Beckton STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
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1. Introduction

The purpose of this Bioaerosols Risk Assessment is to provide supplementary information to support the permit variation application for a bespoke installation permit for the Beckton Sludge Treatment Centre (STC), EPR/PB3238RK/V004.

1.1 Site description

The Beckton STC is located within the Beckton Sewage Treatment Works (STW) and is situated to the north of the River Thames, which forms part of the immediate boundary to the south of the site. The area is generally an industrial area within east London, approximately 1.25 km south of Barking. The River Roding can be found to the east of the site, while the north gives way to undeveloped green space, a cinema and the A13 road. To the west is a local authority Household Waste Re-use and Recycling centre (HWRC), the A1020 road and a number of commercial, leisure and retail developments.

Almost all of the STW site and STC is within a Flood Zone 3 area that benefits from flood defences. This means that the STC would have a high probability of flooding without the local flood defences. These protect the area against a river flood with a 1% chance of happening each year, or a flood from the sea with a 0.5% chance of happening each year. The site is located within an Air Quality Management Area (AQMA). The London Borough of Newham has declared the Newham AQMA (no. 2) for the whole of the Borough for both Annual mean nitrogen dioxide NO_2 and 24-hour mean Particulate Matter PM_{10}.

The site is located outside of a Source Protection Zone (SPZ). There are two designated ecological receptors within the appropriate distance of the STC, including Epping Forest Special Area of Conservation (SAC) which is 7 km from the site, and the Ripple Local Nature Reserve (LNR) which is 1.8 km from the site. There are no Marine Conservation Zones, Ramsar sites and Special Protection Areas (SPA) within 10 km of the site and no Sites of Special Scientific Interest (SSSI) within 2 km of the site. There are 22 non-designated, Local Wildlife Sites within 2 km of the site and no areas of Ancient Woodland within 2 km of the site.

The address of the installation is:

Beckton Sludge Treatment Centre;

Beckton Sewage Treatment Works,

Jenkins Lane,

Barking,

Essex,

IG11 0AD

1.2 Site Activities

Beckton STC is located at the Beckton STW, Barking, Essex, operated by Thames Water Utilities Ltd (Thames Water). The STC undertakes the biological treatment of sewage sludge, both indigenous and imported from other wastewater treatment sites, by anaerobic digestion, with a capacity above the relevant thresholds for requiring an environmental permit. It also includes the importation of specified wastes to the works inlet for treatment through the Urban Waste Water Treatment directive (UWWTD) regulated works.

There are a number of directly associated activities, including the operation of a biogas fuelled CHP engine and boiler for the generation of electricity and heat at the site.

The site includes the following Directly Associated Activities (DAA):

- Biogas storage
- Emergency flare
- Oil storage
- Drainage – surface water drainage
- Drainage – condensate drainage system

- Water treatment demineralisation plant
- Imports of waste, including sludge from other sewage treatment works for treatment.
- Transfer of dewatering liquors via site drainage back to the head of the sewage treatment works.
- Blending of indigenous sludges and imported waste/waste sludge prior to treatment.
- Pre-treatment of sewage sludge by thermal hydrolysis plant (THP)
- Storage of digestate prior to dewatering.
- Dewatering of digested sewage sludge.
- Storage of dewatered digested sludge cake prior to offsite recovery.
- Operation of siloxane filters; and
- Storage of raw materials.

The STC can treat up to 9,120,000m^3 of sludge per year (equating to approximately 9,120,000 wet tonnes per annum). The STC has a total maximum treatment input of 1,983m^3 per day (equating to approximately 1,983 wet tonnes per day).

Biogas is combusted within one of three CHP engines on site, generating electricity for use within the site, and heat is used within the THP boilers. These combustion assets are regulated under Environmental Permit EPR/PB3238RK/V003 as a s1.1A1 listed combustion plant activity due to their thermal input exceeding 50MWth, which is subject to a variation application.

Some of this throughput is sludge, which is subject to dewatering and storage as treated sludge cake at the site prior to removal from site for application to land. Within the area covering the permitted activities, there are two Odour Control Units (OCUs) linked to specific tanks or processes which produce potentially odorous air. These units treat the air through a variety of means, with one OCU using a three-stage treatment of biofilter, chemical scrubber and carbon filter and the second OCU (for the pre-treatment assets) using a two-stage biological treatment system of bio-trickling filter followed by two carbon filters.

The anaerobic digestion process gives rise to biogas, a mixture of biomethane and carbon dioxide, in a mixture with trace components. This biogas is combusted through Combined Heat and Power (CHP) engines or auxiliary boilers at the site with excess biogas being subject to flaring. The biogas handling system is equipped with pressure relief valves (PRVs) which activate as a safety precaution when there is excess biogas over what the CHP engine, boilers and flare can handle.

