East Hyde STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
EPR/TP3505MK/A001

IED STC Permitting
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1. Introduction

The purpose of this Bioaerosols risk assessment is to provide supplementary information to support the permit application for a bespoke installation permit for the East Hyde Sludge Treatment Centre (STC) at East Hyde Sewage Treatment Works (STW), EPR/TP3505MK/A001.

1.1 Site description

The STW is an elongated site, positioned approximately northwest to southeast. The site is located adjacent to the River Lea in a rural area, approximately 4.5 km south-east of the town of Luton. Immediately to the west of the site is the Upper Lea Valley Way shared footpath and part of National Cycleway, followed by agricultural fields. To the north is woodland and part of the River Lea. To the east is the River Lea, the B653 Lower Harpenden Road, a single carriage road and undeveloped green space. A railway line runs north to south beyond this and is approximately 120m away from the site boundary (at its closest point). To the south is further woodland and agricultural fields. The East Hyde STW is split in two by the West Hyde Road, a public road that crosses from west to east outside of the site perimeter; to the north is the works inlet and cess/waste import, while the southern side of the site contains the aerobic and anaerobic treatment assets including a cake barn and cake storage pad.

The nearest premises can be found to the west of the site entrance and adjacent to the site on the B653 and West Hyde Road, comprising residential dwellings, a farm, and a garden centre. A row of houses also borders the southeast of the site. A public footpath runs along the western perimeter of the site. There are a handful of residences close to the inlet to the site, and several cottages below the outfall, which were formerly owned by Thames Water.

The area of the site to the north of West Hyde Road is nearly entirely within a Flood Zone 3 indicating there is a high probability of flooding (having a 1 in 100 or greater annual probability of river flooding). The southern area of the site predominantly sits within a Flood Zone 1 area (>1:1000 annual probability of river flooding), although small areas of the STW are within a Flood Zone 2 or 3. All of the biological treatment assets are within Flood Zone 1, indicating there is a low probability of flooding in this area. The site is not within an Air Quality Management Area (AQMA) or a Source Protection Zone (SPZ). There are no Special Areas of Conservation (SACs), Marine Protection Areas (MPAs), Special Protection Areas (SPAs) or Ramsar sites within 10 km of the site. There are no Local Nature Reserves (LNRs) or Site of Special Scientific Interest (SSSI) within 2 km of the site. Priority Habitats (coastal and floodplain grazing marsh) and deciduous woodland are adjacent to the southern and western site boundaries. There are ten areas of Ancient Woodland within 2 km of the site, with Graves Wood Ancient and Semi-Natural Woodland representing the closest such site approximately 430m to the West of the East Hyde STW. There are twenty non-statutory designated Local Wildlife Sites (LWS's) within 2 km of the site, the closest of which is located adjacent to the East Hyde STW associated with the River Lea.

The address of the installation is:

East Hyde Sludge Treatment Centre;

East Hyde Sewage Treatment Works,

West Hyde Road,

New Mill End,

Luton,

Bedfordshire,

LU1 3TS

1.2 Site Activities

East Hyde STC is located at the East Hyde STW, Bedfordshire, 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):

- 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 dewatering.
- Dewatering of digested sewage sludge.
- Transfer of dewatering liquors via site drainage back to the head of the sewage treatment works.
- Transfer of surface water runoff via site drainage 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 MCPD and SG compliant biogas CHP engine and boiler.
- Transfers of biogas condensate via site drainage back to the head of the sewage treatment works.
- Storage of raw materials.
- Storage of fuel oil.
- Storage of waste; and
- Operation of biogas flare stack.

The STC can treat up to 1,130,000m^3 of sludge per year (equating to approximately 1,130,000 wet tonnes). The STC has a total maximum treatment input of 350m^3 per day (equating to approximately 350 wet 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 is one Odour Control Unit (OCU) linked to specific tanks or processes which produce potentially odorous air. This unit treats 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 engine 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 and emergency 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 East Hyde STC is within 250m of sensitive receptors, as defined by M9. These are detailed in Section 2.5 of this report.

