



EARTH ENVIRONMENTAL  
& GEOTECHNICAL

OUR REF: A0697-19 Letter Report 22<sup>nd</sup> January 2020  
YOUR REF:

22<sup>nd</sup> January 2020

Mr. Paul Briggs  
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**By Email: (paul.briggs@northerndesignpartnership.co.uk)**

Dear Paul,

**Ground Gas Assessment**  
**Plot 1 Laund Road, Huddersfield**

**Background**

It is understood the proposed development at the above-mentioned site will comprise of a number of low-rise residential houses, car parking, private gardens and areas of soft landscaping.

A number of site investigation reports have previously been prepared for the site on behalf of the Client by Earth Environmental and Geotechnical, summarised below, and should be read in conjunction with this letter report.

- Earth Environmental & Geotechnical Ltd Coal Mining Risk Assessment (Reference: A0697/G/1, December 2014)
- Earth Environmental & Geotechnical Ltd Phase I GeoEnvironmental Desk Study (Reference: A0697/17, November 2017)
- Earth Environmental & Geotechnical Ltd Phase II GeoEnvironmental Site Investigation Report (Reference: A0697/19, October 2019)

Based on the ground gas data collected, Earth Environmental and Geotechnical classified the site as Characteristic Situation CS-1 in accordance with BS8485, "Code of practice for the characterisation and remediation of ground gas in affected developments".

Full results of the Earth Environmental and Geotechnical gas monitoring data is included in Appendix A.

Exploratory hole logs are presented in Appendix B.

This letter report reviews the available site investigation data and assesses the risks (if any) from permanent gas pathways to the proposed development, with the aim of further assessing the requirement for ground gas measures as previously recommended.

This report refers to Plot 1 only.

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**Figure 1: Sampling Location Plan**



**Notes for Figure 1:**

Plot 1 marked as area within **Blue** site boundary.

**Site Setting**

The site is located northeast of Laund Road at postcode HD3 3TY, approximately 4km northwest of Huddersfield City centre, and approximately 900m east of Junction 23 of the M62 motorway. The site is roughly L-shaped with maximum approximate dimensions of 70m northwest-southeast by 30m northeast-southwest, occupying an area of 0.25ha. The National Grid Reference for the centre of the site is SE103182 (410379, 418266).

The site is currently occupied by a recently built stone-built bungalow, 120 Laund Road, in the northwest of the site, which is set back from Laund Road, and a recently constructed two-storey four-bedroom house. The site is accessed from Laund Road via an unnamed road/track which is surfaced with tarmacadam.

**Fieldwork**

A site visit was conducted on the 10<sup>th</sup> December 2019, two ground gas monitoring wells were installed on-site in the vicinity of Plot 1 (WS301-WS302). An Ambisense continuous monitor was installed in WS302 to allow for continuous monitoring over a four-week period.

Within one of the wells installed on Plot 1(WS301), an engineer recorded gas concentrations and flow rates over the duration of one working day, at ten-minute intervals.

## Geology

The BGS mapping for the area indicates the site to be directly underlain by solid geology of Carboniferous strata of the Lower Coal Measures, comprising mudstones, sandstones (Soft Bed Flags) and coal seams. Superficial deposits are not shown to be present on the site. The BGS interactive map viewer highlights the site as being in close proximity to a Development High Risk Area.

Earth Environmental and Geotechnical site investigations encountered the following sequence of strata:

