

# Lundwood STF Bioaerosol Risk Assessment

This document discusses the risk associated with bioaerosols that could arise as a result of anaerobic digestion and its directly associated activities

## Document Control

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## Document Approval

<b>Name</b> Hazel Morgan Environmental Regulation	<b>Name</b> Job Role Team name
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1				
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## Lundwood STF: Bioaerosol Risk Assessment

### 1.1 Bioaerosols Introduction

Bioaerosols are defined as micro-organisms suspended in the air and can include bacteria, fungi and viruses, or parts of living organisms, such as spores and plant pollen. Bioaerosols are usually smaller than 10µm in diameter and can cause human health impacts such as allergic responses and inflammation. Bioaerosols are naturally present in the air, but they are also associated with organic waste treatment processes including composting, mechanical biological treatment, and potentially some aspects of anaerobic digestion (AD) which are widely used in the UK.

### 1.2 Receptors

The most recent guidance<sup>1</sup> requires that biological waste treatment facilities provide a site-specific bioaerosol risk assessment if there are sensitive receptors within 250m of activities, regardless of the specific processes carried out at a site. It is noted 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<sup>2</sup>. Technical Guidance Note M9<sup>3</sup> states that receptors located more than 250m away should be discounted as they are not likely to be affected.

### 1.3 Lundwood STF

The nearest residential housing is located approximately 100m to the north, with other residential housing approximately 230m to the west at the closest point. There are industrial/agricultural receptors located closer to the site including industrial premises adjoining the site approximately 10m to the north of the digesters compound and agricultural buildings/premises approximately 75m north of the cake pad. There are amenity/habitat areas located within 250m of the installation boundary including the Trans Pennine Trail approximately 225m to the west and Sunnybank LWS which adjoins the site to the north. Risks associated with industrial, agricultural and amenity receptors are likely to be less significant due to the relatively shorter duration of exposure.

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<sup>1</sup> Environment Agency, consultation draft July 2020, Appropriate measures for the biological treatment of waste.

<sup>2</sup> Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

<sup>3</sup> Environment Agency Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities', July 2018,

Source	Source controls	Pathway	Receptors	Overall risk
Raw sludge intake	Sludge intake tank is covered but with no extraction and treatment. Sludge is fully enclosed within pipework when transferred between tankers and tanks.	Airborne dispersion	<u>Residential housing</u> within 250m, including residential areas 100m to the north and 230m to the west.	Low
Sludge reception – screenings skips	Screenings are not subject to regular disturbance and are stored in relatively small quantities (2 x skips). Screenings are wet, do not produce dust and are not readily susceptible to airborne dispersion.	Airborne dispersion	<u>Industrial/commercial sites</u> within 250m including industrial premises 10m to the north and agricultural premises 75m to the north.	Low
Raw sludge thickening including thickener feed tanks and drum thickeners	Sludge is fully enclosed within tanks or pipework at all times. Displaced air is extracted and dispersed to atmosphere via a two-stage odour control unit (OCU( (see separate entry below).	None	<u>Amenity areas</u> within 250, including the Transpennine trail 225m to the west and Sunnybank LWS adjoining the site to the north, although this	Risk not present – sludge is fully enclosed with extracted air treated in OCU
Odour control unit (OCU)	Air from thickener feed tanks, drum thickeners and thickener building is treated via a two-stage OCU comprising biofilter and activated carbon filtration prior to discharge to atmosphere. OCU subject to monitoring programme and planned maintenance to ensure effective operation.	Airborne dispersion	would only typically be used in a transitory manner.	Very low
Emergency scenario – biogas venting	As the sludge digestion process is a wet process biogas is unlikely to contain significant concentrations of bioaerosols. Venting events infrequent and short-lived.	Airborne dispersion		Very low

