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David Wright
Gleeson Developments Ltd
Rural Enterprise Centre
Redhills
Penrith
Cumbria
CA11 0DT

Date: 30 August 2019

Ref: C8071/7411/APC/APC

Dear David,

Re: C8071 – How Bank Farm, Egremont – Ground Gas Monitoring Addendum Letter

Further to our Geoenvironmental Appraisal Report for the above site (Sirius Report Ref. C8071A, dated July 2019) the planned period of ground gas monitoring is now complete. This letter presents the results of that monitoring and an assessment of the risk posed by hazardous ground gases to the proposed development.

Whilst this letter discusses pertinent findings of the investigation, it must be read in conjunction with the aforementioned report, which presents in detail the site setting and the findings of previous phases of investigation.

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” (BS8485);
- 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;
- NHBC “Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present”, report version 04, March 2007.

It is understood that the proposed development will comprise low rise residential properties. For the purposes of gas risk assessment, the proposed development is therefore considered to be characterised as comprising Type A buildings, as defined in Table 3 of BS 8485:2015.

Site Characterisation Relevant to Gas Risk Assessment

Site History

Historical OS maps show the site to have largely remained as open farm land since at least the mid 1800s. A dam and associated reservoir/ pond are recorded immediately south of the site in the early 1900s, with the pond extending into the south-west of the site. The pond is not recorded by the mid 1900s; possibly as a consequence of natural infilling behind the dam. Surrounding land has been largely rural, with a small stream, a spring, pond and marshy areas 10m to the south and west, with the stream possibly partly culverted in the mid 1900s. Quarries are recorded 100m west and 270m south-west in the late 1800s/ early 1900s, although these appear to remain unfilled.

Summary of Relevant Site Investigation Works

The intrusive ground investigation included the excavation of 10 No. trial pits, the drilling of 8 No. window sample boreholes and hand sampling of shallow soils at two locations.

Geology

Site investigation evidence indicates the following geological sequence to underlay the site:

- Topsoil, up to 0.4m thick.
- Very localised made ground, comprising sandy gravel of sandstone and concrete with brick and coal, present in the south-east corner only to a depth of 0.7m.
- Natural soils comprising firm and stiff red brown sandy gravelly clay across the elevated north-west of the site; and granular soils ranging from sandy silty to sandy gravelly across lower lying central and eastern areas.
- Rockhead was not proven during the investigation but is anticipated to comprise Triassic St. Bees Sandstone strata.

Hydrogeology

The cohesive and granular superficial strata underlying the site are classified by the Environment Agency (EA) as a Secondary (Undifferentiated) Aquifer and Secondary (A) Aquifer, respectively.

The underlying St Bees Sandstone bedrock is classified as a Principal Aquifer.

There are no recorded groundwater abstractions within 1km of the site, although the site does fall within Zone III (Total Catchment) of a groundwater Source Protection Zone (SPZ), associated with public supply abstractions 1km to 1.25km to the south of the site.

The site is not recorded by the EA to be at significant risk of flooding from rivers, although lower lying areas immediately adjacent to the southern boundary are recorded to be at risk of such flooding, and it is understood that the EA is presently considering constructing flood alleviation measures in that area and encroaching into the site.

The site is recorded by the BGS to have limited potential for groundwater flooding of property situated below ground level.

It should also be noted that shallow groundwater was frequently recorded in monitoring wells. During a number of monitoring visits, groundwater within the wells was purged using a bailer, to allow further characterisation of groundwater levels and gas monitoring. Wells notably recharged relatively quickly following such purging.

Waste Disposal

There are no areas of recorded landfill within 500m of the site.

Chemical Contamination that could Influence Ground Gas Composition

No chemical contamination which could influence ground gas composition (e.g. hydrocarbon impacted soils) was identified during the ground investigation.

Ground Gas Monitoring Data

Based upon a perceived very low source potential and high sensitivity end use, a ground gas monitoring programme comprising six visits over a period of three months was specified.

The wells selected for monitoring are described in detail in the above-referenced Geoenvironmental Appraisal Report and are shown on the Exploratory Hole Location Plan presented in Attachment A.

Ground gas and groundwater monitoring wells were installed into 6 No. boreholes, although one monitoring well located toward the middle of the site (WS05) was subsequently lost, possibly owing to the actions of farm animals prior to the first monitoring visit. Wells were screened into screened into superficial deposits. Boreholes WS03, WS06 and WS07 into which wells were installed, were preferentially located in granular soils in the area of the site closest to the perceived source i.e. organic soils associated with the water course, former ponds and culverting along the south-west of the site.

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

The monitoring was carried out during the summer season, with monitoring events covering barometric pressure conditions ranging from 995 to 1010mbar. Two visits coincided with periods of barometric pressure at or below 1000mb, with one visit occurring during a period of low and falling atmospheric pressure. The monitoring is therefore considered to have captured 'worst case' ground gas conditions.

