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Tracey Little
[redacted]

Date: 15th June 2023

Ref: C9758/8363/GH/GH

Dear Tracey,

Re: C9758 – The Paddock, Harras Moor, Whitehaven – Ground Gas Monitoring Risk Assessment Letter

Sirius was commissioned to undertake gas monitoring and subsequent production of a ground gas risk assessment in advance of a proposed development comprising a bungalow and garage on land at Harras Moor, Whitehaven.

It is understood that a pre-commencement condition for the outline planning permission given by Copeland Borough Council states that gas monitoring is required prior to development in accordance with a GeoInvestigate Coal Mining Risk Assessment report, ref. C21030, dated 12 February 2020, previously prepared for the site and a copy of which has been provided to Sirius. The pre-commencement condition stipulates that "*monitoring must include the siting of gas wells in the development area on 6 occasions over a minimum of a 6 week period*", in line with the GeoInvestigate recommendations.

The references for the outline planning permission and GeoInvestigate report are:

- Notice of Grant of Outline Planning Permission, ref. 4/21/20010O1
- GeoInvestigate Coal Mining Risk Assessment report, ref. C21030, dated 12 February 2020

This letter presents the results of that monitoring and an assessment of the risk posed by hazardous ground gases to the proposed development.

An overview of the site setting is given below using the GeoInvestigate Coal Mining Risk Assessment report as a primary source of data which has been used in good faith by Sirius. This report therefore must be read in conjunction with the GeoInvestigate report, which presents in detail the site setting and the findings of the previous phase of intrusive investigation. In addition, Sirius has previously undertaken an intrusive investigation of the

land south and southeast of the site for a relation of the client. Reference has been made to this investigation where pertinent. The reference for the report is:

- C7728, Geoenvironmental Appraisal of Harras Moor, Whitehaven, January 2019

Introduction

In undertaking this assessment, we have taken account of current best practice guidance in the assessment risk posed by hazardous permanent ground gases, including:

- BS8485:2015+A1:2019 “Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings (BS8584)”;
- BS8576:2013 “Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds (VOCs)”;
- CIRIA “Assessing Risks Posed by Hazardous Ground Gases to Buildings”, report C665, 2007;
- CIRIA “The VOCs Handbook. Investigating, Assessing and Managing Risks from Inhalation of VOCs at Land Affected by Contamination”, report C682, 2009;
- CL:AIRE “A Pragmatic Approach to Ground Gas Risk Assessment”, report ref. RB17, November 2012;
- CL:AIRE “Good Practice for Risk Assessment for Coal Mine Gas Emissions”, October 2021
- NHBC “Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present”, report version 04, March 2007.
- NHBC “Hazardous ground gas – an essential guide for housebuilders” NF94 2023.

It is understood that the proposed development will comprise a low rise residential property (bungalow). For the purposes of gas risk assessment, the proposed development is therefore considered to be characterised as comprising a Type A building, as defined in Table 3 of BS 8485.

Site Characterisation Relevant to Gas Risk Assessment

<u>Background Information</u>

The site comprises a current paddock to the south of buildings at Harras Dyke Farm of approximate dimensions of c.55m north-south and c.30m east-west. It is understood the proposed bungalow is to be situated roughly centrally to the paddock.

The GeoInvestigate report includes the following information about the site:

- Site History: Farmland, with a racecourse and wrestling ring shown in close proximity to the site between the mid and late 1800s and mineshafts shown to the southeast and northeast of the site.

- Surface Mining: An opencast, with excavation works undertaken between 1980 and 1987, is present to the east of the site and is not recorded to extend to within the paddock site area. It was anticipated that this may represent a source of ground gas.
- Underground Mining: No shallow workings (<30m) are recorded beneath the site. GeoInvestigate consider that an adequate thickness of rock cover (to prevent surface instability) is present above any potential unrecorded mineworkings which may exist below the site within the shallowest seam (Unnamed G) anticipated at a depth of c.25m beneath the site. The shallowest recorded workings beneath the site are recorded by the Coal Authority at depths of 166m and 183m, which are not considered to pose a risk to surface stability of the site.

Sirius has reviewed the Coal Authority Interactive Map viewer which indicates mineshafts are present c.150m southwest and c.220m southeast of the site. It is noted that the boundary of the opencast is recorded to include the site on both the CA interactive map viewer and on the consultants coal mining report enclosed within the Geoinvestigate report.

It is understood from the Geoinvestigate report that the client has copyright of a desk study previously prepared by Elliott Environmental Surveyors dated 23rd December 2016, which includes plans for the opencast which indicate the area of extraction does not extend into the area of the current site.

In addition Sirius has previously undertaken a site investigation on the land immediately south and east of the current site for a relation of the client which included the review of the abandonment plan for the opencast and trial trenching to delineate the opencast highwall. The reference for the report is:

- C7728, Geoenvironmental Appraisal of Harras Moor, Whitehaven, January 2019

The land immediately to the east of the site along with the site area were not included within the above report however the trial trenching indicates the extraction boundary of the opencast is further east than the extents recorded on the CA online viewer and consultants report obtained by GeoInvestigate, commensurate with the extraction boundary shown on the abandonment plan for the opencast. The completion plans for the opencast indicate the opencast to extend to a depth of c. 21.3m bgl in the east to a depth of 40.7m bgl in the west.

It is therefore considered likely that the opencast does not extend into the current site. Window sample boreholes were drilled along the eastern boundary of the site as part of the programme of monitoring well installation to confirm the absence of made ground soils, which may be representative of the opencast, within the site.

It is also noted that elevated concentrations of methane and carbon dioxide were recorded during gas monitoring undertaken as part of the Sirius investigation in the monitoring wells located within and outwith the former opencast, indicating a potential source of ground gas is present likely to be associated with the infilled opencast or shallow unrecorded workings within coal seams outwith the opencast.

Summary of Site Investigation Works

The intrusive ground investigation included the drilling of 6 No. window sample boreholes to depths of between 1.5m and 2.5m below ground level. Gas monitoring wells were installed within 4 No. boreholes. Drilling was undertaken on 21st April 2023 and the works were supervised by a Sirius geotechnical engineer.

Site investigation evidence indicates the following geological sequence to underlie the site. All depths are given below ground level at the time of the investigation.

