Brookhurst Wood Open Windrow Composting Facility

Environmental Permit Variation EPR/AB3700LS/V006
Bioaerosol Risk Assessment

Biffa Waste Services Ltd

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Quality information

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1. Report Context

1.1 Introduction

AECOM has been commissioned by Biffa Waste Services Limited ("the Operator" or Biffa) to prepare an application to develop an Open Windrow Composting Facility (OWC) at Brookhurst Wood, Warnham, West Sussex. Given the locality of the new development on site, the new OWC will be added as an additional operation to the environmental permit (EPR/AB3700LS) for the Aggregate Treatment and Recycling Facility.

The new OWC facility is being developed to treat up to 60,000 tonnes of green waste per annum (tpa) and 30,000 tonnes per annum of wood waste.

This report has been prepared to support the permit application and details the site specific Bioaerosol Risk Assessment. The report should be read in conjunction with other supporting application information.

1.2 Proposed Facility

There are no changes proposed to the existing Aggregate Treatment and Recycling Facility (ATRF) processes although a new crushing operation will be included, and some additional waste codes will be added to the permitted waste list including mixtures of waste from the mechanical treatment of wastes that contain a high proportion of recoverable aggregate.

The proposed facility will comprise a new plant to facilitate the receipt, shredding and subsequent composting of green waste and the shredding of wood waste. Waste types accepted at the facility will be defined according to their List of Waste (LoW) Code, and will generally consist of:

- wood waste
- green waste;
- leaves;
- grass clippings; and
- horticulture type waste.

The facility will not receive or accept any waste covered by the Animal By-Product (Enforcement) (England) Regulations 2013 (ABPR).

The new plant is designed to effectively shred the constituent parts of the incoming green waste, which is then transferred to open air windrows for composting and maturation. Green waste will be treated through the composting process while wood waste will only be shredded. The intention is to produce a PAS 100 compliant product from the inputs and as such it will be deemed to have reached end of waste criteria and has achieved product status. The product can be utilised for a wide range of beneficial after-uses including; community projects within West Sussex, use in domestic gardens and for agriculture.

1.3 Scope of the Risk Assessment

This report provides an independent bioaerosol risk assessment of the operations of an open windrow composting site at Brookhurst Wood Waste Management Site, for the purposes of Environment Agency (EA) permitting requirements.

The risk assessment aims to demonstrate that bioaerosols from the proposed facility will not pose an unacceptable risk to human health." As the nearest residential receptor is 280m from the site boundary and therefore the risk is already significantly reduced.

