MD Recycling Bioaerosols Report May 2017

Final

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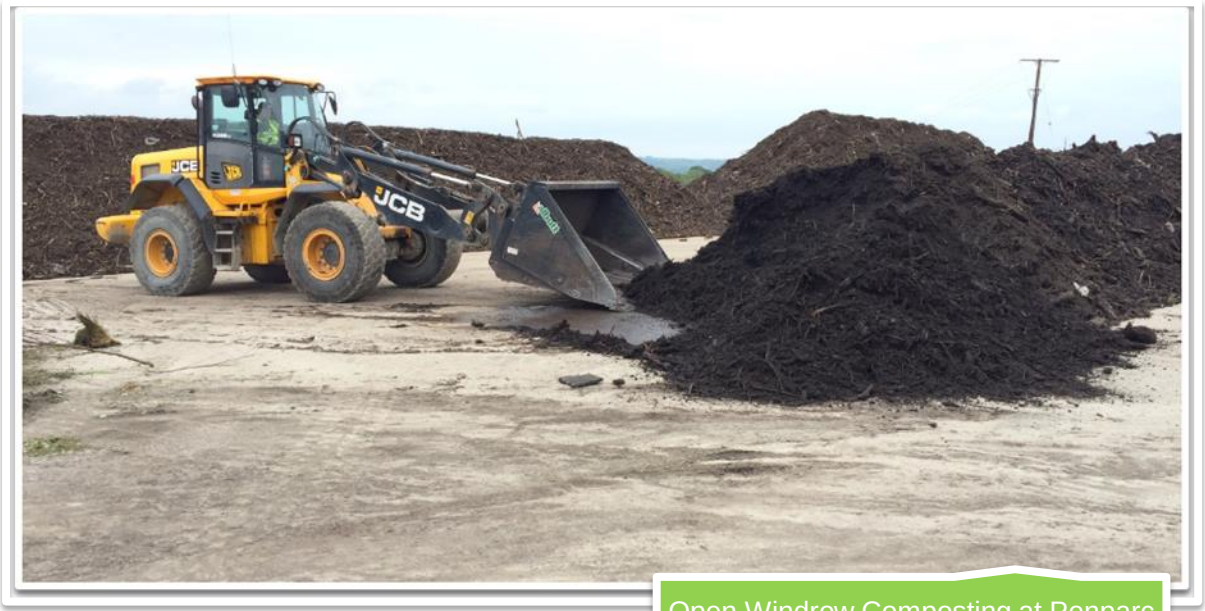

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CONTENTS

1.0 INTRODUCTION 1
1.1 Monitoring Requirements 1
1.2 Definitions 1
1.2.1 Composting 1
1.2.2 Bioaerosols 1

2.0 SAMPLING SITE 3
2.1 Sampling Locations 3
2.1.1 Upwind Location (UW) 4
2.1.2 Downwind Location (DW) 4
*2.1.3 Sensitive Receptor (SR) ..... **Error! Bookmark not defined.***
..... 5
2.2 Feedstock Accepted at the Site 6

3.0 METHODOLOGY 7
3.1 Calibration of Equipment 7
3.2 Viable Counts – Filters 7
3.3 Laboratory Enumeration 7
3.4 Sampling Points 8
3.5 Meteorological Conditions on the Day of Sampling 8
3.6 Site Activities 9
3.7 Tonnage on Site 9
*3.7.1 Other Activities ..... **Error! Bookmark not defined.***
3.8 Transportation Conditions 9

4.0 RESULTS 10
4.1 Environmental Conditions 10
4.2 Current Limits 10
4.3 Microbiological Results 10

5.0 DISCUSSION 13
5.1 Bacteria 13
5.1.1 Upwind 13
5.1.2 Downwind 13
5.1.3 Sensitive Receptor 13
5.2 Aspergillus fumigatus 13
5.3 Replication of Sampling 13

6.0 COMPARISON WITH PREVIOUS RESILTS 14
6.1 Bacteria 14

6.2 *Aspergillus fumigatus* 15

APPENDIX 1 – METEOROLOGICAL SAMPLING CONDITIONS 16

APPENDIX 2 – LABORATORY TEST RESULTS 18

1.0 INTRODUCTION

WRM Ltd has been commissioned by MD Recycling to undertake bioaerosol monitoring on the 31st May 2017. Bioaerosol monitoring has been undertaken following the AfOR Standardised Protocol 2009 Edition[1].

Site Address:
Crugmor Farm
Cardigan
Ceredigion
SA43 1QY

The site is located in Cardigan, South Wales (Easting = 219829, Northing = 246850).

Sampling was undertaken by Adam Newman (MSc) of WRM. WRM staff have several years of experience within the industry and have been trained by microbiologists who specialise in the field of bioaerosol monitoring.

1.1 Monitoring Requirements

Bioaerosols monitoring at MD Recycling is required on a quarterly basis, as per their environmental permit. Quarterly monitoring aims to capture seasonal variability over the course of the year, with one monitoring event per season.

The first monitoring event in 2017 (Winter) was conducted in February.
This is the second monitoring event in 2017(Spring) and was conducted in May.

