

Maindiff Court Farm

**Llantilio Pertholey
Abergavenny
NP7 8AY**

Bioaerosol Monitoring Report

September 2014



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CONTENTS

	Page
Summary	4
1.0 Introduction	6
2.0 Potential Health Effects	6
3.0 Monitoring Protocol	9
4.0 Sample Collection	9
4.1 Selection of Monitoring Locations	
4.2 Site Activity	
5.0 Meteorological Data	16
6.0 Analysis	16
6.1 Selective Media	
6.2 Sampling	
6.3 Enumeration	
6.4 Data Recording	
7.0 Results	20
8.0 Conclusions	26
9.0 Recommendations	27
Appendices	28
1 Graph of Results	29
2 Monitoring Location Plan	31
3 Location Specific Site Data	32
4 Location Specific Metrological Data	36
5 Meteorological Strip Chart	38
Bibliography	

Summary

Maindiff Court Farm operates a green waste composting facility, processing waste from local authority green waste collection and civic amenity sites. The Centre for Health, Safety and Environment (CHSE) / Cardiff Metropolitan University, have been requested to carry out a bioaerosol monitoring programme on behalf of Mr Andrew Lewis, Maindiff Court Farm. The principal reason for the investigation is to address the requirements of the Maindiff Court Farm Environmental Permit (EPR/BP3392LC). This report covers the fifth monitoring exercise carried out on behalf of Maindiff Court Farm.

On-site monitoring and laboratory analysis was carried out in accordance with the current Association for Organics Recycling (AfOR) protocol, 'A standard protocol for the monitoring of bioaerosols at open composting facilities' (AfOR, 2009). The intention of the protocol is to provide guidance for monitoring bioaerosols at open composting facilities and requires that levels of total mesophilic bacteria and the fungi *Aspergillus fumigatus* be monitored. The protocol notes that at enclosed or in-vessel facilities, there may be an additional requirement to monitor gram negative bacteria. The Environmental Permit for Maindiff Court Farm stipulates that monitoring should report concentrations of total mesophilic bacteria, the fungi *Aspergillus fumigatus*, and gram negative bacteria. As a result, concentrations of total mesophilic bacteria, the fungi *Aspergillus fumigatus*, and gram negative bacteria were enumerated and compared with the relevant appropriate levels for interpretation.

On the 01st April 2013, Natural Resources Wales (NRW) was formed as the regulatory authority in Wales by combination of the functions of the Environment Agency, Countryside Council for Wales and the Forestry Commission in Wales. At present, NRW has not issued specific guidance relating to bioaerosols at waste facilities. The analysis and report has therefore been prepared with reference to Environment Agency appropriate levels and guidance. References to policy and guidance from the Environment Agency within the text therefore also refer to NRW.

Monitoring was undertaken on Monday 15th September 2014. The on-site monitoring procedure and data analysis was undertaken in accordance with the current AfOR guidance, “*A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities*” (2009).

Section 7.0, page 20, details the results obtained. At present, there are no statutory levels that exist in order to put the results in to a regulatory context only the guidance values set by the Environment Agency for total bacteria, gram negative bacteria and *Aspergillus fumigatus*. During monitoring, deposited green waste material was shredded and formed in to a windrow in an in-building bay.

Concentrations of bioaerosols higher than background concentrations were recorded at the downwind monitoring location 60m from the working area. Concentrations of all micro-organisms measured, mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus*, at all locations were below the acceptable levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively. A full set of results and analysis can be found in sections 7.0 Results and 8.0 – Conclusions.

In accordance with the precautionary principle, it is recommended that practical risk mitigation measures are employed throughout the process to minimise liberation of bioaerosols as far as is reasonably practical. Practical risk mitigation measures recommended to minimise bioaerosol release, during processes such as turning, shredding and screening, are detailed in Section 9.0 – Recommendations, page 27.

1.0 Introduction

At the request of Maindiff Court Farm, the Centre for Health, Safety and Environment (CHSE) has undertaken a monitoring programme to assess levels of bioaerosol release from the composting operations at the green waste composting facility at Maindiff Court Farm, Llantilio Pertholey, Abergavenny.

As a condition of their Environmental Permit (EPR/BP3392LC), Maindiff Court Farm are required to monitor levels of bioaerosols at specified locations in the vicinity of the facility, on four occasions each year and submit reports of the monitoring to Natural Resources Wales (NRW).

On the 01st April 2013, NRW was formed as the regulatory authority in Wales by combination of the functions of the Environment Agency, Countryside Council for Wales and the Forestry Commission in Wales. At present, NRW has not issued specific guidance relating to bioaerosols at waste facilities. The analysis and report has therefore been prepared with reference to Environment Agency appropriate levels and guidance. References to policy and guidance from the Environment Agency within the text therefore also refer to NRW.

2.0 Potential Health Effects

Bioaerosols are defined as a collection of aerosolised biological particles including actinomycetes, bacteria, fungi protozoa and their components (Millner et al 1994, Millner, 1995, Gilbert and Ward, 1998; Van der Werf, 1996, Epstein, 1994; Fischer et al 1999, Cox and Wathes, 1995). These organisms are fundamental to the composting process. The concern regarding bioaerosols from composting activities arises because of their potential to cause adverse health effects in employees and the public living in close proximity to such facilities. These adverse effects can potentially occur in susceptible individuals from exposure to the micro-organisms associated with the composting process and can elicit an adverse response by infection, allergy or an adverse response to toxins (Environment Agency, 2005). According to Swan *et al.* (2003) the effects of exposure to organic dust on

respiratory health may lead to or exacerbate a number of distinct identifiable conditions including Aspergillosis in immuno-compromised individuals (Millner *et al*,1994, Millner 1995), Allergic Rhinitis and Asthma (Zuskin *et al*, 1994), Extrinsic allergic alveolitis (Farmers Lung) (Flannigan *et al* 1991) where prolonged (usually occupational) exposure occurs, Chronic Obstructive Pulmonary Disease (COPD) (Lacey and Crook, 1988, Matheson, 2005); Toxic Pneumonitis (Lacey and Crook,1988) and upper airway irritation/mucous membrane irritation (Dutkiewicz,1997).

