

By Email

Our ref: 25-446

7 St James Square,
Manchester,
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Manchester

5th January 2026



Arc Environmental Ltd
Solum House
Unit 1 Elliott Court
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DH7 8PN

Re: Ground Investigation Report, Queens Drive, Kirkhale, Rochdale, OL11 2NP

This letter report is an addendum to the Phase 2 Ground Investigation Report (Project No. 25-446, December 2025) undertaken for the proposed development at the above location.

Please find enclosed:

- ARC Environmental Ground Gas & Groundwater Monitoring Certificate

Combined groundwater and gas monitoring standpipes were installed in WS01, WS03 & WS07 to check for possible hazardous ground gas generation and migration as well as to monitor any shallow groundwater levels. A standard 50mm diameter HDPE standpipe, with gravel and geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed within each borehole to the base of the boreholes, and ground gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit.

Monitoring to date has been undertaken using a Gas Data GFM 435 soil gas analyser, with integral flow meter, and a Geotechnical Instruments electronic dip-meter. The response zones were designed to target potential made ground gas generation from both on and off site sources (particularly any potential deeper made ground) and possible migration through the made ground to this site.

Based on the findings of the intrusive investigation works, in accordance with CIRIA Report C665, November 2007, Report Edition No. 04, March 2007 and BS8485:2015+A1:2019 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The development has been considered as medium and high sensitivity i.e., residential (after 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 (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).
- Negligible flow rates are recorded during the monitoring period (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased programme of gas monitoring has been completed, which has obtained 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).

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Re: Ground Investigation Report, Queens Drive, Kirkhale, Rochdale, OL11 2NP (Cont'd):

A summary of the results for the visit undertaken, compared with the 'inert' background gas levels are presented in Table 1 below, with a copy of the monitoring certificate attached.

Table 1

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH ₄ (%v/v)	LEL (%v/v)	CO ₂ (%v/v)	CO (ppm)	O ₂ (%v/v)	Flow Rate (l/hr)
Background		~	~	0	0	0	0	21.0	<0.1
WS01	05/11/2025	987 (Falling)*	1.02	0.0	0.0	0.1	0.0	20.2	<0.1
WS03			0.95	0.0	0.0	9.5	0.0	13.8	<0.1
WS07			1.77	0.0	0.0	4.2	0.0	11.1	<0.1
WS01	11/11/2025	1011 (Rising)*	0.93	0.0	0.0	0.1	0.0	19.9	<0.1
WS03			0.80	0.0	0.0	6.8	0.0	16.5	<0.1
WS07			1.76	0.0	0.0	3.1	0.0	15.2	<0.1
WS01	18/11/2025	996 (Falling)*	0.87	0.0	0.0	0.1	0.0	19.6	<0.1
WS03			0.60	0.0	0.0	5.6	0.0	18.7	<0.1
WS07			1.73	0.0	0.0	1.4	0.0	18.1	<0.1
WS01	03/12/2025	988 (Rising)*	0.95	0.0	0.0	0.4	0.0	19.9	<0.1
WS03			0.78	0.0	0.0	1.9	0.0	19.4	<0.1
WS07			1.75	0.0	0.0	13.3	0.0	13.3	<0.1
WS01	21/01/2026	971-972 (Rising)*	0.97	0.0	0.0	0.1	0.0	19.9	<0.1
WS03			0.78	0.0	0.0	3.7	0.0	18.0	<0.1
WS07			1.68	0.0	0.0	1.3	0.0	16.2	<0.1
WS01	04/02/2025	976 (Falling)*	1.03	0.0	0.0	0.4	0.0	19.7	<0.1
WS03			0.98	0.0	0.0	1.5	0.0	16.5	<0.1
WS07			1.82	0.0	0.0	2.7	0.0	15.7	<0.1

* Note – Atmospheric trend taken from www.weatheronline.co.uk for Manchester.

From the results undertaken, no levels of Methane (CH₄) have been recorded during the monitoring period. However, detectable concentrations of Carbon Dioxide (CO₂) have been recorded, up to a maximum recorded level of 13.3% v/v, with associated Oxygen (O₂) concentrations (minimum 11.1% v/v). Negligible flow rates of <0.1l/hr have been recorded during the current monitoring period. Based on the results, in accordance with CIRIA Report C665, an initial risk assessment has been completed for this site, by converting the results in Table 1 to a gas screening value (GSV), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates (after Wilson & Card).