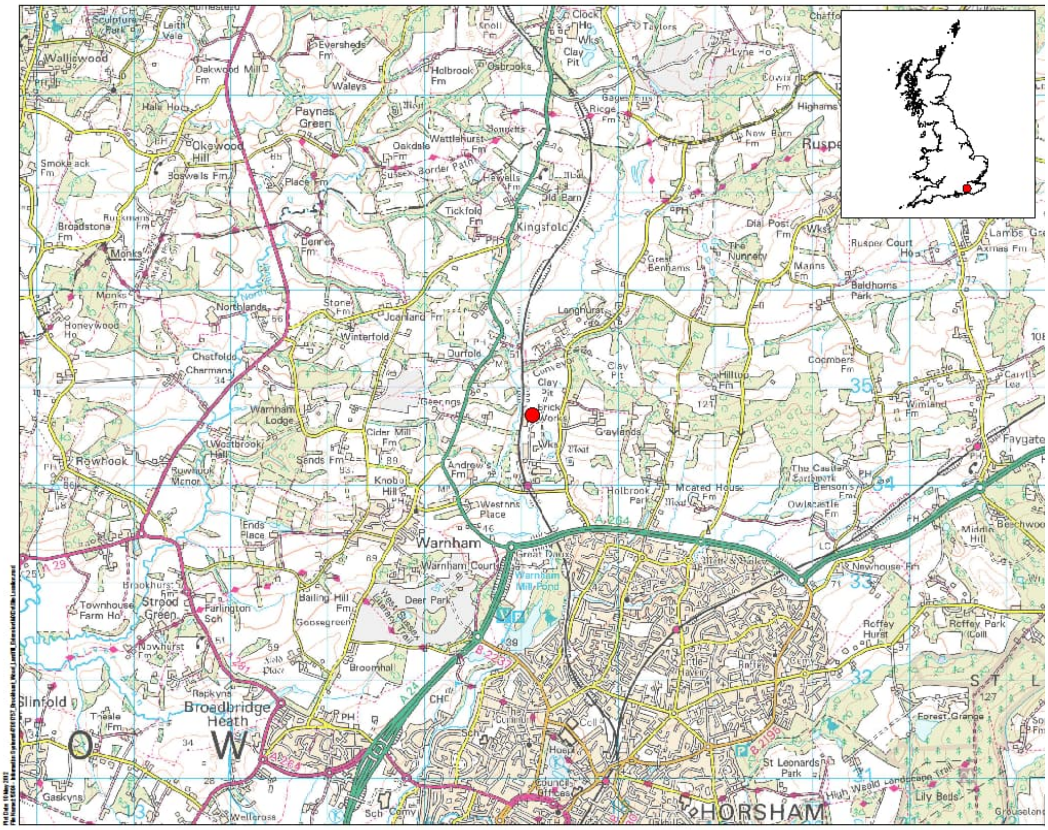
2. Site Description and Information

2.1 Site Description

2.1.1 Site Location

The Brookhurst Wood site is located approximately 4 kilometres to the north of Horsham. The village of Warnham is 1.5 km to the south-west and Kingsfold is 2km to the north. The centre of the overall site is located at grid reference National Grid Reference (NGR) E517105, N134659 at Brookhurst Wood, Langhurstwood, Horsham, West Sussex. This is shown in Figure 1 below.

Figure 1. Site Location



The current activities that take place at the Brookhurstwood Site involve:

- Mechanical Biological Treatment of waste;
- Recycling of road sweepings and aggregate type wastes through an aggregates treatment and recycling facility ('ATRF');
- Non-hazardous landfill which is currently undergoing restoration (due to be completed end-2023); and
- Landfill gas power generation and a leachate treatment plant.

The site where the OWC is proposed is situated adjacent to the south and eastern boundaries of the ATRF and is currently hardstanding.

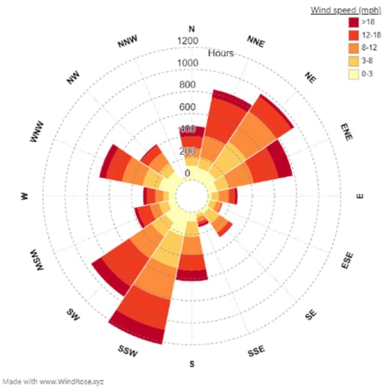
2.1.2 Meteorological Conditions

Windrose diagrams for 2018 to 2022 inclusive from the site meteorological system are provided for the site. All years show similar patterns with the predominant wind pattern of winds coming from the southwest and heading northeast. This wind direction also shows the strongest wind speeds recorded

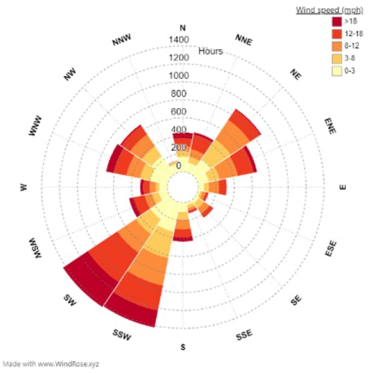
over the 5 year period. Wind from the northeast and southeast occur relatively infrequently (<5% of the time).

Figure 2 Windrose

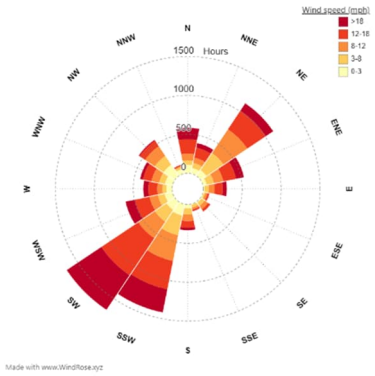
2018



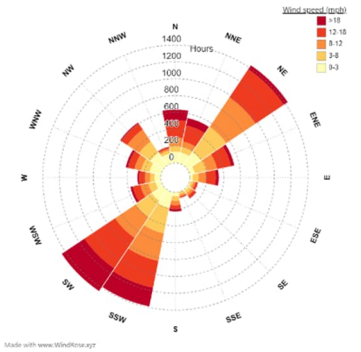
2019



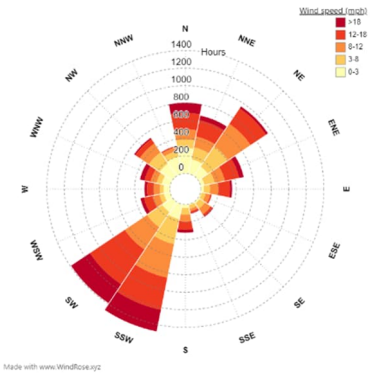
2020



2021



2018



Based on the 5-year average, the percentage of time the wind blows from any single direction is presented in Table 1 below.

