REPORT ON THE REVIEW OF ELEVATED METHANE AND CARBON DIOXIDE CONCENTRATIONS RECORDED IN EXTERNAL GAS MONITORING BOREHOLES LFG27R-A, LFG27R-B, LFG50 AND LFG51.

Report reference: SIG/CW/DFR/1392/01/GAS
July 2023

Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE
Tel. (01827) 717891 Fax. (01827) 718507

CONTENTS

TABLES

FIGURES

APPENDICES

1. Introduction

1.1 Further to the submission of the 2022 Annual Report dated March 2023 we provide in this report an update on the additional monitoring and follow up actions in response to the exceedances of the emission limit for methane and/or the control level for carbon dioxide recorded at external gas monitoring boreholes LFG50, LFG51, LFG27R-A and LFG27R-B.

1.2 Boreholes LFG50 and LFG51 are located close to and south of the landfill site within the boundary of the Environmental Permit. There is currently no residential development within the area of the boreholes and similarly elevated methane concentrations have not been recorded in the boreholes to the south and between the landfill and the Llangyfelach Railway Tunnel. Borehole LFG9 is located to the south of the landfill site outside of the boundary of the Environmental Permit close to the Llangyfelach Railway Tunnel. The location of each borehole is shown on Figure 1. The construction details of boreholes LFG9, LFG50 and LFG51 are presented in Table 3.

1.3 Boreholes LFG27R-A and LFG27R-B are located approximately 45m to the north east of the landfill site in the land above the quarry between the landfill site and the new housing development. Borehole LFG27R-A has been installed to a depth of 4.9m below ground level (bgl) whilst borehole LFG27R-B has been installed to a depth of 8mbgl. As discussed in the 2022 Annual Report, borehole LFG27R-A was mistakenly identified during the routine monitoring as borehole LFG27R-B following installation in October 2022. This error has been corrected and the monitoring database has been updated so that the data reflects the correct locations. The correct locations are referred to throughout this report. Boreholes LFG26R-B and LFG43R are also located in the land between the landfill site and the new housing development. Borehole LFG26R-B is located to the north northeast of the landfill site just to the west of boreholes LFG27R-A and LFG27R-B. Borehole LFG43R is located to the north east of the landfill site just south east of boreholes LFG27R-A and LFG27R-B. The location of each borehole is shown on Figure 1. The construction details of boreholes LFG26R-B, LFG27R-A, LFG27R-B and LFG43R are presented in Table 3.

1.4 We provide at Appendix A the results of the repeated monitoring and the further additional ongoing weekly monitoring in the boreholes. We provide at Appendix B graphs showing the concentrations of methane and carbon dioxide recorded in the boreholes between October 2022 and May 2023. We present at Appendix C and Appendix D the gas laboratory analysis reports for gas samples collected on 13 December 2022 and 16 January 2023.

1.5 We review and comment on the data for the boreholes to the south of the landfill site in Section 2 of this report and we comment on the data for the boreholes to the north east of the landfill site in Section 3 of this report.

2. Boreholes LFG9, LFG50 and LFG51 located to the south of the landfill site

2.1 The methane concentrations recorded in the boreholes external to the waste during 2022 generally were at or below the limit of detection of 0.1% volume/volume (v/v) of the GA5000 gas monitoring instrument. With the exception of boreholes LFG50 and LFG51, no methane concentrations above 1.0% by volume were recorded in any of the boreholes external to the waste to the south or west of the landfill during 2022.

2.2 Following the installation of the boreholes in October 2022 a methane concentration of 5.4% v/v was recorded in borehole LFG50 on 27 October 2022. On 28 November 2022 a methane concentration of 24.6% v/v was recorded in borehole LFG50 and on 25 November 2023 a methane concentration of 2.4% v/v was recorded in borehole LFG51. Similarly elevated methane concentrations were recorded in boreholes LFG50 and LFG51 throughout December 2022 up to 20.9% v/v and 2.6% v/v respectively after the monitoring frequency had been increased. Elevated carbon dioxide and low oxygen concentrations were recorded in boreholes LFG50 and LFG51 in October, November and December 2022. The concentrations of methane in borehole LFG50 are consistently higher than those in borehole LFG51 but they follow a generally similar pattern.

2.3 A Schedule 6 Part A Notification was submitted to Natural Resource Wales (NRW) on 5 December 2022 reporting compliance limit breaches for methane in boreholes LFG50 and LFG51 at the site. In accordance with the contingency action plan specified in the Updated Management Report Table entitled 'Landfill gas in external monitoring boreholes – limits and requirements' (the UMR gas limits table) the monitoring in the boreholes was repeated daily between 2 December 2022 and 7 December 2022. The repeat monitoring at boreholes LFG50 and LFG51 together with borehole LFG9 continued at a weekly frequency during January to March 2023. Gas samples were collected and submitted to a laboratory for trace gas analysis and methane carbon isotope analysis on 13 December 2022. The results of the laboratory gas analysis are reviewed below and the laboratory data sheets are provided at Appendix C and Appendix D.

2.4 As shown in the graphs provided at Appendix B, the methane concentrations in borehole LFG50 have remained high during January to May 2023 at between 24.5% and 33.4% by volume with the methane concentrations in borehole LFG51 recorded

at elevated but lower concentrations of between 1.9% and 5.5% over the same period. The carbon dioxide concentrations in borehole LFG51 have remained elevated during January to May 2023 at between 8.4% and 9.6% by volume with the carbon dioxide concentrations in borehole LFG50 recorded at elevated but lower concentrations of between 4.3% and 5.2% over the same period.

2.5 The concentrations of methane in the boreholes between the landfill and Llangyfelach Railway Tunnel have remained below the methane emission limit of 1.5% over the same period. With the exception of 17 January 2023, 26 January 2023 and 3 February 2023 where the concentration of methane was recorded at between 1.2% and 1.4%, the recorded methane concentrations in borehole LFG9, which have been monitored at an increased frequency during December 2022 to March 2023, have not exceeded 1% between October 2022 and May 2023. The recorded carbon dioxide concentrations over that same period have varied between 0.0% and 2.1%.

Laboratory bulk gas analyses

2.6 SI Green UK Limited arranged for gas samples to be collected from the combined leachate monitoring and gas venting wells L1C/09 and L11/09 in the landfill site and from the southern gas monitoring boreholes LFG50 and LFG51 on 13 December 2022 and submitted them to a laboratory for bulk and trace gas analysis. The results of these analysis are shown in Table 1 and Table 2 respectively.

2.7 The laboratory data show that the carbon dioxide and methane concentrations in boreholes LFG50 and LFG51 generally are similar in order of magnitude to the field readings obtained using portable equipment. The methane concentrations recorded in the samples from both boreholes exceeded the compliance limit for methane on 13 December 2022 with a concentration of 21.71% in borehole LFG50 and a concentration of 3.34% in borehole LFG51. The recorded carbon dioxide concentrations were 4.19% in the sample from LFG50 and 7.76% in the sample from LFG51. On the same date, samples taken from combined wells located in the landfilled waste L1C/09 and L11/09 had recorded concentrations of methane of 50.56% and 77.32% respectively and concentrations of carbon dioxide of 15.45% and 7.79% respectively.

2.8 The concentrations of carbon monoxide recorded in the samples from both boreholes in the waste were unusually high for typical landfill gas at 0.0032% and 0.023% in the samples from L1C/09 and L11/09 respectively. Carbon monoxide was present in borehole LFG51 at a concentration of 0.097% which is a higher concentration than present in the gas sampled from the wells in the waste. Carbon monoxide is typically associated with incomplete combustion processes. It is possible that the relatively high carbon monoxide concentrations are associated with mines gas as there is no suggestion or evidence that the site has had any fires. Carbon monoxide was not detected above the detection limit of 0.0005% in borehole LFG50.

2.9 As summarised in Table 1, the data for the combined wells L1C/09 and L11/09 shows the presence in the waste of a range of alkanes in addition to methane including ethane (C2), propane (C3), butane (C4) and octane (C8). The alkanes pentane (C5), hexane (C6) and heptane (C7) were not detected in the samples from the waste mass. Typical biodegradable waste landfill sites, of which Cwmrhydyceirw Quarry Landfill Site is not one, would usually have traces of ethane, propane and butane present but generally no significant presence of higher carbon number alkanes. In borehole LFG50, other than methane at 21.71%, no alkanes were identified above the detection limit of 0.005%. In borehole LFG51, despite there being a much lower concentration of methane at 3.34% compared with LFG50, traces of ethane, heptane and octane were detected in the sample which suggests there may be a contribution from a source other than the landfill. The potential for a contribution from another source is also indicated by the carbon monoxide data for this borehole as noted above.

Laboratory trace gas analyses

2.10 All gas samples were analysed for Volatile Organic Compounds (VOCs) in air by thermal desorption gas chromatography/mass spectrometry. The laboratory analytical reports with the VOC data are presented at Appendix C and the results are summarised in Table 2.

2.11 The VOC data shows a range of trace compounds in the in-waste wells, with chloroethane, 1-pentene, furan, dichloromethane, benzene and toluene present in both in-waste wells sampled. Carbon disulphide, cis-1,2-dichloroethene and trichloroethene are also identified in well L1C/09 but not in well L11/09. Despite

having a higher concentration of methane than in borehole LFG51, borehole LFG50 only had three VOCs present above the detection limit (dichloromethane, carbon disulphide and toluene). The concentrations of dichloromethane and carbon disulphide in LFG50 are similar to those recorded in the landfilled waste even though the methane concentrations in LFG50 are lower than those recorded in the waste, which is unexpected. Borehole LFG51 has a much lower methane concentration compared with borehole LFG50 but has a greater number of detectable VOCs (chloroethane, 1-pentene, furan, dichloromethane, carbon disulphide, benzene, toluene) most of which are at generally similar (or higher for carbon disulphide) concentrations than in the gas samples from inside the landfill even though the methane concentrations in LFG51 are lower than in borehole LFG50. It must be noted that the VOC concentrations in different locations in the landfilled waste may be very variable through the waste mass so the laboratory data for the samples taken from wells L1C/09 and L11/09 may not be typical of the gas throughout the waste.

Methane carbon isotope analysis

2.12 Gas samples collected on 13 December 2022 from LFG50, LFG51 and in waste wells L1C/09 and L11/09 were subject to laboratory measurement of the ^{3}H and ^{14}C content and the carbon stable isotope ratio ($\delta^{13}C$) in the CH_4 component. The laboratory report with the carbon isotope analysis is presented at Appendix D. The results for L1C/09 and L11/09 were reported with confidence and the sample for LFG50 is reported to have produced less than the optimum CO_2 for processing (following combustion of the methane as described in the report) however the results are reported. The sample obtained from LFG51 failed to produce adequate CO_2 for the measurement to proceed therefore no results are reported for this sample.

2.13 In summary, the report concludes that the review of the results for the $\delta^{14}C$ values in the samples from the waste (L1C/09 and L11/09) are consistent with recent (last sixty) years atmospheric levels. The results are reported as suggesting that the gas from L1C/09 originated either from material growing between 1989 and 1993 or between 1958 and 1959 and that from L11/09 originated either from material growing between 2002 and 2011 or between 1956 and 1957. It is concluded that the stable isotope values for the samples lie in the range observed for biogenically produced methane.

2.14 The report concludes that the review of the results for the $\delta^{14}C$ values in the sample from LFG50 is consistent with recent (last sixty) years atmospheric levels. The results are reported as suggesting that the gas from LFG50 originated from material growing between 1955 and 1956 or the last twenty years. It is concluded that the stable isotope values for the sample lie in the range observed for biogenically produced methane.

2.15 While the results of the methane carbon isotope analyses are not totally clear, they do not support the presence of any significant component of mines gas. However, the sample from LFG51, which from the basis of the higher concentration of carbon monoxide may have had a contribution from mines gas (see above), did not contain sufficient methane carbon to allow analysis and review of the carbon isotopes present.

2.16 In summary, the source of the gas recorded in boreholes LFG50 and LFG51 may arise solely from the gas in the landfill or may include a component of gas from an external source such as mines gas and/or materials present in the ground outside the landfilled waste.

3. Boreholes LFG26R-B, LFG27R-A, LFG27R-B and LFG43R located to the north east of the landfill site

3.1 The methane concentrations recorded in the boreholes external to the waste during 2022 generally were at or below the limit of detection of 0.1% volume/volume (v/v) of the GA5000 gas monitoring instrument. With the exception of borehole LFG27R-A, no methane concentrations above 1.0% by volume were recorded in any of the boreholes external to the waste to the north or east of the landfill site during 2022.

3.2 A methane concentration of 1.8% v/v was recorded in borehole LFG27R-A on 15 December 2022. As shown on Figure 1 borehole LFG27R-A is located approximately 45m to the north east of the landfill site in the land which is at a significantly higher elevation than the landfill site and between the landfill site and the new housing development. Repeat monitoring was carried out in borehole LFG27R-A on 16 December 2023 and a methane concentration of 2.9% v/v was recorded. Similarly elevated methane concentrations were not recorded in boreholes close to borehole LFG27R-A. Slightly elevated carbon dioxide concentrations and low oxygen concentrations were also recorded in borehole LFG27R-A. Methane concentrations in the range 0.4% v/v to 2.9% v/v were recorded subsequently in December 2022 in borehole LFG27R-A. The elevated methane concentrations recorded in borehole LFG27R-A were reported to NRW on 19 and 21 December 2022, gas samples were taken in early 2023 and monitoring at an increased frequency continued.

3.3 The methane concentrations in LFG27R-A began to rise in November 2022 and fluctuated between 0.4%v/v and 4.5%v/v until February 2023 when it dropped below the detection limit until 14 March 2023 when the concentrations rose again up to 6.1% on 28 March 2023 followed by a rapid fall below the detection limit to 0.0%v/v on 4 April 2023 as shown on the graphs presented at Appendix B. The carbon dioxide concentration ranged between 0.1%v/v and 4.8%v/v from December 2022 to February 2023. In LFG27R-B, the methane concentrations generally have been at or below the detection limit and the carbon dioxide concentrations have ranged from 0.1% to 5.5%. Throughout this period borehole LFG43R near to boreholes LFG27R-A and LFG27R-B has had methane concentrations at or slightly above the detection limit with carbon dioxide concentrations ranging from 0.1%v/v to 7.4%v/v between December 2022 and February 2023. The location and the setting of borehole

LFG27R-A and the pattern of sharply fluctuating methane concentrations are not consistent with migration from the landfill site.

3.4 The area around borehole LFG27R-A was the former location of an area of marshy ground close to an area of former mineral processing activities. In addition, it was noted during the development of this area of the site for housing that hydrocarbons were present in the ground that were remediated prior to the construction of the housing.

3.5 SI Green UK Limited carried out some shallow ground spike testing on 27 January 2023 in the soil around and in the vicinity of boreholes LFG27R-A and LFG27R-B. A carbon dioxide concentration of 0.1%v/v and no methane was detected at a distance of 1m from the boreholes and at the corner of a nearby garage to the property. On the same date, a methane concentration of 3%v/v and a carbon dioxide concentration of 2.3%v/v was detected in borehole LFG27R-A.

3.6 A Schedule 6 Part A Notification was submitted to Natural Resource Wales (NRW) on 19 December 2022 reporting a compliance limit breach for methane in borehole LFG27R-A at the site. The methane concentration of 1.8%v/v in borehole LFG27R-A exceeded the compliance limit of 1.5%v/v and whilst this borehole was only installed in October 2022 and therefore not specified in the formal environmental monitoring regime for the site, it was considered appropriate by SI Green UK Limited to report the result to NRW. In accordance with the contingency action plan specified in the UMR gas limits table the monitoring in the borehole was repeated daily between 16 December 2022 and 20 December 2022. As explained in an email to NRW dated 21 December 2022, the repeated monitoring confirmed the presence of methane in landfill gas monitoring borehole LFG27R-A with concentrations in the range 0.4%v/v and 2.9%v/v recorded, consistent with the results reported in our email dated 19 December 2022. SI Green UK Limited arranged for gas samples to be collected from boreholes LFG27R-A, LFG27R-B, LFG43R and LFG26R-B on 16 January 2023 and submitted to a laboratory for trace gas analysis. The results of the laboratory gas analysis are reviewed below and the laboratory data sheets are provided at Appendix C. Repeat gas monitoring of borehole LFG27R-A and other boreholes in close proximity were added to the weekly monitoring visits and the recorded data are included at Appendix A.

Laboratory bulk gas analyses

3.7 As discussed in Section 2 of this report, SI Green UK Limited arranged for gas samples to be collected from the combined leachate monitoring and gas venting wells L1C/09 and L11/09 located in the waste on 13 December 2022 and submitted them to a laboratory for bulk and trace gas analysis in order to identify the range of compounds present in the gas in the landfill site. The results of these are shown in Table 1 and Table 2 respectively. The results of the bulk and trace gas data for the samples collected from boreholes LFG27R-A, LFG27R-B, LFG43R and LFG26R-B on 16 January 2023 also are shown in Tables 1 and 2 respectively.

3.8 The laboratory data shows that the methane and carbon dioxide concentrations in borehole LFG27R-A in the laboratory analysis of the sample collected on 16 January 2023 of 0.98% and 0.78% were lower but generally of a similar order of magnitude as the data recorded using the field equipment on 17 January of 1.3% and 2.3% respectively. Both the laboratory data and the field results show an unusually depleted oxygen concentration of 9.9% (laboratory data for 16 January) and 0.5% (field data for 17 January 2023). A depleted oxygen concentration of 9.4% was recorded also in the laboratory analysis of the sample collected from LFG43R in which the recorded methane and carbon dioxide concentrations were 0.0013% and 2.34% respectively. The laboratory data for the samples collected from boreholes LFG27R-B and LFG26R-B show recorded oxygen concentrations of 19.8% and 19.7% respectively, which are closer to what would be expected with the associated carbon dioxide concentrations of 0.68% and 0.54% and methane concentrations of 0.0063% and 0.0009% respectively. The concentrations of carbon monoxide recorded at the laboratory in the samples collected from the four boreholes on 16 January 2023 were at or slightly above the detection limit.

3.9 The laboratory data in Table 1 show that in borehole LFG27R-A, no alkanes were identified above the detection limit other than methane. In borehole LFG26R-B, other than methane no alkanes were identified above the detection limit with the exception of heptane (C7) and octane (C8) at very low levels. In boreholes LFG27R-B and LFG43R, other than methane no alkanes were identified above the detection limit with the exception of octane at very low levels.

3.10 As summarised in Table 1, the data for the combined wells L1C/09 and L11/09 shows the presence in the waste of a range of alkanes in addition to methane including ethane (C2), propane (C3), butane (C4) and octane (C8). The alkanes pentane (C5), hexane (C6) and heptane (C7) were not detected in the samples from the waste mass. Typical biodegradable waste landfill sites, of which Cwmrhydyceirw Quarry Landfill Site is not one, would usually have traces of ethane, propane and butane present but generally no significant presence of higher carbon number alkanes.

Laboratory trace gas analyses

3.11 All gas samples were analysed for Volatile Organic Compounds (VOCs) in air by thermal desorption gas chromatography/mass spectrometry. The laboratory analytical reports with the VOC data are presented at Appendix C and the results are summarised in Table 2.

3.12 The VOC data shows a range of trace compounds in the in-waste boreholes, with chloroethane, 1-pentene, furan, dichloromethane, benzene and toluene present in both in-waste boreholes sampled. Carbon disulphide, cis-1,2-dichloroethene and trichloroethene are also identified in well L1C/09 but not in well L11/09.

3.13 The VOC data for the boreholes to the north east of the landfill site show (Table 2) elevated concentrations of dichloromethane in all four boreholes sampled ranging between 500µg/m^3 in LFG43R and 1,600µg/m^3 in LFG26R-B. These concentrations are all higher than the range of 410µg/m^3 to 420µg/m^3 recorded in the samples from the wells in the landfilled waste collected on 13 December 2022.

3.14 Carbon disulphide also was recorded in all four boreholes sampled ranging between 80µg/m^3 in LFG27R-A and 4,500µg/m^3 in LFG27R-B. Two of these concentrations are higher than the range of <20µg/m^3 to 100µg/m^3 recorded in the samples from the wells in the landfilled waste collected on 13 December 2022.

3.15 In borehole LFG27R-A no other VOCs were detected above the detection limits other than toluene at 80µg/m^3 which is above the detection limit of 50µg/m^3. The toluene concentration recorded in the sample from the well L11/09 in the landfilled waste collected on 13 December 2023 was lower at 40µg/m^3 but the concentration in the sample from the well L1C/09 was higher at 200µg/m^3. In borehole LFG26R-B no other VOCs were detected above their detection limits other than benzene at 60µg/m^3

which is slightly above the detection limit of 50µg/m^3. The benzene concentration range detected in the samples from the wells in the landfilled waste collected on 13 December 2023 was higher at 80µg/m^3 to 370µg/m^3. No other VOCs were detected above their detection limits in boreholes LFG27R-B or LFG43R.

3.16 In summary, the source of the gas recorded in boreholes to the north east of the site, in particular borehole LFG27R-A, is unlikely to arise from the gas in the landfill site and may comprise gas from an external source such as materials present in the backfilled ground outside the landfilled waste.

4. Conclusions and proposed further actions

Boreholes to the south of the landfill site

4.1 In summary, the data available are not straightforward or clear. It is possible that the source of the gas recorded in boreholes LFG50 and LFG51 may arise solely from the gas in the landfill or may include a component of gas from an external source such as mines gas and/or materials present in the ground outside the landfilled waste.