1.2 Definitions

1.2.1 Composting

"Composting is a method of waste management based in the biological degradation and stabilization of organic matter under aerobic conditions. It results in a sanitised and stabilised product, rich in humic substances that can be used as fertilizer"[2].

1.2.2 Bioaerosols

"Aerosols are liquid or solid particles suspended in a gaseous medium with size ranges from 0.001 to 100µm. Bioaerosols consists of aerosols containing microorganisms (bacteria, fungi, viruses) or organic compounds derived from microorganisms (endotoxins, metabolites, toxins and other microbial fragments). Bioaerosols vary in size (20nm to 100µm) and

[1] Association of Organics Recycling (2009) 'A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities' *ed. T. Gladding for the Association of Organics Recycling*

[2] Wery, N. (2014) 'Bioaerosols from composting facilities – a review'. *Frontiers in Cellular and Infection Microbiology.* P1:42.

composition depending on the source, aerosolisation mechanisms, and environmental conditions prevailing at the site"[3].

Bioaerosols are defined as aerosols, aeroallergens, or particulate matter of microbiological, plant or animal origin. Bioaerosols can interact with living systems through infective, allergenic and/or toxic mechanisms. The biological agents that have been examined in relation to bioaerosol exposures associated with waste handling and treatment processes include pathogenic and non-pathogenic spores, live (viable) or dead (non-viable) bacteria, fungi, viruses, bacterial endotoxins, mycotoxins, and peptidoglycans. Although other types of biological component may also be present as airborne particles such as algal fragments, protozoa and nematodes, these have not been considered in studies of bioaerosols emitted by the waste industry to date[4].

The potential for particulates to be liberated from organic waste treatment sites does exist. Airborne dusts and so bioaerosols are likely to be aerosolised by the handling of the waste materials accepted on site, their storage and movement and by meteorological conditions (presence or absence of precipitation, wind, etc.). Bioaerosols are aerosolised as clumps, aggregates and attached to larger mineral particles in the TSP size range[5]. Hence they generally settle fairly rapidly, i.e. within a minute or two and within 250m of the point of generation. Weather conditions can also affect generation and aerosolisation. Viability can deteriorate according to temperature, humidity and sunlight. Die off is generally exponential, although non-viable (dead) microorganisms may still be able to cause health effects (allergenic/toxic effects in sufficient concentrations). However, the standard protocol for England and Wales[4] and the majority of data at present utilises counts of viable micro-organisms.

It is important to note other activities and environments can affect local concentrations of bioaerosols. In terms of published scientific literature, a range of authors report natural concentrations of bacteria and fungi routinely range from 1000 to 100,000 (10_3 to 10_5) cfu/m^3 air[6]. An investigation of an open windrow site reported high measurements of fungi off-site in wet woodland comparable to on-site. Additionally, it was reported that mowing a nearby meadow also significantly affected results of viable fungi and bacteria (160 and 480 respectively prior to mowing, 15.0 x 10_3 cfu/m_3 and 17.6 x 10_3 cfu/m_3 after)[7].

[3] Mandal, J and Brandl, H. (2011) 'Bioaerosols in Indoor Environment – A review with special reference to residential and occupational locations. *The Open Environmental & Biological Monitoring Journal.* P83:4.

[4] Defra (2009) *Exposure response relationships for bioaerosol emissions from waste treatment processes WR0606*.

[5] Wheeler P.A., Stewart I., Dumitrean P., Donovan B. (2001) *Health Effects of Composting: A Study of Three Compost Sites and Review of Past Data*. Environment Agency R&D Technical Report P1-315/TR.

[6] Cox C.S., Wathes C. M. ed. (1995) 'The Bioaerosols Handbook' Lewis Publications Ltd

[7] Frederickson, J.; Boardman, C. P.; Gladding, T. L.; Simpson, A. E.; Howell, G. and Sgouridis, F. (2013). Evidence: Biofilter performance and operation as related to commercial composting. Environment Agency, Bristol.

2.0 SAMPLING SITE

MD Recycling operate an open windrow composting facility with the capacity to receive up 75 tonnes per day. On the day of the monitoring event (31/05/2017) there were approximately 838 tonnes of material on site.

The site is based in a rural setting with mainly agricultural fields surrounding the site. Adjacent to the south east boundary is an Anaerobic Digestion Plant which processes food wastes. The Anaerobic Digestion Plant is on MD Recycling's property; however, it is operated by a different company.

There are several sensitive receptors within 250m of the site boundary which is the Environment Agency policy for risk associated with bioaerosols[8]. Table 1 and Figure 1 below show the sensitive receptors and their distance to the nearest site boundary:

Table 1 - Nearest Sensitive Receptor to Operational Boundary

Receptor	Distance
Residential Property	220m from the composting pad
Commercial AD Facility	60m from the composting pad

2.1 Sampling Locations

Bioaerosol monitoring was undertaken at 3 locations across the site at MD Recycling. Sampling was conducted at an upwind and downwind location as well as at a sensitive receptor (the AD Facility), in order to ascertain the level of bioaerosols at each location. These monitoring locations are detailed in Figure 1, with each sampling location superimposed upon a plan of the site. Photographs of each of the monitoring locations are provided (Image 1, 2 and 3).