1.3 Regulatory requirements

The sludge treatment activity has not previously required an environmental permit as the digested sewage sludge from the site is normally sent for recovery to land. However, a permit application has been submitted based on the Environment Agency's recent conclusion that sewage sludge is a waste and therefore the treatment of sewage sludge by anaerobic digestion for recovery is a permittable activity under Schedule 1 of the EPR 2016, specifically Chapter 5, Section 5.4, Part A 1(b)(i). The Beckton site has a second listed activity, for a Section 1.1 Combustion Activities – Part A (1) (a) burning any fuel in an appliance with a rated thermal input of 50 or more megawatts.

For new permits, if the site is within 250m of sensitive receptors then there is a requirement to monitor bioaerosols in accordance with the EA technical guidance note[1] '*M9: environmental monitoring of bioaerosols at regulated facilities*'. M9 describes bioaerosols and the risks that they pose, as well as identifying potential sources within biological treatment facilities.

The Beckton STC is within 250m of sensitive receptors, as defined by M9. These are detailed in Section 2.5 of this report.

1.4 Bioaerosols

Bioaerosols are found naturally within the environment. They consist of airborne particles that contain living organisms, such as bacteria, fungi and viruses or parts of living organisms, such as plant pollen, spores and endotoxins from bacterial cells or mycotoxins from fungi. The components of a bioaerosol range in size from

[1] Environment Agency. 2018. Technical Guidance Note (Monitoring) M9: Environmental monitoring of Bioaerosols at regulated facilities, v2, July 2018.

around 0.02 to 100 micrometres (µm) in diameter. The size, density, and shape of a bioaerosol will affect its behaviour, survivability and ultimately its dispersion in the atmosphere.

Bioaerosols are easily breathed into the human respiratory system, potentially causing allergic responses and inflammation. They also have the potential to cause eye irritation, gastrointestinal illness, and dermatitis.

Bioaerosols are associated with composting, anaerobic digestion and mechanical biological treatment, which are the main processes used to treat organic wastes in the UK. As organic waste material breaks down it goes through different temperature dependent stages that are dominated by certain groups of bacteria and fungi. Bacteria are the most numerous groups of microorganisms. Aspergillus fumigatus is a mesophilic fungus that is thermotolerant and is present throughout the different stages of the organic breakdown process. This fungus can cause severe respiratory infection if inhaled.

The dependence on microorganisms to degrade organic material and the way in which the material is processed make biological treatment facilities a potential source of bioaerosols. However, we note that the 2012 EA guidance note[2] for developments requiring planning permission and environmental permits states that the EA do not consider bioaerosols from anaerobic digestion to be a serious concern. This is due to the fact, that anaerobic digestion is generally a wet process undertaken in enclosed tanks and equipment, whereas composting is often undertaken using open systems such as windrows and static piles.

The Beckton STC does not undertake any aerobic composting activities and the anaerobic digestion process on site, undertaken in the Primary Digester Tanks, is an enclosed process with all produced gases captured within the biogas system.

1.4.1 High Risk Activities

The M17 guidance document, in section 3.3.3, outlines a number of potential sources and release mechanisms of particulate matter, including bioaerosols from waste management facilities. These potential sources are not graded for importance within M17 and include: the movement of waste to and from the STC; storage of waste (under certain conditions) on site; the handling and processing of waste materials e.g., shredding of green waste, turning of windrows, daily cover; and wind scouring of waste surfaces.

In terms of potential sources of bioaerosol release at the Beckton STC, which meets the M17 guidance, only the storage and handling (movement within the enclosed Cake Barn and during export) of sludge cake would apply. There is no shredding of waste or turning of stockpiles as part of the management process and all sewage waste is contained and received via pipes.

1.4.2 Relevant Thresholds

Based on the accepted Levels at sensitive receptors as set out in the Environment Agency M17 guidance[3] '*M17 Monitoring of particulate matter in ambient air around waste facilities*', and in line with the Governments regulatory position statement (RPS) 209 outlining when a specific bioaerosol risk assessment and/or monitoring is required and use of the Environment Agency Technical Guidance Note M9[4]; key bioaerosols of interest and their respective threshold Levels (including background) at sensitive receptors are outlined below:

- Total bacteria: 1000 cfu/m^3
- Aspergillus Fumigatus: 500 cfu/m^3

[2] Environment Agency. October 2012. Guidance for developments requiring planning permission and environmental permits

[3] Environment Agency. 2013. Technical Guidance Note (Monitoring) M17: Monitoring Particulate Matter in Ambient Air around Waste Facilities, v2, July 2013 https://www.gov.uk/government/publications/m17-monitoring-of-particulate-matter-in-ambient-air-around-waste-facilities

[4] Environment Agency. 2018. Technical Guidance Note (Monitoring) M9: Environmental monitoring of Bioaerosols at regulated facilities, v2, July 2018.