Using the maximum values recorded, as no increased levels of Methane have been recorded, the GSV for Carbon Dioxide only has been calculated, the results of which are shown below:

$$\text{Carbon Dioxide GSV} = 0.133 (13.3\%) \times 0.1 = 0.0133 \text{ l/hr}$$

When considering these results, in accordance with CIRIA C665, the GSV for CO₂ falls below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification, resulting in no gas protective measures being required. However, as the readings are greater than 5%, it is recommended that the classification be increased by an order of 1 to Characteristic Situation 2 (CS2) meaning gas protective measures are required within the new development.

The results of the groundwater monitoring indicate standing water levels of between c.0.60m and c.1.82m bgl which it is considered to be attributable to a shallow continuous groundwater surface (water table) below the site. As such, it would be considered prudent to allow for some appropriate temporary groundwater control measures to be present on site during future development and excavation works especially during the wetter periods of the year.

Re: Ground Investigation Report, Queens Drive, Kirkhalt, Rochdale, OL11 2NP (Cont'd):

The site is not considered to be at potential risk from Radon gas.

We trust the information we have provided to you is to your satisfaction. However, if you require any further information or clarification, please do not hesitate to contact us.

Yours sincerely,



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For and on behalf of Arc Environmental Ltd

Stephen Donald
Senior Geo-Environmental Engineer

Ground Gas & Groundwater Monitoring Certificate

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Site:	QUEENS DRIVE
Ref:	25-446

Visit	Date	Time	Equipment	Weather	Initials	Comments	Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	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)
										R/F/S	Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Hex %	PID Cf	PID (Isobutylene)	H ₂ S	CO	
1	05/11/2025	9.15am	GFM435	RAIN	PR		WS01	<0.1	987			0.0		0.0		0.1		20.2				0.0	0.0	1.02
							WS03	<0.1	987			0.0		0.0		9.5		13.8				0.0	1.0	0.95
							WS07	<0.1	987			0.0		0.0		4.2		11.1				0.0	0.0	1.77
2	11/11/2025	11:00am	GFM435	CLOUDY	SD		WS01	<0.1	1011			0.0		0.0		0.1		19.9				0.0	0.0	0.93
							WS03	<0.1	1011			0.0		0.0		6.8		16.5				0.0	0.0	0.8
							WS07	<0.1	1011			0.0		0.0		3.1		15.2				0.0	0.0	1.76
3	18/11/25	12.30pm	GFM435	CLEAR	PR		WS01	<0.1	996			0.0		0.0		0.1		19.6				0.0	0.0	0.87
							WS03	<0.1	996			0.0		0.0		5.6		18.7				0.0	0.0	0.6
							WS07	<0.1	996			0.0		0.0		1.4		18.1				0.0	0.0	1.73
4	03/12/2025	11.00am	GFM435	OVERCAST	PR	WS03 Bailed	WS01	<0.1	988			0.0		0.0		0.4		19.9				0.0	0.0	0.95
							WS03	<0.1	988			0.0		0.0		1.9		19.4				0.0	0.0	0.78
							WS07	<0.1	988			0.0		0.0		13.3		13.3				0.0	0.0	1.75
5	21/1/26	10.30am	GFM435	OVERCAST	PR	WS03 Bailed	WS01	<0.1	972			0.0		0.0		0.1		19.9				0.0	0.0	0.97
							WS03	<0.1	972			0.0		0.0		3.7		18.0				0.0	0.0	0.78
							WS07	<0.1	971			0.0		0.0		1.3		16.2				0.0	0.0	1.68
6	02/04/2026	111:00:00	GFM435	CLOUDY	PH		WS01	<0.1	976			0.0		0.0		0.4		19.7				0.0	0.0	1.03
							WS03	<0.1	976			0.0		0.0		1.5		16.5				0.0	0.0	0.98
							WS07	<0.1	976			0.0		0.0		2.7		15.7				0.0	0.0	1.82

Notes:
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)