Risk to the public

Whilst many measurements of airborne concentrations of organisms have been made within and in the vicinity of composting plants, which give ample evidence for a hazard especially to composting workers, there have been very few studies of health effects from which any quantitative indication of risk can be derived for members of the public (IOM, 2008). Concern has been raised by residents in the vicinity of composting sites that composting activities could increase levels of bioaerosols, such as airborne *Aspergillus fumigatus* spores. Most reports show numbers to have declined to 'background' within 200 m from a compost bioaerosol source, although some report levels above background at a greater distance. Background or typical ambient bioaerosol levels may differ by orders of magnitude depending on location, weather and season, which hinder interpretation. Few published studies exist where the health of residents near composting sites has been investigated, but where such work has been done there is little evidence of ill health compared to controls (Millner, 1995). The responses to bioaerosols are host and dose dependent; that is some individuals may respond to a dose that does not affect others (Millner *et al.*, 1994, Millner 1995). However based on the current knowledge, the risk is impossible to quantify due to the lack of accepted dose-response relationships for bioaerosol exposure (Wheeler *et al*, 2001; IOM, 2008; Drew *et al*, 2009; EA, 2009). Bioaerosols are endemic in the environment from decomposing leaves in gardens and woods, wheat fields etc. and the body has many natural defences against them. However individual susceptibilities vary considerably and even natural levels of bioaerosols can be harmful to certain individuals. The Environment Agency

(EA), has established conservative '*acceptable levels*' for micro-organisms in air as shown in Table 1 (EA, 2010). The EA concede that other activities may lead to higher background bioaerosol levels than would normally be expected (EA, 2007).

Table: 1

Environment Agency Reference for Bioaerosol (EA, 2010)	
Reference Pollutant	CFU m⁻³
Total Bacteria	1000
<i>Aspergillus fumigatus</i>	500
Gram negative Bacteria	300

3.0 Monitoring Protocol

The monitoring was undertaken in accordance with the current AfOR guidance, “*A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities*” (2009).

Bioaerosols were sampled at a position 1.5m above ground level using a single stage Anderson sampler during normal site operations. Monitoring was conducted in parallel at each of the monitoring locations. Additional passive samples, i.e. no air drawn through the sampler, were taken at the locations downwind of the working area.

4.0 Sample Collection

Composting operations, at Maindiff Court Farm, are carried out in two locations within the working area detailed in the Environmental Permit:

- an in-building composting area. Windrows are housed within bays of an agricultural building. After shredding, material is formed in to piles within bays. The East facing side of the building is open.
- an open concrete pad area, used for delivery and short-term storage of green waste and for maturation of the output of the in-building bays.

Table 2 details the distances and bearing of the closest receptors to the working area.

Table 2 – Sensitive Receptors

Receptor	From working area		Description
	Distance	Bearing	
Maindiff Court Farm cottages	60m	270°	Residential buildings adjacent to Maindiff Court Farm.
Maindiff Court Hospital grounds	250m +	0° to 60°	Community hospital grounds.
Maindiff Court Hospital buildings	275m +	10° to 50°	Community hospital buildings.
A465	250m	270°	Trunk Road. Linear feature N – S to west of facility.
Green Acres Farm	425m	197°	Agricultural buildings.
Wern Ddu Golf Club	450m	90°	Recreational.
Ross Road, Abergavenny	450m	270°	Residential street.
Tredilion Park	550m	125°	Residential.
Wern Ddu	575m	80°	Residential house.
Blossom Holiday Park	625m	52°	Touring caravan site/Tourism.

In accordance with the Association for Organics Recycling protocol, monitoring locations are adjusted on each monitoring occasion, to account for changes in the prevailing wind direction, site access and other practical issues. The actual monitoring locations utilised are included in Appendix 2, page 31, and indicated as:-

- Up-wind
- Downwind – 60m
- Downwind – 210m
- Sensitive Receptor

4.1. Selection of Monitoring Locations

On arrival at the site on the day of monitoring the weather station was erected on top of an earth bund forming the southern boundary of the working area, away from buildings and trees that may affect meteorological data. From gathered data, a working plan was proposed and monitoring locations selected. The meteorological data was consulted between each monitoring location to ensure that selected monitoring locations were still valid, prior to setting up equipment.

On the day of monitoring, the prevailing wind direction was generally from the North.

Monitoring was carried out at four locations:

- a point 50m upwind of the working area (Upwind),
- a point 60m downwind of the working area (Downwind – 60m), and
- a point downwind of the working area a similar distance from the working areas as the boundary of Maindiff Court Hospital (Downwind 210m).

Upwind – Samples were collected from a monitoring location approximately 50m north north east of the working area in an open field.

Downwind – 60m. - A location 60m south of the border of the working area was selected for the downwind monitoring location. Samples were collected in an open field used for livestock grazing. Slurry had been spread on the fields in the week prior to monitoring. On the day of monitoring, the field was being used for grazing sheep.

The topography between the site and the monitoring location was open grassland. This does not replicate the land between the site and sensitive receptor, which is screened by buildings. The concentrations recorded at the downwind location therefore may over represent the concentration that would be found at the sensitive receptor.

Photograph 1: Downwind – 60m. open ground between monitoring location and working area.



Downwind – 210m. – The Environment Permit for the Maindiff Court Farm requires a monitoring location on the boundary of Maindiff Court Hospital. As Maindiff Court Hospital was not downwind on the day of monitoring, a location

was chosen a similar distance downwind from the working area as the distance between working area and hospital boundary, i.e. approximately 250m. A location was chosen in an open field, used for grazing sheep, to the south of the working area. The open terrain between the working area and monitoring location corresponds to the terrain between the working area and Maindiff Court Hospital.

The monitoring location was as far away from the working area as the field would allow, 210m from the working area. This was slightly closer to the working area than the equivalent distance to the hospital boundary at 250m. A location a greater distance to the south would have placed the monitoring location behind a tree screen surrounding the field and would not have reflected the topography between the site and the hospital receptor.

Photograph 2: Downwind - 210m, view south to tree screening at boundary of field:



Photograph 3. Downwind 210m. Open ground between monitoring location and working area.



Sensitive Receptor – Samples were collected from a monitoring location, approximately 60m from the working area, at the edge of a field adjacent to Maindiff Court cottages. The monitoring location was close to trees and buildings, however the location chosen provided the most open and suitable area of available ground adjacent to the sensitive receptor. The choice of location was limited by the access road, perimeter wall and buildings.

Photograph 4. Sensitive Receptor.



4.2. Site Activity

Between 8 am and 1 pm, green waste material was shredded on the concrete pad area and formed in to a windrow in an in-building bay. Exposure times for each sample were reduced from 20 minutes to 15 minutes to ensure that work was being undertaken throughout the monitoring period.

5.0 Meteorological Data

Meteorological data was logged with a Davis Instruments wireless Vantage Pro2 with associated 'Weatherlink' software throughout the monitoring period. The full meteorological data has been omitted from the report due to the large volume that is generated. However, supplementary meteorological data that provides a general overview is listed in Appendix 4 and 5.

The weather during monitoring was overcast with a light northerly breeze. Early low cloud and mist lifted throughout the day. There was no precipitation during the monitoring period. The average wind speed was 1.3 m/s over the monitoring period. The wind direction throughout the monitoring period was generally from a northerly direction, varying from north east to north north west. Temperatures rose throughout the monitoring period from 12.9 °C on arrival to a peak of 16.0 °C. Humidity was stable throughout the monitoring period, ranging between 77% and 80%.

