AQMAU Acoustics & Air Quality Modelling & Assessment Unit

Environment Agency

Air quality audit report

AQMAU reference: AQMAU-C2916-RP01

Site name: Rivenhall Integrated Waste Management (IWM) Facility

Permit reference: EPR/CP3906LP/V003

Date requested: 08th October 2024

AQMAU response date: 11th March 2025 (WD01)
26th March 2025 (WD02)
26th March 2025 (RP01)

AQMAU recommendation	Conditions / noted
• The consultant's conclusions for human health can be used for permit determination. • The consultant's numerical predictions for human health can be used for permit determination.	• Contributions from the proposed facility are unlikely to be significant or be the cause of exceedance of the environmental standards set for the protection of human health. • Predicted intakes from dioxins and furans, and dioxin-like polychlorinated biphenyl emissions are not considered a risk to health.
• The consultant's conclusions for ecological receptors can be used for permit determination. • The consultant's numerical predictions for ecological receptors can be used for permit determination.	• Contributions from the installation are predicted to be insignificant against the relevant critical levels and critical loads.

Detailed response and evidence starts on Page 2.

1 Summary of work request

1.1 The Environment Agency's Permitting Installations Regime asked the Acoustics and Air Quality Modelling and Assessment Unit (AQMAU) to audit an air quality assessment (AQA) and abnormal emissions assessment[1] (AEA) for a permit variation application for the Rivenhall Integrated Waste Management Facility (the installation). A Human Health Risk Assessment[2] (HHRA) was submitted along with the AQA. The AQA was completed by Fichtner Consulting Engineers Limited (the consultant) on behalf of Indaver Rivenhall Limited (the applicant).

1.2 The currently permitted activities with emissions to air at the installation are:

- A twin-line incinerator which will recover energy in the form of electricity and steam from 595,000 tonnes of residual waste and refuse derived fuel each year. These sources are referred to as the CHP in the AQA and HHRA.
- Two anaerobic digestion (AD) gas engines.
- A pulp plant.
- An AD biofilter.

1.3 The proposed variation would be to allow a phased construction of the installation which would involve a scenario where only the CHP building is constructed, and the CHP lines are the only sources of emissions to air.

1.4 The installation will be located within an excavated quarry area, with the surrounding ground level approximately 20 m higher than the quarry base.

2 Conclusions that lead to AQMAU recommendations

2.1 In the case of human health, the consultant concluded that:

- Either process contributions (PCs) are below 1% and 10% of the long-term (LT) and short-term (ST) environmental standards (ES) or predicted environmental concentrations (PECs) are below the ES for all pollutants.
- There are no predicted exceedances of LT or ST ES associated with abnormal operations.
- For HHRA, the risks to health due to emissions of dioxins and furans, and dioxin-like PCBs are not significant.

2.2 In the case of protected conservation sites, the consultant concluded that:

- At local nature sites, the PCs are less than 100% of the relevant critical levels and loads.

2.3 We have audited the consultant's assessment and have made observations relating to their methods and assumptions. We have conducted our own check modelling and have analysed model sensitivities. The consultant's conclusions for human health and protected conservation sites can be used for permit determination, provided total volatile organic compounds (TVOC) do not all consist of 1,3-butadiene. The conclusions on environmental risk are unchanged from the current permitted activities.

[1] Indaver Rivenhall Limited. Rivenhall IWMF Dispersion Modelling Assessment, revision 1. Fichtner Consulting Engineers Limited. July 2024.
[2] Indaver Rivenhall Limited. Rivenhall IWMF Dioxin Pathway Intake Assessment, revision 0. Fichtner Consulting Engineers Limited. July 2024.

3 Evidence for conclusions

Air quality assessment

3.1 Model software and version – Air dispersion modelling software ADMS 6 has been used.

3.2 Source assumptions – The installation has been modelled to operate at maximum capacity for 8,760 hours per year. The stack height is 55 m (35 m above the surrounding ground level) and the 'combine multiple flues' stack option in ADMS has been used to model the two stacks as a single plume.

