AQMAU Acoustics & Air Quality Modelling & Assessment Unit

Environment Agency

Air quality audit report

AQMAU reference: AQMAU-C2850-RP01

Site name: Tees Valley Energy Recovery Facility

Permit reference: EPR/AP3627SL/A001

Date requested: 07 August 2024

AQMAU response date: 31 October 2024

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 cause an 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 ammonia emissions at Teesmouth and Cleveland Coast SPA, Ramsar and SSSI cannot be used for permit determination. • The consultant's numerical predictions for ecological receptors can be used for permit determination. • The Habitats Assessment Team should be consulted on the potential significance of nutrient nitrogen deposition, annual NO_X and ammonia emissions at Teesmouth and Cleveland Coast SPA, Ramsar and SSSI.	• Our checks confirm the nutrient nitrogen deposition, ammonia (where bryophytes are present) and annual NO_X PCs could be significant at Teesmouth and Cleveland Coast SPA, Ramsar and SSSI. • Our conclusions regarding annual ammonia PCs are different to the consultant's because they did not use a critical load of 1 µg/m^3 for the Teesmouth and Cleveland Coast SPA, Ramsar and SSSI. • At all other sites and for other pollutants, the proposed facility is unlikely to contribute significantly to any exceedances of the critical levels and critical loads set for the protection of habitats.

Detailed response and evidence starts on Page 2.

1 Summary of work request

1.1 The Environment Agency's Installations Regime of Permitting asked the Acoustics and Air Quality Modelling and Assessment Unit (AQMAU) to audit an air quality assessment[1] (AQA) for a permit application for the Tees Valley Energy Recovery Facility (the installation). An Abnormal Emissions Assessment[2] (AEA) and a Human Health Risk Assessment[3] (HHRA) were submitted along with the AQA. The air quality assessment was completed by Fichtner Consulting Engineers Limited (the consultant) on behalf of Viridor Tees Valley Ltd (the applicant).

1.2 The proposed twin-line facility would recover energy in the form of electricity from 495,000 tonnes of waste each year.

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 the LT or ST ES associated with abnormal operations.
- For the HHRA, the risks to health due to emissions of dioxins, furans, and dioxin-like PCBs are not significant.

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

- At Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites and Sites of Special Scientific Interest (SSSIs):
  - PCs are insignificant at the North York Moors SAC.
  - PCs are not insignificant and there could be exceedances of the oxides of nitrogen (NO_X) critical level and nutrient nitrogen deposition critical load at Teesmouth and Cleveland Coast SSSI, Ramsar and SPA.

2.3 We have audited the consultant's assessment and have made observations relating to their methods and assumptions. We have conducted our own modelling to check the applicant's conclusions, including sensitivity to observations we have made during our audit. Whilst we do not agree with the absolute numerical values, the consultant's conclusions for human health and protected conservation sites can be used for permit determination, except for their conclusions regarding annual ammonia (NH_3) PCs at the Teesmouth and Cleveland Coast SSSI, Ramsar and SPA (see paragraph 3.32 for further information).

1 Viridor Tees Valley Limited, EP Application Dispersion Modelling Assessment, Fichtner Consulting Engineers Limited, reference: S3181-0410-0011HKL, 01/07/24, version 2.
2 Viridor Tees Valley Limited, Abnormal Emissions Assessment, Fichtner Consulting Engineers Limited, reference: S3899-0320-0014SMN, 01/07/24, version 2.
3 Viridor Tees Valley Limited, Dioxin Pathway Intake Assessment, Fichtner Consulting Engineers Limited, reference: S3181-0030-0015SMN, 01/07/24, version 2.

3 Evidence for conclusions

Air quality assessment

3.1 Modelling software – The consultant has used air dispersion modelling software ADMS 6.

3.2 Source assumptions – The installation has been modelled to operate at maximum capacity for 8,760 hours per year. The stack height is 80 m, based on a stack height analysis in section 7.1 of the AQA.