- Topsoil: Encountered to depths between 0.2m and 0.3m comprising a clayey gravelly sand.
- Possible buried topsoil: Encountered within WS01 and WS04 from 0.3m to 0.6m and 0.5m comprising a clayey gravelly sand.
- Natural Soils: Comprised clayey gravelly sand and firm to stiff sandy gravelly clay to depths of 1.9m to 2.4m where the base of natural soils could be proven.
- Bedrock: Proven within WS02 and WS04 at 1.9m and 2.4m comprising a weak silty sandstone. The remaining boreholes refused (SPT N value of 50 reached indicating no further significant penetration is possible) at depths between 1.5m and 2m bgl which are considered likely to represent rockhead.

No made ground soils which could be considered indicative of the presence of the opencast were encountered and is it considered that the extraction boundary of the opencast does not extend into the site.

Ground Gas Monitoring Data

An programme of ground gas monitoring comprising six visits over a period of six weeks was specified by Geoinvestigate and Copeland Borough Council, following which a review of the gas monitoring results has been undertaken. It is considered that along with consideration of the CSM, as discussed below, the ground gas monitoring undertaken to date is sufficient to characterize the ground gas regime of the site.

The wells selected for monitoring are shown on the Exploratory Hole Location Plan presented in Attachment A. Borehole records detailing the monitoring installation details are enclosed within Attachment C.

Monitoring wells were installed into 4 No. window sample boreholes (WS02, WS03, WS04 and WS05) and screened into natural superficial deposits, and into the upper surface of bedrock where encountered within WS02 and WS04.

Detailed records of the monitoring data obtained are presented in Attachment B.

The monitoring was carried out during the spring/early summer of 2023, with monitoring visits taking place at barometric pressure conditions ranging from 1010 to 1033mbar. Four visits occurred during periods of falling atmospheric pressure, undertaken on 27th April, 4th May, 10th May and 22nd May 2023 (visit 1, 2, 3 and 5). The period of monitoring is therefore considered to have covered a range of conditions, although as a consequence of the generally prevalent atmospheric conditions during the monitoring period, cannot be considered to have captured the 'worst case' ground gas conditions consisting of a rapid and pronounced fall in atmospheric pressure. The resulting review and risk assessment based on the data has therefore necessarily taken a pragmatic approach.

Monitoring was undertaken on 6 No. occasions in total over the monitoring period. During the monitoring visits, groundwater was observed at shallow depth within most monitoring wells and on most visits. Whist this did not preclude gas monitoring, it was recognised that groundwater levels on some occasions were higher than the top of the slotted 'response zone' section, or that only a very small section of response zone remained between ground water level and the sealed section of the well.

This situation is recognised to have a potential significant influence on gas concentrations and gas flow rates, as described in CL:AIRE research bulletin RB17, and as a consequence, the wells were bailed during each visit, to reduce groundwater level and expose the response zone in an attempt to provide a more accurate representation of gas concentrations. However, for the majority of wells water level returned to high levels prior to the following visit.

Table 1 summarises the gas monitoring results obtained. Where negative gas flows have been recorded, these have conservatively been converted to a positive value in accordance with BS8584:2015+A1:2019 Section 6.3.4, as a similar positive outflow of gas cannot be completely ruled out at this stage.

Table 1 - Summary of Ground Gas and Groundwater Monitoring Data

Well	Screened Response Zone	Concentration ranges (%v/v)			Concentration ranges (ppmv)		Flow (litres/hour)	
		Methane (Peak)	Carbon Dioxide (Steady)	Oxygen (Min.)	Hydrogen sulphide	Carbon monoxide	Peak* (Pre bail results)	Steady* (Pre bail results)
WS02	1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	ND	0.2 – 6.5	16.4 – 20.8	ND	ND	ND – 95	ND
WS03	1 – 2m: Natural sand	ND	0.2 – 2.3	17.4 – 21.5	ND	ND	ND – 112	ND
WS04	1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	ND	0.6 – 2.4	18.6 – 20.7	ND	ND – 62	ND – 73.6	ND
WS05	1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	ND	0.1 - 1.8	18.7 – 21.0	ND	ND - 19	ND – 99.1	ND

ND: None Detected – concentrations of gas or flows below equipment limit of detection

*Post bailing results not included. High flows are considered attributable to shallow groundwater and sealed well conditions. Negative flows have been converted to positive flows.

Elevated concentrations of carbon monoxide were recorded within two wells, WS04 and WS05, on the first monitoring visit only. It is considered likely that these results are not indicative of a sustained source or significant volumes of carbon monoxide although it is noted that typical gas source for carbon monoxide in accordance with BS8485 is disused mineworkings and may be indicative of a potential source of ground gas within or within the vicinity of the site.

Revised Conceptual Site Model for Hazardous Ground Gases

Ground Gas Sources and Associated Pathways

The most significant potential sources of ground gases at this site are considered to be the backfilled opencast to the east of the site, and potential unrecorded mineworkings within the shallow coal seams beneath the site. Gas monitoring undertaken as part of the Sirius investigation on the land to the south and east of the site returned elevated concentrations of methane and carbon dioxide both within and outwith the former opencast which confirms a potential source of ground gas is present, likely associated with the opencast and potential unrecorded mineworkings.

Transport Pathways

Perceived migratory pathways may include migration via fractures and fissures within underlying bedrock, recorded at shallow depth beneath the site and granular strata within the overlying natural superficial deposits.

In addition, migratory pathways may include migration through backfilled opencast strata and laterally through fractures and fissures within bedrock and via granular strata within the overlying natural superficial deposits. It is noted that the highwall of the opencast is close to the eastern boundary of the site which may act as a preferential pathway for gas migration.

Receptors

Proposed future building and occupants.

Construction/maintenance workers operating within enclosed spaces below ground level, if required during the development phase, resulting from the presence of depleted oxygen concentrations.

Potential Influence of the Proposed Development on the Ground Gas Regime and Conceptual Site Model

Preparatory or remedial works for proposed developments, including but not limited to mineworking treatment proposals, foundation solutions and earthwork proposals (cut/fill), have the potential to influence the ground gas regime for development sites, which may require reconsideration following these preparatory or remedial works for the site.

It is understood from the Geoinvestigate report that no further remedial works with respect to mineworkings are required and therefore mineworking treatment proposals will not impact the ground gas regime.

Sirius do not have details of the proposed foundation for the site however it is considered unlikely that deep foundations would be required that negatively impact the ground gas

regime. If this is the case, and piled or vibro stone columns are required, then reassessment of the conclusions of this report may be required.

Consideration of the impact of any remedial or earthworks on the gas regime for the site may be required once development proposals are finalised however at this stage it is anticipated that no significant earthworks are required for the site which may detrimentally impact the ground gas regime.