2. Bioaerosol risk assessment

2.1 Introduction

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health at sensitive receptors within the relevant distance from operations at the Beckton STC. This risk assessment follows a standardised approach, namely:

- Hazard identification: what sources of bioaerosols are present on site.
- Exposure assessment: what are the mechanisms or pathways allowing bioaerosols to migrate off site and reach a sensitive receptor; and
- Risk evaluation: who is potentially exposed to bioaerosols; what is the probability, magnitude, and duration of that exposure.

The assessment describes:

- The processing techniques and equipment used within the installation.
- Feedstock, tonnages processed and any seasonal variations.
- Potential sources of bioaerosols.
- The site layout, including any screens, bunds, or trees around the site.
- What is beyond the site boundaries and the location of sensitive receptors.
- Local wind direction data.

2.2 Processing equipment and techniques

2.2.1 Waste Reception

Waste is delivered directly into the covered works inlet channel through an enclosed connection at two waste import points using a site supplied flexible hose, before the imported waste is processed through the STW outside of the permit boundary. The site also accepts imported sludge from other Thames Water sites to a sludge import point to the THP High Energy Blending Tank.

Indigenous primary sludge is thickened via two routes at Beckton STC. Primary sludge can be pumped via underground sludge pipes to Primary Sludge Thickening Plant or Picket Fence Thickeners. SAS from elsewhere in the aerobic process is pumped to SAS Thickening Plant.

If a sludge spillage occurs, operators will follow the site's spillage response plan in a timely manner and inform the relevant site personnel and authorities. Sludge is relatively viscous and not highly mobile. Spill kits are available around the site to contain a spill and direct it to the site drainage.

2.2.2 Waste Treatment

The waste treatment process of the sludge covered by this permit, starts at either the four PFTs, Primary Sludge Thickening Plant or the SAS Thickening Plant.

There are seven drum thickeners within the Primary Sludge Thickening Plant, which is odour abated via an Odour Control Unit (OCU) with the sludge thickened with the addition of a polymer to aid coagulation. Primary sludge can also be thickened within one of four PFTs. The PFTs are covered tanks and connected to an OCU to manage odour emissions. Thickened sludge from the Primary Sludge Thickening Plant is pumped to two Thickened Primary Sludge Buffer Tanks before it is pumped to the Primary Sludge Blending Tank. Thickened sludge from the PFTs is pumped to the Primary Sludge Blending Tank. Liquor from both the Primary Sludge Thickening Plant and PFTs is returned to the Works Inlet for treatment via the site drainage and Liquor Return Pumping Station 1.

Surplus Activated Sludge (SAS) from elsewhere in the aerobic process is pumped via an underground sludge pipeline to SAS Thickening Plant. The thickened sludge is pumped to the SAS Blending Tank. Liquor returns to the Works Inlet for treatment via the site drainage and the Liquor Return Pumping Stations.

Thickened sludges in the two Sludge Blending Tanks can be blended in the High Energy Blending Tank or pumped to Sludge Buffer Tanks for additional storage (as required). Sludge from the two Sludge Blending

Tanks can either be pumped to the THP Process for treatment and digestion within the installation, pumped to the Sludge Powered Generator (SPG) outside of the installation but within the wider STW site or pumped offsite to Riverside STC. The SPG and Riverside STC are not within scope of this bioaerosol assessment.

Sludge for the THP Process for treatment and digestion within the installation is first pumped to the THP High Energy Blending Tanks. Blended sludge is then pumped to one of two THP Sludge Blending Tanks where further blending takes place. Sludge is then pumped through Sludge Screens to the Pre THP Dewatering Feed Tanks and then to Pre THP Dewatering Plant where the sludge is dewatered with the addition of a polymer. Thickened sludge is then pumped to the THP Feed Silo and is subject to a pre-treatment stage within the THP Process.

From the THP Process, sludge is transferred through the THP Cooler to one of the six Primary Digester Tanks at the site. Following treatment over an appropriate number of days within the Primary Digester Tanks, digested sludge is transferred to two Digested Sludge Buffer Tanks and is then dewatered by Digested Sludge Dewatering Presses. Each Primary Digester Tanks has a roof mounted membrane type Biogas Storage holder on the top of the tank. Biogas Storage holders are fitted with Pressure Relief Valves (PRVs)

Digested sludge cake falls to the Cake Barn below, which is totally enclosed and subject to air extraction, prior to removal from the site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). Liquor from the Digested Sludge Dewatering Presses gravitates to the Liquor Return Pumping Station 5 and is returned to the Works Inlet.

Above ground biogas pipes transfer the biogas from the Biogas Storage Holders for use within CHP engines, boilers, and emergency flare. The biogas pipeline is fitted with condensate pots and foam pots that captures the entrained moisture and foam from the generated biogas.. There are two carbon-based siloxane filters located upstream of the CHP engines on the biogas line and operate in series to remove impurities from the biogas prior to combustion in the CHP engines.

