Air Quality Assessment

Dunbar Energy from Waste Facility

For Viridor Dunbar Waste Services Ltd

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Quality Management

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Executive Summary

This report details the air quality assessment undertaken for the Dunbar Energy Recovery Facility (ERF). A previous air quality assessment was carried out in 2014 [1]. Viridor is seeking to increase the plant performance, which will change the plant characteristics and the flue gas emissions. This report details the revised air quality assessment taking into account the relevant changes due to increased plant performance.

The predicted Process Contributions (PCs) of pollutants under increased performance conditions have been compared with the PCs in the 2014 assessment predicted for the consented plant. To allow for a direct comparison, impacts have been predicted at identical human-health and ecological receptors to those assessed previously.

The assessment has been undertaken based upon appropriate information on the Proposed Development provided by Viridor and its project team. In undertaking this assessment, RPS experts have exercised professional skills and judgement to the best of their abilities and have given professional opinions that are objective, reliable and backed with scientific rigour. These professional responsibilities are in accordance with the code of professional conduct set by the Institution of Environmental Sciences for members of the Institute of Air Quality Management (IAQM).

Regarding the operational phase, the most important consideration is stack emissions. This assessment predicts that ground-level concentrations will be within acceptable levels across the modelled grid and at sensitive receptors and will not give rise to any significant adverse effects.

The proposed development does not, in air quality terms, conflict with national or local policies. There are no constraints to the development in the context of air quality.

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Appendices

1 Introduction

1.1 This report details the air quality assessment undertaken for the Dunbar Energy Recovery Facility (ERF). A previous air quality assessment was carried out in 2014 [1]. Viridor is seeking to increase the plant performance, which will change the plant characteristics and the flue gas emissions. This report details the revised air quality assessment taking into account the relevant changes due to increased plant performance.

1.2 The predicted Process Contributions (PCs) of pollutants under increased performance conditions have been compared with the PCs in the 2014 assessment predicted for the consented plant. To allow for a direct comparison, impacts have been predicted at identical human-health and ecological receptors to those assessed previously.

1.3 This report begins by setting out the policy and legislative context for the assessment. The methods and criteria used to assess potential air quality effects have then been described. The baseline air quality conditions have been established taking into account Defra estimates, local authority documents and the results of any local monitoring. The results of the assessment of air quality impacts have been presented. A conclusion has been drawn on the significance of the residual effects.

2 Policy and Legislative Context

Industrial Emission Directive Limits

2.1 The plant would be designed and operated in accordance with the requirements of the Industrial Emissions Directive (2010/75/EU) [2], known hereafter as the IED, which requires adherence to emission limits for a range of pollutants.

2.2 Emission limits in the IED are specified in the form of half-hourly mean concentrations; daily-mean concentrations; mean concentrations over a period of between 30 minutes and 8 hours; or, for dioxins and furans, mean concentrations evaluated over a period of between six and eight hours.

2.3 For the purposes of this assessment for those pollutants having only one emission limit (for a single averaging period), the facility has been assumed to operate at that limit. Where more than one limit exists for a pollutant, the half-hourly mean emission limit value has been used to calculate short-term (≤ 24-hour average) peak ground-level concentrations (Scenario 1).

2.4 The daily mean emission limit value has been used for these pollutants to calculate long-term (greater than 24-hour average) mean ground-level concentrations (Scenario 2). The IED emission limit values are provided in Table 2.1.

Table 2.1 Relevant Industrial Emission Directive Limit Values

Pollutant	Scenario 1 Short-Term Emission Limits (mg.Nm^{-3})	Scenario 2 Daily-Mean Emission Limits (mg.Nm^{-3})
Particles	30	10
TOC	20	10
Hydrogen Chloride (HCl)	60	10
Hydrogen Fluoride (HF)	4	1
Sulphur Dioxide (SO_2)	200	50
Nitrogen Oxides (NO_X)	400	200
Carbon Monoxide (CO)	-	50
Group 1 metals (a)	-	0.05 (d)
Group 2 metals (b)	-	0.05 (d)
Group 3 metals (c)	-	0.5 (d)
Dioxins and furans	-	0.0000001 (e)

Notes: All concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(a) Cadmium (Cd) and thallium (Tl).
(b) Mercury (Hg).
(c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V).
(d) All average values over a sample period of a minimum of 30 minutes and a maximum of 8 hours.
(e) Average values over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

2.5 Ammonia (NH_3), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) are not specifically regulated under the IED. For the purposes of this assessment, the emission concentrations in Table 2.2 have been used for these pollutants to calculate long-term (greater than 24-hour average) mean ground-level concentrations (Scenario 2).

Table 2.2 Modelled Emission Concentrations for non-IED Regulated Pollutants

Pollutant	Scenario 2 Emission Concentrations (mg.Nm^{-3})	Source
NH_3	10	Requested by SEPA
PCBs	0.005	*Integrated Pollution Prevention and Control Reference Document on the Best Available Techniques for Waste Incineration, August 2006*
PAHs	0.02	From 2008 Assessment.

Notes: All concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.

Environmental Permitting Regulations

2.6 EU Directive 96/61/EC concerning Integrated Pollution Prevention and Control ("the IPPC Directive") [3] applies an integrated environmental approach to the regulation of certain industrial activities. Activities covered include major process industries, waste management and the intensive farming of poultry and pigs. The IPPC Directive is implemented in Scotland through the Pollution Prevention and Control (PPC) (Scotland) Regulations 2012 and regulated by the Scottish Environment Protection Agency (SEPA). The PPC Regulations define activities that require the operator to obtain a PPC permit from SEPA.

2.7 PPC is a regulatory system to control the environmental and health impacts across all environmental media (using an integrated approach) of certain listed industrial and waste activities, via a single permitting process. To gain a permit, Operators must demonstrate in their applications, in a systematic way, that the techniques they are using or are proposing to use for their installation are the Best Available Techniques (BAT) to prevent or minimise the effects of the activity on air, land and water taking account of relevant local factors. The permitting process also places a duty on the regulating body to ensure that the requirements of the IPPC Directive are included for permitted sites to which these apply.

2.8 The essence of BAT is that the techniques selected to protect the environment should achieve a high degree of protection of people and the environment taken as a whole. Indicative BAT standards are laid out in national guidance and where relevant, should be applied unless a different standard can be justified for a particular installation. SEPA is legally obliged to go beyond BAT requirements where EU Air Quality Limit Values may be exceeded by an existing operator.

2.9 The Environment Agency's on-line guidance entitled '*Environmental management – guidance, Air emissions risk assessment for your environmental permit*' [4] provides guidelines for air dispersion modelling. The assessment of air quality effects for the proposed development is consistent with this guidance.

Waste Framework Directive

2.10 Directive 2006/12/EC [5] of the European Parliament and Council on Waste requires member states to ensure that waste is recovered or disposed of without harm to human health and the environment. It requires member states to impose certain obligations on all those dealing with waste at various stages. Operators of waste disposal and recovery facilities are required to obtain a permit, or register a permit exemption. Retention of the permit requires periodic inspections and documented evidence of the activities in respect of waste.

2.11 The Waste Framework Directive (WFD) requires member states to take appropriate measures to establish an integrated and adequate network of disposal installations. The WFD also promotes environmental protection by optimising the use of resources, promoting the recovery of waste over its disposal (the “waste hierarchy”).

2.12 Annex II A and B of the WFD provide lists of the operations which are deemed to be “disposal” and “recovery”, respectively. The terms are mutually exclusive and an operation cannot be a disposal and recovery operation simultaneously. Where the operation is deemed to be a disposal operation, the permit will contain more extensive conditions than for a recovery operation.

2.13 The principal objective of a recovery operation is to ensure that the waste serves a useful purpose, replacing other substances which would have been used for that purpose. Where the combustion of waste is used to provide a source of energy, the operation is deemed to be a recovery operation.

2.14 The PPC (Scotland) Regulations 2012 implements the WFD in Scotland. As such, SEPA is responsible for implementing the obligations set out in the WFD.

Air Quality Standards Regulations

2.15 The Air Quality Standards (Scotland) Regulations 2010 [6] and the Air Quality (Scotland) Amendment Regulations 2016 [7] sets limit values for ambient air concentrations for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene, certain toxic heavy metals (arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons (PAHs). These limit values are legally binding on the Secretary of State. The Government and devolved administrations operate various national ambient air quality monitoring networks to measure compliance and develop plans to meet the limit values.

2.16 The statutory air quality limit values are listed in Table 2.3.

Table 2.3 Statutory Air Quality Limit Values

Pollutant	Averaging Period	Limit Values	Not to be Exceeded More Than
Nitrogen Dioxide (NO_2)	1 hour	200 µg.m^{-3}	18 times pcy
	Annual	40 µg.m^{-3}	-
Particulate Matter (PM_{10})	24 hour	50 µg.m^{-3}	7 times pcy
	Annual	18 µg.m^{-3}	-
Particulate Matter ($PM_{2.5}$)	Annual	10 µg.m^{-3}	-
Carbon Monoxide (CO)	Maximum daily running 8 hour mean	10,000 µg.m^{-3}	-
Sulphur Dioxide (SO_2)	15 minute	266 µg.m^{-3}	> 35 times pcy
	1 hour	350 µg.m^{-3}	> 24 times pcy
	24 hour	125 µg.m^{-3}	> 3 times pcy
Lead (Pb)	Annual	0.25 µg.m^{-3}	-
Arsenic (As)	Annual	0.006 µg.m^{-3}	-
Cadmium (Cd)	Annual	0.005 µg.m^{-3}	-
Nickel (Ni)	Annual	0.02 µg.m^{-3}	-
Benzene	Running annual mean	3.25 µg.m^{-3}	-

Non-Statutory Air Quality Objectives and Guidelines

2.17 The Environment Act 1995 established the requirement for the Government and the devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality, the first being published in 1997 and having been revised several times since, with the latest published in 2007 [8]. The Strategy sets UK air quality standards♦ and objectives# for the pollutants in the Air Quality Standards (Scotland) Regulations plus 1,3-butadiene and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. There is no legal requirement to meet objectives set within the UK AQS except where equivalent limit values are set within the Air Quality Standards Regulations.

♦ Standards are concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Standards, as the benchmarks for setting objectives, are set purely with regard to scientific evidence and medical evidence on the effects of the particular pollutant on health, or on the wider environment, as minimum or zero risk levels.

Objectives are policy targets expressed as a concentration that should be achieved, all the time or for a percentage of time, by a certain date.

2.18 Non-statutory air quality objectives and guidelines also exist within the World Health Organisation Guidelines [9] and the Expert Panel on Air Quality Standards Guidelines (EPAQS) [10]. The non-statutory objectives and guidelines are presented in Table 2.4.

Table 2.4 Non-Statutory Air Quality Objectives and Guidelines

Pollutant	Averaging Period	Guideline
Particulate Matter ($PM_{2.5}$)	Annual	Target of 15% reduction in concentrations at urban background locations
	Annual	25 $\mu g.m^{-3}$
PAHs	Annual	0.00025 $\mu g.m^{-3}$ B[a]P
Sulphur Dioxide (SO_2)	Annual (a)	50 $\mu g.m^{-3}$
Hydrogen Chloride	1 hour (b)	750 $\mu g.m^{-3}$
Hydrogen Fluoride	1 hour (b)	160 $\mu g.m^{-3}$

Notes:
(a) World Health Organisation Guidelines
(b) EPAQS recommended guideline values

Environmental Assessment Levels

2.19 The Environment Agency's on-line guidance entitled '*Environmental management – guidance, Air emissions risk assessment for your environmental permit'* [4] provides further assessment criteria in the form of Environmental Assessment Levels (EALs).

2.20 Table 2.5 presents the most recent available EALs for the pollutants relevant to this assessment. Since the 2014 assessment some of the EALs have changed. For the purposes of this assessment the most recent EALs have been used.

Table 2.5 Environmental Assessment Levels (EALs)

Pollutant	Long-term EAL, $\mu g.m^{-3}$	Short-term EAL, $\mu g.m^{-3}$
Hydrogen chloride (HCl)	-	750
Hydrogen fluoride (HF)	-	160
Antimony (Sb)	5	150
Cadmium (Cd)	0.005	-
Chromium (Cr)	5	150
Chromium VI (oxidation state in the PM_{10} fraction)	0.00025	-
Cobalt (Co)	0.2 (a)	6 (a)
Copper (Cu)	10	200

Pollutant	Long-term EAL, µg.m^{-3}	Short-term EAL, µg.m^{-3}
Manganese (Mn)	0.15	1500
Mercury (Hg)	0.25	7.5
Thallium (Tl)	1 (a)	30 (a)
Vanadium (V)	5	1
PCBs	0.2	6
Ammonia (NH_3)	180	2500

Note: (a) EALs have been obtained from the EA's earlier Horizontal Guidance Note EPR H1 guidance note as no levels are provided in the current guidance.

2.21 Within the assessment, the statutory air quality limit and target values (as presented in Table 2.3) are assumed to take precedent over objectives, guidelines and the EALs. In addition, for those pollutants which do not have any statutory air quality standards, the assessment assumes the lower of either the EAL or the non-statutory air quality objective or guideline where they exist.

3 Assessment Methodology

Approach

3.1 This air quality assessment includes the key elements listed below:

- Establishing the background Ambient Concentration (AC) from consideration of Air Quality Review & Assessment findings and assessment of existing local air quality through a review of available air quality monitoring and Defra background map data in the vicinity of the proposed site.
- Quantitative assessment of the operational effects on local air quality from stack emissions utilising a "new generation" Gaussian dispersion model, ADMS 5. Assessment of Process Contributions (PC) from the facility in isolation, and assessment of resultant Predicted Environmental Concentrations (PEC), taking into account cumulative impacts through incorporation of the AC.

3.2 Air quality guidance advises that the organisation engaged in assessing the overall risks should hold relevant qualifications and/or extensive experience in undertaking air quality assessments. The RPS air quality team members involved at various stages of this assessment have professional affiliations that include Fellow and Member of the Institute of Air Quality Management and Chartered Environmentalist have the required academic qualifications for these professional bodies. In addition, the Director responsible for authorising all deliverables has over 17 years' experience.

Pollutant Concentrations

3.3 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

3.4 The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources. Background pollution levels are described in detail in Section 4.

Dispersion Model Selection

3.5 A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources. Modelling for this study has been undertaken using ADMS 5, a version of the ADMS (Atmospheric Dispersion Modelling System) developed by Cambridge Environmental Research Consultants (CERC) that models a wide range of buoyant and passive releases to atmosphere either individually or in combination. The model calculates the mean concentration over flat terrain and also allows for the effect of plume rise, complex terrain, buildings and deposition. Dispersion models predict atmospheric concentrations within a set level of confidence and there can be variations in results between models under certain conditions; the ADMS 5 model has been formally validated and is widely used in the UK and internationally for regulatory purposes.

3.6 ADMS comprises a number of individual modules each representing one of the processes contributing to dispersion or an aspect of data input and output. Amongst the features of ADMS are:

- An up-to-date dispersion model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface. This approach allows the vertical structure of the boundary layer, and hence concentrations, to be calculated more accurately than does the use of Pasquill-Gifford stability categories, which were used in many previous models (e.g. ISCST3). The restriction implied by the Pasquill-Gifford approach that the dispersion parameters are independent of height is avoided. In ADMS the concentration distribution is Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions, to take account of the skewed structure of the vertical component of turbulence;
- A number of complex modules including the effects of plume rise, complex terrain, coastlines, concentration fluctuations and buildings; and
- A facility to calculate long-term averages of hourly mean concentration, dry and wet deposition fluxes and radioactivity, and percentiles of hourly mean concentrations, from either statistical meteorological data or hourly average data.

3.7 A sensitivity test has been undertaken in Appendix A using an alternate dispersion model, AERMOD.

Model Inputs

Meteorological Data

3.8 The most important meteorological parameters governing the atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed;

- Wind speed affects the distance that the plume travels over time and can affect plume dispersion by increasing the initial dilution of pollutants and inhibiting plume rise; and
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models, including ADMS, use a parameter known as the Monin-Obukhov length that, together with the wind speed, describes the stability of the atmosphere.

3.9 For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made.

3.10 The year of meteorological data that is used for a modelling assessment can have a significant effect on source contribution concentrations. Dispersion model simulations have been performed using five years of data from Edinburgh between 2016 and 2020.

3.11 Wind roses have been produced for each of the years of meteorological data used in this assessment and are presented in Figure 1.

3.12 In the May 2009 response to Schedule 4 comments, several sensitivity tests were undertaken which considered a range of meteorological data. This included Numerical Weather Prediction (NWP) data and data collected by SEPA and Viridor. The results were shown in Table 4.3 of the May 2009 response and is reproduced below.

Table 3-1: Summary of Predicted Ground Level Concentrations (µg.m^{-3}) for Various Meteorological Data Sets (ADMS)

Pollutant	Averaging Period	EAL	Predicted Contributions (µg.m^{-3})												Max PEC	PEC % of EQS
			Edinburgh Gogarbank					Viridor Site Data			NWP Data			SEPA		
			2001	2002	2003	2004	2005	2004	2005	2008	2005	2007	2008	2008		
PM_{10}	24 hour 90.41%'ile	50	0.27	0.29	0.26	0.29	0.29	**0.46**	0.35	0.61	0.15	0.28	0.29	0.23	21.81	43.62
	24 hour 98.08%'ile	50	0.43	0.44	0.57	0.56	0.47	0.76	0.67	**0.90**	0.45	0.64	0.72	0.46	22.10	44.21
	Annual	18	0.07	0.07	0.08	0.08	0.07	**0.13**	0.09	0.21	0.04	0.07	0.07	0.06	10.81	60.07
SO_2	15 minute 99.90%'ile	266	9.87	9.55	9.35	9.85	9.63	9.26	9.32	8.52	**29.99**	8.72	24.69	9.27	35.99	13.53
	1 hour 99.73%'ile	350	**8.22**	8.18	7.87	7.91	7.95	7.99	7.79	7.95	7.42	7.30	7.31	7.54	14.22	4.06
	24 hour 99.18%'ile	125	2.78	2.90	3.86	3.48	3.08	4.37	3.71	**4.94**	2.60	3.93	4.91	2.83	10.94	8.75
	Annual	50	0.36	0.35	0.38	0.40	0.35	0.66	0.47	**1.06**	0.20	0.37	0.35	0.30	4.06	8.13
NO_2	1 hour 99.79%'ile	200	**11.99**	11.74	11.24	11.39	11.89	11.34	11.06	11.17	11.06	10.30	10.31	11.11	39.99	19.99
	Annual	40	1.01	0.97	1.05	1.12	0.99	1.85	1.32	**2.98**	0.55	1.05	0.98	0.83	16.98	42.45

3.13 For the majority of the averaging periods assessed, the 2008 Viridor site data gave the highest results. A sensitivity test has been undertaken in Appendix A that uses the 2008 Viridor meteorological data.

Coastal Effects

3.14 In the May 2009 Schedule 4 Addendum, the coastal effects were considered in two ways:

- Through the use of the coastal module in ADMS; and
- With an altered meteorological file that simulates the conditions during a Haar.

3.15 Haars are described by the UK meteorological office as:

"Sea fog from the North Sea, known locally as "haar" and "sea fret" sometimes ruins what would otherwise be a fine day on or near the east coast, or in the Northern Isles between April and September. Both these types of fog tend to break up and disperse during daytime, although inland, particularly in winter, mist and fog does sometimes persist."

"As winds blow across the sea the air exchanges heat with the water, either warming up in winter or cooling down in summer. If the air cools enough then condensation forms which we see as fog. In the right wind direction (anywhere between north and south-east) this sea fog will roll in over the land."

"If the land is warm then the fog disperses but at night as it gets cold the fret penetrates a long way inland … Sea fret is more likely in early summer before the sea has started to warm but can still turn up in August or September."

3.16 Under Haar conditions the ground level concentrations are anticipated to decrease compared to warm sunny conditions when the highest ground level concentrations of pollutants occur, typically during warm summer afternoons, due to increased atmospheric turbulence. During haar conditions, the strength of solar radiation is reduced by thick fog and strong cooling of the ground occurs, increasing atmospheric stability and so leading to lower ground-level concentrations from the proposed stack. However, this will be offset by an increase in concentrations due to a lower boundary layer height restricting dispersion in the vertical direction. In the winter due to cooler conditions and greater stability the effects of the Haar are expected to be less marked with ground level conditions not significantly affected.

3.17 To assess the impacts of the coastal effects two sensitivity tests were undertaken for the May 2009 report; 1. With the coastal module in ADMS and 2. With an altered met file to simulate the Haar conditions. Utilisation of the coastal module does not allow the effects of buildings and terrain on the dispersion of pollutants to be considered.

3.18 A comparison of predicted effects from coastal module runs and sea Haar against un-altered meteorological files were provided in Table 6.2 of the May 2009 report.

3.19 Generally, the maximum contribution was predicted with the use of unaltered 2004 meteorological data, with the exception of the 24 hour-averages for NO_2 and PM_{10} (98.08th percentile). With the coastal effects module selected, the PCs from the ERF were significantly lower than those predicted without the coastal effects module or when the altered met file (to simulate the Haar) is used, for all averaging periods.

3.20 This would indicate that the effects of buildings and terrain on the dispersion of emissions from the ERF outweigh any effects that may occur due to coastal meteorology. This is logical, given the nature of the development of the boundary layer at the land-sea interface, and taking into account the distance of the ERF from the coast.

3.21 On that basis the modelling in this report uses unaltered meteorological data without the coastal module. The effects of buildings and terrain have been included in the modelling.

