



**Connetts Farm Compost
Land to West of Flightways Business Park
Dunkeswell
EX14 4RD**

50.866627 -3.225663

Bio-Aerosol Risk Assessment

**S21-628/SSBRA
May 2021**

Prepared by :

**Southwest Environmental Limited
Quay House
Kings Wharf
The Quay
Exeter
EX2 4AN**

On behalf of :

**Connetts Farm Compost
Land to West of Flightways Business Park
Dunkeswell
EX14 4RD**



**Connects Farm Compost
Land to West of Flightways Business Park
Dunkeswell
EX14 4RD**

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1.0 Introduction

Acting on instructions from Connetts Farm Compost, Southwest Environmental Limited is to undertake a Site Specific Bio-aerosol Risk Assessment (SSBRA) of their waste operation; Land to West of Flightways Business Park. Site Plans can be found in **Appendix 1**.

Compost: Most bio aerosol guidance is based on compost sites. Where the reader sees compost mentioned throughout this report, it has been done intentionally in an attempt to draw parallels between the two waste treatment processes (Compost and Soils).

1.1 Objectives

The objective of this study is to identify the potential for significant risks to human health in the workplace, dwellings or public buildings within the vicinity of the site and to demonstrate that bio-aerosol risks can be maintained at acceptable levels.

1.2 Scope

The scope of the assessment covers the operation of Connetts Farm Compost waste treatment operation which consists of open window composting and treatment and transfer of soils. Aggregates (Recycle Concrete Aggregates) are also transferred and treated on site, but are not considered in this assessment owing to low Bio-Aerosol Potential. To that end the scope of this report includes the aims of:

- i. Establish the sources of bio-aerosols arising from operations at the site;
- ii. Assess for significant risk of impact at sensitive locations due to emissions from the identified sources; and,
- iii. Identify any additional mitigation to control potential effects

This assessment necessarily relies on secondary data from studies conducted at composting sites.

2.0 Bioaerosols

Bioaerosol is an umbrella term for microscopic matter typically composed of bacteria, fungi, viruses, spores, moulds, rusts, protozoa, pollens, etc and their degradation products and toxins etc. As you might imagine there are very high levels of naturally occurring bio-aerosols, from anthropogenic sources and from currently unregulated activities.

To give some idea of background levels, we might expect 0 – 690 cfu/m³ for typical outdoor air, and up to 35,000 cfu/m³ in houses¹. It is not typical to assess for all types of bio areoles, typically a marker such as *Aspergillus fumigatus* is used.

¹ Swan et al., 2003



2.1 Fungi

Fungal spores produced during reproduction can vary in size, typically between 2 and 50 μm . They are often small, light and therefore easily transported by air.

Fungi produce secondary products during metabolism, such as mycotoxins (toxic substances produced by fungi during their growth), as well as shedding components, such as glucans. Glucans are highly-branched polymers of glucose that occur as components of the cell walls of yeasts and other fungi.

2.2 Bacteria

Bacteria are single-celled prokaryotic organisms and are the most important group during the initial stages of the aerobic degradation (Miller, 1996). Bacteria are usually between 1 and 5 μm in size, and are divided into Gram-negative bacteria (predominantly of animal origin) and Gram-positive bacteria (predominantly of plant origin).

2.3 Actinomycetes

These are filamentous Gram-positive bacteria, some of which are thermophilic and thrive in wet compost. They are of concern since the thermophilic actinomycetes species are recognised respiratory allergens which produce large numbers of very small spores (1-3 μm diameter) capable of deep penetration in the human lung.

2.4 Endotoxin

This is a term given to fragments of the bacterial cell wall from all Gram- negative bacteria and some blue-green algae. Endotoxin is present in compost as a consequence of the presence of Gram-negative bacteria as well as being a component of some organic dusts which may contribute to feedstocks. Endotoxin may cause both short-term and long-term illness by inhalation.