[8] Wheeler P.A., Stewart I., Dumitrean P., Donovan B. (2001) 'Health Effects of Composting: A Study of Three Compost Sites and Review of Past Data' *Environment Agency R&D Technical Report P1-315/TR*

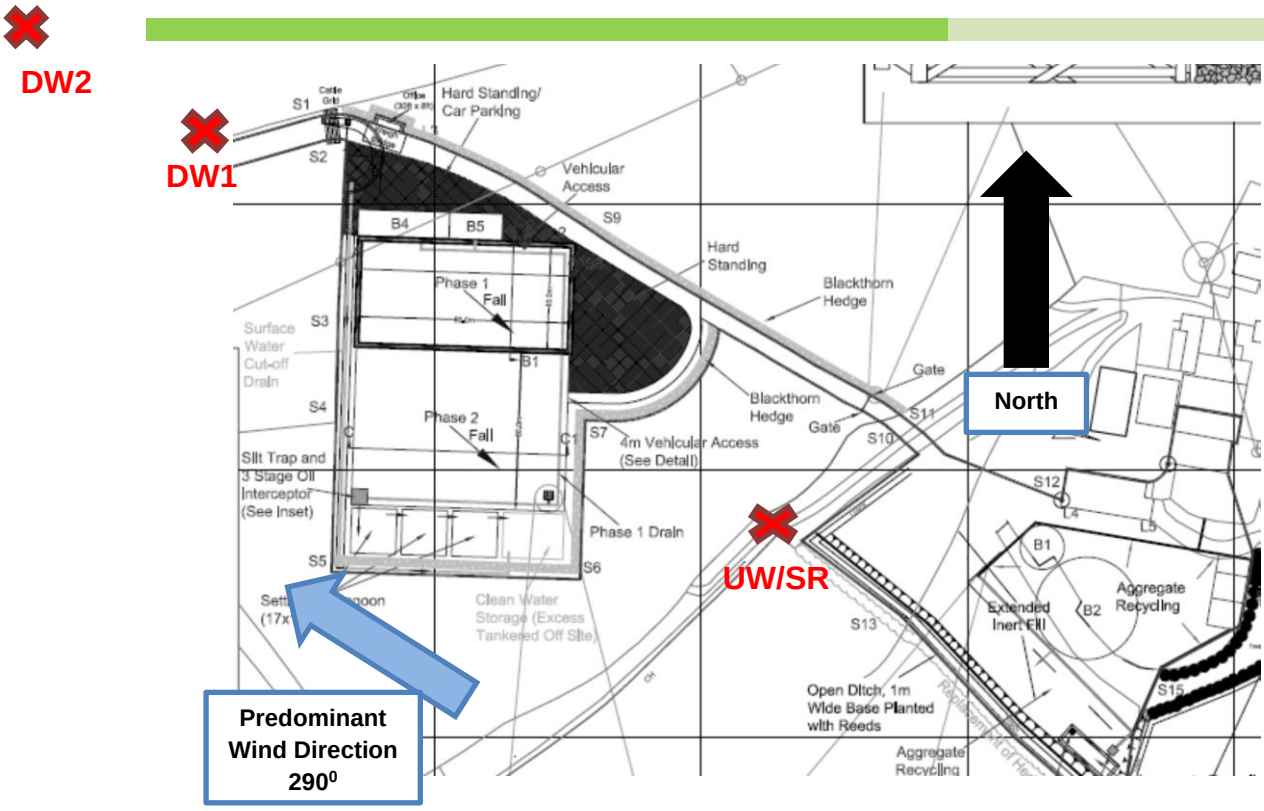

Figure 1 - Wind Direction and Sampling Points on 31/05/2017

2.1.1 Upwind Location/Sensitive Receptor (UW/SR)

Monitoring occurred 50m upwind of the composting pad on a bearing of 110^0. Due to the wind direction (290^0) the SR was situated approximately 50m upwind of the composting activity. Therefore, one set of filters was used to sample the UW and SR location. Over the course of the monitoring event the predominant direction that the wind blew towards was 290^o from true North. There was no apparent composting odour (Intensity 0, H4 Guidance) detected during the monitoring event. Site activity during the monitoring event constituted the delivery of green waste to the site and the screening of waste.

2.1.2 Downwind Location 1 (DW1)

Monitoring took place 60m downwind of the composting pad on a bearing of 290^0. This is the same distance from the composting activity as the SR. The filters were situated in an open field just north of the access road. Over the course of the monitoring event the predominant direction that the wind blew towards was 290^o from true North. No composting odour (Intensity 0, H4 Guidance) was detected. Site activity during the monitoring event constituted the delivery of green waste to the site and the screening of waste.

2.1.3 Downwind Location 2 (DW2)

Monitoring took place 250m from the composting pad on a bearing of 290^0. This location was chosen to investigate the drop-off in bioaerosols downwind of the composting activity at the 250m limit. Over the course of the monitoring event the predominant direction that the wind blew towards was 290^o from true North. No composting odour (Intensity 0, H4 Guidance) was

detected. Site activity during the monitoring event constituted the delivery of green waste to the site and the screening of waste.

