MOTT MACDONALD

# Howdon Sludge Treatment Centre Environmental Permit Application

Bioaerosol risk assessment
100105164_ERA_BioaRA_HOW

February 2023

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# Contents

# 1 Introduction

## 1.1 Overview

Northumbrian Water is applying to vary the existing sewage sludge treatment activity (S0819 No 19) as authorised under the permit reference EPR/KP3394ZE (hereafter referred to as 'the Permit') to include the anaerobic digestion activity and biogas upgrading activity, and to consolidate the bespoke combustion activity under permit reference EPR/YP3331HQ to the same Installation permit for the Howdon Sewage Treatment Works (STW) and Sludge Treatment Centre (STC) ('the Site') on behalf of Northumbrian Water Limited ('Northumbrian Water' or 'the Operator').

Regulatory Position Statement (RPS) 209[1], issued 23 January 2018 by the Environment Agency, states that all sites that have a permit for the treatment of biological waste within 250 metres of a sensitive receptor (a place where people live or work for more than 6 hours at a time) must carry out a site-specific bioaerosol risk assessment. As sensitive receptors are found close the boundary of the Site, the closest of which is approximately 25m from the nearest potential source of bioaerosols at the Site, a bioaerosol risk assessment has been undertaken to accompany the permit application for this Site.

This bioaerosol risk assessment has assessed the magnitude of risk from potential emissions of bioaerosols from the Site at nearby sensitive human health receptors. The assessment has been undertaken in accordance with the methods and principles outlined in Environment Agency's "*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*" [2].

## 1.2 Site location

The Site is situated in an industrial area on Northumberland Dock Road, north of the River Tyne, Wallsend, Newcastle. The centre of the Site is occupied by Chemson Ltd (industrial land use). To the north of the Site is a region of derelict ground and to the east is the Royal Quays Outlets and Independent Centre. To the southeast of the Site is a disused wharf (Northumberland Dock). To the south are series of wharves and a haulage platform, whilst the area to the west/northwest comprises a mixture of residential dwellings.

The layout of the Site is shown in 100105164_MSD_SiteLocationPlan_HOW. The Site includes three advanced anaerobic digesters which are located in the southeast of the Site.

[1] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

[2] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

# 2 Methodology

## 2.1 Overview

Bioaerosols are naturally present in the air, but they are also associated with composting, anaerobic digestion (AD) and mechanical biological treatment, which are the main processes used to treat organic waste in the UK.

Bioaerosols are micro-organisms which are suspended in the air; these can include bacteria, fungi and viruses, or parts of living organisms, such as spores and plant pollen. Bioaerosols range in size from 0.02-100µm but are generally smaller than 10µm in diameter so can easily be breathed into the human respiratory system where they can cause adverse health impacts such as respiratory and gastrointestinal illnesses. Especially relevant to waste treatment facilities are infections of the respiratory system caused by *Aspergillus fumigatus*, which can be fatal, especially for at-risk and immuno-compromised patients. Bioaerosols can also cause eye irritation and dermatitis if they come into contact with the eyes and skin.[3]

## 2.2 Guidance

There is minimal regulatory guidance available for assessing bioaerosol emissions from AD facilities. RPS 031[4] states that bioaerosol concerns would normally be associated with composting activities, which are defined as: *'biological decomposition of biodegradable waste under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat'*.

This RPS also defines operations which are *'likely to result in the uncontrolled release of high levels of bioaerosols'* as including '*the shredding of waste and the turning of waste in the sanitisation, stabilisation and maturation stages of composting where these operations are not contained or are not subject to exhaust ventilation and scrubbing/filtering'*.

These activities do not occur at the Site as the biological decomposition of waste occurs under controlled, anaerobic conditions. Therefore, the Site is unlikely to be a high-risk site for bioaerosol emissions. This is supported by a 2012 Environment Agency guidance note[5] which states that the Environment Agency do not consider bioaerosols from anaerobic digestion to be of serious concern (provided composting activities are not undertaken at the facility).

Nonetheless, current Environment Agency guidance[6] requires any facility which could release bioaerosols to provide a site-specific bioaerosol risk assessment if there are sensitive receptors within 250m of activities. For new permits there is also a requirement to monitor bioaerosols if the site is within 250m of a sensitive receptor[7].

As sensitive human health receptors are found within 250m of the activities at the Site which have the potential to release bioaerosols, a bioaerosol risk assessment has been undertaken.

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[3] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

[4] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[5] Environment Agency. 2012. Guidance for developments requiring planning permission and environmental permits' (England)

[6] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

[7] *"Sensitive receptor – any building, other structure or installation, in which at least one person normally lives or works, other than a building, structure or installation within the same ownership or control as the operator/owner of the composting facility."* Taken from 'Guidance on the evaluation of bioaerosol risk assessments for composting facilities.'

## 2.3 Methodology

The method used for this bioaerosol risk assessment is adapted from the Environment Agency's '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*'[8], which recommends using a Source-Pathway-Receptor model to help determine the magnitude of the risk associated with bioaerosol emissions from a facility.

The magnitude of risk is a function of both the probability of exposure and the consequences of the hazard. The probability of exposure to bioaerosols can be described as:

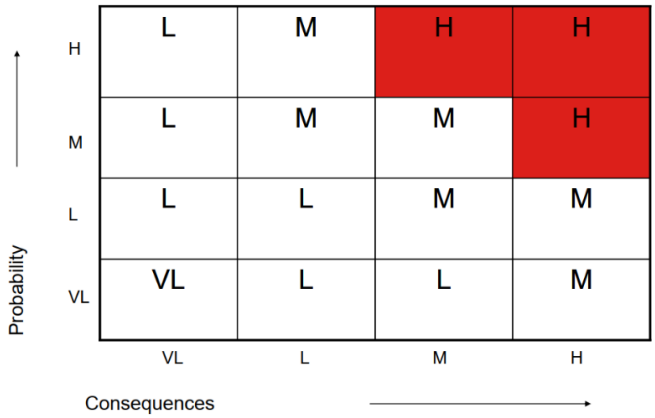
- High – exposure is probable, direct exposure likely with no/few barriers between source and receptor
- Medium – exposure is fairly probable, barriers less controllable
- Low – exposure unlikely, barriers exist to mitigate
- Very low – exposure very unlikely, effective and multiple barriers

The consequence of the hazard considers the nature of the source, the hazard and receptor. These consequences can be described as:

- High – severe consequences, evidence that exposure may result in serious damage
- Medium – significant consequences, evidence that exposure may result in damage that is not severe and is reversible
- Low – minor consequences, damage not apparent, reversible adverse changes possible
- Very low – negligible consequences, no evidence for adverse changes

The probability of exposure and consequence of the hazards are then combined to determine the overall magnitude of the risk, as demonstrated in Figure 2.1.

**Figure 2.1: Magnitude of risk matrices**




Source: Environment Agency, 2009

For this bioaerosol risk assessment, a Source-Pathway-Receptor model has been used to help assess the probability of exposure associated with different processes at the Site (Section 3). Existing control measures have also been identified to help inform the probability of exposure (Section 4). This has then been combined with the consequence of the hazard in Section 5 to determine the overall magnitude of risk associated with the different sources of bioaerosols at the Site, using the risk matrix above.

[8] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

# 3 Source – Pathway – Receptor model

## 3.1 Overview

This section provides a summary of the sources of bioaerosols at the Site and the potential pathways that the bioaerosols could travel to sensitive human health receptors.

