Assessment of New Boiler Emissions at Sharpsmart, Normanton

Air Quality Impact Assessment

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1.1	2022-04-20	Elliot Ross	Annie Danskin	Annie Danskin	Draft to client for review

Contents

1. Introduction

1.1 Background

ITPEnergised has been commissioned by Reva Environmental Limited on behalf of Sharpsmart Limited (hereafter referred to as 'the client') to undertake an air quality impact assessment (AQIA) for the new combustion plant proposed at the Sharpsmart Limited processing facility in Normanton (hereafter, referred to as the 'Installation'). The facility is located within the Normanton Industrial Estate, Normanton, within the Wakefield Council (WC) administrative area. The location of the site is displayed in **Drawing 1**.

It is understood that the Environment Agency (EA) requires Sharpsmart to submit an assessment of air quality impact from a new boiler as part of a variation application to their Environmental Permit (EP). An H1 screening assessment has been undertaken by REVA Environmental which screens out annual mean impacts of oxides of nitrogen (NO_x); however, the predicted short term (1-hour) impacts do not screen out. Due to the proximity to a number of sensitive residential receptors, an assessment of short-term NO_x is required.

There are three Ancient Woodland Inventory sites approximately 1 km from the site, the largest designation being Ackton Pasture Wood as shown in **Drawing 1**.

The proposed new stack location, modelled buildings and the human and ecological receptors are all shown on **Drawing 2.**

The emissions from the proposed new boiler plant were modelled using the atmospheric dispersion modelling software, ADMS 5 at Medium Combustion Plant Directive (MCPD) (The European Parliment and The Council of the European Union, 2015) emissions limits for new gas-fired combustion plant, and other emissions parameters confirmed by the boiler manufacturer. All emissions data are summarised in **Appendix A.**

1.2 Scope of Assessment

The scope of the assessment carried out is as follows:

- Desktop review of baseline air quality in the locality from WC monitoring data (Wakefield Council, 2020) and publicly available background concentration maps;
- Collation of combustion source and emissions data with Sharpsmart via REVA;
- Development of an air dispersion model covering combustion emissions (NO_x) from the facility using Advanced Dispersion Modelling software (ADMS 5). A single scenario was run with the combustion source running continuously on natural gas with emissions at MCPD levels including the effects of adjacent buildings with the EA distance criteria;
- Confirmation of annual mean and prediction of 1-hour process contribution (PC) and process environmental contribution (PEC) concentrations of NO_2 at human receptors in the vicinity of the facility;
- Assessment of the annual and daily mean impacts from emissions of NO_x on sensitive ecological receptors for comparison with critical levels for the protection of vegetation and ecosystems;
- Assessment of nutrient nitrogen deposition and acid deposition as a result of emissions from the proposed boiler against the most stringent critical load levels at ecological receptors at the ecological sites in the study; and
- Reporting and presentation of results with tables and contour maps.

2. Relevant Guidance and Standards

2.1 Relevant Guidance

The assessment has been carried out with consideration to the following guidance and legislation:

- Environment Agency (EA) and Department for Environment, Food & Rural Affairs (Defra) – Guidance, Environmental Permitting: Air Dispersion Modelling Report (EA and Defra, 2019);
- EA and Defra – Guidance, Air Emissions Risk Assessment for your Environmental Permit (EA & Defra, 2020); and
- The European Parliament and Council of the European Union (EU) – Directive on the Limitations of Emissions of Certain Pollutants Into the Air from Medium Combustion Plants (The European Parliment and The Council of the European Union, 2015).

2.2 Air Quality Standards (AQSs) and Critical Levels

This assessment considers the relevant air quality standards (AQSs) for the emitted pollutants which are applicable in England. **Table 1** presents the AQSs set for the protection of human health and designated ecological sites which are relevant to this AQIA. For the ecological sites, the concentration for the annual mean AQS is the Critical Level.

Table 1 – Relevant AQSs and Critical Levels Considered in this AQIA

Pollutant	Concentration	Measured As
Human Health		
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
Designated Ecological Sites		
Oxides of Nitrogen (NO_x)	30 µg/m^3	Annual mean
	75 µg/m^3	24-hour mean

3. Baseline Environment

3.1 Study Area and Sensitive Receptors

The study area has been defined based on professional judgement and a review of sensitive human and ecological receptors within 2 km of the site. Calculations of impacts have been made over a detailed 1 km^2 grid of 20 m resolution to cover the closest potential sensitive receptors and enable contour maps to be prepared for comparison with the relevant AQSs.

