



**Cwm Environmental
(Nantycaws)
Composting Facility**

Bioaerosols Monitoring

**10th December 2014
4th Quarter Report
'Combined IVC and Pad'**

**Prepared on behalf of:
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Cwm Environmental
c/o Compost Site Office
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
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SA 32 8BG**

**Site Detail:
Composting Facility (IVC & Pad)
Nantycaws Landfill Site
Llanddarog Rd.
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**Sampling date 10th December 2014
Report date 26th January 2015**

SUMMARY NANTYCAWS BIOAEROSOLS MONITORING

The In Vessel Composting (IVC) and External Windrow (Pad) Composting Operations

The Cwm Environmental composting facilities are located at the Nantycaws Landfill Site Llanddarog Road, Nantycaws, Carmarthenshire. There are two linked sites: the 'In-Vessel Composting Facility' and the External Composting Pad. The sites are located in a rural area near to the Nantycaws landfill. The two sites were amalgamated under one bespoke Environmental Permit, (EPR/EP3698FL, November 2012), and so this report deals with both areas of the site as a single unit.

The **IVC facility** is just within 250m of a farmstead that is to the east of the facility. However, the IVC is an enclosed process. To the west is a Civic Amenity centre and beyond that to the west is the landfill with various open processes including a waste transfer area, weighbridge and haul roads. There is a new Materials Reclamation Facility (MRF) between the IVC and Open Windrowing pad.

The **Open Windrow facility** is located to the north west of the IVC and north-north east of the landfill. To the NW of the facility is a redundant farmstead that belongs to Cwm Environmental. North of the facility is the main A48 dual carriageway and a Garage/Fuel Station to the NE.

Bioaerosols, composting and health effects

Bioaerosols are complex mixtures of airborne micro-organisms and their products, and are ubiquitous, particularly in rural environments. The most serious health problems appear to arise from *Aspergillus Fumigatus*, but there may be other fungal spores and bacteria that may present environmental effects at or near to composting facilities.

Environment Agency Requirements to Monitor Bioaerosols Emissions

Environment Agency Revised and Updated Policy in regard to Bioaerosols

Bioaerosols comes under the statutory control of the Environment Agency (The EA), which has adopted a 'Policy' to provide the basis for dealing with this. The EA Policy was reviewed and updated in August 2009 and at the time the EA introduced guidance in regard to Bioaerosols Monitoring. In November 2010 the EA produced a 'Position Statement (PS031)' that updated their guidance. The 'Guidance' is now provided within three documents:

Ref 1: Guidance on the Evaluation of Risk Assessments for Composting Facilities, Cranfield University (G.H. Drew et al) published by the EA August 2009 can be found at:

<http://publications.environment-agency.gov.uk/pdf/GEHO0809BQUO-e-e.pdf>

Ref 2: A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities, EA and The Association for Organic Recycling (Afor), edited by Toni Gladding (Open University) available by order at the Afor website [publications] (See Appendix 2): <http://www.organics-recycling.org.uk/>

Ref 3: In 2010, The Environment Agency updated its policy regarding bioaerosols and currently requires sites to monitor bioaerosol levels in instances where there is a sensitive receptor within 250m of the composting facility.

This Report

This report provides the **4th Quarter 2014** bioaerosols monitoring results treating the In Vessel Composting (IVC) and External Windrow Composting Facilities as one site. The day selected was a Wednesday (10th December) so that the procedure of loading material into the stage 1 at the IVC and also materials handling at the external composting pad were taken into account.

On this occasion the wind direction was from the WEST and was toward the Farm 'sensitive receptor' BUT not directly toward the Garage 'sensitive receptors' and so a proxy station was used to the south of the Garage.

Results

The results of sampling reveal that the IVC and the external activities at the facility do generate bioaerosols. The results show that for the IVC, the enclosure and controls help to minimise the emissions and downwind of the external site boundary the bioaerosols are dispersed and reduced in the down wind direction and become similar to the background levels.

This report shows that there is generation and emission of bioaerosols at the facility but that these are capable of being retained well within the guideline values as advised by the EA.

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This Report provides the results of a specific one-day session of sampling of bioaerosols at the Composting Facility. The report follows guidelines provided within the “Afor Protocol” for monitoring bioaerosols and also the Environment Agency guidelines for “Risk Assessment”.

Reference to The AfOR Protocol

The AfOR Protocol (CONTENTS listed at APPENDIX 2.) is referred to throughout; and was used as the basis for the methodology employed during these sampling sessions.

Recogen Ltd. Environmental Quality Reporting – An Independent Assessor

For the purposes of quality assurance in undertaking this risk assessment/monitoring work, Recogen Ltd. is a recognised organisation with appropriately trained, qualified and experienced personnel; *independent* to the composting site operator. This assessment/monitoring work was undertaken by D J Baldwin, BSc (Hons) CEnv. MCIWM, Technical Director with Recogen Ltd. who has 34 years waste and environmental management experience. David is FACTS (fertiliser advice certification) qualified and has the Environmental Permit Operators Certificate.