## 3.2 Sources

### 3.2.1 Overview

The Site includes the following assets which could release bioaerosols:

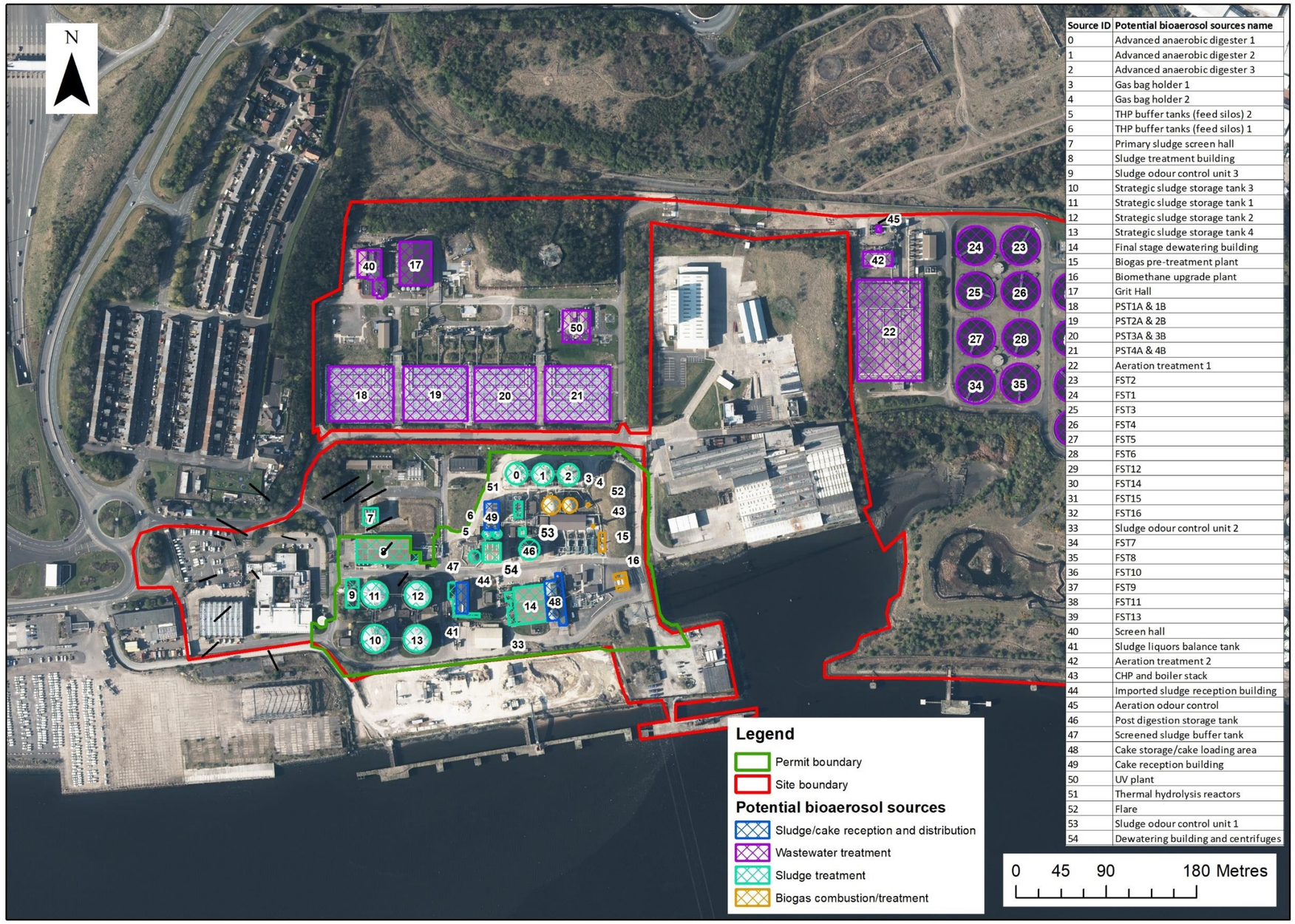
- Imported sludge reception building
- Cake storage/ loading area
- Cake reception building
- Grit hall
- Screen hall
- Four primary settlement tanks (PSTs)
- Two aeration buildings (includes the motor control centre (MCC))
- Aeration odour control unit
- 16 Final Settlement Tanks (FSTs)
- UV plant (wwtw)
- Three advanced anaerobic digesters
- Eight sludge storage tanks (including four strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, two THP buffer tanks (feed silos))
- Primary sludge screen hall
- Sludge treatment building (includes six strain presses and two centrifuges)
- Three sludge odour control units
- Sludge dewatering buildings (includes one post digestion sludge storage tank and two centrifuges)
- Sludge liquor balance tank
- Thermal hydrolysis reactors
- Two gas holders
- Biogas pre-treatment plant
- Biomethane upgrade plant
- One stack (connected to four generators and three Combined Heat and Power (CHP) engines)
- One flare

The following processes undertaken at the Site involving these assets, therefore, have the potential to release bioaerosols:

- Sludge/cake reception and distribution
- Wastewater treatment (settlement tanks, aeration tanks and UV plant)
- Sludge treatment (sludge storage, treatment, digesters and dewatering)
- Biogas combustion/treatment

Figure 3.1 shows the locations of these different processes and assets across the Site. A summary of the activities which occur at the Site involving these assets is then presented below.

**Figure 3.1: Potential sources of bioaerosols at the Site**




| Source ID | Potential bioaerosol sources name |
|---|---|
| 0 | Advanced anaerobic digester 1 |
| 1 | Advanced anaerobic digester 2 |
| 2 | Advanced anaerobic digester 3 |
| 3 | Gas bag holder 1 |
| 4 | Gas bag holder 2 |
| 5 | THP buffer tanks (feed silos) 2 |
| 6 | THP buffer tanks (feed silos) 1 |
| 7 | Primary sludge screen hall |
| 8 | Sludge treatment building |
| 9 | Sludge odour control unit 3 |
| 10 | Strategic sludge storage tank 3 |
| 11 | Strategic sludge storage tank 1 |
| 12 | Strategic sludge storage tank 2 |
| 13 | Strategic sludge storage tank 4 |
| 14 | Final stage dewatering building |
| 15 | Biogas pre-treatment plant |
| 16 | Biomethane upgrade plant |
| 17 | Grit Hall |
| 18 | PST1A & 1B |
| 19 | PST2A & 2B |
| 20 | PST3A & 3B |
| 21 | PST4A & 4B |
| 22 | Aeration treatment 1 |
| 23 | FST2 |
| 24 | FST1 |
| 25 | FST3 |
| 26 | FST4 |
| 27 | FST5 |
| 28 | FST6 |
| 29 | FST12 |
| 30 | FST14 |
| 31 | FST15 |
| 32 | FST16 |
| 33 | Sludge odour control unit 2 |
| 34 | FST7 |
| 35 | FST8 |
| 36 | FST10 |
| 37 | FST9 |
| 38 | FST11 |
| 39 | FST13 |
| 40 | Screen hall |
| 41 | Sludge liquors balance tank |
| 42 | Aeration treatment 2 |
| 43 | CHP and boiler stack |
| 44 | Imported sludge reception building |
| 45 | Aeration odour control |
| 46 | Post digestion storage tank |
| 47 | Screened sludge buffer tank |
| 48 | Cake storage/cake loading area |
| 49 | Cake reception building |
| 50 | UV plant |
| 51 | Thermal hydrolysis reactors |
| 52 | Flare |
| 53 | Sludge odour control unit 1 |
| 54 | Dewatering building and centrifuges |

### 3.2.2 Sludge/cake reception and distribution

The Site accepts approximately 45 tankers a day of trade septic/cess sludge waste. The Site also occasionally accepts cake at the cake reception building from other Northumbrian Water wastewater treatment sites when the facilities at Bran Sands, which normally accepts this, are not available.

### 3.2.3 Wastewater treatment and sludge treatment

#### 3.2.3.1 Wastewater

Wastewater arrives at the Site and is screened and de-gritted before being combined with sludge liquors from the sludge treatment process. The wastewater and sludge liquors then pass to the primary settlement tanks (PSTs) which separates the sludge from the effluent. The effluent from the PSTs then passes to the aeration treatment buildings for secondary treatment. Here, the aeration tanks use a conventional activated sludge process to remove organic pollutants (a process which releases carbon dioxide and water). The filtered effluent then flows to the final settlement tanks (FSTs) before passing into a UV plant for tertiary treatment. The treated effluent is then discharged into the River Tyne saline estuary.