Weather conditions for the 24 hours prior to the monitoring exercise were: Cloudy, dry. The wind was predominantly from the North.

6.0 Analysis

Analysis was carried out for total mesophilic bacteria, the fungi *Aspergillus fumigatus*, and gram negative bacteria using standard 'Cardiff Met Laboratory Protocol' and in line with BS EN ISO 7218:2007 + A1:2013 – "Microbiology of food and animal feeding stuffs. General requirements and guidance for microbiological examinations."

This method is taken from the protocol, "A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities" (AFOR, 2009).

6.1 Selective Media

All laboratory media preparation and sterilisation was carried out in accordance with the standard procedures as set out in the Cardiff School of Health Sciences Laboratory Manual (volume 2, section 5) in line with BS EN ISO 7218:2007 + A1:2013 – "Microbiology of food and animal feeding stuffs.

General requirements and guidance for microbiological examinations.” and ISO 11133-1:2009 (ISO, 2009).

Half-strength nutrient agar medium is used to culture mesophilic bacteria; malt extract medium was used to culture *Aspergillus fumigatus* and MacConkey No.3 agar was used to culture Gram Negative bacteria.

The mesophilic bacterial count derives from the AfOR protocol (2009) and HPA standard methodology. The count for *Aspergillus fumigatus* follows the AfOR protocol (2009). The total gram negative count method is not covered by the AfOR protocol, but is based on reference by Drew et al (2009).

6.2 Sampling

The sampling at the composting site follows the procedures laid out in the guidance, “A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities” (AFOR, 2009).

The exposure time for each sample was reduced from 20 minutes to 15 minutes on the day of monitoring, to ensure that composting activity, i.e. shredding, turning or screening, took place during sampling at each monitoring location.

Petri dishes were stored in a cooled container (at approximately 4°C) following sampling, until all remaining samples had been collected. All dishes were then inverted and placed in an appropriate microbiological incubator at the same time. This is carried out no later than 12 hours after sampling. The nutrient agar medium, selecting for mesophilic bacteria and the MacConkey No. 3 agar medium, culturing for total Gram Negative bacteria were incubated at 37°C. Colonies growing on these media were enumerated after two and three days respectively. The malt extract medium, culturing for *Aspergillus fumigatus*, were incubated at 42°C and enumerated after 2 days.

6.3 Enumeration

Mesophilic Bacteria:

The number of colonies on each nutrient agar medium plate was counted after incubation of the sample for two days at 37°C.

If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Gram Negative Bacteria:

The number of colonies of Gram Negative bacteria growing on each MacConkey No. 3 agar plate after incubation of the sample for three days at 37°C were counted and recorded.

If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Aspergillus fumigatus:

The number of colonies of *A. fumigatus* growing on each malt extract agar medium plate after incubation of the sample for two days at 40°C were counted and recorded. Identification is based upon gross colony colour and morphology plus spore bearing structures according to standard texts.

Identification was confirmed by low magnification bright field light microscopy where necessary.

If enumeration of *Aspergillus fumigatus* is not possible because of the large number of colonies, this is recorded as “Too Numerous To Count” (TNTC). Where spreading colonies of other fungi obscure less than half of a Petri dish, then colonies of *A. fumigatus* were enumerated on the un-obscured half, as long as this appears to be representative of the entire sample. This is recorded and the number of colonies adjusted as if the whole dish were enumerated.

Only colonies that fall at the impaction sites of the sampler were counted and recorded. Satellite colonies growing adjacent to larger colonies at the impaction site and colonies growing around the perimeter of the medium are ignored.

If spreading colonies obscured more than half of one Petri dish, this was recorded as “No results, spreaders”. If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Where spreading colonies obscure less than half of a Petri dish, then colonies were enumerated on the un-obscured half, as long as this appears to be representative of the entire sample. This is recorded and the number of colonies adjusted as if the whole dish were enumerated.

6.4 Data Recording

Laboratory – prior to sampling:

- Date and time of media preparation (media preparation log file)
- Batch numbers of the media components (media preparation log file)
- Laboratory personnel (media preparation log file)
- Trace of the sterilisation temperature profiles (refer to Cardiff Met Laboratory Manual volume 2, section 5.6 “Media Autoclaving” and section 9.22 “Osprey Multicycle Autoclave”)
- Storage conditions of the prepared media (media preparation log file)

Laboratory -post sampling:

For each Petri dish the following was recorded,

- Unique sample number
- Sampling date
- Date and time Petri dishes were placed in incubators
- Date and time Petri dishes were removed from incubators
- Number of colonies on the plate
- Corrected number of colonies (using the Positive Hole Correction Table supplied by the Andersen sampler manufacturer)

7.0 Results

The data interpretation has been conducted and presented in accordance with the AFOR guidance, “A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities” (2009).

In the tabulated results below;

- ‘UW’ refers to the upwind sample location
- ‘DW’ refers to the Downwind sample location
- ‘DHR’ refers to a location downwind at the same distance from the working area as the Maindiff Court Hospital receptor
- ‘SR’ refers to the sensitive receptor location
- ‘½Str Nutrient’ refers to the ½ strength nutrient agar media
- ‘MacConkey’ refers to the MacConkey No. 3 agar media
- ‘Malt extract’ refers to the Malt extract media
- ‘AF’ refers to *Aspergillus fumigatus*
- ‘MB’ refers to Mesophilic Bacteria
- ‘GN’ refers to Gram Negative Bacteria
- ‘Passive’ refers to a sample left in the sampler but with no vacuum applied
- ‘Control’ refers to a sample not exposed to the atmosphere before analysis
- TNTC is indicated when enumeration is not possible because of the large numbers of colonies. This is greater than 399 colonies or greater than 2427 cfu m⁻³
- ‘No Count – Spreaders’ is indicated when spreading fungal growth, other than *A. fumigatus*, has obscured greater than 50% of the plate.
- cfu m⁻³ refers to Colony forming units per cubic meter of air
- ‘Corrected Number of colonies’ refers to the number of colonies per plate adjusted using the Positive Hole Correction Table

The results presented below are for each organism for the monitoring exercise undertaken on 15th September 2014. A graphical overview of the results can be found in Appendix 1, page 29.