Recogen Ltd. is registered as a Quality Environmental Consultancy on the National Business Link Register and is a supplier of Technical Consultancy to DEFRA, The Waste and Resources Action Programme (WRAP) and to The Association for Organic Recycling (AfOR) now part of the Renewable Energy Association.

David has managed or contributed to many major projects on waste management for Government (**DEFRA, ETSU, DTI, WRAP, EA**) and The Waste Management Industry including Composting and Anaerobic Digestion processes, compost site design, product quality assurance (PAS100:2005 and 2011), The Compost Quality Protocol, ISO9001, ISO14001, COSHH and H&S Risk Assessments.

D and F Associates Laboratory (Widnes, Cheshire) was used for provision and enumeration of the Collection Plates. This laboratory operates to the UKAS accredited standards

Notes:

1. Culture media supplied by D and F Associates Laboratory (Widnes, Cheshire) is in accordance with that specified in the AfOR Protocol. The mediums used are particularly useful for the identification of bacteria and the type used for the mould species and allows the Laboratory to accurately identify and quantify *Aspergillus Fumigatus* on plates that may contain many other mould species.

2. D and F Associates Laboratory (Widnes, Cheshire) operates to the UKAS accredited standards and also runs its own internal Quality Management System. All media preparation and storage, is carried-out in accordance with UKAS approved Standard Operating Procedures and fully recorded to appropriate standards. D and F Associates Laboratory is an approved supplier of services to the Environment Agency.

BIOAEROSOLS MONITORING - DEFINITIONS

Bioaerosols, composting and health effects

Bioaerosols are complex mixtures of airborne micro-organisms and their products, and are ubiquitous, particularly in rural environments. The more serious health problems appear to arise from *Aspergillus Fumigatus*, but there are other fungal spores and bacteria that may cause problems. International studies have shown that there is a wide variability in individual susceptibility to bioaerosol exposure.

Commercial scale composting activities tend to generate large amounts of bioaerosols and these are likely to contain human allergens and pathogens. They have potential effects on respiratory health and may cause headaches, nausea and fatigue. There has been very little investigation into the effects of community exposure to bioaerosols from composting, but there is some limited data that suggest that living close to a composting facility may be associated with an increased risk of adverse health effects. The consensus from various studies is that bioaerosols from composting activities decline rapidly within the first 100 metres from a site and generally decline to background levels within 250m.

Composting

Composting is the biological decomposition of biodegradable waste under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat. It may include associated waste storage and treatment operations carried out at the composting facility.

Operations... likely to result in the uncontrolled release of high levels of bioaerosols

include the shredding of waste and the turning of waste in the sanitisation, stabilisation and maturation stages of composting where these operations are not contained or are not subjected to exhaust ventilation and scrubbing/filtering.

sensitive receptors

'Sensitive receptors' refers to people likely to be within 250 metres of the composting operation for prolonged or frequent periods. This term would therefore apply to dwellings (including any associated gardens) and to workplaces where workers would frequently be present. It does not apply to the operators of composting facilities or their staff while carrying out the composting operation as their health is covered by Health and Safety legislation.

acceptable levels at the sensitive receptors

Refers to the concentrations of bioaerosols (as predicted or as derived from direct measurements) at the sensitive receptors that are attributable to the composting operations.

The acceptable (appropriate) levels (given as colony forming units per cubic metre of air) are:

Bioaerosol type	Threshold value	units
total bacteria	1000	cfu m ⁻³
Aspergillus fumigatus	500	cfu m ⁻³
gram-negative bacteria	300	cfu m ⁻³