Ground Gas Risk Assessment

Effect of High Groundwater Level on Monitoring Data

As noted previously, significantly high peak flow rates have been recorded within wells on several monitoring visits. Such flow rates are not consistent with the conceptual model for the site, and are considered to be anomalous and most likely associated with shallow groundwater levels.

Groundwater has been recorded close to, or above the base of the sealed sections of monitoring wells in a number of instances. Following bailing of the monitoring wells on each visit as described previously, groundwater was found to have re-equilibrated to similar levels by the time of the subsequent visit.

CL:AIRE research bulletin RB17 identifies that rising groundwater in the sealed part of the well causes an increase in pressure that is released on opening of the well, to give a brief peak flow, and on this occasion, this is identified as the primary cause of the very high peak flow readings recorded. These peak flow rates are therefore not representative of typical ground gas flux conditions.

Therefore, on the basis of the above, all instances of peak flows where the groundwater level is above the response zone of the well have therefore been excluded from the below assessment.

Worst Case Check for the Site

The risk assessment considers both the detected concentrations of ground gases and borehole flow rates, in accordance with BS8485:2015+A1:2019. Q_{hg} (Quantity of hazardous gas) values for methane and carbon dioxide have been calculated in accordance with BS8485 on the basis of measured gas flows and concentrations or a limit of detection (LoD) of 0.1L/hr and 0.1% v/v, respectively, whichever is the higher (Attachment B).

In accordance with BS8485, an initial worst case check has been calculated for the site as a whole, on the basis of the maximum recorded concentrations, after excluding all flow rates which were elevated as a result of high groundwater levels as discussed above. Post bailing flow rates have also been excluded from the worst case check.

Table 2 – Worst Case Check

Gas	Maximum gas concentration detected (% v/v)	Maximum steady (CO2) rate (l/hr)	Q_{hg}
		Maximum peak (CH4) flow rate (l/hr)	
Carbon Dioxide	6.5	ND	0.0065
Methane	ND	7.3	0.0073

ND – None detected. Instrument limit of detection of 0.1% v/v used.

If these calculated Q_{hgs} are taken as the gas screening values (GSVs) for the site, then these results do not indicate a potential risk from ground gas. However it is noted that the monitoring has generally been undertaken during a period of generally high pressure and has not necessarily covered worse case conditions.

Risk Evaluation

In addition to the BS8485 assessment, given the mining history of the site and its environs reference has been made to CL:AIRE guidance Good Practice for Risk Assessment for Coal Mine Gas Emissions, October 2021. The guidance considers that for opencast sites there is a potential for ground gas from unrecorded workings to be present and provide a source/pathway linkage from the workings into the opencast backfill. The presence of workings within the shallow seams (which have been formerly opencasted to the east) beneath the site and its immediate locality has not been ruled out at this stage. Any potential unrecorded workings are considered unlikely to be flooded, meaning that gas generation and accumulation are possible. The guidance further notes that opencast highwalls, anticipated within close proximity of the site, may provide a potential preferential pathway for ground gas from any unrecorded workings linked to the opencast. It is also noted that drift is thin, typically c.2m in thickness, and generally granular across the site which therefore is unlikely to significantly reduce the potential pathway between ground gas sources and the receptor (proposed development).

Gas monitoring undertaken as part of the Sirius investigation on the land to the south/southeast of the site included the installation and monitoring of a borehole, RO2, located c.50m south of the current site (c.75m south of the proposed bungalow subject to the final proposed location) and outwith the opencast, which was screened into shallow soils. Monitoring results from this borehole returned methane concentrations of up to c.26%v/v and carbon dioxide concentrations of up to c.17%. No significant peak or steady flows were detected within this borehole. It is noted that similar concentrations of methane and carbon dioxide were not recorded during the monitoring undertaken as part of this assessment but the results from RO2 can be considered indicative of a potential source of ground gas in the vicinity of the site and suggests that localised pathways for gas migration may be present. The

absence of detectable flows would however indicate limited volume output of these gases to surface, with gas migration likely to be governed by atmospheric pressure changes

On the basis of the conceptual site model and credible existence of a source (opencast and potential unrecorded mineworkings) - pathway (bedrock and granular superficial deposits) - receptor (proposed development) linkage, with cognisance to the generally low ground gas levels detected within the monitoring undertaken as part of this assessment, it is considered that the site falls within Characteristic Situation (CS) 2 as defined in BS 8485:2015+A1:2019. This indicates a plausible but low potential risk from hazardous ground gas.

Table 4 of BS 8485:2015+A1:2019 indicates that CS2 conditions require a minimum gas protection score of 3.5 for a residential end-use. This score may be achieved, for example, by a passive sub-floor void of suitable design and installation of a suitable gas resistant membrane, installed and verified in accordance with the requirements of BS 8485:2015+A1:2019. A verification plan is understood to be required by the local authority to confirm the gas protective measures to be installed. Verification of the installation of the ground gas protective measures (subject to design this may include verification of the subfloor void, installation of the membrane and sealing of any internal pipework or ducting associated with services to the property e.g. water pipes) will be required.

General Comments

Existing monitoring wells should be appropriately decommissioned (in accordance with Environment Agency Guidance) to prevent them acting as future preferential gas flow pathways.

The site is located within an area where measures may be required for protection of proposed new buildings from the ingress of radon gas in accordance with online mapping at UK Radon. The site is located within a grid square where there is maximum potential probability of 5 to 10% that properties will be affected by radon. According to current building regulations, basic radon protection would be required for properties within this category. Installation of gas protection in accordance with BS8485 CS2 will also provide protection from radon at least equivalent to that required for ‘basic radon protection’ and consequently no additional mitigation in respect of radon is necessary.

Prior to undertaking any construction on the site, this report should be submitted to and approved by the local authority and, if applicable, the NHBC or other insurer.

Notwithstanding the above, to ensure the protection of construction/ maintenance workers from the depleted oxygen concentrations identified within the shallow soils, it is further recommended that gas monitoring of all excavations and/or underground spaces is carried out prior to personnel entry, with continuous monitoring throughout the period of working. Gas

monitoring by way of example should include as a minimum: methane, carbon dioxide, carbon monoxide, and oxygen. Gas monitor(s) shall emit both audible and visual warnings. Alarm levels should be set with due regard to the relevant Occupational Exposure Limits given in HSE EH40/2005, and for low oxygen concentrations. If any anomalous or significantly elevated/depleted gas concentrations are detected then all personnel should immediately evacuate the area and the advice of an appropriate specialist be obtained before work continues.

