Site Investigations
♣
Geologists
♣
Environmental &
Geotechnical
Engineers

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Date: 10th January 2025

GROUND GAS RISK ASSESSMENT

LUF2, Leconfield Industrial Estate, Cleator Moor
S240720/GAS

INTRODUCTION

Authorisation

The site investigation described in this report was carried out by Solmek to the instructions of Morgan Sindall, on land located at Leconfield Industrial Estate, Cleator Moor.

- *AECOM Geotechnical & Structural Design Report (60520781) December 2016*
- *WYG Phase 1 Desk Study (A114312) January 2020*
- *WYG Phase 2 Site Investigation (A114312-1) November 2020*
- *Solmek Phase 2 Site Investigation (S220141) May 2022*
- *Solmek Phase 2 Site Investigation (S230810) October 2023*
- *Solmek Phase 1 Desk Study (S230713) October 2024*
- *Solmek Phase 2 Site Investigation (S240720)*

Reference should be made to the above reports for details of the site's history, environmental/contamination setting and expected underlying geological conditions.

Scope of Works

The site is expected to be developed with new commercial units. The site is shown as Figure 1.

The information provided in this Ground Gas Assessment is based on the investigation fieldwork and is subject to the comments and approval of the various Regulatory Authorities. There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.

GROUND GAS ASSESSMENT

Ground gases such as carbon dioxide (CO_2) and methane (CH_4) can be classed as a form of contamination where there is a potential risk to human health. As a result, gas monitoring has been undertaken. Six visits have been carried out between September and December 2024 to assess the potential risks posed by ground gases.

The gas was monitored by measuring emissions from monitoring points installed into RBH01 to RBH06 during the fieldwork. Figure 2, appended to this letter report, shows the borehole locations.

The monitoring was generally carried out in accordance with current guidance provided within CIRIA C665:2007. The results are attached to this letter report.

Ground Gas Results

The atmospheric pressure has an impact on the concentrations of gas released. The atmospheric pressure was between 980 and 1027 millibars during the surveys. Times of both rising and falling atmospheric pressure regional trends were noted during each survey. This is considered to be a good range of conditions for the time of year and "worst case" conditions (falling pressure <1000mb) have been captured.

The gas levels recorded during the six visits are summarised below in Table 1 and are presented in full in the appendices of this report.

Methane was not detected in any of the boreholes during the survey and no flow rates were recorded. A flow rate of 0.1l/hr has therefore been assumed in order to calculate Gas Screening Values (GSV).

TABLE 1: SUMMARY OF GAS DATA

Borehole	Response Zone (m)	Response Zone Strata	Flow Range (l/hr)	CH_4 Range (%v/v)	CO_2 Range (%v/v)	O_2 Range (%v/v)	GW Range (mbgl)
RBH01	3.00-12.00	CLAY/SAND	0.1	0	0.8 – 1.6	0.0 – 8.3	8.30 – 8.88
RBH02	0.50-3.50	MADE GROUND	0.1	0	0.0 – 0.1	6.7 – 20.9	2.16 – Dry
RBH03	0.50-3.00	MADE GROUND	0.1	0	0.0 – 0.1	9.5 – 17.1	2.41 – Dry
RBH04	1.00-9.00	MADE GROUND	0.1	0	0.0 – 0.1	10.3 – 20.4	5.01 – 5.46
RBH05	3.50-6.50	CLAY	0.1	0	0.0 – 0.3	18.6 – 20.4	2.48 – 3.01
RBH06	7.00-10.00	SANDSTONE/MUDSTONE	0.1	0	0.0 – 0.2	9.2 – 20.0	4.02 – 6.20

Monitoring for vapours (with PID), hydrogen sulphide and carbon monoxide all returned results of 0ppm.

Ground Gas Analysis

The results obtained have been compared with relevant guidance that includes the following:

- BRE/Environment Agency BR414 (2001) – Protective Measures for Housing on Gas-Contaminated Land
- Wilson & Card (1999) – Reliability and Risk in Gas Protection Design
- CIRIA 149 (1995) – Protecting Development from Methane
- CIRIA C665 (2007) – Assessing Risks Posed by Hazardous Ground Gases to Buildings.
- BS8485 (2015) + A1 (2019) – Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings

The Building Regulations set action levels for both methane and carbon dioxide from which an initial assessment can be made. The action threshold for methane is 1% while for carbon dioxide an initial consideration should be undertaken if gas concentrations exceed 1.5%. Action might be required if carbon dioxide concentrations exceed 5%. If these thresholds are exceeded, reference should be made to specific documentation to determine the nature and extent of the gas control measures required.

A Characteristic Situation ranking of between 1 and 6 is given based on the ground gas monitoring results coupled with the gas flow rate. These combined produces a Gas Screening Value (GSV). Where no flow is recorded a flow rate of 0.1l/hr is assumed. The GSV and risk classification define the characteristic situation, which are comparable to the table below, taken from CIRIA C665, and derived from CIRIA R149. Given that the site will be covered by hardstanding and the building will be for commercial use, the protection measures required are based on CIRIA R149, shown in Table 1 below.