Stack Parameters and Emissions Rates used in the Model

3.22 Flue gases are emitted from an elevated stack to allow dispersion and dilution of the residual combustion emissions. The stack needs to be of sufficient height to ensure that pollutant concentrations are acceptable by the time they reach ground level. The stack also needs to be high enough to ensure that releases are not within the aerodynamic influence of nearby buildings, or else wake effects can quickly bring the undiluted plume down to the ground.

3.23 Stack emissions characteristics modelled are provided in Table 3.2 and the mass emissions are provided in Table 3.3. The stack location is shown in Figure 2. The two flues have been modelled as a single source.

Table 3.2 Stack Characteristics

Parameter	Unit	Previous Assessment (2014)	Updated assessment
Stack height	m	80	80
Stack location	m	371183, 676078	371183, 676078
Effective diameter of both flues	m	2.4	2.4
Efflux velocity	$m.s^{-1}$	17.1	17.6
Efflux temperature	^oC	138	145
Actual O_2	%	6.1	6.49
Actual H_2O	%	18.5	21.04
Actual volumetric flow	$m^3.s^{-1}$	77.6	79.6
Normalised volumetric flow (Dry, 0°C, 11% O_2)	$m^3.s^{-1}$	62.6	59.6

Table 3.3 Pollutant Emissions

Pollutant Emissions		Mass Emission Rate ($g.s^{-1}$) Previous Assessment (2014) Long-term	Previous Assessment (2014) Short-term	Updated assessment Long-term	Updated assessment Short-term
Particulate emissions	$mg.Nm^{-3}$	10	30	10	30
	$g.s^{-1}$	0.63	1.88	0.60	1.79
Total Organic Carbon emissions	$mg.Nm^{-3}$	10	20	10	20
	$g.s^{-1}$	0.63	1.25	0.60	1.19
HCl emissions	$mg.Nm^{-3}$	10	60	10	60
	$g.s^{-1}$	0.63	3.76	0.60	3.57
HF emissions	$mg.Nm^{-3}$	1	4	1	4
	$g.s^{-1}$	0.06	0.25	0.0596	0.238
SOx emissions	$mg.Nm^{-3}$	50	200	50	200
	$g.s^{-1}$	3.13	12.52	2.98	11.92
NOx emissions	$mg.Nm^{-3}$	200	400	200	400
	$g.s^{-1}$	12.52	25.04	11.92	23.83
CO emissions	$mg.Nm^{-3}$	50	-	50	-
	$g.s^{-1}$	3.13	-	2.98	-
Group 1 metals emissions (a) (total, each)	$mg.Nm^{-3}$	0.05, 0.025	-	0.05, 0.025	-
	$g.s^{-1}$	3.13×10^{-3}, 1.57×10^{-3}	-	2.98×10^{-3} 1.49×10^{-3}	-
Group 2 metal emissions (b)	$mg.Nm^{-3}$	0.05	-	0.05	-
	$g.s^{-1}$	3.13×10^{-3}	-	2.98×10^{-3}	-
Group 3 metals emissions (c) (total)	$mg.Nm^{-3}$	0.5	-	0.5	-
	$g.s^{-1}$	3.13×10^{-2}	-	2.98×10^{-2}	-
Group 3 metals emissions (c) (each)	-	-	-	See discussion on metals below	
Ammonia emissions	$mg.Nm^{-3}$	5	-	10	-
	$g.s^{-1}$	0.31	-	0.60	-
PAHs	$mg.Nm^{-3}$	0.02	-	0.02	-
	$g.s^{-1}$	0.0013	-	0.0012	-
PCBs	$mg.Nm^{-3}$	-	-	0.005	-
	$g.s^{-1}$	-	-	0.0003	-
N_2O	$mg.Nm^{-3}$	-	-	30	-
	$g.s^{-1}$	-	-	1.79	-

Notes:
a) Cadmium (Cd) and thallium (Tl)
b) Mercury (Hg)
c) Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), and Vanadium (V)

3.24 Emission limits in the IED are provided for total particles. For the purposes of this assessment, all particles are assumed to be less than 10 µm in diameter (i.e. PM_{10}). Furthermore, all particles are also assumed to be less than 2.5 µm in diameter (i.e. $PM_{2.5}$). In reality, the PM_{10} and $PM_{2.5}$ concentrations will be a smaller proportion of the total particulate emissions and the $PM_{2.5}$ concentration will be a smaller proportion of the PM_{10} concentration. Therefore, this can be considered a conservative estimate of the likely particulate emissions in each size fraction.

Group 3 Metals Distribution

3.25 SEPA has requested that the *Waste incineration: guidance on impact assessment for group 3 metals* document is used to assess the impacts of Group 3 metals emissions. Appendix A of the SEPA document (shown below) provides a summary of 34 measured values for each metal recorded at 18 municipal waste and waste wood co-incinerators between 2007 and 2015.

Appendix A

Table A1 contains a summary of 34 measured values for each metal recorded at 18 MWI and Waste Wood Co-incinerators between 2007 and 2015. Note these data may differ from previous guidance notes.

Table A1- Monitoring data[a] from Municipal Waste Incinerators and Waste Wood Co-Incinerators

Pollutant	Measured Concentrations (mg/Nm³)			Percentage of the IED group 3 ELV		
	Max	Mean	Min[b]	Max	Mean	Min[b]
antimony	0.0115	0.0014	0.0001	2.3%	0.3%	0.02%
arsenic	0.0250	0.0010	0.0002	5.0%	0.2%	0.04%
total chromium	0.0920	0.0084	0.0002	18.4%	1.7%	0.04%
chromium VI[c]	1.3×10^{-4}	3.5×10^{-5}	2.3×10^{-6}	0.03%	0.01%	0.0005%
cobalt	0.0056	0.0011	0.0002	1.1%	0.2%	0.03%
copper	0.0290	0.0075	0.0019	5.8%	1.5%	0.4%
lead	0.0503	0.0109	0.0003	10.1%	2.2%	0.1%
manganese	0.0600	0.0168	0.0015	12.0%	3.4%	0.3%
nickel[d]	0.2200	0.0150	0.0025	44.0%	3.0%	0.5%
vanadium	0.0060	0.0004	0.0001	1.2%	0.1%	0.0%

[a] Note all data are referenced to 11% oxygen. Guidance on conversion between oxygen contents can be found in Part 7 Annex VI of the IED.

[b] Minimum values correspond in some cases to the detection limit.

[c] Chromium VI concentrations presented in the table are based on stack measurements for total chromium and measurements of the proportion of chromium VI (to total chromium) in Air Pollution Control (APC) residuals collected at the same plant.

[d] The two highest nickel concentrations are outliers being 44%, as above, and 27% of the ELV. The third highest concentration is 0.53 mg/Nm³ or 11% of the ELV.

3.26 The relative proportion of each of the Group 3 metals (except chromium VI) in the exhaust gas has been calculated based on the maximum percentages column and multiplied by the IED limit of 0.5 $mg.Nm^{-3}$ i.e. antimony is assumed to be 2.3% of the IED group 3 ELV.

3.27 It should be noted that if the assumed mass emission of each metal was summed together to obtain an aggregate figure, it would be greater than the mass emission calculated from the IED limit of Group 3 metals. However, this provides a conservative prediction of the potential impacts of metal emissions.

3.28 For chromium VI, the emission concentration is assumed to be 3.5×10^{-5} $mg.Nm^{-3}$. This approach was used in the 2014 assessment.

3.29 In the 2014 assessment, the relative proportions were based on older data from the National Atmospheric Emissions Inventory (NAEI) which holds data on the emissions of Group 3 metals from incinerators fuelled by Municipal Solid Waste (MSW).

3.30 An analysis of data from the NAEI indicates that antimony, cobalt, manganese and vanadium are below reporting thresholds. Therefore, the IED emission limit for Group 3 metals was divided by the proportion of the five metals for which emissions data were available. This will have overestimated the proportion of the emission for those five metals and therefore ensured that this was a conservative assessment.

3.31 The emission rate for the least abundant metal, arsenic, was assumed for the remaining Group 3 metals which were below reporting thresholds. This will have provided a conservative prediction of the concentrations of metals from the Facility.

Table 3.4 Summary of Metal Emission Data from Combustion of Municipal Solid Waste (NAEI, 2006)

Pollutant	Kt of Metal Emitted per Mt of MSW (2006 data)	Percentage	Proportion of IED Limit ($mg.Nm^{-3}$)
Sb	ND	ND	ND
As	0.0000324	4.9	0.024
Cr	0.000163	24.5	0.123
Co	ND	ND	ND
Cu	0.0000711	10.7	0.053
Pb	0.000233	35.1	0.175
Mn	ND	ND	ND
Ni	0.000165	24.8	0.124
V	ND	ND	ND
Total	0.0006645	100	0.5

ND = No data

Terrain

3.32 The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume centre line and ground level and by increasing turbulence and, hence, plume mixing. A 60 km by 60 km complex terrain file has been used within the model with a grid spacing of 950 m. This is the same complex terrain file as used in the 2014 report to allow a direct comparison.

3.33 The Ordnance Survey terrain data covers an area of 60 km by 60 km at a grid resolution of 950 m and a height scale of 1 m increments.

3.34 It should be noted that part of the modelled domain is formed of sea, and consequently the terrain files used include a terrain height of 0 m for all areas of sea.

Surface Roughness

3.35 The roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for by a parameter called the surface roughness length.

3.36 The land use within 15 km of the proposed ERF can be largely characterised as agricultural land and large water body expanses.

3.37 To account for the varying nature of the study area, a surface roughness length of 0.02 m, representative of open grassland, has been assigned during the meteorological processing in ADMS. Given that much of the modelling domain comprises of sea (with much lower corresponding surface roughness lengths), the adopted length of 0.02 m for the ADMS modelling is considered an appropriate assumption in the context of this assessment. This is the same surface roughness used in the 2014 report so has been used to allow a direct comparison.

3.38 A sensitivity test for the surface roughness has been undertaken in Appendix A using a surface roughness file to vary the parameters between land and sea. A surface roughness of 0.001 m has been applied to all areas with a terrain height of 0 m in the terrain file, and a surface roughness of 0.02 m, representative of open grassland, applied to all areas of terrain with a height greater than zero.

Building Wake Effects

3.39 The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. Where building heights are greater than about 30 - 40% of the stack height, downwash effects can be significant.

3.40 The dominant structures (i.e. with the greatest dimensions likely to promote turbulence) included within the model are listed in Table 3.5. These are the same buildings as modelled in the May 2009 assessment.

Table 3.5 Dimensions of Buildings Included Within the Dispersion Model

ID	Name	Approx Centre Location		Height (m)	Length (m)	Width (m)	Angle (Degrees)
		X (m)	Y (m)				
1	ERF Building	671146	676008	41	151.5	54.78	27
2	Tarmac – Pre-heater Tower	370699	676293	90	21.3	21	15
3	Tarmac – Precipitation Tower	370739	676262	43	16.5	16	15

Cumulative Effects

3.41 The site is adjacent to the Tarmac facility referred to the Lafarge facility in previous assessments. As requested by SEPA, emissions from the Tarmac facility have been considered to assess the cumulative effects. In the previous assessments emissions from the cement kiln (emission point A10 in the permit) were modelled. Since the previous assessment, a new emissions source A17 has been added to the Tarmac facility so has also been modelled. Stack emissions characteristics modelled are provided in Table 3.6 and the mass emissions are provided in Table 3.7. The emission concentrations are based on the permitted emission limit value unless specified.

Table 3.6 Stack Characteristics – Tarmac Facility

Parameter	Unit	A10 – Cement Kiln	Data Source	A17 – Cement Mill 7	Data Source
Stack height	m	105	Permit	21	SEPA
Stack location	m	370780, 676247		370775,676218	
Stack diameter	m	3		1.6	
Efflux velocity	$m.s^{-1}$	27.2	Socotec Stack Emissions monitoring Report – August 2019*	8.1	
Efflux temperature	^{o}C	55		108	
Actual O_2	%	12.4		10.5	Calculated from CES Environmental Stack Emissions Monitoring Report – November 2021
Actual H_2O	%	19.99		2.29	CES Environmental Stack Emissions Monitoring Report – November 2021
Actual volumetric flow	$m^3.s^{-1}$	192.2		16.2	SEPA
Normalised volumetric flow (Dry, 0°C, 11% O_2)	$m^3.s^{-1}$	100.0	Calculated	10.8	Calculated

*SEPA provided six stack emissions monitoring reports for monitoring undertaken between 2019 and 2021. The August 2019 monitoring results had the highest normalised volumetric flow and therefore mass emission rates so has been used to ensure the assessment is conservative.

Table 3.7 Pollutant Emissions – Tarmac Facility

Pollutant Emissions		Mass Emission Rate ($g.s^{-1}$) A10 – Cement Kiln	
		A10 – Cement Kiln	A17 – Cement Mill 7
Particulate emissions	$mg.Nm^{-3}$	20	10
	$g.s^{-1}$	2.00	0.108
Total Organic Carbon emissions	$mg.Nm^{-3}$	80	-
	$g.s^{-1}$	8.00	-
HCl emissions	$mg.Nm^{-3}$	10	-
	$g.s^{-1}$	1.00	-
	$mg.Nm^{-3}$	1	-

Pollutant Emissions		Mass Emission Rate ($g.s^{-1}$) A10 – Cement Kiln	
		A10 – Cement Kiln	A17 – Cement Mill 7
HF emissions	$g.s^{-1}$	0.100	-
SOx emissions	$mg.Nm^{-3}$	400	-
	$g.s^{-1}$	40.0	-
NOx emissions	$mg.Nm^{-3}$	500	-
	$g.s^{-1}$	50.0	-
Group 1 metals emissions (a) (total)	$mg.Nm^{-3}$	0.05	-
	$g.s^{-1}$	0.005	-
Group 2 metal emissions (b)	$mg.Nm^{-3}$	0.05	-
	$g.s^{-1}$	0.005	-
Group 3 metals emissions (c) (total)	$mg.Nm^{-3}$	0.5	-
	$g.s^{-1}$	0.050	-
Group 3 metals emissions (c) (each)	-	See metal distribution section	-
Ammonia emissions	$mg.Nm^{-3}$	10	-
	$g.s^{-1}$	1.00	-
PAHs	$mg.Nm^{-3}$	0.216 (Average of PAHs in six stack emissions monitoring reports)	-
	$g.s^{-1}$	0.022	-

Notes:
a) Cadmium (Cd) and thallium (Tl)
b) Mercury (Hg)
c) Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), and Vanadium (V)

Model Outputs

Receptors

3.42 The air quality assessment predicts the impacts at locations that could be sensitive to any changes. Such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG16 [11] provides examples of exposure locations and these are summarised in Table 3.8.

Table 3.8: Example of Where Air Quality Objectives Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the buildings façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
Hourly-mean	All locations where the annual and 24-hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

3.43 The modelled domain encompasses an area 30 km by 30 km (a 15 km radius around the Facility stack) at the maximum resolution of 300 m.

3.44 In addition to the coarse grid, a finer grid of 5 km by 5 km at a resolution of 50 m has been used to cover the location of maximum predicted impact from the Facility.

3.45 In addition, the effects of the proposed development have been assessed at the façades of a representative selection of discrete local existing receptors. All human receptors have been modelled at a height of 1.5 m, representative of typical head height. These sensitive receptors are considered appropriate for the purpose of assessing predicted exposure to emissions from the Facility at residential areas, and were agreed with SEPA prior to commencement of the modelling in 2009. A review of the area indicates that there are no new residential areas or sensitive receptors.

3.46 The locations of these discrete receptors are listed in Table 3.9 and illustrated in Figure 2.

Table 3.9: Modelled Sensitive Receptors

ID	Receptor Type	Receptor Name	National Grid Reference		Distance (km) and Direction from Site
			X(m)	Y(m)	
1	Whitesands Bay	Location on Whitesands Bay	370886	677521	1.5 N
2	Whitesands Bay	Location on Whitesands Bay	371057	677367	1.3 N
3	Whitesands Bay	Location on Whitesands Bay	371289	677281	1.2 N
4	Residential Properties	Track	372475	676697	1.4 NE
5	Residential Properties	Skateraw	373409	675118	2.4 SE
6	Residential Properties	Innerwick	372037	674051	2.2 S
7	Residential Properties	Thurston Home	371455	674489	1.6 S
8	Residential Properties	Pinkerton Hill Cottage	369427	674758	2.2 SW
9	Residential Properties	Little Pinkerton	369526	676117	1.7 W
10	Residential Properties	Brand's Mill	369394	677015	2.0 NW
11	Residential Properties	Edge of Dunbar	368573	677896	3.2 NW
12	Residential Properties	Broxmouth Gardens	369931	677404	1.8 NW
13	Residential Properties	South Lodge	369851	676994	1.6 NW

Note: Receptors have been modelled at 1.5m above ground level, representative of typical head height

3.47 The annual, daily and hourly-mean AQS objectives apply at the front and rear façades of all residential properties. The daily and hourly-mean AQS objectives only, apply at the industrial receptors. The approaches used to predict the concentrations for these different averaging periods are described below.

3.48 Ecological receptors have been considered in Appendix B. SEPA has requested the grid coordinates for the ecological receptors. Over 500 grid coordinates have been modelled so it is not practical to list them in the report. The coordinates are available in the modelling files submitted with this report.

NO_x to NO_2 Relationship

3.49 The NOx emissions will typically comprise approximately 90-95% nitrogen monoxide (NO) and 5-10% nitrogen dioxide (NO_2) at the point of release. The NO oxidises in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal concern in terms of environmental health effects.

3.50 There are various techniques available for estimating the proportion of NOx converted to NO_2 by the time it has reached receptors. The methods used in this assessment are discussed below.

NOx to NO_2 Assumptions

3.51 The approach to converting the predicted NO_X concentration to NO_2 has followed the Environment Agency's online 'Air emissions risk assessment for your environmental permit' guidance which states that:

"For combustion processes where no more than 10% of nitrogen oxides are emitted as nitrogen dioxide, you can assume worst case conversion ratios to nitrogen dioxide of:

- *35% for short-term average concentrations*
- *70% for long-term average concentrations"*

Modelling of Long-term and Short-term Emissions

3.52 Long-term (annual-mean) concentrations have been modelled for comparison with the relevant annual mean objectives. The models were run with the main stack assumed to run for all hours in the year. The model output was then multiplied by the percentage of the year it is expected to run.

3.53 For short-term NO_2, the objective is for the hourly-mean concentration not to exceed 200 $\mu g.m^{-3}$ more than 18 times per calendar year. As there are 8,760 hours in a non-leap year, the hourly-mean concentration would need to be below 200 $\mu g.m^{-3}$ in 8,742 hours, i.e. 99.79% of the time. Therefore, the 99.79th percentile of hourly NO_2 has been modelled.

Significance Criteria

3.54 The Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT document [12] provides the following method for screening out insignificant emissions to air:

"Identify the emissions that warrant further investigation of their impacts, by screening out those which are emitted in such small quantities that they are unlikely to cause a significant impact on the receiving environment. This is done using the method below:

1. Compare the short-term and long-term process contributions (PC) of substances emitted to air against the relevant short term and long term environmental benchmarks for emissions to air...

2. Identify which emissions warrant further assessment by applying the criteria below:

PC long term > 1% of the long term environmental benchmark

PC short term > 10% of the short term environmental benchmark"

3.55 The IPPC document provides further guidance to *Assess Acceptability against Local Environmental Quality Requirements:*

"1. Check whether the emissions of substances from the proposed options are acceptable in relation to the existing local air quality and any statutory requirements… This should be done for long-term emissions by comparing the long-term Predicted Environmental Concentration of each substance

released to air … with the corresponding long-term EAL or EQS for that substance. For short-term emissions the PEC should be calculated by adding the short-term Process contribution to twice the long-term ambient concentration and then the PEC should be compared with the short term EAL or EQS...")

2. Identify any releases where the EAL or EQS is already exceeded, or where the contribution from the installation will result in the EAL or EQS being exceeded. Such options are unlikely to be considered acceptable and should normally be ruled out of further consideration in this appraisal. …"

3.56 On that basis, for this assessment:

- the effects are not considered significant if the short-term PC is less than 10% of the short-term Environmental Assessment Level (EAL);
- The effects are not considered significant if the long-term PC is less than 1% of the long-term EAL; and
- The effects are not considered significant if the PEC is below the EAL.

Uncertainty

3.57 All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

3.58 The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

3.59 Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the range informed by an analysis of relevant, available data.

3.60 The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 3.10.

Table 3.10 Approaches to Dealing with Uncertainty used Within the Assessment

Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has been run for five full years of meteorological conditions and a sensitivity test using Viridor 2008 meteorological data.	The conservative assumptions adopted ensure that the concentration predicted is towards the top of the uncertainty range, rather than a central estimate.
Model	Two formally validated dispersion models have been used: ADMS and AERMOD.	
Terrain	The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume centre line and ground level and by increasing turbulence and, hence, plume mixing. A complex terrain file has been used within the model.	
Emissions	For the purposes of the assessment, the plant is assumed to operate at the emission and concentration limits set out in the IED. In reality, emissions are likely to be lower than the IED concentration limits.	
Receptors	The model has been run for coarse and fine grids within a 30 km x 30 km area.	

3.61 The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4 Baseline Air Quality Conditions

Overview

4.1 The background concentration often represents a large proportion of the total pollution concentration, so it is important that the background concentration selected for the assessment is realistic. EPUK/IAQM guidance highlight public information from Defra and local monitoring studies as potential sources of information on background air quality.

