Darwen Resource Recovery Park – WTS and AD, Lower Eccleshill Road, Darwen, BB3 0EH

Bioaerosol Risk Assessment

784-B043732
14th May 2024

PRESENTED TO

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DOCUMENT CONTROL

Document:	**Bioaerosol Risk Assessment**
Project:	Darwen Resource Recovery Park
Client:	SUEZ Recycling and Recovery UK Ltd
Job Number:	784-B043762
File Origin:	X:\784-B043732_Darwen_Resource_Recovery_Park\60 Project Output\63 Published

Issue:	**1**	**Status:**	**First Issue**
Date:	28th June 2023		
Prepared by: Dr Zhiyuan Yang Principal Environmental Consultant		**Checked by:** Matthew Smith Associate Environmental Consultant	**Approved By:** Nigel Mann Director

Issue:	**2**	**Status:**	
Date:	25th April 2024		
Prepared by: Dr Zhiyuan Yang Principal Environmental Consultant		**Checked by:** Matthew Smith Associate Environmental Consultant	**Approved By:** Nigel Mann Director
Description of revision:			

Issue:	**3**	**Status:**	
Date:	14th May 2024		
Prepared by: Dr Zhiyuan Yang Principal Environmental Consultant		**Checked by:** Matthew Smith Associate Environmental Consultant	**Approved By:** Nigel Mann Director
Description of revision: Minor amendment			

EXECUTIVE SUMMARY

This report presents the findings of a bioaerosol risk assessment undertaken to assess the potential bioaerosol emission impacts in support of an application to vary the environmental permit to allow the operation of a new Anaerobic Digestion (AD) Facility at Darwen Materials Recovery Facility, Lower Eccleshill Road, Darwen, Blackburn, Lancashire, BB3 0EH.

The report comprises a bioaerosol dispersion modelling assessment undertaken in accordance with national and regulatory guidance for the assessment of risks. It appraises the potential for risks to human health at surrounding receptors.

A Bioaerosols Dispersion Modelling Assessment has been undertaken using AERMOD and representations of bioaerosols emissions from AD facility operations, waste transfer station operations, MRF and the bulking bay operations.

The predicted long-term and short-term bioaerosol concentrations at the receptor locations are all below the acceptable levels of 1000 and 500 cfu/m^3 for total bacteria and Aspergillus for the protection of public health.

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
AD	Anaerobic Digestion
AERMOD	AERMOD is the state-of-the-science, steady-state Gaussian air dispersion model that is EPA-approved for most refined modelling scenarios. BREEZE AERMOD is an enhanced version of the EPA-approved AERMOD that provides modelers with the tools and functionality required to perform air quality analyses that help to address permitting, regulatory, and nuisance issues, perform academic research, and assist companies worldwide with capital planning
AL	Acceptable Level
CHP	Combined Heat and Power
cfu/m^3	Total bacterial colony-forming units per cubic metre
DEFRA	Department for Environment Food & Rural Affairs
EA	Environment Agency
EC	European Commission
HCI	Household, Commercial & Industrial
LT	Long-term
MCP	Medium Combustion Plant
MCPD	The Medium Combustion Plant Directive
NGR	The United Kingdom National Grid Reference
MRF	Material Recycling Facility
MWth	Thermal megawatt
NTF	The National Transfer Format (NTF) is a file format designed in 1988 specifically for the transfer of geospatial information
ODTS	Organic Dust Toxic Syndrome
OS	the UK Ordnance Survey
PC	Process Concentration
PEC	Predicted Environment Concentration
SG	Specified Generator
ST	Short-term
SUEZ	SUEZ Recycling and Recovery UK Ltd
µm	Micrometre
WTS	Waste Transfer Station
UK	The United Kingdom
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

This report presents the findings of a bioaerosol risk assessment undertaken to assess the potential bioaerosol emission impacts in support of an application to vary the environmental permit to allow the operation of a new Anaerobic Digestion (AD) Facility at Darwen Materials Recovery Facility, Lower Eccleshill Road, Darwen, Blackburn, Lancashire, BB3 0EH.

The site is operated by SUEZ Recycling and Recovery UK Ltd (SUEZ) and currently regulated under a bespoke environmental permit (EPR/BB3609KA) which allows the operation of a Material Recycling Facility (MRF), Plastics Physical Treatment Facility, Glass Bulking Facility and Household, Commercial & Industrial (HCI) Waste Transfer Station.

SUEZ are seeking to vary the environmental permit to allow the operation of a new Anaerobic Digestion (AD) Facility. The process will generate biogas which then ultimately feeds into a biogas upgrading plant to National Gas Grid criteria and injected into the gas grid. Alternatively, the biogas may be processed by the Combined Heat and Power (CHP) engines to generate heat and electricity that would be used by the AD plant. Each CHP engine will have a capacity of more than 1 megawatt thermal (MWth) and less than 50MWth. As such, it is considered that the CHP engines will be subject to the Medium Combustion Plant Directive (MCPD) and therefore will comprise 2 engines.

To facilitate the installation and operation of the AD facility, SUEZ are seeking to demolish the existing buildings and site infrastructure and redevelop the whole site.

In addition to the AD Facility, SUEZ will continue to operate a waste transfer station and MRF at the site. Waste that's accepted as part of the waste transfer station and MRF will be stored within the confines of a building or within a canopy building The waste transfer station will comprise a new building which will be used for the acceptance, bulking and treatment of general municipal/residual black bag and bulky waste prior to treatment via shredding. There will also be a canopy building which will be used for the bulking of non-hazardous waste prior to transfer off site for recovery and/or disposal.