4.2 The data show that the methane and carbon dioxide concentrations in borehole LFG50 remain high and well above the emission limit into May 2023. The concentrations in LFG51 are much lower than those in LFG50 but they remain above the emission limit. Additional gas venting wells were drilled in the southern section of the landfilled waste in early 2023 as shown on Figure 1 and rotating gas cowls will be installed on all the venting wells shortly. To date these additional venting wells have not had an observable effect on the methane or carbon dioxide concentrations recorded in monitoring boreholes LFG50 and LFG51. Wind assisted rotating cowl headworks will be fitted to the landfill gas venting wells in the landfill shortly. The headworks will be fitted as soon as the final soil placement on the landfill is completed which it is anticipated will be around the end of July 2023.

Borehole LFG27R-A to the north east of the landfill site

4.3 The VOC data suggests that the source of the gas recorded in borehole LFG27R-A to the north east of the site is unlikely to arise from the gas in the landfill site and may comprise gas from an external source. Given that the area around borehole LFG27R-A was marshy ground close to an area of former mineral processing activities and as it was noted during the development of this area of the site for housing that hydrocarbons were present in the ground that were remediated prior to the construction of the housing, soil samples will be collected shortly from the area around borehole LFG27R-A and analysed for hydrocarbons. Any further action will then be determined based on the results of the analysis of the soil samples.

Ongoing monitoring

4.4 The increased frequency of gas monitoring in the landfill gas monitoring boreholes has ceased and returned to the routine monthly basis. We will keep NRW fully informed of the results of the future monitoring.

Table 1

Results of the bulk gas laboratory analysis for samples collected at Cwmrhydyceirw Quarry Landfill Site

Date	Monitoring location	Carbon Dioxide (CO_2)	Oxygen (O_2)	Carbon Monoxide (CO)	Nitrogen (N_2)	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	n-Butane (n-C_4H_{10})	n-Pentane (n-C_5H_{12})	n-Hexane (n-C_6H_{14})	n-Heptane (n-C_7H_{16})	n-Octane (n-C_8H_{18})
		% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V	% V/V
13/12/2022	LFG50	4.19	3.4	<0.0005	69	21.71	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
13/12/2022	L11/09	7.79	3.0	0.023	14	77.32	0.054	0.0068	0.0044	<0.0005	<0.0005	<0.0005	0.0011
13/12/2022	LFG51	7.76	0.6	0.097	85	3.34	0.0019	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0015
13/12/2022	L1C/09	15.45	3.9	0.0032	30	50.56	0.045	0.0014	0.0008	<0.0005	<0.0005	<0.0005	<0.0005
16/01/2023	LFG27R-A	0.78	9.9	<0.0005	86	0.98	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
16/01/2023	LFG27R-B	0.68	19.8	0.0006	78	0.0063	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008
16/01/2023	LFG43R	2.34	9.4	<0.0005	86	0.0013	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005
16/01/2023	LFG26R-B	0.54	19.7	0.0006	78	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.0030

Table 2

Summary of the results of the trace gas analysis for samples collected at Cwmrhydyceirw Quarry Landfill Site

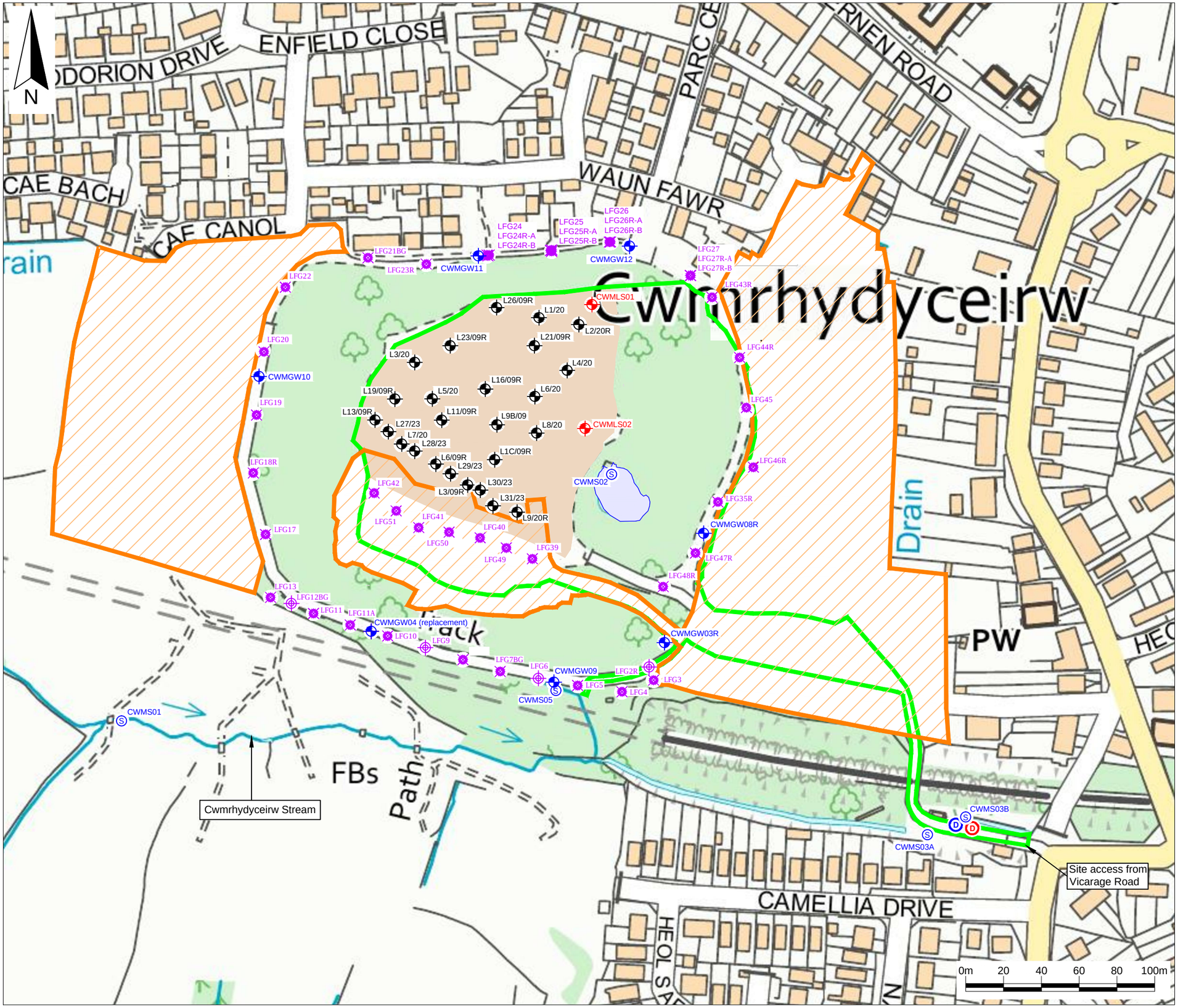
Units	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Sampling date	13 December 2022				16 January 2023			
Sample Location	LFG50	LFG51	L11/09	L1C/09	LFG 27RA	LFG 27RB	LFG 43	LFG 26RB
	South of the landfill		In waste	In waste	North east of the landfill			
Compound	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Chloroethene	<60	<60	<60	<60	<200	<200	<200	<200
Chloroethane	<20	11000	23000	14000	<50	<50	<50	<50
1-Pentene	<40	1300	6100	5200	<100	<100	<100	<100
Furan	<20	100	770	640	<40	<40	<40	<40
Ethyl Mercaptan	<60	<60	<60	<60	<200	<200	<200	<200
1,1-Dichloroethene	<20	<20	<20	<20	<50	<50	<50	<50
Methylsulfide	<20	<20	<20	<20	<50	<50	<50	<50
Dichloromethane	450	480	420	410	930	730	500	1600
Carbon Disulfide	100	340	<20	100	80	4500	200	90
1,1-Dichloroethane	<10	<10	<10	<10	<30	<30	<30	<30
cis-1,2-Dichloroethene	<10	<10	<10	190	<30	<30	<30	<30
Propyl Mercaptan	<40	<40	<40	<40	<100	<100	<100	<100
Tetrachloromethane	<20	<20	<20	<20	<50	<50	<50	<50
Benzene	<20	100	80	370	<50	<50	<50	60
Trichloroethene	<20	<20	<20	70	<50	<50	<50	<50
Butyl Mercaptan	<60	<60	<60	<60	<200	<200	<200	<200
Dimethyldisulfide	<20	<20	<20	<20	<50	<50	<50	<50
Toluene	40	40	40	200	80	<50	<50	<50
Butyric Acid	<90	<90	<90	<90	<200	<200	<200	<200
Ethyl Butyrate	<20	<20	<20	<20	<50	<50	<50	<50
Styrene	<20	<20	<20	<20	<50	<50	<50	<50
2-Butoxy Ethanol	<40	<40	<40	<40	<100	<100	<100	<100
Methyl Mercaptan	<200	<200	<200	<200	<500	<500	<500	<500
1,3-Butadiene	<20	<20	<20	<20	<40	<40	<40	<40
1,2-Dichloroethane	<20	<20	<20	<20	<50	<50	<50	<50

Table 3

Summary of the gas monitoring borehole and the combined gas and groundwater monitoring borehole locations and installation depths relevant to this report

Borehole reference	Easting	Northing	Ground level (mAOD)	Depth of borehole (mbgl)	Base of borehole (mAOD)	Base of slotted pipe (mbgl)	Base of plain pipe (mbg)	Base of gravel (mbgl)	Base of bentonite (mbgl)
LFG9	266437.435	199191.003	62.207	32.0	30.21	29.75	2.75	29.75	1.6
LFG26R-B	266577.306	199387.365	68.109	5.4	62.709	5.4	2.0	5.4	1.5
LFG27R-A	266577.184	199387.410	68.034	4.9	63.134	4.9	0.5	4.9	0.5
LFG27R-B	266577.184	199387.410	68.034	8.0	60.034	8.0	5.0	8.0	5.0
LFG43R	266588.612	199375.904	67.904	35.8	32.104	35.8	2.8	35.8	2.4
LFG50	266449.488	199251.612	48.400	16.0	32.400	16.0	1.5	16.0	1.0
LFG51	266421.362	199263.011	49.154	17.0	32.154	17.0	1.5	17.0	1.0

FIGURES



Key / Notes

- Approximate of boundary of Environmental Permit reference EPR/TP3835LV
- Approximate extent of current and proposed residential development areas including access roads
- Approximate area of the former landfill that has been capped
- 60 — Ground level contour (mAOD) (Pre-development)
- Approximate location of the groundwater and surface water sump
- CWMLS02 — Approximate location of a leachate collection sump
- LFG1 — Approximate location of a gas monitoring borehole
- LFG2 — Approximate location of a combined gas and groundwater monitoring borehole
- L1/09 — Approximate location of a combined leachate monitoring and gas venting well
- CWMGW08 — Approximate location of a groundwater monitoring borehole
- CWMS01 — Approximate location of a surface water monitoring point
- D — Approximate location of the discharge to the Cwmrhydyceirw Stream
- D — Approximate location of the discharge to sewer

Note:

The locations of LFG23R and L21/09R have not yet been surveyed. The actual locations will be surveyed shortly.

Survey data based on MJCA model reference SIG-CW-16797.lss

Rev	Status	Drn	App	Chk	Date
	Final	HL	JAD	GT	04/07/23

Site: CWMRHYDYCEIRW QUARRY LANDFILL

Client: SI Green (UK) Ltd

Title: Plan showing the locations of the gas and groundwater monitoring boreholes, the leachate monitoring and gas venting wells and the surface water monitoring locations

Figure 1 | Scale: 1:2,000@A3

Drawing Ref: SIG/CW/06-23/23768

MJCA
Technical advisers on environmental issues
Baddesley Colliery Offices, Main Road, Baxterley, Atherstone Warwickshire, CV9 2LE.
Telephone : 01827 717891
Fax : 01827 718507

APPENDICES

APPENDIX A

OCTOBER 2022 – MAY 2023 MONITORING DATA

Cwmrhydyceirw Quarry: Site Monitoring October 2022							
Borehole	CH4 (%)	CO2 (%)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	0.0	0.1	21				GAS IN THE WASTE
L3/09R	0.0	0.1	21.4				
L6/09	0.0	0.0	21				
L9B/09	Missed						
L11/09	68.7	9.4	2.1				
L13/09							
L14/09R	0.0	0.0	20.4				
L16/09	Missed						
L19/09	43.1	17.5	4.5				
L21/09R	9.8	16.1	2				
L23/09	Covered						
L26/09	12.1	0.0	20.2				
L1/20	0.2	0.2	21.1				
L2/20	0.0	0.1	20.4				
L3/20	7.3	1.7	15.6				
L4/20	0.0	0.1	20				
L5/20	20.2	0.2	8.8				
L6/20	19.0	11.1	8.9				
L7/20	12.8	2.0	2.0				
L8/20	0.0	0.1	21.2				
L9/20	0.0	0.1	21.4				
LFG**2R**	0.0	0.1	18.1				GAS EXTERNAL TO THE WASTE
LFG**3**	0.0	0.2	20.9				
LFG**4**	0.0	6.2	15.7				
LFG**5**	0.0	5.0	12.6				
LFG**6**	0.0	0.4	18.4				
LFG**7BG**	0.0	0.4	20.7				
LFG**8**	0.0	0.2	18.9				
LFG**9**	No access						
LFG**10**	0.0	2.0	14.2				
LFG**11**	0.0	1.9	13.1				
LFG**11A**	0.0	0.2	18.1				
LFG**12BG**	0.0	0.3	20.7				
LFG**13**	0.0	0.3	21.0				
LFG**17**	0.0	0.0	0.2				
LFG**18R**	0.0	0.1	20.1				
LFG**19**	0.0	0.2	20.9				
LFG**20**	inaccessable - faulty lock						
LFG**21BG**	0.0	0.1	21				
LFG**22**	0.0	2.4	7.5				
LFG**23**	Damaged						
LFG**23R**	Not installed						
LFG**24**	0.0	0.1	20				
LFG**24R-A**	Not installed						
LFG**24R-B**	Not installed						
LFG**25**	0.0	0.3	20				
LFG**25R-A**	Not installed						
LFG**25R-B**	Not installed						
LFG**26**	0.0	0.2	18.8				
LFG**26R-A**	Not installed						
LFG**26R-B**	Not installed						
LFG**27R-A**	0.0	0.1	21.4				
LFG**27R-B**	-	-	-				
LFG**35**R	0.0	0.3	19.0				
LFG**39**	0.0	0.7	19.5				
LFG**40**	0.1	0.0	6.2				
LFG**41**	0.0	4.9	15.9				
LFG**42**	0.0	0.2	18.7				
LFG**43R**	Damaged						
LFG**44R**	0.0	2.5	16.4				
LFG**45**	0.0	1.9	13.4				
LFG**46R**	0.0	2.2	15.7				
LFG**47R**	0.0	0.2	20.8				
LFG**48R**	0.0	0.6	20.5				
LFG**49**	0.1	2.1	18.9				
LFG**50**	5.4	3.3	11.2				
LFG**51**	0.4	4.4	10.6				

Cwmrhydyceirw Quarry: Site Monitoring November 2022								
Borehole	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	0	0.1	1	20.7	1011	0.00	0.1	GAS IN THE WASTE
L3/09R	0.1	0.1	0	19.4	1011	0.00	0.2	
L6/09	0.1	0.1	0	21.2	1011	0.00	0.2	
L9B/09	0.1	0.1	0	21.1	1011	0.00	0.2	
L11/09	Damaged/ Covered							
L13/09	Missing							
L14/09R	0.1	0.1	1	20.8	1011	0.00	0.2	
L16/09	0.1	0.1	0	21.1	1011	0.00	0.2	
L19/09	Inaccessable/ unsafe ground							
L21/09R	0.1	0.1	1	21.2	1011	0.00	0.2	
L**23/09**	Inaccessable/ unsafe ground/ partially covered							
L**26/09**	0	0.1	1	20.8	1011	0.00	-0.2	
L1/20	0	0.1	1	20.6	1011	0.00	-0.1	
L2/20	Flooded							
L3/20	0	0.1	1	21	1011	0.00	-0.1	
L4/20	Flooded							
L5/20	0.1	0.1	0	21	1011	0.00	0.2	
L6/20	0.1	0.1	1	20.9	1011	0.00	0.2	
L7/20	0.1	0.1	0	21	1011	0.00	0.2	
L8/20	0	0.1	1	20.7	1011	0.00	0.2	
L9/20	0.1	0.1	0	21.1	1011	0.00	0.2	
LFG**2R**	0.1	0.1	2	17.4	1011	0.00	0	GAS EXTERNAL TO THE WASTE
LFG**3**	0.1	1.6	1	15.2	1011	0.00	0.1	
LFG**4**	0.1	5.7	0	15.7	1011	0.00	0.6	
LFG**5**	0.1	4	1	14.2	1011	0.00	0.4	
LFG**6**	0.1	0.4	0	20.2	1011	0.00	0	
LFG**7BG**	0	2.1	0	15.4	1011	0.00	0.2	
LFG**8**	0.1	0.7	0	12.4	1011	0.00	0.1	
LFG**9**	0.1	1.4	0	12.9	1011	0.00	0	
LFG**10**	0.1	1.3	0	19.6	1011	0.00	0.2	
LFG**11**	0.1	1.2	0	19.2	1011	0.00	0.1	
LFG**11A**	0.1	0.1	0	21	1011	0.00	0.1	
LFG**12BG**	0.1	0.1	0	21.8	1011	0.00	-0.1	
LFG**13**	Recently Covered							
LFG**17**	0.1	0.4	0	19	1011	0.00	0.3	
LFG**18R**	0.1	3.4	1	16.6	1011	0.00	0.2	
LFG**19**	Flooded							
LFG**20**	0.1	2.4	0	13.4	1011	0.00	0.4	
LFG**21BG**	0.1	0.1	0	21.4	1011	0.00	0.1	
LFG**22**	0.1	2.9	0	13.8	1011	0.00	0.1	
LFG**23**	Damaged/ to be decommissioned							
LFG**24**	0.1	0.2	0	21.3	1011	0.00	0.1	
LFG**25**	0.1	0.3	0	20.2	1011	0.00	0	
LFG**26**	0.1	0.2	0	21.6	1011	0.00	0.2	
LFG**27R-A**	1.1	0.3	0	12.6	1011	0.00	0	
LFG**27R-B**	0.1	0.8	0	20.3	1011	0.00	0	
LFG**35R**	0.1	0.9	0	19.8	1011	0.00	0	
LFG**39**	0.1	0.6	0	19.4	1011	0.00	-4.2	
LFG**40**	0.1	8.5	1	8.7	1011	0.00	0.2	
LFG**41**	0.2	1.3	1	18.2	1011	0.00	0.1	
LFG**42**	0.2	0.1	0	17.5	1011	0.00	0.1	
LFG**43R**	0.1	3.9	1	17.7	1011	0.00	0	
LFG**44R**	0.1	5.2	0	13.8	1011	0.00	0	
LFG**45**	Blocked							
LFG**46R**	0.1	5.4	1	13.6	1011	0.00	-0.1	
LFG**47R**	0.1	0.8	1	20.8	1011	0.00	0.4	
LFG**48R**	0.1	0.1	1	21.3	1011	0.00	0.4	
LFG**49**	0.1	8.5	1	8.7	1011	0.00	0.2	
LFG**50**	24.6	6.3	1	0.4	1011	0.00	-0.6	
LFG**51**	2.4	9	1	1.3	1011	0.00	0.1	