CIRIA R149 GAS REGIMES

Characteristic Situation (CS)	Risk Classification	Gas Screening Value CH4 or CO2 (l/hr)	Additional Factors
1	Very Low Risk	<0.07	*CS1 where CH_4 is <1% and/or CO_2 is <5%, Otherwise increase to CS2*
2	Low Risk	<0.7	
3	Moderate Risk	<3.5	
4	Moderate to High Risk	<15	
5	High Risk	<70	
6	Very High Risk	>70	

During all visits, methane and carbon dioxide levels remained below the relevant action level.

Localised oxygen depletion was noted within RBH01 and RBH02, which had response zones within the made ground. Oxygen depletion can be related to underground mining, however given that the oxygen depletion was limited to the made ground, with no depletion noted within either the drift deposits or solid geology, this is considered to be highly unlikely. Furthermore, given the absence of any flow, there is no mechanism for the oxygen-deficient air to leave the ground/enter buildings and hence it is not considered to pose a significant risk.

The worst case GSV can be taken from the highest flow rate recorded over the visits (0.1l/hr) along with the greatest volume of CO_2 (0.8%). Based on these figures the worst GSV has been calculated as 0.0016(l/hr). The gas screening values from the monitoring visits would place the site in **Characteristic Situation (CS) 1.**

A series of tables adapted from **BS:8485** are attached to the rear of this letter.

The type of building and gas protection level generate a minimum gas protection points score, in this case a commercial/industrial building (Type C/D) combined with CS1 has a score of **0 points**. Given the ground gas levels and associated score, **no ground gas protection measures are considered necessary**.

The site is in a Higher Probability Radon Affected Area, as 10 to 30% of properties are above the Action Level. In accordance with the procedure described in BRE Publication BR211 Radon: Guidance on Protective Measures for New Dwellings, full radon protection measures are necessary for new buildings or extensions on the site.

Yours sincerely,

Leo Cassidy

Principal Environmental Engineer
On behalf of Solmek Ltd.

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Figure Title

Site Location Plan

Project Number

S240720

Project Name

Plots 9 & 12 Leconfield Ind Est, Cleator Moor, Cumbria

Client

Morgan Sindall

Date

September 2024

DRG Number

Figure 1

Scale

1:5000 @ A4 [DO NOT SCALE]