Table 1 Percentage Frequency of Wind Direction

Direction Wind From	% Time Wind in Each Direction	Calm 0 – 0.45 m/s	Light 0.45 – 3.9 m/s	Gentle 3.9 – 5.5 m/s	Moderate 5.5 – 8 m/s	Fresh 8 – 10.8 m/s	Strong 10.8 – 13.9 m/s	Near Gale 13.9-17.2 m/s	Gale > 17.2 m/s
N	7.83%	1.82%	1.98%	1.30%	1.25%	1.03%	0.34%	0.07%	0.04%
NNE	6.58%	0.53%	1.76%	1.66%	1.77%	0.74%	0.11%	0.02%	0.00%
NE	12.12%	0.75%	4.22%	4.60%	1.85%	0.56%	0.13%	0.02%	0.00%
ENE	6.89%	0.47%	1.69%	2.18%	1.52%	0.86%	0.15%	0.01%	0.00%
E	3.59%	0.21%	0.91%	1.25%	0.81%	0.36%	0.04%	0.00%	0.00%
ESE	1.29%	0.09%	0.51%	0.50%	0.16%	0.03%	0.00%	0.00%	0.00%
SE	2.35%	0.18%	0.93%	0.87%	0.30%	0.07%	0.00%	0.00%	0.00%
SSE	1.26%	0.14%	0.48%	0.38%	0.16%	0.09%	0.00%	0.00%	0.00%
S	4.43%	0.40%	1.36%	1.33%	0.72%	0.50%	0.11%	0.02%	0.00%
SSW	15.69%	1.13%	4.49%	4.59%	2.65%	1.86%	0.76%	0.17%	0.03%
SW	15.62%	0.92%	3.07%	3.86%	3.65%	2.81%	0.94%	0.28%	0.09%
WSW	4.88%	0.38%	1.43%	1.32%	1.01%	0.60%	0.12%	0.02%	0.01%
W	3.48%	0.31%	1.08%	0.93%	0.69%	0.36%	0.09%	0.02%	0.00%
WNW	5.89%	0.55%	2.11%	1.66%	0.87%	0.47%	0.17%	0.04%	0.01%
NW	6.30%	0.67%	2.86%	1.91%	0.65%	0.19%	0.02%	0.00%	0.00%
NNW	1.79%	0.23%	1.26%	0.23%	0.07%	0.01%	0.00%	0.00%	0.00%

Monitoring of meteorological information and weather forecasts will be used in the following ways:

- To predict when weather conditions are likely to cause poor odour dispersion, to enable site controls to be amended if required;
- To plan where monitoring of the site boundary should take place during normal operations in order to correctly assess odour impacts;
- To predict the areas where potential odour impacts may occur during abnormal events; and
- During the investigation of odour complaints to ascertain complainants' observations.

Weekly checks will be made on weather conditions to allow for forward planning. Daily observations will also be recorded so that site operations can be rearranged (if required) to adapt to changing conditions. Observations which will be recorded as part of these weather checks include:

- Wind speed;
- Wind direction;
- Potential atmospheric pressure changes; and
- Temperature.

2.1.3 Sensitive Receptors

Receptors which could be potentially affected by bioaerosols from the facility are detailed in Table 2 below.

Table 2 Sensitive Receptors

Receptor	Description	Type	Approximate Distance (m)	Direction from Site	Sensitivity Based on Distance
R1	Greylands Industrial Park	Human/Commercial	546m	E	0
R2	Greylands Lodge	Human/Commercial	260m	E	0.25
R3	Greylands Farm	Human	596m	SE	0
R4	Andrews Farm	Human	650m	SW	0
R5	Lower Chickens Farm	Human	770m	W	0
R6	Cox Farm Lodge	Human/Residential	566m	W	0
R7	Cox Farm	Human	330m	W	0
R8	Sussex Camper Vans	Human/Commercial	394m	NE	0
R9	Orchard Lodge	Human/Residential	550m	NW	0
R10	Durford Hill Farm	Human	668m	NW	0
R11	Fisher Clinical Services	Human/Commercial	587m	N	0
R12	Broadlands Business Centre	Human/Commercial	862m	N	0
R13	Weinerburger Brickworks and adjacent Business Park	Human/Industrial	427m	S	0
R14	Warnham Railway Station	Human/Commercial	600m	S	0
R15	South Lodge	Human/Residential	345m	NE	0
R16	Boldings Brook Academy	Human	575m	W	0
R17	Langhurst Moat Cottage	Human	399m	SE	0
R18	Holmwood	Human	860m	N	0
R19	Gunborn Crossing Cottages	Human	682m	N	0
R20	Nowhere House	Human	754m	NNW	0
R21	Richmond House	Human	817m	NNW	0
R22	Wood Farm	Human	948m	NNW	0
R23	Upper Chickens - Houses and Pet Supply Company	Human/Commercial	980m	NNW	0
R24	Highland House, The Mount & other residences	Human	610m	NW	0
R25	Dog & Duck Pub	Human	777m	NW	0
R26	Geerings	Human	900m	W	0

