Didcot STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
EPR/ AP3542QE/A001

IED STC Permitting
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Jacobs U.K. Limited

7th Floor, 2 Colmore Square
38 Colmore Circus, Queensway
Birmingham, B4 6BN
United Kingdom

T +44 (0)121 237 4000
www.jacobs.com

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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 Didcot Sludge Treatment Centre (STC), EPR/AP3542QE/A001.

1.1 Site description

The Didcot STC is located within a suburban area of Didcot, Oxfordshire with commercial and industrial premises located on all sides. The nearest sensitive receptors are commercial premises located approximately 20m to the south and include a distribution warehouse. The nearest residential dwellings are static homes at approximately 180m to the south of the site.

The permitted area of the site sits within Flood Zone 1 (<1:1000 annual probability of flooding), although is bordered to the North by Flood Zone 2 (area with medium risk of flooding, with between a 1:100 and 1:1,000 annual probability of river flooding) and Flood Zone 3 (area with high risk of flooding indicating a 1:100 or greater annual probability of river flooding) associated with a prominent drainage ditch, which runs parallel to the northern boundary.

The site sits outside the boundaries of a Source Protection Zone (SPZ). The site is not located within or in close proximity to an Air Quality Management Area (AQMA) with the nearest AQMA (Abingdon AQMA) located approximately 5.7km to the North of the site.

The nearest designated habitat to Didcot STC is the Little Wittenham SAC, which is located approximately 4.8 km to the East of the site. The nearest LNR, namely Mowbray Fields, is located in excess of 2 km from the site and the nearest SSSI is Little Wittenham, also located in excess of 2 km from the site. There are no SPA, MPA or Ramsar designated sites within 10 km of the site.

There are also no LNR, NNR or LWS located within 2 km of the Didcot STW.

There is one area of Ancient Woodland within 2 km of the site, comprising an un-named Ancient and Semi-Natural Woodland located approximately 1km to the North-East of the Didcot STW.

There are no protected habitat or species records within the specified screening distance (within 500m) of the site.

The address of the installation is:

Didcot Sludge Treatment Centre
Didcot Sewage Treatment Works
Basil Hill Road,
Didcot,
Oxfordshire,
OX11 7HJ.

1.2 Site Activities

Didcot Sludge Treatment Centre (STC) is located at the Didcot Sewage Treatment Works (STW) and is 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 Wastewater Treatment directive regulated works.

There are a number of directly associated activities at the site.

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

- Imports of waste, including sludge from other sewage treatment works for treatment;
- 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 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;
- Transfer of biogas condensate via site drainage back to the head of the sewage treatment works;
- Combustion of biogas or natural gas in boilers;
- Operation of a ground mounted flare;
- Storage of wastes; and,
- Storage of raw materials.

The waste activities at the site are the imports of waste to the works inlet for treatment through the UWWTD route and the imports of digested sludge cake for temporary storage pending off-site removal.

The STC can treat up to 280,000m^3 of sludge per year (equating to approximately 280,000 wet tonnes). The STC has a total maximum treatment input of 217 m^3 per day (equating to approximately 217 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 are two Odour Control Units (OCUs) linked to specific tanks and processes which produce potentially odorous air. The units treat the air through a variety of means, including use of biofilters and carbon filters.

The anaerobic digestion process gives rise to biogas, a mixture of biomethane and carbon dioxide, in a mixture with trace components. This biogas is combusted through the site's boilers, with excess biogas being subject to emergency 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 boilers and emergency flare can handle.

1.3 Regulatory requirements

The STC 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 Didcot STC 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.

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

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

1.4.1 High Risk Activities

The M17 guidance document, in section 3.3.3, outlines a number of potential sources and release mechanisms of particulate matter, including bioaerosols from waste management facilities. These potential sources are not graded for importance within M17 and include: the movement of waste to and from the 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 bioaerosols release at Didcot STC, which meet the M17 guidance, only the storage and handling (movement on the Cake Pad and during export) of sludge cake would apply. There is no shredding of waste or turning of stockpiles as part of the management process and all sewage waste is contained and received via pipes.

