Barnhurst STW Bioaerosol Risk Assessment

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Severn Trent Water Ltd
EPR/AP3537QP/V002

IED Permitting
19 February 2024

Barnhurst STW 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 application for a bespoke installation permit for the Barnhurst STW, EPR/AP3537QP/V002.

1.1 Site description

Barnhurst works is approximately 3.9 km northwest of the centre of Wolverhampton between the village of Bilbrook and suburb of Oxley. The surrounding land use generally comprises residential properties and open grassland. To the South is the wider sewage works and then leisure, residential and industrial premises, while to the north is open grassland and residential premises. The nearest residential properties are approximately 150m northwest of the site.

The site is classified as flood zone 1 indicating that it has a less than 1:1000 probability of flooding in any year. The site sits inside a designated Zone 3 source protection zone (SPZ) for groundwater. There are no Special Area of Conservation (SACs), Special Protection Areas (SPAs), or RAMSAR sites with 10km of the site and no Sites of Special Scientific Interest (SSSI's) within 2km of the site boundary. There is a single local nature reserve (LNR) and two ancient woodlands within 2km of the site. There are also 21 local wildlife sites (LWS) and protected species within 2km of the site. The site is within Air Quality Management Area for NOx and PM10. The address of the installation is:

Severn Trent Water Limited
Barnhurst STW
Oxley Moor Road
Wolverhampton
WV9 5HN

1.2 NGR: SJ 89852 02024Site Activities

Barnhurst Sludge Treatment Centre (STW) is located at the Barnhurst Sewage Treatment Works and is operated by Severn Trent Water Utilities Ltd (Severn Trent Water). The STW 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 (which is greater than 100 tonnes of waste per day). 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):

- Import of sewage sludge, portaloo waste, cess and septic tank wastes to the inlet;
- Blending of imported wastes prior to treatment;
- import of sewage sludge to the digesters;
- Storage of digestate prior to onsite dewatering;
- Dewatering of digested sewage sludge;
- Transfer of waste waters to the inlet of the sewage treatment works;
- Storage of biogas;
- Combustion of biogas in an MCPD and SG compliant biogas CHP unit and auxiliary boilers;
- Emergency flare; and

- Storage of raw materials.

The STW can treat up to 255,044m^3 of sludge per year (equating to approximately 225,044 tonnes). There are three operational primary digesters, which accept sludges for treatment. The STW has a total maximum treatment input of 699m^3 per day (equating to approximately 699 tonnes per day).

Some of the treatment throughput is sludge which is subject to dewatering as treated sludge cake, deposited in skips and removed daily from site for storage offsite site prior to application to land. Within the area covering the permitted activities, there are seven Odour Control Unit (OCU) linked to specific tanks and processes which produce potentially odorous air. The units treat the air through a variety of means, including use of dry chemical scrubbers and 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 site's Combined Heat and Power engine, to generate electricity both for the site and for export. Additional biogas can be utilised in the site 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 gas over what the boilers 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 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 Barnhurst Sludge Treatment Centre installation is within 250m of sensitive receptors, as defined by M9. These are detailed in Section 2.5 of this report.

1.4 Bioaerosols

Bioaerosols are found naturally within the environment. They consist of airborne particles that contain living organisms, such as bacteria, fungi and viruses or parts of living organisms, such as plant pollen, spores and endotoxins from bacterial cells or mycotoxins from fungi. The components of a bioaerosol range in size from around 0.02 to 100 micrometres (µm) in diameter. The size, density and shape of a bioaerosol will affect its behaviour, survivability and ultimately its dispersion in the atmosphere.

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

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

The dependence on microorganisms to degrade organic material and the way in which the material is processed make biological treatment facilities a potential source of bioaerosols. However, we note that the 2012 EA guidance note[2] for developments requiring planning permission and environmental permits states that the EA

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

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

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 Barnhurst STW 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 bioaerosols release at Barnhurst STW, which meet the M17 guidance, only the temporary storage of sludge cake, which is offloaded directly into skips for transfer offsite 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

[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. Bio aerosol 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 Barnhurst STW. 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

There is an offloading coupling for tankers to discharge UWWTD derived sludge from other waste treatment sites to the digestion process on site. Sludge is passed through a logger to record the incoming volume of sludge into the discharge tank, then screened and passing through an import well. Both the discharge tank and the screens are serviced by Peacemaker OCUs (OCU1 and OCU2). The imported sludge is then blended with thickened, indigenous SAS and indigenous primary sludges prior to the biological treatment process in the pre-digestion thickening blending tank.