3.3 Emission parameters and assumptions – The assessment is predominantly based on the Best Available Techniques Associated Emission Levels (BAT-AELs) obtained from the 2019 waste incineration BAT conclusions (BATC) document[3]. The modelled emissions are presented in table 19 of the AQA. We observe:

- All TVOCs are assumed to be benzene for assessment against the LT and ST benzene ES.
- All polycyclic aromatic hydrocarbons (PAHs) are assumed to be benzo[a]pyrene (B[a]P) and are assessed against the B[a]P ES. An emission concentration of 0.2 µg/m^3 was used, based on a maximum reported emission concentration of B[a]P at a UK plant from figure 8.121 of the 2019 Waste Incineration BREF[4].
- For polychlorinated biphenyls (PCBs) an emission concentration of 0.005 mg/m^3 reported in table 3.8 of the 2006 Waste Incineration BAT reference document (BREF)[5] was used.
- Group 3 metal emissions have been modelled following our guidance[6].
- All other emission concentrations are consistent with the BAT-AELs.

3.4 Meteorological data – Meteorological data observed at Andrewsfield meteorological station for five years 2018 to 2022. This site is 14 km northwest of the installation.

3.5 Surface roughness – A fixed surface roughness of 0.3 m, representing agricultural areas (max) has been used for both the dispersion site and the meteorological site.

3.6 Minimum Monin-Obukhov (M-O) length – A minimum M-O length of 1 m (default value) has been assumed for both the dispersion site and meteorological site.

3.7 Terrain – Flat terrain has been assumed because gradients are not greater than 1:10 outside of the complex terrain of the quarry. To account for the difference in elevation between the quarry base and the surrounding ground level, the stack height and building height have been reduced by 20 m.

[3] Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration.
[4] Neuwahl, F., Cusano, G., Gómez Benavides, J., Holbrook, S. and Roudier, S. Best Available Techniques (BAT) Reference Document for Waste Incineration: Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control), EUR 29971 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-12993-6 (online), doi:10.2760/761437 (online), JRC118637.
[5] Waste Incineration BREF 2006 superseded_wi_bref_0806_0.pdf (europa.eu) [Accessed February 2025]
[6] Waste incinerators: guidance on impact assessment for group 3 metals stack - GOV.UK (www.gov.uk) [Accessed February 2025]

3.8 Buildings – Several building scenarios, as shown in Table 24 of the AQA have been modelled to account for uncertainty regarding the complex terrain of the quarry. In any one scenario, one building structure has been modelled.

3.9 Receptor grid – A 6 km x 6 km Cartesian grid with a spatial resolution of 60 m has been used.

3.10 Discrete receptors – The consultant has modelled 47 discrete receptor locations to represent relevant public exposure based on Table 5 of the AQA. There are an additional twelve discrete receptors included in the specified points file (*.asp*).

3.11 Background concentrations – The background data used is reported in Table 14 of the AQA. A variety of sources has been considered, including: diffusion tubes managed by Braintree Council[7], air quality networks spread across the UK[8] and Defra background maps for the pollutants assessed.

3.12 Oxides of nitrogen (NO_X) to nitrogen dioxide (NO_2) conversion – A 70% LT and 35% ST NO_X to NO_2 conversion has been assumed.

3.13 Summary of AQA results for normal operations – Detailed LT and ST PCs and PECs are reported in the AQA – Appendix C tables 50-53 for the permitted installation, Appendix D tables 60-64 for the CHP only (full build out) and Appendix E tables 71-75 for the CHP only (CHP build out only). We observe for the CHP only (CHP build out only) scenario:

- All pollutant PCs are either insignificant (less than 1% for LT or 10% for ST) or the PECs do not exceed the relevant ES.
- Of the group 3 metals annual Cr VI and 24-hour (long-term) Cu progressed to step 2 before showing acceptable impacts.