Cwmrhydyceirw Quarry: Site Monitoring November 2022									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L11/09	04/12/2022	99.8	10.9	4	0.2				GAS EXTERNAL TO THE WASTE
L5/20	04/12/2022	16.0	0.3	5	10.5				
LFG**5**	05/12/2022	0.1	4.8		13.9	1020	0	0.20	
LFG**5**	06/12/2022	0.1	5		12.7	1021	0.07	0.00	
LFG**5**	07/12/2022	0	5.4		14	1017	0.04	0.10	
LFG**6**	05/12/2022	0.1	0.1		22.2	1020	-0.11	0.10	
LFG**6**	06/12/2022	0.1	0.1		22.7	1021	-0.09	0.20	
LFG**6**	07/12/2022	0.0	0.1		22.4	1017	-0.02	0.10	
LFG**7BG**	05/12/2022	0.1	0.1		22.3	1020	-0.02	0.20	
LFG**7BG**	06/12/2022	0.1	0.1		22.6	1021	0.04	0.10	
LFG**7BG**	07/12/2022	0.0	0.1		22.3	1017	0.11	0.10	
LFG**8**	05/12/2022	0.1	0.2		21.6	1020	-0.03	0.1	
LFG**8**	06/12/2022	0.1	0.2		22.2	1021	0.12	0	
LFG**8**	07/12/2022	0.0	0.4		21.5	1017	-0.02	0.1	
LFG**9**	05/12/2022	0.3	2.1		0.4	1020	-0.02	-0.1	
LFG**9**	06/12/2022	0.4	1.8		0.6	1021	0.02	0.1	
LFG**9**	07/12/2022	0.1	1.9		0.8	1017	0.12	0.1	
LFG**10**	05/12/2022	0.1	1.6		17.9	1020	-0.12	0.3	
LFG**10**	06/12/2022	0.1	1.2		18.3	1021	-0.07	0.2	
LFG**10**	07/12/2022	0.0	1.9		17.1	1017	-0.02	0.2	
LFG**11**	05/12/2022	0.1	0.5		21.1	1020	0.00	-0.8	
LFG**11**	06/12/2022	0.1	0.5		19.6	1021	-0.04	-0.02	
LFG**11**	07/12/2022	0.0	0.8		20.7	1017	0.06	0.2	
LFG**11A**	05/12/2022	0.1	0.3		21.5	1020	-0.07	0.1	
LFG**11A**	06/12/2022	0.1	0.4		20.8	1021	0.03	0.1	
LFG**11A**	07/12/2022	0.0	0.6		20.3	1017	0.11	0.1	
LFG**12BG**	05/12/2022	0.1	0.1		22.3	1020	-0.04	0.1	
LFG**12BG**	06/12/2022	0.1	0.8		19.6	1021	-0.11	0	
LFG**12BG**	07/12/2022	0	3.9		12.4	1017	0.07	0.1	
LFG**13**	05/12/2022	0.1	3.1		12.3	1020	-2.63	-2.4	
LFG**13**	06/12/2022	0.1	1.5		16.3	1021	-0.12	-1.6	
LFG**13**	07/12/2022	0.0	2.4		14.4	1017	0.05	-1.1	
LFG**39**	05/12/2022	0.1	1.2		18.5	1020	-0.12	-2	
LFG**39**	06/12/2022	0.1	1.1		19.5	1021	0.06	-0.6	
LFG**39**	07/12/2022	0.1	1.3		18.9	1017	-0.01	-1.2	
LFG**40**	05/12/2022	0.1	0.1		16.2	1020	-0.12	-2.2	
LFG**40**	06/12/2022	0.1	0.1		8.6	1021	-0.01	0.8	
LFG**40**	07/12/2022	0.1	0.1		7.2	1017	-0.14	0.6	
LFG**41**	05/12/2022	0.1	5.5		14.7	1020	-0.02	-12.7	
LFG**41**	06/12/2022	0.2	1.5		20.7	1021	-31.25	4	
LFG**41**	07/12/2022	0.1	4.5		16.1	1017	-32.13	2.9	
LFG**42**	05/12/2022	0.1	0.1		14.8	1020	0.12	-0.4	
LFG**42**	06/12/2022	0.1	0.1		15.3	1021	0.05	-0.1	
LFG**42**	07/12/2022	0.1	0.2		15.2	1017	0.02	0.1	
LFG**49**	05/12/2022	0.1	1.5		19.6	1020	-0.07	-0.2	
LFG**49**	06/12/2022	0.1	2		19.9	1021	0.02	0.2	
LFG**49**	07/12/2022	0.1	4.6		15.9	1017	0.09	0.1	
LFG**50**	02/12/2022	5.2							
LFG**50**	02/12/2022	20.6	5.5						
LFG**50**	02/12/2022	5.8	1.7						
LFG**50**	04/12/2022	19.0	6.2	0	1.7				
LFG**50**	05/12/2022	20.0	6.3		0.7	1020	-0.14	-0.8	
LFG**50**	06/12/2022	20.4	6.1		0.6	1021	0.12	-0.50	
LFG**50**	07/12/2022	20.5	6.2		0.3	1017	0.19	-0.50	
LFG**51**	02/12/2022	1.9							
LFG**51**	02/12/2022	1.4	5.7						
LFG**51**	02/12/2022	1.4	5.6						
LFG**51**	04/12/2022	1.4	7.6	0	4.8				
LFG**51**	05/12/2022	1.6	8.2		3.1	1020	-0.09	0.2	
LFG**51**	06/12/2022	1.6	8.5		1.9	1021	0.05	0.2	
LFG**51**	07/12/2022	1.6	9		1.1	1017	0.05	0.2	

Cwmrhydyceirw Quarry: Site Monitoring December 2022									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	14/12/2022	57.5	21.1	3.0	0.7	1004	-0.02	0.0	GAS IN THE WASTE
L3/09R	14/12/2022	0.0	0.1	0.0	22.3	1004	0.00	0.0	
L6/09	14/12/2022	0.0	0.2	0.0	22.3	1004	0.00	0.0	
L9B/09	14/12/2022	3.0	1.1	0.0	21.1	1004	0.00	0.0	
L11/09	14/12/2022	100+	11.2	2.0	0.2	1004	0.19	0.1	
L13/09	Covered								
L14/09R	14/12/2022	0.0	0.1	0.0	22.4	1004	0.00	0.0	
L16/09	14/12/2022	13.6	4.5	0.0	16.7	1004	0.00	0.0	
L19/09	14/12/2022	0.0	0.1	0.0	22.6	1004	0.00	0.0	
L21/09R	14/12/2022	1.3	3.8	0.0	16.8	1004	0.00	0.0	
L23/09	Covered								
L26/09	14/12/2022	19.1	2.0	0.0	6.2	1004	0.00	0.0	
L1/20	14/12/2022	0.0	0.2	0.0	22.4	1004	0.00	0.0	
L2/20	Flooded								
L3/20	14/12/2022	0.0	0.1	0.0	22.7	1004	0.00	0.0	
L4/20	14/12/2022	0.0	0.1	0.0	22.3	1004	0.00	0.0	
L5/20	14/12/2022	21.3	0.3	2.0	10.7	1004	0.00	0.0	
L6/20	14/12/2022	0.0	0.1	0.0	22.4	1004	0.00	0.0	
L7/20	14/12/2022	11.6	2.7	1.0	8.1	1004	-0.04	0.1	
L8/20	14/12/2022	0.0	0.1	0.0	22.4	1004	0.00	0.0	
L9/20	14/12/2022	0.2	0.3	0.0	22.1	1004	0.00	0.0	
LFG**2R**	14/12/2022	0.0	0.1	0.0	22.6	1004	0.02	0.0	GAS EXTERNAL TO THE WASTE
LFG**3**	14/12/2022	0.0	0.3	0.0	21.8	1004	0.07	0.0	
LFG**4**	14/12/2022	0.0	3.6	0.0	19.2	1004	0.05	0.1	
LFG**5**	14/12/2022	0.0	7.8	0.0	8.7	1004	0.04	0.0	
LFG**6**	15/12/2022	0.0	0.2	0.0	21.5	1007	-0.09	0.2	
LFG**7BG**	15/12/2022	0.0	0.1	0.0	21.8	1007	0.00	0.0	
LFG**8**	15/12/2022	0.0	0.6	0.0	20.6	1007	-0.02	0.2	
LFG**9**	15/12/2022	0.4	0.8	0.0	1	1007	0.11	0.2	
LFG**10**	15/12/2022	0.0	1.6	0.0	16.4	1007	0.02	0.2	
LFG**11**	15/12/2022	0.0	1.4	0.0	18.8	1007	-0.02	0.1	
LFG**11A**	15/12/2022	0.0	1.2	0.0	16.9	1007	0.02	0.1	
LFG**12BG**	15/12/2022	0.0	5.4	0.0	2.5	1007	-0.02	-0.1	
LFG**13**	15/12/2022	0.0	4.3	0.0	11.7	1007	0.03	-0.2	
LFG**17**	15/12/2022	0.0	0.9	0.0	18.9	1007	-0.05	0.0	
LFG**18R**	15/12/2022	0.0	0.1	0.0	22.6	1007	-0.07	-0.1	
LFG**19**	15/12/2022	0.0	1.5	0.0	6.1	1007	-0.04	-0.1	
LFG**20**	15/12/2022	0.0	4.4	0.0	8.6	1007	-0.05	0.1	
LFG**21BG**	15/12/2022	0.0	0.1	0.0	21.6	1007	0.00	0.1	
LFG**22**	15/12/2022	0.0	2.1	0.0	6.7	1007	0.04	0.0	
LFG**24**	15/12/2022	0.0	5.1	0.0	18.2	1007	-13.81	0.1	
LFG**25**	15/12/2022	0.0	4.5	0.0	12.9	1007	-0.02	0.1	
LFG**26**	15/12/2022	0.0	0.7	0.0	20.9	1007	0.00	0.2	
LFG**27R-A**	15/12/2022	1.8	4.2	0.0	0.6	1007	0.02	0.1	
LFG**27R-B**	15/12/2022	0.0	0.2	0.0	21.7	1007	-0.54	0.1	
LFG**35R**	14/12/2022	0.0	2.0	0.0	20.3	1004	-1.53	0.2	
LFG**39**	14/12/2022	0.0	1.7	0.0	17.9	1004	-0.19	2.1	
LFG**40**	14/12/2022	0.0	0.2	0.0	7.1	1004	-0.69	1.4	
LFG**41**	14/12/2022	0.0	4.9	0.0	16	1004	0.04	1.7	
LFG**42**	14/12/2022	0.0	0.4	0.0	19.7	1004	0.00	-0.2	
LFG**43R**	15/12/2022	0.0	0.9	0.0	21.4	1007	-1.62	0.1	
LFG**44R**	15/12/2022	0.0	0.1	0.0	21.9	1007	-1.69	0.2	
LFG**45**	Flooded								
LFG**46R**	15/12/2022	0.0	2.2	0.0	20.5	1007	-0.04	-0.1	
LFG**47R**	14/12/2022	0.0	0.5	0.0	22.4	1004	-7.13	0.1	
LFG**48R**	14/12/2022	0.0	0.5	0.0	22	1004	-0.35	-2.2	
LFG**49**	14/12/2022	0.0	2.9	0.0	17.4	1004	0.05	0.0	
LFG**50**	14/12/2022	20.9	6.2	0.0	0.8	1004	0.11	0.2	
LFG**51**	14/12/2022	2.6	9.9	0.0	0.5	1004	0.02	0.1	

Cwmrhydyceirw Quarry: Site Monitoring December 2022									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
LFG**5**	16/12/2022	0.0	6.5	0.0	12.1	1014			GAS EXTERNAL TO THE WASTE
LFG**6**	16/12/2022	0.0	0.2	0.0	22.3	1014			
LFG**7BG**	16/12/2022	0.0	0.1	0.0	22.4	1014			
LFG**8**	16/12/2022	0.0	0.2	0.0	22.1	1014			
LFG**9**	16/12/2022	0	1.7	0.0	1.4	1014			
LFG**10**	16/12/2022	0.0	1.4	0.0	17.4	1014			
LFG**11**	16/12/2022	0.0	1.1	0.0	19.1	1014			
LFG**11A**	16/12/2022	0.0	0.1	0.0	21.3	1014			
LFG**12BG**	16/12/2022	0.0	1.5	0.0	17.4	1014			
LFG**13**	16/12/2022	0.0	3.4	0.0	15.8	1014			
LFG**26**	16/12/2022	0.0	0.9	0.0	21.3	1014			
LFG**26**	19/12/2022	0.0	3.4	0.0	14.1	994	17.67	-0.1	
LFG**26**	20/12/2022	0.0	4	0.0	12.3	999	9.31	0.3	
LFG**26**	28/12/2022	0.0	8.2	0.0	2.2	987	2.21	0.0	
LFG**27R-A**	16/12/2022	2.9	3.9	0.0	0.7	1014			
LFG**27R-A**	17/12/2022	2.9	3.8	0.0	0.1	1011			
LFG**27R-A**	18/12/2022	2.4	4	0.0	0.5	1003			
LFG**27R-A**	19/12/2022	0.8	1.1	0.0	0.4	994	-5.11	4.0	
LFG**27R-A**	20/12/2022	0.4	0.6	0.0	9	999	-0.21	2.7	
LFG**27R-B**	16/12/2022	0.0	0.3	0.0	22.2	1014			
LFG**27R-B**	17/12/2022	0.0	0.1	0.0	21.4	1011			
LFG**27R-B**	18/12/2022	0.0	0.2	0.0	21.3	1003			
LFG**27R-B**	19/12/2022	0.0	3.5	0.0	16.9	994	-0.53	0.0	
LFG**27R-B**	20/12/2022	0.0	3.3	0.0	17.2	999	-1.16	0.1	
LFG**39**	16/12/2022	0.0	1.6	0.0	18.5	1014			
LFG**40**	16/12/2022	0.0	0.1	0.0	5.6	1014			
LFG**41**	16/12/2022	0.0	3.6	0.0	15.8	1014			
LFG**42**	16/12/2022	0.0	0.5	0.0	17.7	1014			
LFG**43R**	16/12/2022	0.0	0.1	0.0	21.7	1014			
LFG**43R**	17/12/2022	0.0	1.6	0.0	20.1	1011			
LFG**43R**	18/12/2022	0.0	1.4	0.0	20.8	1003			
LFG**43R**	19/12/2022	0.0	2.4	0.0	5.4	994	-1.07	0.1	
LFG**43R**	20/12/2022	0.0	2.4	0.0	4	999	-2.25	0.0	
LFG**44R**	17/12/2022	0.0	0.1	0.0	21.8	1011			
LFG**44R**	18/12/2022	0.0	0.1	0.0	21.8	1003			
LFG**49**	16/12/2022	0.0	4.3	0.0	16.6	1014			
LFG**50**	16/12/2022	19.3	6.1	0.0	0.9	1014			
LFG**51**	16/12/2022	2.1	9.4	0.0	1.1	1014			

Cwmrhydyceirw Quarry: Site Monitoring January 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	10/01/2023	27.8	16.9	2.0	2.2	1001	0.00	0.0	GAS IN THE WASTE
L3/09R	10/01/2023	5.1	4.6	0.0	14.4	1001	0.00	0.0	
L6/09	10/01/2023	0.0	0.2	0.0	21.4	1001	0.00	0.0	
L9B/09	10/01/2023	12.9	4.6	0.0	14.2	1001	0.00	0.0	
L11/09	10/01/2023	32.2	6.6	1.0	7.3	1001	0.00	0.0	
L13/09	No access								
L14/09R	No access								
L16/09	10/01/2023	5.3	1.7	0.0	20.3	1001	0.00	0.0	
L19/09	No access								
L21/09R	10/01/2023	12.4	11.5	0.0	4.3	1001	0.00	0.0	
L23/09	No access								
L26/09	10/01/2023	12.6	1.0	0.0	7.2	1001	0.00	0.0	
L1/20	10/01/2023	0.0	0	0.0	21.7	1001	0.00	0.0	
L2/20	No access								
L3/20	10/01/2023	0.5	0.7	0.0	12.9	1001	0.00	0.0	
L4/20	10/01/2023	0.0	0.1	0.0	21.8	1001	0.00	0.0	
L5/20	10/01/2023	16.4	0.2	1.0	10.6	1001	0.00	0.0	
L6/20	10/01/2023	15.6	9.5	0.0	7.2	1001	0.00	0.0	
L7/20	10/01/2023	9.4	2.1	1.0	4.3	1001	0.00	0.0	
L8/20	10/01/2023	1.6	3	0.0	14.1	1001	0.00	0.0	
L9/20	10/01/2023	8.9	9.1	0.0	10.8	1001	0.00	0.0	
LFG**2R**	14/12/2022	0.0	0.1	0.0	19.4	1003	0.02	0.0	GAS EXTERNAL TO THE WASTE
LFG**3**	11/01/2023	0.0	0.1	0.0	21.8	1003	-5.57	2.8	
LFG**4**	11/01/2023	0.0	5.7	0.0	15.3	1003	-0.05	0.0	
LFG**5**	11/01/2023	0.0	2.5	0.0	10.7	1003	0.09	0.2	
LFG**6**	11/01/2023	0.0	0.4	0.0	20.6	1003	-0.05	0.2	
LFG**7BG**	11/01/2023	0.0	0.1	0.0	21.8	1003	0.01	0.1	
LFG**8**	11/01/2023	0.0	0.3	0.0	20	1003	0.05	0.2	
LFG**9**	11/01/2023	1	1.5	0.0	0.4	1003	0.04	0.2	
LFG**10**	11/01/2023	0.0	1.4	0.0	15	1003	-0.07	0.2	
LFG**11**	11/01/2023	0.0	0.8	0.0	19.3	1003	-2.11	0.3	
LFG**11A**	11/01/2023	0.0	0.1	0.0	21.6	1003	-0.18	0.1	
LFG**12BG**	11/01/2023	0.0	0.1	0.0	21.4	1003	-0.07	0.2	
LFG**13**	11/01/2023	0.0	3.4	0.0	14.3	1003	0.09	0.2	
LFG**17**	10/01/2023	0.0	0.5	0.0	19.2	1001	0.05	0.1	
LFG**18R**	No access								
LFG**19**	10/01/2023	0.0	0.1	0.0	21.7	1001	0.09	0.2	
LFG**20**	10/01/2023	0.0	0.1	0.0	20.3	1001	0.01	0.3	
LFG**21BG**	10/01/2023	0.0	0.2	0.0	21	1001	0.02	0.1	
LFG**22**	10/01/2023	0.0	2.3	0.0	15.5	1001	0.04	0.1	
LFG**24**	10/01/2023	0.0	5.6	0.0	18.2	1001	0.30	0.1	
LFG**25**	10/01/2023	0.0	9.2	0.0	3.8	1001	-0.02	-0.5	
LFG**26**	10/01/2023	0.0	3.8	0.0	15	1001	0.26	-0.2	
LFG**27R-A**	10/01/2023	1.2	0.5	0.0	0.4	1001	0.21	3.2	
LFG**27R-B**	10/01/2023	0.0	1.2	0.0	20.4	1001	-0.54	0.2	
LFG**35R**	10/01/2023	0.0	0.7	0.0	20.2	1001	-1.84	0.1	
LFG**39**	10/01/2023	0.0	0.5	0.0	90.7	1001	2.02	-0.7	
LFG**40**	10/01/2023	0.0	0.1	0.0	4.7	1001	-5.34	-0.7	
LFG**41**	10/01/2023	0.4	5.6	0.0	13.6	1001	11.33	3.1	
LFG**42**	10/01/2023	0.0	0.1	0.0	19.6	1001	-0.04	1.4	
LFG**43R**	10/01/2023	0.0	2.4	0.0	9.1	1001	-0.90	0.1	
LFG**44R**	10/01/2023	0.0	6.2	0.0	4.7	1001	-0.65	0.2	
LFG**45**	Covered								
LFG**46R**	10/01/2023	0.0	0.2	0.0	21.6	1001	-0.60	0.1	
LFG**47R**	10/01/2023	0.0	0.6	0.0	20.7	1001	-1.53	0.1	
LFG**48R**	10/01/2023	0.0	0.1	0.0	78.4	1001	-3.04	0.6	
LFG**49**	10/01/2023	0.0	5.5	0.0	14	1001	-1.12	-0.1	
LFG**50**	10/01/2023	29.2	4.9	0.0	0.7	1001	-2.25	0.1	
LFG**51**	10/01/2023	4.7	9.2	0.0	1.5	1001	-1.46	0.1	

