Slough 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 Slough Sludge Treatment Centre (STC), EPR/LP3738LC.

1.1 Site description

The site is located immediately south of the M4 motorway and to the south of the conurbation of Slough. To the west, east and south of the site are open green spaces, agricultural land and the Jubilee River.

The site location plan is shown in Appendix A and the address of the installation is:

Slough STW;

Wood Lane,

Slough,

Berkshire,

SL1 9EB.

The majority of the site and the STC sits within Flood Zone1 (>1:1000 annual probability of river flooding) however a small area of southern portion of the site is within a Flood Zone 2 and 3 area with a medium/high annual probability of flooding (between a1:100 and 1:1000 annual probability of flooding) and land having a 1:100 or greater annual probability of flooding.

The site is outside of an Air Quality Management Area (AQMA) but is within a Zone 2 Source Protection Zone (SPZ). There are five habitat sites within the appropriate distance of the STC including three Special Areas of Conservation (SACs), one Ramsar site and one Special Protection Area (SPA), a local wildlife site, ancient woodlands and one Local Nature Reserve (LNR).

1.2 Site Activities

Slough Sludge Treatment Centre (STC), is located at the Slough Sewage Treatment Works (STW), 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 for the generation of electricity and heat at the site.

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

- Imports of waste, including sludge from other sewage treatment works and imports of municipal liquid or sludges similar in composition to UWWTD derived materials.
- Blending of indigenous sludges and imported wastes/waste sludge prior to treatment.
- Storage of digestate prior to de-watering.
- Dewatering of digested sewage sludge.
- Transfer of treated dewatering liquors via site drainage back to the head of the sewage treatment works.
- Transfer of surface water runoff back to the head of the sewage treatment works.
- Storage of dewatered digested sludge cake prior to offsite recovery.
- Storage of biogas.
- Combustion of biogas in a Medium Combustion Plant Directive (MCPD) and Specified Generator (SG) compliant biogas CHP engine and boilers units.
- Combustion of diesel in a MCPD and SG compliant diesel generator.
- Emergency flare.
- Operation of siloxane filter plant.

- Storage of diesel.
- Storage of wastes, including waste oils.
- Storage of raw materials.

The facility can treat up to 203,000m^3 of sludge per year (equating to approximately 203,000 tonnes). There are six operational digesters, with a total storage capacity of 13,364m^3. The sludge treatment facility has a total maximum treatment input of 927m^3 per day (equating to approximately 556 tonnes per day).

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 a number of odour control units linked to specific tanks or processes which produce potentially odorous air. These units treat the air through a variety of means, including use of biofilters.

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 CHP engines at the site with excess biogas being subject to flaring. The biogas handling system is equipped with a number of pressure relief valves (PRVs) which activate as a safety precaution when there is excess gas over what the CHP engine 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) and the treatment of liquors prior to disposal above the relevant threshold, Chapter 5, Section 5.4, Part A 1(a)(i).

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 Slough Sludge Treatment Centre installation 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 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 group 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

[1] Environment Agency. July 2018. M9: Environmental monitoring of bioaerosols at regulated facilities v2, July 2018

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 Slough Sludge Treatment Facility does not undertake any aerobic composting activities and the anaerobic digestion process on site, undertaken in the primary digesters, is an enclosed process with all produced gases captured within the biogas system.

1.4.1 High Risk Activities

The M17 guidance document (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 facility; 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 Slough STC, only the storage of sludge cake and export i.e. the handling and storage of waste (under certain conditions) and wind scouring of waste surfaces would apply. Sewage waste to site is received via pipes and is contained and shredding of waste or turning of stockpiles is not undertaken

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 Slough Sludge Treatment Facility. 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 vegetation around the site.
- What is beyond the site boundaries and the location of sensitive receptors; and
- 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, from tanker deliveries through an enclosed connection, before being processed through the STW outside of the permit boundary. Incoming sludge, in a mixture with other sewerage material is subjected to preliminary treatment through screening and degritting, before separation of sludge from the main flow in the primary settlement tanks. Settled sludge is transferred to the two picket fence thickeners (PFT), both of the PFT tanks are of steel reinforced fibreglass construction, covered and connected to an odour control unit (OCU) for odour abatement.