4.2 For this assessment, the background air quality has been characterised by drawing on information from the following public sources:

- Defra maps [13], which show estimated pollutant concentrations across the UK in 1 km grid squares;
- published results of local authority Review and Assessment (R&A) studies of air quality, including local monitoring and modelling studies; and
- results published by national monitoring networks.

4.3 The background concentrations used in the assessment are set out in Table 4.1. The data sources are the same as the 2014 assessment but considers more recent monitoring data.

Table 4.1 Summary of Assumed Background Concentrations (μg.m^{-3})

Pollutant	Short-term (a)	Long-term	Data Source
Nitrogen dioxide (NO_2)	18.0	9.0	Haddington-Lyn Lea Urban Background Diffusion Tube 2016 – Max of 2015 to 2019
Particulates ($PM_{2.5}$)	-	6.4	Defra Mapped (2018)
Sulphur dioxide (SO_2)	7.3	3.6	Edinburgh St Leonard's AURN - Max of 2017 to 2019
HCl	0.52	0.26	Bush Estate 2015 – latest year of monitoring
Arsenic (As)	4.42E-04	2.21E-04	Auchencorth Moss – Max of 2017 to 2019
Cadmium (Cd)	5.08E-05	2.54E-05	
Nickel (Ni)	7.40E-04	3.70E-04	
B[a]P	-	3.30E-05	
Benzene	-	7.79E-01	Grangemouth - Max of 2017 to 2019

Note:
(a) Short-term background data approximately equate to the 90th percentile, which is approximately equivalent to 2 x the annual mean.

5 Assessment of Air Quality Impacts

5.1 For each of the five years of meteorological data (2016 to 2020), the maximum predicted ground-level concentration across the modelled domain has been derived and are reported below.

5.2 In addition, the following sensitivity tests have been undertaken and the results presented in Appendix A.

– Sensitivity Test 1 – Use of AERMOD dispersion model

– Sensitivity Test 2 – Varying surface roughness

– Sensitivity Test 3 – Use of Viridor meteorological data for 2008

5.3 An assessment of plume visibility is shown in Appendix C.

Scenario 1: Results

5.4 Table 5.1 summarises the maximum predicted PC across the modelled grid to ground-level concentrations for all relevant pollutants with short-term emission limits set out in the IED. The PCs are compared with the most recent Environment Assessment Levels. The 2014 'PCs as a percentage of the EAL' have been recalculated to use the most recent EALs.

5.5 Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table 5.2.

Scenario 2: Results

5.6 Table 5.3 summarises the PCs and the resulting PECs for all pollutants assuming that the proposed development is operating at long-term emission limits. Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table 5.4.

Table 5.1 Predicted Maximum Process Contributions (µg.m^{-3}) at Short-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
HCl	1 hour (maximum)	750	58.2	8	89.5	16.9	58.5	40.3	17.9	89.5	12	10	Yes
HF	1 hour (maximum)	160	3.9	2	6.0	1.1	3.9	2.7	1.2	6.0	4	10	No
SO_2	15 minute (99.90th percentile)	266	38.6	14	33.1	30.5	37.2	32.0	29.4	37.2	14	10	Yes
	1 hour (99.73th percentile)	350	52.5	15	26.1	25.9	26.1	25.4	26.1	26.1	7	10	No
	24 hour (99.18th percentile)	125	-	-	9.9	9.4	9.3	8.0	9.9	9.9	8	10	No
NO_2	1 hour (99.79th percentile)	200	41.2	21	19.0	18.4	18.7	18.5	18.4	19.0	9	10	No
PM_{10}	24 hour (90.41st percentile)	50	-	-	1.3	1.0	1.2	1.0	1.2	1.3	3	10	No
CO	8 hour (maximum daily running)	10000	-	-	49.7	13.7	16.3	16.8	27.8	49.7	0	10	No

Note: 2014 PC is maximum of ADMS and AERMOD.

The higher of the 2014 PC and the updated PC are highlighted in grey.

Table 5.2 Maximum Predicted Environmental Concentrations (µg.m^{-3}) at Short-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC (µg.m^{-3})	Tarmac PC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	PEC is Potentially Significant?
HCl	1 hour (maximum)	750	89.5	12	10	Yes	0.5	4.9	101.7	14	No
SO_2	15 minute (99.90th percentile)	266	37.2	14	10	Yes	7.3	66.1	103.9	39	No

Table 5.3 Predicted Maximum Process Contributions (µg.m^{-3}) at Long-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PM_{10}	24 hour (98.08th percentile)	50	0.84	2	0.42	0.33	0.41	0.34	0.39	0.42	1	10	No
	24 hour (annual mean)	18	0.17	1	0.05	0.06	0.06	0.05	0.05	0.06	0	1	No
$PM_{2.5}$	24 hour (annual mean)	10	-	-	0.05	0.06	0.06	0.05	0.05	0.06	1	1	No
HCl	1 hour (maximum)	750	9.70	1	14.92	2.82	9.75	6.72	2.98	14.92	2	10	No
HF	1 hour (maximum)	160	0.97	1	1.49	0.28	0.98	0.67	0.30	1.49	1	10	No
SO_2	15 minute (99.90th percentile)	266	9.64	4	8.29	7.62	9.31	8.00	7.34	9.31	3	10	No
	1 hour (99.73th percentile)	350	13.14	4	6.53	6.47	6.51	6.35	6.51	6.53	2	10	No
	24 hour (99.18th percentile)	125	5.11	4	2.47	2.35	2.32	2.00	2.47	2.47	2	10	No

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
	1 hour (annual mean)	50	0.83	2	0.25	0.32	0.29	0.26	0.26	0.32	1	1	No
NO_2	1 hour (99.79th percentile)	200	20.58	10	9.48	9.18	9.33	9.25	9.20	9.48	5	10	No
	1 hour (annual mean)	40	2.34	6	0.70	0.91	0.81	0.73	0.73	0.91	2	1	Yes
CO	8 hour (maximum daily running)	10,000	10.36	0	24.87	6.86	8.13	8.42	13.90	24.87	0	10	No
Cd	1 hour (annual mean)	0.005	4.4E-04	9	0.00	0.00	0.00	0.00	0.00	0.00	6	10	No
Tl	1 hour (maximum)	30	2.4E-02	0	7.46E-02	1.41E-02	4.88E-02	3.36E-02	1.49E-02	7.46E-02	0	10	No
	1 hour (annual mean)	1	4.4E-04	0	2.51E-04	3.24E-04	2.89E-04	2.61E-04	2.62E-04	3.24E-04	0	1	No
Hg	1 hour (maximum)	7.5	4.9E-02	1	7.46E-02	1.41E-02	4.88E-02	3.36E-02	1.49E-02	7.46E-02	1	10	No
	1 hour (annual mean)	0.25	8.8E-04	0	2.51E-04	3.24E-04	2.89E-04	2.61E-04	2.62E-04	3.24E-04	0	1	No
Sb	1 hour (maximum)	150	1.70E-01	0	1.72E-02	3.24E-03	1.12E-02	7.73E-03	3.43E-03	1.72E-02	0	10	No
	1 hour (annual mean)	5	2.93E-03	0	5.78E-05	7.46E-05	6.65E-05	6.01E-05	6.03E-05	7.46E-05	0	1	No
As	1 hour (annual mean)	0.006	4.07E-04	7	1.26E-04	1.62E-04	1.45E-04	1.31E-04	1.31E-04	1.62E-04	3	1	Yes
Cr	1 hour (maximum)	150	1.19E-01	0	1.37E-01	2.59E-02	8.97E-02	6.18E-02	2.74E-02	1.37E-01	0	10	No

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
	1 hour (annual mean)	5	2.05E-03	0	4.62E-04	5.96E-04	5.32E-04	4.81E-04	4.82E-04	5.96E-04	0	1	No
Co	1 hour (maximum)	6	1.70E-01	3	8.21E-03	1.55E-03	5.36E-03	3.70E-03	1.64E-03	8.21E-03	0	10	No
	1 hour (annual mean)	0.2	2.93E-03	1	2.76E-05	3.57E-05	3.18E-05	2.88E-05	2.88E-05	3.57E-05	0	1	No
Cu	1 hour (maximum)	200	5.19E-02	0	4.33E-02	8.18E-03	2.83E-02	1.95E-02	8.65E-03	4.33E-02	0	10	No
	1 hour (annual mean)	10	8.93E-04	0	1.46E-04	1.88E-04	1.68E-04	1.52E-04	1.52E-04	1.88E-04	0	1	No
Pb	1 hour (annual mean)	0.25	2.93E-03	1	2.54E-04	3.27E-04	2.92E-04	2.64E-04	2.65E-04	3.27E-04	0	1	No
Mn	1 hour (maximum)	1500	1.70E-01	0	8.95E-02	1.69E-02	5.85E-02	4.03E-02	1.79E-02	8.95E-02	0	10	No
	1 hour (annual mean)	0.15	2.93E-03	2	3.02E-04	3.89E-04	3.47E-04	3.14E-04	3.14E-04	3.89E-04	0	1	No
Ni	1 hour (annual mean)	0.02	2.07E-03	10	1.11E-03	1.43E-03	1.27E-03	1.15E-03	1.15E-03	1.43E-03	7	1	Yes
V	1 hour (maximum)	1	1.70E-01	17	8.95E-03	1.69E-03	5.85E-03	4.03E-03	1.79E-03	8.95E-03	1	10	No
	1 hour (annual mean)	5	2.93E-03	0	3.02E-05	3.89E-05	3.47E-05	3.14E-05	3.14E-05	3.89E-05	0	1	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
Dioxins & Furans	1 hour (annual mean)	-	1.67E-09	-	5.03E-10	6.48E-10	5.79E-10	5.23E-10	5.24E-10	6.48E-10	-	-	-
	1 hour (maximum)	-	9.70E-08	-	1.49E-07	2.82E-08	9.75E-08	6.72E-08	2.98E-08	1.49E-07	-	-	-
PAHs as B[a]P	1 hour (annual mean)	0.00025 (B[a]P)	3.34E-04 (PAHs)	134	1.01E-04	1.30E-04	1.16E-04	1.05E-04	1.05E-04	1.30E-04 (PAHs)	52	1	Yes
PCB	1 hour (annual mean)	0.2	8.34E-05	0	2.51E-05	3.24E-05	2.89E-05	2.61E-05	2.62E-05	3.24E-05	0	1	No
	1 hour (maximum)	6	4.85E-03	0	7.46E-03	1.41E-03	4.88E-03	3.36E-03	1.49E-03	7.46E-03	0	10	No
N_2O	1 hour (annual mean)	-	-	-	1.51E-01	1.94E-01	1.74E-01	1.57E-01	1.57E-01	1.94E-01	-	-	-
TOC	Running annual mean	3.25 (benzene)	1.67E-01	5	5.03E-02	6.48E-02	5.79E-02	5.23E-02	5.24E-02	6.48E-02	2	1	Yes
NH_3	1 hour (annual mean)	180	8.29E-02	0	5.03E-02	6.48E-02	5.79E-02	5.23E-02	5.24E-02	6.48E-02	0	1	No
	1 hour (maximum)	2500	2.98E+00	0	1.49E+01	2.82E+00	9.75E+00	6.72E+00	2.98E+00	1.49E+01	1	10	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
CrVI	1 hour (annual mean)	0.0002	5.84E-07	0	1.76E-07	2.27E-07	2.02E-07	1.83E-07	1.83E-07	2.27E-07	0	1	No

Note: 2014 PC is maximum of ADMS and AERMOD.

2014 PC for Group 3 metals calculated using a different methodology as explained in paragraph 3.25

The higher of the 2014 PC and the updated PC are highlighted in grey.

Table 5.4 Maximum Predicted Environmental Concentrations ($\mu g.m^{-3}$) at Long-Term Emission Limits

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
NO_2	1 hour (annual mean)	40	0.91	2	1	Yes	9.0	1.29	11.2	28	No
As	1 hour (annual mean)	0.006	1.62E-04	3	1	Yes	2.21E-04	9.24E-06	3.92E-04	7	No
Ni	1 hour (annual mean)	0.02	1.43E-03	7	1	Yes	3.70E-04	8.14E-05	1.88E-03	9	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
PAHs as B[a]P	1 hour (annual mean)	0.00025	1.30E-04 (PAHs)	3	1	Yes	3.30E-05 (B[a]P)	8.00E-04 (PAHs)	9.63E-04	385	Yes
TOC	Running annual mean	3.25 (benzene)	6.48E-02	2	1	Yes	7.79E-01 (benzene)	2.96E-01 (TOCs)	1.14E+00	35	No

5.7 The results presented in Table 5.1 show that the predicted PC is below 10% of the relevant EAL for all pollutants except HCl and 15-minute mean SO_2 and the impacts have been screened out as insignificant.

5.8 For HCl and 15-minute mean SO_2, the PC has been added to the AC and the PC from the Tarmac facility to derive the PEC as shown in Table 5.2. For all pollutants, the cumulative PEC is less than the EAL and the impacts have been screened out as insignificant.

5.9 The results presented in Table 5.3 show that the predicted PC is below 1% or 10% of the relevant EAL for all pollutants except annual-mean NO_2, arsenic, nickel, PAHs and TOCs and the impacts have been screened out as insignificant.

5.10 For annual-mean NO_2, arsenic, nickel, PAHs and TOCs, the PC has been added to the AC and the PC from the Tarmac facility to derive the PEC as shown in Table 5.4. For all pollutants except PAHs, the cumulative PEC is less than the EAL and the impacts have been screened out as insignificant.

5.11 For PAHs, the cumulative PEC is 9.63E-04 $\mu g.m^{-3}$ which is 385% of the B[a]P EAL. The majority of this is the PC from the Tarmac facility. Without the Tarmac facility, the PEC would be 1.63E-04 $\mu g.m^{-3}$ which is only 65% of the EAL. As outlined in Table 3.7, the emission limit value for the Tarmac facility was derived from the average of the monitored concentrations of PAHs from six periods of stack monitoring. Monitoring of B[a]P was not undertaken so the Tarmac PC assumes that all PAHs is B[a]P which is highly conservative.

5.12 Monitoring data for UK EfWs has shown that B[a]P emissions are actually only 10% of total PAH emissions. The Integrated Pollution Prevention and Control reference Document on the Best Available Techniques for Waste Incineration, August 2006 section 3.2.2.1, quotes the following measured (non-continuous measurement) emission concentrations for BaP, and total PAH, <0.001 and <0.01 $mg.m^{-3}$, respectively.

5.13 On that basis, if the PC and the Tarmac facility PC was divided by 10 i.e. to calculate B[a]P PCs, the resulting cumulative PEC would be 1.26E-04 $\mu g.m^{-3}$ which is 50% of the B[a]P EAL and the impacts have been screened out as insignificant.

5.14 Figure 3 shows the contours for the annual mean NO_2 PC. The annual-mean contours for other pollutants will have the same dispersion pattern. For all other averaging periods the PCs and PECs are well below the relevant EALs so contours have not been produced.

Metal Deposition

5.15 The maximum metal deposition rates have been calculated from the PC to air and shown in Table 5.5. The PC to ground have been compared with the relevant deposition rate EALs.

5.16 The updated PC to ground are lower than the 2014 PC to ground. The significance of predicted metal deposition rates are further addressed in the Human Health Risk Assessment.

Table 5.5 Maximum Predicted Contributions to Ground ($mg.m^{-2}.day$) at Long-Term Emission Limits

Pollutant	PC to ground ($mg.m^{-2}.day$) - 2014 Assessment	PC to air ($\mu g.m^{-3}$)	PC to ground ($mg.m^{-2}.day$)*	Deposition Rate EAL ($mg.m^{-2}.day$)*	Max PC as % of EAL
Arsenic	0.0043	0.0002	0.0004	0.02	2
Cadmium	0.0019	0.0003	0.0008	0.009	9
Chromium	0.0043	0.0006	0.0015	1.5	0
Copper	0.0043	0.0000	0.0001	0.25	0
lead	0.0043	0.0003	0.0008	1.1	0
mercury	0.0009	0.0003	0.0008	0.004	21
nickel	0.0043	0.0014	0.0037	0.11	3

*Calculated as PC to air x 0.01 x 3 x 86,400 /1000 as set out in the EA's online guidance. The guidance requires the PC to air to be multiplied by the release rate. The release rate is the same as the mass emissions which has already been considered when deriving the PC to air.

Significance of Effects

5.17 As set out in Section 3, it is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts.

5.18 Based on the predicted concentrations in this section and in Appendix A, the effects are deemed to be not significant, with no predicted exceedances of any objectives or standards across the modelled grid.

6 Mitigation

6.1 Predicted concentrations of pollutants have been demonstrated by the assessment to meet all relevant air quality standards, objectives and EALs. On that basis, no mitigation is proposed.

7 Conclusions

7.1 This assessment has considered the air quality impacts during the operational phase of the Dunbar Energy Recovery Facility (ERF).

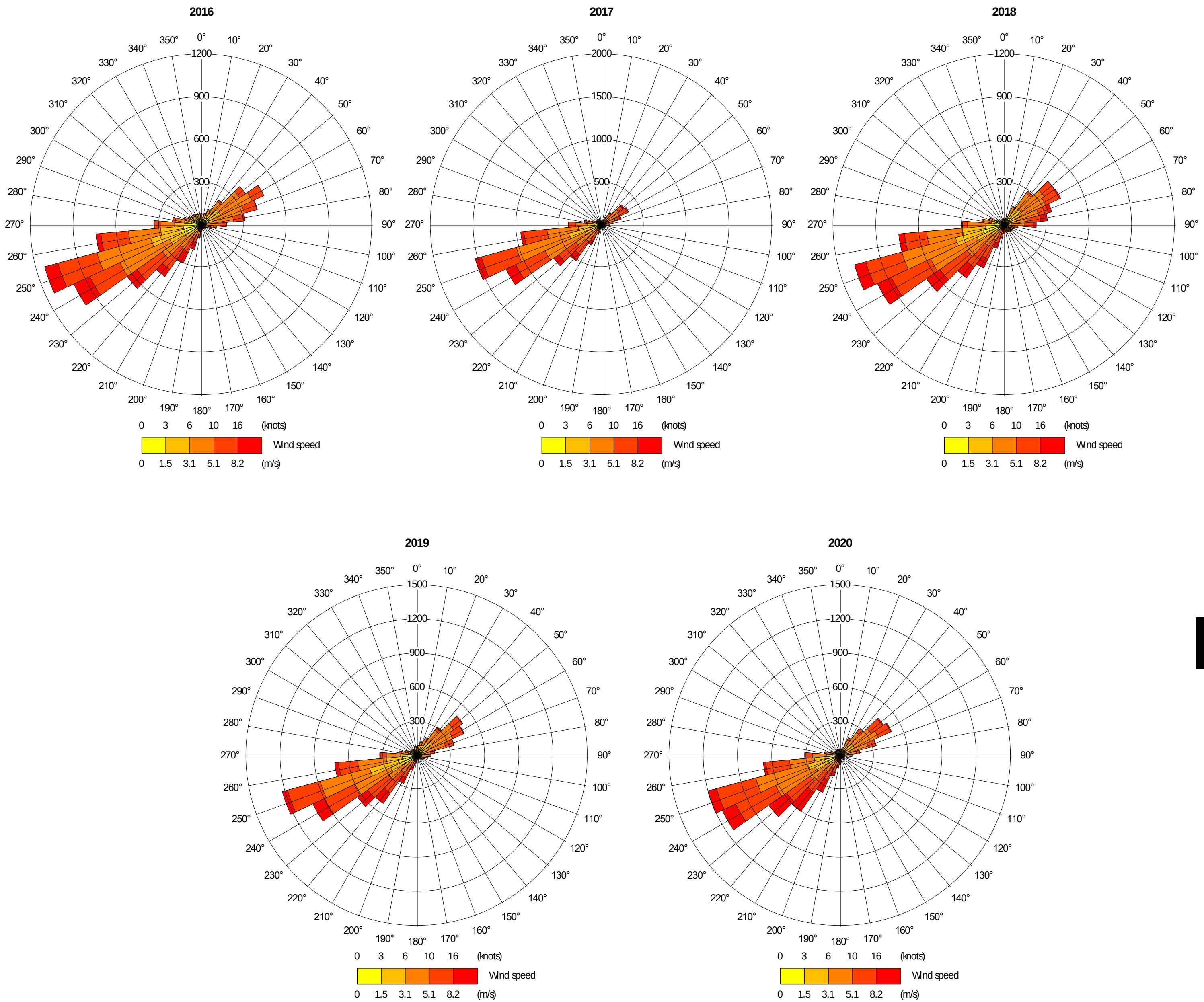
7.2 Emissions from the stack have been assessed through detailed dispersion modelling using best practice approaches. The assessment has been undertaken based on several conservative assumptions. This is likely to result in an over-estimate of the contributions that will arise in practice from the facility. The operational impact on receptors in the local area is predicted to be 'negligible' taking into account the changes in pollutant concentrations and the absolute levels. Using the criteria adopted for the assessment, together with professional judgement, the effects are not considered significant.