1.4.2 Relevant Thresholds

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

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

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

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

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

2. Bioaerosol risk assessment

2.1 Introduction

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health at sensitive receptors within the relevant distance from operations at the Didcot 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, via tanker transfer, is imported to the STW and discharge via a site supplied transfer hose to the Works Inlet, 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. Primary sludge and SAS is transferred for thickening and blending.

There is a second import point at Didcot STC for permitted imports of sludge from other sites via an offloading point consisting of a data logger and transfer hose. Waste is discharged directly into the Sludge Import Tank. Imported sludge is screened and pumped to the Sludge Blending Tank where it combines with indigenous sludge.

If a sludge spillage occurs, spill kits are available on site and staff are trained in their use

2.2.2 Waste Treatment

The treatment process of the sludge covered by this permit is for the anaerobic digestion of sludges within two Primary Digester Tanks. The treatment process begins within the Picket Fence Thickener (PFT) Tanks and SAS Thickening Plant, which receives the separated sludge from the aerobic treatment process, before the sludge is thickened.

Thickened sludge from the PFTs and thickened SAS from SAS Thickening Plant, is pumped to the Sludge Blending Tank where it is mixed with imported sludge from other works and fed to one of the two Primary Digester Tanks. Biogas from the Primary Digester Tanks is collected and transferred to the site Biogas Storage holder and used to fuel the boilers or combusted in an enclosed flare. Odorous air from is continuously extracted to Odour Control Units. The air is treated within the OCU to remove odour and bioaerosols through a biofilter or an activated carbon filter followed by its release to the atmosphere from a discrete stack.

Following digestion, sludge is transferred under gravity to three aboveground Secondary Digester Tanks and is then pumped to the Dewatering Feed Buffer Tank, after which it is pumped to the Sludge Dewatering Plant for dewatering. The Secondary Digester Tanks and the Dewatering Feed Buffer Tank are not covered but do not give rise to significant volumes of biogas as the sludge has been subject to an appropriate digestion duration within the Primary Digester Tanks. The waste within these tanks is below the level of the tank, providing a freeboard distance which reduces the effect of wind scouring and emissions of bioaerosols from this source.

The Sludge Dewatering Plant is located within the enclosed Digested Sludge Press House, and the digested sludge is dewatered, with the digested sludge cake conveyed away from the Sludge Dewatering Plant and deposited onto a concrete surface within a walled storage Cake Pad, where it is stored prior to removal offsite for application to land.

2.2.3 Digested cake

Dewatered digested sludge cake is carried by a covered conveyor from the Digested Sludge Press House and deposited on a concrete surface on the walled storage pad. The conveyor is covered to minimise the risk of the digested sludge cake escaping or being windblown. The cake is deposited from the conveyor onto the 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 from under the conveyor to other parts of the pad. Cake is generally stored in one of the three storage bays, below the level of the surrounding walls which reduces the effect of wind scouring and left to form a crust.

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

2.2.4 Odour Control Units

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

Under the M9 guidance documents, the Environment Agency has identified that biofilters may give rise to bioaerosols during operation. For completeness all OCUs with biofilters and within the permit installation boundary have been included in this assessment.

There is a total of two OCUs present at the Didcot STC, which provide odour abatement to a number of different tanks and pumping station within the treatment process.

2.2.5 Seasonality

Sewage treatment is undertaken at the STC on a continuous basis, 24 hours a day 365 days of the year. Digested sludge 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. 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, 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	Auxiliary Boiler 1	X
A2	Auxiliary Boiler 2	X
A3	Emergency Flare	X
A4	Primary Digester Tank PRV	X
A5	Primary Digester Tank PRV	X
A6	Biogas Storage holder PRV	X
A7	OCU 1	✓
A8	OCU 2	✓

The open Cake Pad and Conveyors is also illustrated in Appendix B and is an additional potential source for consideration of bioaerosols release to atmosphere.