Receptor	Description	Type	Approximate Distance (m)	Direction from Site	Sensitivity Based on Distance
R27	Police House & other adjacent residences	Human	975m	SW	0
R28	Westons Farm & Westons Place Residential Properties	Human	920m	SW	0
R29	Lower Gate House	Human	652m	S	0
R30	Pondtail Farm	Human/Commercial	915m	SSW	0
R31	Brittaniacrest Recycling	Human /Industrial	165m	S	0.5
R32	Biffa MMRC	Human /Industrial	75	SE	1
R33	Panel 2 Panel & Greens	Human/Commercial	563m	S	0
R34	Sewage Works adjacent to Farm	Human/Industrial	525m	SW	0
R35	Wealdon	Human	470m	SE	0
R36	Denhams Auctioneers	Human /Commercial	530m	NW	0
R37	Sussex Health Centre	Human	580m	NW	0
R38	Male Journey	Human	600m	NW	0
R39	White Cottage Cake Company	Human	630m	NW	0
R40	Houses on Station Road	Human	620m	S	0
R41	Little London Hill	Human	650m	W	0
R42	Vale Stud Riding School	Human	886m	NW	0
R43	Biffa ATRF	Human /Industrial	<10m	N & W	1
R44	Biffa Landfill	Human /Industrial	25	N	1

The sensitivity factor based on distance is given such that receptors <75m from activity is 1 reducing in increments of 0.25 until receptors at distances >300m are 0 (this will be used in assessing risk in Section 4 below).

The location of sensitive receptors is shown on drawing BA236000 (see Application Part 13).

2.2 OWC Process Information

Full details of the OWC processing arrangements are presented in the OWC Technical Plan (Application Part 4) and a summary presented below.

It should be noted that all screening and separation processing activities on inputs or outputs will be completed within a building enclosed on three sides with a roof.

2.2.1 Reception

Waste destined for green waste composting treatment will be delivered to site through the new weighbridge and necessary paperwork completed. This includes details of the waste carrier, waste type,

source and quantity (tonnes) of green waste that have been recorded on the Waste Transfer Note or Season Ticket.

The material will then be directed to the green waste reception area. The weighbridge operative will control traffic by two-way radio, and the compost supervisor will allow vehicle to enter the area and deposit the load in the allocated area and in a safe manner. Loads will be visually inspected and pushed up into a heap/or loaded directly into a shredder. Loads may be litter picked to remove contamination if necessary.

2.2.2 Initial Processing

After offloading, any unsuitable or oversized materials will be removed, and the remaining feedstock will be stockpiled and shredded using a mobile shredder. All unsuitable and/or oversized materials will be placed in skips for onward transportation to a suitably licensed recovery or disposal facility.

The feedstock material will be placed in the mobile shredder by a front-end loading shovel and/or a 360° excavator – normally within 5 days of receipt. The mobile shredder will be moved along the treatment pad to form the windrows. Moisture checks will be carried out and adjusted by adding water or fibrous material and/or structuring agents, as required. The water will be sourced from the drainage lagoon to be provided in each of the composting areas. Once the windrow has been completed it will be given a unique batch number and will start the composting process.

The site will operate an information management system that provides batch data records for types, quantities, sources of waste received at the site, shredding and processing data (temperature and moisture for each batch) and final end-product screening and quality characterisation.

2.2.3 Stabilisation, Maturation and Monitoring

For each batch the sanitisation phase will occur during the first two weeks of the 12-week total minimum composting period. The stabilisation period will occur for the following 10 weeks. The feedstock in the windrows will naturally decompose and reach temperatures of between 65°C to 80°C (sufficient to destroy weed seeds etc.). After the initial 2-week period, temperatures will be maintained at >45° C by turning using the front end loading shovel and/or a 360° excavator at least once every two weeks and by managing moisture levels until the end of the stabilization phase. The windrows will be turned in a sequence that allows the material to end up as near to the screening area as possible.

The temperature and moisture content of the windrow will be monitored and recorded on a regular basis, using a probe inserted at least 0.5m into the windrow. During the subsequent final maturation stage the feedstock will either be retained in windrows or be formed into separate stockpiles and the temperature will further decrease. The end of the maturation phase is reached when batch temperatures remain within critical limits for a specified minimum period. At this point each batch will be marked as complete by recording the completion date on a ‘Batch Appraisal Record Sheet.’