Sludge thickening within the PFTs falls within the scope of the STC permit and within the scope of this risk assessment. Surplus activated sludge from elsewhere in the works is dewatered inside of a building before it is pumped to the sludge blending tank.

Imported sludge may also enter the process, via tanker transfer from other TWUL sewage treatment works or from third parties. These imports are transferred by sealed pipeline from tankers into a pre-digestion tank within the process. Sludge is transferred from the pre-digestion tank to the sludge blending tank.

If a sludge spillage occurs, operators will carry out clean up as soon as possible. If the spillage is caused by a lorry or tanker, the driver is responsible for cleaning up the spill before leaving 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. Lorry and tanker drivers are required to hose down any spillage after each loading. No wheel wash facility is available on the site, but a standpipe is available and can be utilised to wash spillage from vehicles as required.

2.2.2 Waste Treatment

The thickened sludge is pumped via a dedicated sludgeline to a covered Sludge Blending Tank, where it is mixed with thickened SAS and any imported sludge from other works, the blending tank is an enclosed concrete tank, linked to an Odour Control Unit (OCU). From the buffer tank, sludge is transferred to one of six primary anaerobic digesters at the site. Four have floating rooves, and two have fixed rooves. There are three secondary digester tanks, which are open topped. Pressure relief valves (PRVs) are fitted to the roof of each tank for safety.

Anaerobic digestion of sludge takes place within a closed system, so the risk of bioaerosols from this source is low.

The digested sludge from secondary digester tanks is then pumped via an above ground sludge line to the centrifuge feed pumps for dewatering, there are two centrifuges with only one operational at one time.

Biogas from the primary and secondary digesters is collected into gas holder and either used to fuel the Combined Heat and Power plant (CHP), heating boilers or combusted in an enclosed flare.

Odorous air from a number of locations is continuously extracted to an Odour Control Unit (OCU). The air is treated within the OCUs to remove odour and bioaerosols using various methods such as biofilters and activated carbon (described in Section 2.3), before it is released to the atmosphere.

Biofilters are considered to be a potential emission source for bioaerosols. Scrubbers are unable to remove 100% of bioaerosols, so in any location where there is a biofilter there is still the potential for bioaerosol emission, however it is expected to be minimal.

Carbon filters are considered to effectively remove bioaerosols and so any OCUs using carbon filters are not considered to be a source of bioaerosols. It should however be noted that where carbon filters are used in combination with biofilters, whilst any emission of bioaerosols are expected to be minimal the possibility of emission cannot be entirely ruled out.

2.2.3 Digested cake

De-watered digested cake is carried by a conveyor and deposited in a concrete surfaced and walled storage bay. Conveyors are covered to minimise the risk of cake escaping. The cake is deposited from the conveyor onto the bay surface from a distance of approximately 2m.

The dewatered digested sludge cake is transferred to the engineered cake maturation/storage pad prior to removal from site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). Centrate is returned via the site drainage system to the works inlet.

Digested sludge cake is then loaded onto trucks using a loading shovel and removed off site for agricultural land spreading. There is considered to be a low risk of bioaerosols from digested sludge cake on the cake pad, despite the proximity of sensitive receptors within 250m of the cake pad who may be present for more than 6 hours at a time. The sludge cake is deposited wet and moved to storage, where it forms a crust within 24 hours. It is not disturbed, until it is taken for export.

2.2.4 Odour Control Units

Sewage treatment works have a number of potentially odorous sources within their boundary. During site assessment and design, some of these sources may be linked to odour control units (OCUs) to treat potentially odorous compounds given off by the process. These units take air extracted from above tanks or process areas, and treat the odours compounds by means of different methodologies dependent upon the nature of the odours 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. Biofilters are considered to be a potential emission source for bioaerosols, whether used in isolation or with a second methodology.

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 cake is, therefore, produced daily and at similar levels across the whole year.

