SITE SPECIFIC BIOAEROSOL RISK ASSESSMENT

FINAL

Report Prepared For	
Cowbridge Compost Ltd	

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CONTENTS

1.0 INTRODUCTION

This report provides an assessment of the operations of a non-hazardous green and food waste IVC and Open/Closed Windrow facility at the Cowbridge Compost site at Cowbridge, Vale of Glamorgan. The intention of this report is to carry out an independent bioaerosol risk assessment of the operations for the purposes of Environment Agency (EA) permitting requirements.

With reference to Annex II of the Waste Framework Directive 2008/98/EC, the facility will operate under R3 “Recycling/Reclamation of organic substances which are not used as solvents”, R13 “Storage of waste from the R3 process” under the heading “Recovery Operations”.

The Environment Agency Technical Guidance Document M17 and the 2009 AfOR Protocol have been used to assess the potential risk of bioaerosol emission that may be associated with the proposed biological process at Cowbridge Compost Ltd (CCL).

1.1 Consultant Competence

The sampling was undertaken by D&F Associates on 4th March 2014.

1.2 Bioaerosols

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 or 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[1].

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[2]. 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

[1] Defra (2009) *Exposure response relationships for bioaerosol emissions from waste treatment processes WR0606*.
[2] 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.

England and Wales[3] and the majority of data at present utilises counts of viable microorganisms.

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. An investigation of an anaerobic digestion 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).

The objective of this assessment is to appraise the potential for significant risks to human health in the workplace, dwellings or other buildings within the vicinity of the existing treatment facility from the operations on the CCL site, and to demonstrate that bioaerosol risks can be maintained at acceptable levels taking into account the proposal to change tonnages accepted and stored on site.

[3] Association of Organics Recycling (2009). *A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities*. Association of Organics Recycling.

2.0 REGULATORY POSITION

Currently Environment Agency (EA) policy requires "licence/permit applicants….to provide a site specific bioaerosol risk assessment where the proposed composting facility will be within 250 metres of dwellings or workplaces. These risk assessments need to demonstrate that bioaerosols from the proposed facility will not pose an unacceptable risk to human health." The statement clarifies various terms, for example noting that 'anaerobic digestion' can be limited to the actual area within the site where waste storage, processing and handling takes place. The EA's draft revised position statement firms up on permitted activities and the definitions of receptors and sources of bioaerosol – sources of bioaerosol being outdoor operations likely to result in the "uncontrolled release of high levels of bioaerosols- including shredding and turning of waste where these operations are not contained or are not subjected to exhaust ventilation and scrubbing/filtering."

The revised EA position statement on bioaerosols is intended to be applied where outdoor composting operations activity may take place. Technically the requirement for a proposed development and the requirement for a Site Specific Bioaerosol Risk Assessment is being applied to an existing facility. However, in this instance 'waste' organic material will be stored and moved on site in increased quantities hence a revision and update of the risk assessment for the site is required to ascertain whether bioaerosol release is of concern in relation to new guidelines.

CCL are seeking consent to continue operating a resource recovery facility currently processing up to 35,000 tonnes a year of non-hazardous food and green wastes primarily from kerbside collected, civic amenity and commercial waste streams. The current Permit allows composting of green and food wastes only up to 35,000 tonnes per annum. The main changes will be:

1. Increase overall tonnages of green waste onsite – there will be no limit to the amount of green waste that can be composted onsite
2. The addition of a leachate tank to the east of the site to accommodate for the additional green waste composting on site – this will increase the site boundary

2.1 Reference Levels

Based on open windrow composting systems, the EA has set reference levels for micro-organisms in air derived from values for an 8-hour working day. These levels are given as follows in Table 1 below.

Table 1 - EA set Reference Levels for Micro-organisms

Reference Pollutant	Threshold Level (cfu/m^3)	Result if dose-response exceeded
Bacteria	10,000	Not stated
	1,000	Not stated
Fungi	5×10^4	Work related respiratory disorders at cont. exposures over 10^5

Reference Pollutant	Threshold Level (cfu/m^3)	Result if dose-response exceeded
	Background	Not stated
	1,000	Not stated
Actinomycetes	2 x 10^4	Work related respiratory disorders at cont. exposures over 10^5
Aspergillus fumigatus	10^5 - 10^6	Sensitisation if exposed repeatedly
	10^8	Hypersensitivity Pneumonitis
Gram-negative Bacteria	300	Not stated
	1 x 10^3	Work related respiratory disorders at cont. exposures over 10^5
	2 x 10^4	Work related respiratory disorders at cont. exposures over 10^5
Endotoxins	1-2 x 10^2 (ng/m^3)	Not stated
	50 (eu/m^3)	Based on no-effect-level of 90 eu/m^3 in clinical trials
	1,000-2,000 (ng/m^3)	Organic dust toxic syndrome
	100-200	Bronchorestriction
	20-50	Mucous membrane irritation

2.2 Health Impacts

Bioaerosols are a mixture of micro-organisms which generate products ubiquitous in rural environments. Bioaerosols can be disrupted during screening, shredding and turning events on composting sites and when they can travel downwind towards sensitive receptors they can cause some health problems. Bioaerosols can travel up to 250m due to their small size of generally less than 10µm (fungi, bacteria and actinomycetes) and are not filtered out by specialised nose cells lining the nose and nose hairs thus penetrating deep into the lungs. These bioaerosols can cause diseases relating to the respiratory system (coughs and fevers), eye irritation, dermatitis and gastro-intestinal symptoms.

Aspergillus fumigatus is of particular concern at composting facilities and it can cause severe infections which can be fatal particularly for people with immune-suppressed diseases. Another acute disease is Organic Dust Toxic Syndrome (ODTS) with symptoms including influenza.

3.0 RISK ASSESSMENT METHODOLOGY

The starting point for every risk assessment is to identify the different aspects, namely the hazards, sources of those hazards, sensitive receptors and the pathways between the source and the receptors. Figure 1 identifies the risk assessment framework[4] with each tier of risk assessment presented to which the methodology within this SSBRA is based.