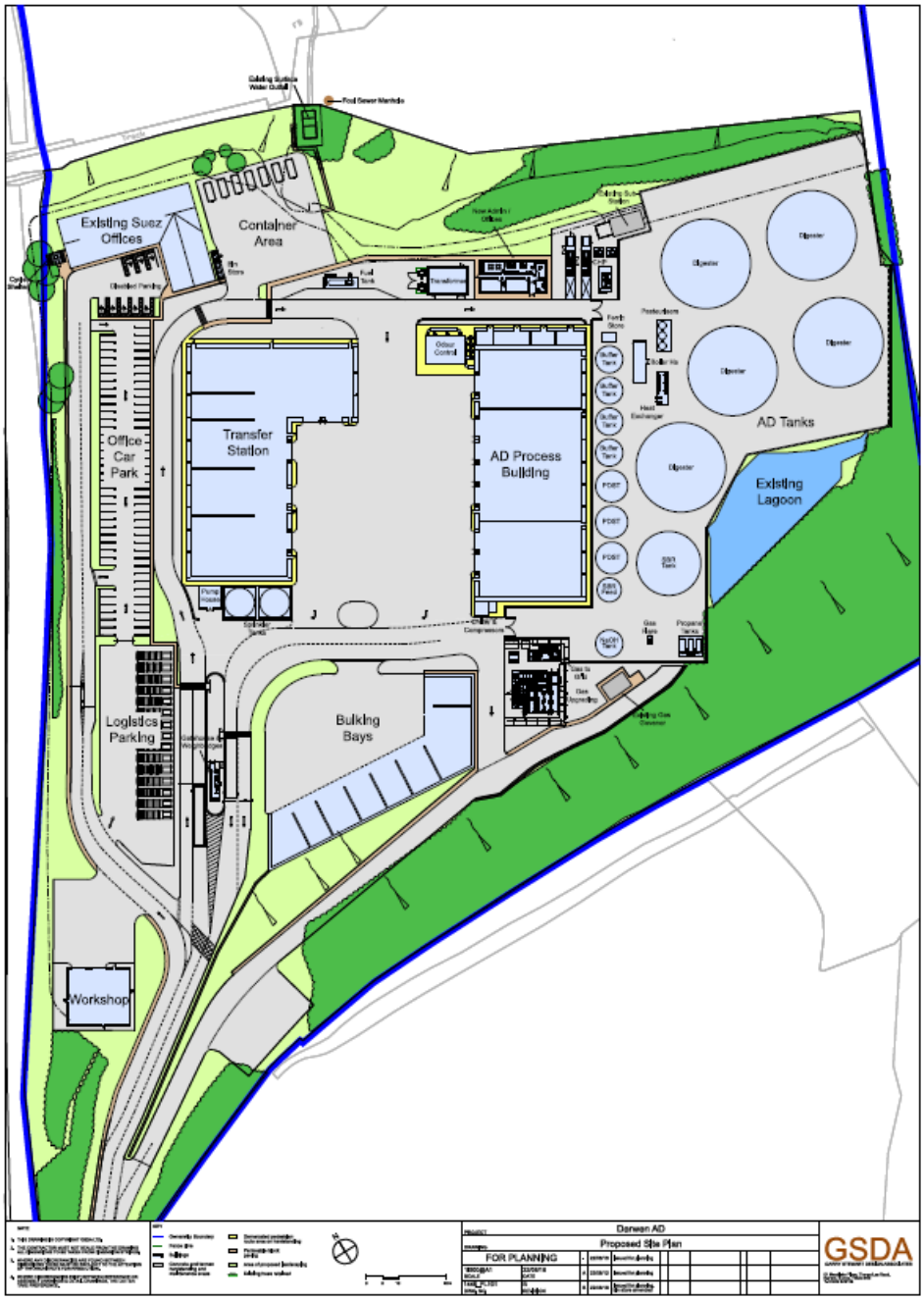
1.1 SITE LOCATION

The Site is located approximately 4km south of Blackburn Town Centre. The central Grid Reference is approximately 369400,423950. The application site is bounded to the north, east and south by woodland with grassland/farmland beyond, to the west by railway lines with industrial and commercial buildings beyond.

Reference should be made to **Figure 1-1** for a map of the application site and surrounding area. The proposed site layout plan is shown in **Figure 1-2**.

Figure 1-1. Site Location

Figure 1-2. The Proposed Site Plan



1.2 OVERVIEW AND SCOPE OF ASSESSMENT

The operation of the facility may result in bioaerosol emissions from a number of activities with the potential impact on the existing sensitive receptors in the surrounding area. The bioaerosols may be released from the AD process building, the transfer station building and the bulking bay area.

The principal objective is to investigate off-site bioaerosol concentrations at nearby sensitive receptors after the operation of a new AD Facility.

The assessment steps include:

1) Identifications of bioaerosol emission sources;
2) Representations of the bioaerosol releases in the modelling; and
3) Predicting the potential additional health risk with the operations of the proposed new AD facility.

1.3 CONTEXT

The objective of this bioaerosol risk assessment is to determine whether off-site impacts from the proposed AD facility and the waste transfer station meet the required acceptable levels for the protection of human health.

The detailed modelling results have been presented in this report in terms of the emitted pollutant Process Contribution (PC) and Predicted Environmental concentration (PEC = PC+ Background concentration). AERMOD modelling was undertaken for the most representative meteorological dataset and the worst-case, highest predicted long-term and short-term PECs were compared to the appropriate acceptable levels.

1.4 REPORT STRUCTURE

Following this introductory section, the remainder of this report is structured as follows:

- Section 1.0: Introduction
- Section 2.0: Definition of Bioaerosols and Health Effects
- Section 3.0: Legislation and best practice guidance
- Section 4.0: Bioaerosol Risk Assessment
- Section 5.0: Detailed Modelling Assessment Results
- Section 6.0: Conclusions

All technical Appendices are included at the end of this report for information.

2.0 DEFINITION OF BIOAEROSOLS AND HEALTH EFFECTS

2.1 BIOAEROSOLS

'Bioaerosol' is a broad term used to describe potentially biologically active matter including microorganisms and their constituent parts: bacteria, fungi, viruses, spores, moulds, rusts, protozoa, pollens, etc. and their degradation products and toxins etc. Bioaerosols are typically associated with organic materials and may be present as clumps, aggregates, or single cells, which may or may not be attached to particles of other material.

Bioaerosols occur naturally in the environment and concentrations vary widely. Bioaerosol sources include natural organic processes in grassland, agriculture and woodland, trades such as leather working, farming, food preparation, woodworking, and human activity in homes, offices, schools, hospitals, canteens as well as waste disposal.

Bioaerosols can be transported by air movements or by attachment to other objects (e.g. dirt attached to vehicle tyres or particulate carried in the wind). 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 particulate. Barriers can create 'sheltered' areas enabling deposition of particles of small size. Barriers can also deflect wind away from the source to prevent release away from the receptor to prevent exposure.

Bioaerosols generated from mushroom growing generally contain the same microorganisms commonly encountered in 'normal' outdoor air. However, where they are released in large quantities, they have the potential to influence some aspects of public health.

Whilst occurring everywhere, microorganisms are fragile and die rapidly on exposure, though individual particles may travel over several kilometres. However, with a combination of dispersion, particulate drop out and loss of viability, bioaerosol concentrations rapidly reduce with distance from the source. Studies indicate that bioaerosol from open window composting is usually reduced to background levels within 200m of the source (often within 100m). The Environment Agency's position is more cautious, with guidance in '*Composting and potential health effects from bioaerosols: out interim guidance for permit applicants',* Position Statement 031, Version 1.0, 1st November 2010, stating that:

> *"The consensus from various studies is that bioaerosols from composting activities decline rapidly within the first 100 metres from a site and generally decline to background levels within 250m".*

Enclosed systems are recognised as providing better control of bioaerosol releases. Compost disturbance is reduced, minimising the generation of bioaerosol and improved control of temperature and conditions eliminate pathogenic micro-organisms.