3.1.1 Specified Sensitive Human and Ecological Receptors

For the purpose of this assessment, specified receptor points to represent sensitive human receptors closest to the Installation in all directions have been selected. Specified receptor points have also been chosen for a selection of ecological sites.

The human receptors chosen are residential properties where long-term AQSs are relevant. A height of 1.5 m for the human receptors has been applied which represents an average human inhalation height above ground level.

The specified ecological receptors are:

- Ancient and Semi-Natural Woodland ID: 1438;
- Ancient and Semi-Natural Woodland ID: 1438; and
- Ancient and Semi-Natural Woodland ID: 20246 Ackton Pasture Wood.

A height of 0 m has been applied at these receptors to represent ground level.

The specified sensitive receptors considered in this assessment are presented in **Table 2** and displayed in **Drawing 2**.

Table 2 – Specified Sensitive Human and Ecological Receptors Considered

Receptor ID	Receptor Description	Coordinates (m)		
		x	y	z
Human Receptors				
R1	Residential property on Beckbridge Road	439478	423195	1.5
R2	Residential property on Castleford Road	439741	423587	1.5
R3	Residential property on Newlaithes Crescent	439486	422791	1.5
R4	Residential property on Rosemount Drive	439857	422322	1.5
R5	Residential property on Arnall Street	440338	424133	1.5
R6	Residential property on Netherfield Close	440882	424032	1.5
R7	Residential property on Ackton Lane	441178	421950	1.5
Ecological Receptors				
E1	AWI: 1438	441472	423303	0
E2	Ackton Pasture Wood	441229	423439	0
E3	AWI: 1438	441178	423714	0

3.2 Background Concentrations

There are no WC monitoring sites near to the installation site which are considered to be representative of the receptor locations. The nearest diffusion tube monitoring site is site 4, on Castleford Road. This is approximately 465 m form the installation site. This monitoring site is located close to major roads and falls within the M62 Air Quality Management Area (AQMA) and therefore is expected to experience higher pollutant concentrations than any of the selected receptors. Therefore, the review of baseline air quality was undertaken using data from publicly available background concentration maps from DEFRA (Defra, 2020).

The background concentrations of NO_x and NO_2 for each of the human receptors and ecological sites was taken from Defra background concentration maps for the year 2022 (Defra, 2020).

The background levels of NO_x and NO_2 that have been derived for ecological and human sensitive receptor locations respectively are presented in **Table 3**.

Table 3 – 2020 Background Map Concentrations for Sensitive Receptors

Receptor ID	National Grid Square Centre Coordinates		Background Concentration Used in the Assessment	
	X (m)	Y (m)	NO_x (µg/m^3)	NO_2 (µg/m^3)
R1	439478	423195	-	23.68
R2	439741	423587	-	23.68
R3	439486	422791	-	16.05
R4	439857	422322	-	16.05
R5	440338	424133	-	17.05
R6	440882	424032	-	17.05
R7	441178	421950	-	12.47
E1	441472	423303	20.49	-
E2	441229	423439	20.49	-
E3	441178	423714	20.49	-

4. Assessment Methodology

4.1 Model Description

The atmospheric emissions dispersion modelling study was undertaken using the latest version of ADMS 5 dispersion modelling software (version 5.2.4.0). The software was developed by Cambridge Environmental Research Consultants Limited (CERC) and has undergone extensive use and validation (Cambridge Environmental Research Consultants, 2020).

4.2 Emissions Sources and Data

The emissions data used for the Installation in this assessment are presented in **Appendix A**.

4.3 ADMS Model Options

4.3.1 Sensitivity Analysis

A sensitivity analysis was undertaken in order to determine the effect of the following within the dispersion model:

- Choice of Surface Roughness – 1.0 m for cities and large towns or 0.5 m for parkland, open suburbia;
- The main building used for the study – The Stack Building or the Factory Building; and
- The year of meteorological data from Doncaster-Sheffield Airport from 2017-2021.

