



**MEASUREMENT OF METHANE GAS
DART ENERGY FORTH VALLEY LTD,
BROADMEADOWS,
CANONBIE**

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Introduction

This report details the measurements of natural gas undertaken by Gareth Payne and Michele MacDonald, in the presence of Ross Hendry (DART Energy), at DART Energy Forth Valley Ltd, Broadmeadows, Canonbie on 24th April 2013.

1. Test Programme, Site Information and Objectives

Following allegations that natural gas, containing methane and carbon dioxide, was potentially leaking from pipework associated with the extraction of coal bed methane at DART Energy Forth Valley Ltd, Broadmeadows, Canonbie, SEPA Operations Directorate requested that SEPA South Field Chemistry carry out gas monitoring.

The primary objective of this sampling exercise was to investigate methane gas levels at well heads and pipework on the site which is situated approximately 1km to the West of Canonbie and currently holds a Controlled Activities Regulations Licence (CAR/L/1092847).

In total fifteen readings were recorded at thirteen locations. Eleven readings were recorded with the well heads closed and a further four readings recorded during the venting of natural gas. See Appendix 1 for the location of the monitoring points.

The following parameters were measured:

1. Methane (CH₄)
2. Carbon Dioxide (CO₂)
3. Oxygen (O₂)

2. Monitoring Method

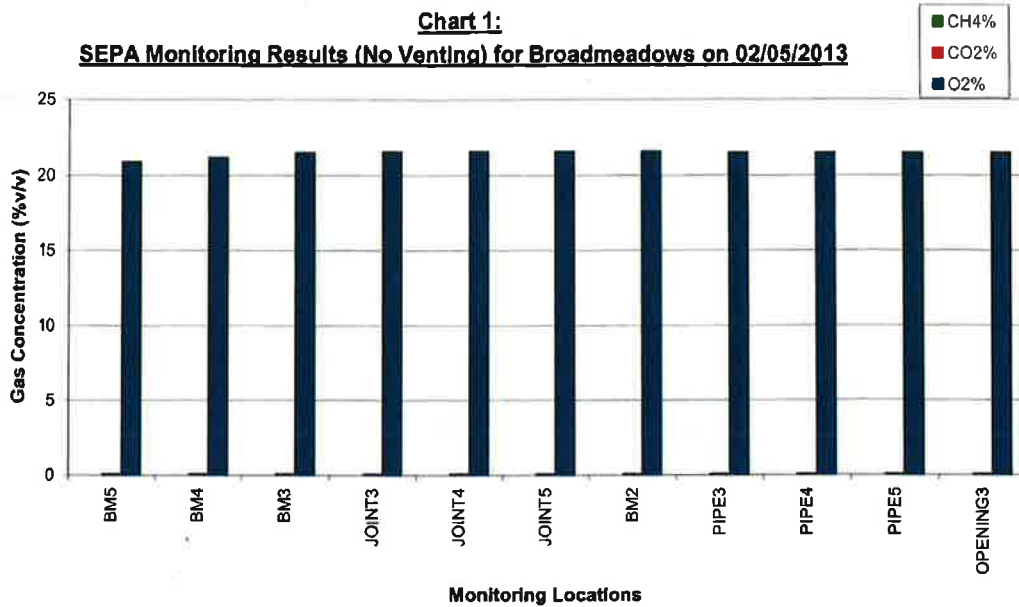
Monitoring was carried out using a Geotechnical Instruments GA5000 landfill gas analyser according to SEPA's in-house procedure, ES-NFC-WP-002, "*Determination of Oxygen, Methane and Carbon Dioxide in Landfill Gas using a Landfill Gas Monitor*". This procedure is UKAS accredited.

To carry out the monitoring a gas sampling tube from the analyser was held at the well heads and various points along the associated pipework. The analyser was then started and the gas levels measured. This method is not UKAS accredited.

Analysis was carried out by Gareth Payne and Michele MacDonald of SEPA South Field Chemistry Team who used G500147 (SEPA reference E C358).

3. Results and Discussion

Chart 1 presents the data initially taken at each monitoring location for methane, carbon dioxide and oxygen by SEPA's GA5000 (E C358). The data used to compile the chart is shown within Table 1 of Appendix 2. These results were taken while no natural gas was being vented on site.