#### 3.2.3.2 Sludge treatment

The Site treats indigenous sludge (from auto de-sludging of the PSTs and aeration lanes) as well as imported sludge and cake. Indigenous sludge is first thickened and combined with the imported sludge before being pumped to the strategic sludge storage tanks for blending. The blended sludge is then screened and dewatered in the sludge treatment building to create dewatered sludge, which is blended with any imported sludge cake prior to the Advanced Anaerobic Digestion (AAD) process.

For AAD, the dewatered sludge is pumped into the thermal hydrolysis reactors, where it is heated to a temperature of up to 180’C. The resultant hydrolysed sludge is then diluted to lower the temperature before being pumped into the advanced anaerobic digesters. Anaerobic digestion provides a controlled environment where micro-organisms, including bacteria and fungi, can grow, multiply and break-down organic material to form water, carbon dioxide and methane (biogas).

The digested sludge is stored in the post digestion sludge storage tank for approximately 18 days before being fed into the centrifuges at the final stage sludge dewatering building. The resulting cake is then transferred to the sludge cake silo before it is transported via conveyor to a covered tipper truck for removal from the Site to be deposited on agricultural land. Digested cake is stored in the final dewatering sludge cake silo for 1-2 days only.

### 3.2.4 Biogas combustion/treatment

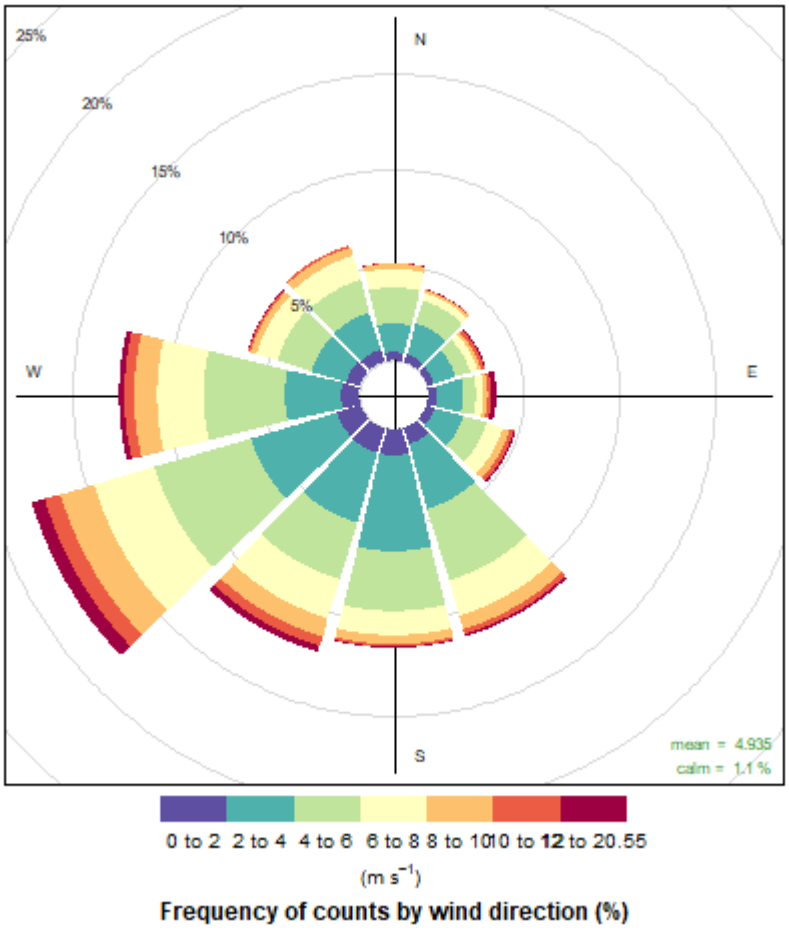
Biogas produced during the AAD process is transferred to the gas bag holders. Biogas will then either be exported to the grid (via the pre-treatment and biomethane upgrade plant) or will be combusted on-site, within the CHPs and generators to generate heat and electricity, which is used on-site to assist with the wastewater and sludge treatment processes. The CHPs and generators can also operate on natural gas, which is the preferred fuel so that biogas can be exported offsite. In the event that it is not possible to export biogas and the CHPs or generators are unavailable, excess biogas will be burned in the flare. However, operational procedures at the Site have been designed to minimise this event so the flare will usually only be used in emergencies, which would be expected to be for less than 5% of the year.

## 3.3 Pathways

Bioaerosols are very small and light in weight so can easily be transported by the wind from their source to a receptor. The 2016-2020 wind rose for the RAF Boulmer meteorological site (located approximately 48km north-west of the Site) is shown below in Figure 3.2. Data from this meteorological site was used as this was considered most representative of the Site due to its location near the coast and at a similar elevation to the Site.

The RAF Boulmer meteorological site experiences the most frequent winds from the southwest, with less frequent winds from the south and west. This suggests that sensitive receptors located to the north-east, north and east of the Site would be at greatest risk from bioaerosol emissions from the Site as they would be downwind of the prevailing wind direction.

**Figure 3.2: Average wind rose for RAF Boulmer meteorological site 2016- 2020**




Concentrations of bioaerosols decline rapidly within the first 100m from a source and generally decrease to background concentrations within 250m[9,10]. Much of the site is surrounded by a bund and is screened by trees and heavy vegetation. This could present a natural barrier to the

[9] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[10] Health and Safety Executive, 2010. Bioaerosol emissions from waste composting and the potential for workers' exposure.

transportation of bioaerosols by the wind. However, this would be dependent on the release height of bioaerosols on Site. Beyond the bund, the area surrounding the Site has relatively flat terrain.

## 3.4 Receptors

Environment Agency guidance[11] recommends a screening distance of 250m from bioaerosol emission sources to static receptor locations. Sensitive receptors are defined as:

"*permitted activities where people are likely to be for prolonged periods. This term would therefore apply to dwellings (including any associated gardens) and to many types of workplaces. We would not normally regard a place where people are likely to be present for less than 6 hours at one time as being a sensitive receptor. The term does not apply to those controlling the permitted facility, their staff when they are at work or to visitors to the facility, as their health is covered by Health and Safety at Work legislation, but would apply to dwellings occupied by the family of those controlling the facility*."

There are four areas of sensitive receptors found within 250m of potential bioaerosol emission sources at the Site. As demonstrated in Figure 3.3, two areas of sensitive receptors (an area of residential properties and an area of industrial land use) are found to the west of the Site. There is also an area of industrial land use at the centre of the Site (at the Chemson Ltd site) and a shopping centre east of the Site. The nearest of these areas to a potential bioaerosol source is the area of residential properties approximately 30m west of the PSTs.

For these four areas of receptors, the distance and direction from each potential bioaerosol emission source on Site to the receptors has been identified below in Table 3.1. Where multiple assets exist for the same process, such as digesters or settlement tanks, only the closest asset to the receptors has been presented.

