MOTT MACDONALD

Sandown Sludge Treatment Centre Environmental Permit Application

Bioaerosol risk assessment
790101_ERA_BioaRA_SAN

December 2023

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Contents

1 Introduction

1.1 Overview

Southern Water is applying for a new environmental permit to operate their sludge treatment facility at Sandown Wastewater Treatment Works (WTW) and Sludge Treatment Centre (STC) ('the Site'). Sludge treatment activity is covered by the Environmental Permitting Regulations (EPR) 2016, which incorporates the application of the Industrial Emissions Directive (IED). The Site currently operates under a T21 exemption and does not have an environmental permit.

Regulatory Position Statement 209[1], issued 23 January 2018 by the Environment Agency (EA), 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 50m 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 the north east of Sandown on the Isle of Wight. The layout of the Site is shown in 790101_MSD_SiteLayoutPlan_SAN December 2023. The Site includes three anaerobic digesters which are located at the centre 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. Regulatory Position Statement (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].

[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.'

However, following a Schedule 5 notice from the Environment Agency for another similar WTW, a conservative approach has been undertaken and human receptors within 500m of the Site have been considered instead of the 250m specified in the Environment Agency guidance[8].

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'*[9], 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:

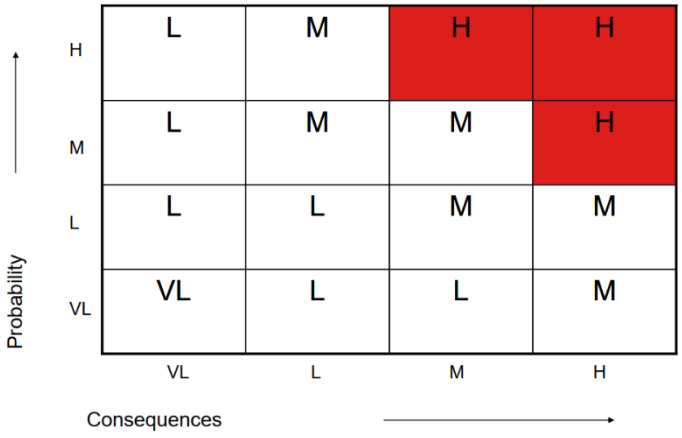
- High – exposure is probable, direct exposure likely with no/few barriers between source and receptor
- Medium – exposure is fairly probable, barriers less controllable
- Low – exposure unlikely, barriers exist to mitigate
- Very low – exposure very unlikely, effective and multiple barriers

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



[8] 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

[9] 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.

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.

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

The Site includes the following assets which could release bioaerosols:

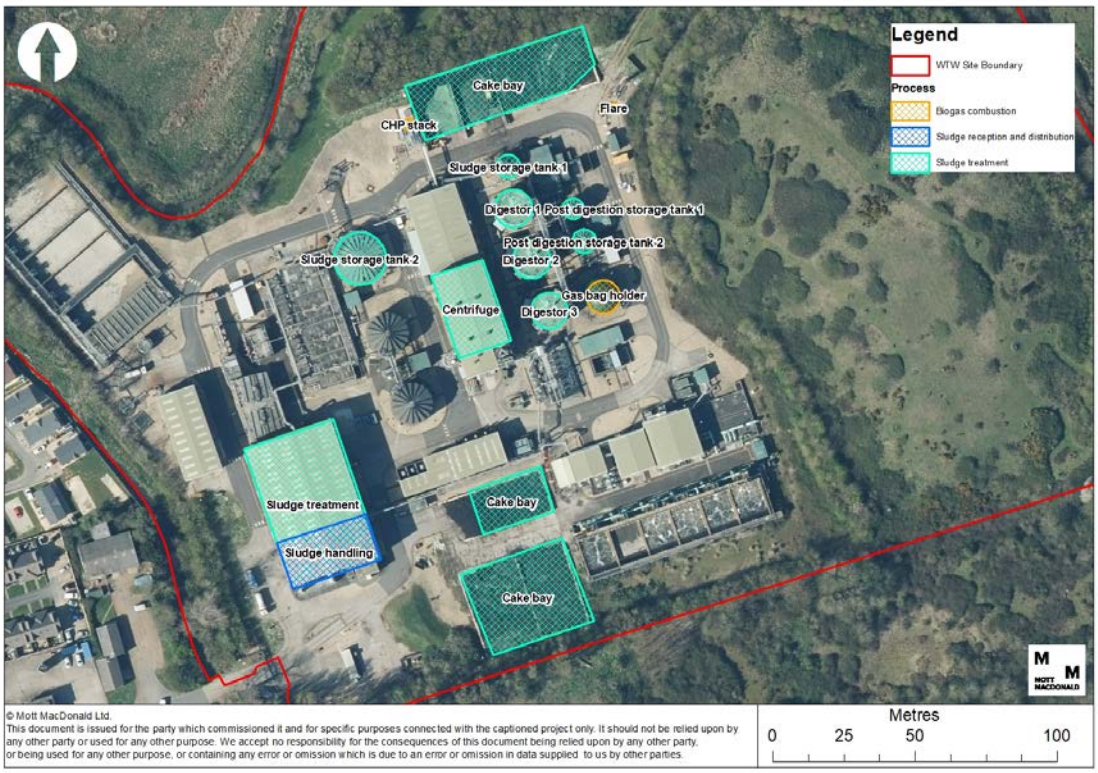
- A sludge treatment centre, including a Biofor Plant with six B-cell activating factor (BAFF) Cells
- Three anaerobic digesters
- Two post digestion storage tanks
- Two centrifuges
- Six cake bays
- One gas bag holder
- One Combined Heat and Power (CHP) unit (0.97 MWth)
- One flare