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

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 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 East Hyde STC 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, 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 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 East Hyde STC, which meets the M17 guidance, only the storage of sludge cake, the handling of sludge cake (movement into storage and during export) and wind scouring of waste surfaces 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 East Hyde 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, 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 de-gritting, before separation of sludge from the main flow in the Primary Settlement Tanks (PSTs). Settled sludge is transferred to the anaerobic digestion process, following thickening in the Picket Fence Thickeners (PFTs).

Sludge may also enter the process via tanker transfer from other TWUL sewage treatment works. These imports are transferred by sealed pipeline from tankers into a Sludge Import Tank within the process.

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.

Digested sludge cake can also be imported to the Cake Pad from other STWs via lorries.

2.2.2 Waste Treatment

The waste treatment process of the sludge covered by this permit, starts at the two covered PFTs, which thicken sludge separated from the main flow from the PSTs. Surplus Activated Sludge (SAS) from elsewhere in the UWWTD Process is thickened in SAS Thickening Plant with the use of a polymer coagulant.

The thickened sludge is then directed to one covered Sludge Blending Tank, where it is mixed with thickened SAS and any imported sludge from satellite works. The Sludge Import Tank is odour abated and connected to an OCU. Two Contingency Storage Tanks are located between the PFTs and Sludge Blending Tank. These tanks are subsurface and of concrete construction with pipework that can be configured to store sludge from either the PFTs or from the Sludge Blending Tank. The covered Sludge Blending Tank is connected to the OCU.

From the Sludge Blending Tank, sludge transfer pumps transfer the sludge to a Digester Feed Buffer Tank where anti foam is dosed in, prior to the sludge being transferred to one of the three Primary Digester Tanks. All three Primary Digester Tanks are of the same glass coated steel construction with an insulating external layer, have fixed roofs, are surrounded by made ground. There are three Secondary Digester Tanks which operate in series with sludge gravitating from Secondary Digester Tank1, to Secondary Digester Tank2 and finally Secondary Digester Tank3. The Secondary Digester Tanks are all open tanks, that are of concrete construction and mainly subsurface.

Fully digested sludge is then transferred to the Sludge Dewatering Buffer Tank and then to the Sludge Dewatering Plant where digested sludge is dewatered, prior to cake maturation.

Biogas is generated within the Primary Digester Tanks. There is one double membrane Biogas Storage holder at East Hyde for storage of biogas, which is equipped with dual Pressure Relief Valves (PRVs) as a safety precaution in the event of over pressurising the system. The above ground biogas transfer pipeline is equipped with condensate pots that capture entrained moisture from the generated biogas and allow it to be drained into the site drainage system for treatment. This improves the quality of the biogas and reduces impurities that could reduce the efficiency of the CHP engine.

Biogas is transferred for use in either the CHP engine, boiler, or emergency flare. A slam shut valve is present on the main biogas line, which would automatically isolate the Biogas Storage holder in the event of an emergency situation. A siloxane filter is located upstream of the CHP engine on the biogas line to remove impurities from the biogas prior to combustion in the CHP engine. Use of siloxane filters reduces incidence of operational issues for the CHP engine. There is one CHP engine on site, located within the boiler house and it receives biogas for combustion, generating electricity and recoverable heat. In the event there is excess biogas, i.e., more than the CHP engine or boiler can utilise, or in the event that the CHP engine or boiler is unavailable, there is a ground mounted emergency flare. This is utilised under 10% of the year, less than 876 hours per year.

Odorous air from the Sludge Import Tank and the Sludge Blending Tank is continuously extracted to an OCU. The air is treated within the OCU to remove odour and bioaerosols in a two-stage process using a biofilter followed by activated carbon, before it is released to the atmosphere. The configuration of this unit means that bioaerosols associated with the biofilter are captured by the activated carbon.