2.3.1 Source Assessment

The boilers 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 are two OCUs (point A7 and A8) serving the STC, connected to the Sludge Import Tank, Screen Sludge Pumping Station, Sludge Import Buffer Tank, Sludge Blending Tank and PFTs. OCU 1 is a biofilter, with the extracted air from the tanks and dewatering plant passed through the support media, which is calcified seaweed, within the biofilter while water is irrigated from above. OCU 2, which serves PFT 2 only, is an activated carbon filter. The microbes on the support media, remove potentially odorous contaminants and the partially treated air discharges via the stack and biofilters are considered to be a potential emission source for bioaerosols.

The Pressure Relief Values (PRVs) (points A4 – A6) are normally closed and do not emit to atmosphere. However, in the event of an abnormal situation such as the failure of the boilers and/or flare stack, the PRVs 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 digested sludge 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 uncovered cake pad.

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. It is managed to control row height and arrangement and is moved by shovel loading vehicle, as required to stockpiles within the designated walled storage bays. There is the potential for entrainment and resuspension of material from via vehicle tyres as the cake is handled. As the digested sludge

cake requires no further treatment before being deposited on agricultural land it is therefore likely to have a low concentration of bioaerosols and the probability of exposure from this source is medium.

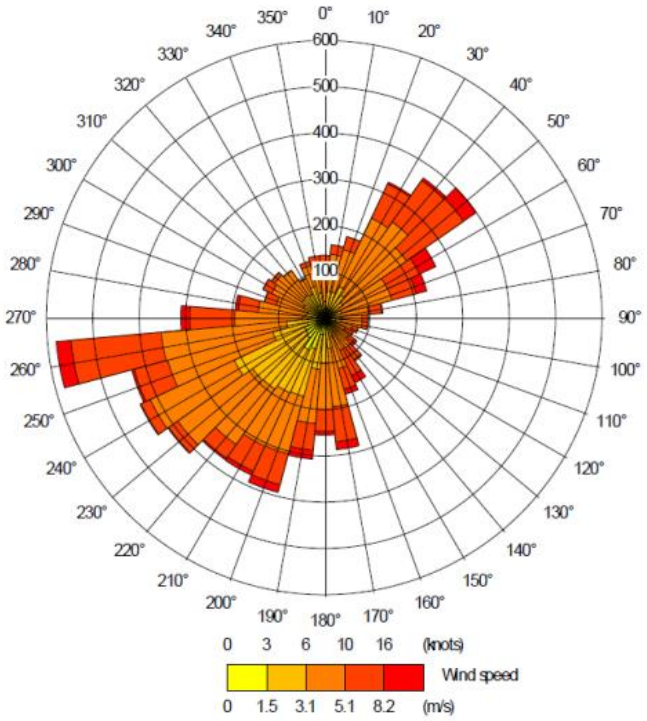
In addition waste treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered. Sludge screening and dewatering takes place in enclosed tanks and units that are located within a building. In addition, the PRVs are only open in abnormal 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 receptor. The 2019 wind rose for a representative meteorological site, Lyneham AB /Lyneham RAF Airbase (located approximately 50 km south-west of the Site), is shown in Figure 1.

The wind rose data shows that the site experiences West southwest to Southwest prevailing winds, predominantly in excess of 6 knots. The Didcot STC and surrounding area has a relatively flat topography. The site is bound by mature trees/ hedgerow along its northern, western and eastern boundary and parts of its southern boundary are heavily screened by dense vegetation.

Figure 1 – Heathrow Airport Wind rose (2019)



As a result 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

[5] RR786 - Bioaerosol emissions from waste composting and the potential for workers' exposure https://www.hse.gov.uk/research/rrhtm/rr786.htm

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.

There are a number of potentially sensitive receptors found within 250m of potential bioaerosol emission sources at the site. As demonstrated in the site plan found in Appendix C, these receptors are found on all sides of the site.

The areas of sensitive receptors have been identified below in Table 2 based on their location and receptor type. For each of these areas, the distance and direction from each potential bioaerosol emission source to the closest sensitive receptor within the area has been identified. Where multiple assets exist for the same process, such as the cake barn, only the closest location has been presented. The receptor closest to a potential emission source are the commercial buildings south of the STC, which is located approximately 8m east of the open cake pad.