Source	Source controls	Pathway	Receptors	Overall risk
Emergency scenario – Sludge spillage	Sludge is wet, does not produce dust and is not readily susceptible to airborne dispersion. Events occur infrequently and in almost all cases will involve small quantities of sludge. Major/catastrophic loss is highly unlikely to occur. Emergency response procedures are in place to ensure such incidents are responded to promptly and spilt material is cleaned up.	Airborne dispersion	<u>Residential housing</u> within 250m, including residential areas 100m to the north and 230m to the west. <u>Industrial/commercial sites</u> within 250m	Very low
Digester feed tank	Digester feed tank is covered but with no extraction and treatment. S enclosed within pipework when transferred between tankers and tanks.	Airborne dispersion	including industrial premises 10m to the north and agricultural premises 75m to the north.	Low
Anaerobic digesters	Sludge is fully contained during digestion process with biogas collected and combusted in CHP, boiler and/or flare.	None	<u>Amenity areas</u> within 250m, including the Transpennine trial	Risk not present – sludge is fully enclosed
Digested sludge dewatering feed tanks (uncovered) x 2	Sludge is wet, does not produce dust and is not readily susceptible to airborne dispersion. Sludge contained within the dewatering feed tanks has been processed at high temperature in the digesters, achieving high levels of pathogen kills. Bioaerosol generation potential is therefore very low.	Airborne dispersion	225m to the west and Sunnybank LWS adjoining the site to the north, although this would only typically be used in a transitory manner.	Low

Source	Source controls	Pathway	Receptors	Overall risk
Digested sludge dewatering centrifuges	Digested sludge has been processed at high temperature in the digesters, achieving high levels of pathogens kill. Bioaerosol generation potential is therefore very low. Sludge cake is wet (approximately 25% solids content), does not produce dust and is not readily susceptible to airborne dispersion. Centrifuges are located within a building.	Airborne dispersion	<u>Residential housing</u> within 250m, including residential areas 100m to the north and 230m to the west. <u>Industrial/commercial sites</u> within 250m	Low
Digested sludge cake handling, storage and maturation – cake pad	Digested sludge has been processed at high temperature in the digesters, achieving high levels of pathogen kill. Bioaerosol generation potential is therefore very low. Sludge cake is wet (approximately 25% solids content), does not produce dust and is not readily susceptible to airborne dispersion. Centrifuges are located within a building.	Airborne dispersion	including industrial premises 10m to the north and agricultural premises 75m to the north. <u>Amenity areas</u> within 250, including the Transpennine trial	Low
As a contingency measure handling and possible short-term storage of undigested sludge cake – cake pad	Sludge cake is wet (approximately 25% solids content), does not produce dust and is not readily susceptible to airborne dispersion. The cake is delivered to the cake pad and is then left undisturbed until treatment and/or removal from site.	Airborne dispersion	225m to the west and Sunnybank LWS adjoining the site to the north, although this would only typically be used in a transitory manner.	Low

Source	Source controls	Pathway	Receptors	Overall risk
Vehicle tracking of materials around on the cake pad and roads, which could dry out and disperse	Washdown and wetting as required in order to reduce dust and keep pad area clean.	Airborne dispersion	<u>Residential housing</u> within 250m, including residential areas 100m to the north and 230m to the west.	Very low
Emergency scenario – Sludge cake spillage	Sludge is wet (approximately 25% solids content), does not produce dust and is not readily susceptible to airborne dispersion. Events occur infrequently and in almost all cases will involve small quantities of sludge. Major/catastrophic loss is highly unlikely to occur. Emergency response procedures are in place to ensure such incidents are responded to promptly and spilt material is cleaned up.	Airborne dispersion	<u>Industrial/commercial sites</u> within 250m including industrial premises 10m to the north and agricultural premises 75m to the north. <u>Amenity areas</u> within 250, including the Transpennine trial 225m to the west and Sunnybank LWS adjoining the site to the north, although this would only typically be used in a transitory manner.	Very low

**Table 1: Review of potential bioaerosol sources and associated risk**

## 1.4 Site Operation and monitoring

Although the individual assets at Lundwood STF have been deemed a low or very low bioaerosol risk, there will be a requirement to undertake bioaerosol monitoring as part of the site's Industrial Emissions Directive-Anaerobic Digestion (IED-AD) permit. Monitoring frequency will be dictated by the environmental permit.

At Lundwood STF, there are a number of sources adjacent to each other, it is therefore not possible to monitor the bioaerosol effect from individual point sources. Bioaerosol monitoring will therefore be considered as a combined single area (fig 1).



Fig 1 – Lundwood STF showing the installation boundary (green) and associated assets some of which may have the potential to cause bioaerosols

## 1.5 Meteorological Conditions

In the UK, the prevailing wind directions are commonly from the west and south-west. The wind direction and speed will impact the potential dispersion of bioaerosols from site.

As there are no representative meteorological stations for Lundwood STF, numerical weather predicted (NWP) meteorological data for Lundwood STF has been used for predicting the wind direction frequency for Lundwood STF. NWP meteorological data has been adopted for this assessment due to the complexity of the topography on site and is likely to give more accurate wind directions and frequencies. The wind rose plot for Lundwood STF is included in Figure 2.