2.2.4 Screening, dispatch and end-use

Once the material has satisfactorily achieved the minimum composting period it will be passed through the screening and separation plant to achieve:

- *0 – 30 mm, soil improver, certified to PAS 100 & CQP*
- *0 – 25 mm, soil improver, certified to PAS 100 & CQP*
- *0 – 10mm, soil improver, certified to PAS 100 & CQP*

This product will then be classed as finished product and stored in the product despatch area where it awaits bulk collection or bagging.

Some compost screened to a 0-10mm grade will be allowed to mature and be either directly bagged or blended with imported sands and soils (non-waste materials) to create a topsoil mix in line with PAS 100 requirements. Bags could range from 25 litre up to a 1- ton builders’ bag. Any small bags will be palletised and shrink wrapped and stored outside until despatch. At this end stage of the process the composting has been completed and left the permitted area.

Coarse woody particles from screening and shredding can be dispatched for disposal, supplied as non-PAS 100 confirming material or reprocessed if physical contamination is low or reduced before re-processing.

Any leachate or surface run off will be reused to irrigate the windrows during the sanitisation phase only.

2.2.5 Output

Up to 45,000 tonnes of compost will be produced each year which complies with the Publicly Available Specification 100 (BSI PAS 100 (2018)) for composted materials and the Compost Quality Protocol. Material not meeting PAS100 standards may be exported for use on landfill restoration under permit.

Up to 30,000 tonnes of shredded wood (not composted) will be produced each year which will be produced from shredding activities following by screening to remove metals. Wood product will be exported for processing into to recycled products or for use in biomass.

3. Risk Assessment Methodology

3.1 Introduction

This section outlines the approach taken to evaluate the potential risks to human health from bioaerosols associated with the operation of the Brookhurst Wood OWC Facility. The impact evaluation process has referred to the appropriate guidance within Environment Agency (2009) *Guidance on the evaluation of bioaerosol risk assessments for composting facilities."* and "B*ioaerosol monitoring at regulated facilities - use of M9: RPS 209*".

3.2 Risk Assessment Methodology

The evaluation methodology used involves three stages:

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

4. Risk Assessment

4.1 Hazard Identification

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.

Based on various studies high levels of micro-organisms are likely to 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.

In order to assess the potential risks from bioaerosols, emission sources need to be considered. Table 3 sets out the source-pathway- receptor linkages for exposure of local sensitive receptors to emissions from airborne bioaerosols at the site.

Table 3 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 will potentially 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 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). However, activities at neighbouring waste facilities must be considered in addition to agricultural activities when assessing the facility.

4.2 Exposure Assessment

4.2.1 Conceptual Model

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 3:

Figure 3 Site Conceptual Model for Pollutant Exposure

SOURCE	PATHWAY	RECEPTOR
		
Release of bioaerosols during windrow formation, windrow turning, screening and transportation.	Airborne transportation.	Nearby sensitive receptors as identified in Table 1, in Section 2.1.2
HAZARD		
Mucous membrane irritation with systemic symptoms such as fever, headache Sensitisation – allergic reaction Infection such as *Aspergillus fumigatus.*		

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.

4.2.2 Potential Emissions Levels

As this is a new composting site, no site-specific monitoring is available, therefore reference has been made to the SNIFFER Report, "*Measurement and Modelling of Emissions from Three Composting Sites*" and similar reports which identify that bioaerosol concentrations are usually elevated during agitation and shredding activities while 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.

In respect of likely process contribution from such composting operations on receptors, using the aforementioned SNIFFER report results for upwind and downwind bioaerosol concentrations the potential process contributions can be estimated. These are shown in Table 4 below.

Table 4 – Potential Bioaerosol Process Contributions

Season	Upwind CFU/m^3	Downwind CFU/m^3	Process Contribution CFU/m^3	EA Threshold Level CFU/m^3
Actinomycetes				
Summer	0	7,100	7,100	20,000
Autumn	56,900	76,400	19,500	
Winter	6,800	8,600	1,800	
Aspergillus fumigatus				

Season	Upwind CFU/m^3	Downwind CFU/m^3	Process Contribution CFU/m^3	EA Threshold Level CFU/m^3
Summer	1,300	1,400	100	100,000 – 1,000,000
Autumn	0	1,500	1,500	
Winter	0	0	0	

In addition to the general impact on sensitive receptors, the SNIFFER Report also provided an indication of likely bioaerosol concentrations from different activities on a compost site – these are summarised in Table 5 below.

