Appendix A7.4 2016 VOC Emission Survey

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KLRP-VOC/SURFACEEMISSIONS/2016/1 SURFACE EMISSIONS SURVEY AT KERDIFFSTOWN, NAAS, CO. KILDARE

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF JACOBS

PREPARED BY:	Dr. John Casey & Dr. Brian Sheridan
ATTENTION:	Ms. Claire McLaughlin
FACILITY NAME:	Kerdiffstown
DATE OF MONITORING VISIT:	26th July 2016
NAME AND ADDRESS OF CLIENT ORGANISATION:	Kerdiffstown Landfill Remediation Project (KLRP), Naas, Co. Kildare
NAME AND ADDRESS OF MONITORING ORGANISATION:	Odour Monitoring Ireland, Unit 32 DeGranville Court, Dublin Road, Trim, Co. Meath
DATE OF REPORTING:	29th Aug. 2016
NAME AND THE FUNCTION OF THE PERSON APPROVING THE REPORT:	Dr. Brian Sheridan, Managing Partner, Odour Monitoring Ireland
REPORT NUMBER:	2016351(1)
REVIEWERS:	

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Executive Summary

Kildare County Council commissioned Odour Monitoring Ireland to perform a surface emissions survey at Kerdiffstown Landfill in order to ascertain any likely sources of facility gas surface emissions. The survey was carried out on the 26th July 2016.

During the surface emissions survey, the following tasks were performed on site:

1. Identification of the key mechanisms that lead to the release of facility gas surface emissions from the site.
2. Identify geographically on a site map, the locations of facility gas surface emissions in order to perform remediation of the identified surface emissions areas.

The following conclusions were drawn from the survey:

- Twelve zones of surface emissions were identified within the facility that exceeded recommended trigger levels. These zones are identified geographically on a site map contained in *Appendix I* of this report.
- Currently none of the facility area is permanently capped. Therefore the surface emission criterion averaged over the capped area does not apply. There were three surface emissions zones greater than or equal to 500 ppm around identified features. There were nine surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the facility footprint.
- Nine zones of surface emissions were identified within the facility on 14th October 2015.

1. Introduction

1.1. Background to work

Odour Monitoring Ireland was commissioned by Kildare County Council to perform a specified independent Volatile organic compound surface emissions survey at the Kerdiffstown facility. The assessment involved a volatile organic compound (VOC) surface emissions survey of the facility in order to ascertain the VOC emission points and mark them upon a map for remediation. This report presents a summary of the findings of a VOC surface emissions survey at Kerdiffstown Landfill Remediation Project (KLRP), Naas, Co. Kildare. The report is based on scientific measurements and observations made during a site visit conducted on the 26th July 2016.

1.2. Scope of work

The main aims of the survey included:

- Surface emissions monitoring in accordance with AG6 requirements carried out by Dr. John Casey,
- Discussion meeting with facility manager once survey was complete in order to communicate main surface emissions areas for immediate remediation, where necessary

2. Techniques used

This section describes the techniques used throughout the study. The surface emissions surveying and reporting was performed by Dr. John Casey, Odour Monitoring Ireland. Dr. John Casey has preformed surface emissions monitoring survey's on behalf of Odour Monitoring Ireland for regulatory bodies in Ireland and Northern Ireland, local authorities in Ireland, private waste operators in Ireland and borough councils in Northern Ireland. A full documented list of previous survey are available upon request.

2.1. "Odour hog" monitoring within the facility

The "odour hog" (i.e. Version 2, 4 years old with less than 3.5 second response time for the flame ionisation detector (FID) VOC analyser is a portable, intrinsically safe, survey VOC dual monitor, which provides fast and accurate readings of organic and inorganic vapours. A photo ionisation detector (PID) uses an ultraviolet (UV) light source (*photo*) to ionise a gas sample and detect its concentration. Ionisation occurs when a molecule absorbs the high energy UV light, ejecting a negatively charged electron and forming of positively charged molecular ion. The gas becomes electrically charged. These charged particles produce a current that is easily measured at the sensor electrodes. Only a small fraction of the VOC molecules are ionised. A PID does not respond to methane. A FID is similar to a flame thermocouple detector, but measures the ions from the flame instead of the heat generated. The FID detects the methane fraction, which provides greater sensitivity in terms of methane surface emissions detection but not necessarily odour hence why the PID data is also interpreted. The FID/PID analyser was calibrated with certified reference material isobutylene and methane before commencement of the survey, (see calibration certificates for gases used in Appendix II). The calibration readings were rechecked in accordance with AG6 requirements.