However, digested sludge cake storage on site, both in relation to duration and volume, varies across time. Digested sludge 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 cake 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 twenty point-source emissions to air from the processes within the installation boundary, at the following locations as described in the main permit. The references and source descriptions match those in the permit:

Table 1: Point source emissions to air

Air emission reference	Source	In scope as a source?
A2	Auxiliary Boiler 2a	x
A3	Auxiliary Boiler 2b	x
A4	Auxiliary Boiler 3	x
A5	Emergency Flare 1	x
A6	Emergency Flare 2	x
A9	BC1 CHP Engine (MWM TCG2016V12)	x
A10	Standby Generator 1	x
A11	Standby Generator 1	x
A12	OCU A - Digester Feed Tank	x
A13	OCU B - Western Area Pumping	x
A14	OCU C - High Level Pumping Station	x
A15	OCU E - New Digested Sludge	✓
A16	OCU F - Picket Fence Thickeners	✓
A17	Gas Holder PRV	x
A18	Digester PRV	x
A19	Digester PRV	x
A20	Digester PRV	x
A21	Digester PRV	x
A22	Digester PRV	x
A23	Digester PRV	x

The location of these emission points is shown on the site layout plan at the emission plan in Appendix B.

The cake pad and storage area are also considered source of bioaerosols emissions and is shown on the plan in Appendix B, however this is considered a diffuse source and not a point source and is therefore not included within the above table.

2.3.1 Source Assessment

The CHP engine, boilers and emergency flares (points A2 – A9) 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 A10 – A11 relate to diesel fuelled generators at the site, which are not linked to any source of bioaerosols. The boilers may also be operated on diesel, which again excludes them as a source of bioaerosols.

There are five no. odour control units (OCUs) (point A12-A16) serving the sludge treatment facility (within the installation boundary), associated with the Digester Feed Tank, the Western Area Pumping, the High Level Pumping Station, the Inlet Works, the New Digested Sludge and the Picket Fence Thickeners.

- OCUs A, B and C use a large size carbon filter and 2 direct drive extract fans.
- OCU E consists of a constantly irrigated large size lava rock bio-filter, 2 polishing carbon filters, and 2 direct drive extract fans.
- OCU F consists of 3 intermittently irrigated medium size calcified seaweed bio-filters, and 2 direct drive extract fans.

Biofilters are considered to be a potential emission source for bioaerosols, whether used in isolation or with a second methodology.

The Pressure Relief Values (PRVs) (points A18 – A24) 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, the PRV's would open to relief excess biogas pressure, potentially resulting in the release of bioaerosols, while the problem is rectified. While the problem is rectified, biogas generation is reduced 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 an unchanneled potential release (diffuse source) from treated, dewatered sewage cake which is stored on the cake pad at the site.

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 greatest probability of exposure from bioaerosols emitted from the site is from uncovered operations such as the cake bay and cake conveyor.

However, the digested sludge cake is at the end of the sludge treatment process, and is moist on deposition from the conveyor to the pad. The cake is managed by dozer and taken to the cake storage bays, which are controlled row height and arrangement and requires no further treatment, prior to export onto before being deposited on agricultural land. It and therefore is likely to have low concentrations of bioaerosols, and therefore, the probability of exposure from this source is also minimised.

In addition, all storage tanks, treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered with metal plates. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only opened in abnormal situations which are temporary and unlikely.