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[4]. The modelled emissions are presented in Table 16 of the AQA. We observe:

- All total volatile organic compounds (TVOC) are assumed to be benzene for assessment against these ES. The consultant has not considered TVOC as 1,3-butadiene, which has lower environmental standards.
- 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 PAHs at a UK plant from figure 8.121 of the 2019 Waste Incineration BREF[5].
- 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)[6] was used.
- Group 3 metal emissions have been modelled following our guidance[7].
- All other emission concentrations are consistent with the BAT-AELs, apart from the daily NO_X concentration of 100 mg/Nm^3 which is lower than the BAT-AEL of 120 mg/Nm^3.

3.4 Meteorological data – Meteorological data observed at Durham Tees Valley Airport for 5 years 2015 – 2019. This site is 19 km southwest of the installation.

3.5 Surface roughness – A spatially-varying surface roughness file has been generated and used to represent the land use characteristics around the installation. For the meteorological site, a surface roughness length of 0.2 m representing agricultural (low) land use has been used.

3.6 Minimum Monin-Obukhov (M-O) length – A minimum M-O length of 30 m for the dispersion site and 10 m for the meteorological site has been assumed.

3.7 Terrain – A terrain file has been used to model terrain effects because there are areas with gradients greater than 1:10.

3.8 Buildings – Six buildings, as shown in Table 22 of the AQA have been modelled.

[4] 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.
[5] 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.
[6] Waste Incineration BREF 2006 superseded_wi_bref_0806_0.pdf (europa.eu) [Accessed October 2024].
[7] Waste incinerators: guidance on impact assessment for group 3 metals stack - GOV.UK (www.gov.uk) [Accessed October 2024].

3.9 Receptor grid – A nested grid of points (a 2 km x 2 km grid with a spatial resolution of 20 m, nested within a 12 km x 12 km grid with a spatial resolution of 120 m) has been used.

3.10 Discrete receptors – The consultant has modelled 11 discrete receptors in locations of relevant public exposure.

3.11 Background concentrations – The background data used is reported in Table 12 of the AQA. A variety of sources has been used, including diffusion tubes managed by Middlesbrough Borough Council (annual status report[8]), air quality networks spread across the UK[9] and Defra background maps for the pollutants assessed.

3.12 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 – LT and ST PCs and PECs are reported in tables 26 and 34 of the AQA. We observe:

- For all pollutants, 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, arsenic and chromium VI progressed to step 2 before showing acceptable impacts.
- The consultant did not assess TVOCs as 1,3-butadiene.

Abnormal emissions assessment (AEA)

3.14 Emission parameters and assumptions – Modelled abnormal emissions are reported in tables 1 and 2 of the AEA. We observe:

- The ST emission concentrations for the pollutants are within the ranges specified for raw flue-gas in Table 3.6 of the 2019 Waste Incineration BREF[10].
- 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)[11].
- 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 abnormal emission concentration and the remaining 20 hours at the daily permitted ELV.
    - Annual impacts have been factored by 60 hours at the abnormal emission concentration and 8,700 hours at the normal daily permitted ELV.

3.15 Summary of AEA results for abnormal operations – The consultant reported ST PCs and PECs in tables 3 and 4 of the AEA. We observe:

[8] Middlesbrough 2023 Air Quality Annual Status Report, July 2023 Middlesbrough Air Quality Annual Status Report (ASR) 2023 | Middlesbrough Council Open Data [Accessed October 2024].
[9] https://uk-air.defra.gov.uk/interactive-map [Accessed October 2024].
[10] Best Available Technique (BAT) reference Document for Waste Incineration, Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention Control), 2019.
[11] 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 October 2024].

- At the location of maximum impact, the PCs for all pollutants are either insignificant (less than 10%) or the PCs are below the ES. PECs have not been presented.
- The LT impacts from abnormal emissions have also been reported in table 5 and 6 of the AEA, and 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 5.0) 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)[12].

3.17 Discrete receptors – 11 receptors and the point of maximum impact have been assessed.

3.18 Pathways – Direct inhalation and ingestion of soil, home grown produce, drinking water, eggs from home reared chickens, home grown poultry, beef, pork, cow's milk and consumption of breast milk for infants are the pathways that have been considered. Ingestion of locally caught fish has not been included because the closest game fishing lake is stated to be the Lockwood Beck Trout Fishery, 15 km away from the installation.

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 a standard congener profile for municipal waste incinerators from HMIP 1996[13] 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 concentration monitored by the Environment Agency between 2008 and 2010. The entire dioxin-like PCB emission has been modelled as Aroclor 1254 and Aroclor 1016 in IRAP-h View.