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Image 1- UW/SR Monitoring Location

Image 2- DW1 Monitoring Location

Image 3- DW2 Monitoring Location

2.2 Feedstock Accepted at the Site

Table 2 below indicates the types of feedstock accepted on site and which waste type is expected during the different seasons. Feedstock changes throughout the year and changing the feedstock ratios will reduce the amount of bioaerosol release.

Table 2 - Feedstock Accepted on Site

Waste Source	Seasonal Variation
Kerbside collected green waste.	**April – September:** Increasing grass clippings content (typically peaking at 40%+ in May-June from experience). Short, sharp, tonnage surges possible (e.g. collections around bank holiday weekends) Accordingly, loads increasingly compacted due to material density.
	October - March: Increase in "woody" type materials (branches etc.), resulting in higher C:N ratios.
Civic amenity green waste.	**April – September: I**ncreasing grass clippings content (peaking at 40%+ in May - June). Short, sharp, tonnage surges possible over bank holiday weekends. Accordingly, loads increasingly compacted due to material density, and contractors desire to maximise bin weights / payloads. Potential for waste to be kept in warm conditions prior to delivery (waste exposed to direct sunlight in site bins).
	October - March: Increase in "woody" type materials (branches etc.), resulting in higher C:N ratios. Potential for significant "spike" post-Christmas (disposal of Christmas trees).
Commercial green waste.	**April – September:** Increasing grass clippings content (typically peaking at 40%+ in May – June from experience). Accordingly, loads increasingly compacted due to material density. Potential for waste to be kept in warm conditions prior to delivery (waste exposed to direct sunlight prior to delivery).
	October to March: Increase in "woody" type materials (branches etc.), resulting in higher C:N ratios.

3.0 METHODOLOGY

The method used in this investigation is formed from the Composting Association guidance[9], Association of Organics Recycling standardised protocol guidance[10] and from research undertaken for the Environment Agency on composting sites[11].

This report uses a sampling technique which is comparable throughout the country. IOM sampling was undertaken following the AfOR Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities.

3.1 Calibration of Equipment

Prior to each visit the pumps are calibrated with a certified reference volume meter – 'rotameter' which has an accuracy rating of more than ±2 per cent expressed in operational cubic meters, referenced to ambient air conditions. The rotameter is connected to the filter head and rotameter head, this is then connected to the pump which is set at 2000ml/minute and is run for 10 minutes. The flow rate is adjusted if required.

3.2 Viable Counts – Filters

The sampling was undertaken following the approach set out in the AfOR protocol (2009)[12]. The SKC IOM cassettes were loaded with a 25mm 0.8µm polycarbonate filter. The flow rate of the IOM pump was operated at 2.0 ± 0.1 litre/min. Pumps were charged until full and calibrated to within ±2 per cent of 2l/min (SKC Group). The IOM filter is weighed prior to being loaded and after loading. To provide field blanks, two controls were loaded but not exposed. The filters at all monitoring points sampled for 45 minutes. The start and stop times of each were recorded for accuracy. Each sampling head was mounted on a tripod in a horizontal hanging position at a height of 1.5m as per the protocol, each IOM head was spaced approximately 20cm apart. After the monitoring had taken place the filters were transported to the laboratory at temperatures of 4^{o}C.

3.3 Laboratory Enumeration

The IOM heads containing a polycarbonate filter were used to determine the bioaerosol exposure under the test conditions. Upon arrival at the University of Hertfordshire laboratory located in Hatfield the bioaerosols impacted on each filter were recovered. The target micro-organisms were cultured using appropriate media.

- Nutrient Agar (NA) agar plates were used for total mesophilic bacteria.
- Malt extract agar (MEA) agar plates were used for *Aspergillus fumigatus*.

[9]Gilbert E. J., Ward C. W., Crook B., Fredrickson J., Garrett A. J., Gladding T. L., Newman A. P., Olsen P., Reynolds S., Stentiford E., Sturdee T., Wheeler P. (1999) 'The Research and Development of a Suitable Monitoring Protocol to Measure the Concentration of Bioaerosols at Distances From Composting Sites" leading to the publication "Standardised Protocol for the Sampling and Enumeration of Airborne Microorganisms at Composting Facilities' ISBN: 0 9532546 2

[10]Association of Organics Recycling (2009) 'A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities' *ed. T. Gladding for the Association of Organics Recycling*

[11]Wheeler P.A., Stewart I., Dumitrean P., Donovan B. (2001) 'Health Effects of Composting: A Study of Three Compost Sites and Review of Past Data' *Environment Agency R&D Technical Report P1-315/TR*

[12]Association of Organics Recycling (2009) 'A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities' *ed. T. Gladding for the Association of Organics Recycling*

Samples were incubated for 2 days at 37^0C (total mesophilic bacteria) and 2 days at 40^0C (*Aspergillus fumigatus).* Identification of *Aspergillus fumigatus* was performed by microscopy.