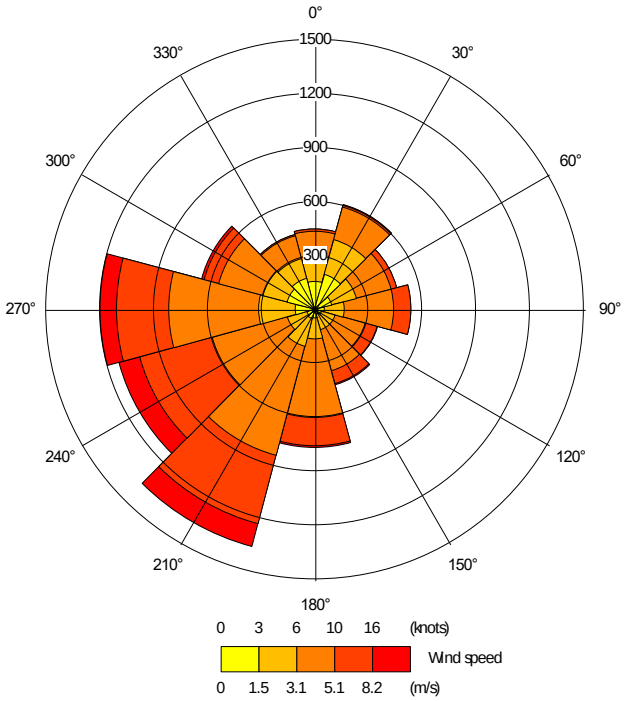
2.4 Pathways

Bioaerosols are very small and light in weight so can easily be transported by the wind from their source to a human health receptor where they may be inhaled.

The 2019 wind rose for the most representative meteorological site, Heathrow airport (located approximately 13.5 km South East of the Site), is shown in Figure 1.

The wind rose data shows that the site experiences strong prevailing south westerly winds, predominantly in excess of 6 knots.

Figure 1 – Heathrow Airport Wind rose (2019)



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. RR786 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.

At present, Thames Water do not have quantitative data for the levels of bioaerosols that might be associated with the potential sources at their sludge treatment centres. 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 pad, 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

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

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.

There are three sensitive receptors found within 250m of potential bioaerosol emission sources at the site, as shown on the site plan found in Appendix C.

For each of these receptors, the distance and direction from each potential bioaerosol emission source to the closest sensitive receptor has been identified. Where multiple assets exist for the same process, such as cake bays, only the closest location has been presented. The receptor closest to a potential emission source are residential properties at Wood Lane to the East of the STC, approximately 80m South of the Odour Control Unit (16) (New Digested Sludge).

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

Receptor	Description	Source	Distance from closest source (m)	Direction from the Source
R1	Residential Properties: Wood Lane (nearest gardens)	A15 OCU E	80m	South
		A16 OCU F	100m	South East
R2	Residential Properties: Haswell Crescent	A15 OCU E	165m	North East
		A16 OCU F	225m	North East
R3	Chippenham Football Club-recreation ground (southern edge of field)	A15 OCU E	145m	North
		A16 OCU F	185m	North

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 bioaerosols release within 250m of static receptors:

- Odour Control Unit E - New Digested Sludge (A16)
- Odour Control Unit F - Picket Fence Thickeners (A17)

The receptors are situated to the North, North East, East, South East and South of the release points and the prevailing wind direction is from the South-west. There is potential for wind-borne transportation of bioaerosols, more so in the direction of Receptors R2 and R3, slightly less so for Receptor R1.

The probability of bioaerosols being emitted from the permitted processes on site is considered to be **low,** and taking into account the location of receptors, their distance from source, and the control measures in place the overall risk is considered to be **low**.

Most 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. There are a number of types of odour control, given the types of OCU, the likelihood of bioaerosol release is anticipated to be minimal.

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

The maximum daily throughput of sludge is 556m^3/day.

Overall, the probability of bioaerosols being released from the sludge treatment process and the identified potential sources is considered to be low.

The potential duration of release of bioaerosols varies from infrequent to frequent. The magnitude of release is considered to be low.

There are residential receptors (R1) that are approximately 80m distance south-east and east from identified potential emission sources. Given that the identified potential sources are considered to represent a low risk, and the intervening distance and the screening provided by the vegetation and trees present, it is considered that the probability of exposure to occupants of these properties from bioaerosols emitted from the site is likely to be **low** (if releases occur at all).

Residential receptors (R2) and Chippenham Football Ground (R3) have been identified, >145m north of the identified potential sources. Given that the identified potential sources are considered to represent a low risk and the intervening distance, and the screening provided by the vegetation and trees present, it is considered that the probability of exposure to people at these locations from bioaerosols emitted from the site is also likely to be **low** (if releases occur at all).

Planned monitoring of bioaerosol emissions by Thames Water is expected to validate the assumption that process contributions from sewage sludge treatment works would comply with the 'acceptable level' thresholds.