Monitoring was undertaken on 6 No. occasions. Shallow groundwater was frequently encountered within monitoring wells, particularly those installed into boreholes WS01, 02 and 03 in the north of the site. Whilst this did not directly preclude gas monitoring, it is recognised that groundwater levels on a number of occasions were higher than the top of the slotted 'response zone' section of monitoring well and/or were within sections of well confined by surrounding low permeability glacial till, which is known to have a considerable impact on peak borehole flow rates and to a lesser extent, gas concentrations.

Consequently, where this was the case, the monitoring wells were purged to lower the water level and were subsequently monitoring again approximately 1 hour following purging. This method can provide some additional data, although it is recognised that both gas flow rates and concentrations of ground gases within purged wells are very unlikely to have re-

equilibrated at the time of the subsequent monitoring. Therefore data obtained in this way must be considered cautiously.

In such cases, borehole flow rates have been carefully reviewed to ensure flow rates used for the risk assessment are not attributable to rapid gas pressures changes during monitoring, within the upper section of the monitoring well, where the base of the well has been sealed by shallow and potentially rising/ re-equilibrating groundwater levels within the well.

Table 1 summarises the gas monitoring results obtained, taking into consideration the constraints noted above.

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	Steady
WS01	Cohesive soil	ND	2.2	14.0	ND	ND	87.1*	ND
WS02	Cohesive and granular soils	ND	7.4	11.7	ND	ND	102.9*	3.1*
WS03	Granular soil	ND	2.5	19.3	ND	ND	34.3*	ND
WS06	Granular soil	ND	3.6	17.8	ND	ND	ND	ND
WS07	Granular soil	ND	2.5	18.6	ND	ND	ND	ND

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

* Significantly high peak and steady state flows considered attributable to shallow groundwater and sealed well conditions. These highest positive flow values are noted to anomalously occur during a period of high atmospheric pressure and are considered not indicative of natural flow rates associated with atmospheric fluctuations. Maximum recorded peak flow excluding such occurrences is considered to be 0.6l/hr, recorded in WS02. No recorded steady state flow excluding such occurrences.

Revised Conceptual Site Model for Hazardous Ground Gases

Ground Gas Sources

The most significant potential sources of ground gases at this site, based on the conceptual site model as presented in the report of January 2019, is considered to be organic soils associated with the water course, former ponds, dams, culverting etc. along the southern and south-western boundaries of the site.

Transport Pathways

Perceived migratory pathways with respect to ground gases included vertical and lateral migration through anticipated highly permeable granular soils proven across much of the centre and south of the site.

Receptors

Proposed future buildings and their occupants, and possibly construction/ maintenance workers operating within enclosed spaces below ground level during the development phase, resulting from the presence of elevated concentrations of methane and/ or carbon dioxide, or depleted oxygen concentrations.

Ground Gas Risk Assessment

The risk assessment considers both the detected concentrations of ground gases and borehole flow rates, in accordance with BS8485. 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).

A 'worst case check' Q_{hg} value has also been calculated for both carbon dioxide and methane.

As noted previously, high peak flow rates have been recorded on occasion. Such flow rates are not consistent with the conceptual model for the site, but are considered to be anomalous and associated with shallow groundwater levels, close to or above the base of sealed sections of monitoring wells. Such incidences can result in abnormally high borehole flow rates being driven by rapidly rising groundwater within the monitoring wells, and are not representative of typical ground gas flux conditions.

In light of this, a peak borehole flow rate of 0.6l/hr, as recorded in borehole WS02 during a period of substantially falling atmospheric pressure, which could reasonably be expected as representative of flow rates during periods of falling or low atmospheric pressures, has been adopted as representative of a worst case positive peak flow rate.

Excluding 'steady state' flows associated with these anomalous positive flow rates, a maximum detected steady state flow rate of 0.2l/hr was recorded, in WS02.

A 'worst case check' Q_{hg} value for **methane**, based on an assumed worst case maximum concentration based on the limit of detection of the monitoring equipment of 0.1%v/v, together with the adopted worst case detected peak flow rate (0.6l/hr, as discussed above), is **0.0006l/hr**.

A 'worst case check' for **carbon dioxide**, in accordance with BS8485 Section 6.3.7.4, based on the maximum recorded concentration of carbon dioxide in any well on any occasion, of 7.4%v/v together with the worst case steady state flow rate detected of 0.2l/hr, is **0.0148l/hr**.

No detectable concentrations of hydrogen sulphide or carbon monoxide were identified and the potential risk from such gases is considered negligible.

Persistently lower than atmospheric oxygen concentrations (<18%v/v) have been recorded in wells installed into WS01 and WS02, although these concentrations also appear to be associated with flooded monitoring wells.