2.2.3 Digested cake

Dewatered digested sludge cake is carried by a conveyor. Conveyors are covered to minimise the risk of cake escaping. The cake is deposited from the conveyor onto the storage bay surface from a distance of approximately 2m. This height allows the operation of the conveyor to be continued without requiring immediate removal of cake into stockpiles on the cake pad. The moisture content in the cake prevents it drying out and the cake forms a crust after 24 hours in storage, so does not give rise to dust readily. Sludge cake is stored on the cake pad below the level of the surrounding walls. There is also a cake barn within the installation boundary, used for storage of sludge cake.

The cake is transferred onto trucks using an excavator and loading shovel and removed off site for agricultural land spreading or transferred to the cake barn for storage.

Digested sludge cake from other STCs can also be imported for temporary storage at East Hyde STC prior to removal from the site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). This is intended to provide contingency storage in the event of spreading to land being temporarily unavailable.

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

However, cake 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 BAS and Sludge Use in Agriculture Regulations (1989), as well as the Farming Rules for Water. As such, 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 cake within the storage bays during the autumn and winter, under normal conditions, than during the summer period.

2.3 Potential Sources

There are eight 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	Auxiliary Boiler 1	X
A3	Emergency Flare	X
A4	Biogas Storage PRV	X
A5	Primary Digester Tank PRV	X
A6	Primary Digester Tank PRV	X
A7	Primary Digester Tank PRV	X
A8	OCU 1	✓

The Cake Pad and Cake Barn are illustrated in Appendix B. These are additional sources for consideration of bioaerosol releases to atmosphere.

2.3.1 Source Assessment

The CHP engine, boiler and emergency flare (points A1 – A3) 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.

There is one OCU (point A8) serving the STC, and connected to the Sludge Blending Tank, and the Sludge Import Tank. The OCU is a two stage biofilter and scrubber system. Extracted air from the tanks is passed through the support media, within the biofilter, while water is irrigated from above. The microbes on the support media, remove potentially odorous contaminants and the partially treated air from the bio-trickling filter is passed to Activated Carbon adsorbers to achieve a stack emission standard of <= 1000 $OuEm^3$ at the outlet. Treated air discharges via the stack. The configuration of the OCU 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 PRVs (points A4 – A7) 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 an unchanneled potential release from treated, dewatered sludge cake which is transferred via covered conveyor and deposited on the cake pad or taken to a semi enclosed cake barn.

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 conveyor and cake pad and cake barn (as shown in Appendix B). However, the sludge cake is likely to have low concentrations of bioaerosols as a result of the treatment processes and is moist on deposition from the conveyor to the pad. 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.**

East Hyde also has a semi enclosed cake barn, used for sludge cake storage. The cake is less exposed to the elements, therefore reducing the effectiveness of dispersion when handled for export, from this location.

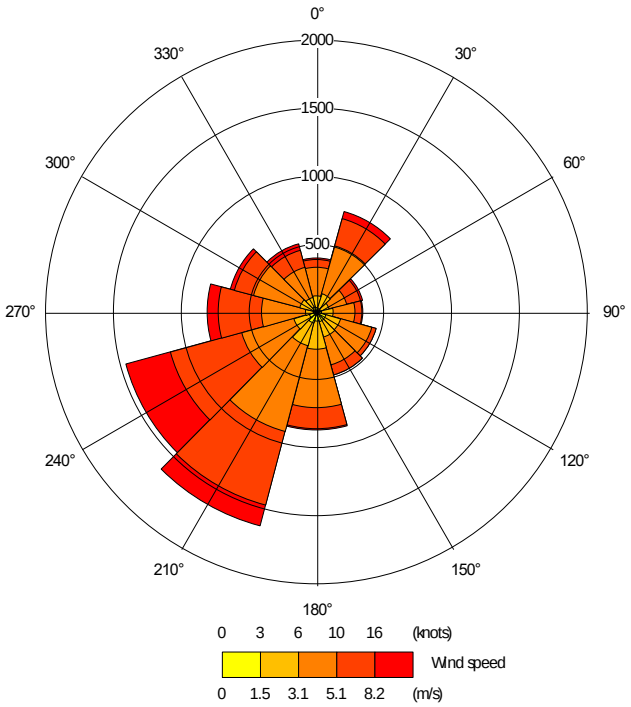
In addition, storage tanks (with the exception of the Secondary Digester Tanks, Sludge Dewatering Buffer Tank and one Contingency Storage Tank), treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered with metal plates. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations which are temporary and unlikely. The two-stage bio-filter process fitted to the OCU, and the maintenance of this asset makes the probability of exposure from this source as **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, Luton airport (located approximately 2.8 km North of the Site centre), 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. The East Hyde STC and surrounding area has a relatively flat topography. The site is surrounded by mature trees that provide some screening, particularly along the southern and western boundaries.