7.3 Overall, the effects of the proposed changes to the maximum throughput are not considered to be significant.

Glossary

ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Effect	The consequences of an impact, experienced by a receptor
EPUK	Environmental Protection UK
IAQM	Institute of Air Quality Management
Impact	The change in atmospheric pollutant concentration and/or dust deposition. A scheme can have an ‘impact’ on atmospheric pollutant concentration but no effect, for instance if there are no receptors to experience the impact
R&A	Review and Assessment
Receptor	A person, their land or property and ecologically sensitive sites that may be affected by air quality
Risk	The likelihood of an adverse event occurring

Figures



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6-7 Lovers Walk
Brighton East Sussex BN1 6AH

[redacted]

Client: Viridor

Project: Dunbar ERF

Job Ref: JAR02797

File location:

Date: 11/02/2022	Rev: 0
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Figure 1: Wind Roses – Edinburgh (2016 -2020)

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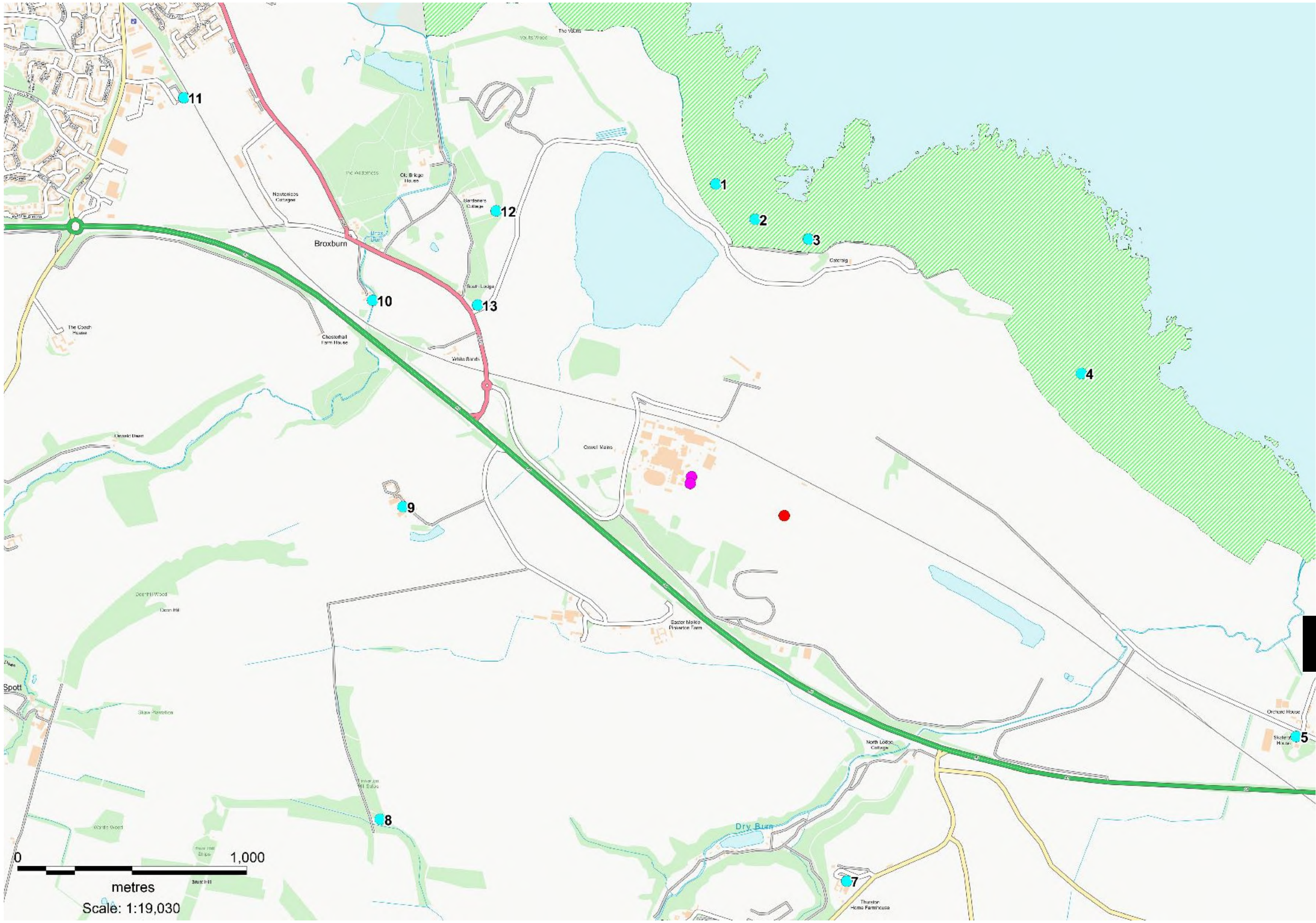

Modelled Stack

Receptors

Modelled Stack - Tarmac

Designated habitat site

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Figure 2: Stacks and Modelled Receptors

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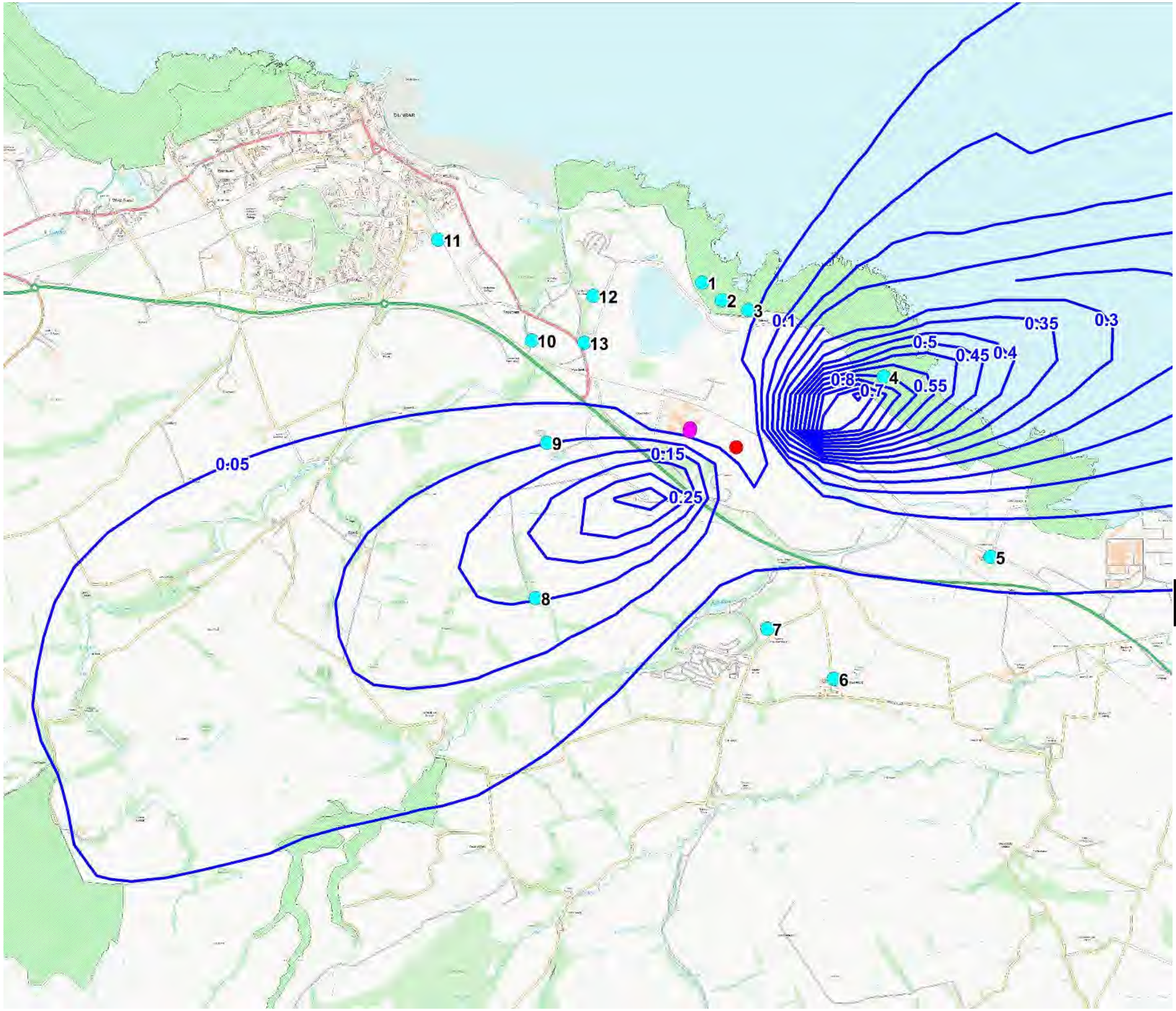

Modelled Stack

Receptors

Modelled Stack - Tarmac

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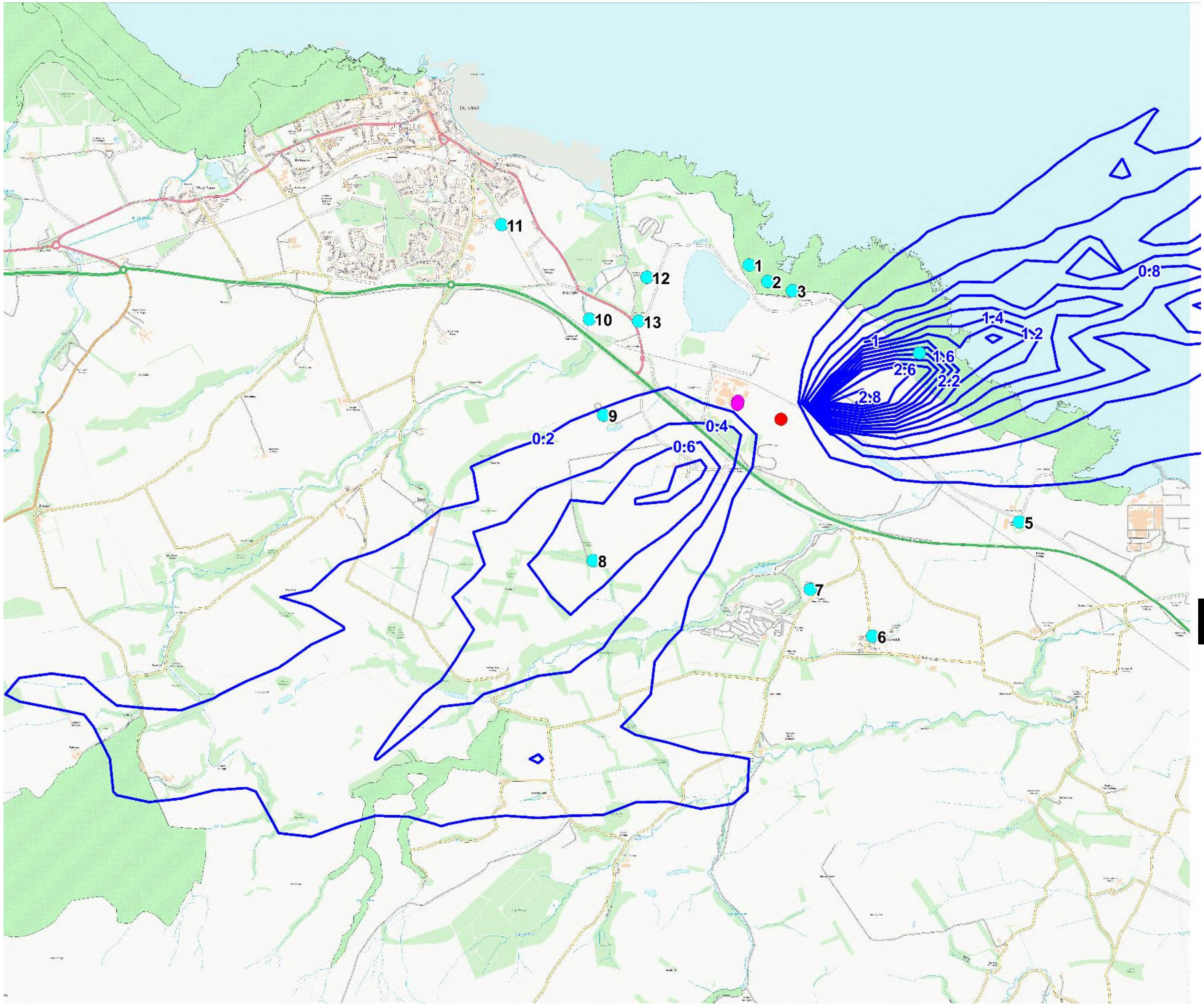
Figure 3: Annual-Mean NO_2 Process Contribution ($\mu g.m^{-3}$) - ADMS



Modelled Stack

Receptors

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Figure 4: Annual-Mean NO_2 Process Contribution ($\mu g.m^{-3}$) - AERMOD

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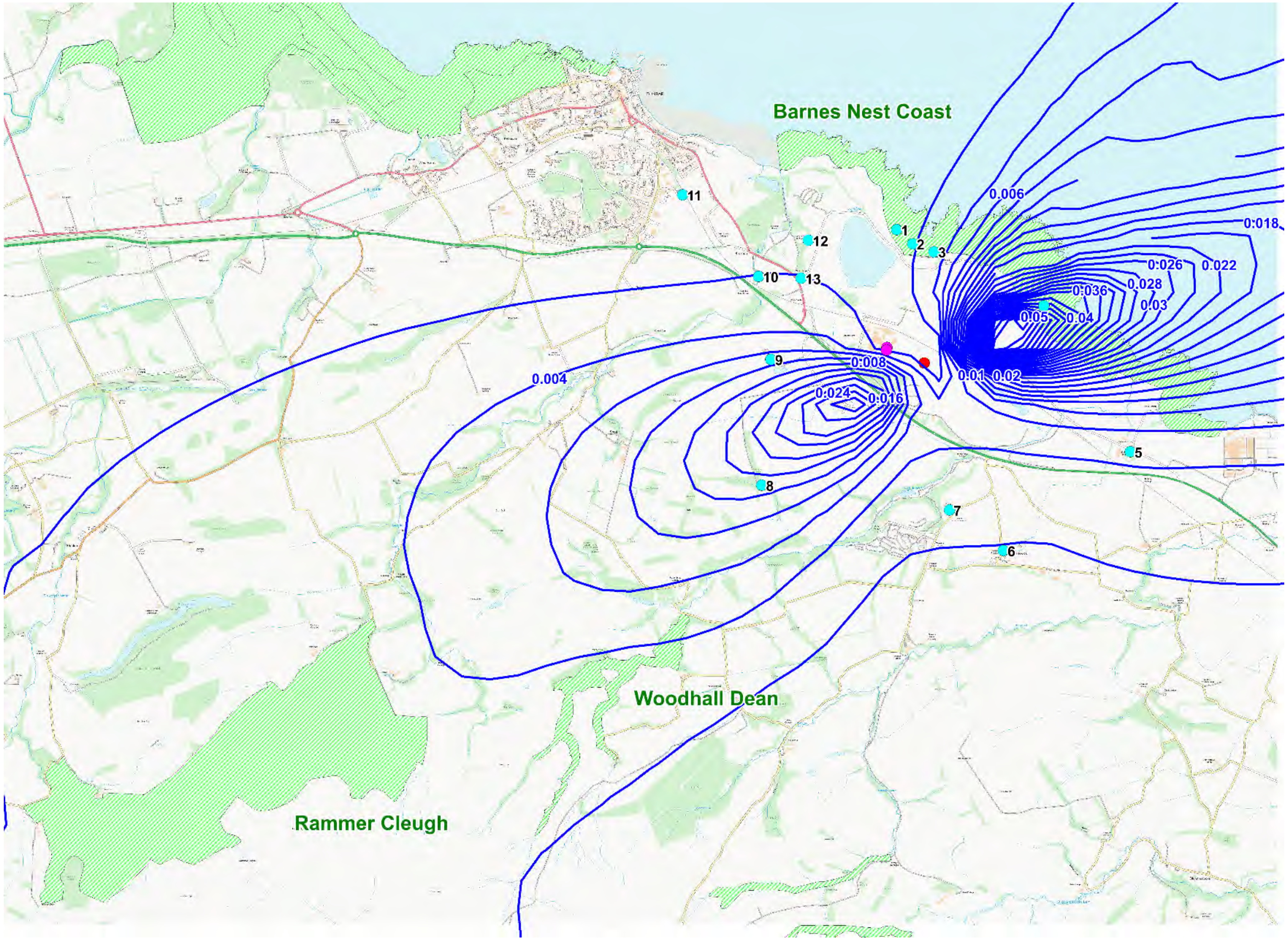

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Receptors

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Figure 5: Annual-Mean NH_3 Process Contribution ($\mu g.m^{-3}$) - ADMS

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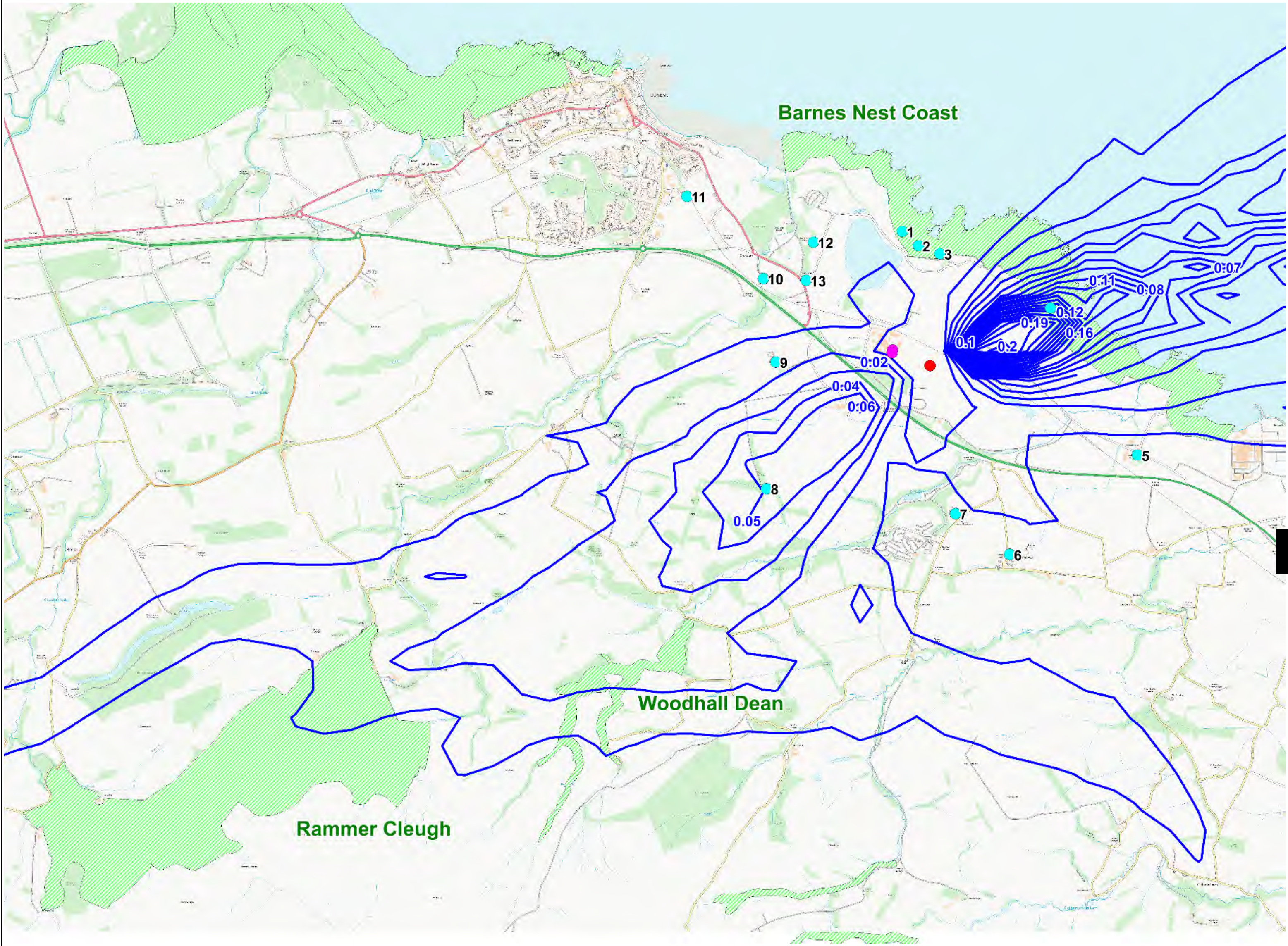

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Figure 6: Annual-Mean NH_3 Process Contribution ($\mu g.m^{-3}$) - AERMOD