Table 5 - Emissions Classification for Site Activities

Site Activity	Summer CFU/m^3	Autumn CFU/m^3	Winter CFU/m^3
Actinomycetes			
Incoming Waste Delivery	-	766,200	-
Waste reception stockpile	-	147,700	6,100
Screening	-	2,460,000	-
Shredding	-	-	40,900
Windrow	18,900	-	93,600
Mature Compost	-	269,300	4,900
Aspergillus fumigatus			
Incoming Waste Delivery	-	45,800	-
Waste reception stockpile	-	8,700	15,500
Screening	-	6,400	-
Shredding	-	-	7,600
Windrow	8,700	-	4,500
Mature Compost	-	3,000	23,500

4.2.3 Emissions Classification

An emissions classification can therefore be drawn from the identified site activities as identified in the section above. Table 6 below presents the classification and comments regarding each class and activity.

Table 6 - Emissions Classification for Site Activities

Emissions Class	Site Activities	Comments	Hours/Week
Low	Vehicle movements	Constant activities but low level of material agitation	80
	Site maintenance		
	Material storage		
Low to Medium	Waste reception	Activities take place on designated unloading and shredding area then composting area.	40
	Shredding		
Medium	Vehicle loading and transportation of finished products.	Limited quantities of mature low potential materials	15
	Stabilisation	Low release from undisturbed windrows.	
High	Screening		12

Emissions Class	Site Activities	Comments	Hours/Week
	Windrow formation	High instantaneous release of bioaerosols in immediacy of activities which are actively agitating materials.	
	Windrow turning		
Very High	Accidents leading to elevated release events.	Rare due to management systems and processes.	<1

4.3 Risk Estimation

The risk estimation 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.

4.3.1 Magnitude of Consequences

Table 7 below 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 expected at or adjacent to the source.

Table 7 - Magnitude of Consequences from Source Emissions

Category	Indicative CFU/m^3 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	Short term highest natural environmental levels for

Category	Indicative CFU/m^3 Range	Category and Consequence	Level of consequences compared to natural levels
		health, welfare, and nuisance. Local dysfunction of communities if continuous. • Local ecosystem changes detectable.	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.

Based on the indicative emission levels above and the meteorological information in section 2.1.2, the magnitude of consequences is expressed as terms of risk in Table 8 below for different sensitive receptors.

Table 8 - Risk Assessment Factor A - Magnitude of Consequence

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R1	Negligible	Negligible	Negligible	Negligible	Negligible
R2	Negligible	Negligible	Mild	Mild	Moderate
R3	Negligible	Negligible	Negligible	Negligible	Negligible
R4	Negligible	Negligible	Negligible	Negligible	Negligible
R5	Negligible	Negligible	Negligible	Negligible	Negligible
R6	Negligible	Negligible	Negligible	Negligible	Negligible
R7	Negligible	Negligible	Negligible	Negligible	Negligible
R8	Negligible	Negligible	Negligible	Negligible	Negligible
R9	Negligible	Negligible	Negligible	Negligible	Negligible
R10	Negligible	Negligible	Negligible	Negligible	Negligible
R11	Negligible	Negligible	Negligible	Negligible	Negligible
R12	Negligible	Negligible	Negligible	Negligible	Negligible
R13	Negligible	Negligible	Negligible	Negligible	Negligible
R14	Negligible	Negligible	Negligible	Negligible	Negligible
R15	Negligible	Negligible	Negligible	Negligible	Negligible
R16	Negligible	Negligible	Negligible	Negligible	Negligible
R17	Negligible	Negligible	Negligible	Negligible	Negligible
R18	Negligible	Negligible	Negligible	Negligible	Negligible
R19	Negligible	Negligible	Negligible	Negligible	Negligible
R20	Negligible	Negligible	Negligible	Negligible	Negligible
R21	Negligible	Negligible	Negligible	Negligible	Negligible
R22	Negligible	Negligible	Negligible	Negligible	Negligible