Figure 1 – Luton 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.

At present, Thames Water do not have quantitative data 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 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

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

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. An additional receptor (R9) to the OMP has been included for this assessment. 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
R1	Residential	OCU (A8)	114	North
		Cake Pad (conveyor)	172	North-east
		Cake Barn	153	East north-east
R5	Residential	Cake Barn	47	North north-west
		Cake Pad (conveyor)	185	North north-west
R8	Garden Centre	OCU (A8)	219	North north-east
		Cake Barn	241	North-east
R9	Residential	OCU (A8)	230	North-west
		Cake Pad (conveyor)	153	North north-west
		Cake Barn	24	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 three potential sources of bioaerosols release within 250m of static receptors:

- Cake Pad (conveyor).
- Cake Barn.
- Odour Control Unit (A8).

The receptors within 250m of potential bioaerosol emission points are situated at all quadrants of the compass in relation to the potential bioaerosol emission sources. The prevailing wind direction is from the Southwest. Whilst the receptors are not all situated immediately down-wind of these sources, there is potential for wind-borne transportation of bioaerosols. The risk of bioaerosols being generated from the permitted processes on site is, however, low.

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

The maximum daily throughput of sludge is 350m^3/day.

Digestate sludge cake is stored predominantly on the Cake Pad. The closest downwind receptor (R1) is approximately 172m from the closest boundary of the Cake Pad. Mature vegetation bounds the Cake Pad and also the B653 (in front of R1), providing natural screening when in leaf (particularly during the warmer, drier months) when wind borne transmissions are more likely. Re-suspension of entrained cake from the loading shovel's tyres is low given the daily addition of moist sludge cake onto the pad.

R9 is <30m from the Cake Barn storage area and is the closest receptor to this potential emission source. The Cake Barn has a roof and high walls (but is not enclosed) and offers some screening from the elements. The closest receptors are also not downwind and therefore at a lower risk of impacts from source emissions during handling.

Pre-digestion storage tanks, treatment tanks and associated pipework are enclosed. Secondary Digester Tanks, the Sludge Dewatering Buffer Tank and one Contingency Storage Tank are not enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to an OCU. There is one type of odour control, a two-stage biofilter and activated carbon scrubber. 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 risk is reduced to **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
Digestate Cake Pad (Conveyor)	Inhalation via wind-borne transportation	R1, R5, R9	Receptors downwind are >170m. The site is surrounded by mature vegetation, more densely to the south and west. This would offer screening during the seasonal months, when the optimum weather conditions for air borne transmission (sunshine, dry, windy, warm temperatures) would be more likely. The closest receptor (R9) is upwind and >150m from the source. The sludge cake is damp on release from the conveyor, therefore less likely to be affected by wind blow. Resuspension of bioaerosols due to movement of sludge cake to the storage areas on the Pad would require significant drying time and specific weather conditions. 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).	The cake conveyors are covered, reducing likelihood of bioaerosol release. The cake conveyor drop heights are minimised to reduce wind borne transportation. Water content in the cake reduces susceptibility of wind-borne releases. Digested sludge cake is moved when required to minimise disturbance on the pad. The cake stockpile levels are managed so that under normal operating conditions it does not exceed the height of the surrounding bund wall. Weather conditions are checked prior to any movement of material if conditions are favourable to dust / bioaerosol transmission (dry, wind speeds >6mph, temperature is favourable).	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
Cake Barn	Inhalation via wind-borne transportation	R1, R5, R8, R9	Receptors downwind are >150m from the source boundary. The closest receptors are upwind and frequency of wind directions from the east is relatively small in relation to other directions. The semi enclosed nature of the structure further reduces the likelihood of wind-blown transmissions. Mature vegetation offers screening along the site boundary between source and closest receptors. 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).	Once deposited in the Cake Barn pad, the digested sludge cake is not disturbed until it is exported offsite. Barn construction reduces potential for wind-blown releases. The cake stockpile levels are managed so that under normal operating conditions it does not exceed the height of the surrounding bund wall. Re-suspension of cake dust / bioaerosols during loading for export is minimised by the moisture content of the sludge cake.	Low
Odour Control Unit	Inhalation via wind-borne transportation	R1, R8, R9	The closest receptor (R1) is approximately 114m away and downwind (of prevailing SW'ly wind direction). Mature vegetation surrounds the site boundaries, offering some screening.	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. The OCU is a two stage unit, with the final state being an activated	Very 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
			Other receptors downwind are >215m away. Probability of exposure from A14 is considered to be **low**		carbon absorber, which is designed to achieve a stack standard of <= 1000 $OuEm^3$. 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.	

