Bracknell STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
EPR/FP3301MX/A001

IED STC Permitting
28 November 2023

Bracknell STC Bioaerosol Risk Assessment

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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 Bracknell Sludge Treatment Centre (STC), EPR/ FP3301MX/A001.

1.1 Site description

The site is located within a rural area, outside of the village of Binfield and approximately 2.7 km to the north of the town of Bracknell, Berkshire. There are fields and woodland on all sides of the STW. The nearest sensitive receptors are residential properties and farmland off Ryehurst Lane, with the closest housing at 75m North-West of the cake barn.

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

Bracknell STW;

Hazelwood Lane,

Bracknell,

Berkshire,

RG42 5NE.

The site is fully located within the boundaries of a Source Protection Zone (SPZ) Zone 3. There are a number of statutory designated habitat sites within the relevant distances of the site. The closes of which is a Local Nature Reserve (LNR), Tinkers Copse, which is approximately 1 km to the south of the site

There are 24 areas of Ancient Woodland within 2 km of the site. The closest of which is Hazelwood Copse which is located to the north-west and adjacent to the boundary of the sludge treatment centre. There are 11 non statutory designated LWS's within 2 km of the site, the closest of which is located to the north-west and adjacent to the boundary of the sludge treatment centre, namely Hazelwood Copse LWS

The area of the site is located entirely within a Flood Zone 1, indicating there is a with a low probability of flooding (<1:1000 annual probability of flooding). The site is not located within or adjacent to the boundaries of an Air Quality Management Area (AQMA).

1.2 Site Activities

Bracknell Sludge Treatment Centre (STC), is located at the Bracknell Sewage Treatment Works (STW), operated by Thames Water Utilities Ltd (Thames Water). The STC comprises of treatment processes for indigenous sludges separated from the UWWTD permitted areas of the site and for treatment processes for imported sludge that arrives at Bracknell STC by road, normally by tanker and consist of sludge from other sites. Waste imports of non-hazardous waste to the STC are considered a secondary waste operation to the main listed activity and consist of imports to the cake barn. There are currently no imports of cess waste via road to Bracknell STC.

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.
- 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 dewatering liquors via site drainage back to the sewage treatment works inlet.
- Transfer of surface water runoff back to the sewage treatment works inlet.
- Storage of dewatered digested sludge cake prior to offsite recovery.
- Storage of biogas.

- Transfer of biogas condensate via site drainage back to the head of the sewage treatment works.
- Combustion of biogas in a Medium Combustion Plant Directive (MCPD) and Specified Generator (SG) compliant biogas CHP engine and boilers.
- Operation of emergency flare.
- Operation of siloxane filter.
- Storage of diesel.
- Storage of wastes, including waste oils.
- Storage of raw materials; and
- Operation of a standby emergency generator (Generator 2).

The facility can treat up to 270,000m^3 of sludge per year (equating to approximately 270,000 tonnes). The sludge treatment facility has a total maximum treatment input of 273m^3 per day (equating to approximately 273 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 two 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 the CHP engine and boilers 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 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).

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 Bracknell 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

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

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 Bracknell 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 (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 Bracknell STC, which meets the M17 guidance, 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 Bracknell 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 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

The STC comprises of treatment processes for indigenous sludges separated from the UWWTD permitted areas of the site and for treatment processes for imported sludge that arrives at Bracknell STC by road, normally by tanker and consist of sludge from other sites. Waste imports of non-hazardous waste to the STC are considered a secondary waste operation to the main listed activity are waste imports to the cake barn. There are currently no imports of cess waste via road to Bracknell STC.

Indigenous sludge is drawn off the Primary Settlement Tanks (PSTs) and pumped to a Picket Fence Thickener (PFT), at which point, it falls into the scope of this permit. The PFT is an aboveground tank of steel construction, on a concrete base. In the PFT, the sludge is subject to thickening by a rotating fence which moves around the inside of the tank, with sludge gravitating to the bottom of the tank where it is removed and pumped to the Digester Feed Tank. Liquor from the tank weirs out of the tank, gravitates to Liquor Return Pumping Station 1 and is returned via site drainage to the inlet for additional treatment. Indigenous sludge can also be thickened in Sludge Thickening Plant and transferred to the Digester Feed Tank, bypassing the PFTs.