Surplus Activated Sludges (SAS) are collected in the SAS buffer tank, an open topped steel tank, from the final settlement tanks UWWTD process. The SAS is pumped to the SAS tank within the SAS building and thickened on three belt thickeners before being mixed with thickened indigenous sludges and imported undigested sludges in the pre-digestion thickening blending tank. Polymer is added to the belts to aid the thickening process.

Blended sludge passes from the pre-digestion thickening blending tank to one of three primary digesters. The site has three above ground primary anaerobic digesters which are of concrete construction. Each of the primary digesters are fitted with two pressure relief valves, which operate in an emergency only. The digesters operate on a continual basis with incoming sludge added to the process as digested sludge is removed to one of the two centrifuge feed tanks. Sludge is held within each digester for the period specified by the site's HACCP (hazard and critical control point) plan for the Sludge (Use in Agriculture) Regulations 1989.

2.2.2 Digested cake

The two centrifuge feed tanks are above ground steel, enclosed tanks, serviced by a Biofilter OCU (OCU3). The digested sludge is then mixed with a polymer coagulant and dewatered using one of three centrifuges. The centrifuges are enclosed and serviced by a Dry Chemical Scrubber UCU (OCU6). The supernatant liquor is returned to the head of the STW through the centrate return well, which is serviced by a Peacemaker OCU (OCU7) for treatment via the UWWTD route.

The sludge cake Is transferred offsite for storage following dewatering. There is no on-site storage of cake. The sludge is analysed to check compliance with Sludge (Use in Agriculture) Regulations 1989 (SUiARs), in accordance with the Biosolids Assurance Scheme (BAS) and once the sludge is confirmed to be compliant it is removed from storage for land spreading.

No cake is stored routinely on site.

2.2.3 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 above 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.

2.2.4 Seasonality

Sewage treatment is undertaken at the STW 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.

2.3 Potential Sources

There are sixteen 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 – Jenbacher 1	X
A2a	Standby Hot Water Boiler 1 - Broxley	X
A2b	Standby Hot Water Boiler 2 – Broxley	X
A2c	Standby Hot Water Boiler 3 – Broxley	X
A3	Flare stack	X
A4	Primary Digester tank pressure relief valves	X
A5	Primary Digester tank pressure relief valves	X
A6	Primary Digester tank pressure relief valves	X
A7	Centrifuge Feed tank pressure relief valves	X
A8	Centrifuge Feed tank pressure relief valves	X
A9	Gas holder pressure relief valve	X
A10	Discharge tank (for imported sludge) OCU (OCU1)	✓

Air emission reference	Source	In scope?
A11	Imported sludge well OCU (OCU2)	√
A12	Screen room and centrifuge tank OCU (OCU3)	√
A13	Pre-digestion blending and primary sludge buffer tanks OCU (OCU4)	√
A14	Primary sludge thickeners OCU (OCU5)	√
A15	Centrifuge OCU (OCU6)	√
A16	Centrate return well OCU (OCU7)	√

2.3.1 Source Assessment

The CHP engine, boilers and emergency flare (points A1; A2a-c; A3) combust the produced biogas at high temperatures (in excess of 450ºC). Due to the combustion of the biogas, these points can be discounted as sources of bioaerosols emissions.

There are seven Odour Control Units (OCU) (points A10-A16) serving the STW.

