AIR QUALITY ASSESSMENT
TEGCO Immingham Limited
Stallingborough, Grimsby

Prepared by:
Sol Environment Ltd

Date:
March 2023

Project Issue Number:
SOL21_PO31_BHE_AQA

VERSION CONTROL RECORD			
Contract/Proposal Number:		SOL_PO31_BHE_AQA	
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Issue	Description of Status	Date	Reviewer Initials
1	Final Issue for Planning Application	6th April 2023	SB

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EXECUTIVE SUMMARY

Sol Environment Ltd has been commissioned by TEGCO Immingham Limited to undertake an air quality assessment for a proposed Energy from Waste facility on land off Netherlands Way, Stallingborough, Grimsby. The facility is designed to operate twenty-four hours per day, seven days per week, except for routine maintenance and planned outages.

The air quality assessment has considered the operational impact of the facility arising from emissions to air from combustion sources and dust filters associated with the operation of the facility.

Detailed dispersion modelling has been undertaken to determine potential impacts arising from the combustion and dust filter sources associated with the facility. Maximum predicted concentrations are compared with the relevant Air Quality Objectives (AQO) and Environmental Assessment Levels (EALs) for the protection of human health. The significance of the air quality impacts has been assessed using criteria provided by the Environment Agency in its Risk Assessment Guidance. The assessment has considered the impact of emissions on human receptors.

The area surrounding the facility is sensitive to ecological impacts. There is one internationally designated habitat site within 10 km of the Site, the Humber Estuary which is designated as a Special Area of Conservation (SAC), a Special Protection Area (SPA), a Ramsar site and a Site of Special Scientific Interest (SSSI). In addition, there are three Local Wildlife Sites (LWS) within 2 km. Therefore, the impact of airborne emissions on habitat sites has also been assessed.

For human health, the maximum impact of pollutant emissions from the facility is considered 'not significant' or the air quality objective likely to be met on the basis of the Environment Agency's risk assessment guidance.

The habitat assessment considered the impact of airborne concentrations of the oxides of nitrogen, sulphur dioxide, ammonia and hydrogen fluoride. Predicted concentrations were compared to relevant critical levels. In addition, the impact of nutrient nitrogen deposition and acidification were assessed with deposition fluxes compared to relevant critical loads for the habitats present at each designated site. Where the impacts could not be screened out (i.e. long term exposure is greater than 1% or short term exposure is greater than 10% of the relevant critical levels/loads) an interpretation of the likelihood of effects on the habitat sites should be provided by the project ecologist.

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1. INTRODUCTION

1.1. Purpose of the Assessment

Sol Environment Ltd has been commissioned by TEGCO Immingham Limited to undertake an assessment of the likely local air quality impacts arising from a proposed Energy from Waste facility at Stallingborough in Grimsby. It is designed to operate twenty-four hours per day, seven days per week, except for routine maintenance and planned outages. This report supports the environmental permit application for the facility.

The facility is located approximately 1.3 km to the east of Immingham. The Site location is presented in Figure 1.1. The area surrounding the Site is predominantly rural and light industrial. The nearest residential receptor is located on Queens Road at the Port of Immingham at a distance of approximately 0.6 km to the northwest of the Site.

The Site is located within the administrative area of North East Lincolnshire Council (NELC). NELC has declared one Air Quality Management Area (AQMA) within its administrative area. This is located in Grimsby at a distance of 8 km to the southeast of the Site and has been declared due to exceedances of the annual mean air quality objective for nitrogen dioxide. Therefore, the Site is not located within or close to an AQMA.

Emissions to air from the combustion unit will be via a dual flue stack at a height of 65 m. In addition, there are a number of small dust filters with emissions to air that have been included in the assessment.

1.2. Scope of the Assessment

The potential air quality impacts arising from the operation of the facility are associated with emissions to air from the energy from waste plant and associated dust filters.

Operational impacts associated with the incineration plant have been assessed using a dispersion model to predict the impact at ground level utilising five years of meteorological data from the Humberside Airport meteorological station (2015 to 2019). This has considered the impact on human health and sensitive habitat sites.

Emissions to air from the combustion unit will be governed by the Industrial Emissions Directive (IED)[1], which requires adherence to emission limits for the following pollutants:

- nitrogen oxides (NOx as NO_2);
- carbon monoxide;

1 The Industrial Emissions Directive, 2010/75/EU

- total dust (as PM_{10} and $PM_{2.5}$);
- gaseous and vaporous organic substances, expressed as total organic carbon;
- sulphur dioxide;
- hydrogen chloride;
- hydrogen fluoride;
- twelve trace metals; and
- dioxins and furans.

The assessment has also considered emissions of polycyclic aromatic hydrocarbons (PAH, as benzo[a]pyrene) and polychlorinated biphenyls (PCBs). It is assumed that NOx emissions will be controlled via the injection of urea and will result in emissions of ammonia from ammonia slip. Therefore, ammonia emissions have been included in the assessment.

A glossary of common air quality terminology is provided in **Appendix A**.

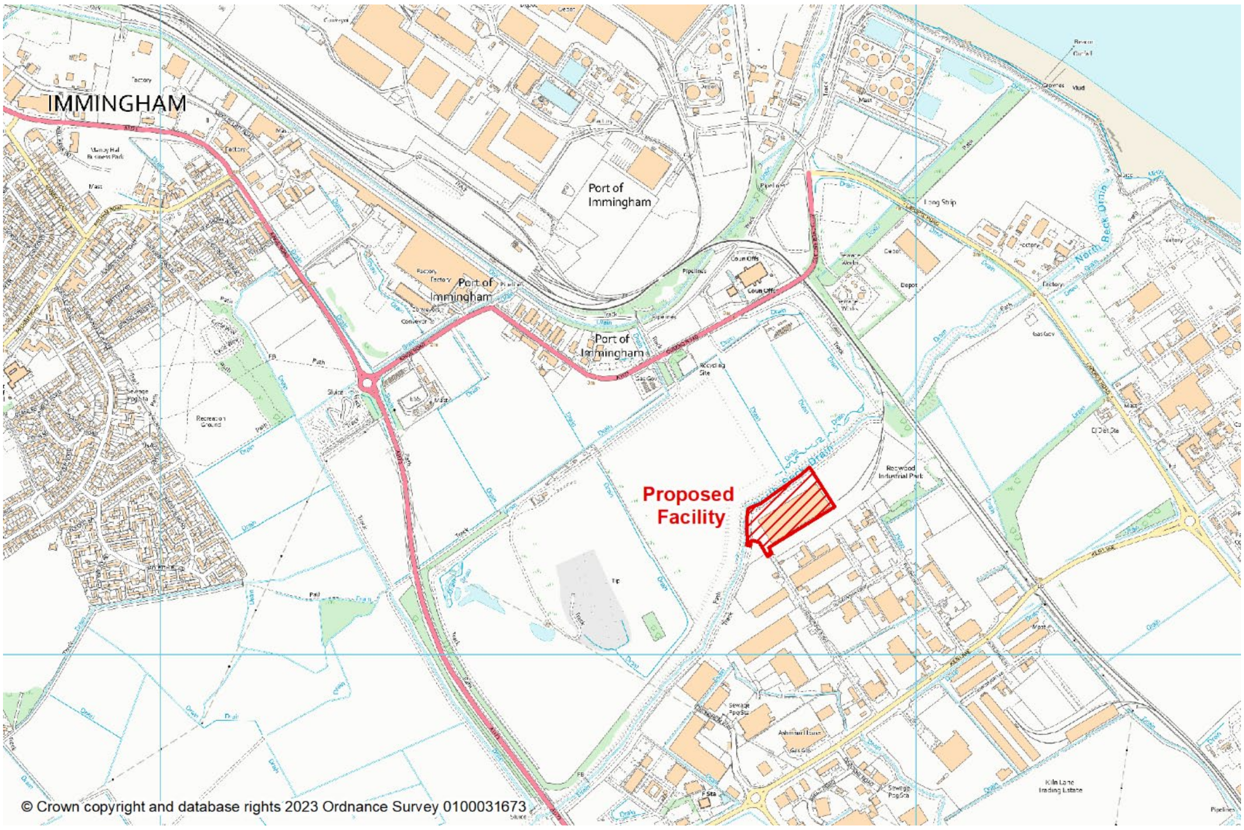

Figure 1.1: Site Location

2. LEGISLATION AND POLICY

2.1. The European Directive on Ambient Air and Cleaner Air for Europe

European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

The pollutants included are sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter of less than 10 micrometres (μm) in aerodynamic diameter (PM_{10}), particulate matter of less than 2.5 μm in aerodynamic diameter ($PM_{2.5}$), lead (Pb), carbon monoxide (CO), benzene (C_6H_6), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

The fourth daughter Directive (2004/107/EC) was not included within the consolidation. It sets health-based Target Values for polycyclic aromatic hydrocarbons (PAHs), cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable. Directives 2008/50/EC and 2004/107/EC are transposed into UK Law into the Air Quality Standards Regulations (2010), and subsequent amendments.

2.2. Air Quality Strategy for England, Scotland, Wales and Northern Ireland

The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland published in July 2007[2], pursuant to the requirements of Part IV of the Environment Act 1995. The Air Quality Strategy sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The Air Quality Strategy is designed to be an evolving process that is monitored and regularly reviewed.

The Air Quality Strategy sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems. These are benzene, 1,3-butadiene, carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10}, $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3) and polycyclic aromatic hydrocarbons (PAHs).

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

2 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – July 2007

The air quality objectives are medium-term policy-based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of nitrogen dioxide (NO_2), the short-term standard is for a 1-hour averaging period, whereas for fine particles (PM_{10}) it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

2.3. Air Quality (England) Regulations

Many of the objectives in the Air Quality Strategy were made statutory in England with the *Air Quality (England) Regulations 2000*[3] and the *Air Quality (England) (Amendment) Regulations 2002*[4] (the Regulations) for the purpose of Local Air Quality Management (LAQM).

The Air Quality Standards (England) Regulations 2010[5] have adopted into UK law the limit values required by EU Directive 2008/50/EC[6] and came into force on the 10th June 2010. These regulations prescribe the 'relevant period' (referred to in Part I2V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

Ozone is not included in the Regulations as, due to its transboundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

The environmental assessment levels (EALs), air quality objectives (AQOs) for the pollutants considered in the assessment are presented in **Appendix B.**

2.4. The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023

The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023[7] sets two legally binding environmental targets for air quality relating to the reduction of levels of fine particulate matter ($PM_{2.5}$) in ambient air: one with the purpose of reducing $PM_{2.5}$ in locations where concentrations are highest, the

3 The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928
4 The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043
5 The Air Quality Standards Regulations 2010 – Statutory Instrument 2010 No. 1001
6 Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe
7 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 - Statutory Instrument 2023 No. 96

annual mean concentration target ("AMCT"); and a second with the purpose of reducing average exposure across the country, the population exposure reduction target ("PERT"). This instrument establishes for each target the level to be achieved and the date for its achievement, as well as making provision about monitoring, measurement, and calculation to assess whether the targets are met.

This instrument satisfies the requirement in section 1(2) of the Environment Act 2021 ("the Environment Act") for government to set at least one target in the priority area of air quality and section 2 of the Environment Act to set a target in respect of the annual mean level of PM2.5 in ambient air.

2.5. Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 also requires local authorities to periodically review and assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in the Regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their Review and Assessment work[8]. This guidance, referred to in this chapter as LAQM.TG(22), has been used where appropriate in the assessment.

2.6. Environment Act 2021

The Environment Act 2021[9] establishes a legally binding duty on the government to bring forward new air quality targets by 31 October 2022 for $PM_{2.5}$.

8 Department for Environment, Food and Rural Affairs (Defra), (2022): Part IV The Environment Act 1995 as Amended by the Environment Act 2021, Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(22).
9 Environment Act 2021, 2021 Chapter 30

The air quality targets have been set by *The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023* and are:

- an Annual Mean Concentration Target - a maximum concentration of 10 µg m^{-3} to be met across England by 31st December 2040; and
- a Population Exposure Reduction Target - a 35% reduction in population exposure by 31st December 2040 (compared to a three year base from 1st January 2016 and 31st December 2018).

Schedule 11 of the Environment Act 2021 also strengthens the Local Air Quality Management (LAQM) framework which was introduced by the Environment Act 1995. Schedule 11 requires the LAQM framework to be reviewed and where appropriate modified within 12 months of the Environment Act coming into force and every 5 years following the initial review. Schedule 11 also places a duty on the local authority to have regard to the LAQM framework when exercising a function which could affect air quality (i.e. determining a planning application with air quality implications).

2.7. Industrial Emissions Directive

The Industrial Emissions Directive (2010/75/EU) came into force on the 6th January 2011, replacing the seven existing Directives, including the Waste Incineration Directive (WID) and Large Combustion Plant Directive (LDPD), implemented through the Environmental Permitting Regulations (EPR).

The aim of the new Directive is to simplify the existing legislation and reduce administrative costs, whilst maintaining a high level of protection for the environment and human health. Permits will still be issued under EPR; however existing and new sites will be required to comply with the requirements of the IED, which places greater emphasis on new plant best available technology (BAT).

The IED has been transposed into UK law via the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (SI 2013 No, 390), which came into force on 27 February 2013.

The design and operation of all new waste incinerations facilities must ensure compliance with emission limit values (ELVs) set out in the IED; these ELVs are summarised in Table 2.1.

Table 2.1: IED Emission Limits (mg/Nm^3)	
Pollutant	ELV (Referenced to 11% O_2)
Daily Average	
Total dust	10
Total organic carbon (TOC)	10
Hydrogen chloride (HCl)	10
Hydrogen fluoride (HF)	1
Sulphur dioxide (SO_2)	50
Oxides of nitrogen (NOx)	200
Carbon monoxide (CO)	50
Half-Hourly Average	
Total dust	30
Total organic carbon (TOC)	20
Hydrogen chloride (HCl)	60
Hydrogen fluoride (HF)	4
Sulphur dioxide (SO_2)	200
Oxides of nitrogen (NOx)	400
Carbon monoxide (CO)	100
Average over a sample period between 30-Minutes and 8-Hours	
Group 1 metals (a)	0.05
Group 2 metals (b)	0.05
Group 3 metals (c)	0.5
Average over a sample period between 6-Hours and 8-Hours	
Dioxins and furans (d)	1×10^{-7}

(a) Cadmium (Cd) and Thallium (Tl)
(b) Mercury (Hg)
(c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V)
(d) I-TEQ

The European Union Best Available Techniques (BAT) Reference Document (BREF) for Waste Incineration was adopted in December 2019. The proposed facility does not currently have an Environmental Permit. Therefore, it will be classed as a new plant.

The BREF provides BAT Associated Emission Limits (AEL) for new plants and existing plants. For the purposes of this assessment, it is assumed that the plant will need to comply with the requirements for new plant. These ELVs are provided as a range of concentrations for each pollutant. Therefore, for the purposes of this assessment it is assumed that the plant will comply with the upper range of emissions as provided in Table 2.2 except for NO_x where a more stringent ELV of 100 mg/Nm^3 has been adopted.

Table 2.2: BAT Associated Emission Limits (mg/Nm^3)	
Pollutant	Emission Limit (a)
Total Dust	5
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10
Sulphur Dioxide	30
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2	120
Carbon Monoxide	50
Hydrogen Chloride	6
Hydrogen Fluoride	1
Ammonia (NH_3)	10
Group I Metals (Cd, Tl)	0.02 (group total)
Group II Metals (Hg)	0.02
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3 (group total)
Dioxins and furans (PCDD/Fs)	0.06×10^{-6}

(a) Dry gas at 273.15K, 101.3mb and 11% O_2

3. METHODOLOGY

3.1. Scope of the Assessment

The scope of the assessment has been determined in the following way:

- review of air quality data for the area surrounding the Site, including data from the Defra Air Quality Information Resource (UK-AIR);
- desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- review and modelling of emissions data which have been used as input to the UK Atmospheric Dispersion Modelling System (ADMS) dispersion model.

The assessment for the facility comprises a review of emission parameters for the development and dispersion modelling to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Predicted ground level concentrations are compared with relevant air quality objectives for the protection of health and critical levels / loads for the protection of sensitive ecosystems and vegetation.

3.2. Dispersion Modelling Parameters

The predicted impact of the facility emissions on local air quality has been undertaken using the UK ADMS dispersion model (Version 5.2).