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R23	Negligible	Negligible	Negligible	Negligible	Negligible
R24	Negligible	Negligible	Negligible	Negligible	Negligible
R25	Negligible	Negligible	Negligible	Negligible	Negligible
R26	Negligible	Negligible	Negligible	Negligible	Negligible
R27	Negligible	Negligible	Negligible	Negligible	Negligible
R28	Negligible	Negligible	Negligible	Negligible	Negligible
R29	Negligible	Negligible	Negligible	Negligible	Negligible
R30	Negligible	Negligible	Negligible	Negligible	Negligible
R31	Negligible	Mild	Mild	Moderate	High
R32	Mild	Moderate	Moderate	High	Severe
R33	Negligible	Negligible	Negligible	Negligible	Negligible
R34	Negligible	Negligible	Negligible	Negligible	Negligible
R35	Negligible	Negligible	Negligible	Negligible	Negligible
R36	Negligible	Negligible	Negligible	Negligible	Negligible
R37	Negligible	Negligible	Negligible	Negligible	Negligible
R38	Negligible	Negligible	Negligible	Negligible	Negligible
R39	Negligible	Negligible	Negligible	Negligible	Negligible
R40	Negligible	Negligible	Negligible	Negligible	Negligible
R41	Negligible	Negligible	Negligible	Negligible	Negligible
R42	Negligible	Negligible	Negligible	Negligible	Negligible
R43	Mild	Moderate	Moderate	High	Severe
R44	Mild	Moderate	Moderate	High	Severe

4.3.2 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 9 below.

Table 9 - 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.

Factor	Description
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 5 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 5.

Table 10- 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 using the following formula:

Hrs Exposed (Table 5) x % wind blows to receptor (Figure 1) x Receptor Occupancy (Table 8) x Sensitivity (Table 1)

The results are shown in Table 11 for possible exposure to emissions from operations on site.

Table 11 - Risk Assessment Factor B - Probability of Consequence

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R1	Negligible	Negligible	Negligible	Negligible	Negligible
R2	Negligible	Negligible	Negligible	Negligible	Moderate
R3	Negligible	Negligible	Negligible	Negligible	Negligible
R4	Negligible	Negligible	Negligible	Negligible	Negligible
R5	Negligible	Negligible	Negligible	Negligible	Negligible
R6	Negligible	Negligible	Negligible	Negligible	Negligible
R7	Negligible	Negligible	Negligible	Negligible	Negligible
R8	Negligible	Negligible	Negligible	Negligible	Negligible
R9	Negligible	Negligible	Negligible	Negligible	Negligible
R10	Negligible	Negligible	Negligible	Negligible	Negligible

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R11	Negligible	Negligible	Negligible	Negligible	Negligible
R12	Negligible	Negligible	Negligible	Negligible	Negligible
R13	Negligible	Negligible	Negligible	Negligible	Negligible
R14	Negligible	Negligible	Negligible	Negligible	Negligible
R15	Negligible	Negligible	Negligible	Negligible	Negligible
R16	Negligible	Negligible	Negligible	Negligible	Negligible
R17	Negligible	Negligible	Negligible	Negligible	Negligible
R18	Negligible	Negligible	Negligible	Negligible	Negligible
R19	Negligible	Negligible	Negligible	Negligible	Negligible
R20	Negligible	Negligible	Negligible	Negligible	Negligible
R21	Negligible	Negligible	Negligible	Negligible	Negligible
R22	Negligible	Negligible	Negligible	Negligible	Negligible
R23	Negligible	Negligible	Negligible	Negligible	Negligible
R24	Negligible	Negligible	Negligible	Negligible	Negligible
R25	Negligible	Negligible	Negligible	Negligible	Negligible
R26	Negligible	Negligible	Negligible	Negligible	Negligible
R27	Negligible	Negligible	Negligible	Negligible	Negligible
R28	Negligible	Negligible	Negligible	Negligible	Negligible
R29	Negligible	Negligible	Negligible	Negligible	Negligible
R30	Negligible	Negligible	Negligible	Negligible	Negligible
R31	Low	Low	Negligible	Negligible	Negligible
R32	Medium	Low	Negligible	Negligible	Negligible
R33	Negligible	Negligible	Negligible	Negligible	Negligible
R34	Negligible	Negligible	Negligible	Negligible	Negligible
R35	Negligible	Negligible	Negligible	Negligible	Negligible
R36	Negligible	Negligible	Negligible	Negligible	Negligible
R37	Negligible	Negligible	Negligible	Negligible	Negligible
R38	Negligible	Negligible	Negligible	Negligible	Negligible
R39	Negligible	Negligible	Negligible	Negligible	Negligible
R40	Negligible	Negligible	Negligible	Negligible	Negligible
R41	Negligible	Negligible	Negligible	Negligible	Negligible
R42	Negligible	Negligible	Negligible	Negligible	Negligible
R43	Low	Low	Negligible	Negligible	Negligible
R44	Low	Negligible	Negligible	Negligible	Negligible

4.3.3 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 8
- Risk Assessment Factor B: Probability of Consequence - Table 11

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 Table12.