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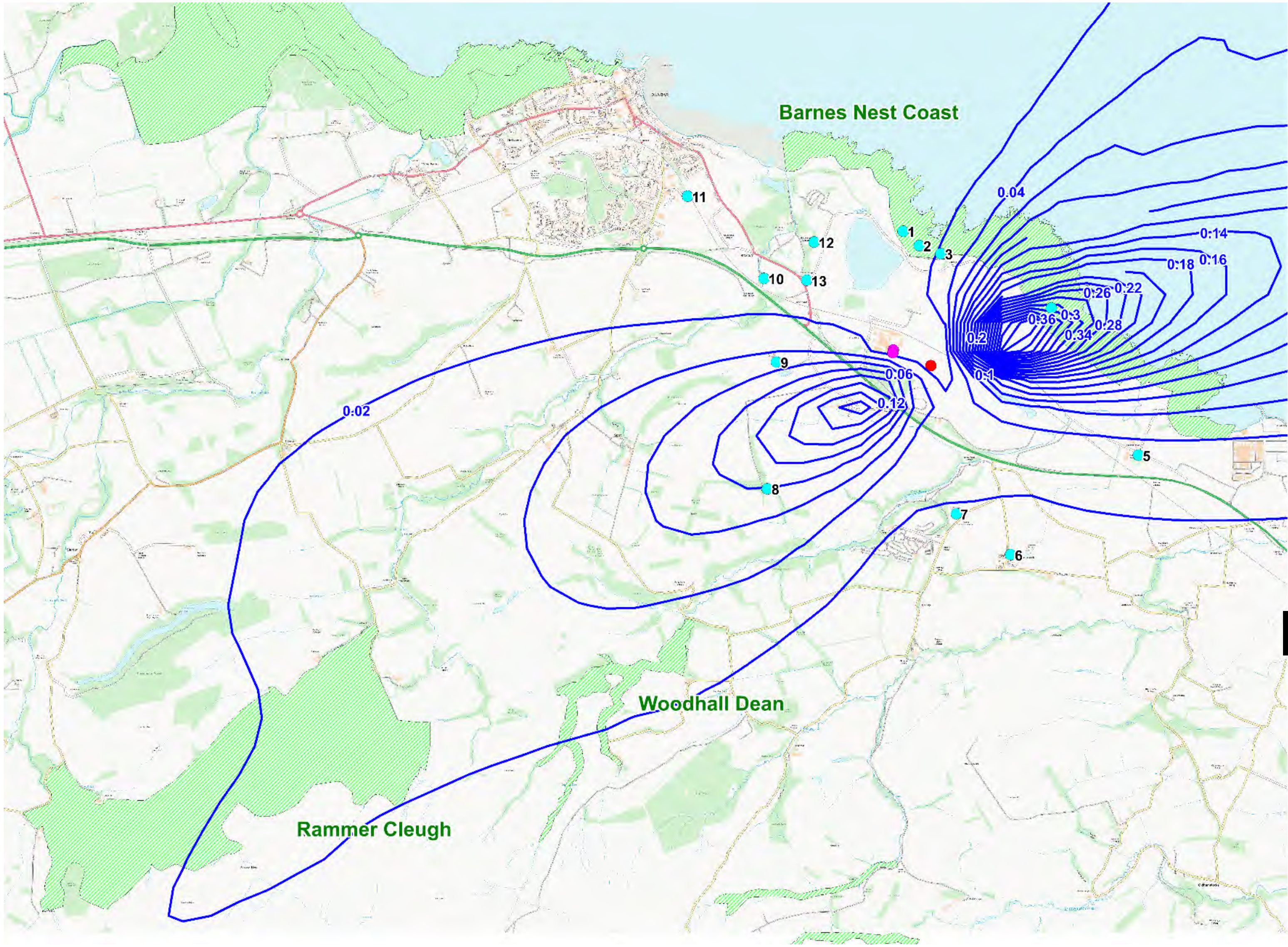

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Figure 7: Annual-Mean Nitrogen Deposition Process Contribution ($\mu g.m^{-3}$) - ADMS

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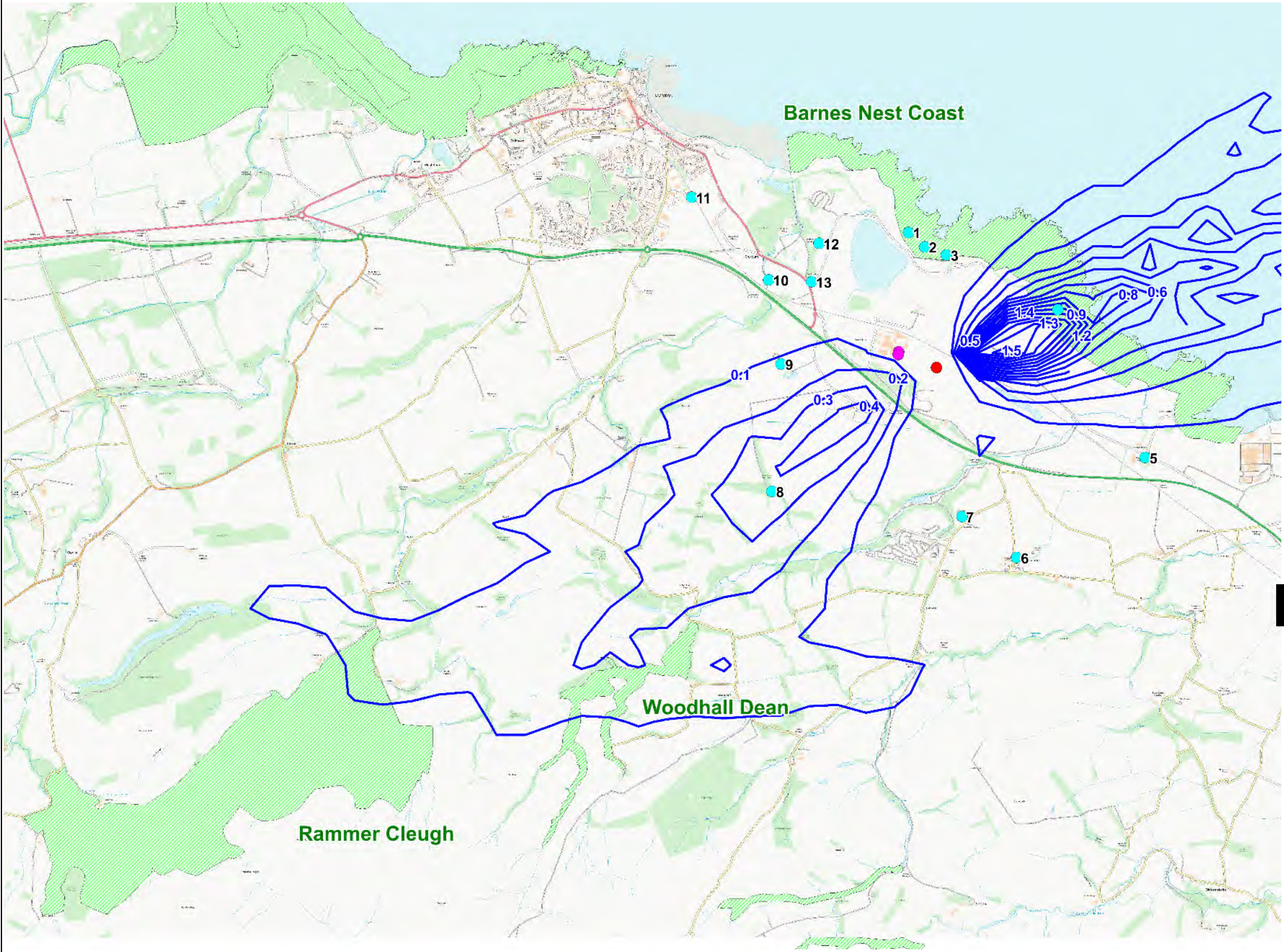

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Figure 8: Annual-Mean Nitrogen Deposition Process Contribution ($\mu g.m^{-3}$) - AERMOD

Appendix A : Results of Sensitivity Tests

A.1 The appendix sets out the results of the following sensitivity tests:

– Sensitivity Test 1 – Use of AERMOD dispersion model

– Sensitivity Test 2 – Varying surface roughness

– Sensitivity Test 3 – Use of Viridor meteorological data for 2008

A.2 Table A.1 and Table A.2 below provide a comparison of the 2014 results with the ADMS results and the three sensitivity tests.

Table A.1 Predicted Maximum Process Contributions (µg.m^{-3}) at Short-Term Emission Limits

Pollutant	Averaging Period	EAL (µg.m^{-3})	Maximum PC (µg.m^{-3})				
			2014 Assessment	ADMS (from Table 5.1)	AERMOD	Varied Surface Roughness	2008 Viridor Met data
HCl	1 hour (maximum)	750	58.2	89.5	36.9	92.1	21.6
HF	1 hour (maximum)	160	3.9	6.0	2.5	6.1	1.4
SO_2	15 minute (99.90th percentile)	266	38.6	37.2	115.0	30.5	29.5
	1 hour (99.73th percentile)	350	52.5	26.1	101.6	26.3	26.9
	24 hour (99.18th percentile)	125	-	9.9	21.2	9.5	17.5
NO_2	1 hour (99.79th percentile)	200	41.2	19.0	72.2	18.9	18.9
PM_{10}	24 hour (90.41st percentile)	50	-	1.3	2.5	1.2	2.4
CO	8 hour (maximum daily running)	10000	-	49.7	53.3	51.2	12.8

Note: 2014 PC is maximum of ADMS and AERMOD.

Table A.2 Predicted Maximum Process Contributions (µg.m^{-3}) at Long-Term Emission Limits

Pollutant	Averaging Period	EAL (µg.m^{-3})	Maximum PC (µg.m^{-3})				
			2014 Assessment	ADMS (From Table 5.3)	AERMOD	Varied Surface Roughness	2008 Viridor Met data
PM_{10}	24 hour (98.08th percentile)	50	0.84	0.42	0.84	0.39	0.79
	24 hour (annual mean)	18	0.17	0.06	0.26	0.06	0.16
$PM_{2.5}$	24 hour (annual mean)	10	-	0.06	0.26	0.06	0.16

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Maximum PC ($\mu g.m^{-3}$)				
			2014 Assessment	ADMS (From Table 5.3)	AERMOD	Varied Surface Roughness	2008 Viridor Met data
HCl	1 hour (maximum)	750	9.70	14.92	6.15	15.36	3.61
HF	1 hour (maximum)	160	0.97	1.49	0.61	1.54	0.36
SO_2	15 minute (99.90th percentile)	266	9.64	9.31	28.76	7.63	7.38
	1 hour (99.73th percentile)	350	13.14	6.53	25.39	6.59	6.74
	24 hour (99.18th percentile)	125	5.11	2.47	5.31	2.39	4.38
	1 hour (annual mean)	50	0.83	0.32	1.34	0.30	0.81
NO_2	1 hour (99.79th percentile)	200	20.58	9.48	36.12	9.43	9.45
	1 hour (annual mean)	40	2.34	0.91	3.74	0.85	2.28
CO	8 hour (maximum daily running)	10,000	10.36	24.87	26.67	25.59	6.38
Cd	1 hour (annual mean)	0.005	4.4E-04	3.24E-04	1.34E-03	3.05E-04	8.14E-04
Tl	1 hour (maximum)	30	2.4E-02	7.46E-02	3.07E-02	7.68E-02	1.80E-02
	1 hour (annual mean)	1	4.4E-04	3.24E-04	1.34E-03	3.05E-04	8.14E-04
Hg	1 hour (maximum)	7.5	4.9E-02	7.46E-02	3.07E-02	7.68E-02	1.80E-02
	1 hour (annual mean)	0.25	8.8E-04	3.24E-04	1.34E-03	3.05E-04	8.14E-04
Sb	1 hour (maximum)	150	1.70E-01	1.72E-02	7.07E-03	1.77E-02	4.15E-03
	1 hour (annual mean)	5	2.93E-03	7.46E-05	3.07E-04	7.01E-05	1.87E-04
As	1 hour (annual mean)	0.006	4.07E-04	1.62E-04	6.68E-04	1.52E-04	4.07E-04
Cr	1 hour (maximum)	150	1.19E-01	1.37E-01	5.66E-02	1.41E-01	3.32E-02
	1 hour (annual mean)	5	2.05E-03	5.96E-04	2.46E-03	5.61E-04	1.50E-03
Co	1 hour (maximum)	6	1.70E-01	8.21E-03	3.38E-03	8.45E-03	1.98E-03
	1 hour (annual mean)	0.2	2.93E-03	3.57E-05	1.47E-04	3.35E-05	8.96E-05
Cu	1 hour (maximum)	200	5.19E-02	4.33E-02	1.78E-02	4.45E-02	1.05E-02
	1 hour (annual mean)	10	8.93E-04	1.88E-04	7.75E-04	1.77E-04	4.72E-04
Pb	1 hour (annual mean)	0.25	2.93E-03	3.27E-04	1.35E-03	3.08E-04	8.22E-04
Mn	1 hour (maximum)	1500	1.70E-01	8.95E-02	3.69E-02	9.21E-02	2.16E-02
	1 hour (annual mean)	0.15	2.93E-03	3.89E-04	1.60E-03	3.66E-04	9.77E-04
Ni	1 hour (annual mean)	0.02	2.07E-03	1.43E-03	5.88E-03	1.34E-03	3.58E-03
V	1 hour (maximum)	1	1.70E-01	8.95E-03	3.69E-03	9.21E-03	2.16E-03
	1 hour (annual mean)	5	2.93E-03	3.89E-05	1.60E-04	3.66E-05	9.77E-05
	1 hour (annual mean)	-	1.67E-09	6.48E-10	2.67E-09	6.10E-10	1.63E-09

Pollutant	Averaging Period	EAL (µg.m-3)	Maximum PC (µg.m-3)				
			2014 Assessment	ADMS (From Table 5.3)	AERMOD	Varied Surface Roughness	2008 Viridor Met data
Dioxins & Furans	1 hour (maximum)	-	9.70E-08	1.49E-07	6.15E-08	1.54E-07	3.61E-08
PAHs as B[a]P	1 hour (annual mean)	0.00025 (B[a]P)	3.34E-04 (PAHs)	1.30E-04	5.35E-04	1.22E-04	3.26E-04
PCB	1 hour (annual mean)	0.2	8.34E-05	3.24E-05	1.34E-04	3.05E-05	8.14E-05
	1 hour (maximum)	6	4.85E-03	7.46E-03	3.07E-03	7.68E-03	1.80E-03
N_2O	1 hour (annual mean)	-	-	1.94E-01	8.02E-01	1.83E-01	4.89E-01
TOC	Running annual mean	3.25 (benzene)	1.67E-01	6.48E-02	2.67E-01	6.10E-02	1.63E-01
NH_3	1 hour (annual mean)	180	8.29E-02	6.48E-02	2.67E-01	6.10E-02	1.63E-01
	1 hour (maximum)	2500	2.98E+00	1.49E+01	6.15E+00	1.54E+01	3.61E+00
CrVI	1 hour (annual mean)	0.0002	5.84E-07	2.27E-07	9.36E-07	2.13E-07	5.70E-07

Note: 2014 PC is maximum of ADMS and AERMOD.

2014 PC for Group 3 metals calculated using a different methodology as explained in paragraph 3.25

A.3 The PCs using the AERMOD dispersion model are in some cases substantially higher than the PCs predicted by the ADMS model and have been considered in more detail in the following section.

A.4 The PCs with the varied surface roughness and the 2008 Viridor met data are similar to or lower than the PCs in Table 5.1 and Table 5.3 and the AERMOD PCs so have not been considered further.

AERMOD Results

Scenario 1: Results

A.5 Table A.3 summarises the maximum predicted PC across the modelled grid to ground-level concentrations for all relevant pollutants with short-term emission limits set out in the IED. The PCs are compared with the most recent Environment Assessment Levels. The 2014 'PCs as a percentage of the EAL' have been recalculated to use the most recent EALs.

A.6 Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table A.4.

Scenario 2: Results

A.7 Table A.5 summarises the PCs and the resulting PECs for all pollutants assuming that the proposed development is operating at long-term emission limits. Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table A.6.

Table A.3 Predicted Maximum Process Contributions (µg.m^{-3}) at Short-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
HCl	1 hour (maximum)	750	58.2	8	36.9	36.7	36.6	36.3	36.6	36.9	5	10	No
HF	1 hour (maximum)	160	3.9	2	2.5	2.4	2.4	2.4	2.4	2.5	2	10	No
SO_2	15 minute (99.90th percentile)	266	38.6	14	103.9	104.9	112.6	108.0	115.0	115.0	43	10	Yes
	1 hour (99.73th percentile)	350	52.5	15	100.1	97.1	100.7	101.6	100.1	101.6	29	10	Yes
	24 hour (99.18th percentile)	125	-	-	16.3	15.6	21.2	17.6	15.2	21.2	17	10	Yes
NO_2	1 hour (99.79th percentile)	200	41.2	21	71.1	69.1	71.7	72.2	71.7	72.2	36	10	Yes
PM_{10}	24 hour (90.41st percentile)	50	-	-	2.1	2.1	2.5	2.2	2.1	2.5	5	10	No
CO	8 hour (maximum daily running)	10000	-	-	42.3	53.3	38.7	26.6	34.4	53.3	1	10	No

Note: 2014 PC is maximum of ADMS and AERMOD.

The higher of the 2014 PC and the updated PC are highlighted in grey.

Table A.4 Maximum Predicted Environmental Concentrations (µg.m^{-3}) at Short-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC (µg.m^{-3})	Tarmac PC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	PEC is Potentially Significant?
SO_2	15 minute (99.90th percentile)	266	115.0	43	10	Yes	7.3	66.1	188.4	71	No

	1 hour (99.73th percentile)	350	101.6	29	10	Yes	7.3	57.3	166.1	47	No
	24 hour (99.18th percentile)	125	21.2	17	10	Yes	7.3	19.0	47.5	38	No
NO_2	1 hour (99.79th percentile)	200	72.2	36	10	Yes	18.0	25.8	116.0	58	No

Table A.5 Predicted Maximum Process Contributions ($\mu g.m^{-3}$) at Long-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PM_{10}	24 hour (98.08th percentile)	50	0.84	2	0.70	0.71	0.84	0.73	0.70	0.84	2	10	No
	24 hour (annual mean)	18	0.17	1	0.20	0.26	0.21	0.23	0.21	0.26	1	1	No
$PM_{2.5}$	24 hour (annual mean)	10	-	-	0.20	0.26	0.21	0.23	0.21	0.26	3	1	Yes
HCl	1 hour (maximum)	750	9.70	1	6.15	6.11	6.10	6.05	6.09	6.15	1	10	No
HF	1 hour (maximum)	160	0.97	1	0.61	0.61	0.61	0.60	0.61	0.61	0	10	No
SO_2	15 minute (99.90th percentile)	266	9.64	4	25.97	26.23	28.15	27.00	28.76	28.76	11	10	Yes
	1 hour (99.73th percentile)	350	13.14	4	25.04	24.27	25.19	25.39	25.04	25.39	7	10	No
	24 hour (99.18th percentile)	125	5.11	4	4.07	3.90	5.31	4.41	3.80	5.31	4	10	No
	1 hour (annual mean)	50	0.83	2	1.01	1.34	1.05	1.14	1.03	1.34	3	1	Yes
NO_2	1 hour (99.79th percentile)	200	20.58	10	35.54	34.56	35.85	36.12	35.84	36.12	18	10	Yes
	1 hour (annual mean)	40	2.34	6	2.83	3.74	2.94	3.18	2.90	3.74	9	1	Yes

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
CO	8 hour (maximum daily running)	10,000	10.36	0	21.15	26.67	19.36	13.29	17.19	26.67	0	10	No
Cd	1 hour (annual mean)	0.005	4.4E-04	9	1.01E-03	1.34E-03	1.05E-03	1.14E-03	1.03E-03	1.34E-03	27	10	Yes
Tl	1 hour (maximum)	30	2.4E-02	0	3.07E-02	3.06E-02	3.05E-02	3.02E-02	3.05E-02	3.07E-02	0	10	No
	1 hour (annual mean)	1	4.4E-04	0	1.01E-03	1.34E-03	1.05E-03	1.14E-03	1.03E-03	1.34E-03	0	1	No
Hg	1 hour (maximum)	7.5	4.9E-02	1	3.07E-02	3.06E-02	3.05E-02	3.02E-02	3.05E-02	3.07E-02	0	10	No
	1 hour (annual mean)	0.25	8.8E-04	0	1.01E-03	1.34E-03	1.05E-03	1.14E-03	1.03E-03	1.34E-03	1	1	No
Sb	1 hour (maximum)	150	1.70E-01	0	7.07E-03	7.03E-03	7.02E-03	6.96E-03	7.01E-03	7.07E-03	0	10	No
	1 hour (annual mean)	5	2.93E-03	0	2.33E-04	3.07E-04	2.42E-04	2.61E-04	2.38E-04	3.07E-04	0	1	No
As	1 hour (annual mean)	0.006	4.07E-04	7	5.05E-04	6.68E-04	5.26E-04	5.68E-04	5.17E-04	6.68E-04	11	1	Yes
Cr	1 hour (maximum)	150	1.19E-01	0	5.66E-02	5.62E-02	5.61E-02	5.56E-02	5.60E-02	5.66E-02	0	10	No
	1 hour (annual mean)	5	2.05E-03	0	1.86E-03	2.46E-03	1.93E-03	2.09E-03	1.90E-03	2.46E-03	0	1	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
Co	1 hour (maximum)	6	1.70E-01	3	3.38E-03	3.36E-03	3.36E-03	3.33E-03	3.35E-03	3.38E-03	0	10	No
	1 hour (annual mean)	0.2	2.93E-03	1	1.11E-04	1.47E-04	1.16E-04	1.25E-04	1.14E-04	1.47E-04	0	1	No
Cu	1 hour (maximum)	200	5.19E-02	0	1.78E-02	1.77E-02	1.77E-02	1.75E-02	1.77E-02	1.78E-02	0	10	No
	1 hour (annual mean)	10	8.93E-04	0	5.86E-04	7.75E-04	6.10E-04	6.59E-04	6.00E-04	7.75E-04	0	1	No
Pb	1 hour (annual mean)	0.25	2.93E-03	1	1.02E-03	1.35E-03	1.06E-03	1.15E-03	1.05E-03	1.35E-03	1	1	No
Mn	1 hour (maximum)	1500	1.70E-01	0	3.69E-02	3.67E-02	3.66E-02	3.63E-02	3.66E-02	3.69E-02	0	10	No
	1 hour (annual mean)	0.15	2.93E-03	2	1.21E-03	1.60E-03	1.26E-03	1.36E-03	1.24E-03	1.60E-03	1	1	No
Ni	1 hour (annual mean)	0.02	2.07E-03	10	4.45E-03	5.88E-03	4.63E-03	5.00E-03	4.55E-03	5.88E-03	29	1	Yes
V	1 hour (maximum)	1	1.70E-01	17	3.69E-03	3.67E-03	3.66E-03	3.63E-03	3.66E-03	3.69E-03	0	10	No
	1 hour (annual mean)	5	2.93E-03	0	1.21E-04	1.60E-04	1.26E-04	1.36E-04	1.24E-04	1.60E-04	0	1	No
	1 hour (annual mean)	-	1.67E-09	-	2.02E-09	2.67E-09	2.10E-09	2.27E-09	2.07E-09	2.67E-09	-	-	-

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC (2014 Assessment)	2014 PC as % of EAL	Met Data - 2016	Met Data - 2017	Met Data - 2018	Met Data - 2019	Met Data - 2020	Max PC – all Met Data Years ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
Dioxins & Furans	1 hour (maximum)	-	9.70E-08	-	6.15E-08	6.11E-08	6.10E-08	6.05E-08	6.09E-08	6.15E-08	-	-	-
PAHs as B[a]P	1 hour (annual mean)	0.00025 (B[a]P)	3.34E-04 (PAHs)	134	4.04E-04	5.35E-04	4.21E-04	4.54E-04	4.14E-04	5.35E-04 (PAHS)	214	1	Yes
PCB	1 hour (annual mean)	0.2	8.34E-05	0	1.01E-04	1.34E-04	1.05E-04	1.14E-04	1.03E-04	1.34E-04	0	1	No
	1 hour (maximum)	6	4.85E-03	0	3.07E-03	3.06E-03	3.05E-03	3.02E-03	3.05E-03	3.07E-03	0	10	No
N_2O	1 hour (annual mean)	-	-	-	6.07E-01	8.02E-01	6.31E-01	6.81E-01	6.21E-01	8.02E-01	-	-	-
TOC	Running annual mean	3.25 (benzene)	1.67E-01	5	2.02E-01	2.67E-01	2.10E-01	2.27E-01	2.07E-01	2.67E-01	8	1	Yes
NH_3	1 hour (annual mean)	180	8.29E-02	0	2.02E-01	2.67E-01	2.10E-01	2.27E-01	2.07E-01	2.67E-01	0	1	No
	1 hour (maximum)	2500	2.98E+00	0	6.15E+00	6.11E+00	6.10E+00	6.05E+00	6.09E+00	6.15E+00	0	10	No
CrVI	1 hour (annual mean)	0.0002	5.84E-07	0	7.08E-07	9.36E-07	7.36E-07	7.95E-07	7.24E-07	9.36E-07	0	1	No

Note: 2014 PC is maximum of ADMS and AERMOD.

