standard gas

# Air Quality Assessment

Scottow Enterprise Park

1st May 2025

Project No.: SOL_24_P090_STA_AQA

...consulting sustainability

sol environment

| Document details | |
|---|---|
| Document title | Air Quality Assessment |
| Document subtitle | Scottow Enterprise Park |
| Project No. | SOL_24_P090_STA_AQA |
| Date | 1st May 2025 |
| Version | QMS_7.5.38_TEM – Template – Report Long Form – New Style (Perm) v4 |
| Author | Sol Environment Ltd |
| Client Name | Standard Gas SG No.1 Limited |

| Document history | | | | |
|---|---|---|---|---|
| Version | Comments | Date | Author Initials | Reviewer Initials |
| I1 | 1st Submission to the EA | 1st May 2025 | SG | SR |

Signature Page

1st May 2025

# Air Quality Assessment

Scottow Enterprise Park

Amanda Gair

Technical Director

Sophie Rainey

Permitting Lead

*This report has been prepared by Sol Environment with all reasonable skill, care, and diligence, and taking account of the Services and the Terms agreed between Sol Environment Ltd and the Client. This report is confidential to the client, and Sol Environment accepts no responsibility whatsoever to third parties to whom this report, or any part thereof, is made known, unless formally agreed by Sol Environment Ltd beforehand. Any such party relies upon the report at their own risk.*

*Sol Environment disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the Services*

Registered office: 10 The Lees, Malvern, Worcestershire, WR14 3HT

Company Registered in England no. 7068933

Sol is ISO 9001:2015 certified by British Assessment Bureau Limited, a UKAS Accredited Certification Body number 8289 for the scope of Environmental Consultancy providing a range of services to companies in the UK and Europe. Certificate number: 259774.

# CONTENTS

1. INTRODUCTION .... 2

2. LEGISLATION AND POLICY .... 4

2.1 The European Directive on Ambient Air and Cleaner Air for Europe .... 4
2.2 Environment Act 2021 .... 4
2.3 Air Quality Strategy 2023 .... 4
2.4 Air Quality (England) Regulations .... 5
2.5 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 .... 6
2.6 Local Air Quality Management (LAQM) .... 6
2.7 Medium Combustion Plant Directive .... 6
2.8 Industrial Emissions Directive .... 8

3. METHODOLOGY .... 10

3.1 Scope of the Assessment .... 10
3.2 Dispersion Model Parameters .... 10
3.2.1 Meteorological Data .... 11
3.2.2 Building Downwash / Entrainment .... 11
3.2.3 Topography .... 11
3.2.4 Nitric Oxide to $NO_2$ Conversion .... 12
3.3 Sensitive Receptors .... 12
3.4 Habitat Assessment .... 13
3.5 Significance Criteria .... 16
3.5.1 Impacts on Human Health .... 16
3.5.2 Impacts on Ecology .... 17

4. BASELINE CONDITIONS .... 18

4.1 Local Authority Monitoring .... 18
4.2 Nitrogen Dioxide .... 18
4.3 Carbon Monoxide (CO) .... 18
4.4 Particulate Matter ($PM_{10}$ and $PM_{2.5}$) .... 19
4.5 Sulphur Dioxide ($SO_2$) .... 19
4.6 Total Organic Carbon (as 1,3-Butadiene) .... 19
4.7 Hydrogen Chloride .... 19
4.8 Hydrogen Fluoride (HF) .... 19
4.9 Trace Metals .... 20
4.10 Dioxins and Furans .... 21
4.11 Polycyclic Aromatic Hydrocarbons (as benzo[a]pyrene) .... 21
4.12 Polychlorinated Biphenyls .... 22
4.13 Summary of Background Concentrations .... 22

5. ASSESSMENT OF IMPACTS ON HUMAN HEALTH .... 24

5.1 Introduction .... 24
5.2 Normal Operation (MCPD) .... 24
5.3 Abnormal Operation (IED) .... 26
5.3.1 Nitrogen Dioxide .... 26
5.3.2 Carbon Monoxide .... 28
5.3.3 Sulphur Dioxide ($SO_2$) .... 29
5.3.4 Particulate Matter (as $PM_{10}$) .... 30
5.3.5 Particulate Matter (as $PM_{2.5}$) .... 32
5.3.6 Total Organic Carbon (as 1,3-Butadiene) .... 34
5.3.7 Hydrogen Chloride .... 35
5.3.8 Hydrogen Fluoride .... 36
5.3.9 Dioxins and Furans .... 37
5.3.10 PAH (as Benzo[a]pyrene) .... 37
5.3.11 Polychlorinated Biphenyls .... 38

5.3.12 Trace Metals .....39

6. ASSESSMENT OF IMPACTS ON HABITAT SITES ..... 41

6.1 Introduction .....41
6.2 Airborne Concentrations of NOx, $SO_2$ and HF – Abnormal Operation .....41
6.2.1 NOx .....41
6.2.2 $SO_2$ .....41
6.2.3 HF .....42
6.3 Nutrient Nitrogen Deposition – Abnormal Operation .....42
6.4 Acidification – Abnormal Operation .....43

7. SENSITIVITY ANALYSIS ..... 44

7.1 Emissions at Half-hourly ELVs .....44
7.2 Sensitivity Analysis .....45
7.2.1 Introduction .....45
7.2.2 Meteorological Data .....45
7.2.3 Main Building Selection .....46
7.2.4 Surface Roughness .....46
7.2.5 Summary .....47

8. CONCLUSION ..... 48

## List of Tables

Table 2.1: MCPD Emission Limits for MCP other than Engines and Gas Turbines (mg/Nm$^3$) .....7
Table 2.2: MCPD Emission Limits for MCP for Engines and Gas Turbines (mg/Nm$^3$) .....7
Table 2.3: IED Emission Limits (mg/Nm$^3$) .....8
Table 3.1: Building Downwash Structures .....11
Table 3.2: Human Health Receptors .....12
Table 3.3: Sensitive Habitat Receptors .....14
Table 3.4: Dry Deposition Velocities (m/s) .....15
Table 4.1: Annual Average UK Trace Metal Concentrations (ng/m$^3$) – Heigham Holmes .....20
Table 4.2: UK PCDD/Fs Concentrations (fg TEQ/m$^3$) .....21
Table 4.3: Summary of Background Concentrations .....22
Table 5.1: Predicted $NO_2$ Concentrations – Normal Operation (µg/m$^3$) .....24
Table 5.2: Predicted $NO_2$ Concentrations – Abnormal Operation (µg/m$^3$) .....26
Table 5.3: Predicted CO Concentrations – Abnormal Operation (µg/m$^3$) .....28
Table 5.4: Predicted $SO_2$ Concentrations – Abnormal Operation (µg/m$^3$) .....29
Table 5.5: Predicted $PM_{10}$ Concentrations – Abnormal Operation (µg/m$^3$) .....31
Table 5.6: Predicted $PM_{2.5}$ Concentrations – Abnormal Operation (µg/m$^3$) .....32
Table 5.7: Predicted 1,3 Butadiene Concentrations – Abnormal Operation (µg/m$^3$) .....34
Table 5.8: Predicted HCl Concentrations – Abnormal Operation (µg/m$^3$) .....35
Table 5.9: Predicted HF Concentrations – Abnormal Operation (µg/m$^3$) .....36
Table 5.10: Predicted Dioxin and Furan Concentrations – Abnormal Operation (fg/m$^3$) .....37
Table 5.11: Predicted BaP Concentrations – Abnormal Operation (ng/m$^3$) .....37
Table 5.12: Predicted PCB Concentrations – Abnormal Operation (ng/m$^3$) .....38
Table 5.13: Predicted Maximum Long Term Trace Metal Concentrations – Abnormal Operation (Step 1) ..39
Table 5.14: Predicted Maximum Short Term Trace Metal Concentrations – Abnormal Operation (Step 1) .40
Table 5.15: Maximum Long Term Trace Metal Concentrations – Abnormal Operation (Typical Emissions) .40
Table 6.1: Predicted Maximum NOx Concentrations – Abnormal Operation .....41
Table 6.2:Predicted Maximum $SO_2$ Concentrations – Abnormal Operation .....42
Table 6.3: Predicted Maximum HF Concentrations – Abnormal Operation .....42
Table 6.4: Predicted Nutrient Nitrogen Deposition Rate – Abnormal Operation (kg N/ha/a) .....43
Table 6.5: Predicted Acidification Rates – Abnormal Operation (keq/ha/yr) .....43
Table 7.1: Maximum Predicted Short-term Concentrations at the Half-hourly ELVs – Abnormal Operation44

Table 7.2: Maximum Predicted Concentrations of $NO_2$ for Annual Meteorological Data Sets – Abnormal Operation ....45
Table 7.3: Predicted Maximum $NO_2$ Concentrations for Variable Main Buildings – Abnormal Operation ....46
Table 7.4: Predicted Maximum $NO_2$ Concentrations for Variable Surface Roughness Values – Abnormal Operation ....47

## List of Figures

Figure 1.1: Site Location ....3
Figure 3.1: Sensitive Human Health Receptor Locations ....13
Figure 3.2: Sensitive Habitat Receptor Locations ....15
Figure 5.1: Predicted Annual Mean $NO_2$ Concentrations for 2020 – Normal Operation (µg/m$^3$) ....25
Figure 5.2: Predicted 99.8$^{th}$ Percentile of Hourly Mean $NO_2$ Concentrations for 2020 – Normal Operation (µg/m$^3$) ....26
Figure 5.3: Predicted Annual Mean $NO_2$ Concentrations for 2020 – Abnormal Operation (µg/m$^3$) ....27
Figure 5.4: Predicted 99.8$^{th}$ Percentile of Hourly Mean $NO_2$ Concentrations for 2020 – Abnormal Operation (µg/m$^3$) ....28
Figure 5.5: Predicted 99.9$^{th}$ Percentile of 15-minute Mean $SO_2$ Concentrations 2020 – Abnormal Operation (µg/m$^3$) ....30
Figure 5.6: Predicted 90.4$^{th}$ Percentile of 24-hour Mean $PM_{10}$ Concentrations 2020 – Abnormal Operation (µg/m$^3$) ....32
Figure 5.7: Predicted Annual Mean $PM_{2.5}$ (and $PM_{10}$) Concentrations 2020 – Abnormal Operation (µg/m$^3$) ....33
Figure 5.8: Predicted Maximum 24-Hour Mean TOC Concentrations 2020 – Abnormal Operation (µg/m$^3$) 35

## Acronyms and Abbreviations

| Name | Description |
|---|---|
| ADMS | Atmospheric Dispersion Modelling System |
| AEL | Associated Emission Limit |
| AMCT | Annual Mean Concentration Target |
| APIS | Air Pollution Information System |
| AQAL | Air Quality Assessment Level |
| AQAP | Air Quality Action Plan |
| AQMA | Air Quality Management Area |
| AQO | Air Quality Objective |
| As | Arsenic |
| ATT | Advanced Thermal Treatment |
| BaP | Benzo(a)pyrene |
| BAT | Best Available Technology |
| BDC | Broadland District Council |
| BREF | BAT Reference |

| | |
|---|---|
| Cd | Cadmium |
| Co | Cobalt |
| CO | Carbon Monoxide |
| Cu | Copper |
| CrIII | Trivalent Chromium |
| CrVI | Hexavalent Chromium |
| Defra | Department for Environment, Food and Rural Affairs |
| EAL | Environmental Assessment Level |
| ELV | Emission Limit Value |
| EPR | Environmental Permitting Regulations |
| EU | European Union |
| HCl | Hydrogen Chloride |
| HF | Hydrogen Fluoride |
| Hg | Mercury |
| IAQM | Institute of Air Quality Management |
| IED | Industrial Emissions Directive |
| LAQM | Local Air Quality Management |
| LCPD | Large Combustion Plant Directive |
| LNR | Local Nature Reserve |
| LWS | Local Wildlife Site |
| MCPD | Medium Combustion Plant Directive |
| Mn | Manganese |
| NAEI | National Atmospheric Emissions Inventory |
| $NH_3$ | Ammonia |
| Ni | Nickel |
| NNDC | North Norfolk District Council |
| NNR | National Nature Reserve |
| $NO_2$ | Nitrogen Dioxide |
| NOx | Oxides of Nitrogen |
| PAH | Polycyclic Aromatic Hydrocarbons |
| Pb | Lead |
| PC | Process Contribution |

| | |
|---|---|
| PCB | Polychlorinated Biphenyl |
| PEC | Predicted Environmental Concentration |
| PERT | Population Exposure Reduction Target |
| $PM_{10}$ | Particulate Matter <10 µm |
| $PM_{2.5}$ | Particulate Matter <2.5 µm |
| RDF | Refuse Derived Fuels |
| SAC | Special Area of Conservation |
| $SO_2$ | Sulphur Dioxide |
| SPA | Special Protection Area |
| SRF | Solid Recovered Fuels |
| SSSI | Site of Special Scientific Interest |
| SWIP | Small Waste Incineration Plant |
| Tl | Thallium |
| TOC | Total Organic Carbon |
| TOMPS | Toxic Organic Micropollutants |
| UK-AIR | UK Air Information Resource |
| V | Vanadium |
| VOC | Volatile Organic Compound |
| WHO | World Health Organization |
| WID | Waste Incineration Directive |

## EXECUTIVE SUMMARY

Sol Environment Ltd has been commissioned by Standard Gas SG No.1 Limited to undertake an assessment of the likely local air quality impacts arising from an advanced thermal treatment plant which thermochemically produces clean syngas from pre-processed non-hazardous solid wastes, principally Solid Recovered Fuels (SRF) and Refuse Derived Fuel (RDF). The syngas will be used to operate a series of gas fired combined heat and power (CHP) generation units to generate power and provide heat to the wider Scottow Enterprise Park. The purpose of the assessment is to support an Environmental Permit application for the facility.

The site lies within the administrative area of North Norfolk District Council (NNDC) but less than 500 m from the Broadland District Council (BDC) administrative area. NNDC and BDC have not been required to declare any Air Quality Management Areas (AQMAs) and air quality in the region is relatively good.

The facility will generate approximately 5MWe of renewable electricity and approximately 2.5MWth of heat. The plant has been designed to process approximately 6 tonnes per hour of pre-prepared non-hazardous solid waste.

The relevant listed activity for the proposed Standard Gas pyrolysis technology is defined by Section 1.2 Part A(1)(f)(iv). All emissions from the combustion activities shall be in accordance with the MCP Directive, noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply where Article 42 (1) is achieved – deeming syngas as no longer a waste and causing emissions no higher than combustion of natural gas.

Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

Detailed dispersion modelling has been undertaken to determine the potential impacts arising from the proposed 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 impacts has been assessed using criteria provided in the Environment Agency's Risk Assessment Guidance.

During normal operation and abnormal operation, the maximum impact of pollutant emissions from the facility on local air quality is considered not significant on the basis of the Environment Agency's risk assessment criteria and professional judgement.

The impact of emissions from the facility on local habitat sites was also assessed and found to be not significant compared with existing background conditions and relevant critical levels and loads.

# 1. INTRODUCTION

Sol Environment Ltd has been commissioned by Standard Gas SG No.1 Limited to undertake an assessment of the likely local air quality impacts arising from an advanced thermal treatment plant which thermochemically produces clean syngas from pre=processed non-hazardous solid wastes, principally Solid Recovered Fuels (SRF) and Refuse Derived Fuel (RDF). The syngas will be used to operate a series of gas fired combined heat and power (CHP) generation units to generate power and provide heat to the wider Scottow Enterprise Park. The purpose of the assessment is to support an Environmental Permit application for the facility.

The site lies within the administrative area of North Norfolk District Council (NNDC) but less than 500 m from the Broadland District Council (BDC) administrative area. NNDC and BDC have not been required to declare any Air Quality Management Areas (AQMAs) and air quality in the region is relatively good.

The facility site is located in an area dominated by light industrial and commercial use within the Scottow Enterprise Park to the east of Badersfield in Norfolk. The site location is presented in **Figure 1.1**. The nearest sensitive receptor is HM Bure Prison, less than 300 m to the west of the facility.

There would be two emissions to air from the facility and would comprise emissions from the pyrolyser and combined emissions from the CHP generation units. The facility will generate approximately 5 MWe of renewable electricity and approximately 2.5 MWth of heat. The plant has been designed to process approximately 6 tonnes per hour of pre-prepared non-hazardous solid waste. As a worst-case, it is assumed that the CHP generation units will have a total net rated input of 20 MWth and will likely comprise a number of smaller units with emissions via a common multi-flue stack.

The relevant listed activity for the proposed Advanced Thermal Treatment (ATT) pyrolysis installation is defined by Section 1.2 Part A(1)(f) (iv). All emissions from the combustion activities shall be in accordance with the MCP Directive, noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply where Article 42 (1) is achieved – deeming syngas as no longer a waste and causing emissions no higher than combustion of natural gas.

Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

Emissions to air from the pyrolyser and combined CHP generation units would be via individual 18.2 m high stacks (Emission Point A1 and A2). Under normal operation, the assessment has considered emissions of the oxides of nitrogen. For abnormal operation, the following have been considered.

- oxides of nitrogen (NOx);
- carbon monoxide;
- 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).

The site is also equipped with an emergency flare (Emission Point A3) for operation during start-up, shutdown and emergency scenarios which due to limited use has not been considered further in this assessment.

This report presents the findings of a dispersion modelling assessment to determine the impact of the installation on air quality at sensitive human and habitat receptors in the surrounding area.

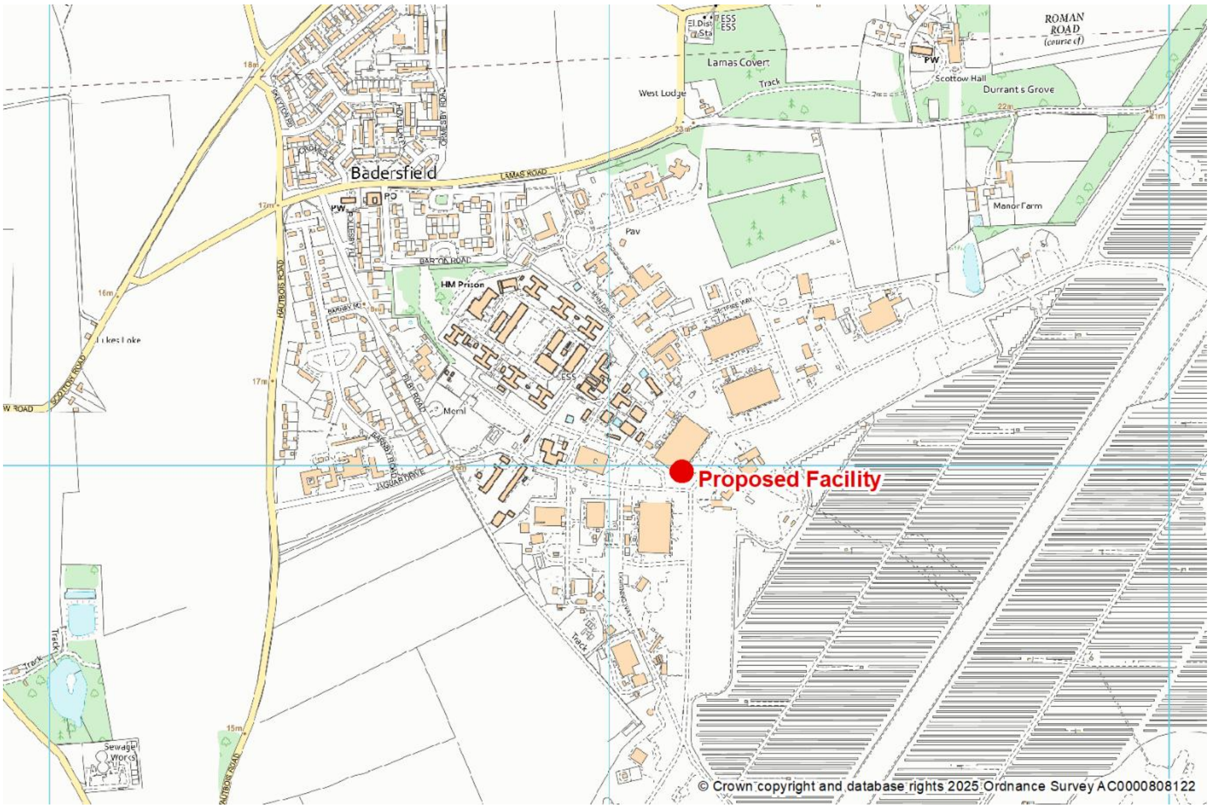



*Figure 1.1: Site Location*

# 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, ozone ($O_3$), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

## 2.2 Environment Act 2021

The Environment Act 2021 [1] establishes a legally binding duty on the government to bring forward new air quality targets by 31 October 2022 for $PM_{2.5}$.