Legend Key

Project Bounds - Project Bounds

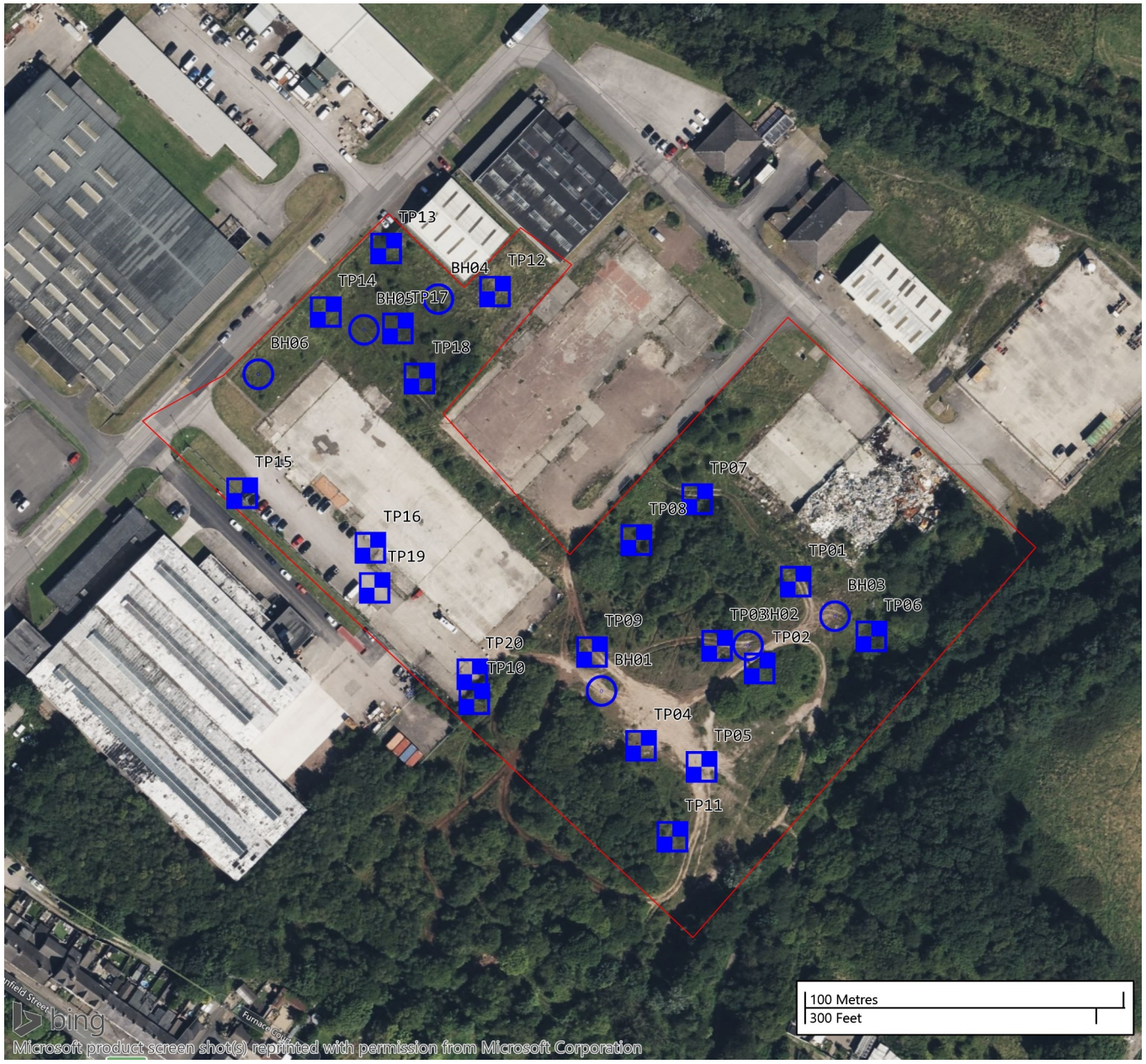

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Figure Title

Exploratory Hole Location Plan

Project Number

S240720

Project Name

Plots 9 & 12 Leconfield Ind Est, Cleator Moor, Cumbria

Client

Morgan Sindall

Date

September 2024

DRG Number

Figure 2

Scale

1:2000 @ A4 [DO NOT SCALE]

Legend Key

- Locations By Type - RO
- Locations By Type - TP
- Project Bounds - Project Bounds

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	1
Date	25/09/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Sunny
Ground Conditions	Wet
Ambient Atmospheric Pressure	986
Regional Pressure Trend	Falling

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	986	0.0	0.0	0.0000	0.8	0.7	0.0008	0.0	0.1	0.0	0.0	0.0	8.32	12.00	
RBH02	0.1	986	0.0	0.0	0.0000	0.0	0.0	0.0000	20.9	20.9	0.0	0.0	0.0	Dry	3.50	
RBH03	0.1	986	0.0	0.0	0.0000	0.0	0.0	0.0000	17.1	17.3	0.0	0.0	0.0	2.86	3.00	
RBH04	0.1	986	0.0	0.0	0.0000	0.0	0.0	0.0000	10.3	15.4	0.0	0.0	0.0	5.30	9.00	
RBH05	0.1	986	0.0	0.0	0.0000	0.0	0.0	0.0000	19.9	20.0	0.0	0.0	0.0	2.96	6.50	
RBH06	0.1	986	0.0	0.0	0.0000	0.0	0.0	0.0000	15.5	15.6	0.0	0.0	0.0	6.20	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	2
Date	09/10/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Cloudy
Ground Conditions	Wet
Ambient Atmospheric Pressure	980
Regional Pressure Trend	Falling

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	980	0.0	0.0	0.0000	0.9	0.7	0.0009	8.3	8.4	0.0	0.0	0.00	8.30	12.00	
RBH02	0.1	980	0.0	0.0	0.0000	0.0	0.0	0.0000	8.6	8.6	0.0	0.0	0.00	2.30	3.50	
RBH03	0.1	980	0.0	0.0	0.0000	0.1	0.0	0.0001	10.9	10.9	0.0	0.0	0.00	2.70	3.00	
RBH04	0.1	980	0.0	0.0	0.0000	0.0	0.0	0.0000	11.0	12.5	0.0	0.0	0.00	5.46	9.00	
RBH05	0.1	980	0.0	0.0	0.0000	0.0	0.0	0.0000	19.2	19.3	0.0	0.0	0.00	3.01	6.50	
RBH06	0.1	980	0.0	0.0	0.0000	0.1	0.0	0.0001	14.2	14.4	0.0	0.0	0.00	6.16	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	3
Date	23/10/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Cloudy
Ground Conditions	Wet
Ambient Atmospheric Pressure	1014
Regional Pressure Trend	Falling

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	1014	0.0	0.0	0.0000	1.6	1.6	0.0016	0.0	0.0	0.0	0.0	0.00	8.68	12.00	
RBH02	0.1	1014	0.0	0.0	0.0000	0.1	0.0	0.0001	7.3	7.4	0.0	0.0	0.00	2.16	3.50	
RBH03	0.1	1014	0.0	0.0	0.0000	0.0	0.0	0.0000	9.5	9.8	0.0	0.0	0.00	Dry	3.00	
RBH04	0.1	1014	0.0	0.0	0.0000	0.1	0.0	0.0001	20.4	20.5	0.0	0.0	0.00	5.21	9.00	
RBH05	0.1	1014	0.0	0.0	0.0000	0.1	0.0	0.0001	20.4	20.5	0.0	0.0	0.00	2.80	6.50	
RBH06	0.1	1014	0.0	0.0	0.0000	0.0	0.0	0.0000	9.2	10.0	0.0	0.0	0.00	6.20	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	4
Date	06/11/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Wet
Ground Conditions	Wet
Ambient Atmospheric Pressure	1018
Regional Pressure Trend	Rising