2.2 HEALTH EFFECTS

Bioaerosols are generally less than 10µm in size and 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 composting are infections caused by *Aspergillus fumigatus*. Invasive aspergillosis is a severe infection, which may be fatal and is a concern with 'at risk' and 'immunosuppressed' patients (*Guidance on the evaluation of bioaerosol risk assessment for composting facilities*, Cranfield University, Published by the Environment Agency, 2009).

Organic Dust Toxic Syndrome (ODTS) is an acute disease, which results in symptoms resembling those of influenza, such as shivering, an increase in body temperature, dry cough, and muscle and joint pains (Rylander, 1997). Particularly relevant to waste management facilities are infections caused by *Aspergillus fumigatus*. Invasive aspergillosis is a particularly severe infection, which may be fatal and is primarily a concern with at risk and immuno-suppressed patients (*Guidance on the evaluation of bioaerosol risk assessment for composting facilities*, Cranfield University, Published by the Environment Agency, 2009).

One of the current knowledge gaps for bioaerosols is their dose-response relationships. We currently cannot state with any certainty that a given concentration will result in a particular health impact. This is because of the number of bioaerosols as well as the complexities associated with human responses to different micro-organisms (*Guidance on the evaluation of bioaerosol risk assessment for composting facilities*, Cranfield University, Published by the Environment Agency, 2009).

Human health is the focus for bioaerosol risk assessment. The revised EA position statement defines receptors as referring to 'people likely to be within 250 metres' for 'prolonged or frequent periods' (The Environment Agency, '*Composting and potential health effects from bioaerosols: out interim guidance for permit applicants*', Position Statement 031, Version 1.0, 1st November 2010).

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.

3.0 LEGISLATION AND BEST PRACTICE GUIDANCE

The risk assessment approach is based on the EA Guidance: '*Guidance on the evaluation of bioaerosol risk assessment for composting facilities, 2009'* and the '*EA Technical Guidance note (Monitoring) M9: Environmental monitoring of bioaerosols at regulated facilities'*, Environment Agency, July 2018, Version 2.

The EA guidance presents the Environment Agency's current policy position on composting and potential health effects from bioaerosols, stating that they will:

> *"[…] take into account the potential effects of bioaerosols on human health when authorising new waste composting facilities or changes to existing facilities. To do this, applicants will have to provide us with a site-specific bioaerosol risk assessment if there is a workplace or dwelling within 250 metres of the composting site boundary... The assessment must be based on clear scientific evidence and show that bioaerosols can and will be maintained at appropriate levels at any workplace or boundary of a dwelling."* (*Guidance on the evaluation of bioaerosol risk assessment for composting facilities*, Cranfield University, Published by the Environment Agency, 2009).

The site-specific bioaerosol risk assessments provide operators with the basis for identifying operational controls on site and allow them to target controls where exposures to significant hazards are of greatest concern. Furthermore, they should reassure the regulator and local communities that facilities are being operated safely and responsibly without undue risks to operational staff, to public health or to the environment.

The EA's Position Statement of "composting and potential health effects from bioaerosols: our interim guidance for permit applicants" (1st November 2010) provides the definitions of the receptors and acceptable levels at the receptors.

Receptors

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

Acceptable Levels at the Receptors

This refers to the concentrations of bioaerosols (as predicted or as derived from direct measurements) at the receptors which are attributable to the composting operations. The acceptable levels are 1000 and 500 cfu m^{-3} for total bacteria and *Aspergillus* respectively (*Guidance on the evaluation of bioaerosol risk assessment for composting facilities*, Cranfield University, Published by the Environment Agency, 2009).

4.0 BIOAEROSOL RISK ASSESSMENT

4.1 IDENTIFICATION OF BIOAEROSOL EMISSION SOURCES

The operation of the facility may result in bioaerosol emissions from a number of activities. The following potential sources were identified as potential bioaerosol emission sources:

(1) Fugitive emissions from the AD Process Building;
(2) Fugitive emissions from the Transfer Station building;
(3) Fugitive emission from the bulking bays in a canopy building; and
(4) Stack emission from the odour control system.

4.1.1 AD Process Building

All putrescible waste for the AD facility will be unloaded and pre-treated from within an enclosed building. This building benefits from a roller shutter door on the outside and a speed door on the inside will be kept closed when not in use (i.e. arrival or departure of vehicles). In addition, pedestrian doors are also closed when not in direct use This will minimise the potential for any bioaerosols generated on site to impact receptors beyond the site boundary.

The AD facility will operate 24 hours a day and 7 days a week, vehicle movements will be restricted to 07:00 – 19:00 Monday – Sunday.

Although it is considered that the stated control mechanisms will provide effective reductions in bioaerosol concentrations, it is recognised that there is the potential for the release of residual bioaerosols when the trucks/lorries entering or leaving the building. As such, emissions have been evaluated further as part of the dispersion modelling assessment.

4.1.2 Transfer Station

The transfer station (TS) will be stored and processed within a building. The TS building benefits from a roller shutter door on the outside and a speed door on the inside will be kept closed when not in use (i.e. arrival or departure of vehicles). In addition, pedestrian doors are also closed when not in direct use. This will minimise the potential for any bioaerosols generated on site to impact receptors beyond the site boundary.

All loading/unloading activities at the waste transfer station will be undertaken within the hours that are stipulated under the existing planning permissions (07.00 - 19.00 Monday to Saturday and 07:00 to 13:00 on Sundays and Bank Holidays).

Although it is considered that the stated control mechanisms will provide effective reductions in bioaerosol concentrations, it is recognised that there is the potential for the release of residual bioaerosols when the trucks/lorries entering or leaving the transfer station building. As such, emissions have been evaluated further as part of the dispersion modelling assessment.

4.1.3 Bulking Bays

A canopy building will be used for the bulking of non-hazardous waste prior to transfer off site for recovery and/or disposal.

Waste that's stored within the canopy building may include wood, hardcore, green waste and road sweepings. These waste streams will be stored within bays within the building that's enclosed on three sides.

Bioaerosols are most likely to be released when waste materials are disturbed, for example loading and unloading activities at the bulking bays storage area. Bioaerosols may also release from static waste piles within the bulking bays.

The green waste stream has the higher potential bioaerosol release than other waste streams.

Therefore, the potential bioaerosols releases within the canopy building in the assessment include:

(1) The waste surface area in the bulking bay storage area;
(2) Unloading the waste to the bays;
(3) Loading the waste from the bays.

It is assumed that the entire bulking bay area is green waste storage area to produce a worst-case assessment.

4.1.4 Bioaerosol Emissions from Odour Control System

It is proposed to install an odour control system at the AD facility located within the site. The odour control system will consist of biofilters, activated carbon bed filters, and pre-bed dust filtration to treat the odorous air that are extracted from the processing buildings and the local extraction sources. The proposed odour control system will reduce the odour emissions and will reduce the bioaerosol emissions as well.