The proposed air quality targets currently under consultation (consultation closed on 27th June 2022) are:

- An Annual Mean Concentration Target - a maximum concentration of 10 µg $m^{-3}$ to be met across England by 2040; and
- A Population Exposure Reduction Target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

These have been adopted into the first revision of Defra's Environmental Improvement Plant 2023 for England published in February 2023.

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).

## 2.3 Air Quality Strategy 2023

The Air Quality Strategy [2] is the government's strategic framework for local authorities and other partners. It sets out their powers, responsibilities, and further actions the government expects them to take. It sets out a framework to enable local authorities to deliver for their communities and contribute to the government's long-term air quality goals, including ambitious new targets for fine particulate matter ($PM_{2.5}$).

1 Environment Act 2021, 2021 Chapter 30
2 Air Quality Strategy, Framework for Local Authority Delivery, Department for Environment, Food and Rural Affairs (2023)

It fulfils the statutory requirement of the Environment Act 1995 as amended by the Environment Act 2021 to publish an Air Quality Strategy setting out air quality standards, objectives, and measures for improving ambient air quality every 5 years. It does not replicate or replace other air quality guidance documents relevant to local authorities.

The government's national-level air quality regulations for concentrations consist of the Air Quality Standards Regulations 2010, which set limits for several pollutants, including nitrogen oxides, particulate matter, and others. In addition, under the Environment Act 2021, the government has set two new legally-binding long-term targets to reduce concentrations of fine particulate matter, $PM_{2.5}$.

The two new targets are an annual mean concentration of 10 µg/m3 and a reduction in average population exposure by 35% by 2040, compared to a 2018 baseline. These targets are designed to help drive reductions in the worst $PM_{2.5}$ hotspots across the country, whilst ensuring nationwide action to improve air quality for everyone.

There are also an interim targets for each long-term target in the Environmental Improvement Plan which will promote early action and improvement. These are an annual mean $PM_{2.5}$ concentration of 12 $\mu g/m^3$ by January 2028 and a 22% reduction in average population exposure by January 2028 compared to a 2018 baseline.

## 2.4 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'.

The Air Quality Standards (England) Regulations 2010[7] have adopted into UK law the limit values required by EU Directive 2008/50/EC[8] 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.

---

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 Air Quality Standards Regulations 2010 – Statutory Instrument 2010 No. 1001

8 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

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

## 2.5 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023

The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023[9] 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 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 $PM_{2.5}$ in ambient air.

## 2.6 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 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[10]. This guidance, referred to in this chapter as LAQM.TG(22), has been used where appropriate in the assessment.

## 2.7 Medium Combustion Plant Directive

The Medium Combustion Plant Directive (2015/2193) came into force on 18th December 2015 and regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50 MWth.

9 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 - Statutory Instrument 2023 No. 96
10 Department for Environment, Food and Rural Affairs (DEFRA), (2022): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(22)

It regulates emissions of $SO_2$, NOx and dust into the air with the aim of reducing those emissions and the risks to human health and the environment they may cause. It also lays down rules to monitor emissions of carbon monoxide (CO).

It fills the regulatory gap at EU level between large combustion plants (> 50 MWth), covered under the Industrial Emissions Directive (IED) and smaller appliances (heaters and boilers <1 MWth) covered by the Ecodesign Directive.

The Medium Combustion Plant is implemented through the Environmental Permitting Regulations (EPR).

The design and operation of all new Medium Combustion Plants must ensure compliance with emission limit values (ELVs) set out in the MCPD; these ELVs are summarised in **Table 2.1** and **2.2**.

*Table 2.1: MCPD Emission Limits for MCP other than Engines and Gas Turbines (mg/Nm$^3$)*

| Pollutant | Emission Limit (Dry gas at 273.15K, 101.3mb and 3% $O_2$) | | | | | |
|---|---|---|---|---|---|---|
| | Solid Biomass | Other Solid Fuels | Gas Oil | Liquid Fuels Other Than Gas Oil | Natural Gas | Gaseous Fuels Other Than Natural Gas |
| $SO_2$ | 200(1) | 400 | - | 350(2) | - | 35(3)(4) |
| NOx | 300(5) | 300(5) | 200 | 300(6) | 100 | 200 |
| Dust | 20(7) | 20(7) | - | 20(8) | - | |

(1) The value does not apply in the case of plants firing exclusively woody solid biomass.

(2) Until 1 January 2025, 1 700 mg/Nm$^3$ in the case of plants which are part of SIS or MIS.

(3) 400 mg/Nm$^3$ in the case of low calorific gases from coke ovens, and 200 mg/Nm$^3$ in the case of low calorific gases from blast furnaces, in the iron and steel industry.

(4) 100 mg/Nm$^3$ in the case of biogas.

(5) 500 mg/Nm$^3$ in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW.

(6) Until 1 January 2025, 450 mg/Nm$^3$ when firing heavy fuel oil containing between 0,2 % and 0,3 % N and 360 mg/Nm$^3$ when firing heavy fuel oil containing less than 0,2 % N in the case of plants which are part of SIS or MIS.

(7) 50 mg/Nm$^3$ in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW; 30 mg/Nm$^3$ in the case of plants with a total rated thermal input greater than 5 MW and less than or equal to 20 MW.

(8) 50 mg/Nm$^3$ in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5

*Table 2.2: MCPD Emission Limits for MCP for Engines and Gas Turbines (mg/Nm$^3$)*

| Pollutant | Emission Limit (Dry gas at 273.15K, 101.3mb and 15% $O_2$) | | | | |
|---|---|---|---|---|---|
| | Combustion Type | Gas Oil | Liquid Fuels Other Than Gas Oil | Natural Gas | Gaseous Fuels Other Than Natural Gas |
| $SO_2$ | Engines and gas turbines | - | 120(9) | - | 15(10) |
| NOx | Engines | 190(11) | 190(11)(12) | 95(13) | 190 |

| | | | | | |
|---|---|---|---|---|---|
| | Gas turbines | 75 | 75(14) | 50 | 75 |
| Dust | Engines and gas turbines | - | 10(15)(16) | - | - |

(9) Until 1 January 2025, 590 mg/Nm$^3$ for diesel engines which are part of SIS or MIS
(10) 40 mg/Nm$^3$ in the case of biogas
(11) 225 mg/Nm$^3$ for dual fuel engines in liquid mode.
(12) 225 mg/Nm$^3$ for diesel engines with a total rated thermal input less than or equal to 20 MW with ≤ 1 200 rpm
(13) 190 mg/Nm$^3$ for dual fuel engines in gas mode.
(14) Until 1 January 2025, 550 mg/Nm$^3$ for plants which are part of SIS or MIS.
(15) Until 1 January 2025, 75 mg/Nm$^3$ for diesel engines which are part of SIS or MIS
(16) 20 mg/Nm$^3$ in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW

The pyrolyser would be classed as MCP (other than engines or gas turbines) utilising natural gas as a fuel and would be required to comply with an emission limit value for NOx of 100 mg/Nm$^3$ (dry gas at 273.15K, 101.3mb and 3% $O_2$). The generating units would be classed as engines and would be required to comply with an emission limit value for NOx of 95 mg/Nm$^3$ (dry gas at 273.15K, 101.3mb and 15% $O_2$).

## 2.8 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 (LCPD), implemented through the Environmental Permitting Regulations (EPR).

The aim of the 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 2.3**.

*Table 2.3: 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) | $1 \times 10^{-7}$ |

(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

Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

# 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 has been used as an input to the UK Atmospheric Dispersion Modelling System (ADMS) dispersion model.

The assessment for the facility comprises a review of emission parameters for the installation 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 standards for the protection of health and critical levels/ loads for the protection of sensitive ecosystems and vegetation.

## 3.2 Dispersion Model Parameters

The predicted impact of the facility emissions on local air quality has been undertaken using the UK ADMS dispersion model (Version 6.0). For normal operation, it is assumed that emissions will be compliant with the MCPD, as provided in **Table 2.1** and **Table 2.2**. For normal operation, only emissions of NOx are considered.

For abnormal operation, it is assumed that emissions will be compliant with the emission limits prescribed by Chapter IV of the IED (refer to **Table 2.3**). For the purposes of the modelling assessment, both emission sources are 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 abnormal operation, the full suite of IED pollutants have been considered.

For Group III trace metal predictions, it has been assumed in accordance with the Environment Agency's metals guidance[11], that each of the metals is emitted at the maximum ELV for the group (assumed to be 0.5 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 waste incineration plants have been used, as specified in the guidance.

An emission limit of 9 x 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[12]. Information on PCB emissions has been obtained from the Waste Incineration BREF document which provides a range of PCB emissions

11 Releases from waste incinerators, Guidance on assessing group 3 metal stack emissions from incinerators – Version 4
12 WR 0608 Emissions from Waste Management Facilities, ERM Report on Behalf of Defra (July 2011)

from the incineration of municipal waste. This states that the annual average PCB emission is less than 0.005 mg/Nm$^3$. Therefore, the PCB emission is assumed to be 0.005 mg/Nm$^3$ in the absence of an ELV.

A summary of the input parameters used in the assessment are provided in **Appendix B**.

### *3.2.1 Meteorological Data*

Dispersion modelling has been undertaken using five years (2019-2023) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. Data from the meteorological station at Norwich Airport, approximately 10 km to the south of the site have been used for this assessment.

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

### *3.2.2 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. Details of the buildings included in the model are provided in **Table 3.1**. In ADMS, building footprints can only be represented as a rectangle or circle. Therefore, the building dimensions in the model represent the building shape rather than actual measurements. For buildings with a pitched roof, the mean height is used for the building height. The Hangar Building has been selected as the main building within the model.

*Table 3.1: Building Downwash Structures*

| Building | Easting | Northing | Height (m) | Length (m) | Width (m) | Angle (°) |
|---|---|---|---|---|---|---|
| B1 Hangar Building | 626129 | 323036 | 12.3 | 94.7 | 47.6 | 35 |
| B2 Building South | 626081 | 322889 | 12.2 | 91.5 | 50.5 | 1 |
| B3 Northeast of Gas Store | 626107 | 322986 | 10.0 | 8.5 | 11.0 | 35 |
| B4 East of Gas Store | 626109 | 322973 | 8.5 | 4.7 | 6.5 | 35 |
| B5 Gas Store | 626095 | 322974 | 14.8 | Diameter of 17.0 m | | |

### *3.2.3 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.

A detailed topographical data set 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.

### 3.2.4 Nitric Oxide to $NO_2$ 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 the 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 Environment Agency guidance.

## 3.3 Sensitive Receptors

LAQM.TG(22) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations 'where members of the public are regularly present' should be considered. At such locations, members of the public will be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standards (i.e. 15-minute mean or 1-hour mean) may be relevant. However, at a school or adjacent to a private dwelling where exposure may be for longer periods, comparison with long-term (such as 24-hour mean or annual mean) standards may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

The location of the discrete sensitive receptors selected for the assessment is presented in **Table 3.2**. and **Figure 3.1.**

*Table 3.2: Human Health Receptors*

| Ref. | Receptor | Type | Easting | Northing |
|---|---|---|---|---|
| D1 | 3D at Depth | Commercial/industrial | 626183 | 322937 |
| D2 | October Studios | Commercial/industrial | 626074 | 323034 |
| D3 | Specialist Vehicle Training | Commercial/industrial | 625992 | 322999 |
| D4 | HM Prison | Residential | 625884 | 323105 |
| D5 | Filby Road | Residential | 625679 | 323025 |
| D6 | Barton Road | Residential | 625764 | 323384 |
| D7 | West Lodge | Residential | 626176 | 323633 |
| D8 | Manor Farm | Residential | 626657 | 323474 |
| D9 | Malthouse Farm | Residential | 627447 | 323034 |
| D10 | Honeysuckle Cottage | Residential | 626473 | 322058 |
| D11 | The White House | Residential | 625380 | 321990 |

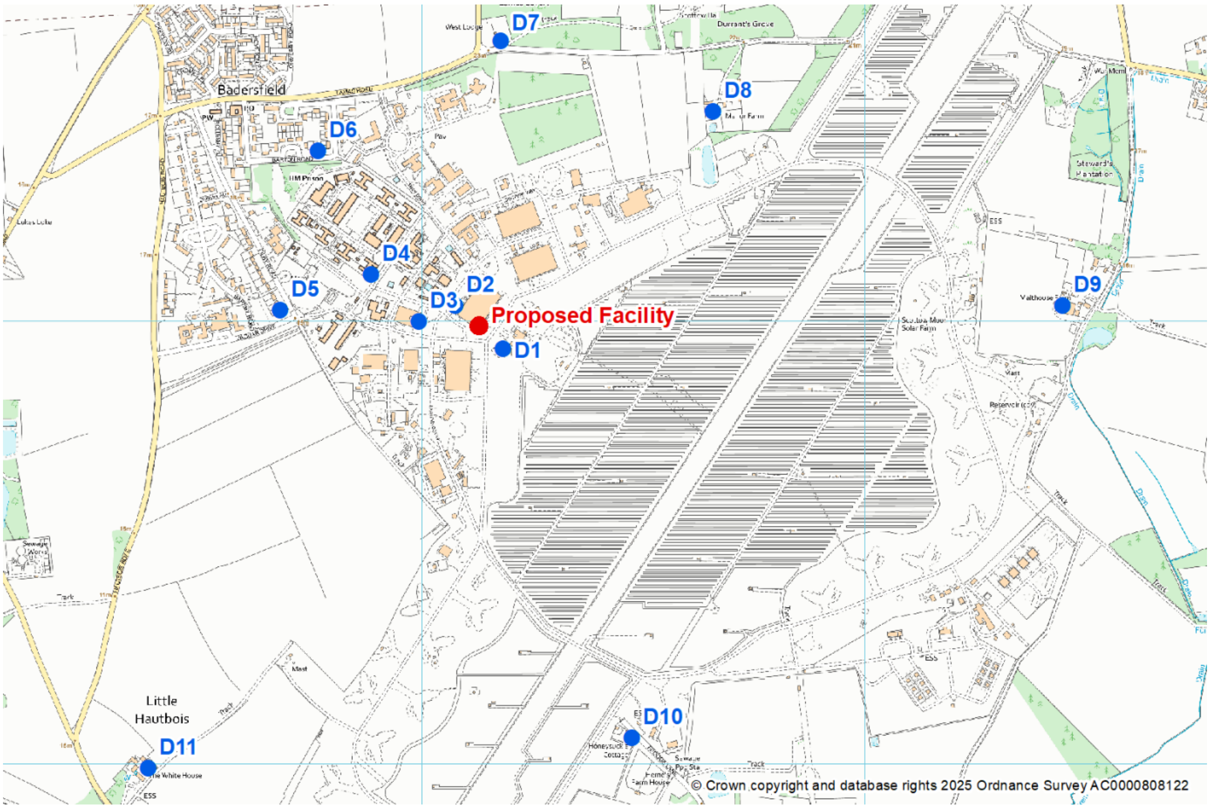



*Figure 3.1: Sensitive Human Health Receptor Locations*

Pollutant concentrations have been predicted at both discrete receptor locations and over a 3 km by 3 km Cartesian grid of 30 m resolution.

## 3.4 Habitat Assessment

The Environment Agency's Risk Assessment Guidance[13] 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[14];
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive[15;] and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[16.]

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);

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

- local wildlife sites (Sites of Interest for Nature Conservation, SINC and Sites of Local Interest for Nature Conservation, SLINC); and
- Ancient woodland.

However, the habitat screening for MCP installations is 5 km for European sites and 2 km for SSSI. There are no European sites within 5 km or SSSIs within 2 km. Therefore, for normal operation the impact of emissions on habitat sites can be screened out of the assessment.

For abnormal operation, habitat receptor designations and locations relevant to the assessment are presented in **Table 3.3** and **Figure 3.2.** There are three European sites within 10 km, no SSSI's within 2 km and there are three LWS within 2 km of the facility site. The Broads SAC and Broadland SPA/Ramsar are co-located and multiple areas of these sites occur at various locations around the site. Therefore, the nearest areas have been identified (four locations) and the maximum predicted concentration or deposition rate is compared to the relevant critical level or critical load.