All filters were extracted from the cassettes (including the two blanks which were retained from the visit) as per the protocol in a controlled and sterilised environment. After the incubation period of 48 hours (see above) the numbers of colonies were counted and the total number of colonies was expressed as colony-forming units (cfu/m^3). Colony-forming units were also counted after 7 days, in line with the AfOR standard protocol[13]. Samples were plated in triplicate. Bioaerosol recovery was conducted in line with the IOM operating instructions, 5ml of recovery solution was utilised to wash the filters in. The blank filters were loaded onto plates in the same way as the filters which had undergone bioaerosol monitoring. The blank filters show any contamination errors which could occur during sampling.

3.4 Sampling Points

All sampling was undertaken during one visit. The sampling points were dependent upon the AfOR protocol and the direction of the wind. This included points upwind of the site, downwind of operations whereby, screening and material was being transported to the external composting pad.

On the day of sampling and one point was chosen at the nearest sensitive receptor. At each point three filters were used as per the AfOR protocol. Pumps were run for five minutes prior to sampling taking place and each pump was checked on a rotameter to ensure each pump was running at the correct flow rate (one unloaded IOM head is used and kept with the calibration equipment). After calibration the pumps are operated for 45 minutes at each location and started within 30 seconds of each other. After sampling had finished at each point the filters were removed from the IOM head, wrapped in tinfoil and marked and stored in a sealed bag within a container overnight. Processing took place within 24 hours of monitoring.

3.5 Meteorological Conditions on the Day of Sampling

A Davis Vantage Pro 2 was used to collect data once a minute over the entire period on site. The data logged included temperatures, relative humidity, wind speed and wind direction. The weather station is situated above the site office, ~6m from the ground. To ensure upwind and downwind locations are correct other physical evidence such as odour are taken into account. Relative humidity and temperature were also recorded using a hand held data logger. Cloud cover and general weather conditions were recorded manually. All meteorological data are presented in Appendix 1.

- Wind speed ranged from 3.1 m/s to 7.7 m/s with an average speed of 3.8m/s.
- The direction the wind blew towards at the UW, DW and SR locations fluctuated between 280^o and 305^o (NW) with an average direction of 290^0.

[13] Association of Organics Recycling (2009) 'A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities' *ed. T. Gladding for the Association of Organics Recycling*

3.6 Site Activities

During the monitoring event material was being delivered to the site and material on the composting pad was being tipped and moved.

3.7 Tonnage on Site

- Active Composting - 838 tonnes
- Finished - 0 tonnes

3.8 Transportation Conditions

After sampling was concluded, filters were placed into their protective cassettes, wrapped individually in tin foil and placed in a resealable plastic bag. In total 4 of these bags were used, one to store the 3 UW/SR samples, one to store the 3 DW1 samples, one to store the 3 DW2 samples and one to store the 2 blank controls. All four of these bags containing samples were then placed in a Tupperware box, to protect from disturbing impacts. The Tupperware box was placed in a cool box to ensure that the samples were stored in darkness and at a temperature of 4^0C. The cool box containing the samples was stored securely in the car boot during transit. Temperature and humidity conditions in the car boot were recorded using a temperature/humidity probe. These readings were taken twice and are displayed in Table 3. Temperature and humidity readings were also taken in the cool box (Table 4).

Immediately after samples were collected and stored in the aforementioned conditions, they were driven, by Adam Newman, from the MD Recycling to the laboratory (BIODET) in Hatfield, Hertfordshire. The samples were in transit for approximately 5 hours 10 minutes. Sampling concluded at 10.40am. The samples left the site at 11.00am. The samples were delivered to BIODET at 16.10pm. Laboratory analysis began on the same afternoon.

Table 3- Temperature and Humidity conditions of car boot during transit

Time	Temperature (^{0}C)	Humidity (%)	Trip duration
11.00	17.7	37.6	5 hours 10 minutes
16.10	20.1	42.3	5 hours 10 minutes

Table 4- Temperature and Humidity conditions of the cool box during transit

Time	Temperature (^{0}C)	Humidity (%)	Trip duration
11.00	4	33.4	5 hours 10 minutes
16.10	4	32.9	5 hours 10 minutes

4.0 RESULTS

4.1 Environmental Conditions

Table 3 below presents the average weather conditions across the whole time on site. Full results are presented in Appendix 1.

Table 4 - Weather Conditions during Bioaerosol Monitoring

Date	Weather/Rain	Cloud Cover (8^{th})	Temperature (^oC)	Relative Humidity (%)	Windspeed (m/s)
31/05/2017	Dry, Gentle Breeze (3, Beaufort scale)	8	17.1	37.6	3.8

The average wind direction blew towards 290 degrees (NW). Wind speeds were recorded from 3.1 m/s to 7.7 m/s. The detection of odour and other physical characteristics of the wind ensured that the sampling of the downwind location was in the correct place, this will be seen in the results.

4.2 Current Limits

According to the EA[14], acceptable levels of bioaerosols are as follows:

1) Total bacteria 1,000 cfu/m^3
2) Thermophilic fungus *Aspergillus fumigatus* 500 cfu/m^3

4.3 Microbiological Results

Table 5 and Table 6 show all viable counts of micro-organisms on the IOM Filter samples for bacteria and fungi. Table 7 and Table 8 show the amount of micro-organisms per cubic metre (m^3). All samples can be seen in Appendix 2.