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	1018	0.0	0.0	0.0000	1.4	1.3	0.0014	0.5	0.5	0.0	0.0	0.0	8.42	12.00	
RBH02	0.1	1018	0.0	0.0	0.0000	0.1	0.0	0.0001	6.7	6.9	0.0	0.0	0.0	2.18	3.50	
RBH03	0.1	1018	0.0	0.0	0.0000	0.0	0.0	0.0000	10.4	10.6	0.0	0.0	0.0	2.50	3.00	
RBH04	0.1	1018	0.0	0.0	0.0000	0.0	0.0	0.0000	14.0	14.3	0.0	0.0	0.0	5.26	9.00	
RBH05	0.1	1018	0.0	0.0	0.0000	0.0	0.0	0.0000	19.4	19.7	0.0	0.0	0.0	2.89	6.50	
RBH06	0.1	1018	0.0	0.0	0.0000	0.2	0.2	0.0002	19.2	19.3	0.0	0.0	0.0	5.63	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	5
Date	10/12/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Sunny
Ground Conditions	Wet
Ambient Atmospheric Pressure	1027
Regional Pressure Trend	Steady

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	1027	0.0	0.0	0.0000	1.4	1.3	0.0014	0.0	0.0	0.0	0.0	0.0	8.88	12.00	
RBH02	0.1	1027	0.0	0.0	0.0000	0.0	0.0	0.0000	7.1	7.1	0.0	0.0	0.0	3.45	3.50	
RBH03	0.1	1027	0.0	0.0	0.0000	0.0	0.0	0.0000	13.9	14.2	0.0	0.0	0.0	2.5	3.00	
RBH04	0.1	1027	0.0	0.0	0.0000	0.0	0.0	0.0000	15.2	15.3	0.0	0.0	0.0	5.2	9.00	
RBH05	0.1	1027	0.0	0.0	0.0000	0.0	0.0	0.0000	18.9	19.1	0.0	0.0	0.0	2.48	6.50	
RBH06	0.1	1027	0.0	0.0	0.0000	0.0	0.0	0.0000	19.9	19.9	0.0	0.0	0.0	5.5	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

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GAS MONITORING RESULTS

Project number	S240720
Project name	Leconfield Ind Est, Cleator Moor
Client	Morgan Sindall
Visit no	6
Date	20/12/2024
Equipment	GFM 435 Gas Analyser
Operator	LO

Weather Conditions	Wet
Ground Conditions	Wet
Ambient Atmospheric Pressure	997
Regional Pressure Trend	Rising

Position	Flow (l/hr)	Pressure	CH4			CO2			O2		PID (ppm)	CO (ppm)	H2S (ppm)	Groundwater Level (mbgl)	Depth to Base (mbgl)	Notes
			Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)	GSV (l/hr)	Peak (% v/v)	Steady (% v/v)						
RBH01	0.1	997	0.0	0.0	0.0000	1.3	1.3	0.0013	0.4	0.5	0.0	0.0	0.0	8.41	12.00	
RBH02	0.1	997	0.0	0.0	0.0000	0.0	0.0	0.0000	7.4	7.4	0.0	0.0	0.0	3.44	3.50	
RBH03	0.1	997	0.0	0.0	0.0000	0.0	0.0	0.0000	14.1	14.2	0.0	0.0	0.0	2.41	3.00	
RBH04	0.1	997	0.0	0.0	0.0000	0.0	0.0	0.0000	17.3	17.6	0.0	0.0	0.0	5.01	9.00	
RBH05	0.1	997	0.0	0.0	0.0000	0.3	0.2	0.0003	18.6	18.8	0.0	0.0	0.0	2.84	6.50	
RBH06	0.1	997	0.0	0.0	0.0000	0.0	0.0	0.0000	20.0	20.3	0.0	0.0	0.0	4.02	10.00	

KEY

CH_4 = Methane, **CO_2** = Carbon Dioxide, **O_2** = Oxygen, **CO** = Carbon Monoxide, **H_2S** = Hydrogen Sulphide, **GSV** = Gas Screening Value (If no flow is recorded a value of 0.1 is assumed), ND = Not Detected, * = not measured, N/A = Not applicable, % = % by volume, mbgl = m below ground level, ppm = parts per million.