*Table 3.3: Sensitive Habitat Receptors*

| Receptor | Primary Habitat | Approx. Location (Relative to Site) |
|---|---|---|
| H1. The Broads SAC | Transition mires and quaking bogs | Various locations within 10 km |
| H1. Broadland SPA/Ramsar | Northern wet heath and dwarf shrub heath | Various locations within 10 km |
| H2. Norfolk Valley Fens SAC | Valley mires, poor fens and transition mires and bogs | 8.2 km west |
| H3. Scottow Pond and Oak Belt LWS | Assumed broadleaved deciduous woodland | 1.7 km north |
| H4. Stakebridge Beck LWS | Assumed neutral grassland | 1.6 km northwest |
| H5. Low Common and Plantations LWS | Assumed broadleaved deciduous woodland | 1.9 km north |

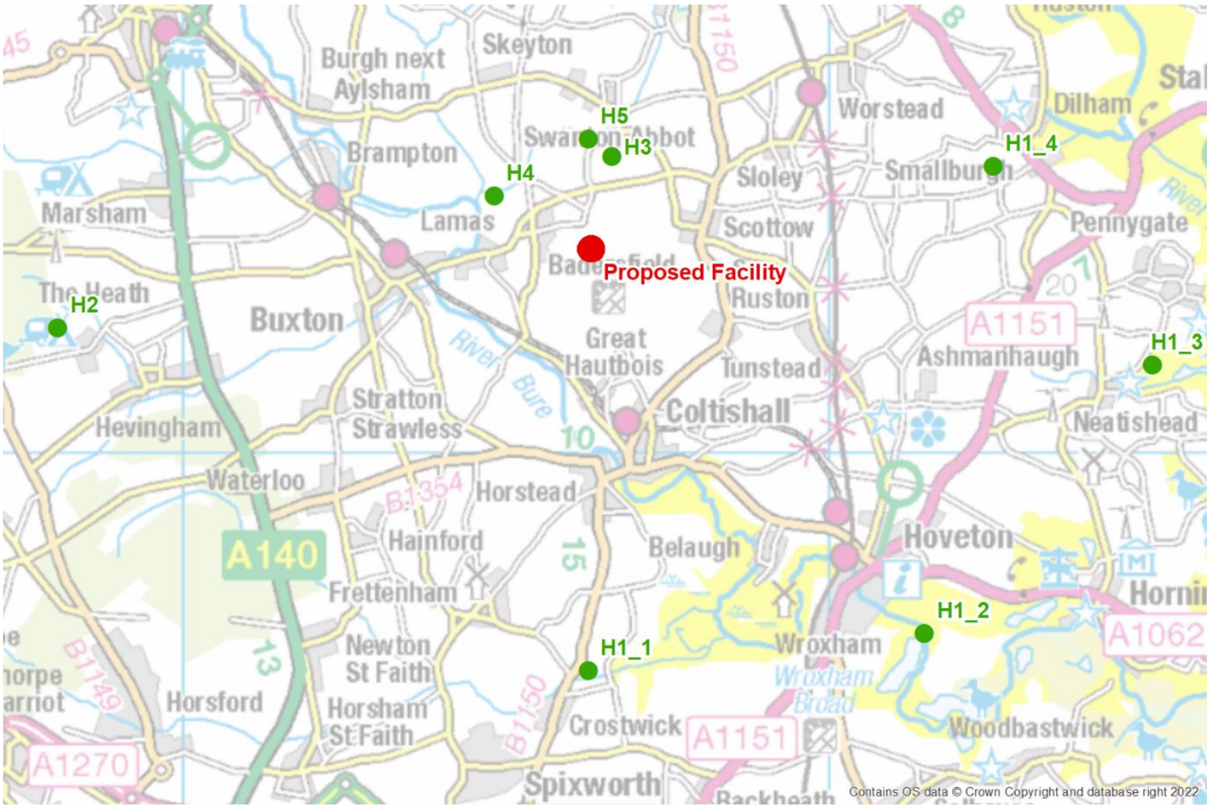



*Figure 3.2: Sensitive Habitat Receptor Locations*

The habitat sites have been represented in the model by discrete receptors at the boundary of the designated area closest to the facility site. For the Broadland SPA/Ramsar and The Broads SAC, four locations have been identified representative of the different areas designated for these habitat sites.

The modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical $NO_2$, $SO_2$ and HCl dry deposition velocities is presented in **Table 3.4.**

*Table 3.4: Dry Deposition Velocities (m/s)*

| Pollutant | Heathland | Woodland |
|---|---|---|
| Nitrogen Dioxide ($NO_2$) | 0.0015 | 0.0030 |
| Sulphur Dioxide ($SO_2$) | 0.012 | 0.024 |
| Hydrogen Chloride (HCl) | 0.025 | 0.060 |

The predicted nitrogen deposition rates assume 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 consequently results in lower deposition rates.

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

AQTAG06[17] states that the wet deposition of $SO_2$ and$NO_2$ is 'not significant' within a short range. However, wet deposition of HCl should be considered where a process emits this pollutant. It is considered that 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 1:1 at all of the identified habitat sites. Therefore, the HCl wet deposition is equivalent to the HCl dry deposition rate (i.e. the total deposition of HCl is twice the dry deposition rate of HCl).

## 3.5 Significance Criteria

### *3.5.1 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[18]. A process contribution (PC) is considered not significant if:

- the long-term PC <1% of the long-term air quality standard; and/or
- 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 (PEC) <70% of the air quality standard; and/or
- the short-term PC <20% of the air quality standard minus the short-term background concentration, where the short-term background concentration is assumed to be twice the long-term background concentration.

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 air quality standard, then the PEC should be compared to the air quality standard.
    - Where the PEC exceeds 100% of the air quality standard, then the assessment should proceed to Step Two.

17 AQTAG06 – Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, Environment Agency (March 2014)
18 https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

- Step Two – make predictions for the metals exceeding the criteria in Step One, using emission concentrations provided in the guidance. Where the PC of any metal exceeds 1% of the long-term or 10% of the short-term air quality standard, then the PEC should be compared to the air quality standard. Where the PEC exceeds 100% of the air quality standard, then the impact of the metal can be considered to be significant.

### *3.5.2 Impacts on Ecology*

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

Stage 1

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

- The long term PC <1% of the long-term critical level/load
- The short term PC <10% of the short-term critical level/load

Stage 2

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

- The long term PC + background concentration/deposition rate (PEC) <70% of the critical level/load
- The short term PC <20% of the (critical level/load – short term background concentration or deposition rate)

For Local Wildlife Sites (SINCs, SLINC's, NNRs, LNRs and ancient woodland, a process contribution (PC) is considered not significant if:

- The long term PC <100% of the long-term critical level/load
- The short term PC <100% of the short-term critical level/load

# 4. BASELINE CONDITIONS

## 4.1 Local Authority Monitoring

North Norfolk District Council (NNDC) and Broadland District Council (BDC) carry out frequent review and assessments of air quality within their administrative areas and produce Annual Status Reports in accordance with the requirements of Defra. NNDC and BDC currently do not have any declared Air Quality Management Areas (AQMAs).

## 4.2 Nitrogen Dioxide

NNDC undertook monitoring of ambient $NO_2$ concentrations using a network of passive diffusion tubes and in 2020 there were 16 monitoring sites. However, in 2023 diffusion tube monitoring had ceased. In 2023, monitoring at two automatic monitoring sites was undertaken but these were at roadside locations in Wroxham (6.4 km southeast of the site) and Cromer (19.6 km north of the site) and would not be characteristic of the site and surroundings.

BDC undertook monitoring at 29 locations in 2023. However, the majority of monitoring sites are located within more urban areas at kerbside locations that would not be representative of concentrations at the installation site. The nearest monitoring location is at Coltishall, 2.7 km to the south of the site. This is a kerbside site location and monitoring commenced in 2023 at its current location. Measured concentrations were 15.2 $\mu g/m^3$ in 2023 but at the previous location were 11.6 $\mu g/m^3$ in 2021 and 9.5 $\mu g/m^3$ in 2022.

As data are limited, annual mean $NO_2$ background concentrations for 2024 have been obtained from the Defra UK Background Air Pollution Maps[19]. The latest background maps (for $NO_2$, $PM_{10}$ and $PM_{2.5}$) were issued in November 2024 and are based on 2021 monitoring data.

The highest 2024 mapped annual mean background concentration for the area surrounding the facility site is 6.7 $\mu g/m^3$, which includes a contribution from traffic on the primary routes through the area. This is the maximum for the sixteen 1 $km^2$ grids surrounding the site. This is substantially lower than measured at Coltishall. Therefore, an annual mean background concentration of 12.1 $\mu g/m^3$ has been assumed based on the average measurements at Coltishall and is considered representative of a worst-case.

## 4.3 Carbon Monoxide (CO)

Monitoring of background CO concentrations is not currently undertaken by NNDC or BDC. Therefore, concentrations have been obtained from the Defra maps. The CO mapping is based on 2001 monitoring data.

The 2001 maximum annual mean background CO concentration for the area surrounding the facility site is 265 $\mu g/m^3$ for the sixteen 1 $km^2$ grids surrounding the site. It is assumed that the 2001 concentrations are representative of future years.

19 https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

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

The 2024 maximum mapped background $PM_{10}$ concentration for the area is 12.4 µg/m$^3$. This is the maximum for the sixteen 1 km$^2$ grids around the facility site.

Similarly, background $PM_{2.5}$ concentrations have been obtained from the Defra mapped concentrations and are assumed to be representative of background concentrations at the facility site. The maximum 2024 annual mean $PM_{2.5}$ concentration for the area around the facility is 5.6 µg/m$^3$, which is 32% of the EU target value of 20 µg/m$^3$.

## 4.5 Sulphur Dioxide ($SO_2$)

Automatic monitoring of $SO_2$ concentrations is not currently undertaken by NNDC or BDC. The maximum mapped $SO_2$ concentration for the area surrounding the facility site is 2.1 µg/m$^3$. The $SO_2$ mapping is based on 2001 monitoring data and the 2024 $SO_2$ concentrations are assumed to be 100% of the published 2001 estimates and represent a worst-case.

## 4.6 Total Organic Carbon (as 1,3-Butadiene)

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

The maximum estimated 2003 annual mean background 1,3-butadiene concentration for the area surrounding the facility site is 0.11 µg/m$^3$.

## 4.7 Hydrogen Chloride

Ambient monitoring of hydrogen chloride (HCl) is carried out as part of the Defra Acid Gases and Aerosols Network (AGANET) at a number of, predominantly rural, locations around the UK. The nearest monitoring site is located at Stoke Ferry (rural background site), 61 km to the southwest of the facility site. However, monitoring of HCl ceased in 2016. For 2015, the monthly mean concentrations of HCl varied between 0.11 and 0.66 µg/m$^3$ and it is assumed as a worst-case that the maximum monthly concentration of 0.66 µg/m$^3$ is representative of the annual mean background concentration at the facility site and nearby sensitive receptors.

## 4.8 Hydrogen Fluoride (HF)

It is difficult to identify an appropriate background HF concentration as HF is not routinely measured in the UK, even historically. Furthermore, any measurements that have been made have been obtained from heavily industrialised locations.

Measurements obtained in the UK between 1984 and 1986 in the Marston Vale region of Bedfordshire where there was a high density of brickworks[20], a known source of HF, revealed monthly mean concentrations of 0.040 to 0.86 µg/m$^3$. Daily mean concentrations of up to 2.2 µg/m$^3$ were also

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

measured. These concentrations would not be characteristic of measured concentrations around the facility as concentrations measured forty years ago would not reflect present day regulatory controls. Data provided by the UK National Atmospheric Emissions Inventory (NAEI) indicate that emissions of HF have reduced from around 8 kilotonnes per annum (kt/a) in 1993 to less than 1 kt/a in 2021 mainly due to the decommissioning of coal fired power stations.

Information provided by the World Health Organization (WHO) in 2002[21] indicated that in areas not in the direct vicinity of emission sources, the mean concentrations of fluoride in ambient air would be generally less than 0.1 µg/m$^3$. Therefore, given the reduction in emissions since this time it is concluded that a concentration of 0.1 µg/m$^3$ as an annual mean would be representative of the worst-case for the facility 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 Networks. Monitoring at a site in Heigham Holmes is the nearest rural background location to the facility site. A summary of monitored concentrations for 2021 to 2023 is provided in **Table 4.1**.

*Table 4.1: Annual Average UK Trace Metal Concentrations (ng/m$^3$) – Heigham Holmes*

| Pollutant | 2021 | 2022 | 2023 | AQAL |
|---|---|---|---|---|
| Antimony (Sb) | | Not measured | | 5,000- |
| Arsenic (As) | 0.55 | 0.54 | 0.49 | 6 |
| Cadmium (Cd) | 0.086 | 0.074 | 0.059 | 5 |
| Chromium (Cr) | 0.39 | 0.46 | 0.54 | - |
| Cobalt (Co) | 0.038 | 0.044 | 0.036 | 1,000 |
| Copper (Cu) | 1.5 | 1.7 | 1.2 | - |
| Lead (Pb) | 2.9 | 2.9 | 2.2 | 250 |
| Manganese (Mn) | 2.4 | 3.0 | 1.9 | 150 |
| Mercury (Hg) – London Westminster | | 2.7 (maximum for 2015 to 2018) | | - |
| Nickel (Ni) | 0.54 | 0.61 | 0.42 | 20 |
| Thallium (Tl) | | Not measured | | 1,000 |
| Vanadium (V) | 1.1 | 1.1 | 0.89 | - |

There are no measurements of antimony, mercury or thallium. There have been some historical measurements of gaseous mercury at a couple of monitoring locations up to 2018 when monitoring appears to have ceased. Measured concentrations of gaseous mercury were measured at the London Westminster site and the Runcorn Weston Point site between 2015 and 2018. Neither of these sites are characteristic of the facility location as London is heavily trafficked and Runcorn Weston Point is heavily industrial. Maxima annual mean concentrations at these two sites for the four years were 2.7 ng/m$^3$ and 20.1 ng/m$^3$ for the London Westminster and Runcorn Weston Point site, respectively.

21 Fluorides, Environmental Health Criteria 227, World Health Organization (2002)

For the purposes of the assessment, it is assumed that measured concentrations at London Westminster (2.7 ng/m$^3$) are more characteristic of the site and surroundings but are likely to overestimate concentrations given the more rural nature of the facility site.

All the measured concentrations are well below their respective air quality assessment level (AQAL) where monitoring is carried out. Guidance issued by the Environment Agency[11] for the assessment of Group 3 metals, states that for screening purposes it should be assumed that CrVI comprises 20% of the total background chromium concentration. On this basis the annual average CrVI concentration (up to 0.11 ng/m$^3$) is well below the AQAL of 0.25 ng/m$^3$. For the purposes of the assessment the maximum concentration measured over the three-year period has been adopted as a background concentration for the site and surrounding location.

## 4.10 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 4.2.**

*Table 4.2: UK PCDD/Fs Concentrations (fg TEQ/m$^3$)*

| Monitoring Site | Type | 2014 | 2015 | 2016 |
|---|---|---|---|---|
| London | Urban background | 2.9 | 4.4 | 21 |
| Manchester | Urban background | 17.0 | 6.0 | 12 |
| Auchencorth Moss | Rural background | 0.01 | 0.01 | 0.15 |
| High Muffles | Rural background | 1.1 | 0.5 | 2.8 |
| Hazelrigg | Rural background | 2.6 | 5.3 | 4.6 |
| Weybourne | Rural background | 1.6 | 1.4 | 18 (b) |

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 10.6 fg TEQ/m$^3$. Whereas for the rural background sites the mean is 3.2 fg TEQ/m$^3$.

Therefore, the average concentration measured at the four rural background monitoring sites from 2014 to 2016 (3.2 fg TEQ/m$^3$) is assumed to be reasonably representative of the baseline dioxin and furan concentration at the facility site and nearby sensitive receptors.

## 4.11 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 site is located at Stoke Ferry and is a rural background site. Measured concentrations of BaP varied between 0.099 and 0.11 ng/m$^3$ between 2021 and 2023. As a rural background site, concentrations are likely to be characteristic of the facility site and it is assumed that the maximum annual mean for this site (0.11 ng/m$^3$) is a reasonable estimate of the background concentration in the vicinity of the facility site.

## 4.12 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) 24 pg/m$^3$. Given the more rural nature of the facility site, the average rural background concentration is assumed to be reasonably representative of the baseline PCB concentration at the facility site and nearby sensitive receptors.

## 4.13 Summary of Background Concentrations

A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in **Table 4.3**. The current background concentrations are assumed to be representative of future year concentrations. Since pollutant concentrations are expected to decline in the future, this ensures that the worst-case impacts are determined (i.e. future impacts combined with existing air quality).

*Table 4.3: Summary of Background Concentrations*

| Pollutant | Annual Mean | Short-Term | |
|---|---|---|---|
| | | Concentration | Averaging Period |
| Particles ($PM_{10}$) | 12.4 μg/m$^3$ | 14.6 μg/m$^3$ (a)(b) | 24-hour |
| Particles ($PM_{2.5}$) | 5.6 μg/m$^3$ | n/a | n/a |
| Nitrogen Dioxide ($NO_2$) | 12.1 μg/m$^3$ | 24.2 μg/m$^3$ (a) | 1-hour |
| Sulphur Dioxide ($SO_2$) | 2.1 μg/m$^3$ | 2.5 μg/ m$^3$ (a)(b)<br>4.2 μg/m$^3$ (a)<br>5.6 μg/m$^3$ (a)(d) | 24-hour<br>1-hour<br>15-minute |
| Carbon Monoxide (CO) | 265 μg/m$^3$ | 371 μg/m$^3$ (a)(c)<br>530 μg/m$^3$ (a) | 8-hour<br>1-hour |
| Hydrogen Fluoride (HF) | 0.1 μg/m$^3$ | 0.2 μg/m$^3$ (a)<br>0.2 μg/m$^3$ (e) | 1-hour<br>Monthly/weekly |
| Hydrogen Chloride (HCl) | 0.66 μg/m$^3$ | 1.3 μg/m$^3$ (a) | 1-hour |
| TOC (1,3-butadiene) | 0.11 μg/m$^3$ | 0.13 μg/m$^3$ (a)(b) | 24-hour |
| Dioxins and Furans (PCDD/Fs) | 3.2 fg/m$^3$ | n/a | n/a |
| Antimony (Sb) | No data available | n/a | n/a |
| Arsenic (As) | 0.55 ng/m$^3$ | n/a | n/a |
| Cadmium (Cd) | 0.086 ng/m$^3$ | 0.10 ng/m$^3$ (a)(b) | 24-hour |
| Chromium (Cr) | 0.54 ng/m$^3$ | 0.64 ng/m$^3$ (a)(b) | 24-hour |
| Cobalt (Co) | 0.044 ng/m$^3$ | n/a | n/a |
| Copper (Cu) | 1.7 ng/m$^3$ | 2.0 ng/m$^3$ (a)(b) | 24-hour |
| Lead (Pb) | 2.9 ng/m$^3$ | n/a | n/a |

| | | | |
|---|---|---|---|
| Manganese (Mn) | 3.0 ng/m$^3$ | 6.0 ng/m$^3$ (a) | 1-hour |
| Mercury (Hg) | 2.7 ng/m$^3$ | 3.2 ng/m$^3$ (a)(b)<br>5.4 ng/m$^3$ (a) | 24-hour<br>1-hour |
| Nickel (Ni) | 0.61 ng/m$^3$ | 1.2 ng/m$^3$ (a) | 1-hour |
| Thallium (Tl) | No data available | n/a | n/a |
| Vanadium (V) | 1.1 ng/m$^3$ | 1.3 ng/m$^3$ (a)(b) | 24-hour |
| Polycyclic Aromatic Hydrocarbons (as BaP) | 0.11 ng/m$^3$ | n/a | n/a |
| Polychlorinated biphenyls (PCBs) | 0.024 ng/m$^3$ | 0.048 ng/m$^3$ (a) | 1-hour |

(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.

(e) In the absence of correction factors for this averaging period.

# 5. ASSESSMENT OF IMPACTS ON HUMAN HEALTH

## 5.1 Introduction

Predicted process contributions (PC) for the five years of meteorological data are presented as the maximum arising off-site and at each of the discrete receptors identified in **Table 3.1**. Initial results are presented for normal operation with emissions at the MCPD ELVs. Abnormal operation assumes emissions at the IED ELVs.

The maximum PC is compared with the relevant air quality assessment level (AQAL which include air quality objectives, air quality limits and environmental assessment levels) to determine the significance of the impact, in accordance with the Environment Agency's Risk Assessment Guidance. Where a potentially significant impact is identified, the total predicted environmental concentration (PEC, which is the PC plus the background) is compared with the AQAL to assess the likelihood of an exceedance.

## 5.2 Normal Operation (MCPD)

The predicted annual mean and 99.8$^{th}$ percentile of 1-hour mean ground level $NO_2$ process contributions (PCs) are presented in **Table 5.1** for normal operation. The annual mean and 99.8$^{th}$ percentile of hourly mean $NO_2$ concentrations for 2020 are presented as a contour plot in **Figure 5.1** and **Figure 5.2**, respectively.

