AIR POLLUTION SERVICES

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PERMIT - Air Emission Risk Assessment: SWIP, 544 Duncombe Road, Bradford

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Quality Assurance

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Experts in Air Quality, Odour and Climate Change








Contents

1 Introduction

Purpose of the study

1.1 Air Pollution Services Ltd (APS) has been commissioned by The End Journey Ltd to assess the risk of adverse air quality impacts associated with the operation of the small waste incineration plant (SWIP) located on land at 544 Duncombe Road, Bradford.

1.2 The facility comprises of a pyrolysis plant which will use either refuse derived fuel (RDF) or rubber tyres as the feedstock for the process. The waste is non-hazardous. This assessment has been carried out based on information provided by The End Journey Limited.

1.3 The pyrolysis process uses heat to decompose the feedstock material. The heat is provided by gas burners which use gas collected on each previous process to fuel the burners and provide the heat for the pyrolysis to occur. As such the plant is considered an incineration facility.

1.4 The facility will use two gas burners to provide heat to the pyrolysis reactor. Each of these burners has a thermal output of 360 kW (a net thermal input of ~360 kW). As such the gas burners are not medium combustion plant (i.e. below 1 MW).

1.5 The process is non-continuous and instead is a batch process. A single batch process will last for about 12-14 hours and will involve loading of approximately 10-12 tonnes of feedstock material During the process heat from the gas burners is provided for only 9-10 hours.

1.6 The plant is assumed to process one batch per day, five days per week. Thus, the total hours the gas burners will operate is approximately 2,600 hours per year (10 hours x 5 days per week x 52 weeks per year).

1.7 The impacts of the site are considered in relation to the Environmental Permitting Regulations (EPR). These require the regulator, in this case Bradford Council, to ensure the facility will not have a significant adverse contribution to a breach of the environmental standards. The process is considered to be a SWIP and will therefore need a to be a regulated facility and require a Schedule 13 waste incineration permit regulated by the local authority.

1.8 Emissions from the combustion of the fuel have the potential to impact local sensitive receptors. The pollutants covered in this assessment are primarily those for which the IED specifies a maximum emission rate. These are:

- nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- total dust, which includes fine airborne particulate matter (PM_{10} and $PM_{2.5}$);
- carbon monoxide (CO);
- hydrogen chloride (HCl);
- hydrogen fluoride (HF);

- Volatile Organic Compounds (VOCs);
- the following trace metals:
    - cadmium (Cd);
    - thallium (Tl);
    - mercury (Hg);
    - antimony (Sb);
    - arsenic (As);
    - lead (Pb);
    - chromium (Cr);
    - copper (Cu);
    - manganese (Mn);
    - nickel (Ni); and
    - vanadium (V).

1.9 Receptors which are potentially sensitive to impacts from the pollutant emissions are grouped into two categories:

- Human health impacts; and
- Sensitive ecological system impacts.

1.10 The facility location is shown in Figure 2. This also shows the land uses in the surrounding area derived from the Corine Land-use database (Copernicus, 2018). The site is located within an industrial area of west Bradford. There are few human health receptors in the immediate vicinity of the site, most being outdoor areas like pavements where members of the public are unlikely to spend significant periods of times. There is, however, a school approximately 150 m to the east, and residential properties approximately 200 m to the northwest, 180 m to the southwest, 500 m to the north and 500 m to the east.

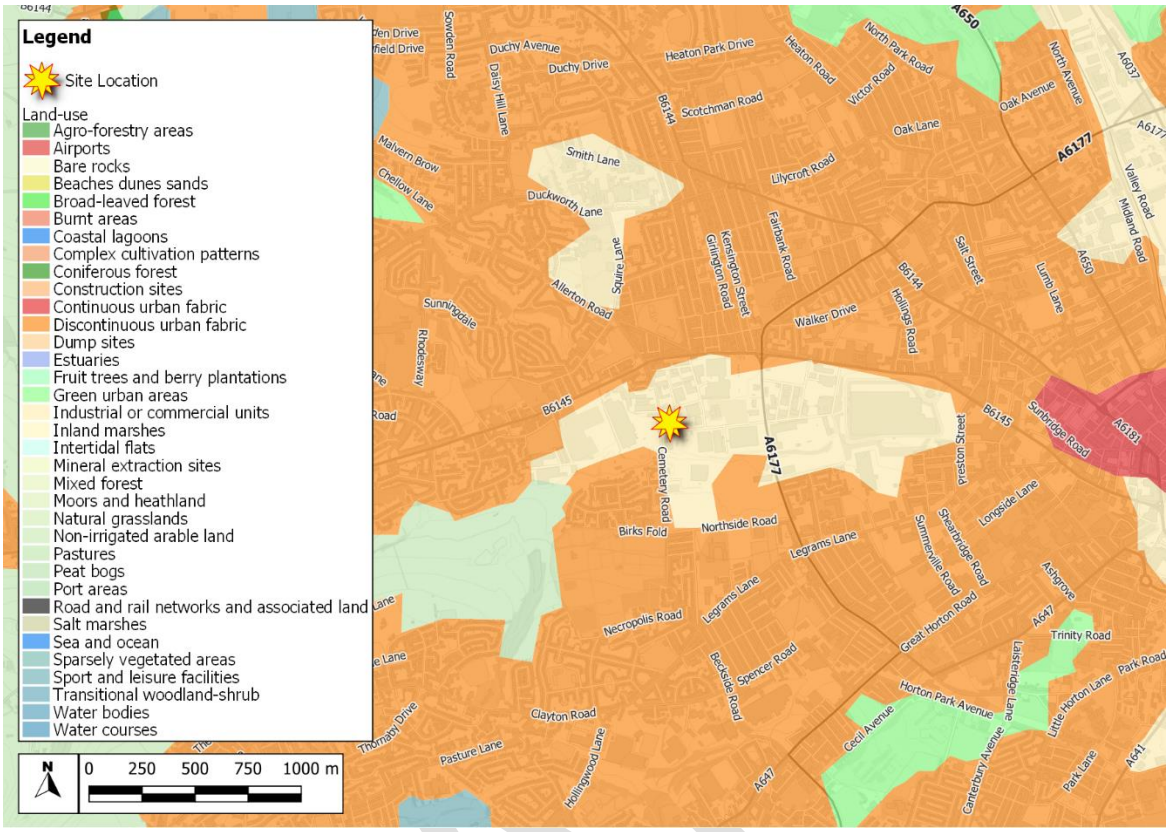

Figure 1: Site location and Land-use

1.11 Bradford Council has investigated air quality within their area as part of their responsibilities under the Local Air Quality Management regime. The Council has declared four Air Quality Management Areas (AQMAs), all for exceedences of annual mean nitrogen dioxide air quality objective. The nearest AQMA is 1.9 km to the northeast of the facility as shown in Figure 2. The AQMAs represent areas where there is human health exposure to unacceptable pollution levels.

Figure 2: Site location and AQMAs

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1.12 In addition to human receptors in the local area, there are potentially sensitive ecological habitats. Within 2 km of the site there are no locally designated ecological sites (local nature reserve (LNR) or ancient woodland (AW)) or nationally designated ecological sites (national nature reserve (NNR) or Site of Special Scientific Interest (SSSI)). However, within 10 km of the facility is the South Pennine Moors which is a Special Area of Conservation (SAC), Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI) which may be sensitive to small changes. This is shown in Figure 3.

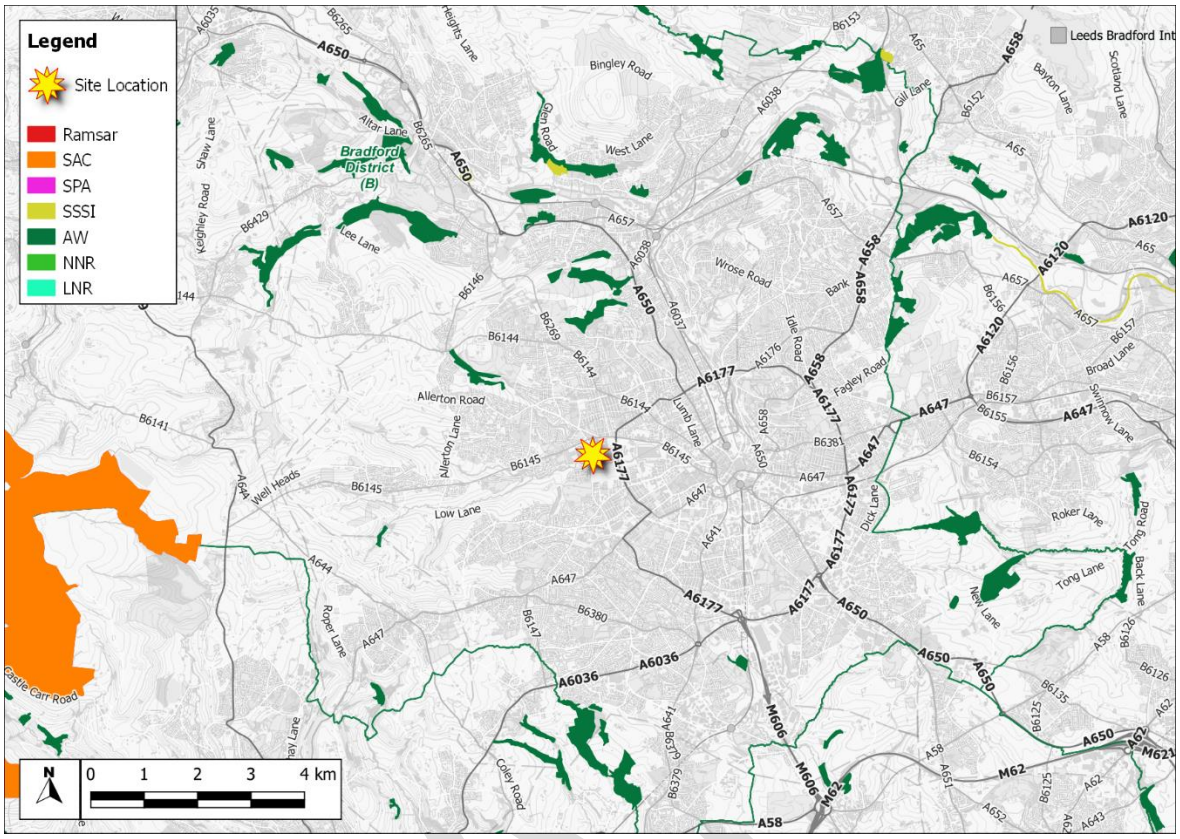

Figure 3: Site location and Designated Ecological Sites

1.13 The facility will include abatement to minimise the release of pollutant emissions to air. This report sets out the impacts and risk of these emissions.

1.14 There is a flexible power generation facility adjacent to the site which will generate emissions in the local area, where impacts from the SWIP facility cannot be screened out consideration of the combined impacts with other sources will be made.

1.15 The facility also incorporates an odour abatement system for releases of odour from the facility. The odour abatement system is designed to minimise the risk of significant adverse odour impacts. Details of the odour abatement system are provided in support of the permit application.

Planning background

1.16 The planning application relevant to the site issued by Bradford Council is Application No. 18/02212/FUL dated 15 October 2018.

1.17 The two burners exhaust through a consented single flue with a flue height above the peak of the existing building roof is 2.4 m.

2 Background

Air Quality Standards, Critical Levels/Loads, Limit Values and Air Quality Objectives

2.1 The Environment Act 1995 (HMSO, 1995) sets out the requirements of the Local Air Quality Management (LAQM) regime and the requirement for the Government to produce an Air Quality Strategy including standards and objectives.

2.2 The latest Air Quality Strategy was published in 2007 (Defra, 2007) and sets out the Air Quality Standards (AQS), which consider the effects on human health and ecosystems, and The National Air Quality Objectives (AQOs) for ambient pollution. The AQOs for use by local authorities when considering human health were incorporated into UK legislation within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002). In addition to the AQO for protection of human health set out in the Air Quality Regulations, both critical levels and critical loads are defined for protection of ecosystems. These critical levels and critical loads also form part of the AQOs in the strategy.

2.3 The Strategy explains that the AQSs for the protection of human health are defined as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The AQS are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedences allowed per year (if any) and a date by which it must be achieved. An exceedence is a breach of the threshold for the concentration for the specific averaging period. In terms of ecosystems the AQS are based on the critical levels and critical loads, which are derived for habitats and exceedence of these values are used as an indication of the potential for harmful effects to systems at steady state thus giving an indication of risk to the system. Critical loads are values of pollutants deposited below which significant effects do not occur. Critical levels are the concentrations of pollutants above which direct adverse effects on vegetation or ecosystems may occur.

2.4 The AQO's set out the extent to which the Government expects the AQS to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and possible timescales. AQO are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedences, within a specified timescale. The LAQM regime, introduced by the Environment Act 1995, requires local authorities to review air quality within their boundary and work towards achieving and maintaining the AQO.

2.5 The Strategy describes the LAQM regime that has been established by Part IV of the Environment Act 1995, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an AQMA and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the AQOs.

The strategy also provides the policy framework for air quality management and assessment in the UK.

2.6 In additional to the AQOs set within the Air Quality Strategy, the European Union (EU) also set limit values and target values for the protection of human health and critical levels for the protection of ecosystems. These were transposed into the Air Quality Standards Regulations (HMSO, 2010), which sets out the UK's limit values, target values and critical levels for specific pollutants. Like the AQO, the limit values, target values and critical levels are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedences allowed per year (if any) and a date by which it must be achieved. Some pollutants have more than one value covering different dates or averaging times. While the AQO are policy targets, the government has the duty to ensure compliance with the legally binding limit values which is a national obligation rather than a local one.

The Industrial Emissions Directive (IED)

2.7 The Industrial Emissions Directive (IED, 2010/75/EU), a European Union Directive, consolidated seven existing directives including the Waste Incineration Directive (WID) into a single directive. Chapter IV of the IED applies to incineration and co-incineration plants (which accept waste and other fuels such as biomass) which thermally treat waste as defined in the Waste Framework Directive. The IED defines requirements for facilities classified as waste incinerators under the IED definition. The IED also defines emission limit values (ELVs) for emissions to air.

Protection of Nature Conservation Sites

2.8 Sites of nature conservation importance at a European, national and local level, are provided environmental protection from development, including from emissions to air.

2.9 The Conservation of Habitats and Species Regulations 2017 (as amended)[1] (known as the 'Habitats Regulations') transposes the Habitats Directive, a European Directive, into UK legislation. The Habitats Regulations require that a development proposal will not cause a likely significant effect or, where likely significant effects cannot be discounted, no adverse effect on the integrity of European sites. It requires an assessment to determine if significant effects (alone or in combination) are likely, followed by an 'appropriate assessment' by the competent authority, if necessary. More information regarding the Habitats Directive are set out in Appendix A2.

2.10 Similarly, the Countryside and Rights of Way (CRoW) Act 2000 provides protection to Sites of Special Scientific Interest (SSSIs) to ensure that developments are not likely to cause them damage.

2.11 Locally important sites (such as National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) or Sites of Importance for Nature Conservation (SINCs) and Ancient Woodland (AW)) are also protected by legislation to ensure that developments do not cause significant pollution.

[1] HMSO, 2017, The Conservation of Habitats and Species Regulations 2017 Statutory Instruments No. 1012

Environmental Permitting

2.12 The Environmental Permitting (England and Wales) Regulations (HMSO, 2016) (EPR) transpose the IED in UK legislation. The EPR are designed to ensure the competent authority regulates emissions, including emissions to air, from processes to minimise adverse impacts. The latest amendment was in 2018.

2.13 The EPR states that a SWIP is defined as a waste incineration plant or waste co-incineration plant with a capacity less than or equal to 10 tonnes per day for hazardous waste or 3 tonnes per hour for non-hazardous waste, as is the case for this facility.

2.14 Schedule 13 of the EPR explains that Chapter IV of the IED applies to SWIP. Chapter IV of the IED sets out the provisions for waste incineration plants. The chapter states:

"This Chapter shall not apply to gasification or pyrolysis plants, if the gases resulting from this thermal treatment of waste are purified to such an extent that they are no longer a waste prior to their incineration and they can cause emissions no higher than those resulting from the burning of natural gas."

2.15 While the process is a pyrolysis plant, gas from the pyrolysis process is combusted to provide heat to the reactor and thus the process is considered an incinerator.

2.16 The chapter also states:

"Emissions into air from waste incineration plants and waste co-incineration plants shall not exceed the emission limit values set out in parts 3 and 4 of Annex VI or determined in accordance with Part 4 of that Annex."

Emissions

2.17 The IED defines emission limit values (ELVs) for emissions to air from waste incineration facilities. These ELVs are detailed in Table 1 for information. The EU also produces Best Available Techniques Reference (BREF) documents. The IPPC Reference Document on BAT for Waste Incineration (European Commission, 2019b) issued in November 2019 includes Best Available Techniques - Associated Emission Levels (BAT-AEL) that are more stringent than the IED ELV's. The BAT-AELs are detailed in Table 2. These are emission limits which the EU consider are achievable for waste incineration plant based on evidence and technology available.

Table 1: IED Emission Rates

Pollutant	Emission Limits (mg/Nm^3) [a]		
	24-hour Mean	30-minute Mean	
		100th Percentile	97th Percentile
Continuous measurement			
Total PM	10	30	10
TOC	10	20	10
HCl	10	60	10

HF	1	4	2
SO_2	50	200	50
NOx	200	400	200
CO	50	100 [a]	-
Spot sample measurement			
Group 1 metals [b]	0.05	-	-
Group 2 metals [c]	0.05	-	-
Group 3 metals [d]	0.5	-	-
Dioxins and furans [e]	0.0000001	-	-

[a] For CO there is also an ELV of 150 mg/Nm^3 as a 15-minute mean.