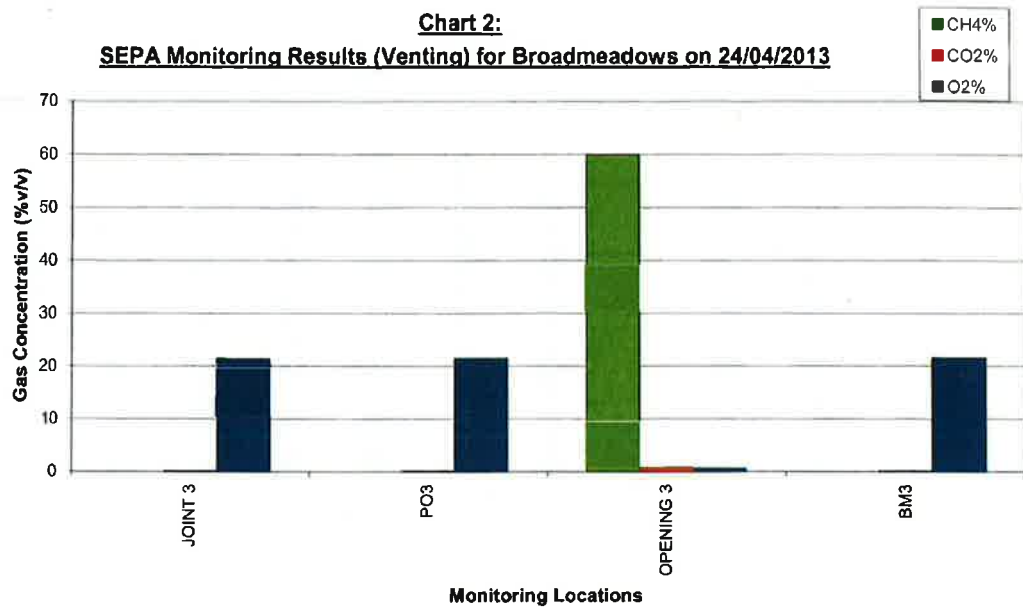


Monitoring locations BM2, BM3, BM4 and BM5 were situated at the four well heads located on the site. Locations JOINT3, JOINT4 and JOINT5 were situated at joints for metal pipework through which extracted natural gas would travel and PIPE3, PIPE4 and PIPE5 were situated at joints on plastic pipework. An additional location, OPENING3, was monitored at the end of the pipework associated with well BM3 to assess if natural gas was inadvertently venting while the wells were closed.

SEPA results showed no methane or carbon dioxide and no reduction in the level of ambient oxygen around the wells or along associated pipework.

One of the well heads (BM3) was then opened by DART operator Ross Hendry to allow natural gas to vent through the pipework and additional gas readings were taken to indicate if leaks were evident. Chart 2 presents the data taken at each monitoring location for methane, carbon dioxide and oxygen by SEPA's GA5000 (E C358). The data used to compile the chart is shown within Table 2 of Appendix 2.

Chart 2:
SEPA Monitoring Results (Venting) for Broadmeadows on 24/04/2013



As was expected during venting, monitoring at the point of exit for the natural gas (OPENING3) showed gas within the well contained >60% v/v methane as well as elevated carbon dioxide (0.9% v/v) and reduced oxygen levels (0.6% v/v). One location was monitored at the well head (BM3) and two locations along the pipework (JOINT3 and PO3) to establish if the system was leaking during venting of natural gas.

SEPA results showed no methane or carbon dioxide and no reduction in the level of ambient oxygen during the venting of natural gas.

It should also be noted that the well heads partially sit in small pits which were filled with water at the time of monitoring. No bubbling of gas was evident within these pools.

Calibration checks were carried out on SEPA's GA5000 landfill gas analyser both before and after the monitoring. This was done using a check gas of 5% v/v methane, 5% v/v oxygen, 10% v/v carbon dioxide and also using ambient air to check the oxygen cell (20.9% v/v). The values recorded both before and after the monitoring were within the defined acceptable limits.

4. Conclusions

Monitoring of the wellheads and pipework highlighted no elevated levels of methane or carbon dioxide while the wellheads remained shut. This would suggest that no leaks were present during the monitoring.

