow rate of 0.6 l/hr. The full set of monitoring results is attached



Risk Assessment

The British Standard, BS 8485: 2015, 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 on the 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

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 Q _{hg} (CO ₂)	Max BH Q _{hg} (CH ₄)
BH1	0.1	4.9	0.0	0.005	0.000
BH3	0.6	6.5	0.0	0.039	0.000
BH4	0.1	10.5	0.0	0.011	0.000

Worst-credible Q_{hg} (l/hr) *	0.039	0.000
Worst-possible Q_{hg} (l/hr) +	0.063	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 CH₄ and CO₂ is 0.0% v/v and 10.5% 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 CH₄ and 0.039 l/hr for carbon dioxide. Based on the Q_{hg} values, a Characteristic Situation of CS1 is indicated.

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 0.063 l/hr for carbon dioxide. Therefore, the worst-possible Q_{hg}, for carbon dioxide also indicates that a CS of 1 is applicable for the site.

However, guidance also recommends considering raising the class to CS2 when carbon dioxide concentrations in excess of 5% are detected, as occurred in on this site, with concentrations of up to 10.5% recorded. Therefore, it is considered prudent to assume CS2 conditions apply to the site, given the known coal mine entries on the site and proximity to the infilled sandstone quarry.

Low level gas protection measures are, therefore, recommended for the proposed development, against carbon dioxide.

Conclusions

Based on the gas monitoring undertaken on site, a CS of 2 is indicated for carbon dioxide. CS2 gas protection measures are, therefore, required for the proposed development against carbon dioxide.

The specific design of the protection measures, and the verification required, is dependent on the detailed foundation design, the selection of products/suppliers, and who installs the protection. Once more of these factors are known, as a minimum following foundation design and design of the protection measures, a Statement on Gas Protection should be prepared. The document should



provide information for the Client and other interested parties, such as the regulatory authorities, including detailed drawings of the gas protection, how the design has been arrived at, how the protection will be installed, and how the installation will be verified as satisfactory. The document should be agreed, prior to implementation, with the relevant Regulatory Authorities, usually the local Planning Authority and NHBC or other building control provider.

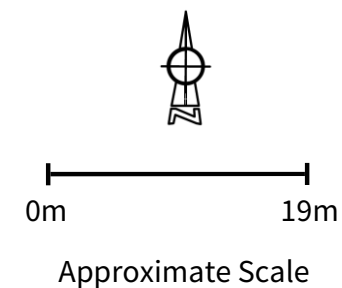
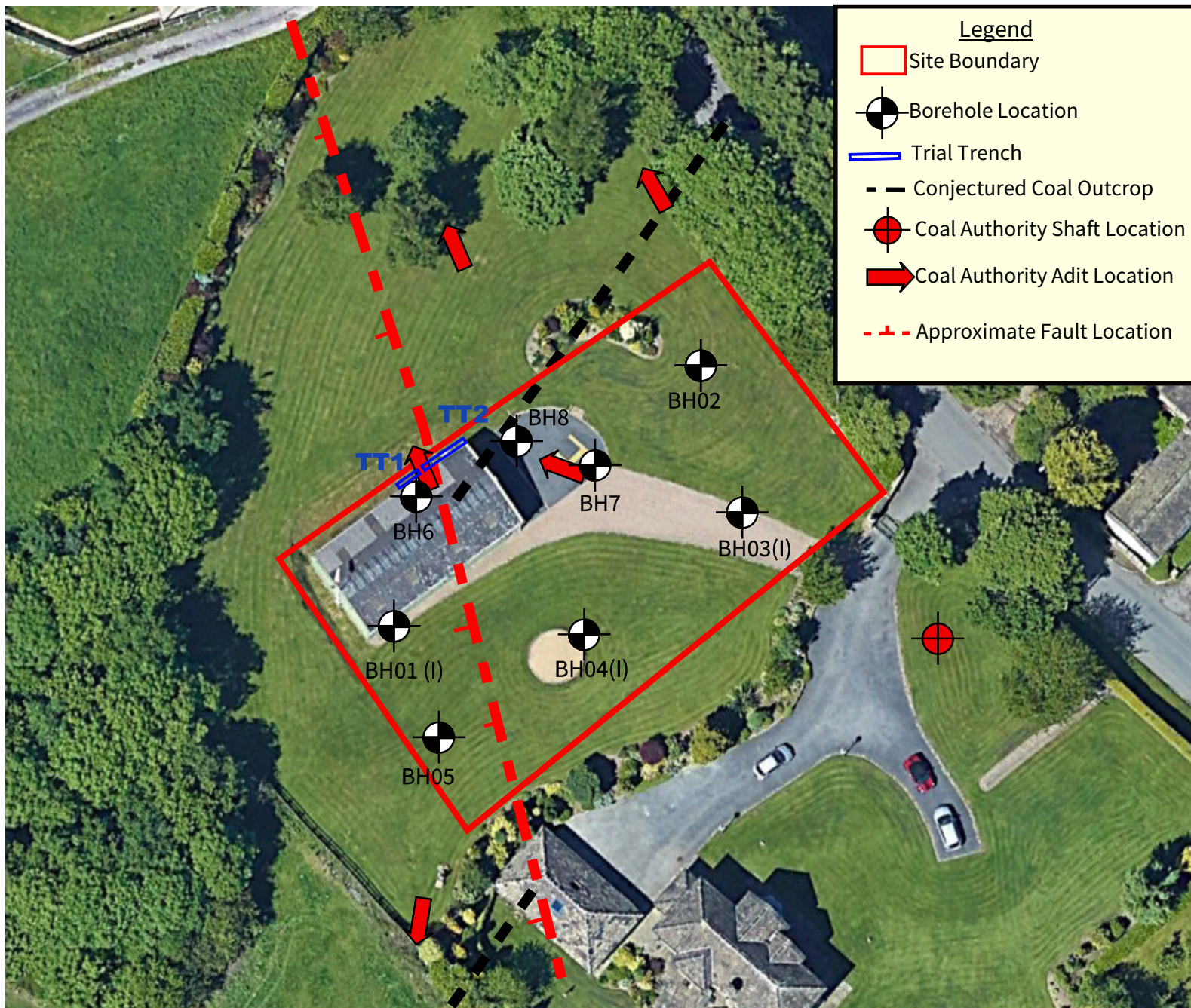
These conclusions are subject to the agreement of the regulatory authorities.