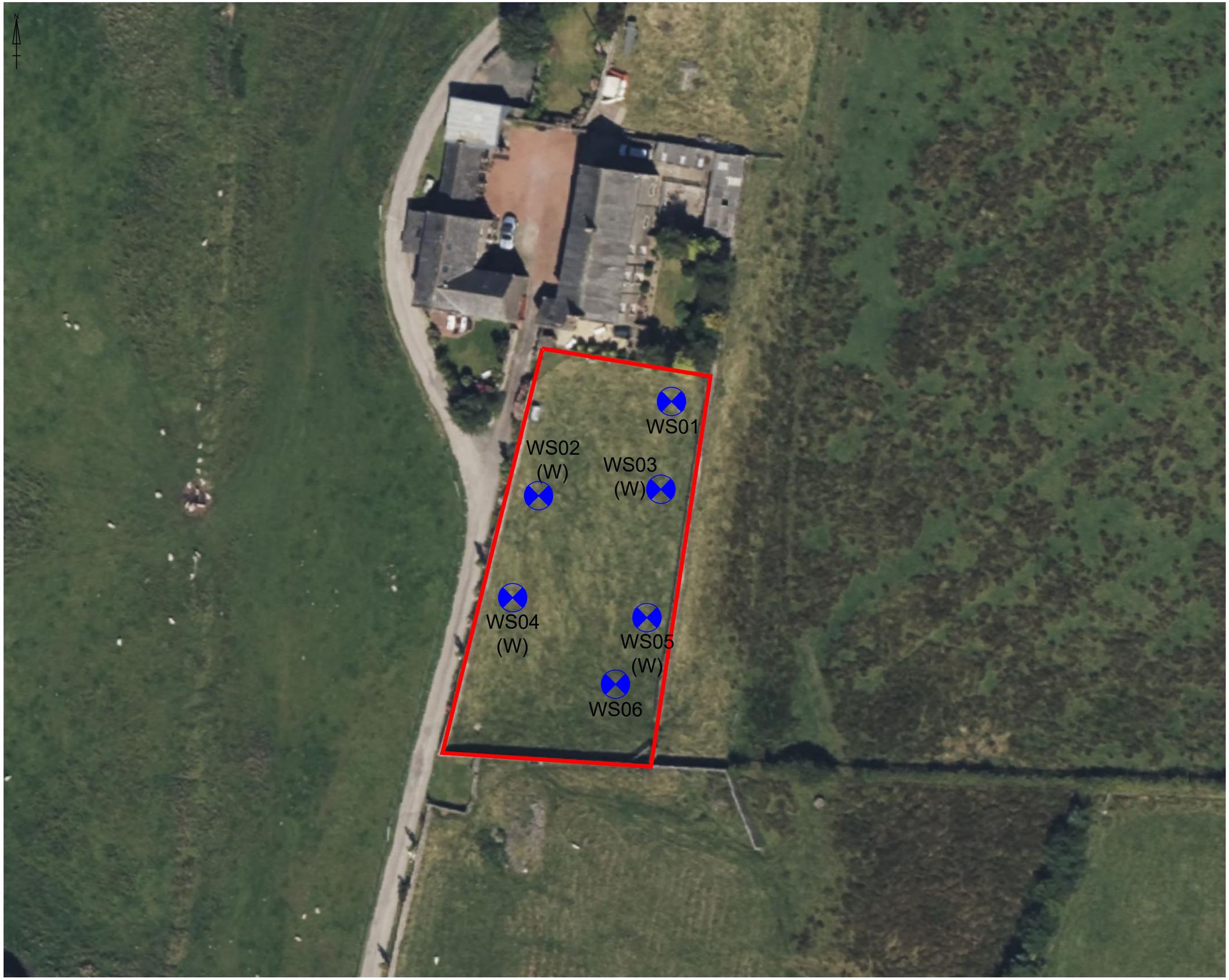
The conclusions and recommendations presented in this letter report are considered reasonable based on the findings of the work described. However, these cannot be guaranteed to gain regulatory or other approvals and, therefore, the report should be passed by the client to the appropriate regulatory authorities and/or other appropriate organisations for their comment and approval prior to undertaking any development works at the site.

[redacted]

Senior Engineer

For and on behalf of Sirius Geotechnical Ltd

Enc.: Attachment A. Drawings.
Attachment B. Ground Gas Monitoring Results.
Attachment C. Borehole Logs



NOTES

Site Boundary

Window Sample Borehole

(W) With gas/groundwater monitoring well

Notes

1. This drawing should not be viewed in isolation from the accompanying report.
2. All exploratory hole locations are approximate and based on handheld GPS coordinates unless stated otherwise on the exploratory hole logs.
3. The locations of services shown on this drawing are approximate and are based on utility plans provided by the client. Locations of services are given for the purposes of indicating constraints to the site investigation only. Reference should be made to original utility plans and HSG47 for locating of services within the site.
4. All marked site features (including historical features, mining features (ie, opencast boundaries and mineshafts), potential contaminant constraints, and any other potential constraint or feature of note) shown on this drawing are given for indicative purposes only. This drawing should not be underlaid in isolation to determine proposed development layouts. Reference should be made to the accompanying report for commentary on the potential location of these features including coordinates if available and any further works required to locate features if required.

REVISION		BY	DATE
0	For Information	MF	17/04/23
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

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CLIENT

Tracey Little

SITE

**The Paddock,
Harras Moor,
Whitehaven**

DRAWING TITLE

**Exploratory Hole
Location Plan**

DRAWING NO.	REVISION NO.
C9758/01	0
DRAWN BY	APPROVED BY
MF	GH

DATE	SCALE	PAPER SIZE
April 2023	1:500	A3

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 1 **of** 6
Date: 27/04/2023 **Operator:** JWM **Project Manager:** GH