- **Topsoil** – encountered in WS101, WS103, WS301, WS302, WS403 RO1 and RO2 to depths of between 0.20m and 0.80m bgl and described as:
  - Grass over brown sandy, gravelly CLAY with roots and gravel of sandstone, mudstone and rare brick and tile inclusions.
- **Made Ground** – encountered at the surface all other exploratory holes to depths of between 0.10m and 2.00m and typically described as:
  - Soft greyish brown, sandy, gravelly CLAY with gravel and cobble sized inclusions of concrete, brick, mudstone, sandstone, coal, clinker, glass, tile, plastic and general miscellaneous fly-tipped waste in variable proportions. Or;
  - Dark brownish black, clayey, gravelly SAND with inclusions as above.
- **Possible Relict Topsoil** – encountered beneath the Made Ground in TP4-TP6 as a 0.40m-0.50m thick horizon of soft brown silty/sandy, slightly gravelly CLAY with roots.
- **Pennine Lower Coal Measures Formation (PLCM)** – encountered beneath the Topsoil or Made Ground in all locations as:
  - Soft to firm greyish brown or orangish brown mottled grey, sandy, gravelly CLAY (destructured/completely weathered).
  - Weakly bedded dark grey mottled orange weathered MUDSTONE recovered as weak shaley gravel with clayey matrix.
  - Yellow, thinly bedded SANDSTONE recovered as silty, sandy gravel.
  - Dull black COAL.
- **Suspected Backfill Material** – encountered in the northwestern part of the site only (TP14, TP15 and WS7) beneath the natural strata at minimum and maximum depths of 1.00m and 2.60m bgl, and described as:
  - Loose, wet, dark grey very clayey/silty fine to coarse, subangular GRAVEL of mudstone.

## Monitoring Installations

Ground gas installations were emplaced in both WS301 and WS302.

Table 1 below provides a summary of the installations at both locations.

**Table 1: Summary of Gas Installations**

Location	Response Zone (m)	Material Encountered	Water level (m)
WS301	1.00-2.00	Soft clay and sandstone	
WS302	1.00-2.00	Soft clay and sandstone/mudstone	0.78-1.34

## Potential Sources of Ground Gas

The desk study highlighted that the site was first developed with a small structure in the early 1900s, which had been demolished and replaced by a larger (residential) structure in the northwest of the site by 1918, followed by the addition of several other small structures in subsequent years.

Potential sources of Ground Gas include Made Ground deposits and coal bearing strata at considerable depth. The site is at risk from shallow coal mine workings, a Coal Authority Mine Mining Report states that coal may have been mined at shallow (<30m) depth beneath the site, although there are no records for this. Also, during the phase II site investigation intact coal and loose wet deposits which associated with bell pit mining were encountered. There are no shafts on or near to the site on historical mapping, however, excavations are shown in an adjacent field to the north of the site on the mapping dated 1894, which may possibly be coal related.

## Summary of Ground Gas Monitoring Data

Table 2 below summarises the maximum concentrations of carbon dioxide and methane, together with the maximum flow rate and maximum Gas Screening Value (GSV) for the site investigation.

**Table 2: Summary of Continuous Ambient Ground Gas Monitoring Data (WS302)**

Max. Steady CO2 Concentration (% v/v)	Max. Steady CH4 Concentration (% v/v)	Max. Steady Flow Rate (l/hr)	Calculated CO2 GSV (l/hr)	Calculated CH4 GSV (l/hr)	CIRIA 149 Characteristic Situation (CS)
2.49	0.14	0.64	0.015	0.0008	CS-1

**Notes for Table 2:**

Values in red exceed CS-1 criteria based Modified Wilson & Card Classification (CIRIA Report 665)

**Table 3: Summary of Engineer Continuous Monitoring Data (WS301)**

Max. Steady CO2 Concentration (% v/v)	Max. Steady CH4 Concentration (% v/v)	Max. Steady Flow Rate (l/hr)	Calculated CO2 GSV (l/hr)	Calculated CH4 GSV (l/hr)	CIRIA 149 Characteristic Situation (CS)
6.2	0.5	0.7	0.043	0.000	CS-1

**Notes for Table 3:**

Values in red exceed CS-1 criteria based Modified Wilson & Card Classification (CIRIA Report 665)

The above results suggest the site can be given, a Characteristic Situation-1 (CS-1), i.e. 'very low risk' classification, in accordance with Table 3 shown overleaf.