Emissions (refer to Table 2.2) have been assumed based on the requirements of the BREF for new plant. For the purposes of the modelling assessment, the plant is assumed to be operating at full load, continually throughout the year, ensuring that a worst-case assessment of impacts is presented. Stack emission parameters (flow rate, temperature etc.) have been provided by the technology supplier.

For the Group III trace metal predictions, it has been assumed in accordance with the Environment Agency's (EA) metals guidance[10], that each of the metals is emitted at the maximum ELV (assumed to be 0.3 mg/Nm^3) as a worst case. The same approach has also been adopted for the Group I and II metals.

Where the screening criteria set out in the guidance are not met, typical emission concentrations for energy from waste plants have been used, as specified in the guidance. The plant will be equipped with air pollution control equipment specifically designed to control emissions from energy from waste

10 Releases from waste incinerators, Guidance on assessing group 3 metal stack emissions from incinerators – Version 4

facilities. Therefore, it is reasonable to assume that emissions from the facility will be no worse than the maximum measured at municipal waste incinerators.

An emission limit of 9×10^{-5} mg/Nm^3 has been assumed for PAH (benzo(a)pyrene) based on the Defra (WR0608) report on emissions from waste management facilities[11]. Information on PCB emissions has also been obtained from the Defra report WR0608. Based on the information provided, a maximum emission concentration of 3.6×10^{-9} mg/m^3 is assumed for PCBs.

A summary of the input parameters used in the assessment are identified in **Appendix C**.

3.3. Meteorological Data

Dispersion modelling has been undertaken using five years (2015 to 2019) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from a meteorological station at Humberside Airport (approximately 11 km west-southwest of the Site) has been used for the assessment. This is the most representative data currently available for the area and, in line with normal practice, it is essential to use a verified source of data which meets stringent criteria.

Wind roses for each year of meteorological data are presented in **Appendix D.**

3.4. Dispersion Model Inputs

Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called building downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and results in higher ground level concentrations closer to the stack.

Downwash effects are only significant where building heights are greater than 30 to 40% of the emission release height. The downwash structures also need to be sufficiently close for their influence to be significant.

All potential downwash structures have been included in the model as detailed in Table 3.1. The boiler house has been selected as the main building for all emission sources. A sensitivity analysis for main building choice is provided in Section 5.4.

11 WR 0608 Emissions from Waste Management Facilities, ERM Report on Behalf of Defra (July 2011)

Table 3.1: Building Downwash Structures					
Building	Easting	Northing	Height	Dimensions	Angle
Boiler house (main)	520661	414370	42.4	38 by 36 m	58
Fly ash silo	520610	414371	30	Diameter = 2.6 m	-
FGCr silo	520606	414365	30	Diameter = 3.3 m	-
FGCr silo	520603	414360	30	Diameter = 3.3 m	-
Lime silo	520617	414360	30	Diameter = 2.5 m	-
Lime silo	520621	414362	30	Diameter = 2.5 m	-
PAC silo	520613	414357	10	Diameter = 2.5 m	-
Flue gas treatment	520626	414347	24	40 by 27 m	58
Turbine hall	520675	414347	21	39 by 16 m	58
Tipping hall	520692	414385	39.3	30 by 60 m	58

Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants by increasing turbulence and reducing the distance between the plume centre line and the ground level.

Terrain data has been included in the model to ensure that the impact of terrain features on the dispersion of emissions from the facility is taken into account.

Nitric Oxide to NO2 Conversion

Oxides of nitrogen (NO_x) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O_3).

A conversion ratio of 70% NOx:NO_2 has been assumed for comparison of predicted concentrations with the long-term objectives for NO_2. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by the Environment Agency's risk assessment guidance.

3.5. Sensitive Receptors

Sensitive Human Receptors

The locations of the discrete sensitive receptors selected for the assessment are presented in Table 3.2 and Figure 3.1.

Pollutant concentrations have been predicted at both discrete receptor locations and the maximum predicted concentration over a 6 km by 6 km Cartesian grid of 75 m grid resolution.

Table 3.2: Human Health Receptors				
ID	Receptor	Type	Easting	Northing
R1	Council Offices	Commercial	520579	414992
R2	Queens Road	Residential	520034	414789
R3	Mauxhall Farm	Residential	519197	413212
R4	Immingham	Residential	519219	414216
R5	Recreation Ground	Leisure	519293	414601
R6	Kings Road	Residential	519385	414945
R7	Grassmere	Residential	521286	413107

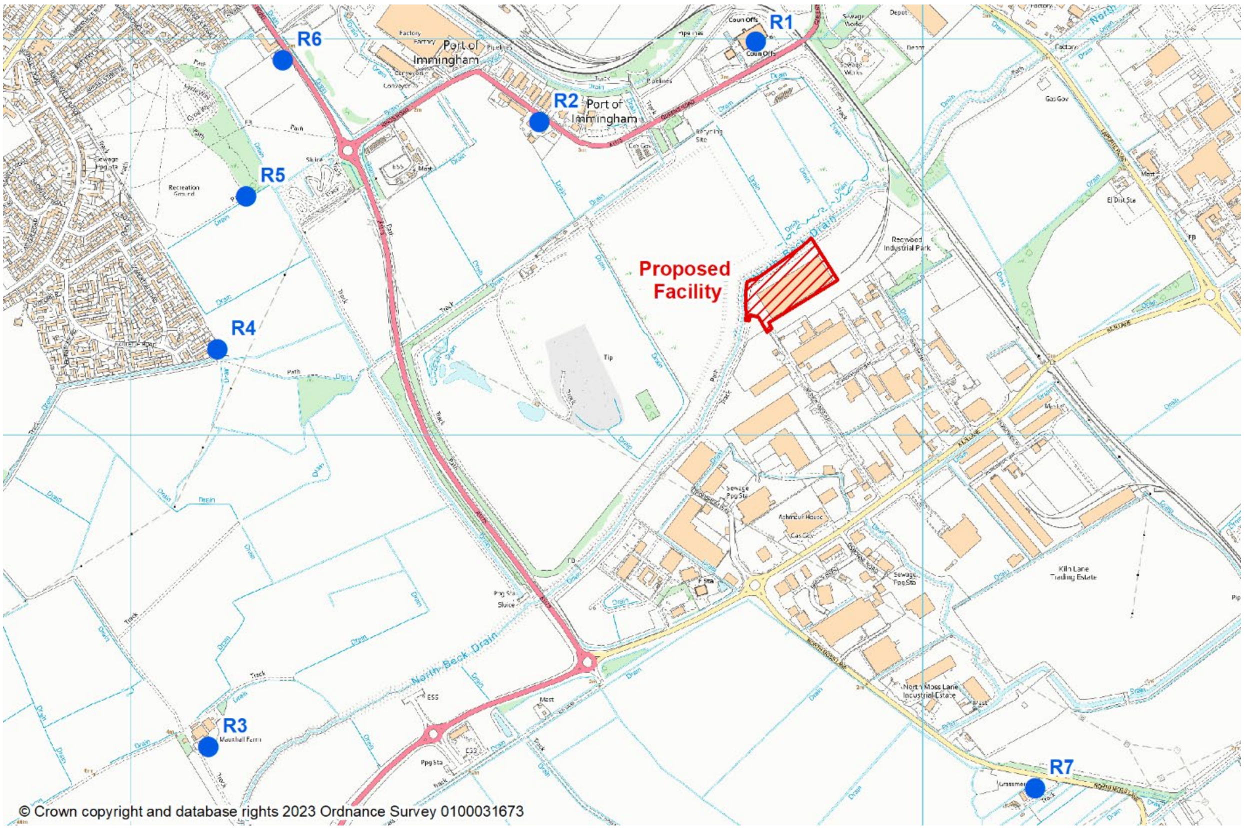

Figure 3.1: Sensitive Human health Receptor Locations

Sensitive Habitat Receptors

The Environment Agency's risk assessment guidance[12] states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive[13];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[14;] and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[15.]

Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);
- local wildlife sites (Sites of Interest for Nature Conservation, SINC and Sites of Local Interest for Nature Conservation, SLINC); and
- Ancient Woodland (AW).

Habitat receptor designations and locations relevant to the assessment are presented in Table 3.3 and the location of each is presented in Figure 3.2. The Humber Estuary is located 1.1 km from the Site at its nearest point. As the area of this habitat is extensive, it has been represented by twelve separate locations (H1_1 to H1_12) in order to determine the worst-case impact.

Table 3.11: Sensitive Habitat Receptors

Receptor	Primary Habitat	Approx. Location (Relative to the Site)
H1. Humber Estuary SAC	Atlantic salt marsh	1.1 km northeast
H1. Humber Estuary SPA/Ramsar	Pioneer, low-mid, mid-upper saltmarshes	1.1 km northeast
H1. Humber Estuary SSSI	Intertidal mudflats	1.1 km northeast
H2. North Moss Lane Meadow SNCI	Assumed low and medium altitude hay meadows	1.3 km south-southeast
H3. Immingham Dock Reedbeds SNCI	Assumed rich fen	0.8 km north
H4. Laporte Road Brownfield Site LWS	Assumed inland dune pioneer grasslands	0.8 km northeast

12 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
13 Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
14 Council Directive 79/409/EEC on the conservation of wild birds
15 Ramsar (1971), The Convention of Wetlands of International Importance especially as Waterfowl Habitat.

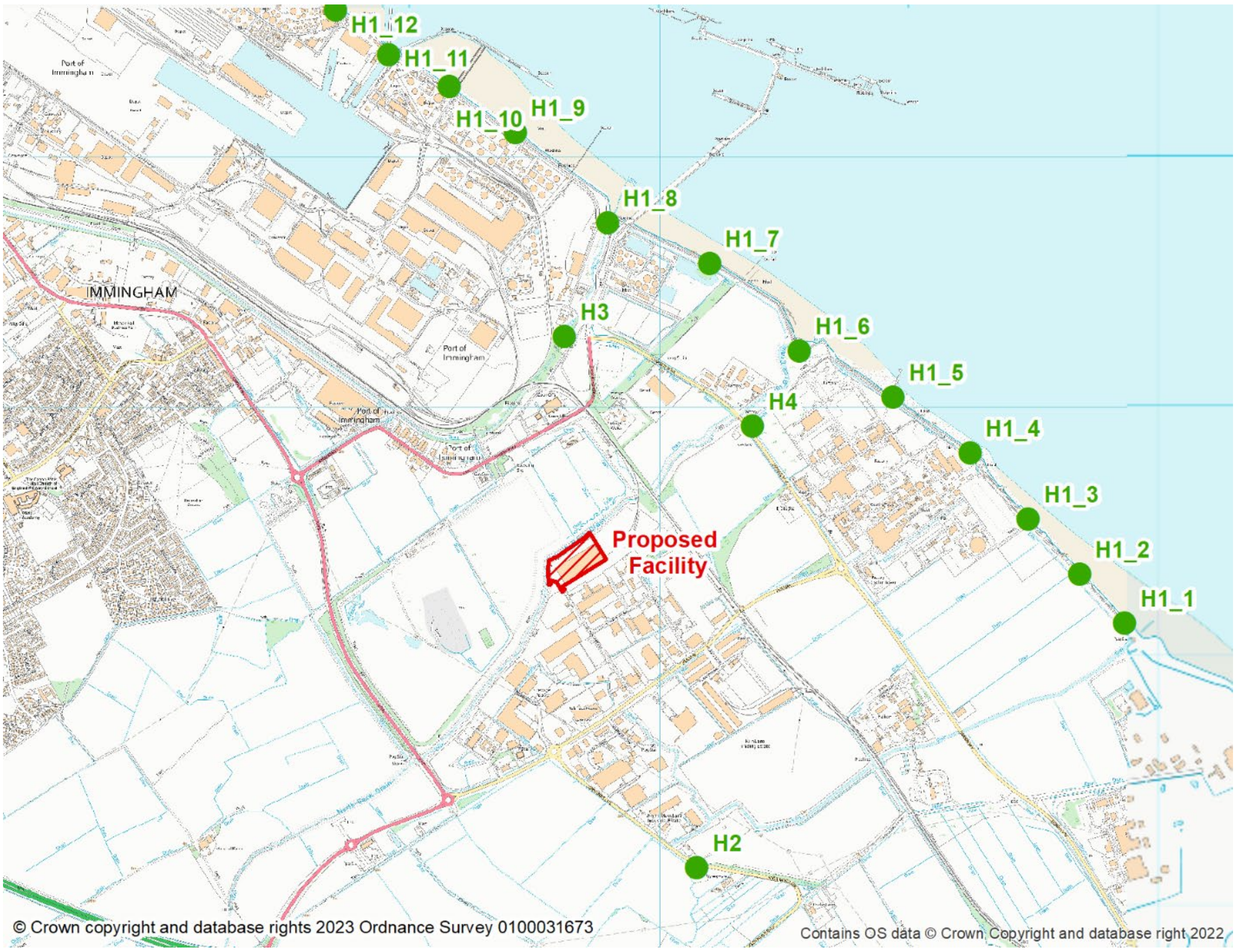

Figure 3.2: Sensitive Habitat Receptor Locations

Where appropriate, the modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO_2, NH_3, SO_2 and HCl dry deposition velocities is presented in Table 3.12.

Table 3.12: Dry Deposition Velocities (m/s)

Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO_2)	0.0015	0.0030
Ammonia (NH_3)	0.020	0.030
Sulphur Dioxide (SO_2)	0.012	0.024
Hydrogen Chloride (HCl)	0.025	0.06

The predicted nitrogen deposition rate assumes a 100% NOx: NO_2 conversion. This represents a worst-case for the assessment since nitric oxide (NO) has a lower deposition velocity than NO_2 and would consequently result in lower deposition rates.

It is considered that wet deposition of SO_2, NO_2 and NH_3 is not significant within a short range[16]. However, wet deposition of HCl and HNO_3 should be considered where a process emits these species. Therefore, a wet deposition rate for HCl has been calculated using a dry to wet deposition ratio, as follows:

HCl wet deposition rate = HCl dry deposition rate x wet-to-dry deposition ratio

Within a few kilometres of the source, the wet deposition rate is comparable to the dry deposition rate and with increasing distance, the wet deposition fraction becomes a smaller fraction of the total HCl deposition. As a worst-case, the wet-to-dry deposition ratio is assumed to be unity at all the identified habitat sites.

Predicted ground level concentrations and acidification / deposition rates are compared with relevant critical levels and critical loads for the protection of sensitive ecosystems and vegetation (see **Appendix E**).

3.6. Significance Criteria

Impacts on Human Health

The Environment Agency has developed criteria for assessing the significance of an impact compared with relevant air quality standards and background air quality[17]. A process contribution (PC) is considered potentially significant if:

- The long-term PC > 1% of the long-term air quality standard;
- The short-term PC > 10% of the short-term air quality standard.

At 1% of the long-term air quality standard, the impact of a development is unlikely to be significant compared with background air quality. Both the short and long-term criteria are also designed to ensure that there is a substantial safety margin to protect public health and the environment.

If the screening criteria are not met, the process contribution should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long-term PC + background concentration < 70% of the air quality standard;
- The short-term PC < 20% (air quality standard – short-term background concentration), where the short-term background concentration is assumed to be twice the long-term background concentration.

16 AQTAG06 Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air
17 Environment Agency Risk Assessment Guidance (https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit)

For the Group III metals the significance of emissions is determined following the Environment Agency guidance on releases from waste Incinerators, which recommends a two-step approach to screening group III metal emissions, which is as follows:

- Step One – predict metal concentrations assuming each metal is being emitted at 100% of the group ELV. The results are compared against the following criteria:
  - Where the PC of any metal exceeds 1% of the long-term or 10% of the short-term AQAL, then the PEC should be compared to the AQAL.
  - Where the PEC exceeds 100% of the AQAL, then the assessment should proceed to Step Two.
- Step Two – make predictions for the metals exceeding the criteria in Step One, using emission factors provided in the guidance. Where the PC of any metal exceeds 1% of the long-term or 10% of the short-term AQAL, then the PEC should be compared to the AQAL. Where the PEC exceeds 100% of the AQAL, then the impact of the metal can be considered to be significant.

<u>Impacts on Habitat Sites</u>

The Environment Agency has developed criteria for assessing impacts at SPAs, SACs, Ramsar sites and SSSIs, compared with the relevant critical level or critical load and background exposure. The criteria are designed to ensure that there is a substantial safety margin to protect the environment.