2.5 Mycotoxins

These are non-volatile low molecular weight secondary metabolites produced by fungi. Most commonly encountered through ingestion, mycotoxins can be carcinogenic, neurotoxic and teratogenic, and may also contribute to occupational lung disease in workers exposed to organic dusts².

2.6 Glucans

These are polymeric species of glucose found in the cell walls of fungi, some bacteria and plants. (1 \rightarrow 3)- β -D-glucan is a potent inflammatory agent which has been associated with an increased prevalence of atopy, decrease in lung function and adverse respiratory health effects in the indoor and occupational environment. There is evidence that (1 \rightarrow 3)- β - D-glucans may enhance pre-existing inflammation in human subjects.

² Swan et al. , 2002



2.7 Pathways

Transport by wind is most significant and therefore 'line of sight' with the absence of significant barriers is relevant for the assessment of pathways and identification of receptors. Winds >3.1m/s are more normally associated with lifting and transport of organic particulates. Barriers can create 'sheltered' areas enabling deposition of particles of small size. Barriers can also deflect wind away from the source to prevent release or away from the receptor to prevent exposure.

Wind direction and strength is a key factor in determining the migration of bio aerosol from point of production to sensitive receptors.

3.0 Potential Health Effects

As mentioned above bioaerosols can penetrate deep into the lungs; causing respiratory and gastro-intestinal symptoms such as inflammation, coughs, fever and exacerbation of respiratory diseases. Endotoxins cause symptoms from eye irritation and dermatitis or in extreme cases resemble those of influenza, such as shivering, an increase in body temperature, dry cough, and muscle and joint pains. Relevant to waste management are infections caused by *Aspergillus fumigatus*. Invasive aspergillosis is a severe infection, which may be fatal and is a concern with 'at risk' and 'immuno-suppressed' patients.

Healthy individuals are not usually affected by bioaerosol in the natural environment and there is no published evidence that nearby occupiers have suffered ill health effects from bioaerosol from waste sites. However, it is accepted that, at some point, high concentrations or long exposure could affect a vulnerable individual and in some circumstances bioaerosol or associated toxins could overwhelm the body's natural defences. Therefore a precautionary principle is adopted for the assessment of potential health risks.

A study of health effects from waste management on behalf of Defra³ reviews bioaerosol from various waste activities. In addition to worker health the report considers public health. For example, the report refers to studies by the HSE & others measuring bio-aerosol from various waste locations that found levels reduced to background within 50 metres of the sites; suggesting that emissions are not likely to be significant.

4.0 Regulation

Outline of regulation that relates to bio aerosols.

4.1 Environmental Permit

Standard rules for treatment of waste include a requirement for the activity to be located more than 250m from any off site building used by the 'public', including dwelling houses.

'Building(s)' and 'Public' are not defined and many consider that the staff of the same commercial business parks and industrial estates should be excluded.

³ Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes



Where an activity does not comply with a 'standard permit' a 'bespoke permit' is required. A 'bespoke permit' allows waste treatment within 250m of a receptor, provided risks are deemed low, or are mitigated against.

4.2 Bioaerosol Position Statement

The EA has issued a policy statements⁴ on potential health effects of bio aerosols from **composting** and biowaste. The policy covers the risks posed by bio aerosols on human health from composting. Although the AD process is dissimilar to composting in some respects receiving, loading, shredding and mixing of AD feedstock are similar in terms of their footprint to activities one might find on a composting site.

Currently EA policy requires 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 'composting' 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 bio aerosol - sources of bioaerosol being outdoor composting 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*.

4.2.1 Receptors

Human health is the focus for bioaerosol risk assessment. The revised EA statement defines sensitive receptors as referring to;

'people likely to be within 250 metres' for 'prolonged or frequent periods'.

The expression *'prolonged or frequent periods'* is not defined but we might assume 4 hours, based on exposure at for 33% of a 12 hours period.