2.2.3 Digested cake

The Cake Barn is a fully enclosed and is subject to air abstraction and discharge to atmosphere without abatement via a 45 m tall stack. The Cake Barn is a large area of engineered hardstanding which receives the digested and dewatered sludge cake from the mezzanine floor above. Digested sludge cake is moved by a shovel loader (or similar mobile plant) into one large storage bay for regular removal from site. Fast acting roller shutter doors operate to minimise the release of dust or bioaerosols from handling and storage within the Cake Barn.

Digested sludge cake is subject to removal from site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). As the cake barn is enclosed and equipped with an air extraction system

2.2.4 Odour Control Units

Sewage treatment works have a number of potentially odorous sources within their boundary. Some of these sources may be linked to OCUs to treat potentially odorous compounds given off by the process. These units take air extracted from the above-mentioned tanks or process areas and treat the odour compounds by means of different methodologies dependent upon the nature of the odour compounds. Treatment methodologies include activated carbon systems; biofilters or other biological treatment; and chemical scrubbing. Individual OCUs may use one or more of these methodologies in series.

Under the M9 guidance documents, the Environment Agency has identified that biofilters may give rise to bioaerosols during operation. For completeness all OCUs with biofilters and within the permit installation boundary have been included in this assessment. There are two OCUs at Beckton STC which provide odour abatement to a number of different tanks within the treatment process.

2.2.5 Seasonality

Sewage treatment is undertaken at the STC on a continuous basis, 24 hours a day 365 days of the year. Digested sludge is, therefore, produced daily and at similar levels across the whole year.

However, digested sludge storage on site, both in relation to duration and volume, varies across time. Cake is removed from site for spreading to land. Land spreading is controlled under the Biosolids Assurance Scheme and Sludge Use in Agriculture Regulations (1989), as well as the Farming Rules for Water. As such, digested sludge will remain on site longer during wet periods and during autumn and winter periods where there would be limited uptake of nutrients from the solids. This means that there will be more digested sludge cake within the storage bays during the autumn and winter, under normal conditions, than during the summer period.

2.3 Potential Sources

There are thirty-two point-source emissions to air from the processes within the installation boundary, as presented in Table 1 and illustrated in Appendix B. The references and source descriptions match those in the permit:

Table 1: Point source emissions to air

Air emission reference	Source	In scope?
A1	CHP Engine 1	X
A2	CHP Engine 2	X
A3	CHP Engine 3	X
A4	Boiler 1	X
A5	Boiler 2	X
A6	Emergency Flare	X
A7 – A10	4 x Perkins Emergency Standby Engines ASP4	X
A11 – A15	5 x Finning CAT Emergency Standby Engines, Power house	X
A16	1 x Finning CAT Emergency Standby Engines, Fine Screen	X
A17	Perkins Emergency Standby Generator, Detritor	X
A18	Cummings B Emergency Lighting Standby Generator	X
A19	Boilers Potterton, Admin Block Boilers	X
A20	Boiler Remeha Quinta, Operation Building	X
A21	THP PRV	X
A22 – A27	Biogas Storage Holder PRVs	X
A28	OCU 3	✓
A29	OCU 6	✓
A30	Cake Barn Ventilation	✓
A33	Inlet Works Standby Generator	X

The fully enclosed cake barn is also illustrated in Appendix B. This is an additional source for consideration of bioaerosol releases to atmosphere via the 45-metre stack.

2.3.1 Source Assessment

The CHP engines, boilers, and emergency flare (points A1 – A6) combust the produced biogas at high temperatures (in excess of 450°C). Due to the combustion of the biogas, these points can be discounted as sources of bioaerosols emissions.

Points A7 – A20 relate to diesel fuelled emergency generators, and diesel fuelled boilers at the site, which are not linked to any source of bioaerosols.

There are two OCU emission points to air (A28 – A29) serving the STC in scope of this risk assessment. OCU 3 removes hydrogen sulphide (H2S) and other odorous compounds and then exhausts treated air via a dispersion stack at 14.5 m. Dampers are set at commissioning to ensure the correct air extraction from all elements. The first biofilter stage has four units, whilst the carbon stage (third) has two units to allow maintenance. The design allows for full treatment in the event that the chemical scrubber (second) stage needs to be shutdown for maintenance.

OCU 6 is a 2-stage biological treatment system, a lave rock bio-trickling filter stage followed by 2 carbon filters installed in parallel. Each of the carbon filters is designed for 100% of the design flow rate. The OCU removes hydrogen sulphide and other odorous compounds and then exhausts the treated air via a 15-m dispersion stack. The configuration of the OCUs means that any bioaerosols emitted from the biofilter stage should be captured by the activated carbon stage, and therefore, the likelihood of bioaerosol release is anticipated to be minimal, if at all

The Pressure Relief Valves (PRVs) (points A21 – A27) are normally closed and do not emit to atmosphere. However, in the event of an abnormal situation such as the failure of the flare stack and/or CHP engine, the PRV's would open to relieve excess biogas pressure, potentially resulting in the release of bioaerosols. While the problem is rectified, biogas generation would be limited by reducing or inhibiting the digester feed. These abnormal events are unlikely, temporary, and infrequent due to the extensive monitoring and maintenance programmes undertaken at the site, as well as the procedures and warning systems in place.