[b] Cadmium (Cd) and thallium (Tl)

[c] Mercury (Hg)

[d] Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V)

[e] The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

Table 2: BREF note (November 2019) includes BAT-Associated Emission Levels (BAT-AEL)

Pollutant	Emission Limits (mg/Nm^3) [a]
Total PM	2-5
TOC	3-10
HCl	2-6
HF	<1
SO_2	5-30
NOx	50-120
CO	10-50
Group 1 metals	0.005-0.02
Group 2 metals	0.005-0.02
Group 3 metals	0.01-0.3
Dioxins and furans	0.0000001-0.0000002

Guidance documents

2.18 The assessment uses several guidance documents and information notes.

Environment Agency Guidance: Air emissions risk assessment for your environmental permit

2.19 The Environment Agency provides guidance on assessing the impacts of emissions released air from permitted sites. The guidance provides a methodology along with assessment thresholds for pollutants.

Environment Agency Guidance: Environment Agency Interim Guidance Note for Metals 2012

2.20 The Environment Agency provides guidance on assessing group 3 metal stack emissions from incinerators

3 The Facility

Waste Fuel

3.1 The specific waste composition is not known, however, the facility will operate on either waste rubber tyres or RDF. The RDF and rubber tyre waste feedstock is assumed to have a typical composition as presented in Table 3 and Table 4. The net calorific value of the rubber tyres (as received) is assumed to be 31.55 MJ/kg. The net calorific value of the RDF (as received) is assumed to be 17.40 MJ/kg. The RDF has a much lower calorific value than the rubber tyres.

Table 3: Fuel composition – Rubber Tyres

Parameter		As Received (ar)	Dry Basis (dry)	Dry Ash Free (daf)
%Mass	Carbon	79.95%	81.16%	86.89%
	Hydrogen	6.99%	7.10%	7.60%
	Nitrogen	0.25%	0.25%	0.27%
	Oxygen	3.27%	3.32%	3.55%
	Sulphur	1.56%	1.58%	1.69%
	Chlorine	6.50%	6.60%	86.89%
	Fluorine	79.95%	81.16%	7.60%
	Ash	6.99%	7.10%	-
	Moisture Content	0.25%	-	-
	Total	100.00%	100.0%	100.00%
Net Calorific Value (LHV) (MJ/kg)		31.55	32.06	-
Gross Calorific Value (HHV) (MJ/kg)		33.11	33.61	35.98

Table 4: Fuel composition – Rubber Tyres

Parameter		As Received (ar)	Dry Basis (dry)	Dry Ash Free (daf)
%Mass	Carbon	46.20%	49.23%	59.19%
	Hydrogen	7.65%	8.15%	9.80%
	Nitrogen	1.71%	1.82%	2.19%
	Oxygen	22.27%	23.73%	28.53%
	Sulphur	0.23%	0.24%	0.29%
	Chlorine	15.78%	16.82%	59.19%
	Fluorine	6.16%	49.23%	9.80%
	Ash	46.20%	8.15%	-
	Moisture Content	7.65%	-	-
	Total	100.00%	100.0%	100.00%
Net Calorific Value (LHV) (MJ/kg)		17.40	18.70	-
Gross Calorific Value (HHV) (MJ/kg)		19.22	20.48	24.62

Combustion fuel

3.2 The waste feedstock goes through the pyrolysis process and as a product of the process, gas fuel (syn-gas) is collected and stored. The pyrolysis process is powered by heat from two gas burners combusting syn-gas collected from the previous pyrolysis process.

3.3 In the absence of full details, the gas fuel which is collected from each waste type (RDF and rubber tyres) is estimated to have a similar calorific value to the waste fuel it was derived from.

3.4 On occasion natural gas may be used to start the process, however, for the propose of modelling pessimistic emissions, it has been assumed that the syn-gas will always be used.

3.5 The two gas burners used within the process are rated as outputting 360 kW of heat each and this is required for the pyrolysis process to occur. The burners have been assumed to be 100% efficient and therefore the net fuel in is assumed to be 360 kW of syn-gas. The volume of combustion gas is thus dependent on the calorific value of the syn-gas. As there is a single flue, the two burners are considered a single combustion plant of 720 kW.

3.6 The relevant combustion parameters including calculated actual (A) and normalised (N) exhaust flow rates, for the Facility, are given in Table 5 for each derived syn-gas. These are based on the complete combustion of the syn-gas in 25% excess combustion air.

3.7 Throughout this report, 'normalised' (N) units are used. This refers to no moisture (dry), 11% oxygen, and 0 degrees Celsius. These are the reference conditions at which the relevant Industrial Emission Directive (IED) emissions limits are expressed.

Table 5: Plant Specifications and Release Conditions (per Generator)

Parameter	RDF	Rubber Tyres
Power Output (kW_{out})	720	720
Combustion Input		
Net Input Fuel Rate (kW_{in})	720	720
Gross Input Fuel Rate (kW_{in})	726	756
Gross Fuel Consumption (kg/hr)	143.5	82.2
Combustion Air_{in} (kg/h)	1434.49	1205.73
Excess Air (%)	25	25
Combustion Products		
Exhaust Temperature (°C)	62.3	62.3
Exhaust Flow (kg/h) for Actual Flow	1523	1280
Molar Flow Rate (mol/s) for Actual Flow	14.72	12.02
Molecular Mass (g/mol) for Actual Flow	28.74	29.58
Exhaust Flow (Am^3/s) [b, c] for Actual Flow	0.405	0.331
Exhaust Flow (kg/h) for Normalised Flow [d]	1342	1165
Molar Flow Rate (mol/s) for Normalised Flow [d]	12.37	10.62
Exhaust Flow (Nm^3/s) [d, e] for Normalised Flow	0.277	0.238

[b] Actual flow conditions assumed to be: RDF - 62.3 ºC, 3.9% O_2, wet (12.1% H_2O) and Rubber Tyres - 62.3 ºC, 4.0% O_2, wet (7.6% H_2O).

[c] Calculated from molar flow rate x 8.3145 x (T+273.13) / 101,325.

[d] Normalised to 0 ºC, 101.325 kPa, 0% O_2, dry.

[e] Calculated from normalised molar flow rate x 8.3145 x (273.13) / 101,325.

Emissions

3.8 An example of emissions measured at a similar plant are provided in a stack emissions monitoring report provided by Alkom Synergy PVT Ltd, the report is presented in Appendix A1. The report is dated 24th Feb 2020 and provides measurements based on rubber tyres as the feedstock. The

author of the report has confirmed[2] the pollutant concentration shown in the report are presented at 12% O_2, dry and at 0 degrees Celsius and 101.3 kPa. The values have been adjusted to match the normalized units used in the report and are presented in Table 6.

Table 6: Measured emissions at a similar plant

Pollutant	Measured Emission Concentrations (mg/Nm^3)
Total PM	13.79
TOC [a]	0.01
HCl	0.59
HF	Not measured
SO_2	15.91
NOx	5.80
CO	Not measured
Group 1 metals [b]	0.0007
Group 2 metals [c]	0.0003
Group 3 metals [d]	0.0133

[a] The sum of benzene, ethyl benzene, toluene and xylene measurements.

[b] Based on cadmium (Cd) measurements

[c] Based on mercury (Hg) measurements

[d] Based on lead (Pb) measurements

3.9 The typical pollutant emission limits for similar plant to the one used in the facility have been used to estimate the realistic conservative emission limits for the facility. Where the emissions are not available from the measurements, BAT-AEL limits have been used instead (European Commission, 2019b).

3.10 It is anticipated that the process will not result in significant emissions of polychlorinated biphenyls (PCBs) or polycyclic aromatic hydrocarbons (PAHs), however, emission limits of 0.13 μg/Nm^3 and 0.75 ng/Nm^3 respectively, have been assumed based on measurements at European waste incineration facilities as specified in the IPPC Reference Document on BAT for Waste Incineration (European Commission, 2019b).

3.11 The pollutant emission limits for the facility are detailed in Table 7 and were used in this assessment.

3.12 The plant tested by Alkom Synergy PVT Ltd included a wet scrubber as part of the abatement system, similar the one proposed for this facility. However, this facility is committing to a system which reduces the total PM emission to 10 mg/Nm^3, which is the limit set in IED.

[2] Confirmed by email from Alkom Synergy Pvt Ltd info@alkom.in on 14 April 2020.

Table 7: Facility Pollutant Emission Limits

Pollutant	Emission Limits (mg/Nm^3)
Total PM	10
TOC	3
HCl	2
HF	1
SO_2	30
NOx	50
CO	50
Group 1 metals [a]	0.005
Group 2 metals [b]	0.005
Group 3 metals [c]	0.01
Dioxins and furans [d]	0.0000001
NH_3	10
PAH [e]	0.00013
PCBs [f]	0.000000075

[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), vanadium (V)

[d] The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

[e] An emission rate for PAH (as B[a]P) has been taken from Figure 8.121 of the BREF (European Commission, 2019b), which presents measured emission rates at municipal solid waste incineration sites. The maximum "average" emission rate of 0.13 μg/Nm^3 from any site included in the graph has been estimated from the graph and used as the annual mean emission rate, which is considered worst-case.

[f] An emission rate for PCBs has been taken from Figure 8.117 of the BREF (European Commission, 2019b), which presents measured emission rates at municipal solid waste incineration sites. The maximum "average" emission rate of 0.75 ng/Nm^3 from any site included in the graph has been estimated from the graph and used as the annual mean emission rate, which is considered worst-case.

Operating Profile

3.13 A single process will take approximately 12-14 hours, during which heat from the gas burners is provided for 9-10 hours. The maximum duration of gas combustion is assumed to be 10 hours per process.

3.14 The plant is assumed to process one batch per day, five times per week. Thus, the total hours the gas burners will operate is approximately 2,600 hours per year (10 hours x 5 days per week x 52 weeks per year).

3.15 The process is assumed to be able to occur during any hour of the year and operations are not restricted to specific times of the day.

4 Air Quality Assessment Levels (AQALs)

Relevant exposure

AQO Receptors

Human Health

4.1 The annual mean AQO applies at locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals and care homes.

4.2 Places of work like factories or offices are not considered places where members of the public might be regularly exposed and therefore the AQO's do not apply at these locations.

4.3 The 1-hour mean AQO applies at the annual mean locations of exposure and at hotels, residential gardens and any outdoor location where members of the public might reasonably be expected to spend one hour or longer, such as busy pavements, outdoor bus stations and locations with outdoor seating.

Ecological

1.1 Discussion regarding the types of ecological sites can be found at Appendix A2. Nationally designated ecological sites (Sites of Special Scientific Interest (SSSIs), Areas of Special Scientific Interest (ASSIs), National Nature Reserves (NNRs)) and internationally designated ecological sites (SAC, SPAs and Ramsar sites) are considered relevant receptors for the NOx annual mean critical level, 24-hour mean proxy critical level and annual mean critical loads. Locally designated sites (LNRs, local wildlife sites (LWSs) and AW) are also considered sensitive receptors, however, they are less sensitive to changes and less weight is attributed to these sites. The IAQM guidance explains that:

"Under the Directive, assessment of compliance with the critical levels is strictly only required at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways. In practice, however, assessment against critical levels for vegetation is frequently undertaken to inform planning and permitting processes across the country, regardless of this definition."

Limit Value Receptors

4.4 In accordance with Article 2(1), Annex III, Part A, paragraph 2 of Directive 2008/50/EC details locations where compliance with the limit values does not need to be assessed:

"Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations:

a) Any locations situated within areas where members of the public do not have access and there is no fixed habitation;

b) In accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply; and

c) On the carriageway of roads; and on the central reservation of roads except where there is normally pedestrian access to the central reservation."

4.5 The government models compliance with the Directive at locations 4 m from the kerbside, 2 m high, more than 25 m from major road junctions and adjacent to at least 100 m of road length where the limit value applies.

Criteria for this Assessment

4.6 The AQALs for the assessment are set out in the following section, these comprise of AQO, limit values, critical levels and critical loads.

Air Quality Objectives, Limit Values, and Critical Levels

4.7 The AQOs, limit values and critical levels for England for the pollutants relevant to this project are detailed in Table 8.

4.8 Air quality assessment levels (AQALs) have been derived from the AQOs set out in the Air Quality Regulations, the limit values and target values set out in the Air Quality Standards Regulations and the Environmental Assessment Levels (EALs) set out by the Environment Agency. The AQAL used within this assessment are set out in Table 8.

4.9 Where there is no EAL quoted in Environment Agency guidance, one has been derived from the Health and Safety Executive's workplace exposure limits (HSE, 2020). This applies to the short-term EAL for chromium VI, and the short- and long-term EALs for thallium and cobalt.

Table 8: AQOs, Limit Values and EALs

Pollutant	Time Period	Source of AQAL [a]	Concentration, and the number of exceedences allowed per year (if any)	Date AQO / Limit Value to be Achieved From and Maintained After
Human-Health				
NO_2	1-hour Mean	AQO / Limit Value	200 µg/m³ not to be exceeded more than 18 times a year	31st December 2005 / 1st January 2010
	Annual Mean	AQO / Limit Value	40 µg/m³	31st December 2005 / 1st January 2010
PM_{10}	24-hour Mean	AQO / Limit Value	50 µg/m³ not to be exceeded more than 35 times a year	31st December 2004 / 1st January 2005
	Annual Mean	AQO / Limit Value	40 µg/m³	31st December 2004 / 1st January 2005
$PM_{2.5}$	Annual Mean	AQO / Target Value	25 µg/m³	2020 / 2010
SO_2	15-minute Mean	AQO	266 µg/m³ not to be exceeded more than 35 times a year	31st December 2005
	1-hour Mean	AQO / Limit Value	350 µg/m³ not to be exceeded more than 24 times a year	31st December 2004 / 1st January 2005

	24-hour Mean	AQO / Limit Value	125 µg/m³ not to be exceeded more than 3 times a year	31st December 2004 / 1st January 2005
CO	Maximum daily 8-hour mean	AQO / Limit Value	10 mg/m³	31st December 2003 / 1st January 2005
Benzene [b]	Annual Mean	AQO / Limit Value	5 µg/m³	31st December 2010 / 1st January 2010
	Running Annual Mean	AQO	16.25 µg/m³	31st December 2003
1,3-butadiene [b]	Annual Mean	AQO	2.25 µg/m³	31st December 2003
Dimethyl sulphate [c]	Annual Mean	AQO	2.25 µg/m³	31st December 2003
Hydrogen Fluoride (HF)	1-hour Mean	EA EAL	160 µg/m³	-
	Annual Mean	EA EAL	16 µg/m³	-
Hydrochloric acid (HCl)	1-hour Mean	EA EAL	750 µg/m³	-
	Annual Mean	EA EAL	20 µg/m³ [a]	-
Ammonia	Annual Mean	EA EAL	180 µg/m³	-
	1-hour Mean	EA EAL	2500 µg/m³	-
Benzo(a)pyrene [c]	Annual Mean	AQO / Target Value	0.25 ng/m³ / 1 ng/m³	31st December 2010 / 31st December 2012
Dioxins and -furans (PCCD/F) [d]	Annual Mean	WHO	0.3 pg/m³	-
Polychlorinated biphenyls (PCBs)	1-hour Mean	EA EAL	6 µg/m³	-
Antimony	1-hour Mean	EA EAL	150 µg/m³	-
	Annual Mean	EA EAL	5 µg/m³	-
Arsenic	Annual Mean	Target Value / EA EAL	0.006 µg/m³/ 0.003 µg/m³	31st December 2012 / -
Cadmium	Annual Mean	Target Value / EA EAL	0.005 µg/m³	31st December 2012
Chromium(III)	1-hour Mean	EA EAL	150 µg/m³	-
	Annual Mean	EA EAL	5 µg/m³	-
Chromium(VI)	1-hour Mean	EA EAL [e]	15 µg/m³	-
	Annual Mean	EA EAL	0.0002 µg/m³	-
Cobalt	1-hour Mean	EA EAL [e]	30 µg/m³	-

	Annual Mean	EA EAL [e]	1 µg/m^3	-
Copper	1-hour Mean	EA EAL	200 µg/m^3	-
	Annual Mean	EA EAL	10 µg/m^3	-
Lead	Annual Mean	AQO / Limit Value	0.25 µg/m^3/ 0.5 µg/m^3	31st December 2008 / 1st January 2005
Manganese	1-hour Mean	EA EAL	1500 µg/m^3	-
	Annual Mean	EA EAL	0.15 µg/m^3	-
Mercury	1-hour Mean	EA EAL	7.5 µg/m^3	-
	Annual Mean	EA EAL	0.25 µg/m^3	-
Nickel	Annual Mean	Target Value	0.02 µg/m^3	31st December 2012
Thallium	1-hour Mean	EA EAL [e]	30 µg/m^3	-
	Annual Mean	EA EAL [e]	1 µg/m^3	-
Vanadium	1-hour Mean	EA EAL	5 µg/m^3	-
	Annual Mean	EA EAL	1 µg/m^3	-
	Annual Mean	EA EAL	0.2 µg/m^3	-
Ecological				
NOx	24-hour Mean	EA EAL / Proxy Critical level [f]	75 / 200 [g] µg/m^3	-
	Annual Mean	AQO / Critical Level	30 µg/m^3	31st December 2000 / 19th July 2001
SO_2	Winter Mean	AQO / Critical Level	20 µg/m^3	31st December 2000 / 19th July 2001
	Annual Mean	AQO / Critical Level	20 µg/m^3	31st December 2000 / 19th July 2001
	Annual Mean	EA EAL	10 µg/m^3 where lichens or bryophytes are present	-
O3	5-year Mean	AQO / Target Level	18,000 µg/m^3 as an average of 1-hour Means between May-July	1st January 2010 / 1st January 2010
NH_3	Annual Mean	EA EAL	1 µg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present 3 µg/m^3 where they're not present	-

Hydrogen Fluoride (HF)	Weekly Mean	EA EAL	0.5 µg/m^3	-

[a] Air Quality Objectives (AQOs) from the Air Quality Regulations; limit values, target values and critical levels from the Air Quality Standards Regulations; and EA EALs from the Environmental Agency Air emissions risk assessment for your environmental permit guidance.