<u>Stage 1</u>

A process contribution (PC) is considered not significant if:

- The long term PC < 1% of the long-term EAL
- The short term PC < 10% of the short-term EAL

<u>Stage 2</u>

If the Stage 1 screening criteria are not met, the PC should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long term PC + background concentration < 70% of the EAL
- The short term PC < 20% of the (EAL – short term background concentration)

For local nature sites (SINCs, SLINCs, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- The long term PC < 100% of the long-term EAL
- The short term PC < 100% of the short-term EAL

4. BASELINE CONDITIONS

4.1. Introduction

This section provides an assessment of baseline conditions for the Site. The assessment of impacts requires an analysis of the change in pollutant concentrations with the relevant air quality standard taking into account background concentrations of the pollutant. Background monitoring data is not always available locally, particularly in areas that have good air quality. However, it is normal practice to obtain data from a comparable location to describe the air quality at the Site. Therefore, air quality at the Site has been characterised based on monitoring data and modelled data obtained from national and local sources.

4.2. Nitrogen Dioxide (NO_2)

North East Lincolnshire Council (NELC) undertook automatic ambient air quality monitoring of NOx in 2021 at three locations including an urban background site in Immingham. The Council also has a network of 30 diffusion tube sites for monitoring NO_2, three of which are located in Immingham. These are all roadside sites and may not be characteristic of air quality at the Site. A summary of the monitoring sites close to the proposed facility is provided in Table 4.1 and the location of each is presented in Figure 4.1.

Table 4.1: Monitoring Sites Close to the Facility

Monitoring Site	Type	Distance to Relevant Exposure	Distance to Kerb of Nearest Road
Automatic site	Urban background	10 m	4 m
Diffusion tube NEL 23	Roadside	20 m	1 m
Diffusion tube NEL 24	Kerbside	10 m	1 m
Diffusion tube NEL 25	Kerbside	29 m	0.5 m

A summary of annual mean concentrations of NO_2 measured at the monitoring sites is presented in Table 4.2. Measured concentrations are well below the air quality objective for NO_2 of 40 µg/m^3. There were no hours where the hourly mean concentration exceeded the short-term air quality objective of 200 µg/m^3 at the automatic monitoring site. Generally, concentrations measured in 2019 were higher than in 2020 and 2021 and are likely partly due to the reduction in traffic due to the COVID pandemic. At the urban background site, most likely to be characteristic of the site location, measured concentrations were 13.5 µg/m^3 as the maximum for the three years. This represents 34% of the air quality objective of 40 µg/m^3.

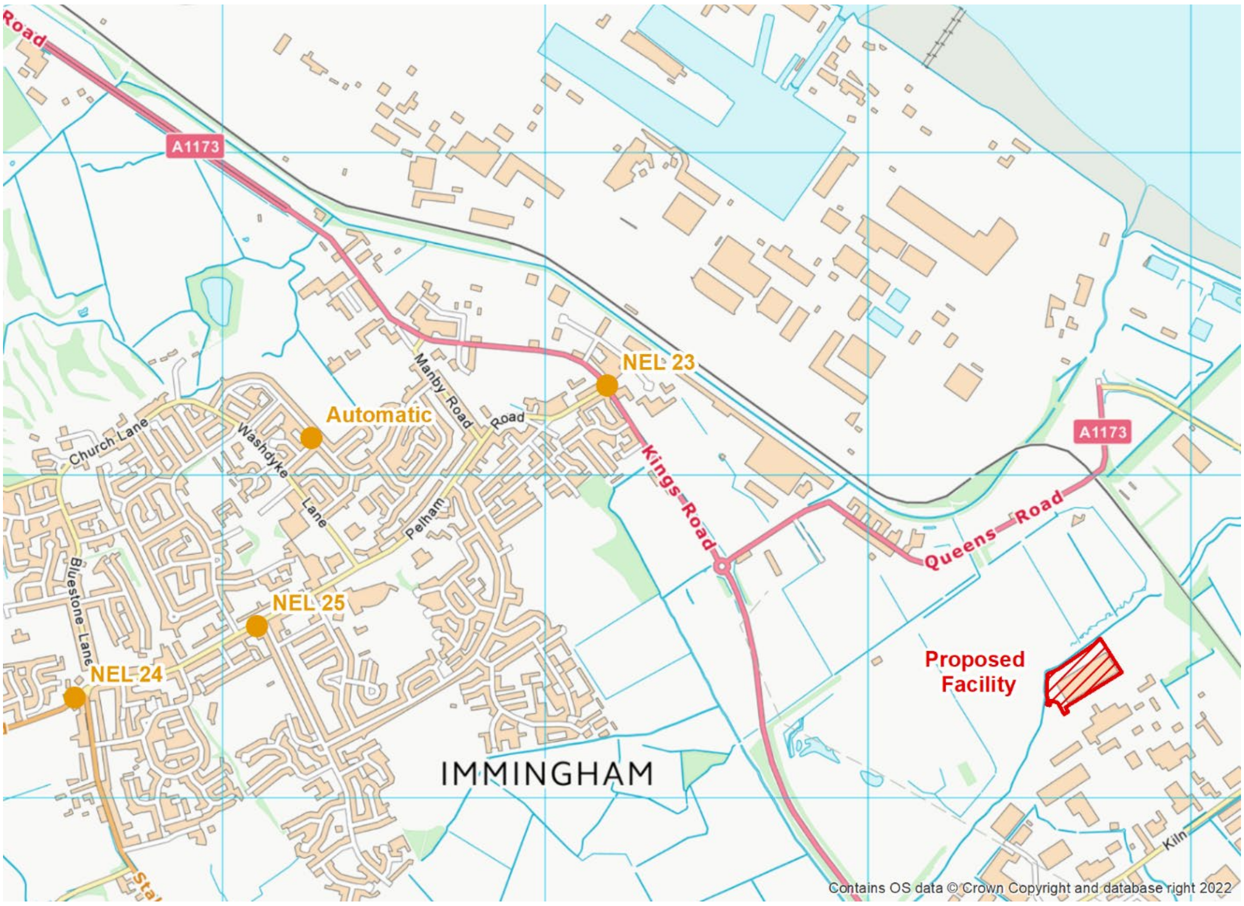

Figure 4.1: Monitoring Sites Close to the Proposed Facility

Table 4.2: Measured Annual Mean Concentrations of NO_2

Monitoring Site	Type	2019	2020	2021
Automatic site	Urban background	13.5	11.0	12.1
Diffusion tube NEL 23	Roadside	24.5	21.1	25.3
Diffusion tube NEL 24	Kerbside	16.5	12.5	15.0
Diffusion tube NEL 25	Kerbside	19.1	16.0	18.2

Annual mean NO_2 background concentrations for 2022 have also been obtained from the Defra UK Background Air Pollution Maps. The latest background maps were issued in August 2020 and are based on 2018 monitoring data. The 2022 mapped annual mean NO_2 background concentration for the Site and surrounding area is 11.2 to 19.0 µg/m^3, 28% to 48% of the air quality objective. This is the range for the nine 1 km^2 grid squares surrounding the facility. The lower end of the range is comparable to measurements at the urban background site. Therefore, measured concentrations at the urban background monitoring site are considered a reasonable baseline NO_2 concentration for the assessment.

For the purposes of the assessment, a background concentration of 13.5 µg/m^3 has been adopted based on the highest concentration measured over the three years at the automatic monitoring site in Immingham.

4.3. Carbon Monoxide (CO)

Monitoring of background CO concentrations is not currently undertaken by NELC. Therefore, concentrations have been obtained from the Defra maps. The CO mapping is based on 2001 monitoring data and factors are available to project the concentrations to future years [18].

The 2022 maximum annual mean background CO concentration for the nine 1 km^2 grids surrounding the Site is 121 µg/m^3 with the application of a factor of 0.448 to convert from 2001 to 2022.

4.4. Particulate Matter (PM_{10} and $PM_{2.5}$)

NELC did not undertake automatic monitoring of PM_{10} or $PM_{2.5}$ in 2021. The maximum Defra background mapped concentrations for 2022 are 15.7 µg/m^3 for PM_{10} and 8.6 µg/m^3 for $PM_{2.5}$ for the nine 1 km^2 grids located around the Site. These are assumed to be representative of air quality at the facility Site.

4.5. Sulphur Dioxide (SO_2)

Automatic monitoring of SO_2 concentrations is not currently undertaken by NELC. The maximum mapped SO_2 concentration for the area surrounding the Site is 14.5 µg/m^3. The SO_2 mapping is based on 2001 monitoring data and the 2022 SO_2 concentrations are assumed to be 100% of the published 2001 estimates and represents a worst-case.

4.6. Total Organic Carbon (as 1,3-Butadiene and Benzene)

NELC do not undertake ambient monitoring of 1,3-butadiene or benzene. Therefore, concentrations have been obtained from the Defra UK Background Air Pollution Maps. The mapped benzene and 1,3-butadiene concentrations are based on 2001 monitoring data, projected to 2010 for benzene and 2003 for 1,3-butadiene. These are the most recent projections available and are assumed to be representative of concentrations in future years.

The maximum estimated 2010 annual mean background benzene concentration for the area surrounding the Site is 0.39 µg/m^3. For 1,3-butadiene, the 2003 estimate is 0.11 µg/m^3.

18 http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html

4.7. Hydrogen Chloride (HCl)

Ambient monitoring of hydrogen chloride has been carried out as part of the Defra Acid Gases & Aerosol Network at a number of locations around the UK. The closest monitoring site is at Caenby in Lincolnshire (rural background site), which is 32 km southwest of the Site. This is some distance from the Site but in a similarly rural location and will likely be characteristic of measured concentrations at the Site.

There is no data beyond 2015 but monthly measured concentrations in 2015 varied between 0.15 and 0.31 µg/m^3. Therefore, the highest monthly concentration (0.31 µg/m^3) is assumed to be representative of annual mean concentrations at the Site.

4.8. Hydrogen Fluoride (HF)

Monitoring of ambient levels of hydrogen fluoride is not currently carried out in the UK. However, the Expert Panel on Air Quality Standards (EPAQS) report on halogen and hydrogen halides in ambient air[19] cites a modelling study which suggests that the typical natural background HF concentration is 0.5 µg/m^3, with an elevated background of 3 µg/m^3 where there are local anthropogenic emission sources.

There is no indication that a significant source of HF is present at the Site and a background HF concentration of 0.5 µg/m^3 is assumed to be applicable at sensitive human health and habitat receptors in the vicinity of the Site.

4.9. Trace Metals

Defra has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Network. The nearest monitoring site is located at the Scunthorpe Low Santon site to the east of Scunthorpe. The monitoring site is an urban industrial site and measured concentrations are likely to be higher than at the Site. The monitoring site is located around 28 km to the west of the Site. Concentrations measured at the Low Stanton site in 2021 are summarised in Table 4.3.

19 EPAQS (February 2006), Guidelines for Halogen and Hydrogen Halides in Ambient Air for Protecting Human Health Against Acute Irritancy Effects.

Table 4.3: Average Trace Metal Concentrations at Scunthorpe Low Stanton in 2021 (ng/m^3)		
Pollutant	Annual Mean (ng/m^3)	EAL
Antimony (Sb)	No data available	5,000
Arsenic (As)	0.73	6
Cadmium (Cd)	0.81	5
Chromium (Cr)	3.5	5,000
Cobalt (Co)	0.22	1,000
Copper (Cu)	4.2	10,000
Lead (Pb)	21.1	250
Manganese (Mn)	81.9	150
Mercury (Hg)	No data available	250
Nickel (Ni)	1.5	20
Thallium (Tl)	No data available	1,000
Vanadium (V)	9.3	5,000

Guidance issued by the Environment Agency[10] for the assessment of Group 3 metals, states that for screening purposes it should be assumed that Cr(VI) comprises 20% of the total background chromium. On this basis the average Cr(VI) concentration would exceed the EAL of 0.2 ng/m^3 by a factor of 3.5.

4.10. Ammonia

Ambient monitoring of ammonia (NH_3) concentrations is carried out as part of the National Ammonia Monitoring Network (NAMN). The closest monitoring site is at Caenby. The annual mean monitored NH_3 concentration at this site for 2019 to 2021 varied between 1.4 and 3.0 $\mu g/m^3$ with an average for the three years of 2.1 $\mu g/m^3$. It is assumed that the average concentration (2.1 $\mu g/m^3$) measured during this three-year period is a reasonable estimate of the background NH_3 concentration in the vicinity of the Site.

4.11. Dioxins and Furans

Monitoring of PCDD/Fs is currently carried out by Defra at six locations in the UK (Hazelrigg, High Muffles, London, Manchester, Auchencorth Moss and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network.

To provide an indication of the range of PCDD/F concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2013 and 2015 is presented in Table 4.4.

In general, the concentration of dioxins and furans at rural locations is considerably lower than at urban locations. The mean for urban background locations for the three years is 7.3 fg TEQ/m^3. Whereas for the rural background sites the mean is 1.5 fg TEQ/m^3.

Therefore, the average concentration measured at the four rural background monitoring sites from 2013 to 2015 (1.5 fg TEQ/m^3) is assumed to be reasonably representative of the baseline dioxin and furan concentration at the Site and nearby sensitive receptors.

Table 4.4: UK PCDD/Fs Concentrations (fg TEQ/m^3)

Monitoring Site	Type	2013	2014	2015
London	Urban background	3.5	2.9	4.4
Manchester	Urban background	10.0	17.0	6.0
Auchencorth Moss	Rural background	0.87	0.01	0.01
High Muffles	Rural background	0.6	1.1	0.5
Hazelrigg	Rural background	2.0	2.6	5.3
Weybourne	Rural background	2.3	1.6	1.4

4.12. Polycyclic Aromatic Hydrocarbons (as benzo[a]pyrene)

Monitoring of benzo(a)pyrene (BaP) is currently carried out by Defra at a number of locations in the UK as part of the TOMPS and PAH monitoring and analysis network. The nearest monitoring location is at Scunthorpe Low Stanton and is an urban industrial site. Measured concentrations of BaP varied between 0.51 and 0.85 ng/m^3 between 2019 and 2021. It is assumed that the maximum annual mean for this site (0.85 ng/m^3) is a conservative estimate of the background concentration in the vicinity of the facility Site.

4.13. Polychlorinated Biphenyls

Monitoring of PCBs is currently carried out by Defra at six locations in the UK as part of the TOMPs Network. The average PCB concentration measured at the urban background monitoring sites (London and Manchester) from 2013 to 2015 is 106 pg/m^3 and for the rural background sites (Auchencorth Moss, High Muffles, Hazelrigg and Weybourne) 23.7 pg/m^3. Given the rural nature of the Site, the average rural background concentration is assumed to be reasonably representative of the baseline PCB concentration at the Site and nearby sensitive receptors.

4.14. Summary of Background Concentrations

A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in Table 4.5. The current background concentrations are assumed to be representative of future year concentrations. Since pollutant concentrations are expected to decline in the future, this methodology ensures that the worst-case impacts are determined (i.e. future impacts combined with existing air quality).

Table 4.5: Summary of Background Concentrations		
Pollutant	Annual Mean	Short-Term
Particles (PM_{10})	15.7 µg/m^3	18.5 µg/m^3 (a)(b)
Particles ($PM_{2.5}$)	8.6 µg/m^3	n/a
Nitrogen Dioxide (NO_2)	13.5 µg/m^3	27.0 µg/m^3 (a)
Sulphur Dioxide (SO_2)	14.5 µg/m^3	24- hour 17.1 µg/ m^3 (a)(b) 1-hour 29.0 µg/m^3 (a) 15- minute 38.9 µg/m^3 (a)(d)
Carbon Monoxide (CO)	121 µg/m^3	8 – hour 169 µg/m^3 (a)(c) 1 – hour 242 µg/m^3 (a)
Hydrogen Fluoride (HF)	0.5 µg/m^3	1.0 µg/m^3 (a)
Hydrogen Chloride (HCl)	0.31 µg/m^3	0.62 µg/m^3 (a)
Ammonia (NH_3)	2.1 µg/m^3	4.2 µg/m^3 (a)
Benzene	0.39 µg/m^3	0.46 µg/m^3 (a)(b)
1,3-butadiene	0.11 µg/m^3	n/a
Dioxins and Furans (PCDD/Fs)	1.5 fg/m^3	n/a
Antimony (Sb)	No data available	No data available
Arsenic (As)	0.73 ng/m^3	1.5 ng/m^3 (a)
Cadmium (Cd)	0.81 ng/m^3	n/a
Chromium (Cr)	3.5 ng/m^3	7.0 ng/m^3 (a)
Cobalt (Co)	0.22 ng/m^3	n/a
Copper (Cu)	4.2 ng/m^3	8.4 ng/m^3
Lead (Pb)	21.1 ng/^{m3}	n/a
Manganese (Mn)	81.9 ng/m^3	164 ng/m^3 (a)
Mercury (Hg)	No data available	No data available
Nickel (Ni)	1.5 ng/m^3	n/a
Thallium (Tl)	No data available	n/a
Vanadium (V)	9.3 ng/m^3	11.0 ng/m^3 (a)(b)
Polycyclic Aromatic Hydrocarbons (PAH, as BaP)	0.85 ng/m^3	n/a
Polychlorinated biphenyls (PCBs)	0.024 ng/m^3	0.048 ng/m^3 (a)

(a) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the EA Guidance.
(b) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the EA Guidance.
(c) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the EA Guidance.
(d) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the EA Guidance.