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.
- The dry particle and particle-bound deposition velocities of 1 cm/s is higher than the recommended value from our guidance, 0.11 cm/s. The dry to wet deposition ratio of 1 to 2 are conservative values from our guidance[14].

3.22 Summary of HHRA – The consultant reported their results in tables 8 and 9 of the HHRA. We observe:

- The Committee on Toxicity tolerable daily intake (COT TDI)[15] of 2 pg WHO-TEQ/kg(BW)/day has been used.
- The predicted maximum contribution is 5.3 % of the TDI for an adult, and 7.5 % of the TDI for a child.

[12] Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, EPA 2005.
[13] Table 7.2a DOE (1996) Risk Assessment of Dioxin Releases from Municipal Waste Incineration Processes Contract No. HMIP/CPR2/41/1/181.
[14] Air emissions risk assessment for your environmental permit - GOV.UK (www.gov.uk) [Accessed October 2024]
[15] Tolerable Daily Intake (TDI) of 2 picogrammes toxic equivalent (TEQ) of dioxins and dioxin-like PCBs per kilogramme human body weight per day.

- The predicted intakes for dioxins, furans and dioxin-like PCBs have 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, Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar and North York Moors SAC, are presented in Table 14 of the AQA.

3.24 Background concentrations, critical levels and critical loads – The APIS website[16] has been used to establish baseline concentrations and deposition fluxes, critical levels and critical loads for the conservation sites assessed.

3.25 Deposition – AQTAG06[17] 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 tables 38, 53 and 57 of the AQA. We observe:

- At the North York Moors SAC LT PCs are less than 1% and ST PCs are less 10%, so are insignificant.
- At the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar the annual NO_X and nutrient nitrogen deposition PCs are not insignificant, and the backgrounds already exceed the critical levels and loads. The AQA states that the "only priority habitat present in the area where the PC of oxides of nitrogen exceeds 1% of the Critical Load is mudflats, which is not sensitive to additional loading of oxides of nitrogen". The significance of the nutrient nitrogen deposition PCs has been addressed in the ecological interpretation of the AQA (Appendix E)[18].
- For all other pollutants, the LT PCs are less than 1% and ST PCs are less 10% so are insignificant, or the PECs do not exceed the critical levels and loads.

Cumulative assessment

3.27 The cumulative impacts of the installation with the following proposed developments have been modelled:

- TeesREP Biomass Plant (planning reference: R/2008/0671/EA)
- Teesside Combined Cycle Power Plant (R/2017/0119/DCO)
- Grangetown Peaking Plant (R/2018/0098/FF)
- Peak African Minerals Resources Refinery (R/2017/0876/FFM)
- Redcar Energy Centre (R/2020/0411/FFM)
- Circular Fuels Arboretum renewable gas plant (R/2023/0080/ESM)
- CSG Wilton Waste Treatment Plant (R/2023/0820/ESM)

3.28 Summary of cumulative assessment for human health – The cumulative predictions and resultant PECs are reported in tables 39 and 40 of the AQA. We

[16] Air Pollution Information System www.apis.ac.uk [Accessed October 2024].
[17] AQTAG06 Guidance on detailed modelling approach for an appropriate assessment for emissions to air. March 2014.
[18] Viridor Tees Valley Limited, Tees Valley Energy Recovery Facility Grangetown Prairie, Dorman Point, Shadow Habitat Regulations Assessment, Terence O'Rourke Limited, August 2024.

observe that the cumulative PECs do not change the conclusions for the pollutants assessed at human health receptors.

3.29 Summary of cumulative assessment for ecological sites – The cumulative predictions and resultant PECs are reported in in tables 41, 42, 54, 56 and 58 of the AQA. We observe:

- The cumulative PECs change the conclusions for the pollutants assessed at ecological receptors.
- At the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar the cumulative PECs lead to an exceedance of annual NO_X across a larger area of the site. The significance of this effect has been assessed in the ecological interpretation of the AQA (appendix E). For all other pollutants, there is no change in conclusions.
- The North York Moors SAC did not require consideration within the in-combination assessment, because all PCs from the installation at this conservation site are insignificant.