[b] Emissions of TOCs are assessed against the EALs for benzene, 1,3-butadiene and dimethyl sulphate, since these are the most stringent EALs for any VOCs.

[c] Dioxins and furans are a group of organic compounds with similar structures, which are formed as a result of combustion in the presence of chlorine. There are no assessment criteria for dioxins and furans. The World Health Organisation (WHO) provides an indicator of the air concentrations above which it considers it necessary to identify and control local emission sources; this value is 0.3 pg/m^3 (300 fg/m^3). In the absence of suitable criteria, the WHO indicator concentration for which it is considered necessary to identify and control emission sources has been used.

[d] PAHs are members of a large group of organic compounds widely distributed in the atmosphere. The best known PAH is benzo[a]pyrene (B[a]P). For the purpose of this assessment, Emissions of PAH have been assessed against the AQAL set for benzo(a)pyrene as this is the only PAH which an AQAL has been set.

[e] Long- and short-term EALs for thallium and cobalt, the long-term EAL for HCl and the short-term EAL for chromium(VI) has been calculated from the exposure limits in EH40/2005, and converted to the respective EAL.

[f] While there is not a short-term critical level in the Air Quality Regulations, research has demonstrated exposure to very high concentrations of NOx for short periods (hours/days) may also have an adverse effect under certain conditions even if the long-term concentrations are below the limit value.

[g] The critical level for short-term NOx has been defined by the World Health Organization and is dependent on the O_3 and SO_2 concentrations. The WHO, explain that: "Experimental evidence exists that the CLE [critical level] decreases from around 200 µg/m^3 to 75 µg/m^3 when in combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NOx concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 µg/m^3 is proposed for the 24 h mean". Based on this, where O_3 and SO_2 are not elevated above their critical levels, a value of 200 µg/m^3 is recommended for assessments.

Critical Loads for this Assessment

4.10 Habitats are sensitive to deposition resulting in eutrophication and acidification. Deposition occurs both in the form of dry deposition and wet deposition.

4.11 Critical loads are defined as (APIS, 2019a):

"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"

4.12 While critical levels are (APIS, 2019a):

"concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge".

4.13 The critical loads used to assess the impact of compounds deposited to land which result in eutrophication and acidification are expressed in terms of kilograms of the relevant pollutant deposited per hectare per year (for example for nitrogen the unit is kg N/ha/yr) and kilo-equivalents H^+ ions deposited per hectare per year (keq/ha/yr). The unit of 'equivalent' (eq) is used, rather than a unit of mass, for the purposes of assessing acidification from multiple species. The unit eq. (1 keq ≡ 1,000 eq) refers to molar equivalent of potential acidity resulting from e.g. sulphur, oxidised and reduced N, as well as base cations. Essentially, it is a measure of how acidifying a particular chemical species can be.

4.14 Critical loads are set by the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution. Natural England site-specific critical loads for SPA, SAC and SSSI sites in England are established from The Working Group on Effects of the UNECE Convention on Long Range Transboundary Air Pollution. The information is available via the Air Pollution Information Service (APIS, 2019b) which contains information on applicable critical loads for various habitats and species.

4.15 Where the sites of interest for an assessment are locally designated sites (LNR and AW), there are no site-specific critical loads. However, the APIS website does provide habitat-specific critical loads for use in impact assessment. The main habitats for locally designated sites are taken from the 'MAGIC' website (Defra, 2020) managed by Natural England on behalf of the MAGIC partnership organisations.

4.16 The critical loads used in this assessment are presented in Table 9 and Table 10. These include a range for each site. The lower end of the range have been used for a conservative assessment.

Table 9: Nitrogen Critical Loads

Habitat / Ecosystem	N Nutrient Critical Load (CL) range (kg N/ha/yr)
Raised and blanket bogs	5 – 10
Valley mires, poor fens and transition mires	10-15
Acidophilous Quercus-dominated woodland	10-15
Northern wet heath: Erica tetralix dominated wet heath	10 - 20
Dry heaths	10 - 20

Table 10: Acidity Critical Loads a

Habitat / Ecosystem	Acidity range $CL_{min}N$, $CL_{max}N$ and CLmaxS (keq /ha/yr)
Bogs	MinCLminN: 0.321 | MaxCLminN: 0.321 MinCLMaxS: 0.248 | MaxCLMaxS: 0.86 MinCLMaxN: 0.569 | MaxCLMaxN: 1.181
Unmanaged Broadleafed/Coniferous Woodland	MinCLminN: 0.142 | MaxCLminN: 0.5 MinCLMaxS: 0.428 | MaxCLMaxS: 4.355 MinCLMaxN: 0.713 | MaxCLMaxN: 4.712
Dwarf shrub heath	MinCLminN: 0.499 | MaxCLminN: 1.107 MinCLMaxS: 0.19 | MaxCLMaxS: 2 MinCLMaxN: 0.749 | MaxCLMaxN: 3.027

[a] APIS advises that where the total acid nitrogen deposition is greater than the N_{min}, the sum of acid nitrogen, sulphur and hydrochloric (and other contributors like hydrofluoric) acid deposition should be compared against the N_{max} value.

5 Assessment Approach for Evaluating the Risk of Adverse Impacts

Human Health

Screening PCs

5.1 As a first step, the assessment has considered the predicted process contributions (PCs) using the following criteria:

- is the long-term (annual mean) PC less than 1% of the long-term AQAL; and
- is the short-term (24-hour mean or shorter) PC of the assessed percentile less than 10% of the short-term AQAL?

5.2 These screening criteria are initially applied to the maximum predicted value across the study area regardless of the presence of relevant receptors. Where both criteria are met, then the impacts can be screened out as being not significant. Where impacts are not screened out, the area of potential impact is considered with regard to the presence of receptors relevant for the averaging periods of the AQALs.

Screening PECs

5.3 Where the above criteria are exceeded at relevant locations, then a more detailed assessment, considering total concentrations incorporating local baseline conditions (Predicted Environmental Concentrations or PECs), is required.

5.4 The PECs are then screened out as insignificant if:

- the short-term PC is less than 20% of the short-term AQAL minus twice the long-term baseline concentration; and
- the long-term PEC is less than 70% of the long-term AQAL.

5.5 Where the PECs are above these levels the impacts cannot automatically be screened out, however, it does not mean the impacts of the process are necessarily having a significant contribution to adverse air quality.

5.6 The highest impacts are not always at locations closest to the emission source. Consideration has therefore been given to whether the baseline concentration is elevated such that a small PC could result in a risk of an exceedance of the AQAL.

Ecological

5.7 The Environment Agency published instructions regarding detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation (Operational instruction 67_12). This document explains that where the long-term PEC is greater than 70% of the AQAL a detailed assessment is required, which ensures that the process will not:

- “result in an ‘adverse effect’ on the integrity of a European site”;
- “be an operation likely to damage (OLD)[sic] a SSSI”;

- "result in significant pollution of a NNR, LNR, LWS or ancient woodland."

5.8 Where the PEC is below 70% of the AQAL the Environment Agency consider there to be a low risk to the site of significant effects.

5.9 AQTAG21 (Environment Agency,, 2015) provides guidance on defining the *'Likely significant effect' – use of 1% and 4% long-term thresholds and 10% short-term threshold.* The Environment Agency, Natural England and Natural Resources Wales (NRW) have an agreed four stage process to assess the potential impact of industrial processes on European sites. The 4% long-term threshold is related to farmer; with respect to industrial facilities, this guidance states:

"Where the maximum, worst-case concentration within the emission footprint in any part of the European site(s) is less than 1% of the relevant long-term benchmark (critical level and/or critical load) and less than 10% of the relevant short-term benchmark (if available), AQTAG considers that the emission is not likely to have a significant effect alone, irrespective of the background levels."

5.10 The Environment Agency guidance goes on to state:

"Where the predicted long-term contribution from the industrial process is greater than 1% of the relevant long-term benchmark, consideration also needs to be given to the predicted environmental contribution (PEC). Where the PEC (process contribution + background) is less than 70% of the relevant long-term benchmark then a conclusion of no likely significant effect can be reached, even if the process contribution is greater than 1%."

5.11 For nationally and internationally designated sites (SSSI, SAC, SPA and Ramsar sites):

- If long-term PCs are below 1% of the AQAL the impacts from the facility in isolation are considered to be insignificant; and
- where short-term impacts are considered, if the PC is less than 10% of the AQAL the impacts are considered insignificant.

5.12 For locally designated sites (LNR, LWS and AW sites), the Environment Agency uses less stringent criteria in its permitting decisions:

- if either the short-term or long-term PC is less than 100% of the critical level or load, they do not require further assessment to support a permit application.

5.13 Where impacts are above these levels an ecology assessment will be required to determine whether the impacts are significant or not.

Nutrient deposition

5.14 With regards to nutrient critical loads set out in Table 9 the lower value in the range has been used as the AQAL.

5.15 The Environment Agency states (Environment Agency, 2014):

"It is considered that wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range".

5.16 Dry deposition occurs when material is lost from the air through contact with solid surfaces, such as at the surface of the ground, thus reducing the airborne concentration of the pollutant. Wet

deposition occurs when there is precipitation (rain, sleet, snow, etc.) and material is washed out of the air to the surface of the ground.

5.17 Therefore, the assessment only considers dry deposition of nutrient Nitrogen (N) compounds (i.e. NO_2 and NH_3).

Acid deposition

5.18 The critical loads for acidification are more complicated, in that the impact from multiple pollutants needs to be considered at the same time. While reduced nitrogen and sulphur dominate acid deposition in the UK, other compounds also contribute to acid deposition, e.g. hydrochloric acid (HCl) and hydrofluoric acid (otherwise known as hydrogen fluoride, HF). The contributions from all relevant compounds have been included in the assessment.

5.19 Due to these complexities, a critical load function is specified for acidification, via the use of three critical load parameters:

- CLmaxS — the maximum critical load of S, above which the deposition of S alone would be considered to lead to an exceedence;
- CLminN — a measure of the ability of a system to "consume" deposited N (e.g. via immobilisation and uptake of the deposited N); and
- CLmaxN — the maximum critical load of acidifying N, above which the deposition of N alone would be considered to lead to an exceedence.

5.20 These three quantities define the critical load function shown in Figure 4.

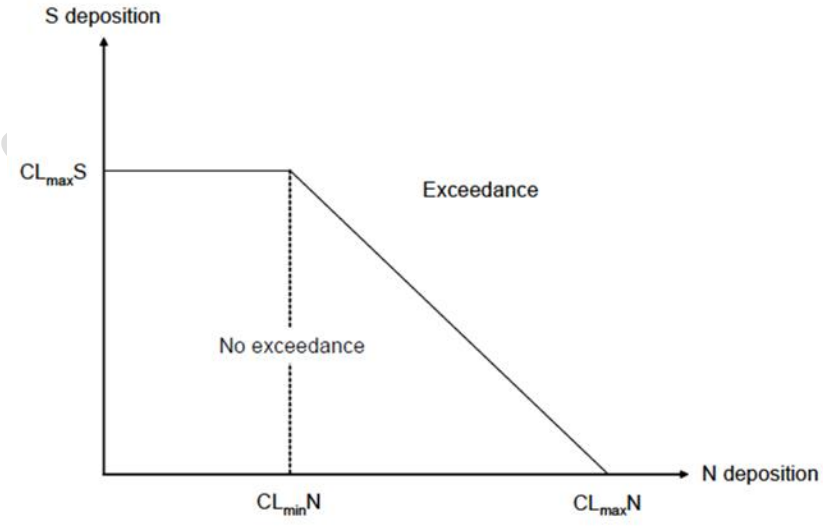

Figure 4: Critical Load Diagram

5.21 The AQTAG6 document (Environment Agency, 2014) explains that, for facilities with other pollutant emissions which can impact the total acidity deposition, the process contribution of pollutants, in addition to the sulphur and nitrogen components, should be considered in the acidity critical load assessment. The documents goes on to explain that the H+ from HCl (and other pollutants like HF) should be added to the S contribution (and treated as S in the APIS tool).

5.22 APIS advises that where the total acid nitrogen deposition is greater than CLminN, the total acidity PC should be calculated as a proportion of the CLmaxN. However, as a worst-case approach the proportion of the PC has been calculated based on the most stringent out of the CLminN and CLmaxS.

5.23 As explained previously, wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range. Therefore, the assessment only considers dry deposition of acidic Nitrogen (N) compounds, acidic Sulphur (S) compounds and acidic Hydrogen compounds (i.e. HF) and wet deposition from acidic Hydrogen compounds (i.e. HCl). The wet deposition of HCl has been taken as two times the dry deposition rate as suggested by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU), in lieu of any precipitation rate in the meteorological data file. This is a conservative screening assumption.

6 Methodology

Modelling approach overview

The model

6.1 Concentrations have been predicted at locations of sensitive exposure within the local area using the ADMS-5 atmospheric dispersion model (v5.2) developed and validated by Cambridge Environmental Research Consultants (CERC). The model is used extensively throughout the UK for regulatory compliance purposes and Local Air Quality Management and is accepted as an appropriate tool by local authorities and the EA.

6.2 The model requires a range of input parameters which are discussed further below.

Modelled output domain and receptors

6.3 Concentrations have been predicted across nested Cartesian grids. These grids have a spacing of:

- 10 m x 10 m within 200 m of the site;
- 40 m x 40 m within 500 m of the site; and
- 100 m x 100 m within 1 km of the site.

6.4 The receptor grid has been modelled at a height of 1.5 m above ground level. The extent of this modelled receptor grid defines the 'Study Area'. The study area is considered appropriate to consider impacts on both human-health receptors and sensitive ecological receptors. Figure 5 shows the extent of the grid.

6.5 A receptor representing the nearest location within the South Pennine Moors SAC, SPA and SSSI to the facility is shown in Figure 6, this receptor has been used for the assessment of the effects on the ecological sites.