5. ASSESSMENT OF OPERATIONAL IMPACTS

5.1. Human Health Impacts

Introduction

Predicted process contributions (PC) for the five years of meteorological data are presented as the maximum concentration for each of the discrete receptors identified in Section 3.5. Emissions from the facility are assumed to be at the BREF emission limits for new plant except for NOx where a more stringent emission limit of 100 mg/Nm^3 has been adopted.

The maximum PC is added to the estimated background concentration for the area (see Table 4.5) to give the total predicted environmental concentration (PEC) for comparison with the relevant air quality objectives. The significance of the impacts has been assessed in accordance with the Environment Agency's Risk Assessment Guidance.

Nitrogen Dioxide (NO_2)

The maximum predicted annual mean and 99.8th percentile of 1-hour mean ground level NO_2 concentrations are presented in Table 5.1.

Table 5.1: Predicted Concentrations of NO_2

Receptor	Annual Mean		99.8th Percentile of 1-hour Means (ug/m^3)
	PC (µg/m^3)	PC (% AQO)	PC
Maximum Predicted	1.9	4.6%	8.3
R1. Council Offices	0.22	0.5%	2.9
R2. Queens Road	0.057	0.1%	2.3
R3. Mauxhall Farm	0.10	0.2%	1.7
R4. Immingham	0.14	0.3%	2.1
R5. Recreation Ground	0.101	0.3%	1.8
R6. Kings Road	0.068	0.2%	1.7
R7. Grassmere	0.059	0.1%	1.7
AQO (µg/m^3)	40		200
Background (µg/m^3)	13.5		27.0
Maximum PC as %age of AQO	4.6%		4.1%
Maximum PEC as %age of AQO	38.4%		17.6%

For the maximum predicted anywhere within the model domain, the impact would be assessed as potentially significant as the PC is >1% of the AQO. However, the PEC is well below 70% of the AQO and it is unlikely that the AQO would be exceeded. The location of the predicted maximum occurs to the northeast of the facility (refer Figure 5.1) where there is no relevant public exposure. Therefore, it is concluded that the long-term impact of emissions of NO_x from the facility would not result in an exceedance of the AQO.

The hourly-mean predicted concentrations are less than 10% of the AQO at all locations including the maximum predicted and the impact would be described as 'not significant' according to the Environment Agency's Risk Assessment Guidance.

Predicted annual mean and 99.8th percentile of hourly mean NO_2 concentrations for the worst-case meteorological year (2015), are presented as contour plots in Figures 5.1 and 5.2 respectively.

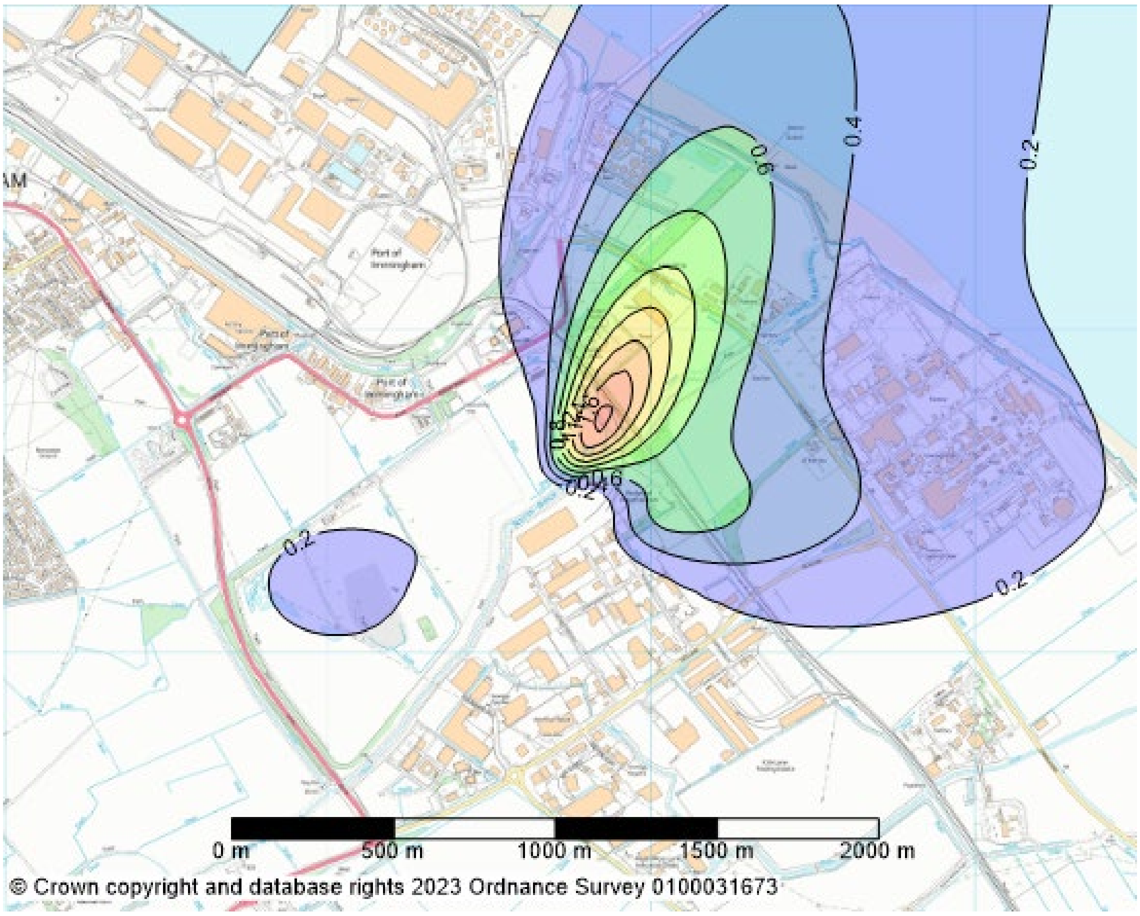

Figure 5.1: Predicted Annual Mean NO_2 Concentrations (µg/m^3)

Carbon Monoxide (CO)

Maximum predicted 8-hour and 1-hour mean ground level CO concentrations are compared to the relevant AQO in Table 5.2.

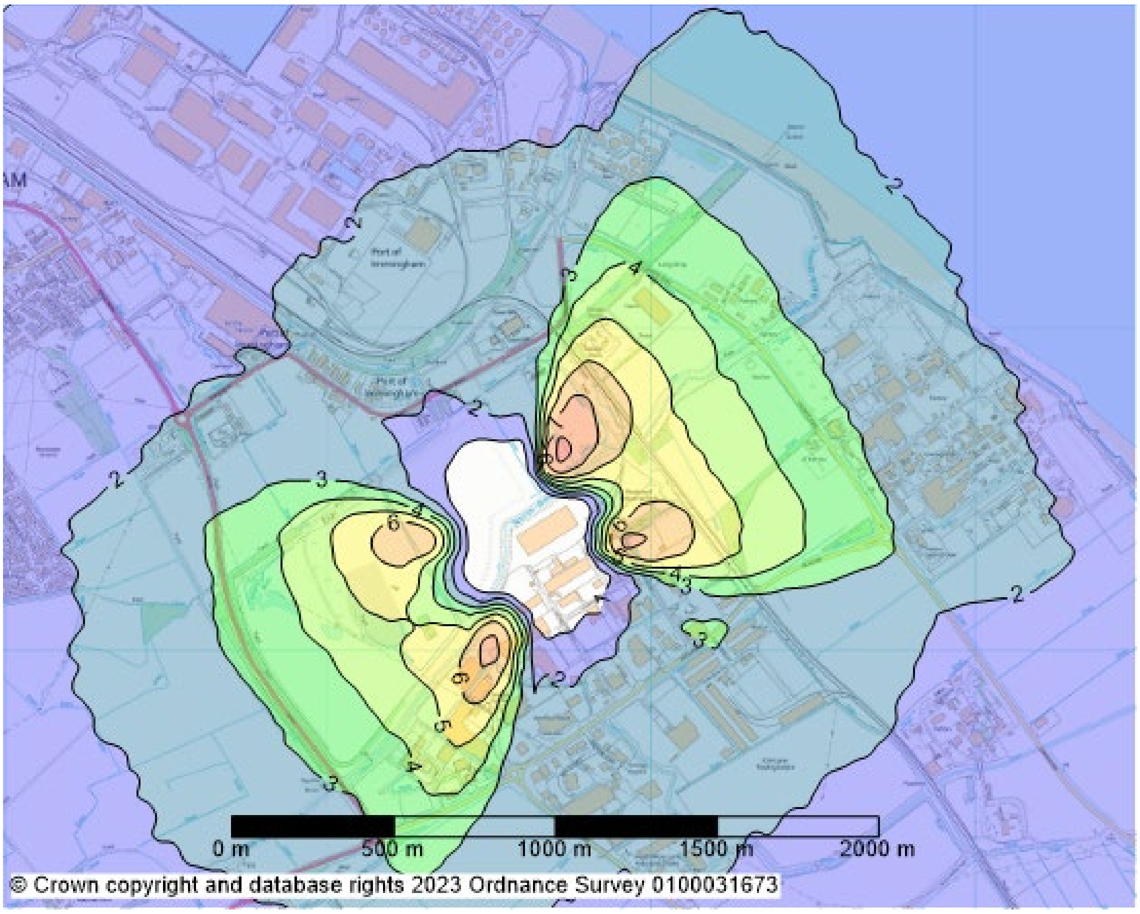

Figure 5.2: Predicted 99.8th Percentile of 1-Hour Mean NO_2 Concentrations (µg/m³)

Table 5.2: Predicted CO Concentrations		
Receptor	8-Hour Mean	1-Hour Mean
	PC (µg/m³)	PC (µg/m³)
Maximum Predicted	10.8	13.0
R1. Council Offices	3.4	5.3
R2. Queens Road	3.2	5.0
R3. Mauxhall Farm	2.0	2.9
R4. Immingham	3.0	3.6
R5. Recreation Ground	2.3	3.0
R6. Kings Road	1.9	2.9
R7. Grassmere	1.9	2.8
AQO / EAL (µg/m³)	10,000	30,000
Background (µg/m³)	169	242
Maximum PC as %age of AQO	0.1%	<0.1%
Maximum PEC as %age of AQO	1.8%	0.8%

The maximum 8-hour and 1-hour mean concentrations are all less than 10% of the AQO and the impact at all receptors would be described as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

Sulphur Dioxide (SO_2)

The predicted SO_2 concentrations (PC) at identified sensitive receptor locations are compared to the relevant AQO in Table 5.3. A contour plot of the 99.2nd percentile of 24-hour means is also presented in Figure 5.3.

Table 5.3: Predicted SO_2 Concentrations

Receptor	99.2nd Percentile of 24-Hour Means PC (µg/m^3)	99.7th Percentile of 1-Hour Means PC (µg/m^3)	99.9th Percentile of 15-Minute Means PC (µg/m^3)
Maximum predicted	4.8	7.1	7.6
R1. Council Offices	1.1	2.5	2.7
R2. Queens Road	0.53	1.9	2.5
R3. Mauxhall Farm	0.64	1.5	1.8
R4. Immingham	0.84	1.8	2.4
R5. Recreation Ground	0.75	1.5	1.8
R6. Kings Road	0.61	1.5	1.7
R7. Grassmere	0.40	1.5	1.8
AQO (µg/m^3)	125	350	266
Background (µg/m^3)	17.1	29.0	38.9
Maximum PC as %age of AQO	3.8%	2.0%	2.9%
Maximum PEC as %age of AQO	17.5%	10.3%	17.5%

The contribution from the facility (PC) is less than 10% of the AQOs at all locations and the impact at all locations would be described as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

Particulate Matter (as PM_{10})

Predicted annual mean and 90.4th percentile of 24-hour mean PM_{10} concentrations at the selected receptor locations are presented in Table 5.4. These are for the combined emissions from the energy from waste facility and the associated dust filters. The predictions assume that 100% of the particulate matter emitted from all sources is PM_{10}. A contour plot of the 90.4th percentile of 24-hour means is also presented in Figure 5.4.

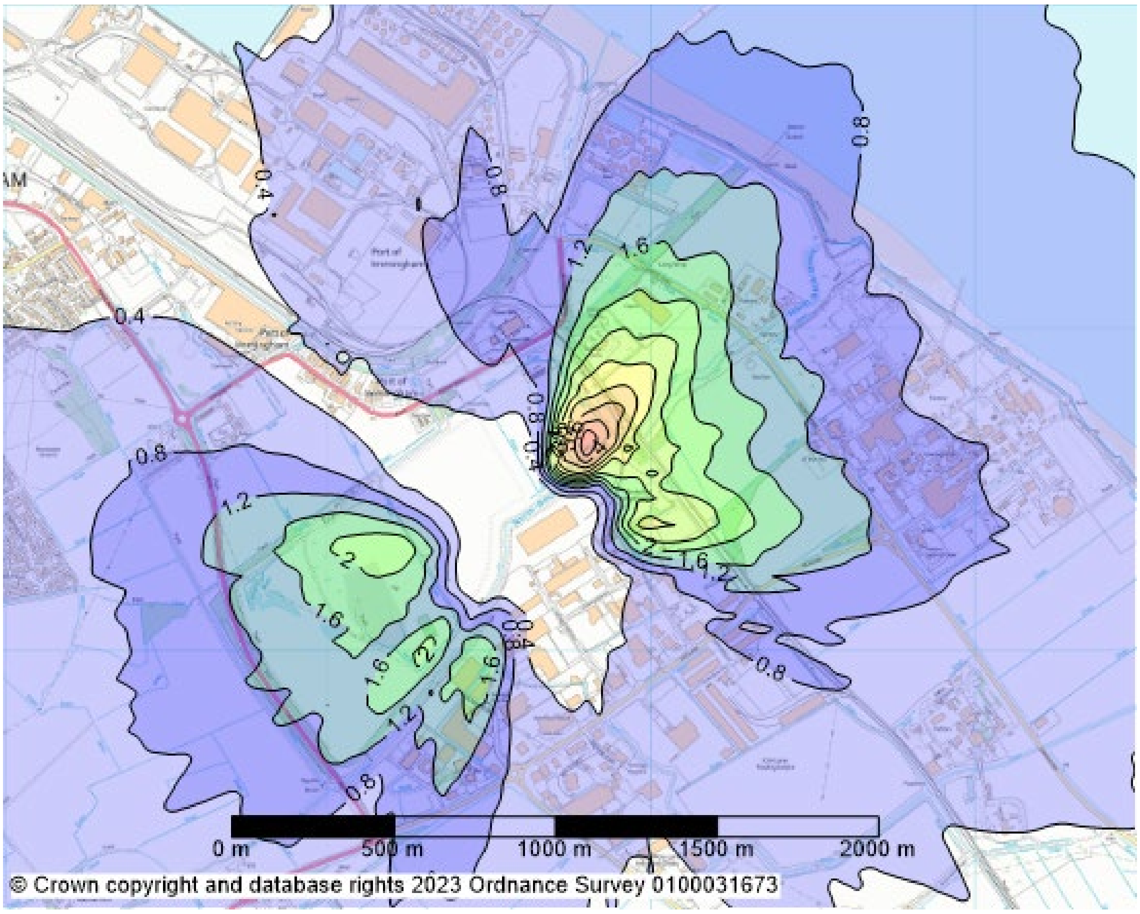

Figure 5.3: Predicted 99.2nd Percentile of 24-Hour Mean SO_2 Concentrations (µg/m³)