Table 3 summaries 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	Consequence (what is the harm that can be caused)	Managing the risk (Control Measures)	Overall/residual risk
Odour Control Unit E - New Digested Sludge (A16)	Inhalation via wind-borne transportation	R1, R2, R3	Receptors downwind are >140m away and also screened by vegetation and trees. The closest receptor is approximately 80m, however this is not in the direction of the prevailing wind and so less likely to be affected. The receptor is also protected to an extent by vegetation and trees. Probability of exposure from A16 is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	Most 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. There are a number of types of odour control, given the types of OCU, the likelihood of bioaerosol release is anticipated to be minimal. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.	Low
Odour Control Unit F - Picket Fence Thickeners (A17)	Inhalation via wind-borne transportation	R1, R2, R3	Receptors downwind are >160m away and also screened by vegetation and trees. The closest receptor is approximately 100m, however this is also protected to an extent by vegetation and trees. Probability of exposure from A17 is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	Most 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. There are a number of types of odour control, given the types of OCU, the likelihood of bioaerosol release is anticipated to be minimal. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.	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. Such an event would result in releases of biogas from the PRV's 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.

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 from bioaerosols arising from operations at the Slough 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 of exposure. This considered control measures in place to reduce the probability or magnitude of release.

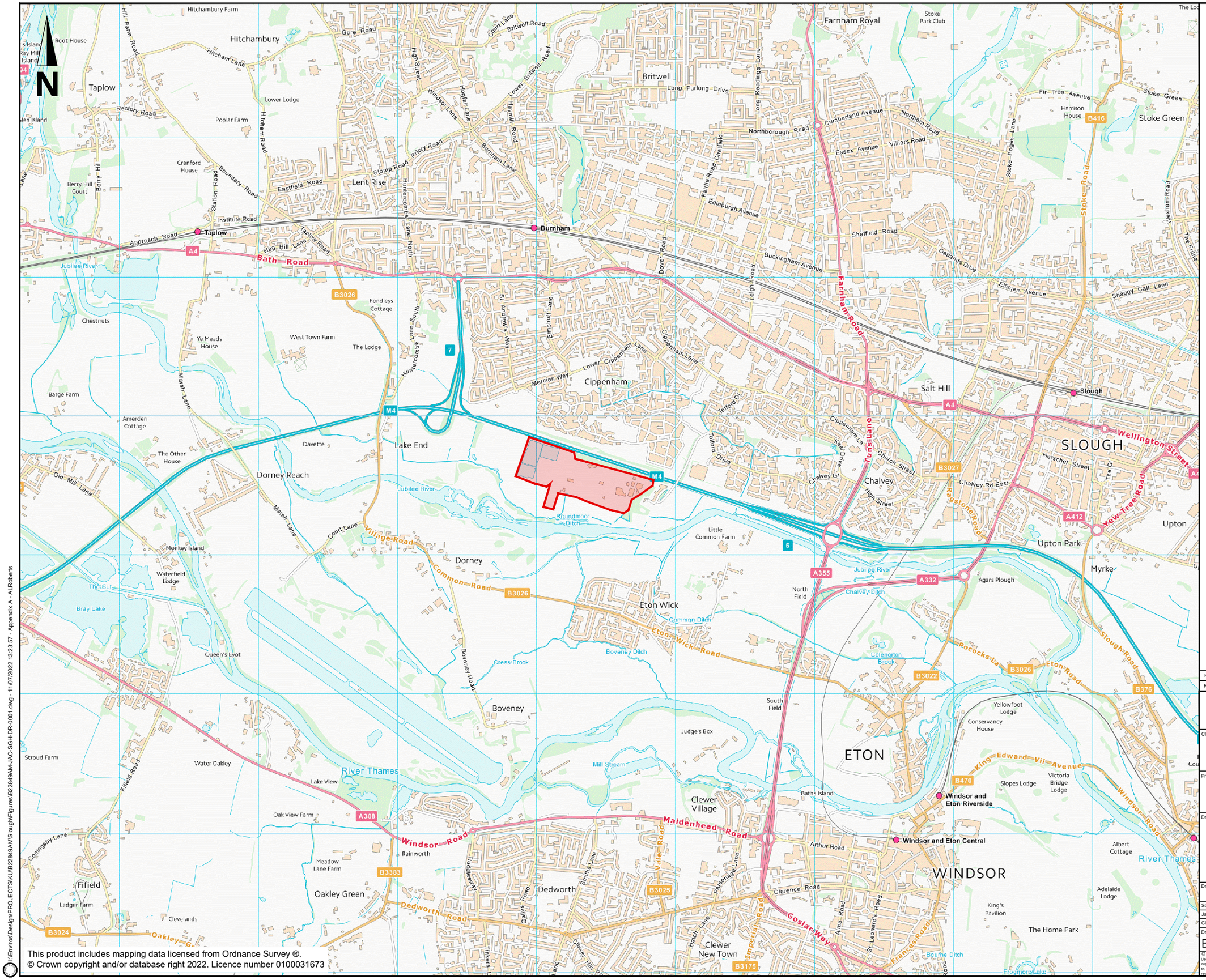
A small number of potential sources of bioaerosols within the site processes have been identified, however only two are within 250m of a static receptor. However, given the distance from the emission point and the trees and vegetation which are likely to be protective of the receptor and the control measures in place to contain bioaerosols and prevent their release the overall (residual risk) to receptors is considered to be low.