The ventilation rate requirements (air to be treated) from building extraction and local / source extraction are detailed as below:

Building Extraction:

(1) Pre-treatment Building. Ventilation rate at 3 Air changes / hour is 20,300 m^3/hr;
(2) Reception Hall / Building. Ventilation rate at 3 Air changes / hour is 32,500 m^3/hr; and
(3) Digestate Out Building. Ventilation rate at 3 Air changes / hour is 29,800 m^3/hr.

Total Building Extraction Rate required: 82,600 m^3/hr.

Local / Source Extraction:

(1) Hydrolysis Buffer Tanks. Maximum Feed Rate 200 m^3/hr;
(2) Pasteurisation Plant. Maximum Feed Rate 200 m^3/hr;
(3) Pre-Treatment units and associated Local Extract Ventilation (LEV) equipment - estimated 4200 m^3/hr; and
(4) Digestate Dewatering unit and associated LEV equipment - estimates 500 m^3/hr.

Total Local / Source Extraction Rate required: 5,100 m^3/h.

The bacteria emissions from the odour control system stack and the stack parameters are presented in **Table 4-1**.

Table 4-1. Bacteria Emissions for the Assessment and Stack Parameters

Parameter	Emission Rate	Unit
Odour Control System Stack – Modelled as a Point Source		
Total Gas Volume	82,600 m^3/hr of building extraction rate + 5100 m^3/hr = 87,711 m^3/hr	m^3/hr
Bacteria Concentrations	11,000	CFU/m^3
Stack Gas Temperature	25	°C
Bacteria Emission Rate	2,012,228	CFU/s
Stack diameter	1.3	m
Stack velocity	17.29	m/s
Stack Height	18.3 m above Ground Level	m

4.2 REPRESENTATIONS OF THE BIOAEROSOL RELEASES IN THE MODELLING

The bioaerosols releases from the activities of AD plant, waste transfer station and bulking bay canopy building have been modelled using a line source, point source or an area source.

(1) A line source has been used for representing the bioaerosol release from the opening AD process building door. An emission rate of 10^5 CFU/m/s has been used and which is derived from the emission data in the final report of “Defra Project WR 1121 Bioaerosols and odour emissions from composting facilities” (20 August 2013).

The roller shutter door will only be open to accommodate access for the lorry entering or the leaving the building. When considering lorry movements, it is reasonable to assume that the shutter could potentially be open for a maximum of 5 minutes in any 1 hour.

(2) A line source has been used for representing the bioaerosol release from the opening the transfer station building door. An emission rate of 10^5 CFU/m/s has been used and which derived from on the emission data in the final report of “Defra Project WR 1121 Bioaerosols and odour emissions from composting facilities” (20 August 2013).

The roller shutter door will only be open to accommodate access for the lorry entering the leaving the building. When considering lorry movements, it is reasonable to assume that the shutter could potentially be open for a maximum of 5 minutes in any 1 hour.

(3) A point source has been used for representing waste loading and unloading activities at bulking bay storage area. The emission rate of 10^3 CFU/s (an emission rate being equivalent to an emission rate of shredding operations at open composting facilities) has been used and which derived from on the

emission data in the final report of “Defra Project WR 1121 Bioaerosols and odour emissions from composting facilities” (20 August 2013).

It is assumed loading and unloading activity will be continuous to produce a worst-case assessment.

(4) An area source has been used for representing the waste storage pile surface area emissions in the bulking bays. The emission rate of is 10^2 CFU/m^2/s (an emission rate being equivalent to mature compost area at open composting facilities) has been used and which is derived from the emission data in the final report of “Defra Project WR 1121 Bioaerosols and odour emissions from composting facilities” (20 August 2013).

It is assumed all bulking bays are all green waste storage area to produce a worst-case assessment.

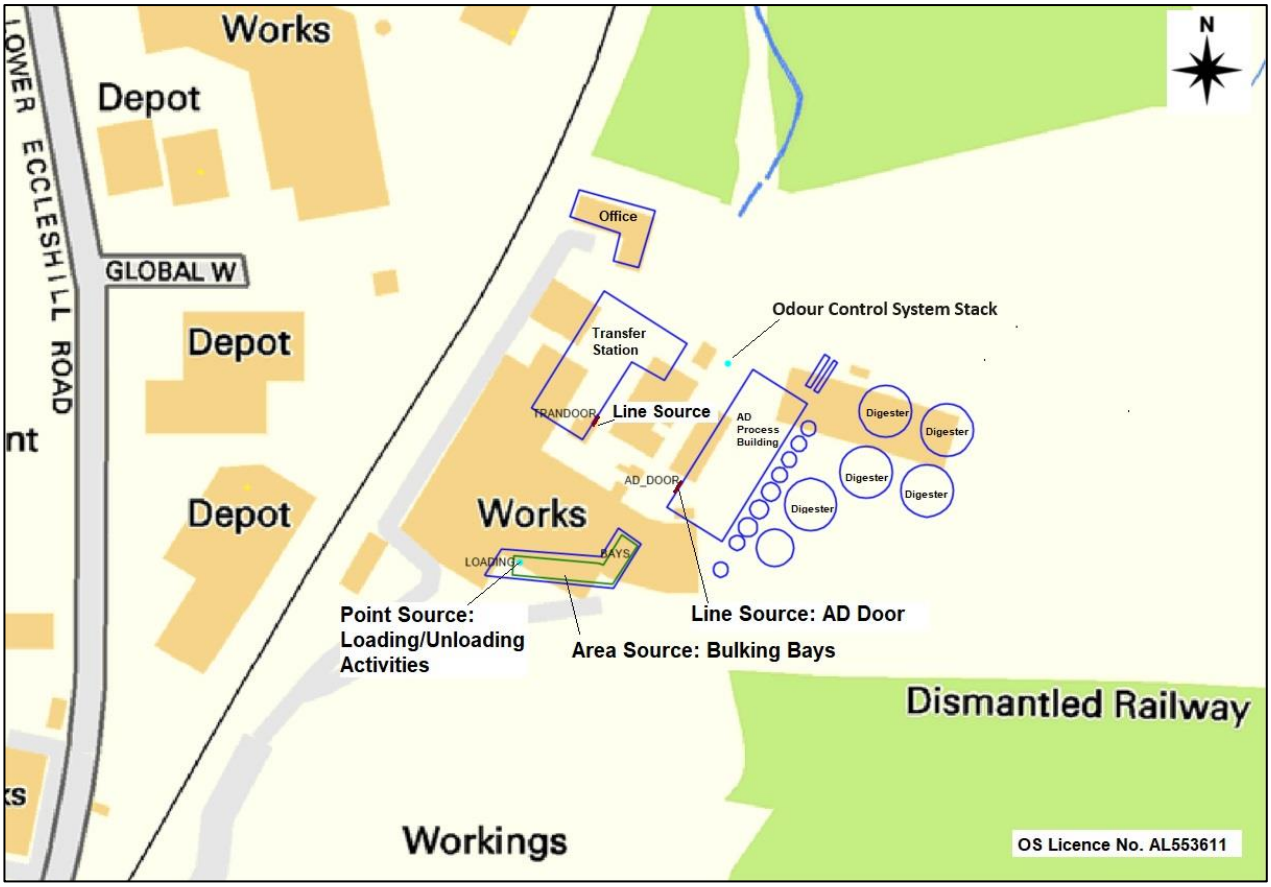
4.2.1 Model Input Parameters

The model input data are summarised as below:

- The 2018, 2019, 2020, 2021 and 2022 meteorological data;
- A line source of 6 m in length for the AD processing building shutter door, 10^5 CFU/m/s;
- A line source of 6 m in length for the transfer station building shutter door, 10^5 CFU/m/s;
- A point source for the green waste loading and unloading activities; 10^3 CFU/s; and
- A polygon area source having an approximate size of 738 m^2 for the green waste storage area; 10^2 CFU/m^2/s,
- A point source for odour control system stack, 2,012,228 CFU/s.

The locations of the modelled emission sources are illustrated in **Figure 4-1**.

Figure 4-1. Modelled Emission Sources



4.3 SENSITIVE RECEPTORS

The discrete sensitive receptors identified for the purposes of this bioaerosol risk assessment are contained in **Table 4-2** and shown in **Figure 4-2**. The assessment has been undertaken to determine the potential impacts on those selected receptors.

It should be noted that these do not represent an exhaustive list of all receptors within the vicinity of the Site, rather worst-case representative locations within and adjacent to the site, both within and outside the 250m requirement stated in guidance.

Table 4-2. Modelled Sensitive Human Receptors

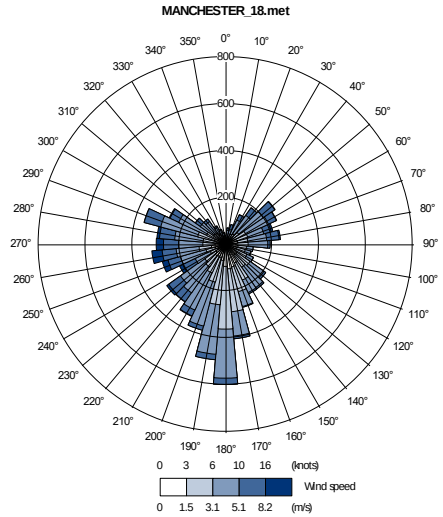
Receptor ID	Receptor Name	UK NGR (m)	
		X	Y
D1	Lady Close (Residential)	369350	424507
D2	Lord's Crescent (Residential)	369404	424521
D3	Davy Field Gardens (Residential)	369975	424141
D4	Manor House Farm (residential)	369983	423629
D5	Knowle Cottage, Knowle Fold (Residential)	369503	423418
D6	Langriggs Farm (Residential)	369352	423340
D7	Snape Street (Residential)	368956	423165
D8	Surrey Avenue (Residential)	368901	423377
D9	Clarence Street (Residential)	368726	423445
D10	Anchor Avenue (residential)	368539	423939
D11	Redvers Road (residential)	368486	424186
D12	Centurion Business Park	369487	424550
D13	Wheelbase Engineering	369322	424189
D14	Wilkinson Catering	369154	424114
D15	Darwen MOT Centre	369179	423945

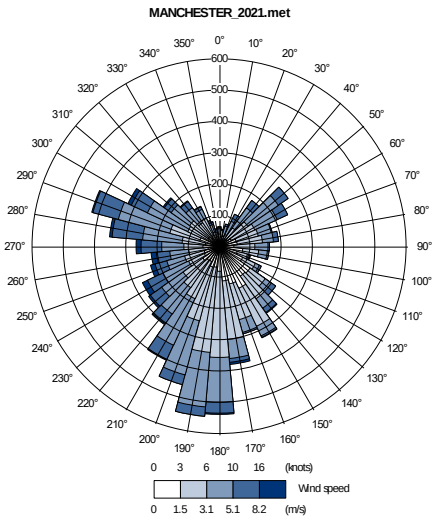
Figure 4-2. Location of Sensitive Human Receptors

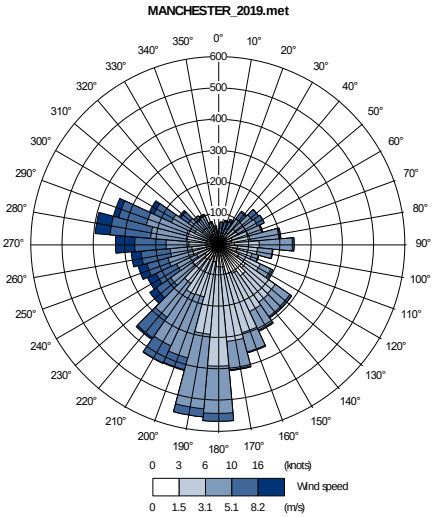
4.4 METEOROLOGICAL DATA

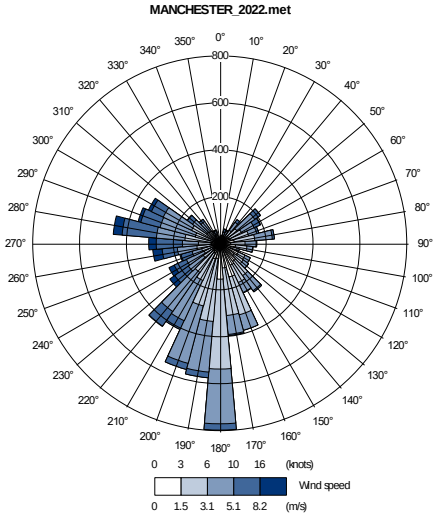
The 5-year meteorological data (2018 – 2022 inclusive) used in the assessment is derived from Manchester Airport weather station, which is considered representative of conditions within the vicinity of the site, with all the complete parameters necessary for the AERMOD model. Reference should be made to **Figure 4-3** for an illustration of the prevalent wind conditions at the Manchester Airport weather station.