Cwmrhydyceirw Quarry: Site Monitoring January 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
LFG5	04/01/2023	0.1	3.6	0.0	7.7	1011	-0.05	0.0	GAS EXTERNAL TO THE WASTE
LFG5	17/01/2023	0.1	3.1		11.2	987	0.06	0.3	
LFG5	26/01/2023	0.0	4.7		14.8	1030	0.53	0.1	
LFG6	04/01/2023	0.1	0.5	0.0	19.3	1011	-0.11	0.2	
LFG6	17/01/2023	0.0	0.4		21.6	987	0.05	0.2	
LFG6	26/01/2023	0.0	0.3		21.8	1030	0.03	0.2	
LFG7BG	04/01/2023	0.1	0.7	0.0	18.9	1011	-0.04	0.2	
LFG7BG	17/01/2023	0.1	0.2		22.6	987	-2.67	0.2	
LFG7BG	26/01/2023	0.0	0.4		21.3	1030	-0.11	0.1	
LFG8	04/01/2023	0.1	0.2	0.0	19.4	1011	-0.33	0.2	
LFG8	17/01/2023	0.0	0.5		19.4	987	-0.21	0.2	
LFG8	26/01/2023	0.0	0.3		20.1	1030	-0.13	0.1	
LFG9	04/01/2023	0.5	1.6	0.0	1	1011	0.11	0.1	
LFG9	17/01/2023	1.2	1.7		0.8	987	0.02	0.1	
LFG9	26/01/2023	1.4	1.5		0.3	1030	0.26	0.2	
LFG10	04/01/2023	0.2	1.4	0.0	10.5	1011	-0.11	0.2	
LFG10	17/01/2023	0.0	1.5		13.8	987	0.05	0.3	
LFG10	26/01/2023	0.0	0.1		22.1	1030	0.12	0.1	
LFG11	04/01/2023	0.1	1.2	0.0	17.9	1011	-3.40	0.1	
LFG11	17/01/2023	0.0	1.3		19.4	987	0.05	-0.2	
LFG11	26/01/2023	0.0	0.5		22.1	1030	-0.05	0.2	
LFG11A	04/01/2023	0.1	0.1	0.0	18.7	1011	0.02	0.2	
LFG11A	17/01/2023	0.0	0.2		22.7	987	0.07	-0.7	
LFG11A	26/01/2023	0.0	0.2		22.2	1030	0.02	-0.03	
LFG12BG	04/01/2023	0.1	0.1	0.0	21.2	1011	0.00	-0.1	
LFG12BG	17/01/2023	0.0	0.1		22.8	987	-0.02	0.3	
LFG12BG	26/01/2023	0.0	0.2		21.7	1030	-0.05	0.1	
LFG13	04/01/2023	0.1	4.1	0.0	13	1011	-2.00	-0.2	
LFG13	17/01/2023	0.0	3.6		15.1	987	-2.61	0.2	
LFG13	26/01/2023	0.0	5.2		16.8	1030	-2.02	0.2	
LFG18R	17/01/2023	0.0	1.1		19.7	987	-2.99	0.2	
LFG26	04/01/2023	0.1	0.5	0.0	21	1011	-0.12	0.2	
LFG26	17/01/2023	0.0	6		7.9	987	-0.21	-0.4	
LFG26	26/01/2023	0.0	4.1		10.8	1030	-0.15	0.1	
LFG26R-A	17/01/2023	0.0	0.5		21.1	987	-0.05	-0.9	
LFG26R-A	26/01/2023	0.0	0.8		20.6	1030	-0.02	0.2	
LFG26R-B	17/01/2023	0.0	2.7		13.8	987	0.19	0.2	
LFG26R-B	26/01/2023	0.0	2.2		14.5	1030	0.11	0.2	
LFG27R-A	04/01/2023	1.0	0.6	0.0	2.8	1011	-0.20	0.2	
LFG27R-A	17/01/2023	1.3	2.3		0.5	987	0.04	0.3	
LFG27R-A	26/01/2023	4.5	2.1		1.2	1030	0.03	0.3	
LFG27R-B	04/01/2023	0.1	0.9	0.0	20	1011	-0.40	0.2	
LFG27R-B	17/01/2023	0.0	2.4		15.6	987	0.05	0.2	
LFG27R-B	26/01/2023	0.0	0.1		22.3	1030	-14.72	0.1	
LFG39	04/01/2023	0.2	0.9	0.0	18.9	1011	-0.09	0.1	
LFG39	17/01/2023	0.0	0.2		21.6	987	3.14	0.1	
LFG39	26/01/2023	0.1	1.1		15.9	1030	-9.43	0.1	
LFG40	04/01/2023	0.1	0.2	0.0	3.8	1011	-4.00	0.4	
LFG40	17/01/2023	0.1	0.1		0.3	987	-6.97	0.7	
LFG40	26/01/2023	0.1	0.1		0.3	1030	-9.63	4.4	
LFG41	04/01/2023	0.2	5.7	0.0	13.3	1011	8.50	0.3	
LFG41	17/01/2023	0.5	5.4		14.5	987	-0.51	0.4	
LFG41	26/01/2023	0.1	5.9		13.5	1030	-50.80	2.2	
LFG42	04/01/2023	0.1	0.2	0.0	18.7	1011	-8.50	0.2	
LFG42	17/01/2023	0.1	0.2		20.7	987	0.01	1.9	
LFG42	26/01/2023	0.0	0.5		18	1030	-0.74	0.1	
LFG43R	04/01/2023	0.1	2.3	0.0	11.4	1011	-2.40	0.1	
LFG43R	17/01/2023	0.1	7.4		2.8	987	0.07	0.3	
LFG43R	26/01/2023	0.1	0.1		22.2	1030	-0.04	0.1	
LFG44R	04/01/2023	0.1	0.1	0.0	21	1011	-1.68	0.2	
LFG44R	17/01/2023	0.0	9.9		6.2	987	1.37	0.3	
LFG44R	26/01/2023	0.0	1.8		16.4	1030	-1.25	0.2	
LFG45	26/01/2023	0.0	2.6		15.8	1030	0.23	0.1	
LFG49	04/01/2023	0.1	4.2	0.0	15.6	1011	0.33	1.2	
LFG49	17/01/2023	0.0	5.4		15.1	987	-2.07	0.1	
LFG49	26/01/2023	0.0	4.6		16.2	1030	-0.23	0.3	
LFG50	04/01/2023	26.9	5.02	0.0	0.7	1011	0.20	0.2	
LFG50	17/01/2023	33.0	4.8		0.9	987	-1.35	0.2	
LFG50	26/01/2023	25.2	5.2		1.3	1030	-5.11	0.2	
LFG51	04/01/2023	3.6	9.3	0.0	0.53	1011	-0.80	0.2	
LFG51	17/01/2023	5.5	9.3		3.3	987	-0.93	0.1	
LFG51	26/01/2023	3.2	9.3		0.2	1030	-0.07	0.2	

Cwmrhydyceirw Quarry: Site Monitoring February 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	02/02/2023	52	19.3	1.0	1.5	1024	0.00	0.0	GAS IN THE WASTE
L3/09R	02/02/2023	0.3	0.4	0.0	21.1	1024	0.00	0.0	
L6/09	02/02/2023	0.0	0.5	0.0	21.1	1024	0.00	0.0	
L9B/09	02/02/2023	5.4	1.7	0.0	19.1	1024	0.00	0.0	
L11/09	02/02/2023	65.6	8.6	0.0	4.8	1024	0.00	0.0	
L13/09	Covered								
L14/09R	Missing								
L16/09	02/02/2023	0	0.1	0.0	21.7	1024	0.00	0.0	
L19/09	02/02/2023	0	0.1	0.0	21.4	1024	0.00	0.0	
L21/09R	02/02/2023	0	0.1	0.0	21.6	1024	0.00	0.0	
L23/09	Covered								
L26/09	02/02/2023	19.4	1.1	0.0	5.9	1024	0.00	0.0	
L1/20	02/02/2023	0.0	0.1	0.0	21.6	1024	0.00	0.0	
L2/20	Flooded								
L3/20	02/02/2023	0.0	0.1	0.0	21.6	1024	0.00	0.0	
L4/20	02/02/2023	0.3	0.2	1.0	21.4	1024	0.00	0.0	
L5/20	02/02/2023	17.3	0.2	0.0	11.6	1024	0.00	0.0	
L6/20	02/02/2023	0.0	0.1	0.0	21.7	1024	0.00	0.0	
L7/20	02/02/2023	8.3	2.2	1.0	7.6	1024	0.00	0.0	
L8/20	02/02/2023	0.0	0.1	0.0	21.7	1024	0.00	0.0	
L9/20	02/02/2023	0	0.1	0.0	21.5	1024	0.00	0.0	
LFG**2R**	03/02/2023	0.0	0.1	0.0	19.4	1029	-0.32	0.4	GAS EXTERNAL TO THE WASTE
LFG**3**	03/02/2023	0.0	0.2	0.0	21.5	1029	0.77	0.2	
LFG**4**	03/02/2023	0.0	1.4	0.0	20.1	1029	0.02	0.2	
LFG**5**	03/02/2023	0.0	2.6	0.0	14.9	1029	-0.02	0.2	
LFG**6**	03/02/2023	0.0	0.2	0.0	21.3	1029	0.05	0.1	
LFG**7BG**	03/02/2023	0.0	0.1	0.0	21.7	1029	0.00	0.2	
LFG**8**	03/02/2023	0.0	0.1	0.0	21.4	1029	0.30	0.2	
LFG**9**	03/02/2023	1.2	1.3	1.0	0.7	1029	0.32	0.1	
LFG**10**	03/02/2023	0.0	0.3	0.0	20.6	1029	0.01	0.2	
LFG**11**	03/02/2023	0.0	0.1	0.0	21.4	1029	2.76	0.2	
LFG**11A**	03/02/2023	0.0	1.2	0.0	15.3	1029	0.05	0.1	
LFG**12BG**	03/02/2023	0.0	0.1	0.0	21.5	1029	0.02	-0.3	
LFG**13**	03/02/2023	0.0	5.2	0.0	10.4	1029	0.02	0.3	
LFG**17**	02/02/2023	0.0	0.1	0.0	21.8	1024	-0.21	0.2	
LFG**18R**	02/02/2023	0.0	0.1	0.0	21.8	1024	0.03	0.2	
LFG**19**	02/02/2023	0.0	0.1	0.0	21.9	1024	0.02	0.3	
LFG**20**	02/02/2023	0.0	0.1	0.0	21.9	1024	-0.63	0.2	
LFG**21BG**	02/02/2023	0.1	0.2	0.0	20.9	1024	0.02	0.2	
LFG**22**	02/02/2023	0.0	0.1	0.0	21.8	1024	-4.51	0.2	
LFG**24**	02/02/2023	0.0	0.3	0.0	21.3	1024	0.07	0.1	
LFG**24R-A**	02/02/2023	0.0	0.2	0.0	21.4	1024	0.09	0.3	
LFG**24R-B**	02/02/2023	0.0	2.2	0.0	19.1	1024	-0.93	0.2	
LFG**25**	02/02/2023	0.0	0.2	0.0	20.7	1024	-0.02	0.1	
LFG**25R-A**	02/02/2023	0.0	2.2	0.0	16.5	1024	-1.01	0.2	
LFG**25R-B**	02/02/2023	0.1	5.4	0.0	0.3	1024	0.05	0.2	
LFG**26**	02/02/2023	0.0	1	0.0	19.5	1024	0.02	1.5	
LFG**27R-A**	02/02/2023	0.0	0.1	0.0	21.9	1024	0.00	0.0	
LFG**27R-B**	02/02/2023	0.0	0.1	0.0	21.9	1024	0.00	0.0	
LFG**35R**	03/02/2023	0.0	1.3	0.0	20.1	1029	-1.32	0.1	
LFG**39**	02/02/2023	0.1	1	0.0	17.8	1024	-3.41	0.5	
LFG**40**	02/02/2023	0.1	0	0.0	1.1	1024	-15.12	1.2	
LFG**41**	02/02/2023	0.0	5.2	0.0	14.1	1024	-53.12	1.4	
LFG**42**	02/02/2023	0.0	0.8	0.0	15.6	1024	-0.04	0.2	
LFG**43R**	02/02/2023	0.2	1.5	0.0	20.5	1024	-0.24	0.2	
LFG**44R**	02/02/2023	0.8	1.4	0.0	19.7	1024	-1.88	0.1	
LFG**45**	02/02/2023	1.3	1.9	0.0	18.3	1024	0.03	0.2	
LFG**46R**	03/02/2023	0.0	10.3	0.0	8.4	1029	-15.86	0.4	
LFG**47R**	03/02/2023	0.0	0.5	0.0	21.1	1029	-0.16	0.6	
LFG**48R**	03/02/2023	0.1	2.9	0.0	16.6	1029	-24.87	1.0	
LFG**49**	02/02/2023	0.0	0.1	0.0	21.4	1024	-0.04	0.1	
LFG**50**	02/02/2023	25.2	4.9	0.0	0.7	1024	-0.16	0.1	
LFG**51**	02/02/2023	3.1	9.2	0.0	0.9	1024	-0.12	0.2	

Cwmrhydyceirw Quarry: Site Monitoring February 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
LFG5	08/02/2023	0.0	2.7		17.2	1030	0.04	0.3	GAS EXTERNAL TO THE WASTE
LFG5	15/02/2023	0.0	3.9		17.6	1015	-0.04	0.4	
LFG5	23/02/2023	0.0	4.4		17.1	1014	-0.09	0.3	
LFG6	08/02/2023	0.0	0.2		21.7	1030	0.18	0.2	
LFG6	15/02/2023	0.0	0.1		21.6	1015	-0.05	0.5	
LFG6	23/02/2023	0.0	0.1		22.6	1014	-0.02	0.2	
LFG7BG	08/02/2023	0.0	0.1		22	1030	0.12	0.2	
LFG7BG	15/02/2023	0.0	0.1		20.8	1015	0.04	0.6	
LFG7BG	23/02/2023	0.0	0.1		22.5	1014	-0.41	0.2	
LFG8	08/02/2023	0.0	0.8		19.1	1030	0.01	0.2	
LFG8	15/02/2023	0.0	1.1		17.2	1015	0.07	0.6	
LFG8	23/02/2023	0.0	0.6		18.6	1014	-0.04	0.1	
LFG9	08/02/2023	0.9	1.5		0.7	1030	0.02	0.2	
LFG9	15/02/2023	0.6	1.3		0.5	1015	0.02	0.3	
LFG9	23/02/2023	0.8	1.4		1.8	1014	0.11	0	
LFG10	08/02/2023	0.0	1.1		19.8	1030	0.02	0.1	
LFG10	15/02/2023	0.0	1.3		19.2	1015	0.11	0.5	
LFG10	23/02/2023	0.0	1.2		16.9	1014	0.02	0.2	
LFG11	08/02/2023	0.0	1.5		19.2	1030	0.01	-0.8	
LFG11	15/02/2023	0.0	1.7		18.4	1015	-0.05	0	
LFG11	23/02/2023	0.0	2.3		18.3	1014	0.07	0.1	
LFG11A	08/02/2023	0.0	1.3		15.2	1030	0.11	0.2	
LFG11A	15/02/2023	0.0	1.6		11.3	1015	-0.33	0.1	
LFG11A	23/02/2023	0.0	1.8		9.9	1014	0.12	0	
LFG12BG	08/02/2023	0.0	0.6		21	1030	0.04	0.2	
LFG12BG	15/02/2023	0.0	0.1		21.9	1015	0.00	0	
LFG12BG	23/02/2023	0.0	1.3		17.3	1014	0.01	0.2	
LFG13	08/02/2023	0.0	4.5		12.5	1030	-0.81	0.4	
LFG13	15/02/2023	0.0	6		9.2	1015	0.77	0.3	
LFG13	23/02/2023	0.0	5.1		10.6	1014	0.09	0.5	
LFG24R-A	02/02/2023	0.0	0.2	0.0	21.4		0.09	0.3	
LFG24R-B	02/02/2023	0.0	2.2	0.0	19.1		-0.93	0.2	
LFG25	08/02/2023	0.1	3.4		8.2	1030	-0.02	0.3	
LFG25	15/02/2023	0.0	2.8		10.9	1015	-0.02	0.3	
LFG25	23/02/2023	0.0	1.3		18.1	1014	0.00	0.2	
LFG25R-A	02/02/2023	0.0	0.2	0.0	16.5		-1.01	0.2	
LFG25R-A	08/02/2023	0.0	2.1		18.3	1030	-0.11	0.1	
LFG25R-A	15/02/2023	0.0	2.7		16.6	1015	0.05	0.3	
LFG25R-A	23/02/2023	0.0	3.4		16.7	1014	0.11	0.2	
LFG25R-B	02/02/2023	0.1	5.4	0.0	0.3		0.05	0.2	
LFG25R-B	08/02/2023	0.0	6		0.3	1030	0.18	0.2	
LFG25R-B	15/02/2023	0.4	6.2		0.5	1015	-0.04	0.4	
LFG25R-B	23/02/2023	0.5	8.7		0.3	1014	-0.25	0.2	
LFG26	08/02/2023	0.0	4.7		11.6	1030	4.57	0.1	
LFG26	15/02/2023	0.0	6.3		8.6	1015	7.61	0.8	
LFG26	23/02/2023	0.0	1.3		19.1	1014	0.02	0.1	
LFG26R-A	02/02/2023	0.0	3.6	0.0	11.7		-3.31	0.2	
LFG26R-A	08/02/2023	0.0	4.1		14.2	1030	-0.04	0.3	
LFG26R-A	15/02/2023	0.0	4.6		13.2	1015	0.02	0.4	
LFG26R-A	23/02/2023	0.1	2.9		2.1	1014	-0.02	0.2	
LFG26R-B	02/02/2023	0.0	1.4	0.0	19.5		0.07	0.2	
LFG26R-B	08/02/2023	0.0	9.7		9	1030	-12.71	0.2	
LFG26R-B	15/02/2023	0.0	5.8		13.7	1015	0.81	0.4	
LFG26R-B	23/02/2023	0.1	4.5		14.4	1014	0.05	0.2	
LFG27R-A	02/02/2023	0.0	0.1	0.0	21.9				
LFG27R-A	08/02/2023	0.0	2.2		18.5	1030	-14.61	0.3	
LFG27R-A	15/02/2023	0.0	3.5		16.1	1015	-4.44	0.2	
LFG27R-A	23/02/2023	0.0	4.8		14.2	1014	-4.29	0.2	
LFG27R-B	02/02/2023	0.0	0.1	0.0	21.9				
LFG27R-B	08/02/2023	0.7	3.7		0.4	1030	0.07	0.4	
LFG27R-B	15/02/2023	0.4	4.6		0.3	1015	-5.02	0.3	
LFG27R-B	23/02/2023	0.0	5.5		3.1	1014	0.02	0.3	
LFG39	08/02/2023	0.0	1		17.4	1030	-0.11	0.3	
LFG39	15/02/2023	0.0	1.3		18.3	1015	-4.37	0.2	
LFG39	23/02/2023	0.0	1.6		17.2	1014	-2.14	0.3	
LFG40	08/02/2023	0.0	0		0.4	1030	-5.48	0.6	
LFG40	15/02/2023	0.0	7.7		13.1	1015	0.14	0.1	
LFG40	23/02/2023	0.2	0.1		1.5	1014	2.51	0.1	
LFG41	08/02/2023	0.0	3.6		15.8	1030	-22.38	0.5	
LFG41	15/02/2023	0.3	4.8		14.5	1015	14.58	0	
LFG41	23/02/2023	0.1	5.5		13.8	1014	-0.16	0.1	
LFG42	08/02/2023	0.0	1.1		15.4	1030	0.02	0.2	
LFG42	15/02/2023	0.0	1.4		15.7	1015	0.11	0.1	
LFG42	23/02/2023	0.0	2		12.1	1014	-0.01	0.5	
LFG43R	08/02/2023	0.0	1.4		19.1	1030	-0.07	0.5	
LFG43R	15/02/2023	0.0	4.2		10.7	1015	0.83	0.5	
LFG43R	23/02/2023	0.0	4.5		10.1	1014	-0.25	0.2	
LFG44R	08/02/2023	0.1	4.4		9.7	1030	2.18	0.5	
LFG44R	15/02/2023	0.0	7.7		6.8	1015	-3.37	0.4	
LFG44R	23/02/2023	0.0	5.1		14.9	1014	-1.35	0	
LFG45	08/02/2023	0.5	2.1		19.2	1030	-5.67	0.3	
LFG45	15/02/2023	0.2	2		19.5	1015	0.12	0.3	
LFG45	23/02/2023	0.0	2		17.9	1014	-4.15	0.4	
LFG49	08/02/2023	0.0	7.2		11.6	1030	0.02	0.7	
LFG49	15/02/2023	0.0	0.1		9.7	1015	0.02	0.2	
LFG49	23/02/2023	0.0	8.8		9.5	1014	-0.02	1.4	
LFG50	08/02/2023	24.5	4.6		0.5	1030	0.05	0.1	
LFG50	15/02/2023	25.5	4.6		0.3	1015	0.12	0.2	
LFG50	23/02/2023	28.2	4.8		0.5	1014	0.12	0	
LFG51	08/02/2023	1.9	8.8		1	1030	-0.51	0.3	
LFG51	15/02/2023	2.3	9.1		0.7	1015	0.04	5.3	
LFG51	23/02/2023	3.6	9.5		0.8	1014	1.77	0.3	