Unit	OCU Type	System details	Media type
OCU 1 Imported sludge discharge tank	Moderator/ 3000 Peacemaker system	Fully enclosed system, vents to atmosphere via a single exhaust point	Pellets impregnated with stabilised chlorine dioxide and absorptive (carbon) media
OCU 2 Screened imported sludge well	Moderator/ 2000 Peacemaker system	Fully enclosed system, vents to atmosphere via a single exhaust point	1st Stage: Catalytic iron filter 2nd Stage: Pellets impregnated with stabilised chlorine dioxide and absorptive (carbon) media.
OCU 3 Screens room & centrifuge feed & sludge holding tanks	Biofilter	Fully enclosed system, vents to atmosphere via a single exhaust point	Crushed shell
OCU 4 Pre digestion thickening blending & primary sludge buffer tanks	P500 Peacemaker	Fully enclosed system, vents to atmosphere via a single exhaust point	1st Stage: Catalytic iron filter 2nd Stage: Pellets impregnated with stabilised chlorine dioxide and absorptive (carbon) media.
OCU 5 Primary sludge thickeners	1 x CIF 6000/ 6000 Peacemaker	Fully enclosed system, vents to atmosphere via a single exhaust point	1st Stage: Catalytic iron filter 2nd Stage: Pellets impregnated with stabilised chlorine dioxide and absorptive (carbon) media.

Unit	OCU Type	System details	Media type
OCU 6 Centrifuges	Dry chemical scrubber	Fully enclosed system, vents to atmosphere via a single exhaust point	Pellets impregnated with stabilised chlorine dioxide and absorptive (carbon) media
OCU 7 Centrate returns	Moderator/ 2 x P500 Peacemakers	Fully enclosed system, vents to atmosphere via a single exhaust point	

One of the seven OCU's within the permit scope is a biofilters and therefore potentially poses a risk of bioaerosols.

The Pressure Relief Values (PRVs) (points A4 – 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 boilers, the PRVs 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.

There is no storage of cake on the cake pad at the site. It is deposited from the conveyors directly into sealed skips from where it is transferred offsite each working day for storage pending offsite application to land.

2.3.2 Risk

The overall treatment process is considered to be a very low source of bioaerosols.

There is no sewage cake stored on the site. It is deposited into skips which are removed from site on a daily basis for off site storage. Skips are covered both when being filled and also in transit, minimising the risk of cake escaping.

While there are OCU's in use for the permitted activities at the site, the majority of these are chemical based scrubbers and as such, do not pose a risk of generating bioaerosols through normal operation. There is a single biofilter OCU, OCU 3 (A12) which may pose a risk of bioaerosols

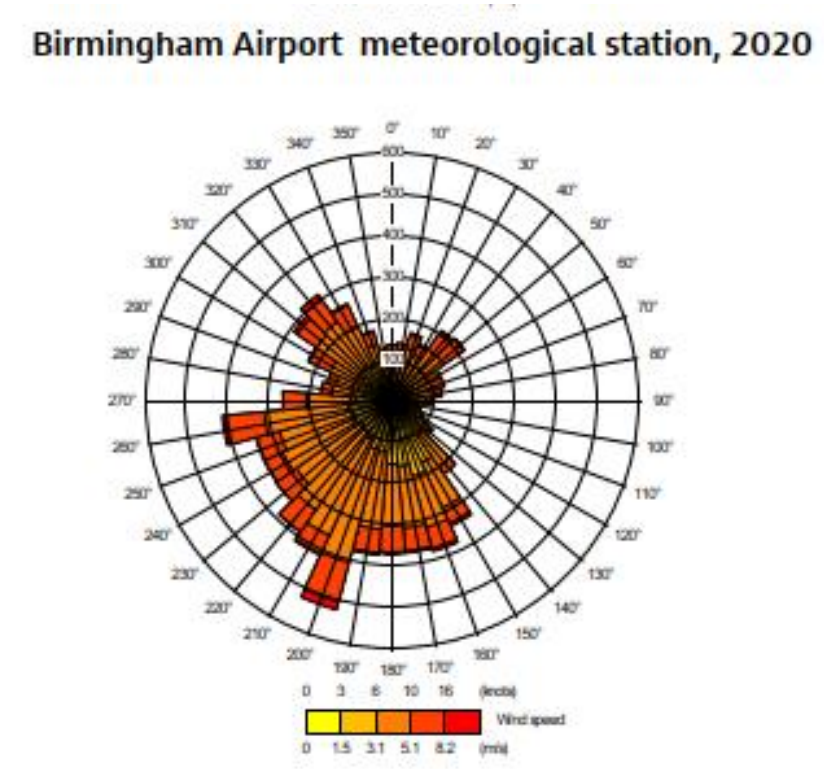
As discussed above, there are a number of control measures in place at the site to reduce and contain emissions of bioaerosols. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.