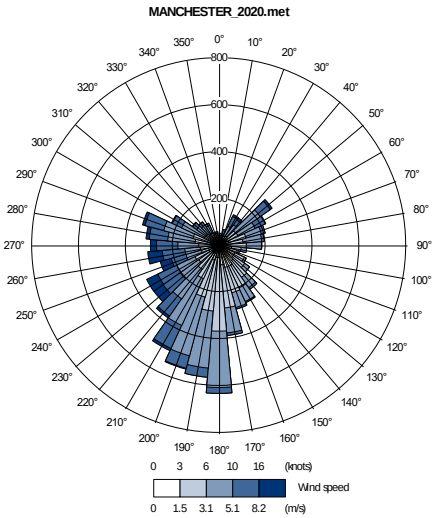
Figure 4-3. Manchester Airport Meteorological Station Windrose











4.5 SURFACE CHARACTERISTICS

The land uses surrounding the Site are mostly described as woodlands, industrial/commercial uses and grasslands. A surface roughness value of 0.5 m (a value for parkland and open suburbia land use) has been used in the modelling for a worst-case assessment.

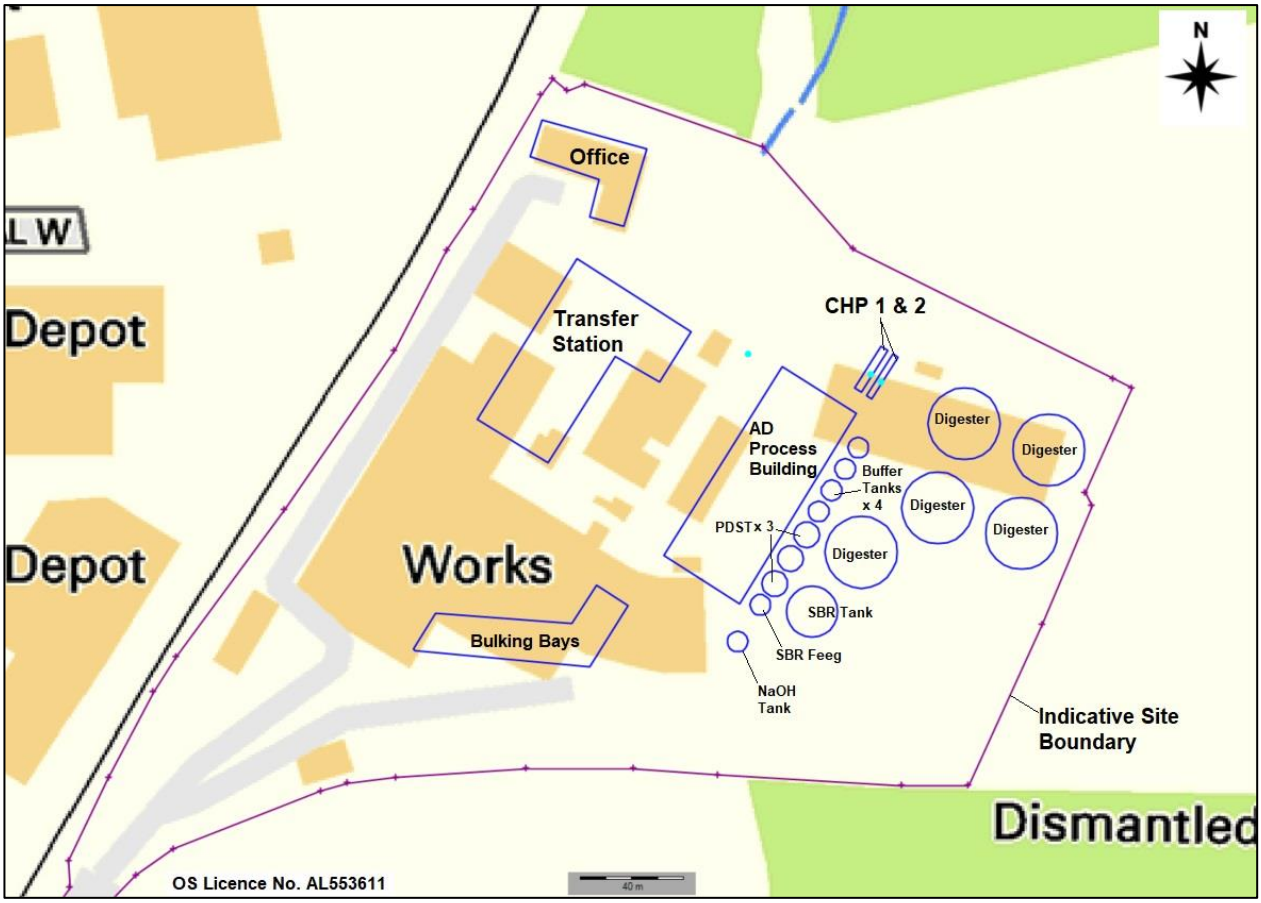
4.6 BUILDINGS IN THE MODELLING ASSESSMENT

Buildings nearby or immediately adjacent to the stacks could potentially cause building downwash effects on emission sources and have therefore been modelled. The locations and dimensions of the buildings used in the model are given in **Table 4-3** and illustrated in **Figure 4-4**.

Table 4-3. Locations and Heights of Buildings Used in the Model

ID	Name	UK NGR (m)		Modelled Building Height (m)	Note
		X	Y		
OFFICE	Existing Suez Office	369357	424105	9.24	-
TRANSFER	Transfer Station	369414	424023	11.74	-
AD	AD Process Building	369433	423916	16.2	-
BULKING	Bulking Bays	369375	423892	11.6	-
DIGEST1	Digester Tank 1	369521	423987	15.3	Radius = 14 m
DIGEST2	Digester Tank 2	369554	423976	15.3	Radius = 14 m
DIGEST3	Digester Tank 3	369511	423954	15.3	Radius = 14 m
DIGEST4	Digester Tank 4	369543	423944	15.3	Radius = 14 m
DIGEST5	Digester Tank 5	369481	423936	15.3	Radius = 14 m
SBR_T	SBR Tank	369462	423913	13.0	Radius = 10 m
BUFFER1	Buffer Tank 1	369480	423977	17.8	Radius = 4 m
BUFFER2	Buffer Tank 2	369475	423969	17.8	Radius = 4 m
BUFFER3	Buffer Tank 3	369469	423961	17.8	Radius = 4 m
BUFFER4	Buffer Tank 4	369464	423952	17.8	Radius = 4 m
PDST1	PDST Tank 1	369460	423943	11.5	Radius = 5 m
PDST2	PDST Tank 2	369453	423934	11.5	Radius = 5 m
PDST3	PDST Tank 3	369447	423924	11.5	Radius = 5 m
SBR_F	SBR Feed	369441	423916	8.0	Radius = 4 m
NAOH	NaOH Tank	369433	423902	8.0	Radius = 4 m

Figure 4-4. Locations of Modelled Buildings



4.7 TREATMENT OF TERRAIN

The presence of steep terrain can influence the dispersion of emissions and the resulting pollutant concentrations. USEPA guidance indicates that terrain effects should be considered if the gradient exceeds 1:10. A digital terrain file in the UK Ordnance Survey (OS) Landranger format (.NTF) has been used in the assessment.