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

- Sludge reception and distribution
- Sludge treatment (sludge treatment, digesters, centrifuge and cake bays)
- Biogas combustion

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



3.2.1 Sludge reception and distribution

Liquid sludge from 18 satellite sites on the Isle of Wight arrives at the Site via tanker. The liquid sludge is pumped from a tanker directly into a sludge reception tank within the sludge treatment building.

3.2.2 Sludge treatment

The Site serves as the sludge treatment centre for Isle of Wight. Imported liquid sludge from 18 satellite sites across the Isle of Wight arrives by tanker and is received by the sludge reception tank. Both indigenous sludge (from the Primary Settlement Tanks (PSTs) and the secondary biological treatment process) and imported sludge is pumped through the strainpress to the sludge storage tank. The screened sludge is then transferred to the post screen storage tanks from where it is fed to belt thickeners. The resulting thickened sludge is stored in a digester feed tank.

The thickened sludge is then fed into the anaerobic digesters. The anaerobic digestion process 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). After AD, the sludge is stored in secondary digesters and dosed with lime and dewatered by two centrifuges. The cake produced from the secondary digesters is transferred to a trailer and transported across the Site to be stored in the cake bays. The cake is stored in the cake bays for a few days to allow it to mature before it is collected by trucks and taken to agricultural land for spreading. All vehicles entering and leaving sites are covered to minimise potential odours.

Sludge liquors from the belt thickeners and centrifuges are collected at the works return pumping station and pumped upstream or downstream of primary treatment.

3.2.3 Sludge treatment - Odour control

A two-stage chemical scrubbing plant is used at the Site to control odour from the sludge treatment building. The first stage consists of an acid scrubber to remove odorous basic compounds, such as ammonia, while the second stage consists of an alkali scrubber to remove acidic odorous compounds such as hydrogen sulphide. Separate ventilation systems are attached to the sludge building and sludge recirculation kiosk where air is extracted and treated with carbon filters. Treated air is released to the atmosphere via stacks to assist dispersion.

3.2.4 Biogas combustion

Biogas produced during AD, the digestion and post digestion storage tanks is transferred to the gas bag holder and then to the CHP and back-up boilers where it is combusted to generate heat and electricity, which is used on-site to assist with the wastewater and sludge treatment processes. When more biogas is produced on-site than can be combusted within the CHP and there is insufficient space in the gas bag holder to store surplus biogas, excess biogas is sent to the flare to be burned. Currently, more biogas is produced on-site than can be used by the CHP so the flare is in operation on a daily basis.

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 2018-2022 wind rose for the nearest meteorological site, St. Catherine's Point (located approximately 14.3km south west of the Site), is shown in Figure 3.2. This monitoring site experiences strong prevailing winds from the west, with occasional strong winds from the east. However, this meteorological site is located on a headland while the Site is located within a bay and therefore, in addition, an atmospheric hindcast model (Vortex) has also been used to assess the wind conditions at the Site.

The Vortex model uses historic ERA5 data from the European Centre for Medium-Range Weather Forecasts (ECMWF) and works by combining past meteorological data with current weather models. This allows meteorological parameters, such as wind speed and direction, to be predicted at any location for any time period from the past 40 years, accounting for some localised effects. The data from this model is a popular dataset for climate modellers and is used by the World Meteorological Organization for their annual State of the Climate report.

Figure 3.3 presents the wind rose generated for the Site from the Vortex model for the period from 2018-2022. The wind rose demonstrates that historically this location experiences strong prevailing winds from the west and south west, with occasional gusts from the north east. This suggests that sensitive receptors located to the east of the Site would be at the greatest risk from bioaerosol emissions from the Site as they would be downwind of the prevailing wind direction.

Overall, the two datasets show general agreement with the modelled data indicating the predominant wind originating from a south westerly direction rather than a westerly direction.