Cwmrhydyceirw Quarry: Site Monitoring March 2023

Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	07/03/2023	23.5	8.6	0.0	13.2	996	0.00	0.0	GAS IN THE WASTE
L3/09R	07/03/2023	0.0	0.1	0.0	21.5	996	0.00	0.0	
L6/09	07/03/2023	3.0	1.9	0.0	19.5	996	0.00	0.0	
L9B/09	07/03/2023	0.3	0.2	0.0	22	996	0.00	0.0	
L11/09	07/03/2023	41.1	0.8	0.0	6.2	996	0.00	0.0	
L13/09	07/03/2023	0	0.1	0.0	22.3	996	0.00	0.0	
L16/09	07/03/2023	0	0.1	0.0	22.3	996	0.00	0.0	
L19/09	07/03/2023	9.2	0.1	0.0	12.9	996	0.00	0.0	
L21/09R	08/03/2023	0	0.2	0.0	22.2	988	0.00	0.0	
L23/09	08/03/2023	22.1	5.6	0.0	2.9	988	0.00	0.0	
L26/09	08/03/2023	0.1	0.1	1.0	21.5	988	0.00	0.0	
L1/20	07/03/2023	0.1	0.1	0.0	22.3	996	0.00	0.0	
L2/20	07/03/2023	0	0.1	0.0	22.3	996	0.00	0.0	
L3/20	07/03/2023	0.0	0.1	0.0	22.2	996	0.00	0.0	
L4/20	07/03/2023	0.0	0.1	0.0	21.8	996	0.00	0.0	
L5/20	07/03/2023	19	0.3	0.0	9.4	996	0.00	0.0	
L6/20	07/03/2023	26.2	9.9	0.0	11.8	996	0.00	0.0	
L7/20	07/03/2023	2.4	0.8	0.0	17.8	996	0.00	0.0	
L8/20	07/03/2023	0.0	0.1	0.0	22.3	996	0.00	0.0	
L9/20	07/03/2023	0	0.1	0.0	22.2	996	0.00	0.0	
LFG**2R**	08/03/2023	0.0	0.1	0.0	20.2	988	-7.61	0.1	GAS EXTERNAL TO THE WASTE
LFG**3**	08/03/2023	0.4	0.2	1.0	22.3	988	-0.05	0.1	
LFG**4**	08/03/2023	0.0	6.2	0.0	16.3	988	0.02	0.1	
LFG**5**	08/03/2023	0.0	2.3	0.0	18.7	988	-0.04	0.2	
LFG**6**	08/03/2023	0.0	0.1	2.0	22.6	988	0.04	0.2	
LFG**7BG**	08/03/2023	0.0	0.8	0.0	18.9	988	0.05	0.2	
LFG**8**	08/03/2023	0.0	0.7	0.0	19.6	988	0.14	0.1	
LFG**9**	08/03/2023	0	1.2	0.0	3	988	0.19	-0.3	
LFG**10**	08/03/2023	0.0	1.2	0.0	17.5	988	0.14	0.2	
LFG**11**	08/03/2023	0.0	1.5	0.0	18.8	988	-0.04	-0.2	
LFG**11A**	08/03/2023	0.0	1.3	0.0	16.8	988	0.02	0.3	
LFG**12BG**	08/03/2023	0.0	1.5	0.0	17.2	988	-0.04	0.2	
LFG**13**	08/03/2023	0.0	6.7	0.0	12.4	988	0.02	-0.6	
LFG**17**	08/03/2023	0.0	1.1	0.0	13.4	988	-1.07	0.2	
LFG**18R**	08/03/2023	0.0	3.3	2.0	13.3	988	0.02	0.2	
LFG**19**	08/03/2023	0.0	1.4	0.0	13.3	988	0.02	0.2	
LFG**20**	08/03/2023	0.0	2.9	0.0	8.6	988	0.04	0.2	
LFG**21BG**	08/03/2023	0.0	0.1	0.0	21.9	988	0.02	0.2	
LFG**22**	08/03/2023	0.0	1.4	0.0	18.9	988	0.03	0.0	
LFG**24**	08/03/2023	0.0	0.2	0.0	20.5	988	0.09	0.1	
LFG**24R-A**	08/03/2023	0.0	0.3	0.0	21.3	988	-0.11	0.2	
LFG**24R-B**	08/03/2023	0.0	5.3	0.0	14.6	988	-0.02	0.3	
LFG**25**	08/03/2023	0.4	2.4	1.0	14.2	988	0.11	0.1	
LFG**25R-A**	08/03/2023	0.0	4.7	0.0	14.6	988	0.09	0.1	
LFG**25R-B**	08/03/2023	0.4	7.5	0.0	0.6	988	0.07	0.2	
LFG**26**	08/03/2023	0.0	2.8	0.0	16.4	988	0.18	0.0	
LFG**27R-A**	08/03/2023	0.0	6.7	0.0	4.6	988	-3.30	0.1	
LFG**27R-B**	08/03/2023	0.0	5.4	0.0	13.5	988	-5.02	0.1	
LFG**35R**	07/03/2023	0.0	2.8	0.0	19.4	996	-0.84	0.2	
LFG**39**	07/03/2023	0.1	1.7	0.0	16.7	996	0.12	0.0	
LFG**40**	07/03/2023	0.0	0.1	0.0	2.5	996	4.72	0.4	
LFG**41**	07/03/2023	0.3	5.9	0.0	13.5	996	1.62	0.9	
LFG**42**	07/03/2023	0.0	3.1	0.0	10.5	996	0.02	0.3	
LFG**43R**	07/03/2023	0.4	7.9	0.0	3.4	996	1.33	0.1	
LFG**44R**	07/03/2023	0.0	7.6	0.0	6.9	996	3.78	0.0	
LFG**45**	07/03/2023	0.0	2.1	0.0	17.2	996	-0.27	0.2	
LFG**46R**	07/03/2023	0.0	11.3	0.0	5.3	996	7.24	0.1	
LFG**47R**	07/03/2023	0.0	0.6	0.0	21.8	996	-1.56	0.3	
LFG**48R**	07/03/2023	0.0	0.6	0.0	21.4	996	-0.96	0.1	
LFG**49**	07/03/2023	0.0	8.5	0.0	10.1	996	0.05	0.1	
LFG**50**	07/03/2023	30.7	5	0.0	0.3	996	0.07	0.2	
LFG**51**	07/03/2023	4.0	9.6	0.0	0.9	996	-5.81	0.3	

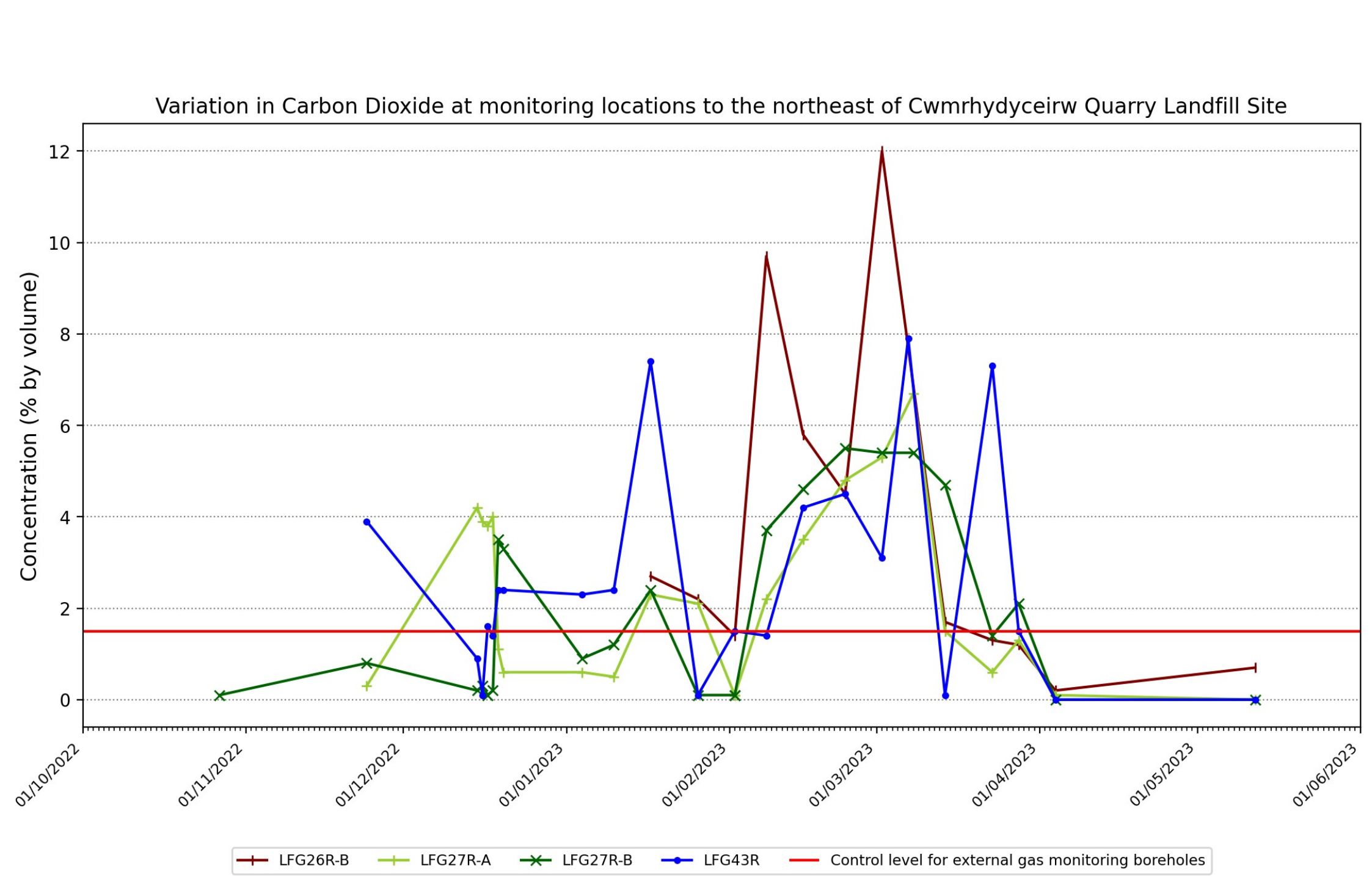
Cwmrhydyceirw Quarry: Site Monitoring March 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
LFG5	02/03/2023	0.0	3.8		17.1	1019	0.11	0.2	GAS EXTERNAL TO THE WASTE
LFG5	14/03/2023	0.0	3.1		13.2	999	0.08	0.2	
LFG5	23/03/2023	0.0	2.6		12.8	988	0.03	0.1	
LFG5	28/03/2023	0.0	3.58		16.44	1007	0.02	0.28	
LFG6	02/03/2023	0.0	0.1		22.5	1019	0.02	0.1	
LFG6	14/03/2023	0.0	0.2		21.6	999	0.11	0.2	
LFG6	23/03/2023	0.0	0.4		20.3	988	0.06	0.2	
LFG6	28/03/2023	0.0	0.14		22	1007	0.05	0.24	
LFG7BG	02/03/2023	0.0	0.1		22.5	1019	-1.28	0.2	
LFG7BG	14/03/2023	0.0	0.1		22.4	999	0.05	0.3	
LFG7BG	23/03/2023	1.1	1.9		14.9	988	0.02	0.2	
LFG7BG	28/03/2023	0.0	0.1		22.04	1007	-0.30	0.3	
LFG8	02/03/2023	0.0	0.2		21.9	1019	0.09	0.1	
LFG8	14/03/2023	0.0	0.2		21.5	999	0.09	0.3	
LFG8	23/03/2023	0.0	0.1		21.3	988	0.07	0.2	
LFG8	28/03/2023	0.0	0.58		19.66	1007	0.04	0.26	
LFG9	02/03/2023	0.2	1.1		11.4	1019	-0.05	0.1	
LFG9	14/03/2023	0.0	1.1		5.3	999	-0.07	-0.1	
LFG9	23/03/2023	0.0	0.7		11.7	988	-0.06	0.1	
LFG9	28/03/2023	0.5	1.28		3.94	1007	0.01	0.1	
LFG10	02/03/2023	0.0	0.5		20.4	1019	0.11	0.1	
LFG10	14/03/2023	0.0	1.3		16.4	999	0.09	0.2	
LFG10	23/03/2023	0.0	0.4		19.4	988	0.06	0.2	
LFG10	28/03/2023	0.0	1.08		18.54	1007	0.07	0.2	
LFG11	02/03/2023	0.0	1.2		19.8	1019	0.07	0.6	
LFG11	14/03/2023	0.0	0.1		22.1	999	-0.18	0.2	
LFG11	23/03/2023	0.0	1		18.1	988	0.01	0.1	
LFG11	28/03/2023	0.0	1.36		19.56	1007	-0.02	0.02	
LFG11A	02/03/2023	0.0	1.2		15.3	1019	-0.05	0.1	
LFG11A	14/03/2023	0.0	0.1		21.8	999	-11.36	-0.2	
LFG11A	23/03/2023	0.0	0.1		21.4	988	-9.51	0.3	
LFG11A	28/03/2023	0.0	1.2		14.7	1007	-2.30	0.04	
LFG12BG	02/03/2023	0.0	2.8		15.1	1019	0.02	0.1	
LFG12BG	14/03/2023	0.0	0.1		22.1	999	-0.09	0.2	
LFG12BG	23/03/2023	0.0	0.1		21.6	988	-0.05	0.2	
LFG12BG	28/03/2023	0.0	0.98		19.48	1007	0.00	0.14	
LFG13	02/03/2023	0.0	4.6		12.5	1019	-0.79	-0.5	
LFG13	14/03/2023	0.0	2.8		15.6	999	-3.37	0.8	
LFG13	23/03/2023	0.0	2.1		16.7	988	-2.51	0.4	
LFG13	28/03/2023	0.0	4.6		12.08	1007	-0.82	0.3	
LFG24	28/03/2023	0.0	5.1		17.3	1007	0.03	0.4	
LFG24R-A	28/03/2023	0.0	0.4		20.3	1007	-1.00	0.2	
LFG24R-B	28/03/2023	0.0	6.9		14.5	1007	-1.19	0.3	
LFG25	02/03/2023	0.0	2.5		14.6	1019	-0.05	0.2	
LFG25	14/03/2023	0.0	0.1		21.5	999	0.02	0.1	
LFG25	23/03/2023	0.0	0.2		18.9	988	0.01	0.1	
LFG25	28/03/2023	0.0	0.4		20.8	1007	0.02	0.2	
LFG25R-A	02/03/2023	0.0	4.6		14.1	1019	0.23	0.2	
LFG25R-A	14/03/2023	0.0	0.8		20.9	999	0.25	0.2	
LFG25R-A	23/03/2023	0.0	0.6		21.2	988	0.22	0.1	
LFG25R-A	28/03/2023	0.0	0.8		20.7	1007	-4.09	0.2	
LFG25R-B	02/03/2023	0.6	7.9		0.4	1019	-0.04	0.3	
LFG25R-B	14/03/2023	0.3	10		2	999	0.07	0.2	
LFG25R-B	23/03/2023	0.3	9.3		2.7	988	0.06	0.2	
LFG25R-B	28/03/2023	0.2	8.7		0.6	1007	0.04	0.2	
LFG26	02/03/2023	0.0	0.6		20.9	1019	0.23	0.1	
LFG26	14/03/2023	0.0	0.1		21.6	999	-0.32	0.3	
LFG26	23/03/2023	0.0	0.7		19.9	988	0.33	0.2	
LFG26	28/03/2023	0.0	2.2		18.1	1007	0.18	-0.1	
LFG26R-A	02/03/2023	1.6	5.5		1	1019	-12.65	0.1	
LFG26R-A	14/03/2023	0.0	1.4		18.5	999	-0.04	0.2	
LFG26R-A	23/03/2023	0.0	1.2		17.8	988	-0.02	0.2	
LFG26R-A	28/03/2023	0.0	4.2		16.1	1007	0.05	0.2	
LFG26R-B	02/03/2023	0.1	12		1.3	1019	0.05	0.1	
LFG26R-B	14/03/2023	0.0	1.7		13.4	999	-12.49	2.1	
LFG26R-B	23/03/2023	0.0	1.3		14.9	988	-10.11	0.5	
LFG26R-B	28/03/2023	0.0	1.2		19.8	1007	-0.02	0.2	
LFG27R-A	02/03/2023	0.0	5.3		13.5	1019	0.04	0.1	
LFG27R-A	14/03/2023	4.7	1.5		0.2	999	0.26	2.5	
LFG27R-A	23/03/2023	5.9	0.6		0.3	988	-0.44	0.2	
LFG27R-A	28/03/2023	6.1	1.3		1.1	1007	-0.95	0.2	
LFG27R-B	02/03/2023	0.7	5.4		0.8	1019	0.01	0.1	
LFG27R-B	14/03/2023	0.0	4.7		12.8	999	0.28	0.3	
LFG27R-B	23/03/2023	0.0	1.4		19	988	-1.11	0.2	
LFG27R-B	28/03/2023	0.0	2.1		19.2	1007	-1.91	0.1	
LFG39	02/03/2023	0.0	1.3		17.6	1019	0.07	-0.4	
LFG39	14/03/2023	0.0	0.9		19.3	999	-3.79	0.1	
LFG39	23/03/2023	0.0	0.5		15.8	988	-2.81	0.1	
LFG39	28/03/2023	0.0	1.22		17.96	1007	-2.07	0.1	
LFG40	02/03/2023	0.2	0.1		1.1	1019	-0.41	0.2	
LFG40	14/03/2023	0.0	0.1		5.5	999	-0.33	1.2	
LFG40	23/03/2023	0.0	0.1		5.1	988	-1.53	0.2	
LFG40	28/03/2023	0.0	0.3		9.7	1007	0.86	0.3	
LFG41	02/03/2023	0.0	5.7		13.6	1019	-16.49	-0.1	
LFG41	14/03/2023	0.0	5.3		13.8	999	0.07	7.5	
LFG41	23/03/2023	0.0	5.7		12.7	988	25.57	0.1	
LFG41	28/03/2023	0.0	5.9		13.4	1007	-2.33	-1.8	
LFG42	02/03/2023	0.0	2.2		10	1019	0.07	0.5	
LFG42	14/03/2023	0.0	1		17	999	0.02	3.9	
LFG42	23/03/2023	0.0	0.2		20	988	-0.05	0.2	
LFG42	28/03/2023	0.0	0.5		19.3	1007	-0.40	-1.6	
LFG43R	02/03/2023	0.0	3.1		17.4	1019	-0.58	0.1	
LFG43R	14/03/2023	0.0	0.1		21.4	999	-0.58	0.2	
LFG43R	23/03/2023	0.0	7.3		4.4	988	0.93	0.1	
LFG43R	28/03/2023	0.0	1.5		21.2	1007	0.04	0.2	
LFG44R	02/03/2023	0.0	3.4		17.7	1019	0.93	0.2	
LFG44R	14/03/2023	0.0	0.1		21.4	999	-0.21	0.3	
LFG44R	23/03/2023	0.0	11.3		0.4	988	-0.18	0.2	
LFG44R	28/03/2023	0.0	6.6		0.4	1007	-0.26	0.5	
LFG45	02/03/2023	0.0	2.2		16.6	1019	-0.02	0.1	
LFG45	14/03/2023	0.0	0.5		21	999	0.02	0.2	
LFG45	23/03/2023	0.0	1.8		15.8	988	-3.83	0.2	
LFG45	28/03/2023	0.0	2.3		17.1	1007	-0.33	0.1	
LFG49	02/03/2023	0.0	8.4		10.9	1019	0.01	0.2	
LFG49	14/03/2023	0.0	8.3		9.2	999	-0.88	0.1	
LFG49	23/03/2023	0.0	8.5		9.3	988	-0.07	0.2	
LFG49	28/03/2023	0.0	6.56		10.18	1007	-0.17	0.52	
LFG50	02/03/2023	27.9	4.8		0.8	1019	0.14	0.2	
LFG50	14/03/2023	32.2	4.6		0.4	999	0.09	0.3	
LFG50	23/03/2023	32.2	4.3		0.4	988	-0.56	0.3	
LFG50	28/03/2023	32.6	4.5		0.8	1007	0.39	0.3	
LFG51	02/03/2023	3.1	9.3		1.5	1019	0.05	0.4	
LFG51	14/03/2023	4.7	9.4		0.6	999	-1.83	0.4	
LFG51	23/03/2023	5.0	9.3		0.6	988	-7.62	0.2	
LFG51	28/03/2023	5.1	9.5		0.9	1007	-2.21	0.2	