[11] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 – Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

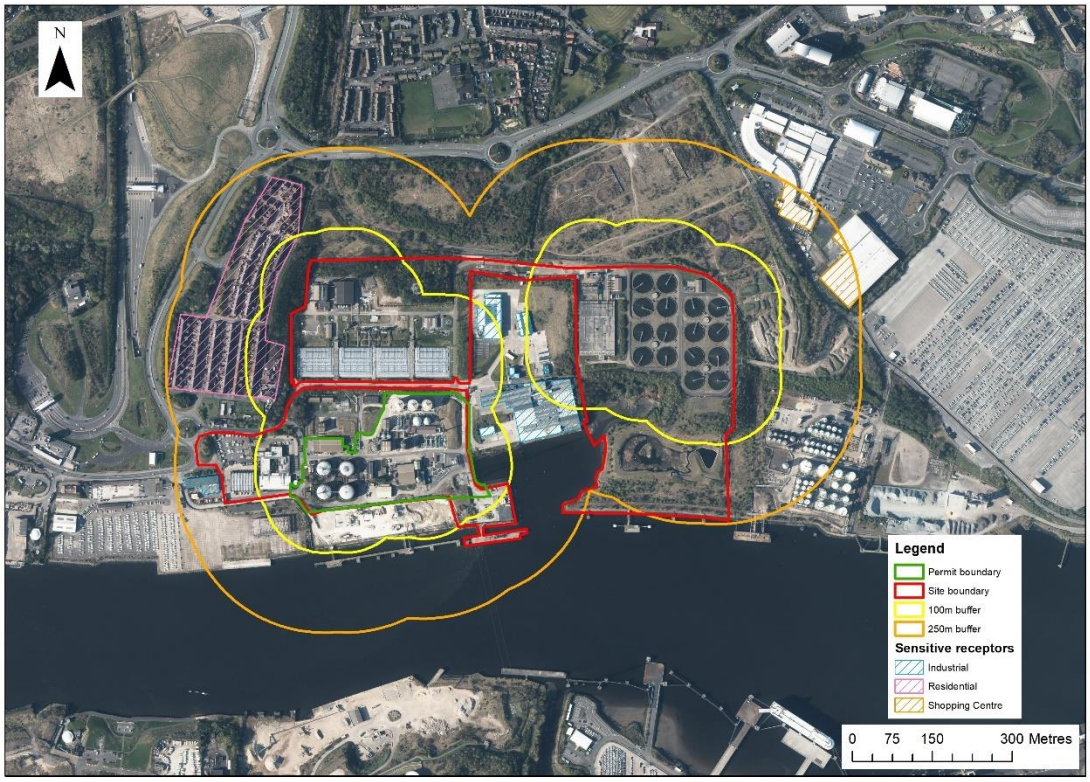
**Table 3.1: Receptors within 250m of potential emission sources at the Site**

| Nearest potential emission source to receptor | Process | Distance (m) and direction of different receptors[a] from nearest potential emission source [b] | | | |
|---|---|---|---|---|---|
| | | Residential properties west of the Site (m) | Industrial land use west of the Site (m) | Chemson Ltd at the centre of the Site (industrial land use) (m) | Shopping Centre east of the Site (m) |
| Imported sludge reception building | Sludge/cake reception and distribution | 210, West | >250, West | 210, Northeast | >250, Northeast |
| Cake storage/ loading area | Sludge/cake reception and distribution | >250, West | >250, West | 115, Northeast | >250, Northeast |
| Cake reception building | Sludge/cake reception and distribution | 205, West | >250, West | 170, East | >250, Northeast |
| Grit hall | Wastewater treatment | 110, West | >250, Southwest | 230, East | >250, Northeast |
| Screen hall | Wastewater treatment | 75, West | >250, Southwest | >250, East | >250, Northeast |
| Primary settlement tanks (PSTs) | Wastewater treatment | 30, West | >250, Southwest | 70, East | >250, Northeast |
| Aeration treatment buildings | Wastewater treatment | >250, West | >250, Southwest | 50, West | >250, Northeast |
| Aeration odour control unit | Wastewater treatment | >250, West | >250, Southwest | 135, Southwest | >250, Northeast |
| Final Settlement Tanks (FSTs) | Wastewater treatment | >250, West | >250, Southwest | 125, West | 185, Northeast |
| UV plant | Wastewater treatment | >250, West | >250, Southwest | 75, East | >250, Northeast |
| Advanced anaerobic digesters | Sludge treatment | 220, Northwest | >250, Southwest | 90, East | >250, Northeast |
| Sludge storage tanks* | Sludge treatment | 145, Northwest | 185, West | 130, Northeast | >250, Northeast |
| Primary sludge screen hall | Sludge treatment | 90, Northwest | 205, Southwest | >250, East | >250, Northeast |
| Sludge treatment building | Sludge treatment | 105, Northwest | 185, Southwest | 245, East | >250, Northeast |
| Sludge odour control units | Sludge treatment | 130, Northwest | 170, Southwest | 140, East | >250, Northeast |
| Sludge dewatering buildings | Sludge treatment | 215, Northwest | >250, West | 135, East | >250, Northeast |
| Sludge liquor balance tank | Sludge treatment | 205, Northwest | >250, West | 205, East | >250, Northeast |
| Thermal hydrolysis reactors | Sludge treatment | 235, West | >250, West | 145, East | >250, East |
| Gas bag (holders) | Biogas combustion/treatment | >250, West | >250, Southwest | 90, East | >250, Northeast |
| Biogas pre-treatment plant | Biogas combustion/treatment | >250, Northwest | >250, Southwest | 65, East | >250, Northeast |

| Nearest potential emission source to receptor | Process | Distance (m) and direction of different receptors[a] from nearest potential emission source [b] | | | |
|---|---|---|---|---|---|
| | | Residential properties west of the Site (m) | Industrial land use west of the Site (m) | Chemson Ltd at the centre of the Site (industrial land use) (m) | Shopping Centre east of the Site (m) |
| Biomethane upgrade plant | Biogas combustion/treatment | >250, Northwest | >250, West | 60, East | >250, Northeast |
| Combined Heat and Power (CHP) and boiler stack | Biogas combustion/treatment | >250, Northwest | >250, Southwest | 75, East | >250, Northeast |
| Flare | Biogas combustion/treatment | >250, West | >250, Southwest | 80, East | >250, Northeast |

Source: (a) Refers to the receptors presented within Figure 3.4.
(b) Distance from source to receptor is rounded to the nearest 5m
* Sludge storage tanks include four strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, and two THP buffer tanks (feed silos)

**Figure 3.3: Sensitive receptors within 250m**




## 3.5 Summary

Table 3.2 below summarises the potential sources of bioaerosol emissions at the Site, the sensitive receptors most at risk and the pathways through which the bioaerosols could travel from source to receptor.

**Table 3.2: Source-Pathway-Receptor model**

| Source process | Potential emission source | Pathway | Nearest receptor |
|---|---|---|---|
| Sludge/cake reception and distribution | Imported sludge reception building | Air transport then:<br>• Inhalation (through nose or mouth)<br>• Ingestion (eating or swallowing)<br>• Absorption/contact (through skin or eyes)<br>• Injection (by high pressure equipment/ contaminated sharp objects) | Residential property – 210m northwest |
| | Cake storage/ loading area | | Industrial land use “Chemson Ltd” – 115m northeast |
| | Cake reception building | | Industrial land use “Chemson Ltd” – 170m east |
| Wastewater treatment | Grit hall | | Residential property – 110m west |
| | Screen hall | | Residential property – 75m west |
| | Primary settlement tanks (PSTs) | | Residential property – 30m west |
| | Aeration treatment buildings | | Industrial land use “Chemson Ltd” – 50m west |
| | Aeration odour control unit | | Industrial land use “Chemson Ltd” – 135m southwest |

| Source process | Potential emission source | Pathway | Nearest receptor |
|---|---|---|---|
| | Final Settlement Tanks (FSTs) | | Industrial land use “Chemson Ltd” – 125m west |
| | UV plant | | Industrial land use “Chemson Ltd” – 75m east |
| Sludge treatment | Advanced anaerobic digesters | | Industrial land use “Chemson Ltd” – 90m east |
| | Sludge storage tanks* | | Industrial land use “Chemson Ltd” – 130m northeast |
| | Primary sludge screen hall | | Residential property – 90m northwest |
| | Sludge treatment building | | Residential property – 105m northwest |
| | Sludge odour control units | | Residential property – 130m northwest |
| | Sludge dewatering buildings | | Industrial land use “Chemson Ltd” – 135m east |
| | Sludge liquor balance tank | | Residential property – 205m northwest |
| | Thermal hydrolysis reactors | | Industrial land use “Chemson Ltd” – 145m east |
| Biogas combustion/ treatment | Gas bag (holders) | | Industrial land use “Chemson Ltd” – 90m east |
| | Biogas pre-treatment plant | | Industrial land use “Chemson Ltd” – 65m east |
| | Biomethane upgrade plant | | Industrial land use “Chemson Ltd” – 60m east |
| | Combined Heat and Power (CHP) and boiler stack | | Industrial land use “Chemson Ltd” – 75m east |
| | Flare | | Industrial land use “Chemson Ltd” – 80m east |

* Sludge storage tanks include four strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, and two THP buffer tanks (feed silos)

# 4 Control measures

## 4.1 Overview

The three primary ways to mitigate emissions of bioaerosols[12] are to:

- Reduce emissions
- Contain emissions
- Enhance dispersion

The sections below outline the different control measures in place at the Site for sludge/cake reception and distribution, wastewater treatment, sludge treatment and biogas combustion/treatment processes. These control measures aim to reduce and contain emissions of bioaerosols to prevent the source-pathway-receptor link associated with each of the potential emission sources identified in Section 3.5.