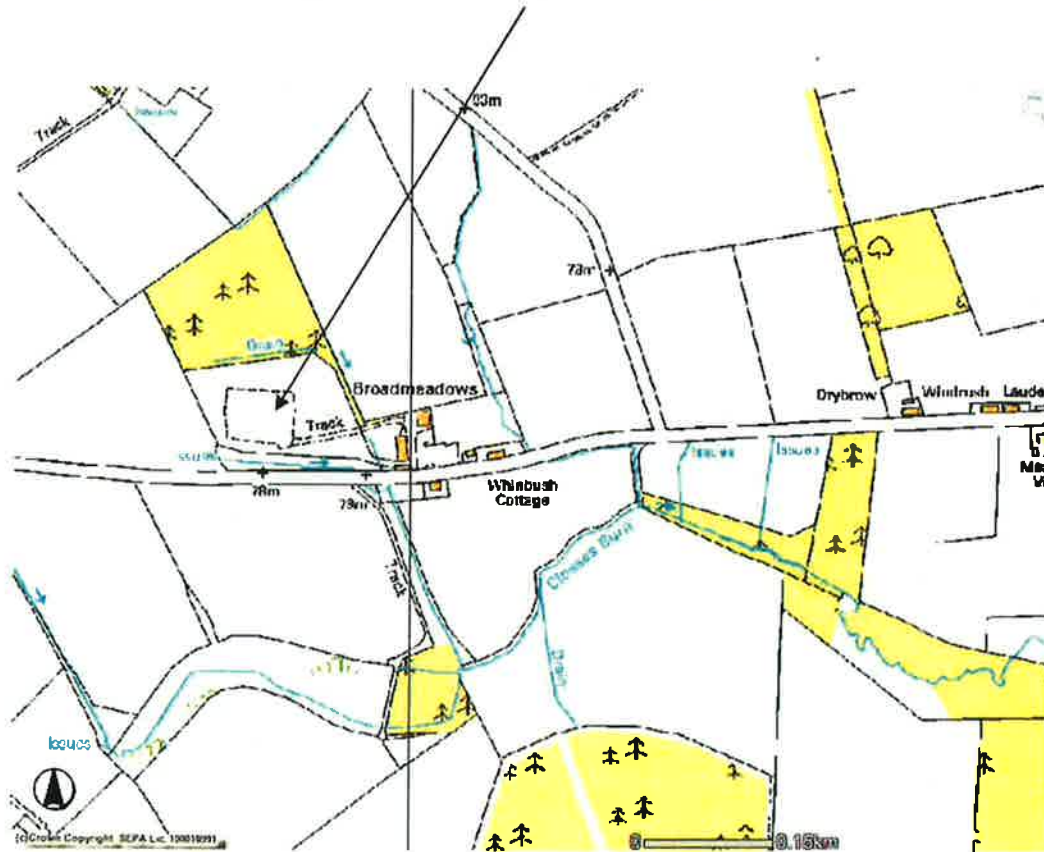
Monitoring carried out during the venting of natural gas also highlighted no elevated levels of methane or carbon dioxide around the opened wellhead (BM3) and along the associated pipework. This would suggest that no leaks were present during the venting process.

As stated previously, no bubbling of gas was evident in pools of water on the site again suggesting that no leaks were occurring during the monitoring.