Mesophilic Bacteria Counts – 15th September 2014

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
DW MB Passive	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	11	15	0	11	n/a
DHR MB Passive	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	1	15	0	0	n/a
Control 1	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	0	n/a	n/a	n/a	n/a
Control 2	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	0	n/a	n/a	n/a	n/a
DW MB 1	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	189	15	0.0283	245	577
DW MB 2	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	180	15	0.0283	239	563
DHR MB 1	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	147	15	0.0283	183	431
DHR MB 2	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	139	15	0.0283	171	403
SR MB 1	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	38	15	0.0283	40	94
SR MB 2	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	50	15	0.0283	53	125
UW MB 1	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	5	15	0.0283	5	12
UW MB 2	½Str Nutrient	15/09/2014	17/09/2014	n/a	17/09/2014	5	15	0.0283	5	12

Total Gram Negative Bacteria Counts – 15th September 2014

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
DW GN Passive	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	20	0	0	n/a
DHR GN Passive	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	20	0	0	n/a
Control 1	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	n/a	n/a	n/a	n/a
Control 2	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	n/a	n/a	n/a	n/a
DW GN 1	MacConkey	15/09/2014	18/09/2014	62 G -ve	18/09/2014	62	15	0.0283	67	158
DW GN 2	MacConkey	15/09/2014	18/09/2014	59 G -ve	18/09/2014	59	15	0.0283	64	151
DHR GN 1	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	15	0.0283	0	0
DHR GN 2	MacConkey	15/09/2014	18/09/2014	1 G -ve	18/09/2014	1	15	0.0283	1	2
SR GN 1	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	15	0.0283	0	0
SR GN 2	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	15	0.0283	0	0
UW GN 1	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	15	0.0283	0	0
UW GN 2	MacConkey	15/09/2014	18/09/2014	n/a	18/09/2014	0	15	0.0283	0	0

Aspergillus fumigatus Counts – 15th September 2014

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
DW AF Passive	Malt Extract	15/09/2014	17/09/2014	n/a	17/09/2014	0	20	0	0	n/a
DHR AF Passive	Malt Extract	15/09/2014	17/09/2014	n/a	17/09/2014	0	20	0	0	n/a
Control 1	Malt Extract	15/09/2014	17/09/2014	n/a	17/09/2014	0	n/a	n/a	n/a	n/a
Control 2	Malt Extract	15/09/2014	17/09/2014	n/a	17/09/2014	0	n/a	n/a	n/a	n/a
DW AF 1	Malt Extract	15/09/2014	17/09/2014	78 +ve <i>A. fumigatus</i>	17/09/2014	78	15	0.0283	87	205
DW AF 2	Malt Extract	15/09/2014	17/09/2014	68 +ve <i>A. fumigatus</i>	17/09/2014	68	15	0.0283	75	177
DHR AF 1	Malt Extract	15/09/2014	17/09/2014	61 +ve <i>A. fumigatus</i>	17/09/2014	61	15	0.0283	66	155
DHR AF 2	Malt Extract	15/09/2014	17/09/2014	75 +ve <i>A. fumigatus</i>	17/09/2014	75	15	0.0283	83	196
SR AF 1	Malt Extract	15/09/2014	17/09/2014	6 +ve <i>A. fumigatus</i>	17/09/2014	6	15	0.0283	6	14
SR AF 2	Malt Extract	15/09/2014	17/09/2014	6 +ve <i>A. fumigatus</i>	17/09/2014	6	15	0.0283	6	14
UW AF 1	Malt Extract	15/09/2014	17/09/2014	6 +ve <i>A. fumigatus</i>	17/09/2014	6	15	0.0283	6	14
UW AF 2	Malt Extract	15/09/2014	17/09/2014	8 +ve <i>A. fumigatus</i>	17/09/2014	8	15	0.0283	8	19

During monitoring on 16th September 2014, stockpiled green waste material was shredded and formed in to a windrow in one of the bays of the building adjacent to the concrete yard. Exposure times for each sample were reduced from 20 minutes to 15 minutes to ensure that composting activities were being undertaken throughout the monitoring period.

All concentrations of bioaerosols measured on 16th September 2014 at Maindiff Court Farm were below guidance levels suggested by the Environment Agency of 1000 cfu/m³ for mesophilic bacteria, 500 cfu/m³ for *Aspergillus fumigatus* and 300 cfu/m³ for gram negative bacteria.

The wind direction during sampling was relatively stable, blowing from a generally North Easterly direction throughout the period. As a result, the sampling locations used provide good representations of the concentrations at each location.

The North Easterly prevailing wind placed the downwind monitoring location in an open field to the south of the working area. The open ground between the monitoring location and the working area does not represent the same conditions between the working area and sensitive area, which consist of building which would act to screen the sensitive receptor from bioaerosols. As a result, the results from the current monitoring may overestimate the likely concentrations experienced at the sensitive receptor. Concentrations at the downwind location were significantly above background levels (mesophilic bacteria: mean 570 cfu/m³, gram negative bacteria: mean 155 cfu/m³, *Aspergillus fumigatus*: mean 191 cfu/m³) but were below guidance levels suggested by the Environment Agency.

In order to represent monitoring at the boundary of the Maindiff Court Hospital grounds, monitoring at approximately 250m from the working area is undertaken during each monitoring exercise. During the current monitoring, a location was chosen in an open field to the south of the site 210m from the working area. This is closer to the working area than the hospital boundary. A location 250m from the working area would have placed the monitoring point behind a tree screen that would not have been representative of the ground between the working area and hospital boundary. As the selected monitoring location is closer to the working area than the

hospital boundary, the concentrations measured may over estimate concentrations at the boundary of the hospital grounds.

Concentrations of mesophilic bacteria (mean 417 cfu/m³) and *Aspergillus fumigatus* (176 cfu/m³) at the location 210m downwind of the working area were slightly below concentrations measured at the downwind location, however they had not returned to background concentrations. Concentrations of gram negative bacteria had returned to background levels at this location (mean 1 cfu/m³). This may suggest secondary sources of bioaerosol contributing to the concentrations. In an agricultural environment there may be a number of possible secondary sources of bioaerosol. Slurry had been spread on the field during the week before monitoring. The concentrations measured at the location 210m from the working area were below guidance levels suggested by the Environment Agency.

Concentrations of mesophilic bacteria at the sensitive receptor were above background levels (mean 110 cfu/m³). During monitoring at the sensitive receptor, the difference in bearing between the sensitive receptor and the direction that the wind was blowing to was 53°. This suggests that bioaerosols liberated by in the working area contributed to the concentrations recorded. This effect was not seen in the concentrations of *Aspergillus fumigatus* and gram-negative bacteria at the sensitive receptor. Concentrations of *Aspergillus fumigatus* at the upwind and sensitive receptor locations were similar (upwind: mean 17 cfu/m³, sensitive receptor: mean 14 cfu/m³). Gram negative bacteria were not detected at the upwind and sensitive receptor locations during monitoring.

Suggested risk mitigation measures can be found in section 9.0 – Recommendations.

8.0 Conclusions

In conclusion, the CHSE / Cardiff Met have completed ambient air monitoring of bioaerosols in accordance with Association for Organics Recycling approved methodology. Selective media has been used to enumerate mesophilic bacteria, the fungus *Aspergillus fumigatus* and gram negative bacteria.