Abnormal emissions assessment (AEA)

3.14 Emission parameters and assumptions – Modelled abnormal emissions are reported in Table 41 of the AQA. We observe:

- The ST emission concentration for NO_X, PM_{10}, SO_2, HCl, HF, Hg, Cd, relevant Group 3 metals and PCBs are within the ranges specified for raw flue-gas in table 3.6 of the 2019 Waste Incineration BREF[9].
- The emission concentration for particulate matter (PM) is consistent with the 150 mg/Nm^3 half-hourly average ELV specified in IED Annex VI Part 3 (2)[10].
- Emission concentrations were not provided for VOCs and CO.
- 24-hour and annual abnormal impacts have been factored to reflect the 4 hours of uninterrupted abnormal emissions for up to 60 hours per year from Article 46 (6) of the IED.
    - 24-hour impacts have been factored by 4 hours at the assumed abnormal emission concentration and the remining 20 hours at the daily permitted ELV.
    - Annual impacts have been factored by 60 hours at the abnormal emission concentration and 8700 hours at the normal daily permitted ELV.

[7] Braintree District Council. 2024 Air Quality Annual Status Report. June 2024.
[8] https://uk-air.defra.gov.uk/interactive-map [Accessed February 2025]
[9] Best Available Technique (BAT) reference Document for Waste Incineration, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention Control), 2019
[10] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). EUR-Lex - 02010L0075-20110106 - EN - EUR-Lex (europa.eu) [Accessed February 2025]

3.15 Summary of AEA results for abnormal operations – The consultant reported PCs and PECs in tables 43-47 of the AQA. We observe:

- At the location of maximum impact, the predicted abnormal PC for 1-hour Ni (worst-case concentration) is predicted to exceed the ES. The consultant has multiplied the worst-case Ni concentration of 0.22 mg/Nm^3 by 2900%.
- The 1-hour Ni PEC is predicted to not exceed when the mean emission concentration multiplied by 2900% is used from the guidance[6]. The consultant explains that the worst-case emission concentrations are outliers and that the mean concentration is more appropriate.
- All other ST pollutant PCs are either insignificant (less than 10%) or the PECs do not exceed the relevant ES.
- At the location of maximum impact, the predicted LT abnormal impacts are either insignificant (less than 1%) or the PECs do not exceed the relevant ES. These are low risk compared to the ST impacts.

Human health risk assessment (HHRA)

3.16 Model software – Proprietary software Lakes IRAP-h View (version 5.1.1) has been used to conduct the HHRA. IRAP-h View implements the United States Environmental Protection Agency (US EPA) Human Health Risk Assessment Protocol (HHRAP)[11].

3.17 Discrete receptors – 26 receptors have been assessed.

3.18 Pathways – Direct inhalation and ingestion of soil, home grown produce, eggs from home reared chickens, home grown poultry, beef, pork, cow's milk, drinking water and consumption of breast milk for infants are the pathways that have been considered. Ingestion of locally caught fish has not been included because there are no game fishing lakes or commercial fish farms within the modelling domain.

3.19 Dioxin and furan (PCDD/F) congener profile – The congener profile and emission rates are presented in Table 6 of the HHRA. The emissions for each congener in terms of toxic equivalent (I-TEQ) have been based on standard congener profile for municipal waste incinerators from HMIP 1996[12] and scaled to the BAT-AEL of 0.04 ng I-TEQ N/m^3.

3.20 Dioxin-like PCBs – The dioxin-like PCB emission rate is based on the maximum monitored PCB concentration taken at 24 municipal waste incinerators between 2008 and 2010. The entire dioxin-like PCB emission has been modelled as Aroclor 1254 and Aroclor 1016 in IRAP-h View, with the highest impact of the two reported.

3.21 Deposition assumptions – The deposition assumptions are shown in Table 5 of the HHRA. We observe:

- The dry vapour deposition velocity of 0.5 cm/s is the value recommended in HHRAP for organic contaminants.

[11] Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, EPA 2005.
[12] Table 7.2a DOE (1996) Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes Contract No. HMIP/CPR2/41/1/181.

- The dry particle and particle-bound deposition velocities of 0.11 cm/s and the dry to wet deposition ratio of 1 to 2 are conservative values from our guidance[13].