	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA					Comments
Monitoring Point	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
WS02	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.17	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bung valve blocked, bailed to 1.68m
Post Bail WS02	**ND**	ND	ND	ND	0.6	**0.6**	ND	ND	ND	ND	20.2	20.2	NR	NR	ND	ND	ND	ND	0.0001	0.0006	1.35	1.98				
WS03	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.14	1.85			1 – 2m: Natural sand	Bung valve blocked, bailed to 1.34m
Post Bail WS03	**ND**	ND	ND	ND	0.7	**0.7**	ND	ND	ND	ND	20.0	20.0	NR	NR	49.7	ND	ND	40	0.0497	0.0007	1.08	1.85				
WS04	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.08	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bung valve blocked, bailed to 1.71m
Post Bail WS04	**ND**	ND	ND	ND	0.9	**0.9**	ND	ND	ND	ND	19.8	19.8	NR	NR	22.4	ND	ND	16	0.0224	0.0009	1.07	2.04				
WS05	**NR**	NR	NR	NR	NR	**NR**	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	1.15	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bung valve blocked, bailed to 1.74m
Post Bail WS05	**ND**	ND	ND	ND	0.4	**0.4**	ND	ND	ND	ND	20.3	20.3	NR	NR	9.8	ND	ND	4	0.0098	0.0004	1.51	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**0.9**	**0.9**	**ND**	**ND**	**ND**	**ND**	**20.3**	**20.3**	**NR**	**NR**	**49.7**	**ND**	**ND**	**40**	**0.0497**	**0.0009**	**1.51**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.4**	**0.4**	**ND**	**ND**	**ND**	**ND**	**19.8**	**19.8**	**NR**	**NR**	**9.8**	**ND**	**ND**	**ND**	**0.0001**	**0.0004**	**1.07**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION:

(Select correct box with X or enter data, as applicable)

State of ground:	x	Dry	x	Moist		Wet		Snow		Frozen
Wind:		Calm	x	Light	x	Moderate		Strong		
Cloud cover:		None		Slight		Cloudy	x	Overcast		
Precipitation:	x	None		Slight		Moderate		Heavy		
Time monitoring performed:			11:30	Start			13:00	End		
Barometric pressure (mbar):			1014	Start			1012.9	End		
Pressure trend (Daily):			x	Falling		Steady		Rising		
Source:	Gas monitor									
Pressure trend (3 day trend):			x	Falling	x	Steady		Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			12	Before			11	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12746
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 17/04/2023
Date of next external calibration: 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 20.7

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 2 **of** 6
Date: 04/05/2023 **Operator:** JWM **Project Manager:** GH

Monitoring Point	GAS CONCENTRATIONS: Methane (%v/v) Peak	Methane (%v/v) Steady	%LEL Peak	%LEL Steady	Carbon dioxide (%v/v) Peak	Carbon dioxide (%v/v) Steady	Carbon monoxide (ppmv) Peak	Carbon monoxide (ppmv) Steady	Hydrogen sulphide (ppmv) Peak	Hydrogen sulphide (ppmv) Steady	Oxygen (%v/v) Min.	Oxygen (%v/v) Steady	VOLATILES: PID Peak (ppm)	Product thickness (mm)	FLOW DATA: Flow rate (l/hr) Peak	Flow rate (l/hr) Steady	Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Qhg per borehole: Methane (l/hr)	CO2 (l/hr)	WELL AND WATER DATA: Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	Comments
WS02	**ND**	ND	ND	ND	2.1	**2.1**	ND	ND	ND	ND	19.3	19.3	NR	NR	ND	ND	ND	ND	0.0001	0.0021	1.38	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bailed to 1.77m
Post Bail WS02	**ND**	ND	ND	ND	0.3	**0.3**	ND	ND	ND	ND	20.6	20.6	NR	NR	ND	ND	ND	ND	0.0001	0.0003	1.54	1.98				
WS03	**ND**	ND	ND	ND	1.6	**1.6**	ND	ND	ND	ND	17.4	17.4	NR	NR	ND	ND	ND	ND	0.0001	0.0016	1.27	1.85			1 – 2m: Natural sand	Bailed to 1.43m
Post Bail WS03	**ND**	ND	ND	ND	0.2	**0.2**	ND	ND	ND	ND	20.5	20.5	NR	NR	ND	ND	ND	ND	0.0001	0.0002	1.27	1.85				
WS04	**ND**	ND	ND	ND	2.2	**2.2**	62	62	ND	ND	18.6	18.6	NR	NR	ND	ND	ND	ND	0.0001	0.0022	1.19	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bailed to 1.50m
Post Bail WS04	**ND**	ND	ND	ND	0.7	**0.7**	ND	ND	ND	ND	20.2	20.2	NR	NR	ND	ND	ND	ND	0.0001	0.0007	1.20	2.04				
WS05	**ND**	ND	ND	ND	1.6	**1.6**	19	19	ND	ND	18.7	18.7	NR	NR	ND	ND	ND	ND	0.0001	0.0016	1.24	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bailed to 1.73m
Post Bail WS05	**ND**	ND	ND	ND	0.2	**0.2**	ND	ND	ND	ND	20.7	20.7	NR	NR	ND	ND	ND	ND	0.0001	0.0002	1.60	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**2.2**	**2.2**	**62**	**62**	**ND**	**ND**	**20.7**	**20.7**	**NR**	**NR**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0022**	**1.60**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.2**	**0.2**	**ND**	**ND**	**ND**	**ND**	**17.4**	**17.4**	**NR**	**NR**	**ND**	**ND**	**ND**	**ND**	**0.0001**	**0.0002**	**1.19**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:	x	Dry		Moist		Wet		Snow		Frozen
Wind:		Calm		Light	x	Moderate		Strong		
Cloud cover:		None		Slight		Cloudy	x	Overcast		
Precipitation:	x	None		Slight		Moderate		Heavy		
Time monitoring performed:			11:15	Start			12:30	End		
Barometric pressure (mbar):			1017	Start			1016.6	End		
Pressure trend (Daily):			x	Falling		Steady		Rising		
Source:	weather.com									
Pressure trend (3 day trend):			x	Falling		Steady		Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			9	Before			12	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12746
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 17/04/2023
Date of next external calibration 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 20.85

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 3 **of** 6
Date: 10/05/2023 **Operator:** JWM/BAJ **Project Manager:** GH