During monitoring, material was shredded and formed in to a windrow on the concrete pad.

During the monitoring exercises on 15th September 2014, levels of mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus* were all below the appropriate levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively, at all locations monitored.

Concentrations for all the micro-organisms measured showed higher concentrations at the location 60m downwind of the working area than background (mesophilic bacteria: mean 570 cfu/m³, *Aspergillus fumigatus*: mean 191 cfu/m³ and gram negative: mean 155 cfu/m³). The ground between the working area and monitoring location was open and as a result may overestimate concentrations at the sensitive receptor which is screened from the working area by buildings. The concentrations of mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus* measured were all below the appropriate levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively, at this location.

Practical control measures are provided in Section 9.0 – Recommendations.

9.0 Recommendations

Practical risk mitigation measures are recommended to minimise bioaerosol exposure through processes such as turning, shredding and screening. The Environment Agency Technical Guidance on Composting Operations (October 2001 – Draft for External Consultation) recommends the following;

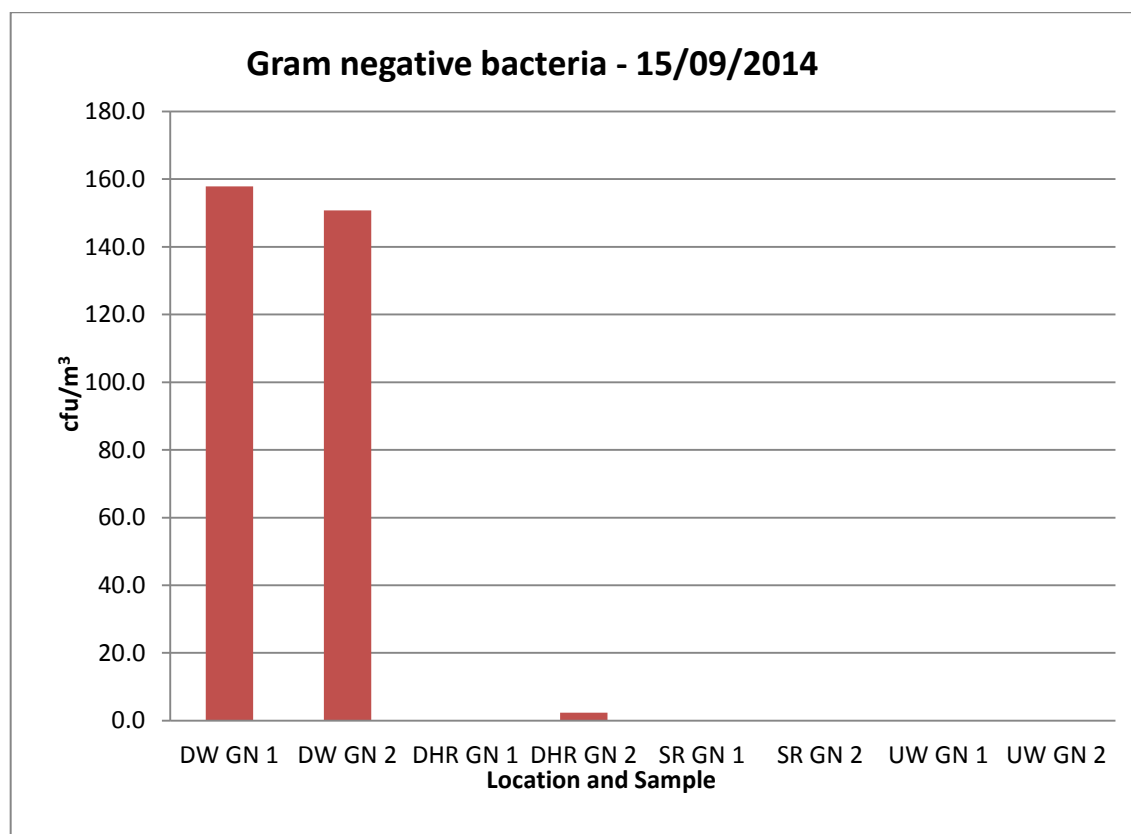
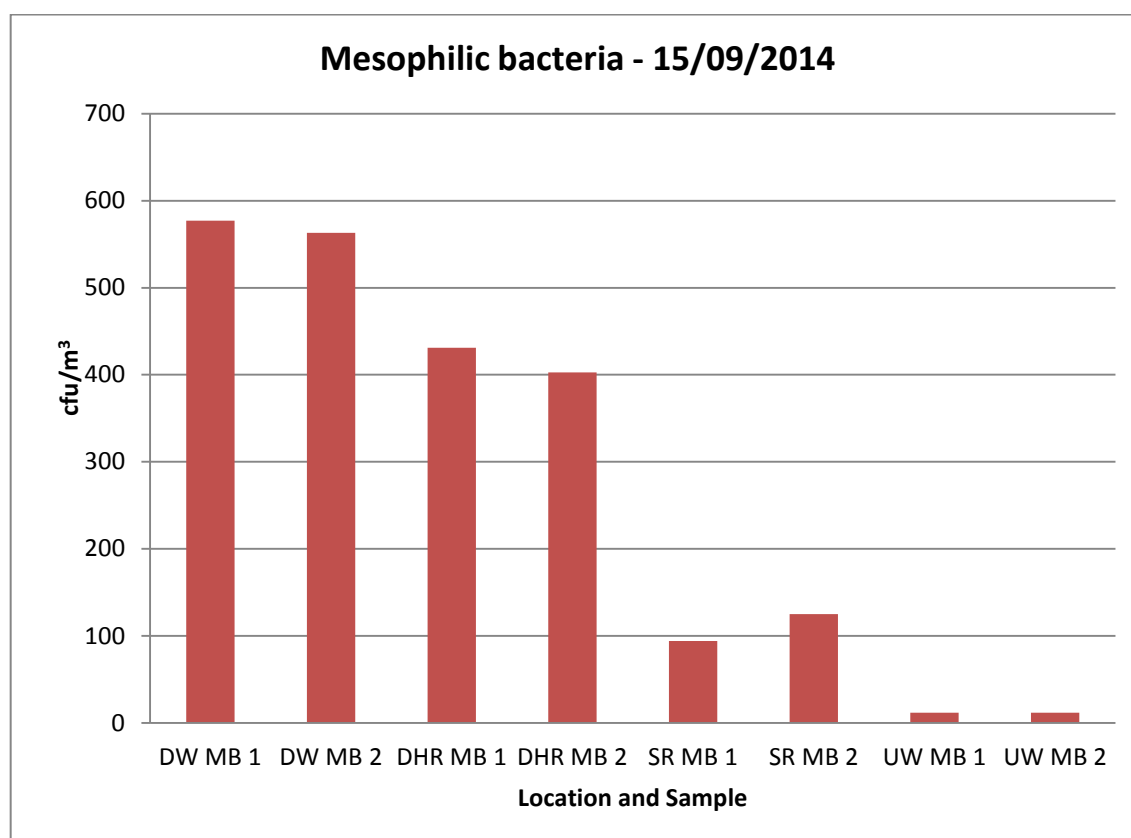
- The moisture content within all stages of the composting process should be monitored to avoid the waste and materials drying out and potentially forming dusts.
- The formation or turning of windrows or piles should be avoided if possible on windy days. Screening and shredding should also be undertaken when wind speeds are calm or wind direction is away from sensitive receptors.
- Site surfaces such as roads and tracks and the piles or windrows themselves should be regularly dampened down and/or regularly swept to suppress dust.
- Plant and machinery should be well maintained to avoid dust generation. The use of enclosures for screens and hoppers can be useful.
- Physical barriers such as mounds or walls can prevent dust leaving a site. Site construction and specific landscaping techniques can contain dusts that are generated on site.
- The composting of waste within buildings can provide excellent containment for the control of dust.