The focus of the sensitivity analysis was on the potential effect of the predictions of 1-hour NO_2 concentrations at sensitive receptors and the results are shown in **Appendix B.**

4.3.2 Meteorological Data

The dispersion model has used meteorological data representative of the local area to calculate atmospheric conditions and therefore the dispersion of emissions from the proposed stacks.

The dispersion model has made use of hourly meteorological data measured at Doncaster-Sheffield Airport. Doncaster-Sheffield Airport meteorological station is approximately 35 km south-east of the site of the Installation and is the closest meteorological station with a high data capture for the previous five years.

The wind roses for each of the previous five years of hourly meteorological data from Doncaster-Sheffield Airport are presented in **Drawing 3**.

4.3.3 Surface Roughness and Minimum-Obukhov Length

A surface roughness of 1 m representative of parkland, open suburbia has been selected to represent the area around the Installation.

A surface roughness of 0.2 m is considered to be representative of the surface roughness at Doncaster-Sheffield Airport meteorological site.

Monin-Obukhov length (L_{MO}) is used to calculate the minimum stability of the atmosphere. The minimum L_{MO} was selected to be 30 m at around the Installation and the model calculated default for each hour of meteorological data at Doncaster-Sheffield Airport meteorological site.

Model default values of 0.23 and 1.0 for surface albedo and Priestly-Taylor parameter respectively were selected for both the area around the Installation and the location of Doncaster-Sheffield Airport meteorological station.

Precipitation factor for the area around the Installation was selected to be the same as that for the Doncaster-Sheffield Airport meteorological site.

4.3.4 Modelling of Building Effects

Buildings can have a significant effect on the dispersion of pollutants from sources attached to or in close proximity to them and have the potential to entrain pollutants into the cavity region in the immediate leeward side of the building, bringing them rapidly down to ground level. As a consequence, concentrations near the buildings can be increased, with downwind concentrations decreased.

The buildings included as part of the modelling assessment are displayed in **Drawing 4**. The parameters of the modelled buildings were sourced from aerial mapping and heights provided by the client and are reported in **Table 4.** The modelled stack was 2 m above the modelled height of the building it was located on (Stack Building), and 4m lower than the Sharpsmart factory building. The You Can building has a height of 10 m, however as the building is on ground 1.5 m lower than the Stack Building, its height has been adjusted to 8.5 m.

Table 4 – Modelled Building Parameters

Building ID	Length (m)	Width (m)	Average Height (m)
Stack Building	4	7.1	4
Factory Building	44.8	73	10
You Can Building	24.5	9	8.5

The sensitivity analysis showed that the maximum predicted 1-hour concentrations were predicted with the following parameters:

- Surface roughness: 1
- L_{MO}: 30
- Main Building: Stack Building
- Year of Meteorological Data: 2020

The results presented in **Section 5** are based on this combination of input parameters.

4.3.5 Modelling Scenarios

A conservative approach has been adopted, assuming that the Installation will operate 24 hours a day, 365 days per year. In reality, operational time of the Installation will be less than this.

4.3.6 Cumulative Effects

It is considered that the background concentrations chosen for this assessment include contributions from all neighbouring industrial, transport, commercial and domestic and transboundary sources.

4.3.7 Treatment of Nitrogen Dioxide

Emissions of NO_x comprise both NO_2 and NO (nitric oxide). Emissions of NO_x will undergo oxidation in the atmosphere to form NO_2, however the rate of conversion will depend on a number of factors before equilibrium in the atmosphere is reached. Estimates of the percentage of NO_2 in the total NO_x emission are made in the model to represent the primary (direct) NO_2 emission and that formed by secondary formation.

The EA guidance (EA & Defra, 2020) provides guidance on assumptions relating to the proportions of NO_2 in an estimated NO_x emission. In line with the guidance, this assessment has considered NO_x emissions as 70% NO_2 when considering compliance with the long-term (annual mean) AQS and as 35% NO_2 when considering compliance with the short-term (1-hour mean) AQS. Using these proportions is considered to be a worst-case assessment according to the EA guidance.

4.3.8 Model Uncertainty

This study is based on the conservative assumption that the Installation operate 24/7 for 365 days of the year. It is therefore considered that actual impacts from the proposed new stack once operational, will be lower than those predicted.