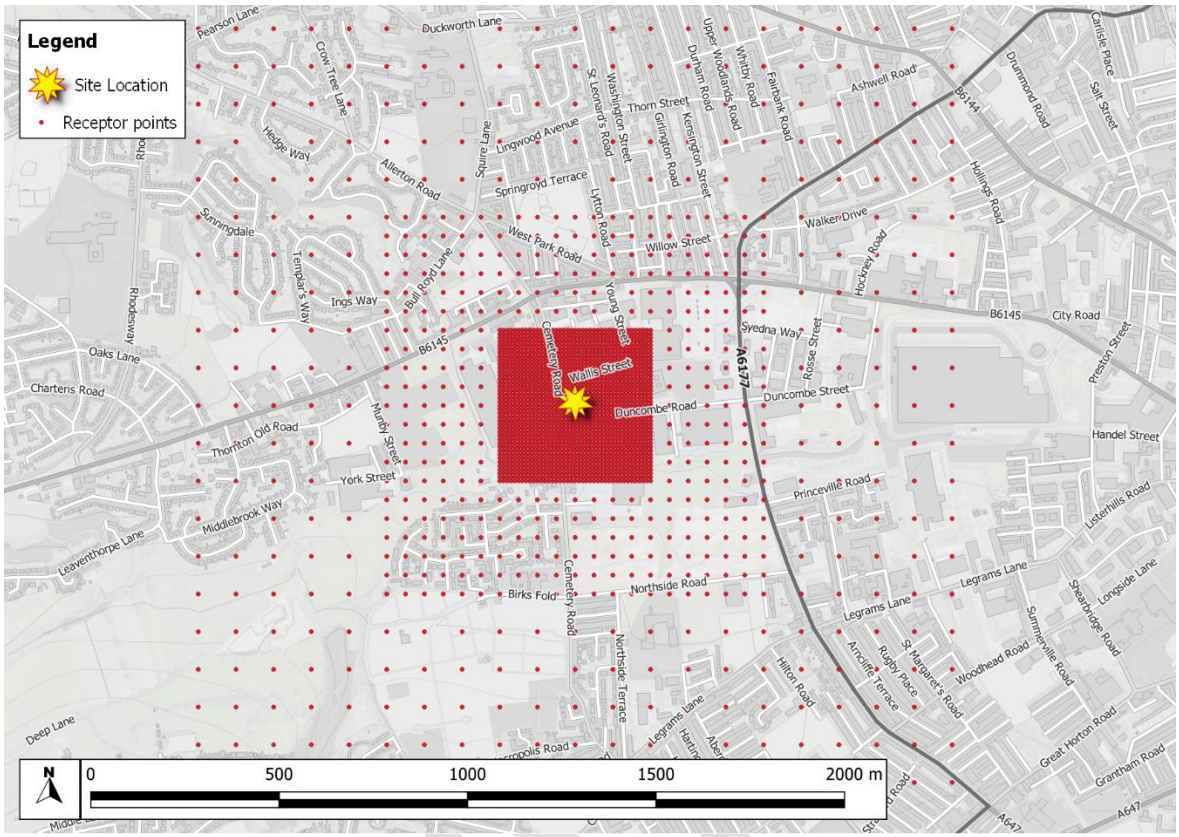

Figure 5: Modelled Receptors and Site Location

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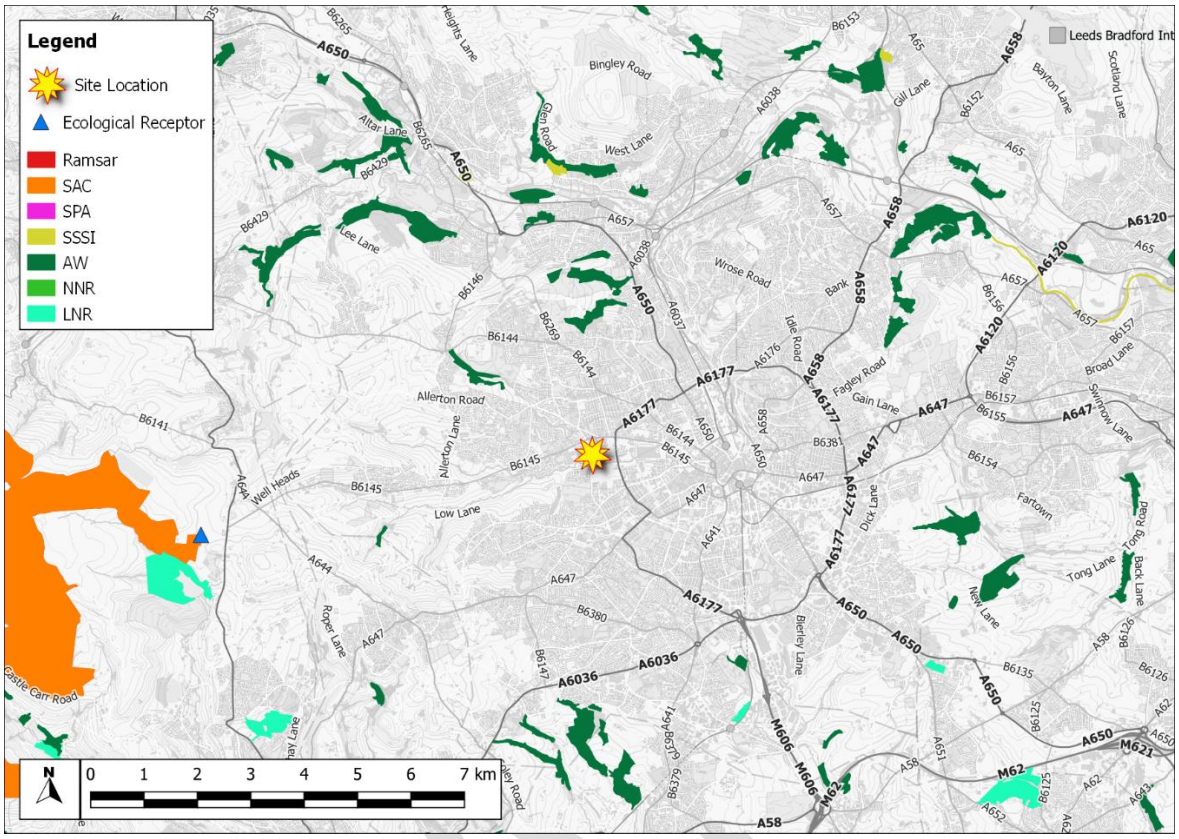

Figure 6: Modelled Ecological Receptor and Site Location

Point Source Parameters

6.6 Within the model, the generators have been positioned across the site as shown in Figure 7. Table 11 shows the coordinates and release height of each point source (the flues each servicing a generator).

Table 11: Point Source Locations and Heights

Source	X (m)	Y (m)	Height (m)
Flue	413841.8	433348.2	11

Figure 7: Point Source Location (red circle)

6.7 Table 12 presents the parameters entered into the model for each point source.

Table 12 Point Source Model Parameters

Parameter	RDF	Rubber Tyres
Exhaust Temperature (ºC)	62.3	62.3
Molecular Mass (g/mol) for Actual Flow	28.74	29.58
Height (m)	11	11
Flue Internal Diameter (m)	0.2	0.2
Exhaust Velocity (Am/s) [a] for Actual Flow	0.41	0.33

[b] Actual flow conditions assumed to be: RDF - 62.3 ºC, 3.9% O_2, wet (12.1% H_2O) and Rubber Tyres - 62.3 ºC, 4.0% O_2, wet (7.6% H_2O).

Emissions

PM

6.8 The IED specifies a maximum emission of total particulate matter (PM). In order to assess the potential emissions of PM; a precautionary approach has been taken that all PM is both PM_{10} and $PM_{2.5}$.

TOC

6.9 The IED specifies a maximum emission of Total Organic Carbon (TOC). In order to assess the potential emissions of TOCs; a worst-case approach has been taken, assuming that all TOCs are volatile organic compounds (VOCs). There are no assessment values for TOC or VOC, therefore a precautionary approach has been taken that all VOCs are both benzene and 1,3 butadiene with respect to annual mean concentrations; and that all VOCs are dimethyl sulphate with respect to short-term EALs. This situation would not happen in practice and provides an extremely conservative assessment.

Dioxins and furans

6.10 Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F) also known as dioxins and furans have been modelled using a total emission concentration of dioxins and furans calculated using the concept of toxic equivalence.

PAH

6.11 The IED doe not specify a maximum emission of polycyclic aromatic hydrocarbons (PAH). In order to assess the potential emissions of PAH; a worst-case approach has been taken, assuming that all PAH B(a)P and the emissions have been taken from measurements at European waste incineration facilities as specified in the IPPC Reference Document on BAT for Waste Incineration (European Commission, 2019b).

PCBs

6.12 The IED doe not specify a maximum emission of polychlorinated biphenyls (PCBs). In order to assess the potential emissions of PCBs a representative worst-case emission has been taken from

measurements at European waste incineration facilities as specified in the IPPC Reference Document on BAT for Waste Incineration (European Commission, 2019b).

Metals

6.13 For the group 1 metals – cadmium (Cd) and thallium (Tl) – and the group 2 metal – mercury (Hg), when assessing against each of the AQAL for each metal in turn, it has been assumed that the total group metal emission rate is made up entirely of that metal. Similarly, for the group 3 metals – Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), vanadium (V), when assessing against each of the AQALs for each metal in turn, it has been assumed that the total group 3 metals emission rate is made up entirely of that metal.

6.14 This is a worst-case approach. It may not be possible to screen out the potential for significant impacts of specific metals using this method. As this is overly pessimistic, the Environment Agency have set out an approach to consider more detailed metal specific emission rates in its Interim Guidance Note for Metals (Environment Agency, 2012). This includes three steps. The first step is what has initially been assumed in this assessment; that the total group 3 metals emission rate is made up entirely of each metal in turn. The second step assumes that each metal comprises 11% of the total group emissions. Step 3 of the Environment Agency guidance is to use typical emission concentrations for ERF plant, which are presented in the guidance and are set out in Table 13.

Table 13: EA Measured Concentrations Group 3 metals (mg/Nm^3)

Pollutant	Max	Mean	Min [a]
Antimony	0.0115	0.0014	0.0001
Arsenic	0.0250	0.0010	0.0002
Total chromium	0.0920	0.0084	0.0002
Chromium(VI) [b]	1.3×10^{-4}	3.5×10^{-5}	2.3×10^{-6}
Cobalt	0.0056	0.0011	0.0002
Copper	0.0290	0.0075	0.0019
Lead	0.0503	0.0109	0.0003
Manganese	0.0600	0.0168	0.0015
Nickel [c]	0.2200	0.0150	0.0025
Vanadium	0.0060	0.0004	0.0001

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

[b] 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.

[c]The two highest nickel concentrations are outliers being 44%, as above, and 27% of the ELV. The third highest concentration is 0.53 mg/Nm^3 or 11% of the ELV.

Modelled Buildings

6.15 The "Building downwash effect" can result in elevated concentrations in the lee of large structures. The model can incorporate the impact of buildings on the concentrations in the downwind area of buildings. However, it should be noted that buildings with a height, H, significantly lower than the stack are automatically ignored in the model.

6.16 The EA guidance on dispersion modelling states buildings should be considered when:

- the stack height is less than 2.5 times the height of a building; and
- the distance of a building from the stack is less than 5L – where L is the lesser dimension of the building height and maximum projected width (such as the distance between 2 opposing corners of a roof).

6.17 The flue is a 11 m high, therefore any building less than 4.4 m (40% or the stack height) does not need to be considered. The process building and two other nearby buildings are greater than 4.4 m; one immediately to the west and the other to the northwest.

6.18 Entrainment of the plumes into the wake of the buildings has been taken into account by including the buildings within the model. Two separate modelling scenarios have therefore been run:

- scenario 1: no buildings; and
- scenario 2: the process building and the two nearby buildings of a significant height.

6.19 The modelled buildings are shown in Figure 8 with the heights set out in Table 14.

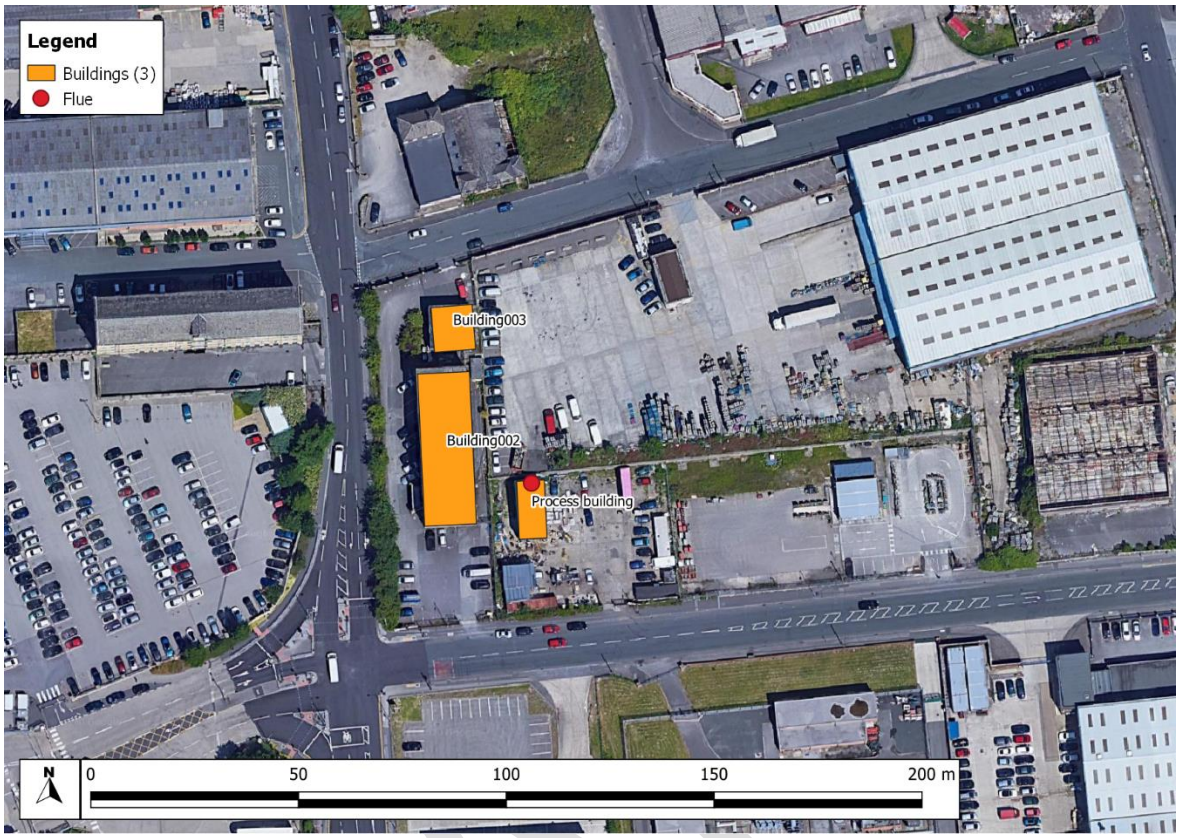

Figure 8: Modelled Buildings (Green) and Flue Location (Red Circle)

Imagery ©2020 Google. Map data ©2020.

Table 14 Building Heights

Building	Height (m)
Process building	9
Building002	11
Building003	7

Meteorology

6.20 The dispersion model includes a meteorological pre-processor developed by the UK Met Office to calculate values of meteorological parameters in the boundary-layer. The pre-processor requires a set of meteorological parameters on an hour-by-hour basis: wind speed, wind direction, temperature and cloud cover. There are a limited number of sites in the UK where this data is measured and recorded. There is also variation in annual recordings.

6.21 To account for the annual meteorological variation multiple years of meteorological data from two representative sites have been used in the model. Three meteorological years from the Leeds and Bradford meteorological station and three meteorological years from the Bingley NO_2 meteorological station have been used in this assessment. Leeds and Bradford station is approximately 5.25 km west of the facility. Bingley NO_2 station is approximately 11.75 km northeast of the facility. Data from the two stations have been used to provide a robust assessment.

6.22 The meteorological data represents measurements at a height of 10 m above ground level. The surface characteristics of the meteorological station are also required to account for differences between the meteorological site and the model domain. Where data capture is low, data from nearby sites have been used to populate the annual data. Final data capture for each year is greater than 95%.

6.23 Figure 9 and Figure 10 show the frequency of wind speeds and directions measured at the Bingley No_2 meteorological station, which has been inputted into ADMS, and the frequency of wind speeds and directions processed by the ADMS-roads model for the dispersion site for the years 2017-2019. These illustrate that wind predominantly comes from the southwest and that the model has marginally lower wind speed at the dispersion site (due to the surface characteristics being different).

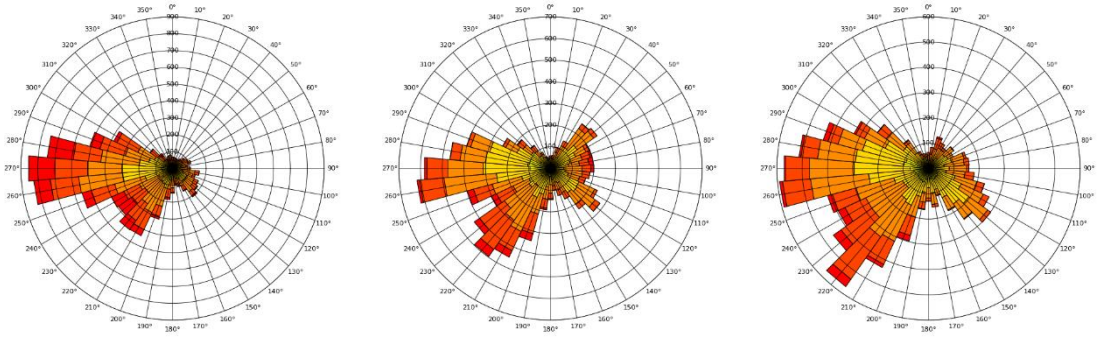

Figure 9: Wind Rose showing the frequency of wind speed and wind direction for the meteorological station at Bingley No_2 for the years of 2017 (left) to 2019 (right)

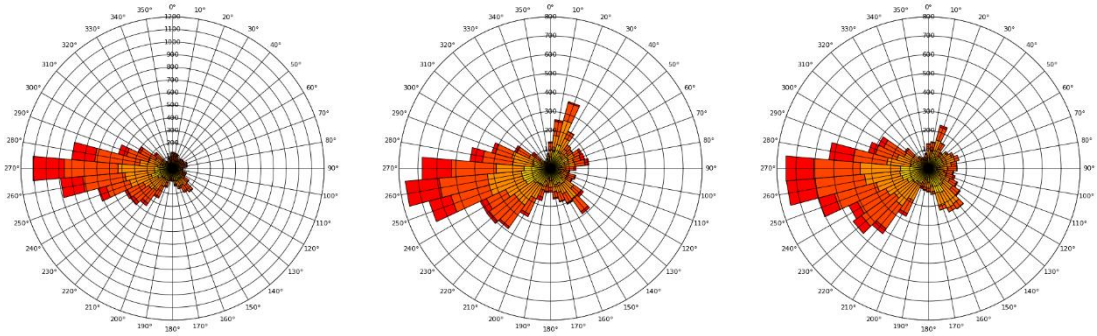

Figure 10: Wind Rose showing the frequency of wind speed and wind direction for the modelled dispersion site for the years of 2017 (left) to 2019 (right) when Leeds and Bradford meteorological data is used

6.24 Figure 11 and Figure 12 show the frequency of wind speeds and directions measured at the Leeds and Bradford meteorological station, which has been inputted into ADMS, and the frequency of wind speeds and directions processed by the ADMS-roads model for the dispersion site for the years 2017-2019. These illustrate that wind predominantly comes from the southwest and that the model has marginally lower wind speed at the dispersion site (due to the surface characteristics being different).