4.8 MODELLING UNCERTAINTY

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - including emissions estimates, background estimates and meteorology; and,
- Variability - randomness of measurements used.

However, potential uncertainties in model results have been minimised as far as practicable and worst-case inputs considered in order to provide a robust assessment. This included the following:

- Choice of model - AERMOD is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Facility operating parameters - Operational parameters were provided for the facility;

- Emission rates - Emissions were based on 24-hour operation, this is likely to overestimate impacts as periods of shut down have not been considered;
- Background concentrations - Background pollutant concentrations were obtained from a number of recognised sources in order to consider baseline levels in the vicinity of the site, as detailed within the main report text; and,
- Variability - All model inputs are as accurate as possible and worst-case conditions have been considered where necessary in order to ensure a robust assessment of potential pollutant concentrations.

5.0 DETAILED MODELLING ASSESSMENT RESULTS

The detailed atmospheric dispersion modelling of process emissions was undertaken using the input parameters detailed in Section 5.

All predicted concentrations have been compared to the relevant environmental assessment criteria, as detailed in Section 3.

5.1 LONG-TERM (LT) MODELLING

Assumptions

As there are no long term statutory Environmental Assessment Levels or Environmental Quality Standards for long term releases of bioaerosols, only an acceptable level, we have used the acceptable levels as outlined within the EA's own guidance documents and compared long term releases to these guidelines.

5.1.1 Total Bacteria (LT)

The long-term emissions of total bacteria at identified receptors from the sources considered were assessed for all 5 years of meteorological data. The maximum PCs of total bacteria at the receptor are presented in **Table 5-1**. From the meteorological dataset, the year resulting in maximum long-term total bacteria concentration at sensitive residential receptor location was identified as 2022. Therefore, the 2022 results have been used to compare the acceptable levels.

Table 5-1. The Long-Term Process Concentrations of Total Bacteria

ID	Name	Long-Term Process Contribution (PC) cfu/m^3				
		2018 Met Data	2019 Met Data	2020 Met Data	2021 Met Data	2022 Met Data
D1	Lady Close (Residential)	3.84	3.61	3.48	3.68	4.08
D2	Lord's Crescent (Residential)	3.86	3.67	3.62	3.66	4.26
D3	Davy Field Gardens (Residential)	1.69	1.42	1.39	1.55	1.27
D4	Manor House Farm (residential)	0.85	0.80	0.76	1.06	0.94
D5	Knowle Cottage, Knowle Fold (Residential)	0.29	0.35	0.32	0.41	0.21
D6	Langriggs Farm (Residential)	0.26	0.30	0.27	0.34	0.16
D7	Snape Street (Residential)	0.33	0.20	0.27	0.27	0.20
D8	Surrey Avenue (Residential)	0.56	0.40	0.47	0.52	0.43
D9	Clarence Street (Residential)	0.63	0.48	0.57	0.65	0.57
D10	Anchor Avenue (residential)	0.95	0.94	0.88	0.96	0.89
D11	Redvers Road (residential)	0.83	0.92	0.71	0.85	0.70
D12	Centurion Business Park	3.33	3.27	3.32	3.27	3.79
D13	Wheelbase Engineering	10.92	10.82	9.96	11.43	11.47
D14	Wilkinson Catering	6.19	7.59	5.80	7.42	5.58
D15	Darwen MOT Centre	8.44	7.89	7.76	8.80	7.85

There is no bioaerosol background information background available at the Site.

An ambient bioaerosol background value, however, has been used in the assessment and which is derived from a bioaerosol concentration sampling data at a composting facility in Leicestershire. The sampled composing site is situated in a rural setting. A total of 15 bioaerosol samples at the upwind locations to the composting site has been analysed and the those sampled concentrations can be used to represent background levels. The sampled bioaerosol concentrations range from less than 167 cfu/m^3 to 389 cfu/m^3, with an average of 261 cfu/m^3. A background bioaerosol concentration value of 389 cfu/m^3 has been used.

In addition, a sampled background 'fungi as aspergillus' concentration value of 167 cfu/m^3 has been used in the assessment.

The total bacteria concentrations (PC + background concentration) using 2022 met data (the year resulting in maximum long-term PC concentration), are presented in **Table 5-2**.

Table 5-2. The Maximum Long-Term (Annual Mean) PEC of Total bacteria

ID	Name	Long-Term Process Contribution (PC) cfu/m^3		
		Process Contrib'tn (PC)	Background[(a)]	PEC[(a)] (PC +Background)
D1	Lady Close (Residential)	4.08	389	393.08
D2	Lord's Crescent (Residential)	4.26	389	393.26
D3	Davy Field Gardens (Residential)	1.27	389	390.27
D4	Manor House Farm (residential)	0.94	389	389.94
D5	Knowle Cottage, Knowle Fold (Residential)	0.21	389	389.21
D6	Langriggs Farm (Residential)	0.16	389	389.16
D7	Snape Street (Residential)	0.20	389	389.20
D8	Surrey Avenue (Residential)	0.43	389	389.43
D9	Clarence Street (Residential)	0.57	389	389.57
D10	Anchor Avenue (residential)	0.89	389	389.89
D11	Redvers Road (residential)	0.70	389	389.70
D12	Centurion Business Park	3.79	389	392.79
D13	Wheelbase Engineering	11.47	389	400.47
D14	Wilkinson Catering	5.58	389	394.58
D15	Darwen MOT Centre	7.85	389	396.85

From **Table 5-2**, it can be seen that the predicted long term total bacteria concentrations at any of the modelling receptors are all below the acceptable level of 1000 cfu/m^3.

5.1.2 Fungi as Aspergillus (LT)

For fungi as aspergillus concentrations, the ratios of the measured fungi concentration to the measured mesophilic bacteria at a composting facility in Leicestershire have been calculated and the ratio has been identified as 26/100.

The fungi as aspergillus concentrations (PC + background concentration) using 2022 met data (the year resulting in maximum long-term PC concentration), are presented in **Table 5-3**.

Table 5-3. The Long-Term (Annual Mean) PEC of Fungi as Aspergillus

ID	Name	Long-Term Process Contribution (PC) cfu/m^3		
		Process Contrib'tn (PC)	Background[(a)]	PEC[(a)] (PC +Background)
D1	Lady Close (Residential)	1.06	167	168.06
D2	Lord's Crescent (Residential)	1.11	167	168.11
D3	Davy Field Gardens (Residential)	0.33	167	167.33
D4	Manor House Farm (residential)	0.24	167	167.24
D5	Knowle Cottage, Knowle Fold (Residential)	0.05	167	167.05
D6	Langriggs Farm (Residential)	0.04	167	167.04
D7	Snape Street (Residential)	0.05	167	167.05
D8	Surrey Avenue (Residential)	0.11	167	167.11
D9	Clarence Street (Residential)	0.15	167	167.15
D10	Anchor Avenue (residential)	0.23	167	167.23
D11	Redvers Road (residential)	0.18	167	167.18
D12	Centurion Business Park	0.99	167	167.99
D13	Wheelbase Engineering	2.98	167	169.98
D14	Wilkinson Catering	1.45	167	168.45
D15	Darwen MOT Centre	2.04	167	169.04

From **Table 5-3**, it can be seen that the predicted long-term fungi as aspergillus concentrations at any of the modelling receptors are all below the acceptable level of 500 cfu/m^3.