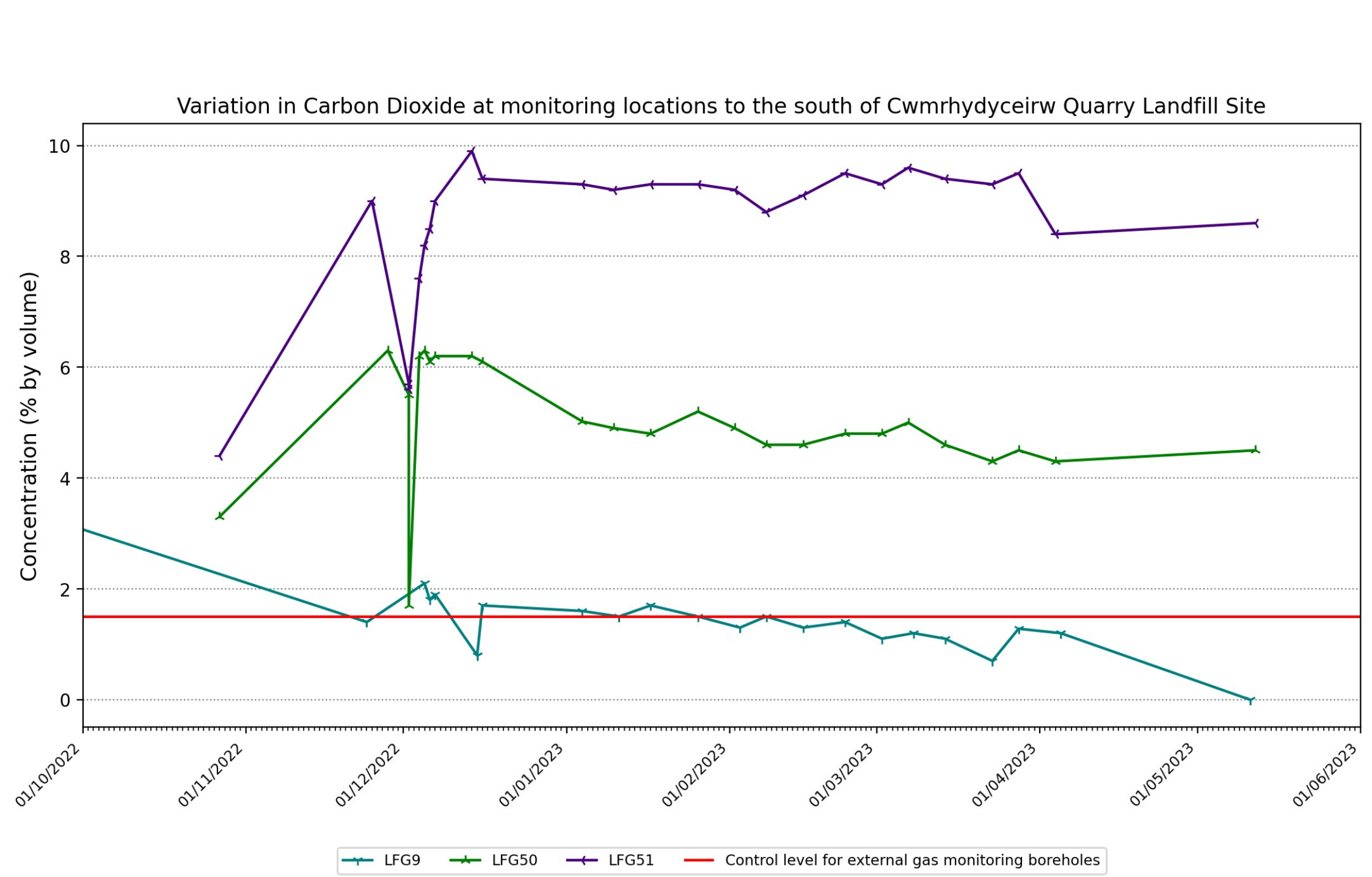
Cwmrhydyceirw Quarry: Site Monitoring April 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	04/04/2023	0.4	0.3	0.0	20.5	1024	0.00	0.0	GAS IN THE WASTE
L3/09R	04/04/2023	0.0	0	0.0	21.2	1024	0.00	0.0	
L6/09	04/04/2023	10.5	6	1.0	10.1	1024	0.00	0.0	
L9B/09	04/04/2023	0.0	0	0.0	20	1024	0.00	0.0	
L11/09	04/04/2023	33.2	1.1	19.0	5.6	1024	0.00	0.0	
L13/09	04/04/2023	0	0.1	0.0	19.1	1024	0.00	0.0	
L16/09	04/04/2023	46.1	12.3	4.0	1	1024	0.00	0.0	
L19/09	04/04/2023	8.4	0	2.0	7.9	1024	0.00	0.0	
L21/09R	04/04/2023	0	0	0.0	21.2	1024	0.00	0.0	
L23/09	04/04/2023	0	0	0.0	21.2	1024	0.00	0.0	
L26/09	04/04/2023	0	0.1	0.0	21	1024	0.00	0.0	
L1/20	04/04/2023	0.0	0	0.0	21.2	1024	0.00	0.0	
L2/20	Flooded								
L3/20	04/04/2023	0.0	0	0.0	21.2	1024	0.00	0.0	
L4/20	04/04/2023	0.0	0	0.0	21.2	1024	0.00	0.0	
L5/20	04/04/2023	9.9	0.1	0.0	14	1024	0.00	0.0	
L6/20	04/04/2023	29.5	11.2	1.0	7.5	1024	0.00	0.0	
L7/20	04/04/2023	1.3	1.1	0.0	6.7	1024	0.00	0.0	
L8/20	04/04/2023	0.0	0	0.0	21.1	1024	0.00	0.0	
L9/20	04/04/2023	0	0	0.0	21.1	1024	0.00	0.0	
LFG**2R**	05/04/2023	0.0	0.1	0.0	21.9	1014	-0.15	0.2	GAS EXTERNAL TO THE WASTE
LFG**3**	05/04/2023	0.0	0.5	0.0	21.3	1014	0.02	0.3	
LFG**4**	05/04/2023	0.0	3.3	0.0	19.2	1014	-0.05	0.1	
LFG**5**	05/04/2023	0.0	2.8	0.0	14.4	1014	-0.07	0.1	
LFG**6**	05/04/2023	0.0	0	0.0	22.3	1014	0.14	0.1	
LFG**7BG**	05/04/2023	0.0	1.9	0.0	15.7	1014	-0.02	0.1	
LFG**8**	05/04/2023	0.0	0.3	0.0	21.1	1014	-0.15	0.1	
LFG**9**	05/04/2023	0	1.2	0.0	10.7	1014	0.07	0.1	
LFG**10**	05/04/2023	0.0	0.6	0.0	20	1014	-0.07	0.2	
LFG**11**	05/04/2023	0.0	0.6	0.0	21.3	1014	0.02	0.2	
LFG**11A**	05/04/2023	0.0	0.1	0.0	22.6	1014	-0.10	0.1	
LFG**12BG**	05/04/2023	0.0	0.1	0.0	22.3	1014	-0.06	0.1	
LFG**13**	05/04/2023	0.0	7.5	0.0	10.1	1014	-0.09	0.1	
LFG**17**	05/04/2023	0.0	0.9	0.0	19.3	1014	0.07	0.2	
LFG**18R**	05/04/2023	0.0	0.2	0.0	21.9	1014	-0.95	0.2	
LFG**19**	05/04/2023	0.0	0.4	0.0	20.3	1014	-0.02	0.1	
LFG**20**	Flooded								
LFG**21BG**	04/04/2023	0.0	0	1.0	21.6	1024	0.00	0.0	
LFG**22**	05/04/2023	0.0	1.3	0.0	21.2	1014	0.05	0.1	
LFG**24**	04/04/2023	0.0	1.4	0.0	0	1024	0.03	0.1	
LFG**24R-A**	04/04/2023	0.0	1	1.0	20.2	1024	3.11	0.1	
LFG**24R-B**	04/04/2023	0.0	1.6	0.0	19.4	1024	0.02	0.1	
LFG**25**	04/04/2023	0.0	0.6	0.0	15	1024	2.01	0.1	
LFG**25R-A**	04/04/2023	0.0	1.4	0.0	17.9	1024	0.07	0.0	
LFG**25R-B**	04/04/2023	0.1	7.3	0.0	0.7	1024	-0.09	0.1	
LFG**26**	04/04/2023	0.0	0.1	0.0	21.4	1024	-1.92	0.1	
LFG**26R-A**	04/04/2023	0.0	2.9	0.0	15.7	1024	0.05	0.1	
LFG**26R-B**	04/04/2023	0.0	0.2	0.0	20.1	1024	-60.82	0.1	
LFG**27R-A**	04/04/2023	0.0	0.1	0.0	20.4	1024	0.00	0.0	
LFG**27R-B**	04/04/2023	0.0	0	0.0	20.9	1024	0.00	0.0	
LFG**35R**	04/04/2023	0.0	0.5	0.0	21.4	1024	0.19	0.0	
LFG**39**	04/04/2023	0.0	0.5	0.0	19.8	1024	-0.12	0.1	
LFG**40**	04/04/2023	0.0	0.1	0.0	9.3	1024	0.12	0.0	
LFG**41**	04/04/2023	0.0	5.5	0.0	12.7	1024	-11.21	0.0	
LFG**42**	04/04/2023	0.0	0.1	0.0	19.7	1024	0.03	0.1	
LFG**43R**	04/04/2023	0.0	0	1.0	21.1	1024	3.75	0.1	
LFG**44R**	04/04/2023	0.0	0	1.0	21.2	1024	-1.17	0.1	
LFG**45**	04/04/2023	0.0	2.5	1.8	16.2	1024	0.36	0.1	
LFG**46R**	04/04/2023	0.0	11.2	0.0	8.4	1024	-9.15	0.1	
LFG**47R**	04/04/2023	0.0	0.9	1.0	20	1024	-3.22	0.1	
LFG**48R**	04/04/2023	0.0	0.3	0.0	21.2	1024	-0.67	0.1	
LFG**49**	04/04/2023	0.0	8.2	0.0	8.9	1024	-0.46	0.0	
LFG**50**	04/04/2023	32.1	4.3	1.0	0.8	1024	0.21	0.2	
LFG**51**	04/04/2023	4.5	8.4	0.0	0.7	1024	-1.72	0.2	

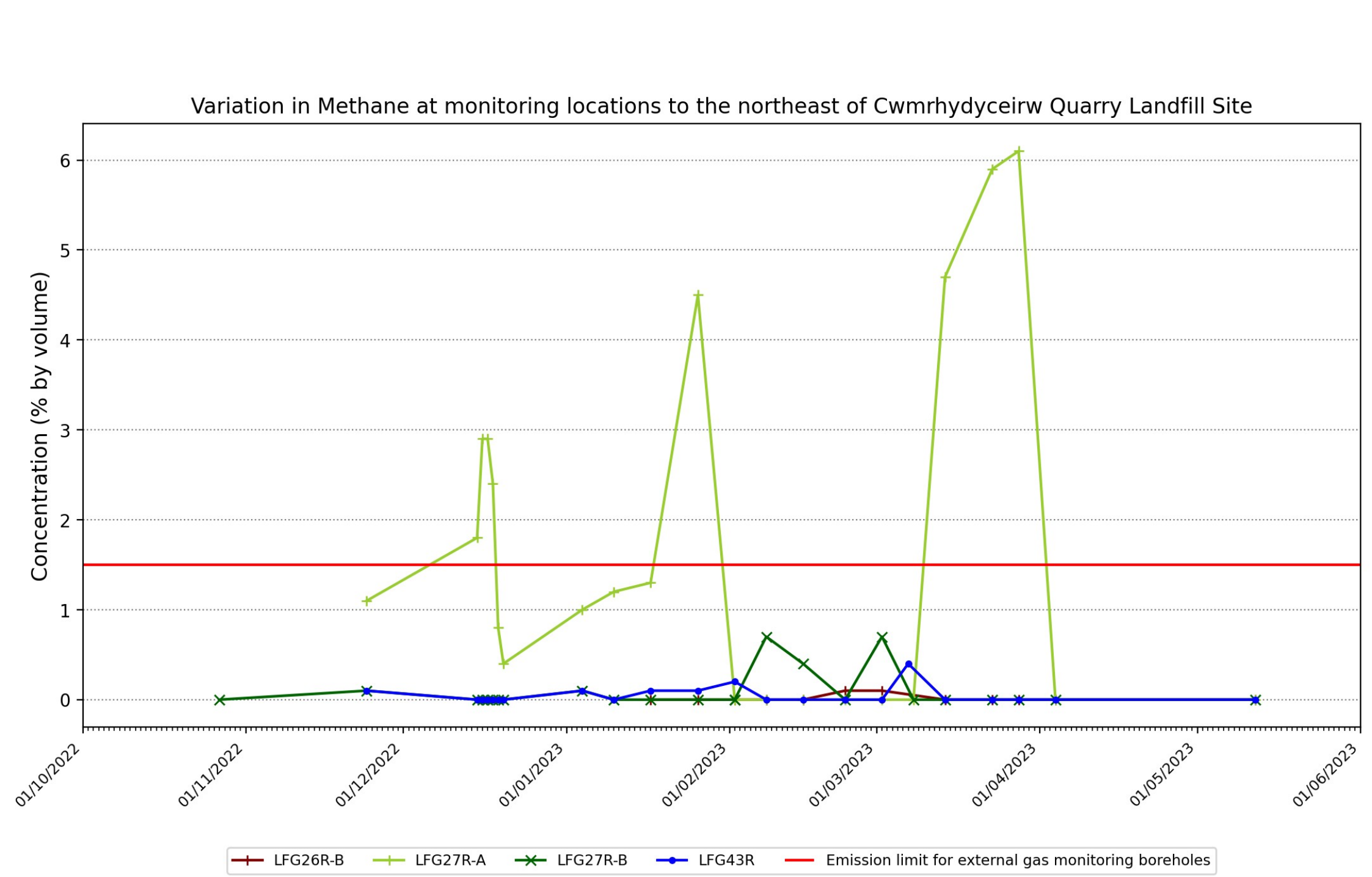
Cwmrhydyceirw Quarry: Site Monitoring May 2023									
Borehole	Date taken	CH4 (%)	CO2 (%)	CO (ppm)	O2 (%)	Barom Press	Gas Pressure	Internal flow (l/h)	
L1C/09	11/05/2023	0	0	0.0	21	1022			GAS IN THE WASTE
L3/09R	11/05/2023	0.2	0.2	0.0	21.1	1022			
L6/09	11/05/2023	0.0	0	0.0	20.8	1022			
L9B/09	11/05/2023	0.0	1	0.0	21.2	1022			
L11/09	11/05/2023	26.4	1	1.5	6.9	1022			
L13/09	11/05/2023	0	0	0.0	20.8	1022			
L16/09	11/05/2023	27.2	9	5.0	6.3	1022			
L19/09	11/05/2023	6.2	0	7.0	9.3	1022			
L21/09R	11/05/2023	0	0	0.0	21.1	1022			
L23/09	11/05/2023	0	0.1	0.0	20.8	1022			
L26/09	11/05/2023	0	0.0	0.0	21	1022			
L1/20	11/05/2023	0.0	0	0.0	21.1	1022			
L2/20	11/05/2023	0.0	0	0.0	20	1022			
L3/20	11/05/2023	0.0	0	0.0	20.9	1022			
L4/20	11/05/2023	0.0	0.1	0.0	21.8	1022			
L5/20	11/05/2023	0	0	0.0	20.9	1022			
L6/20	11/05/2023	4.4	2.1	0.0	19.3	1022			
L7/20	11/05/2023	0	0	0.0	20.8	1022			
L8/20	11/05/2023	0.0	0	0.0	21	1022			
L9/20	11/05/2023	0	0.1	0.0	20.6	1022			
LFG**2R**	11/05/2023	0.0	0	0.0	16.4	1022	0.07	0.1	GAS EXTERNAL TO THE WASTE
LFG**3**	11/05/2023	0.0	0	0.0	22.2	1022	0.12	0.1	
LFG**4**	11/05/2023	0.0	2.3	0.0	18.8	1022	0.02	0.1	
LFG**5**	11/05/2023	0.0	1.2	0.0	19.7	1022	0.05	0.2	
LFG**6**	11/05/2023	0.0	0	0.0	22.2	1022	0.12	0.2	
LFG**7BG**	11/05/2023	0.0	0	0.0	22.2	1022	0.06	0.2	
LFG**8**	11/05/2023	0.0	0	0.0	21.8	1022	0.05	0.3	
LFG**9**	11/05/2023	0	0	0.0	22.1	1022	0.02	0.1	
LFG**10**	11/05/2023	0.0	0.5	1.0	19.5	1022	0.02	0.1	
LFG**11**	11/05/2023	0.0	0.5	0.0	19.6	1022	0.09	0.1	
LFG**11A**	11/05/2023	0.0	0.4	1.0	17.3	1022	0.12	0.2	
LFG**12BG**	11/05/2023	0.0	0	1.0	21.2	1022			
LFG**13**	11/05/2023	0.0	7.6	3.0	2	1022	-2.49	0.2	
LFG**17**	12/05/2023	0.0	0	1.0	20.6	1020	-0.21	0.1	
LFG**18R**	12/05/2023	0.0	0	2.0	21.4	1020	-0.07	0.3	
LFG**19**	12/05/2023	0.0	0	0.0	21.3	1020	0.12	0.1	
LFG**20**	12/05/2023	0.0	0.1	0.0	21.9	1020	-0.58	0.1	
LFG**21BG**	12/05/2023	0.0	0	0.0	20.7	1020			
LFG**22**	12/05/2023	0.0	0	0.0	21.3	1020	0.12	0.1	
LFG**24**	12/05/2023	0.0	0	0.0	21.1	1020	0.02	0.1	
LFG**24R-A**	12/05/2023	0.0	0.1	0.0	20.8	1020	0.14	0.2	
LFG**24R-B**	12/05/2023	0.0	2.7	0.0	17.9	1020	0.04	0.2	
LFG**25**	12/05/2023	0.0	0.1	0.0	21	1020	0.09	0.3	
LFG**25R-A**	12/05/2023	0.0	0.1	0.0	14.1	1020	0.07	0.1	
LFG**25R-B**	12/05/2023	0.1	8.9	3.0	0.4	1020	-0.05	0.2	
LFG**26**	12/05/2023	0.0	1.3	0.0	18.2	1020	0.21	0.2	
LFG**26R-A**	12/05/2023	0.4	4.9	12.0	0.4	1020	-0.04	0.2	
LFG**26R-B**	12/05/2023	0.0	0.7	1.0	19.5	1020	0.04	0.2	
LFG**27R-A**	12/05/2023	0.0	0	0.0	21.2	1020			
LFG**27R-B**	12/05/2023	0.0	0	0.0	21.3	1020			
LFG**35R**	12/05/2023	0.0	0.0	1.0	20.8	1020	-0.11	0.2	
LFG**39**	12/05/2023	0.0	0.9	0.0	18.4	1020	0.02	0.1	
LFG**40**	12/05/2023	0.0	0.1	0.0	4.2	1020	-5.41	0.2	
LFG**41**	12/05/2023	0.0	5.3	0.0	12.4	1020	-0.23	0.2	
LFG**42**	12/05/2023	0.0	0.9	0.0	9.9	1020	0.25	0.1	
LFG**43R**	12/05/2023	0.0	0	0.0	21.3	1020	-0.19	0.2	
LFG**44R**	12/05/2023	0.0	0	0.0	21.4	1020	0.01	0.2	
LFG**45**	12/05/2023	0.0	0	0.0	21.5	1020	0.02	0.2	
LFG**46R**	12/05/2023	0.0	0.1	0.0	21.6	1020	-0.60	0.1	
LFG**47R**	12/05/2023	0.0	0.5	2.0	19.7	1020	0.19	0.2	
LFG**48R**	12/05/2023	0.0	0.2	1.0	20.4	1020	0.04	0.2	
LFG**49**	12/05/2023	0.0	0.4	0.0	20.3	1020	0.18	0.2	
LFG**50**	12/05/2023	33.4	4.5	1.0	1.4	1020	-2.34	0.1	
LFG**51**	12/05/2023	4.2	8.6	1.0	2.9	1020	-0.05	0.1	

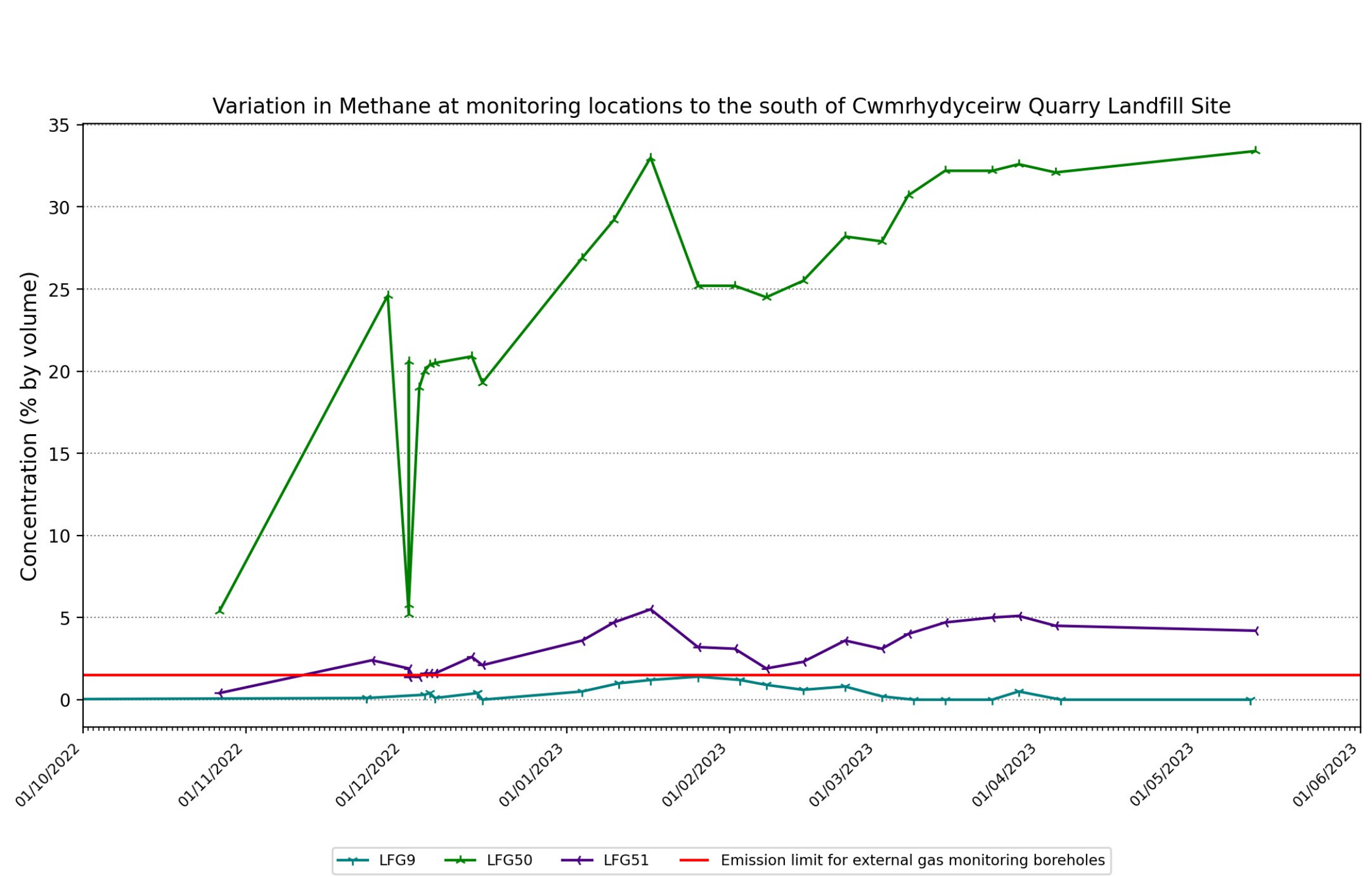
APPENDIX B

CARBON DIOXIDE AND METHANE GRAPHS


Variation in Carbon Dioxide at monitoring locations to the northeast of Cwmrhydyceirw Quarry Landfill Site
Concentration (% by volume)
0
2
4
6
8
10
12
01/10/2022
01/11/2022
01/12/2022
01/01/2023
01/02/2023
01/03/2023
01/04/2023
01/05/2023
01/06/2023
LFG26R-B
LFG27R-A
LFG27R-B
LFG43R
Control level for external gas monitoring boreholes


Variation in Carbon Dioxide at monitoring locations to the south of Cwmrhydyceirw Quarry Landfill Site
Concentration (% by volume)
10
8
6
4
2
0
01/10/2022
01/11/2022
01/12/2022
01/01/2023
01/02/2023
01/03/2023
01/04/2023
01/05/2023
01/06/2023
LFG9
LFG50
LFG51
Control level for external gas monitoring boreholes


Variation in Methane at monitoring locations to the northeast of Cwmrhydyceirw Quarry Landfill Site
Concentration (% by volume)
0
1
2
3
4
5
6
01/10/2022
01/11/2022
01/12/2022
01/01/2023
01/02/2023
01/03/2023
01/04/2023
01/05/2023
01/06/2023
LFG26R-B
LFG27R-A
LFG27R-B
LFG43R
Emission limit for external gas monitoring boreholes


Variation in Methane at monitoring locations to the south of Cwmrhydyceirw Quarry Landfill Site
Concentration (% by volume)
35
30
25
20
15
10
5
0
01/10/2022
01/11/2022
01/12/2022
01/01/2023
01/02/2023
01/03/2023
01/04/2023
01/05/2023
01/06/2023
LFG9
LFG50
LFG51
Emission limit for external gas monitoring boreholes

APPENDIX C

CWMRHYDYCEIRW QUARRY LABORATORY ANALYSIS REPORTS BY SOCOTEC

Mr James Disney
MJCA
Baddesley Colliery Offices
Main Road
Atherstone
Baxterley
CV9 2LE

Email to:
jamesdisney@mjca.co.uk

SOCOTEC
Environment & Safety
Derwent House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554461
Web: www.socotec.co.uk

Report Ref: SLA-2023-232845-56104-001

4 January 2023

Gas Sampling & Analysis : Cwmrhydyceirw Quarry Landfill

Dear Mr. Disney,

Should you require any further information concerning the report covering this visit, please do not hesitate to contact us.