To calculate the arithmetic mean of Colony forming units per cubic metre of air (cfu/m^3) the mean number of colonies on the duplicate plates is multiplied by the dilution factor. The result of this calculation is then divided by the Volume of air that was drawn through the filters. Calculation of the arithmetic mean is done in accordance with the AfOR Standardised Protocol. Natural viability in a sample size this small will not affect average concentrations to any great degree.

Two controls were loaded and not exposed during the sampling period. There was no contamination found per membrane for bacteria or fungi.

[14]Environment Agency (2009) 'Guidance on the evaluation of bioaerosol risk assessments for composting facilities' *Environment Agency for England and Wales*

Table 5 – Bacteria Count, Exposure 45 minutes

Sample No.	Details of Siting	cfu per plate	Time (pm)	Bearing of samplers (°)	Mean direction wind blows to (°)	Difference between wind and bearing
1 2 3	Upwind/SR 50m	0,0,0 1,0,0 1,0,0	9.00-9.45	110	290	180
4 5 6	DW1 60m	0,0,0 0,0,0 1,0,0	9.02-9.47	290	290	0
7 8 9	DW2 250m	2,1,0 2,0,0 0,0,0	9.55-10.40	290	290	0

Table 6 – *Aspergillus fumigatus* Count, Exposure 45 minutes

Sample No.	Details of Siting	cfu per plate	Time	Bearing of samplers (°)	Mean wind direction (°)	Difference bearing and wind direction (°)
1 2 3	Upwind/SR 50m	0,0,0 0,0,0 0,0,0	9.00-9.45	110	290	180
4 5 6	DW1 60m	0,0,0 0,0,0 0,0,0	9.02-9.47	290	290	0
7 8 9	DW2 250m	0,0,0 0,0,0 0,0,0	9.55-10.40	290	290	0

Table 7 - Total amounts of Mesophilic Bacteria (cfu/m^3)

Sample No.	Details of Siting	cfu/m^3	Arithmetic Mean	Time	Bearing of samplers (°)	Mean wind direction (°)	Difference bearing and wind direction (°)
1 2 3	Upwind/SR 50m	<185 185 185	<185	9.00-9.45	110	290	180
4 5 6	DW1 60m	<185 <185 185	<185	9.02-9.47	290	290	0
7 8 9	DW2 250m	555 370 <185	<463	9.55-10.40	290	290	0

Table 8. Total amounts of Fungi (cfu/m^3)

Sample No.	Details of Siting	cfu/m^3	Arithmetic Mean	Time	Bearing of samplers (°)	Mean wind direction (°)	Difference bearing and wind direction (°)
1 2 3	Upwind/SR 50m	<185 <185 <185	0	9.00-9.45	110	290	180
4 5 6	DW1 60m	<185 <185 <185	0	9.02-9.47	290	290	0
7 8 9	DW2 60m	<185 <185 <185	0	9.55-10.40	290	290	0

n.b The University of Hertfordshire (BIODET) uses 185 cfu/m^3 as their Limit of Detection (LOD).

5.0 DISCUSSION

Table 9 presents the mean results for bacteria and *Aspergillus fumigatus* against the respective EA Suggested Thresholds.

Table 9 – EA Suggested Threshold against on site bioaerosol levels[15]

	EA Suggested Threshold (cfu/m^3)	Upwind (cfu/m^3)	Downwind (cfu/m^3)	Sensitive Receptor (cfu/m^3)
Bacteria	1,000	<185	<185	<463
Aspergillus fumigatus	500	<185	<185	<185

5.1 Bacteria

5.1.1 Upwind

The mean result at the UW monitoring location (<185 cfu/m^3) falls below the EA Suggested Threshold.

5.1.2 Downwind

The mean result at the DW monitoring location (<185 cfu/m^3) is below the EA Suggested Threshold.

5.1.3 Sensitive Receptor

The mean result at the DW monitoring location (<463 cfu/m^3) is below the EA Suggested Threshold.

5.2 Aspergillus fumigatus

The mean results for all three monitoring locations (<185 cfu/m^3) fall below the EA Suggested Threshold (500 cfu/m^3).

5.3 Replication of Sampling

It is possible to replicate the sampling points at the site however the variables will change due to weather, wind patterns, activity on site and seasonal variations of feedstock. As such sampling for bioaerosols can only tell you what is present at the time of sampling. The longer the sampling is undertaken for the greater response the filters will take and will therefore give us a better understanding of how activities are dispersing bioaerosols.

WRM undertake sampling for 45 minutes and at a minimum of three points, this increases to 4+ points where required. Sampling was undertaken during a minimum 45-minute period with three replicates and one blank used per sampling point.

[15] Environment Agency (2009) 'Guidance on the evaluation of bioaerosol risk assessments for composting facilities' Environment Agency for England and Wales

6.0 COMPARISON WITH PREVIOUS RESILTS

This section presents all results from previous monitoring events at MD Recycling.