**Table 4: Modified Ground Gas Classification Table (Risk and Reliability in Gas Protection Design, 2019)**

Characteristic Situation	Pathway vertical permeability $y$ (m/s)	GSV CH <sub>4</sub> (l/hr)	GSV CO <sub>2</sub> (l/h)	GSV oxygen deficient gas (Nitrogen) (l/h)	Maximum borehole gauge pressure (Pa)	Limiting sustained gas concentrations in unsaturated zone within 10m of surface	Limitations	Risk level
CS-1	$\leq 1 \times 10^{-7}$	$< 2$	$< 11.9$	$< 217$ for all permeability (care when using this value. Usually oxygen deficient gas emissions are sporadic and monitoring should cover suitable situations)	500 (50mm water) – ASTM (2016)	$< 30\%$ methane $< 21\%$ carbon dioxide	No nearby Municipal Solid Waste landfills or other credible source of gas. No pathway for migration to the site being considered. No potential high-volume gas reservoirs in ground.	Negligible to very low
	$1 \times 10^{-7} < k < 1 \times 10^{-5}$	$< 1.5$	$< 9.0$			No limit on oxygen depletion because it is widespread in natural		
	$\geq 1 \times 10^{-5}$	$< 7.2$	$< 7.2$					
CS-2	$\leq 1 \times 10^{-7}$	$\leq 35.6$	$< 248.8$	$< 390$		$< 30\%$ methane		
	$1 \times 10^{-7} < k < 1 \times 10^{-5}$	$\leq 21.7$	$< 152.0$	$< 296$	No limit	$< 30\%$ carbon dioxide	Where oxygen deficient ground gas or carbon dioxide is likely to be emitted from shaft, fractured rock or ground where $k > 1 \times 20^{-4}$ m/s assume CS3 for Type A and B development and CS2 for Type C and D development (or alternatively undertake DQRA)	Low to moderate
	$\geq 1 \times 10^{-5}$	$\leq 18.2$	$< 127.0$	$< 238$		$< 90\%$ combined methane and carbon dioxide		
CS-3	$\leq 1 \times 10^{-7}$	$\leq 85.3$		No limiting values (site specific check required that gas emission can be managed by protection measures)	No limit	No limit		Moderate to high
	$1 \times 10^{-7} < k < 1 \times 10^{-5}$	$\leq 52.1$						
	$\geq 1 \times 10^{-5}$	$\leq 43.6$						
CS-4		$< 100$ m <sup>3</sup> /h total LFG generation rate	N/A	N/A			Sites that are domestic/commercial landfill sites where gas generation is still managed by extraction systems such as calorific flaring	Very high