Using the continuous kinematic "odour hog" with integrated GPS (i.e Magellan Professional with sub centimetre accuracy post processed), the capping of the facility was surveyed for potential surface emissions areas. Those areas identified were geo-referenced and highlighted for remediation. This technique is useful for comparison in surface emissions area within the same facility on different surveys. The surface emissions maps generated for the particular facility can be used to assess the effectiveness of implemented mitigation techniques and to qualitatively assess the nature of surface emissions from the facility. All surface emissions surveying was carried out in accordance with Air Guidance Note 6.

Efforts should be made to attain surface emissions <100 ppm from open surfaces and <500 ppm around features such as vertical wells, leachate collection sumps, leachate slope risers and other projections out of the waste body (Casey et al., 2008). These are minimum standards, which should lead to greater facility collection efficiencies thus reducing the impact on the general environment.

2.2. Meteorological conditions

Table 2.1 illustrates the predominant wind direction during the monitoring exercise. The meteorological conditions were characterised for the day of monitoring and were as follows:

Table 2.1. Meteorological conditions during Kerdiffstown facility TVOC survey.

26th Jul. 2016	
Average wind speed 13 km/hr	Wind direction southerly
Temperature 19^{0}C	1019 mbar
Dry weather	--

During the VOC and gas field survey, wind deviated from a southerly direction.

2.3 Current facility gas collection infrastructure on the facility

The current collection system consists of vertical wells, there are gravity condensate removal devices on the landfill gas abstraction system within the facility. Vertical facility gas abstraction is employed in the facility. There are two operational installed facility gas enclosed flares (500 m^3/hr & 250 m^3/hr) capacity enclosed flares. At the time of the survey one flare was in operation.

3. Results

3.1. Volatile organic compound surface emissions locations identified within KLRP

Figure 6.2 and Table 3.1 illustrates the results obtained for the capping surface emissions survey. A total of twelve individual surface emissions zones were identified. Each surface emissions zone is discussed separately in this manner in order to allow for the development of remediation strategies to mitigate the individual surface emissions areas.

Table 3.1. Capping VOC surface emission locations results with source identities correlating with *Figure 6.2 (see Appendix I)*.

Location ID	Easting (m)	Northing (m)	Max VOC conc. (ppm)	Identification and Mitigation	Recommended trigger levels
K1	291395	222205	557	Discrete Feature: Intermediate Cap, Vertical Well G35. Investigate and remediate the cause of the surface emissions.	<500ppm
K2	291407	222233	594	Discrete Feature: Intermediate Cap, Vertical Well G31. Investigate and remediate the cause of the surface emissions.	<500ppm
K3	291374	222272	3,847	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K4	291326	222261	387	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K5	291380	222296	184	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K6	291369	222337	398	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K7	291291	222310	6,947	Discrete Feature: Intermediate Cap, Vertical Well. Investigate and remediate the cause of the surface emissions.	<500ppm
K8	291220	222295	154	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K9	291215	222327	384	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K10	291238	222333	3,954	Discrete Location: Intermediate Cap, Surface areas. Investigate and remediate the cause of the surface emissions.	<100ppm
K11	291246	222369	4,178	Discrete Location: Intermediate Cap, Surface area. Investigate and remediate the cause of the surface emissions.	<100ppm
K12	291263	222324	3,749	Discrete Location: Intermediate Cap, Surface areas. Investigate and remediate the cause of the surface emissions.	<100ppm

Twelve sources of facility gas surface emissions were identified (*see Figures 6.2 and Table 3.1*) within the facility.