There is currently no wind station on site to measure meteorological conditions. When a meteorological station is installed in line with the site’s environmental permit, onsite wind conditions will be taken into consideration in relation to this site specific bioaerosol risk assessment.

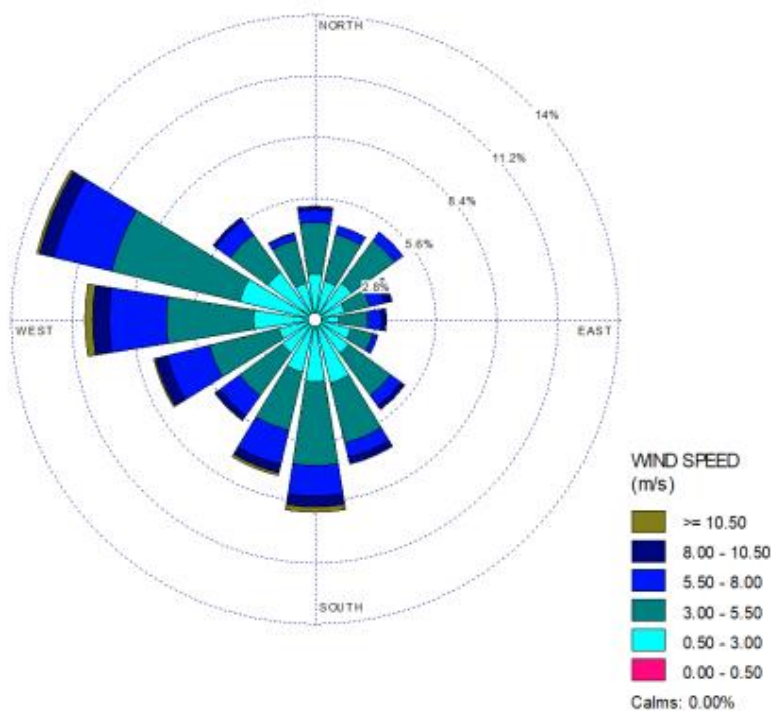


Fig 2 – Lundwood STF NWP Wind Rose Plot (NWP)

## 1.6 Site Monitoring Locations

The wind conditions will always be taken into consideration when conducting the bioaerosol monitoring. 1 upwind and 3 downwind samples in a fan shape will be undertaken. As the monitoring will be dictated by onsite wind conditions, the sampling locations may not match the prevailing wind as dictated in figure 2.

All sampling will be undertaken in line with EA M9 sampling guidance.

In November 2021, a one off monitoring assessment was undertaken, the monitoring locations are replicated in figure 3. The wind conditions did not match the expected wind results (figure 2) on the day of assessment. Wind conditions will always be noted and reported on within the bioaerosol monitoring report.

One upwind sampling location (marked with a blue dot on fig 3) was used to measure upwind concentrations of bioaerosols. Three samples were taken in a fan shape arrangement downwind of STF operations.



Any future monitoring locations will be dictated by the onsite wind conditions at the time of sampling and may or may not match figure 3. Downwind monitoring locations will be placed so that it captures the key bioaerosol locations, which will incorporate the dewatering, digestion and thickening/cake pad area.

Samples will be taken and assessed for the parameters and against the threshold limits given in table 2.

As a one-off assessment for the permit application, YW also requested some additional fixed sampling locations. These details and associated results can be found in the bioaerosol monitoring report dated December 2021.



Figure 3 – Lundwood STF Site Plan showing the installation boundary (green) with bioaerosol monitoring locations marked (blue dot = upwind, pink dot = downwind)

Parameter	Threshold limit (CFU/m <sup>3</sup> )
Total bacteria (TB)	1000
<i>Aspergillus fumigatus</i> (AF)	500

Table 2 – Bioaerosol monitoring parameters and threshold limits

### 1.7 Bioaerosol Monitoring Results

YW has undertaken quantitative bioaerosols monitoring in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. This monitoring exercise was carried out by Element Materials Technology Environmental UK Ltd

on 15<sup>th</sup> November 2021 (appendix 1). Sampling was undertaken at 3 downwind and one upwind location on site, with three parallel samples collected per location. All median concentration results for total bacteria and *Aspergillus fumigatus* were found to be below the guidance limit (1000 and 500 CFU/m<sup>3</sup> respectively) at all four sampling locations.

The next bioaerosol monitoring will be carried out in line with permit responsibilities. The results will be updated here.