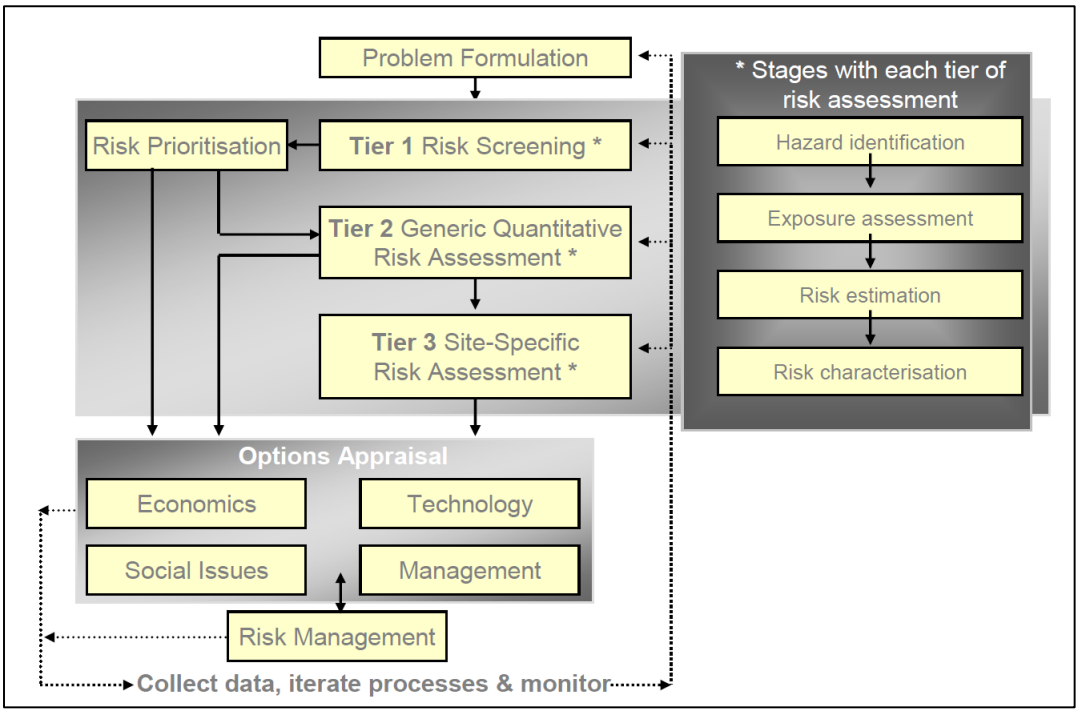


Figure 1 - The Environmental Risk Assessment Framework

The four stages within each tier of risk assessment are identified below.

Hazard identification: The situation that could lead to harm. Including what sources of hazard(s) are present and what are their properties/what data is available? Is this substance toxic (or situation hazardous) and how toxic (hazardous) is it?

Exposure assessment: Evaluate the plausibility of the hazard being realised at the receptor - by which mechanisms, allowing an assessment of the probability, magnitude and duration of exposure. Who (or what) is exposed, how long and often?

Risk estimation: Of what relative scale is the probability and extent of possible harm? How big a risk is this? This includes the probability and frequency of a hazard being present, potential pathways and possible harm, e.g. dose-response relationships. (Dose-

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

response relationships in turn depend on duration and concentration of exposure).

Risk characterisation: How significant is the risk and what are the uncertainties? Is this something I need to worry about and if so, how much should I worry? The probability and magnitude of consequences are placed in context and an evaluative judgement is made in response to the data that is available currently.

4.0 SITE DESCRIPTION AND INFORMATION

The CCL facility currently comprises a green and food waste composting site with an annual processing capacity currently of 35,000tpa.

The site is located north of Cowbridge, approximately 5km south of the M4. Bridgend is situated approximately 9km to the west of the site and Cardiff 17km to the east. Access to the site is via the A4222. The site is very elongated with the western proportion of the site for the reception of food waste. The western portion of the site also contains the In Vessel Composting shed. The northern section of the site contains tunnels for the windrow composting along with open air storage tunnels for the compost when complete. As well as this there will be the addition of a leachate storage tank to the east of the site to accommodate the increase in leachate that will be produced by the additional green waste composting on site.

The nearby sensitive receptors include the Penllyn Estate Dairy Farm, Task Force Paintball and the Cowbridge and Vale Cars business.

Table 2a - Feedstock Variation and Management Controls

Waste Source	Seasonal Variation	Odour Implication	Management Controls	Age and Source of Material
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.	Degradation could begin rapidly. Excess nitrogen will form ammonia and odorous compounds.	Source additional “woody” / carbonaceous material in anticipation of warm, wet, weather when possible. In the event of sudden summer green waste “surge” overwhelming treatment capacity, broker material to other local compost facility.	Local Authority collections undertake on a bi-weekly basis. Material up to 14days old.
	October - March: Increase in “woody” type materials (branches etc), resulting in higher C:N ratios.	Material unlikely likely to compost rapidly, so odour potential is decreased, but still present if stored too long.	Green waste loads from October to March containing large amounts of “woody” type materials (branches etc) may need to be blended	

Waste Source	Seasonal Variation	Odour Implication	Management Controls	Age and Source of Material
			together to improve C:N ratio.	
Civic amenity green waste.	**April – September:** Increasing 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).	Degradation could begin rapidly. Excess nitrogen will form ammonia and odorous compounds. Increased risk of evaporation.	Source additional "woody" / carbonaceous material in anticipation of warm, wet, weather when possible. In the event of sudden summer green waste "surge" overwhelming treatment capacity, leading to green stockpile in reception building longer than 2 days, broker material to other local compost facility.	Local CA sites where material is stored between 1 and 2 weeks before arriving on site. Material up to 14 days old.
	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).	Material unlikely likely to compost rapidly, so odour potential is decreased, but still present if stored too long.	Adjust green to "woody" green waste ratios during October – March to meet desired C:N ratio. Green wastes loads may need to be blended together to improve C:N ratio.	
Commercial green waste.	**April – September:** Increasing grass clippings content (typically peaking at 40%+ in May – June from	Degradation could begin rapidly. Excess nitrogen will form ammonia and odorous compounds.	Source additional "woody" / carbonaceous material in anticipation of warm, wet, weather when possible.	Sourced from a variety of local landscape contractors typically within a day of cutting,

Waste Source	Seasonal Variation	Odour Implication	Management Controls	Age and Source of Material
	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).	Increased risk of evaporation.	In the event of sudden summer green waste "surge" overwhelming treatment capacity, leading to green stockpile in reception building longer than 2 days, broker material to other local compost facility.	but potentially up to a week. Material up to 7 days old.
	October to March: Increase in "woody" type materials (branches etc), resulting in higher C:N ratios.	Material unlikely likely to compost rapidly, so odour potential is decreased, but still present if stored too long.	Adjust green waste to "woody" green waste ratios during October – March to meet desired C:N ratio. Green wastes loads may need to be blended together to improve C:N ratio.	
Kerbside collected food waste.	Seasonal variation is minimal. Waste is collected in corn-starch liners from householders, most of which are sealed, reducing evaporation potential during warm weather. Waste produced over public holidays could be greater in amount and older / more compacted due to collection round disruptions.	The low C:N ratio of this waste (approx 15) means it is highly susceptible to degradation with age. Treatment as soon as possible is crucial to prevent / minimise nitrogen volatilisation in the form of ammonia and other odours.	Ensure food waste is processed as soon as delivered to site. Food waste blended with less odorous \ carbonaceous material immediately following shredding. All food waste material to be processed and loaded into vessels on same day – no storage in reception building overnight. If material significantly odorous consider alternative disposal: landfill or other local composting facility.	Local Authority collections undertake on a bi-weekly basis. Material up to 14days old.
Commercial food waste.	Some wastes are collected in corn-starch liners from	The low C:N ratio of this waste (approx 15) means	Ensure food waste is processed as soon as delivered to site.	Sourced from a variety of local food processing

Waste Source	Seasonal Variation	Odour Implication	Management Controls	Age and Source of Material
	customers. Liners will be sealed on collection, reducing evaporation potential during warm weather. Waste produced over public holidays could be variable: offices may produce less waste due to low staff levels, whilst pubs and restaurants could produce more due to increased business.	it is highly susceptible to degradation with age. Treatment as soon as possible is crucial to prevent / minimise nitrogen volatilisation in the form of ammonia and other odours.	Food waste blended with less odorous \ carbonaceous material immediately following shredding. All food waste material to be processed and loaded into vessels on same day – no storage in reception building overnight. If material significantly odorous consider alternative disposal: landfill or other local composting facility.	facilities. Material delivered as past sell/use by date. Material up to 7 days old.