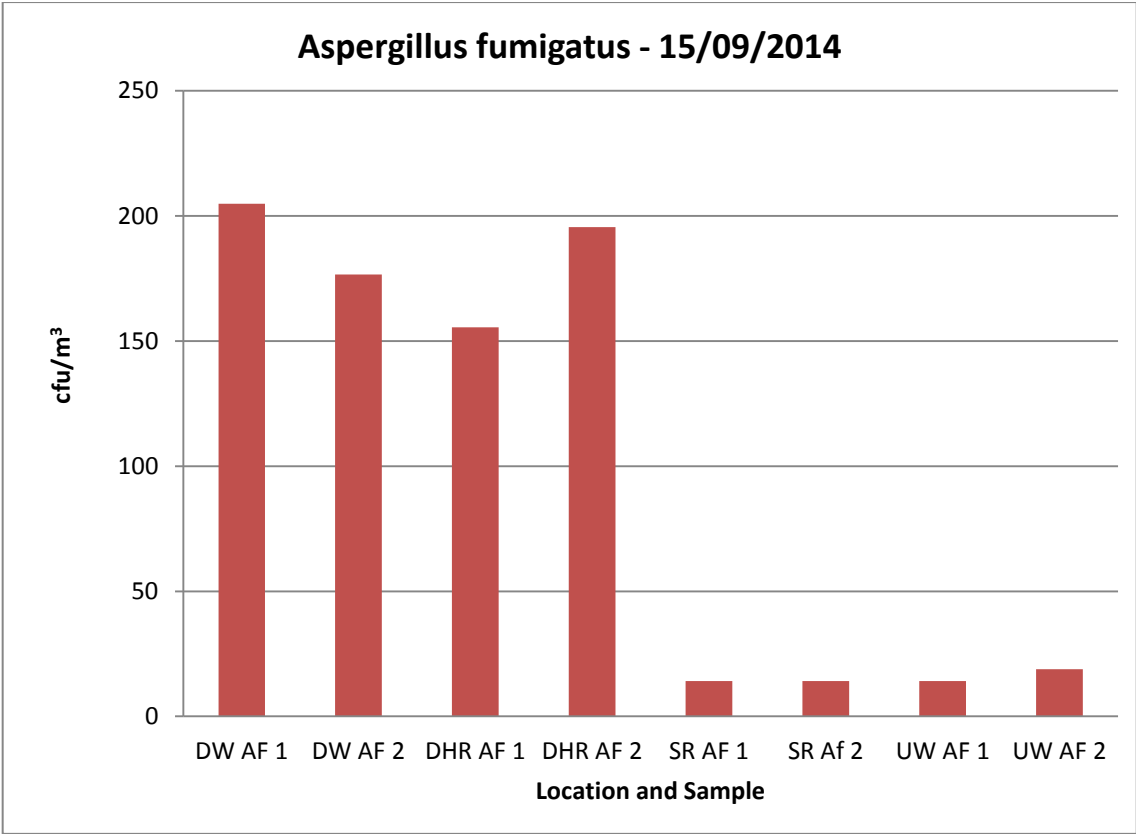
In addition to the recommendations in the Technical Guidance note, it is recommended that:

- Stockpiling of material before shredding should be minimised. This would reduce the potential for decomposition to begin before shredding takes place. The early stages of decomposition see a proliferation in the numbers of micro-organisms on the more readily available sources of nutrients.
- Drop heights should be minimised, to reduce the agitation of the material when being moved.