	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA					Comments
Monitoring Point	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
WS02	**ND**	ND	ND	ND	1.9	**1.9**	ND	ND	ND	ND	19.4	19.4	NR	NR	95.0	ND	ND	80	0.0950	0.0019	1.06	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bailed to 1.7m
Post Bail WS02	**ND**	ND	ND	ND	0.3	**0.3**	ND	ND	ND	ND	20.5	20.5	NR	NR	12.8	ND	ND	30	0.0128	0.0003	1.17	1.98				
WS03	**ND**	ND	ND	ND	1.8	**1.8**	ND	ND	ND	ND	17.5	17.5	NR	NR	112.0	ND	ND	105	0.1120	0.0018	0.89	1.85			1 – 2m: Natural sand	Bailed to 1.19m
Post Bail WS03	**ND**	ND	ND	ND	0.5	**0.5**	ND	ND	ND	ND	21.5	21.4	NR	NR	85.0	ND	ND	95	0.0850	0.0005	0.80	1.85				
WS04	**ND**	ND	ND	ND	2.2	**2.2**	ND	ND	ND	ND	18.6	18.6	NR	NR	73.6	ND	ND	32	0.0736	0.0022	1.00	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bailed to 1.27m
Post Bail WS04	**ND**	ND	ND	ND	0.9	**0.9**	ND	ND	ND	ND	20.4	20.4	NR	NR	98.4	ND	ND	35	0.0984	0.0009	0.93	2.04				
WS05	**ND**	ND	ND	ND	1.6	**1.6**	ND	ND	ND	ND	19.1	19.1	NR	NR	99.1	ND	ND	115	0.0991	0.0016	0.94	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bailed to 1.71m
Post Bail WS05	**ND**	ND	ND	ND	0.2	**0.2**	ND	ND	ND	ND	20.5	20.5	NR	NR	ND	ND	ND	ND	0.0001	0.0002	1.42	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**2.2**	**2.2**	**ND**	**ND**	**ND**	**ND**	**21.5**	**21.4**	**NR**	**NR**	**112.0**	**ND**	**ND**	**115**	**0.1120**	**0.0022**	**1.42**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.2**	**0.2**	**ND**	**ND**	**ND**	**ND**	**17.5**	**17.5**	**NR**	**NR**	**12.8**	**ND**	**ND**	**ND**	**0.0001**	**0.0002**	**0.80**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:		Dry	x	Moist		Wet		Snow		Frozen
Wind:		Calm	x	Light		Moderate		Strong		
Cloud cover:		None		Slight		Cloudy	x	Overcast		
Precipitation:		None	x	Slight		Moderate		Heavy		
Time monitoring performed:			11:15	Start			12:30	End		
Barometric pressure (mbar):			1010	Start			1009.8	End		
Pressure trend (Daily):				Falling		Steady	x	Rising		
Source:	weather.com									
Pressure trend (3 day trend):			x	Falling		Steady		Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			8	Before			9	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12746
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 17/04/2023
Date of next external calibration 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 20.65

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 4 **of** 6
Date: 18/05/2023 **Operator:** JWM **Project Manager:** GH

Monitoring Point	GAS CONCENTRATIONS: Methane (%v/v) Peak	Methane (%v/v) Steady	%LEL Peak	%LEL Steady	Carbon dioxide (%v/v) Peak	Carbon dioxide (%v/v) Steady	Carbon monoxide (ppmv) Peak	Carbon monoxide (ppmv) Steady	Hydrogen sulphide (ppmv) Peak	Hydrogen sulphide (ppmv) Steady	Oxygen (%v/v) Min.	Oxygen (%v/v) Steady	VOLATILES: PID Peak (ppm)	Product thickness (mm)	FLOW DATA: Flow rate (l/hr) Peak	Flow rate (l/hr) Steady	Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Qhg per borehole: Methane (l/hr)	CO2 (l/hr)	WELL AND WATER DATA: Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	Comments
WS02	**ND**	ND	ND	ND	2.3	2.3	ND	ND	ND	ND	19.9	19.9	NR	NR	-12.5	ND	ND	19	0.0125	0.0023	1.14	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bailed to 1.85m
Post Bail WS02	**ND**	ND	ND	ND	0.2	0.2	ND	ND	ND	ND	20.1	20.1	NR	NR	ND	ND	ND	ND	0.0001	0.0002	1.45	1.98				
WS03	**ND**	ND	ND	ND	1.4	1.4	ND	ND	ND	ND	19.5	19.5	NR	NR	-7.3	ND	ND	10	0.0073	0.0014	1.24	1.85			1 – 2m: Natural sand	Bailed to 1.48m
Post Bail WS03	**ND**	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	20.6	20.6	NR	NR	ND	ND	ND	ND	0.0001	0.0006	1.26	1.85				
WS04	**ND**	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	20.6	20.6	NR	NR	-67.1	ND	ND	42	0.0671	0.0008	1.06	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bailed to 1.6m
Post Bail WS04	**ND**	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	20.3	20.3	NR	NR	26.6	ND	ND	27	0.0266	0.0008	1.17	2.04				
WS05	**ND**	ND	ND	ND	1.3	1.3	ND	ND	ND	ND	20.2	20.2	NR	NR	ND	ND	ND	ND	0.0001	0.0013	1.24	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bailed to 1.76m
Post Bail WS05	**ND**	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	21.0	21.0	NR	NR	ND	ND	ND	ND	0.0001	0.0001	1.66	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**2.3**	**2.3**	**ND**	**ND**	**ND**	**ND**	**21.0**	**21.0**	**NR**	**NR**	**26.6**	**ND**	**ND**	**42**	**0.0671**	**0.0023**	**1.66**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.1**	**0.1**	**ND**	**ND**	**ND**	**ND**	**19.5**	**19.5**	**NR**	**NR**	**-67.1**	**ND**	**ND**	**ND**	**0.0001**	**0.0001**	**1.06**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:	x	Dry		Moist		Wet		Snow		Frozen
Wind:	x	Calm		Light		Moderate		Strong		
Cloud cover:		None		Slight		Cloudy	x	Overcast		
Precipitation:	x	None		Slight		Moderate		Heavy		
Time monitoring performed:			12:45	Start			14:00	End		
Barometric pressure (mbar):			1027	Start			1027.4	End		
Pressure trend (Daily):				Falling		Steady	x	Rising		
Source:	weather.com									
Pressure trend (3 day trend):				Falling		Steady	x	Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			12	Before			12	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12778
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 11/05/2023
Date of next external calibration 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 21

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 5 **of** 6
Date: 22/05/2023 **Operator:** JWM **Project Manager:** GH