Planned monitoring of bioaerosol emissions by Thames Water is expected to validate the assumption that process contributions from sewage sludge treatment works would comply with the 'acceptable level' thresholds.

3.1 Next Steps

At present, Thames Water do not have quantitative data for the levels of bioaerosols that might be associated with the potential sources at their sludge treatment centres. 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 pad, including sampling points both directly upwind of the downwind sampling point and additional samples in the direction of the nearest sensitive receptors. This testing will be carried out before the end of October 2022.

Appendix A. Site Location Plan



KEY:

Site Location

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	MAY. 2022	FOR INFORMATION	AR	HEK	JK	MM

Jacobs
1180 Eskdale Road, Winnersh, Wokingham, RG41 5TU
Tel:+44(0)946 284 7000
www.jacobs.com

Client: Thames Water

Project: STC IED PERMIT
SLOUGH 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-SGH-DR-0001

Appendix B. Potential Bioaerosol Emission Points

N

ISLAND ROAD

Recycling Site

Cess/Waste Import Point

Inlet Building

Cake Silos

A6
A10
A9
A11
A12
A13
A14
A16
A15
A7
A8
A1
A2
A3
A4
A5

Dewatering Building with:
Digested Sludge Buffer Tanks
Centrifuges

Sludge Building with:
Raw Sludge Tanks
Sludge Blending Tanks
Sludge Dewatering Plant
SAS Dewatering Plant
Pasteurisation Plant
Boilers

Power Building with :
CHP Engines
Standby Generators

Sludge Import Point

Sewage Works

Ford

A33

KEY:

Installation Boundary

Air Emission Point

A1 - CHP Engine 1a
A2 - CHP Engine 1b
A3 - Boiler 2a
A4 - Boiler 2b
A5 - Boiler 2c
A6 - Biogas Flare
A7 - Standby Generator 1
A8 - Standby Generator 2
A9 - Gas Holder PRV
A10 - Gas Holder RV
A11 - Primary Digester PRV
A12 - Primary Digester PRV
A13 - Primary Digester PRV
A14 - Primary Digester PRV
A15 - Inlet Building OCU
A16 - Sludge Building OCU

0 20 40 60 80 100
METRES

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	MAY. 2022	FOR INFORMATION	AR	HEK	JK	MM

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Client: Thames Water

Project: STC IED PERMIT
READING STW

Drawing title: APPENDIX B
POTENTIAL BIOAEROSOL
EMISSION SOURCES

Drawing status: PERMITTING

Scale	1:1250	DO NOT SCALE
Jacobs No.	B22849AM	Rev P01
Client no.		

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

Appendix C. Receptors within 250m of potential emission points

P01	MAY. 2022	FOR INFORMATION	AR	HEK	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
READING STW

Drawing title

APPENDIX C
RECEPTORS WITHIN 250m OF POTENTIAL BIOAEROSOL EMISSION SOURCES

Drawing status

PERMITTING

Scale	1:1250	DO NOT SCALE
Jacobs No.	B22849AM	Rev
Client no.		P01

Drawing number

B22849AM-JAC-RDG-DR-0004