Sensitive Receptors are typically defined as

- a 'dwelling' including the garden but not land such as a paddock or field; and
- a 'workplace' where workers are present for prolonged or frequent periods; not including staff on the same site as they are covered by Health & Safety legislation.

Typically sensitive receptors include schools, hospitals, hotels, caravan parks, etc but not areas where exposure is transient e.g. footpaths, bridleways, byways, highways, roads, open space, etc. Former guidance did refer to the need to identify roads, pathways and recreational areas, but did not indicate whether these could be considered to be 'sensitive' with regard to bioaerosol.

⁴ [http://organics-recycling.org.uk/uploads/article1822/Composting & bioaerosols position statement - fina 20101%5B1%5D.pdf](http://organics-recycling.org.uk/uploads/article1822/Composting_%20&%20bioaerosols_position_statement_-_fina_20101%5B1%5D.pdf)



Other guidance refers to different receptors. For example, in guidance to permit exemptions; receptors include surface & groundwater, wells and boreholes, soils, humans, wildlife and their habitats and elsewhere makes reference to a range of designated protection areas including SSSI, SPA, Ramsar, cSAC, AONB, etc.

The table below shows the ODPM sensitivity ranking for potential receptors to for dust. There are minor differences in sensitivity categories to include several issues such as dust, odour & bioaerosol.

High Sensitivity	Medium Sensitivity	Low Sensitivity
Hospitals and clinics	Schools	Farms
Retirement homes	Residential areas	Light and heavy industry
Hi-tech industries	Food retailers	Outdoor storage
Painting and furnishing	Glasshouses and nurseries	
Food processing	Horticultural land	
	Offices	

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4.2.2 Precautionary Zone - 250 Metre

For bioaerosol risk assessment the revised EA statement defines the 250m distance as being from operations *"likely to result in the uncontrolled release of high levels of bioaerosols"*. This includes the *"shredding of waste and the turning of waste where these operations are not contained or are not subjected to exhaust ventilation and scrubbing/filtering"*.

Effectively the 250 metres is measured from the 'active composting' area inside the site. This area is marked on plans in **Appendix 1**.

4.2.3 Environmental & Air Quality Criteria

The EA's position regarding standards is described in Guidance M17⁶, which notes that the EA *"does not consider it currently appropriate to derive ambient environmental yardsticks...."* but *"...advocates the use of a risk based approach"*.

'Appropriate Levels' identified by the EA have been revised in recent guidance as shown the table below. These are derived from values for an 8-hour working day. The EA concedes levels *"are often exceeded in natural outdoor situations where health effects are not generally noted"* and state that these levels *"are probably conservative given that health effects are not reported downwind of the sites"*.

⁵ http://www.leics.gov.uk/mps02_annex_1_dust.pdf (Mineral Policy Statement 2)

⁶ <http://publications.environment-agency.gov.uk/PDF/GEHO1105BJXU-E-E.pdf> (M17)



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

5.0 Assessment Methodology

A risk assessment has been assembled based on guidance found in Guidance on the evaluation of bioaerosol risk assessments for composting facilities. The process tree can be viewed in **Appendix 3**.

The first stage is to define the problem, the hazards, the risk of the hazards occurring, and the consequences. This has been done over the course of following sections.

5.1 Risk Assessment Level

Risk assessment is typically split in the three levels each one more complex than the next, for Standard Rules Permits a generic risk assessment is generally sufficient, and sometimes these can be used for bespoke permits. For bespoke composting activities a level 3 risk assessment is called for, as stated in the position statement.

5.1.1 Risk Screening (Level 1)

Risk Screening prioritises issues for assessment. Tier 1 assessment summarises the existence of a potential hazard-pathway-receptor linkage.

5.1.2 Generic Risk Assessment (Level 2)

Generic Risk Assessment examines whether a potential linkage can be ruled out as not significant. Assessment is based on generic conditions and concept models considering aspects such as type of activity, potential frequency of exposure, distance to receptor, etc. Local factors are considered in general terms only - e.g. frequency of wind direction. Indicative consequences to generic downwind concentrations are considered to establish whether significant risks may exist and require more detailed examination.