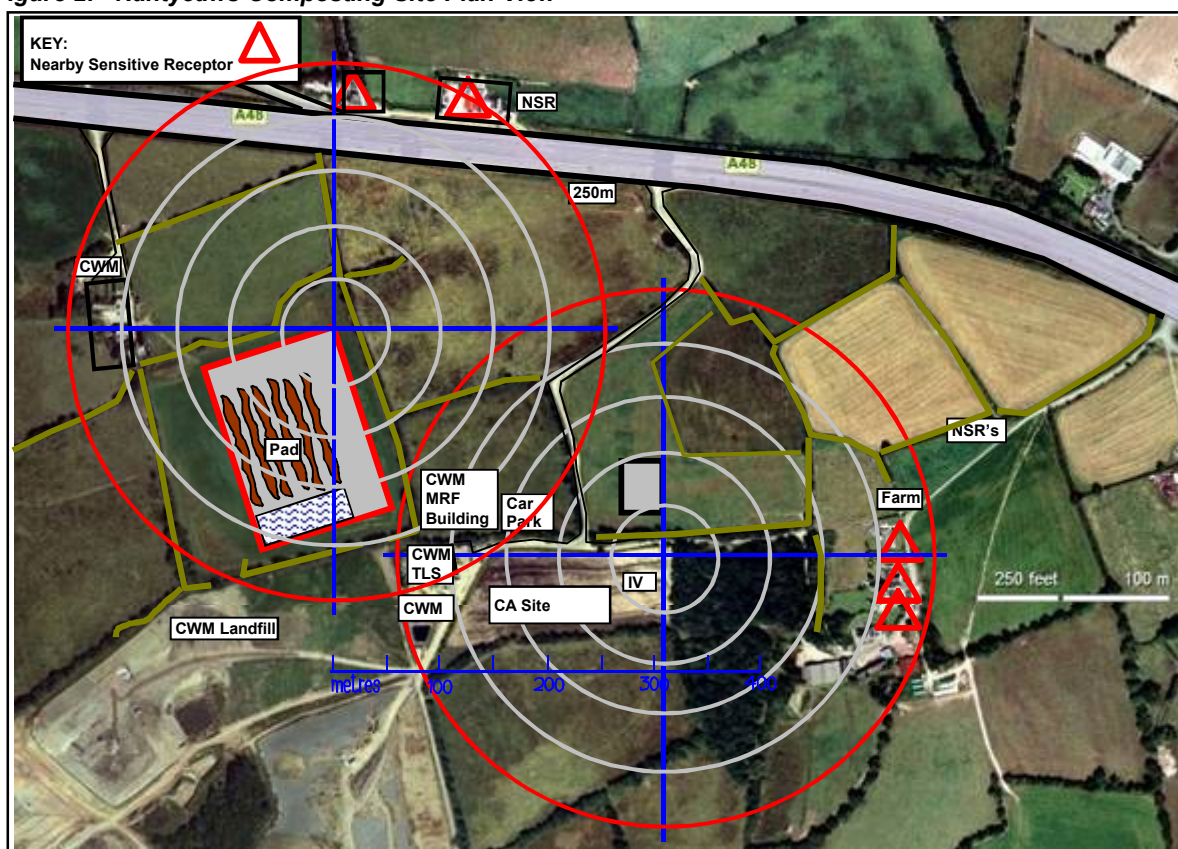
1.0 SITE LOCATION (IVC and External Composting Facility)

The Composting Facility
Cwm Environmental
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
Carmarthen
SA 32 8BG

Figure 1: Nantycaws Composting Site Location Map



Figure 2: Nantycaws Composting Site Plan View



2.0 INTERPRETATION OF THE EA's BIOAEROSOL POLICY

2.1 Composting and Bioaerosols

Composting processes rely on biological activity, notably the utilisation of bacteria and fungi in order to bio-degrade the volatile material and convert it to more stable forms of humic substance. The process relies on mechanical treatment in the preparation and handling of the material, as well as specialist facilities for controlling the processes involved.

It is recognised that when any agitation of organic material occurs, especially turning, screening or shredding, or when leachate is recirculated, elevated numbers of micro-organisms may be released into the air. Once released into the air they can remain airborne for long periods and form a 'bioaerosol' — an aerosol of biological particles.

2.2 Bioaerosols Risk

Bioaerosols are small particles of biologically active material that may be carried independently in the air or otherwise may become attached to other particles of dust or moisture. Consequently the minute particles may be inhalable and also respirable (deposited in the air sacs of the lungs where gases are exchanged). Some of the small particles (<3-5microns) in bioaerosols have the potential to be harmful to human health and can cause pathogenic or allergenic reactions. Human physiology and therefore susceptibility is receptor-dependent and so the EA have advised arbitrary values as reference levels for risk.

2.3 Environment Agency Policy and Approach to Bioaerosols.

The Environment Agency (The EA) has recently reviewed, updated and re-published ([Ref 3] 2010) its 'Policy' in regard to bioaerosols. This built upon the 2009 policy in regard to the use of 250metres as a distance from a composting activity, within which there was deemed greater risk. In summary, **the 2009 policy highlighted *the need to maintain bioaerosols at appropriate levels at any dwelling or workplace.***

In regard to this (see definitions in the Introduction on page 1) the 2009 policy provided the following: 'appropriate levels' may be....

- i) those before the start of the composting process or*
- ii) bioaerosols levels no greater than*
 - 1,000 colony forming units (cfu) m⁻³ total bacteria,*
 - 500 cfu m⁻³ Aspergillus Fumigatus and*
 - 300 cfu m⁻³ gram-negative bacteria (for In Vessel facilities)*

Reference to **appropriate levels** takes into account background levels specific to that locality. Background levels are highly variable and range from 1- 1,000 cfu/m³ or more.

2.4 Applying the Environment Agency Bioaerosols Policy to the Composting Site.

The open windrow Composting Facility at Nantycaws is situated within 250m of third party workplaces and/or dwellings (see fig 2). These have been taken account of during monitoring.

3.0 COMPOSTING SITE - SENSITIVE RECEPTORS

3.1 IVC Site Situation with Regard to Sensitive Receptors

The IVC composting facility is located in the east of the site, in a rural setting and is separated from sensitive receptors by distances of >200 m. However, there is a farmstead and dwellings to the east that are 210m distant.