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 digesters 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 East Hyde 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 small number of potential sources of bioaerosols within the site processes have been identified, connected to the storage and movement of treated digestate sludge cake at the site and the operation of the 2-stage bio-filter odour control unit. 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 to the identified, receptors within 250m of potential bioaerosol sources associated with the sludge treatment process is considered to be **Low** based on the receptor distances, 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 the following locations and will sample the OCU on a bi-annual basis:

- OCU 1 (A14) TL 12216 17911

In addition, sampling will also take place in relation to TL 12034 17955 and TL 12131 17811 (approx. NGR of centre of cake barn and cake pad respectively) which are diffuse sources and hence will be monitored purely by agar plates.

Downwind samples will tend to be towards the east of the site, as the prevailing wind is from the South-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
OCU1	TL 1218 1787	TL 1223 1802	TL 1228 1800	TL 1232 1795

*Location points may require to be changed due to the presence of existing structures making access unsafe or impractical

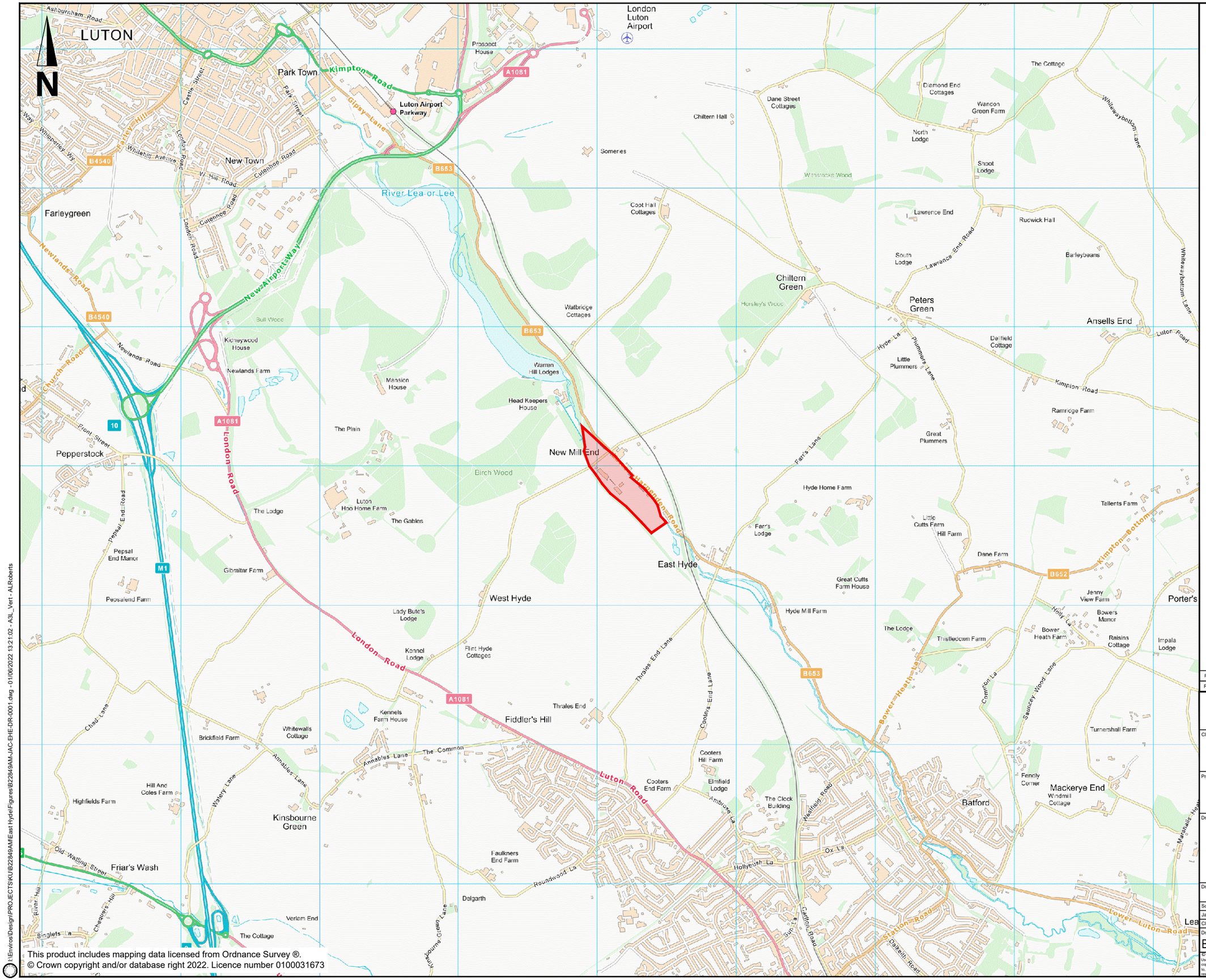
Cake Barn:
Upwind sample location which is approx. 50m SW of the cake barn: NGR TL 1200 1791
Downwind sample location 1 which is approx. 24m N of the cake barn: NGR TL 1203 1797
Downwind sample location 2 which is approx. 24m NE of the cake barn: NGR TL 1204 1797
Downwind sample location 3 which is approx. 24m E of the cake barn: NGR TL 1205 1796

Cake Pad:
Upwind sample location which is approx. 50m SW of the cake pad: NGR TL 1210 1777
Downwind sample location 1 which is approx. 153m N of the cake pad: NGR TL 1215 1796

Downwind sample location 2 which is approx. 153m NE of the cake pad: NGR TL 1222 1793
Downwind sample location 3 which is approx. 153m E of the cake pad: NGR TL 1227 1786