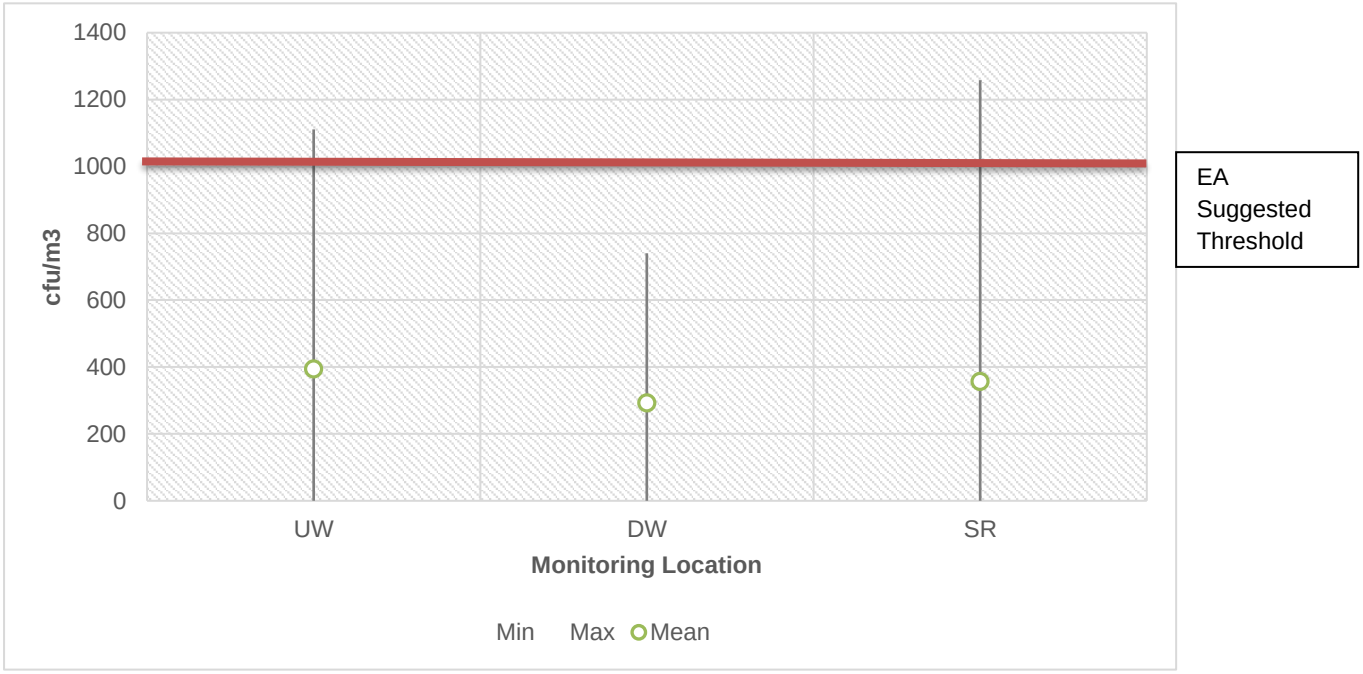
6.1 Bacteria

Table 10- Mean Bacteria levels recorded at previous monitoring events (cfu/m^3)

Date of Sampling	Upwind (cfu/m^3)	Downwind (cfu/m^3)	Sensitive Receptor (cfu/m^3)
26/11/2015	111	222	111
26/05/2016	0	37	37
11/08/2016	592	481	**1,258**
25/10/2016	556	278	185
23/02/2017	**1,111**	740	555
31/05/2017	<185	<185	<185

Table 10 demonstrates that the EA Suggested Threshold (1,000 cfu/m^3) has been exceeded twice, once at the UW location on 23/02/17 and once at the SR location on 11/08/2016.

Graph 1 –minimum, maximum and mean Bacteria results at MD Recycling



Graph 1 demonstrates that the average mean result at the UW (395 cfu/m^3), DW (293 cfu/m^3) and SR (358 cfu/m^3) monitoring locations are all below the EA Suggested Threshold.