2014 PC for Group 3 metals calculated using a different methodology as explained in paragraph 3.25

The higher of the 2014 PC and the updated PC are highlighted in grey.

Table A.6 Maximum Predicted Environmental Concentrations ($\mu g.m^{-3}$) at Long-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC* ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
$PM_{2.5}$	24 hour (annual mean)	10	0.26	3	1	Yes	6.4	0.16 (A17) + 0.08 (A10)	6.9	69	No
SO_2	15 minute (99.90th percentile)	266	28.76	11	10	Yes	7.3	66.1	102.1	38	No
	1 hour (annual mean)	50	1.34	3	1	Yes	3.6	1.48	6.4	13	No
NO_2	1 hour (99.79th percentile)	200	36.12	18	10	Yes	18.0	25.8	79.9	40	No
	1 hour (annual mean)	40	3.74	9	1	Yes	9.0	1.29	14.0	35	No
Cd	1 hour (annual mean)	0.005	1.34E-03	27	1	Yes	2.54E-05	1.85E-04	1.55E-03	31	No

As	1 hour (annual mean)	0.006	6.68E-04	11	1	Yes	2.21E-04	9.24E-06	8.99E-04	15	No
Ni	1 hour (annual mean)	0.02	5.88E-03	29	1	Yes	3.70E-04	8.14E-05	6.33E-03	32	No
PAHs as B[a]P	1 hour (annual mean)	0.00025	5.35E-04 (PAHs)	214	1	Yes	3.30E-05 (B[a]P)	8.00E-04 (PAHs)	1.37E-03	547	Yes
TOC	Running annual mean	3.25 (benzene)	2.67E-01	8	1	Yes	7.79E-01 (benzene)	2.96E-01 (TOCs)	1.34	41	No

*Only pollutant for stack A17 is PM.

A.8 The results presented in Table A.3 show that the predicted PC is below 10% of the relevant EAL for all pollutants except NO_2 and SO_2 and the impacts have been screened out as insignificant.

A.9 For NO_2 and SO_2, the PC has been added to the AC and the PC from the Tarmac facility to derive the PEC as shown in Table A.4. For all pollutants, the cumulative PEC is less than the EAL and the impacts have been screened out as insignificant.

A.10 The results presented in Table A.5 show that the predicted PC is below 1% or 10% of the relevant EAL for all pollutants except $PM_{2.5}$, SO_2, NO_2, cadmium, arsenic, nickel, PAHs and TOCs and the impacts have been screened out as insignificant.

A.11 For $PM_{2.5}$, SO_2, NO_2, cadmium, arsenic, nickel, PAHs and TOCs, the PC has been added to the AC and the PC from the Tarmac facility to derive the PEC as shown in Table A.6. For all pollutants except PAHs, the cumulative PEC is less than the EAL and the impacts have been screened out as insignificant.

A.12 For PAHs, the cumulative PEC is 1.37E-03 $\mu g.m^{-3}$ which is 547% of the B[a]P EAL.

A.13 On the basis that monitoring shows that approximately 10% of PAHs is B[a]P, if the PC and the Tarmac facility PC was divided by 10 i.e. to calculate at B[a]P PCs, the resulting cumulative PEC would be 1.66E-04 $\mu g.m^{-3}$ which is 67% of the B[a]P EAL and the impacts have been screened out as insignificant.

A.14 A contour plot of the annual-mean NO_2 PC is shown in Figure 4.

Appendix B: Impacts at Ecological Receptors

Scope

B.1 The assessment considers the impact of the development at the following designated sites:

- Firth of Forth Ramsar, Special Protection Area (SPA), Site of Special Scientific Interest (SSSI) 4.62 km NW
- River Tweed Special Area of Conservation (SAC), SSSI 10.57 km S
- St Abb's Head to Fast Castle SAC, SPA, SSSI 13.55 km SE
- Abbey St Bathans Woodlands SSSI 12.44 km SSE
- Barns Ness Coast SSSI 1.14 km NE
- Lammermuir Deans SSSI 5.33 km S
- Papana Water SSSI 14.04 km WSW
- Pease Bay Coast SSSI 6.92 km SE
- Pease Bridge Glen SSSI 9.78 km SE
- Rammer Cleugh SSSI 6.56 km SW
- Traprain Law SSSI 12.63 km W
- Woodhall Dean SSSI 3.74 km SW
- Berwickshire Coast (intertidal) SSSI 13.55 km ESE

Critical Levels

B.2 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. Process Contributions (PCs) and Predicted Environmental Concentrations (PECs) of nitrogen oxides (NOx), sulphur dioxide (SO_2) ammonia (NH_3) and hydrogen fluoride (HF) have been calculated for comparison with the relevant critical levels.

Critical Loads

B.3 Critical loads refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge.

Critical Loads – Nutrient Nitrogen Deposition

B.4 Percentage contributions to nutrient nitrogen deposition have been derived from the results of the ADMS and AERMOD dispersion modelling. Deposition rates have been calculated using empirical methods recommended by the Environment Agency, as follows:

- The dry deposition flux (µg.$m^{-2}.s^{-1}$) has been calculated by multiplying the ground level NO_2, NH_3 and SO_2 concentrations (µg.m^{-3}) by the deposition velocities ($m.s^{-1}$) set out in the table below.

Table B.1 Deposition Velocities

Pollutant	Deposition Velocity ($m.s^{-1}$)	
	Grassland	Woodland
NOx	0.0015	0.003
SO_2	0.012	0.024
NH_3	0.02	0.03

- Units of µg.$m^{-2}.s^{-1}$ have been converted to units of kg.$ha^{-1}.year^{-1}$ by multiplying the dry deposition flux by the standard conversion factor of 96 for NO_2, 259.9 for NH_3 and 157.7 for SO_2. The total N deposition flux has then been calculated as the sum of the contribution from NO_2 and NH_3.
- Predicted contributions to nitrogen and sulphur deposition have been calculated and compared with the relevant critical load range for the habitat types associated with the designated site. These have been derived from the APIS database.

Critical Loads – Acidification

B.5 The acid deposition rate, in equivalents keq.$ha^{-1}.year^{-1}$, has been calculated by multiplying the dry deposition flux (kg.$ha^{-1}.year^{-1}$) by a conversion factor of 0.071428 for N and 0.0625 for S. This takes into account the degree to which a chemical species is acidifying, calculated as the proportion of N within the molecule.

B.6 Wet deposition in the near field is not significant compared with dry deposition for N and S [14] and therefore for the purposes of this assessment, wet deposition has not been considered.

B.7 Predicted contributions to acid deposition have been calculated and compared with the critical load function for the habitat types associated with the designated site as derived from the APIS database.

Significance Criteria

B.8 The PCs and PECs have been compared against the relevant critical level/load, for the relevant habitat type/interest feature.

B.9 For SACs, SPAs, SSSIs and Ramsars, the Environment Agency guidelines (EA, 2020b) state that:

"To screen out a PC for any substance so that you don't need to do any further assessment of it, the PC must meet both of the following criteria:

- *the short-term PC is less than 10% of the short-term environmental standard*
- *the long-term PC is less than 1% of the long-term environmental standard*

If you meet both of these criteria you don't need to do any further assessment of the substance.

If you don't meet them you need to carry out a second stage of screening to determine the impact of the PEC."

B.10 It continues by stating that:

"If your long-term PC is greater than 1% and your PEC is less than 70% of the long-term environmental standard, the emissions are insignificant – you don't need to assess them any further.

If your PEC is greater than 70% of the long-term environmental standard, you need to do detailed modelling."

B.11 For this project SEPA has stated “Instead of applying the criteria specified in the EA’s online ‘Air emissions risk assessment for your environmental permit’ guidance, the applicant must determine whether the effects can be screened out as insignificant…. by applying the following criteria to SSSIs, SACs and SPAs:

- *where the process contribution is less than 1% OR*
- • *where process contribution is greater than 1% AND the PEC is less than 100%”*

B.12 On that basis, the following criteria have been used to determine if the impacts are significant:

- If the long-term PC does not exceed 1% of relevant critical level/load the emission is considered not significant;
- If the short-term PC does not exceed 10% of relevant critical level/load the emission is considered not significant; and
- If the long-term PC exceeds 1% or the short-term PC exceeds 10% but the resulting PEC is below 100% of the relevant critical level/load, the emission is not considered significant.

Results

B.13 The maximum predicted PCs of NOx, SO_2, NH_3 and HF (from ADMS and AERMOD modelling utilising Edinburgh 2016 – 2020 meteorological data) are compared with the relevant Critical Levels in Table B.2 to Table B.13..

Table B.2 Predicted Annual-Mean NOx Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC (µg.m^{-3})	ADMS PC (µg.m^{-3})	AERMOD PC (µg.m^{-3})	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	0.06	0.02	0.06	0	0	No
Firth of Forth SPA	0.06	0.02	0.06	0	0	No
St Abb's Head to Fast Castle SPA	0.03	0.03	0.02	0	0	No
River Tweed SAC	0.23	0.05	0.10	0	0	No
St Abb's Head to Fast Castle SAC	0.03	0.03	0.02	0	0	No
Barns Ness Coast SSSI	2.03	0.99	3.57	3	12	Yes
Firth of Forth SSSI	0.06	0.02	0.06	0	0	No
Lammermuir Deans SSSI	0.40	0.05	0.22	0	1	No
Papana Water SSSI	0.23	0.06	0.18	0	1	No
Rammer Cleugh SSSI	0.48	0.10	0.55	0	2	Yes
Traprain Law SSSI	0.22	0.04	0.04	0	0	No
Woodhall Dean SSSI	0.55	0.12	0.82	0	3	Yes
Abbey St Bathans Woodlands SSSI	0.18	0.03	0.09	0	0	No
Berwickshire Coast (intertidal) SSSI	0.03	0.03	0.02	0	0	No
Pease Bay Coast SSSI	0.04	0.03	0.05	0	0	No
Pease Bridge Glen SSSI	0.03	0.02	0.05	0	0	No
River Tweed SSSI	0.23	0.04	0.09	0	0	No
St Abb's Head to Fast Castle SSSI	0.03	0.03	0.02	0	0	No

Annual-Mean NO_X Critical Level = 30 µg.m^{-3}

Table B.3 Predicted Annual-Mean NOx Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	0.51	0.99	3.57	5.83	1.61	11.01	No
Rammer Cleugh SSSI	0.12	0.10	0.55	4.40	0.38	5.34	No
Woodhall Dean SSSI	0.14	0.12	0.82	4.50	0.40	5.73	No

Annual-Mean NO_X Critical Level = 30 $\mu g.m^{-3}$

Table B.4 Predicted Annual-Mean SO_2 Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	0.01	0.01	0.02	0	0	No
Firth of Forth SPA	0.01	0.01	0.02	0	0	No
St Abb's Head to Fast Castle SPA	0.01	0.01	0.01	0	0	No
River Tweed SAC	0.01	0.01	0.03	0	0	No
St Abb's Head to Fast Castle SAC	0.06	0.01	0.01	0	0	No
Barns Ness Coast SSSI	0.51	0.25	0.89	2	9	Yes
Firth of Forth SSSI	0.02	0.01	0.02	0	0	No
Lammermuir Deans SSSI	0.10	0.01	0.05	0	1	No
Papana Water SSSI	0.06	0.02	0.05	0	0	No
Rammer Cleugh SSSI	0.12	0.03	0.14	0	1	No
Traprain Law SSSI	0.05	0.01	0.01	0	0	No
Woodhall Dean SSSI	0.14	0.03	0.21	0	2	Yes
Abbey St Bathans Woodlands SSSI	0.04	0.01	0.02	0	0	No
Berwickshire Coast (intertidal) SSSI	0.01	0.01	0.01	0	0	No
Pease Bay Coast SSSI	0.01	0.01	0.01	0	0	No
Pease Bridge Glen SSSI	0.01	0.00	0.01	0	0	No
River Tweed SSSI	0.06	0.01	0.02	0	0	No
St Abb's Head to Fast Castle SSSI	0.01	0.01	0.01	0	0	No

Annual-Mean SO_2 Critical Level = 10 $\mu g.m^{-3}$

Table B.5 Predicted Annual-Mean SO_2 Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	0.51	0.25	0.89	1.07	1.29	3.25	No
Woodhall Dean SSSI	0.14	0.03	0.21	0.54	0.32	1.07	No

Annual-Mean SO_2 Critical Level = 10 $\mu g.m^{-3}$

Table B.6 Predicted Annual-Mean NH_3 Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	0.001	0.001	0.003	0	0	No
Firth of Forth SPA	0.001	0.001	0.003	0	0	No
St Abb's Head to Fast Castle SPA	0.001	0.001	0.001	0	0	No
River Tweed SAC	0.006	0.003	0.005	0	1	No
St Abb's Head to Fast Castle SAC	0.001	0.001	0.001	0	0	No
Barns Ness Coast SSSI	0.051	0.049	0.179	5	18	Yes
Firth of Forth SSSI	0.002	0.001	0.003	0	0	No
Lammermuir Deans SSSI	0.010	0.002	0.011	0	1	No
Papana Water SSSI	0.006	0.003	0.009	0	1	No
Rammer Cleugh SSSI	0.012	0.005	0.028	1	3	Yes
Traprain Law SSSI	0.005	0.002	0.002	0	0	No
Woodhall Dean SSSI	0.014	0.006	0.041	1	4	Yes
Abbey St Bathans Woodlands SSSI	0.004	0.001	0.005	0	0	No
Berwickshire Coast (intertidal) SSSI	0.001	0.001	0.001	0	0	No
Pease Bay Coast SSSI	0.001	0.002	0.002	0	0	No
Pease Bridge Glen SSSI	0.001	0.001	0.003	0	0	No
River Tweed SSSI	0.006	0.002	0.005	0	0	No
St Abb's Head to Fast Castle SSSI	0.001	0.001	0.001	0	0	No

Annual-Mean NH_3 Critical Level = 1 $\mu g.m^{-3}$

Table B.7 Predicted Annual-Mean NH_3 Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC (µg.m-3)	ADMS PC (µg.m-3)	AERMOD PC (µg.m-3)	Background Concentration (µg.m-3)	Tarmac PC (µg.m-3)	PEC (µg.m-3)	PEC is Potentially Significant?
Barns Ness Coast SSSI	0.051	0.049	0.179	1.40	0.03	1.61	Yes
Rammer Cleugh SSSI	0.012	0.005	0.028	1.24	0.01	1.29	Yes
Woodhall Dean SSSI	0.014	0.006	0.041	1.08	0.01	1.13	Yes

Table B.8 Predicted Daily-Mean NOx Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC (µg.m-3)	ADMS PC (µg.m-3)	AERMOD PC (µg.m-3)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	1.0	1.0	2.5	1	3	No
Firth of Forth SPA	1.0	1.0	2.5	1	3	No
St Abb's Head to Fast Castle SPA	0.5	0.5	0.5	1	1	No
River Tweed SAC	4.4	2.4	2.4	3	3	No
St Abb's Head to Fast Castle SAC	0.5	0.5	0.5	1	1	No
Barns Ness Coast SSSI	10.9	8.4	21.0	11	28	Yes
Firth of Forth SSSI	1.0	1.0	2.5	1	3	No
Lammermuir Deans SSSI	8.2	3.2	4.0	4	5	No
Papana Water SSSI	3.0	1.2	6.7	2	9	No
Rammer Cleugh SSSI	11.6	2.1	48.2	3	64	Yes
Traprain Law SSSI	3.9	0.9	0.8	1	1	No
Woodhall Dean SSSI	12.5	2.8	18.9	4	25	Yes
Abbey St Bathans Woodlands SSSI	4.0	2.0	2.4	3	3	No
Berwickshire Coast (intertidal) SSSI	0.4	0.5	0.5	1	1	No
Pease Bay Coast SSSI	0.9	0.9	1.0	1	1	No
Pease Bridge Glen SSSI	0.6	0.6	1.5	1	2	No
River Tweed SSSI	4.2	2.0	2.4	3	3	No
St Abb's Head to Fast Castle SSSI	0.5	0.5	0.5	1	1	No

Daily Mean NOx Critical Level = 75 µg.m^{-3}

Table B.9 Predicted Daily-Mean NOx Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	10.9	8.4	21.0	11.2	1.61	34.3	No
Rammer Cleugh SSSI	11.6	2.1	48.2	8.8	0.38	57.3	No
Woodhall Dean SSSI	12.5	2.8	18.9	9.0	0.40	28.3	No

Daily Mean NOx Critical Level = 75 $\mu g.m^{-3}$

Table B.10 Predicted Daily-Mean HF Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	0.005	0.005	0.012	0	0	No
Firth of Forth SPA	0.005	0.005	0.012	0	0	No
St Abb's Head to Fast Castle SPA	0.002	0.002	0.002	0	0	No
River Tweed SAC	0.022	0.012	0.012	0	0	No
St Abb's Head to Fast Castle SAC	0.002	0.002	0.002	0	0	No
Barns Ness Coast SSSI	0.055	0.042	0.105	1	2	Yes
Firth of Forth SSSI	0.005	0.005	0.012	0	0	No
Lammermuir Deans SSSI	0.041	0.016	0.020	0	0	No
Papana Water SSSI	0.015	0.006	0.034	0	1	No
Rammer Cleugh SSSI	0.058	0.010	0.241	0	5	Yes
Traprain Law SSSI	0.020	0.005	0.004	0	0	No
Woodhall Dean SSSI	0.062	0.014	0.095	0	2	Yes
Abbey St Bathans Woodlands SSSI	0.020	0.010	0.012	0	0	No
Berwickshire Coast (intertidal) SSSI	0.002	0.002	0.002	0	0	No
Pease Bay Coast SSSI	0.004	0.004	0.005	0	0	No
Pease Bridge Glen SSSI	0.003	0.003	0.008	0	0	No
River Tweed SSSI	0.021	0.010	0.012	0	0	No
St Abb's Head to Fast Castle SSSI	0.002	0.002	0.002	0	0	No

Daily Mean HF Critical Level = 5 $\mu g.m^{-3}$

Table B.11 Predicted Daily-Mean HF Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	0.055	0.042	0.105	No data	0.003	0.11	No
Rammer Cleugh SSSI	0.058	0.010	0.241	No data	0.001	0.24	No
Woodhall Dean SSSI	0.062	0.014	0.095	No data	0.001	0.10	No

Daily Mean HF Critical Level = 5 $\mu g.m^{-3}$

Table B.12 Predicted Weekly-Mean HF Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	0.005	0.000	0.003	0	1	No
Firth of Forth SPA	0.005	0.000	0.003	0	1	No
St Abb's Head to Fast Castle SPA	0.002	0.000	0.000	0	0	No
River Tweed SAC	0.022	0.001	0.003	0	1	No
St Abb's Head to Fast Castle SAC	0.002	0.000	0.000	0	0	No
Barns Ness Coast SSSI	0.055	0.019	0.038	4	8	Yes
Firth of Forth SSSI	0.005	0.001	0.003	0	1	No
Lammermuir Deans SSSI	0.041	0.002	0.006	0	1	No
Papana Water SSSI	0.015	0.002	0.006	0	1	No
Rammer Cleugh SSSI	0.058	0.003	0.022	1	4	Yes
Traprain Law SSSI	0.020	0.002	0.002	0	0	No
Woodhall Dean SSSI	0.062	0.004	0.034	1	7	Yes
Abbey St Bathans Woodlands SSSI	0.020	0.001	0.002	0	0	No
Berwickshire Coast (intertidal) SSSI	0.002	0.001	0.000	0	0	No
Pease Bay Coast SSSI	0.004	0.001	0.001	0	0	No
Pease Bridge Glen SSSI	0.003	0.000	0.003	0	1	No
River Tweed SSSI	0.021	0.001	0.002	0	0	No
St Abb's Head to Fast Castle SSSI	0.002	0.001	0.000	0	0	No

Weekly Mean HF Critical Level = 0.5 $\mu g.m^{-3}$

Table B.13 Predicted Weekly-Mean HF Concentrations at Designated Habitat Sites

Habitat Receptor	2014 Assessment PC ($\mu g.m^{-3}$)	ADMS PC ($\mu g.m^{-3}$)	AERMOD PC ($\mu g.m^{-3}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	0.055	0.019	0.038	No data	0.003	0.04	No
Rammer Cleugh SSSI	0.058	0.00.3	0.022	No data	0.001	0.02	No
Woodhall Dean SSSI	0.062	0.004	0.034	No data	0.001	0.03	No

Weekly Mean HF Critical Level = 0.5 $\mu g.m^{-3}$

B.14 The maximum PCs of nutrient nitrogen (N) deposition are compared against the relevant Critical Loads (CLs) in Table B.14.