*Table 5.1: Predicted $NO_2$ Concentrations – Normal Operation (µg/m$^3$)*

| Receptor | Annual Mean | | 99.8$^{th}$ Percentile of 1-Hour Means | |
|---|---|---|---|---|
| | PC (µg/m$^3$) | PC (% AQAL) | PC (µg/m$^3$) | PC (% AQAL) |
| Maximum Off-Site | 3.8 | 9.5% | 25.1 | 12.6% |
| D1. 3D at Depth | 0.93 | 2.3% | 17.5 | 8.8% |
| D2. October Studios | 0.55 | 1.4% | 14.0 | 7.0% |
| D3. Specialist Vehicle Training | 0.62 | 1.6% | 15.1 | 7.5% |
| D4. HM Prison | 0.35 | 0.9% | 5.1 | 2.6% |
| D5. Filby Road | 0.32 | 0.8% | 4.4 | 2.2% |
| D6. Barton Road | 0.56 | 1.4% | 3.7 | 1.8% |
| D7. West Lodge | 0.80 | 2.0% | 3.1 | 1.6% |
| D8. Manor Farm | 0.19 | 0.5% | 1.8 | 0.9% |
| D9. Malthouse Farm | 0.15 | 0.4% | 2.0 | 1.0% |
| D10. Honeysuckle Cottage | 0.13 | 0.3% | 1.7 | 0.8% |
| D11. The White House | 0.02 | <0.1% | 0.4 | 0.2% |
| AQAL (µg/m$^3$) | 40 | | 200 | |
| Background (µg/m$^3$) | 12.1 | | 24.2 | |
| Maximum PEC (µg/m$^3$) | 15.9 | | 49.3 | |
| Maximum PEC (% AQAL) | 39.7% | | 24.7% | |

At some receptor locations, the predicted annual mean concentration is 1% or more of the AQAL and would be assessed as potentially significant. However, including the background concentration of 12.1 µg/m3, the predicted maximum off-site annual mean concentration (PEC) is 39.7% of the air quality objective of 40 µg/m3. Therefore, it is concluded that the AQAL would be met. The maximum impact occurs to the immediate east of the facility over the industrial estate.

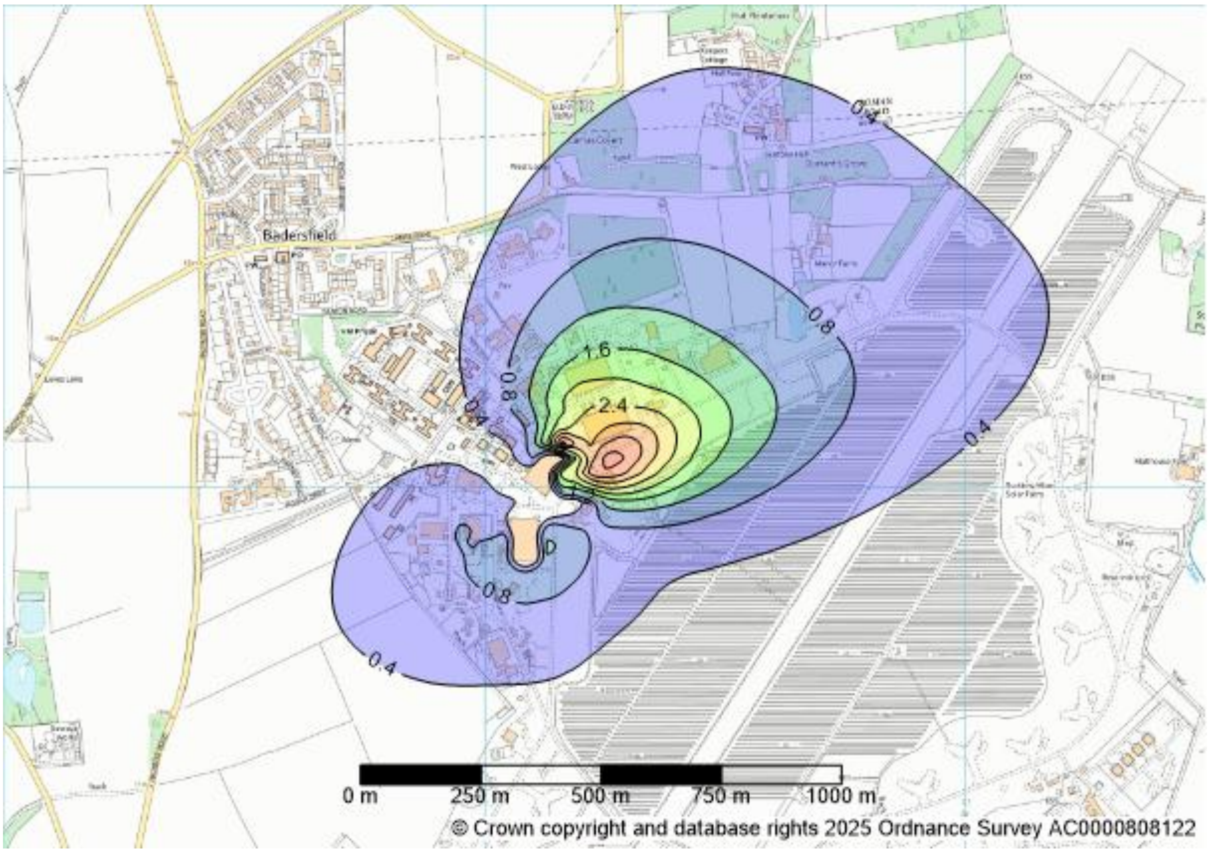



*Figure 5.1: Predicted Annual Mean $NO_2$ Concentrations for 2020 – Normal Operation (µg/m$^3$)*

The maximum predicted short-term concentrations are less than 10% of the hourly mean air quality objective at all sensitive receptors and would be assessed as not significant. As the maximum predicted, the predicted short-term concentration exceeds 10% of the AQAL but the maximum predicted concentration is less than 20% of the difference between the AQAL and the background concentration (35.2 µg/m$^3$) and it is unlikely the AQAL would be exceeded.

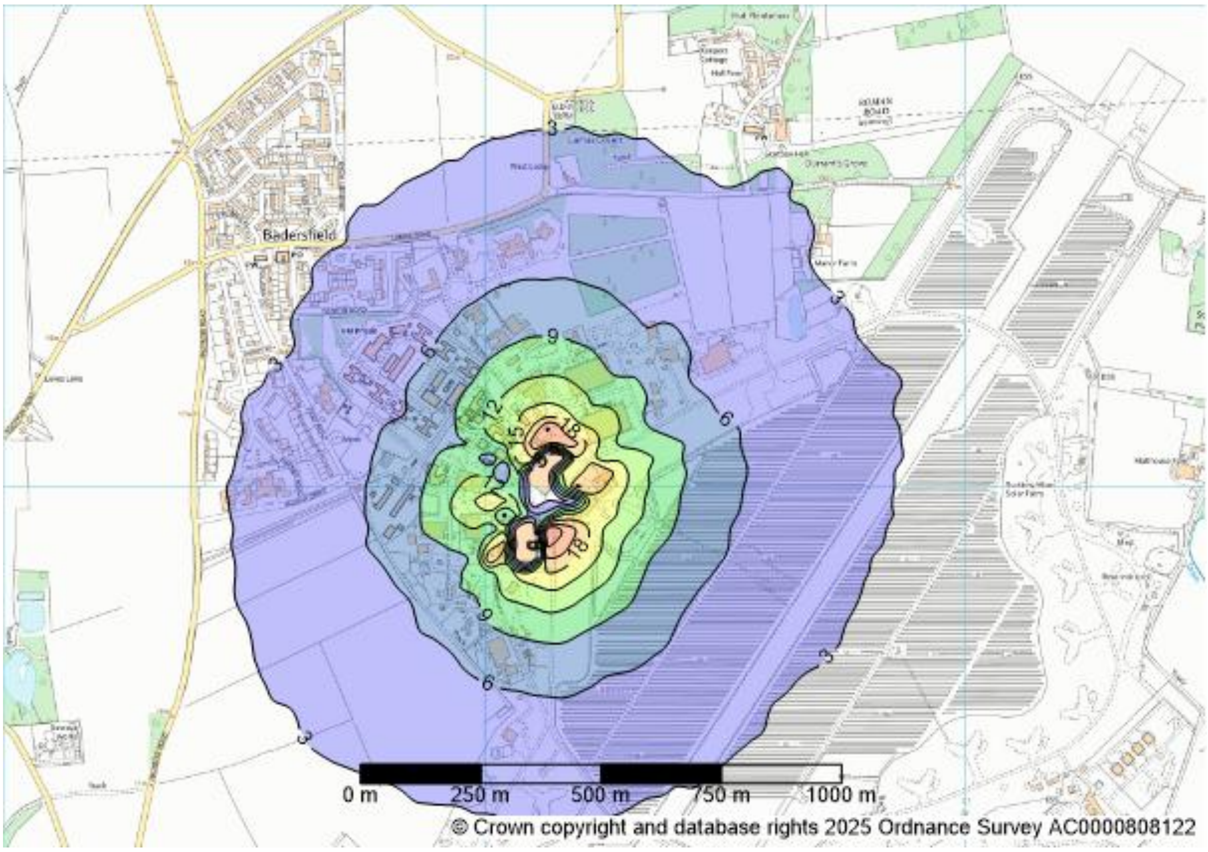



*Figure 5.2: Predicted 99.8th Percentile of Hourly Mean $NO_2$ Concentrations for 2020 – Normal Operation (µg/m³)*

## 5.3 Abnormal Operation (IED)

### *5.3.1 Nitrogen Dioxide*

The predicted annual mean and 99.8th percentile of 1-hour mean ground level $NO_2$ process contributions (PC) are presented in **Table 5.2**. The annual mean and 99.8th percentile of hourly mean $NO_2$ concentrations for 2020 are also presented as a contour plot in **Figure 5.3** and **Figure 5.4**, respectively.

*Table 5.2: Predicted $NO_2$ Concentrations – Abnormal Operation (µg/m³)*

| Receptor | Annual Mean | | 99.8th Percentile of 1-Hour Means | |
|---|---|---|---|---|
| | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 6.1 | 15.2% | 39.5 | 19.7% |
| D1. 3D at Depth | 1.5 | 3.9% | 27.4 | 13.7% |
| D2. October Studios | 0.93 | 2.3% | 22.6 | 11.3% |
| D3. Specialist Vehicle Training | 1.0 | 2.6% | 23.7 | 11.9% |
| D4. HM Prison | 0.84 | 2.1% | 13.1 | 6.5% |
| D5. Filby Road | 0.55 | 1.4% | 7.9 | 4.0% |
| D6. Barton Road | 0.50 | 1.3% | 6.9 | 3.5% |

| | | | | |
|---|---|---|---|---|
| D7. West Lodge | 0.89 | 2.2% | 5.8 | 2.9% |
| D8. Manor Farm | 1.2 | 3.1% | 4.8 | 2.4% |
| D9. Malthouse Farm | 0.30 | 0.7% | 2.8 | 1.4% |
| D10. Honeysuckle Cottage | 0.24 | 0.6% | 3.2 | 1.6% |
| D11. The White House | 0.21 | 0.5% | 2.6 | 1.3% |
| AQAL (µg/m³) | 40 | | 200 | |
| Background (µg/m³) | 12.1 | | 24.2 | |
| Maximum PEC (µg/m³) | 18.2 | | 63.7 | |
| Maximum PEC (% AQAL) | 45.5% | | 31.8% | |

At the majority of receptor locations, the predicted annual mean concentration is 1% or more of the AQAL and would be assessed as potentially significant. However, including the background concentration of 12.1 µg/m³, the predicted maximum off-site annual mean concentration (PEC) is 45.5% of the air quality objective of 40 µg/m³. Therefore, it is concluded that the AQAL would be met. The maximum impact occurs to the immediate east of the facility over the industrial estate.

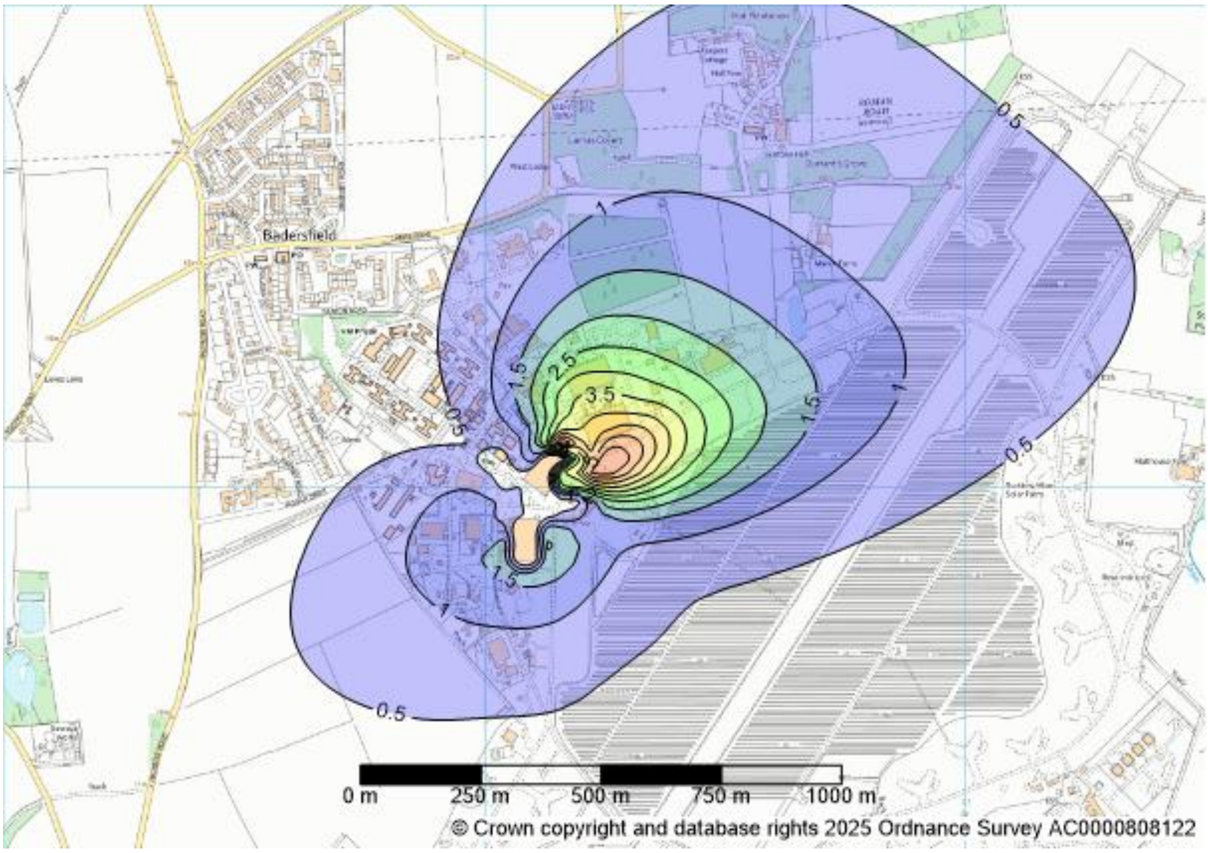



*Figure 5.3: Predicted Annual Mean $NO_2$ Concentrations for 2020 – Abnormal Operation (µg/m³)*

The maximum predicted short-term concentrations are less than 10% of the hourly mean air quality objective at the majority of sensitive receptors and would be assessed as not significant. As the maximum predicted and Receptors D1 to D3, the PC exceeds 10% of the AQAL and is potentially significant. However, at sensitive receptors the PC is less than 20% of the difference between the AQAL and the background concentration (35.2 µg/m³) and it is unlikely that the AQAL would be exceeded.

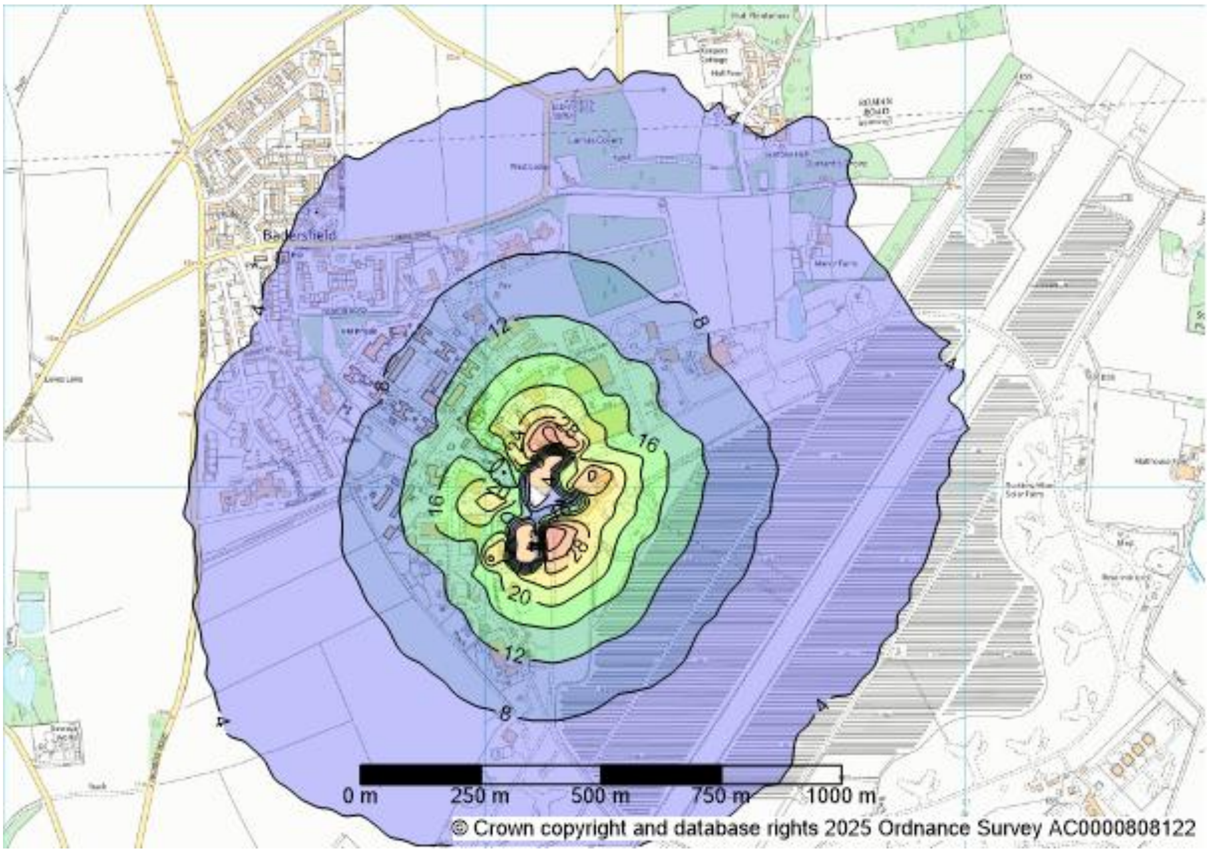



*Figure 5.4: Predicted 99.8th Percentile of Hourly Mean $NO_2$ Concentrations for 2020 – Abnormal Operation (µg/m³)*

### *5.3.2 Carbon Monoxide*

Maximum predicted 8-hour and 1-hour mean ground level CO process contributions are presented in Table 5.3.