On the basis of the worst case Q_{hg} values, the site would currently be considered to fall within Characteristic Situation (CS) 1 as defined in BS8485.

However, in addition to Q_{hg} values, BS8485 also requires that, for a site to be considered as CS1, then concentrations of methane and carbon dioxide should typically be <1% and <5% respectively.

This monitoring programme has consistently recorded concentrations of methane of <1% in all wells, and concentrations of methane can be considered to be typically <1%, concurring with a CS1 scenario.

Two instances of carbon dioxide in excess of 5%v/v have also been recorded, although concentrations are typically in the range 1% to 4% and it can be reasoned that carbon dioxide concentrations are typically <5%v/v, also concurring with a CS1 scenario.

Conclusions and Recommendations

On the basis of the data obtained, and the previous assessment of that data, the site could be considered to fall within Characteristic Situation (CS) 1 as defined in BS8485, for which no specific precautions are considered necessary for the protection of proposed residential properties.

This assessment is in general agreement with the historical and environmental setting of the site, and the revised conceptual model for the site with respect to ground gas risk potential.

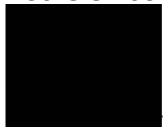
The site is located within an area where no additional gas protection measures are required for protection of proposed new buildings from the ingress of radon gas.

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 substantially depleted oxygen concentrations identified within the shallow soils, it is 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. This is particularly pertinent for excavations which extend to rockhead, or in the vicinity of the mineshaft. 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.

Yours sincerely

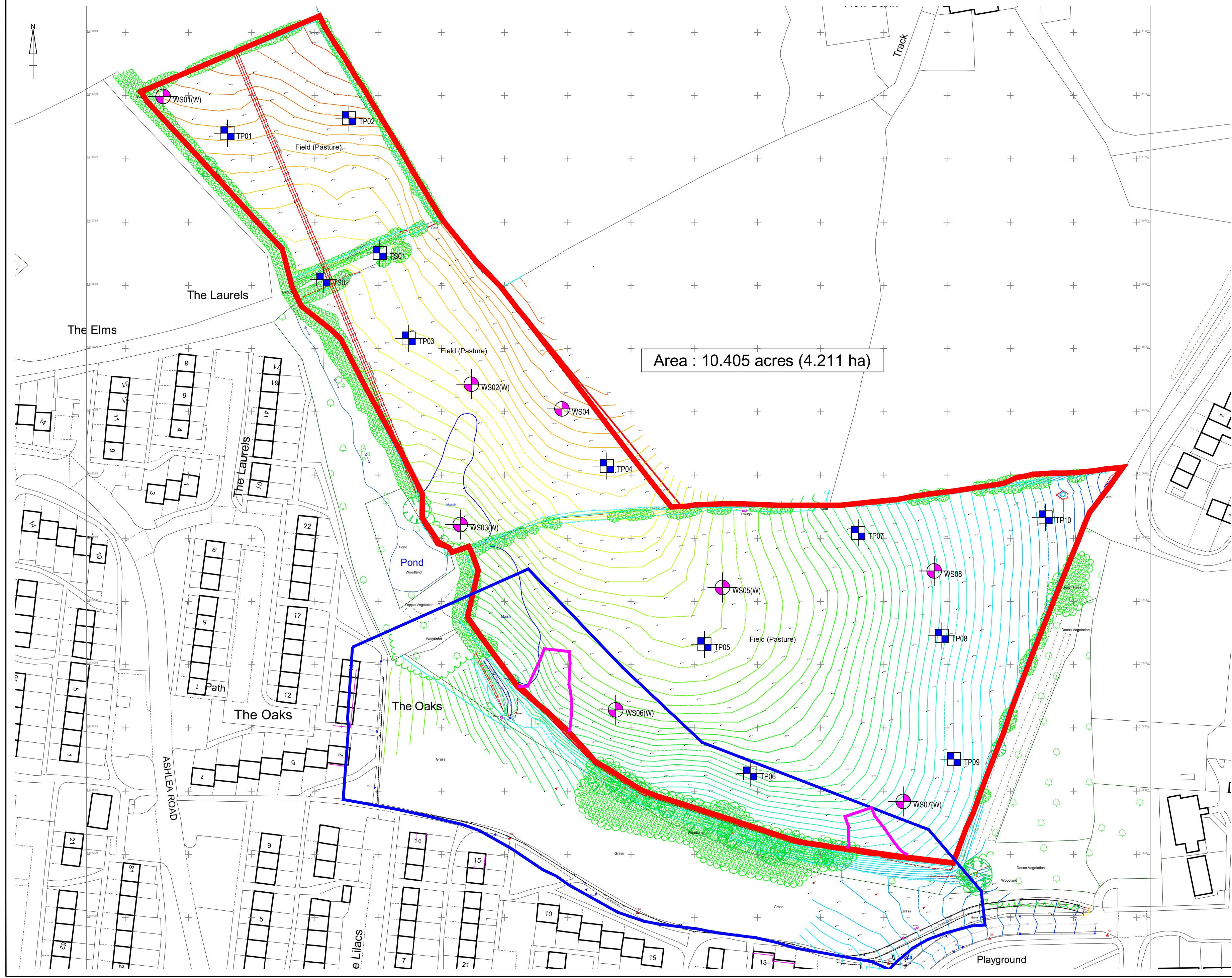


Alastair Cook
Principal Engineer

For and on behalf of Sirius Geotechnical Ltd

Enc.: Attachment A. Drawings.