GAS PROTECTION REQUIREMENTS IN LINE WITH BS8485:2015 + A1:2019

Characteristic Situation	Minimum gas protection score (points)			
	High Risk	Medium Risk		Low Risk
	Type A (Private)	Type B (Private or commercial /public)	Type C (Commercial /public)	Type D (Commercial /industrial)
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5 A)	5.5 A)	4.5	3.5
5	B)	6.0 A)	5.5	4.5
6	B)	B)	B)	6.0

A) Residential should not be built on CS4 or higher without additional levels of protection
B) The gas hazard is too high for this empirical method used to define gas protection measures

Adapted from Table 4 of BS:8485:2015 +A1:2019

Element	Score
Floor and Substructure Design	
Precast suspended segmental subfloor (i.e. Beam and block)	0
Cast in situ ground bearing floor slab (with only minimum mesh reinforcement)	0.5
Cast in situ monolithic reinforced ground bearing raft or suspended floor slab with minimal penetrations	1 or 1.5
Basement floor and walls conforming to BS8102:2009 Grade 2 C) + D)	2
Basement floor and walls conforming to BS8102:2009 Grade 3 C) + D)	2.5
Venting Design	
Pressure relief pathway	0.5
Passive sub floor dispersal layer	1.5 or 2.5
Active dispersal layer	1.5-2.5
Active positive pressurization	1.5-2.5
Ventilated car park	4
Gas Membrane	
Gas membrane meeting requirements	2

Adapted from Tables 5, 6 and 7 of BS:8485:2015 +A1:2019

SOLMEK NOTES ON CONTAMINATION GUIDANCE (REF: VERSION 1/2024)

UK BACKGROUND

Environmental Protection Act 1990: Part 2A Revised Statutory Guidance (April 2012)

This revised document explains how the Local Authority should decide if land, based on a legal interpretation, is contaminated. The document replaces the previous guidance given in Annex 3 of DEFRA Circular 01/2006, issued in accordance with section 78YA of the 1990 Environmental Protection Act.

The main objectives of the Part 2A regime are to *"identify and remove unacceptable risks to human health and the environment" and* to *"seek to ensure that contaminated land is made suitable for its current use".*

Part 2A uses a risk based approach to defining contaminated land whereby the "risk" is interpreted as *"the likelihood that harm, or pollution of water, will occur as a result of contaminants in, on or under the land"* and by *"the scale and seriousness of such harm or pollution if it did occur".*

For a relevant risk to exist a contaminant, pathway and receptor linkage must be present before the land can be considered to be contaminated. The document explains that *"for a risk to exist there must be contaminants present in, on or under the land in a form and quantity that poses a hazard, and one or more pathways by which they might significantly harm people, the environment, or property; or significantly pollute controlled waters."*

A conceptual model is used to develop and communicate the risks associated with a particular site.

To determine if land is contaminated the local authority use various categories from 1 to 4. Categories 1 and 2 include *"land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health."*

Categories 3 and 4 *"encompass land which is not capable of being determined on such grounds".*

PRELIMINARY CONCEPTUAL MODEL

Preliminary Conceptual Models are undertaken in accordance with CIRIA C552. The Preliminary Conceptual Model assesses the consequence and the likelihood of a risk being realised to provide a risk classification, using the tables detailed below.

CONSEQUENCE OF RISK BEING REALISED (Based on C552 CIRIA, 2001)

Classification	Definition	Example
Severe	Short-term (acute) risk to human health, the environment, an element of the development or other aspect with is likely to result in *significant harm*, damage or both.	High concentrations of cyanide on the surface of an informal recreational area. Major spills of contaminants from site into controlled water. High concentrations of explosive gas in the subsurface environment that have a clear unobstructed pathway into buildings.
Moderate	Chronic damage to human health, a plausible chance that an event will occur, although the timeline is not immediate to be in the short-term.	Appreciable concentration of contamination that over the longer-term will cause significant harm i.e. high lead concentration in topsoil. Shallow mine workings that are potentially unstable but may remain in a satisfactory or stable conditions for a number of years.
Mild	Low level pollution of non-sensitive water, a feasible hazardous scenario although the timeline of such occurring can probably be considered in 10's of years.	The effect of high sulphate concentrations on structural concrete. Pollution of non-classified groundwater.
Minor	Harm, although not necessarily significant to human health, or with respect to other aspects of the development, which are considered implausible in terms of occurrence, or will have little consequential impact.	The presence of contaminants at such low concentrations that protective equipment is required during site works. Any damage to structures is minimal and will not be structural in characteristics.

PROBABILITY OF RISK BEING REALISED (C552 CIRIA, 2001)

Classification	Definition
High Likelihood	There is a viable pollutant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence that the receptor has been harmed or polluted.
Likely	There is a viable pollutant linkage and all elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a viable pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a viable pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

RISK CLASSIFICATION MATRIX (C552 CIRIA, 2001)

Risk = Probability x Consequence		Consequence			
		Severe	Moderate	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

HUMAN RECEPTORS

Human exposure to contaminants present in soils can occur via several pathways. Direct exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatised compounds, and inadvertent soil ingestion (or deliberate soil ingestion in the case of some children). Other indirect pathways include human ingestion of plants grown in contaminated soil or contaminated ground or surface water. Contaminants associated with wind blown dust can affect humans on surrounding sites.

VEGETATION

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, lead, nickel, and zinc.

To establish if the levels of contaminants present on a site may pose a risk to vegetation the results of the contamination testing are compared to a series of threshold values published in 'Code of Good Agricultural Practice for the Protection of Soil'.