4.4 Calculation of Process Environmental Concentration (PEC) of Emitted Pollutants

The concentrations of emitted pollutants from the Installation (PC) have been predicted across the study area and combined with the existing background concentrations to obtain the Predicted Environmental Concentration (PEC). Relevant PECs have been calculated as follows:

- PEC for long-term concentrations: PC + the background; and
- PEC for short-term concentrations: PC + twice the background.

Short-term concentrations refer to any pollutant concentration which is measured over an averaging time period of one hour or less. Anything above one hour is defined as long-term.

4.5 Calculation of Deposition of Emitted Pollutants

The calculations of both nutrient nitrogen deposition and acid deposition have been calculated using the method provided in the technical guidance on detailed modelling approach for an appropriate assessment for emissions to air under the Habitats Directive 2004 (AQAG, 2021).

4.5.1 Nutrient Nitrogen Deposition

The annual mean PC concentration of NO_x was at specified designated ecological sites as described in **Table 3.** The assessment of deposition effects assumes a conservative worst case that all NO_x is NO_2.

The deposition flux was calculated from the modelled PC concentration using the formula:

Dry Deposition Flux ($\mu g/m^2/s$) = ground level concentration (PC) ($\mu g/m^3$) x deposition velocity (m/s)

The AQTAG recommended dry deposition velocity for grassland of 0.0015 m/s was used in the calculations.

The AQTAG dry deposition flux conversion factor for NO_2 of 95.9 was used in calculations to convert dry deposition flux to nutrient nitrogen deposition in kg N/ha/yr.

4.5.2 Acid Deposition

The dry deposition flux was calculated for NO_2 as above.

In accordance with AQTAG21, wet deposition of NO_2 is not considered to be significant within a short range and was therefore not included in the calculations of deposition effects.

The AQTAG dry deposition flux conversion factor of 6.84 for NO_2 was used in calculations to convert dry deposition flux to acid deposition in keq/ha/yr.

4.6 Screening PCs for significance

The assessment of significance of the effects of the PC contributions follows the criteria in the EA Air emissions risk assessment guidance (EA & Defra, 2020).

4.6.1 Screening at Human Receptors.

The EA risk assessment guidance states that:

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

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

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

These criteria have been applied at all specified human receptors using the AQSs in **Table 1.**

4.6.2 Screening at Local Nature Sites

The EA risk assessment guidance goes on to state that:

*When there are local nature sites within the specified distance**, if** your emissions meet both of the following criteria they're insignificant – you do not need to assess them any further:*

- *the short-term PC is less than 100% of the short-term environmental standard*

- *the long-term PC is less than 100% of the long-term environmental standard*

  You do not need to calculate PEC for local nature sites. If your PC exceeds the screening criteria you need to do detailed modelling.

These criteria have been used at the specified ecological receptors identified as AWIs using the critical levels in **Table** 1, and the recommended critical loads for nutrient nitrogen deposition and acid deposition for broadleaf woodland taken from the Air Pollution Information System (UK Centre for Ecology and Hydrology, 2022) in the 5 km^2 area within which the three AWI designated sites are located as shown in **Appendix C, Tables C-4 and C-5.**

5. Assessment Results

The dispersion model results are summarised in the following sections. All results tables for predicted pollutant concentrations are the maximum across modelled meteorological data for 2020 and are provided in **Appendix C.**

5.1 Human Receptors

5.1.1 Nitrogen Dioxide (NO_2)

5.1.1.1 Annual Mean

The maximum annual mean NO_2 concentrations at each human receptor relevant for long-term exposure are presented in **Appendix C Table C-1**.

The maximum predicted annual mean PC of NO_2 is 0.037 µg/m^3 at R2, (a residential receptor on Castleford Road), which is 0.09% of the annual mean AQS.

The predicted annual mean NO_2 PC is below 1% of the annual mean AQS at all receptors where long-term exposure is relevant and is therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020).

5.1.1.2 1-Hour Mean

The 99.79th percentile of model predicted hourly mean NO_2 concentrations at each human receptor is presented in **Appendix C** as **Table C-2.**

The highest predicted 99.79th percentile of hourly mean NO_2 PC is 0.8 µg/m^3 at receptor R2 (a residential receptor on Castleford Road) which is 0.4% of the short-term AQS.

All predicted 99.79th percentiles of hourly mean NO_2 PCs are below 10% of the short-term hourly mean AQS and are therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020).