*Table 5.3: Predicted CO Concentrations – Abnormal Operation (µg/m³)*

| Receptor | 8-Hour Mean | | 1-Hour Mean | |
|---|---|---|---|---|
| | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 28.1 | 0.3% | 29.5 | 0.1% |
| D1. 3D at Depth | 19.0 | 0.2% | 21.7 | 0.1% |
| D2. October Studios | 18.2 | 0.2% | 20.0 | 0.1% |
| D3. Specialist Vehicle Training | 15.1 | 0.2% | 18.9 | 0.1% |
| D4. HM Prison | 8.1 | 0.1% | 10.9 | 0.0% |
| D5. Filby Road | 5.2 | 0.1% | 6.2 | 0.0% |
| D6. Barton Road | 4.1 | 0.0% | 5.6 | 0.0% |
| D7. West Lodge | 3.4 | 0.0% | 4.2 | 0.0% |

| | | | | |
|---|---|---|---|---|
| D8. Manor Farm | 2.9 | 0.0% | 4.9 | 0.0% |
| D9. Malthouse Farm | 1.3 | 0.0% | 3.0 | 0.0% |
| D10. Honeysuckle Cottage | 1.8 | 0.0% | 2.8 | 0.0% |
| D11. The White House | 1.4 | 0.0% | 2.6 | 0.0% |
| AQAL (µg/m³) | 10,000 | | 30,000 | |
| Background (µg/m³) | 371 | | 530 | |
| Maximum PEC (µg/m³) | 399 | | 560 | |
| Maximum PEC (% AQAL) | 4.0% | | 1.9% | |

The predicted maximum CO concentrations at all locations are well below the Environment Agency's 10% short-term screening criteria. Therefore, the impact of CO emissions from the installation are assessed as not significant.

### *5.3.3 Sulphur Dioxide ($SO_2$)*

The predicted $SO_2$ process contributions are presented in **Table 5.4**. Predicted concentrations for 2024 as the 99.9$^{th}$ percentile of 15-minute means are presented in **Figure 5.5**.

***Table 5.4: Predicted $SO_2$ Concentrations – Abnormal Operation (µg/m$^3$)***

| Receptor | 99.2$^{nd}$ Percentile of 24-Hour Means | | 99.7$^{th}$ Percentile of 1-Hour Means | | 99.9$^{th}$ Percentile of 15-Minute Means | |
|---|---|---|---|---|---|---|
| | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 18.9 | 15.1% | 28.0 | 8.0% | 29.8 | 11.2% |
| D1. 3D at Depth | 10.6 | 8.4% | 19.5 | 5.6% | 21.1 | 8.0% |
| D2. October Studios | 5.3 | 4.3% | 15.7 | 4.5% | 18.1 | 6.8% |
| D3. Specialist Vehicle Training | 7.8 | 6.2% | 16.8 | 4.8% | 18.3 | 6.9% |
| D4. HM Prison | 3.6 | 2.9% | 9.3 | 2.6% | 10.2 | 3.9% |
| D5. Filby Road | 2.7 | 2.2% | 5.5 | 1.6% | 6.5 | 2.4% |
| D6. Barton Road | 2.5 | 2.0% | 4.8 | 1.4% | 5.7 | 2.1% |
| D7. West Lodge | 2.5 | 2.0% | 4.1 | 1.2% | 4.7 | 1.8% |
| D8. Manor Farm | 2.0 | 1.6% | 3.4 | 1.0% | 4.1 | 1.5% |
| D9. Malthouse Farm | 0.68 | 0.5% | 1.9 | 0.5% | 2.9 | 1.1% |
| D10. Honeysuckle Cottage | 0.99 | 0.8% | 2.2 | 0.6% | 3.0 | 1.1% |
| D11. The White House | 0.87 | 0.7% | 1.7 | 0.5% | 2.8 | 1.1% |
| AQAL (µg/m³) | 125 | | 350 | | 266 | |
| Background (µg/m³) | 2.5 | | 4.2 | | 5.6 | |
| Maximum PEC (µg/m³) | 21.4 | | 32.2 | | 35.5 | |
| Maximum PEC (% AQAL) | 17.1% | | 9.2% | | 13.3% | |

Predicted maximum $SO_2$ concentrations at receptor locations are substantially below the relevant short-term AQALs. The contribution from the installation (PC) is less than 10% of the 24-hour, 1-hour mean and 15-minute AQALs at all sensitive receptor locations and would be assessed as not significant according to the Environment Agency's Risk Assessment Guidance. As the maximum predicted, the 10% criterion is exceeded for the 24-hour mean and 15-minute mean but the PCs are below 20% of the difference between the AQAL and the background concentration and it is unlikely that the AQAL would be exceeded.

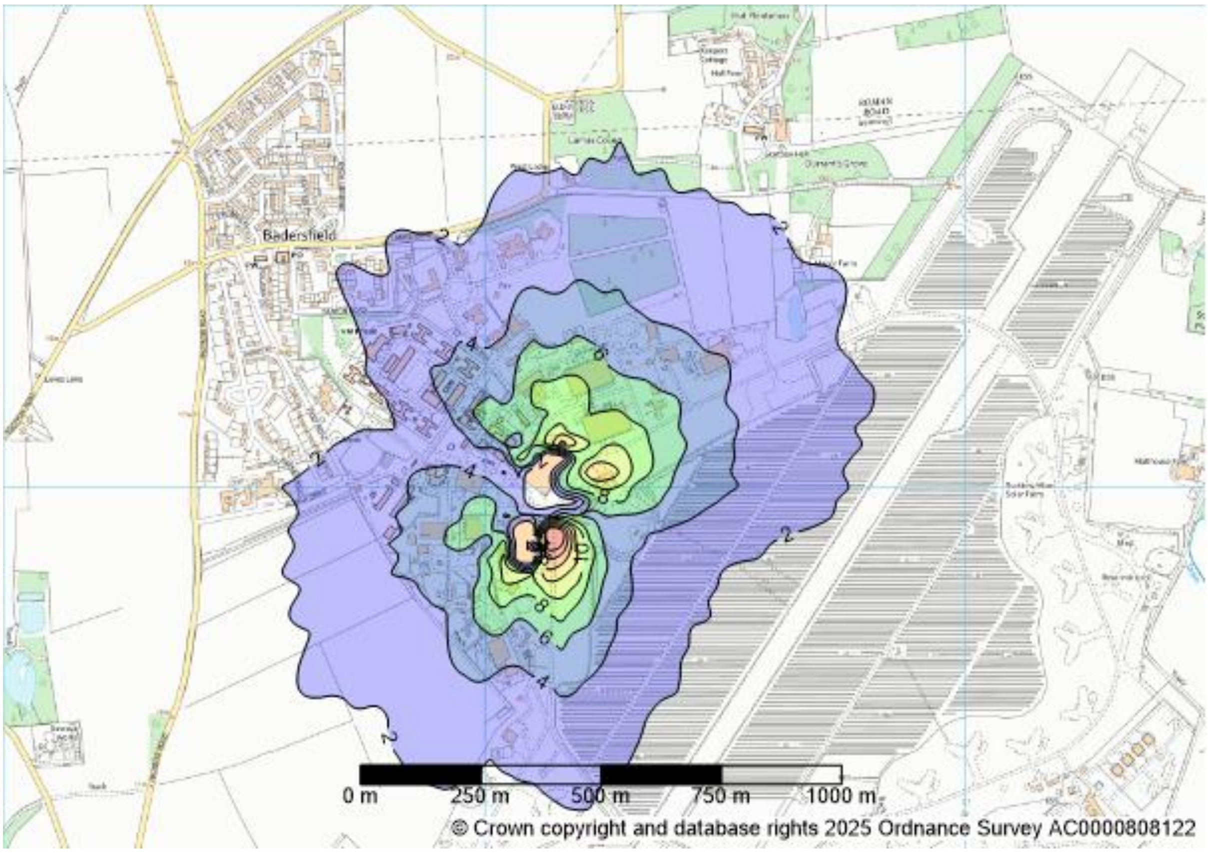



*Figure 5.5: Predicted 99.9th Percentile of 15-minute Mean $SO_2$ Concentrations 2020 – Abnormal Operation (µg/m³)*

### 5.3.4 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 5.5.** The predictions assume that 100% of the particulate matter emitted from the stack is in the $PM_{10}$ fraction. A contour plot of the 90.4th percentile of 24-hour means for 2020 is presented in **Figure 5.6.**

*Table 5.5: Predicted $PM_{10}$ Concentrations – Abnormal Operation (µg/m³)*

| Receptor | Annual Mean | | 90.4th Percentile of 24-Hour Means | |
|---|---|---|---|---|
| | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 0.43 | 1.1% | 1.6 | 3.2% |
| D1. 3D at Depth | 0.11 | 0.3% | 0.33 | 0.7% |
| D2. October Studios | 0.067 | 0.2% | 0.18 | 0.4% |
| D3. Specialist Vehicle Training | 0.075 | 0.2% | 0.22 | 0.4% |
| D4. HM Prison | 0.060 | 0.1% | 0.22 | 0.4% |
| D5. Filby Road | 0.039 | 0.1% | 0.16 | 0.3% |
| D6. Barton Road | 0.036 | 0.1% | 0.14 | 0.3% |
| D7. West Lodge | 0.064 | 0.2% | 0.21 | 0.4% |
| D8. Manor Farm | 0.089 | 0.2% | 0.27 | 0.5% |
| D9. Malthouse Farm | 0.021 | 0.1% | 0.069 | 0.1% |
| D10. Honeysuckle Cottage | 0.017 | 0.0% | 0.074 | 0.1% |
| D11. The White House | 0.015 | 0.0% | 0.055 | 0.1% |
| AQAL (µg/m³) | 40 | | 50 | |
| Background (µg/m³) | 12.4 | | 14.6 | |
| Maximum PEC (µg/m³) | 12.8 | | 16.2 | |
| Maximum PEC (% AQAL) | 32.1% | | 32.4% | |

At sensitive receptors, the predicted $PM_{10}$ concentrations are less than 1% and 10% of the relevant long and short-term AQALs respectively and would be assessed as not significant. At the maximum predicted the annual mean PC exceeds 1% of the AQAL and is potentially significant. However, the PEC is well below 70% of the AQAL and it is unlikely that this would be exceeded.

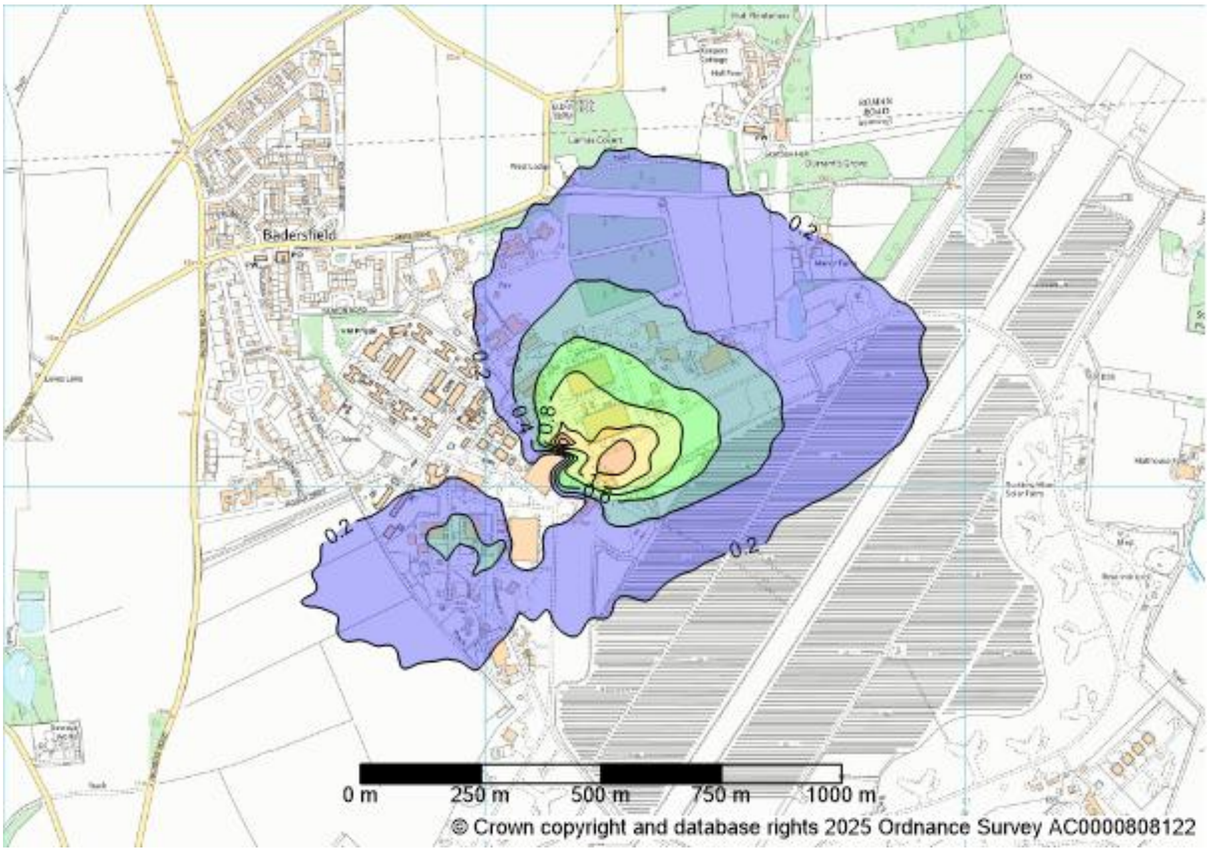



*Figure 5.6: Predicted 90.4th Percentile of 24-hour Mean $PM_{10}$ Concentrations 2020 – Abnormal Operation (µg/m³)*

### 5.3.5 Particulate Matter (as $PM_{2.5}$)

Predicted annual mean $PM_{2.5}$ process contributions are presented in **Table 5.6**. The predictions assume that 100% of the particulate matter emitted from the stack is in the $PM_{2.5}$ fraction. A contour plot of annual mean $PM_{2.5}$ (and $PM_{10}$) concentrations for 2020 is presented in **Figure 5.7.**

*Table 5.6: Predicted $PM_{2.5}$ Concentrations – Abnormal Operation (µg/m³)*

| Receptor | Annual Mean | |
|---|---|---|
| | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 0.43 | 2.2% |
| D1. 3D at Depth | 0.11 | 0.6% |
| D2. October Studios | 0.067 | 0.3% |
| D3. Specialist Vehicle Training | 0.075 | 0.4% |
| D4. HM Prison | 0.060 | 0.3% |
| D5. Filby Road | 0.039 | 0.2% |
| D6. Barton Road | 0.036 | 0.2% |
| D7. West Lodge | 0.064 | 0.3% |
| D8. Manor Farm | 0.089 | 0.4% |
| D9. Malthouse Farm | 0.021 | 0.1% |

| | | |
|---|---|---|
| D10. Honeysuckle Cottage | 0.017 | 0.1% |
| D11. The White House | 0.015 | 0.1% |
| AQAL (µg/m$^3$) | 20 | |
| Background (µg/m$^3$) | 5.6 | |
| Maximum PEC (µg/m$^3$) | 6.0 | |
| Maximum PEC (% AQAL) | 30.2% | |

At sensitive receptors, the annual mean $PM_{2.5}$ concentration is less than 1% of the AQAL of 20 µg/m$^3$ and would be assessed as not significant. The maximum predicted annual mean concentration exceeds 1% of the AQAL but the PEC is well below 70% of the AQAL and it is unlikely that this would be exceeded.

Compared to the AMCT of 10 µg/m$^3$ (to be met by 2040), the PC would be 4.3% of the limit and would be potentially significant. However, the PEC would only be 60% of the AMCT and it is unlikely that this would be exceeded. Furthermore, given the policies and regulations to reduce concentrations of $PM_{2.5}$, it is likely that background concentrations of $PM_{2.5}$ in the future would be lower than current levels.

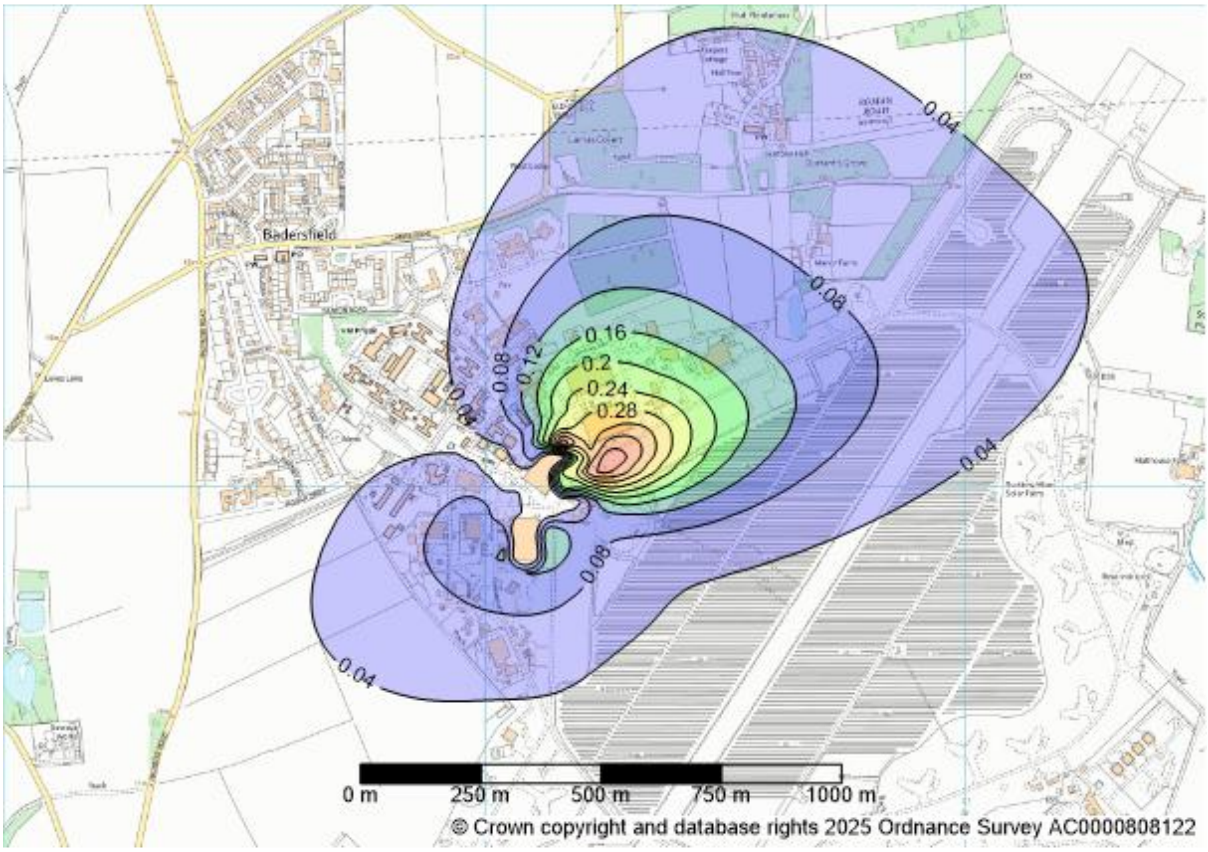



*Figure 5.7: Predicted Annual Mean $PM_{2.5}$ (and $PM_{10}$) Concentrations 2020 – Abnormal Operation (µg/m$^3$)*

### *5.3.6 Total Organic Carbon (as 1,3-Butadiene)*

Predicted annual mean and 24-hour mean ground-level 1,3-butadiene concentrations (PC) are presented in **Table 5.7.** This assumes that all of the total organic carbon (TOC) emitted from the facility comprises entirely of 1,3-butadiene and represents an extreme worst-case.