In addition to the point sources identified above, there is also potential point source release from treated, dewatered sludge cake, which is deposited within the fully enclosed Cake Barn. The Cake Barn is equipped with continuous air extraction, which vents via an unabated 45m stack via A30

2.3.2 Risk

The overall treatment process is considered to be a low source of bioaerosols. 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 digested sludge cake is handled and stored within a fully enclosed Cake Barn, with continuous air extraction. Fast acting doors are installed on the vehicle entrance and exit and vehicles pass through a wheel-wash after exiting to reduce transfers to site roads. Therefore, fugitive releases of bioaerosols would be minimised. However, the digested sludge cake is likely to have low concentrations of bioaerosols as a result of the treatment processes and is moist on deposition. The cake is managed by dozer and deposited within the storage areas where it forms a crust within 24 hours. The cake storage areas are monitored for row height and arrangement and require no further treatment or disturbance prior to export onto agricultural land. The probability of exposure from this source is Medium.

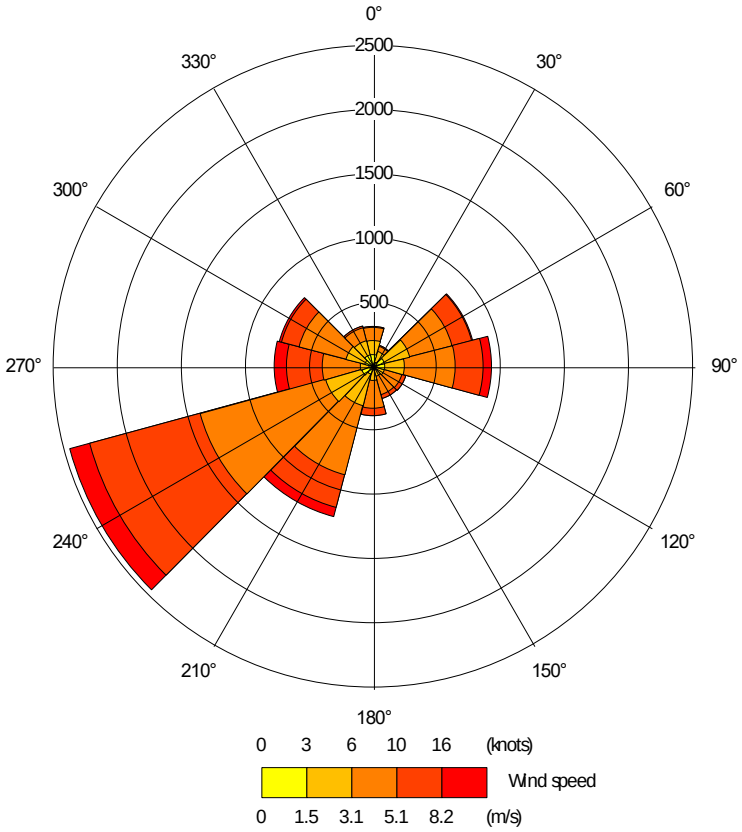
All storage tanks, treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are covered. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations, which are temporary and unlikely. The biofilter process fitted to the OCUs and the maintenance of these assets make the probability of exposure from these sources low, under normal operating conditions.

2.4 Pathways

Bioaerosols are very small and light in weight so can easily be transported by the wind from their source to a receptor. The 2020 wind rose for the most representative meteorological site, London City airport (located approximately 2.8 km Southwest of the Site centre), is shown in figure 1.

The wind rose data shows that the site experiences strong prevailing West south westerly to South westerly winds, predominantly in excess of 6 knots. The Beckton STC and surrounding area has a relatively flat topography. The site is bound to the North, Northwest and East by mature trees that provide some screening. The South and parts of the western boundary contain scrub vegetation leading onto commercial shopping parks and industrial / warehouse areas. The far South of the site is bound by the River Thames.

Figure 1 – London City Airport Wind rose (2020)



Because of the dilution effect in open air, bioaerosol concentrations fall away rapidly with distance from the source. It has been shown by research by the HSE[5] that by 100 to 200m away, the bioaerosol concentration has mostly returned to background levels. Between 50m and 100m distances downwind of the process, bioaerosol concentrations were substantially reduced by comparison to those level measurements at source. Research Report (RR)786 confirmed previous published studies which showed that at a distance of 250m from composting activity, in most cases, the bioaerosol concentrations will be reduced to background levels. Note that this research was undertaken on aerobic composting sites, which generate higher levels of bioaerosols than anaerobic digestion sites, although the 250m separation distance has been retained.