Currently none of the facility area is permanently capped. Therefore the surface emission criterion averaged over the capped area does not apply. There were three surface emissions zones greater than or equal to 500 ppm around identified features. There were nine surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the facility footprint.

3.2. Close out meeting with facility manager

Following completion of the surface emissions survey, the surface emissions team and the facility manager discussed all aspects and general conclusions of the survey. The facility manager was informed of the potential areas of surface emissions (see section 2.4 and section 3 of the report for details).

4. Conclusions

The following conclusions were drawn from the survey of Kerdiffstown Facility:

- The surface emissions contour map generated from the kinematic Volatile organic compound (VOC) survey illustrated surface areas of facility gas surface emissions.
- Currently none of the facility area is permanently capped. Therefore the surface emission criterion averaged over the capped area does not apply. There was three surface emissions zones greater than or equal to 500 ppm around identified features. There were nine surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the facility footprint.

5. References

- Casey, J.W., Sheridan, B.A., Henry, M., Reynolds, K., (2008). Effective tools for managing odours from facility facilities. International Conference on Environmental Odour Monitoring and Control**,** Rome, Italy**,** July 6-8, 2008**.**

6. *Appendix I*- Volatile organic compound surface emissions contour map & Cell capping outline & LFG infrastructure map

Figure 6.1. Cell capping outline & LFG infrastructure on the facility.