3.2 External Windrow Site Situation in Regard to Sensitive Receptors

The external windrow composting site is located within a rural area and is separated from sensitive receptors by distances of >200 m. There is a garage on northern side of the A48 carriageway and a dwelling just westward at the Nantycaws junction. These are 250m and 225m distant from the pad composting facility.

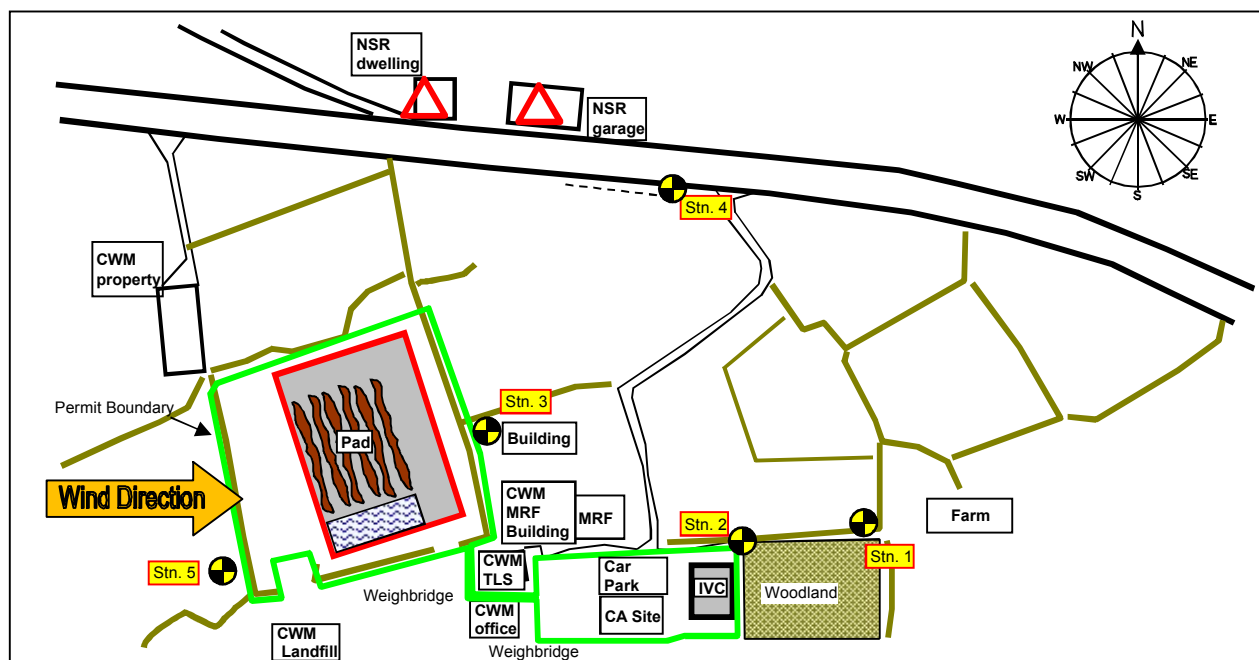
4.0 BIOAEROSOL SAMPLING STATIONS

The following plan for sampling stations was utilised. The wind was from the **WEST**, and meant that the Farm being one of the 'nearest sensitive receptors' was directly 'downwind' of the site. Sampling stations were selected to provide data in accordance with the 'upwind' to the West of the Composting Site.

A Sampling **Station No. 1** was established as close as possible to the (Farmstead) being the **Nearest Sensitive Receptor (NSR)** using a location as near the NSR as possible without encroaching on the private property;

Given the westerly wind direction, an additional 'downwind' **Station No. 2** was established to provide useful information in regard to the IVC Vessel loading taking place. **Station No. 3** was established to provide useful information in regard to the external windrow compost movements. **Station No. 4** was located near to the entrance to the site, opposite the Garage on the A48. This was also to provide information in regard to the external windrow compost movements. The Upwind sampling **Station No. 5** was located to the west of the landfill leachate lagoon.

Figure 3: Sampling Station Locations – IVC and Windrow Composting Facility



There is a new building shown as the Materials Recovery Facility (MRF) and this treats municipal waste under a separate permit. Any emissions from this were not measured specifically.

5.0 BIOAEROSOL TYPES

The following types of bioaerosol were enumerated

Description	Total Bacteria	Aspergillus Fumigatus	Gram Negative bacteria
	cfu/cu.m	cfu/cu.m	cfu/cu.m

These types relate to the EA guidance given earlier (Section 2.3 on page 3)

The gram negative bacteria are included because the IVC composting activity is based on material that includes catering waste (meat inclusive food material).

6.0 BIOAEROSOL SAMPLING PROCEDURE

6.1 Standardised sampling Procedure

The procedure was based on the Compost Association Protocol, which concurs with the Association for Organic Recycling (AfOR) Protocol. (Ref 2: and refer to Annex 1).

6.2 Sampling Equipment

6.2.1 Samplers

Samplers comprised the 3 part 'Andersen' type sampler design, with base, sampling hole manifold and collection funnel. Hemi-cylindrical air stagnation baffles extending 150mm above the inlet to the cone were fitted during sampling. The samplers were mounted as a pair on a platform at the top of an adjustable tripod that enabled the inlet cone to be held at between 1.5 and 1.8m above ground level.