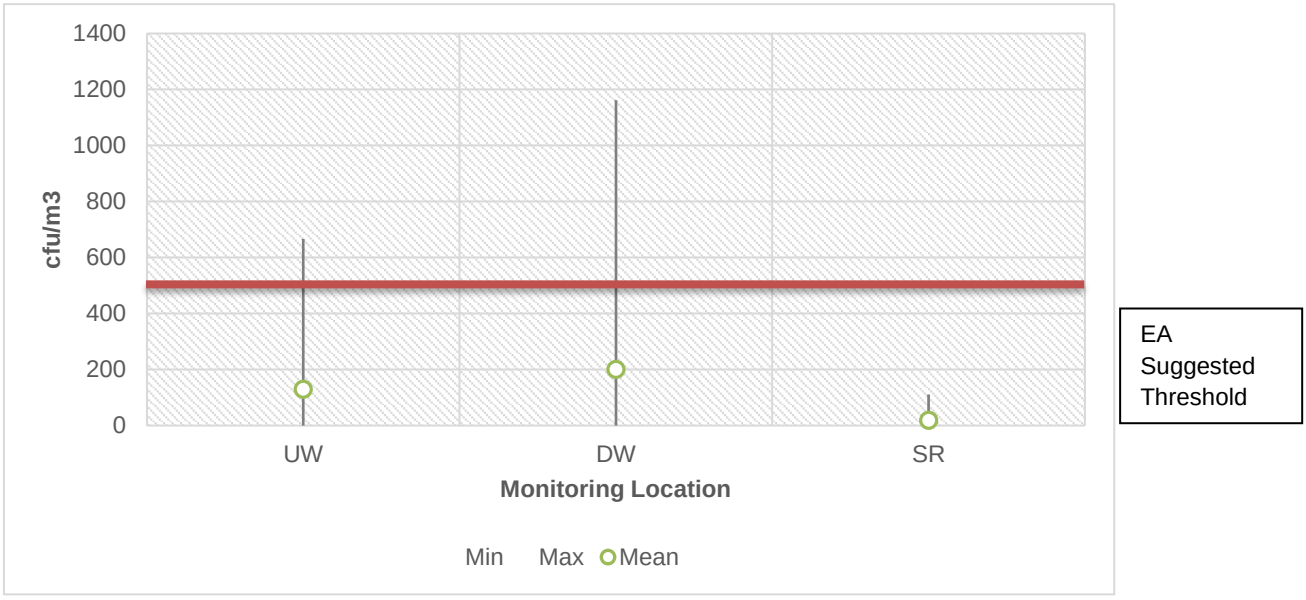
6.2 *Aspergillus fumigatus*

Table 11 - Mean *Aspergillus fumigatus* levels recorded at previous monitoring events (cfu/m^3)

Date of Sampling	Upwind (cfu/m^3)	Downwind (cfu/m^3)	Sensitive Receptor (cfu/m^3)
26/11/2015	**667**	**1,162**	111
26/05/2016	0	0	0
11/08/2016	111	37	0
25/10/2016	0	0	0
23/02/2017	0	0	0
31/05/2017	<185	<185	<185

Table 11 demonstrates that the EA Suggested Threshold (500 cfu/m^3) has been exceeded twice, once at the UW and once at the DW monitoring locations on 26/11/2015.

Graph 2- minimum, maximum and mean *Aspergillus fumigatus* results at MD Recycling



Graph 2 demonstrates that the average mean result at the UW (130 cfu/m^3), DW (200 cfu/m^3) and SR (19 cfu/m^3) monitoring locations are all below the EA Suggested Threshold.

APPENDIX 1 – METEOROLOGICAL SAMPLING CONDITIONS

Weather Conditions on Day of Sampling

Sample	Time	Mean wind direction (°)	Mean wind speed (m/s)	Air temperature (°C)	Relative humidity (%)	Cloud Cover (Oktas)
1 2 3	9.00-9.45	290	3.8	17.7	38.7	8
4 5 6	9.02-9.47	290	3.8	17.7	38.7	8
7 8 9	9.55-10.40	290	3.4	18.3	39.1	8

Weather Conditions 24 Hours Earlier

Temp Max (°C)	Temp Min (°C)	Temp Mean (°C)	Humidity Max (%)	Humidity Min (%)	Humidity Mean (%)	Precipitation (mm)	Average Wind speed (m/s)
18	12	15	94	67	81	0.0	5

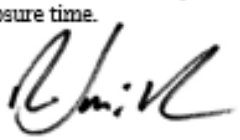
APPENDIX 2 – LABORATORY TEST RESULTS

Site MD Recycling
Site Operator: Marc Davies
Date 31st May 2017
Comments: All polycarbonate filters and filter heads were in good condition.

Table 1. Microbiological Results from MD Recycling green waste site:

Sample no.	Sample Head no.	Volume (litres)	Total Mesophilic Bacteria (cfu per plate)	*Aspergillus Fumigatus* (cfu per plate)	Total Mesophilic Bacteria (cfu per m^3)	*Aspergillus Fumigatus* (cfu per m^3)
1	No.1	90	0, 0, 0	0, 0, 0	<185	<185
2	No.2	90	1, 0, 0	0, 0, 0	185	<185
3	No.3	90	1, 0, 0	0, 0, 0	185	<185
	Mean				**<185**	**<185**
4	No.4	90	0, 0, 0	0, 0, 0	<185	<185
5	No.5	90	0, 0, 0	0, 0, 0	<185	<185
6	No.6	90	1, 0, 0	0, 0, 0	185	<185
	Mean				**<185**	**<185**
7	No.7	90	2, 1, 0	0, 0, 0	555	<185
8	No.8	90	2, 0, 0	0, 0, 0	370	<185
9	No.9	90	0, 0, 0	0, 0, 0	<185	<185
	Mean				**<463**	**<185**
10	No.10	Blank control	1, 0, 0 (per plate)	0, 0, 0 (per plate)	17 (per membrane)	<17 (per membrane)
11	No.11	Blank control	0, 0, 0 (per plate)	0, 0, 0 (per plate)	<17 (per membrane)	<17 (per membrane)

Exposure results are expressed as total micro-organisms per cubic metre collected during the exposure time.



12th June 2017
DATE

R. SMITH
BIODET

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