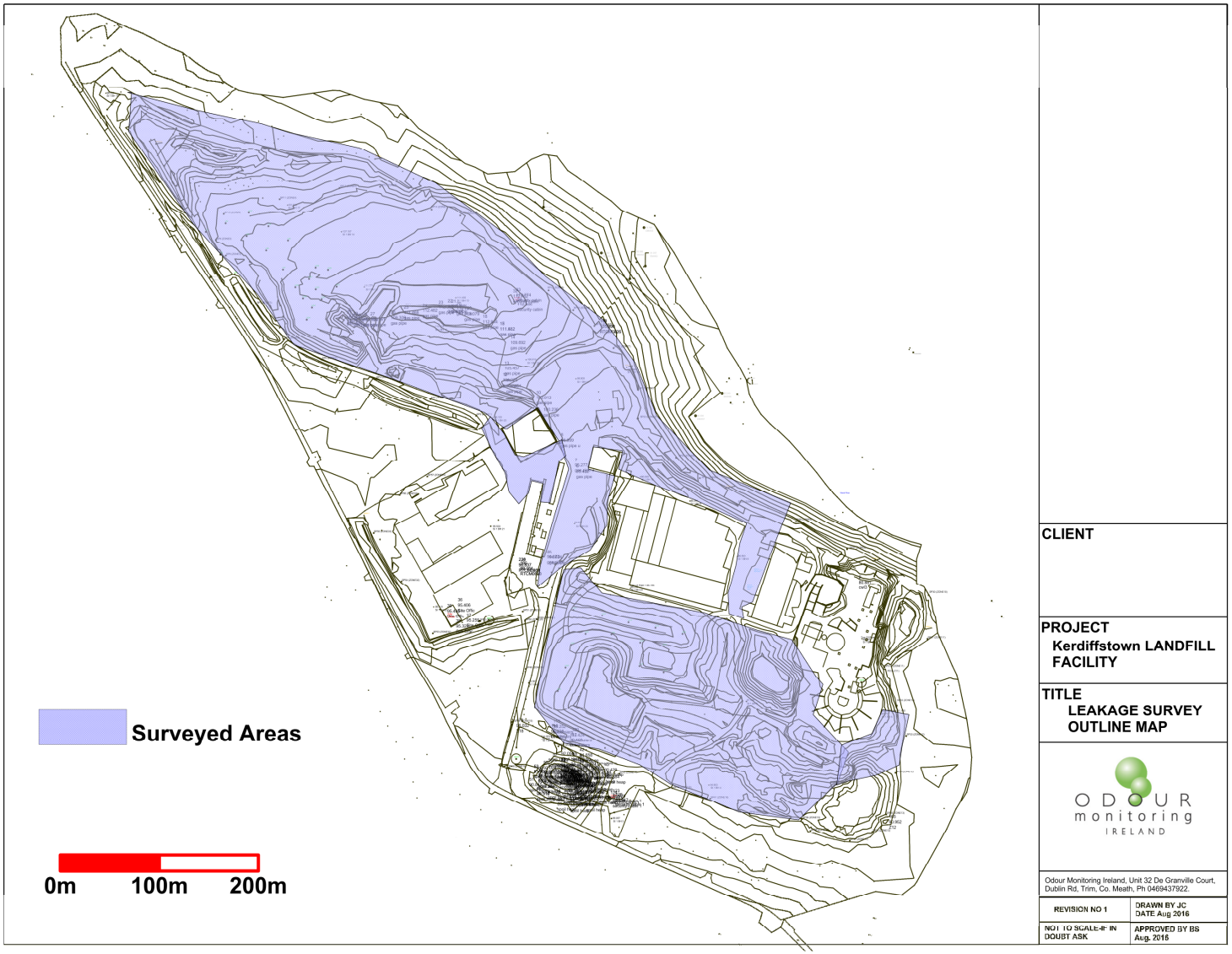
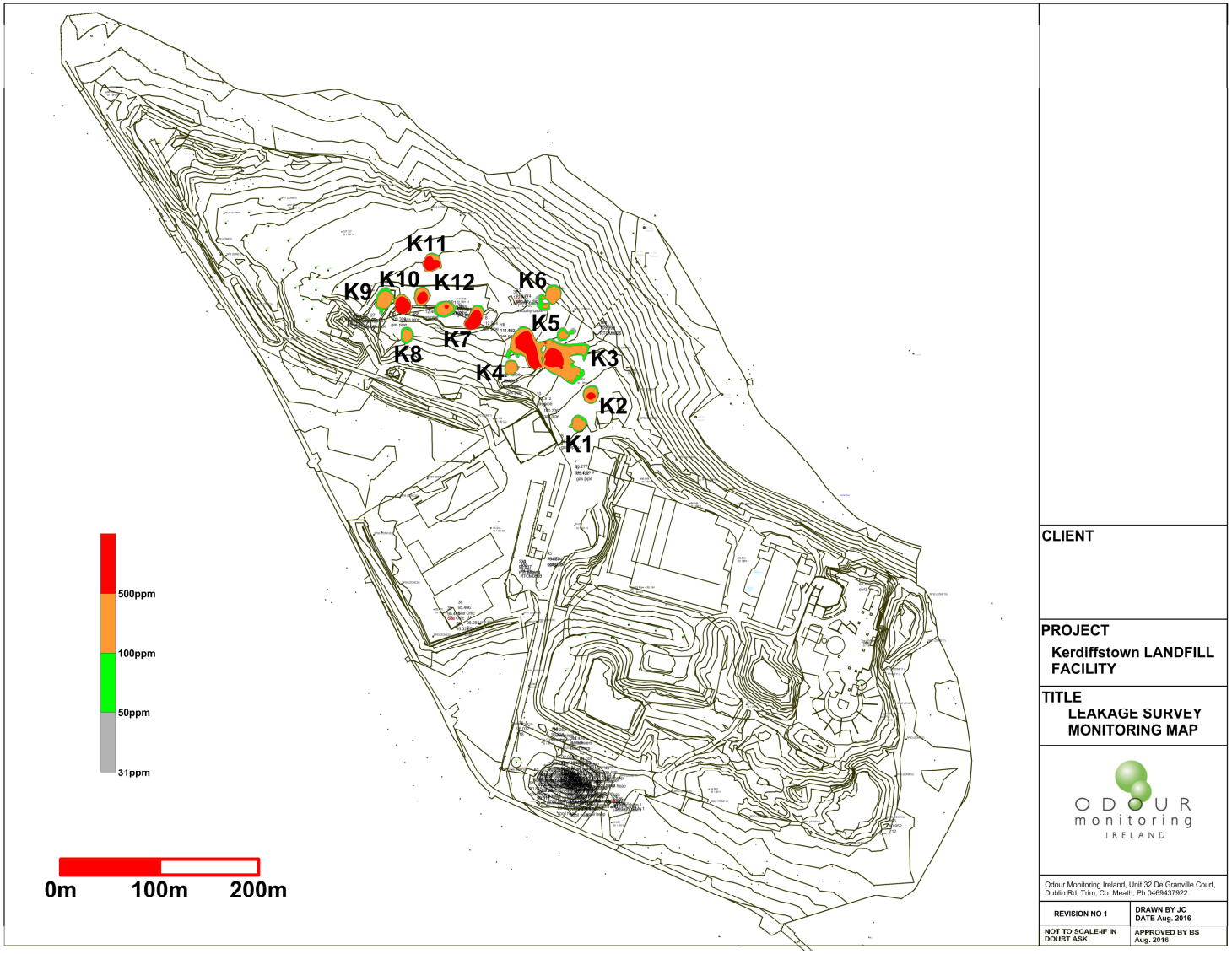