Due to seasonal variations it is difficult to say the exact amounts of certain wastes that will come through the site. Woody, garden waste will go through the open windrow system and food will go through the IVC facility. Both green and food can also go through the IVC facility if mixed together to create the correct C:N ratio. The proposed tonnage limits for the new processing is broken down as below:

- IVC and Open Windrow Composting: 35,000tpa
- **TOTAL:** **35,000tpa**

Table 2b – Waste Activities and Operational Limits

Activity	Specified Waste Management Operation	Permitted Waste Category	Limits on Specified Waste Operation
Open Windrow and IVC Composting	**R13** Storage of waste pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection on the site where it is produced).	All	i) Storage of waste prior to shredding shall take place on area of impermeable pavement. ii) Storage time prior to commencement of process limited to 7 days – green waste only and within 24 hours for food wasre.

	R3 Recycling or reclamation of organic substances which are not used as solvents.		i) The quantity of waste prior to composting shall not exceed a total of 500 tonnes at any one time. ii) The total quantity of waste being composted and stored for maturation shall not exceed 5000 tonnes at any one time. iii) The quantity of finished compost shall not exceed 1000 tonnes at any one time. iv) All shredding and composting operations shall be carried out on areas of impermeable pavement.

4.1 Description of Process

4.1.1 The IVC Sanitisation

The source segregated organic food and green waste will enter the site and follow the directional signage to the weighbridge. On entering the weighbridge area, the driver must have the waste transfer documentation with the correct details of the waste on board.

The site operative will inspect the waste transfer documentation, when the site operative is satisfied that the documentation is in order the driver will be instructed to enter the weighbridge, where the weights will be documented.

The driver will then be instructed to proceed to the waste reception hall that is designated for the waste. The site operative will then inspect the load to ensure that it is to the correct standard that is acceptable under the operational procedures; if acceptable the driver will be instructed to tip the waste onto the reception area. The driver will then proceed back to the weighbridge to be weighed out and provide with a copy of the weighbridge ticket for his records.

Wastes will be deposited in the reception hall at the IVC facility and a site operative shall spread and inspect each load deposited at the storage area. The load shall be rejected if, by subjective assessment, it contains more than 5% litter/contrary material unsuitable for composting. The waste will be shredded as required within the reception hall to <400mm in order to comply with ABPR regulations.

The Batch formation during the IVC stage will be based on a maximum available batch size of 80 – 100 tonnes to progress through the IVC stage of the process. Continuous temperature logging is recorded to comply with ABPR requirements that are for a 2 stage catering waste process. Moisture correction is undertaken during the shredding stage by mixing in green waste materials. Residency times are 4 weeks for this stage of the process.

Once ABPR standards are achieved the compost is moved to the open/covered stabilisation pad to complete the compost process.

4.1.2 Open/Closed Windrow Sanitisation (Green Waste Process)

The source segregated green waste will enter the site and follow the directional signage to the weighbridge. On entering the weighbridge area, the driver must have the waste transfer documentation with the correct details of the waste on board.

The site operative will inspect the waste transfer documentation, when the site operative is satisfied that the documentation is in order the driver will be instructed to enter the weighbridge, where the weights will be documented.

The driver will then be instructed to proceed to the waste reception hall that is designated for the waste. The site operative will then inspect the load to ensure that it is to the correct standard that is acceptable under the operational procedures; if acceptable the driver will be instructed to tip the waste onto the reception area. The driver will then proceed back to the weighbridge to be weighed out and provide with a copy of the weighbridge ticket for his records.

Wastes will be deposited in the reception area at the green waste facility and a site operative shall spread and inspect each load deposited at the storage area. The load shall be rejected if, by subjective assessment, it contains more than 5% litter/contrary material unsuitable for composting. The waste will be shredded as required within the reception hall to <400mm in order to comply with CQP regulations.

The Batch formation during the open windrow stage will be based on a maximum available batch size of 150 – 400 tonnes to progress through to the stabilisation stage of the process. Temperature logging is recorded daily in the first two weeks then weekly in the last six weeks. Moisture correction is undertaken during the shredding stage by mixing in green waste materials. Residency times are 2 weeks for the sanitisation stage of the process.

4.1.3 Open/Closed Windrow Stabilisation (Green Waste and IVC waste mixed together Process)

Following the sanitisation phase the compost is transferred to the batch formation shed batches are formed together ready for open windrow composting. The dimensions of each windrow shall be approximately 3 metres high, 10 metres wide and 13 metres long. Gaps of suitable width to enable turning/monitoring and litter picking will be left between the windrows.

The stabilisation phase is a minimum 6 week process during which time monitoring equipment will be used for temperature monitoring and moisture levels will be assessed by grip test to ensure critical limits for composting are being met. During this period a minimum of 4 turns are made to fully incorporate the compost by loading shovel. The last week of stabilisation takes place under cover.

At the end of the stabilisation phase the compost will be screened and sampled, on achieving all the criteria for the PAS 100 & QCP the compost will be moved to the storage area to await dispatch.

Table 2c - Operational Activities on Site – IVC

Activity	Description
Reception	Wastes will be deposited in the reception hall at the IVC facility and a site operative shall spread and inspect each load deposited at the storage area.
Shredding	Any large objects, for example tree trunks and root stocks, over 50cm in diameter shall be manually reduced in size before shredding. Material is pre-shred to <400mm prior to the active composting stage using a high speed shredder located within the reception area. No more than 300t to be waiting before being loaded into tunnels.
Mixing	All feedstocks are blended to create as even and clean a feedstock as possible. This includes blending kerbside, oversize and civic amenity wastes. Where possible an open structure is implemented due to aid diffusion.
Sanitisation - Barrier 1	Critical limits: >60°C Critical limits: Grip test score 3-4 (Indicative moisture 50 - 65% m/m) Critical limits: needs to achieve 60°C for a minimum of 2 consecutive days in each barrier – as per ABPR 8 turn from Barrier 1 into Barrier 2 moving down the 16 bunkers (as per ABPR)
Screening	The screened compost shall be inspected by a site operative, in particular for physical contaminants. 0-30mm, soil improver, certified to PAS 100 & CQP
Storage	Each product batch shall be identifiable in its storage location by a marker that displays its unique product batch code. Each product batch shall contain compost from no greater than 6 wbatches and may be stored for a maximum of 12 months before dispatch to the customer.
Product Movements	Prior to dispatch, each load shall be checked to ensure information supplied to the recipient and kept on record by the compost is correct. Compost from this composting process is supplied for use in the following markets: 0 - 30mm grade, agriculture and soft landscape market

Table 2d - Operational Activities on Site – OW

Activity	Description
Reception	Wastes will be deposited in the reception hall at the green waste facility and a site operative shall spread and inspect each load deposited at the storage area.
Shredding	Any large objects, for example tree trunks and root stocks, over 50cm in diameter shall be manually reduced in size before shredding. Material is pre-shred to <400mm prior to the active composting stage using a high speed shredder located within the reception area.
Mixing	All feedstocks are blended to create as even and clean a feedstock as possible. This includes blending kerbside, oversize and civic amenity wastes. Where possible an open structure is implemented due to aid diffusion.
Sanitisation	Critical limits: >65°C Critical limits: Grip test score 3-4 (Indicative moisture 50 - 65% m/m) Critical limits: needs to achieve 60oC for a minimum of 7 days
Stabilisation	Critical limits: 45 – 80°C Critical limits: Grip test score 3-4 (Indicative moisture 50 - 65% m/m) Critical limits: 8 weeks 4 turns during the minimum duration above