[5] Research Report 786 - Bioaerosol emissions from waste composting and the potential for workers' exposure https://www.hse.gov.uk/research/rrhtm/rr786.htm

At present, Thames Water do not have any empirical evidence for the levels of bioaerosols that might be associated with the potential sources at their STCs.

As a responsible operator, Thames Water are arranging for bioaerosol monitoring at a number of typical STC's in order to confirm that the understanding of the wider waste water treatment industry, that sewage sludge treatment processes do not give rise to elevated levels of bioaerosols, is correct. The sampling will be in accordance with the requirements of M9 and M17, and consist of a series of agar gel plates being placed downwind and upwind of the cake barn, including sampling points both directly upwind of the downwind sampling point and additional samples in the direction of the nearest sensitive receptors.

2.5 Receptors

Environment Agency guidance note M9 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, commercial or industrial premises nearby where people might be exposed for the requisite period.

Sensitive receptors (identified for the Odour Management Plan (OMP)) and within 250m of potential bioaerosol sources, have been considered and are presented in Table 2 and shown in Appendix C. The distance and direction from each potential bioaerosol emission source to the closest sensitive receptor has been reported.

Table 2: Static Receptors within 250m of Potential Bioaerosol Sources

Receptor	Description	Source	Distance from closest source (m)	Direction from the source
R7	Gemini Business Park / Warehousing	OCU 3 (A28)	95	West
		OCU 6 (A29)	150	West
		Cake Barn Vent (A30)	240	West north-west

2.6 Risk Assessment

The method used for this bioaerosol risk assessment is adapted from the EA's standard guidance on risk assessments for environmental permitting, which recommends using a Source-Pathway-Receptor model[6] to help determine the magnitude of the risk associated with bioaerosol emissions from a facility.

There are two potential sources of bioaerosol release within 250m of static receptors:

- Odour Control Units (A28, A29,)
- Cake Barn (A30).

The closest sensitive receptors are within 95m of an OCU emission point and 240m of the Cake Barn Vent / door openings. The receptors within 250m of potential bioaerosol emission points are situated predominantly West of identified emission sources and are upwind of the prevailing wind direction at the site, which is West southwest to Southwest. The frequency of an effective pathway is therefore small.

The maximum daily throughput of sludge is 1,983m^3/day (equivalent to 1,983 wet tonnes per day). The fully digested sludge is dewatered however, the sludge cake remains damp as it passes from the presses to the enclosed Cake Barn. The moisture content in the cake prevents it drying out and the cake forms a crust after

[6] Risk assessments for your environmental permit - GOV.UK (www.gov.uk)

24 hours in storage, so does not give rise to dust readily. The sludge cake is shovelled to storage areas within the Cake Barn and is not disturbed until it is removed for export, further minimising the potential to generate bioaerosol releases. The continuous air extraction system and 45m stack increases the dispersion distance and aids the dilution of any releases to atmosphere. Roller shutter doors installed on the vehicle entrance and exit, and wheel-wash facilities for vehicles after exiting the Cake Barn, further reduce the likelihood of fugitive releases or entrainment of material offsite.

Storage tanks, treatment tanks and associated pipework are enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to an OCU. OCUs are 2-stage or 3-stage biofilters. Given the type of OCU, the likelihood of bioaerosol release is anticipated to be negligible to low.

The probability of exposure from bioaerosols generated from the permitted processes on site is considered to be **Medium.** However, when considering the location of receptors, receptor distances from source, the prevailing wind direction and the onsite management and mitigation measures in place, the overall risks of bioaerosols being generated from the permitted processes on site is likely to be **Low** to **Very Low**.

Planned monitoring of bioaerosol emissions by Thames Water is expected to validate the expectation that process contributions of bioaerosols from sewage sludge treatment works, would comply with the 'acceptable level' thresholds, set out within EA guidance.

Table 3 summarises the risk assessment.

Table 3: Risk Assessment of Potential Bioaerosols Sources

What has the potential to cause harm? Source	How can the source reach the receptor? Pathway	Who can be affected? Receptors	Assessing the risk Probability of Exposure	What is the harm that can be caused? Consequence	Control Measures Managing the Risk	Overall / Residual risk
Cake Barn	Inhalation via wind-borne transportation	R7	Receptors downwind are greater than 600m from the Cake Barn Vent. The closest receptors are upwind and frequency of wind directions from the east /northeast is small in relation to other directions. The enclosed nature of the structure reduces the likelihood of wind-blown transmissions during handling or export. The air extraction vent is unabated. Bioaerosol content is considered to be small and colony forming units anticipated to be within acceptable levels. Probability of exposure is considered to be **medium**.	Impact on human health (considered to be a sensitive receptor).	Fully enclosed Cake Barn, with continuous air extraction, aids the dilution of bioaerosol concentrations within the building and subsequently, the vented air to atmosphere. Stack height of 45m, increases the dispersion dilution once released. Roller shutter doors and wheel wash facilities significantly reduce the probability of fugitive releases during handling and/ or export activities. The cake stockpile levels are managed so that under normal operating conditions levels within the Cake Barn will not exceed storage capacity onsite. Once deposited in the storage barn, the sludge cake is not disturbed until it is exported offsite. Re-suspension of cake dust / bioaerosols during loading for export is minimised by the	Low