GROUNDWATER AND SURFACE WATER RECEPTORS

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology. Surface watercourses may also accumulate contamination as contaminated sediments are deposited within the water body.

Where the site investigated overlies major/principal aquifers (and in some cases minor/secondary aquifers depending on certain conditions), groundwater Source Protection Zones and areas in close proximity to groundwater abstractions, contamination test results have been compared with the Water Supply (Water Quality) Regulations 1989 and The Water Supply (Water Quality) Regulations 2000.

Should a surface water receptor, such as a fresh water environment (river, canal, stream, lake etc), or marine environment be considered sensitive in relation to a site, then test results are compared with DEFRA & SEPA Environmental Quality Standards (2004). Many of the Environmental Quality Standards are hardness ($CaCO_3$) depended. Where no hardness values are available, Solmek assume conservative values (of between 0 and 50mg/l).

In the absence of vulnerable ground and surface water environments, Solmek may compare any test results with the Environment Agency Leachate Quality Threshold Values.

DETAILED QUANTITATIVE RISK ASSESSMENT (DQRA)

In line with Environment Agency's guidance document Environment Agency *Land Contamination Risk Management*, which replaced the now-withdrawn *Contaminated Land Report 11 – Model Procedures for the Management of Land Contamination (2004)*, a DQRA for groundwater/human health may be required following a Phase 2 investigation and before the preparation of a Phase 3 Remediation Strategy. For human health DQRA, a site specific assessment criteria is undertaken using CLEA Software Version 1.06. For groundwater DQRA, the Environment Agency Remedial Targets Worksheet Version 3.1 is used.

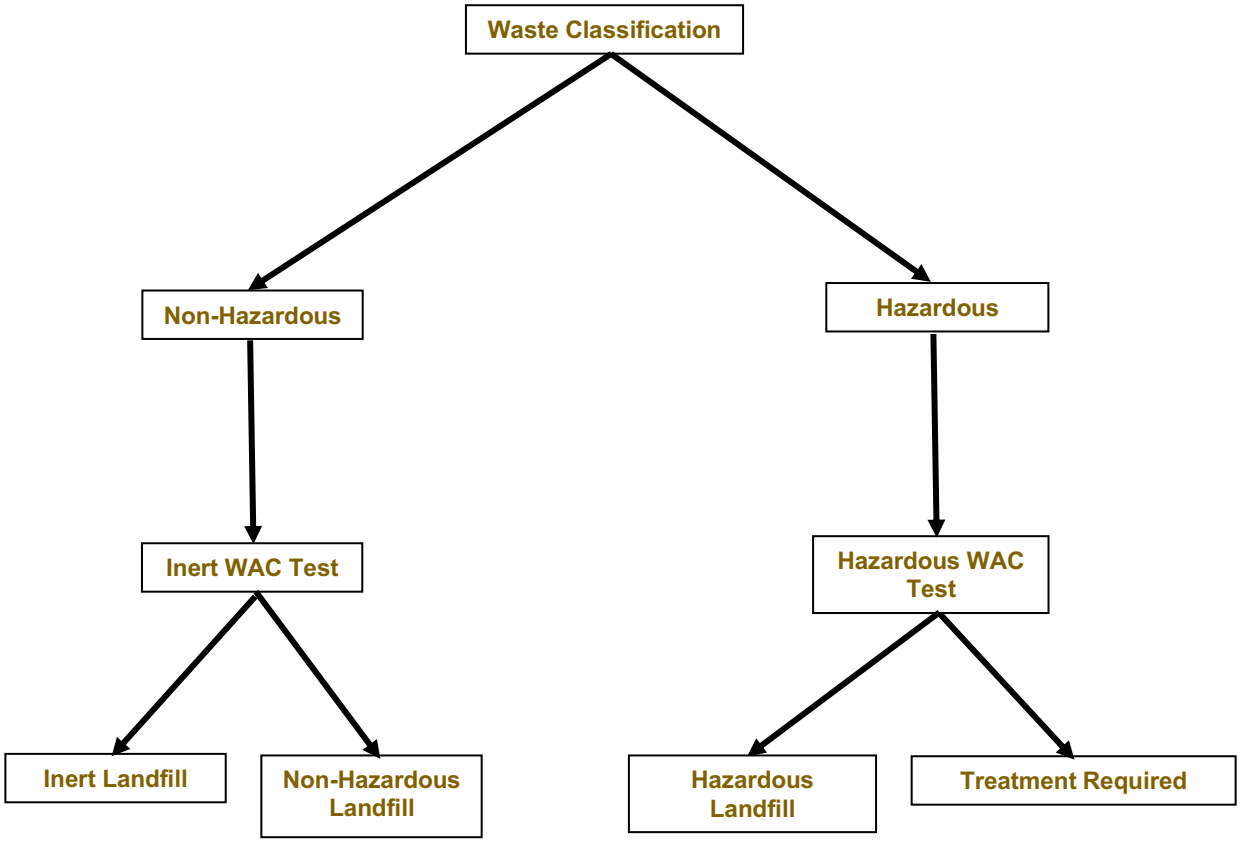
WASTE CLASSIFICATION AND WASTE ACCEPTANCE CRITERIA

During the site strip and construction activities, material may be required to be removed from site. Any such material would require classification, in line with Environment Agency Technical Guidance *Waste Classification: Guidance on the classification and assessment of waste (2015)*. This would classify the material as either Non-Hazardous or Hazardous Waste.