Monitoring Point	GAS CONCENTRATIONS: Methane (%v/v) Peak	Methane (%v/v) Steady	%LEL Peak	%LEL Steady	Carbon dioxide (%v/v) Peak	Carbon dioxide (%v/v) Steady	Carbon monoxide (ppmv) Peak	Carbon monoxide (ppmv) Steady	Hydrogen sulphide (ppmv) Peak	Hydrogen sulphide (ppmv) Steady	Oxygen (%v/v) Min.	Oxygen (%v/v) Steady	VOLATILES: PID Peak (ppm)	Product thickness (mm)	FLOW DATA: Flow rate (l/hr) Peak	Flow rate (l/hr) Steady	Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Qhg per borehole: Methane (l/hr)	CO2 (l/hr)	WELL AND WATER DATA: Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	Comments
WS02	**ND**	ND	ND	ND	6.5	6.5	ND	ND	ND	ND	17.7	17.7	NR	NR	ND	ND	ND	ND	0.0001	0.0065	1.43	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bailed to 1.73m
Post Bail WS02	**ND**	ND	ND	ND	0.8	0.8	ND	ND	ND	ND	20.7	20.7	NR	NR	ND	ND	ND	ND	0.0001	0.0008	1.49	1.98				
WS03	**ND**	ND	ND	ND	2.2	2.2	ND	ND	ND	ND	18.2	18.2	NR	NR	ND	ND	ND	ND	0.0001	0.0022	1.31	1.85			1 – 2m: Natural sand	Bailed to 1.51m
Post Bail WS03	**ND**	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	20.6	20.6	NR	NR	ND	ND	ND	ND	0.0001	0.0006	1.31	1.85				
WS04	**ND**	ND	ND	ND	1.9	1.9	ND	ND	ND	ND	19.4	19.4	NR	NR	ND	ND	ND	ND	0.0001	0.0019	1.19	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bailed to 1.50m
Post Bail WS04	**ND**	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	20.7	20.7	NR	NR	5.8	ND	ND	15	0.0058	0.0006	1.20	2.04				
WS05	**ND**	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	20.3	20.3	NR	NR	ND	ND	ND	ND	0.0001	0.0015	1.29	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bailed to 1.74m
Post Bail WS05	**ND**	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	21.0	21.0	NR	NR	ND	ND	ND	ND	0.0001	0.0005	1.63	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**6.5**	**6.5**	**ND**	**ND**	**ND**	**ND**	**21.0**	**21.0**	**NR**	**NR**	**5.8**	**ND**	**ND**	**15**	**0.0058**	**0.0065**	**1.63**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.5**	**0.5**	**ND**	**ND**	**ND**	**ND**	**17.7**	**17.7**	**NR**	**NR**	**5.8**	**ND**	**ND**	**ND**	**0.0001**	**0.0005**	**1.19**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:	x	Dry		Moist		Wet		Snow		Frozen
Wind:	x	Calm		Light		Moderate		Strong		
Cloud cover:		None	x	Slight		Cloudy		Overcast		
Precipitation:	x	None		Slight		Moderate		Heavy		
Time monitoring performed:			12:05	Start			13:30	End		
Barometric pressure (mbar):			1025	Start			1024.4	End		
Pressure trend (Daily):				Falling		Steady	x	Rising		
Source:	weather.com									
Pressure trend (3 day trend):			x	Falling		Steady		Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			13	Before			13	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12778
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 11/05/2023
Date of next external calibration 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 21.15

Ground Gas and Groundwater Monitoring Record Sheet

JOB DETAILS:

Client: Tracey Little **Job No:** C9758
Site: The Paddock, Harras Moor **Visit No:** 6 **of** 6
Date: 30/05/2023 **Operator:** BAJ **Project Manager:** GH

	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA					Comments
Monitoring Point	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		PID Peak (ppm)	Product thickness (mm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (secs)	Methane (l/hr)	CO2 (l/hr)	Water level (mbgl)	Depth of well (m)	Top of BH (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	**Steady**	Peak	Steady	Peak	Steady	Min.	Steady			Peak	Steady										
WS02	**ND**	ND	ND	ND	2.5	**2.4**	ND	ND	ND	ND	16.4	16.5	NR	NR	NR	NR	NR	NR	NR	NR	1.55	1.98			1 – 1.3m: Natural clay 1.3 – 1.9m: Natural sand 1.9 – 2.0m: Sandstone	Bailed to 1.86m
Post Bail WS02	**ND**	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	20.8	20.8	NR	NR	NR	NR	NR	NR	NR	NR	1.57	1.98				
WS03	**ND**	ND	ND	ND	2.3	2.3	ND	ND	ND	ND	18.8	18.8	NR	NR	NR	NR	NR	NR	NR	NR	1.44	1.85			1 – 2m: Natural sand	Bailed to 1.57m
Post Bail WS03	**ND**	ND	ND	ND	0.3	0.3	ND	ND	ND	ND	20.9	20.9	NR	NR	NR	NR	NR	NR	NR	NR	1.44	1.85				
WS04	**ND**	ND	ND	ND	2.4	2.4	ND	ND	ND	ND	19.1	19.1	NR	NR	NR	NR	NR	NR	NR	NR	1.30	2.04			1 – 2.4m: Natural sand 2.4 – 2.5m: Sandstone	Bailed to 1.45m
Post Bail WS04	**ND**	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	20.6	20.6	NR	NR	NR	NR	NR	NR	NR	NR	1.30	2.04				
WS05	**ND**	ND	ND	ND	1.8	1.8	ND	ND	ND	ND	20.1	20.1	NR	NR	NR	NR	NR	NR	NR	NR	1.39	1.87			1 – 1.4m: Natural clay 1.4 – 1.8m: Natural sand	Bailed to 1.80m
Post Bail WS05	**ND**	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	21.0	21.0	NR	NR	NR	NR	NR	NR	NR	NR	1.74	1.87				
Max	**ND**	**ND**	**ND**	**ND**	**2.5**	**2.4**	**ND**	**ND**	**ND**	**ND**	**21.0**	**21.0**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**1.74**	**2.04**	**NR**	**NR**		
Min	**ND**	**ND**	**ND**	**ND**	**0.1**	**0.1**	**ND**	**ND**	**ND**	**ND**	**16.4**	**16.5**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**1.30**	**1.85**	**NR**	**NR**		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equiment limit of detection (0.1l/hr). Where negative flows recorded, these are converted to positive values for calculation of Qhg.

METEOROLOGICAL AND SITE INFORMATION: (Select correct box with X or enter data, as applicable)

State of ground:	x	Dry		Moist		Wet		Snow		Frozen
Wind:		Calm	x	Light		Moderate		Strong		
Cloud cover:	x	None		Slight		Cloudy		Overcast		
Precipitation:	x	None		Slight		Moderate		Heavy		
Time monitoring performed:			10:00	Start			11:30	End		
Barometric pressure (mbar):			1033	Start			1033.4	End		
Pressure trend (Daily):				Falling		Steady	x	Rising		
Source:	weather.com									
Pressure trend (3 day trend):				Falling		Steady	x	Rising		
Source:	weatheronline.com									
Air Temperature (Deg. C):			14	Before			13	After		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436 - 12746
Gas Range: **CH_4** 0-100% **CO_2** 0-100% **O_2** 0-25%
Gas Flow range: +100 to -60 l/hr
Differential Pressure: +1250/-1250 Pa
Date of last external calibration: 02/03/2023 **Date of last in-house calibration:** 11/05/2023
Date of next external calibration 02/03/2024