Surveyed Areas
0m
100m
200m
CLIENT
PROJECT
Kerdiffstown LANDFILL FACILITY
TITLE
LEAKAGE SURVEY OUTLINE MAP
ODOUR monitoring IRELAND
Odour Monitoring Ireland, Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath, Ph 0469437922.
REVISION NO 1
DRAWN BY JC
DATE Aug 2016
NOT TO SCALE-IF IN DOUBT ASK
APPROVED BY BB
Aug. 2016

Figure 6.2. Facility gas surface emissions monitoring within the facility (colour scale area indicating TVOC gas colour scale).


K11
K10
K12
K9
K6
K5
K7
K8
K3
K4
K2
K1
500ppm
100ppm
50ppm
31ppm
0m
100m
200m
CLIENT
PROJECT
Kerdiffstown LANDFILL FACILITY
TITLE
LEAKAGE SURVEY MONITORING MAP
ODOUR monitoring IRELAND
Odour Monitoring Ireland, Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath. Ph 0469437922
REVISION NO 1
DRAWN BY JC
DATE Aug. 2016
NOT TO SCALE-IF IN DOUBT ASK
APPROVED BY BS
Aug. 2016

7. Appendix II-Calibration certificates and procedures.

7.1 Span & Calibration procedure

Necessary Calibration gases: Zero gas (0ppm), 98.8ppm and 988ppm methane (Calibration certificates below).

Calibration is carried out in accordance with manufacturers guidelines.

Location: Zero span instrument onsite.

Frequency: Before, midway through, and after the surface emissions survey, typically therefore at 3-4 hour intervals. If the survey only last 2 to 3 hours the instrument is checked before and after the event.

Instrument settling: The FID is switched on and left to settle for a period of 30 minutes minimum.

Span Procedure: The zero and span gases shall be introduced under the same flow and pressure conditions using the sample probe at the end of the sample line. The adjustment procedure shall be as follows:

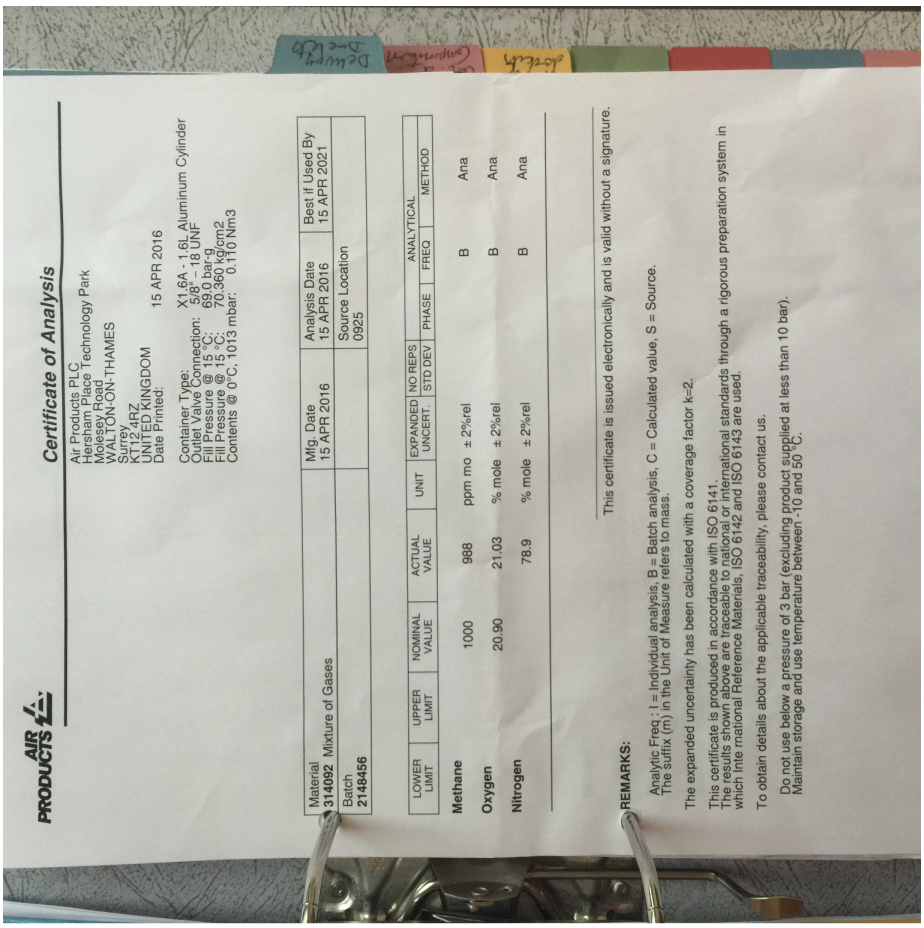
a) Feed the zero gas (0ppm) into the FID and set the zero;

b) Feed the span gas (98.8ppm) and adjust the instrument accordingly;

c) Feed the zero gas into the FID once more and check that the reading returns to zero; if not repeat steps a) to c).

d) repeat procedure A to C to verify

Equipment is maintained and operated as specified by the manufacturer.



AIR PRODUCTS

Certificate of Analysis

Air Products PLC
Hersham Place Technology Park
Molesey Road
WALTON-ON-THAMES
Surrey
KT12 4RZ
UNITED KINGDOM
Date Printed: 15 APR 2016

Container Type: X1.6A - 1.6L Aluminum Cylinder
Outlet Valve Connection: 5/8" – 18 UNF
Fill Pressure @ 15 °C: 69.0 bar-g
Fill Pressure @ 15 °C: 70.360 kg/cm2
Contents @ 0°C, 1013 mbar: 0.110 Nm3

Material	Mfg. Date	Analysis Date	Best if Used By
314092 Mixture of Gases	15 APR 2016	15 APR 2016	15 APR 2021
Batch 2148456		Source Location 0925	

	LOWER LIMIT	UPPER LIMIT	NOMINAL VALUE	ACTUAL VALUE	UNIT	EXPANDED UNCERT.	NO REPS STD DEV	PHASE	ANALYTICAL FREQ	METHOD
Methane			1000	988	ppm mo	± 2%rel			B	Ana
Oxygen			20.90	21.03	% mole	± 2%rel			B	Ana
Nitrogen				78.9	% mole	± 2%rel			B	Ana

This certificate is issued electronically and is valid without a signature.