Imports of sludge from other sites can also be made to Bracknell STC. The sludge is discharged from tanker vehicles and through a sludge logger unit into the Sludge Import Tank. The Sludge Import Tank is an aboveground tank of steel construction, on a concrete base. From the Sludge Import Tank, sludge is screened in order to remove inorganic material, which is deposited into a skip for offsite disposal, and then the screened sludge is pumped to Thickener Feed Tank.

Screened imported sludge is pumped for dewatering in Sludge Thickening Plant, which uses a liquid polymer from an intermediate bulk container (IBC) to aid coagulation. Thickened imported sludge discharges into the Digester Feed Tank where it mixes with thickened indigenous sludge. Liquor from the Sludge Thickening Plant drains to the Liquor Return Pumping Station 1 and is returned to the inlet of the works via site drainage for further treatment. An Odour Control Unit (OCU) abates the Digester Feed Tank and PFT.

2.2.2 Waste Treatment

The thickened blended sludge is pumped via duty/standby pumps to one of the four Primary Digester Tanks at the site. Two Primary Digester Tanks are of concrete construction while two Primary Digester Tanks are of

steel construction, all four Primary Digester Tanks have fixed roof The Primary Digester Tanks are partially subsurface and extending approximately 4 m underground with a conical bottom. The contents of each anaerobic digester are subject to biogas mixing while the contents undergo anaerobic digestion. The Primary Digester Tanks operate on a continuous basis, receiving batches of sludge that is pumped sequentially into each tank in turn. Primary Digester Tanks have a normal retention time of approximately 12 days. Each Primary Digester Tank is fitted with dual pressure relief valves (PRVs).

Heat exchange systems for each Primary Digester Tanks are located within the digester gallery, which provides external heat input to each Primary Digester Tanks. The heat exchanges use heat generated on site by either the CHP engine or by the two boilers. Sludge is drawn from the base of each digester, via a pump through a heat exchanger and returned mid-way up the digester; with undigested sludge also joining the sludge line from the heat exchanger. Probes monitor the temperature within each Primary Digester Tanks. After the required duration, digested sludge is continuously transferred from the Primary Digester Tanks to the primary digested sludge sump, where pumps transfer the digested sludge to the Secondary Digester Tanks. The Secondary Digester Tanks operate in series, continuously transferring from Secondary Digester Tank 4 in turn to Secondary Digester Tank number 3, Secondary Digester Tank number 2 and Secondary Digester Tank number 1. Any of the Secondary Digester Tanks can be bypassed as required for maintenance requirements. The Secondary Digester Tanks are mainly subsurface, of concrete construction with an aboveground steel collar. with a normal retention time of approximately 14 days. All four Secondary Digester Tanks are subject to air mixing to prevent settling, are fitted with an ultrasonic level, high level float alarm and low-level probe for monitoring. Digested sludge is pumped from to the Dewatering Feed Tank, adjacent to the cake barn.

In the event of the Secondary Digester Tanks being unavailable, digested sludge can gravitate to one of three Emergency Storage Tanks located adjacent to the sludge pumping station. These tanks, are only needed as a short-term contingency storage

2.2.3 Digested cake

The Dewatering Feed Tank is an aboveground tank of steel construction that is located on a concrete base. The tank is uncovered and fitted with an ultrasonic level which measures the level of sludge within the tank and inhibits the transfer pumps to prevent overfilling of the tank.

The sludge is subject to air mixing to prevent settling. Sludge is then pumped to the Digested Sludge Dewatering Plant located within the Cake Barn by dedicated feed pumps. Pumping of sludge to the Digested Sludge Dewatering Plant is inhibited by low-levels within the Dewatering Feed Tank. A polymer solution is made up from a bulk bag system, mixed in a mixing tank and stored within a storage tank before being automatically dosed to the Digested Sludge Dewatering Plant. Liquor from the Digested Sludge Dewatering Plant gravitates to a sump and is pumped to the works inlet via the Liquor Balancing Tank and Return Liquor Pumping Station 2 and digested sludge cake is conveyed into the cake barn.