5.1.3 Tailored Site Specific Risk Assessment (Level 3)

Tailored *Site Specific* Risk Assessment extends the generic assessment to include estimations based on information specific to a receptor, such as the specific wind direction frequency of source releases, duration of site activity, etc affecting a specific receptor, etc. Site specific risk assessment is also based on more meaningful categories for the assessment of the *magnitude of consequences* relevant to exposure to bioaerosol concentration. Site specific risk assessment can include Quantitative Risk Assessment

⁷ Position Statement



(QRA) that includes mathematical evaluation such as probabilistic and deterministic estimation of the scope and extent of individual exposure.

6.0 Factors to be considered in Risk Assessment

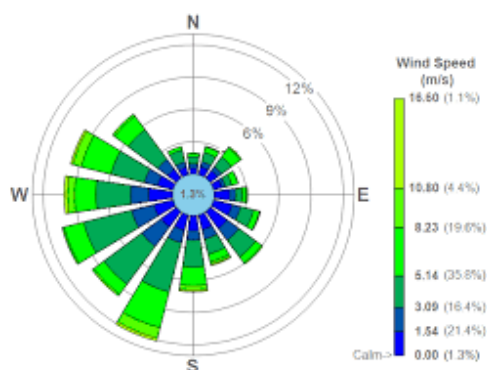
Fraddon BioGas is shown on the location and site plans in **Appendix 1**. It is situated to the south of India Queens, situated in Cornwall.

6.1 Weather

Weather can have effects on the dispersal of all pollutants, and as much is the same for bio aerosols.

6.1.1 Wind

As the wind rose⁸ below shows winds in the southwest of the UK, are NW to SSW for around 60% of the time, calm conditions are apparent only 1.3% of the time. Wind data from Yeolvilton Airbase (EDGY) shows a westerly to west south west trend.

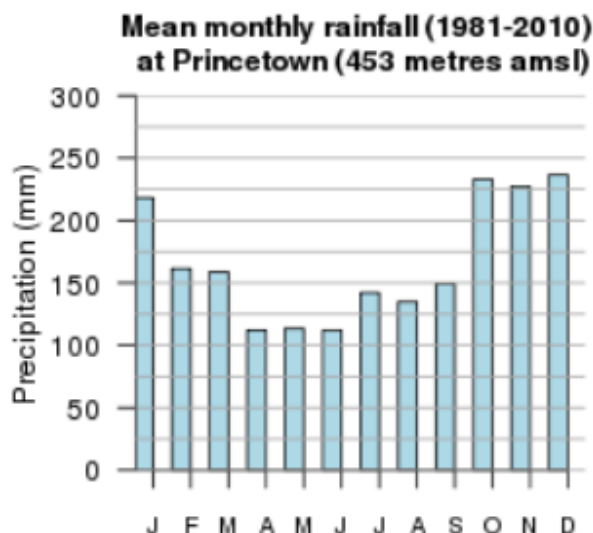


Wind is a useful tool in managing risk from bio aerosols; strong winds can quickly disperse air borne matter, whilst wind direction can be used to blow particulates, odour and pathogens away from sensitive receptors. The receptors of main concern are situated to the north of treatment operations. Care should be taken to manage barrier to funnel wind away from receptor, or away from sources.

6.1.2 Rain

The rain fall⁹ for the site can be expected to be similar to the levels shown in the graph below.

⁸ https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/south-west-england_-_climate---met-office.pdf



6.2 Receptors within 250 Metres

The receptors plan included within **Appendix 1** shows receptors within 250m of the site, in the table below they are listed in order of sensitivity.