REMARKS:

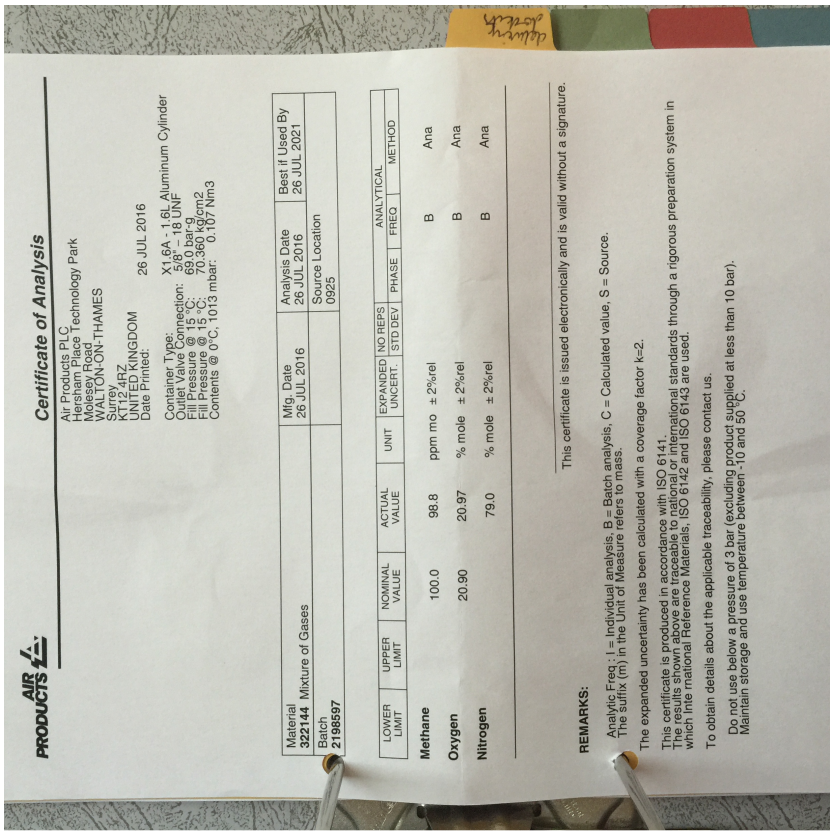
Analytic Freq : I = Individual analysis, B = Batch analysis, C = Calculated value, S = Source.
The suffix (m) in the Unit of Measure refers to mass.

The expanded uncertainty has been calculated with a coverage factor k=2.

This certificate is produced in accordance with ISO 6141.
The results shown above are traceable to national or international standards through a rigorous preparation system in which inte rnational Reference Materials, ISO 6142 and ISO 6143 are used.

To obtain details about the applicable traceability, please contact us.

Do not use below a pressure of 3 bar (excluding product supplied at less than 10 bar).
Maintain storage and use temperature between -10 and 50 °C.



AIR PRODUCTS

Certificate of Analysis

Air Products PLC
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Molesey Road
WALTON-ON-THAMES
Surrey
KT12 4RZ
UNITED KINGDOM
Date Printed: 26 JUL 2016

Container Type: X1.6A - 1.6L Aluminum Cylinder
Outlet Valve Connection: 5/8" – 18 UNF
Fill Pressure @ 15 °C: 69.0 bar-g
Fill Pressure @ 15 °C: 70.360 kg/cm2
Contents @ 0°C, 1013 mbar: 0.107 Nm3

Material	Mfg. Date	Analysis Date	Best if Used By
322144 Mixture of Gases	26 JUL 2016	26 JUL 2016	26 JUL 2021
Batch 2198597		Source Location 0925	

	LOWER LIMIT	UPPER LIMIT	NOMINAL VALUE	ACTUAL VALUE	UNIT	EXPANDED UNCERT.	NO REPS STD DEV	PHASE	ANALYTICAL FREQ	METHOD
Methane			100.0	98.8	ppm mo	± 2%rel			B	Ana
Oxygen			20.90	20.97	% mole	± 2%rel			B	Ana
Nitrogen				79.0	% mole	± 2%rel			B	Ana

This certificate is issued electronically and is valid without a signature.