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

Receptor	Description	Source	Distance from closest source (m)	Direction from the Source
R1	Pedestrians on Collect Way footpath*	Cake Pad / conveyors	8m	East
		Primary Digester Tank PRVs	15m	East
		Biogas Storage holder PRV	35m	East
		OCU 2	130m	East
R2	Southmead Industrial Estate (south) – Retail distribution warehouse -	Cake Pad / conveyors	185m	South-west
		Primary Digester Tank PRVs	130m	South-west
		Biogas Storage holder PRV	145m	South-west
		OCU 1	20m	South
R3	Southmead Industrial Estate (east) – Distribution warehouse	Cake Pad / conveyors	50m	East
		Primary Digester Tank PRVs	75m	East
		Biogas Storage holder PRV	105m	East
		OCU 2	190m	East
R4	Southmead Industrial Estate (north) – Industrial units	Cake Pad / conveyors	100m	North
		Primary Digester Tank PRVs	210m	North
		Biogas Storage holder PRV	185m	North

Receptor	Description	Source	Distance from closest source (m)	Direction from the Source
		OCU 2	195m	North
R5	Southmead Industrial Estate (west) – Industrial site	Cake Pad / conveyors	215m	West
		Primary Digester Tank PRVs	175m	West
		Biogas Storage holder PRV	180m	West
		OCU 1	80m	North-west
R6	Thames Valley Network Rails	Cake Pad / conveyors	190m	East
		Primary Digester Tank PRVs	200m	East
		Biogas Storage holder PRV	225m	East
R7	Foxhall Residential Park	Primary Digester Tank PRVs	235m	South
		OCU 1	185m	South

*The relevant receptor here would be pedestrians and recreational users of the footpath. They are unlikely to be present for >6hours in one location.

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 to help determine the magnitude of the risk associated with bioaerosol emissions from a facility.

There are three potential sources of bioaerosol releases within 250m of static receptors:

- OCU 1
- OCU 2
- Cake pad / conveyors

The receptors are situated all around the site, but the closest receptors are to the East and South of release points and the prevailing wind is from the South-west. Receptor R1 is excluded from the scope of further assessment as it is not likely that human receptors would be present in one location for greater than 6 hours as they traverse the footpath adjacent to the STC.

Whilst not all of the receptors are situated immediately down-wind of these sources, there is potential for wind-borne transportation of bioaerosols with a medium probability of exposure at Receptors R3, R4 and R6 at down-wind locations.

Receptor R2 is 20m from OCU 1at the closest point although the vehicle loading operations that are more likely to result in human receptors being outside of the warehouse take place further west and south. While human receptors may work for more than six hours in these areas the potential for exposure to bioaerosols is reduced as receptors are not likely to work within the same area at all times, the warehouse buildings provide shielding from this exposure and receptors are likely to be upwind of the potential source.

Receptor R3 is also distribution warehouses that are downwind of the potential sources of bioaerosols and are protected by a continuous stand of vegetation meaning screening may reduce the concentration of the release. Receptor R6 is also in a downwind location of potential sources of bioaerosols and a greater distance away than Receptor R3 with the same vegetation screening provided.

Receptors R4 and R5 are industrial sites that are up-wind of potential sources and a greater distance from potential sources meaning that a dilution effect will reduce the concentration of any potential release.

Receptors R7 are residential properties that are not directly downwind of the potential sources and separated by a large, dense area of vegetation and on the upper limits of the recommended screening distance. While human receptors are likely to be present for more than 6 hours, these mitigations will reduce the concentration and likelihood of potential releases.

The daily throughput of sludge is 217 m3/day (equivalent to 217 wet tonnes per day). The bioaerosol content within the digested sludge cake is low following the sludge treatment processes. The fully digested sludge remains damp as it passes from the covered Conveyor onto the Cake Pad, thus minimising windblown transmissions. The sludge cake forms a crust after 24 hours in storage, so does not give rise to dust readily. The sludge cake is shovelled from the Conveyor deposits to storage areas within the Cake Pad and then left until it is disturbed for export, further minimising the potential to generate bioaerosols emissions to air.