Figure 3.2: Average wind rose for St. Catherine's Point meteorological site, Isle of Wight 2018- 2022

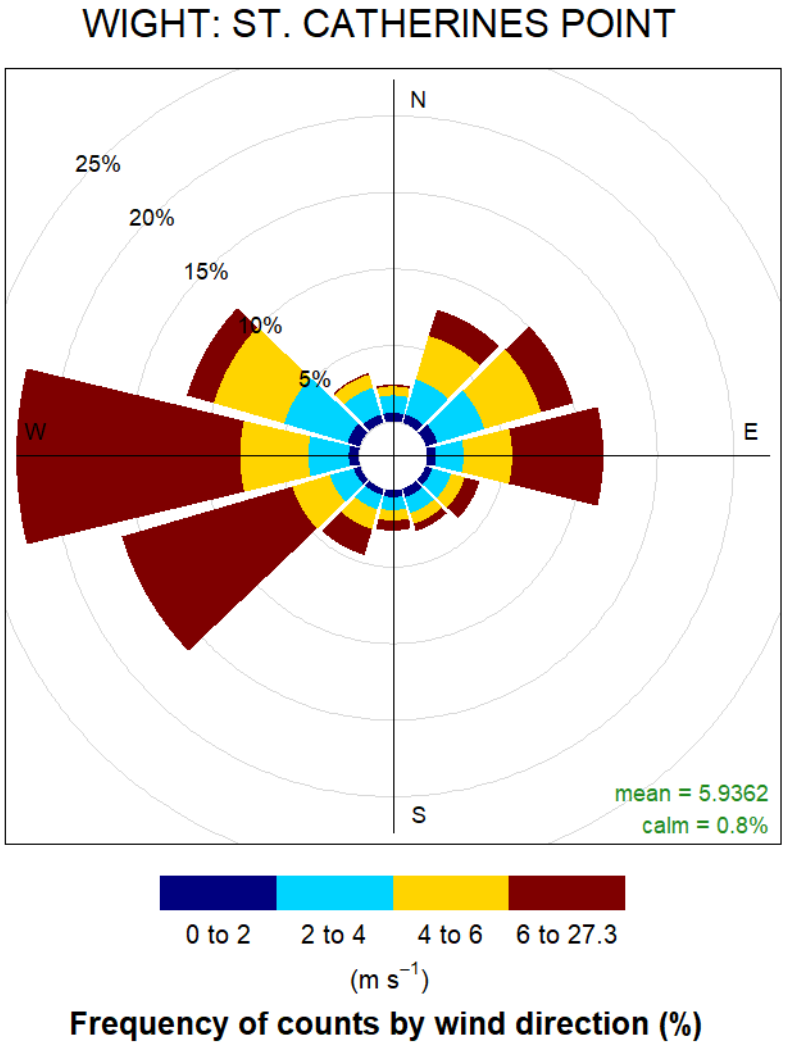
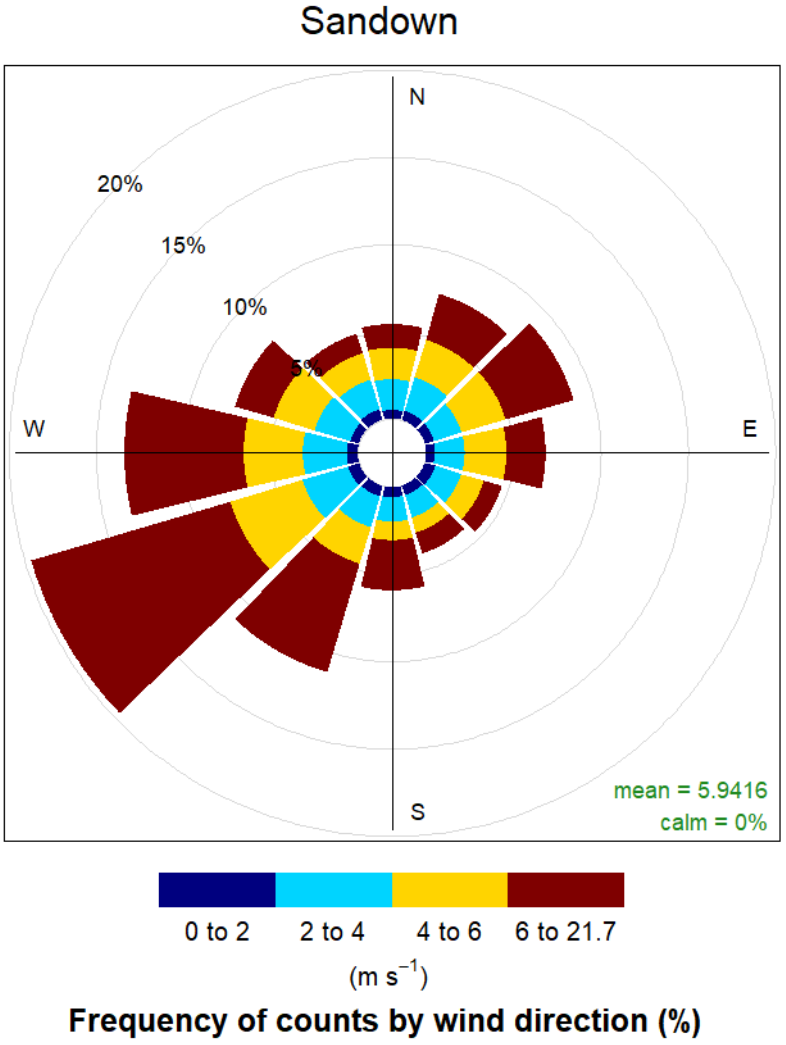


Figure 3.3: Average wind rose for the Site from the Vortex model, 2018- 2022



Concentrations of bioaerosols decline rapidly within the first 100m from a source and generally decrease to background concentrations within 250m[10,11]. The local terrain in the 250m area surrounding the Site is relatively flat, with some low-lying trees bordering the Site to the south and west (so there would be few obstacles to inhibit the pathway between source and receptor). There is a large, 12m high bund located on the eastern half of the Site (a former landfill site) which could present a natural barrier to the transportation of bioaerosols by the wind. However, this would be dependent on the release height of bioaerosols on-site.