The cake barn is fully enclosed and odour abated via an OCU. A shovel loader or similar plant moves digested sludge cake from under each conveyor belt into the larger cake storage bay, for storage prior to removal from the site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS).

As the cake barn is totally enclosed there is a low risk from bioaerosols from stored digested sludge cake although there is a sensitive receptor within 250 m of the cake barn. If any noncompliant cake is produced, it is segregated and held for an extended period of time to achieve the required level of pathogen kill There are two bays within the large cake barn, of which one is used for storage of non-compliant cake.

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 OCUs with biofilters and within the permit installation boundary have been included in this assessment.

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 eleven 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?
A1	CHP engine 1	x
A2	Boiler 1	x
A3	Boiler 2	x
A4	Emergency Flare	x
A5-A8	Primary Digester Tank PRVs	x
A9	Biogas Storage PRV	x
A10	OCU 2	✓
A11	OCU 1	✓
A12	Standby Generator 2	x

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

2.3.1 Source Assessment

The CHP engine, boilers and emergency flares (points A1 – A4) 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.

The boilers may also be operated on diesel, which again excludes them as a source of bioaerosols.

OCU 2 (point A10) is sited adjacent to the Cake Barn and extracts air from the 'high' odour sources which is treated by a first stage lava rock biological filter unit followed by a carbon polishing stage. The air from the 'low' odour sources (general building) will be extracted separately and treated by the carbon polishing stage only.

OCU 1 (point A11) is a biofilter unit that extracts air from the Sludge Import Tank, Sludge Screens, Digester Feed Tank and PFT.

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 A5 – A9) 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 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.

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 operations such as the cake barn, however this is enclosed and controlled mitigated with an OCU.

In addition, the majority of 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.

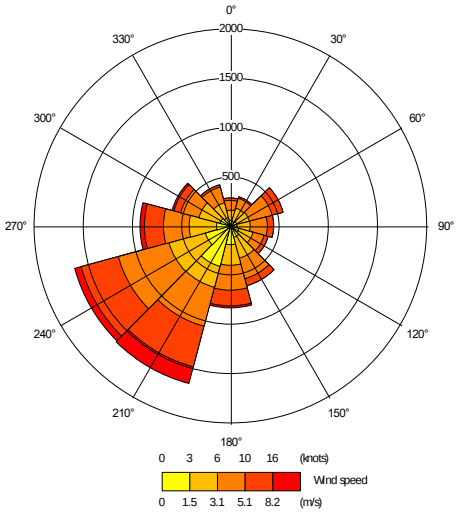
2.4 Pathways

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, Farnborough (located approximately 18.5 km South 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. Farnborough 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 sources, 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.

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

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

Table 2. Static Receptor within 250m of Potential Bioaerosol Source

Receptor	Description	Source	Distance from closest source (m)	Direction from the Source
R1	Residential Properties: Ryehurst Lane (closest houses)	Cake Barn (A10 OCU 2)	75m	North-West
R4	Public foot path Hazelwood Lane	OCU 1 (A11)	150m	South-east

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 Unit associated with Cake Barn (A10)
- Odour Control Unit associated with the Sludge Import Tank, Sludge Screens, Digester Feed Tank and PFT (A11)

The are two receptors within 250m; the closest sensitive receptor, represented by R1 of this potential source is residential housing and farms along Ryehurst Lane, with the closest housing at 75m North-West (measured from the edge of the cake barn). There is also a public footpath approximately 150m South-East of OCU 1, A11 although it is unlikely for visitors to be within this location for six hours or more. Due to the prevailing wind direction being from the South-West, the probability of exposure from this source is considered to be very low and this potential source of bioaerosols is scoped out of further assessment.

Receptors are situated to the North and North-West of the release point A10 and the prevailing wind direction is from the South-West. There is potential for wind-borne transportation of bioaerosols, however receptors are not in the direct direction of wind and so there may be some degree of protection for the closest residential receptor. There is also vegetation between the source and receptors which is also expected to afford the receptor some protection.