Table 5.4: Predicted PM_{10} Concentrations			
Receptor	Annual Mean		90.4th Percentile of 24-Hour Means
	PC (µg/m³)	PC (% of AQO)	PC (µg/m³)
Maximum predicted	0.13	0.3%	0.40
R1. Council Offices	0.016	0.0%	0.065
R2. Queens Road	0.0042	0.0%	0.015
R3. Mauxhall Farm	0.0072	0.0%	0.030
R4. Immingham	0.010	0.0%	0.040
R5. Recreation Ground	0.0075	0.0%	0.031
R6. Kings Road	0.0051	0.0%	0.017
R7. Grassmere	0.0042	0.0%	0.014
AQO (µg/m³)	40		50
Background (µg/m³)	15.7		18.5
Maximum PC as %age of AQO	0.3%		0.8%
Maximum PEC as %age of AQO	39.6%		37.8%

The maximum predicted PM_{10} concentrations are less than 1% and 10% of the relevant long and short-term AQOs, respectively. Therefore, the impacts would be described as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

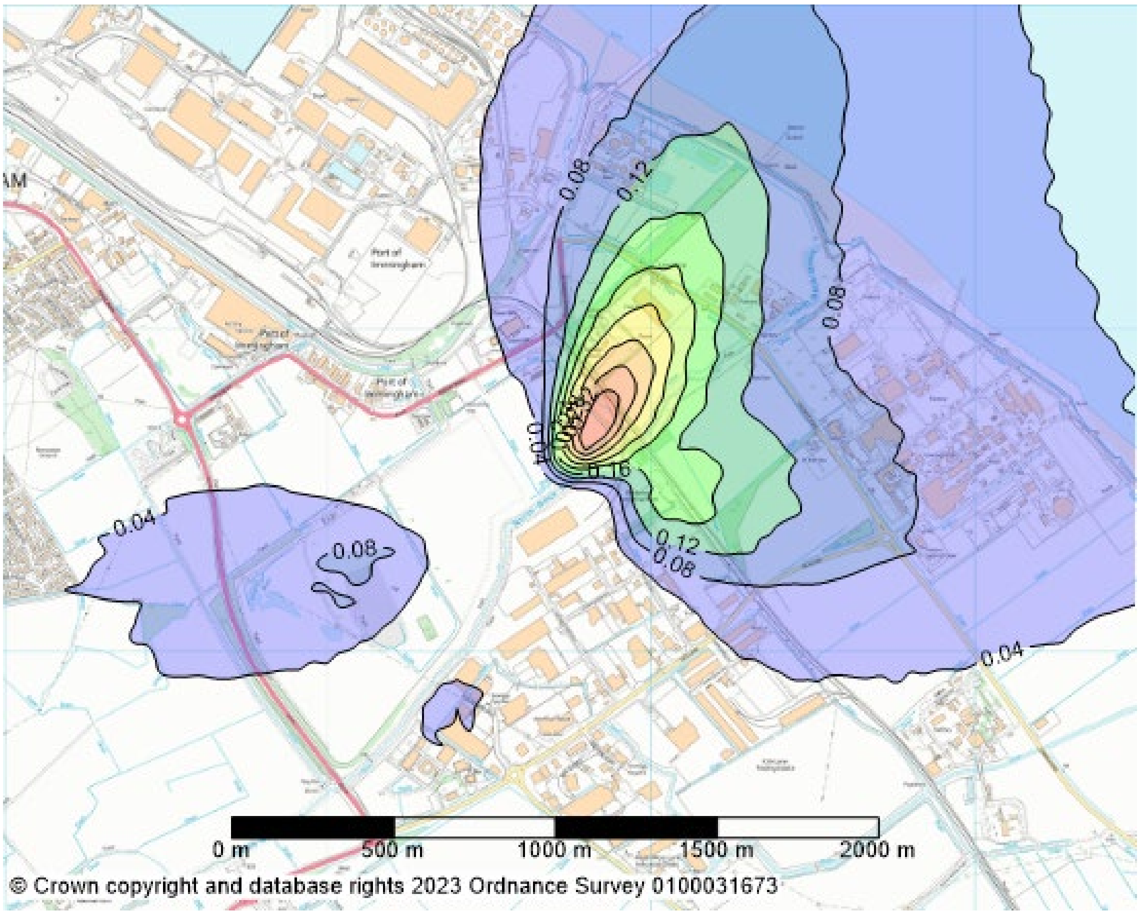

Figure 5.4: Predicted 90.4th Percentile of 24-Hour Mean PM_{10} Concentrations (µg/m^3)

<u>Particulate Matter (as $PM_{2.5}$)</u>

Predicted annual mean $PM_{2.5}$ concentrations at the selected receptor locations are presented in Table 5.5. These are for the combined emissions from the energy from waste facility and the associated dust filters. The predictions assume that 100% of the particulate matter emitted from all sources is $PM_{2.5}$. A contour plot of annual mean $PM_{2.5}$ (and PM_{10}) is presented in Figure 5.5.

The maximum predicted $PM_{2.5}$ concentration is less than 1% of EU limit value and the impact would be described as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

Table 5.5: Predicted $PM_{2.5}$ Concentrations		
Receptor	Annual Mean	
	PC (µg/m^3)	PC (% of AQO)
Maximum predicted	0.13	0.7%
R1. Council Offices	0.016	0.1%
R2. Queens Road	0.004	0.0%
R3. Mauxhall Farm	0.007	0.0%
R4. Immingham	0.010	0.1%
R5. Recreation Ground	0.007	0.0%
R6. Kings Road	0.005	0.0%
R7. Grassmere	0.004	0.0%
Limit Value (µg/m^3)	20	
Background (µg/m^3)	8.6	
Maximum PC as %age of AQO	0.7%	
Maximum PEC as %age of AQO	43.7%	

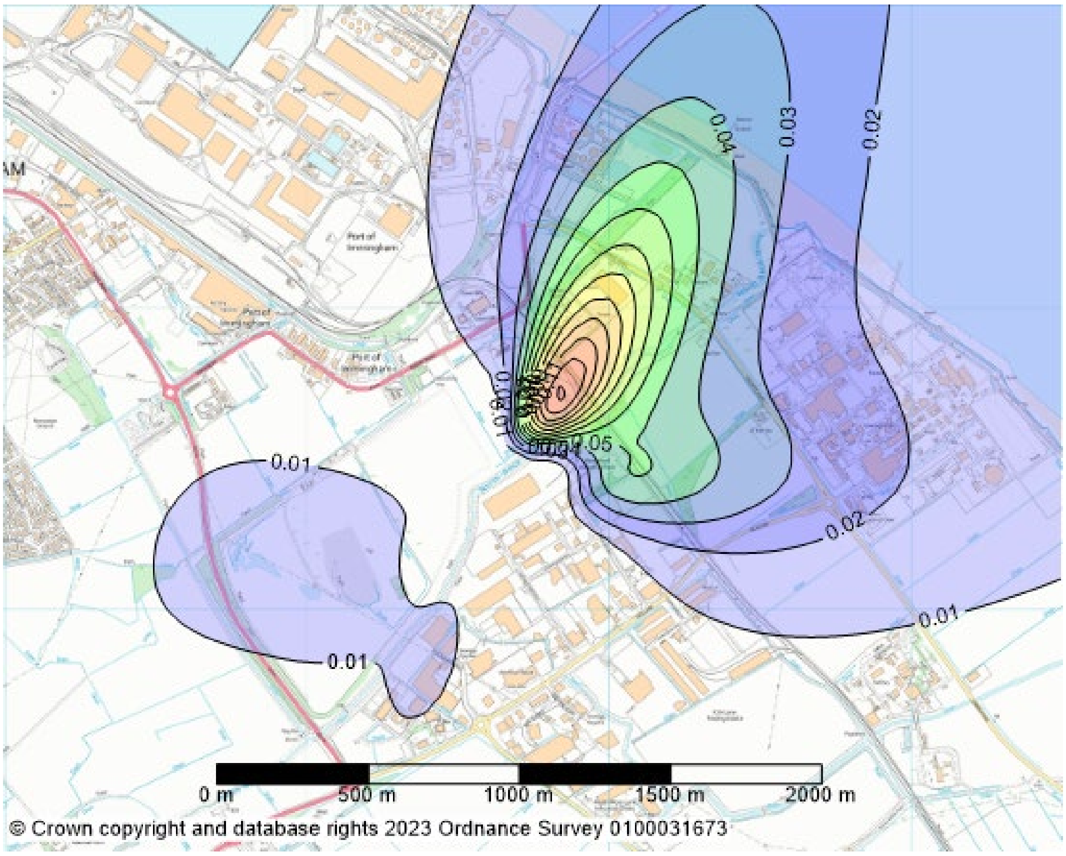

Figure 5.5: Predicted Annual Mean $PM_{2.5}$ and PM_{10} Concentrations (µg/m^3)

Total Organic Carbon (as 1,3-Butadiene and Benzene)

Predicted annual mean 1,3 butadiene and maximum 24 hour mean ground-level benzene concentrations are presented in Table 5.6.

Table 5.6: Predicted 1,3-Butadiene Concentrations

Receptor	Annual Mean 1,3-butadiene		Maximum 24-Hourly Mean Benzene
	PC (µg/m^3)	PC (% of AQO)	PC (µg/m^3)
Maximum predicted	0.26	11.8%	1.9
R1. Council Offices	0.031	1.4%	0.48
R2. Queens Road	0.008	0.4%	0.29
R3. Mauxhall Farm	0.014	0.6%	0.31
R4. Immingham	0.019	0.9%	0.40
R5. Recreation Ground	0.014	0.6%	0.37
R6. Kings Road	0.010	0.4%	0.26
R7. Grassmere	0.008	0.4%	0.24
Limit Value/EAL (µg/m^3)	2.25		30
Background (µg/m^3)	0.11		0.46
Maximum PC as %age of AQO	11.8%		6.4%
Maximum PEC as %age of AQO	16.7%		8.0%

Maximum predicted annual mean ground level 1,3-butadiene concentrations are 11.8% of the AQO and are potentially significant. However, the PEC is well below 70% of the AQO and it is unlikely that the AQO would be exceeded. Maximum 24-hourly mean concentrations of benzene are well below 10% of the EAL and the impact on short term benzene concentrations would be described as 'not significant'.

Therefore, it is concluded that the impact on air quality of total organic carbon emissions from the facility would be 'not significant'.

Hydrogen Chloride (HCl)

The predicted maximum 1-hour mean ground-level hydrogen chloride concentrations at identified sensitive receptor locations are presented in Table 5.7.

The maximum predicted hourly mean concentrations are less than 10% of the EPAQS Guideline Value and would be described as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

Hydrogen Fluoride (HF)

The predicted maximum monthly (weekly) mean and 1-hour mean ground-level hydrogen fluoride concentrations at identified sensitive receptor locations are presented in Table 5.8.

Table 5.7: Predicted HCl Concentrations	
Receptor	Maximum 1-Hour Mean PC (µg/m³)
Maximum predicted	1.6
R1. Council Offices	0.64
R2. Queens Road	0.60
R3. Mauxhall Farm	0.35
R4. Immingham	0.43
R5. Recreation Ground	0.36
R6. Kings Road	0.34
R7. Grassmere	0.34
EPAQS Guideline Value (µg/m³)	750
Background (µg/m³)	0.62
Maximum PC as %age of AQO	0.2%
Maximum PEC as %age of AQO	0.3%

Table 5.8: Predicted HF Concentrations		
Receptor	Monthly (Weekly) Mean PC (µg/m³)	Maximum 1-Hour Mean PC (µg/m³)
Maximum predicted	0.093	0.26
R1. Council Offices	0.018	0.11
R2. Queens Road	0.007	0.10
R3. Mauxhall Farm	0.011	0.058
R4. Immingham	0.015	0.072
R5. Recreation Ground	0.010	0.059
R6. Kings Road	0.011	0.057
R7. Grassmere	0.008	0.057
EPAQS Guideline Value (µg/m³)	16	160
Background (µg/m³)	0.5	1.0
Maximum PC as %age of AQO	0.6%	0.2%
Maximum PEC as %age of AQO	3.7%	0.8%

The maximum predicted HF concentrations are less than 10% of the EPAQS short-term Guideline Values. Therefore, in accordance with the Environment Agency's Risk Assessment Guidance the impacts would be assessed as 'not significant'.

Trace Metals

The predicted maximum long and short-term trace metal concentrations for emissions at the maximum BREF limits for new plant are presented in Tables 5.9 and 5.10 respectively.

For the Step 1 screening it is assumed that for chromium VI the predicted PC and background concentrations are apportioned 20% of the total chromium concentration.

Table 5.9: Maximum Long-Term Trace Metal Concentrations, Step 1

Pollutant	EAL (ng/m^3)	PC (% of EAL)	PEC (% of EAL)	Further Assessment Required?
Cd	5	**10.6%**	26.8%	No
Tl	1,000	0.1%	0.1%	No
Hg	250	0.2%	0.2%	No
Sb	5,000	0.2%	0.2%	No
As	**6**	**132%**	**145%**	**Yes**
Cr	5,000	0.2%	0.2%	No
Cr (VI) (a)	**0.2**	**795%**	**1145%**	**Yes**
Co	1,000	0.8%	0.8%	No
Cu	10,000	0.1%	0.1%	No
Mn	150	**5.3%**	59.9%	No
Ni	20	**39.7%**	47.2%	No
Pb	250	**3.2%**	11.6%	No
V	5,000	0.2%	0.3%	No

(a) The predicted and background concentrations are apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance.

Table 5.10: Maximum Short-Term Trace Metal Concentrations, Step 1

Pollutant	EAL (ng/m^3)	PC (% of EAL)	Further Assessment Required?
Hg	7,500	0.1%	No
Sb	150,000	0.1%	No
As	15,000	0.5%	No
Cr (III)	150,000	0.1%	No
Cu	200,000	0.0%	No
Mn	150,000	0.1%	No
V	1,000	5.8%	No

For the Group III metals, on the basis of the Step 1 screening advice provided by the Environment Agency, further assessment is required for long term chromium VI and arsenic. Emissions of all the remaining trace metals are considered to be not significant or the air quality assessment level unlikely to be exceeded.

The EA guidance note for the assessment of Group III metals provides measured concentrations of emissions of metals from waste Incinerators. In accordance with the guidance note, revised concentrations for CrVI and As have been predicted using the maximum measured emission concentrations (0.00013 mg/Nm^3 for CrVI and 0.025 mg/Nm^3 for As). For this typical emission concentration, maximum predicted ground level concentrations are presented in Table 5.11.

Table 5.11: Maximum Long-Term Trace Metal Concentrations – Typical Emissions				
Pollutant	EAL (ng/m^3)	PC (% of EAL)	PEC (% of EAL)	Further Assessment Required?
Cr (VI) (a)	0.2	1.7%	352%	Yes
As	6	11.0%	23.2%	No

(a) The background concentrations is apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance.

On the basis of Step 2 of the assessment, no further assessment is required for As since the PEC is less than 70% of the air quality assessment level. However, for CrVI, the PC is 1.7% and the PEC 352% of the target value. The PEC exceeds the target value due to the assumed background concentration that is 3.5 times the target value. Therefore, a more detailed assessment of CrVI emissions is required.

Maximum predicted annual mean concentrations occur to the northeast of the site where there is no public exposure. Predicted annual mean CrVI concentrations at the sensitive receptor locations for typical emissions of CrVI is presented in Table 5.12.

Table 5.12: Predicted Annual Mean CrVI Concentrations for Typical Emissions		
Receptor	Annual Mean	
	PC (ng/m^3)	PC (% of AQO)
Maximum predicted	0.0040	2.0%
R1. Council Offices	0.00047	0.2%
R2. Queens Road	0.00012	0.1%
R3. Mauxhall Farm	0.00021	0.1%
R4. Immingham	0.00029	0.1%
R5. Recreation Ground	0.00022	0.1%
R6. Kings Road	0.00015	0.1%
R7. Grassmere	0.00013	0.1%

At all sensitive receptor locations where there is the potential for public exposure, predicted annual mean CrVI concentrations are less than 1% of the target value. Therefore, it is concluded that emissions of CrVI would be not significant.