*Table 5.7: Predicted 1,3 Butadiene Concentrations – Abnormal Operation (µg/m$^3$)*

| Receptor | Annual Mean | | 24-hour Mean | |
|---|---|---|---|---|
| | PC (µg/m$^3$) | PC (% AQAL) | PC (µg/m$^3$) | PC (% AQAL) |
| Maximum Off-Site | 0.43 | 19.3% | 4.5 | 202% |
| D1. 3D at Depth | 0.11 | 4.9% | 2.7 | 122% |
| D2. October Studios | 0.067 | 3.0% | 1.4 | 62.7% |
| D3. Specialist Vehicle Training | 0.075 | 3.3% | 2.6 | 116% |
| D4. HM Prison | 0.060 | 2.7% | 0.95 | 42.0% |
| D5. Filby Road | 0.039 | 1.7% | 0.76 | 33.8% |
| D6. Barton Road | 0.036 | 1.6% | 0.56 | 24.8% |
| D7. West Lodge | 0.064 | 2.8% | 0.56 | 25.0% |
| D8. Manor Farm | 0.089 | 3.9% | 0.45 | 20.1% |
| D9. Malthouse Farm | 0.021 | 0.9% | 0.17 | 7.6% |
| D10. Honeysuckle Cottage | 0.017 | 0.8% | 0.24 | 10.9% |
| D11. The White House | 0.015 | 0.7% | 0.21 | 9.6% |
| AQAL (µg/m$^3$) | 2.25 | | 2.25 (short term) | |
| Background (µg/m$^3$) | 0.11 | | 0.13 | |
| Maximum PEC (µg/m$^3$) | 0.54 | | 4.7 | |
| Maximum PEC (% AQAL) | 24.2% | | 207% | |

The maximum annual mean 1,3-butadiene concentration is 19.3% of the AQAL and is potentially significant. However, the PEC is 24.2% of the AQAL and it is concluded that it is unlikely that the AQAL would be exceeded.

The maximum predicted 24-hour mean concentrations exceed 10% of the short-term AQAL for the majority of receptors and exceeds the AQAL as the maximum predicted anywhere within the model domain as well as at Receptors D1 and D3. However, there is no relevant public exposure at the location of maximum impact (refer **Figure 5.8** which shows peaks to the east, south and north of the facility). Furthermore, this assumes that all of the TOC comprises 1,3-butadiene. In reality, predicted concentrations would be substantially less than this. Therefore, it is concluded that emissions of TOC would be not significant or that it would be unlikely that the AQAL would be exceeded.

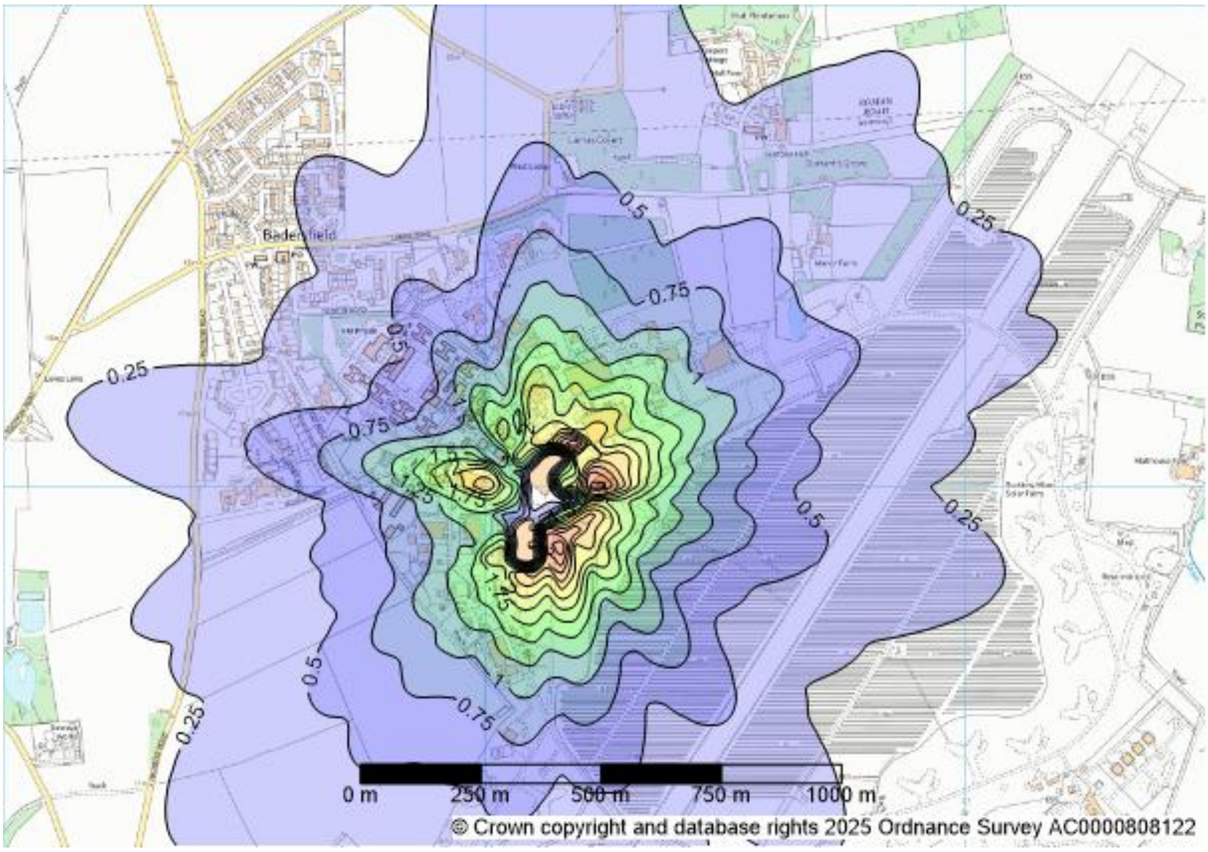



*Figure 5.8: Predicted Maximum 24-Hour Mean TOC Concentrations 2020 – Abnormal Operation (µg/m³)*

### 5.3.7 Hydrogen Chloride

Predicted annual mean ground-level HCl concentrations (PC) are presented in **Table 5.8**. The maximum predicted hourly mean concentrations are less than 10% of the AQAL and would be assessed as not significant.

*Table 5.8: Predicted HCl Concentrations – Abnormal Operation (µg/m³)*

| Receptor | 1-Hour Mean | |
|---|---|---|
| | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 5.9 | 0.8% |
| D1. 3D at Depth | 4.3 | 0.6% |
| D2. October Studios | 4.0 | 0.5% |
| D3. Specialist Vehicle Training | 3.8 | 0.5% |
| D4. HM Prison | 2.2 | 0.3% |
| D5. Filby Road | 1.2 | 0.2% |
| D6. Barton Road | 1.1 | 0.1% |
| D7. West Lodge | 0.85 | 0.1% |
| D8. Manor Farm | 0.98 | 0.1% |
| D9. Malthouse Farm | 0.60 | 0.1% |

| | | |
|---|---|---|
| D10. Honeysuckle Cottage | 0.56 | 0.1% |
| D11. The White House | 0.52 | 0.1% |
| AQAL (µg/m³) | 750 | |
| Background (µg/m³) | 0.66 | |
| Maximum PEC (µg/m³) | 6.6 | |
| Maximum PEC (% AQAL) | 0.9% | |

### 5.3.8 Hydrogen Fluoride

The predicted maximum monthly (weekly) and 1-hour mean ground-level hydrogen fluoride concentrations are presented in **Table 5.9**. The ADMS model is unable to predict monthly mean concentrations and as a worst-case the weekly mean concentrations are presented.

*Table 5.9: Predicted HF Concentrations – Abnormal Operation (µg/m³)*

| Receptor | Monthly (Weekly) Mean | | 1-Hour Mean | |
|---|---|---|---|---|
| | PC (µg/m³) | PC (% AQAL) | PC (µg/m³) | PC (% AQAL) |
| Maximum Off-Site | 0.20 | 1.2% | 0.59 | 0.4% |
| D1. 3D at Depth | 0.074 | 0.5% | 0.43 | 0.3% |
| D2. October Studios | 0.048 | 0.3% | 0.40 | 0.3% |
| D3. Specialist Vehicle Training | 0.080 | 0.5% | 0.38 | 0.2% |
| D4. HM Prison | 0.033 | 0.2% | 0.22 | 0.1% |
| D5. Filby Road | 0.030 | 0.2% | 0.12 | 0.1% |
| D6. Barton Road | 0.024 | 0.2% | 0.11 | 0.1% |
| D7. West Lodge | 0.027 | 0.2% | 0.085 | 0.1% |
| D8. Manor Farm | 0.023 | 0.1% | 0.098 | 0.1% |
| D9. Malthouse Farm | 0.006 | 0.0% | 0.060 | 0.0% |
| D10. Honeysuckle Cottage | 0.012 | 0.1% | 0.056 | 0.0% |
| D11. The White House | 0.014 | 0.1% | 0.052 | 0.0% |
| AQAL (µg/m³) | 16 | | 160 | |
| Background (µg/m³) | 0.2 | | 0.2 | |
| Maximum PEC (µg/m³) | 0.40 | | 0.79 | |
| Maximum PEC (% AQAL) | 2.5% | | 0.5% | |

At sensitive receptors, the maximum monthly (weekly) mean HF concentration is less than 1% of the AQAL and the impact would be assessed as not significant. As the maximum predicted, the PC exceeds 1% but the PEC is well below 70% of the AQAL and it is unlikely that the AQAL would be exceeded.

The maximum short-term HF concentrations are less than 10% of the AQAL at all off-site locations and would also be assessed as not significant.

### *5.3.9 Dioxins and Furans*

The predicted annual mean ground-level dioxin and furan process contributions at identified sensitive receptor locations are presented in **Table 5.10**. The results are presented in femtograms (fg) per cubic metre ($10^{-15}$ g/m$^3$).

***Table 5.10: Predicted Dioxin and Furan Concentrations – Abnormal Operation (fg/m$^3$)***

| Receptor | Annual Mean | |
|---|---|---|
| | PC (fg/m$^3$) | PC (% Background) |
| Maximum Off-Site | 2.6 | 81.4% |
| D1. 3D at Depth | 0.66 | 20.7% |
| D2. October Studios | 0.40 | 12.5% |
| D3. Specialist Vehicle Training | 0.45 | 14.0% |
| D4. HM Prison | 0.36 | 11.2% |
| D5. Filby Road | 0.23 | 7.3% |
| D6. Barton Road | 0.22 | 6.8% |
| D7. West Lodge | 0.38 | 12.0% |
| D8. Manor Farm | 0.53 | 16.6% |
| D9. Malthouse Farm | 0.13 | 4.0% |
| D10. Honeysuckle Cottage | 0.10 | 3.2% |
| D11. The White House | 0.09 | 2.7% |
| Background (fg/m$^3$) | 3.2 | |

There are no assessment criteria for dioxins and furans. The predicted maximum contribution from the installation at any location is 81.4% of the average background concentration measured at rural monitoring sites in the UK. The impact of dioxin emissions on human health is provided in the human health risk assessment (HHRA) submitted in support of the permit application.

### *5.3.10 PAH (as Benzo[a]pyrene)*

The maximum predicted annual mean ground level BaP process contributions are presented in **Table 5.11.** The results are presented in nanograms (ng) per cubic metre ($10^{-9}$ g/m$^3$). This assumes as a worst-case that all of the PAH emission comprises BaP.

***Table 5.11: Predicted BaP Concentrations – Abnormal Operation (ng/m$^3$)***

| Receptor | Annual Mean | |
|---|---|---|
| | PC (ng/m$^3$) | PC (% AQAL) |
| Maximum Off-Site | 0.0039 | 1.6% |
| D1. 3D at Depth | 0.00099 | 0.4% |
| D2. October Studios | 0.00060 | 0.2% |

| | | |
|---|---|---|
| D3. Specialist Vehicle Training | 0.00067 | 0.3% |
| D4. HM Prison | 0.00054 | 0.2% |
| D5. Filby Road | 0.00035 | 0.1% |
| D6. Barton Road | 0.00032 | 0.1% |
| D7. West Lodge | 0.00057 | 0.2% |
| D8. Manor Farm | 0.00080 | 0.3% |
| D9. Malthouse Farm | 0.00019 | 0.1% |
| D10. Honeysuckle Cottage | 0.00015 | 0.1% |
| D11. The White House | 0.00013 | 0.1% |
| AQAL (ng/m$^3$) | 0.25 | |
| Background (ng/m$^3$) | 0.11 | |
| Maximum PEC (ng/m$^3$) | 0.11 | |
| Maximum PEC (% AQAL) | 45.6% | |

The maximum predicted off site concentration is 1.6% of the AQAL and would be assessed as potentially significant but the PEC is well below 70% of the AQAL and it is unlikely that this would be exceeded. At sensitive receptor locations where there is relevant public exposure, predicted concentrations are 0.3% or less compared to the AQAL.

### *5.3.11 Polychlorinated Biphenyls*

The predicted annual mean and maximum 1 hour mean ground level PCB process contributions are presented in **Table 5.12**. The results are presented in nanograms (ng) per cubic metre ($10^{-9}$ g/m$^3$).

***Table 5.12: Predicted PCB Concentrations – Abnormal Operation (ng/m$^3$)***

| Receptor | Annual Mean | | 1-Hour Mean | |
|---|---|---|---|---|
| | PC (ng/m$^3$) | PC (% AQAL) | PC (ng/m$^3$) | PC (% AQAL) |
| Maximum Off-Site | 0.22 | 0.1% | 3.0 | <0.1% |
| D1. 3D at Depth | 0.055 | <0.1% | 2.2 | <0.1% |
| D2. October Studios | 0.033 | <0.1% | 2.0 | <0.1% |
| D3. Specialist Vehicle Training | 0.037 | <0.1% | 1.9 | <0.1% |
| D4. HM Prison | 0.030 | <0.1% | 1.1 | <0.1% |
| D5. Filby Road | 0.020 | <0.1% | 0.62 | <0.1% |
| D6. Barton Road | 0.018 | <0.1% | 0.56 | <0.1% |
| D7. West Lodge | 0.032 | <0.1% | 0.42 | <0.1% |
| D8. Manor Farm | 0.044 | <0.1% | 0.49 | <0.1% |
| D9. Malthouse Farm | 0.011 | <0.1% | 0.30 | <0.1% |
| D10. Honeysuckle Cottage | 0.008 | <0.1% | 0.28 | <0.1% |
| D11. The White House | 0.007 | <0.1% | 0.26 | <0.1% |

| | | |
|---|---|---|
| AQAL ($ng/m^3$) | 200 | 6000 |
| Background ($ng/m^3$) | 0.024 | 0.048 |
| Maximum PEC ($ng/m^3$) | 0.24 | 3.0 |
| Maximum PEC (% AQAL) | 0.1% | 0.1% |

Maximum predicted ground level annual mean and 1-hour mean PCB concentrations are less than 1% and 10% of the long and short-term AQALs, respectively. Therefore, the impact would be assessed as not significant.

### *5.3.12 Trace Metals*

The predicted maximum long and short-term trace metal concentrations for emissions at the maximum IED limits are presented in **Table 5.13** and **Table 5.14,** respectively. This assumes that each metal is emitted at the ELV for the group.

Step 1: Emissions at the Group ELV

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

*Table 5.13: Predicted Maximum Long Term Trace Metal Concentrations – Abnormal Operation (Step 1)*

| Pollutant | EAL ($ng/m^3$) | Max. PC ($ng/m^3$) | Background ($ng/m^3$) | PC (% AQAL) | PEC (% of AQAL) | Further Assessment Required? |
|---|---|---|---|---|---|---|
| Cadmium (Cd) | 5 | 2.2 | 0.085 | 43.4% | 45.2% | No |
| Thallium (Tl) | 1,000 | 2.2 | - | 0.2% | 0.2% | No |
| Mercury (Hg) | 60 | 22.7 | 3.2 | 37.8% | 43.1% | No |
| Antimony (Sb) | 5,000 | 21.7 | - | 0.4% | 0.4% | No |
| **Arsenic (As)** | **6** | **21.7** | **0.55** | **362%** | **371%** | **Yes** |
| Chromium (Cr) | 2,000 | 227 | 0.64 | 11.3% | 11.4% | No |
| **Chromium VI** | **0.25** | **4.3** | **0.11** | **1737%** | **1781%** | **Yes** |
| Cobalt (Co) | 1,000 | 21.7 | 0.044 | 2.2% | 2.2% | No |
| **Copper (Cu)** | **50** | **227** | **2.0** | **454%** | **458%** | **Yes** |
| Manganese (Mn) | 150 | 21.7 | 3.0 | 14.5% | 16.5% | No |
| **Nickel (Ni)** | **20** | **21.7** | **0.61** | **109%** | **112%** | **Yes** |
| Lead (Pb) | 250 | 21.7 | 2.9 | 8.7% | 9.8% | No |

*Table 5.14: Predicted Maximum Short Term Trace Metal Concentrations – Abnormal Operation (Step 1)*

| Pollutant | AQAL (ng/m$^3$) | Max. PC (ng/m$^3$) | Background (ng/m$^3$) | PC (% AQAL) | PEC (% AQAL) | Further Assessment Required? |
|---|---|---|---|---|---|---|
| Cd (24-hour) | 30 | 22.7 | 0.10 | 75.6% | 75.9% | No |
| Hg (1-hour) | 600 | 29.5 | 5.4 | 4.9% | 5.8% | No |
| Sb (1-hour) | 150,000 | 295 | - | 0.2% | 0.2% | No |
| Mn (1-hour) | 1,500,000 | 295 | 6.0 | 0.0% | 0.0% | No |
| Ni (1-hour) | 700 | 295 | 1.2 | 42.2% | 42.4% | No |
| V (24-hour) | 1,000 | 227 | 1.3 | 22.7% | 22.8% | No |

On the basis of the Step 1 screening, further assessment is required for long-term arsenic (annual mean), chromium (VI) (annual mean), copper (24-hour long-term mean) and nickel (annual mean).

The maximum predicted short-term impacts are well below the relevant AQALs and for all metals the PCs are less than 10% and/or the PECs are less than 100% of the relevant AQAL. Therefore, these can all be screened from further assessment.