Distance	Receptor	Direction
0-250m	Airfield Classic Cars	W
	The Laurels (Live Work)	W
	Flightway Industrial	W
250-500m	Tubby's TakeAway	N
	Dunkeswell Air Field	SE
500-1000m	Eastern Outskirt Denkeswell Village	W
		E

Green text represents low sensitivity, orange medium and red high sensitivity. There are no high sensitivity receptors within 250m of the site.

A further examination of distances relating to sub 250m receptors is given below. Distances are given from the processing area for manure / bedding shred area.

Distance (m)	Receptor	Direction
88	Airfield Classic Cars	W
40	Flight Way Industrial (Nearest)	W
80	The Laurels (Residential)	W



All receptors are in excess of 107m from the shredding area. The nearest medium sensitivity receptor is 107m from the shredding area.

6.3 Frequency Wind Blows towards Receptors

As the wind rose below shows winds in the southwest of the UK, are NW to SSW for around 60% of the time, calm conditions are apparent only 1.3% of the time. Wind data from Yeovilton Airbase (EDGY) shows a westerly to west southwest trend.

6.4 Facilities and Operations

The site consist of the following elements:

- Access Road;
- **Shredding, Screening**, Crushing Area
- Various Storage Areas
- Welfare & Office
- Vehicle Parking

We have highlighted in green the elements that we proposed as sources of bio-aerosol.

6.4.1 Pollution Control

The site is purpose built, and operates under an Environmental Permit. Pollution control is both modern and thorough. The Environment Agency conduct annual audits, and will deliver compliance assessment reports which outline any inadequacies regarding pollution control.

The Odour Assessment for the development conducted in relation to application PA12/01700, details the inclusion of air filtration in the reception building.

We have made an assumption that there is a correlation between odour and bio-aerosols and as such reference odour sources as detailed in the Odour Impact Assessment from ADAS carried out in 2012.

"Emissions from the proposed biogas plant are based on an assumed odour concentration of 8,000 ouE/m³ within the building . In reality such a high concentration will be confined to the waste reception hall and odour levels would be significantly lower elsewhere in the building. Ventilation of the building would be through a biofilter, which is expected to achieve 90% abatement of the odour, at a rate of 6,000 m³ Thus the final emission rate from the biofilter is calculated to be 1,333 ouE/s. Fugitive emissions elsewhere from elsewhere on the site are expected to be small."

The remainder of the system is effectively sealed and bio-aerosol emissions are likely to be minimal in other areas of the site.



6.5 Sources of Bioaerosol

The table below describes potential on site bioaerosol sources.

Element	Activity	Duration (hours per week)	Potential Release Rate	Comments
Reception	Loads arrive in covered lorries.	10	Low	Building operated under negative air pressure, extract through bio-filter.
Tipping	Tipping of lorries and trailers in to loading area.	10	Low	Building operated under negative air pressure, extract through bio-filter.
Loading	Use of loading shovel to load feed stock in to feed hopper.	10	Low	Building operated under negative air pressure, extract through bio-filter.

Other aspects of the development are not considered to be significant bio aerosol sources and have not been considered further. No bio aerosol measurements have been undertaken. Bio-filters vary in their effectiveness. But concentration of *Aspergillus fumigatus* are for the most part remain below 2000 cfu/m³¹⁰.

7.0 Risk Assessment

From Section 1.0 the objective of this study is to assess the potential for significant risks to human health at the workplace(s) or dwelling(s) or public buildings within the vicinity of the Compost Centre and to demonstrate that bio aerosols can and will be maintained at appropriate levels and to provide sufficient information for permits to be issued.

7.1 Regulation

Based on regulatory policy risk appraisal has focussed on risks within 250metres of the installation.

Quantitative data available includes wind speed and direction, location of sources and duration of activities, distance to receptors and frequency of occupation. There is scattered data from various studies that have been carried out to try and judge the risk posed by bio aerosols, and these are referenced where applicable.