No specific bioaerosol control measures, such as covers, are in place for the FSTs at the Site. However, this is a 'wet' process, so the likelihood of the resuspension of bioaerosols from this potential source, and therefore the probability of exposure, is minimised so no additional control measures would be required.

## 4.2 Control measures

### 4.2.1 Sludge/cake reception and distribution

The transfer of trade liquid sludge from the tankers has a short duration and, under normal operations, takes place up to 45 times a day. The liquid sludge is pumped directly from the tanker into the strategic sludge storage tanks while the imported cake is unloaded via tipper trucks. The liquid sludge and imported cake are accepted within the imported sludge reception building and the cake reception building respectively. The doors to both buildings are kept closed at all times except when access is required and the buildings are kept under negative pressure. Therefore, the potential for release of bioaerosols is minimal.

Unloading and loading procedures are also designed to limit emissions. For example, when the tanker drives into the imported sludge reception building, the shutter door is closed before unloading. Covered trucks are also only able to unload imported cake once the doors to the cake reception building are closed. In both imported sludge and cake reception buildings, external doors cannot open if either internal doors are open. Meanwhile, during loading, processed cake (from the sludge dewatering building) is loaded directly from the cake silo onto tipper trucks. Each vehicle is then covered prior to leaving the loading bay in the cake storage/ loading area.

If a spillage of sludge/cake occurs, the area is cordoned off and the site manager or owner is informed. If the spillage has been stopped and contained, the spillage is then cleaned up in accordance with the site spillage procedure. However, if the release of sludge/cake cannot be stopped, the site manager or owner may escalate the incident in line with the Emergency Management Manual and seek advice from relevant persons to stop and contain the spillage. Significant spillage incidents will be recorded in the site diary.

[12] Wheeler P.A., Stewart, I., Dumitrean, P. and Donovan, B., 2001. Health Effects of Composting: A Study of Three Compost Sites and Review of Past Data. R&D Technical Report P1-315/TR, Environmental Agency, Bristol.

To further limit emissions of bioaerosols at the reception facilities, odours from the cake reception area, cake import hoppers and the silo in the cake storage/loading area are extracted and treated. The scrubbed air is then released to atmosphere.

### 4.2.2 Wastewater and sludge treatment

#### 4.2.2.1 Containment of emissions

To contain emissions of bioaerosols during wastewater and sludge treatment, covers and doors to the screening hall, grit hall, primary sludge screening hall, sludge treatment building, sludge dewatering buildings and aeration treatment buildings are kept closed at all times except when access is required. All PSTs, sludge storage tanks and sludge liquor balance tanks are also sealed and covered.

When access is required for operation and maintenance, the covers and seals to these treatment facilities will only be opened for minimum periods. If access is required for an extended period of time, i.e. for maintenance activities, additional mitigation measures are implemented to minimise the impact associated with bioaerosols, such as additional containment and notifying nearby stakeholders in advance of maintenance.

#### 4.2.2.2 Reduce emissions

Throughout the sludge treatment process, biological material which could give rise to emissions of bioaerosols is broken down. This primarily occurs during anaerobic digestion which removes microorganisms which could give rise to bioaerosols. Therefore, at each stage of the sludge treatment process, the potential quantity of bioaerosols decreases, reducing the risk of exposure; the concentration of bioaerosols that could potentially be emitted from the sludge dewatering plant (at the end of the sludge treatment process) is much lower than the sludge within the strategic sludge storage (prior to anaerobic digestion).

Nevertheless, odorous air from all wastewater and sludge treatment processes (except the FSTs) is extracted and treated by either an Odorgard chemical scrubber, acid venturi scrubber or a catalytic iron filter to remove odorous compounds. This reduces the risk of bioaerosol emissions from these processes.

### 4.2.3 Biogas combustion/treatment

Biogas produced during anaerobic digestion is stored within the gas bag holder before either being exported to the grid or combusted at high temperatures within the CHP, generators or flare. The gas bag (holder) stores the biogas within an air-tight container with methane monitors which prevents the release of bioaerosol emissions. During combustion, any bioaerosols present within the biogas would be destroyed. Therefore, emissions of bioaerosols associated with biogas combustion would be de minimis.

## 4.3 Maintenance of control measures

Daily checks, measurements and sampling are conducted of the treatment processes on-site to ensure the equipment is working correctly. The parameters measured include: dry solid percentage of primary unthickened sludge, liquors return flow, drum thickener flow, turbidity, methane production (full list of parameters monitored are found within the parameters measured sheet for the Site). Where desired operating parameters are not met, various corrective actions and operating procedures are in place to rectify the problem. Performance issues and equipment problems are also reported promptly.

Daily, weekly and monthly maintenance tasks/servicing are performed on key equipment across the Site by Northumbrian Water staff and specialist contractors e.g. periodic testing of the odour containment and extraction systems. Northumbrian Water has also issued generic maintenance task manuals for use across all their sites which include protocols for the maintenance of equipment.

Furthermore, there are multiple good housekeeping practices that are employed at the Site to maintain the efficacy of equipment. For example, scum is automatically removed from PSTs which are auto-desludged to maintain efficient sludge removal.

Stocks of chemicals on-site are also carefully managed to ensure there are sufficient stocks so that the necessary treatment processes, control measures and maintenance activities can be undertaken when required.

## 4.4 Emergency procedures

In the event of plant failures or emergency situations, an alarm would be raised on the Site Supervisory Control and Data Acquisition (SCADA) or telemetry systems. The alarm will then be received by the regional control room, which is manned 24 hours per day, and the site operators will subsequently be contacted.

Depending upon the nature of the fault or emergency, the Production Team Leader (Incident Controller), Works Manager (Main Controller) or Nominated Responsible Person would be contacted and would attend the Site as soon as practicable, if required. Electrical, Mechanical and Instrumentation (EMI) assistance can also be requested immediately to ensure as rapid a response and resolution as possible. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached.

In the event of an emergency/failure of equipment on-site, there are various contingency measures in place. For example, in the event of the failure of the odour control system, standby equipment can be installed.

## 4.5 Monitoring

### 4.5.1 Overview

Bioaerosol emissions associated with the operation of the Site will be monitored in line with the EA Technical Guidance Note (TGN) M9[13] requirements to monitor effectiveness of control measures.

Sampling of bioaerosols using either impaction, filtration or impingement samplers will be undertaken by an MCERTS accredited organisation. The final approach would be determined prior to appointment in accordance with the requirements of TGN M9.

### 4.5.2 Monitoring Locations

As indicated in Figure 3.2, the prevailing wind direction at the Site is from the south west, therefore, in accordance with TGN M9, three samplers will be positioned to the north east of the Site to capture downwind bioaerosol concentrations and one sampler will be located upwind, to the south west of the Site.