Screening	The screened compost shall be inspected by a site operative, in particular for physical contaminants. 0-30mm, soil improver, certified to PAS 100 & CQP
Storage	Each product batch shall be identifiable in its storage location by a marker that displays its unique product batch code. Each product batch shall contain compost from no greater than 6 batches and may be stored for a maximum of 12 months before dispatch to the customer.
Product Movements	Prior to dispatch, each load shall be checked to ensure information supplied to the recipient and kept on record by the compost is correct. Compost from this composting process is supplied for use in the following markets: 0 - 30mm grade, agriculture and soft landscape market

4.2 Climate Data

The following section identifies the prevailing weather conditions on site, in particular the wind direction, in order to predict the path of likely aerial dispersion of bioaerosols generated on site.

Information on wind direction has been derived from the onsite weather station during 2012 (data collected automatically every 15 minutes). This data is illustrated by the wind rose in Figure 2. Wind data is collected daily as part of the routine monitoring on site. 16 point wind directions are provided below, note that calm days are also included to provide a complete data record.

Table 3 - Wind Direction and Occurrence on Site

Wind Direction (from)	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**
% Occurrence	6	7	11	31	15	2	4	2
Wind Direction (from)	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**
% Occurrence	3	4	6	1	0	0	2	6

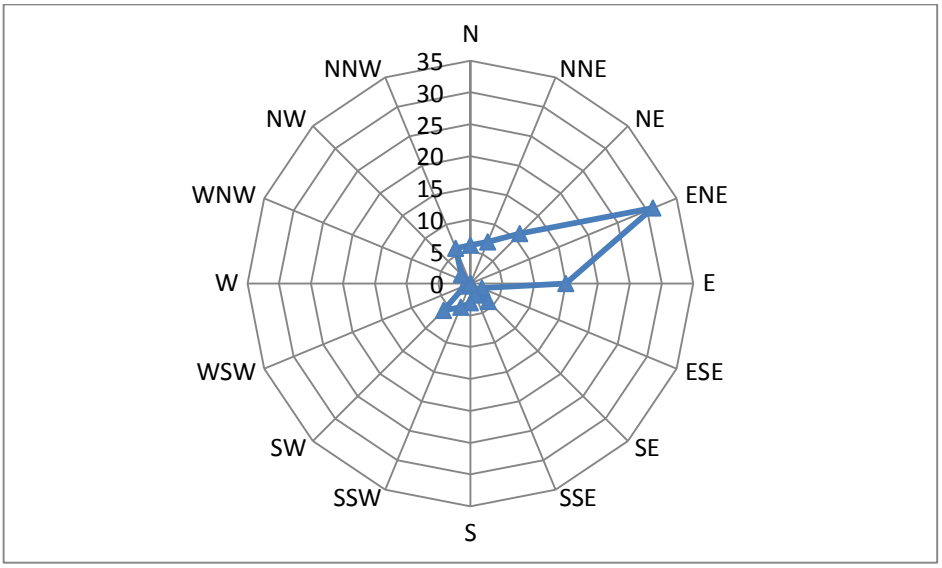


Figure 2 - Wind Direction Rose for CCL Weather Station 2012

Cowbridge Compost Ltd operates a Davis Vantage weather station on site. The station records wind speed and direction, temperature, relative humidity, and rainfall, and enables the site management team to monitor site specific weather conditions. In addition to the site weather monitoring station, the site has erected a wind sock to provide an instant visual guide as to the wind strength and direction to assist site operative carrying out daily operations on site. As a result the site is able to determine what activities should be undertaken. For instance, screening and shredding will not take place when the wind blows in the direction of the sensitive receptor. There are several operatives on site which are equipped with changing roles on site at a moment's notice. If there is no rain predicted but then it does start to rain then the operative understand that they will have to change the job they are doing. This is the same with wind, the site is located in a valley where swirling wind can take place at a moment's notice, as a result operations on site are determined by the weather conditions at that point in time.

4.3 Potentially Sensitive Receptors

The EA refers to Receptors as a 'workplace' or a 'dwelling'. A dwelling includes a garden boundary, and a workplace is where workers are frequently present (a workplace does not normally include areas where workers are present for short periods). The EA does not explicitly class transient receptors including footpaths, recreational open spaces, bridleways, highways, roads, railways or livestock as potentially sensitive receptors to bioaerosols.

DEFRA ranks the sensitivity of potential receptors to general waste management activities as given in Table 4. There are minor differences in sensitivity categories to bioaerosols and dust. In the latest EA position statement duration of exposure was also mentioned as:

'Sensitive receptors refer 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'.

Table 4 - Ranking of Sensitive Receptors

Sensitivity Ranking	Category of Receptor
High Individuals living and/or working in the vicinity for prolonged frequent periods.	Houses and residents (schools, hospitals etc.).
Medium Individuals working in the vicinity for prolonged frequent periods.	Trade premises and factories (offices, industrial premises).
Medium/Low Individuals in the area for frequent periods.	Public footpaths (local environmental areas).
Low Individuals unlikely to be in the area of direct exposure for prolonged or frequent periods.	Other amenities (minor roads and open public spaces).

4.4 Site Specific Sensitive Receptors

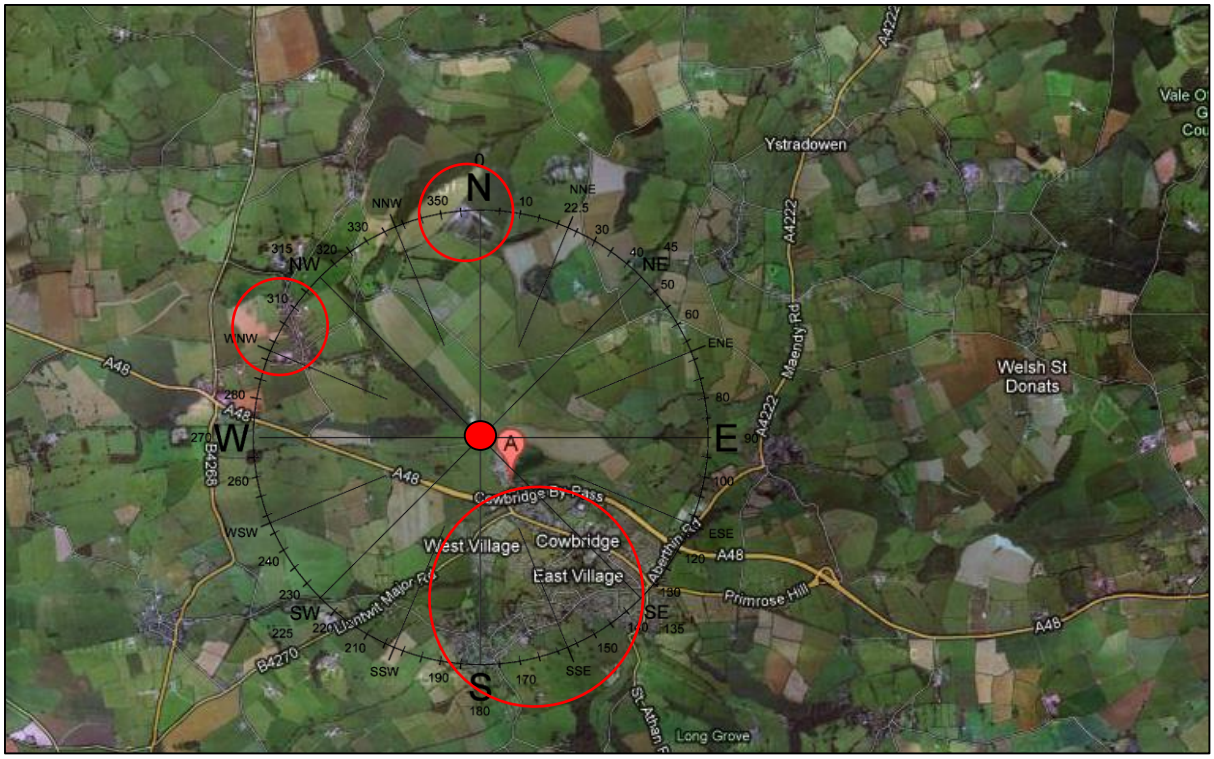
Site specific sensitive receptors that are located within 250m of the site boundary are identified in Table 5 below. Distances to receptors are given from the OW composting area within the site boundary.