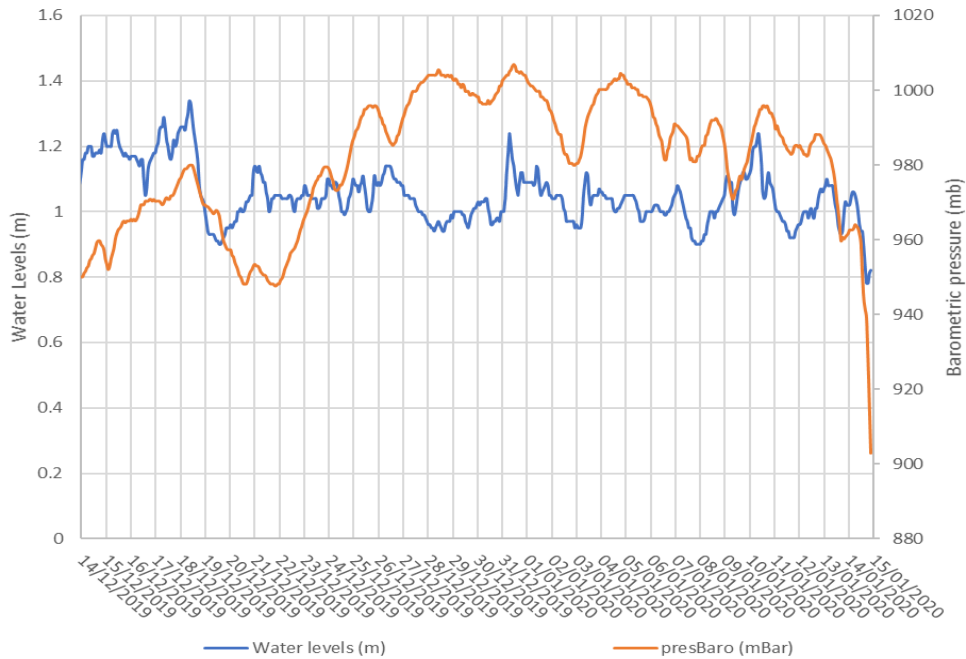
## Data Assessment

Figure 2 below presents an assessment of the relationship between barometric pressure and water levels. The figure shows that as barometric pressure increases water levels decrease.

The water levels in WS302 fluctuated between 0.78m and 1.18m below ground level.

Barometric pressure fluctuated between 902mb and 1006mb over the same monitoring period.

**Figure 2: Water Level to Barometric Pressure Ratio Plot**



**Figure 3: Flow Rate to Barometric Pressure Ratio Plot**

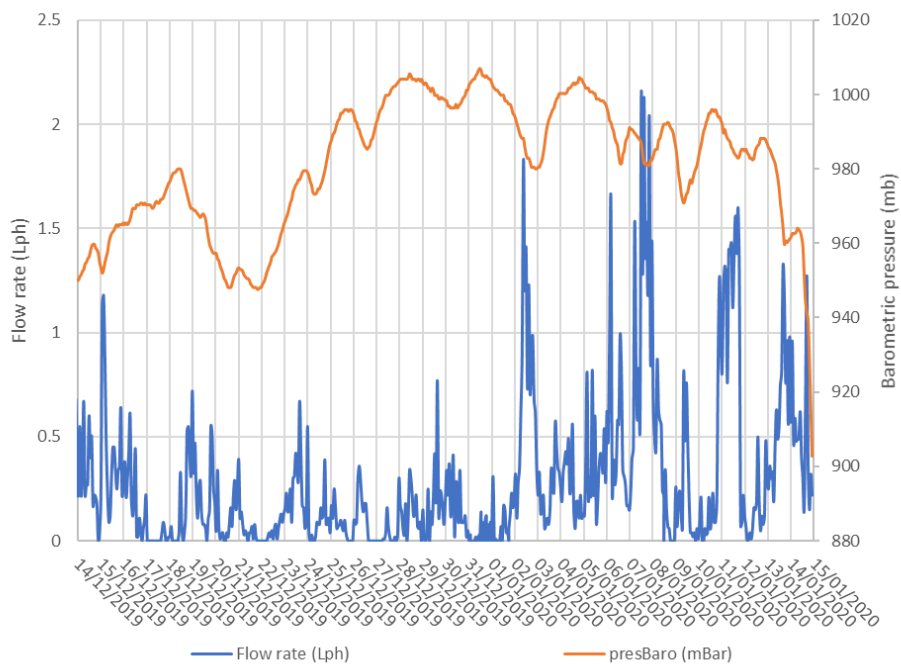


Figure 3 above presents an assessment of the relationship between barometric pressure and average flow rate. The figure shows that barometric pressure has no effect on flow rates. The water levels in WS302 fluctuated between 0.0 and 2.15 litres/hour. Barometric pressure fluctuated between 902mb and 1006mb over the same monitoring period.