The probability of exposure from bioaerosols generated from the permitted processes on site is considered to be Medium and the potential duration of release of bioaerosols varies from infrequent to frequent.

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

Planned monitoring of bioaerosol emissions by Thames Water is expected to validate the expectation that process contributions of bioaerosols from sewage sludge treatment works, would comply with the 'acceptable level' thresholds, set out within EA guidance. Table 3 summarises the risk assessment.

Table 5: Risk Assessment of Potential Bioaerosol 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
Cake Pad and conveyors	Inhalation via wind-borne transportation	R2, R3, R4, R5, R6	Receptor R3 is the closest receptor to the Cake Pad, approximately 50m East of the Cake Pad wall and further from the conveyor (70m). All other Receptors are 100m or more from the cake pad wall (at the nearest point). Receptors R3, R4 and R6 are within a downwind range of the cake pad but R2 and R5 are not. Receptors that are further away from the cake pad and upwind of the cake pad are likely to receive a lower concentration of bioaerosols in the event of a release. The concrete wall surrounding the Cake Pad and the vegetation between the Cake Pad and the receptors reduces the likelihood of wind-blown transmission during handling and export. The bioaerosol content is considered to be small in digested sludge cake. Due to the proximity the probability of exposure at the closest Receptor is considered to be **medium**. Exposure at other Receptors is **low**.	Impact on human health (considered to be a sensitive receptor).	The cake Conveyor is covered, reducing likelihood of bioaerosol release. The cake Conveyor drop heights and the drop heights from dozers handling the sludge cake are minimised to reduce the risk of wind borne transportation during deposition onto the Cake Pad, and via handling and movement around the Cake Pad or off site. The cake pad and each cake storage bay is enclosed on all sides by a low-level wall which protects it from the wind. Water content in the sludge cake reduces susceptibility of wind-borne releases. Stockpile levels are managed so that under normal operating conditions they do not exceed the height of the surrounding bund wall Sludge cake is moved only when required to minimise disturbance and does not occur every day. Spillages are cleaned up in a timely manner to reduce generating windblown bioaerosols or resuspension via vehicle movements.	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	Consequence (what is the harm that can be caused)	Managing the risk (Control Measures)	Overall / residual risk
Odour Control Units	Inhalation via wind-borne transportation	R2, R3, R4, R5, R7	Receptor R2 is the closest receptor, approximately 20m to the South of OCU 1 with some screening afforded by vegetation. Other receptors are greater distance from the OCUs. Receptor R5 is also within 100m of an OCU but is upwind of the potential source of bioaerosols. All other Receptors are greater than 100m from the potential source of bioaerosols from OCU 2. Due to the proximity the probability of exposure is considered to be **medium** at Receptor R2. Other receptors will have a reduced probability of exposure.	Impact on human health (considered to be a sensitive receptor).	The OCUs are maintained regularly by an agreed Framework contractor to reduce the likelihood of equipment failure. The OCUs and associated tanks are connected by enclosed pipework.	Low
Pressure Relief Valves (Primary Digester Tanks / Biogas Storage holder)	Inhalation via wind-borne transportation	R2, R3, R4, R5, R6, R7	Receptor R3 is the closest receptor to a PRV, approximately 80m east of the Primary Digester Tanks. However, release of bioaerosols from the PRVs would be considered an abnormal event and the probability of exposure is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	PRV's are closed under normal operating conditions. The valves are regularly monitored by visual inspections by the site operators. In the event of an abnormal situation requiring a PRV to open, biogas generation is reduced by reducing or inhibiting the digester feed.	Very Low

2.7 Abnormal Situations

In the event of plant failures or abnormal situations, an alarm would be raised on the Site Supervisory Control and Data Acquisition (SCADA) or telemetry systems, which will be reacted to by on-site or regional control room operators and Duty Managers. Depending upon the nature of the fault or emergency, where required, an operator would contact a mechanical or electrical technician, both of whom are on-call 24-hours, to attend site as soon as practicable.

If the on-call technicians are already engaged upon other response work, there is the facility to access staff from other TW geographic divisions, coordinated by the Duty Manager. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached. One such abnormal event would be failure of the flare stack and/or boilers. 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 and minimise the likelihood of a catastrophic failure 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 Didcot 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.