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

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

3.4 Receptors

Although Environment Agency guidance[12] recommends a screening distance of 250m from bioaerosol emission sources to static receptor locations, a screening distance of 500m has been used as a conservative approach. 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 five areas of sensitive receptors found within 500m of potential bioaerosol emission sources at the Site. As demonstrated in Figure 3.4, areas of residential receptors are found to the north, east and west of the Site, whilst an area of industrial land use is located to the south west, and an area of office land use is found to the west.

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

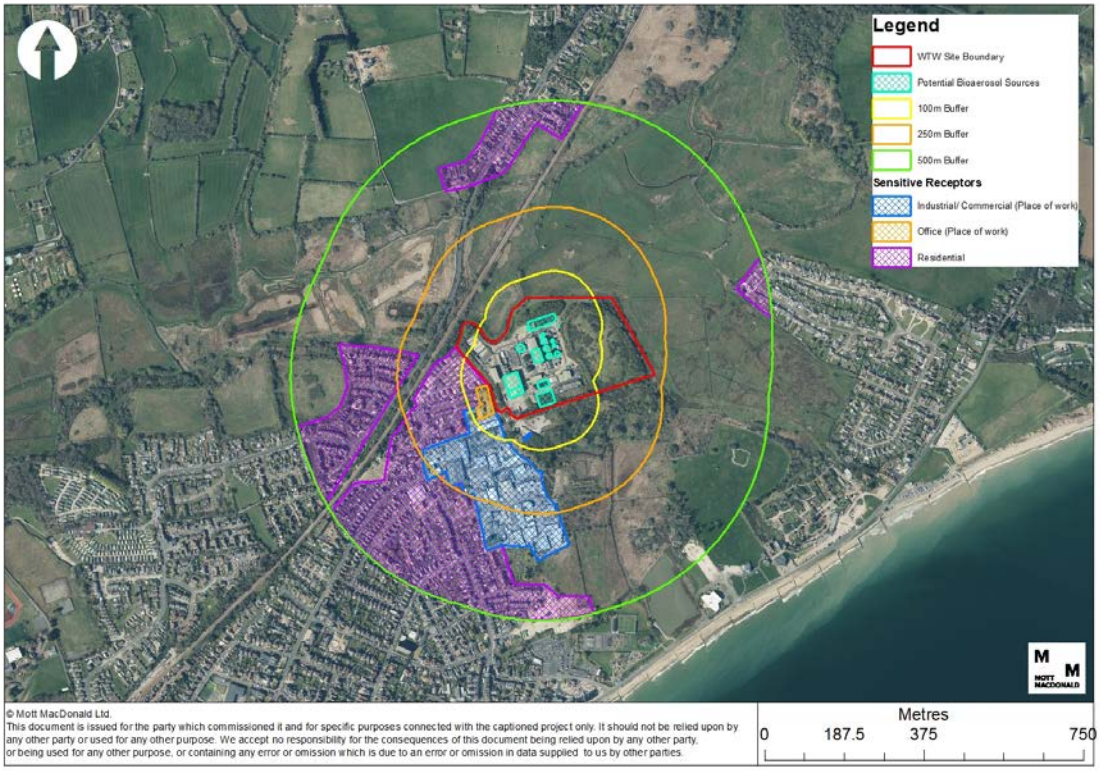
[12] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 – Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

Table 3.1: Receptors within 500m 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 north of the Site (m)	Residential properties east of the Site (m)	Residential properties west of the Site (m)	Office west of the Site (m)	Industrial land use west of the Site (m)
Sludge handling	Sludge reception and distribution	>500, South	>500, West	75, West	50, West	60, South west
Sludge treatment plant	Sludge treatment	470, South	>500, West	55, West	50, South west	65, South west
Sludge storage tank	Sludge treatment	385, South	460, West	110, West	120, South west	155, South west
Digester	Sludge treatment	400, South	460, West	165, West	160, South west	180, South west
Post digestion storage tanks	Sludge treatment	410, South	445, West	185, South West	185, South west	210, South west
Centrifuge	Sludge treatment	420, South	485, West	135, West	130, South west	155, South west
Cake bay	Sludge treatment	355, South	430, West	135, North West	115, West	65, South west
Gas bag holder	Biogas combustion	440, South	440, West	185, West	185, South west	190, South west
Flare	Biogas combustion	380, South	425, West	220, South west	230, South west	260, South west
CHP stack	Biogas combustion	370, South	495, West	160, South west	175, South west	220, South west