Ambient air check: **CH_4** 0 **CO_2** 0 **O_2** 21

WINDOW SAMPLING RECORD

BH No. **WS01**
Sheet 1 of 1

Site: Harras Moor, Whitehaven
Contract No: C9758
Client: Tracey Little
Date: 21/04/2023
Method: Tracked window sampling rig.
Scale: 1:25
Logged By: DG
Checked By: JWM
Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
ES	0.30 - 0.40			Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).	0.30			
				Dark brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. Possible buried topsoil.	0.60			
D	0.90 - 1.00	N=36 (4,5/6,6,8,8,16)		Brown mottled grey very clayey gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal.				
D	1.40 - 1.50	N=50 (15,10/50 for 275mm)		End of Borehole at 1.50m	1.50			

1
2
3
4
5

Remarks and Groundwater Observations:

1. Groundwater observed at 1.4m

GL (m AOD)
Easting:
Northing:

Fig No.
WS01

WINDOW SAMPLING RECORD

BH No. **WS02** Sheet 1 of 1

Site: Harras Moor, Whitehaven

Contract No: C9758

Client: Tracey Little

Date: 21/04/2023

Method: Tracked window sampling rig.

Scale: 1:25

Logged By: DG | Checked By: JWM

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
ES	0.00 - 0.10			Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).				
				Firm to stiff orange brown mottled grey very sandy slightly gravelly CLAY of high plasticity (field estimate). Gravel is angular to sub rounded fine to coarse sandstone and occasional coal.	0.30			
			1	*From 1.1m to 1.3m: Becomes red brown.*				
		N=18 (0,0/2,5,5,6)	▼					
				Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.30			
D	1.50 - 1.60							
				Weak red brown silty fine to coarse SANDSTONE.	1.90			
		N=50 (7,8/50 for 230mm)	2	End of Borehole at 2.00m	2.00			
			3					
			4					
			5					

Remarks and Groundwater Observations:

1. Inspection pit dug to 1.2m. 2. Groundwater observed at 1.3m.

GL (m AOD)

Easting:

Northing:

Fig No.

WS02

WINDOW SAMPLING RECORD

BH No. **WS03**
Sheet 1 of 1

Site: Harras Moor, Whitehaven
Contract No: C9758
Client: Tracey Little
Date: 21/04/2023
Method: Tracked window sampling rig.
Scale: 1:25
Logged By: DG
Checked By: JWM
Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
		28.0		Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).				
				Soft to firm low strength orange brown mottled grey very sandy CLAY of high plasticity (field estimate). Root fragments present to 0.8m.	0.25			
D	0.80 - 0.90	45.0						
		N=23 (2,4/4,5,6,8)	1	Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.00			
D	1.50 - 1.60							
		50 (8,17/50 for 245mm)	2	End of Borehole at 2.00m	2.00			
			3					
			4					
			5					

Remarks and Groundwater Observations:

1. Groundwater observed at 1.3m.

GL (m AOD)
Easting:
Northing:

Fig No.
WS03

WINDOW SAMPLING RECORD

BH No. **WS04** Sheet 1 of 1

Site: Harras Moor, Whitehaven

Contract No: C9758

Client: Tracey Little

Date: 21/04/2023

Method: Tracked window sampling rig.

Scale: 1:25

Logged By: DG Checked By: JWM

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
				Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).				
				Dark brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. Possible buried topsoil.	0.30			
				Stiff orange brown and brown very sandy slightly gravelly CLAY of high plasticity (field estimate). Gravel is angular to sub rounded fine to coarse sandstone and occasional coal.	0.50			
			1	Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.00			
		N=18 (3,3/4,5,4,5)						
D	1.50 - 1.60							
			2	Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.90			
D	2.10 - 2.20	N=13 (1,2/2,4,3,4)						
				Weak red brown silty fine to coarse SANDSTONE.	2.40			
		25 (25,25/25 for 235mm)		End of Borehole at 2.50m	2.50			
			3					
			4					
			5					

Remarks and Groundwater Observations:

1. Inspection pit dug to 1.2m. 2. Groundwater observed at 1.2m.

GL (m AOD)

Easting:

Northing:

Fig No.

WS04

WINDOW SAMPLING RECORD

BH No. **WS05** Sheet 1 of 1

Site: Harras Moor, Whitehaven

Contract No: C9758

Client: Tracey Little

Date: 21/04/2023

Method: Tracked window sampling rig.

Scale: 1:25

Logged By: DG | Checked By: JWM

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
ES	0.10 - 0.20			Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).				
				Firm low to medium strength orange brown mottled grey very sandy CLAY of high plasticity (field estimate).	0.30			
		40.0						
D	0.80 - 0.90			*From 0.8m to 1.4m: Becomes medium strength.*				
		53.0						
		N=16 (2,2/3,4,4,5)	1					
				Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.40			
D	1.50 - 1.60							
		50 (15,10/50 for 240mm)		End of Borehole at 1.80m	1.80			
			2					
			3					
			4					
			5					

Remarks and Groundwater Observations:

1. Groundwater not observed.

GL (m AOD)

Easting:

Northing:

Fig No.

WS05

WINDOW SAMPLING RECORD

BH No. **WS06** Sheet 1 of 1

Site: Harras Moor, Whitehaven

Contract No: C9758

Client: Tracey Little

Date: 21/04/2023

Method: Tracked window sampling rig.

Scale: 1:25

Logged By: DG Checked By: JWM

Driller: DMW Drilling Ltd

SAMPLE DETAILS				STRATA RECORD				
Type	Depth From - To(m)	SPT (N), {ppm}, Vane Result (kN/m2)	Ground-water	Description	Depth (m)	Level (m AOD)	Legend	Well
				Brown clayey slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse sandstone, limestone, occasional coal. (Topsoil).	0.20			
				Firm low strength orange brown mottled grey very sandy CLAY of high plasticity (field estimate).				
		31.0		*At 0.8m: Ceramic field drain.*				
		N=12 (1,0/2,3,3,4)	1					
		61.0		*From 1.2m to 1.3m: Becomes medium strength.*				
				Red brown silty slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse sandstone and occasional coal. Occasional cobbles of sandstone.	1.30			
		50 (16,9/50 for 240mm)		End of Borehole at 1.80m	1.80			
			2					
			3					
			4					
			5					

Remarks and Groundwater Observations:

1. Groundwater observed at 1.7m

GL (m AOD)

Easting:

Northing:

Fig No.

WS06