Table 5 - Sensitive Receptors to the Site Boundary

Receptor	OW site		Details
	Occurrence %	Distance from site (m)	
Penllyn Estate Dairy Farm**	6	>200	Trade
Penllyn Estate Residential Property**	6	227	Residential
Task Force Paintball**	15	150	Trade

** Sites within 250m of the operational boundary

Conditions and factors that may affect bioaerosol releases and release pathways have also been given although the full mitigating effects of topography (height) or screening (buildings trees etc.) are not fully considered in this assessment. Mitigating factors may be used during subsequent estimations or evaluations if and as appropriate. The frequency of the wind direction blowing towards each Receptor has been calculated from the wind rose diagram given in section 4.2.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315
320
330
350
A
A48
A4222
B4270
B4263
Maendy Rd
Cowbridge By Pass
West Village
Cowbridge
East Village
Aberthin Rd
Primrose Hill
Llantwit Major Rd
Ystradowen
Welsh St Donats
Long Grove

5.0 RISK ASSESSMENT

The process on site is a biological process that is predominantly moist and aerobic. If oxygen levels are depleted due to high moisture levels, some processes could become anaerobic. High levels of micro-organisms will be present during periods of activity and bioaerosols may be dispersed via material movement, screening, natural evaporation (during the drying process) or by wind influences. If process temperatures are sufficiently high, bioaerosols may also be dispersed via steam plumes.

This risk assessment has considered the staged risk assessment techniques presented in the guidance 'An Environmental Risk Management Framework for Composting Facilities in England & Wales', and the iterative risk assessment techniques described by DEFRA as the best available risk assessment model to apply to the biological process.

5.1 Hazard Identification

Section 1.1 outlines the hazard to be evaluated in this case – bioaerosols which may be released from the process that takes place at the site, including the increased risk from the increase in green waste composting on the site. In order to assess the potential risks from bioaerosols, emission sources need to be considered. Table 6 sets out the source-pathway-receptor linkages for exposure of local sensitive receptors to emissions from airborne bioaerosols at the site.

Table 6 - Source-Pathway-Receptors Identified for Bioaerosol Emissions

Primary Source	Hazard	Transportation	Exposure Medium	Receptor
Windrow turning and screening.	Chronic or acute illness due to bioaerosol exposure.	Atmospheric dispersion.	Aerial deposition.	Those within 250m of the site.
Roadways and vehicles, material transportation and storage.	Irritation/nuisance due to deposition of larger particles.	Fugitive emissions.	Re-aerosolised material.	Localised to within 50m of the activity.
Reception of material.	Chronic or acute illness due to bioaerosol exposure.	Atmospheric dispersion.	Aerial deposition.	Those within 250m of the site.
Shredding of material.	Chronic or acute illness due to bioaerosol exposure.	Atmospheric dispersion.	Aerial deposition.	Those within 250m of the site.
Construction of windrows.	Chronic or acute illness due to bioaerosol exposure.	Atmospheric dispersion.	Aerial deposition.	Those within 250m of the site.

Fugitive dusts are likely to be liberated by the handling of the materials accepted on site, their storage and movement and by meteorological conditions (presence or absence of precipitation, but particularly wind).Vehicles on site may exacerbate this situation at sites with hard-standing where surfaces dry out.

Bioaerosols are mostly likely to be released when materials are agitated or processed; current guidance indicates that turning is likely to generate the highest concentrations of bioaerosols. Although little data is available re: specific material types, green waste has the potential to be biologically active at this point, hence it is likely to be the point source likely to generate the most bioaerosols at the site (risk will be discussed in more detail below).

It should be noted that there are some agricultural activities surrounding the site, e.g. crop harvesting, have previously been identified as significant sources of bioaerosols, specifically 10^5cfu/m^3 of bacteria and 10^3cfu/m^3 of fungi including *Aspergillus fumigatus*[5]. In addition, activities at neighbouring waste facilities must be considered in addition to agricultural activities when assessing the facility.

5.2 Exposure Assessment

An assessment necessarily requires the consideration of potential routes of exposure of individuals to bioaerosols should they escape from the site. Potential pathways of exposure are:

- **Inhalation:** breathing via nose or mouth;
- **Ingestion:** eating or swallowing;
- **Absorption:** through skin or via the eyes (directly or indirectly;
- **Contact:** with the surface of the skin or eyes; and
- **Injection:** by high pressure equipment/contaminated sharp objects.

It is assumed the most important potential route of any exposure for a sensitive receptor in the vicinity of a site will be airborne inhalation as other routes would involve direct contact with the material (which is more of an occupational issue). The conceptual model for the exposure assessment is outlined in Figure 4:

[5] Swan J.R.M., Kelsey A., Crook B., Gilbert E.J. (2003) *Occupational and environmental exposure to bioaerosols from composts and potential health effects – A critical review of published data*. HSE Research Report 130 ISBN 0 7176 2707

SOURCE	PATHWAY	RECEPTOR
		
Release of bioaerosols during, windrow forming, windrow turning, screening and transportation.	Airborne transportation.	Nearby sensitive receptors identified in section 4.4.
HAZARD		
Mucous Membrane; Irritation; Systemic symptoms e.g. fever, headache; Sensitisation; Allergic reaction; Infection e.g. *Aspergillus fumigatus*.		

Figure 4 - Site Conceptual Model for Pollutant Exposure

The conceptual model requires further refinement in terms of the duration of exposure and other issues such as whether effects are likely to be acute (short-term) or chronic (long-term) i.e. the consequences, which will be explored below. However, the differing volumes of material on site are not assumed to be a significant factor affecting the source, as machinery processing rates will not alter, although duration may increase.

5.2.1 Emissions Classification

In terms of reported concentrations at composting sites, many reports specify that concentrations are elevated during agitation only, and during periods of little to no activity concentrations are similar to background. Indeed, the EA state that bioaerosol release is episodic with reception movement potentially generating the highest releases. An emissions classification can therefore be drawn from the identified site activities as identified in section 4.1. Table 7 below presents the classification and comments regarding each class and activity.