The highest predicted 99.79th percentile of hourly mean PEC for NO_2 is 34.9 µg/m^3 at receptor R2 (a residential receptor on Castleford Road), which is 17.5% of the AQS. There is no risk of exceedance of the 1-hour AQS for NO_2 at any sensitive human receptors within the study area.

5.1.2 Contour Plots for Comparison of PC Against AQSs at Human Receptors

Contour plots of the modelled pollutant concentrations from the Installation over a 1 km^2 study area are shown in **Drawings 5 – 7.** Each plot provides the PC concentration as a percentage of the AQS being considered.

Contour plots have been produced for 2020 meteorological data for the following:

- NO_2 Annual Mean PC;
- NO_2 99.79th Percentile (1-Hour Mean) PC; and
- NO_2 100th Percentile PC;

5.2 Ecological Receptors

5.2.1 Annual Mean Concentration of Nitrogen Oxides (NO_x)

The maximum model predicted annual mean NO_x concentrations at each specified ecological receptor are presented in **Appendix C Table C-3**.

The maximum predicted annual mean NO_x PC is 0.03 µg/m^3 at receptor E2 Ackton Pasture Wood which is 0.09% of the critical level of 30 µg/m^3.

The predicted annual mean NO_x PC at all ecological receptors is less than 100% of the annual mean critical level and therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020) applicable to LNSs.

Based on the calculated PCs screening out of further assessment, it is not necessary to consider the PECs.

On the basis that the annual mean PC of NO_x is < 1% of the critical level it is concluded that there is no requirement to assess either nutrient nitrogen deposition or acid deposition effects at the ecological sites.

5.2.2 24-Hour Mean Concentration of Nitrogen Oxides (NO_x)

The maximum model predicted daily mean PC NO_x concentrations at each specified ecological receptor are presented in **Appendix C Table C-3**.

The highest predicted daily mean NO_x PC is 0.03µg/m^3 at receptor E2 (Ackton Pasture Wood), which is 0.04% of the AQS.

The predicted daily mean NO_x PC at all local nature sites (LNSs) is less than 100% of the daily mean critical level and therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020) applicable to LNSs.

Based on the calculated PCs screening out of further assessment, it is not necessary to consider the PECs.

5.2.3 Nutrient Nitrogen Deposition

Nutrient nitrogen deposition was calculated at each of the specified ecological receptors using the AQTAG method described in Section 4.5.1.

5.2.3.1 Assessment at AWI Sites

Receptors E1-E3 represent the closest point of three AWI designated sites to the Installation. For any given grid reference, APIS does not provide a list of interest features or habitats present; however, the named AWI of Ackton Pasture Wood is described as a Mixed Broadleaf Woodland[1]. The recommended critical load value for screening purposes this habitat from APIS is 10 kg N/ha/yr. The PC has been calculated at each receptor and presented as a percentage of the screening critical load to assess for potential risk to habitat.

The results are presented in **Appendix C** as **Table C-4.** The nutrient nitrogen deposition PC is significantly below 100% of the critical load value (<0.1%) at the AWI sites and as is therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020) applicable to local nature sites.

5.2.4 Acid Deposition

Acid deposition was calculated at each of the specified ecological receptors using the AQTAG method described in Section 4.5.2.

5.2.4.1 Assessment at AWI sites

The assessment of the acid deposition PC as a percentage of the critical load function has been carried out for receptors E1-E2, using a CLminN of 0.357 and CLmaxN of 2.878 for broadleaf woodland. The results in **Appendix C Table C-5** show that the PC acid deposition is significantly less than 100% (<0.1%) of the critical

[1] https://www.woods4sale.co.uk/woodlands/northern-england/1645.htm

load function at each receptor and is therefore considered ***insignificant*** as per the EA guidance (EA & Defra, 2020) applicable to local nature sites.

6. Conclusions

This report is the AQIA undertaken to assess the potential impact the operation of a new gas-fired boiler (the "Installation") at the Sharpsmart Ltd waste processing facility in Normanton, West Yorkshire could have on local air quality and nearby sensitive receptor locations.

The AQIA involved a detailed dispersion modelling study using the modelling software ADMS 5 to predict concentrations of NO_x and NO_2 within the study area as a result of the operation of the Installation.

The focus of the study was compliance with the short-term AQS for NO_2 at nearby residential receptors as long term (annual) concentrations were screened out by an H1 assessment.