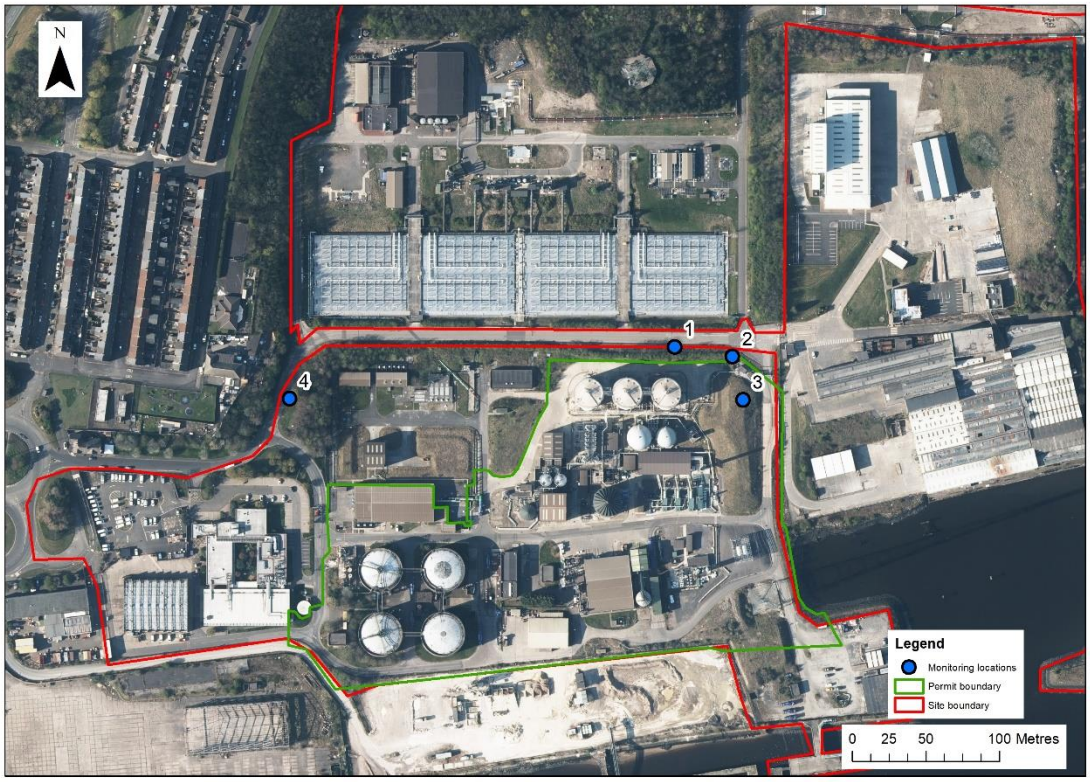
[13] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 - Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

Figure 4.1**Error! Reference source not found.** presents the indicative sampling locations identified for the Site. Locations 1, 2 and 3 represent the proposed locations for the three downwind samplers and are located at the same distance as the closest sensitive receptor (30m) from the nearest source of bioaerosols. The downwind samplers are arranged in a fan shape to ensure the maximum concentrations of bioaerosols are captured and variable wind directions will be accounted for.

The indicative monitoring location 4 represents the upwind sampler and is positioned approximately 50m from the nearest bioaerosol source. This location will provide a baseline concentration of bioaerosols, representative of background concentrations and any neighbouring sources of bioaerosols, such as agricultural activities, without contributions from the Site.

The exact sampling locations are dependent on the accessibility of each location and will be confirmed by the MCERTS accredited organisation that will conduct the sampling.

**Figure 4.1: Indicative bioaerosol monitoring locations**




### 4.5.3 Sampling methodology

Appropriate sampling of bioaerosols will be conducted by an MCERTS accredited organisation using procedures relevant to the sampler type, as described in TGN M9. Sampling at the upwind and downwind locations will be undertaken concurrently so that results can be compared.

Sampling will be undertaken during appropriate weather conditions such as avoiding rain, sleet and snow, depending on the sampling technique, and will consider the wind speed and direction

at the time of sampling. Meteorological conditions including wind speed, wind direction, cloud cover, temperature, relative humidity, and atmospheric conditions will be recorded by an automatic weather station with an integral data logger during monitoring periods and this data will be recorded. The meteorological station will be positioned in a suitable location, away from anything which could influence measurements, such as at locations very close to buildings.

A minimum of three measurements of Aspergillus fumigatus and mesophilic bacteria will be taken from each sampler during each monitoring visit. Appropriate equipment and methodologies for each sampler type are described in TGN M9 and this guidance will be followed during the bioaerosol monitoring.

Following the measurements, samples will be stored and transported appropriately before being analysed in a laboratory.

Detailed and accurate records of the bioaerosol monitoring will be kept and the data will be recorded using the standard report forms provided in TGN M9 or an appropriate alternative.

## 4.6 Summary

As discussed above, there are a number of control measures in place at the Site to reduce and contain emissions of bioaerosols. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.

Across the Site, the potential for bioaerosol emissions which could result in significant consequences is limited. The greatest risk of significant bioaerosol emissions from the Site where there would be the greatest consequence of the hazard, is associated with emergency situations such as a failure of the odour control units, which could result in uncontrolled emissions of bioaerosols. However, such an emergency event would be unlikely, temporary, and infrequent due to the extensive monitoring and maintenance programmes undertaken at the Site as well as the emergency procedures and warning systems in place.

# 5 Risk assessment

## 5.1 Overview

This section assesses the probability of exposure and consequence of the hazard associated with potential emissions of bioaerosols at the Site to determine the overall magnitude of risk. The descriptors used ('very low' to 'high') are based on the descriptors outlined in the Environment Agency guidance[14], as summarised in Section 2.3.

## 5.2 Probability of exposure

As described in Section 3, the main potential sources of bioaerosols at the Site are associated with:

- Sludge/cake reception and distribution
- Wastewater treatment (settlement tanks, aeration tanks and UV plant)
- Sludge treatment (sludge storage, treatment, digesters and dewatering)
- Biogas combustion/treatment

These processes have the potential to emit bioaerosols, which are transported through the air by the wind and could cause harm to nearby human health receptors. However, as discussed in Section 4, there are multiple control measures in place at the Site which restrict the Source-Pathway-Receptor link by reducing and containing emissions of bioaerosols from these processes. Therefore, across all potential bioaerosol sources at the Site, the overall probability of exposure is either '**very low**' or '**low**'.

The final probability of exposures to bioaerosols assessed for each emission source is presented below in Table 5.1.

**Table 5.1: Probability of exposure to bioaerosols from different sources at the Site**

| Process | Potential source of bioaerosols | Probability of exposure | Justification |
|---|---|---|---|
| Sludge/cake reception and distribution | Imported sludge reception building | Very Low | Stringent loading and unloading procedures. Extracted air from the cake loading area is treated by odour control unit – uncontrolled release of bioaerosols very unlikely |
| | Cake storage/ loading area | Very Low | Stringent loading and unloading procedures. Extracted air from the cake silo is treated by odour control unit – uncontrolled release of bioaerosols very unlikely |
| | Cake reception building | Very Low | Stringent loading and unloading procedures. Extracted air from the building is treated by odour control unit – uncontrolled release of bioaerosols very unlikely |
| Wastewater treatment | Grit hall | Very Low | Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely |

[14] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

| Process | Potential source of bioaerosols | Probability of exposure | Justification |
|---|---|---|---|
| | Screen hall | Very Low | Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Primary settlement tanks (PSTs) | Very Low | Tanks are covered and extracted air is treated by odour control unit and processes monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Aeration treatment buildings | Very Low | Aeration lanes covered and contained within a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Aeration odour control unit | Very low | Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Final Settlement Tanks (FSTs) | Low | Uncovered, 'wet' process - exposure to bioaerosol emissions unlikely |
| | UV plant | Very Low | Processes enclosed in a building - exposure to bioaerosol emissions very unlikely |
| Sludge treatment | Advanced anaerobic digesters | Very Low | Digesters covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Sludge storage tanks * | Very Low | Tanks covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Primary sludge screen hall | Very Low | Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Sludge treatment building | Very Low | Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Sludge odour control units | Very Low | Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Sludge dewatering buildings | Very Low | Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Sludge liquor balance tank | Very Low | Tanks covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Thermal hydrolysis reactors | Very Low | Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |

| Process | Potential source of bioaerosols | Probability of exposure | Justification |
|---|---|---|---|
| Biogas combustion/ treatment | Gas bag (holders) | Very Low | Gas bag holders sealed to prevent uncontrolled release of bioaerosols – uncontrolled release of bioaerosols very unlikely |
| | Biogas pre-treatment plant | Very Low | Tanks sealed, process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Biomethane upgrade plant | Very Low | Tanks sealed, process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Combined Heat and Power (CHP) and boiler stack | Very Low | Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely |
| | Flare | Very Low | Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely |

* Sludge storage tanks include four Strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, and two THP buffer tanks (feed silos).