In addition waste treatment tanks and associated pipework are enclosed. The wet wells and tanks used to receive incoming sludge are either below ground and covered or above ground, covered and abated. 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. Historical prevailing wind data below from the Met Office shows the predominant direction is West / South West. The site is located in a built up area, which may impact on dispersion patterns. Barnhurst STW is surrounded by sensitive receptors so the aim is to keep impacts to a minimum whatever the wind direction.

Figure 1 – Wind rose for Birmingham Airport meteorological station 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. 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, Severn Trent Water do not have any empirical evidence for the levels of bioaerosols that might be associated with the potential sources at all of their Sludge Treatment Centres, however, the data they do have from a number of sites indicates there are no bioaerosols given off by their processes.

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

2.5 Receptors

Environment Agency guidance note M9 recommends a screening distance of 250m from bioaerosol emission sources to static receptor locations. Sensitive receptors are defined as: 'permitted activities where people are likely to be for prolonged periods'. This term would therefore apply to dwellings (including any associated gardens) and to many types of workplaces. We would not normally regard a place where people are likely to be present for less than 6 hours at one time as being a sensitive receptor. The term does not apply to those controlling the permitted facility, their staff when they are at work or to visitors to the facility, as their health

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

is covered by Health and Safety at Work legislation but would apply to dwellings, commercial or industrial premises nearby where people might be exposed for the requisite period.

There are a number of potentially sensitive receptors found within 250m of potential bioaerosol emission sources at the site.

The nearest residential receptors are located approx. 225m west of the site around Eastney Crescent and Coldridge Close. There are trees and scrub between the site and the residential receptors adjacent to operational areas. There is also an industrial receptor, Napton Narrowboats located to the east of the site within 250m.

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 no potential sources of bioaerosol releases within 250m of static receptors.

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 STW geographic divisions, coordinated by the Duty Manager. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached. One such abnormal event would be failure of the flare stack and/or CHP. Such an event would result in releases of biogas from the PRV's located on the roofs of the digesters and in the gas holder compound, which could release bioaerosols. This occurs to prevent over pressurisation and minimise the likelihood of a catastrophic failure of the digesters and gas systems. While the problem is rectified, biogas generation is reduced by reducing or inhibiting the digester feed.

3. Conclusions

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health in dwellings and other nearby buildings from bioaerosols arising from operations at the Wargrave Sludge Treatment Facility. 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.

No potential sources of bioaerosols within the site processes have been identified at the site, due to the lack of cake storage and type of OCU installed.

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 'Very Low' risk based on the lack of source, probability of exposure and onsite management and maintenance, which would minimise the magnitude of any releases.

3.1 Sampling

Sampling locations are being reviewed for Barnhurst STW.

Appendix A. Site boundary and emission points

See Main ASD site layout drawing

N

KEY:

- Installation Boundary
- Air Emission Point
- Liquor Transfer Point
- Sampling Point