### **1.8 Bioaerosol Risk Assessment – conclusions**

The bioaerosol risk assessment undertaken concludes that the Lundwood STF installation is unlikely to be a significant source of bioaerosols.

This is due to:

- All potential bioaerosol sources at Lundwood STF are wet, do not produce dust and are not readily susceptible to airborne dispersion.
- Digested sludge has been processed at high temperature via the digesters achieving high levels of pathogen kill. Bioaerosol generation potential from digested sludge sources is therefore very low.
- Undigested sludge sources are fully contained with displaced air extracted and treated in a two-stage biofilter prior to release to atmosphere.

The consensus of studies is that bioaerosols decline to background levels within 250m and guidance states that receptors located more than 250m away should be discounted as they are not likely to be affected. However, there are a significant number of potential bioaerosol receptors located within 250m of Lundwood STF. This includes residential housing, industrial and commercial sites and local amenity areas. Therefore, as a precautionary measure given the proximity of potential receptors, YW will undertake quantitative bioaerosol monitoring in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. The median concentration of total bacteria and of *Aspergillus fumigatus* was found to be below the guidance limit (1000 and 500 CFU/m<sup>3</sup> respectively) at all sampling locations.

Further bioaerosol monitoring will be conducted in line with the Environmental Permit associated with Lundwood STF.

Appendix 1 – Bioaerosol Monitoring Report by Element Materials Technology Environment UK Limited.



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Report: **Bioaerosol Monitoring**  
Client: Yorkshire Water Services Ltd  
Date of Site Work: 15<sup>th</sup> November 2021

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Issue date: 15<sup>th</sup> December 2021  
Report Ref: **106021 V1**

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### Executive Summary

Tom Broderick of Yorkshire Water Services Ltd requested that Element Materials Technology Environmental UK Limited undertake monitoring of bioaerosols at its Lundwood site. Monitoring was undertaken in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'.

Site work was undertaken by Andrew Carrighan on 15<sup>th</sup> November 2021.

The purpose of the bioaerosol monitoring exercise was to establish the amount of bioaerosols being dispersed from the site to the nearest sensitive receptor.

#### Monitoring Findings:

Sampling Location	Analyte	Guidance Limit (CFU/m <sup>3</sup> )	Median Concentration of Parallel Samples (CFU/m <sup>3</sup> )
Upwind	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125
Downwind	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125
Downwind Left Hand Fan	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125
Downwind Right Hand Fan	Total bacteria	1000	<125
	<i>Aspergillus fumigatus</i>	500	<125
Sampling Point 1	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125
Sampling Point 2	Total bacteria	1000	<125
	<i>Aspergillus fumigatus</i>	500	<125
Sampling Point 3	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125
Sampling Point 4	Total bacteria	1000	125
	<i>Aspergillus fumigatus</i>	500	<125

< Less than CFU/m<sup>3</sup> Colony Forming Units Per Cubic Metre

Below Limit	Exceeds Limit
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## 1. Introduction

Element Materials Technology Environmental UK Ltd was commissioned by Yorkshire Water Services Ltd to carry out a bioaerosol monitoring exercise at the Waste Water Treatment Works at their site in Lundwood.

The purpose of the bioaerosol monitoring exercise was to establish the amount of bioaerosols being dispersed from the site to the nearest sensitive receptor, as part of a permit application.

Monitoring was undertaken in accordance with Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. This report details the survey methodology and results on the monitoring of all locations.

Site work was undertaken by Andrew Carrighan of Element Materials Technology Environmental UK Ltd on 15<sup>th</sup> November 2021.

## 2. Measurement Methodology

Measurements were carried out in accordance with parameters specified in Technical Guidance Note M9 'Environmental Monitoring of Bioaerosols at Regulated Facilities'. Of the methods suggested in the protocol, the filter method was utilised in this project.

On site calibration checks were performed on the pumps used and were found to be within the permitted tolerance of the standard.

For all measurements the sample head was located 1.5 metres above ground level. The upwind sample was taken further away from the centre of operations than recommended in the guidance. This was to ensure the sample was outside the operational area and represented a true upwind value.

Triplicate samples were carried out at each selected sampling location. Once completed, filters were transferred in a refrigerated container to the laboratory within 24 hours.

The IOM heads containing a polycarbonate filter were used to determine the bioaerosol exposure under the test conditions. Upon arrival at the laboratory the bioaerosols impacted on each filter were recovered in 2 ml maximum recovery diluent. The target micro-organisms were cultured using appropriate dilutions on the following media.