¹⁰ Sniffer - Understanding Bio filter Performance - June 2014



7.2 Risk Screening (Level 1)

Risk screening identifies the existence of potential hazards and receptors. No account is taken of the existence or non-existence of pathways or mitigation measures and the probability of consequences is assumed to be absolute.

Hazards have been identified in section 4.5 and receptors in section 4.2, without further investigation it can be summed there is a potential risk.

7.3 Generic Risk Assessment (Level 2)

A risk screening has identified potential risk; a level 2 generic risk assessment is there for required.

7.3.1 Conceptual Model

Potential hazards are summarised in the conceptual model in **Appendix 2**. The bio filter is considered primary source.

7.3.2 Consequences

The significance of the potential consequences that the identified hazards represent are classified depending upon:

- a) The levels of the impact that potential risks may pose.
- b) The application of these impacts in relation to the highlighted receptors (humans).

Five categories from “*negligible*” to “*extremely*” severe are suggested by DEFRA and other categories are suggested by the EA. A *moderate* risk is deemed as acceptable¹¹, based on the values included in the table below. The table below highlights some health potential impacts from anticipated levels.

risk	cfu/m³	effects
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

¹¹ <http://www.environment-agency.gov.uk/research/library/position/41211.aspx>



		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 (immune-compromised/frail/elderly/sick). Continuous long term - robust individuals unaffected. Potential health effects on vulnerable individuals (immune compromised/frail/elderly/sick). Potential minor effect on population structure or size. No observable effect on local ecosystem. Upper-range natural environmental levels.
High	3000 - 10000	Short-term - no significant impacts on robust individuals. Vulnerable individuals affected including welfare and nuisance. Continuous long term - vulnerable individuals affected including health, welfare, 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

7.3.3 Generic Down-Wind Concentrations

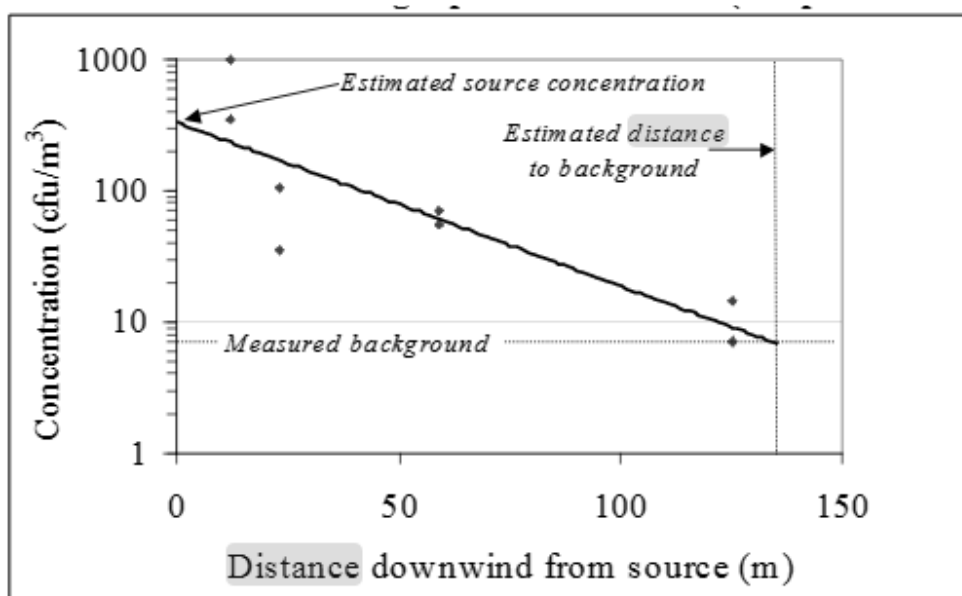
The table below indicates best available data for downwind concentrations.



Over viewing the data presented in this document it is become apparent that in many case bio-aerosols may be naturally in excess of “appropriate” levels, with much of the data showing little relationship between distance from facilities and levels of cfu’s.

In the case of this operation, it can be not that the most sensitive receptors are not downwind when considering prevailing wind.