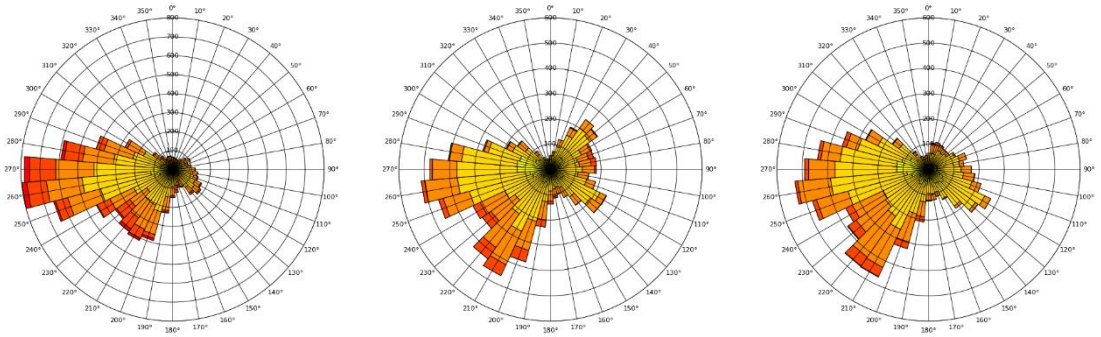

Figure 11: Wind Rose showing the frequency of wind speed and wind direction for the meteorological station at Leeds and Bradford for the years of 2017 (left) to 2019 (right)

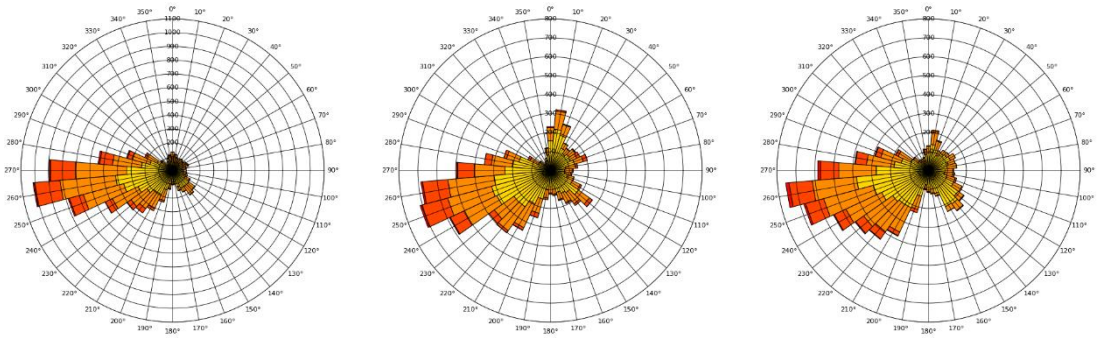

Figure 12: Wind Rose showing the frequency of wind speed and wind direction for the modelled dispersion site for the years of 2017 (left) to 2019 (right) when Leeds and Bradford meteorological data is used

Surface characteristics

6.25 Land-use and surface characteristics have an important influence in determining turbulent fluxes and, hence, the stability of the boundary layer and atmospheric dispersion.

6.26 Surface roughness length used within the model represents the aerodynamic effects of surface friction and is defined as the height at which the extrapolated surface layer wind profile tends to zero. This value is an important parameter used by the built-in meteorological pre-processor of ADMS to interpret the vertical profile of wind speed and estimate friction velocities which are, in turn, used to define heat and momentum fluxes and, consequently, the degree of turbulent mixing. Surface roughness values for different land-use classifications are provided in the 2018 Corine Land Use dataset (Copernicus, 2018). Due to the large model domain, a variable surface roughness file has been used within the model based on the spatially variable land-uses and the equivalent roughness values from the dataset. Figure 13 shows the values used across the modelled domain.

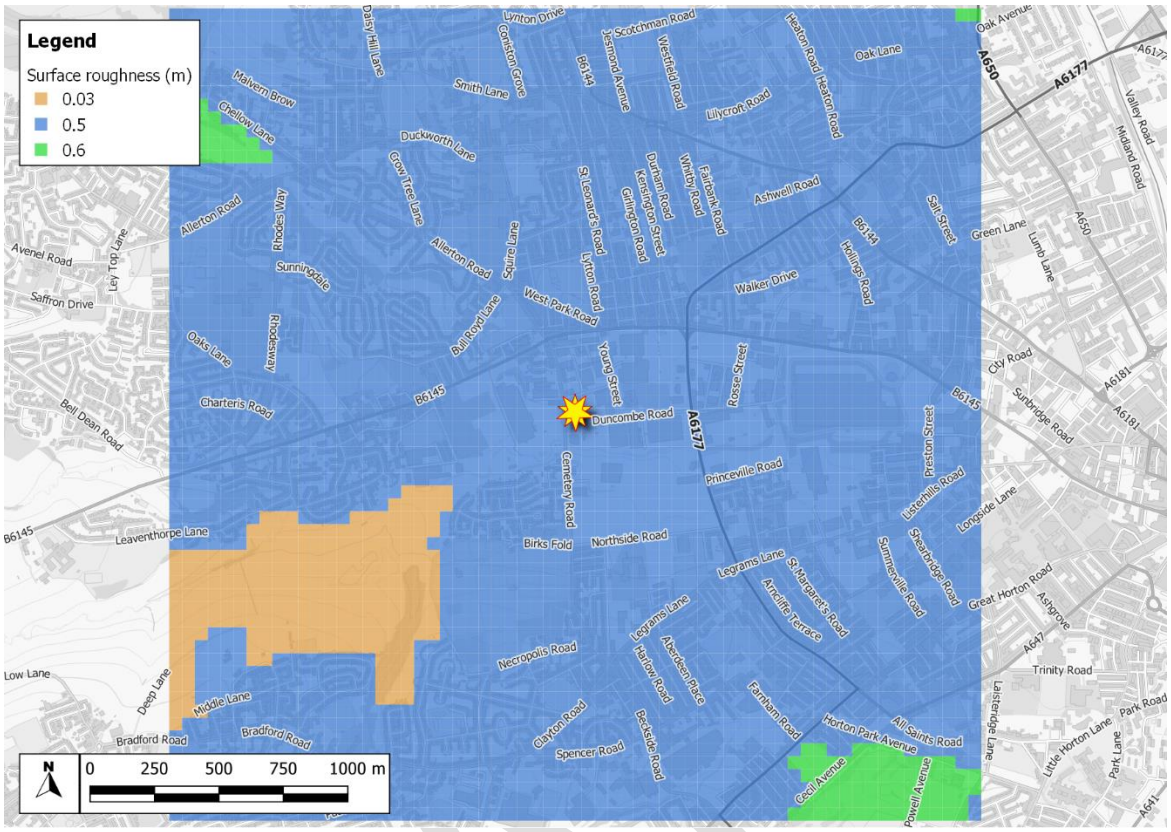

Figure 13: Modelled Surface Roughness

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6.27 The surface albedo is the ratio of reflected to incident shortwave solar radiation at the surface of the earth. This varies depending on the land use, and thus area-weighted average albedos have been derived for the meteorological and dispersion sites and used in the model. Albedo values have been taken from US Environmental Protection Agency (EPA) guidance (2018) and associated with the different land uses in the 2018 Corine Land Use dataset (Copernicus, 2018).

6.28 The Priestley-Taylor parameter is a parameter representing the surface moisture available for evaporation. A Priestley-Taylor parameter of 1 has been set in the model.

6.29 The CERC user guide explains that *"the Monin-Obukhov length provides a measure of the stability of the atmosphere. In very stable conditions in a rural area its value would typically be 2 to 20 m. In urban areas, there is a significant amount of heat generated from buildings and traffic, which warms the air above the town/city"*. For large urban areas this is known as the urban heat island. It has the effect of preventing the atmosphere from ever becoming very stable. Mimimum Monin-Obukhov length can be defined in the model to account for the urban heat island effect which is not represented by the meteorological data. A value of 10 m has been used in the model.

6.30 Details of the parameter values used in the modelling are provided in Table 15. Values for the meteorological station have been derived using the same approach as for the dispersion site, but with weighted averages derived from a 2 km radius.

Table 15: Meteorological parameters values used in the model

Parameter	Leeds and Bradford Meteorological Site Value	Bingley NO_2 Meteorological Site Value	Dispersion Site Value
Latitude (°)	n/a	n/a	53.8
Surface roughness (m)	0.0188	0.03	n/a
Surface albedo	0.1798	0.180	0.1708
Minimum Monin-Obukhov length (m)	28.36	10	30
Priestley-Taylor parameter	Dispersion site value	Dispersion site value	1

Terrain

6.31 The effects of complex topography on atmospheric flows can result in elevated pollutant concentrations. These effects are most pronounced when the terrain gradient exceeds 1 in 10, i.e. a 100 m change in elevation per 1 km step in horizontal plane. The gradients in the area surrounding the facility may have an impact on pollutant concentrations and therefore the terrain module within ADMS has been used. The local terrain data is based on Ordinance Survey Terrain 50 data. Figure 14 shows the terrain data entered into the model.

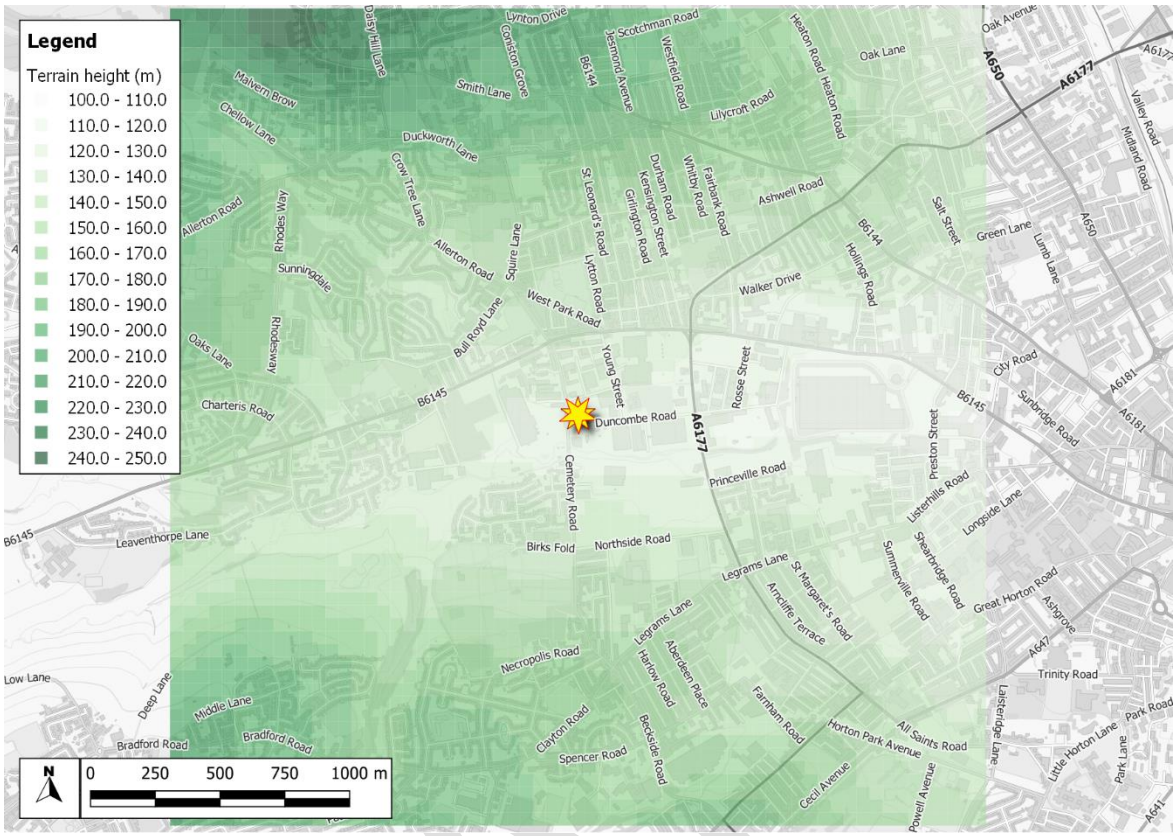

Figure 14: Terrain

Chemistry (Conversion of NOx to NO_2)

6.32 The grid of receptors used for the assessment of the impacts on the AQO receptors have not used the in-built model chemistry features and the chemistry has been dealt with during the post-processing stage.

Percentiles

6.33 Where the short-term AQAL considers the number of periods exceeding a standard rather than a single concentration not to be exceeded, it is not possible to usefully assign a magnitude of change. In these cases, the impacts have been considered in relation to the relevant assessment percentile concentration for the pollutant and objective. For example, the 1-hour AQAL and limit value for NO_2 allow 18 hours a year to exceed 200 µg/m^3, which is represented by the 99.79th percentile of hourly concentrations. The assessment percentiles are set out in Table 16.

Table 16: Assessment Percentiles

Pollutant	Time Period	Concentration, and the number of exceedences allowed per year (if any)	Assessment percentile
NO_2	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year	99.79th
PM_{10}	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year	90.41st

SO_2	15-minute Mean	266 µg/m^3 not to be exceeded more than 35 times a year	99.24th
	1-hour Mean	350 µg/m^3 not to be exceeded more than 24 times a year	99.73rd
	24-hour Mean	125 µg/m^3 not to be exceeded more than 3 times a year	99.18th
O_3	8-hour Mean	100 µg/m^3 not to be exceeded more than 10 times a year / 125 µg/m^3 not to be exceeded more than 25 times a year averaged over 3 years	99.89th / 99.71st

6.34 In most cases, especially where specific operating hours are not defined, it is important to run the model for a full year of continuous operation, in order to capture the varied meteorological conditions that can occur throughout the year. However, it should be noted that, when the operation of the facility is not continuous and annual operation is significantly lower than a full year, as is the case here, this approach is overly conservative.

Post Processing

6.35 The maximum concentrations predicted using any of the five years of meteorological data have been used in the preparation of the results set out in Section 5.

Chemistry (Conversion of NOx to NO_2)

6.36 NOx emissions from the generators will be predominantly in the form of nitric oxide (NO) with a small proportion of primary NO_2 (approximately 5-10% for natural gas combustion in generators). Excess oxygen in the combustion gases and in the atmosphere after the gases are released result in oxidation of NO to NO_2. NOx chemistry in the lower troposphere is strongly interlinked in a complex chain of reactions involved O_3 and volatile organic compounds (VOCs).

6.37 Given the complex nature of NOx chemistry, the EA's Air Quality Modelling and Assessment Unit (AQMAU) have adopted a pragmatic, risk-based approach in determining the rate of conversion of NOx to NO_2 (Environment Agency, n.d.). This approach is routinely used as part of detailed assessments of point sources. The AQMAU guidance advises that a tiered approach can be used when considering ambient NO_2 to NOx ratios:

- Screening Scenario: 50% and 100% of the modelled NOx process contributions should be used for short-term and long-term average concentration, respectively. That is, 50% of the predicted NOx concentrations should be assumed to be NO_2 for short-term assessments and 100% of the predicted NOx concentrations should be assumed to be NO_2 for long-term assessments;

- Worst case Scenario: 35% and 70% of the modelled NOx process contributions should be used for short-term and long-term average concentration, respectively. That is, 35% of the predicted NOx concentrations should be assumed to be NO_2 for short-term assessments and 70% of the predicted NOx concentrations should be assumed to be NO_2 for long-term assessments; and

- Case specific Scenario: Operators are asked to justify their use of percentages lower than 35% for short-term and 70% for long-term assessments in their application reports.

6.38 ADMS-5 has been run to predict the contribution of the generators to annual mean concentrations of NOx, a percentile of 1-hour mean NOx and the 100th percentile of 24-hour mean NOx.

6.39 For the assessment of the impact on AQO receptors, the worst-case Scenario approach has been used to predict annual mean NO_2 contributions and the percentile of 1-hour mean NO_2 contributions. This assumes that:

- annual mean NO_2 contributions = annual mean NOx x 0.7; and
- percentile of 1-hour mean NO_2 contributions = percentile of 1-hour mean NOx x 0.35.

6.40 For the assessment of the impact of NOx on ecological receptors, the relevant concentrations were outputted directly from the model and no post-processing was required.

Deposition

6.41 Although the model has the ability to calculate deposition, because the model has been used to predict NOx concentrations, dry deposition has been calculated based on the predicted NO_2 PC calculated outside the model.

6.42 The rate of dry deposition is assumed to be proportional to the near-surface concentration, i.e.:

$$F_d = v_d C(x, y, 0)$$

Where F_d is the rate of dry deposition per unit area per unit time (µg/m^2/s), v_d is the deposition velocity in m/s, and C is the predicted airborne concentration at the position (x,y,0) in µg/m^3.

6.43 Environment Agency guidance AQTAG06 (Environment Agency, 2011) recommends deposition velocities for various pollutants dependent upon the habitat type, these are shown in Table 17.

Table 17: Dry deposition velocity (m/s)

Pollutant	Grass	Forest
NO_2	0.0015	0.003
SO_2	0.012	0.024
HCl	0.025	0.06
HF	0.016 [a] or 0.002 [b]	0.031 [a] or 0.004 [b]

[a] Deposition velocity for crops.

[b] Reference: Fluorides in the Environment, Weinstein, LH and Davison, AW, CABI Publishing.

6.44 Deposition is assessed against the critical loads which are provided in kilogrammes of deposition per hectare per year. A factor to convert the deposition flux calculated from the model outputs to these units is required. The factor is 96 which is calculated from the unit conversions using the following formula:

- µg to kg - 1/100,000,000;
- m^2 to ha - 1/10,000;
- seconds to year - 60*60*24*365; and
- N in NO_2 - 14/46.

*Factor = ((1/100,000,000) / (1/10,000)) x (60*60*24*365) x (14/46)*

6.45 To calculate the acidity, the kilogramme equivalent of N is determined based on the following relationships can be used: 1 keq/ha/yr =14 kgN/ha/yr, i.e. nutrient deposition values have been divided by 14 to obtain acid deposition values.

6.46 The wet deposition velocity for HCl has been taken as two times the dry deposition rate set out in Table 17. This is a conservative screening assumption.

Operating Profile

6.47 Since the precise hours when the plant will operate are not known, it has been assumed in the model that facility will run continuously throughout the year. The predicted annual mean concentrations, assuming continuous operation, have then been adjusted to account for the 2,600 hours of operation by applying a factor of 0.297 (which is 2,600/8,760).