B.15 There are various interest features within the habitat sites that are sensitive to N deposition. Only the results for the most-sensitive interest features are shown. Data on Critical Loads have been obtained from the UK Air Pollution Information System (APIS) database [15].

Table B.14 Predicted Nutrient Nitrogen Deposition Rates at Designated Habitat Sites

Habitat Receptor	Critical Load ($kgN.ha^{-1}.yr^{-1}$)	2014 Assessment PC ($kgN.ha^{-1}.yr^{-1}$)	ADMS PC ($kgN.ha^{-1}.yr^{-1}$)	AERMOD PC ($kgN.ha^{-1}.yr^{-1}$)	Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
Firth of Forth Ramsar	8.00	0.013	0.010	0.025	0	0	No
Firth of Forth SPA	8.00	0.013	0.010	0.025	0	0	No
St Abb's Head to Fast Castle SPA	No APIS Data	0.006	0.011	0.009	-	-	-
River Tweed SAC	No APIS Data	0.054	0.021	0.041	-	-	-
St Abb's Head to Fast Castle SAC	No APIS Data	0.006	0.011	0.009	-	-	-
Barns Ness Coast SSSI	8.00	0.467	0.398	1.442	5	18	Yes
Firth of Forth SSSI	8	0.014	0.010	0.025	0	0	No
Lammermuir Deans SSSI	10	0.092	0.019	0.088	0	1	No
Papana Water SSSI	5	0.090	0.024	0.074	0	1	No
Rammer Cleugh SSSI	5	0.190	0.041	0.223	1	4	Yes
Traprain Law SSSI	10	0.051	0.018	0.015	0	0	No
Woodhall Dean SSSI	5	0.219	0.050	0.332	1	7	Yes
Abbey St Bathans Woodlands SSSI	5	0.041	0.011	0.038	0	1	No
Berwickshire Coast (intertidal) SSSI	No APIS Data	0.006	0.011	0.009	-	-	-
Pease Bay Coast SSSI	No APIS Data	0.010	0.012	0.019	-	-	-
Pease Bridge Glen SSSI	5	0.012	0.007	0.020	0	0	No
River Tweed SSSI	No APIS Data	0.054	0.018	0.038	-	-	-
St Abb's Head to Fast Castle SSSI	No APIS Data	0.006	0.011	0.009	-	-	-

Table B.15 Predicted Nutrient Nitrogen Deposition Rates at Designated Habitat Sites

Habitat Receptor	Critical Load ($kgN.ha^{-1}.yr^{-1}$)	2014 Assessment PC ($kgN.ha^{-1}.yr^{-1}$)	ADMS PC ($kgN.ha^{-1}.yr^{-1}$)	AERMOD PC ($kgN.ha^{-1}.yr^{-1}$)	Background Concentration ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC is Potentially Significant?
Barns Ness Coast SSSI	8	0.467	0.398	1.442	12.74	0.33	14.5	Yes
Rammer Cleugh SSSI	5	0.190	0.041	0.223	24.08	0.08	24.4	Yes
Woodhall Dean SSSI	5	0.219	0.050	0.332	22.26	0.08	22.7	Yes

B.16 The maximum PCs of acid deposition are compared against the relevant Critical Loads in Table B.16. There are various interest features within the habitat sites that are sensitive to acid deposition. Only the results for the most-sensitive interest features are shown. Data on Critical Loads have been obtained from the UK Air Pollution Information System (APIS) database.

Table B.16 Predicted Acid Deposition Rates at Designated Habitat Sites

Habitat Receptor	Critical Load (keq.ha-1.yr-1)			2014 Assessment PC (kgN.ha-1.yr-1)	ADMS PC (keq.ha-1.yr-1)		AERMOD PC (keq.ha-1.yr-1)		Max ADMS PC/Critical Level (%)	Max AERMOD PC/Critical Level (%)	PC is Potentially Significant?
	MinN	MaxN	MaxS		N	S	N	S			
Firth of Forth Ramsar	0.86	4.86	4.00	0.004	0.001	0.001	0.002	0.002	0	0	No
Firth of Forth SPA	0.86	4.86	4.00	0.004	0.001	0.001	0.002	0.002	0	0	No
St Abb's Head to Fast Castle SPA	No Data	No Data	No Data	0.002	0.001	0.001	0.001	0.001	-	-	No
River Tweed SAC	No Data	No Data	No Data	0.018	0.001	0.002	0.003	0.003	-	-	No
St Abb's Head to Fast Castle SAC	No data	No data	No data	0.002	0.001	0.001	0.001	0.001	-	-	No
Barns Ness Coast SSSI	0.86*	4.86*	4*	0.159	0.028	0.029	0.103	0.106	1	1	No
Firth of Forth SSSI	0.86	4.86	4.00	0.005	0.001	0.001	0.002	0.002	0	0	No
Lammermuir Deans SSSI	0.86	4.86	4.00	0.031	0.001	0.001	0.006	0.006	0	0	No
Papana Water SSSI	0.14	1.95	0.95	0.038	0.002	0.002	0.005	0.005	0	0	No
Rammer Cleugh SSSI	0.14	1.42	0.90	0.079	0.003	0.003	0.016	0.016	0	0	No
Traprain Law SSSI	1.71	5.71	4.00	0.017	0.001	0.001	0.001	0.001	0	0	No
Woodhall Dean SSSI	0.14	0.58	0.29	0.091	0.004	0.004	0.024	0.024	1	1	No
Abbey St Bathans Woodlands SSSI	0.14	1.13	0.96	0.014	0.001	0.001	0.003	0.003	0	0	No
Berwickshire Coast (intertidal) SSSI	no data	no data	no data	0.002	0.001	0.001	0.001	0.001	-	-	No
Pease Bay Coast SSSI	No Data	No Data	No Data	0.003	0.001	0.001	0.001	0.001	-	-	No
Pease Bridge Glen SSSI	0.14	1.94	0.95	0.005	0.001	0.001	0.001	0.001	0	0	No
River Tweed SSSI	No Data	No Data	No Data	0.018	0.001	0.001	0.003	0.003	-	-	No
St Abb's Head to Fast Castle SSSI	No Data	No Data	No Data	0.002	0.001	0.001	0.001	0.001	-	-	No

*Critical loads for calcareous grassland as considered more suitable in RPS April 2008 *Assessment Concerning Potential Air Quality Impacts on the Barns Ness SSSI*.

Conclusion

B.17 The maximum predicted PCs do not exceed 1% of the relevant annual-mean or 10% of the relevant weekly/daily-mean critical levels/loads for all sites except Barns Ness Coast, Rammer Cleugh and Wood Hall Dean and the impacts can be screened out as insignificant.

B.18 For Barns Ness Coast, Rammer Cleugh and Wood Hall Dean, the PECs are below the critical levels/loads except for annual-mean NH_3 and nutrient nitrogen deposition and the impacts can be screened out as insignificant.

B.19 For annual-mean NH_3 and nutrient nitrogen deposition, the PEC is greater than the critical level/load at Barns Ness Coast, Rammer Cleugh and Wood Hall Dean and the impacts are potentially significant. This is in large part because the background concentrations already exceed the critical level/loads.

B.20 For annual-mean NH_3 the lower critical level of 1 $\mu g.m^{-3}$ has been used which applies where lichens or bryophytes are present. At Rammer Cleugh there are no lichens or bryophytes present and the higher critical level of 3 $\mu g.m^{-3}$ is applicable. The PEC at Rammer Cleugh is 1.29 $\mu g.m^{-3}$ which is well below the higher critical level of 3 $\mu g.m^{-3}$ and the impacts can be screened out as insignificant.

B.21 The projects ecologist has advised:

"In order to determine the correct critical level for ammonia NH_3 at the Barns Ness SSSI, a site survey was undertaken on 17th March 2022 of the coastline located within the emissions plume from the development. The aim of the survey was to determine the extent of habitat that could support important bryophytes meaning a critical level for NH_3 of 1 $\mu g.m^{-3}$ would be appropriate, or if the habitat was considered highly unlikely to do so (with an associated critical level of 3 $\mu g.m^{-3}$).

The 1999 NVC survey map of the area (Dargie) was referenced to check locations of known sand dune habitats within defined survey area. Randomly located quadrats were then generated for each mapped SD polygon (7 quadrats in total). Quadrat locations were then marked in the field using canes and nylon cord. Species present within each survey quadrat were then identified and % cover assessed using DAFOR scale. Any changes to habitat extent within the survey boundary were also noted (using 1999 NVC as baseline) and a broad 'visual' assessment of grazing levels was also carried out across the survey area.

The majority of the survey area appeared consistent with the 1999 NVC survey, dominated by a range of sand dune grasslands. Some of areas of sand dune had fragmented, however, while gorse cover appeared to have generally increased. The area is now heavily grazed by sheep and rabbits and there are areas of surface compaction along the footpaths from public access. Although the survey was undertaken at a somewhat sub-optimal time of year for a vegetation survey, most of the quadrats contained layers of dense leaf litter and overall bryophyte cover across the site was relatively sparse, especially in sand dune areas (only 4/7 quadrats contained any mosses (<5% cover) and no liverworts were recorded), and no notable bryophyte species were recorded. Checks of the NBN Atlas also do not show any records of bryophytes of conservation importance in this area.

Further, from other work in the area, the surveyor noted that there is much better quality sand dune habitat along the coast to the west at Gullane and at John Muir Country Park (Tyninghame Links); it is likely, therefore, that any important bryophyte populations associated with the SSSI are in these locations rather than around the lighthouse.

Therefore, on this basis, it is concluded that there is little chance of important bryophyte populations being present in the area of the SSSI within the ammonia plume. As such, a critical level of 3 $\mu g.m^{-3}$ is considered the most appropriate."

The PEC is less than 3 $\mu g.m^{-3}$ and the impacts of NH_3 are considered to be insignificant.

B.22 A contour plot of the annual-mean NH_3 PC and nutrient nitrogen deposition PC are shown in Figures 5 to 8. Contours plots have not been provided for other pollutants as the impacts can be screened out as insignificant for all habitat sites. The pattern of dispersion for the annual-mean averaging periods will be the same as the NH_3 and nutrient nitrogen deposition contours.

B.23 Table B.15 shows that the updated PCs are higher than the PCs in the 2014 assessment when using AERMOD and lower when using ADMS. For Barns Ness SSSI, the PC using AERMOD is 3.5 times higher than the PC modelled using ADMS. This is a large change when compared to the 2014 modelled PCs.

B.24 The change in the model predictions between 2014 and 2022 is mainly due to differences in the emissions parameters, the meteorological data used and changes in the model processes themselves. Each of these has been considered in turn below.

B.25 The differences in emissions parameters are relatively minor and the emission rates are lower using the 2022 data than the 2014 data. The velocity and temperature of the stack gases are slightly different (17.1 vs 17.6 m/s and 138 vs 145 ^{0}C). A PC would not normally increase by a factor of 3.5 based on these relatively small changes in the emissions data alone.

B.26 Both assessments considered a wide range of meteorological conditions using five years of hourly sequential data. As shown in Figures 7 and 8, the dispersion patterns are fairly similar for ADMS and AERMOD which indicates that the meteorological observations are not a major factor in explaining the differences in the magnitude of the predictions.

B.27 This tends to indicate that the main difference in the predictions is likely to be the model processes themselves. The *R&D Technical Report P362 An Inter-comparison of the AERMOD, ADMS and ISC Dispersion Models* for *Regulatory Applications* [16] undertaken on behalf of BRE Ltd compared the output of ADMS and AERMOD models for a range of test cases and concluded that for "*the ratios of ADMS/AERMOD maximum concentrations, about 28% of the ADMS/AERMOD ratios exceeded a factor of two…. Considering the relative similarity in the structure of the basic dispersion calculations in the advanced models, the large differences in predicted concentration between them at times seemed surprising."* This indicates that differences of a factor of two or more are not uncommon.

B.28 The report also stated that "*Even the quite specific individual aspects of dispersion examined here exhibited quite variable relationships between the models. It was not, therefore practicable to offer reliable blanket guidance on the differences between the models."* This indicates that the researchers have not been able to attribute differences in the model output to any specific aspect of the model scenario under consideration.

B.29 The report continued by stating that *"It appears that the advanced models and their meteorological pre-processors are still in a state of scientific development which has not yet converged to a consensus view of how they should behave. This situation means that ongoing modifications to the models (for example between successive versions of the same model) can produce significant changes in both their absolute and relative performance. The use of advanced models for regulatory purposes remains necessary as these models offer improved versatility and performance in many aspects of dispersion modelling, but some caution and understanding is needed in their use. The further development of these dispersion models, and of their meteorological preprocessors, should be encouraged by an open attitude to their contents and working. This is somewhat lacking at present with regard to the ADMS model."*

B.30 The intercomparison in Technical Report P362 was undertaken in 2000 when the ADMS model had only been in use for about six years. Both the ADMS and AERMOD models have undergone several updates and improvements since then and ADMS is now the most commonly used model in the UK. Versions of the models in 2014 predicted relatively similar concentrations to each other whereas the using the 2022 versions of the model, the differences are largely pointing towards a divergence in the approach adopted within the model itself.

B.31 What can be said is that the ADMS model is developed in the UK and has been validated against monitored concentrations at locations in the UK, whereas the AERMOD is developed in the US. On that basis and because the ADMS modelled concentrations are more similar to the 2014 results as would be expected based on the small change in emissions parameters, the PCs modelled using ADMS may be considered more consistent with the changes in emissions parameters for this site.

Appendix C: Plume Visibility

Introduction

C.1 This report sets out the results of the plume visibility assessment undertaken for the Dunbar Energy from Waste facility. The results have been compared with the results from the November 2008 PPC Application - Air Quality Technical Appendix.

Methodology

C.2 Visible plumes can arise when hot, wet exhaust gases are cooled to ambient temperature, resulting in the condensation of water vapour and a white plume. The extent of the plume is dependent on the volumetric flow rate of gases from the source, the amount of water vapour in the cooled gases, the relative humidity of the atmosphere and the extent of plume dispersion in the atmosphere.

C.3 It is often desirable to recover heat from the exhaust gases for useful energy, rather than rejecting this to the atmosphere. However, issues arise with corrosion once the dew point of the acid gas is reached (at any point in the cooling system) and in finding a disposal route for the condensed water. There is, therefore, a trade-off between the amount of heat that can be usefully recovered from the exhaust gas stream and the heat required to avoid condensation under all atmospheric conditions.

C.4 The likely incidence and dimensions of a visible plume emitted from the proposed stack has been predicted using the ADMS 5 plume visibility module, based on an initial mixing ratio of the plume of 0.1584 kg of H_2O per 1 kg of air. Modelling has been undertaken using five years of hourly sequential meteorological data from the Edinburgh meteorological station between 2016 and 2020.

C.5 Table C.1 shows the model input data.

Table C.1 Predicted Model Input

Parameter	Value
Stack Location (x,y)	371183, 676078
Stack height (m)	80
Internal Diameter (m)	2.4
Velocity (m/s)	17.6
Temperature (C)	145
Mass of H_20 (kg/kg)	0.1584

C.6 Resultant data have been used to determine the number of hours that the length of the plume may exceed the average distance to the site boundary during daylight hours per year.

C.7 SEPA no longer provides guidance to determine the significance of plume visibility effects. The historic Horizontal Guidance Note IPPC H1, Environmental Assessment and Appraisal of BAT (Environment Agency *et al.,* 2003) provided a method of quantifying the impact of a plume. This scale is reproduced in Table C.2.

C.8 This guidance was used in the November 2008 PPC Application - Air Quality Technical Appendix.

Table C.2: Plume Visibility Impact Descriptors

Impact	Quantitative Description
Zero	No visible impacts resulting from operation of process.
Insignificant	Regular small impact from operation of process. Plume length exceeds boundary <5% of daylight hours per year. No local sensitive receptors.
Low	Regular small impact from operation of process. Plume length exceeds boundary <5% of daylight hours per year. Sensitive local receptors.
Medium	Regular large impact from operation of process. Plume length exceeds boundary >5% of daylight hours per year. Sensitive local receptors.
High	Continuous large impact from operation of process. Plume length exceeds boundary >25% of daylight hours per year with obscuration. Local sensitive receptors.

C.9 The plume visibility has been assessed using these impact descriptors. The guidance continues by stating that *"Conditions that result in medium or lower impacts can be considered acceptable".* Where the impacts are considered acceptable, the effects are not considered significant.

Results

C.10 Table C.3 provides a summary of the results of plume visibility modelling.

Table C.3: Summary of Plume Visibility Results

Parameter	2016	2017	2018	2019	2020	Range	Units
Percent of year that a visible plume is predicted	40.8	37.9	35.9	35.4	39.2	35.4 – 40.8	%
Number of visible plumes	3580	3323	3149	3102	3444	3102 – 3580	-
Maximum plume length	347	487	622	386	615	347 – 622	m
Average plume length	21	19	23	20	25	19 – 25	m
Minimum plume length	0.13	0.17	0.16	0.17	0.16	0.13 – 0.17	m
Time when length of plume exceeds stack to average site boundary distance	469	396	649	542	797	396 – 797	hr/yr
Time when length of plume exceeds stack to average site boundary distance in daylight	262	233	336	304	373	233 – 373	hr/yr
Percent of year when length of plume exceeds stack to average site boundary distance in daylight	6.5	5.8	8.4	7.7	9.2	5.8 – 9.2	%
SEPA H1 classification						Medium	

C.11 Visible plumes can occur at any time, but predominantly occur during night-time hours when the ambient temperature is cooler. Model results indicate that the plume would not be visible at release or at grounding for any modelled hour.

C.12 Based on modelled results using five years of hourly sequential meteorological data, a plume is predicted to be visible outside the site boundary for less than 10% of daylight hours in each of the five years modelled. As there are local sensitive receptors, using the impact descriptors adopted for the assessment, the impact is considered ‘medium’ and can be considered ‘acceptable’.

C.13 An occasional visible plume is quite normal for combustion processes which generate energy by conversion of chemical energy with the main combustion products being water (vapour) and carbon dioxide. Plume visibility is effectively controlled in energy recovery facilities being dictated primarily by the temperature at which the reagent reaction (lime or sodium bicarbonate with acid gas) is optimised with the aim of maximising energy efficiency as in conventional domestic boilers).

Comparison with 2008 Assessment

C.14 Table C.4 reproduces the Plume Visibility Results shown in Table 1.36 of the November 2008 PPC Application - Air Quality Technical Appendix. The results in Table C.4 predict that the number of plumes using the latest emissions data and water content is higher than the number predicted in the November 2008 PPC Application - Air Quality Technical Appendix. This will be due to differences in the emissions data and meteorological data used in the models. Whilst the number of plumes has increased the impact is still considered to be ‘acceptable’.

Table C.4: Summary of Plume Visibility Results from 2008 Assessment

Parameter	2001	2002	2003	2004	2005	Range	Units
Percent of year that a visible plume is predicted	22.7	20.5	19.4	21.8	21.9	19.4 – 21.9	%
Number of visible plumes	1989	1792	1704	1917	1917	1704 – 1917	-
Maximum plume length	297	219	201	233	213	201 – 233	m
Average plume length	40.4	38.4	35.6	37.5	38.9	35.6 – 38.9	m
Minimum plume length	0.05	0.45	0.04	0.05	0.71	0.0 – 0.71	m
Time when length of plume exceeds stack to average site boundary distance	164	113	100	82	155	82 - 155	hr/yr
SEPA H1 classification						Low	

Summary

C.15 A visible plume extending beyond the site boundary is predicted for less than 10% of daylight hours in each of the five years modelled. Using the impact descriptors adopted for the assessment, the impact is considered ‘medium’ and the plume visibility is considered to be ‘acceptable’ and the effects are not considered to be significant.

Appendix D: Comparison of Predictions for Different Calorific Values

Introduction

D.1 This appendix sets out a comparison of predicted concentrations from the Dunbar Energy from Waste Facility under three different operating conditions. The results in the Section 5 are the predicted concentrations using stack characteristics and emissions data based on a calorific value (CV) of 10 MJ/kg. This appendix also sets out the results based on a calorific value of 8.5 and 9 MJ/kg.