The probability of bioaerosols being emitted from the permitted processes on site is considered to be **low,** especially considering that the cake barn is enclosed and associated with an OCU. 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**.

The potential duration of release of bioaerosols varies from infrequent to frequent. The magnitude of release 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.

Table 3 summaries the risk assessment.

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

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 (A10) – associated with cake barn	Inhalation via wind-borne transportation	R1	The closest receptor is approximately 75m, however this is not directly 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 A10 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. This OCU extracts air from the 'high' odour sources (belt filter presses, conveyors, the liquor tank and liquor pumping station) which is treated by a first stage lava rock biological filter unit followed by a carbon polishing stage. The air from the 'low' odour sources (general building) will be extracted separately and treated by the carbon polishing stage only. 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 engine. 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 from bioaerosols arising from operations at the Bracknell 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.

Only one potential source of bioaerosols within the site processes have been identified as impacting upon sensitive receptors, which is the cake barn and associated OCU, and there is only one receptor 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.

3.1 Sampling

Thames Water confirms it will use MCERTS accredited providers for the sampling from the following location, A10 – OCU 2 (NGR SU 85719 71994) and will sample this OCU on a bi-annual basis.

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 the 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
OCU 2	SU 8568 7195	SU 8577 7204	SU 8573 7206	SU 8579 7201

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

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

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Client: Thames Water

Project: STC IED PERMIT
BRACKNELL STW

Drawing title: FIGURE 1
SITE LOCATION PLAN

Drawing status: PERMITTING

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

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

Appendix B. Potential Bioaerosol Emission Points

N

Digested Sludge Dewatering Plant
Cake Barn
Wheel Wash
Hazelwood Copse
A12
A10
Site Liquor Return Pumping Station
Dewatering Feed Tank
Liquor Balancing Tank
Liquor Return Pumping Station 2
Biogas Pipeline
Secondary Digester Tanks
Digester Feed Tank
Thickener Feed Tank
Sludge Thickening Plant
Sludge Import Point
Liquor Return Pumping Station 1
Remote Containment
Remote Containment
A11
A5
A4
Flare
A6
Sludge Import Tank
Picket Fence Thickener
Sludge Screens
A7
A2
A3
A8
Primary Digester Tanks
Boiler House
Primary Digester Tanks
A1
Emergency Storage Tanks
Biogas Storage
A9
Secondary Digester Tanks
CHP Engine
Biogas Pipeline
Siloxane Filter
Sludge Grit and Decant Chamber

KEY:

Installation Boundary

Air Emission Point

A1 - CHP Engine 1
A2 - Auxiliary Boiler 1
A3 - Auxiliary Boilter 2
A4 - Emergency Flare
A5 - Primary Digester PRV
A6 - Primary Digester PRV
A7 - Primary Digester PRV
A8 - Primary Digester PRV
A9 - Biogas Holder PRV
A10 - OCU2
A11 - OCU1
A12 - Standby Generator 2

0 20 40 60
METRES

P03	NOV 2023	FOR INFORMATION	AR	JK	JK	MM
P02	AUG 2023	FOR INFORMATION	AR	HEK	JK	MM
P01	JUL 2022	FOR INFORMATION	AR	HEK	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Project: STC IED PERMIT
BRACKNELL STW