AQMAU modelling and assessment

3.30 We have undertaken modelling and sensitivity analysis, based on the consultant's modelling files, to check the validity of their predictions. Sensitivity analyses from the recent AQMAU audit of the Tees Valley Energy Recovery Facility permit application (EPR/ZP3309LW/A001, our ref: C2538) have been used to inform this audit, because it was an audit that considered a similar incinerator at the same location. The elements listed in this section were deemed necessary to understand additional model sensitivities and uncertainties in the consultant's reported predictions:

- Our own 4 km resolution NWP[19] data modelled at locations near the installation for 2009.
- Surface roughness lengths of 0.5 m for the dispersion site, and 0.5 m and 0.2 m for the meteorological sites of Teesside and Middlesbrough East Lazenby NWP, respectively.
- Conservative background pollutant concentrations.
- Additional discrete receptor points for the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar.
- Alternative NH_3 critical level of 1 µg/m³ at locations within the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar where Natural England confirmed bryophytes are present during the C2538 audit.
- Using several sources[20] to investigate potential fish intake from members of the public to verify if fish is likely to be a pathway.
- More conservative emission concentrations for the abnormal operations.
- An alternative minimum critical load of 5 kgN/ha/yr for nutrient nitrogen deposition for the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar.

3.31 Our modelling and sensitivity analysis indicates that for human health:

- We agree the proposed installation either has insignificant impacts or will

[19] A numerical forecast atmospheric model from the UK Met Office based on the deterministic UK forecast model with a resolution of 4 km.
[20] The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) website available at https://www.cefas.co.uk/eu-register/?filter=M [Accessed October 2024].

not cause exceedances of the ES set for the protection of human health, for normal and abnormal operations.

- Our checks indicate the dioxin, furan and dioxin-like PC intakes are below 10% of the COT TDI 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 advice 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, then if the PC from the facility is less than 10% it would be unlikely to result in a significant risk.
- We agree that cumulative impacts from the proposed installation with nearby proposed developments will not cause a breach of any ES set for the protection of human health, for normal and abnormal operations, apart from for 24-hour PCs of VOCs as 1,3-butadiene.
- In-combination VOCs as 1,3-butadiene PCs (including PCs from the installation and seven nearby planned sites) exceed the 24-hour 1,3-butadiene ES for both normal and abnormal operations. We note, however, that the PC from the Circular Fuels Arboretum renewable gas plant (CFA) alone exceeds 100% of the ES at the maximum receptor location, and the PC from the Tees Valley ERF makes up only 17% of the total PEC. There would be no exceedances without the contributions from the CFA. It is unlikely the CFA would be permitted with such high 1,3-butadiene emissions; therefore, the risk of exceedance is considered low.

3.32 Our modelling and sensitivity analysis, which includes consideration of the cumulative impact with the other proposed developments, indicates that for ecological receptors:

- At the North York Moors SAC, LT PCs are less than 1% and ST PCs are less 10% and are insignificant.
- At the Teesmouth and Cleveland Coast SSSI, SPA, and Ramsar the annual NO_X, annual NH_3, and nutrient nitrogen deposition PCs are not insignificant, and the existing backgrounds exceed the critical levels and loads of 30 µg/m³, 1 µg/m³, and 5 kgN/ha/yr respectively. For all other pollutants, the LT PCs are less than 1% and ST PCs are less 10% so are insignificant, or the PECs do not exceed the critical levels and loads.
- The operator has provided an ecological interpretation of the AQA to justify their predicted exceedances; we recommend that this is reviewed by the Habitats Assessment Team along with the following information:
    - The consultant's numerical predictions and isopleth maps (tables 38 and 53, Figure 17 of the AQA) can be used for consultation.
    - The HRA stage 2, completed for the EPR/ZP3309LW/A001 permit application, may be relevant because this is a similar installation with the same ecological receptors.
    - Our conclusions differ from the applicant as they did not apply a critical load of 1 µg/m³ for NH_3 at the Teesmouth and Cleveland

Coast SSSI, SPA and Ramsar. Natural England have previously confirmed that bryophytes are present at the designated site.

- Considering cumulative impacts with the other proposed developments did not change conclusions at any ecological receptor.