6.48 For the assessment of short-term impacts, it has been assumed that the facility will operate continuously throughout the year, to ensure that potential impacts under all meteorological conditions are considered. As a result, the assessment is conservative and is likely to have over-predicted the actual impacts of the scheme in terms of concentrations in relation to the short-term mean AQALs.

Total Concentrations (PECs)

6.49 Where total concentrations are considered (PEC), the following post-processing has been carried out:

- annual mean PEC = annual mean PC + annual mean baseline concentration; and
- short-term mean PEC = short-term PC + (2 x annual mean baseline concentration).

6.50 Where the annual mean contributions include contributions from changes in road traffic generated by the Proposed Development; the processing of these contributions are described further below.

Uncertainty

6.51 The assessment involves a range of uncertainties, including the model inputs, assumptions, the model and post-processing of model results.

6.52 The dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which are variable in reality.

6.53 There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms, although the model has been validated, it is not possible to verify the point-source model outputs.

6.54 Although there is a wide range of uncertainty associated with air quality modelling, the predictions made by this assessment have been carried out in a robust manner in order to minimise uncertainties where possible; the approach has been to use reasonable worst-case assumptions.

7 Process Contributions

7.1 In this section the predicted concentrations resulting from the facility (i.e. the process contribution (PC)) are presented and discussed with relation to the AQALs.

7.2 As discussed previously, the results from each modelled meteorological year from the two meteorological stations and from each of the building scenarios have been compiled and the maximum value from any of the modelled meteorological years has been used to create a worst-case sets of PCs at any location in the area. These impacts may therefore be overpredicted and should be treated as worst-case.

Human Health Impacts

7.3 Consideration is first given to the area over which impacts could occur regardless of the presence of sensitive receptors or not. Once the extent of the potential impacts is defined, consideration will be made regarding the likely presence of sensitive receptors within the area. Where sensitive receptors are identified within the bounds of potential impacts, the PECs are then considered.

Annual Mean

7.4 The annual mean AQAL applies at locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals and care homes. Places of work, such as factories or offices, are not considered places where members of the public might be regularly exposed and therefore the AQAL's do not apply at these locations.

7.5 Annual mean impacts are initially considered based on the maximum PC anywhere in the modelled domain regardless of the presence of relevant exposure. Where the maximum PCs cannot be screened out, consideration of the presence of relevant exposure will be accounted for. Where the PC cannot be screened out at relevant exposure locations the baseline concentrations will be considered and the PEC assessed in relation to the AQAL based on the EPUK and the IAQM impact descriptors and assessment of significance approach.

7.6 From the EA guidance it can be inferred that any change in concentration smaller than 1% of the long-term (annual mean) AQAL (<0.4 µg/m^3 for NO_2) will be insignificant, regardless of the existing air quality conditions.

Consideration of PC impacts anywhere in the modelled domain.

7.7 The maximum PCs associated with emissions released from the facility are shown in Table 18.

Table 18: Maximum Annual Mean PC at any Location – RDF (µg/m^3)

Pollutant	AQAL	PC as % of AQAL		Impacts
		RDF	Rubber Tyre	
NO_2	40	1.8%	1.8%	Further consideration required
Total PM as PM_{10}	40	0.5%	0.5%	Insignificant

Total PM as $PM_{2.5}$		25	0.8%	0.9%	Insignificant
VOC as Benzene		5	1.2%	1.2%	Further consideration required
VOC as 1,3-Butadiene		2.25	2.7%	2.8%	Further consideration required
HCl		20	0.2%	0.2%	Insignificant
HF		16	0.1%	0.1%	Insignificant
NH_3		180	<0.1%	<0.1%	Insignificant
PAH as B(a)P		0.00025	1.1%	1.1%	Further consideration required
Dioxins and furans (PCCD/F)		0.3 pg/m^3	0.7%	0.8%	Insignificant
Polychlorinated biphenyls (PCBs)		0.2	<0.1%	<0.1%	Insignificant
Group 1 metals	Cadmium	0.005	2.0%	2.1%	Further consideration required
	Thallium	1	<0.1%	<0.1%	Insignificant
Group 2 metals	Mercury	0.25	<0.1%	<0.1%	Insignificant
Group 3 metals	Antimony	5	<0.1%	<0.1%	Insignificant
	Arsenic	150	6.7%	6.9%	Further consideration required
	Chromium(III)	5	<0.1%	<0.1%	Insignificant
	Chromium(VI)	0.0002	101.2%	103.8%	Further consideration required
	Cobalt	1	<0.1%	<0.1%	Insignificant
	Copper	10	<0.1%	<0.1%	Insignificant
	Lead	0.25	0.1%	0.1%	Insignificant
	Manganese	0.15	0.1%	0.1%	Insignificant
	Nickel	0.02	1.0%	1.0%	Further consideration required
	Vanadium	5	<0.1%	<0.1%	Insignificant

7.8 There are a number of pollutants which cannot be screened out at this stage and require further consideration, these include:

- NO_2;
- VOCs;
- PAH;
- Group 1 metals; and
- Group 3 metals.

Consideration of PC impacts at relevant AQO receptors.

Nitrogen Dioxide

7.9 An isopleth showing the area where the PCs cannot be screened out explicitly by considering the PC is shown in Figure 15. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with the PC greater than 1% of the annual mean AQAL. The risk of significant adverse effects of NOx emissions can therefore be discounted.

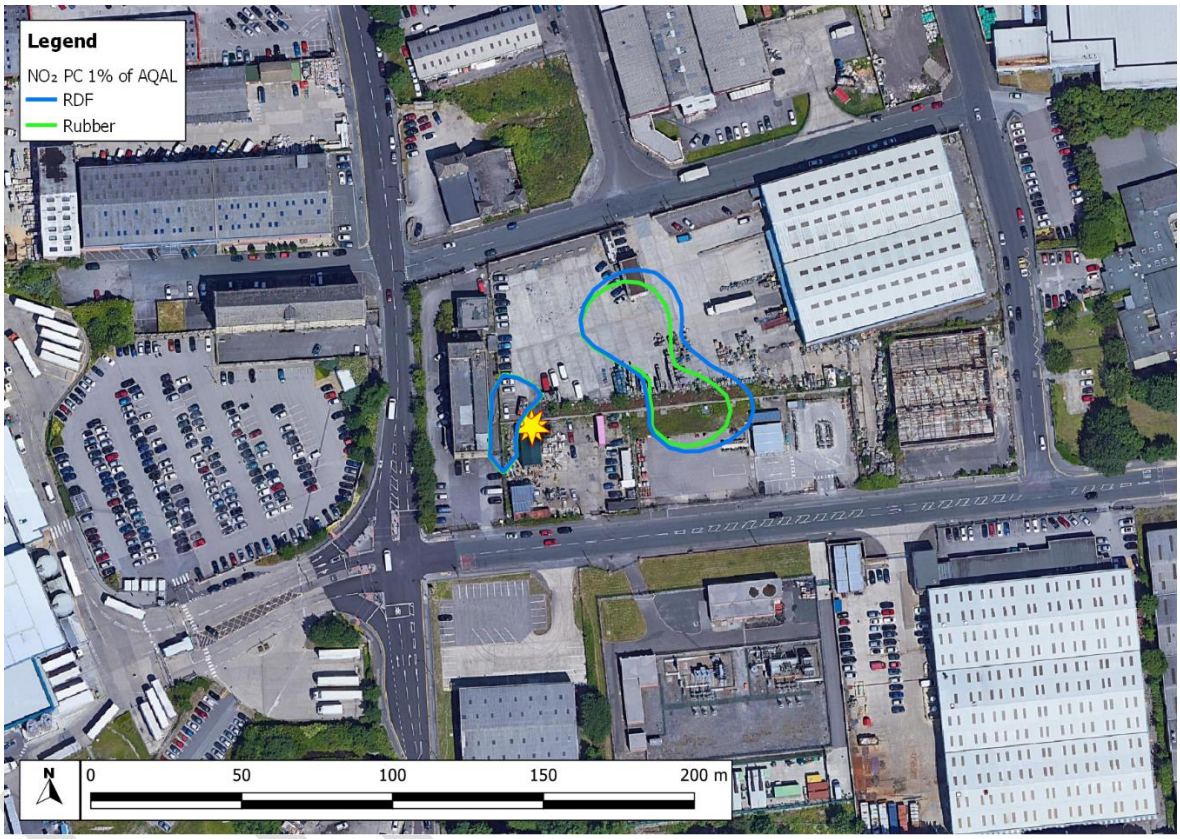

Figure 15: NO_2 PC contour lines

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Volatile Organic Compounds

7.10 If it is assumed that the entire VOC's emissions consist of only benzene, the maximum PC anywhere in the study area, regardless of the presence of a relevant receptor, is 1.2% of the AQAL. If it is assumed the entire VOC's emissions consist of only 1,3-butadiene, the maximum PC anywhere in the study area, regardless of the presence of a relevant receptor, is 2.7% of the AQAL.

7.11 Figure 16 and Figure 17 present isopleths showing the areas where the PCs cannot be screened out explicitly by considering the PC, assuming all VOC emissions are assessed against the benzene and 1,3-butadiene AQALs respectively. Consideration must be given to whether there are relevant sensitive receptors within the area. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with

the PC greater than 1% of the annual mean AQAL. The risk of significant adverse effects of VOC emissions can therefore be discounted.

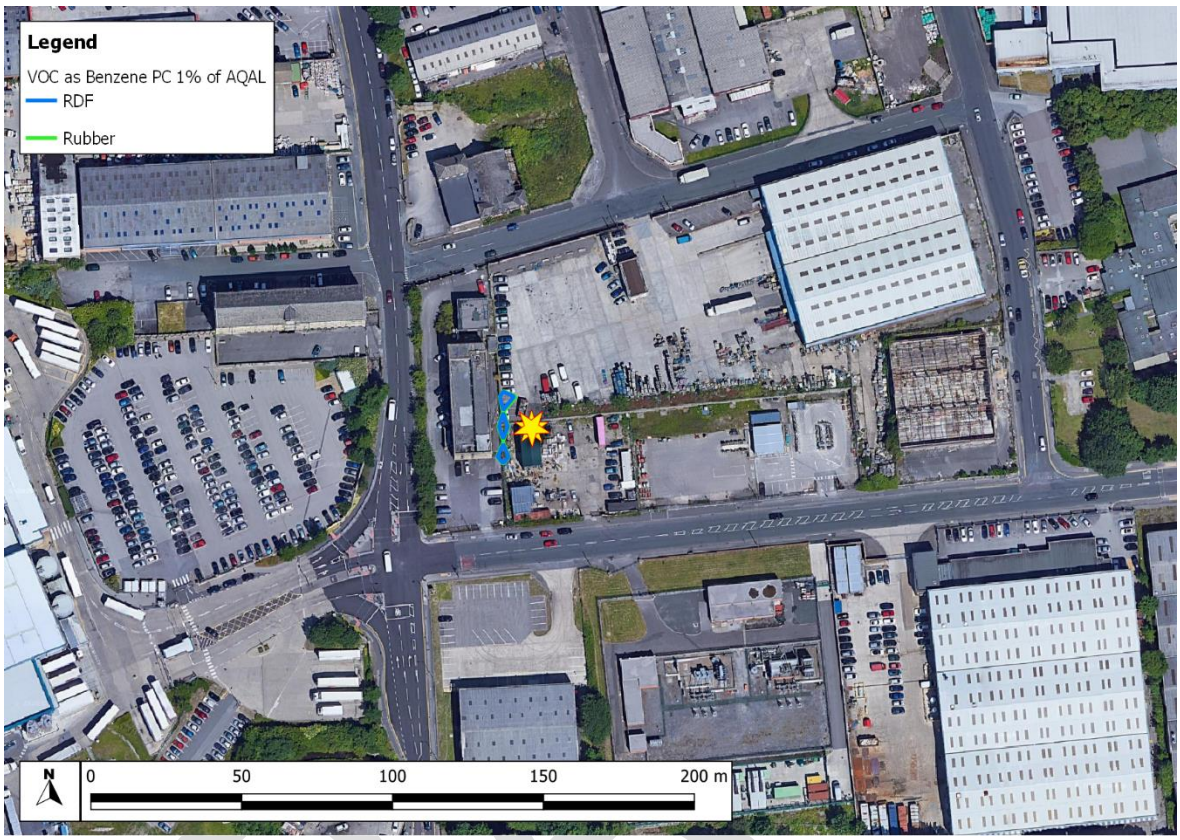

Figure 16: Benzene PC contour lines

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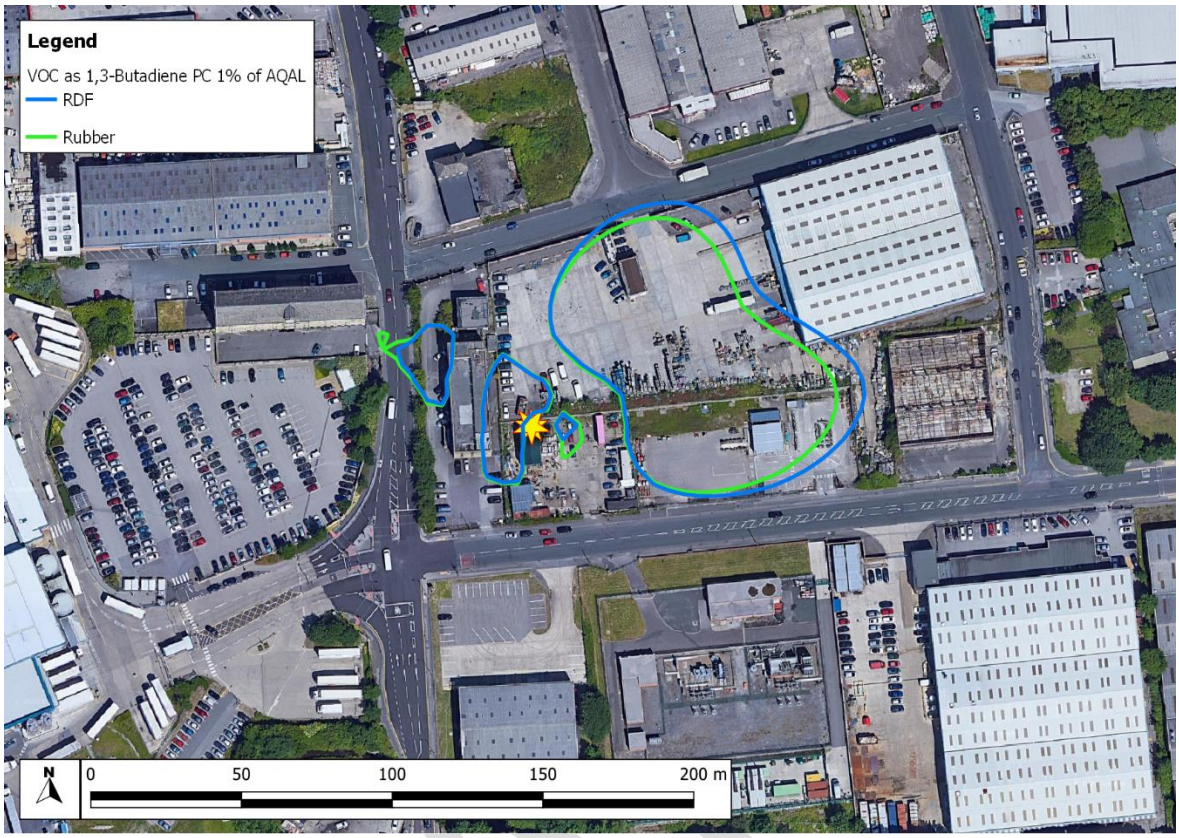

Figure 17: 1,3-butadiene PC contour lines

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Polycyclic Aromatic Hydrocarbons

7.12 If it is assumed that the entire PAH emission consist of only B(a)P, the maximum PC anywhere in the study area, regardless of the presence of a relevant receptor, is 1.1% of the AQAL.

7.13 Figure 16 presents an isopleth of showing the area where the PCs, assuming all PAH emissions are assessed against the B(a)P AQAL, cannot be screened out explicitly by considering the PC. Consideration must be given to whether there are relevant sensitive receptors within the area. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with the PC greater than 1% of the annual mean AQAL. The risk of significant adverse effects of PAH emissions can therefore be discounted.