“bioaerosols deplete rapidly with distance from their source, and measurements at distance (say >50 m and beyond) are far more difficult to authenticate as being from a specific operation as opposed to other, non-compost sources.”¹²



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The above graph describes a situation where bio aerosol concentrations fall by a factor of 20 for every 50 meters for source. If we consider the shredding operation as the principal source, with a concentration of 5000 cfu/m³. It is likely that the concentration will be in the region of 100 cfu/m³. Which is would have the following effect at a distance of 80m:

"No observable effect on health of individuals. No observable effect at the population level or on local ecosystem. Mid range of natural environmental levels."

7.4 Risk Assessment Tables

The hazards and receptors have been identified as have the consequences and the likely hood of those consequences. Residual risks are low, if properly managed.

¹² <http://www.prairieswine.com/pdf/2959.pdf> Bioaerosol releases from compost facilities: evaluating passive and active source terms at a green waste facility for improved risk assessments – MP Taha

¹³ <http://www.hse.gov.uk/research/rrpdf/rr130.pdf>



8.0 Managing Risk

The following good practices have been adopted as an integral part of the operation and, where appropriate, include the following good practice operation and mitigation measures:-

- a) Barriers for wind such as earth bunds and planting should be maintained.
- b) Waste handling and treatment processes shall take place in internal and abated areas.
- a) Operational areas and surfaces shall be maintained in a clean condition and regularly scraped/swept.
- b) Incoming materials shall be inspected and offloaded as soon as possible and contrary materials shall be removed offsite.
- i) Daily visual observations shall take place and include activities, bio- filter, drainage, litter checks, fugitive releases and conditions potentially affecting bio aerosol release and shall be daily recorded in a site log book.
- j) Activities or conditions associated with potentially high emission of bio-aerosols shall be controlled, e.g. by curtailing those activities when significant winds are blowing towards sensitive receptors.
- k) When the site is closed, reasonable security measures shall be implemented, e.g. locking off access gate and buildings and maintaining site boundary fencing.

9.0 Conclusions

There is potential for bio aerosol releases from the shredding and screening of organic wastes on site.

High sensitivity receptors are in 80m of the considered source. At this distance given a wind blowing towards the receptor, we might expect a bio aerosols to have:

"No observable effect on health of individuals. No observable effect at the population level or on local ecosystem. Mid-range of natural environmental levels."

The magnitude of risk is therefore low, and this combined with the frequency of risk, which is likely to be less than 20% of the time in any given year (owing to prevailing winds), and intermittency of the considered processes, is further reassurance of an overall low risk to assessed receptors.

10.0 Certification

This report was produced for the sole use of the Client, and no responsibility of any kind, whether for negligence or otherwise, can be accepted for any Third Party who may rely upon it. However, it necessarily relies on the co-operation of other organizations and the free availability of information and total access.

No responsibility can, therefore, be accepted for conditions arising from information that was not available to the investigating team as a result of information being withheld or access being denied. For the avoidance of doubt, the parties hereby expressly agree that the Consultant



takes no liability for and gives not warranty against actual harm or financial loss to any entity in relation to the performance of the service.