6.2.2 Positive Displacement Suction Pumps

The air suction diaphragm pumps, were Charles Austen Pumps, twin headed parallel pumps operating off 12v DC Motors. The Pumps were pre-calibrated to provide a uniform air-flow rate with the target flow of 28.3 litres/minute (+/- 2%) (0.57 l/min).

Measured flow-rates are shown in the results for each sampler.

6.3 Sample Collection media and Enumeration

The collection media and laboratory based incubation and enumeration was undertaken by 'D&F Associates Labs' a laboratory working to UKAS accredited procedures.

6.4 Weather Monitoring Equipment

Weather during the sampling was monitored using a portable or on-site weather station, with temperature, humidity, wind direction and wind-speed monitoring. See section 7.

6.5 Sampler Locations

The sampling station locations were selected to provide the data for environmental purposes. Station locations are shown at figure 3.

6.6 Sample Chain of Custody

The unexposed plates and the exposed plates were stored within a 12 volt powered refrigerator 'cool-box' prior to during and after the sampling sessions. They were held within the cool-box during transport to the laboratories. The samples were taken to the laboratory and registered with the processing (incubation) being started soon after receipt.

7.0 MET DATA DURING SAMPLING

Weather data was recorded during the sessions of sampling. The Station was a Kestrel 4500, mounted on a tripod and mast at approx. 2.0m height above ground level. It was located on a clear open area of grass, approx. 25m west of the compost site office. The station comprises a wind vane, anemometer, temperature and humidity sensors and programmable data-logger set at logging intervals of 2 minutes. The data is shown at Table 1.

Table 1: Met Data 10th December 2014

Time	Wind Direction	Wind Bearing	Wind Speed ms ⁻¹	Air Temp °C	RH %	BP mb
11:05:00	245	WSW	5.5	6.7	82.3	1,012
11:07:00	240	WSW	7.8	6.7	83.4	1,012
11:09:00	230	SW	9.1	6.8	84.1	1,012
11:11:00	231	SW	10.5	6.8	83.5	1,012
11:13:00	230	SW	7.4	6.8	84.1	1,012
11:15:00	240	WSW	8.6	6.9	84.1	1,012
11:17:00	235	SW	9.0	6.9	83.9	1,012
11:19:00	222	SW	6.9	6.9	83.9	1,012
11:21:00	231	SW	8.8	6.9	84.2	1,012
11:23:00	215	SW	7.8	6.9	85.3	1,012
11:25:00	213	SW	9.0	6.9	84.5	1,012
11:27:00	224	SW	8.3	7.0	84.6	1,012
11:29:00	219	SW	7.5	7.0	84.3	1,012
11:31:00	228	SW	7.2	7.0	84.4	1,012
11:33:00	229	SW	5.5	6.9	84.8	1,012
11:35:00	211	SW	4.8	6.9	85.4	1,011
11:37:00	273	W	4.9	7.0	84.6	1,011
11:39:00	273	W	5.1	7.0	84.7	1,011
11:41:00	274	W	5.6	6.9	85.2	1,011
11:43:00	276	W	4.7	7.0	85.4	1,011
11:45:00	276	W	4.8	7.1	84.7	1,011
11:47:00	275	W	3.7	7.0	85.5	1,011
11:49:00	275	W	4.4	7.0	86.1	1,011
11:51:00	279	W	6.4	7.1	85.8	1,011
11:53:00	279	W	5.2	7.2	85.4	1,011
11:55:00	277	W	5.6	7.1	85.8	1,011
11:57:00	277	W	6.5	7.2	85.4	1,011
11:59:00	276	W	5.6	7.3	85.2	1,010
12:01:00	276	W	7.4	7.3	85.3	1,010
12:03:00	276	W	8.9	7.2	86.6	1,010
12:05:00	276	W	5.6	7.3	86.5	1,010
12:07:00	276	W	4.7	7.1	87.2	1,010
12:09:00	277	W	6.4	7.4	85.9	1,010
12:11:00	274	W	3.1	7.2	87.4	1,010
12:13:00	273	W	4.8	7.4	86.9	1,010
12:15:00	276	W	5.6	7.3	86.6	1,010
12:17:00	275	W	4.0	7.3	86.5	1,010
12:19:00	275	W	5.3	7.4	86.3	1,009
12:21:00	276	W	4.8	7.3	86.8	1,009
12:23:00	277	W	6.2	7.4	86.2	1,009
12:25:00	278	W	4.1	7.4	86.9	1,009
12:27:00	276	W	5.2	7.4	86.4	1,009
12:29:00	275	W	5.0	7.4	86.9	1,009
12:31:00	271	W	6.0	7.4	86.8	1,009
12:33:00	272	W	4.8	7.4	87.4	1,009
12:35:00	271	W	7.6	7.5	86.6	1,009
12:37:00	271	W	5.0	7.5	87.1	1,008
12:39:00	275	W	3.8	7.6	87.2	1,008
12:41:00	276	W	9.9	7.9	85.5	1,009