5.2 SHORT-TERM (ST) MODELLING

5.2.1 Total Bacteria (ST)

The short-term (1-Hour Mean) emissions of total bacteria at identified receptors from the sources considered were assessed for all 5 years of meteorological data. The maximum PCs of total bacteria at the receptor are presented in **Table 5-4**. From the meteorological dataset, the year resulting in maximum short-term total bacteria concentration at sensitive residential receptor location was identified as 2020. Therefore, the 2020 results have been used to compare the acceptable levels.

Table 5-4. The Short-Term Process Concentrations of Total Bacteria

ID	Name	Short-Term Process Contribution (PC) cfu/m^3				
		2018 Met Data	2019 Met Data	2020 Met Data	2021 Met Data	2022 Met Data
D1	Lady Close (Residential)	136.82	136.65	164.17	189.87	185.78
D2	Lord's Crescent (Residential)	133.78	142.64	135.33	171.86	126.47
D3	Davy Field Gardens (Residential)	198.38	148.37	119.13	136.99	118.76
D4	Manor House Farm (residential)	41.85	48.02	46.32	51.97	59.39
D5	Knowle Cottage, Knowle Fold (Residential)	44.06	55.66	64.71	50.77	36.87
D6	Langriggs Farm (Residential)	64.32	110.99	114.47	88.11	68.72
D7	Snape Street (Residential)	60.13	75.92	65.97	59.86	40.55
D8	Surrey Avenue (Residential)	69.68	71.07	59.89	69.02	50.29
D9	Clarence Street (Residential)	51.81	51.68	48.86	74.49	58.28
D10	Anchor Avenue (residential)	86.34	101.63	118.69	104.79	81.74
D11	Redvers Road (residential)	105.67	73.44	87.27	78.92	66.27
D12	Centurion Business Park	151.31	163.11	169.88	169.71	127.02
D13	Wheelbase Engineering	392.77	386.75	445.51	499.03	430.94
D14	Wilkinson Catering	377.13	381.52	368.94	381.62	234.68
D15	Darwen MOT Centre	403.53	527.01	583.87	541.98	400.34

The short-term total bacteria concentrations (PC + background concentration) using 2020 met data (the year resulting in maximum short-term PC concentration), are presented in **Table 5-5**.

Table 5-5. The Short-Term (1-Hour Mean) PEC of Total Bacteria

ID	Name	Short-Term Process Contribution (PC) cfu/m^3		
		Process Contrib'tn (PC)	Background[(a)]	PEC[(a)] (PC +Background)
D1	Lady Close (Residential)	164.17	389	553.17
D2	Lord's Crescent (Residential)	135.33	389	524.33
D3	Davy Field Gardens (Residential)	119.13	389	508.13
D4	Manor House Farm (residential)	46.32	389	435.32
D5	Knowle Cottage, Knowle Fold (Residential)	64.71	389	453.71
D6	Langriggs Farm (Residential)	114.47	389	503.47
D7	Snape Street (Residential)	65.97	389	454.97
D8	Surrey Avenue (Residential)	59.89	389	448.89
D9	Clarence Street (Residential)	48.86	389	437.86
D10	Anchor Avenue (residential)	118.69	389	507.69

D11	Redvers Road (residential)	87.27	389	476.27
D12	Centurion Business Park	169.88	389	558.88
D13	Wheelbase Engineering	445.51	389	834.51
D14	Wilkinson Catering	368.94	389	757.94
D15	Darwen MOT Centre	583.87	389	972.87

From **Table 5-5**, it can be seen that the predicted short-term total bacteria concentrations at any of the modelling receptors are all below the acceptable level of 1000 cfu/m^3.

5.2.2 Fungi as Aspergillus (ST)

The short-term concentrations (PC + background concentration) of fungi as aspergillus using 2020 met data (the year resulting in maximum short-term PC concentration), are presented in **Table 5-6**.

Table 5-6. The Short-Term (Annual Mean) PEC of Fungi as Aspergillus

ID	Name	Short-Term Process Contribution (PC) cfu/m^3		
		Process Contrib'tn (PC)	Background[(a)]	PEC[(a)] (PC +Background)
D1	Lady Close (Residential)	42.68	167	209.68
D2	Lord's Crescent (Residential)	35.19	167	202.19
D3	Davy Field Gardens (Residential)	30.97	167	197.97
D4	Manor House Farm (residential)	12.04	167	179.04
D5	Knowle Cottage, Knowle Fold (Residential)	16.82	167	183.82
D6	Langriggs Farm (Residential)	29.76	167	196.76
D7	Snape Street (Residential)	17.15	167	184.15
D8	Surrey Avenue (Residential)	15.57	167	182.57
D9	Clarence Street (Residential)	12.70	167	179.70
D10	Anchor Avenue (residential)	30.86	167	197.86
D11	Redvers Road (residential)	22.69	167	189.69
D12	Centurion Business Park	44.17	167	211.17
D13	Wheelbase Engineering	115.83	167	282.83
D14	Wilkinson Catering	95.92	167	262.92
D15	Darwen MOT Centre	151.81	167	318.81

From **Table 5-6**, it can be seen that the predicted short-term fungi as aspergillus concentrations at any of the modelling receptors are all below the acceptable level of 500 cfu/m^3.

6.0 CONCLUSIONS

Tetra Tech have undertaken a bioaerosol risk assessment to assess the potential bioaerosol emission impacts in support of an application to vary the environmental permit to allow the operation of a new Anaerobic Digestion (AD) Facility at Darwen Materials Recovery Facility, Lower Eccleshill Road, Darwen, Blackburn, Lancashire, BB3 0EH.

The report comprises a bioaerosol dispersion modelling assessment undertaken in accordance with national and regulatory guidance for the assessment of risks. It appraises the potential for risks to human health at surrounding receptors.

Bioaerosols dispersion modelling assessment has been undertaken using AERMOD and representations of bioaerosols emissions from the operations of AD process facility, waste transfer station and bulking bays waste storage building.

The predicted long-term and short-term bioaerosol concentrations at the receptor locations are all below the acceptable levels of 1000 and 500 cfu/m^3 for total bacteria and Aspergillus for the protection of public health.

APPENDIX A - REPORT TERMS & CONDITIONS

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The whole of the report must be read as other sections of the report may contain information which puts into context the findings in any executive summary.

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