APPENDIX 1

Plans



**Connetts Farm
Compost**

Plan: Layout

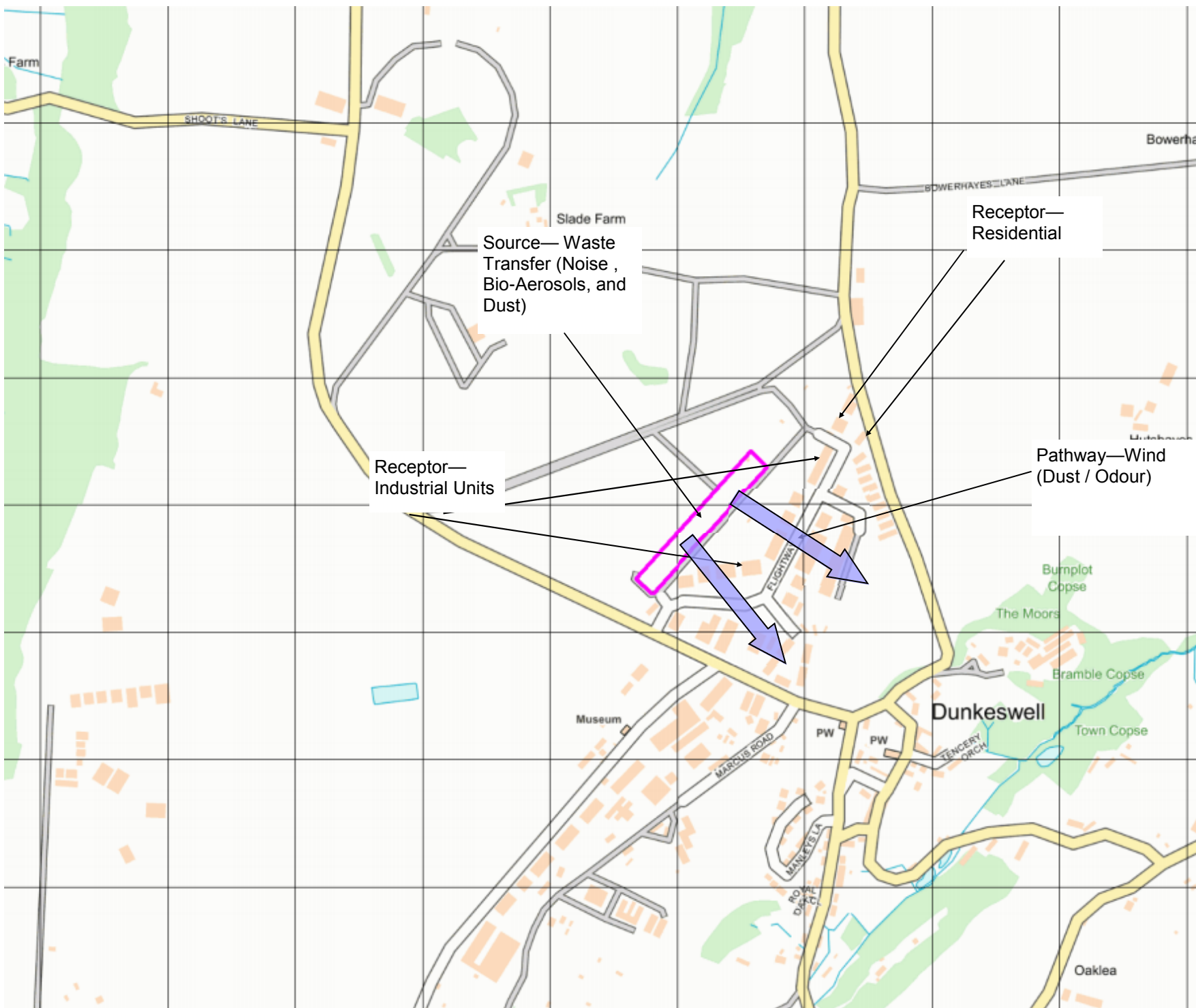
**Drawing Ref:
S21-628/011**

Note: "Mobile Plant"
Refers to intermittent
use of shredding,
crusher and screener
for treatment of
wastes. This layout
must be adopted to
ensure noise, dust and
bio-aerosol assessment
remain valid.

Connetts Farm Compost

Plan: Source, Pathway, Receptor (500 meter)

Drawing Ref: S21-628/005



Source—Waste Transfer (Noise, Bio-Aerosols, and Dust)

Receptor—Industrial Units

Receptor—Residential

Pathway—Wind (Dust / Odour)

Dunkeswell



APPENDIX 2

Conceptual Model

Conceptual Model of Composting Facility