**Figure 4: Carbon Dioxide to Barometric Pressure Ratio Plot**

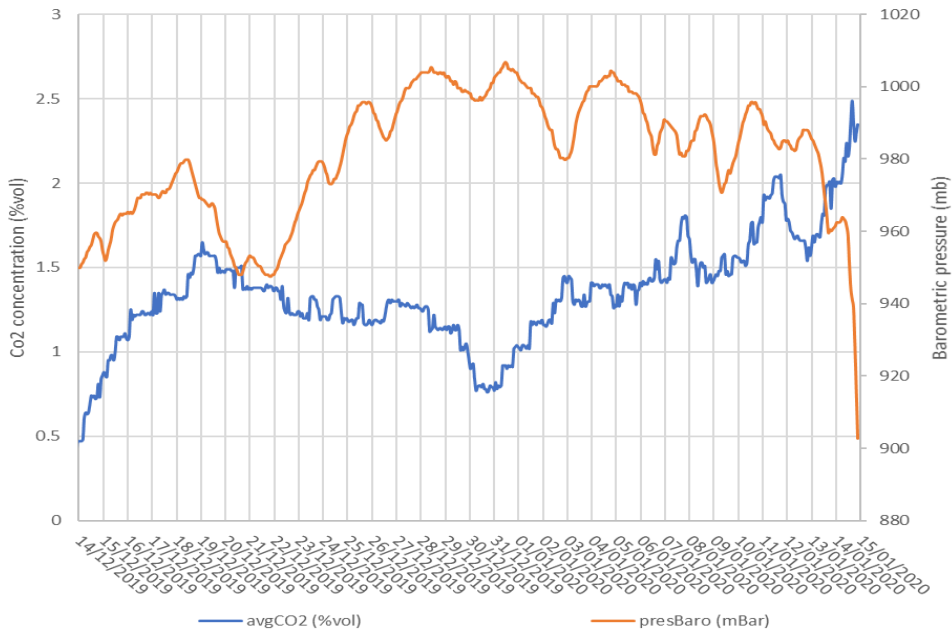


Figure 4 above presents an assessment of the relationship between barometric pressure and average carbon dioxide values. The figure shows that as barometric pressure increases average carbon dioxide levels decrease. The carbon dioxide levels in WS302 fluctuated between 0.34 and 2.49%. Barometric pressure fluctuated between 902mb and 1006mb over the same monitoring period.

**Figure 5 Methane to Barometric Pressure Ratio Plot**

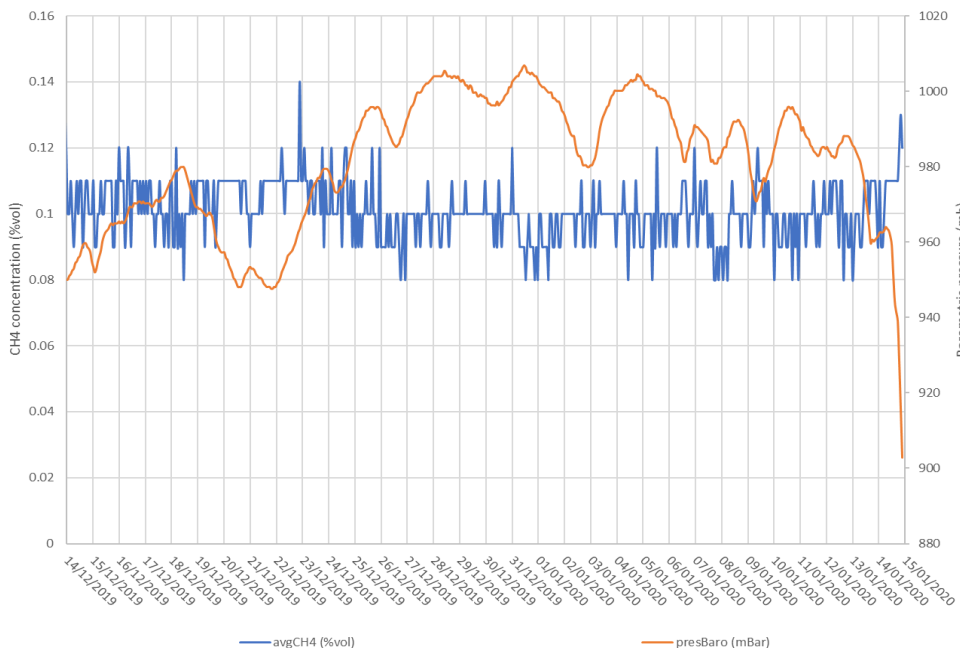


Figure 5 above presents an assessment of the relationship between barometric pressure and average methane values. The figure shows that as barometric pressure increases average methane levels decrease. The methane levels in WS302 fluctuated between 0.08 and 0.14%.