Half-strength nutrient agar (1/2NA) plates were used for total mesophilic bacteria. Malt extract agar (MEA) plates were used for *Aspergillus fumigatus*.

Samples were incubated for up to seven days at 37°C (total mesophilic bacteria), and for two days at 45°C (*Aspergillus fumigatus*).

The laboratory retained information regarding each sample. Dates and times of preparation, incubation times, batch numbers, personnel responsible, storage medium and incubator temperature were all recorded.

### 3. Site Information

Yorkshire Water Services Ltd operates a Waste Water Treatment Works at their site in Lundwood, Yorkshire. The site currently is not required to undertake ambient air monitoring but has done so to support a permit application.

The site is not currently permitted, with an application being submitted in the near future. As such the limits used are the standard limits used by the Environment Agency (EA).

Parameter	Threshold limit (CFU/m <sup>3</sup> )
Total bacteria (TB)	1000
<i>Aspergillus fumigatus</i> (AF)	500



Table 1. Environmental Parameters - Bioaerosol monitoring				Job Number 106021			
Site:		Lundwood, Yorkshire		Site Operator		Yorkshire Water Services Ltd	
Date:		15/11/21		Commissioning Laboratory		EMT Environmental	
				Types of materials processed on site		Waste Water	
Location	Bearing of samplers from boundary of operational area (degrees °)	Mean direction the wind blows to during the sampling period (degrees °)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Mean wind speed (mph)	Arithmetic mean of air temperature °C	Arithmetic mean of relative humidity (%)	Prevailing weather conditions including cloud cover
Upwind	180	0	180	8	11	78	Cloudy. 8/8
Downwind	0	0	0	8	11	78	Cloudy. 8/8
Downwind Left Hand Fan	330	0	30	8	11	78	Cloudy. 8/8
Downwind Right Hand Fan	30	0	30	8	11	78	Cloudy. 8/8

#### 4. Measurement Results

The results for measurements undertaken at all locations are shown within a number of standardised tables on the following pages:

Table 2. Upwind: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms									Job Number 106021
Site:			Lundwood, Yorkshire			Site Operator:			Yorkshire Water Services Ltd
Date:			15/11/21			Commissioning Laboratory:			EMT Environmental
Activities affecting Bioaerosol Conc <sup>a</sup>			None			Types of materials processed on site:			Waste Water
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> )*	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Upwind	106021 – 15	95	180	10:59 – 11:59	60	TB	125	TB: <125	-
	106021 – 16	95	180			TB	<125		
	106021 – 17	95	180			TB	<125		
Upwind	106021 – 15	95	180	10:59 – 11:59	60	AF	<125	AF: <125	-
	106021 – 16	95	180			AF	<125		
	106021 – 17	95	180			AF	<125		

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>

Below permit limit
Exceeds permit limit

Table 3. Downwind: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms									Job Number 106021
Site:			Lundwood, Yorkshire			Site Operator:			Yorkshire Water Services Ltd
Date:			15/11/21			Commissioning Laboratory:			EMT Environmental
Activities affecting Bioaerosol Conc <sup>a</sup>			None			Types of materials processed on site:			Waste Water
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> )*	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Downwind	106021 – 18	70	0	11:36 – 12:36	60	TB	<125	TB: 125	-
	106021 – 19	70	0			TB	250		
	106021 – 20	70	0			TB	125		
Downwind	106021 – 18	70	0	11:36 – 12:36	60	AF	125	AF: <125	-
	106021 – 19	70	0			AF	<125		
	106021 – 20	70	0			AF	<125		

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>

Below permit limit
Exceeds permit limit

Table 4. Downwind Left Hand Fan: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 106021	
Site:			Lundwood, Yorkshire			Site Operator:		Yorkshire Water Services Ltd	
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental	
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:		Waste Water	
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> ) <sup>a</sup>	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Downwind Left Hand Fan	106021 – 21	100	30	11:23 – 12:23	60	TB	250	TB: 125	-
	106021 – 22	100	30			TB	<125		
	106021 – 23	100	30			TB	125		
Downwind Left Hand Fan	106021 – 21	100	30	11:23 – 12:23	60	AF	<125	AF: <125	-
	106021 – 22	100	30			AF	<125		
	106021 – 23	100	30			AF	<125		