Source: (a) Refers to the receptors presented within Figure 3.4. (b) Distance from source to receptor is rounded to the nearest

Figure 3.4: Sensitive receptors within 500m



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 reception and distribution	Sludge/cake loading and unloading	Air transport then: • Inhalation (through nose or mouth) • Ingestion (eating or swallowing) • Absorption/contact (through skin or eyes) • Injection (by high pressure equipment/contaminated sharp objects)	Commercial property (50m)
Sludge treatment	Sludge treatment plant		Commercial property (50m)
	Sludge storage tank		Residential property (110m)
	Digester		Commercial property (160m)
	Post digestion storage tanks		Commercial property and residential property (185m)
	Centrifuge		Commercial property (130m)
	Cake bays		Industrial property (65m)
Biogas combustion	Gas bag holders		Commercial property and residential (185m)
	Flare		Residential property (220m)
	CHP stack		Residential property (160m)

4 Control measures

4.1 Overview

The three primary ways to mitigate emissions of bioaerosols[13] is to:

- Reduce emissions
- Contain emissions
- Enhance dispersion

The sections below outline the different control measures in place at the Site. 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 3.2.5.

4.2 Control measures

4.2.1 Sludge reception and distribution

The transfer of liquid sludge from the tankers has a short duration and on average takes place five times a day, so the potential for release of bioaerosols is minimal.

To further minimise emissions of bioaerosols, lorry/tanker drivers are required to ensure that the doors to the sludge and cake reception facilities are closed before discharging or unloading.

If a spillage of sludge/cake occurs, operators will carry out clean up as soon as possible (using disinfectant where necessary). If the spillage is caused by a lorry or tanker, the driver is responsible for cleaning up the spill before leaving the Site. If a lorry or tanker left a spillage behind, operators will log and report any incident observed and the driver or company involved will be asked to return to the Site immediately to clean up. Significant spillage incidents will be recorded in the site diary.

Appropriate wash up facilities are also provided for drivers to clean the vehicles after loading or unloading in sludge storage bays and loading points. Lorry and tanker drivers are required to hose down any spillage after each loading or unloading and clean contaminated wheels before leaving the Site.

4.2.2 Sludge treatment

4.2.2.1 Containment of emissions

To contain emissions of bioaerosols during sludge treatment, doors, covers and hatches to the buildings housing the sludge treatment works are kept closed at all times except when access is required. When access is required for operation and maintenance, the doors and hatches to these treatment facilities will only be opened for minimum periods. If access is required for an extended period of time, such as for maintenance activities, additional mitigation measures are implemented to minimise the impact associated with bioaerosols. This includes the use of scented odour misting when the wind direction is blowing towards residential properties.

[13] 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 contain bioaerosol emissions, the primary digestion tanks are covered or within process buildings. All sludge tanks and process units are covered, in addition to the digesters and post digestion storage tanks.

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 AD, with subsequent processes such as liming being undertaken to further remove microorganisms by raising the pH and temperature. Therefore, at each stage of the sludge treatment process, the quantity of bioaerosols decreases; the concentration of bioaerosols that could potentially be emitted from the cake bays (at the end of the sludge treatment process) is much lower than from the sludge treatment works (pre-AD).

While the cake bays are not covered, once the cake is deposited within the bays, it is not handled further until it is loaded into trucks to be transported off-site to farmland. This reduces the risk of bioaerosol emissions as agitation of cake could facilitate the resuspension of any remaining bioaerosols into the air. Samples of cake are tested at the end of the maturation period to ensure that the bacteria levels meet the Biosolids Assurance Scheme (BAS) before being transported off-site, so by the time it is loaded into trucks, the risk from bioaerosols is de minimis. Covers on lorries are removed when they are being filled with cake prior to exporting to farms, this is at the end of the treatment process. Therefore, though it is uncovered, there is a low chance of bioaerosol emissions. Southern Water is committing to a programme of monitoring to confirm there are no fugitive emissions from the cake bays.

To further reduce potential bioaerosol emissions associated with sludge treatment, sludge produced on-site is processed immediately. This prevents processing of old sludge which is more odorous and difficult to process. Liquid sludge arriving on-site is also processed immediately to help minimise bioaerosol emissions.

As discussed above in Section 4.2.2.1, to prevent emissions from sludge treatment activities, processes with the greatest potential to release bioaerosols are covered and odour controlled. This odorous air is then treated either within the chemical scrubber plant or using carbon filters to remove odour and bioaerosols before it is released to the atmosphere. While the odour control plant is unable to remove 100% of bioaerosols, any bioaerosol emissions from the odour control plant are anticipated to be negligible.

4.2.3 Biogas combustion

Biogas produced during AD is stored within the gas bag holder before being combusted at high temperatures within the CHP or flare. The gas bag holder stores the biogas within an air-tight container 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: sludge blanket thickness, dissolved oxygen content, turbidity, temperature, pH and alkalinity (full list of parameters monitored are found within the operating plan for the WTW). 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 to Process Scientists, M&E technicians, ICA technicians or Specialist Contractors as appropriate.