The AQIA predicted that the annual mean PCs for NO_2 at all relevant human receptors will be below the EA criteria of 1% of the relevant long-term environmental assessment level (EAL) and are therefore concluded to be ***insignificant***.

The AQIA predicted that the short-term PCs of NO_2 at all human receptors will be below the EA criteria of 10% of the relevant short-term EAL and are therefore concluded to be ***insignificant***.

Predicted long-term and short-term PECs for NO_2 at all human receptors are significantly below the relevant AQSs.

The AQIA predicted the annual mean and daily mean PCs of NO_x to be below the EA criteria of 100% of the long-term critical levels respectively. The predicted effects are therefore concluded to be ***insignificant***.

The AQIA predicted the PC of nutrient nitrogen deposition at the AWIs to be below the EA criteria of 100% of the screening critical load. The predicted effects of the Installation on nitrogen nutrient deposition within the study area are therefore concluded to be ***insignificant***.

The AQIA predicted the PC of acid deposition at the AWIs to be below the EA criteria of 100% of the critical load function. The predicted effects of the Installation on acid deposition within the study area are therefore concluded to be ***insignificant***.

The overall effect of the Installation operating at MCPD ELVS on local air quality and sensitive ecological sites is therefore concluded to be ***insignificant***.

7. References

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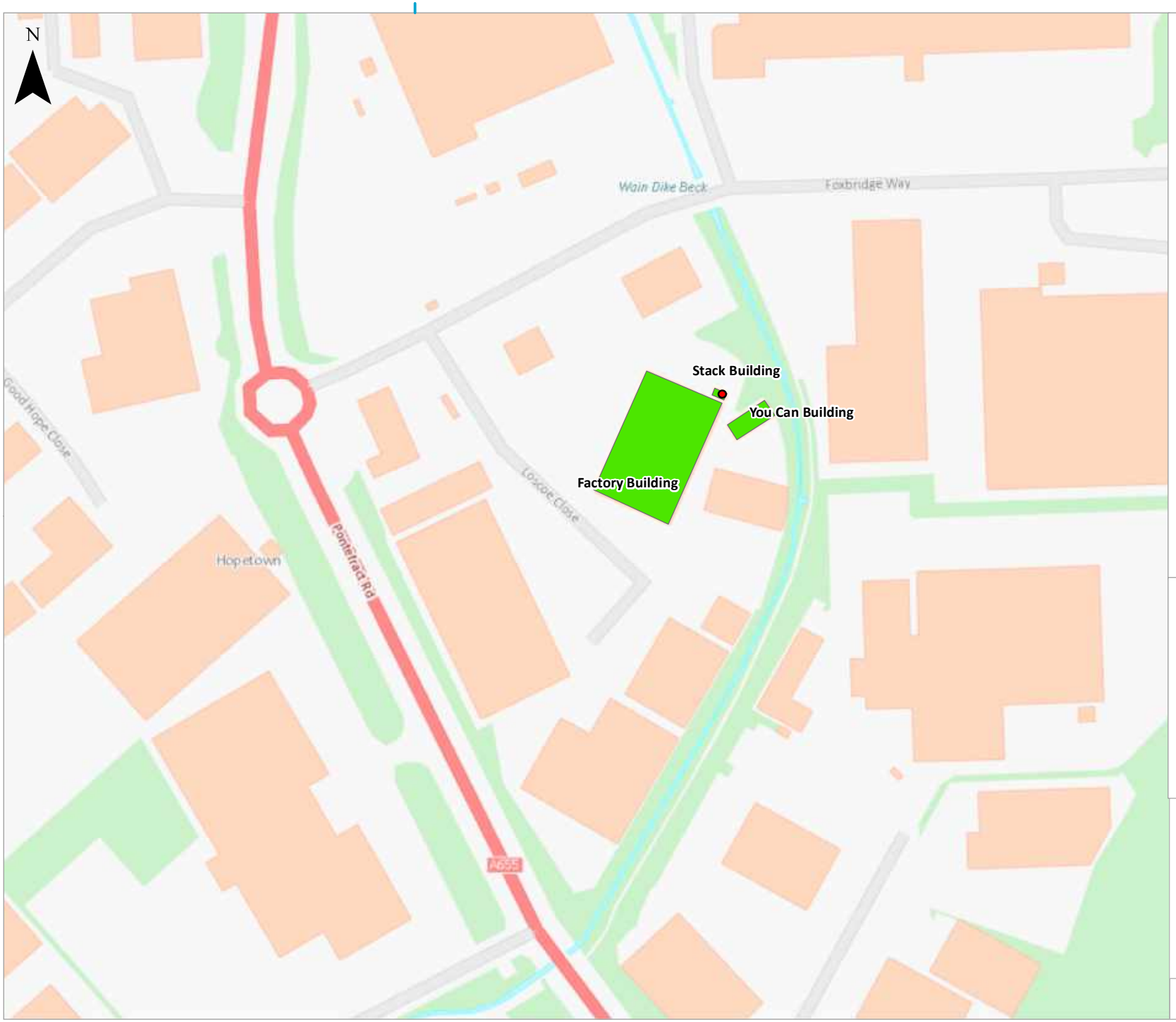
Drawings