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>



Table 5. Downwind Right Hand Fan: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 106021	
Site:			Lundwood, Yorkshire			Site Operator:		Yorkshire Water Services Ltd	
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental	
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:		Waste Water	
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> ) <sup>a</sup>	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Downwind Right Hand Fan	106021 – 24	150	30	11:48 – 12:48	60	TB	<125	TB: <125	-
	106021 – 25	150	30			TB	<125		
	106021 – 26	150	30			TB	125		
Downwind Right Hand Fan	106021 – 24	150	30	11:48 – 12:48	60	AF	<125	AF: <125	-
	106021 – 25	150	30			AF	<125		
	106021 – 26	150	30			AF	<125		

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>



Table 6. Sample Point 1: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms										
Site:			Lundwood, Yorkshire			Site Operator:		Job Number 106021		Yorkshire Water Services Ltd
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental		Waste Water
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:				
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> )*	Median of parallel samples (CFU/m <sup>3</sup> )	Comments	
Sample Point 1	106021 – 01	85	40	08:46 – 09:46	60	TB	125	TB: 125	-	
	106021 – 02	85	40			TB	125			
	106021 – 03	85	40			TB	<125			
Sample Point 1	106021 – 01	85	40	08:46 – 09:46	60	AF	<125	AF: <125	-	
	106021 – 02	85	40			AF	<125			
	106021 – 03	85	40			AF	<125			

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>

Below permit limit	Exceeds permit limit
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Table 7. Sampling Point 2: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms										
Site:			Lundwood, Yorkshire			Site Operator:		Job Number 106021		Yorkshire Water Services Ltd
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental		Waste Water
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:				
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> )*	Median of parallel samples (CFU/m <sup>3</sup> )	Comments	
Sample Point 2	106021 – 06	375	100	09:04 – 10:04	60	TB	<125	TB: <125	-	
	106021 – 07	375	100			TB	<125			
	106021 – 08	375	100			TB	<125			
Sample Point 2	106021 – 06	375	100	09:04 – 10:04	60	AF	<125	AF: <125	-	
	106021 – 07	375	100			AF	<125			
	106021 – 08	375	100			AF	<125			

\* Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup>      *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>

Below permit limit	Exceeds permit limit
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Table 8. Sample Point 3: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 106021	
Site:			Lundwood, Yorkshire			Site Operator:		Yorkshire Water Services Ltd	
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental	
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:		Waste Water	
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> ) <sup>a</sup>	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Sample Point 3	106021 – 09	75	250	09:15 – 10:15	60	TB	125	TB: 125	-
	106021 – 10	75	250			TB	125		
	106021 – 11	75	250			TB	<125		
Sample Point 3	106021 – 09	75	250	09:15 – 10:15	60	AF	<125	AF: <125	-
	106021 – 10	75	250			AF	<125		
	106021 – 11	75	250			AF	<125		

<sup>a</sup> Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup> *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>



Table 9. Sample Point 4: Bioaerosol monitoring – Estimated Concentrations of Airborne Micro-organisms								Job Number 106021	
Site:			Lundwood, Yorkshire			Site Operator:		Yorkshire Water Services Ltd	
Date:			15/11/21			Commissioning Laboratory:		EMT Environmental	
Activities affecting Bioaerosol Conc <sup>n</sup>			None			Types of materials processed on site:		Waste Water	
Location	Sample REF	Distance from centre of operational area (m)	Difference in bearing between location of samplers from boundary and mean direction wind blows to (degrees °)	Sampling Times	Sampling duration (mins)	Microbial Type	Calculated concentration of airborne microorganisms (CFU/m <sup>3</sup> ) <sup>a</sup>	Median of parallel samples (CFU/m <sup>3</sup> )	Comments
Sample Point 4	106021 – 12	165	300	09:29 – 10:29	60	TB	125	TB: 125	-
	106021 – 13	165	300			TB	125		
	106021 – 14	165	300			TB	500		
Sample Point 4	106021 – 12	165	300	09:29 – 10:29	60	AF	<125	AF: <125	-
	106021 – 13	165	300			AF	<125		
	106021 – 14	165	300			AF	<125		

<sup>a</sup> Site permit limits: Total Bacteria (TB) = 1000 CFU/m<sup>3</sup> *Aspergillus fumigatus* (AF) = 500 CFU/m<sup>3</sup>