Three potential sources of bioaerosols within the site processes have been identified, connected to the storage and movement of treated digested sludge cake at the site and the operation of two Odour Control Units. The risk from abnormal releases from pressure relief valves is scoped out.

Although only qualitative data is available, the overall bioaerosol risk to the identified, potential, receptors within 250m of potential bioaerosol sources associated with the sludge treatment process is considered to be a 'Low' or 'Very Low' risk 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 OCUs on a bi-annual basis:

- OCU 1 (A7) SU 51872 91223
- OCU 2 (A8) SU 51914 91270

In addition, sampling will also take place in relation to SU 52049 91313 (approx. NGR of centre of the cake pad) which are diffuse sources and hence will be monitored purely by agar plates.

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 stacks 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	SU 5182 9121	SU 5188 9123	SU 5189 9122	SU 5189 9121
OCU 2	SU 5186 9126	SU 5201 9135	SU 5204 9129	SU 5203 9122

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

Cake Pad:
Upwind sample location which is approx. 50m W-SW of the cake pad: NGR SU 5200 9130
Downwind sample location 1 which is approx. 50m NE of the cake pad: NGR SU 5208 9134
Downwind sample location 2 which is approx. 50m E of the cake pad: NGR SU 5209 9132
Downwind sample location 3 which is approx. 50m SE of the cake pad: NGR SU 5209 9129

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 boundary and emission points

KEY:

Site Location

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

Jacobs

Jacobs House, Shrewsbury Business Park, SY2 6GG
Tel:+44(0)1743 284 8000 Fax:+44(0)1743 284 800
www.jacobs.com

Client

Thames Water

Project

STC IED PERMIT
DIDCOT 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-DDT-DR-0001

Appendix B. Site plan showing static receptors within 250m of potential bioaerosol sources

N

A3

Above Ground Biogas Pipe

Cake Pad

Digested Sludge Press House

Dewatering Feed Buffer Tank

Liquor Return Pumping Station 3

Picket Fence Thickener No.2

A8

Boiler House

Subsurface Biogas Pipeline

A1

A2

Sludge Import Buffer Tank

Biogas Storage

A6

SAS BufferTank

SAS Thickening Plant

A7

A4

Primary Digester Tanks

A5

Above Ground Biogas Pipe

COLLETT

Heat Exchange Kiosks

Sludge Import Tank

Sludge Import Area

Sludge Blending Tank

Picket Fence Thickener No.1

Liquor Return Pumping Station 2

Cess/Waste Import Point

Liquor Balancing Tank

Liquor Return Pumping Station 1

Secondary Digester Tanks

KEY:

- Installation Boundary
- Presumed Biogas Pipeleine Route
- Area/Tank Excluded from Permit Scope
- Air Emission Point

A1 - Boiler 1
A2 - Boiler 2
A3 - Emergency Flare
A4 - Primary Digester PRV
A5 - Primary Digester PRV
A6 - Biogas Storage PRV
A7 - OCU1
A8 - OCU2

0 10 20 30 40 50
METRES

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

Jacobs
1180 Eskdale Road, Winnersh, Wokingham, RG41 5TU
Tel:+44(0)118 946 7000
www.jacobs.com