Daily, weekly and monthly maintenance tasks/servicing are also performed on key equipment across the Site by Southern Water staff and specialist contractors. Southern Water has also issued generic maintenance task manuals for use across all their sites which include protocols for the maintenance of equipment such as absorbers, biofilters, odour extraction, fresh air supply ducting, wet scrubber (cleaning, pre-winter service, pH probe calibration, redox probe calibration), direct driven fan, belt driven fan and dryer exhaust ducting.

Currently bioaerosols are not directly monitored, however, future monitoring will be accordance with Environment Agency's Technical Guidance Note (TGN) M9[14] requirements to monitor effectiveness of control measures, where appropriate. Alternatively, the Odour Management Plan requires routine sniff tests and mitigation to odours, and therefore the Plan will indirectly aid the prevention and monitoring of bioaerosol.

Odour is controlled via one current Odour Control Unit (OCU). This is equipped with carbon filters for air treatment and abatement to reduce odours and the generation of other gaseous compounds. The OCU treats air from the sludge treatment building and the sludge reception tank.

Treated odour streams are discharged to the environment through the OCU stack as shown by A09 in 790101_SiteLayoutPlan_SAN and monitored hourly to ensure the absence of odorous compounds.

The OCU is maintained in accordance with manufacturer's requirements to ensure treatment of bioaerosols and odours are effective The Odour Control Unit is maintained by a third-party company, ERG.

Most of the Site operations are fully enclosed or covered with the exception of the aeration lanes and the cake bays which are uncovered. With the exception of the cake bays, these operations are not part of the sludge treatment process, they are also all 'wet' processes therefore the likelihood of the resuspension of bioaerosols, and the probability of exposure, is minimised.

Diffuse emissions from the cake bays are minimised by:

- Sludge cake not being handled once in the cake bay (unless liming is required, however this requires minimal handling) until it is being removed from site;
- All exported sludge cake being transported in covered lorries.

To minimise odour nuisance, it is important to ensure that the Sandown WTW and STC is operating as designed. Covers and hatches are replaced to maintain the integrity of enclosures provided to collect odorous air.

The effectiveness of measures to prevent and limit bioaerosols, as well as odour, is undertaken by reviewing the Supervisory Control and Data Acquisition (SCADA) system to identify out of specification operation of assets. When alerts are raised, the measures within the Odour Management Plan will be followed to bring the operations in line with normal conditions.

[14] 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

Stocks of chemicals on-site are also carefully managed to ensure there are sufficient stocks of chemicals on-site 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 SCADA or telemetry systems, which will be reacted to by on-site or regional control room operators and Duty Managers.

Depending upon the nature of the fault or emergency, a mechanical or electrical technician, both of whom are on-call 24-hours, would be contacted and would attend the Site as soon as practicable if required. Where the on-call technicians are already engaged upon other response work, there is the facility to access staff from other Southern Water geographic divisions, coordinated by the Duty Manager. All faults, break-downs and emergencies are logged electronically together with records of the action taken and the solutions reached.

One such emergency event would be failure of the flare stack and/or CHP. Such an event would result in releases of biogas from the Whessoe Valves located on the roofs of the digesters and in the gas holder compound, which would release bioaerosols. This occurs to prevent over pressurisation of the digesters and gas systems. While the problem is rectified, biogas generation is reduced by reducing or inhibiting the digester feed.

4.5 Monitoring

4.5.1 Overview

Bioaerosol emissions associated with the operation of the Site will be monitored in line with the Environment Agency Technical Guidance Note (TGN) M9[15] 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 detailed in Section 3.3, 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.

Figure 4.1 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 (50m) 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.