Once the material has been classified, determining the suitable landfill for disposal is governed by landfill directive Waste Acceptance Criteria (WAC) testing, with landfills categorized as Inert Waste, Stable Non-Reactive Hazardous Waste and Hazardous Waste. The WAC testing relates to materials that are to be exported from a site/development to landfill, and do not directly relate to human health specifically. The testing results are generally presented as certificates which can be used by site owners/contractors etc, which should be presented to the accepting waste facility or waste contractor.

If waste classification and/or WAC testing are not undertaken, material taken off site may be subject to WAC testing by the appropriate waste disposal company. The decision on whether or not to accept waste, or whether further testing is required, is at the discretion of the waste disposal company.

The below flow chart provides further information on the waste classification process.



CONSTRUCTION MATERIALS

Materials at risk from possible soil contaminants include inorganic matrices such as cement and concrete and also organic material such as plastics and rubbers. Acid ground conditions and high levels of sulphates can accelerate the corrosion of building materials. Where pH and soluble sulphate analysis has been undertaken, Solmek compare the test results with the guidelines presented within BRE Special Digest 1, 2005 (3rd Edition) 'Concrete in Aggressive Ground'. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

The levels of potential contaminants should be compared to thresholds supplied in the UK Water Industry Research (UKWIR) publication "Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites" (January 2011). A Brownfield Site is defined in the document as "Land or premises that have not previously been used or developed that may be vacant or derelict". It should be noted that Brownfield sites may not be contaminated. The guidance does not apply to Greenfield Sites however water companies may have their own assessment criteria which should be checked by the developer. The table below outlines the pipe material selection threshold concentrations.

	Pipe Material (Threshold concentrations in mg/kg)					
Parameter group	**PE**	**PVC**	**Barrier pipe (PE-AL-PE)**	**Wrapped Steel**	**Wrapped Ductile Iron**	**Copper**
Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5	0.125	Pass	Pass	Pass	Pass
+ BTEX + MTBE	0.1	0.03	Pass	Pass	Pass	Pass
SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C5-C10)	2	1.4	Pass	Pass	Pass	Pass
+ Phenols	2	0.4	Pass	Pass	Pass	Pass
+ Cresols and chlorinated phenols	2	0.04	Pass	Pass	Pass	Pass
Mineral oil C11-C20	10	Pass	Pass	Pass	Pass	Pass
Mineral oil C21-C40	500	Pass	Pass	Pass	Pass	Pass
Corrosive (Conductivity, Redox and pH)	Pass	Pass	Pass	Corrosive if pH <7 and conductivity >400µS/cm	Corrosive if pH <5, Eh not neutral and conductivity >400µS/cm	Corrosive if pH <5 or >8 and Eh positive
Specific suite identified as relevant following site investigation						
Ethers	0.5	1	Pass	Pass	Pass	Pass
Nitrobenzene	0.5	0.4	Pass	Pass	Pass	Pass
Ketones	0.5	0.02	Pass	Pass	Pass	Pass
Aldehydes	0.5	0.02	Pass	Pass	Pass	Pass
Amines	Fail	Pass	Pass	Pass	Pass	Pass

REQUIREMENTS OF PARTIES WITHIN THE DEVELOPMENT PROCESS

Interested parties involved in the development process may use the data in different ways and there may be varying views and interpretation of the factual data. Local Authority staff may have a view on contamination and human health and the wider environment. The Environment Agency are concerned principally with the protection of Controlled waters. Building insurers, funders and purchasers may be primarily concerned with issues of potential commercial blight. Purchasers are also not always fully informed, and perceptions on issues associated with risk can affect the decision to purchase. Developers and construction organisations will focus on financial aspects of dealing with the contamination in the context of the development and construction programme.

RISKS & LIABILITIES FROM CONTAMINATION

In simple terms, risks associated with contamination may be considered in terms of 1) statutory risks and 2) development related risks. If contamination is severe or forms a potential hazard based on its potential to affect groundwater, surface water or human health, a statutory risk may be present, and as such, if the risk is not reduced, criminal proceedings may be instigated by a government body or local authority.

If the contamination is less severe or not considered to be mobile, it may be considered a commercial liability which could, in theory remain untreated, but which may at a later date affect the value of the property, or, with changing legislation, become a statutory risk. Commercial liabilities could give rise to civil proceedings by third parties if there are grounds for action.