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

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

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Client: Thames Water

Project: STC IED PERMIT
EAST HYDE STW

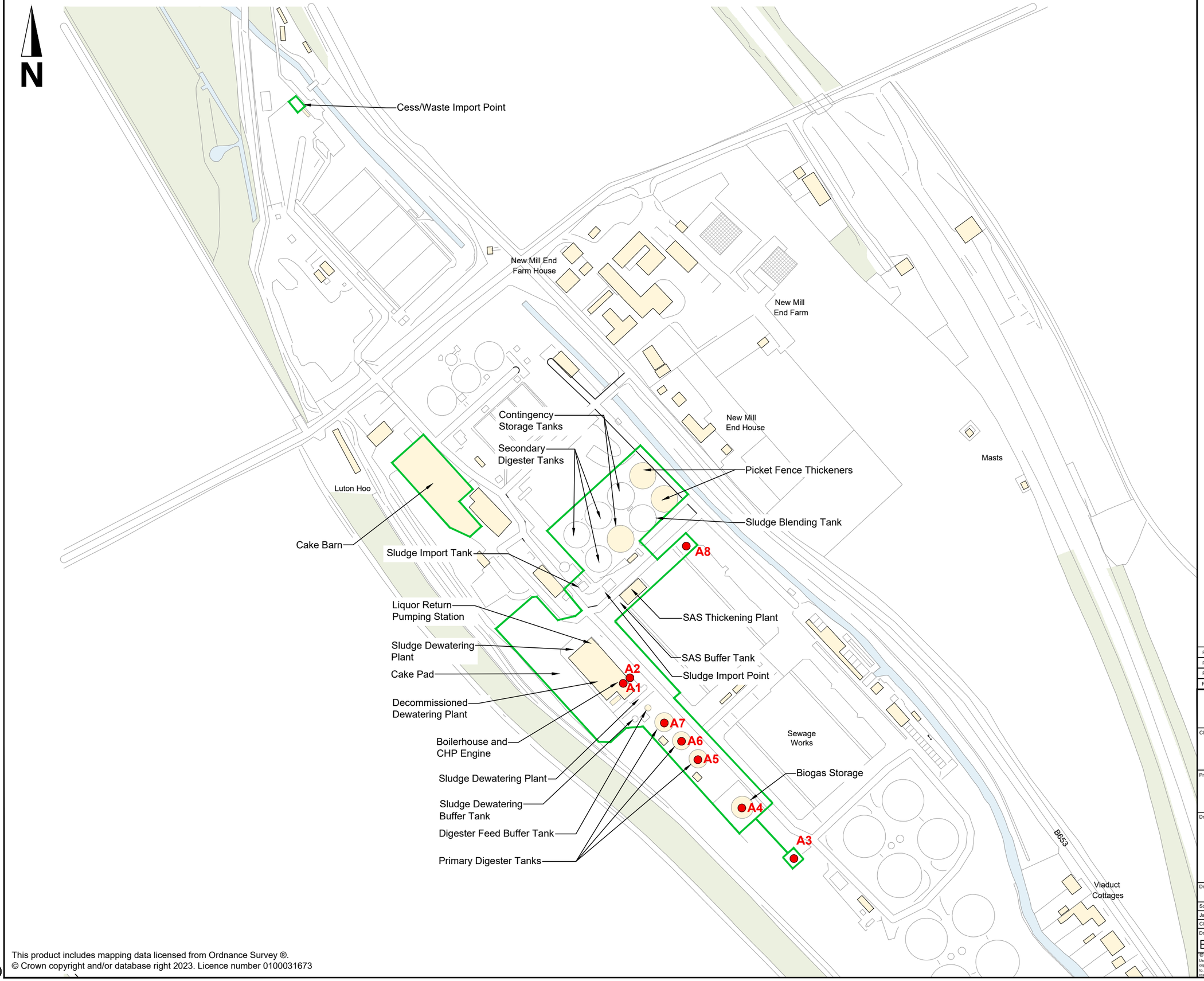
Drawing title: APPENDIX A
SITE LOCATION PLAN

Drawing status: PERMITTING

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

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

Appendix B. Installation Boundary and Air Emission Points



KEY:

Installation Boundary

Potential Bioaerosol Emission Sources

A1 - CHP Engine
A2 - Auxiliary Boiler 1
A3 - Emergency Flare
A4 - Biogas Storage PRV
A5 - Primary Digester Tank PRV
A6 - Primary Digester Tank PRV
A7 - Primary Digester Tank PRV
A8 - OCU 1

0 20 40 60 80 100
METRES

P03	NOV. 2023	FOR INFORMATION	AR	JK	JK	MM
P02	JAN. 2023	FOR INFORMATION	AR	SK	JK	MM
P01	JUN. 2022	FOR INFORMATION	AR	SK	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
EAST HYDE STW