## 5.3 Consequence of hazard

While the probability of exposure of receptors to bioaerosols is ‘very low’ or ‘low’ as a result of the control measures in place or the nature of processes on Site, there is still a risk that nearby receptors could be exposed to bioaerosols, for example when sludge and cake is unloaded/loaded into trucks or tankers or if there was a failure of the control equipment. Should this occur, any exposure to bioaerosols would likely be temporary/infrequent due to the contingency measures in place at the Site. Furthermore, if the exposure was due to a failure of control equipment, the fault would be detected by the SCADA system to generate an alarm and management response, and the Emergency Management Manual would be followed to rectify the fault as soon as possible.

However, if exposure to bioaerosols did occur, this could result in adverse health impacts at sensitive receptors. These impacts could include (but are not limited to):

- Respiratory infections and inflammation of the respiratory system
- Reduced lung function
- Allergic reactions
- Gastro-intestinal disorders
- Dermatitis
- Eye irritation

The consequence of the hazard at sensitive receptors (i.e. the severity of impacts on human health) is largely determined by the proximity of the receptor to the emission source; concentrations of bioaerosols decline rapidly within the first 50-100m from a source (and generally decrease to background concentrations within 250m) [15,16]. Therefore, receptors within

[15] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[16] Health and Safety Executive, 2010. Bioaerosol emissions from waste composting and the potential for workers’ exposure.

100m of bioaerosol emission sources will experience a greater hazard consequence than those more than 100m from the emission source.

For the purpose of this assessment, receptors within 50m of bioaerosol sources and downwind of the prevailing wind direction are considered to be '**high**' consequence of hazard. This is because within 50m of a source, consequences could be "severe", and "exposure may result in significant damage", as being downwind of the prevailing wind direction also increases the likelihood of exposure. Receptors within 50m of bioaerosols that are upwind of the prevailing wind direction are considered to have a '**medium**' consequence of hazard, as though they are in close proximity to a bioaerosol source, they are less likely to be exposed due to the prevailing wind direction.

Sources of bioaerosols within 50-100m of receptors are also considered to have a '**medium**' consequence of hazard, irrespective of whether they are upwind or downwind of the emission source. This is because within 50-100m of the source, concentrations of bioaerosols would reduce, so temporary exposure could result in "significant consequences" and potentially result in "damage that is not severe and is reversible". Beyond 100m, up to 250m, the consequence of the hazard is considered to be '**low**' as concentrations of bioaerosols would be lower so the consequence of the hazard would also be lower, resulting in "minor consequences" where damage is "not apparent, reversible adverse changes possible". Beyond 250m, the consequence is considered '**very low**' as concentrations of bioaerosols generally decrease to background concentrations at this distance so there would be "no evidence for adverse changes" at sensitive receptors at this distance.

The final consequence of hazard assessed for each emission source is presented below in Table 5.2. Across all potential bioaerosol emission sources at the Site, the consequence of hazard is '**low**' or '**medium**'.

**Table 5.2: Consequence of hazard from bioaerosols at the Site**

| Source process | Potential source of bioaerosols | Nearest receptor | Consequence of hazard | Justification |
|---|---|---|---|---|
| Sludge/cake reception and distribution | Imported sludge reception building | 210m west | Low | Nearest receptor <250m from potential source |
| | Cake storage/ loading area | 115m northeast | Low | Nearest receptor <250m from potential source |
| | Cake reception building | 170m, east | Low | Nearest receptor <250m from potential source |
| Wastewater treatment | Grit hall | 110m west | Low | Nearest receptor <250m from potential source |
| | Screen hall | 75m west | Medium | Nearest receptor <100m from potential source |
| | Primary settlement tanks (PSTs) | 30m west | Medium | Nearest receptor <50m, upwind from potential source |
| | Aeration treatment buildings | 50m west | Medium | Nearest receptor <100m from potential source |
| | Aeration odour control unit | 135m southwest | Low | Nearest receptor <250m from potential source |
| | Final Settlement Tanks (FSTs) | 125m west | Low | Nearest receptor <250m from potential source |
| | UV plant | 75m east | Medium | Nearest receptor <100m from potential source |

| Source process | Potential source of bioaerosols | Nearest receptor | Consequence of hazard | Justification |
|---|---|---|---|---|
| Sludge treatment | Advanced anaerobic digesters | 90m east | Medium | Nearest receptor <100m from potential source |
| | Sludge storage tanks* | 130m northeast | Low | Nearest receptor <250m from potential source |
| | Primary sludge screen hall | 90m northwest | Medium | Nearest receptor <100m from potential source |
| | Sludge treatment building | 105m northwest | Low | Nearest receptor <250m from potential source |
| | Sludge odour control units | 130m northwest | Low | Nearest receptor <250m from potential source |
| | Sludge dewatering buildings | 135m east | Low | Nearest receptor <250m from potential source |
| | Sludge liquor balance tank | 205m northwest | Low | Nearest receptor <250m from potential source |
| | Thermal hydrolysis reactors | 145m east | Low | Nearest receptor <250m from potential source |
| Biogas combustion/ treatment | Gas bag (holders) | 90m east | Medium | Nearest receptor <100m from potential source |
| | Biogas pre-treatment plant | 65m east | Medium | Nearest receptor <100m from potential source |
| | Biomethane upgrade plant | 60m east | Medium | Nearest receptor <100m from potential source |
| | Combined Heat and Power (CHP) and boiler stack | 75m east | Medium | Nearest receptor <100m from potential source |
| | Flare | 80m east | Medium | Nearest receptor <100m from potential source |

* Sludge storage tanks include four strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, and two THP buffer tanks (feed silos).

## 5.4 Magnitude of risk

Table 5.3 below summarises the probability of exposure, consequence of hazard and resulting magnitude of risk for each potential bioaerosol emission source at the Site. Across all sources, there is a ‘very low’ or ‘low’ probability of exposure due to the nature of the processes and control measures in place which would prevent uncontrolled releases of bioaerosols. The consequence of hazard is described as ‘low’ to ‘medium’ depending on the proximity of the potential emission source to a sensitive receptor.

In accordance with Environment Agency guidance[17], across all potential bioaerosol emission sources, the magnitude of risk is described as ‘**low**’. Therefore, based on the level of risk assessed, operation of the Site is unlikely to lead to significant impacts at nearby sensitive receptors from bioaerosol emissions.

Nonetheless, due to the proximity of the Site to sensitive receptors, monitoring of bioaerosols should be undertaken at the Site[18]. The requirements for bioaerosol monitoring at the Site will

[17] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

[18] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

need to be agreed with the Environment Agency within the Environmental Permit issued for the Site.