Table 7 - Emissions Classification for Site Activities

Emission Class	Site Activities	Comments	Hours/Week
Low	Vehicle movements	Constant activities but low level of material agitation.	52
	Site maintenance		
	Material storage		
Low to Medium	Waste reception	Activities take place on designated unloading and shredding area then composting area.	45
	Shredding		
	Sanitisation		
	Maturation	Optional Maturation takes place in dedicated maturation area.	
Medium	Vehicle loading and transportation of finished products	Limited quantities of mature low potential materials.	20
	Stabilisation	Low release from undisturbed windrows.	
High	Screening	High instantaneous release of bioaerosols in immediacy of activities which are actively agitating materials.	12
	Windrow formation		
	Windrow turning		
Very High	Accidents leading to elevated release events.	Rare due to management systems and processes.	<1

5.3 Monitoring Results

Appendix A presents the bioaerosol results report that was compiled from the last monitoring event taken from the site. The Sensitive Receptor was upwind of the OWC at the time of sampling according to the report undertaken by D&F Associates and downwind of the IVC. The downwind sampling points were done at the equivalent distance to the Sensitive Receptor. The results from the latest sampling occasion determined that:

Bacteria on 04/03/2014

Sample No.	Details of Siting	Calculated conc. of airborne micro-organisms (cfu/60L)	Calculated conc. of airborne micro-organisms (cfu/m^3)	Average cfu/m^3
1A 1B 1C	Upwind IVC ~25m	<10 <10 <10	<167 <167 <167	<167
2A 2B 2C	Downwind IVC ~120m	<10 10 40	<167 167 667	<334
3A 3B 3C	~50m (Pad Boundary)	<10 <10 10	<167 <167 <167	<167
4A 4B 4C	180-190m (Green waste screening) ~390 (IVC)	20 <10 <10	333 <167 <167	<222

5A 5B 5C	~165m (Green waste screening) 225-250m (OWC)	20 <10 20	333 <167 333	<278

Fungi on 04/03/2014

Sample No.	Details of Siting	Colonies counted	Each filter cfu/m^3	Average cfu/m^3
1D 1E 1F	Upwind IVC ~25m	<10 <10 <10	<167 <167 <167	<167
2D 2E 2F	Downwind IVC ~120m	<10 <10 <10	<167 <167 <167	<167
3D 3E 3F	~50m (Pad Boundary)	<10 <10 <10	<167 <167 <167	<167
4D 4E 4F	180-190m (Green waste screening) ~390 (IVC)	<10 <10 <10	<167 <167 <167	<167
5D 5E 5F	~165m (Green waste screening) 225-250m (OWC)	<10 10 <10	<167 167 <167	<167

Gram-negative bacteria 04/03/2014

Sample No.	Details of Siting	Colonies counted	Each filter cfu/m^3	Average cfu/m^3
1G 1H 1I	Upwind IVC ~25m	<5 <5 <5	<83 <83 <83	<83
2G 2H 2I	Downwind IVC ~120m	<5 10 15	<83 167 250	<167
3G 3H 3I	~50m (Pad Boundary)	5 5 <5	83 83 <83	<83
4G 4H 4I	180-190m (Green waste screening) ~390 (IVC)	10 5 <5	167 83 <83	<111
5G 5H 5I	~165m (Green waste screening) 225-250m (OWC)	5 <5 10	83 <83 167	<111

The latest evidence indicates that the site is controlling bioaerosol release and concentrations are dropping rapidly with distance. The addition of more materials accepted by and stored at the site are unlikely to materially affect the concentrations released downwind.

5.4 Risk Estimation

Site specific data is available that permits a more detailed, or at least a 'semi-quantitative' risk assessment. To overcome potential difficulties with the uncertainty of information such as source emission rates or micro-organism decay, conservative assumptions have been made. Risk estimation uses deterministic and probabilistic techniques that offer a way of dealing with the inherent variability and uncertainties in exposure estimation.

The risk estimation calculated within this SSBRA is based upon a calculation of the probability of exposure and the magnitude of the consequence. Semi-quantitative scoring is assigned to each factor and combined in order to score the risk to each potential receptor from operations on site due to bioaerosol release.

5.4.1 Magnitude of Consequences

Table 8 indicates the magnitude of consequences based on DEFRA (Negligible to Mild) and Environment Agency (Moderate to Extremely Severe) categories and their descriptions. These broad categories provide a mechanism for comparative assessment. The category of consequence is therefore assigned to the magnitude of risk for assessment based upon levels of micro-organisms monitored at or adjacent to the source.

Table 8 - Magnitude of Consequences from Source Emissions

Category	Indicative Range	Category and Consequence	Level of Consequences compared to natural levels
Negligible	<300	No observable effect on individuals or populations. No effect on local ecosystem, individual species or local features.	Low range of natural environmental levels.
Mild	300 - 1000	No observable effect on health of individuals. No observable effect at the population level or on local ecosystem..	Mid-range of natural environmental levels.
Moderate	1000 - 3000	Health effects generally not noted. Short term: no significant impacts on robust individuals, populations or ecosystems. Potential minor health or nuisance impacts for vulnerable individuals (frail/elderly/sick). Continuous long term: robust individuals unaffected. Potential health effects on vulnerable individuals (frail/elderly/sick). No observable effect on local ecosystem.	Upper-range natural environmental levels.
High	3000 - 10,000	Short-term: no significant impacts on robust individuals. Vulnerable individuals affected including welfare and nuisance. Continuous long term: vulnerable individuals affected including health, welfare and nuisance. Potential effects on population structure or size and local ecosystem impacts possibly detectable. Equivalent to occupational exposure levels.	High range of natural environmental levels.
Severe	10,000 - 30,000	Short term and long term: some robust individuals affected including health, welfare, and nuisance. Local dysfunction of communities if continuous. Local ecosystem changes detectable.	Short term highest natural environmental levels for specific events e.g. harvesting.
Very Severe	30,000 - 100,000	Probable effects on robust individuals. Widespread effects on the functioning of communities and ecosystems.	Rare natural environmental levels.

Extremely Severe	>100,000	Widespread health effects. Impacts on the functioning of regionally important ecosystems.	Maximum of natural environmental events.

It is difficult to ascribe a consistent source emission rate as values quoted are highly variable and masked by variations in ambient concentrations. Detailed estimation would require the use of dispersion models with appropriate modules for calculation of airborne and deposited particulate. The EA indicates that there are 'numerous uncertainties' with air quality modelling and refers to the use of deterministic or probabilistic models. The EA uses a simple straight-line fit to estimate the downwind distance to meet the reference level.

Based on the last monitoring event, as detailed in section 5.3, the magnitude of consequences are expressed as terms of risk in Table 9 below for the site specific data. Results indicated low to medium to high levels of micro-organisms at all monitoring points but allowance is made for potentially elevated events during high and very high classification site activities, in a worst-case scenario.