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.

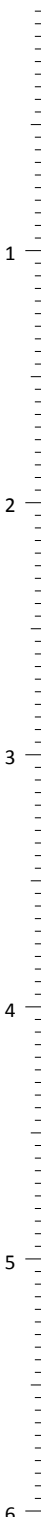
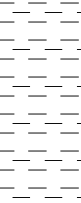
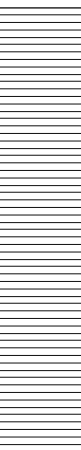
Yours faithfully
for ARP GEOTECHNICAL LTD

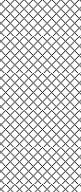
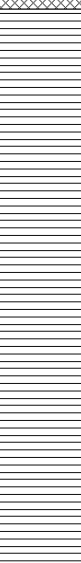
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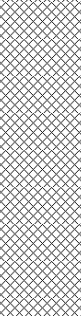
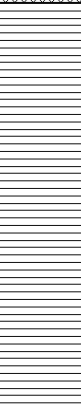
 ARP NORTH WEST LTD CHARTERED CONSULTING ENGINEERS 2nd Floor · 3 Hardman Square · Manchester M3 3EB Telephone : 0113 245 8498 · E-Mail : manchester@arnorthwest.co.uk	
Project LAND AT FALHOUSE LANE WHITLEY	
Client MR TRANTER	
Title ROTARY BOREHOLE AND TRIAL TRENCH LOCATION PLAN	
Date APRIL 2021	
Drawn OG	Scale AS SHOWN
Job No. TRN/01	

 ARP Geotechnical Limited				Rotary Drilling Log				Borehole No. BH1(I) Sheet 1 of 1	
Project Name: Land at Falhouse Lane, Whitley				Project No. TRN/01		Co-ords: -		Hole Type RO	
Location: Land at Falhouse Lane, Whitley						Level:		Date 08/07/2021	
Client: Mr Shaun Tranter						Plant Used: Casigrande C6		Scale 1:30	
Hole Dia.:		Bit Used:		Flush: Water		Rig Crew: GSS		Logged Driller	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Drillers description	
								CLAY: Drillers description	
									
					1.20				1
					3.00			End of Borehole at 3.000m Target depth	3
									4
									5
									6
Groundwater: Any groundwater would be masked by use of water flush during drilling. Backfill: Monitoring well installed to 3m depth. Casing: Remarks:									