REMARKS:

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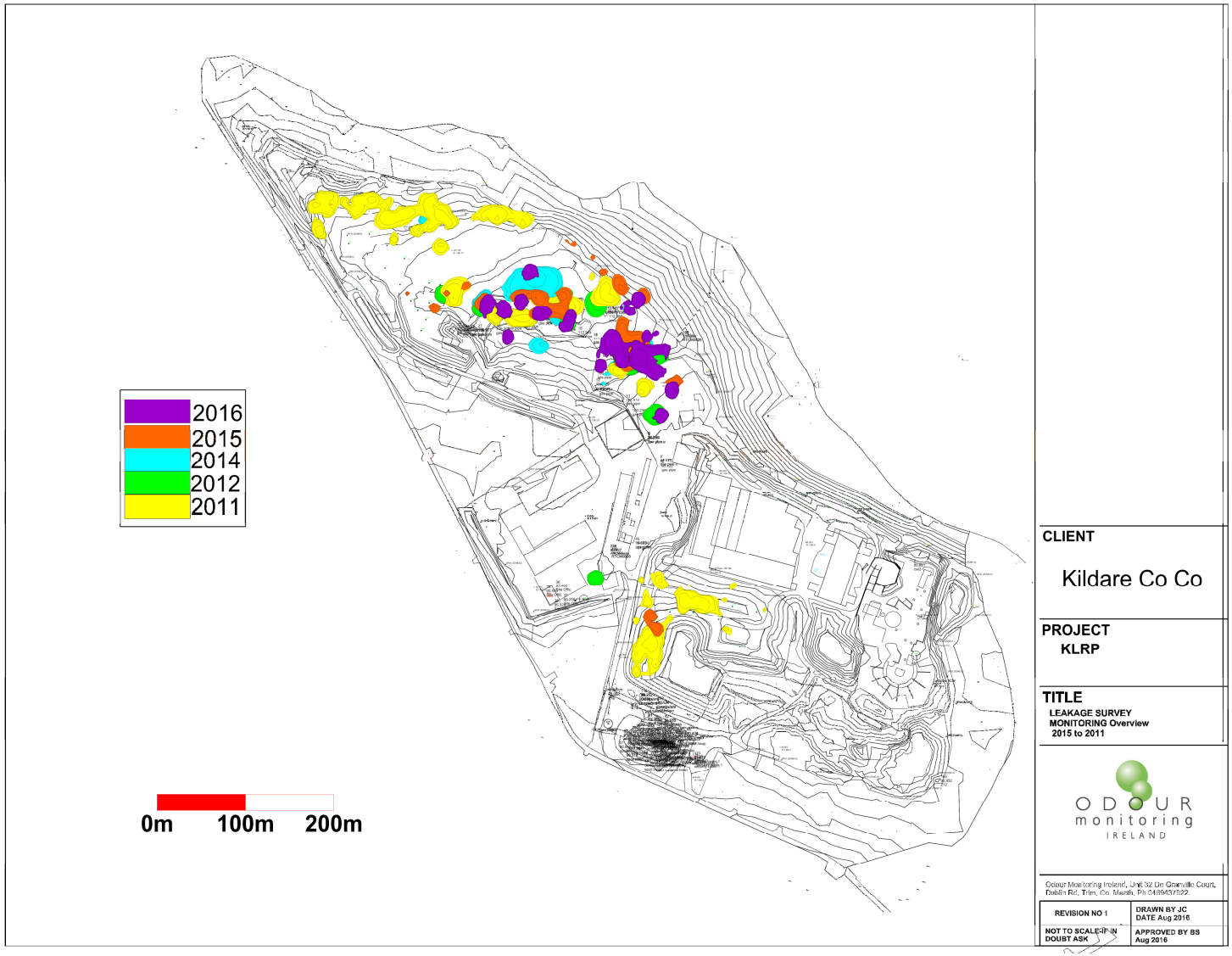
Maintain storage and use temperature between -10 and 50 °C.

8. Appendix III Surface emissions mapping from 2011 to 2016.



Surface emissions mapping from Northern part of the facility 26/08/2016