Attachment B. Ground Gas Monitoring Results.



NOTES

- Site Boundary
- Extent of Environment Agency Flood Alleviation Scheme
- Proposed Embankments as Part of EA Works
- Window Sample (W - With Well)
- Trial Pits

REVISION	BY	DATE
0 For Information	MF	31/05/19
A >>	>>	>>
B >>	>>	>>
C >>	>>	>>
D >>	>>	>>

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CLIENT

Gleeson Regeneration Ltd

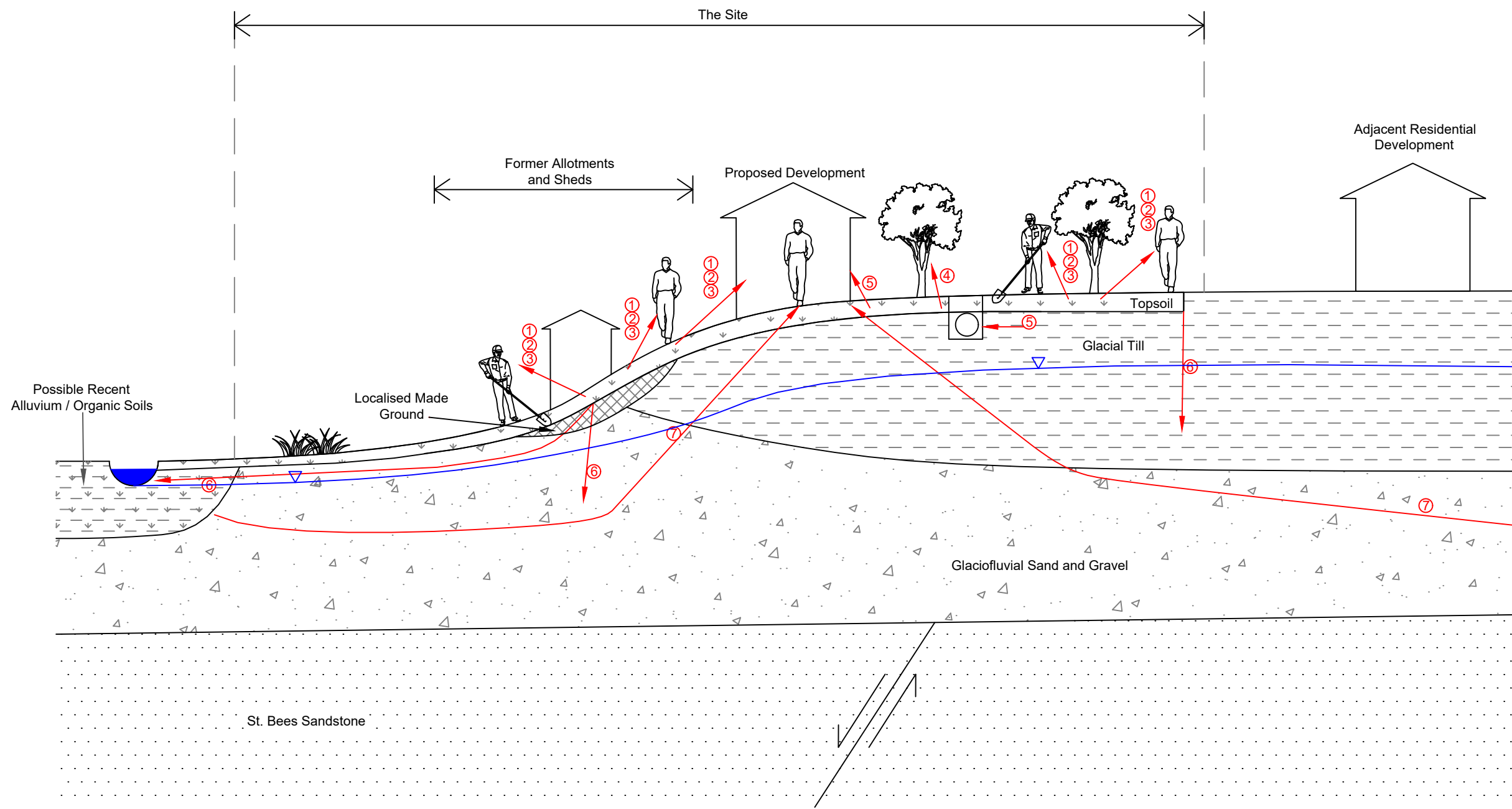
SITE

**How Bank Farm,
Egremont,
Cumbria**

DRAWING TITLE

**Exploratory Hole
Location Plan**

DRAWING NO. C8071A/03	REVISION NO. 0	
DRAWN BY MF	APPROVED BY APC	
DATE June 2019	SCALE 1:1000	PAPER SIZE A2



Contamination Sources	Contamination Pathway	Potential Receptors	Likelihood of Significant Pollutant Linkage
Metal, metalloid, organic and inorganic contaminants including asbestos in agricultural topsoil	1. Direct and indirect ingestion	End users	Low
	2. Inhalation of contaminant particles/dust/vapours	Construction workers	
	3. Dermal contact		
	4. Plant uptake	Gardens and Landscaping	Low
	5. Direct contact with construction materials	Construction products incl. buried concrete and plastics	Low
	6. Leaching	Controlled waters	Low
Metal, metalloid, organic and inorganic contaminants including asbestos in shallow made ground/ topsoil around former allotments	1. Direct and indirect ingestion	End users	Low
	2. Inhalation of contaminant particles/dust/vapours	Construction workers	
	3. Dermal contact		
	4. Plant uptake	Landscaping	Low
	5. Direct contact with construction materials	Construction products incl. buried concrete and plastics	Low
	6. Leaching	Controlled waters	Low
Generation of hazardous gases in possible nearby shallow organic soils associated with stream, and off site backfilled quarries.	7. Migration through permeable soils	End Users	Low
		Construction Workers	Low
		Built Environment	Low

NOTES