Yours sincerely

Michael Thomas
Project Leader (SLA)
Environment & Safety

E-mail: Michael.Thomas@socotec.com
M: 07920411817
T: 01283 554461

MJCA

Gas Sampling & Analysis
Cwmrhydyceirw Quarry Landfill

13th December 2022

Gas Sampling & Analysis

Cwmrhydyceirw Quarry Landfill

Project No	EN- 232845
Carried Out For	Mr James Disney MJCA Baddesley Colliery Offices Main Road Atherstone Baxterley CV9 2LE
Carried Out	13/12/2022
Prepared By	Marie Bridges, Office Manager, SLA
Authorised By	Michael Thomas, Project Leader (SLA)
Date of Issue	04/01/2023
Copy No	1
Revision	0
Report No	SLA-2023-232845-56104-001

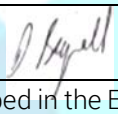
SOCOTEC
Environment & Safety
Derwent House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554400

1015

Table of Contents

1.0 DOCUMENT CONTROL

Issue No Date	Status	Prepared by	Typed By	Checked by	Approved by
1 4 January 2023	UKAS	Michael Thomas, Project Leader (SLA)	Marie Bridges Office Manager	Daniel Bignell Quality Manager, SLA	Michael Thomas, Project Leader (SLA)
					

Method ENV/GAS14 which complies with the requirements prescribed in the Environment Agency Landfill Directive LFTGN07 V2 2010 'Guidance on monitoring landfill gas surface emissions

Non UKAS accredited tests are indicated by an asterisk (*) within the body of this report.

Results relate only to the sample under test.

Any opinions and interpretations expressed herein are not covered by the scope of our UKAS accreditation.

1015

Appendix One: Laboratory Analysis Certificates

Report GA13139 23-Dec-2022
ASC56379 Report * Not UKAS Accredited

UKAS TESTING
1015

TEST REPORT

The results relate only to the items tested, calibrated or sampled

SOCOTEC

GAS ANALYSIS

Customer: **MJCA, Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE**

Date Received: 14 December 2022 Date Sampled: 13 December 2022 **Report N° GA13139**

Date Analysed: 23 December 2022 Site: Cwmrhydyceirw Quarry Landfill Site, Swansea

SAMPLE REFERENCE	Analysis % V/V											
	Carbon Dioxide (CO_2)	Oxygen (O_2)	Carbon Monoxide (CO)	Nitrogen (N_2)	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	n-Butane (n-C_4H_{10})	n-Pentane (n-C_5H_{12})	n-Hexane (n-C_6H_{14})	n-Heptane (n-C_7H_{16})	n-Octane (n-C_8H_{18})
Method of Analysis	6	4	6	4	3	3	3	3	3	3	3	3
LFG51	7.76	0.6	0.097	85	3.34	0.0019	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0015
L11/09	7.79	3.0	0.023	14	77.32	0.054	0.0068	0.0044	<0.0005	<0.0005	<0.0005	0.0011

Method of Analysis:-
3 G.C. with F.I.D. - ENV/GAS03
4 G.C. with T.C.D. - ENV/GAS09
6 G.C. with F.I.D. - ENV/GAS09

Customer Analytical Requirements
CO_2, O_2, CO, N_2, CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, n-C_5H_{12}, n-C_6H_{14}, n-C_7H_{16}, n-C_8H_{18}

Authorised by
Daniel Bignell

Comment Box

Authorised by:

Daniel Bignell, Senior Analyst
Direct Dial: 01 283 554461

SOCOTEC accepts no responsibility for the collection of any of the samples referred to in this report.

Analyst: Stephen Bass

Issue Date: 23 December 2022

UKAS TESTING
1015

TEST REPORT

The results relate only to the items tested, calibrated or sampled

SOCOTEC

GAS ANALYSIS

Customer: **MJCA, Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE**

Date Received: 14 December 2022 Date Sampled: 13 December 2022 **Report N° GA13139**

Date Analysed: 23 December 2022 Site: Cwmrhydyceirw Quarry Landfill Site, Swansea

SAMPLE REFERENCE	Analysis % V/V											
	Carbon Dioxide (CO_2)	Oxygen (O_2)	Carbon Monoxide (CO)	Nitrogen (N_2)	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	n-Butane (n-C_4H_{10})	n-Pentane (n-C_5H_{12})	n-Hexane (n-C_6H_{14})	n-Heptane (n-C_7H_{16})	n-Octane (n-C_8H_{18})
Method of Analysis	**6**	**4**	**6**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
LIC/09	15.45	3.9	0.0032	30	50.56	0.045	0.0014	0.0008	<0.0005	<0.0005	<0.0005	<0.0005
LFG50	4.19	3.4	<0.0005	69	21.71	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Method of Analysis:-
3 G.C. with F.I.D. - ENV/GAS03
4 G.C. with T.C.D. - ENV/GAS09
6 G.C. with F.I.D. - ENV/GAS09

Customer Analytical Requirements
CO_2, O_2, CO, N_2, CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, n-C_5H_{12}, n-C_6H_{14}, n-C_7H_{16}, n-C_8H_{18}

Authorised by
Daniel Bignell

Comment Box

Authorised by:

Daniel Bignell, Senior Analyst
Direct Dial: 01 283 554461

SOCOTEC accepts no responsibility for the collection of any of the samples referred to in this report.

Analyst: Stephen Bass

Issue Date: 23 December 2022

TEST REPORT ASC/56379

Customer:	Environmental Chemistry SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Testing Facility:	Advanced Chemistry and Research SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Purchase Order Number:	56104
Date Samples Received:	14 December 2022
Condition of Samples:	Ambient and Satisfactory
Approved by:	
Approver's name:	Laura Wightman
Job Title:	Analyst
Test Report Date:	03 January 2023

Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
4	**ATD Tubes (Dual Bed)**	ASC/SOP/210	**ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN AIR BY THERMAL DESORPTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY-** Samples were analysed for VOCs by ATD-GC-MS

Results

Table 1:

	Units	ng	ng	ng	ng
	Method ID (ASC/SOP/xxx)	210	210	210	210
	UKAS	No	No	No	No
	Customer Sample Reference	LFG50	L11/09	LFG51	L1C/09
	Laboratory Sample Reference	ASC/56379.001	ASC/56379.002	ASC/56379.003	ASC/56379.004
	Tube ID	246921	Mi193266	Mi083626	Mi096230
Compound	**Limit of Detection**	**Result**	**Result**	**Result**	**Result**
Chloroethene	30	<30	<30	<30	<30
Chloroethane	10	<10	4700*	2200*	2800*
1-Pentene	20	<20	1200*	260	1000*
Furan	7	<7	150	20	130
Ethyl Mercaptan	30	<30	<30	<30	<30
1,1-Dichloroethene	9	<9	<9	<9	<9
Methylsulfide	10	<10	<10	<10	<10
Dichloromethane	10	90	80	100	80
Carbon Disulfide	10	30	<10	70	20
1,1-Dichloroethane	6	<6	<6	<6	<6
cis-1,2-Dichloroethene	5	<5	<5	<5	40
Propyl Mercaptan	20	<20	<20	<20	<20
Tetrachloromethane	10	<10	<10	<10	<10
Benzene	10	<10	20	20	70
Trichloroethene	10	<10	<10	<10	10
ButylMercaptan	30	<30	<30	<30	<30
Dimethyldisulfide	10	<10	<10	<10	<10
Toluene	10	<10	<10	<10	40
Butyric Acid	40	<40	<40	<40	<40
Ethyl Butyrate	9	<9	<9	<9	<9
Styrene	10	<10	<10	<10	<10
2-ButoxyEthanol	20	<20	<20	<20	<20
Methyl Mercaptan	100	<100	<100	<100	<100
1,3-Butadiene	7	<7	<7	<7	<7
1,2-Dichloroethane	10	<10	<10	<10	<10

1. *This result is over the calibration range of 1000ng, therefore has a higher level of uncertainty.

Table 2:

Units		µg/m³	µg/m³	µg/m³	µg/m³
Method ID (ASC/SOP/xxx)		210	210	210	210
UKAS		No	No	No	No
Customer Sample Reference		LFG50	L11/09	LFG51	L1C/09
Laboratory Sample Reference		ASC/56379.001	ASC/56379.002	ASC/56379.003	ASC/56379.004
Tube ID		246921	Mi193266	Mi083626	Mi096230
Compound	**Limit of Detection**	**Result**	**Result**	**Result**	**Result**
Chloroethene	30	<60	<60	<60	<60
Chloroethane	10	<20	23000	11000	14000
1-Pentene	20	<40	6100	1300	5200
Furan	7	<20	770	100	640
Ethyl Mercaptan	30	<60	<60	<60	<60
1,1-Dichloroethene	9	<20	<20	<20	<20
Methylsulfide	10	<20	<20	<20	<20
Dichloromethane	10	450	420	480	410
Carbon Disulfide	10	100	<20	340	100
1,1-Dichloroethane	6	<10	<10	<10	<10
cis-1,2-Dichloroethene	5	<10	<10	<10	190
Propyl Mercaptan	20	<40	<40	<40	<40
Tetrachloromethane	10	<20	<20	<20	<20
Benzene	10	<20	80	100	370
Trichloroethene	10	<20	<20	<20	70
ButylMercaptan	30	<60	<60	<60	<60
Dimethyldisulfide	10	<20	<20	<20	<20
Toluene	10	40	40	40	200
Butyric Acid	40	<90	<90	<90	<90
Ethyl Butyrate	9	<20	<20	<20	<20
Styrene	10	<20	<20	<20	<20
2-ButoxyEthanol	20	<40	<40	<40	<40
Methyl Mercaptan	100	<200	<200	<200	<200
1,3-Butadiene	7	<20	<20	<20	<20
1,2-Dichloroethane	10	<20	<20	<20	<20

END OF TEST REPORT

Mr James Disney
MJCA
Baddesley Colliery Offices
Main Road
Atherstone
Baxterley
CV9 2LE

Email to:
jamesdisney@mjca.co.uk

SOCOTEC
Environment & Safety
Derwent House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554461
Web: www.socotec.co.uk

Report Ref: SLA-2023-233958-56180-020

14 February 2023

Gas Sampling & Analysis : Cwmrhydyceirw Quarry Landfill

Dear Mr. Disney,

Should you require any further information concerning the report covering this visit, please do not hesitate to contact us.

Yours sincerely

Michael Thomas
Project Leader (SLA)
Environment & Safety

E-mail: Michael.Thomas@socotec.com
M: 07920411817
T: 01283 554461

MJCA

Gas Sampling & Analysis
Cwmrhydyceirw Quarry Landfill

16th January 2023

Gas Sampling & Analysis

Cwmrhydyceirw Quarry Landfill

Project No	EN- 233958
Carried Out For	Mr James Disney MJCA Baddesley Colliery Offices Main Road Atherstone Baxterley CV9 2LE
Carried Out	16/01/2023
Prepared By	Marie Bridges, Office Manager, SLA
Authorised By	Michael Thomas, Project Leader (SLA)
Date of Issue	14/02/2023
Copy No	1
Revision	0
Report No	SLA-2023-233958-56180-020

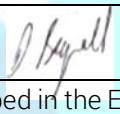
SOCOTEC
Environment & Safety
Etwall House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554461

UKAS TESTING
1015

Table of Contents

1.0 DOCUMENT CONTROL

Issue No Date	Status	Prepared by	Typed By	Checked by	Approved by
1 14 February 2023	UKAS	Michael Thomas, Project Leader (SLA)	Marie Bridges Office Manager	Daniel Bignell Quality Manager, SLA	Michael Thomas, Project Leader (SLA)
					

Method ENV/GAS14 which complies with the requirements prescribed in the Environment Agency Landfill Directive LFTGN07 V2 2010 'Guidance on monitoring landfill gas surface emissions

Non UKAS accredited tests are indicated by an asterisk (*) within the body of this report.

Results relate only to the sample under test.

Any opinions and interpretations expressed herein are not covered by the scope of our UKAS accreditation.

1015

Appendix One: Laboratory Analysis Certificates

Report GA13208 26-Jan-2023
ASC56649 Report * Not UKAS Accredited

1015

TEST REPORT

The results relate only to the items tested, calibrated or sampled

SOCOTEC

GAS ANALYSIS

Customer: **MJCA, Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE**

Date Received: 20 January 2023 Date Sampled: 16 January 2023 **Report N° GA13208**

Date Analysed: 26 January 2023 Site: Cwmrhydyceirw Quarry Landfill Site, Swansea

SAMPLE REFERENCE	Analysis % V/V											
	Carbon Dioxide (CO_2)	Oxygen (O_2)	Carbon Monoxide (CO)	Nitrogen (N_2)	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	n-Butane (n-C_4H_{10})	n-Pentane (n-C_5H_{12})	n-Hexane (n-C_6H_{14})	n-Heptane (n-C_7H_{16})	n-Octane (n-C_8H_{18})
Method of Analysis	6	4	6	4	3	3	3	3	3	3	3	3
LFG 26 RB	0.54	19.7	0.0006	78	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.0030
LFG 27 RA	0.78	9.9	<0.0005	86	0.98	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Method of Analysis:-
3 G.C. with F.I.D. - ENV/GAS03
4 G.C. with T.C.D. - ENV/GAS09
6 G.C. with F.I.D. - ENV/GAS09

Customer Analytical Requirements
CO_2, O_2, CO, N_2, CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, n-C_5H_{12}, n-C_6H_{14}, n-C_7H_{16}, n-C_8H_{18}

Authorised by
Daniel Bignell

Comment Box

Authorised by:

Daniel Bignell, Senior Analyst
Direct Dial: 01 283 554461

SOCOTEC accepts no responsibility for the collection of any of the samples referred to in this report.

Analyst: Stephen Bass

Issue Date: 26 January 2023

UKAS TESTING
1015

TEST REPORT

The results relate only to the items tested, calibrated or sampled

SOCOTEC

GAS ANALYSIS

Customer: **MJCA, Baddesley Colliery Offices, Main Road, Baxterley, Atherstone, Warwickshire, CV9 2LE**

Date Received: 20 January 2023 Date Sampled: 16 January 2023 **Report N° GA13208**

Date Analysed: 26 January 2023 Site: Cwmrhydyceirw Quarry Landfill Site, Swansea

SAMPLE REFERENCE	Analysis % V/V											
	Carbon Dioxide (CO_2)	Oxygen (O_2)	Carbon Monoxide (CO)	Nitrogen (N_2)	Methane (CH_4)	Ethane (C_2H_6)	Propane (C_3H_8)	n-Butane (n-C_4H_{10})	n-Pentane (n-C_5H_{12})	n-Hexane (n-C_6H_{14})	n-Heptane (n-C_7H_{16})	n-Octane (n-C_8H_{18})
Method of Analysis	**6**	**4**	**6**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
LFG 27 RB	0.68	19.8	0.0006	78	0.0063	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008
LFG 43	2.34	9.4	<0.0005	86	0.0013	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005

Method of Analysis:-
3 G.C. with F.I.D. - ENV/GAS03
4 G.C. with T.C.D. - ENV/GAS09
6 G.C. with F.I.D. - ENV/GAS09

Customer Analytical Requirements
CO_2, O_2, CO, N_2, CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, n-C_5H_{12}, n-C_6H_{14}, n-C_7H_{16}, n-C_8H_{18}

Authorised by
Daniel Bignell

Comment Box

Authorised by:

Daniel Bignell, Senior Analyst
Direct Dial: 01 283 554461

SOCOTEC accepts no responsibility for the collection of any of the samples referred to in this report.

Analyst: Stephen Bass

Issue Date: 26 January 2023

TEST REPORT ASC/56649

Customer:	SOCOTEC SHOE Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Testing Facility:	Advanced Chemistry & Research SOCOTEC Etwall Building Bretby Business Park Ashby Road Burton Upon Trent DE15 0YZ
Purchase Order Number:	56180
Date Samples Received:	17 January 2023
Condition of Samples:	Ambient and Satisfactory
Approved by:	
Approver's name:	Nicola Baker
Job Title:	Senior Analyst
Test Report Date:	26 January 2023

Opinions and Interpretations expressed herein are outside the scope of our UKAS accreditation
The results reported relate only to the sample tested
The results apply to the sample as received

Sample and Method Descriptions

Number of Samples Received	Matrix / Sample Description	Method ID	Description
4	**ATD Tubes (Dual Bed)**	ASC/SOP/210	**ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN AIR BY THERMAL DESORPTION GAS CHROMATOGRAPHY / MASS SPECTROMETRY** – Samples were analysed for VOCs by ATD-GC-MS.

Results

Table 1:

Units		ng	ng	ng	ng
Method ID (ASC/SOP/xxx)		210	210	210	210
UKAS		NO	NO	NO	NO
Customer Sample Reference		LFG 27RA	LFG 27RB	LFG 43	LFG 26RB
Laboratory Sample Reference		ASC/56649.001	ASC/56649.002	ASC/56649.003	ASC/56649.004
Tube ID		337008	Mi130997	202373	Mi130984
Compound	**Limit of Detection**	**Result**	**Result**	**Result**	**Result**
Chloroethene	30	<30	<30	<30	<30
Chloroethane	10	<10	<10	<10	<10
1-Pentene	20	<20	<20	<20	<20
Furan	7	<7	<7	<7	<7
Ethyl Mercaptan	30	<30	<30	<30	<30
1,1-Dichloroethene	9	<9	<9	<9	<9
Methylsulfide	10	<10	<10	<10	<10
Dichloromethane	10	190	150	100	320
Carbon Disulfide	10	20	910	50	20
1,1-Dichloroethane	6	<6	<6	<6	<6
cis-1,2-Dichloroethene	5	<5	<5	<5	<5
Propyl Mercaptan	20	<20	<20	<20	<20
Tetrachloromethane	10	<10	<10	<10	<10
Benzene	10	<10	<10	<10	10
Trichloroethene	10	<10	<10	<10	<10
ButylMercaptan	30	<30	<30	<30	<30
Dimethyldisulfide	10	<10	<10	<10	<10
Toluene	10	20	<10	<10	<10
Butyric Acid	40	<40	<40	<40	<40
Ethyl Butyrate	9	<9	<9	<9	<9
Styrene	10	<10	<10	<10	<10
2-ButoxyEthanol	20	<20	<20	<20	<20
Methyl Mercaptan	100	<100	<100	<100	<100
1,3-Butadiene	7	<7	<7	<7	<7
1,2-Dichloroethane	10	<10	<10	<10	<10

Results

Table 2:

Units		µg/m³	µg/m³	µg/m³	µg/m³
Method ID (ASC/SOP/xxx)		210	210	210	210
UKAS		NO	NO	NO	NO
Customer Sample Reference		LFG 27RA	LFG 27RB	LFG 43	LFG 26RB
Laboratory Sample Reference		ASC/56649.001	ASC/56649.002	ASC/56649.003	ASC/56649.004
Tube ID		337008	Mi130997	202373	Mi130984
Compound	**Limit of Detection**	**Result**	**Result**	**Result**	**Result**
Chloroethene	200	<200	<200	<200	<200
Chloroethane	50	<50	<50	<50	<50
1-Pentene	100	<100	<100	<100	<100
Furan	40	<40	<40	<40	<40
Ethyl Mercaptan	200	<200	<200	<200	<200
1,1-Dichloroethene	50	<50	<50	<50	<50
Methylsulfide	50	<50	<50	<50	<50
Dichloromethane	50	930	730	500	1600
Carbon Disulfide	50	80	4500	200	90
1,1-Dichloroethane	30	<30	<30	<30	<30
cis-1,2-Dichloroethene	30	<30	<30	<30	<30
Propyl Mercaptan	100	<100	<100	<100	<100
Tetrachloromethane	50	<50	<50	<50	<50
Benzene	50	<50	<50	<50	60
Trichloroethene	50	<50	<50	<50	<50
ButylMercaptan	200	<200	<200	<200	<200
Dimethyldisulfide	50	<50	<50	<50	<50
Toluene	50	80	<50	<50	<50
Butyric Acid	200	<200	<200	<200	<200
Ethyl Butyrate	50	<50	<50	<50	<50
Styrene	50	<50	<50	<50	<50
2-ButoxyEthanol	100	<100	<100	<100	<100
Methyl Mercaptan	500	<500	<500	<500	<500
1,3-Butadiene	40	<40	<40	<40	<40
1,2-Dichloroethane	50	<50	<50	<50	<50

END OF TEST REPORT

APPENDIX D

CWMRHYDYCEIRW QUARRY CARBON DATING REPORT BY SOCOTEC

Mr James Disney
MJCA
Baddesley Colliery Offices
Main Road
Atherstone
Baxterley
CV9 2LE

Email to:
jamesdisney@mjca.co.uk

SOCOTEC
Environment & Safety
Derwent House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554461
Web: www.socotec.co.uk

Report Ref: SLA-2023-232845-56104-034

6 March 2023

Gas Sampling & Analysis : Cwmrhydyceirw Quarry Landfill

Dear Mr. Disney,

Should you require any further information concerning the report covering this visit, please do not hesitate to contact us.