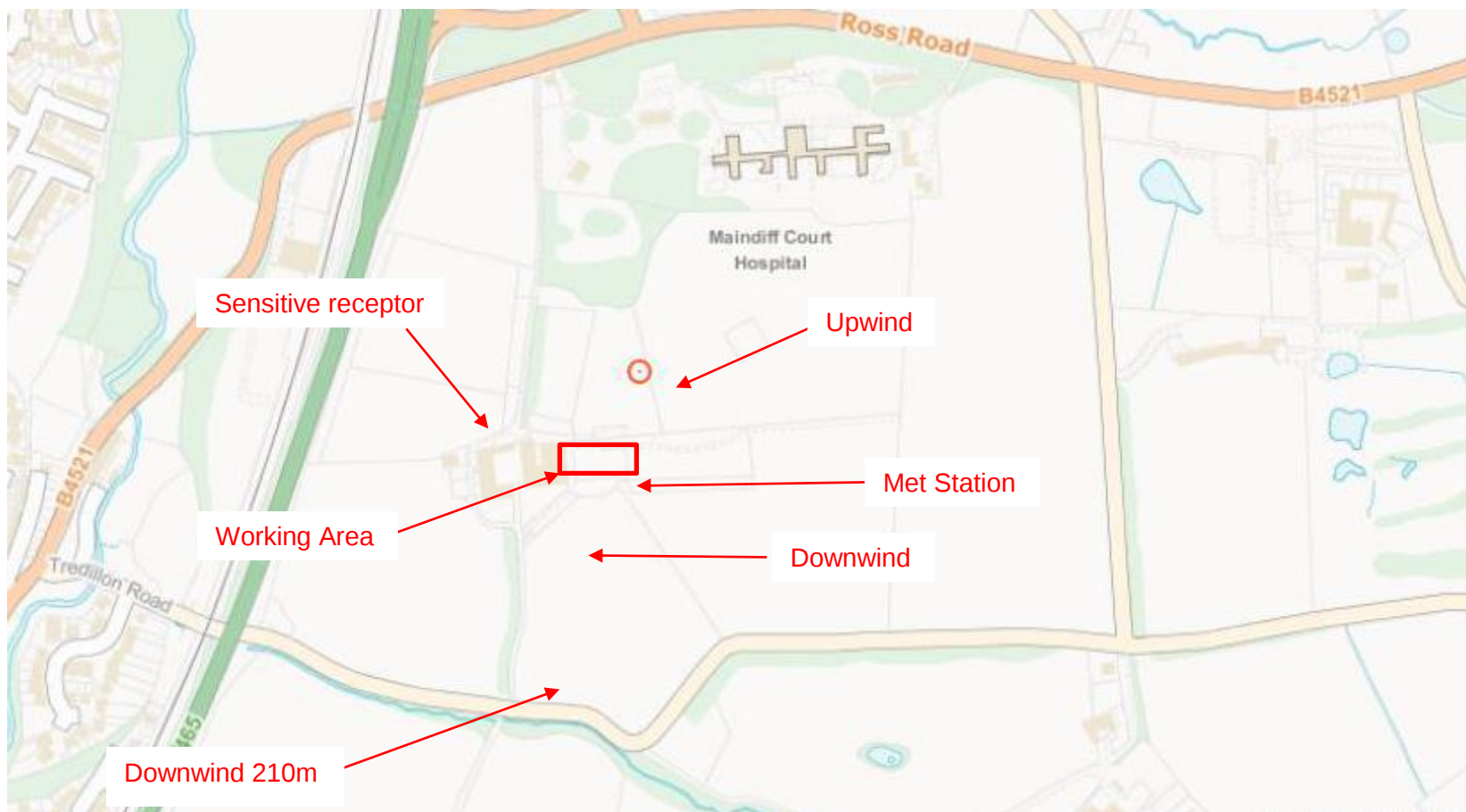
Appendices

Appendix 1 – Variation in monitored levels of specific micro-organisms **15th September 2014**





Appendix 2 Monitoring Location Plan – 15th September 2014



Appendix 3 – Location Specific Site Data

Upwind location – 15th September 2014

Upwind											
Site: Maindiff Court Farm, Abergavenny							Site Operator: Mr Andrew Lewis				
Sampling Date: 15/09/2014							Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Estimated Mass of Material:							Type of Material Processed on site: Green Waste				
Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Upwind	AF UW 1	50.0	192	8.35	15	AF	Shredding green waste and forming windrow in building.	Green Waste	14	17	
Upwind	AF UW 2	50.0	192	8.35	15	AF			19		
Upwind	MB UW 1	50.0	147	8.52	15	MB			12	12	
Upwind	MB UW 2	50.0	147	8.52	15	MB			12		
Upwind	GN UW 1	50.0	134	9.10	15	GN			0	0	
Upwind	GN UW 2	50.0	134	9.10	15	GN			0		

Downwind – 15th September 2014

Downwind.

Site: Maindiff Court Farm, Abergavenny

Sampling Date: 15/09/2014

Estimated Mass of Material:

Site Operator: Mr Andrew Lewis

Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff

Type of Material Processed on site: Green Waste

Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Downwind	AF DW 1	60.0	13	10.07	15	AF	Shredding green waste and forming windrow in building.	Green waste	205	191	Slurry recently spread on field. Grazing sheep close to monitoring location.
Downwind	AF DW 2	60.0	13	10.07	15	AF			177		
Downwind	MB DW 1	60.0	14	10.24	15	MB			577	570	
Downwind	MB DW 2	60.0	14	10.24	15	MB			563		
Downwind	GN DW 1	60.0	30	10.44	15	GN			158	155	
Downwind	GN DW 2	60.0	30	10.44	15	GN			151		
Downwind	AF DW Passive	60.0	13	10.07	15	AF	Shredding green waste and forming windrow in building.	Green waste	0*	n/a	*Presumptive count per plate
Downwind	MB DW Passive	60.0	14	10.24	15	MB			11*	n/a	
Downwind	GN DW Passive	60.0	30	10.44	15	GN			0*	n/a	

Downwind Hospital Receptor – 15th September 2014

Downwind - Distance equivalent to hospital boundary											
Site: Maindiff Court Farm, Abergavenny							Site Operator: Mr Andrew Lewis				
Sampling Date: 15/09/2014							Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Estimated Mass of Material:							Type of Material Processed on site: Green Waste				
Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Downwind - 210m	AF DHR 1	210.0	10	11.30	15	AF	Shredding green waste and forming windrow in building bays.	Green waste	155	176	Slurry recently spread on field. Grazing sheep close to monitoring location.
Downwind - 210m	AF DHR 2	210.0	10	11.30	15	AF			196		
Downwind - 210m	MB DHR 1	210.0	12	11.48	15	MB			431	417	
Downwind - 210m	MB DHR 2	210.0	12	11.48	15	MB			403		
Downwind - 210m	GN DHR 1	210.0	11	12.05	15	GN			0	1	
Downwind - 210m	GN DHR 2	210.0	11	12.05	15	GN			2		
Downwind - 210m	AF DW Passive	210.0	10	11.30	15	AF	Shredding green waste and forming windrow in building bays.	Green waste	0*	n/a	*Presumptive count per plate
Downwind - 210m	MB DW Passive	210.0	12	11.48	15	MB			0*	n/a	
Downwind - 210m	GN DW Passive	210.0	11	12.05	15	GN			0*	n/a	

Sensitive Receptor – 15th September 2014

Sensitive Receptor Site: Maindiff Court Farm, Abergavenny Sampling Date: 15/09/2014 Estimated Mass of Material:							Site Operator: Mr Andrew Lewis Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff Type of Material Processed on site: Green Waste				
Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Sensitive Receptor	AF SR 1	60.0	61	12.42	15	AF	Shredding green waste and forming windrow in building.	Green waste	14	14	
Sensitive Receptor	AF SR 2	60.0	61	12.42	15	AF			14		
Sensitive Receptor	MB SR 1	60.0	53	13.00	15	MB			94	110	
Sensitive Receptor	MB SR 2	60.0	53	13.00	15	MB			125		
Sensitive Receptor	GN SR 1	60.0	57	13.17	15	GN			0	0	
Sensitive Receptor	GN SR 2	60.0	57	13.17	15	GN			0		