Step 2: Typical Emissions

The Environment Agency 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 As, CrVI, Cu and Ni have been predicted using the maximum measured emission concentration (0.025 mg/Nm$^3$, 0.00013 mg/Nm$^3$, 0.029 mg/Nm$^3$ and 0.053 mg/Nm$^3$ for As, CrVI, Cu and Ni, respectively). Except for Ni, these are the maximum measured concentrations and for Ni the third highest concentration is used as the highest two values were identified by the Environment Agency as outliers. For these typical emission concentrations, maximum predicted ground level concentrations are presented in **Table 5.15.**

*Table 5.15: Maximum Long Term Trace Metal Concentrations – Abnormal Operation (Typical Emissions)*

| Pollutant | EAL (ng/m$^3$) | PC (ng/m$^3$) | PC (% of EAL) | PEC (% of EAL) | Further Assessment Required? |
|---|---|---|---|---|---|
| As – annual mean | 6 | 1.1 | 18.1% | 27.3% | No |
| CrVI (a) – annual mean | 0.25 | 0.0056 | 2.3% | 45% | No |
| Cu – 24-hour mean (long-term) | 50 | 13 | 26.3% | 30.3% | No |
| Ni – annual mean | 20 | 2.3 | 11.5% | 14.6% | No |
| (a) The background concentrations is apportioned 20% CrVI in accordance with the Environment Agency's guidance. | | | | | |

On the basis of Step 2 of the assessment, no further assessment is required. Although the PCs for all four metals exceed 1% of the respective AQAL, the PECs are all well below 100% of the AQAL.

# 6. ASSESSMENT OF IMPACTS ON HABITAT SITES

## 6.1 Introduction

For normal operation, the impact of emissions on habitat sites has been screened out as there are no habitat sites within the relevant distances for MCP facilities. Results are presented for abnormal operation only.

## 6.2 Airborne Concentrations of NOx, $SO_2$ and HF – Abnormal Operation

Predicted maximum ground level concentrations of NOx, $SO_2$ and HF at the identified habitat sites are compared with the relevant critical levels (CL) in **Table 6.1** to **Table 6.3** for NOx, $SO_2$ and HF, respectively.

### *6.2.1 NOx*

Predicted annual mean and maximum 24-hour mean NOx concentrations are compared to the relevant critical levels in **Table 6.1**.

*Table 6.1: Predicted Maximum NOx Concentrations – Abnormal Operation*

| Habitat Site | Annual Mean $NO_x$ (µg/m$^3$) | Percentage of CL | 24-hour Mean (µg/m$^3$) | Percentage of CL |
|---|---|---|---|---|
| H1. The Broads SAC | 0.071 | 0.2% | 0.63 | 0.8% |
| H1. Broadland SPA/Ramsar | 0.071 | 0.2% | 0.63 | 0.8% |
| H2. Norfolk Valley Fens SAC | 0.023 | 0.1% | 0.52 | 0.7% |
| H3. Scottow Pond and Oak Belt LWS | 0.44 | 1.5% | 3.6 | 4.8% |
| H4. Stakebridge Beck LWS | 0.16 | 0.5% | 2.6 | 3.5% |
| H5. Low Common and Plantations LWS | 0.35 | 1.2% | 3.6 | 4.8% |
| *Critical Level (µg/m$^3$)* | *30* | | *75* | |

Predicted annual mean concentrations of $NO_x$ at the European sites are less than 1% of the critical level of 30 µg/m$^3$ and for the 24-hour mean are less than 10% of the critical level of 75 µg/m$^3$ and would be assessed as not significant. For the LWS, predicted NOx concentrations are less than 100% of the long-term and short-term critical levels. Therefore, the impact of $NO_x$ emissions on habitat sites would be assessed as not significant.

### *6.2.2 $SO_2$*

For $SO_2$, there are two critical levels depending on the presence of lichens. For The Broads SAC and the Norfolk Valley Fens SAC, APIS indicates the most stringent critical level is applicable. For the LWS, there is little information available on the likely presence of lichens. Therefore, the more stringent critical level of 10 µg/m$^3$ for $SO_2$ has been adopted for these habitats. Predicted $SO_2$ concentrations are presented in **Table 6.2**.

*Table 6.2:Predicted Maximum $SO_2$ Concentrations – Abnormal Operation*

| Habitat Site | Annual Mean $SO_2$ (µg/m$^3$) | Percentage of CL |
|---|---|---|
| H1. The Broads SAC | 0.018 | 0.2% |
| H1. Broadland SPA/Ramsar | 0.018 | 0.1% |
| H2. Norfolk Valley Fens SAC | 0.0057 | 0.1% |
| H3. Scottow Pond and Oak Belt LWS | 0.11 | 1.1% |
| H4. Stakebridge Beck LWS | 0.039 | 0.4% |
| H5. Low Common and Plantations LWS | 0.088 | 0.9% |
| *Critical Level (µg/m$^3$)* | *10 - 20* | |

Predicted annual mean concentrations of $SO_2$ at the European sites are less than 1% of the applicable critical level and would be assessed as not significant. For the LWS, predicted $SO_2$ concentrations are less than 100% of the most stringent long-term critical levels. Therefore, the impact of $NO_x$ emissions on habitat sites would be assessed as not significant.

### 6.2.3 HF

Predicted HF concentrations as the maximum weekly mean and maximum 24-hour mean are presented in **Table 6.3**.

*Table 6.3: Predicted Maximum HF Concentrations – Abnormal Operation*

| Habitat Site | Weekly Mean HF (µg/m$^3$) | Percentage of CL | 24-hour Mean HF (µg/m$^3$) | Percentage of CL |
|---|---|---|---|---|
| H1. The Broads SAC | 0.0014 | 0.3% | 0.0031 | 0.1% |
| H1. Broadland SPA/Ramsar | 0.0014 | 0.3% | 0.0031 | 0.1% |
| H2. Norfolk Valley Fens SAC | 0.00081 | 0.2% | 0.0026 | 0.1% |
| H3. Scottow Pond and Oak Belt LWS | 0.0096 | 1.9% | 0.018 | 0.4% |
| H4. Stakebridge Beck LWS | 0.0051 | 1.0% | 0.013 | 0.3% |
| H5. Low Common and Plantations LWS | 0.0068 | 1.4% | 0.018 | 0.4% |
| *Critical Level (µg/m$^3$)* | *0.5* | | *5* | |

Predicted weekly mean concentrations of HF at the European sites are less than 1% of the critical level of 0.5 µg/m$^3$ and for the 24-hour mean are less than 10% of the critical level of 5 µg/m$^3$ and would be assessed as not significant. For the LWS, predicted HF concentrations are less than 100% of the long-term and short-term critical levels. Therefore, the impact of HF emissions on habitat sites would be assessed as not significant.

## 6.3 Nutrient Nitrogen Deposition – Abnormal Operation

Predicted maximum nutrient nitrogen deposition rates are compared with the lower critical load for each habitat in **Table 6.4**.

*Table 6.4: Predicted Nutrient Nitrogen Deposition Rate – Abnormal Operation (kg N/ha/a)*

| Habitat Site | PC | PEC | Critical Load | PC (as %age of CL) |
|---|---|---|---|---|
| H1. The Broads SAC | 0.010 | 16.09 | 5 | 0.2% |
| H1. Broadland SPA/Ramsar | 0.010 | 16.09 | 5 | 0.2% |
| H2. Norfolk Valley Fens SAC | 0.0033 | 21.10 | 5 | 0.1% |
| H3. Scottow Pond and Oak Belt LWS | 0.13 | 32.91 | 10 | 1.3% |
| H4. Stakebridge Beck LWS | 0.023 | 18.43 | 10 | 0.2% |
| H5. Low Common and Plantations LWS | 0.10 | 32.88 | 10 | 1.0% |

Due to the high background nitrogen deposition rates, the PECs exceed the relevant critical loads at all habitat sites. However, the predicted contributions (PCs) from the installation at the three European sites are less than 1% of the relevant critical loads and less than 100% for the LWS. Therefore, the impact of the facility emissions on nutrient nitrogen deposition would be assessed as not significant.

## 6.4 Acidification – Abnormal Operation

Predicted acidification rates are expressed as a percentage of the critical load function (CLF) in **Table 6.5**.

*Table 6.5: Predicted Acidification Rates – Abnormal Operation (keq/ha/yr)*

| Habitat Site | PC | PEC | Critical Load (CLmaxN) | PC (as a %age of the CLF) |
|---|---|---|---|---|
| H1. The Broads SAC | 0.0039 | 1.15 | 0.497 | 0.8% |
| H1. Broadland SPA/Ramsar | 0.0039 | 1.15 | 0.837 | 0.5% |
| H2. Norfolk Valley Fens SAC | 0.0013 | 1.52 | 0.514 | 0.2% |
| H3. Scottow Pond and Oak Belt LWS | 0.052 | 2.42 | 1.756 | 3.0% |
| H4. Stakebridge Beck LWS | 0.0087 | 1.33 | 5.071 | 0.2% |
| H5. Low Common and Plantations LWS | 0.042 | 2.41 | 1.756 | 2.4% |

Due to the high background acidification rates, the PECs exceed the relevant critical loads at all habitat sites except H4. However, the predicted contributions (PCs) from the installation at the three European sites are less than 1% of the relevant critical loads and less than 100% for the LWS. Therefore, the impact of the facility emissions on acidification impacts would be assessed as not significant.

# 7. SENSITIVITY ANALYSIS

## 7.1 Emissions at Half-hourly ELVs

For abnormal operation, the dispersion modelling results presented in **Section 5** 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. This is an extreme 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 limit values prescribed in the IED. 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$^3$ (10 mg/Nm$^3$ 97% compliance);
- hydrogen chloride – 60 mg/Nm$^3$ (10 mg/Nm$^3$ 97% compliance);
- hydrogen fluoride – 4 mg/Nm$^3$ (2 mg/Nm$^3$ 97% compliance);
- sulphur dioxide – 200 mg/Nm$^3$ (50 mg/Nm$^3$ 97% compliance);
- oxides of nitrogen – 400 mg/Nm$^3$ (200 mg/Nm$^3$ 97% compliance); 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, maximum predicted short-term concentrations for emissions at the half hourly limit values are provided in **Table 7.1**. It should be noted that these results represent a very worst-case and for some of the pollutants ($NO_2$, $SO_2$ and $PM_{10}$) there are a number of occasions when the AQAL can be exceeded.

*Table 7.1: Maximum Predicted Short-term Concentrations at the Half-hourly ELVs – Abnormal Operation*

| Pollutant | PC (µg/m$^3$) | PC (%) | PEC (%) |
|---|---|---|---|
| $NO_2$ (maximum 1-hour) | 82.7 | 41.3% | 53.4% |
| $SO_2$ (maximum 15-minute) | 158.3 | 59.5% | 60.4% |
| $SO_2$ (maximum 1-hour) | 118.1 | 33.7% | 34.9% |
| $SO_2$ (maximum 24-hour) | 90.7 | 72.6% | 77.1% |
| $PM_{10}$ (maximum 24-hour) | 13.6 | 27.2% | 56.5% |
| HCl (maximum 1-hour) | 35.4 | 4.7% | 4.8% |
| HF (maximum 1-hour) | 2.36 | 1.5% | 1.6% |
| CO (maximum 8-hour) | 56.2 | 0.6% | 4.3% |
| CO (maximum 1-hour) | 59.1 | 0.2% | 2.0% |

Predicted concentrations are between 0.2% and 72.6% of the short term AQAL. Highest concentrations relative to the AQAL are predicted for $SO_2$ as the 15-minute mean. The PECs for all pollutants and averaging periods are all well below 100% of the respective AQAL. On the basis of these worst-case results, it is very unlikely that the AQAL would be exceeded anywhere within the model domain. 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.

## 7.2 Sensitivity Analysis

### *7.2.1 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 and has both a long-term and short-term AQAL. Predicted concentrations of $NO_2$ are provided as the maximum predicted for the annual mean and the 99.8$^{th}$ percentile of hourly means. The assessment is provided for abnormal operation where highest impacts are predicted.

### *7.2.2 Meteorological Data*

Dispersion modelling for five years of Norwich Airport meteorological data was undertaken. Results presented in **Section 5** and **Section 6** are the highest predicted for each averaging period and each receptor. For abnormal operation, a comparison of predicted concentrations of $NO_2$ for each of the five years is presented in **Table 7.2** as the maximum predicted anywhere within the modelling domain.

***Table 7.2: Maximum Predicted Concentrations of $NO_2$ for Annual Meteorological Data Sets – Abnormal Operation***

| Year | Annual Mean | | 99.8$^{th}$ Percentile of 1-hour Means | |
|---|---|---|---|---|
| | PC (µg/m$^3$) | PC (%age AQAL) | PC (µg/m$^3$) | PC (ug/m$^3$) |
| Norwich Airport 2019 | 5.2 | 13.1% | 37.2 | 18.6% |
| Norwich Airport 2020 | 6.1 | 15.2% | 39.5 | 19.7% |
| Norwich Airport 2021 | 5.0 | 12.4% | 38.3 | 19.1% |
| Norwich Airport 2022 | 5.3 | 13.3% | 35.6 | 17.8% |
| Norwich Airport 2023 | 5.9 | 14.8% | 39.1 | 19.6% |
| Norwich Airport Average | 5.5 | 13.8% | 37.9 | 19.0% |

For the annual mean, predicted concentrations for the five years are reasonably variable with the lowest concentration (2021) being 82% of the highest concentration (2020). The average for the five years is 5.5 µg/m$^3$ (90% of the maximum year). The hourly mean concentrations show slightly less variability with the lowest concentration (2022) 90% of the highest concentration (2020).

### *7.2.3 Main Building Selection*

The nearest building to the stack is the main Hangar Building at a maximum height of 12.3 m and this has been selected as the main building in the model. However, the Gas Store is slightly larger at 14.8 m although as a worst-case it has been represented in the model as cylinder of height 14.8 m rather than as a ball of maximum height of 14.8 m.

A sensitivity analysis was undertaken with the Gas Store as the main building. Results for 2020 are presented in **Table 7.3**. This provides the maximum predicted anywhere within the model domain and the maximum receptor concentration where there is relevant public exposure (Receptors D4 to D11 for the annual mean and all receptors for the hourly mean).

*Table 7.3: Predicted Maximum $NO_2$ Concentrations for Variable Main Buildings – Abnormal Operation*

| Main Building | Annual Mean | | 99.8$^{th}$ Percentile of 1-hour Means | |
|---|---|---|---|---|
| | PC (µg/m$^3$) | PC (%age AQAL) | PC (µg/m$^3$) | PC (%age AQAL) |
| Hangar Building at 12.3 m 2020 Maximum | 6.1 | 15.2% | 39.5 | 19.7% |
| Hangar Building at 12.3 m 2020 Receptor | 1.1 | 2.7% | 27.4 | 13.7% |
| Gas Storage at 14.8 m 2020 Maximum | 9.7 | 24.3% | 45.1 | 22.5% |
| Gas Storage at 14.8 m 2020 Receptor | 1.1 | 2.7% | 27.4 | 13.7% |
| Gas Storage at 11.1 m 2020 Maximum | 6.2 | 15.5% | 39.5 | 19.7% |
| Gas Storage at 11.1 m 2020 Receptor | 1.1 | 2.7% | 27.4 | 13.7% |

For the maximum predicted anywhere within the model domain, the use of Gas Store as the main building results in higher concentrations compared to the Hangar Building. However, at sensitive receptors, predicted concentrations are the same for both building options. Assuming the Gas Store is a cylinder at a height of 14.8 m represents a worst-case since the Gas Store is a ball with an average height of around 11.1 m. Therefore, results are also presented for the Gas Store at a mean height of 11.1 m. For this scenario, predicted concentrations are comparable to the Hangar Building scenario.

### *7.2.4 Surface Roughness*

The assessment provided assumes that the surface roughness surrounding the facility is 0.5 m mainly due to the immediate industrial and commercial surroundings but with a rural setting beyond the industrial and commercial units. The effect of varying the surface roughness is provided in **Table 7.4** for a lower surface roughness of 0.3 m and a higher surface roughness of 0.7 m.

*Table 7.4: Predicted Maximum $NO_2$ Concentrations for Variable Surface Roughness Values – Abnormal Operation*

| Surface Roughness | Annual Mean | | 99.8th Percentile of 1-hour Means | |
|---|---|---|---|---|
| | PC (µg/m³) | PC (%age AQAL) | PC (µg/m³) | PC (%age AQAL) |
| Surface roughness of 0.3 m 2020 | 5.5 | 13.9% | 41.2 | 20.6% |
| Surface roughness of 0.5 m 2020 | 6.1 | 15.2% | 39.5 | 19.7% |
| Surface roughness of 0.7 m 2020 | 6.8 | 17.0% | 40.5 | 20.2% |

The use of the higher surface roughness in the model results in a small increase in the maximum predicted annual mean concentration and a small increase in the short-term concentration for both alternative surface roughness options.

### *7.2.5 Summary*

The sensitivity analysis has demonstrated that varying the assumptions made for the assessment does significantly vary the predicted concentrations for most choices. However, except for surface roughness (where differences are small) and main building choices (adopting worst-case building shapes), the analysis has demonstrated that the worst-case assumptions have been adopted for the assessment. Therefore, it is concluded that overall the assessment provided is robust and representative of worst-case conditions.

# 8. CONCLUSION

An assessment of the likely local air quality impacts arising from an advanced conversion plant which thermochemically produces clean syngas from pre-processed non-hazardous solid wastes, principally Solid Recovered Fuels (SRF) and Refuse Derived Fuel (RDF) has been undertaken. The syngas will be used to operate a series of gas fired combined heat and power (CHP) generation units to provide heat and power to the wider Scottow Enterprise Park. The purpose of the assessment is to support an Environmental Permit application for the facility.

There would be two emissions to air from the facility and would comprise emissions from the pyrolyser and combined emissions from the CHP generation units. The facility will generate approximately 5 MWe of renewable electricity and approximately 2.5 MWth of heat. The plant has been designed to process approximately 6 tonnes per hour of pre-prepared non hazardous fuels. As a worst-case, it is assumed that the CHP generation units will have a total net rated input of 20 MWth and will likely comprise a number of smaller units with emissions via a common multi-flue stack.

The relevant listed activity for the proposed Advanced Thermal Treatment (ATT) pyrolysis installation is defined by Section 1.2 Part A(1)(f) (iv). All emissions from the combustion activities shall be in accordance with the MCP Directive, noting that Chapter IV of the Industrial Emissions Directive (IED) does not apply where Article 42 (1) is achieved – deeming syngas as no longer a waste and causing emissions no higher than combustion of natural gas.

Under Abnormal Operating Conditions it is anticipated that the plant will be required to mirror the Emission Limit Values (ELV) prescribed by Chapter IV of the IED.

Therefore, the assessment has considered the impact of the facility under normal conditions and compliance with the MCPD ELV and abnormal operation and compliance with the IED.

Taking into consideration the worst-case assumptions adopted for the assessment, predicted maximum off-site concentrations are well below the relevant air quality standards for all pollutants considered.

The predicted process contributions are negligible compared with the critical levels for airborne NOx, $SO_2$ and HF and critical loads for nutrient nitrogen deposition and acidification at nearby sensitive habitat sites.