REVISION	BY	DATE
0	For Information	MF 03/07/19
A	Updated Following Gas Monitoring	MF 28/08/19
B	>>	>>
C	>>	>>
D	>>	>>

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Gleeson Regeneration Ltd

SITE

How Bank Farm,
Egremont,
Cumbria

DRAWING TITLE

Revised Conceptual
Site Model

DRAWING NO. C8071A/04A	REVISION NO. A	
DRAWN BY MF	APPROVED BY APC	
DATE August 2019	SCALE NTS	PAPER SIZE A3

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 20/06/2019

Job No: C8071
Visit No: 1 of 6
Operator: DB

Project Manager: APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA			Qhg per borehole		WELL AND WATER DATA						Comments
	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										
WS01	ND	ND	ND	ND	1.2	1.2	ND	ND	ND	ND	17.2	17.2	NR	NR	71.4	ND	0.0	25S	0.0714	0.0012	0.90	3.00	NR	NR	Clay	
WS02																									Clay and sand	Not found
WS03	ND	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	19.3	19.3	NR	NR	45.4	ND	0.0	30S	0.0454	0.0015	0.63	2.28	NR	NR	Sand	
WS05																									Sand and clay	Not found
WS06																									Sand	Not found
WS07	ND	ND	ND	ND	2.4	2.4	ND	ND	ND	ND	18.9	18.9	NR	NR	ND	ND	0.0	0	0.0001	0.0024	DRY	3.06	NR	NR	Sand	
Max	ND	ND	ND	ND	2.4	2.4	ND	ND	ND	ND	19.3	19.3	NR	NR	71.4	ND	0.0	0	0.0714	0.0024	0.90				NR	
Min	ND	ND	ND	ND	1.2	1.2	ND	ND	ND	ND	17.2	17.2	NR	NR	45.4	ND	0.0	0	0.0001	0.0012	DRY				NR	

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☒ Moist ☐ Wet ☐ Snow ☐ Frozen
Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
Time monitoring performed: ☐ Start ☐ End
Barometric pressure (mbar): ☐ 12.00 ☐ 1007 ☐ End
Pressure trend (Daily): ☐ Falling ☒ Steady ☐ Rising
Source: ☐ weatheronline.co.uk
Air Temperature (Deg. C): ☐ 19 Before ☐ 19 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12778
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 07/06/2019
Date of next calibration: 01/07/2019