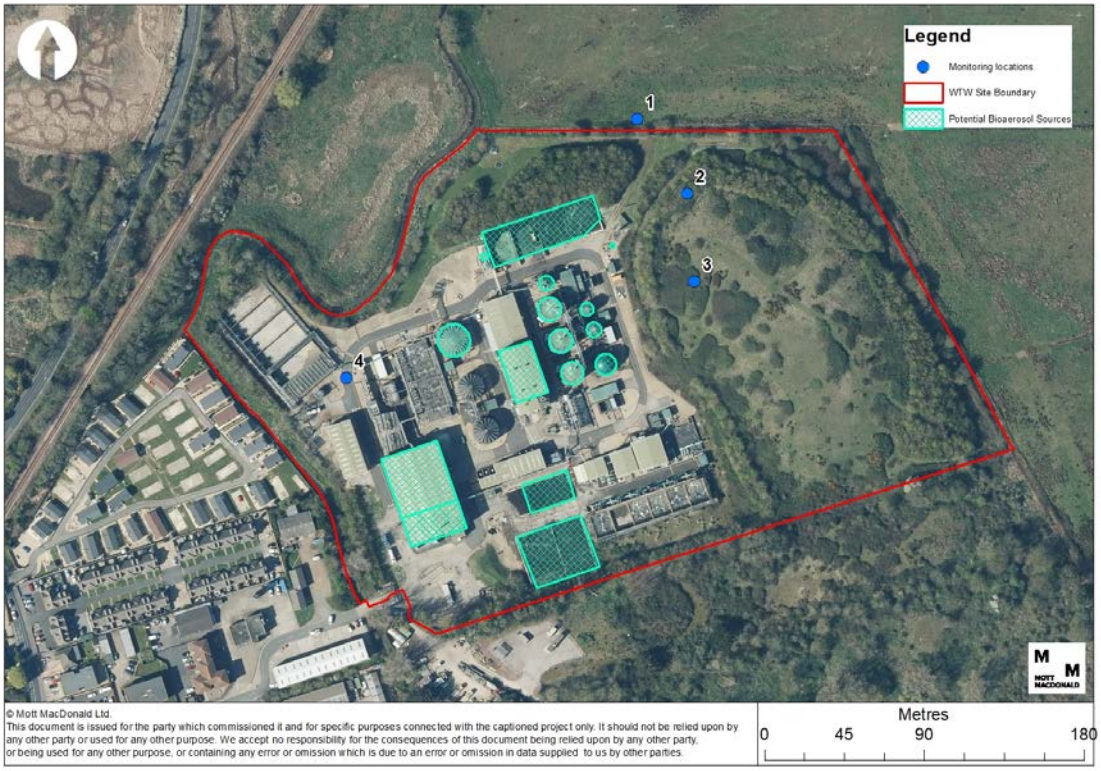
The indicative monitoring location 4 represents the upwind sampler and is positioned approximately 50m from the nearest bioaerosol source. This location will provide a baseline concentration of bioaerosols, representative of background concentrations and any

[15] 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

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 and frequency

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. Monitoring will be undertaken on a quarterly basis for the first 12months after permit issue and then six monthly thereafter. Where the bioaerosol action limit is exceeded, then quarterly monitoring will resume until such time that is it demonstrated that the site has adequate mitigation for a 12month period. Where it is confirmed that the risk is very low or low, Southern Water will make the decision as to whether further monitoring will be needed and under what circumstances it may need to be resumed, if at all.

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. The greatest risk associated with emissions of bioaerosols from the Site is associated with emergency situations such as a failure of the flare or CHP, which could result in uncontrolled emissions of bioaerosols. However, such events would be 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[16], 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 reception and distribution
- Sludge treatment (sludge treatment, digesters, centrifuge and cake bays)
- Biogas combustion

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, the nearest of which is approximately 50m from the sludge treatment building. 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. The overall probability of exposure of sensitive receptors to bioaerosols at the Site is therefore considered to be '**very low**' as exposure of the receptors to bioaerosols is "very unlikely" due to the "effective and multiple barriers" (control measures) in place.

5.3 Consequence of hazard

While the probability of exposure of receptors to bioaerosols is very low as a result of the control measures in place, there is still a risk that nearby receptors could be exposed bioaerosols, for example if there is a failure of the control equipment. Should this occur, any exposure to bioaerosols would likely be temporary as the fault would be detected by the SCADA system and the emergency protocols would be undertaken 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

[16] 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.

generally decrease to background concentrations within 250m) [17,18]. Therefore, receptors within 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, sources of bioaerosols within 50m 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". Sources of bioaerosols within 50-100m of receptors are considered to have a 'medium' consequence of hazard. 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, up to 500m, 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. Beyond 500m, the consequence is not applicable (n/a). The final consequence of hazard assessed for each emission source is presented below in Table 5.1.

5.4 Magnitude of risk

Table 5.1 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 - 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 exposure is described as 'low' to 'medium' depending on the potential emission source due to their proximity to sensitive receptors.

In accordance with Environment Agency guidance[19], across all potential bioaerosol emission sources, the magnitude of risk is described as '**low**' and therefore 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[20]. The requirements for bioaerosol monitoring at the Site will need to be agreed with the Environment Agency within the Environmental Permit issued for the Site.

Table 5.1: Magnitude of risk from bioaerosols at the Site

Process	Potential source of bioaerosols	Probability of exposure	Consequence of exposure	Magnitude of risk	Justification
Sludge reception and distribution	Sludge loading and unloading	Very Low	Medium	Low	Nearest receptor <100m away from potential source, not downwind of the prevailing wind direction

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

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

[19] 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.

[20] 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

Process	Potential source of bioaerosols	Probability of exposure	Consequence of exposure	Magnitude of risk	Justification
					Stringent loading and unloading procedures – uncontrolled release of bioaerosols unlikely
Sludge treatment	Sludge treatment plant	Very Low	Medium	Low	Nearest receptor <100m from potential source, not downwind of the prevailing wind direction Sludge treatment plant covered and enclosed, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Sludge storage tank	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction Sludge storage tanks covered and enclosed, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Digester	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction Digesters covered and enclosed, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Post digestion storage tanks	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction Tanks covered and enclosed, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Centrifuge	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction Centrifuge covered and enclosed, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Cake bays	Very Low	Medium	Low	Nearest receptor <100m from potential source, not downwind of the prevailing wind direction While uncovered, cake within bays at the end of treatment process so bioaerosol concentrations would be at very low/de minimis (any exposure would not result in “significant” consequences). No disturbance of cake while in bays except for removal.
Biogas combustion	Gas bag holder	Very Low	Medium	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction. Gas bag holder air-tight to prevent uncontrolled release of bioaerosols. SCADA system in place to detect leaks.
	Flare	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction. Combustion of biogas at very high temperatures which would destroy bioaerosols
	CHP stack	Very Low	Low	Low	Nearest receptor >100m from potential source, not downwind of the prevailing wind direction. Combustion of biogas at very high temperatures which would destroy bioaerosols