<u>Dioxins and Furans</u>

The predicted annual mean ground level dioxin and furan concentrations (PC) at identified sensitive receptor locations are presented in Table 5.13.

Table 5.13: Predicted PCDD/Fs Concentrations	
Receptor	Annual Mean PC (fg/m^3)
Maximum predicted	1.6
R1. Council Offices	0.19
R2. Queens Road	0.049
R3. Mauxhall Farm	0.084
R4. Immingham	0.117
R5. Recreation Ground	0.086
R6. Kings Road	0.058
R7. Grassmere	0.051
Background (fg/m^3)	1.5
PC as a %age of background Concentrations	106%

There are no assessment criteria for dioxins and furans. Compared with the average background concentration measured at rural monitoring sites in the UK, the predicted impact of the facility represents 106% of the background concentration. However, it should be noted that health impacts from exposure to dioxins and furans can arise via inhalation and ingestion exposure. Therefore, the health impacts of the emissions of dioxins and furans and dioxin-like PCBs have been assessed in the human health risk assessment submitted in support of the permit application for the facility.

PAH (as Benzo(a)pyrene)

Predicted annual mean ground-level benzo(a)pyrene concentrations are presented in Table 5.14.

Table 5.14: Predicted Benzo(a)pyrene Concentrations		
Receptor	Annual Mean	
	PC (ng/m^3)	PC (% of AQO)
Maximum predicted	0.0024	0.2%
R1. Council Offices	0.00028	0.0%
R2. Queens Road	0.00007	0.0%
R3. Mauxhall Farm	0.00013	0.0%
R4. Immingham	0.00017	0.0%
R5. Recreation Ground	0.00013	0.0%
R6. Kings Road	0.00009	0.0%
R7. Grassmere	0.00008	0.0%
Limit Value (ng/m^3)	1	
Background (ng/m^3)	0.85	
Maximum PC as %age of AQO	0.2%	
Maximum PEC as %age of AQO	85.2%	

Predicted ground level benzo(a)pyrene concentrations would be described as 'not significant' according to the Environment Agency's Risk Assessment Guidance for all receptors.

Polychlorinated Biphenyls

The predicted maximum annual mean and 1-hour mean ground-level PCB concentrations at the identified sensitive receptor locations are presented in Table 5.15.

Table 5.15: Predicted PCB Concentrations

Receptor	Annual Mean		Maximum 1-Hour Mean
	PC (ng/m^3)	PC (% of AQO)	PC (ng/m^3)
Maximum predicted	<0.0001	<0.1%	<0.001
R1. Council Offices	<0.0001	<0.1%	<0.001
R2. Queens Road	<0.0001	<0.1%	<0.001
R3. Mauxhall Farm	<0.0001	<0.1%	<0.001
R4. Immingham	<0.0001	<0.1%	<0.001
R5. Recreation Ground	<0.0001	<0.1%	<0.001
R6. Kings Road	<0.0001	<0.1%	<0.001
R7. Grassmere	<0.0001	<0.1%	<0.001
EAL (µg/m^3)	200		6,000
Background (ng/m^3)	0.024		0.048
Maximum PC as %age of AQO	<0.1%		<0.1%
Maximum PEC as %age of AQO	<0.1%		<0.1%

The maximum predicted PCB concentrations are less than 1% and 10% of the long and short-term EALs, respectively. In accordance with the Environment Agency's Risk Assessment Guidance the impact at all receptors would be described as 'not significant.

Ammonia

The predicted maximum annual mean and 1-hour mean ground level ammonia concentrations at identified sensitive receptor locations are presented as a percentage of the EAL in Table 5.16.

The maximum predicted NH_3 concentrations are less than 1% and 10% of the long and short-term EALs, respectively. In accordance with the Environment Agency's Risk Assessment Guidance, the impact at all receptors would be assessed as not significant.

Table 5.16: Predicted NH_3 Concentrations (μg/m³)			
Receptor	Annual Mean		1-Hour Mean
	PC	PC (%)	PC
Maximum Off-Site	0.26	0.1%	2.6
R1. Council Offices	0.031	0.0%	1.1
R2. Queens Road	0.008	0.0%	1.0
R3. Mauxhall Farm	0.014	0.0%	0.58
R4. Immingham	0.019	0.0%	0.72
R5. Recreation Ground	0.014	0.0%	0.59
R6. Kings Road	0.010	0.0%	0.57
R7. Grassmere	0.008	0.0%	0.57
AQS	180		2500
Background	2.1		4.2
Maximum PC (% AQS)	0.1%		0.1%
Maximum PEC (% AQS)	1.3%		0.3%

5.2. Habitat Impact

Introduction

This section provides an impact assessment of air emissions on habitat sites and has considered airborne NO_x, SO_2, NH_3 and HF as well as acidification and nutrient nitrogen deposition. Results are presented for the meteorological year that gives rise to the highest concentration at each habitat site for the five years of meteorological data used. The average annual mean for the five years is 77% of the worst-case year. Therefore, the results are representative of a worst-case.

Where predicted concentrations or deposition rates exceed the screening criteria (1% of the critical level/load for long-term impacts or 10% of the critical level or critical load for short-term impacts) an ecological interpretation is required to assess any adverse effects on sensitive habitats and should be provided by the project ecologist.

Airborne Concentrations of NOx, SO_2 NH_3 and HF

Predicted maximum ground level concentrations of NOx, SO_2, NH_3 and HF at the identified habitat sites are compared with the relevant critical levels in Tables 5.17 to 5.20. For the Humber Estuary, the maximum predicted concentration for the twelve receptors considered is presented.

Table 5.17: Predicted Maximum NOx Concentrations (µg/m^3)				
Habitat Site	Annual Mean		24-Hour Mean	
	PC (µg/m^3)	PC (% of CL)	PC (µg/m^3)	PC (% of CL)
H1. Humber Estuary SAC	0.91	3.0%	4.5	6.0%
H1. Humber Estuary SPA/Ramsar	0.91	3.0%	4.5	6.0%
H1. Humber Estuary SSSI	0.91	3.0%	4.5	6.0%
H2. North Moss Lane Meadow SNCI	0.10	0.3%	2.3	3.1%
H3. Immingham Dock Reedbeds SNCI	0.38	1.3%	4.1	5.5%
H4. Laporte Road Brownfield Site LWS	0.75	2.5%	5.4	7.2%
Critical Level (µg/m^3)	30		75	

For the Humber Estuary, predicted 24-hour mean concentrations of NO_x are less than 10% of the short-term critical level. However, the maximum annual mean concentration at 0.91 µg/m^3 is 3.0% of the critical level and is potentially significant. The background NOx at the location of maximum impact is 21.32 µg/m^3 and the PEC would be 22.23 µg/m^3 (74.1% of the critical level). Although this is slightly in excess of 70% of the critical level, it is considered that there would be sufficient headroom such that an exceedance of the critical level would be unlikely.

For the locally designated sites, predicted annual mean and 24-hour mean concentrations of NO_x are less than 100% of the critical levels and would be assessed as 'not significant' in accordance with Environment Agency guidance.

For sulphur dioxide, there are two critical levels depending on the presence of lichens. An appropriate critical level (CL) for each habitat site has been obtained from the Air Pollution Information System (APIS). These are also provided in Table 5.18.

Table 5.18: Predicted Maximum SO_2 Concentrations (µg/m^3)			
Habitat Site	Annual Mean		
	PC (µg/m^3)	CL (µg/m^3)	PC (% of CL)
H1. Humber Estuary SAC	0.27	20	1.4%
H1. Humber Estuary SPA/Ramsar	0.27	20	1.4%
H1. Humber Estuary SSSI	0.27	20	1.4%
H2. North Moss Lane Meadow SNCI	0.029	20	0.1%
H3. Immingham Dock Reedbeds SNCI	0.11	20	0.6%
H4. Laporte Road Brownfield Site LWS	0.22	20	1.1%
Critical Level (µg/m^3)	10 - 20		

For the Humber Estuary, predicted annual mean concentrations of SO_2 are slightly in excess of 1% of the critical level and are potentially significant. However, the background SO_2 at the location of maximum impact is 3.49 µg/m^3 and the PEC would be 3.76 µg/m^3 (18.8% of the critical level of 20 µg/m^3). Therefore, at less than 70% of the critical level, it is considered that an exceedance of the critical level would be unlikely.

For the locally designated sites, predicted annual mean concentrations of SO_2 are less than 100% of the critical level and would be assessed as 'not significant' in accordance with Environment Agency guidance.

For ammonia, there are also two critical levels depending on the presence of bryophytes and lichens. The most appropriate critical level for each habitat has been obtained from APIS and are provided in Table 5.19.

Table 5.19: Predicted Maximum NH_3 Concentrations (µg/m^3)

Habitat Site	Annual Mean		
	PC (µg/m^3)	CL (µg/m^3)	PC (% of CL)
H1. Humber Estuary SAC	0.091	3	3.0%
H1. Humber Estuary SPA/Ramsar	0.091	3	3.0%
H1. Humber Estuary SSSI	0.091	3	3.0%
H2. North Moss Lane Meadow SNCI	0.0097	3	0.3%
H3. Immingham Dock Reedbeds SNCI	0.038	3	1.3%
H4. Laporte Road Brownfield Site LWS	0.075	3	2.5%
Critical Level (µg/m^3)	1 - 3		

For the Humber Estuary, the maximum annual mean NH_3 concentration at 0.091 µg/m^3 is 3.0% of the critical level and is potentially significant. The background NH_3 at the location of maximum impact is 1.96 µg/m^3 and the PEC would be 2.05 µg/m^3 (68.4% of the critical level). Therefore, at less than 70% of the critical level, it is considered that an exceedance of the critical level would be unlikely.

For the locally designated sites, predicted annual mean concentrations of NH_3 are less than 100% of the critical level and would be assessed as 'not significant' in accordance with the Environment Agency guidance.

Predicted concentrations of HF as the weekly mean and 24-hour mean are presented in Table 5.20. For the SAC, ppSPA and SSSI, predicted weekly and 24-hour concentrations of HF are less than 10% of the critical levels. Therefore, the impact of HF emissions on these habitats would be assessed as 'not significant'. For the locally designated sites, predicted concentrations of HF are less than 100% of the critical levels and would also be assessed as 'not significant' in accordance with the Environment Agency guidance.

Table 5.20: Predicted Maximum HF Concentrations (µg/m³)				
Habitat Site	Weekly Mean		24-Hour Mean	
	PC (µg/m³)	PC (% of CL)	PC (µg/m³)	PC (% of CL)
H1. Humber Estuary SAC	0.027	5.4%	0.076	1.5%
H1. Humber Estuary SPA/Ramsar	0.027	5.4%	0.076	1.5%
H1. Humber Estuary SSSI	0.027	5.4%	0.076	1.5%
H2. North Moss Lane Meadow SNCI	0.0084	1.7%	0.039	0.8%
H3. Immingham Dock Reedbeds SNCI	0.016	3.2%	0.069	1.4%
H4. Laporte Road Brownfield Site LWS	0.027	5.5%	0.090	1.8%
Critical Level (µg/m³)	0.5		5	

Nutrient Nitrogen Deposition

Predicted maximum nutrient nitrogen deposition rates arising from emissions of NOx and NH_3 from the facility are presented in Table 5.21. The process contributions (PC) are compared with the relevant critical loads (CL) and combined with the relevant background concentrations (refer to **Appendix E).** Habitats associated with the Humber Estuary SSSI are not considered sensitive to nutrient nitrogen deposition.

Table 5.21: Predicted Nutrient Nitrogen Deposition (kg N/ha/a)				
Habitat Site	PC	Total Deposition (PEC)	Lowest CL	PC (% CL)
H1. Humber Estuary SAC	0.60	19.64	20	3.0%
H1. Humber Estuary SPA/Ramsar	0.60	19.64	20	3.0%
H1. Humber Estuary SSSI	0.60	19.64	Not sensitive	-
H2. North Moss Lane Meadow SNCI	0.065	19.24	20	0.3%
H3. Immingham Dock Reedbeds SNCI	0.25	19.29	15	1.7%
H4. Laporte Road Brownfield Site LWS	0.50	19.68	8	6.2%

For the Humber Estuary European site, the maximum nutrient nitrogen deposition rate is 0.60 kg N/ha/a which is 3.0% of the critical load and is potentially significant. The background deposition rate at the location of maximum impact is 19.04 kg N/ha/a and the PEC would be 19.64 kg N/ha/a (98.2% of the critical load) and there is a risk that the critical load could be exceeded. Therefore, the effect of this additional nutrient deposition on the integrity of the European site should be assessed by the project ecologist.

For the locally designated sites, predicted deposition rates are less than 100% of the critical load and would also be assessed as 'not significant' in accordance with the Environment Agency guidance.

Acidification

Predicted maximum acid deposition rates predicted for the five years of meteorological data are presented in Table 5.22. The contribution from HCl has been included with 100% assigned to sulphur. The process contributions (PC) are compared with the relevant critical loads provided in **Appendix E.** The percentage of the critical load has been calculated using the Critical Function Tool on the APIS website. The qualifying features of the Humber Estuary and the habitats associated with Immingham Dock Reedbeds SNCI are not considered sensitive to acidification impacts.

Table 5.22: Predicted Acid Deposition Rates (keq/ha/a)

Habitat Site	PC (N)	PC (S)	PC (% CL)	PEC (% CL)
H1. Humber Estuary SAC	0.043	0.056	Not sensitive	
H1. Humber Estuary SPA/Ramsar	0.043	0.056	Not sensitive	
H1. Humber Estuary SSSI	0.043	0.056	Not sensitive	
H2. North Moss Lane Meadow SNCI	0.005	0.006	0.2%	25.4%
H3. Immingham Dock Reedbeds SNCI	0.018	0.023	Not sensitive	
H4. Laporte Road Brownfield Site LWS	0.035	0.046	1.7%	28.3%

For the locally designated sites, predicted deposition rates are less than 100% of the critical load and would be assessed as 'not significant' in accordance with the Environment Agency guidance.

Emissions at Half-hourly ELVs

The dispersion modelling results presented Section 5.1 have been predicted assuming that the installation is operating for all hours in the year with the pollutant concentrations exactly at the daily emission limit value prescribed by the IED or BREF. This is a cautious assumption, especially for the annual average concentrations, since the facility could never operate with release rates as high as this in practice and remain compliant with legislation.

Short term peak concentrations may arise if the facility emits pollutants at levels approaching the half hourly IED limit values. These pollutants are particulate matter, nitrogen dioxide, sulphur dioxide, hydrogen chloride, hydrogen fluoride and carbon monoxide and have the following half-hourly emission limit values:

- total dust – 30 mg/Nm^3 (97% compliance with the daily ELV);
- hydrogen chloride – 60 mg/Nm^3 (97% compliance with the daily ELV);
- hydrogen fluoride – 4 mg/Nm^3 (97% compliance with the daily ELV);

- sulphur dioxide – 200 mg/Nm^3 (97% compliance with the daily ELV);
- oxides of nitrogen – 400 mg/Nm^3 (97% compliance with the daily ELV); and
- carbon monoxide – 100 mg/Nm^3.

Such excursions above daily limit values are permitted for only 3% of a year. The probability of such occasions occurring at the same time as the meteorological conditions that produce the highest one hour mean ground level concentrations is unlikely. On the basis of these worst-case assumptions (operating all year at the half hourly limits), maximum predicted short-term concentrations for emissions at the half hourly limit values are provided in Table 5.23. It should be noted that these results represent an extreme worst-case and for some of the pollutants (NO_2, SO_2 and PM_{10}) there are a number of occasions when the AQO can be exceeded.

Table 5.23: Maximum Predicted Short-term Concentrations at the Half-hourly ELVs		
Pollutant	PC (µg/m^3)	PC (%)
NO_2 (maximum 1-hour)	36.3	18.2%
SO_2 (maximum 15-minute)	69.5	26.1%
SO_2 (maximum 1-hour)	51.9	14.8%
SO_2 (maximum 24-hour)	38.7	30.9%
PM_{10} (maximum 24-hour)	5.8	11.6%
HCl (maximum 1-hour)	15.6	2.1%
HF (maximum 1-hour)	1.04	0.6%
CO (maximum 8-hour)	21.5	0.2%
CO (maximum 1-hour)	25.9	0.1%

Predicted concentrations are between 0.1% and 30.9% of the short term AQO. Highest concentrations relative to the AQO are predicted for SO_2 (as the maximum 24-hour mean) but assumes that the facility operates for 24 hours at the half hourly limit which would also result in an exceedance of the daily ELV. On the basis of these worst-case results, it is very unlikely that the AQO would be exceeded. Therefore, it is concluded that emissions at the half hourly limits would not have a significant impact on air quality even assuming worst case dispersion conditions occurring during periods of elevated emissions.