Ambient air check: CH₄ ☐ ND ☐ CO₂ ☐ ND ☐ O₂ ☐ 20.2

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 24/06/2019

Job No: C8071
Visit No: 2 of 6
Operator: DB

Project Manager: APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA						Comments
	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											
WS01	ND	ND	ND	ND	1.2	1.2	ND	ND	ND	ND	18.1	18.1	NR	NR	22.8	ND	0.0	38	0.0228	0.0012	0.82	3.00	NR	NR	Clay	Bailed to 2.84m, 5.5L removed	
WS02	ND	ND	ND	ND	2.0	2.0	ND	ND	ND	ND	19.2	19.2	NR	NR	55.8	ND	0.0	20	0.0558	0.0020	0.91	3.00	NR	NR	Clay and sand	Bailed to 2.79m, 3.5L removed	
WS03	ND	ND	ND	ND	1.1	1.1	ND	ND	ND	ND	19.9	19.9	NR	NR	ND	ND	0.0	0	0.0001	0.0011	0.70	2.28	NR	NR	Sand	Bailed to 2.06m, 2.5L removed	
WS05																									Sand and clay	Not found	
WS06	ND	ND	ND	ND	3.0	3.0	ND	ND	ND	ND	18.1	18.1	NR	NR	ND	ND			0.0001	0.0030	1.94	3.02	NR	NR	Sand		
WS07	ND	ND	ND	ND	2.5	2.5	ND	ND	ND	ND	18.6	18.6	NR	NR	ND	ND			0.0001	0.0025	DRY	3.06	NR	NR	Sand		
WS 01	ND	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	20.6	20.6	NR	NR	ND	ND			0.0001	0.0001	2.71	3.01				Monitored 1hr following bailing	
WS 02	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	20.3	20.3	NR	NR	89.4	ND	0.0	45	0.0894	0.0004	1.84	3.00				Monitored 1hr following bailing	
WS 03	ND	ND	ND	ND	0.5	0.5	ND	ND	ND	ND	20.4	20.4	NR	NR	120.0	ND	0.0	90	0.1200	0.0005	1.59	2.46				Monitored 1hr following bailing	
Max	ND	ND	ND	ND	3.0	3.0	ND	ND	ND	ND	20.6	20.6	NR	NR	120.0	ND	0.0	90	0.1200	0.0030	2.71			NR			
Min	ND	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	18.1	18.1	NR	NR	22.8	ND	0.0	0	0.0001	0.0001	DRY			NR			

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☐ Moist ☒ Wet ☐ Snow ☐ Frozen
Wind: ☒ Calm ☐ Light ☐ Moderate ☐ Strong
Cloud cover: ☐ None ☐ Slight ☐ Cloudy ☒ Overcast
Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
Time monitoring performed: ☐ 11.30 Start ☐ 15.30 End
Barometric pressure (mbar): ☐ 1005 Start ☐ 1005 End
Pressure trend (Daily): ☐ Falling ☒ Steady ☐ Rising
Source: ☐ weatheronline.co.uk
Air Temperature (Deg. C): ☐ 18 Before ☐ 22 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12778
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 07/06/2019
Date of next calibration: 01/07/2019

Ambient air check: CH₄ ☐ ND ☐ CO₂ ☐ ND ☐ O₂ ☐ 20.8

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 08/07/2019

Job No: C8071
Visit No: 3 of 6
Operator: DB **Project Manager:** APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA						Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)				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															
WS01	ND	ND	ND	ND	2.2	2.2	ND	ND	ND	ND	14.0	14.0	NR	NR	0.5	ND	0.0	3	0.0005	0.0022	1.28	3.00	NR	NR	Clay		
WS02	ND	ND	ND	ND	7.2	7.2	ND	ND	ND	ND	12.9	12.9	NR	NR	0.6	ND	0.0	8	0.0006	0.0072	1.24	3.00	NR	NR	Clay and sand		
WS03	ND	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	19.6	19.6	NR	NR	ND	ND	0.0	0	0.0001	0.0015	0.87	2.28	NR	NR	Sand	Bailed to 1.98m, 2.5L removed	
WS05																									Sand and clay	Not found	
WS06	ND	ND	ND	ND	3.6	3.6	ND	ND	ND	ND	17.8	17.8	NR	NR	ND	ND	0.0	0	0.0001	0.0036	1.92	3.02	NR	NR	Sand		
WS07	ND	ND	ND	ND	2.5	2.5	ND	ND	ND	ND	18.8	18.8	NR	NR	ND	ND	0.0	0	0.0001	0.0025	3.03	3.06	NR	NR	Sand		
WS 03	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	20.4	20.4	NR	NR	-12.3	ND	0.0	0	0.0123	0.0004	1.36	2.36	NR	NR		Monitored 1hr following bailing	
Max	ND	ND	ND	ND	7.2	7.2	ND	ND	ND	ND	20.4	20.4	NR	NR	0.6	ND	0.0	8	0.0123	0.0072	3.03			NR			
Min	ND	ND	ND	ND	0.4	0.4	ND	ND	ND	ND	12.9	12.9	NR	NR	-12.3	ND	0.0	0	0.0001	0.0004	0.87			NR			