Table 9 – Risk Assessment Factor A – Magnitude of Consequence

Receptor	Emission Classification				
	Low	Low/Medium	Medium	High	Very High
Penllyn Estate Dairy Farm	Negligible	Negligible	Negligible	Mild	Mild
Penllyn Estate Residential Property	Negligible	Negligible	Negligible	Mild	Mild
Task Force Paintball	Negligible	Negligible	Negligible	Mild	Mild

5.4.2 Probability of Exposure

Simple factors can be used to generate indicative probabilities of an event occurring. Each can be the product of several variables. For example, the fraction of the time that the wind blows towards a receptor multiplied by fraction of time that material is disturbed. Conservative (i.e. 'worst case' conditions) probability factors for the occurrence of a release event have been derived and are described in Table 10 below.

Table 10 – Factor Determining the Probability of Exposure

Factor	Description
Receptor	*The proportion of time that a receptor is present at the identified location.* The receptor is only affected when present. In Residential property and Hospitals a value of 1 is assumed; equivalent to continual occupancy. At commercial/school properties, a value of 0.25 is equivalent to slightly more than a 40-hour week. At amenity and other facilities, a value of 0.01 is equivalent to 2 hours a week for any individual.
Wind Direction	*The proportion of time averaged over 1 year that wind blows towards the receptor – no modification is made for wind speed.*

	Probability factors are calculated as the proportion of the time that the wind blows to the receptor from any part of the biological activity for all release cases. Average climatic data is used to calculate wind direction probabilities.
Activity Classification	*Classification as to the frequency of bioaerosol release from each identified site activity.* Classification as identified within Table 4 with hours per week of operations for each site activity.

Criteria for probability as a function of frequency and duration are defined below. These are conservative and are based upon site activity duration as identified in Table 7.

Table 11 – Criteria for Probability of Exposure Occurrence

Probability Criteria	Description of Probability
Negligible	Exposure of less than 25 hours per year (½ hour per week).
Low	Exposure of 25-100 hours per year (<2 hours per week).
Medium	Exposure of 100-250 hours per year (<5 hours per week).
High	Exposure of >250 hours per year (>5 hours per week).

Based on these factors, the probability of conditions occurring to affect each receptor has been estimated for the probability criteria defined above. The results are shown in Table 12 for possible exposure to emissions from operations on site. The number of hours of potential bioaerosol exposure at the receptors has been determined by multiplying the site activity operational hours (Table 7) by the percentage of time the wind blows to each receptor (Table 3) and the receptor occupancy factor (Table 10). These factors have been used to determine the likely probability criteria applicable for each receptor and bioaerosol emission case. The potential probability of consequences is given in Table 12 below based on criteria as identified in Table 11.

Table 12 – Risk Assessment Factor B – Probability of Consequence

Receptor	Emission Classification				
	Low	Low/Medium	Medium	High	Very High
Penllyn Estate Dairy Farm	Low	Low	Low	Negligible	Negligible
Penllyn Estate Residential Property	High	High	Medium	Low	Negligible
Task Force Paintball	Medium	Medium	Low	Low	Negligible

5.4.3 Significance of Risk

In order to provide an estimation of the risk of bioaerosol release on site, an assessment combining the following risk assessment factors are required:

- Risk Assessment Factor A: Magnitude of Consequence – Table 9
- Risk Assessment Factor B: Probability of Consequence – Table 12

There is no single formula for combining the frequency and magnitude of exposure and simple intuitive methods are therefore employed. A risk matrix is generally considered to be an accepted method of identifying the magnitude and probability of the potential risk. A general matrix to estimate the magnitude and the probability of a potential risk is given in Table 13.

Table 13 – Risk Estimation Matrix

Probability (Factor B)	**Magnitude (Factor A)**						
	Negligible	Mild	Moderate	High	Severe	Very Severe	Extremely Severe
Negligible	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Low	**2**	**4**	**6**	**8**	**10**	**12**	**14**
Medium	**3**	**6**	**9**	**12**	**15**	**18**	**21**
High	**4**	**8**	**12**	**16**	**20**	**24**	**28**

Applying the above risk estimation matrix to the combined risk assessment factors for CCL, the significance of the risk to sensitive receptors located near to the site are calculated as below in Table 14 under each emission classification event.

Table 14 – Significance of Risk from Site Operations

Receptor	**Emission Classification**				
	Low	Low/Medium	Medium	High	Very High
Penllyn Estate Dairy Farm	**2**	**2**	**2**	**2**	**2**
Penllyn Estate Residential Property	**4**	**4**	**4**	**4**	**2**
Task Force Paintball	**3**	**3**	**2**	**4**	**2**

5.5 Risk Characterisation

Having calculated the significance of the risk from site operations, it is possible to assign categories of tolerability to the scores based on the position in the risk estimation matrix (Table 13). These are not definitive categories, but indicate the likely degree of risk acceptability from the risk assessment calculations and site management requirements. Table 15 provides a tolerability criterion (based on DEFRA classifications) for bioaerosol risk assessment scores.

Table 15 - Tolerability Criterion

Tolerability Level	Criteria
Acceptable	Risks are in the low range and are likely to be acceptable in all circumstances.
Tolerable	Risks are in the medium range and are likely to be acceptable where best available techniques (BAT) are employed to mitigate risks.
Unacceptable	Risks are unlikely to be acceptable under any circumstances.

The risk assessment carried out indicates that the potential risk of bioaerosol exposure from the aerobic biological process and associated activities at CCL are likely to be as follows:

- The risks to potentially sensitive receptors are low in all cases.
- The tolerability of site operations is considered to be acceptable in all circumstances.
- Emissions are unlikely to cause any significant health effects.

The site should use best practice techniques to reduce any residual risk to as low as reasonably practicable (see Section 7). The operator should focus on reducing the potential for bioaerosol emission during unfavourable conditions, and during direct disturbance activities that may include material movement, windrow turning, shredding and screening of reclaimed /recycled solids (as applicable).

5.6 Most Significant Risks

1) There will be no addition in tonnages through the site regarding compost, however there will be no limit to the amount of green waste that can be processed on site.
    a. Shredding Area: there is a dedicated shredding area known as the reception; this is designed to handle 35,000 tonnes of waste per annum. The shredding of waste can produce high levels of emissions but good housekeeping and cleaning will reduce dust and bioaerosol agitation later on.
    b. Sanitisation and Stabilisation Area: The food waste goes through the IVC which has a dedicated biofilter and the both the green and food waste is already accounted for within the Bioaerosol Report which was undertaken for open windrow and IVC composting at 35,000 tonnes per annum. The material will also be sanitised to prevent pathogens. The material will be wetted if required; this will be determined by monitoring the compost.
    c. Screening Area: Screening can generate moderate to high releases of bioaerosols which are also in an open setting. The waste will be screened post shredding but after windrow formation once stabilised, this will prevent bioaerosol release.
    d. Screening takes place in a part enclosed shed to shelter the screening activities from any wind that blows towards the sensitive receptor.

2) The second most significant risk will be a high exposure event with high winds in the direction of a sensitive receptor. Wind direction in the pathway of the sensitive receptor is very low at 11% (to the south west) and 0% (to the west) and bioaerosol dispersal

usually drops at 250m. There is only 1 residential building within 250m of the site based in the south west, 1 farm also south – south west and 1 business to the east.