Table 12 - Risk Estimation Matrix

Probability Factor B	Magnitude of Consequence (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

Table 13 - Significance of Risk from Site Operations

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R1	1	1	1	1	1
R2	1	1	2	2	3
R3	1	1	1	1	1
R4	1	1	1	1	1
R5	1	1	1	1	1
R6	1	1	1	1	1
R7	1	1	1	1	1
R8	1	1	1	1	1
R9	1	1	1	1	1
R10	1	1	1	1	1
R11	1	1	1	1	1
R12	1	1	1	1	1
R13	1	1	1	1	1
R14	1	1	1	1	1
R15	1	1	1	1	1
R16	1	1	1	1	1
R17	1	1	1	1	1
R18	1	1	1	1	1
R19	1	1	1	1	1
R20	1	1	1	1	1

RECEPTOR	EMISSION CLASSIFICATION				
	Low	Low - Medium	Medium	High	Very High
R21	1	1	1	1	1
R22	1	1	1	1	1
R23	1	1	1	1	1
R24	1	1	1	1	1
R25	1	1	1	1	1
R26	1	1	1	1	1
R27	1	1	1	1	1
R28	1	1	1	1	1
R29	1	1	1	1	1
R30	1	1	1	1	1
R31	2	4	2	3	4
R32	6	6	3	4	5
R33	1	1	1	1	1
R34	1	1	1	1	1
R35	1	1	1	1	1
R36	1	1	1	1	1
R37	1	1	1	1	1
R38	1	1	1	1	1
R39	1	1	1	1	1
R40	1	1	1	1	1
R41	1	1	1	1	1
R42	1	1	1	1	1
R43	4	3	3	4	5
R44	4	3	3	4	5

4.3.4 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 11).

These are not definitive categories but indicate the likely degree of risk acceptability from the risk assessment calculations and site management requirements. Table 14 provides a tolerability criterion (based on DEFRA classifications) for bioaerosol risk assessment scores.

Table 14- Tolerability Criterion

Tolerability Level	Criteria
Acceptable	Risks are in the low range and are likely to be acceptable in all circumstances.

Tolerability Level	Criteria
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 Brookhurst Wood are likely to be as follows:

- The risks to potentially offsite sensitive receptors are negligible given the distance from the site boundary.
- The risk to operational staff undertaking other site activities (e.g., landfill, MBT or ATRF) is primarily low although it increases to moderate levels for activities taking place in close proximity to those activities which have a high or very high risk of releasing bioaerosols (e.g., windrow turning or accidents).
- The tolerability of site operations is considered to be acceptable in most circumstances. It increases to tolerable when the wind is blowing towards other site operational areas. However, emissions are unlikely to cause any significant health effects when face masks are provided in these circumstances.
- The site will use best practice techniques to reduce any residual risk to as low as reasonably practicable. The operator will 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 materials as applicable).

4.4 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 will be 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 will be monitored to avoid the waste and materials drying out and potentially forming dusts.

b. The formation or turning of windrows will be avoided, if possible, on windy days.

c. Screening and separation activities will be only undertaken inside the screening and separation building.

d. Inspections of the infrastructure will be undertaken to ensure that requisite maintenance is regularly undertaken. Checks will include fencing, gates, processing equipment, compost treatment pad and the surface water drainage system.

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

f. A Fire Prevention Plan (FPP) will be in place in order to prevent and manage potential fire risks on site.

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

h. An onsite meteorological station will be used to log the required data (i.e., wind direction and wind speed) to identify conditions of high winds blowing towards the receptor(s).

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

j. Composting process and controls will be inline within industry best practice, being PAS100 and QP certified.

k. All employees at the composting site will be provided with appropriate RPE when they are dealing with green waste. If the adjacent landfill, MBT and ATRF operations are likely to affected on any day then operators at these areas will be provided with similar RPE.

l. All boiler suits will be taken off prior to entering any food preparation area such as the site mess facilities.

m. Site surfaces such as roads and tracks will be regularly dampened down and/or regularly swept to suppress dust and bioaerosols.

n. 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 need additional dampening. Steaming of windrows will be reduced by ensuring the compost pile is within the correct temperature range.

o. Frequent turning of the waste will be avoided.

5. Conclusion

In conclusion, while the proposed composting activities are in the open, the operational area (source of release) is more than 330 metres from the nearest offsite sensitive receptor and as such there should be no impact on sensitive offsite receptors.

Onsite sensitive receptors (e.g., operators at the landfill, MBT and ATRF areas) should be largely unaffected by the OWC operations although it is recognised that they may be affected if work activities are taking place downwind and close to OWC activities (e.g., windrow turning) with high bioaerosol release potential, particularly for operators using the adjacent Landfill facilities. However, proposed mitigation measures as outlined in Section 4.4 should reduce any potential risks to tolerable levels in these circumstances.