Yours sincerely

Michael Thomas
Project Leader (SLA)
Environment & Safety

E-mail: Michael.Thomas@socotec.com
M: 07920411817
T: 01283 554461

MJCA

Gas Sampling & Analysis
Cwmrhydyceirw Quarry Landfill

13th December 2022

Gas Sampling & Analysis

Cwmrhydyceirw Quarry Landfill

Project No	EN- 232845
Carried Out For	Mr James Disney MJCA Baddesley Colliery Offices Main Road Atherstone Baxterley CV9 2LE
Carried Out	13/12/2022
Prepared By	Marie Bridges, Office Manager, SLA
Authorised By	Michael Thomas, Project Leader (SLA)
Date of Issue	06/03/2023
Copy No	1
Revision	0
Report No	SLA-2023-232845-56104-034

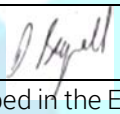
SOCOTEC
Environment & Safety
Etwall House
Bretby Business Park
Ashby Road
Bretby
Burton-upon-Trent
DE15 0YZ

Tel: 01283 554400

1015

Table of Contents

1.0 DOCUMENT CONTROL

Issue No Date	Status	Prepared by	Typed By	Checked by	Approved by
1 6 March 2023	UKAS	Michael Thomas, Project Leader (SLA)	Marie Bridges Office Manager	Daniel Bignell Quality Manager, SLA	Michael Thomas, Project Leader (SLA)
					

Method **ENV/GAS14** which complies with the requirements prescribed in the Environment Agency Landfill Directive LFTGN07 V2 2010 'Guidance on monitoring landfill gas surface emissions

Subcon lab results only

Results relate only to the sample under test.

Any opinions and interpretations expressed herein are not covered by the scope of our UKAS accreditation.

1015

Appendix One: Laboratory Analysis Certificates

* Report C2050223

R
C[14] Lockinge
D

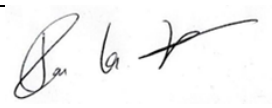
Unit 1
Lockinge Stables
East Lockinge
Wantage
Oxon, OX12 8QY

Report on Carbon-14 and Tritium Measurements on Gas Samples

for

Daniel Bignell
Environment and Safety
Socotec
Etwall House,
Bretby Business Park
Ashby Road,
Burton on Trent,
DE15 0YZ

8th February 2023

Report prepared by:	
Report checked by:	

1.0 Samples

Four samples of gas were received in December 2022 for measurement of the ^{3}H and ^{14}C content and the carbon stable isotope ratio ($\delta^{13}C$) in the CH_4 component Two results are reported here, a third sample which produced less than the optimum CO_2 for processing is in measurement and will be reported later and one sample failed to produce adequate CO_2 for the measurement to proceed.

2.0 Measurement Procedure

2.1 Chemical Processing

Gas from the sample bags was passed through a processing line first to remove the CO_2 content and secondly to dry the gas of possible water vapour. Then, with added O_2 (obtained from dried, CO_2 free air) it was passed through a heated catalyst to combust the methane component after which the produced water and CO_2 were separately collected cryogenically. The produced CO_2 was then converted to C_6H_6 through the stages of lithium carbide and acetylene. An aliquot of the CO_2 was sent to the Godwin Laboratory, Cambridge for measurement of the carbon stable isotope ratio.

2.2 Counting

For the ^{14}C measurement the processed C_6H_6 samples were made up for counting using butyl-pbd as scintillant and counted in a Wallac Quantulus liquid scintillation counter, optimised for low level counting, in association with both background and modern standards. The samples were counted for either 2000 minutes or the time necessary to achieve ~1.0% counting statistics.

The total water produced, was made up for counting with a proprietary scintillant and similarly counted in a Wallac Quantulus liquid scintillation counter in association with background and standard samples. The samples were counted for > 2000 minutes.

The error term given is 1 sigma standard deviation, 68.3% probability and represents the full estimated replicate sample reproducibility and not counting statistics alone.

3.0 Results

The results are given in the table below as percent modern carbon for the ^{14}C measurement (corrected for $\delta^{13}C$), per mil (‰) for the $\delta^{13}C$ and Bq/l and TU for the tritium.

RCD Reference	Sample Reference	^{14}C Activity (Percent Modern Carbon)	$\delta^{13}C$ (‰)	Tritium Activity	
				Bq/l	TU
RCD-9912 T-18752	LIC/09	115.2 ± 1.0	-55.9	14 ± 1	120 ± 10
RCD-9913 T-18753	L11/09	106.1 ± 1.0	-64.6	34 ± 1.4	285 ± 15

Notes:

Carbon-14
The ^{14}C values are consistent with recent (last sixty) years atmospheric levels. On face value the result would suggest that the gas from RCD-9912 originated either from material growing between 1989 and 1993 or between 1958 and 1959 and that from RCD-9913 originated either from material growing between 2002 and 2011 or between 1956 and 1957. The current atmospheric level of ^{14}C is around 103 percent modern.

Tritium
The tritium values show a very slight enhancement above background levels, which may indicate the presence of 'modern' gas. However, the results should be treated with caution, particularly that for RCD-9912. In the notes in section 4.3 we suggest that only samples giving a tritium value greater than 20 Bq/l should be suspected of containing a higher (modern) level component and as the value for RCD-9912 is < 20 Bq/l it is not necessarily indicative of a modern component in the sample gas

Stable Isotopes
The stable isotope values for the sample lie in the range observed for biogenically produced CH_4.

4.0 Note on presentation of results and their interpretation

4.1 Carbon-14

^{14}C activity is expressed as 'Percent Modern Carbon' (pMC), 100 pMC being the internationally agreed undisturbed level at which ^{14}C is naturally produced in the atmosphere. It is, in theory, the level which all organic material achieves during its

life as a plant or animal. After death this level slowly diminishes by the radioactive decay process, to half its original value after 5730 years (Half Life).

Two situations have upset the theoretical ^{14}C in the atmosphere situation in recent years (demonstrated in Figure 1). Firstly, pre-1950, the level is slightly below 100 pMC at ~98 pMC and this is attributable to the dilution of CO_2 in the atmosphere by the combustion of fossil fuels (zero ^{14}C) since the onset of the industrial revolution. Secondly, beginning in 1950, the atmospheric level increased rapidly to a peak approximately twice the normal level by 1963. This was due to the atmospheric nuclear weapons' testing programmes which took place between 1950 and 1963. Since then the levels have slowly fallen to around 104 pMC by 2014. This decrease is due to absorption of the CO_2 into the greater CO_2 reservoir of the oceans, not radioactive decay.

At RCD the measurement precision attained is generally of the order of ± 1% (standard deviation). This means that the lowest measurement that can be quoted with confidence as a positive value has to be greater than 3 times the obtained standard deviation. Levels measured below this are, therefore, reported as 'less than' values but might, in fact , be just below the indicated value or even as low as zero. For samples below 10 pMC the precision of measurement may be significantly higher.

On a practical point concerning the collection and processing of gas samples it is recognised that with the ambient level of air at ~104 pMC non-contamination of a truly zero sample is sometimes difficult to achieve and may need further testing (by replicate sampling) to confirm values even up to 10 percent modern.

4.2 Stable Isotope Ratio ($\delta^{13}C$)

$\delta^{13}C$ is the second isotope measurement reported in the landfill gas results, it is given in terms of a difference (‰) in the $^{13}C/^{12}C$ ratio value of the gas compared with that in an internationally agreed standard. Negative values indicate a depletion in the relative ^{13}C content of the sample compared with that of the standard. $\delta^{13}C$ values range between around + 2‰ in natural geological materials (eg rock carbonate) to around -70‰ in biogenically produced CH_4, such as found in a typical landfill gas CH_4. $\delta^{13}C$ values of organic material, eg most terrestrial plants and trees, however, are around -25‰ with generally less than ± 5% variation from species to species (except for some C4 plants, not common in the UK, which centre around -12‰). In contrast biogenic CH_4 sources show wide variation sometimes in excess of ± 30% of the values given above.

4.3 Tritium

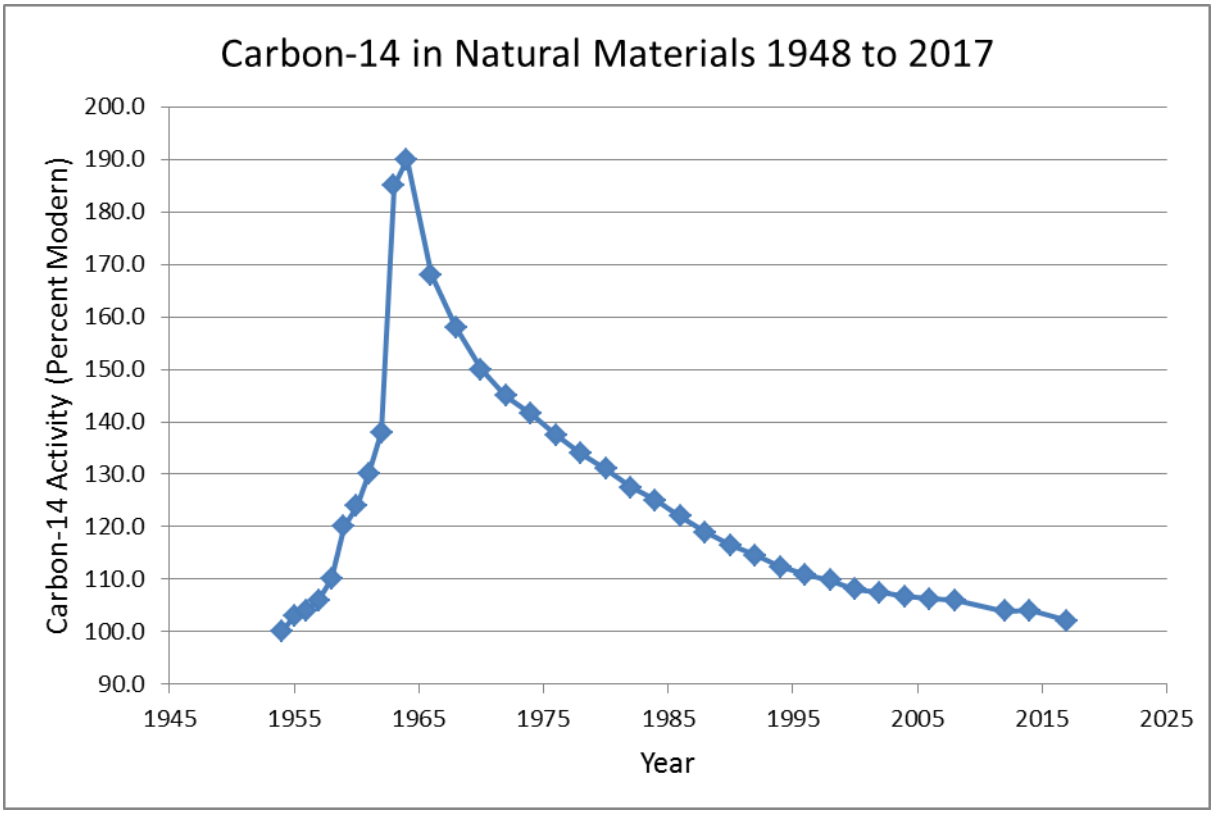
Tritium measurements are expressed as Bq/l, the SI units for radioactivity specific activity measurements and/or in the ratio form favoured by many geologists and hydrologists, 'TU'. The TU presentation is independent of the quantity measured and refers to the ratio of the non-radioactive to radioactive atoms present in whatever organic or inorganic species in which it occurs. By definition 1 TU is a ratio of 1 atom of Tritium to 10^{18} atoms of protium (hydrogen).

Like ^{14}C, ^{3}H also occurs naturally in our atmosphere and produces a level estimated to be around 0.2 Bq/l (~2 TU). During the thermonuclear weapons trials of the 1950s to 1960s these levels increased several hundredfold and produced identifiable peak levels in soil moisture. Since then, however, through dilution and radioactive decay (half-life 12.32 years) these elevated levels are barely discernible in groundwater or soil moisture, the current precipitation levels being only of the order of 1 to 3 Bq/l (~30 TU maximum).

In landfill gases, tritium can be measured by direct counting of the water produced in the oxidation of the CH_4 content. A minimum of around 1g H_2O is required to obtain a measurement precision of ± 1 Bq/l (~10 TU), which corresponds to a theoretical least measurable level of ~3 Bq/l (~30 TU). However the attainment of this least detectable level depends upon the quantity of water obtained from the CH_4 combustion. In general samples giving greater than, say 20 Bq/l are suspected of containing a small higher level component. Much higher levels (factor of x1000 higher) are frequently found in CH_4 from waste sites in which artificially produced ^{3}H has been deposited. ^{3}H was used extensively in the late 1960s to 1970s to enhance the luminosity of such items as clock and watch dials, objects which eventually turned up in landfill sites and, by methanogenesis, into CH_4. The presence of ^{3}H in landfill gases is in general a positive identifier of modern waste, but the reverse is not valid as not all sites received this kind of waste.

A J Walker
RCD Lockinge Ltd
Unit 1, Lockinge Stables,
East Lockinge,
Wantage, Oxon OX12 8QY

8th February 2023


Carbon-14 in Natural Materials 1948 to 2017
Carbon-14 Activity (Percent Modern)
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
1945
1955
1965
1975
1985
1995
2005
2015
2025
Year

R
^{14}C Lockinge
D

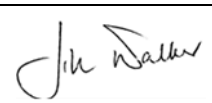
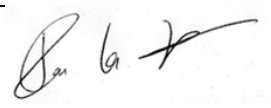
Unit 1
Lockinge Stables
East Lockinge
Wantage
Oxon, OX12 8QY

Report on Carbon-14 and Tritium Measurements on Gas Sample

for

Daniel Bignell
Environment and Safety
Socotec
Etwall House,
Bretby Business Park
Ashby Road,
Burton on Trent,
DE15 0YZ

22nd February 2023

Report prepared by:	
Report checked by:	

1.0 Samples

Four samples of gas were received in December 2022 for measurement of the ^{3}H and ^{14}C content and the carbon stable isotope ratio ($\delta^{13}C$) in the CH_4 component. This report is for the sample which produced less than the optimum CO_2 for processing.

2.0 Measurement Procedure

2.1 Chemical Processing

Gas from the sample bag was passed through a processing line first to remove the CO_2 content and secondly to dry the gas of possible water vapour. Then, with added O_2 (obtained from dried, CO_2 free air) it was passed through a heated catalyst to combust the methane component after which the produced water and CO_2 were separately collected cryogenically. The produced CO_2 was then converted to C_6H_6 through the stages of lithium carbide and acetylene. An aliquot of the CO_2 was sent to the Godwin Laboratory, Cambridge for measurement of the carbon stable isotope ratio.

2.2 Counting

For the ^{14}C measurement the processed C_6H_6 sample was made up for counting using butyl-pbd as scintillant and counted in a Wallac Quantulus liquid scintillation counter, optimised for low level counting, in association with both background and modern standards. The sample was counted for 3200 minutes the time necessary to achieve ~1.0% counting statistics.

The total water produced, was made up for counting with a proprietary scintillant and similarly counted in a Wallac Quantulus liquid scintillation counter in association with background and standard samples. The sample was counted for 1000 minutes.

The error term given is 1 sigma standard deviation, 68.3% probability and represents the full estimated replicate sample reproducibility and not counting statistics alone.

3.0 Results

The results are given in the table below as percent modern carbon for the ^{14}C measurement (corrected for $\delta^{13}C$), per mil (‰) for the $\delta^{13}C$ and Bq/l and TU for the tritium.

RCD Reference	Sample Reference	^{14}C Activity (Percent Modern Carbon)	$\delta^{13}C$ (‰)	Tritium Activity	
				Bq/l	TU
RCD-9914 T-18754	LFG 50	102.9 ± 1.4	-58.8	< 10	< 100

Notes:

Carbon-14
The ^{14}C value is consistent with recent (last sixty) years atmospheric levels. On face value the result would suggest that the gas originated either from material growing between 1955 and 1956 or the last twenty years. The current atmospheric level of ^{14}C is around 103 percent modern.

Tritium
The tritium values shows no enhancement above background levels.

Stable Isotopes
The stable isotope value for the sample lie in the range observed for biogenically produced CH_4.

4.0 Note on presentation of results and their interpretation

4.1 Carbon-14

^{14}C activity is expressed as 'Percent Modern Carbon' (pMC), 100 pMC being the internationally agreed undisturbed level at which ^{14}C is naturally produced in the atmosphere. It is, in theory, the level which all organic material achieves during its life as a plant or animal. After death this level slowly diminishes by the radioactive decay process, to half its original value after 5730 years (Half Life).

Two situations have upset the theoretical ^{14}C in the atmosphere situation in recent years (demonstrated in Figure 1). Firstly, pre-1950, the level is slightly below 100 pMC at ~98 pMC and this is attributable to the dilution of CO_2 in the atmosphere by the combustion of fossil fuels (zero ^{14}C) since the onset of the industrial revolution. Secondly, beginning in 1950, the atmospheric level increased rapidly to a peak approximately twice the normal level by 1963. This was due to the atmospheric nuclear weapons' testing programmes which took place between 1950 and 1963. Since then the levels have slowly fallen to around 104 pMC by 2014. This decrease is due to absorption of the CO_2 into the greater CO_2 reservoir of the oceans, not radioactive decay.

At RCD the measurement precision attained is generally of the order of ± 1% (standard deviation). This means that the lowest measurement that can be quoted with confidence as a positive value has to be greater than 3 times the obtained standard deviation. Levels measured below this are, therefore, reported as 'less than' values but might, in fact , be just below the indicated value or even as low as zero. For samples below 10 pMC the precision of measurement may be significantly higher.

On a practical point concerning the collection and processing of gas samples it is recognised that with the ambient level of air at ~104 pMC non-contamination of a truly zero sample is sometimes difficult to achieve and may need further testing (by replicate sampling) to confirm values even up to 10 percent modern.

4.2 Stable Isotope Ratio ($\delta^{13}C$)

$\delta^{13}C$ is the second isotope measurement reported in the landfill gas results, it is given in terms of a difference (‰) in the $^{13}C/^{12}C$ ratio value of the gas compared with that in an internationally agreed standard. Negative values indicate a depletion in the relative ^{13}C content of the sample compared with that of the standard. $\delta^{13}C$ values range between around + 2‰ in natural geological materials (eg rock carbonate) to around -70‰ in biogenically produced CH_4, such as found in a typical landfill gas CH_4. $\delta^{13}C$ values of organic material, eg most terrestrial plants and trees, however, are around -25‰ with generally less than ± 5% variation from species to species (except for some C4 plants, not common in the UK, which centre around -12‰). In contrast biogenic CH_4 sources show wide variation sometimes in excess of ± 30% of the values given above.

4.3 Tritium

Tritium measurements are expressed as Bq/l, the SI units for radioactivity specific activity measurements and/or in the ratio form favoured by many geologists and hydrologists, 'TU'. The TU presentation is independent of the quantity measured and refers to the ratio of the non-radioactive to radioactive atoms present in whatever organic or inorganic species in which it occurs. By definition 1 TU is a ratio of 1 atom of Tritium to 10^{18} atoms of protium (hydrogen).

Like ^{14}C, ^{3}H also occurs naturally in our atmosphere and produces a level estimated to be around 0.2 Bq/l (~2 TU). During the thermonuclear weapons trials of the 1950s to 1960s these levels increased several hundredfold and produced identifiable peak levels in soil moisture. Since then, however, through dilution and radioactive decay (half-life 12.32 years) these elevated levels are barely discernible in groundwater or soil moisture, the current precipitation levels being only of the order of 1 to 3 Bq/l (~30 TU maximum).

In landfill gases, tritium can be measured by direct counting of the water produced in the oxidation of the CH_4 content. A minimum of around 1g H_2O is required to obtain a measurement precision of ± 1 Bq/l (~10 TU), which corresponds to a theoretical least measurable level of ~3 Bq/l (~30 TU). However the attainment of this least detectable level depends upon the quantity of water obtained from the CH_4

combustion. In general samples giving greater than, say 20 Bq/l are suspected of containing a small higher level component. Much higher levels (factor of x1000 higher) are frequently found in CH_4 from waste sites in which artificially produced ^3H has been deposited. ^3H was used extensively in the late 1960s to 1970s to enhance the luminosity of such items as clock and watch dials, objects which eventually turned up in landfill sites and, by methanogenesis, into CH_4. The presence of ^3H in landfill gases is in general a positive identifier of modern waste, but the reverse is not valid as not all sites received this kind of waste.

A J Walker
RCD Lockinge Ltd
Unit 1, Lockinge Stables,
East Lockinge,
Wantage, Oxon OX12 8QY

22nd February 2023