5.3. Abnormal Emissions

Introduction

Initial results are based on normal operating conditions and using daily emission limits where daily and half hourly values are provided. Article 46 of the Industrial Emissions Directive (IED) allows abnormal operation, where emission limit values can be exceeded for certain periods, without being in contravention of the Environmental Permit for the facility. This assessment identifies foreseeable events at the facility which constitute abnormal operations, which may have an impact on the subsequent emissions to air. The assessment then goes on to quantify the impacts to air quality in the vicinity of the facility as a result of these changes in emissions. The assessment focuses on the potential changes in emissions arising from failure of abatement plant, and mechanical failure.

Overview of Abnormal Emissions

In the event of any process upset or mechanical failure the immediate action to implement process controls, which ensure that standby equipment, where available and associated abatement systems are operational. In addition, various actions and monitoring procedures will be initiated by the Operator to ensure that combustion parameters and emissions remain within the Environmental Permit, thereby avoiding an abnormal operation where possible. If any process upset or mechanical failure results in a significant change to the emission conditions or process that cannot be easily and quickly remedied, the primary response from the operator will be to reduce load or initiate a controlled shutdown of the facility as appropriate.

Abnormal operation is not applicable to high CO or total organic carbon (TOC) emissions; in the event of emission levels of either being above the ELV the plant load would be reduced and a controlled shutdown initiated. Therefore, it is considered that periods where the plant continues to operate for extended periods with CO or TOC above the ELV would not occur.

Approach

The abnormal modelling approach has considered the short-term impacts during periods of abnormal operation, assuming a worst case of complete abatement failure. A series of factors have been derived in order to ascertain the likely increases in emissions that may occur for each pollutant due to various foreseeable abnormal operations. For particulate matter, CO, and TOC the limits in Annex VI, Part 3 of the IED were used for this assessment.

The dispersion modelling approach used to assess impacts under normal operating conditions uses daily emission limits to predict short term ground level pollutant concentrations. These predictions are then compared to the relevant air quality standard. For the assessment of abnormal emissions, the impact on short term concentrations is of more importance since occasional excursions above the ELV would have negligible impact on long term air quality impacts. However, the long-term impact of abnormal conditions is considered for some pollutants namely dioxins and furans, mercury and PCBs.

Abnormal Emissions – Short-term Impacts

Article 46(6) of the IED states that 'under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limits values are exceeded'. In addition, Article 46(6) also states that 'the cumulative duration of operation in such conditions over one year shall not exceed 60 hours'. Therefore, in order to assess the short-term ground level conditions that would result from the facility operating at a plausible abnormal operational emission level for four hours, the assessment has considered the short-term ground level concentrations where emissions occur at above half-hourly emission limits. The short-term emissions that are assumed to occur during abnormal conditions are presented in Table 5.24.

Table 5.24: Short-term Abnormal Emission Concentrations – Non-metals

Pollutant	Half-hour ELV (mg/Nm^3)	Assumed Daily ELV (mg/Nm^3)	Plausible Abnormal Emission (mg/Nm^3)(a)	Plausible Abnormal Emission (g/s)
NOx	400	100	500 (b)	32.3
SO_2	200	30	258 (15-minute) 258 (hourly) 68 (daily)	16.7 (c) 16.7 (c) 4.4 (c)(d)
Total dust (PM_{10})	30	5	29.2 (e)(f)	1.9
HCl	60	6	398	25.7 (g)
HF	4	1	3.4	0.22 (h)
CO	100	50	75 (8-hourly) (i) 100 (hourly)	4.8 6.5
PCBs	-	3.6×10^{-9} (j)	3.6×10^{-7} (k)	2.3×10^{-8}

(a) Abnormal emissions assumed to occur for 4 hours, for the remainder of the averaging period (e.g. for emissions with 24-hour or 8-hour AQO) emissions are assumed to be at the daily ELV
(b) Highest unabated concentration for municipal waste provided in Table 3.6 of the BREF for waste Incineration
(c) Calculated from a fuel input of 15 t/h (dry) and a sulphur content of 0.2% by weight (dry) as provided by the operator
(d) Calculated as 4 hours at 258 mg/Nm^3 and 20 hours at 30 mg/Nm^3
(e) The maximum total dust emission is restricted to 150 mg/Nm^3 (Annex VI, Part 3(2) of the IED)
(f) Calculated as 4 hours at 150 mg/Nm^3 and 20 hours at 5 mg/Nm^3
(g) Calculated from a fuel input of 15 t/h (dry) and a chlorine content of 0.6% by weight (dry) as provided by the operator
(h) Calculated from a fuel input of 15 t/h (dry) and a fluorine content of 0.05% by weight (dry) as provided by the operator
(i) Calculated as 4 hours at 100 mg/Nm^3 and 4 hours at 50 mg/Nm^3, half hour emission limit not to be exceeded
(j) Assumed emission concentration in the absence of an emission limit and as assumed for normal emissions
(k) Assumed to increase by a factor of 100

For metals other than mercury, it is assumed that metals are associated with the particle phase and that the emission will increase at the same rate as the total dust emission (i.e. by a factor of 30 = 150/5). For mercury, it is assumed that the abnormal emission concentration is 100 times the emission limit. Therefore, short-term emission concentrations for trace metals would be as follows:

- 0.6 mg/Nm^3 (0.039 g/s) for thallium;
- 2 mg/Nm^3 (0.13 g/s) for mercury;
- 9 mg/Nm^3 (0.58 g/s) for antimony, arsenic, chromium, cobalt and manganese with hourly EALs; and
- 1.8 mg/Nm^3 (0.11 g/s) for vanadium which has a 24 hour EAL (4 hours at 9 mg/Nm3 and 20 hours at 0.3 mg/Nm^3).

Abnormal Emissions – Long-term Impacts

For assessing abnormal emissions on long-term concentrations of mercury, dioxins and furans and PCBs, it is assumed that complete failure of the abatement equipment occurs for the full 60 hours allowed per annum and that emissions are 100 times the limit for all of these 60 hours. There is no air quality objective (AQO) or environmental assessment level (EAL) for dioxins/furans. Therefore, the impact of abnormal emissions of dioxins/furans is provided in the human health risk assessment and is not considered further here. Assuming that the plant operates at the emission limit (or assumed emission concentration) for 8,700 hours and at 100 times the limit for 60 hours of the year, the emission concentrations for PCBs and mercury would be 6.04 x 10^{-9} mg/Nm^3 (3.9 x 10^{-10} g/s) and 0.034 mg/Nm^3 (0.0022 g/s), respectively.

Results – Short-term Impacts

Maximum predicted concentrations are provided for the relevant averaging period assuming that abnormal emissions occur during the period of worst-case dispersion conditions for the five years of meteorological data in Table 5.25. Exceedance of the limit value does not necessarily indicate non-compliance with the AQO as some of the pollutants considered (e.g. NO_2, SO_2 and PM_{10}) have AQO where a number of exceedances are allowed. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same.

Table 5.25: Maximum Predicted Short-term Concentrations for Abnormal Emissions

Pollutant	PC (µg/m^3)	PC (%)
NO_2 (maximum 1-hour)	45.4	22.7%
SO_2 (maximum 15-minute)	89.7	33.7%
SO_2 (maximum 1-hour)	67.0	19.1%
SO_2 (maximum 24-hour)	13.2	10.5%
PM_{10} (maximum 24-hour)	5.6	11.3%
HCl (maximum 1-hour)	103.3	13.8%
HF (maximum 1-hour)	0.9	0.6%
CO (maximum 8-hour)	16.1	0.2%
CO (maximum 1-hour)	25.9	0.1%
Pollutant	PC (ng/m^3)	PC (%)
Thallium (maximum 1-hour)	156	0.5%
Mercury (maximum 1-hour)	519	6.9%
Antimony (maximum 1-hour)	2334	1.6%
Arsenic (maximum 1-hour)	2334	15.6%
Chromium (maximum 1-hour)	2334	1.6%
Cobalt (maximum 1-hour)	2334	7.8%
Copper (maximum 1-hour)	2334	1.2%
Manganese (maximum 1-hour)	2334	1.6%
Vanadium (maximum 24-hour)	338	33.8%
PCBs (maximum 1-hour)	0.000093	0.0%

Emissions at the abnormal emission concentrations even for the worst-case assumptions adopted are less than 100% of the AQO. Therefore, an exceedance is unlikely even for worst-case meteorological conditions. Therefore, it is concluded that abnormal emissions would not result in short-term adverse impacts.

Results – Long-term Impacts

The long-term impact of abnormal emissions of mercury and PCBs is summarised in Table 5.26. Predicted concentrations are provided for the worst-case meteorological year. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same. Predicted concentrations are less than 1% of the relevant EALs and would be assessed as not significant.

Table 5.26: Predicted Annual Mean Concentrations for Abnormal Emissions

Pollutant	PC (ng/m^3)	PC (%)
Mercury	0.89	0.4%
PCBs	1.6×10^{-7}	<0.1%

5.4. Sensitivity Analysis

Introduction

For the detailed assessment provided, a conservative approach has been undertaken in order to avoid underestimating the impact of the installation on local air quality. This has included emissions at the maximum permissible, the worst-case meteorological year for each averaging period and continuous operation of the installation at full load. The effect of varying some of these parameters is considered. This sensitivity analysis has been carried out for emissions of NOx as this is considered to be the key pollutant emitted from the installation. Predicted concentrations of NO_2 are provided as the maximum predicted for the annual mean and the 99.8th percentile of hourly means.

Meteorological Data

Dispersion modelling for five years of meteorological data for the Humberside Airport meteorological observing station was undertaken. Results presented in Section 5.1 are the highest predicted for each averaging period. A comparison of predicted concentrations of NO_2 for each of the five years is presented in Table 5.27 as the maximum predicted anywhere within the modelling domain.

Table 5.27: Maximum Predicted Concentrations of NO_2 for Annual Meteorological Data Sets

Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC ($\mu g/m^3$)	PC (%age AQO)		PC (ug/m^3)
2015 Humberside Airport	1.85	4.6%	8.3	4.1%
2016 Humberside Airport	1.30	3.2%	7.9	4.0%
2017 Humberside Airport	1.42	3.5%	8.1	4.1%
2018 Humberside Airport	1.15	2.9%	7.9	4.0%
2019 Humberside Airport	1.44	3.6%	8.0	4.0%
Average	1.43	3.6%	8.1	4.0%

For the annual mean, predicted concentrations for the five years are quite variable with the lowest concentration (2018) being 62% of the highest concentration (2015). The average for the five years is 1.43 µg/m³ (77% of the maximum year). The hourly mean concentrations are more comparable with the lowest concentration (2016 and 2018) 95% of the highest concentration (2015).

Surface Roughness

The assessment provided assumes that the surface roughness surrounding the facility is 0.3 m mainly due to the open areas of land to the west, north and east. However, buildings to the south may increase the surface roughness of the area. Therefore, the effect of modelling at a higher surface roughness of 0.5 m has been assessed. Results for both surface roughness values are provided in Table 5.28 for 2015, worst-case meteorological year for both the long-term and short-term means.

Table 5.28: Predicted Maximum NO_2 Concentrations for Variable Surface Roughness Values

Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg/m³)	PC (%age AQO)		PC (ug/m³)
2015 surface roughness of 0.3 m	1.85	4.6%	8.3	4.1%
2015 surface roughness of 0.5 m	1.91	4.8%	8.0	4.0%

The use of the higher surface roughness in the model results in a small increase in annual mean concentrations (0.2% of the AQO) and a small decrease for the short-term concentration (0.1% of the AQO). For both averaging periods, the impact would be assessed as not significant or the air quality objective unlikely to be exceeded for the higher surface roughness.

Main Building Choice

The boiler house building was selected as the 'main' building within the model for all sources as it is the tallest building and has a large footprint. However, the flue gas treatment building is closer to the various stack emissions but of a lower height. Therefore, a sensitivity analysis was carried out setting the flue gas treatment building as the 'main' building within the model. A comparison for 2015 is provided in Table 5.29.

Table 5.29: Predicted Maximum NO_2 Concentrations for Main Building Choice

Year	Annual Mean		99.8th Percentile of 1-hour Means	
	PC (µg/m³)	PC (%age AQO)		PC (ug/m³)
2015 Boiler House	1.85	4.6%	8.3	4.1%
2015 Flue Gas Treatment	0.69	1.7%	3.3	1.7%

Selecting the flue gas treatment as the main building results in substantially lower predicted concentrations for both the annual mean and the 99.8th percentile of hourly means. Therefore, the assessment provided is representative of the worst-case.

Summary

The sensitivity analysis has demonstrated that varying the assumptions made for the assessment does not significantly vary the predicted concentrations for most choices. Furthermore, except for surface roughness where there was a small increase in predicted concentrations, the assumptions adopted were representative of the worst-case. Therefore, it is concluded that the assessment provided is robust and overall representative of worst-case conditions.

6. CONCLUSIONS

An assessment has been carried out to determine the local air quality impacts associated with the proposed operation of a proposed Energy from Waste facility at Stallingborough near Grimsby.

Detailed air quality modelling using the UK ADMS dispersion model has been undertaken to predict the impacts associated with stack emissions from the facility. Emissions from the Site have been assumed to occur at the BREF daily emission limit values for new plant except for NO_x where a more stringent emission limit value was adopted.

For a proposed stack height of 65 m, predicted maximum off-site concentrations are assessed as 'not significant' or well below the relevant air quality standards for all pollutants considered.

Considering the worst-case assumptions adopted for the assessment, the predicted process contributions would not result in significant harm to habitat sites compared with the critical levels for NO_x, SO_2, NH_3 and HF and critical loads for acidification. However, predicted nutrient nitrogen deposition at the Humber Estuary indicates there is a risk that the facility could result in an exceedance of the critical load. Therefore, an ecological interpretation of the air quality impacts should be provided by the project ecologist to determine the potential effect of emissions on the integrity of the European habitat site.

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Appendix A – Air Quality Terminology

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
Defra	Department for Environment, Food and Rural Affairs.
Exceedence	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
$\mu g/m^3$ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).