What has the potential to cause harm? Source	How can the source reach the receptor? Pathway	Who can be affected? Receptors	Assessing the risk Probability of Exposure	What is the harm that can be caused? Consequence	Control Measures Managing the Risk	Overall / Residual risk
					moisture content of the sludge cake.	
Odour Control Units	Inhalation via wind-borne transportation	R7	The closest receptor (R7) is approximately 95m away and upwind (of prevailing WSW to SW wind direction). Other receptors downwind of the prevailing wind direction are more than 550m away. Probability of exposure from the biofilter OCUs is considered to be **low**	Impact on human health (considered to be a sensitive receptor).	Storage tanks, treatment tanks and associated pipework are enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to an OCU. OCUs are 2-stage and 3-stage biofilters. In addition, the OCU is monitored and regularly maintained making the uncontrolled release of bioaerosols very unlikely. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.	Very Low

2.7 Abnormal Situations

In the event of plant failures or abnormal situations, an alarm would be raised on the Site Supervisory Control and Data Acquisition (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, where required, an operator would contact a mechanical or electrical technician, both of whom are on-call 24-hours, to attend site as soon as practicable.

If the on-call technicians are already engaged upon other response work, there is the facility to access staff from other TW geographic divisions, coordinated by the Duty Manager. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached. One such abnormal event would be failure of the flare stack and/or CHP Engines. Such an event would result in releases of biogas from the PRV's located on the roofs of the Primary Digester Tanks and in the Biogas Storage Holder compound, which would release bioaerosols. This occurs to prevent over pressurisation of the Primary Digester Tanks and biogas systems. While the problem is rectified, biogas generation is reduced by reducing or inhibiting the digester feed.

3. Conclusions

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health in dwellings and other nearby buildings/ community spaces from bioaerosols arising from operations at the Beckton STC. The risk assessment followed a standardised approach, namely:

- Hazard identification: what sources of bioaerosols are present;
- Exposure assessment: what are the mechanisms or pathways allowing bioaerosols to migrate off site and reach a receptor; and
- Risk evaluation: what is the probability, magnitude, and duration of exposure. This considered control measures in place to reduce the probability or magnitude of release.

A number of potential sources of bioaerosols within the site processes have been identified, connected to the storage and movement of treated digestate sludge cake in the Cake Barn and the operation of the bio-filter odour control units. The risk from abnormal releases from pressure relief valves was scoped out.

Although only qualitative data is available at this stage, the overall bioaerosol risk from the permitted process on site is considered to be **Low** to **Very Low** based on the receptor distances, reception locations, probability of exposure and onsite management and maintenance, which would minimise the magnitude of any releases.

3.1 Sampling

Thames Water confirms it will use MCERTS accredited providers for the sampling of bioaerosols from stack emissions and will sample OCUs on a bi-annual basis:

- OCU 3 (A28) TQ 44919 81773
- OCU 6 (A29) TQ 44977 81741
- Cake Barn Ventilation (A30) TQ 45063 81692

Downwind samples will tend to be towards the east of the site, as the prevailing wind is from the SouthWest, so receptors are less likely to be impacted from these potential sources, as receptors are mostly found to the west.

In line with M9, ambient sampling will be conducted to identify background emissions. A sampling round, consisting of four induvial sampling points, each with its own agar plate will be carried out. One point will be located 50m upwind of each OCU stack to give a background concentration, and three will be located in a fan like arrangement downwind and at the same distance to the nearest sensitive receptor (as per M9):

Source	Upwind Location NGR	Downwind Location 1 NGR	Downwind Location 2 NGR	Downwind Location 3 NGR
OCU3	TQ 4487 8174	TQ 4496 8185	TQ 4500 8182	TQ 4501 8177
OCU4	TQ 4493 8171	TQ 4504 8186**	TQ 4510 8182	TQ 4512 8174
Cake Barn Ventilation	TQ 4502 8166	TQ 4517 8189***	TQ 4518 8176****	TQ 4521 8169*****

*Location points may require to be changed due to the presence of existing structures making access unsafe or impractical
** downwind location 1 NGR only 140m from source as building structure prevents sampling at 150m.
*** downwind location 1 NGR only 226m from source as building structure prevents sampling at 240m
**** downwind location 2 NGR only 140m from source as structure prevents sampling at 240m
****** downwind location 3 NG only 150m from source as structure prevents sampling at 240m

NGR's for sampling locations are only 8 digits at present, to allow the contractor flexibility as to precise location, taking into account the ability to safely locate and access (and security) of the sampling plates.