Table 6. Controls and Filter Counts - Bioaerosol monitoring				Job Number: 106021
Site: Lundwood, Yorkshire		Date: 15/11/21	Site Operator : Yorkshire Water Services Ltd	Commissioning Laboratory : EMT Environmental
Types of materials processed on site : Waste Water				
Location	Sample Ref Number	Microbial Type	Average Count of microorganisms (CFU/filter)	Comments
Upwind	106021 – 15	TB	1	None received
		AF	0	
Upwind	106021 – 16	TB	0	None received
		AF	0	
Upwind	106021 – 17	TB	0	None received
		AF	0	
Downwind	106021 – 18	TB	0	None received
		AF	1	
Downwind	106021 – 19	TB	2	None received
		AF	0	
Downwind	106021 – 20	TB	1	None received
		AF	0	
Downwind Left Hand Fan	106021 – 21	TB	2	None received
		AF	0	
Downwind Left Hand Fan	106021 – 22	TB	0	None received
		AF	0	
Downwind Left Hand Fan	106021 – 23	TB	1	None received
		AF	0	
Downwind Right Hand Fan	106021 – 24	TB	0	None received
		AF	0	
Downwind Right Hand Fan	106021 – 25	TB	0	None received
		AF	0	
Downwind Right Hand Fan	106021 – 26	TB	1	None received
		AF	0	

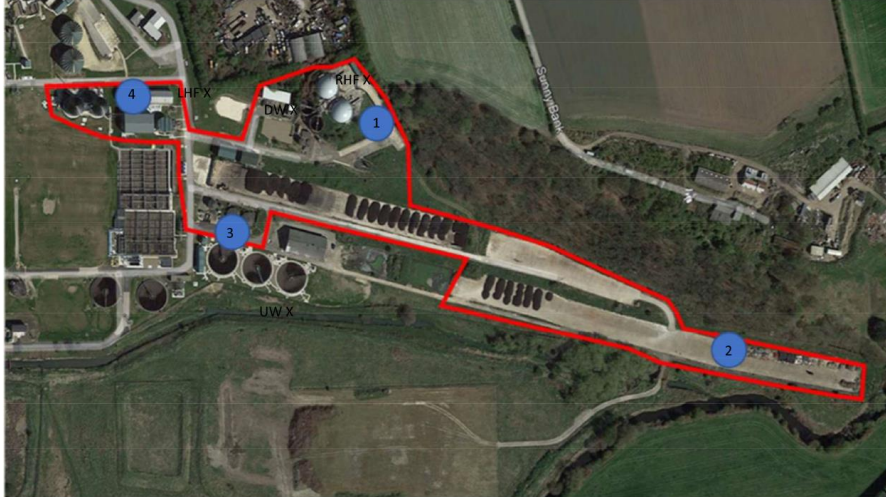
## 5. Plan

A standard map is shown on the next page. The operational boundary of the site is shown in red and the sample points are shown and labelled.



<b>Bioaerosol Monitoring – Estimated Concentrations of Airborne Micro Organisms</b>		Job Number 106021	
Site	Lundwood, Yorkshire	Site Operator	Yorkshire Water Services Ltd
Date	15/11/21	Commissioning Laboratory	EMT Environmental
Types of materials processed on site	Municipal solid waste		

Site boundary marked on red.



## 6. Discussion

Samples for this monitoring were collected using the filter option of the guidance document M9.

It is important to continue to monitor the site. It would be particularly useful to monitor on a day when the prevailing wind is in a different direction.

Whilst it is possible to replicate the sampling points, many other variables will have changed such as temperature, wind speed and wind direction. As such this monitoring is only a snapshot of the situation on site, not a complete picture. The sampling should be carried out at least quarterly to build up an idea of the characteristics of the site.

There were no nearby activities observed which could adversely impact the upwind results.

All results for total bacteria and *Aspergillus fumigatus* (AF) were below the limits.

It should be noted that the fixed points were undertaken in addition to the required sampling locations at the request of Yorkshire Water.

## 7. Conclusions

Element Materials Technology Environmental UK Limited was commissioned by Yorkshire Water Services Ltd to carry out a bioaerosol monitoring exercise at the In-Vessel Composting Facility at their site in Lundwood, Yorkshire.

Measurements were carried out in accordance with parameters specified in Technical Guidance Note M9 'Environmental monitoring of bioaerosols at regulated facilities'. Of the methods suggested in the protocol, the filter method was utilised in this project.

All results for total bacteria and *Aspergillus fumigatus* (AF) were below the limits.

The site would be due to be re-assessed in February 2022 assuming the standard frequency requested by the Environment Agency.