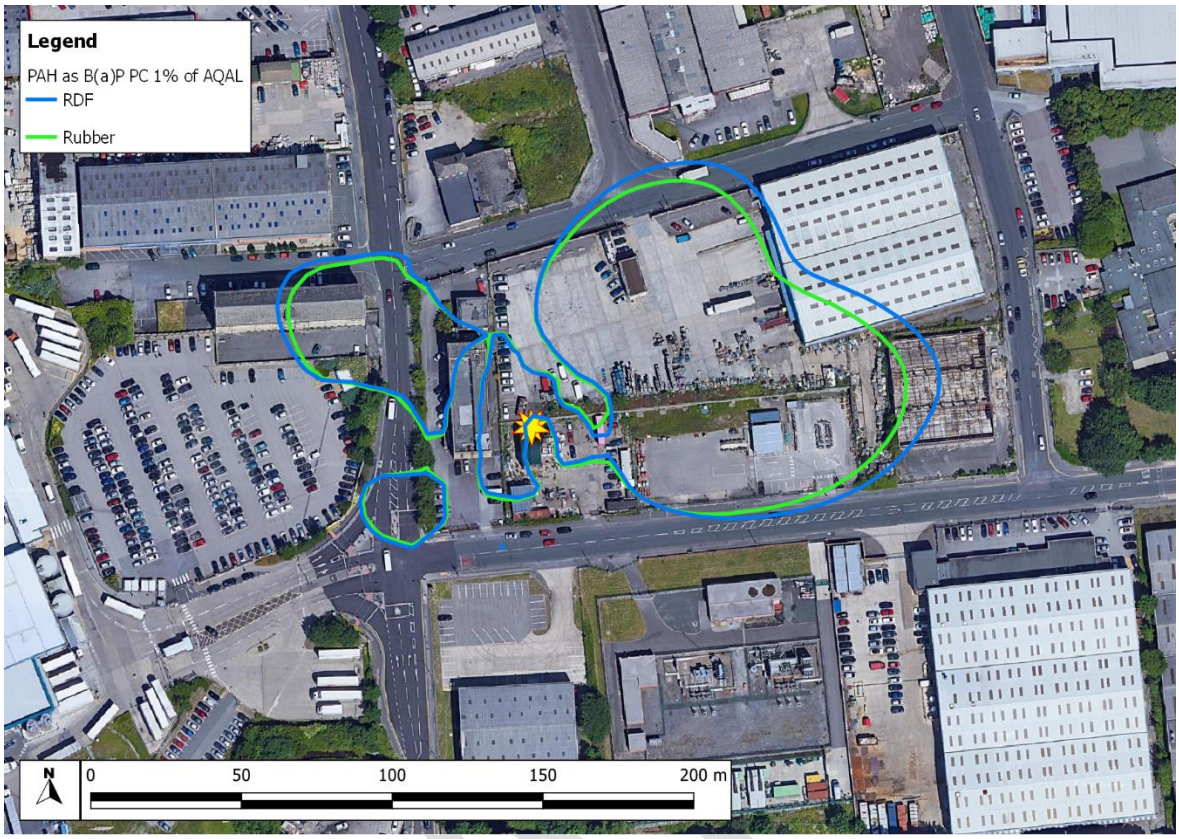

Figure 18: PAH PC contour lines

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Group 1 metals

7.14 If it is assumed that the entire Group 1 metals emission consist of only Cadmium, the maximum PC anywhere in the study area, regardless of the presence of a relevant receptor, is 2.0% of the AQAL.

7.15 Figure 16 presents an isopleth of showing the area where the PCs, assuming all Group 1 metal emissions are assessed against the Cadmium AQAL, cannot be screened out explicitly by considering the PC. Consideration must be given to whether there are relevant sensitive receptors within the area. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with the PC greater than 1% of the annual mean AQAL. The risk of significant adverse effects of Group 1 metal emissions can therefore be discounted.

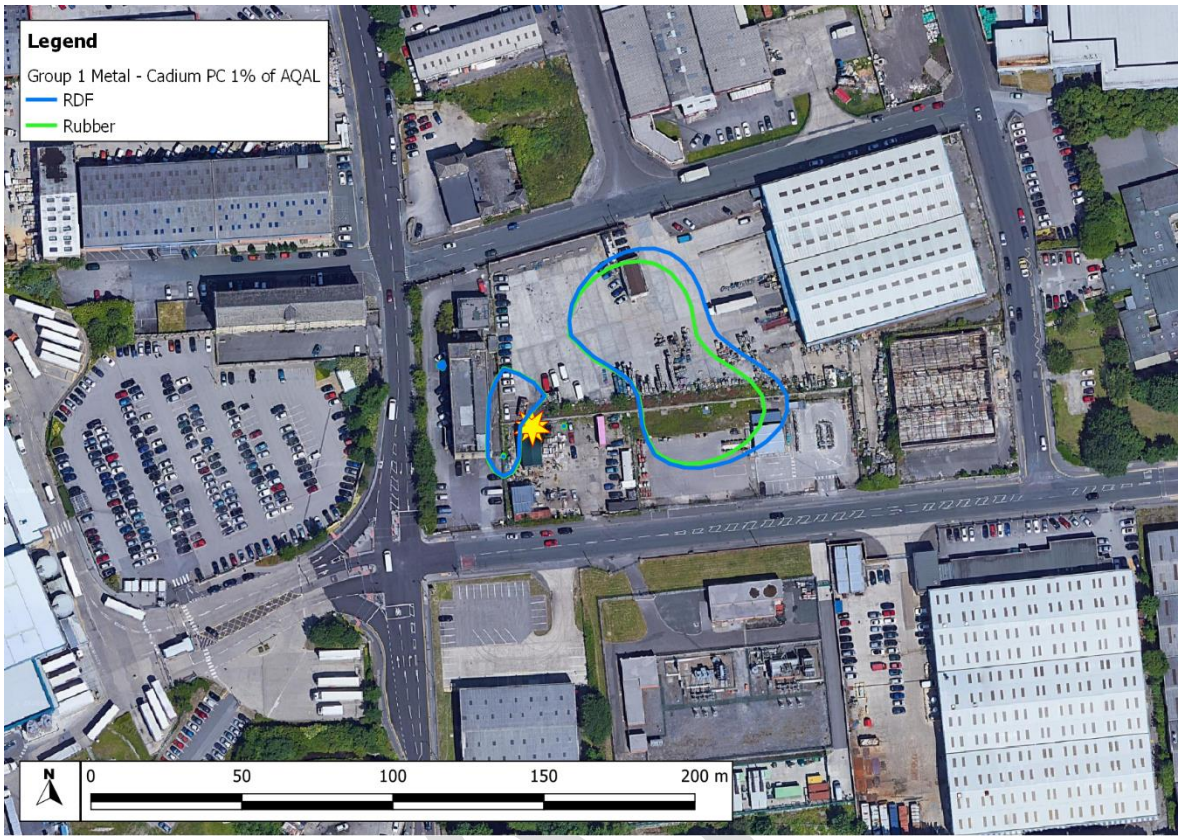

Figure 19: Cadmium PC contour lines

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Group 3 metals

7.16 Each metal is initially considered assuming that metal comprises of 100% of the Group 3 metal emission. Based on this:

- antimony, chromium(III), colbalt, copper, lead, mangasnese and vanadium impacts are insignificant based on their maximum PCs anywhere in the study area being less than 1% of the AQAL, regardless of the presents of relevant exposure, see Table 18.
- further consideration is required for arsenic, chromium(VI) and Nickel.

7.17 Given that the Group 3 total metal emissions will be made up of a proportion of each metal, assuming the entire emission is each metal is pessimistic. The EA have provided a range of typical Group 3 emissions based on measurements. The maximum, mean and minimum measured concentrations for waste incineration plant specified by the EA are set out in Table 13. Based on these emissions, Table 19 presents the highest PCs at any locations regardless of the presence of relevant exposure, using the maximum specific metal proportion set out in Table 13.

7.18 The arsenic, chromium(VI) and Nickel PCs are all insignificant based on their maximum PCs anywhere in the study area being less than 1% of the AQAL, regardless of the presents of relevant exposure.

Table 19: Group 3 Metal Maximum Annual Mean PC at Relevant Exposure Location Based on Typical Emissions

Pollutant	AQAL	PC as % of AQAL	Impact descriptor
Arsenic	0.003	0.3%	Insignificant
Chromium(VI)	0.0002	<0.1%	Insignificant
Nickel	0.02	0.4%	Insignificant

Consideration of PC impacts at relevant Limit Value receptors.

7.19 There are no PCM roads within the bounds where impacts on the compliance receptors needs to be considered. Significant impacts at limit value compliance receptors can thus be discounted.

Short-term Human Health Impacts

7.20 From the EA guidance it can be inferred that any change in concentration smaller than 10% of the short-term AQAL will be insignificant, regardless of the existing air quality conditions.

7.21 Short-term mean impacts are initially considered based on the maximum PC anywhere in the modelled domain regardless of the presence of relevant exposure. Where the PC cannot be screened out the baseline concentrations are considered to calculate the PEC. Where the PEC exceeds the AQAL the presence of relevant exposure is considered.

7.22 Locations of relevant exposure for the 8-hour and 24-hour mean AQALs are considered to be at locations where the annual mean AQALs apply and at hotels and gardens of residential properties. Locations of relevant exposure for the 15-minute and 1-hour mean AQALs are considered to be at the annual mean locations of exposure and at hotels, residential gardens and any outdoor location where members of the public might reasonably be expected to spend 15-minutes or 1-hour, or longer, such as busy pavements, outdoor bus stations and locations with outdoor seating.

7.23 The maximum short-term PCs from the development related emissions released are shown in Table 20.

Table 20: Maximum Short-Term Mean PC at any Location (µg/m^3)

Pollutant	Time period	AQAL	PC as % of AQAL		Screening threshold = 10%
			RDF	Rubber Tyres	
NO_2	1-hour	200	8.6%	8.1%	Insignificant
PM_{10}	24-hour	50	3.4%	3.4%	Insignificant
SO_2	15-minute	266	18.4%	17.1	Further consideration required
	1-hour	350	7.3%	7.1	Insignificant
	24-hour	125	6.7%	6.8	Insignificant
CO	Maximum daily 8-hour	10000	1.0%	1.0%	Insignificant
	1-hour	30000	0.3%	0.3%	Insignificant

Dimethyl sulphate		1-hour	15.6	49.6%	46.3%	Further consideration required
HCl		1-hour	750	0.7%	0.6%	Insignificant
HF		1-hour	160	1.6%	1.5%	Insignificant
NH_3		1-hour	2500	0.1%	0.1%	Insignificant
PCBs		1-hour	6	<0.1%	<0.1%	Insignificant
Group I	Thallium	1-hour	30	<0.1%	<0.1%	Insignificant
Group 2	Mercury	1-hour	7.5	0.2%	0.2%	Insignificant
Group 3	Antimony	1-hour	150	<0.1%	<0.1%	Insignificant
	Chromium(III)	1-hour	150	<0.1%	<0.1%	Insignificant
	Chromium(VI)	1-hour	15	0.2%	0.2%	Insignificant
	Cobalt	1-hour	30	0.1%	0.1%	Insignificant
	Copper	1-hour	200	<0.1%	<0.1%	Insignificant
	Manganese	1-hour	1500	<0.1%	<0.1%	Insignificant
	Vanadium	1-hour	1	2.6%	2.4%	Insignificant

7.24 There are a number of pollutants which cannot be screened out at this stage and required further consideration, these include:

- 15-minute mean SO_2; and
- 1-hour mean dimethyl sulphate (VOCs).

Consideration of PC impacts at relevant AQO receptors.

Sulphur Dioxide

7.25 Figure 16 presents an isopleth of showing the area where the PCs cannot be screened out explicitly by considering the PC. Consideration must be given to whether there are relevant sensitive receptors within the area. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with the PC greater than 10% of the 15-minute mean AQAL. The risk of significant adverse effects of SO_2 emissions can therefore be discounted.

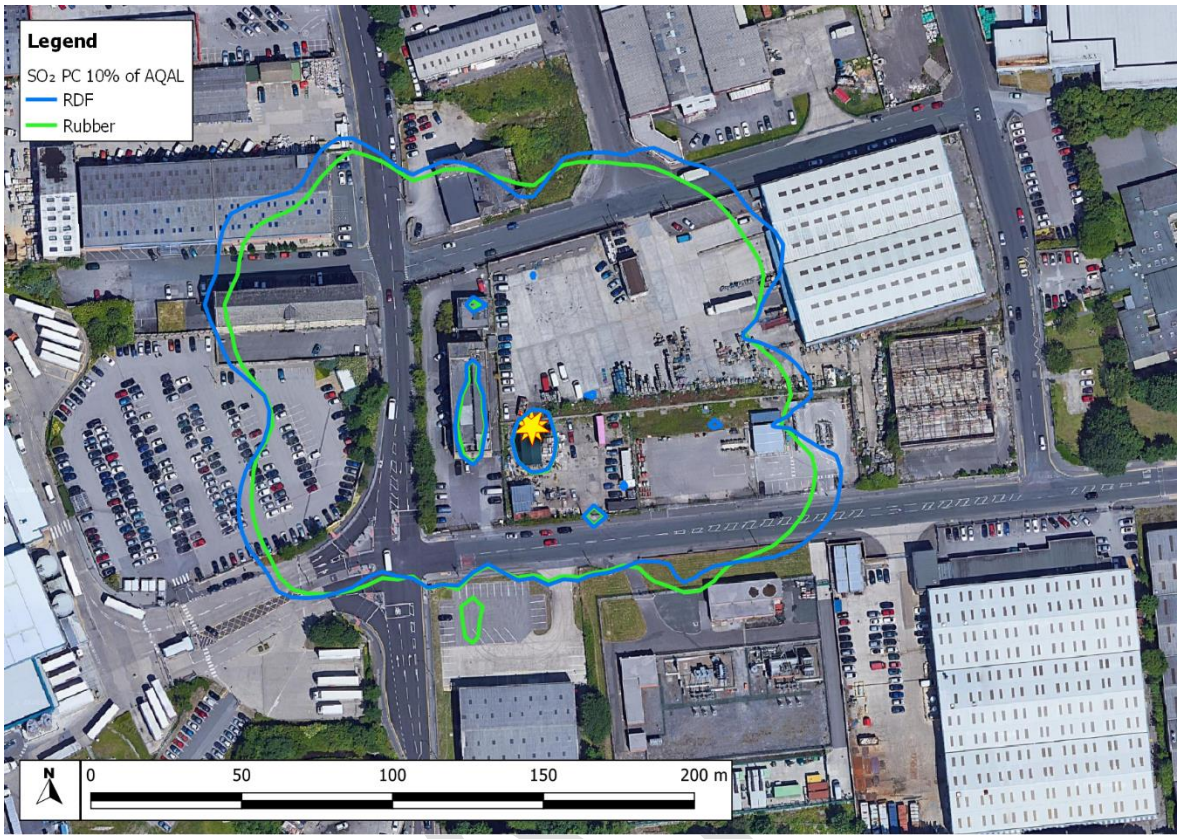

Figure 20: 15-Minute Mean SO_2 PC Contour Lines

Imagery ©2020 Google. Map data ©2020.

Volatile Organic Compounds

7.26 If it is assumed that the entire VOCs emissions consist of only dimethyl sulphate the maximum PC anywhere in the study area, regardless of the presence of a relevant receptor, is 49.6% of the AQAL.

7.27 Figure 16 presents an isopleth of showing the area where the PCs cannot be screened out explicitly by considering the PC, assuming all VOC emissions are assessed against the dimethyl sulphate AQAL. Consideration must be given to whether there are relevant sensitive receptors within the area. Within this area there are no relevant receptors for the annual mean objective, there is thus no risk of an exceedance of the AQAL and no relevant location with the PC greater than 10% of the 1-hour mean AQAL. The risk of significant adverse effects of VOC emissions can therefore be discounted.

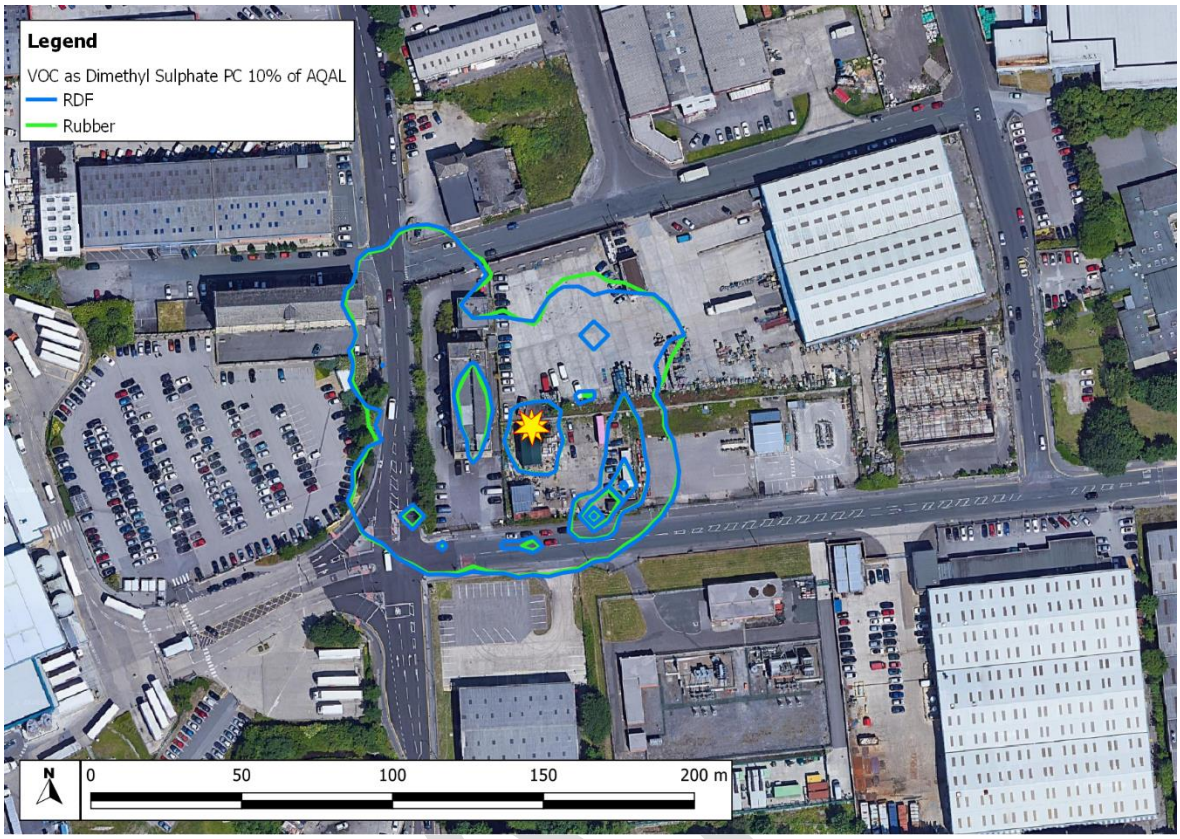

Figure 21: 1-Hour Mean Dimethyl Sulphate PC Contour Lines

Imagery ©2020 Google. Map data ©2020.