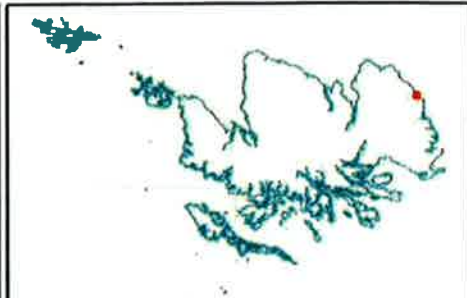
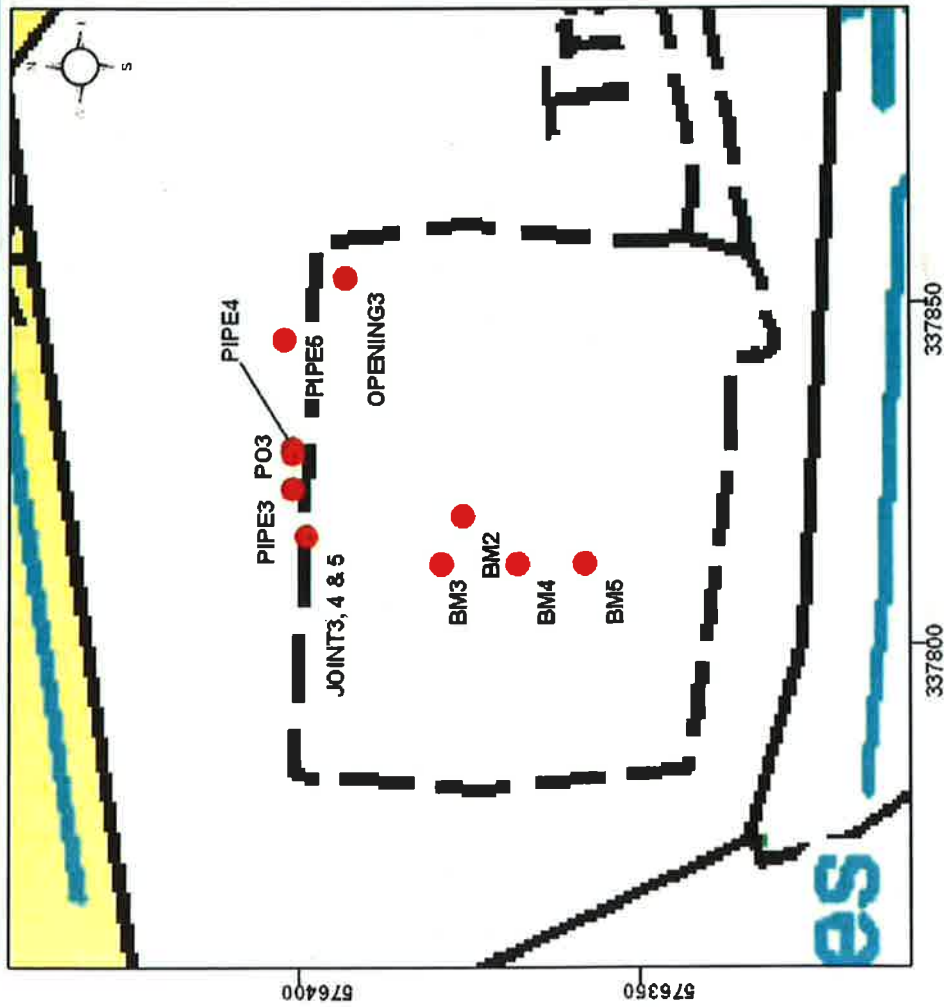
Quality control checks carried out on E C358 before and after the monitoring confirm the accuracy of the data recorded by SEPA.

**Appendix 1 – Location of DART Energy Forth Valley Ltd, Broadmeadows,
Canonbie / Monitoring Locations**

DART Energy Forth Valley Ltd, Broadmeadows, Canonbie



Broadmeadows 24th April 2013



**Appendix 2 – Gas Concentrations Recorded at DART Energy Forth Valley Ltd,
Broadmeadows, Canonbie on 24th April 2013**

Table 1 –Gas Concentrations Recorded by SEPA's E C358 (No Venting)

Monitoring Location	Date	Time	CH ₄ %	CO ₂ %	O ₂ %	Grid Reference		
BM5	24/04/13	10:11	<0.3	<0.3	20.9	NY	37812	76358
BM4	24/04/13	10:17	<0.3	<0.3	>20.9	NY	37812	76368
BM3	24/04/13	10:24	<0.3	<0.3	>20.9	NY	37812	76379
JOINT3	24/04/13	10:32	<0.3	<0.3	>20.9	NY	37816	76399
JOINT4	24/04/13	10:35	<0.3	<0.3	>20.9	NY	37816	76399
JOINT5	24/04/13	10:39	<0.3	<0.3	>20.9	NY	37816	76399
BM2	24/04/13	10:42	<0.3	<0.3	>20.9	NY	37819	76376
PIPE3	24/04/13	10:47	<0.3	<0.3	>20.9	NY	37823	76401
PIPE4	24/04/13	10:50	<0.3	<0.3	>20.9	NY	37829	76401
PIPE5	24/04/13	10:55	<0.3	<0.3	>20.9	NY	37845	76402
OPENING3	24/04/13	11:01	<0.3	<0.3	>20.9	NY	37854	76393

Table 2 –Gas Concentrations Recorded by SEPA's E C358 (Venting)

Monitoring Location	Date	Time	CH ₄ %	CO ₂ %	O ₂ %	Grid Reference		
JOINT 3	24/04/13	11:05	<0.3	<0.3	>20.9	NY	37816	76399
PO3	24/04/13	11:03	<0.3	<0.3	>20.9	NY	37828	76401
OPENING 3	24/04/13	11:10	>60	0.9	0.6	NY	37854	76393
BM3	24/04/13	11:13	<0.3	<0.3	>20.9	NY	37812	76379