3.22 Summary of HHRA – The consultant reported their results in Table 8 of the HHRA. We observe:

- The Committee on Toxicity tolerable daily Intake (COT TDI)[14] of 2 pg WHO-TEQ/kg(BW)/day has been used.
- The predicted maximum contribution at the point of maximum impact is 4.63% of the TDI for an adult, and 6.54% of the TDI for a child.
- The predicted intakes for dioxins, furans and dioxin-like PCBs have not been adjusted for lifetime exposure.

Ecological assessment

3.23 Sites assessed – A screening distance of 10 km for SACs, SPAs and Ramsar sites, and 2 km for SSSIs and local nature sites has been used. The assessed conservation sites are presented in Table 6 of the AQA.

3.24 Background concentrations, critical levels and critical loads – The APIS website[15] has been used to establish baseline concentrations and deposition fluxes, critical levels and critical loads for the conservation sites assessed.

3.25 Deposition – AQTAG06[16] guidance was followed to calculate the contribution of pollutants to nutrient nitrogen and acid deposition.

3.26 Summary of ecological assessment – The PCs and PECs at the conservation sites are reported in the AQA – Appendix C tables 54-60 for the permitted installation, Appendix D tables 65-71 for the CHP only (full build out) and Appendix E tables 76-82 for the CHP only (CHP build out only). We observe for the CHP only (CHP build out only) scenario:

- At all assessed local nature sites, the LT and ST PCs are less than 100% of the critical levels and critical loads and are insignificant.

AQMAU check modelling and assessment

3.27 We carried out check modelling and sensitivity analysis to several of the assumptions and input parameters made by the consultant. Our assumptions for surface roughness and M-O length were taken from our previous audits on this installation[17,18]. The checks listed in this section were carried out in this audit and were deemed necessary to understand model sensitivity and uncertainties in the consultant's reported predictions:

- ADMS 6.0.2, the latest version of the dispersion model.
- All TVOCs assumed to be 1,3-butadiene and assessed against the LT and ST 1,3-butadiene ES.

[13] Air emissions risk assessment for your environmental permit - GOV.UK (www.gov.uk) [Accessed February 2025]
[14] Tolerable Daily Intake (TDI) of 2 picogrammes toxic equivalent (TEQ) of dioxins and dioxin-like PCBs per kilogramme human body weight per year.
[15] Air Pollution Information System www.apis.ac.uk [Accessed February 2025]
[16] AQTAG06 Guidance on detailed modelling approach for an appropriate assessment for emissions to air. March 2014.
[17] AQMAU. AQMAU-C1757-RP01. February 2019.
[18] AQMAU. AQMAU-C1510-RP02. August 2017.

- Five years of meteorological data observed at Andrewsfield meteorological station for the years 2016-2020.
- Effects of complex terrain using a terrain file processed from 50 m resolution Ordinance Survey (OS) data as well as an edited terrain file to represent an assumed constant base elevation of the quarry.
- Effects with and without buildings as well as the consultant's building scenarios.
- Lifetime exposure of dioxins, furans, and dioxin-like PCBs.
- Dioxin, furan and dioxin-like PC modelled at the maximally impacted location on the grid.

3.28 Our check modelling and sensitivity analysis indicates for human health:

- We agree the proposed installation either has insignificant impacts or will not cause exceedance of the ES set for the protection of human health, for normal and abnormal operations.
- We find that the 24-hour 1,3-butadiene ES is predicted to exceed at receptor locations to the west of the installation, however, we consider it unlikely that all TVOCs will comprise of 1,3-butadiene, therefore, we consider exceedances unlikely.
- Our checks indicate the dioxin, furan and dioxin-like PC intakes are below 10% of the COT TDI at the maximally impacted location and are not considered a significant risk to health. This also applies to any increased emissions of dioxins, furans and dioxin-like PCBs during worst-case abnormal operations. This is based on the UKHSA advise that:
    - A total exposure including the PC from dioxins, furans and dioxin-like PCBs is without appreciable health risk if the total exposure is below the TDI.
    - If total exposure including the PC results in an exceedance of the COT TDI, if the PC from the facility is less than 10% it would be unlikely to result in a significant risk.

3.29 Our check modelling and sensitivity analysis, indicates:

- At all nearby local conservation sites, the LT and ST PCs are less than 100% of the critical levels and critical loads and are considered insignificant.