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

T4 T3 T2 T1 S1

Shropshire Union Canal

Sewage Works

COLDRIDGE CL

BEBINGTON CLOSE

BARDWELL CL

ENT

ALDERFORD CL

SWOOD AVENUE

LAWNSWOOD RISE

OXLEY MOOR ROAD

OXLEY MOOR RD

BLAYDON ROAD

0 20 40 60 80 100
METRES

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BARNHURST STW

Drawing title: FIGURE 2
INSTALLATION BOUNDARY
AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	1:2500 @ A3	DO NOT SCALE
Jacobs No.	B19589DB	Rev P04
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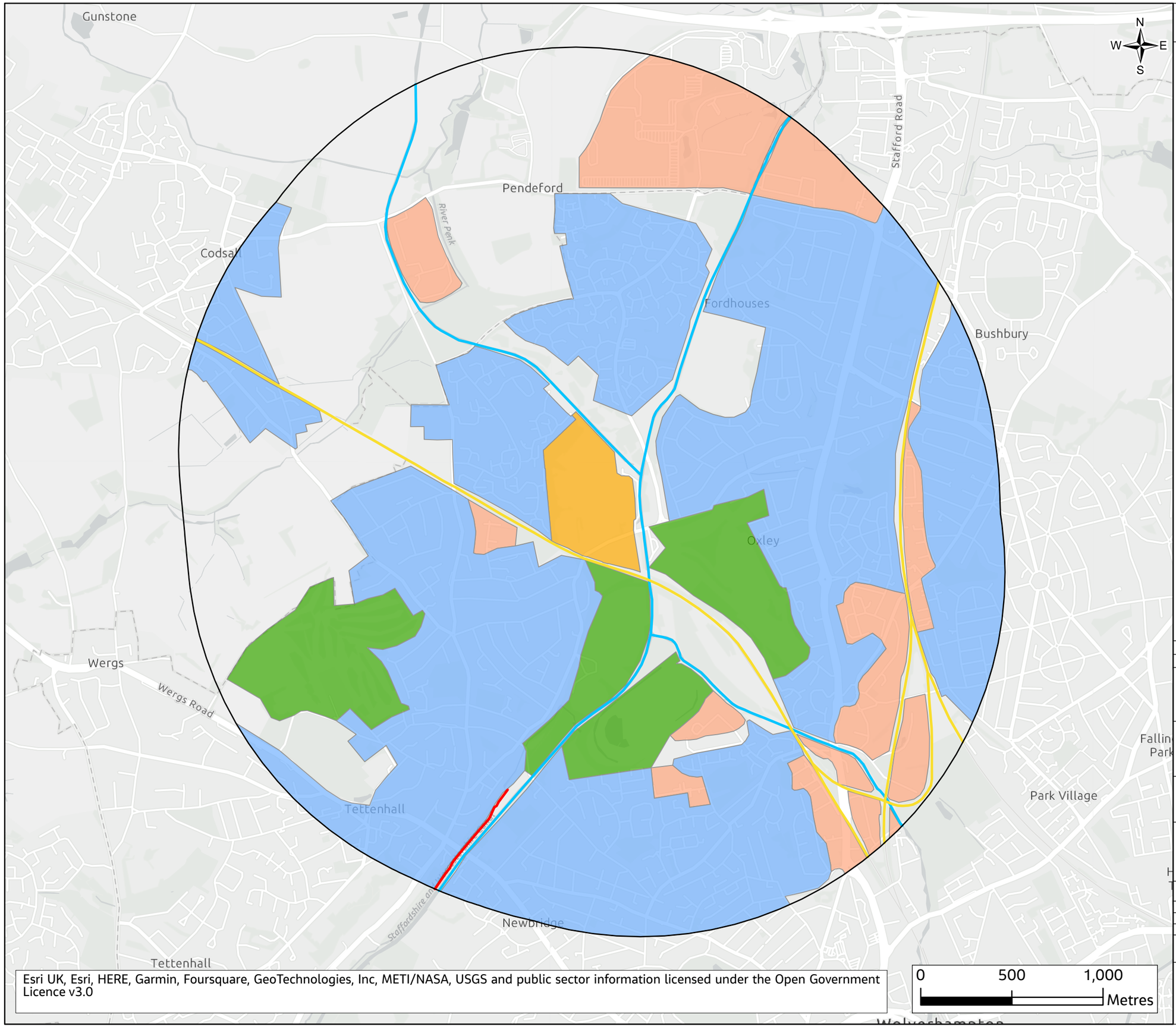
Drawing number: B19589DB-JAC-BHT-DR-0002

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



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GIS FIGURE

Legend

- Barnhurst STW 2km Buffer
- STW Site
- Commercial
- Recreational
- Residential
- Main River
- Canal
- Railway Line

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
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Project: STW EMS

Drawing Title: BARNHURST VULNERABLE LOCATIONS

Drawing Status: FINAL

Scale @ A3	1:20,000		DO NOT SCALE
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Drawing No.: BARNHURST STW