**Table 5.3: Magnitude of risk from bioaerosols at the Site**

| Process | Potential source of bioaerosols | Probability of exposure | Consequence of Hazard | Magnitude of risk | Justification |
|---|---|---|---|---|---|
| Sludge/cake reception and distribution | Imported sludge reception building | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Stringent loading and unloading procedures. Extracted air from the cake loading area is treated by odour control unit – uncontrolled release of bioaerosols very unlikely. |
| | Cake storage/ loading area | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Stringent loading and unloading procedures. Extracted air from the cake silo is treated by odour control unit – uncontrolled release of bioaerosols very unlikely. |
| | Cake reception building | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Stringent loading and unloading procedures. Extracted air from the building is treated by odour control unit – uncontrolled release of bioaerosols very unlikely. |
| Wastewater treatment | Grit hall | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Screen hall | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Primary settlement tanks (PSTs) | Very Low | Medium | Low | Nearest receptor <50m and upwind from potential source<br>Tanks are covered and extracted air is treated by odour control unit and processes monitored and regularly maintained - exposure to bioaerosol emissions very unlikely. |
| | Aeration treatment buildings | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Aeration lanes covered and contained within a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely. |

| Process | Potential source of bioaerosols | Probability of exposure | Consequence of Hazard | Magnitude of risk | Justification |
|---|---|---|---|---|---|
| | Aeration odour control unit | Very low | Low | Low | Nearest receptor <250m from potential source<br>Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Final Settlement Tanks (FSTs) | Low | Low | Low | Nearest receptor <250m from potential source<br>Uncovered, 'wet' process - exposure to bioaerosol emissions unlikely |
| | UV plant | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Processes enclosed in a building - exposure to bioaerosol emissions very unlikely |
| Sludge treatment | Advanced anaerobic digesters | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Digesters covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Sludge storage tanks* | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Tanks covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Primary sludge screen hall | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Processes enclosed in a building. Extracted air is treated by odour control unit and processes monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Sludge treatment building | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - uncontrolled release of bioaerosols very unlikely. |
| | Sludge odour control units | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Sludge dewatering buildings | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |

| Process | Potential source of bioaerosols | Probability of exposure | Consequence of Hazard | Magnitude of risk | Justification |
|---|---|---|---|---|---|
| | Sludge liquor balance tank | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Tanks covered and connected to an odour control unit. Process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely |
| | Thermal hydrolysis reactors | Very Low | Low | Low | Nearest receptor <250m from potential source<br>Processes enclosed in a building and all processes within the building are covered and connected to an odour control unit. Process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| Biogas combustion/ treatment | Gas bag (holders) | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Gas bag holders sealed to prevent uncontrolled release of bioaerosols – uncontrolled release of bioaerosols very unlikely |
| | Biogas pre-treatment plant | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Tanks sealed, process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Biomethane upgrade plant | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Tanks sealed, process monitored and regularly maintained - exposure to bioaerosol emissions very unlikely |
| | Combined Heat and Power (CHP) and boiler stack | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely |
| | Flare | Very Low | Medium | Low | Nearest receptor <100m from potential source<br>Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely |

* Sludge storage tanks include four strategic sludge storage tanks, one post digestion storage tank, one screened sludge buffer tank, and two THP buffer tanks (feed silos).

# 6 Summary

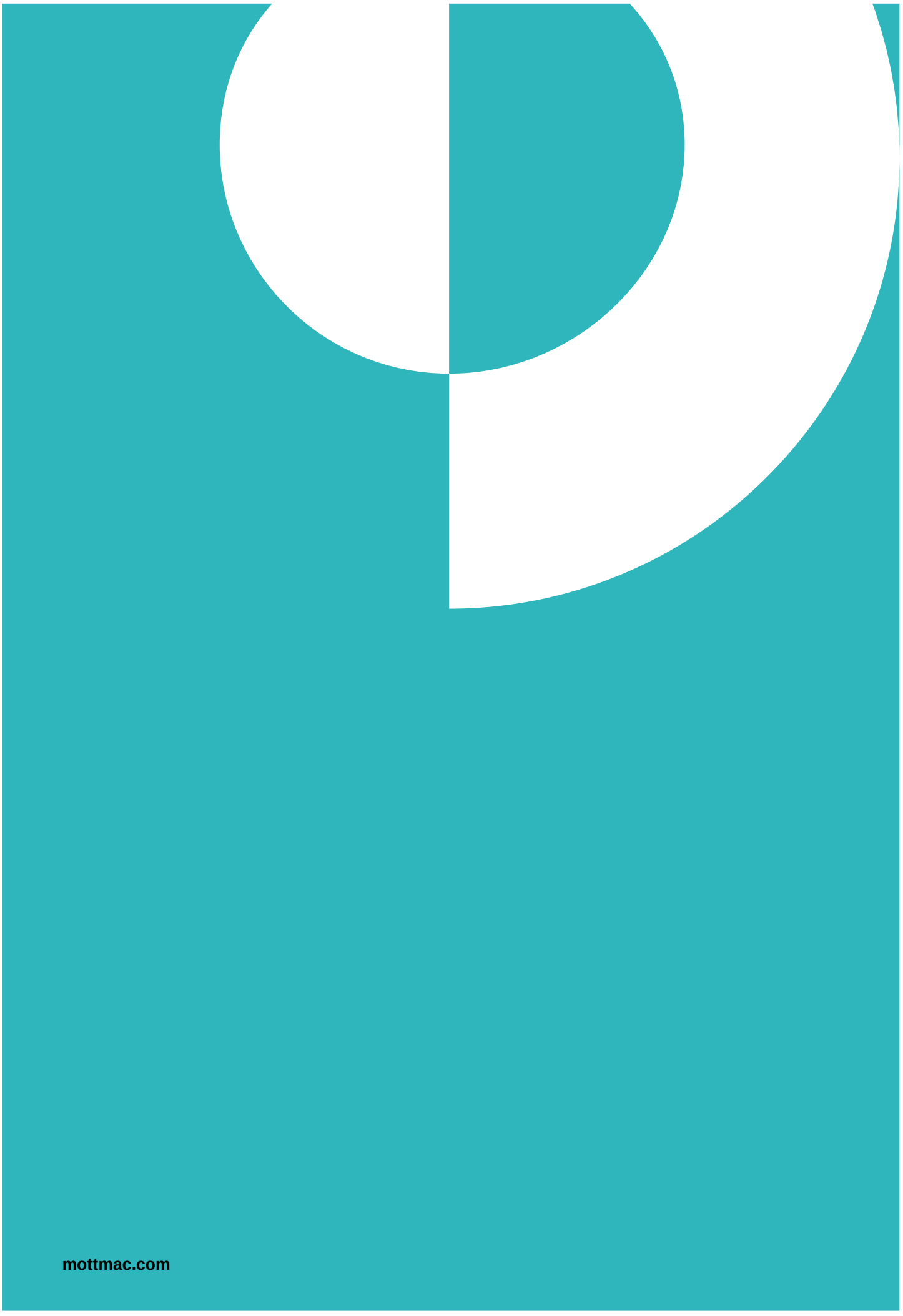
At the Site, there is the potential for bioaerosol emissions from:

- Sludge/cake reception and distribution
- Wastewater treatment (settlement tanks, aeration tanks and UV plant)
- Sludge treatment (sludge storage, treatment, digesters and dewatering)
- Biogas combustion/treatment

Bioaerosol emissions associated with these processes could be transported by the wind to nearby sensitive human health receptors bordering the Site, resulting in adverse health effects. As these sensitive human health receptors are within 250m of potential emission sources at the Site, a bioaerosol risk assessment has been undertaken in accordance with EA guidance.

To inform the assessment, a Source-Pathway-Receptor model was developed and the control measures at the facility to reduce and contain bioaerosol emissions were reviewed. This was undertaken to determine the probability of exposure, consequence of hazard and overall magnitude of risk associated with different processes at the Site.

Based on the ‘very low’ to ‘low’ probability of exposure and ‘low’ to ‘medium’ consequence of hazards associated with different processes at the Site, the overall magnitude of the risk associated with bioaerosols emissions from the Site is considered to be ‘low’. Operation of the Site is therefore unlikely to lead to significant impacts at nearby sensitive receptors from bioaerosol emissions. This is primarily due to the control measures in place which are considered to be effective at reducing, containing and monitoring emissions of bioaerosols, inhibiting the pathway between source and receptor.



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