### Appendix 1. Analysis Certificates



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OL3 5DT

Our Ref: ELE/21/07

Date: 7<sup>th</sup> December 2021

#### BIOAEROSOL EXPOSURE REPORT

Log No. 3939  
Sample date.  
Engineer: Andy Fisher  
Job no.: 110602

Twenty-six IOM bioaerosol exposure heads were received on 16<sup>th</sup> November 2021.  
Occupational exposure events were monitored:

	Sample Head no.	Date	Volume (litres)
1	No.1	n/a	120
2	No.2	n/a	120
3	No.3	n/a	120
4	No.4	n/a	120
5	No.5	n/a	120
6	No.6	n/a	120
7	No.7	n/a	120
8	No.8	n/a	120
9	No.9	n/a	120
10	No.10	n/a	120
11	No.21	n/a	120
12	No.12	n/a	120
13	No.13	n/a	120
14	No.14	n/a	120
15	No.15	n/a	120
16	No.16	n/a	120
17	No.17	n/a	120
18	No.18	n/a	120
19	No.19	n/a	120
20	No.20	n/a	120
21	No.21	n/a	120



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22	No.22	n/a	120
23	No.23	n/a	120
24	No.24	n/a	120
25	No.25	n/a	120
26	No.26	n/a	120

The IOM heads containing a polycarbonate filter were used to determine the bioaerosol exposure under the test conditions. Upon arrival at the laboratory the bioaerosols impacted on each filter were recovered in 3 ml maximum recovery diluent. The target micro-organisms were cultured using appropriate dilutions on the following media.

Nutrient agar (NA) agar plates were used for total mesophilic bacteria.  
Malt extract agar (MEA) agar plates were used for *Aspergillus fumigatus*.

Samples were incubated for 5 days at 37C (total mesophilic bacteria), and for 2 days at 41C (*Aspergillus fumigatus*).

**Results:**

Site 110602

Date

Comments: All polycarbonate filters and filter heads were in good condition.

**Table 1. Microbiological Culture Plate Data:**

Sample no.	Sample Head no.	Volume (litres)	Total Mesophilic Bacteria (cfu per plate)	<i>Aspergillus Fumigatus</i> (cfu per plate)
1	No.1	120	1,0	0,0
2	No.2	120	1,0	0,0
3	No.3	120	0,0	0,0
4	No.4	120	0,0	0,0
5	No.5	120	0,0	0,0
6	No.6	120	0,0	0,0
7	No.7	120	0,0	0,0
8	No.8	120	0,0	0,0
9	No.9	120	1,0	0,0
10	No.10	120	1,0	0,0
11	No.21	120	0,0	0,0
12	No.12	120	1,0	0,0
13	No.13	120	1,0	0,0



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14	No.14	120	4,0	0,0
15	No.15	120	1,0	0,0
16	No.16	120	0,0	0,0
17	No.17	120	0,0	0,0
18	No.18	120	0,0	1,0
19	No.19	120	1,1	0,0
20	No.20	120	1,0	0,0
21	No.21	120	2,0	0,0
22	No.22	120	0,0	0,0
23	No.23	120	1,0	0,0
24	No.24	120	0,0	0,0
25	No.25	120	0,0	0,0
26	No.26	120	1,0	0,0

Table 2. Microbiological Results:

Sample no.	Sample Head no.	Volume (litres)	Total Mesophilic Bacteria (cfu per m <sup>3</sup> )	<i>Aspergillus Fumigatus</i> (cfu per m <sup>3</sup> )
1	No.1	120	125	<125
2	No.2	120	125	<125
3	No.3	120	<125	<125
4	No.4	120	<125	<125
5	No.5	120	<125	<125
6	No.6	120	<125	<125
7	No.7	120	<125	<125
8	No.8	120	<125	<125
9	No.9	120	125	<125
10	No.10	120	125	<125
11	No.21	120	<125	<125
12	No.12	120	125	<125
13	No.13	120	125	<125



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14	No.14	120	500	<125
15	No.15	120	125	<125
16	No.16	120	<125	<125
17	No.17	120	<125	<125
18	No.18	120	<125	125
19	No.19	120	250	<125
20	No.20	120	125	<125
21	No.21	120	250	<125
22	No.22	120	<125	<125
23	No.23	120	125	<125
24	No.24	120	<125	<125
25	No.25	120	<125	<125
26	No.26	120	125	<125

Exposure results are expressed as total micro-organisms per cubic metre collected during the exposure time.



BIODET

7<sup>th</sup> December 2021