Time	Wind Direction	Wind Bearing	Wind Speed ms ⁻¹	Air Temp °C	RH %	BP mb
12:43:00	273	W	5.5	7.8	86.1	1,008
12:45:00	272	W	6.1	7.9	85.9	1,008
12:47:00	279	W	5.3	7.9	86.0	1,008
12:49:00	279	W	9.6	8.1	84.7	1,008
12:51:00	272	W	10.5	8.2	84.4	1,008
12:53:00	272	W	8.5	8.2	84.1	1,008
12:55:00	272	W	7.7	8.2	84.6	1,008
12:57:00	271	W	7.0	8.1	84.7	1,008
12:59:00	274	W	9.4	8.1	84.7	1,008
13:01:00	274	W	7.2	8.2	84.6	1,007
13:03:00	278	W	7.6	8.2	84.4	1,007
13:05:00	277	W	8.1	8.3	83.8	1,007
13:07:00	274	W	8.9	8.3	83.8	1,007
13:09:00	275	W	6.1	8.1	85.4	1,007
13:11:00	277	W	8.3	8.4	84.2	1,007
13:13:00	277	W	7.9	8.3	84.6	1,008
13:15:00	276	W	6.9	8.2	85.2	1,007
13:17:00	275	W	9.8	8.4	84.1	1,007
13:19:00	281	W	11.0	8.5	83.4	1,007
13:21:00	281	W	11.3	8.5	83.5	1,007
13:23:00	282	WNW	9.6	8.5	84.0	1,007
13:25:00	282	WNW	6.2	8.5	84.1	1,007
13:27:00	283	WNW	5.3	8.4	84.8	1,007
13:29:00	283	WNW	5.9	8.4	84.8	1,007
13:31:00	277	W	8.3	8.5	84.1	1,007
13:33:00	278	W	7.2	8.5	84.0	1,008
13:35:00	280	W	5.5	8.5	84.9	1,008
13:37:00	280	W	9.1	8.7	83.9	1,007
13:39:00	279	W	7.3	8.6	83.9	1,007
13:41:00	279	W	5.3	8.5	84.5	1,007
13:43:00	282	WNW	9.0	8.8	82.6	1,007
13:45:00	282	WNW	6.7	8.8	82.7	1,007
13:47:00	281	W	9.1	8.8	82.8	1,007
13:49:00	280	W	6.7	8.7	83.4	1,007
13:51:00	280	W	7.5	8.8	83.1	1,007
13:53:00	281	W	6.8	8.7	83.7	1,007
13:55:00	281	W	6.7	8.9	82.7	1,007
13:57:00	282	WNW	7.6	8.9	82.6	1,007
13:59:00	280	W	6.6	9.0	81.5	1,007
14:01:00	279	W	7.5	9.1	80.5	1,007
14:03:00	280	W	9.2	9.0	80.9	1,007
14:05:00	280	W	8.8	9.1	80.6	1,007
14:07:00	284	WNW	8.5	9.1	80.8	1,007
14:09:00	284	WNW	7.5	9.0	81.3	1,006
14:11:00	282	WNW	6.5	8.9	82.1	1,006
14:13:00	282	WNW	7.4	9.0	81.9	1,006
14:15:00	278	W	6.5	8.9	82.6	1,006
14:17:00	278	W	6.5	8.9	82.4	1,007
14:19:00	282	WNW	6.9	9.0	81.8	1,006

The wind was predominantly from the West, strong and gusting at between 0.5 to 3.2 m/sec. The late morning started with cloud cover at 85% - 90% and remained stable through the day. Air temperatures started cool (6.7 – 9° C) rising slightly through the session. The humidity was moderately high at ~82 % RH to 85% RH.

8.0 SUMMARY OF THE BIOAEROSOL SAMPLING RESULTS

Table 2: Bioaerosols Data Summary 10th December 2014

Sampler location	Sampling Station No.	Start time	Total Bacteria cfu m-3	Aspergillus fumigatus cfu m-3	Gram -ve bacteria cfu m-3
DOWNWIND OF IVC / NSR (Farm)	1	11:15	29	0	0
DOWNWIND OF IVC / NSR (Farm)	1	11:15	50	0	0
DOWNWIND OF IVC	2	11:33	50	0	7
DOWNWIND OF IVC	2	11:33	29	0	0
DOWNWIND of the COMPOSTING PAD	3	11:57	250	0	7
DOWNWIND of the COMPOSTING PAD	3	11:57	136	0	0
DOWNWIND of the PAD NSR (Garage)	4	12:39	21	0	21
DOWNWIND of the PAD NSR (Garage)	4	12:39	21	0	0
DOWNWIND of the PAD NSR (Garage)	4	12:53	21	0	7
DOWNWIND of the PAD NSR (Garage)	4	12:53	29	0	21
UPWIND	5	13:20	21	0	7
UPWIND	5	13:20	21	7	0
UPWIND	5	13:37	21	0	0
UPWIND	5	13:37	21	0	7

Table 3: Bioaerosols Control Plate Values

Reference	Total Bacteria cfu m-3	Aspergillus fumigatus cfu m-3	Gram -ve bacteria cfu m-3
Control Plate 1	0	0	0
Control Plate 2	0	0	0

9.0 INTERPRETATION OF RESULTS

9.1 The Upwind Bioaerosol levels

The Upwind bioaerosol samples reveal that the background levels are fairly LOW. This was regarded as typical for this time of year; being mainly due to the cool conditions and the damp weather.