3) Another significant risk includes deliveries of waste. When deliveries are made on site the waste shall be inspected to see how much has been degrading, if the waste looks as if it has been degrading for longer than two weeks producing fouls odours then the waste will be rejected as this can cause high bioaerosol release on tipping in the waste reception. Tipping shall take place in the reception building of the IVC which is fully enclosed and green waste only will be tipped into the part enclosed building in the green waste area of the site. The weather will be constantly monitored to ensure that no bioaerosol release goes towards the sensitive receptor. The IVC reception hall will provide adequate protection from windy conditions. The waste will not be tipped in the green waste reception area when wind is blowing towards the sensitive receptors.

The tonnage on site should not affect local populations as the closest sensitive receptors are approximately 150m north of the site. All winds are able to transport bioaerosols however the activities such as shredding and screening will not take place when the winds are in the direction of the sensitive receptors. The 'no limit' on the amount of green waste on site will also have no effect on bioaerosol production. Table 16 below outlines the increased risks associated with the tonnage through the site.

Table 16 – Sources and Hazards Associated with Bioaerosols and Dust

Primary Source	Secondary Source	Hazard	Transport Mechanism	Pathway	Medium of Exposure	Receptor
Waste - Release of breakdown products, micro-organisms, biological particles.	Disturbed materials – unloading, storage, preparations, treatment, sorting. Abatement, plant, vents, filters, etc.	Lung disease, allergies, irritation of mucus membranes; asthma	Carried with airborne dust	Inhalation via nose or mouth	Air	Humans: Residents, occupiers and users of facilities
		Fever, headache, diarrhoea, systemic infection		Ingestion – eating or swallowing	Air & deposited materials	
		Irritation of eye and mucus membranes, skin infection		Absorption: Direct contact with airborne bioaerosol	Air & deposited materials	
				Indirect contact via clothing or surfaces		
		Skin infection, irritation of mucus membranes		Contact with skin or eyes	Air	

Primary Source	Secondary Source	Hazard	Transport Mechanism	Pathway	Medium of Exposure	Receptor
		Tissue damage, skin infection, systemic infection		Injection by puncture, HP equipment or sharps	Deposited materials.	

6.0 CONCLUSIONS

In conclusion, a variety of studies have shown different dispersal distances and have used differing reference values for estimating effects on health to local populations. The results in this report indicate that **the risk of bioaerosols emissions to sensitive receptors is low** and the **current activities are acceptable in terms of risk tolerability**. Although there are potentially emissive operations on site, the low to moderate occurrence of wind being in the direction of sensitive receptors reduces the overall exposure potential.

The concentrations of bioaerosols released by the site are unlikely to increase due to an increase in tonnage; processing and turning rates will remain at the same machinery pace, albeit they may be of slightly longer duration. However, the site could potentially present a risk to the surrounding population in a worst case scenario if material is allowed to be processed in dry conditions during wind directions that blow towards the nearest sensitive receptors. This can be mitigated by taking note of the wind direction, with the option to cease operations that could cause issues. If effective management of the site and the material is maintained to reduce potential point source and fugitive emissions, the risk to sensitive receptors will remain small.

Taking into account the proximity of the commercial development as the nearby sensitive receptor, and the increase in amount of materials received, monitoring as per the AfOR protocol should occur at least twice per annum in the first instance.

7.0 RISK MITIGATION MEASURES

The Association for Organics Recycling (AfOR) provides a Code of Good Practice for the management of composting facilities. The following good practice operation and mitigation measures are currently adopted in order to control activities that may generate or affect the release of bioaerosols.

a) 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.

b) The shredding and formation or turning of windrows is avoided if possible on windy days. Screening is also undertaken when wind speeds are calm or wind direction is away from sensitive receptors.

c) The composting of waste at the sanitisation phase is carried out within the dedicated area.

d) Inspections of the buildings and infrastructure are undertaken to ensure that requisite maintenance is regularly undertaken. Checks include fencing, gates, building facilities and the foul and surface water drainage systems.

e) The site is swept and kept clear of all loose material on a regular basis.

f) An Accident Management Plan is in place in order to prevent and manage potential fire risks on site.

g) Plant and machinery are well maintained in line with a maintenance schedule to avoid dust generation.

h) An onsite weather data collector collects the required data every day (for wind direction and wind speed) to identify conditions of high winds blowing towards the receptor(s).

i) A windsock will be located onsite to provide a visual indication of the wind direction to site workers and third parties.

j) Material transportation from the shredding area to the composting area, and for final product out of site, takes place under sheeted vehicles.

k) Composting process and controls are inline within industry best practice, being PAS100 and QP certified.

7.1 Measures the Site will take to reduce Bioaerosol Release and control Emissions

The site currently employs robust measures for the control of bioaerosol emissions from site in line with operational procedures. The additional measures which will be undertaken:

1) Site surfaces such as roads and tracks will be regularly dampened down and/or regularly swept to suppress dust and bioaerosols. Roads will be swept when there is no wind blowing on a daily basis. Water will be used when dust starts to show as there is an increased possibility of the liberalisation of dust and bioaerosols from the roads and tracks when they are drier. Drier roads and tracks also increase the production and abundance of spore forming micro-organisms which can survive more environmentally challenging conditions.

    a. The dampening and sweeping of dusts will reduce bioaerosols at the increased throughput as the bioaerosols will bond to the surface of the tracks and roads.
    b. Lower relative humidity and higher temperatures will also be monitored as the drying of roads and tracks relates to release of bioaerosols and dust emissions.

2) The compost piles or windrows themselves will also be regularly dampened down and swept around the piles / windrows. Temperature and moisture readings will determine when the windrows will need additional dampening.

    a. The dampening of compost piles will take place on a regular basis or depending on relative humidity and temperature inside and outside the compost pile.
    b. Bioaerosols can bond to the surface of compost when they are wet which reduces the number of spore forming micro-organisms which can be released. The bioaerosols are able to travel with the wind in the atmosphere, the wet bioaerosols will be too heavy to travel which will ensure they do not pose harm or risk to the wider population.
    c. Moisture readings will determine how wet the compost is inside the pile. Turning of the waste will not take place if the compost is too dry, additional liquid will be added the pile and allowed to percolate through the pile before the turning commences. The compost will then be dropped to the ground slowly so reduce the amount of aerosolisation of particles.
    d. The turning/screening/shredding of compost will not take place when the wind blows towards the direction of identified sensitive receptors. The compost will be monitored to ensure the material is moist enough prior to the activity taking place. This will reduce the amount of dust and bioaerosols available for exposure.
    e. The steaming of windrows can also lead to bioaerosol release. Steaming will be reduced by ensuring the compost pile is within the correct temperature range. Frequent turning of the waste may result in the compost not degrading effectively or getting up to temperature and under turning will mean the compost pile over heats and generates too much steam.

3) Screening operations are undertaken in a part enclosed shed. This will protect the sensitive receptors located in the south west. Shredding and screening in the green waste area of stabilised material takes place next to a high wall which screens the sensitive receptor to the west. Shredding also takes place in the IVC building for some green waste and all food waste.

4) When deliveries are made in windy conditions the waste is to be deposited in front of the IVC providing shelter or in the part enclosed shed in the green waste area. This will also be recorded in the site diary along with multiple checks of wind direction.

7.2 Additional Measures which could be considered in the Future

1) 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.

2) A mist spray incorporating an odour absorber (surfactant) may be incorporated at the site boundary. The effectiveness of such systems are unknown however, and implementation of such systems should not be considered as a priority.

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