♣Solmek conditions of offer, notes on limitations & basis for contract (ref: version1/2024)

These conditions accompany our tender and supercede any previous conditions issued. Solmek will prepare a report solely for the use of the Client (the party invoiced) and its agent(s). No reliance should be placed on the contents of this report, in whole or in part by 3rd parties. The report, its content and format and associated data are copyright, and the property of Solmek. Photocopying of part or all of the contents, transfer or reproduction of any kind is forbidden without written permission from Solmek. A charge may be levied against such approval, the same to be made at the discretion of Solmek.

Solmek cannot be held liable and do not warrant, or otherwise guarantee the validity of information provided by third parties and subsequently used in our reports. Solmek are not responsible for the action negligent of otherwise of subcontractors or third parties.

Site investigation is a process of sampling. The scope and size of an investigation may be considered proportional to levels of confidence regarding the ground and groundwater conditions. The exploratory holes undertaken investigate only a small volume of the ground in relation to the overall size of the site, and can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions as encountered within each of the exploratory holes. There may be different ground conditions elsewhere on the site which have not been identified by this investigation and which therefore have not been taken into account in this report. Reports are generally subject to the comments of the local authority and Environment Agency. The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that mobile contamination, ground gas levels and groundwater levels may vary owing to seasonal, tidal and/or weather related effects. Solmek cannot be held liable for any unrecorded or unforeseen obstructions between exploratory boreholes and trial pits. This includes instances where previous structures on the site (buried man made structures) or the presence of boulder clay (cobbles and/or boulder obstructions) have been anticipated. All types of piling operations should make allowance for obstructions within the construction budget to accommodate this. Unrecorded ancient mining may occur anywhere where seams that have been worked and influence the rock and soil above. Dissolution cavities can occur where gypsum or chalk is present. Rotary drilling is the recommended technique to prove the integrity of the rock.

Where the scope of the investigation is limited via access to information, time constraints, equipment limitations, testing, interpretation or by the client or his agents budgetary constraints, elements not set out in the proposal and excluded from the report are deemed to be omitted from the scope of the investigation.

Desk studies are generally prepared in accordance with RICS guidelines. Environmental site investigations are generally undertaken as 'exploratory investigations' in accordance with the definitions provided in paragraph 5.4 of BS 10175:2011 in order to confirm the conceptual assumptions. You are advised to familiarize yourself with the typical scope of such an investigation. No pumping of water will be undertaken unless a licence or facilities/equipment have been arranged by others.

Where the type, number or/and depth of exploratory hole is specified by others, Solmek cannot and will not be responsible for any subsequent shortfall or inadequacy in data, and any consequent shortfall in interpretation of environmental and geotechnical aspects which may be required at a later date in order to facilitate the design of permanent or temporary works.

All information acquired by Solmek in the course of investigation is the property of Solmek, and, only also becomes the joint property of the Client only on the complete settlement of all invoices relating to the project. Solmek reserve the right to use the information in commercial tendering and marketing, unless the Client expressly wishes otherwise in writing. The quoted rates do not include VAT, and payment terms are 30 days from dispatch of invoice from our offices. Quotes are subject to a site visit.

We have allowed for 1 mobilisation and normal working hours unless otherwise stated. The scope of the investigation may be reviewed following the desk study and/or fieldwork. The presence or otherwise of Japanese Knotweed or other invasive plants can be difficult to identify especially during winter months. If Japanese Knotweed or other invasive species are suspect, it should be confirmed by an ecologist. We have not allowed for acquiring services information, and cannot be responsible for damage to underground services or pipes not shown to us or not clearly shown on plans. Costs incurred will be passed on to you, and in commissioning Solmek you understand and accept that you/your agent have a contractual relationship with Solmek & you accept this. Our rates assume unobstructed, reasonably level and firm access to the exploratory positions and adequate clear working areas and headroom. We have priced on the basis that you or your client have the necessary permissions, wayleaves and approvals to access land. All boreholes and pits are backfilled with arisings except where gas monitoring pipes are installed with stopcock covers. Solmek are not responsible for any uneven surfaces as a result of siteworks and rutting and backfilled excavations may require re-levelling and/or making good by others after fieldwork is complete, and Solmek has not allowed for this. No price has been provided or requested for a return visit to remove pipework and covers. Hourly rates apply to consultancy only and do not include expenses unless otherwise shown. If warranties are required, legal costs incurred will be passed on to you assuming Solmek agree to complete such warranties, modified or otherwise and you understand and agree to pay all costs.

We reserve the right to pursue full payment of the invoice prior to release of any information including reports. We advise you/your client that we may elect to pursue our statutory rights under late payment legislation, and will apply 8% to the base rate for unreasonably late payments. Solmek are exempt from the CIS Scheme. Solmek offer to undertake work only in strict accordance with conditions covered by our current insurances, which are available for inspection. Solmek are not responsible for acts, negligent or otherwise of subcontractors and as a matter of policy cannot indemnify any other parties. Professional indemnity Insurance is limited to ten times the invoice net total except where stated otherwise by Solmek. Solmek give notice that consequential loss as a direct or indirect result of Solmek's activities or omission of the same are excluded.