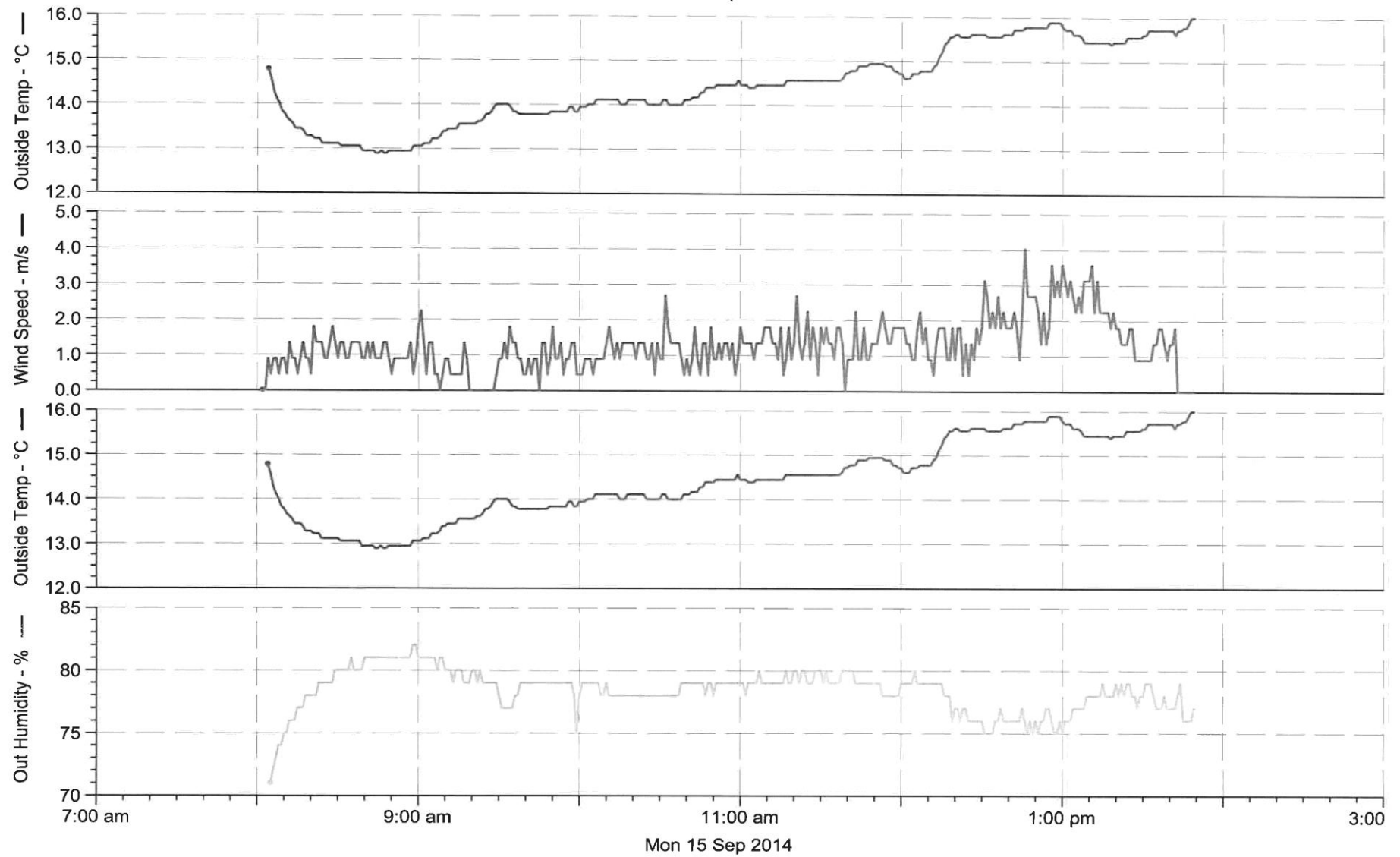
Appendix 4 – Location Specific Meteorological Data – 15th September 2014

Site: Maindiff Court Farm, Abergavenny					Site Operator: Mr Andrew Lewis				
Sampling Date: 15/09/2014					Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Estimated Mass of Material:					Type of Material Processed on site: Green waste				
Location:	Sampling Reference Number:	Bearing of samplers from boundary of operational area or turning / screening operation (o from true north)	Mean direction the wind blows from during the sampling period (each individual sample) (o from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (o from true north)	Difference in bearing between location of samplers from boundary / source and mean direction wind blows to (o)	Mean wind speed during sampling (m s-1)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)
Up Wind	AF UW 1	30	42	222	192	1.1	13.0	81	8/8
Up Wind	AF UW 2	30	42	222	192	1.1	13.0	81	8/8
Up Wind	MB UW 1	30	357	177	147	0.9	13.0	81	8/8
Up Wind	MB UW 2	30	357	177	147	0.9	13.0	81	8/8
Up Wind	GN UW 1	30	344	164	134	0.4	1.5	80	7/8
Up Wind	GN UW 2	30	344	164	134	0.4	13.5	80	7/8
Down Wind	AF DW 1	185	352	172	13	1.1	14.1	78	8/8
Down Wind	AF DW 2	185	352	172	13	1.1	14.1	78	8/8
Down Wind	AF DW Passive	185	352	172	13	1.1	14.1	78	8/8
Down Wind	MB DW 1	185	19	199	14	1.2	14.0	78	8/8
Down Wind	MB DW 2	185	19	199	14	1.2	14.0	78	8/8
Down Wind	MB DW Passive	185	19	199	14	1.2	14.0	78	8/8
Down Wind	GN DW 1	185	35	215	30	0.9	14.4	79	8/8
Down Wind	GN DW 2	185	35	215	30	0.9	14.4	79	8/8
Down Wind	GN DW Passive	185	35	215	30	0.9	14.4	79	8/8

Location:	Sampling Reference Number:	Bearing of samplers from boundary of operational area or turning / screening operation (o from true north)	Mean direction the wind blows from during the sampling period (each individual sample) (o from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (o from true north)	Difference in bearing between location of samplers from boundary / source and mean direction wind blows to (o)	Mean wind speed during sampling (m s-1)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)
Down Wind 237m	AF DHR 1	180	10	190	10	1.2	14.7	79	8/8
Down Wind 237m	AF DHR 2	180	10	190	10	1.2	14.7	79	8/8
Down Wind 237m	AF DHR Passive	180	10	190	10	1.2	14.7	79	8/8
Down Wind 237m	MB DHR 1	180	348	168	12	1.5	14.8	79	8/8
Down Wind 237m	MB DHR 2	180	348	168	12	1.5	14.8	79	8/8
Down Wind 237m	MB DHR Passive	180	348	168	12	1.5	14.8	79	8/8
Down Wind 237m	GN DHR 1	180	11	191	11	1.2	15.0	79	6/8
Down Wind 237m	GN DHR 2	180	11	191	11	1.2	15.0	79	6/8
Down Wind 237m	GN DHR Passive	180	11	191	11	1.2	15.0	79	6/8
Sensitive Receptor	AF SR 1	275	34	214	61	2.2	15.8	76	7/8
Sensitive Receptor	AF SR 2	275	34	214	61	2.2	15.8	76	7/8
Sensitive Receptor	MB SR 1	275	42	222	53	2.8	15.5	77	8/8
Sensitive Receptor	MB SR 2	275	42	222	53	2.8	15.5	77	8/8
Sensitive Receptor	GN SR 1	275	38	218	57	1.4	15.5	78	8/8
Sensitive Receptor	GN SR 2	275	38	218	57	1.4	15.5	78	8/8

Appendix 5 –Meteorological Strip Chart – 15th September 2014

CHSE2014
8 hr Span



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