Ecological Impacts

7.28 The South Pennine Moors SAC ecological site is located approximately 7.5 km to the west of the facility.

7.29 Following the approach set out in Paragraph 5.7 to 5.23 the percentage PC compared to the relevant AQAL has been calculated. Where long-term PCs are below 1% of the AQAL, the impacts can be considered insignificant. Where short-term PCs are below 10% of the AQAL the impacts are considered insignificant.

7.30 The maximum contribution from the operation of the facility based on either RDF or Rubber Tyre derived Syn-gas to the critical levels and both the nitrogen nutrient deposition and total acidity deposition at the designated ecological site are shown in Table 21 and Table 22.

Table 21: PC Concentrations (µg/m^3)

Pollutant	Time period	AQAL	%PC of AQAL	Screening
NOx	Annual	30	<0.01%	Insignificant
	24-hour	200	<0.01%	Insignificant
NH_3	Annual	1	<0.01%	Insignificant
SO_2	Annual	20	<0.01%	Insignificant

Table 22: PC Deposition (kg/ha/yr)

Pollutant	Time period	AQAL	%PC of AQAL	Screened out
Nitrogen nutrient (kg) [a]	Annual	5	0.01%	Insignificant
Total acid (keq) [b]	Annual	0.19 [c]	0.01%	Insignificant

[a].The nitrogen nutrient deposition accounts for NOx and NH3

[b] The Acidity deposition accounts for deposition from nitrogen, HF HCl and SO_2

[c] The minimum of the lowest NminCL and SmaxCL for all features anywhere in the SAC.

7.31 The maximum contribution from the operation of the facility to the critical levels and both the N nutrient and total acidity deposition at the identified sensitive habitat has been considered in relation to the AQAL. Based on this, the impacts can be discounted as insignificant (long-term <1% and short-term PCs <10% of AQAL).

Summary of PC Impacts

7.32 The human health and ecological impacts of all pollutants released from the facility have been demonstrated to be screened out based on the PCs being insignificant.

7.33 Since impacts can be screened out based on the PCs, there is therefore no requirement for the assessment to set out baseline conditions or PECs; no information of these has therefore been presented.

8 Monitoring

8.1 The following section sets out the requirements of the air emissions monitoring which will be needed to satisfy the SWIP permit. Once operational with the approved permit, the air emission concentrations will need to be measured to ensure the facility is complying with the emission limits specified in the permit.

8.2 The Article 48 of the IED sets out information regarding monitoring of emissions. These requirements are set out below:

- monitoring of emissions will be carried out in accordance with Parts 6 and 7 of Annex VI of the IED.
- Any installation and functioning of an automated measuring systems shall be subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI of the IED.
- The location of the sampling or measurement points to be used for monitoring of emissions shall be agreed with the competent authority, in this case the local authority.
- All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority (the local authority in this case) to verify compliance with the operating conditions and emission limit values which are included in the permit.

8.3 Monitoring will be carried out in accordance with these requirements.

8.4 It is not proposed to include a continuous monitoring system, instead spot samples will be measured at a frequency agreed with the local authority.

9 Summary and Conclusions

9.1 The impacts associated with the SWIP facility have been assessed in relation to the relevant air quality assessment levels set to protect human health and to protect sensitive ecosystems. The assessment has considered an annual operation of 2,600 hours. In addition to the impacts on air quality objective receptors, consideration has been given to whether the facility will lead to compliance with the limit values being delayed.

9.2 The impacts have been predicted using the ADMS-5 dispersion model and include a range of sensitivity tests to ensure the assessment is robust.

Conclusion

9.3 The assessment has shown that based on the modelled emission, there will be insignificant impacts on both human health receptors and ecological receptors from all pollutants considered.

10 Glossary, References and Appendices

Glossary

APIS	Air Pollution Information Service
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AQO	Air Quality Objectives
AQS	Air Quality Standards
ASSI	Areas of Special Scientific Interest
AW	Ancient Woodland
CAZ	Clean Air Zone
EA	Environment Agency
ELV	Emission Limit Value
EPR	Environmental Permitting Regulations
Exceedence	A period of time (defined for each standard) where the concentration is higher than that set out in the Standard.
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MCP	Medium Combustion Plant
N	Nitrogen
NNR	National Nature Reserve
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
PC	Process Contribution
PCM	Pollution Climate Mapping model
PEC	Predicted Environmental Concentration

S	Sulphur
SAC	Special Areas of Conservation
SSSI	Sites of Special Scientific Interest
SPA	Special Protection Area
SWIP	Small Waste Incineration Plant
µg/m^3	Microgrammes per cubic metre

References

Environment Agency,, 2015. *Habitats Directive AQTAG21, 'Likely significant effect' – use of 1% and 4% long-term thresholds and 10% short- term threshold.* [Online].

European Commission, 2006. *Integrated Pollution prevention and Control Reference Document on the Best Available Techniques for Waste.* [Online].

APIS, 2019a. *APIS indicative critical load values.* [Online]
Available at: APIS indicative critical load values:

APIS, 2019b. [Online]
Available at: http://www.apis.ac.uk/

Basildon Council, 2019. *2019 Air Quality Annual Status Report (ASR).* s.l.:s.n.

Copernicus, 2018. *CLC 2018.* [Online]
Available at: https://land.copernicus.eu/pan-european/corine-land-cover/clc2018

Defra, 2007. *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.* s.l.:s.n.

Defra, 2017a. *2017 NO2 projections data (2015 reference year).* [Online]
Available at: https://uk-air.defra.gov.uk/library/no2ten/2017-no2-projections-from-2015-data

Defra, 2018. *Local Air Quality Management Technical Guidance (TG16)..* [Online]
Available at: https://laqm.defra.gov.uk/technical-guidance/

Defra, 2019. *2019 NO2 projections data (2017 reference year).* [Online]
Available at: https://uk-air.defra.gov.uk/library/no2ten/2019-no2-projections-from-2017-data

Defra, 2019b. *Background Mapping data for local authorities.* [Online]
Available at: https://uk-air.defra.gov.uk/data/laqm-background-home

Defra, 2019c. *UK Ambient Air Quality Interactive Map.* [Online]
Available at: https://uk-air.defra.gov.uk/data/gis-mapping

Defra, 2020. *LAQM Tools - Nitogren Dixoide fall off with distance.* [Online]
Available at: https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html

Defra, 2020. *Natural England Et al. MAGIC.* [Online]
Available at: https://magic.defra.gov.uk/

EA, 2016. *The Environmental Permitting (England & Wales) Regualtions 2016.* s.l.:s.n.

EA, 2019a. *Air emissions risk assessment for your environmental permit.* [Online]
Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

Environment Agency, 2012. *Environment Agency Interim Guidance Note for Metals 2012.* [Online]
Available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/532474/LIT_7349.pdf

Environment Agency, 2014. *Habitats Directive AQTAG 6 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air.* [Online].

Environment Agency, n.d. *Conversion Ratios for NOx and NO2.* [Online]
Available at:
https://webarchive.nationalarchives.gov.uk/20140328232919/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

EPA, 2018. *User's Guide for the AERMOD Meteorological Preprocessor (AERMET).* s.l.:s.n.

European Commission, 2019b. *Best Available Techniques (BAT) Reference Document for Waste Incineration: Industrial Emissions Directive 2010/75/EU.* [Online]
Available at: https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC118637_WI_Bref_2019_published_0.pdf

European Environment Agency, 2019. *E-PRTR Facilities.* [Online]
Available at: https://prtr.eea.europa.eu/#/home

HMSO, 1995. *Environment Act.* s.l.:HMSO.

HMSO, 2000. *The Air Quality Regulations, 2000, Statutory Instrument 928.* s.l.:HMSO.

HMSO, 2002. *The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043.* s.l.:HMSO.

HMSO, 2010. *The Air Quality Standards Regulations 2010, ENVIRONMENTAL PROTECTION, 2010 No. 1001, STATUTORY INSTRUMENTS.* s.l.:s.n.

HMSO, 2016. *The Environmental Permitting (England and Wales) Regulations 2016 Statutory Instruments No. 1154.* [Online].

HSE, 2020. *Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended).* [Online].

IAQM, 2019. *A guide to the assessment of air quality impacts on designated nature conservation sites.* s.l.:s.n.

MAGIC Partnership Organisations, 2019. *MAGIC.* [Online]
Available at: https://magic.defra.gov.uk/home.htm

Natural England, 2019. *APIS - Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments.* [Online]
Available at: http://www.apis.ac.uk/indicative-critical-load-values

A1 Emission Measurements

ALKOM SYNERGY
PVT LTD

STACK EMISSION MONITORING & ANALYSIS

Our Company M/s Alkom Synergy Private Limited and M/s Noida Testing Laboratories performed Stack Emission Monitoring at Kosi town in the Indian state of Uttar Pradesh on 19/02/2020.

Sampling of various pollutions was carried by our team at site and then samples were analyzed at the Laboratory.

NOISE MONITORING AT PLANT

Noise Monitoring was also performed at this site to monitor the noise levels in the surroundings due to the operation process of plant. This test was performed using a Sound Measuring Device.

Our team of Sampling and Analysis included:

1. Krishan Rajput – Environmental Engineer: M-Tech (Environmental Engineering),
2. Rishabh Sahni - Environmental Engineer: B-Tech (Environmental Engineering).
3. Dr R.K Singh- Laboratory Head: Msc and Phd (Environment)
4. Mr Hasan Ali- Sampling Technician: (Bsc)
5. Mr Pankaj Sharma -: Lab Analysist B-Tech (Chemical Engineering).
6. Mr Praveen - Lab Analysist (Bsc)

During this work, the following set of instruments was used for Field Sampling and Laboratory analysis:

1. Iso-Kinetic Stack Sampler
2. Flue Gas Analyser
3. VOC Sampler
4. Inductive Coupled Plasma (ICP)
5. Gas Chromatograph (GC)
6. Spectrophotometer
7. Charcoal Tube
8. Sound Level Meter

The Findings of the test are as follows:

NOIDA TESTING LABORATORIES

(An ISO : 9001 : 2008, 14001 : 2004 & OHSAS : 18001 : 2007 Certified & NABL Accredited Laboratory)

MoEF & CC (Ministry of Environment, Forest & Climate Change), UPPCB & HSPCB Recognized Laboratory

Analyzing for an Assured Future

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TEST CERTIFICATE

Test Report of	Report Code	Date of Issue
Pyrolysis Plant Boiler Stack Emission	BST-240220-1	24/02/2020

Issued To: **M/s The END JOURNEY LTD.**
KOSI, Uttar Pradesh (INDIA)

SAMPLING & ANALYSIS DATA

Sample Drawn on	:	19/02/2020
Sample Drawn By	:	Mr. Rakesh /Krishan/Hasan
Sampling Time	:	210 minutes
Sampling Plan &Procedure	:	SOP/SE/09
Analysis Duration	:	19/02/2020to 24/02/2020
Ambient Temperature(°C)	:	17.7
Stack Temperature (°C)	:	62.3
Source of Emission	:	Stack Attached ToPyrolysis Plant Boiler
Fuel Used	:	Rubber Tyre
Capacity	:	**(10TPH)**
Operating Load	:	Normal
Type of Stack	:	Metal circular
Top Diameter of Stack(Meter)	:	0.2032
Port Hole Diameter of Stack(Meter)	:	0.1016
Height of Stack from ground level (Meter)	:	30.48
Average Velocity of Flue Emission (m/s)	:	8.749
Efflux Velocity (m/s)	:	0.3057
Quantity of Emission (Nm3/hr)	:	910.36
ESP Details (if provided)	:	Wet Scrubber

EMISSION SUMMARY

S.N.	Parameter	Test Method	Release Rate (g/s)	Concentration (mg/m3)
1.	Total Particulate Matter (PM)	IS:11255(Part-1)	$3.21x10^{-3}$	12.4
2.	Particulate Matter (PM2.5)	IS:11255(Part-1)	1.0×10^{-3}	4.0
3.	Particulate Matter (PM10)	IS:11255(Part-1)	2.1×10^{-3}	8.0
4.	Quantity of Emission (Nm3/hr)	IS:11255(Part-3)	-	910.36
5.	Stack Temperature (°C)	IS:11255(Part-3)	-	62.3
6.	Volumetric Flow Rate (m3/s)	IS:11255(Part-3)	-	932.64
7.	SulpherDioxide as SO2	Flue Gas Analyzer	3.7×10^{-3}	14.3
8.	Nitrogen Dioxide as NOx	IS:11255(Part-7)	1.45×10^{-3}	4.8
9.	Nitric Oxide as NO	IS:11255(Part-7)	1.05×10^{-5}	0.41
10.	Carbon monoxide (as CO)	Flue Gas Analyzer	-	BDL

Laboratory : *GT-20, Sector-117, Noida, Gautam Budh Nagar - 201301*

E. : *noida.laboratory@gmail.com, info@noidalabs.com* ***W.:*** *www. noidalabs.com*

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TEST CERTIFICATE

EMISSION SUMMARY				
S.N.	**Parameter**	**Test Method**	**Release Rate (g/s)**	**Concentration (mg/m3)**
11.	Oxygen	Orsat Apparatus	4.68×10^{-2}	18.1
12.	Lead	USEPA-29	-	0.012
13.	Cadmium	USEPA-29	-	0.0006
14.	Fluoride	IS:11255(Part-5)	-	BDL
15.	Mercury	USEPA-30	-	0.0003
16.	Benzene	USEPA-18	-	0.0042
17.	Ethyl benzene	USEPA-18	-	0.0036
18.	Toluene	USEPA-18	-	0.0009
19.	Xylene (mixed isomers)	USEPA-18	-	0.0012
20.	Hydrogen chloride	Ion Chromatography	1.37×10^{-4}	0.53
21.	Free Formaldehyde	USEPA-323	1.63×10^{-5}	0.0021
22.	Hydrogen Sulphide	IS:11255(Part-4)	0.0016×10^{-5}	0.063
Weather Data				
23.	Wind Direction	N		
24.	Wind Speed	0.42 km/hr		
25.	Humidity	58 %		

CHECKED BY

NOIDA TESTING LABORATORIES NTL NOIDA

AUTHORIZED SIGNATORY

***Laboratory** : GT-20, Sector-117, Noida, Gautam Budh Nagar - 201301*

***E.** : noida.laboratory@gmail.com, info@noidalabs.com **W.**: www. noidalabs.com*

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In our opinion, the Best Available Technology to control emissions is a "high energy venturi scrubber" in comparison to the existing stack/scrubber which will successfully reduce 99% of pollutants.

The below link is the supporting document from Nottingham University which further explains about this technology.

https://www.nottingham.ac.uk/etc/sol_v_scrubbers.php

Test performed and Report generated by:

M/s ALKOM SYNERGY PRIVATE LIMITED

Address: C- 212, 2nd Floor, Sector- 10, Noida,
Uttar Pradesh, Pin Code: 201301, India

Email: info@alkom.in
Mobile: (091) 9818493979, 8882196187, 9354009115

A2 Ecological Sites

A2.1 The "Habitats Directive" (The Council of European Communities, 1992) requires member states to introduce a range of measures for the protection of habitats and species, which was transposed into law in England and Wales via The Regulations (2010). They require the Secretary of State to provide the European Commission with a list of sites which are important for the habitats or species listed in the Directive. The Commission then designates worthy sites as Special Areas of Conservation (SACs). The Regulations also require the compilation and maintenance of a register of European sites, to include SACs and Special Protection Areas (SPAs), with these classified under the "Birds Directive" (The European Parliament and the Council of the European Union, 2009). These sites form a network termed "Natura 2000".

A2.2 The Regulations primarily provide measures for the protection of European Sites and European Protected Species, but also require local planning authorities to encourage the management of other features that are of major importance for wild flora and fauna.

A2.3 The Habitats Directive (as implemented by the Regulations) requires the competent authority to firstly evaluate whether the development is likely to give rise to a significant effect on the European site. Where this is the case, it has to carry out an 'appropriate assessment' in order to determine whether the emissions will adversely affect the integrity of the ecological site.

A2.4 Sites of national importance may be designated as Sites of Special Scientific Interest (SSSIs). Originally notified under the National Parks and Access to the Countryside Act (1949), SSSIs have been re-notified under the Wildlife and Countryside Act (1981). Improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way Act (2000) (the "CROW" act). If a facility is "likely to damage" a SSSI, the CROW act requires that a relevant conservation body (i.e. Natural England) is consulted. The CROW act also provides protection to local nature conservation sites, which can be particularly important in providing 'stepping stones' or 'buffers' to SSSIs and European sites. In addition, the Environment Act (1995) and the Natural Environment and Rural Communities Act (2006) both require the conservation of biodiversity.

A3 Professional Experience

Dr Austin Cogan, MPhys (Hons) PhD MIEnvSc MIAQM

Dr Cogan is a Director of APS and has over eleven years' experience in environmental sciences. Austin has extensive experience of air quality, dust and odour assessments for a range of industries as well as services for local authorities, including Clean Air Zone and micro-simulation modelling. He is also an international expert in the field of climate change, having monitored greenhouses gases globally, published numerous scientific papers and presented at conferences internationally.

Kieran Laxen, MEng (Hons) MIEnvSc MIAQM

Mr Laxen is a Director of APS and has over eleven years' experience in the field of air quality. Kieran is an active member of the IAQM committee. He has extensive experience of air quality monitoring and is a leading UK expert in the assessment of power generating facilities for both permitting and planning applications. He has been a stakeholder in Defra's and the Environment Agency's consultations into implementing the MCPD and Specified Generator Controls.