6 Summary

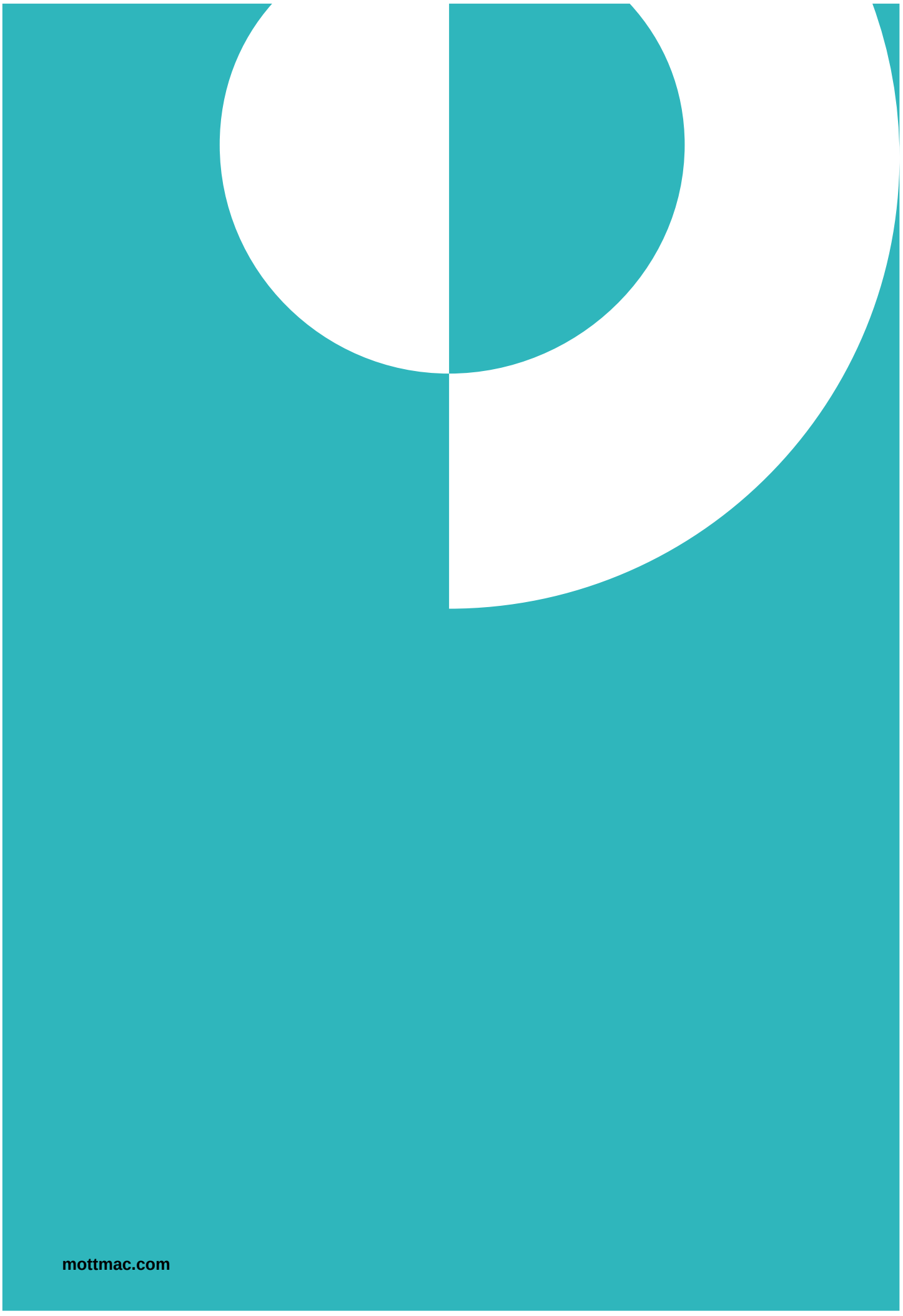
At the Site, there is the potential for bioaerosol emissions from:

- Sludge reception and distribution
- Sludge treatment (sludge treatment, digesters, centrifuge and cake bays)
- Biogas combustion

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 Environment Agency guidance. However, based on comments from the Environment Agency on a bioaerosol risk assessment undertaken for another similar WTW, a conservative approach has been undertaken and human receptors within 500m of the Site have been considered instead of 250m in the bioaerosol risk assessment.

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’ 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’. This is primarily due to the control measures in place at the Site which are considered to be effective at reducing and containing emissions of bioaerosols, inhibiting the pathway between source and receptor.



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