Term	Definition
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

Appendix B – Air Quality Standards and Objectives and Environmental Assessment Levels

Pollutant	Averaging Period	EAL / AQS (µg/m^3)	Comments
Nitrogen dioxide (NO_2)	annual	40	UK AQO and EU Limit Value
	1-hour	200	UK AQO and EU Limit Value, not to be exceeded more than 18 times per annum, equivalent to the 99.8th percentile of 1-hour means
Sulphur dioxide (SO_2)	24-hour	125	UK AQO and EU Limit Value, not to be exceeded more than 3 times per annum, equivalent to the 99.2nd percentile of 24-hour means
	1-hour	350	UK AQO and EU Limit Value, not to be exceeded more than 24 times per annum, equivalent to the 99.7th percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9th percentile of 15-minute means
Carbon monoxide (CO)	8-hour	10,000	UK AQO and EU Limit Value
	1-hour	30,000	Environmental Assessment Level (EAL)
Particulate matter (as PM_{10})	annual	40	UK AQO and EU Limit Value
	24-hour	50	UK AQO and EU Limit Value, not to be exceeded more than 35 times per annum, equivalent to the 90.4th percentile of 24 hour means
Particulate matter (as $PM_{2.5}$)	annual	20	EU Target Value
Benzene	24-hour	30	EAL
1,3-butadiene	annual	2.25	EU Target Value
Hydrogen Chloride (HCl)	1-hour	750	EAL
Hydrogen Fluoride (HF)	1 hour	160	EAL
	monthly	16	EAL
Antimony (Sb)	annual	5	EAL
	1-hour	150	EAL
Arsenic (As)	annual	0.006	EU Target Value
	1 hour	15	EAL
Cadmium (Cd)	annual	0.005	EU Target Value

Chromium III (CrIII)	annual	5	EAL
	1-hour	150	EAL
Chromium VI (CrVI)	annual	0.0002	EAL
Cobolt (Co)	annual	1	EAL
Copper (Cu)	annual	10	EAL
	1-hour	200	EAL
Manganese (Mn)	annual	0.15	EAL
	1-hour	150	EAL
Lead (Pb)	annual	0.25	UK AQO
Mercury (Hg)	annual	0.25	EAL
	1-hour	7.5	EAL
Nickel (Ni)	annual	0.02	EU Target Value
Thallium (Tl)	annual	1	EAL
Vanadium (V)	annual	5	EAL
	24-hour	1	EAL
Ammonia (NH_3)	annual	180	EAL
	1-hour	2500	EAL
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo[a]Pyrene	annual	0.00025	UK AQO
	annual	0.001	EU Limit Value
Polychlorinated Biphenyls (PCBs)	annual	0.2	EAL
	1-hour	6	EAL

Appendix C –Dispersion Model Input Parameters

Table C1: Stack Emission Parameters – Energy from Waste Facility		
Parameter	Single Stream	Two Streams Combined
Stack height (m)	65	65
Flue exit diameter (m)	1.85	2.62
Temperature of release (ºC)	170	170
Moisture content (%v/v)	16.1	16.1
Oxygen content (%v/v dry)	8.6	8.6
Actual flow rate (Am^3/s)	50.16	100.32
Normalised flow rate (Nm^3/s) (a)	32.27	64.54
Emission velocity at flue exit (m/s)	18.66	18.66
Emission Concentration (mg/Nm^3) (a)	**Emission Concentration (mg/Nm^3) (a)**	**Combined Emission Rate (g/s)**
$PM_{10}/PM_{2.5}$	5	0.32
TOC	10	0.65
HCl	6	0.39
HF	1	0.065
CO	50	3.2
SO_2	30	1.9
NOx	100	6.5
NH_3	10	0.65
Group I (Cd, Tl)	0.02	1.3×10^{-3}
Group II (Hg)	0.02	1.3×10^{-3}
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3	0.019
Dioxins and Furans	0.06 ng/Nm^3	3.8×10^{-9}
PAHs (as B[a]P)	9×10^{-5}	5.8×10^{-6}
PCBs	3.6×10^{-9}	2.3×10^{-10}

(a) Normalised to 273K, 1 atmosphere, dry and 11% O_2

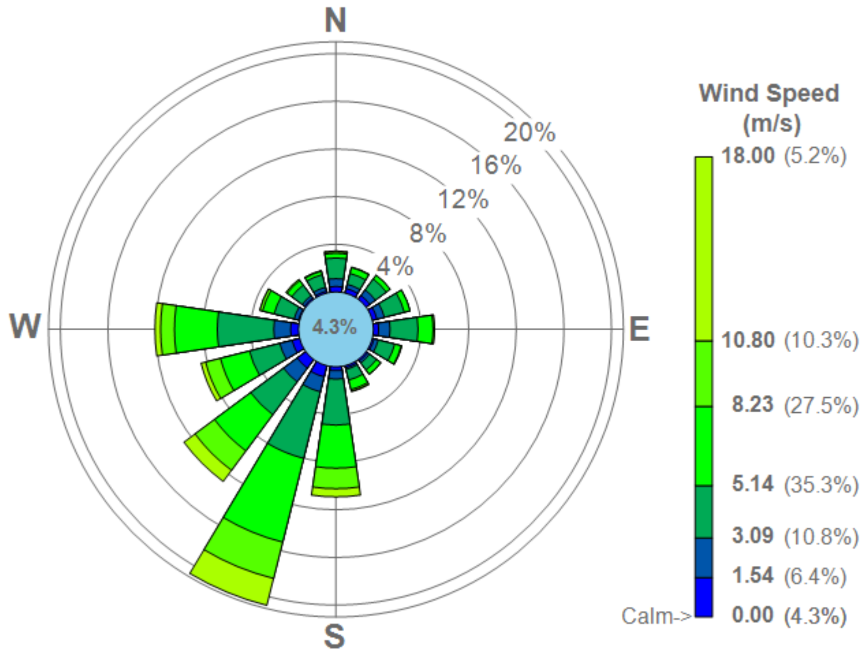
Table C2: Stack Emission Parameters – Dust Filters				
Parameter	A3 Fly Ash Silo	A4 and A5 FGCr Silo (per filter)	A6 and A7 Lime Silo (per filter)	A8 Carbon Silo
Number of sources	1	2	2	1
Stack height (m)	31.1	31.1	31.1	31.1
Flue exit diameter (m)	0.78	0.55	0.28	0.28
Temperature of release (ºC)	170 (b)	170(b)	Ambient	Ambient
Actual flow rate (Am^3/s)	0.017	0.0083	0.0011	0.0011
Normalised flow rate (Nm^3/s) (a)	0.010	0.0051	0.0011	0.0011
Emission velocity at flue exit (m/s)	0.035	0.035	0.019	0.019
Total suspended particles (mg/Nm^3)	5	5	5	5
Total suspended particles (g/s)	0.000051	0.000026	0.0000054	0.0000054

(a) Normalised to 273K only

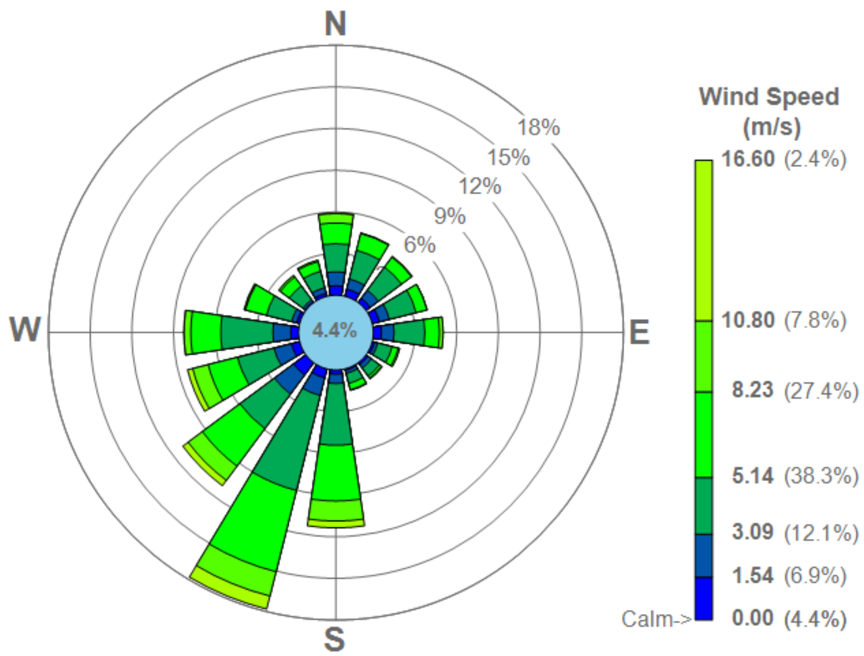
(b) Vents are horizontal and within the model the temperature is set as ambient to minimise the thermal buoyancy of the emissions

Appendix D – Wind Roses for Humberside Airport (2015 to 2019)

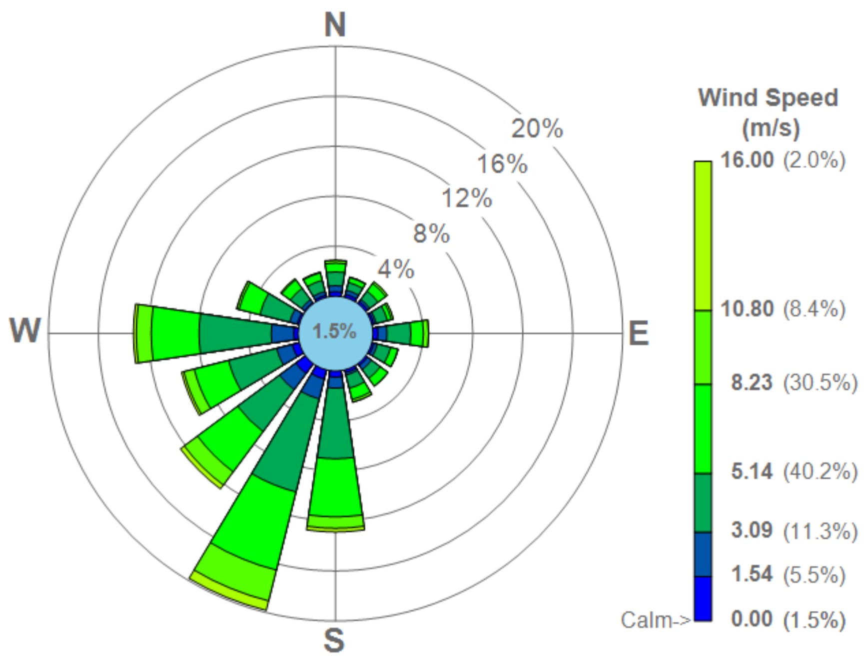
2015



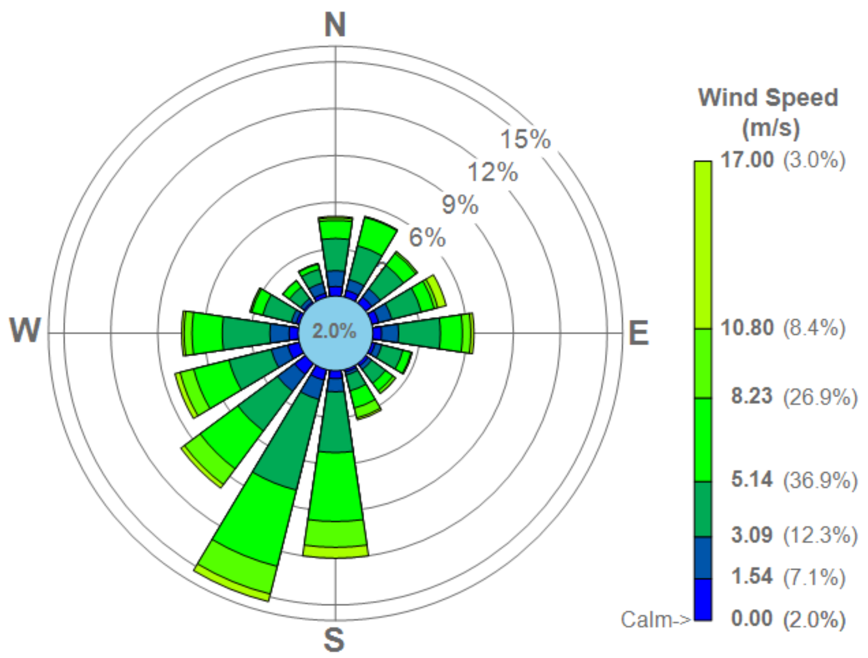
2016



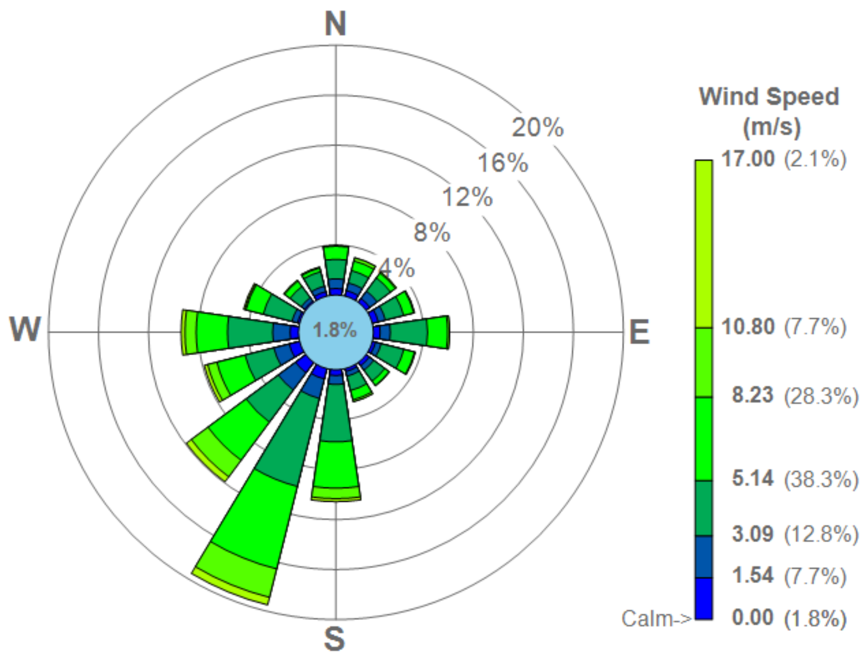
2017


N
S
E
W
4%
8%
12%
16%
20%
1.5%
Wind Speed (m/s)
16.00 (2.0%)
10.80 (8.4%)
8.23 (30.5%)
5.14 (40.2%)
3.09 (11.3%)
1.54 (5.5%)
Calm->
0.00 (1.5%)

2018


N
S
E
W
6%
9%
12%
15%
2.0%
Wind Speed (m/s)
17.00 (3.0%)
10.80 (8.4%)
8.23 (26.9%)
5.14 (36.9%)
3.09 (12.3%)
1.54 (7.1%)
Calm->
0.00 (2.0%)

2019


N
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4%
8%
12%
16%
20%
1.8%
Wind Speed (m/s)
17.00 (2.1%)
10.80 (7.7%)
8.23 (28.3%)
5.14 (38.3%)
3.09 (12.8%)
1.54 (7.7%)
0.00 (1.8%)
Calm->

Appendix E – Environmental Assessment Levels for the Protection of Vegetation and Ecosystems

Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems (as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations) that are relevant to the assessment are summarised in Table E1.

Table E1: Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Averaging Period	Concentration (µg/m^3)
Oxides of Nitrogen (NOx)	Annual Mean	30
	24-Hour Mean	75
Sulphur Dioxide (SO_2)	Annual Mean / Winter Mean (31 Oct to 1 Mar)	10 (sensitive habitats with lichen and bryophytes)
		20 (all other habitats)
Ammonia (NH_3)	Annual Mean	1 (sensitive habitats with lichen and bryophytes)
		3 (all other habitats)
Hydrogen Fluoride (HF)	Weekly Mean	0.5
	Daily Mean	5

The critical levels are based on monitoring criteria and only apply in the following areas:

- more than 20 km from agglomerations; and
- more than 5 km away from other built up areas, industrial installations motorways and major roads with a traffic count of more than 50,000 vehicles per day.

Nationally, around 37% of designated sites currently do not fall within the above criteria and are therefore excluded from the objectives. None of the habitat sites within 10 km of the proposed facility are sufficiently rural for the objectives to apply; however, the Environment Agency's H1 guidance states that:

"the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm".

Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS and are summarised in Table E2 for the identified habitats present.

Table E2: Critical Loads for Eutrophication

Habitat Site	Critical Load Class	Lowest Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
H1. Humber Estuary SAC	Atlantic salt meadows	20	19.04
H1. Humber Estuary SPA/Ramsar	Pioneer, low-mid, mid-upper saltmarshes	20	19.04
H1. Humber Estuary SSSI	Intertidal mudflats	Not sensitive	19.04
H2. North Moss Lane Meadow SNCI	Assumed low and medium altitude hay meadows	20	19.18
H3. Immingham Dock Reedbeds SNCI	Assumed rich fen	15	19.04
H4. Laporte Road Brownfield Site LWS	Assumed inland dune pioneer grasslands	8	19.18

For acidic deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF) which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

Where the acidification PEC from nitrogen exceeds the CLminN (all cases for the habitats considered), then the PC (and PEC) as a percentage of the critical load is the combined PC (or PEC) from nitrogen and sulphur divided by CLmaxN. Therefore, information on CLmaxN only is required.

Critical loads (CLmaxN) and background acid deposition rates have been obtained from APIS and are summarised in Table E3 for the identified habitat sites.

Table E3: Critical Loads for Acid Deposition (keq/ha/yr)			
Habitat Site	Critical Load Class	Critical Load CLmaxN (keq/ha/a)	Background Acidification (N + S) (keq/ha/a)
H1. Humber Estuary SAC	Atlantic salt meadows	Not sensitive	1.3
H1. Humber Estuary SPA/Ramsar	Pioneer, low-mid, mid-upper saltmarshes	Not sensitive	1.3
H1. Humber Estuary SSSI	Intertidal mudflats	Not sensitive	1.3
H2. North Moss Lane Meadow SNCI	Assumed low and medium altitude hay meadows	5.071	1.28
H3. Immingham Dock Reedbeds SNCI	Assumed rich fen	Not sensitive	1.3
H4. Laporte Road Brownfield Site LWS	Assumed inland dune pioneer grasslands	4.814	1.28