9.2 Bioaerosol Downwind of The IVC Facility

Feedstock was being loaded from the IVC Reception into the Stage 1 Vessel. This activity is completely enclosed and with the exception of emissions from the small amount of green waste stored in the yard for the IVC, the emissions would be expected to be LOW. The results reveal that near to the IVC Building, the Bioaerosol levels are Very Low, with negligible levels of Aspergillus Fumigatus and Gram negative Bacteria. Consequently, the levels nearer to the NSR (further from the IVC) are very similar and also similar to the Background levels.

9.3 Bioaerosol levels at the Downwind Boundary of the External Pad

The samples at the downwind boundary of the external pad were elevated for Total Bacteria, but not excessively so. The station was directly downwind of the composting pad where there were ongoing windrowing and screening activities. These raised levels would be attributable to the activities generating the release of bioaerosols and the strong wind conditions which to some extent cause the release of bioaerosols to increase, but also lead to rapid dispersion. The Bacteria levels (Total and Gram negative bacteria) and *Aspergillus Fumigatus* bioaerosol levels were well within the EA guideline values.

9.4 Bioaerosol Levels at the Offset NSR Downwind of The External Facility

The results reveal that the Bioaerosol levels are Very Low, with undetectable levels of *Aspergillus* *Fumigatus*. These levels nearer are very similar to the Background levels found at the UPWIND Station.

10.0 CONCLUSIONS- COMPOSTING SITE BIOAEROSOL SAMPLING

10.1 General Conclusions

The following may be concluded:

1. The IVC Process activity may generate moderate levels of bioaerosols during compost transfer from the Reception to the Stage 1 Vessel. The process is enclosed and so the levels detected downwind were very low and these remain very low near to the Farm to the east. These levels were well within the EA limits.
2. The results revealed that the bioaerosols levels downwind of the composting pad boundary were elevated but not excessively so.
3. With the benefit of the distance from the external operational area it was found that these levels reduced (due to dispersal) and were found to be again very low near to the NSR proxy location taken as opposite the Garage on the A48. In all instances, the levels were well below the EA guideline levels.

10.2 Overall Conclusion

The results of sampling reveal that the IVC and the external activities at the facility do generate bioaerosols. The results show that for the IVC, the enclosure and controls help to minimise the emissions and downwind of the external site boundary the bioaerosols are dispersed and reduced in the down wind direction and become similar to the background levels.

This report shows that there is generation and emission of bioaerosols at the facility but that these are capable of being retained well within the guideline values as advised by the EA.

APPENDIX 1. Bioaerosols Sampling Record and Results

Results Table A1: Bioaerosol levels DOWN-WIND of THE IVC as a Proxy for the 'FARM' NSR

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ⁻³	Aspergillus Fumigatus cfu m ⁻³	Gram -ve Bacteria cfu m ⁻³
C 1	TVC	DOWNWIND IVC NSR	1	YA	P1	28	11:15	11:20	5	4	29		
C 1	TVC	DOWNWIND IVC NSR	1	YB	P2	28	11:15	11:20	5	7	50		
C 2	AF	DOWNWIND IVC NSR	1	RA	P3	28	11:15	11:20	5	0		0	
C 2	AF	DOWNWIND IVC NSR	1	RB	P4	28	11:15	11:20	5	0		0	
C 3	gram-ve	DOWNWIND IVC NSR	1	RA	P3	28	11:22	11:27	5	0			0
C 3	gram-ve	DOWNWIND IVC NSR	1	RB	P4	28	11:22	11:27	5	0			0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A2: Bioaerosol levels DOWN-WIND BOUNDARY (EAST OF THE IVC)

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ⁻³	Aspergillus Fumigatus cfu m ⁻³	Gram -ve Bacteria cfu m ⁻³
C 11	TVC	DOWNWIND IVC	2	YA	P1	28	11:33	11:38	5	7	50		
C 11	TVC	DOWNWIND IVC	2	YB	P2	28	11:33	11:38	5	4	29		
C 12	AF	DOWNWIND IVC	2	RA	P3	28	11:33	11:38	5	0		0	
C 12	AF	DOWNWIND IVC	2	RB	P4	28	11:33	11:38	5	0		0	
C 13	gram-ve	DOWNWIND IVC	2	RA	P3	28	11:40	11:45	5	1			7
C 13	gram-ve	DOWNWIND IVC	2	RB	P4	28	11:40	11:45	5	0			0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A3: Bioaerosol levels DOWN-WIND BOUNDARY (EAST OF THE EXTERNALCOMPOSTING PAD)