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☐ Moist ☐ Wet ☐ Snow ☐ Frozen
 Wind: ☒ Calm ☐ Light ☐ Moderate ☐ Strong
 Cloud cover: ☐ None ☐ Slight ☐ Cloudy ☒ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
 Time monitoring performed: ☐ 11.30 Start ☐ 12.45 End
 Barometric pressure (mbar): ☐ 1010 Start ☐ 1010 End
 Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
 Source:
 Air Temperature (Deg. C): Before After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12778
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 01/07/2019
Date of next calibration: 05/08/2019
Ambient air check: CH₄ CO₂ O₂

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 22/07/2019

Job No: C8071
Visit No: 4 of 6
Operator: DB
Project Manager: APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA			Qhg per borehole		WELL AND WATER DATA						Comments
	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										
WS01	ND	ND	ND	ND	2.2	2.2	ND	ND	ND	ND	17.4	17.4	NR	NR	41.1	ND	1.0	19	0.0411	0.0022	1.11	3.00	NR	NR	Clay	
WS02	ND	ND	ND	ND	7.4	7.4	ND	ND	ND	ND	11.7	11.7	NR	NR	98.2	3.1	22.0	225	0.0982	0.2294	0.91	3.00	NR	NR	Clay and sand	Bailed to 2.6m, 8.5L removed
WS03	ND	ND	ND	ND	1.7	1.7	ND	ND	ND	ND	19.6	19.6	NR	NR	34.3	ND	1.0	14	0.0343	0.0017	0.57	2.28	NR	NR	Sand	Bailed to 1.92m, 3.5L removed
WS05																									Sand and clay	Not found
WS06	ND	ND	ND	ND	2.0	2.0	ND	ND	ND	ND	19.1	19.1	NR	NR	ND	ND	0.0	0	0.0001	0.0020	1.78	3.03	NR	NR	Sand	
WS07	ND	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	19.5	19.5	NR	NR	ND	ND	0.0	0	0.0001	0.0015	DRY	3.06	NR	NR	Sand	
WS 02	ND	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	19.6	19.6	NR	NR	101.1	6.1	36.0	210	0.1011	0.0915	1.19	3.00	NR	NR		Monitored 1hr 45 following bailing
WS 03	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	20.4	20.4	NR	NR	111.4	3.0	2.5	290	0.1114	0.0180	1.45	2.18	NR	NR		Monitored 1hr 45 following bailing
Max	ND	ND	ND	ND	7.4	7.4	ND	ND	ND	ND	20.4	20.4	NR	NR	111.4	6.1	36.0	290	0.1114	0.2294	1.78			NR		
Min	ND	ND	ND	ND	0.6	0.6	ND	ND	ND	ND	11.7	11.7	NR	NR	34.3	3.0	0.0	0	0.0001	0.0015	DRY			NR		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☒ Moist ☒ Wet ☐ Snow ☐ Frozen
 Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
 Cloud cover: ☐ None ☐ Slight ☐ Cloudy ☒ Overcast
 Precipitation: ☒ None ☐ Slight ☐ Moderate
 Time monitoring performed: ☐ 11.30 Start ☐ 14.45 End
 Barometric pressure (mbar): ☐ 1006 Start ☐ 1007 End
 Pressure trend (Daily): ☐ Falling ☒ Steady ☐ Rising
 Source:
 Air Temperature (Deg. C): Before After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM437-12778
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 01/07/2019
Date of next calibration: 05/08/2019

Ambient air check: CH₄ CO₂ O₂

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 05/08/2019

Job No: C8071
Visit No: 5 of 6
Operator: DB **Project Manager:** APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA			Qhg per borehole		WELL AND WATER DATA						Comments
	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										
WS01	ND	ND	ND	ND	1.8	1.8	ND	ND	ND	ND	18.2	18.2	0.0	0.0	87.1	ND	0.0	10	0.0871	0.0018	1.07	3.00	NR	NR	Clay	
WS02	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	18.8	18.8	0.0	1.1	102.9	0.2	2.0	165	0.1029	0.0074	0.99	2.99	NR	NR	Clay and sand	
WS03	ND	ND	ND	ND	1.3	1.3	ND	ND	ND	ND	20.2	20.2	0.0	0.0	8.5	ND	0.0	10	0.0085	0.0013	0.59	2.28	NR	NR	Sand	
WS05																									Sand and clay	Not found
WS06	ND	ND	ND	ND	2.5	2.5	ND	ND	ND	ND	19.5	19.5	0.0	0.1	ND	ND	0.0	0	0.0001	0.0025	1.83	3.03	NR	NR	Sand	
WS07	ND	ND	ND	ND	2.1	2.1	ND	ND	ND	ND	19.6	19.6	0.0	0	ND	ND	0.0	0	0.0001	0.0021	DRY	3.06	NR	NR	Sand	
Max	ND	ND	ND	ND	3.7	3.7	ND	ND	ND	ND	20.2	20.2	0	1.1	102.9	0.2	2.0	165	0.1029	0.0074	1.83			NR		
Min	ND	ND	ND	ND	1.3	1.3	ND	ND	ND	ND	18.2	18.2	0	0	8.5	0.2	0.0	0	0.0001	0.0013	DRY			NR		