Emissions Data

D.2 Table D.1 sets out the stack characteristics modelled. With a CV of 8.5MJ/kg, the assessment assumes that 439,577 tonnes of waste will be thermally treated annually; this is significantly more than 390,000 tonnes which the variation is seeking. Furthermore, the actual number of available operating hours will be less than 8,760 when compared to the basis for the variation. Applying a maximum permitted tonnage of 390,000 tonnes per annum, the maximum number of hours assuming a CV of 8.5 MJ/kg will be 7,772 hours. The results presented in this appendix assume that the number of operational hours at a CV of 8.5 MJ/kg is 7,772 hours. For 9 and 10 MJ/kg the results presented assume that the facility is operational for a full year i.e. 8760. For the 9 MJ/kg scenario in particular this is conservative as the facility will not operate all year.

Table D.1 Stack Characteristics

Parameter	Unit	10 MJ/kg	9 MJ/kg	8.5 MJ/kg
Stack height	m	80		
Stack location	m	371183, 676078		
Effective diameter of both flues	m	2.4		
Efflux velocity	$m.s^{-1}$	17.6	18.6	19.2
Efflux temperature	o C	145	145	146
Actual O_2	%	6.49	6.9	6.9
Actual H_2O	%	21.04	19.6	19.4
Actual volumetric flow	$m^3.s^{-1}$	79.6	84.1	86.8
Normalised volumetric flow (Dry, 0°C, 11% O_2)	$m^3.s^{-1}$	59.6	62.3	64.3

Results

ADMS

Scenario 1: Results

D.3 Table D.2 summarises the maximum predicted Process Contribution (PC) across the modelled grid to ground-level concentrations for all relevant pollutants with short-term emission limits set out in the IED. The PCs are compared with the most recent Environment Assessment Levels.

D.4 Where the PC cannot be screened out as insignificant, the resulting Predicted Environmental Concentrations (PECs) have been calculated by adding the PC to the background ambient concentration (AC) and the PC from the adjacent Tarmac facility and are shown in Table D.3.

Scenario 2: Results

D.5 Table D.4 summarises the PCs and the resulting PECs for all pollutants assuming that the proposed development is operating at long-term emission limits. Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table D.5.

Table D.2 Predicted Maximum Process Contributions ($\mu g.m^{-3}$) at Short-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg report ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
HCl	1 hour (maximum)	750	89.5	95.9	93.2	95.9	13	10	Yes
HF	1 hour (maximum)	160	6.0	6.4	6.2	6.4	4	10	No
SO_2	15 minute (99.90th percentile)	266	37.2	31.7	32.1	37.2	14	10	Yes
	1 hour (99.73th percentile)	350	26.1	28.1	27.2	28.1	8	10	No
	24 hour (99.18th percentile)	125	9.9	9.8	10.0	10.0	8	10	No
NO_2	1 hour (99.79th percentile)	200	19.0	20.1	19.5	20.1	10	10	No
PM_{10}	24 hour (90.41st percentile)	50	1.3	1.2	1.2	1.3	3	10	No
CO	8 hour (maximum daily running)	10000	49.7	53.3	51.8	53.3	1	10	No

Table D.3 Maximum Predicted Environmental Concentrations ($\mu g.m^{-3}$) at Short-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
HCl	1 hour (maximum)	750	95.9	13	10	Yes	7.3	4.9	108.1	14	No
SO_2	15 minute (99.90th percentile)	266	37.2	14	10	Yes	0.6	66.1	103.9	39	No

Table D.4 Predicted Maximum Process Contributions (µg.m^{-3}) at Long-Term Emission Limits - ADMS

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC - 10MJ/kg (µg.m^{-3})	PC - 8.5MJ/kg (µg.m^{-3})	PC - 9MJ/kg (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PM_{10}	24 hour (98.08th percentile)	50	0.42	0.40	0.40	0.42	1	10	No
	24 hour (annual mean)	18	0.06	0.05	0.06	0.06*	0	1	No
$PM_{2.5}$	24 hour (annual mean)	10	0.06	0.05	0.06	0.06*	1	1	No
HCl	1 hour (maximum)	750	14.92	15.99	15.54	15.99	2	10	No
HF	1 hour (maximum)	160	1.49	1.60	1.55	1.60	1	10	No
SO_2	15 minute (99.90th percentile)	266	9.31	7.92	8.02	9.31	3	10	No
	1 hour (99.73th percentile)	350	6.53	7.03	6.81	7.03	2	10	No
	24 hour (99.18th percentile)	125	2.47	2.46	2.49	2.49	2	10	No
	1 hour (annual mean)	50	0.32	0.31	0.34	0.34*	1	1	No
NO_2	1 hour (99.79th percentile)	200	9.48	10.07	9.76	10.07	5	10	No
	1 hour (annual mean)	40	0.91	0.87	0.95	0.95*	2	1	Yes

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
CO	8 hour (maximum daily running)	10,000	24.87	26.65	25.90	26.65	0	10	No
Cd	1 hour (annual mean)	0.005	3.24E-04	3.10E-04	3.39E-04	3.39E-04*	7	10	No
Tl	1 hour (maximum)	30	7.46E-02	8.00E-02	7.77E-02	8.00E-02	0	10	No
	1 hour (annual mean)	1	3.24E-04	3.10E-04	3.39E-04	3.39E-04*	0	1	No
Hg	1 hour (maximum)	7.5	7.46E-02	8.00E-02	7.77E-02	8.00E-02	1	10	No
	1 hour (annual mean)	0.25	3.24E-04	3.10E-04	3.39E-04	3.39E-04*	0	1	No
Sb	1 hour (maximum)	150	1.72E-02	1.84E-02	1.79E-02	1.84E-02	0	10	No
	1 hour (annual mean)	5	7.46E-05	7.14E-05	7.80E-05	7.80E-05*	0	1	No
As	1 hour (annual mean)	0.006	1.62E-04	1.55E-04	1.69E-04	1.69E-04*	3	1	Yes
Cr	1 hour (maximum)	150	1.37E-01	1.47E-01	1.43E-01	1.47E-01	0	10	No
	1 hour (annual mean)	5	5.96E-04	5.71E-04	6.24E-04	6.24E-04*	0	1	No
Co	1 hour (maximum)	6	8.21E-03	8.80E-03	8.55E-03	8.80E-03	0	10	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
	1 hour (annual mean)	0.2	3.57E-05	3.41E-05	3.73E-05	3.73E-05*	0	1	No
Cu	1 hour (maximum)	200	4.33E-02	4.64E-02	4.51E-02	4.64E-02	0	10	No
	1 hour (annual mean)	10	1.88E-04	1.80E-04	1.97E-04	1.97E-04*	0	1	No
Pb	1 hour (annual mean)	0.25	3.27E-04	3.13E-04	3.42E-04	3.42E-04*	0	1	No
Mn	1 hour (maximum)	1500	8.95E-02	9.59E-02	9.32E-02	9.59E-02	0	10	No
	1 hour (annual mean)	0.15	3.89E-04	3.72E-04	4.07E-04	4.07E-04*	0	1	No
Ni	1 hour (annual mean)	0.02	1.43E-03	1.37E-03	1.49E-03	1.49E-03*	8	1	Yes
V	1 hour (maximum)	1	8.95E-03	9.59E-03	9.32E-03	9.59E-03	1	10	No
	1 hour (annual mean)	5	3.89E-05	3.72E-05	4.07E-05	4.07E-05*	0	1	No
Dioxins & Furans	1 hour (annual mean)	-	6.48E-10	6.20E-10	6.78E-10	6.78E-10*	-	-	-
	1 hour (maximum)	-	1.49E-07	1.60E-07	1.55E-07	1.60E-07	-	-	-
PAHs as B[a]P	1 hour (annual mean)	0.00025 (B[a]P)	1.30E-04	1.24E-04	1.36E-04	1.36E-04*	56	1	Yes

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PCB	1 hour (annual mean)	0.2	3.24E-05	3.10E-05	3.39E-05	3.39E-05*	0	1	No
	1 hour (maximum)	6	7.46E-03	8.00E-03	7.77E-03	8.00E-03	0	10	No
N_2O	1 hour (annual mean)	-	1.94E-01	1.86E-01	2.03E-01	2.03E-01*	-	-	-
TOC	Running annual mean	3.25 (benzene)	6.48E-02	6.20E-02	6.78E-02	6.78E-02*	2	1	Yes
NH_3	1 hour (annual mean)	180	6.48E-02	6.20E-02	6.78E-02	6.78E-02*	0	1	No
	1 hour (maximum)	2500	1.49E+01	1.60E+01	1.55E+01	1.60E+01	1	10	No
CrVI	1 hour (annual mean)	0.0002	2.27E-07	2.01E-07	2.37E-07	2.37E-07*	0	1	No

*Maximum is based on 9MJ/kg which conservatively assumes that the facility is operational all year.

Table D.5 Maximum Predicted Environmental Concentrations ($\mu g.m^{-3}$) at Long-Term Emission Limits

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
NO_2	1 hour (annual mean)	40	0.95	2	1	Yes	9.0	1.29	11.24*	28	No
As	1 hour (annual mean)	0.006	1.69E-04	3	1	Yes	2.21E-04	9.24E-06	4.00E-04*	7	No
Ni	1 hour (annual mean)	0.02	1.49E-03	7	1	Yes	3.70E-04	8.14E-05	1.94E-03*	10	No
PAHs as B[a]P	1 hour (annual mean)	0.00025	1.36E-04 (PAHs)	54	1	Yes	3.30E-05 (B[a]P)	8.00E-04 (PAHs)	9.69E-04*	387	Yes
TOC	Running annual mean	3.25 (benzene)	6.78E-02	2	1	Yes	7.79E-01 (benzene)	2.96E-01 (TOCs)	1.14E+00*	35	No

*Maximum is based on 9MJ/kg which conservatively assumes that the facility is operational all year.

AERMOD

Scenario 1: Results

D.6 Table D.6 summarises the maximum predicted PC across the modelled grid to ground-level concentrations for all relevant pollutants with short-term emission limits set out in the IED. The PCs are compared with the most recent Environment Assessment Levels.

D.7 Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table D.7.

Scenario 2: Results

D.8 Table D.8 summarises the PCs and the resulting PECs for all pollutants assuming that the proposed development is operating at long-term emission limits. Where the PC cannot be screened out as insignificant, the resulting PECs have been calculated by adding the PC to the background AC and the PC from the Tarmac facility and are shown in Table D.9.

Table D.6 Predicted Maximum Process Contributions (µg.m^{-3}) at Short-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC - 10MJ/kg (µg.m^{-3})	PC - 8.5MJ/kg (µg.m^{-3})	PC - 9MJ/kg (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
HCl	1 hour (maximum)	750	36.9	38.6	37.8	38.6	5	10	No
HF	1 hour (maximum)	160	2.5	2.6	2.5	2.6	2	10	No
SO_2	15 minute (99.90th percentile)	266	115.0	121.2	118.4	121.2	46	10	Yes
	1 hour (99.73th percentile)	350	101.6	106.8	104.3	106.8	31	10	Yes
	24 hour (99.18th percentile)	125	21.2	21.9	21.6	21.9	18	10	Yes
NO_2	1 hour (99.79th percentile)	200	72.2	74.9	73.5	74.9	37	10	Yes
PM_{10}	24 hour (90.41st percentile)	50	2.5	2.6	2.6	2.6	5	10	No
CO	8 hour (maximum daily running)	10000	53.3	55.6	54.7	55.6	1	10	No

Table D.7 Maximum Predicted Environmental Concentrations ($\mu g.m^{-3}$) at Short-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
SO_2	15 minute (99.90th percentile)	266	121.2	46	10	Yes	7.3	66.1	194.6	73	No
	1 hour (99.73th percentile)	350	106.8	31	10	Yes	7.3	57.3	171.3	49	No
	24 hour (99.18th percentile)	125	21.9	18	10	Yes	7.3	19.0	48.2	39	No
NO_2	1 hour (99.79th percentile)	200	74.9	37	10	Yes	18.0	25.8	118.6	59	No

Table D.8 Predicted Maximum Process Contributions (µg.m^{-3}) at Long-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL (µg.m^{-3})	PC - 10MJ/kg (µg.m^{-3})	PC - 8.5MJ/kg (µg.m^{-3})	PC - 9MJ/kg (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PM_{10}	24 hour (98.08th percentile)	50	0.84	0.86	0.85	0.86	2	10	No
	24 hour (annual mean)	18	0.26	0.24	0.27	0.27*	1	1	Yes
$PM_{2.5}$	24 hour (annual mean)	10	0.26	0.24	0.27	0.27*	3	1	Yes
HCl	1 hour (maximum)	750	6.15	6.43	6.31	6.43	1	10	No
HF	1 hour (maximum)	160	0.61	0.64	0.63	0.64	0	10	No
SO_2	15 minute (99.90th percentile)	266	28.76	30.31	29.60	30.31	11	10	Yes
	1 hour (99.73th percentile)	350	25.39	26.70	26.08	26.70	8	10	No
	24 hour (99.18th percentile)	125	5.31	5.48	5.41	5.48	4	10	No
	1 hour (annual mean)	50	1.34	1.19	1.34	1.34*	3	1	Yes
NO_2	1 hour (99.79th percentile)	200	36.12	37.44	36.77	37.44	19	10	Yes
	1 hour (annual mean)	40	3.74	3.33	3.76	3.76*	9	1	Yes

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
CO	8 hour (maximum daily running)	10,000	26.67	27.82	27.34	27.82	0	10	No
Cd	1 hour (annual mean)	0.005	1.34E-03	1.19E-03	1.34E-03	1.34E-03*	27	10	Yes
Tl	1 hour (maximum)	30	3.07E-02	3.22E-02	3.15E-02	3.22E-02	0	10	No
	1 hour (annual mean)	1	1.34E-03	1.19E-03	1.34E-03	1.34E-03*	0	1	No
Hg	1 hour (maximum)	7.5	3.07E-02	3.22E-02	3.15E-02	3.22E-02	0	10	No
	1 hour (annual mean)	0.25	1.34E-03	1.19E-03	1.34E-03	1.34E-03*	1	1	No
Sb	1 hour (maximum)	150	7.07E-03	7.39E-03	7.25E-03	7.39E-03	0	10	No
	1 hour (annual mean)	5	3.07E-04	2.74E-04	3.09E-04	3.09E-04*	0	1	No
As	1 hour (annual mean)	0.006	6.68E-04	5.95E-04	6.71E-04	6.71E-04*	11	1	Yes
Cr	1 hour (maximum)	150	5.66E-02	5.92E-02	5.80E-02	5.92E-02	0	10	No
	1 hour (annual mean)	5	2.46E-03	2.19E-03	2.47E-03	2.47E-03*	0	1	No
Co	1 hour (maximum)	6	3.38E-03	3.54E-03	3.47E-03	3.54E-03	0	10	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
	1 hour (annual mean)	0.2	1.47E-04	1.31E-04	1.48E-04	1.48E-04*	0	1	No
Cu	1 hour (maximum)	200	1.78E-02	1.86E-02	1.83E-02	1.86E-02	0	10	No
	1 hour (annual mean)	10	7.75E-04	6.91E-04	7.78E-04	7.78E-04*	0	1	No
Pb	1 hour (annual mean)	0.25	1.35E-03	1.20E-03	1.35E-03	1.35E-03*	1	1	No
Mn	1 hour (maximum)	1500	3.69E-02	3.86E-02	3.78E-02	3.86E-02	0	10	No
	1 hour (annual mean)	0.15	1.60E-03	1.43E-03	1.61E-03	1.61E-03*	1	1	Yes
Ni	1 hour (annual mean)	0.02	5.88E-03	5.24E-03	5.90E-03	5.90E-03*	30	1	Yes
V	1 hour (maximum)	1	3.69E-03	3.86E-03	3.78E-03	3.86E-03	0	10	No
	1 hour (annual mean)	5	1.60E-04	1.43E-04	1.61E-04	1.61E-04*	0	1	No
Dioxins & Furans	1 hour (annual mean)	-	2.67E-09	2.38E-09	2.68E-09	2.68E-09*	-	-	-
	1 hour (maximum)	-	6.15E-08	6.43E-08	6.31E-08	6.43E-08	-	-	-
PAHs as B[a]P	1 hour (annual mean)	0.00025 (B[a]P)	5.35E-04	4.76E-04	5.37E-04	5.37E-04*	215	1	Yes

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	PC - 10MJ/kg ($\mu g.m^{-3}$)	PC - 8.5MJ/kg ($\mu g.m^{-3}$)	PC - 9MJ/kg ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?
PCB	1 hour (annual mean)	0.2	1.34E-04	1.19E-04	1.34E-04	1.34E-04*	0	1	No
	1 hour (maximum)	6	3.07E-03	3.22E-03	3.15E-03	3.22E-03	0	10	No
N_2O	1 hour (annual mean)	-	8.02E-01	7.15E-01	8.05E-01	8.05E-01*	-	-	-
TOC	Running annual mean	3.25 (benzene)	2.67E-01	2.38E-01	2.68E-01	2.68E-01*	8	1	Yes
NH_3	1 hour (annual mean)	180	2.67E-01	2.38E-01	2.68E-01	2.68E-01*	0	1	No
	1 hour (maximum)	2500	6.15E+00	6.43E+00	6.31E+00	6.43E+00	0	10	No
CrVI	1 hour (annual mean)	0.0002	9.36E-07	7.73E-07	8.98E-07	8.98E-07*	0	1	No

*Maximum is based on 9MJ/kg which conservatively assumes that the facility is operational all year.

Table D.9 Maximum Predicted Environmental Concentrations (µg.m^{-3}) at Long-Term Emission Limits - AERMOD

Pollutant	Averaging Period	EAL (µg.m^{-3})	Max PC (µg.m^{-3})	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC (µg.m^{-3})	Tarmac PC (µg.m^{-3})	PEC (µg.m^{-3})	PEC as % of EAL	PEC is Potentially Significant?
$PM_{2.5}$	24 hour (annual mean)	10	0.27	3	1	Yes	6.4	0.16 (A17) + 0.08 (A10)	6.9*	69	No
SO_2	15 minute (99.90th percentile)	266	30.31	11	10	Yes	7.3	66.1	103.6	39	No
	1 hour (annual mean)	50	1.34	3	1	Yes	3.6	1.48	6.5*	13	No
NO_2	1 hour (99.79th percentile)	200	37.44	19	10	Yes	18.0	25.8	81.2	41	No
	1 hour (annual mean)	40	3.76	9	1	Yes	9.0	1.29	14.1*	35	No
Cd	1 hour (annual mean)	0.005	1.34E-03	27	1	Yes	2.54E-05	1.85E-04	1.55E-03*	31	No

Pollutant	Averaging Period	EAL ($\mu g.m^{-3}$)	Max PC ($\mu g.m^{-3}$)	Max PC as % of EAL	Criteria (%)	PC is Potentially Significant?	AC ($\mu g.m^{-3}$)	Tarmac PC ($\mu g.m^{-3}$)	PEC ($\mu g.m^{-3}$)	PEC as % of EAL	PEC is Potentially Significant?
As	1 hour (annual mean)	0.006	6.71E-04	11	1	Yes	2.21E-04	9.24E-06	9.01E-04*	15	No
Ni	1 hour (annual mean)	0.02	5.90E-03	30	1	Yes	3.70E-04	8.14E-05	6.35E-03*	32	No
PAHs as B[a]P	1 hour (annual mean)	0.00025	5.37E-04 (PAHs)	215	1	Yes	3.30E-05 (B[a]P)	8.00E-04 (PAHs)	1.37E-03*	548	Yes
TOC	Running annual mean	3.25 (benzene)	2.68E-01	8	1	Yes	7.79E-01 (benzene)	2.96E-01 (TOCs)	1.34*	41	No

*Maximum is based on 9MJ/kg which conservatively assumes that the facility is operational all year.

Conclusion

D.9 The results show that for some averaging periods, the PCs for the 8.5 MJ/kg or 9 MJ/kg scenarios were slightly higher than those modelled in section 5. However, for all pollutants except PAHs, the PC is either less than 1% of the short-term EAL or 10% of the long-term EAL or the PEC is below the EAL. On that basis, regardless of the CV, the impacts can be screened out as insignificant.

D.10 With a CV of 8.5MJ/kg, the assessment assumes that 439,577 tonnes of waste will be thermally treated annually; this is significantly more than 390,000 tonnes which the variation is seeking. Furthermore, the actual number of available operating hours will be less than 8,760 when compared to the basis for the variation. Applying a maximum permitted tonnage of 390,000 tonnes per annum, the maximum number of hours assuming a CV of 8.5 MJ/kg will be 7,772 hours. The results presented in this appendix assume that the number of operational hours at a CV of 8.5 MJ/kg is 7,772 hours. For 9 and 10 MJ/kg the results presented assume that the facility is operational for a full year i.e. 8760. For the 9 MJ/kg scenario in particular this is conservative as the facility will not operate all year.

D.11 For PAHs, as was the case in section 5, the PEC exceeds the EAL. AERMOD predicted a higher PC than ADMS and the maximum cumulative PEC is 1.37E-05 $\mu g.m^{-3}$ which is 548% of the B[a]P EAL.

D.12 Monitoring data for UK EfWs has shown that B[a]P emissions are actually only 10% of total PAH emissions. The Integrated Pollution Prevention and Control reference Document on the Best Available Techniques for Waste Incineration, August 2006 section 3.2.2.1, quotes the following measured (non-continuous measurement) emission concentrations for BaP, and total PAH, <0.001 and <0.01 $mg.m^{-3}$, respectively.

D.13 On that basis, if the PC and the Tarmac facility PC was divided by 10 i.e. to calculate B[a]P PCs, the resulting cumulative PEC would be 1.67E-04 $\mu g.m^{-3}$ which is 67% of the B[a]P EAL and the impacts have been screened out as insignificant.

D.14 For all three CV scenarios, the impacts have been screened out as insignificant for all pollutants.

References

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