# APPENDIX A AIR QUALITY STANDARDS AND OBJECTIVES

| Pollutant | Averaging Period | EAL / AQAL ($\mu g/m^3$) | 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 | 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 |
| 1,3-Butadiene | annual | 2.25 | AQO (England and Wales) |
| | 24-hour (short term) | 2.25 | EAL |
| 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 |
| Cadmium (Cd) | annual | 0.005 | EU Target Value |
| | 24-hour (short term) | 0.03 | EAL |
| Chromium III (CrIII) | 24-hour (long term) | 2.0 | EAL |
| Chromium VI (CrVI) | annual | 0.00025 | EAL |
| Cobalt (Co) | annual | 1 | Derived from HSE EH40/2002 OEL |
| Copper (Cu) | 24-hour (long term) | 0.05 | EAL |
| Manganese (Mn) | annual | 0.15 | EAL |
| | 1-hour | 1,500 | EAL |
| Lead (Pb) | annual | 0.25 | UK AQO |

| | | | |
|---|---|---|---|
| Mercury (Hg) | 24-hour (long term) | 0.06 | EAL |
| | 1-hour | 0.6 | EAL |
| Nickel (Ni) | annual | 0.02 | EU Target Value |
| | 1-hour | 0.7 | EAL |
| Thallium (Tl) | annual | 1 | Derived from HSE EH40/2002 OEL |
| Vanadium (V) | 24-hour | 1 | WHO |
| Polycyclic Aromatic Hydrocarbons (PAH) as Benzo[a]Pyrene | annual | 0.00025 | UK AQO |
| Polychlorinated Biphenyls (PCBs) | annual | 0.2 | EAL |
| | 1-hour | 6 | EAL |

# APPENDIX B DISPERSION MODEL INPUT PARAMETERS

*Table B 1: Stack Emission Parameters for the Pyrolyser (Emission Point A1)*

| Parameter | Value |
|---|---|
| Stack height (m) | 18.2 |
| Flue exit diameter (m) | 0.7 |
| Temperature of release (ºC) | 500 |
| Actual flow rate ($Am^3/s$) | 12.5 |
| Moisture content (%v/v) | 7.58 |
| Oxygen content (%v/v dry) | 10.75 |
| Normalised flow rate at 3% $O_2$ ($Nm^3/s$) | 2.11 (a) |
| Normalised flow rate at 11% $O_2$ ($Nm^3/s$) | 4.18 (b) |
| Emission velocity at flue exit (m/s) | 24.7 |
| **Emission Concentration ($mg/Nm^3$)** | **ELV** |
| NOx – normal operation | 100 (a) |
| IED ELVs for abnormal operation | Refer **Table 2.3** (b) |

(a) For normal operation, 3% O2 273K, 101.3 kPa, dry

(b) For abnormal operation, 11% O2 273K, 101.3 kPa, dry

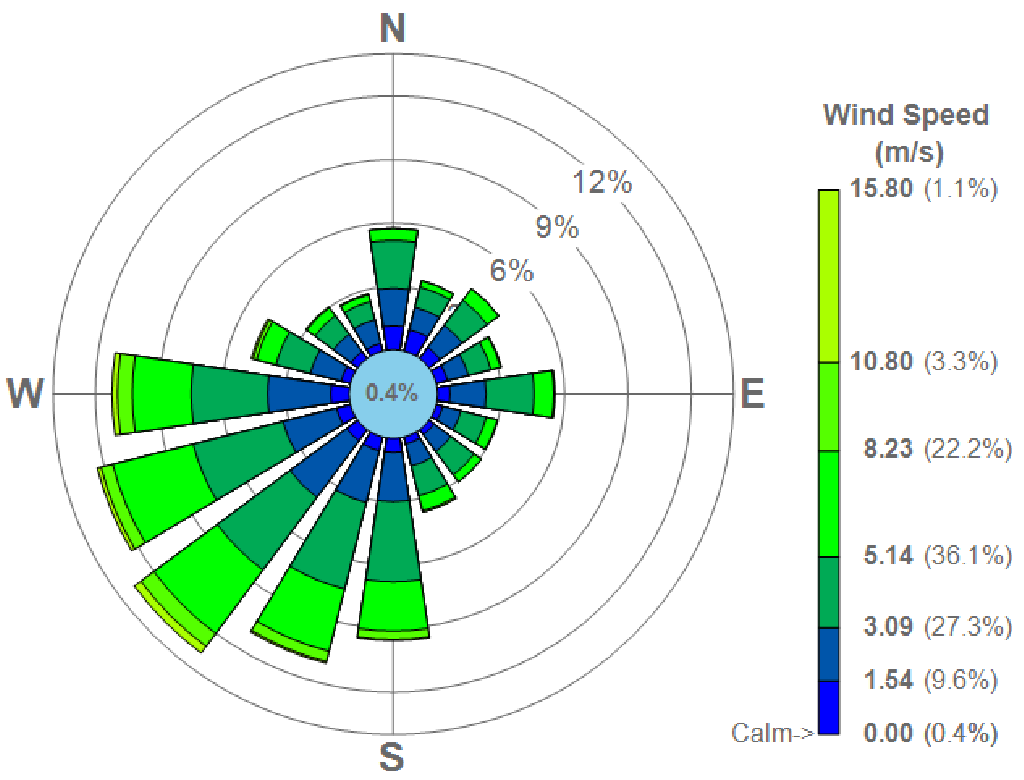
*Table B 2: Stack Emission Parameters – 20 MWth of Generators Combined (Emission Point A2)*

| Parameter | Value |
|---|---|
| Stack height (m) | 18.2 |
| Flue exit diameter (m) | 1.0 |
| Temperature of release (ºC) | 365 |
| Actual flow rate ($Am^3/s$) | 24.3 |
| Moisture content (%v/v) | 10.0 |
| Oxygen content (%v/v dry) | 7.8 |
| Normalised flow rate at 15% $O_2$ ($Nm^3/s$) | 20.78 (a) |
| Normalised flow rate at 11% $O_2$ ($Nm^3/s$) | 12.38 (b) |
| Emission velocity at flue exit (m/s) | 24.7 |
| **Emission Concentration ($mg/Nm^3$) (a)** | **ELV** |
| NOx – normal operation | 95 (a) |
| IED ELVs for abnormal operation | Refer **Table 2.3** (b) |

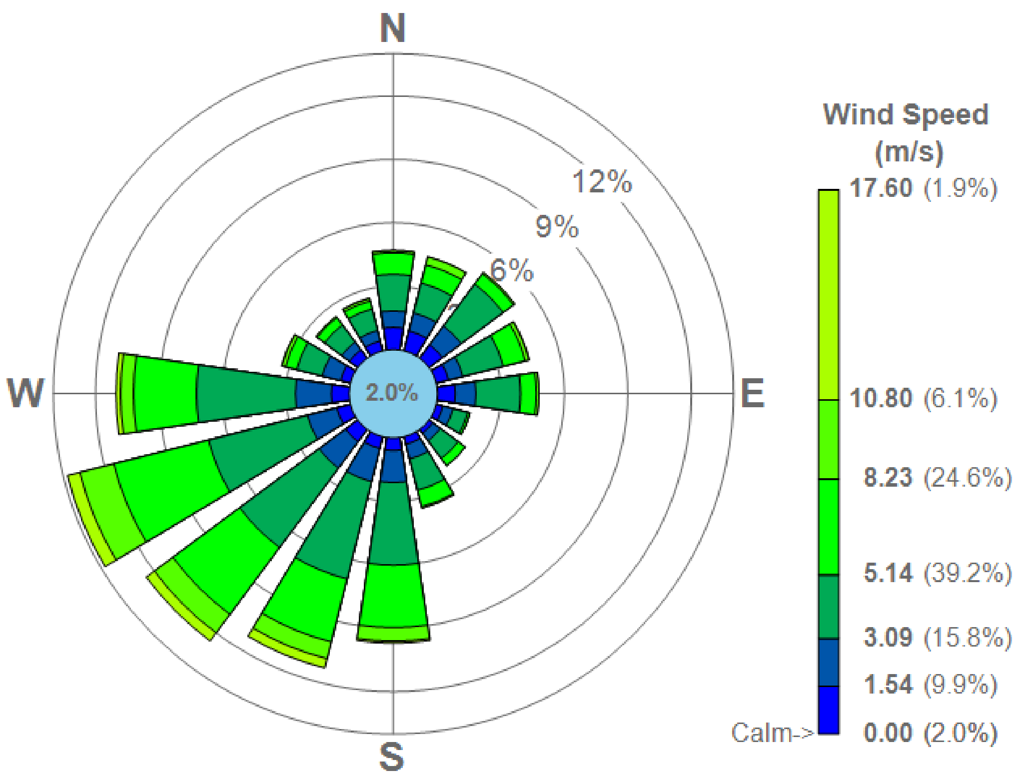
(a) For normal operation, 15% O2 273K, 101.3 kPa, dry

(b) For abnormal operation, 11% O2 273K, 101.3 kPa, dry

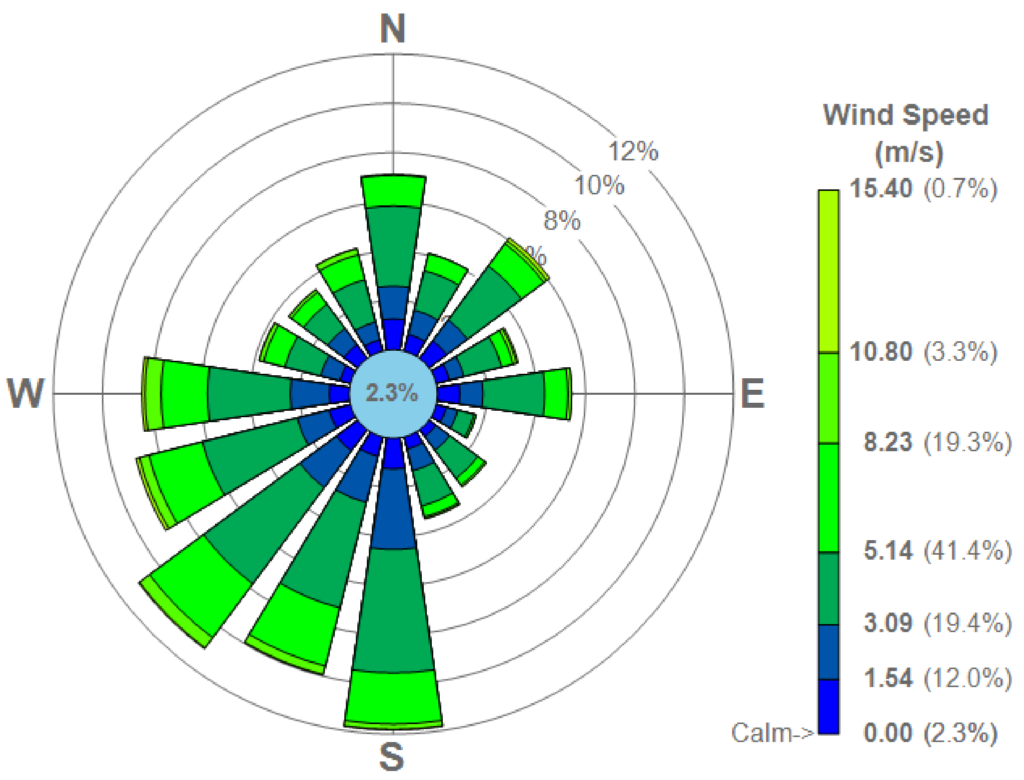
# APPENDIX C WIND ROSES FOR NORWICH AIRPORT



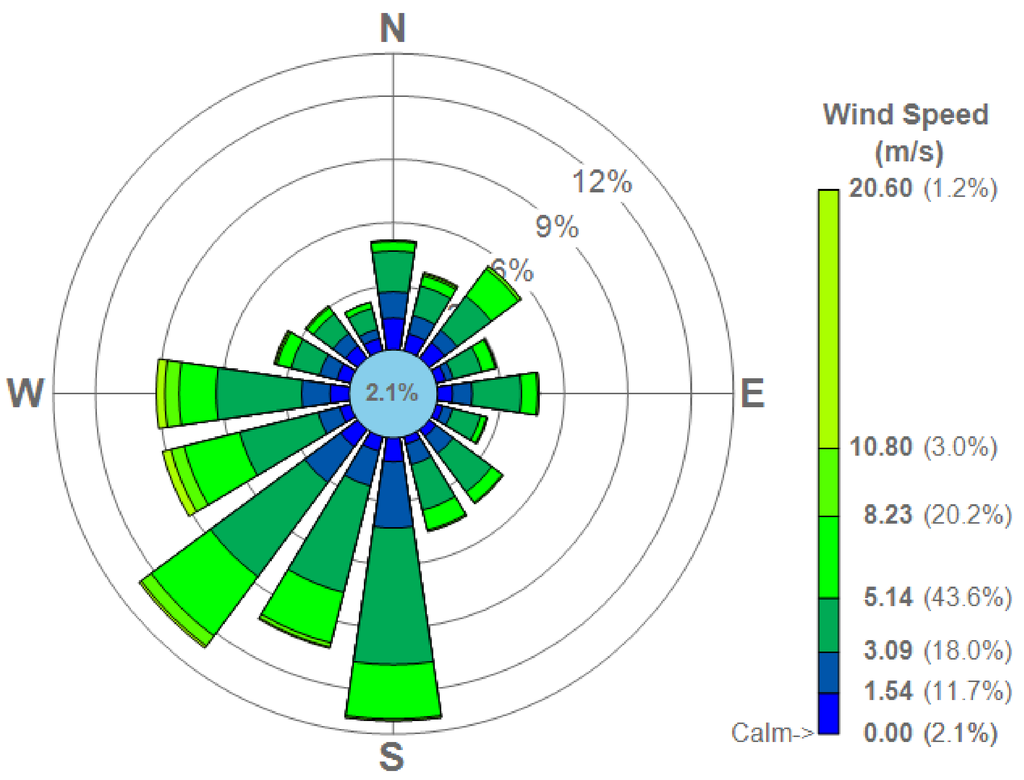

Norwich Airport 2019



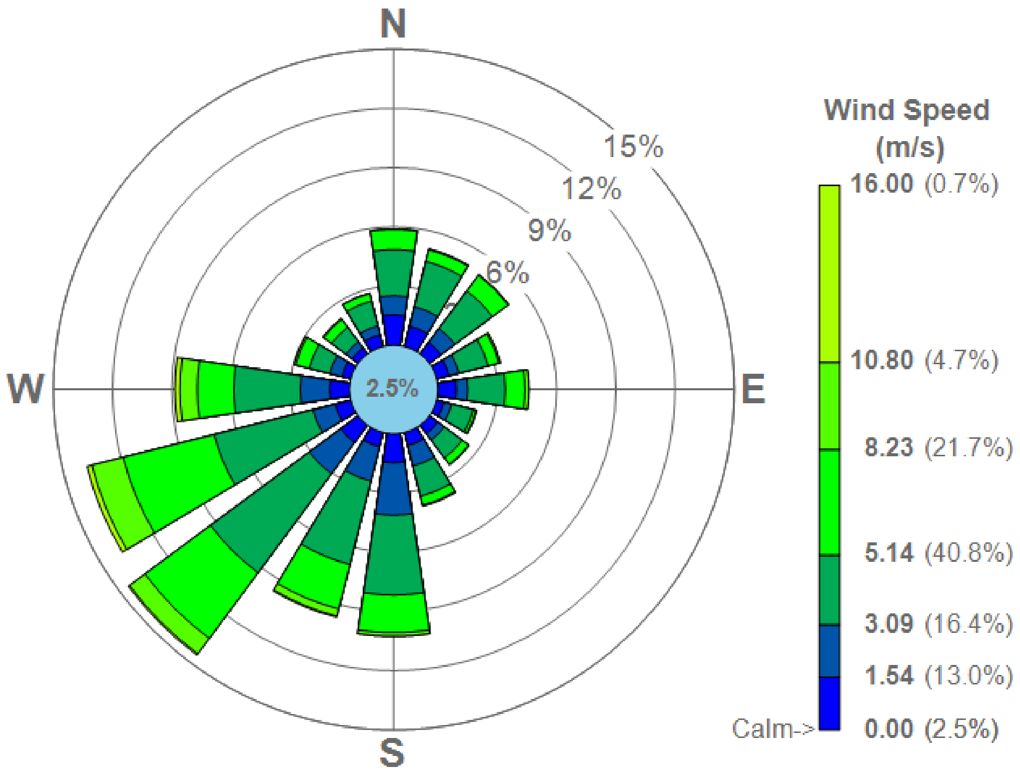

Norwich Airport 2020




Norwich Airport 2021




Norwich Airport 2022




Norwich Airport 2023

# APPENDIX D CRITICAL LEVELS AND CRITICAL LOADS FOR THE PROTECTION OF SENSITIVE HABITAT SITES

## Airborne Impacts

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 D1**. Background pollutant concentrations for each habitat site are presented in **Table D2**.

*Table D 1: 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) |
| Hydrogen Fluoride (HF) | Weekly Mean | 0.5 |
| | Daily Mean | 5 |

*Table D 2: Airborne Pollutant Concentrations*

| Habitat | NOx (µg/m$^3$) | $SO_2$ (µg/m$^3$) | HF (µg/m$^3$) |
|---|---|---|---|
| H1. The Broads SAC | 9.17 | 0.82 | 0.2 |
| H1. Broadland SPA/Ramsar | 9.17 | 0.82 | 0.2 |
| H2. Norfolk Valley Fens SAC | 8.97 | 1.05 | 0.2 |
| H3. Scottow Pond and Oak Belt LWS | 8.94 | 0.84 | 0.2 |
| H4. Stakebridge Beck LWS | 8.96 | 0.91 | 0.2 |
| H5. Low Common and Plantations LWS | 8.94 | 0.84 | 0.2 |

## 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 the Air Pollution Information System (APIS) and are summarised in Table D3 for the identified habitat sites.

*Table D 3: Critical Loads (Eutrophication) and Background Nutrient Nitrogen Deposition*

| Habitat Site | Primary Sensitive Habitat | Critical Load (kg N/ha/a) | Background N Deposition (kg N/ha/a) |
|---|---|---|---|
| H1. The Broads SAC | Valley mires, poor fens and transition mires | 5 to 15 | 16.08 |
| H1. Broadland SPA/Ramsar | Northern wet heath | 5 to 15 | 16.08 |
| H2. Norfolk Valley Fens SAC | Valley mires, poor fens and transition mires | 5 to 15 | 21.10 |
| H3. Scottow Pond and Oak Belt LWS | Assumed broadleaved deciduous woodland | 10 to 15 | 32.78 |
| H4. Stakebridge Beck LWS | Assumed neutral grassland | 10 to 15 | 18.41 |
| H5. Low Common and Plantations LWS | Assumed broadleaved deciduous woodland | 10 to 15 | 32.78 |

The background nutrient nitrogen deposition rate exceeds the upper critical load at all of the identified habitat sites.

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.

The critical loads for acidification for the local habitat sites are presented in **Table D4**.

*Table D 4: Critical Loads (Acidification) and Background Nitrogen and Sulphur Acidification Rates*

| Habitat Site | Primary Sensitive Habitat | Critical Load (keq/ha/a) | | | Background Acidification (keq/ha/a) |
|---|---|---|---|---|---|
| | | Max S | Min N | Max N | |
| H1. The Broads SAC | Transition mires and quaking bogs | 0.176 | 0.321 | 0.497 | 1.15 |
| H1. Broadland SPA/Ramsar | Dwarf shrub heath | 0.176 | 0.499 | 0.837 | 1.15 |
| H2. Norfolk Valley Fens SAC | Bogs | 0.193 | 0.321 | 0.514 | 1.52 |
| H3. Scottow Pond and Oak Belt LWS | Assumed broadleaved deciduous woodland | 1.614 | 0.142 | 1.756 | 2.37 |

| | | | | | |
|---|---|---|---|---|---|
| H4. Stakebridge Beck LWS | Assumed neutral grassland | 4 | 1.071 | 5.071 | 1.32 |
| H5. Low Common and Plantations LWS | Assumed broadleaved deciduous woodland | 1.614 | 0.142 | 1.756 | 2.37 |