Barometric pressure fluctuated between 902mb and 1006mb over the same monitoring period.

**Figure 6 Carbon Dioxide and Oxygen change over one working day**

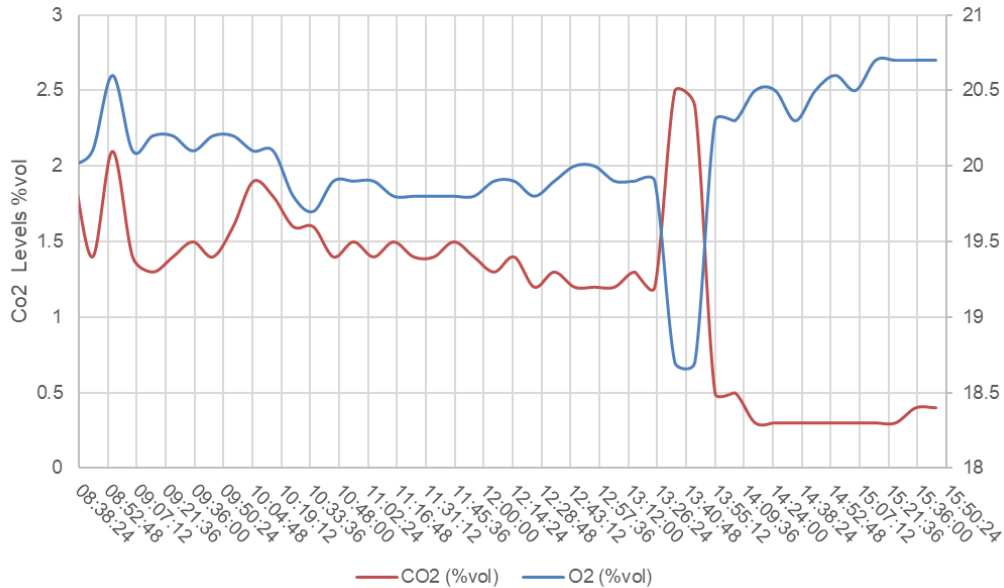


Figure 6 above presents the results of the intensive monitoring carried out by an EEG engineer at WS301 in Plot 1 on the 7<sup>th</sup> of January 2020. Carbon dioxide levels remained constant, no methane, carbon monoxide or hydrogen sulphide were recorded over the monitoring period.

### Conclusions

A review of the site history indicated potential sources of ground gas to be include Made Ground deposits and coal bearing strata at considerable depth.

However, over the duration of the intensive monitoring period undertaken by an EEG engineer, carbon dioxide recharge was found to be low. Low flow rates also encountered in both wells ranging from -0.1 to 2.5 litres per hour over the monitoring period further reduce the risk of potentially harmful gases encountered.

Intensive gas monitoring data identified no ground gas concentrations in monitoring wells within Plot 1 being above a guideline value of 5%.

## Recommendations

The concentrations of methane and carbon dioxide at the site are therefore considered to pose a very low risk to the proposed development. The site has been given a classification of CS-1, and gas protection measures will not be required.

Yours sincerely,

*A Czarnecki*

**Adam Czarnecki**

**Director**

**For and on behalf of Earth Environmental & Geotechnical Ltd**

Appendix A Gas Monitoring Data

Appendix B Borehole Logs

**APPENDIX A**

**EARTH ENVIRONMENTAL  
GAS MONITORING DATA (2019)**

## **APPENDIX B**

### **BOREHOLE LOGS**