KEY

- Site Boundary
- Buildings
- Stack

Coordinate System: British National Grid
Projection: Transverse Mercator

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020; Historic Environment Scotland and Ordnance Survey data ©

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Kilometers

1:2,950

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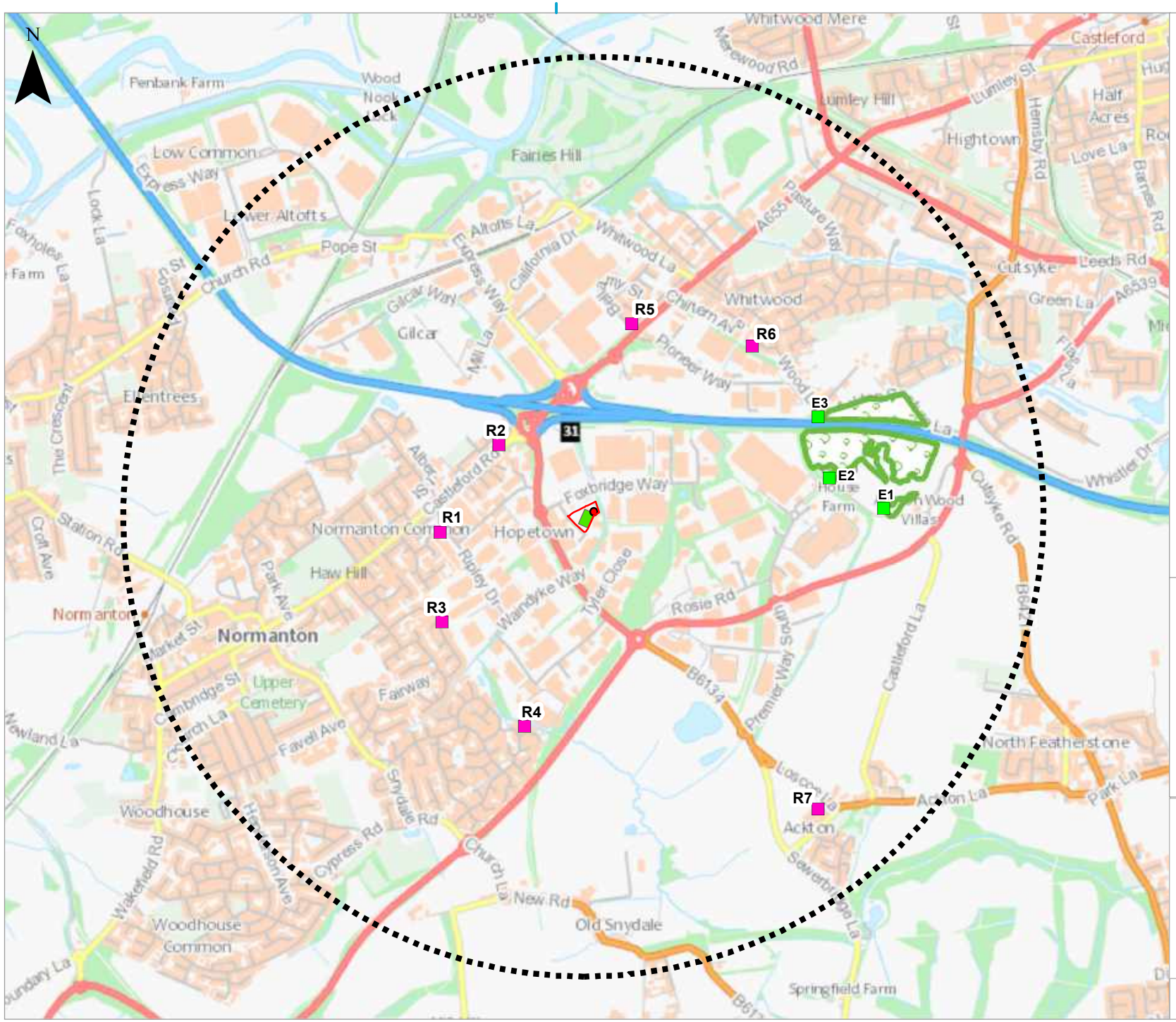
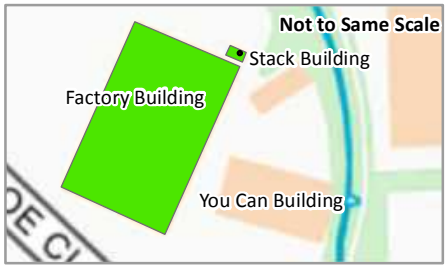
Sharpsmart Normanton, New Boiler
Air Quality Impact Assessment
Drawing 1
Site Location