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☒ Moist ☐ Wet ☐ Snow ☐ Frozen
Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
Time monitoring performed: ☐ 11.30 Start ☐ 13.30 End
Barometric pressure (mbar): ☐ 995 Start ☐ 995 End
Pressure trend (Daily): ☒ Falling ☐ Steady ☐ Rising
Source: ☐ weatheronline.co.uk
Air Temperature (Deg. C): ☐ 18 Before ☐ 26 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-127446
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 05/08/2019
Date of next calibration: 01/09/2019

Ambient air check: CH₄ ☐ ND ☐ CO₂ ☐ ND ☐ O₂ ☐ 21.2

Ground Gas and Groundwater Monitoring Record Sheet



JOB DETAILS:

Client: Gleeson Rregeneration.Ltd
Site: How Bank Farm, Egremont
Date: 19/08/2019

Job No: C8071
Visit No: 6 of 6
Operator: DB

Project Manager: APC

Monitoring Point	GAS CONCENTRATIONS												VOLATILES		FLOW DATA				Qhg per borehole		WELL AND WATER DATA						Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)				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													
	WS01	ND	ND	ND	ND	1.4	1.4	ND	ND	ND	ND	18.5	18.5	NR	NR	0.1	ND	0.0	1	0.0001	0.0014	0.97	3.00	NR	NR	Clay	
WS02	ND	ND	ND	ND	3.8	3.8	ND	ND	ND	ND	18.2	18.2	NR	NR	ND	ND	0.0	0	0.0001	0.0038	0.81	2.99	NR	NR	Clay and sand	Bailed to 2.65m, 7.5L removed	
WS03	ND	ND	ND	ND	2.5	2.5	ND	ND	ND	ND	19.0	19.0	NR	NR	ND	ND	0.0	0	0.0001	0.0025	0.60	2M	NR	NR	Sand	Bailed to 1.85m, 3.0L removed	
WS05																									Sand and clay		
WS06	ND	ND	ND	ND	3.0	3.0	ND	ND	ND	ND	19.2	19.2	NR	NR	ND	ND	0.0	0	0.0001	0.0030	1.13	3.03	NR	NR	Sand		
WS07	ND	ND	ND	ND	2.1	2.1	ND	ND	ND	ND	19.4	19.4	NR	NR	ND	ND	0.0	0	0.0001	0.0021	DRY	3.06	NR	NR	Sand		
WS 01	ND	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	21.2	21.2	NR	NR	1.8	ND	0.0	3	0.0018	0.0001	2.80	3.00	NR	NR		Monitored 1hr 10 following bailing	
WS 02	ND	ND	ND	ND	0.3	0.3	ND	ND	ND	ND	21.0	21.0	NR	NR	ND	ND	0.0	0	0.0001	0.0003	1.56	2.00	NR	NR		Monitored 1hr 15 following bailing	
WS 03	ND	ND	ND	ND	0.9	0.9	ND	ND	ND	ND	20.6	20.6	NR	NR	ND	ND	0.0	0	0.0001	0.0009	1.11	2.00	NR	NR		Monitored 1hr 20 following bailing	
Max	ND	ND	ND	ND	3.8	3.8	ND	ND	ND	ND	21.2	21.2	NR	NR	1.8	ND	0.0	3	0.0018	0.0038	2.80			NR			
Min	ND	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	18.2	18.2	NR	NR	0.1	ND	0.0	0	0.0001	0.0001	DRY			NR			

ND - Not detected

NR - Not recorded

NB: Where no flow (ND) recorded, Qhg values are calculated using equipment 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 ☒ Moist ☐ Wet ☐ Snow ☐ Frozen
Wind: ☐ Calm ☒ Light ☐ Moderate ☐ Strong
Cloud cover: ☐ None ☒ Slight ☐ Cloudy ☐ Overcast
Precipitation: ☒ None ☐ Slight ☐ Moderate ☐ Heavy
Time monitoring performed: ☐ 11.30 Start ☐ 15.00 End
Barometric pressure (mbar): ☐ 999 Start ☐ 1002 End
Pressure trend (Daily): ☐ Falling ☒ Steady ☐ Rising
Source: ☐ weatheronline.co.uk
Air Temperature (Deg. C): ☐ 17 Before ☐ 20 After

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GFM436-12746
Gas Range: CH₄ CO₂ O₂
Gas Flow range:
Differential Pressure:
Date of last calibration: 09/05/2019
Date of next calibration: 01/09/2019

Ambient air check: CH₄ ☐ ND ☐ CO₂ ☐ ND ☐ O₂ ☐ 21.1