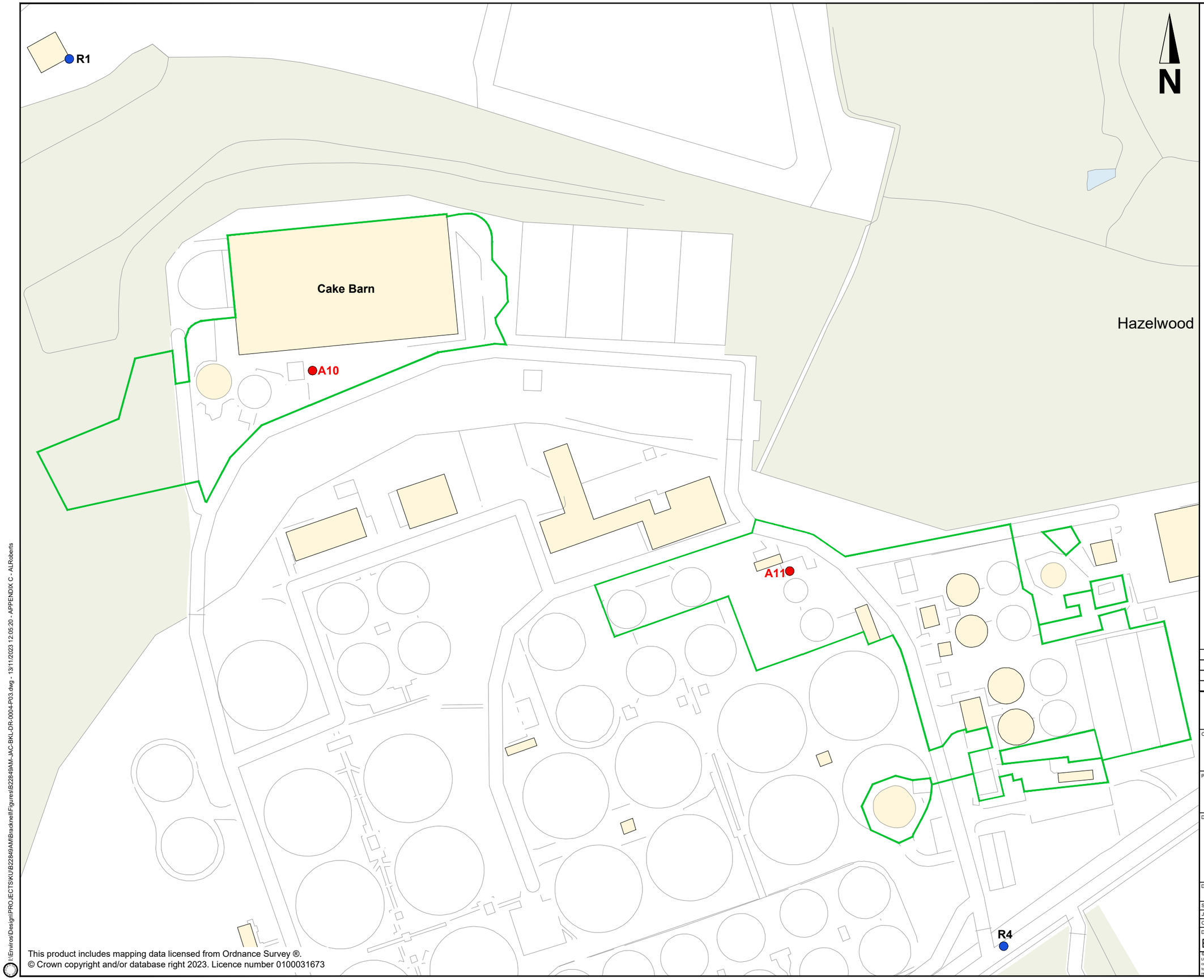
Drawing title: APPENDIX B
POTENTIAL BIOAEROSOL
EMISSION POINTS

Drawing status: PERMITTING

Scale	1:1250	DO NOT SCALE
Jacobs No.	B22849AM	Rev P03
Client no.		

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

Appendix C. Receptors within 250m of potential emission points



KEY:

- Installation Boundary
- Air Emission Point
- Receptor Point

A10 - OCU2
A11 - OCU1

R1 - Ryehurst Lane
R2 - Hazlewood Lane

0 20 40 60
METRES

P03	NOV 2023	FOR INFORMATION	AR	HEK	JK	MM
P02	AUG 2023	FOR INFORMATION	AR	HEK	JK	MM
P01	JUL 2022	FOR INFORMATION	AR	HEK	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Project: STC IED PERMIT
BRACKNELL STW

Drawing title: APPENDIX C
RECEPTORS WITHIN 250m
OF EMISSION POINTS

Drawing status: PERMITTING

Scale	1:1250	DO NOT SCALE
Jacobs No.	B22849AM	Rev P03
Client no.		

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