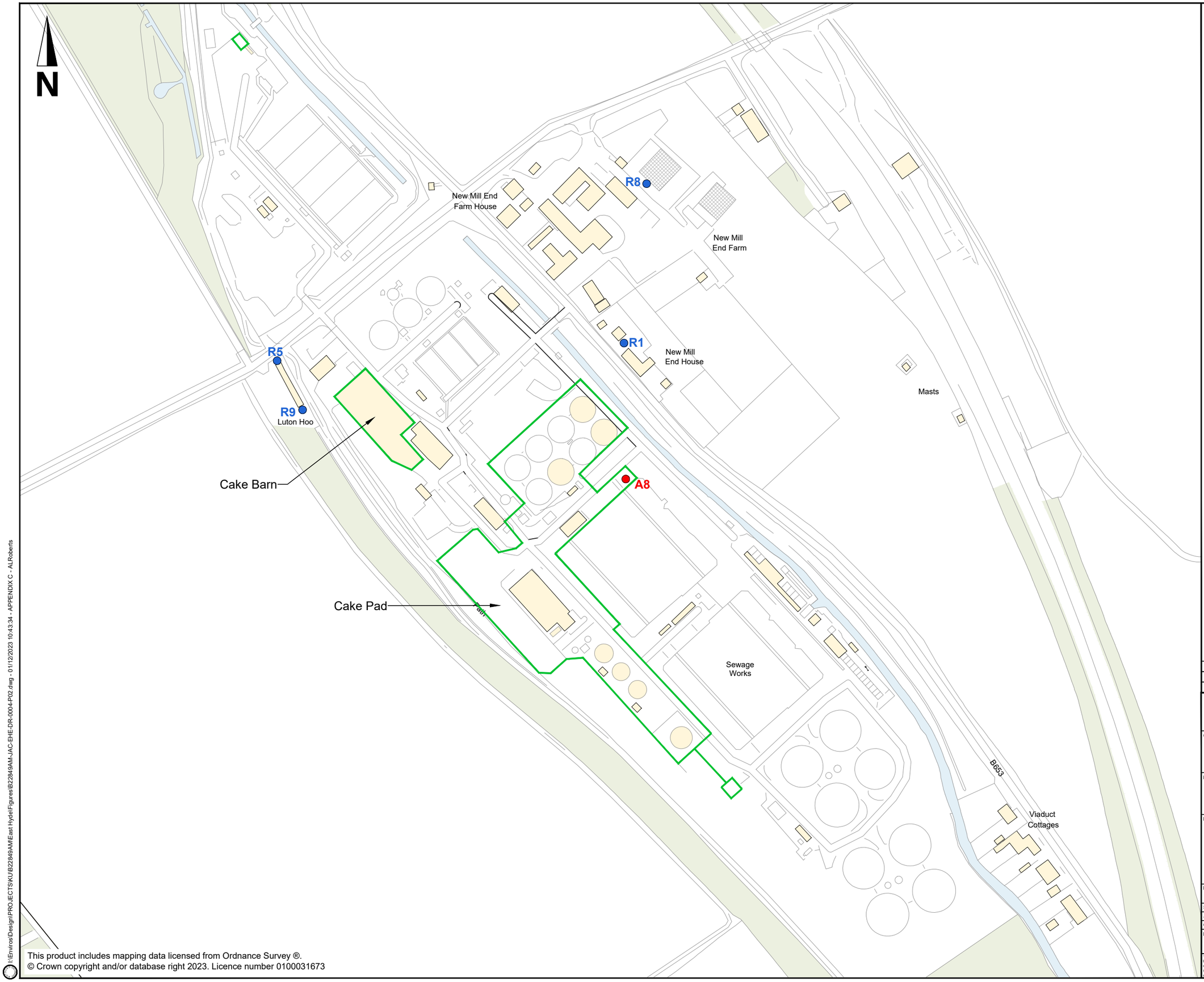
Drawing title: APPENDIX B
POTENTIAL BIOAEROSOL EMISSION SOURCES

Drawing status: PERMITTING

Scale	1:2500	DO NOT SCALE
Jacobs No.	B22849AM	Rev P03
Client no.		

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

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



KEY:

- Installation Boundary
- Air Emission Point
- Receptor Location

A8 - OCU 1

0 20 40 60 80 100
METRES

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

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Client: Thames Water

Project: STC IED PERMIT
EAST HYDE STW

Drawing title: APPENDIX C
RECEPTORS WITHIN 250m OF POTENTIAL BIOAEROSOL EMISION SOURCES

Drawing status: PERMITTING

Scale	1:2500	DO NOT SCALE
Jacobs No.	B22849AM	Rev P02
Client no.		

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