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ⁻³	Aspergillus Fumigatus cfu m ⁻³	Gram -ve Bacteria cfu m ⁻³
C 21	TVC	DOWNWIND PAD	3	YA	P1	28	11:57	12:02	5	35	250		
C 21	TVC	DOWNWIND PAD	3	YB	P2	28	11:57	12:02	5	19	136		
C 22	AF	DOWNWIND PAD	3	RA	P3	28	11:57	12:02	5	0		0	
C 22	AF	DOWNWIND PAD	3	RB	P4	28	11:57	12:02	5	0		0	
C 23	gram-ve	DOWNWIND PAD	3	RA	P3	28	12:04	12:09	5	1			7
C 23	gram-ve	DOWNWIND PAD	3	RB	P4	28	12:04	12:09	5	0			0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A4: Bioaerosol levels DOWN-WIND as a Proxy for the NSR- Near to the Garage on the A48

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ⁻³	Aspergillus Fumigatus cfu m ⁻³	Gram -ve Bacteria cfu m ⁻³
C 31	TVC	DWIND PAD NSR	4	YA	P1	28	12:39	12:44	5	3	21		
C 31	TVC	DWIND PAD NSR	4	YB	P2	28	12:39	12:44	5	3	21		
C 32	AF	DWIND PAD NSR	4	RA	P3	28	12:39	12:44	5	0		0	
C 32	AF	DWIND PAD NSR	4	RB	P4	28	12:39	12:44	5	0		0	
C 33	gram-ve	DWIND PAD NSR	4	RA	P3	28	12:46	12:51	5	3			21
C 33	gram-ve	DWIND PAD NSR	4	RB	P4	28	12:46	12:51	5	0			0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A5: Bioaerosol levels DOWN-WIND as a Proxy for the NSR- Near to the Garage on the A48

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ⁻³	Aspergillus Fumigatus cfu m ⁻³	Gram -ve Bacteria cfu m ⁻³
C 41	TVC	DWIND PAD NSR	4	YA	P1	28	12:39	12:44	5	3	21		
C 41	TVC	DWIND PAD NSR	4	YB	P2	28	12:39	12:44	5	4	29		
C 42	AF	DWIND PAD NSR	4	RA	P3	28	12:39	12:44	5	0		0	
C 42	AF	DWIND PAD NSR	4	RB	P4	28	12:39	12:44	5	0		0	
C 43	gram-ve	DWIND PAD NSR	4	RA	P3	28	12:46	12:51	5	1			7
C 43	gram-ve	DWIND PAD NSR	4	RB	P4	28	12:46	12:51	5	3			21

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A6: Bioaerosol levels UP-WIND of the Composting Facility

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ³	Aspergillus Fumigatus cfu m ³	Gram -ve Bacteria cfu m ³
C 51	TVC	UPWIND	5	YA	P1	28	13:20	13:25	5	3	21		
C 51	TVC	UPWIND	5	YB	P2	28	13:20	13:25	5	3	21		
C 52	AF	UPWIND	5	RA	P3	28	13:20	13:25	5	0		0	
C 52	AF	UPWIND	5	RB	P4	28	13:20	13:25	5	1		7	
C 53	gram-ve	UPWIND	5	RA	P3	28	13:27	13:32	5	1			7
C 53	gram-ve	UPWIND	5	RB	P4	28	13:27	13:32	5	0			0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A7: Bioaerosol levels UP-WIND of the Composting Facility

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu	Total Bacteria cfu m ³	Aspergillus Fumigatus cfu m ³	Gram -ve Bacteria cfu m ³
C 61	TVC	UPWIND	5	YA	P1	28	13:37	13:42	5	3	21		
C 61	TVC	UPWIND	5	YB	P2	28	13:37	13:42	5	3	21		
C 62	AF	UPWIND	5	RA	P3	28	13:37	13:42	5	0		0	
C 62	AF	UPWIND	5	RB	P4	28	13:37	13:42	5	0		7	
C 63	gram-ve	UPWIND	5	RA	P3	28	13:44	13:49	5	0			0
C 63	gram-ve	UPWIND	5	RB	P4	28	13:44	13:49	5	1			7

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

Results Table A8: Bioaerosol Control Plates

Ref No.	Sample Type	PLATE COUNT cfu
TVC Control 1	Total Bacteria Count	0
TVC Control 2	Total Bacteria Count	0
AF Control 1	Aspergillus Fumigatus	0
AF Control 2	Aspergillus Fumigatus	0
G-ve Control 1	Gram-negative Bacteria	0
G-ve Control 2	Gram-negative Bacteria	0

TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. gram-ve = Gram Negative Bacteria

The control plates were used as indicator plates kept with the sample plates during the journey and sampling sessions.

APPENDIX 2. The Association for Organic Recycling Protocol (Contents list)

A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities

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REFERENCES

The AfOR Protocol is available by order from the AfOR website [publications]:
<http://www.organics-recycling.org.uk/>