Appendix A. Site Location Plan

KEY:

Site Location

P01	JUN 2021	FOR INFORMATION	AR	SK	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

Jacobs

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Client: Thames Water

Project: STC IED PERMIT
BECKTON STW

Drawing title: APPENDIX A
SITE LOCATION PLAN

Drawing status: PERMITTING

Scale	1:25,000	DO NOT SCALE	
Jacobs No.	B22849AM	Rev	P01
Client no.			

Drawing number: B22849AM-JAC-BKN-DR-0001

Appendix B. Installation Boundary and Air Emission Points

N

Wind Turbine

A19

A7,A8

A9,A10

Sewage Works

Cess/Domestic Waste Imports 1

A17

A33

Cess/Domestic Waste Imports 2

A16

Conveyors

A18

A14 A15 A12 A13 A11

HORNET WAY

Drain

A20

Primary Sludge Buffer Tanks

Primary Sludge Thickening Plant

Thickened Primary Sludge Buffer Tanks

Liquor Return Pumping Station 1

Picket Fence Thickeners

Primary Digester Tank

Digested Sludge Buffer Tanks

THP Plant

THP Feed Silo

Pre THP Dewatering Plant

Digested Sludge Dewatering Plant

Cake Barn

SAS Buffer Tank

SAS Thickening Plant

A6 A28 A29 A1 A23 A2 A4 A3 A22 A5 A25 A24 A21 A26 A27 A30

Liquor Return Pumping Station 3b

Liquor Return Pumping Station 5

Liquor Return Pumping Station 3a

SAS Thickening Plant

SAS Buffer Tank

Liquor Return Pumping Station 2

Undigested Sludge Transfer Blending Tank

Undigested Sludge Transfer Buffer Tanks

High Energy Blending Tank

SAS Blending Tank

Primary Sludge Blending Tank

Liquor Return Pumping Station 4

THP High Energy Blending Tank

THP Sludge Blending Tanks

Pre THP Dewatering Feed Tanks

Sludge Buffer Tanks

Sludge Buffer Tanks

HORNET Wy

Gallions Reach Shopping Park

Gemini Business Park

Mud

JENKINS LANE

KEY:

Installation Boundary

Tanks Excluded from Permit Scope

Air Emission Point

A1 - CHP Engine 1
A2 - CHP Engine 2
A3 - CHP Engine 3
A4 - Boiler 1
A5 - Boiler 2
A6 - Emergency Flare Stack
A7 to A10 - 4 x Perkins Emergency Standby Engines ASP4
A11 to A15 - 5 x Finning CAT Emergency Standby Engines, Power house
A16 - 1 x Finning CAT Emergency Standby engine, Fine Screen
A17 - Perkins Emergency Standby Generator, Detritor
A18 - Cummings B Emergency Lighting Standby Generator
A19 - Boilers Potterton, Admin Block Boilers
A20 - Boiler Remeha Quinta, Operation Building
A21 - THP PRV
A22 to A27 - Biogas Storage Holder PRVs
A28 - OCU 3
A29 - OCU 6
A30 - Cake Barn Ventilation
A33 - Inlet Works Standby Generator

0 20 40 60 80 100 120 140 150
METRES

P02	DEC. 2023	FOR INFORMATION	AR	MM	JK	MM
P01	JUN. 2022	FOR INFORMATION	AR	MM	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Client: Thames Water

Project: STC IED PERMIT
BECKTON STW

Drawing title:
APPENDIX B
INSTALLATION BOUNDARY AND AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	AS SHOWN	DO NOT SCALE
Jacobs No.	B22849AM	Rev P02
Client no.		

Drawing number: B22849AM-JAC-BKN-DR-0002

Appendix C. Receptors within 250m of Potential Bioaerosol Emission Sources

N

R1

R2

R7

A28

A29

A30

Cake Barn

Drain

HORNET WAY

JENKINS LANE

Gallions Reach
Shopping Park

Gemini
Business Park

Mud

KEY:

- Installation Boundary
- Tanks Excluded from Permit Scope
- Air Emission Point
- Receptor Point

A28 - OCU 3
A29 - OCU 6
A30 - Cake Barn Ventilation

0 20 40 60 80 100 120 140 150
METRES

P02	DEC. 2023	FOR INFORMATION	AR	MM	JK	MM
P01	JUN. 2022	FOR INFORMATION	AR	MM	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Project: STC IED PERMIT
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Drawing title: APPENDIX C
RECEPTORS WITHIN 250m OF POTENTIAL BIOAEROSOL EMISSION SOURCES

Drawing status: PERMITTING

Scale	AS SHOWN	DO NOT SCALE
Jacobs No.	B22849AM	Rev P02
Client no.		

Drawing number: B22849AM-JAC-BKN-DR-0004