Client: Thames Water

Project: STC IED PERMIT
DIDCOT STW

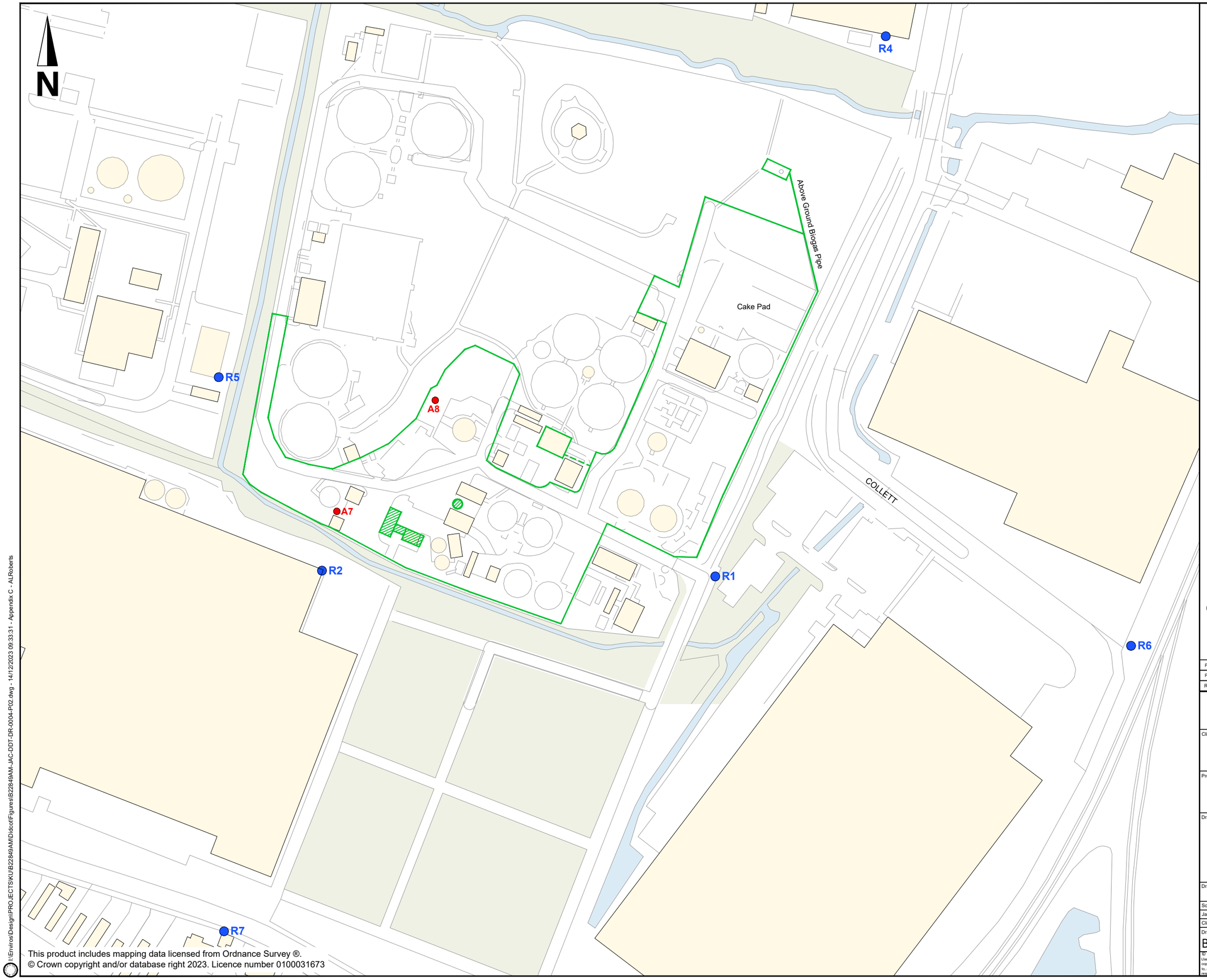
Drawing title: APPENDIX B
INSTALLATION BOUNDARY
AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	1:1000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev P01
Client no.		

Drawing number: B22849AZ-JAC-DDT-DR-0002

Appendix C. Receptors within 250m of potential emission points



KEY:

- Installation Boundary
- Presumed Biogas Pipeleine Route
- Area/Tank Excluded from Permit Scope
- Air Emission Point
- Receptor Point

A7 - OCU1
A8 - OCU2

0 20 40 60 80
METRES

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

Jacobs
1180 Eskdale Road, Winnersh, Wokingham, RG41 5TU
Tel:+44(0)118 946 7000
www.jacobs.com

Client: Thames Water

Project: STC IED PERMIT
DIDCOT STW

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

Drawing status: PERMITTING

Scale	AS SHOWN	DO NOT SCALE
Jacobs No.	B22849AZ	Rev P02
Client no.		

Drawing number: B22849AZ-JAC-DDT-DR-0002