 ARP Geotechnical Limited				Rotary Drilling Log				Borehole No. BH3(I) Sheet 1 of 1	
Project Name: Land at Falhouse Lane, Whitley				Project No. TRN/01		Co-ords: -		Hole Type RO	
Location: Land at Falhouse Lane, Whitley						Level:		Date 08/07/2021	
Client: Mr Shaun Tranter						Plant Used: Casigrande C6		Scale 1:30	
Hole Dia.:		Bit Used:		Flush: Water		Rig Crew: GSS		Logged Driller	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.80			MADE GROUND: Drillers description.	
								MUDSTONE: Drillers description	1
					3.00			End of Borehole at 3.000m Target depth	3
									4
									5
									6

Groundwater: Any groundwater would be masked by use of water flush during drilling.
 Backfill: Monitoring well installed to 3m depth.
 Casing:
 Remarks:

RrRO_v1.03

 ARP Geotechnical Limited				Rotary Drilling Log				Borehole No. BH4(I) Sheet 1 of 1	
Project Name: Land at Falhouse Lane, Whitley				Project No. TRN/01		Co-ords: -		Hole Type RO	
Location: Land at Falhouse Lane, Whitley						Level:		Date 08/07/2021	
Client: Mr Shaun Tranter						Plant Used: Casigrande C6		Scale 1:30	
Hole Dia.:		Bit Used:		Flush: Water		Rig Crew: GSS		Logged Driller	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 TOPSOIL: Drillers description  MADE GROUND: Drillers description	1	
					1.40		 MUDSTONE	2	
					3.00		End of Borehole at 3.000m Target depth	3	
								4	
								5	
								6	

Groundwater: Any groundwater would be masked by use of water flush during drilling.
 Backfill: Monitoring well installed to 3m depth.
 Casing:
 Remarks:

RrRO_v1.03

ARP GEOTECHNICAL BOREHOLE MONITORING RESULTS

JOB NO. TRN/01

CLIENT: SHAUN TRANTER

SITE: FALHOUSE LANE, DEWSBURY

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)*	Trend*
15/04/2021	Sunny	1034	1034	-	1027	Rising
28/04/2021	Overcast	1010	1009	1020	1031	Falling
10/05/2021	Overcast	993	994	999	1014	Falling
25/05/2021	Overcast	1010	1000	1005	1001	Rising
08/06/2021	Sunny	1022	1023	1025	1024	Falling
22/06/2021	Sunny	1023	1018	1011	1014	Rising

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: TRN/01 **CLIENT:** SHAUN TRANTER

SITE: FALHOUSE LANE, DEWSBURY

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
15/04/2021	0.1	0.0	0.000	3.1	0.003	16.4	2.95	
28/04/2021	0.1	0.0	0.000	2.8	0.003	17.2	Dry	
10/05/2021	0.1	0.0	0.000	1.9	0.002	18.0	1.44	
25/05/2021	0.1	0.0	0.000	4.7	0.005	9.6	Dry	
08/06/2021	0.1	0.0	0.000	4.9	0.005	10.5	Dry	
22/06/2021	0.1	0.0	0.000	4.3	0.004	16.0	Dry	

* 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: TRN/01 **CLIENT:** SHAUN TRANTER

SITE: FALHOUSE LANE, DEWSBURY

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
15/04/2021	0.1	0.0	0.000	1.9	0.002	19.6	2.36	
28/04/2021	0.1	0.0	0.000	6.5	0.007	15.5	3.07	
10/05/2021	0.1	0.0	0.000	4.3	0.004	13.5	2.80	
25/05/2021	0.6	0.0	0.000	1.2	0.007	17.9	1.23	
08/06/2021	0.1	0.0	0.000	1.7	0.002	19.1	1.77	
22/06/2021	0.1	0.0	0.000	5.9	0.006	8.4	Dry	

* 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: TRN/01 **CLIENT:** SHAUN TRANTER

SITE: FALHOUSE LANE, DEWSBURY

BH: BH4

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
15/04/2021	0.1	0.0	0.000	4.7	0.005	17.6	2.74	
28/04/2021	0.1	0.0	0.000	3.6	0.004	15.0	2.70	
10/05/2021	0.1	0.0	0.000	3.0	0.003	14.5	3.00	
25/05/2021	0.1	0.0	0.000	9.4	0.009	7.0	2.75	
08/06/2021	0.1	0.0	0.000	10.5	0.011	4.9	3.00	
22/06/2021	0.1	0.0	0.000	8.6	0.009	13.6	3.07	

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

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