Date: 14/04/2022	Lead: ER	Review: AD	Version: V1



KEY

- Site Boundary
- Buildings
- Stack
- 2km Buffer
- Ancient Woodland
- Human Receptors
- Ecological Receptors



Coordinate System: British National Grid
Projection: Transverse Mercator

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0 0.1 0.2 0.4 0.6 0.8 Kilometers

1:24,000

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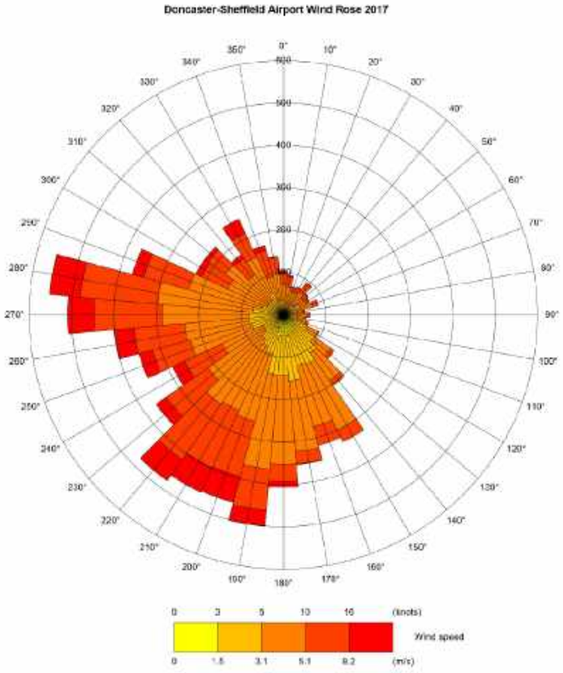
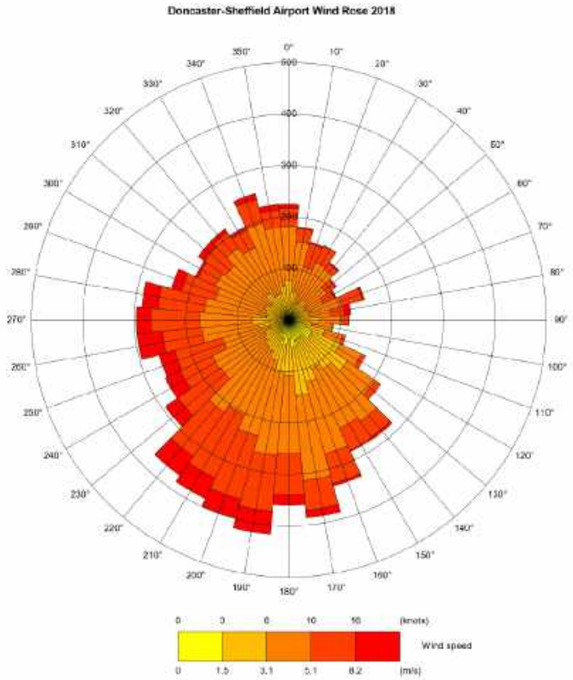
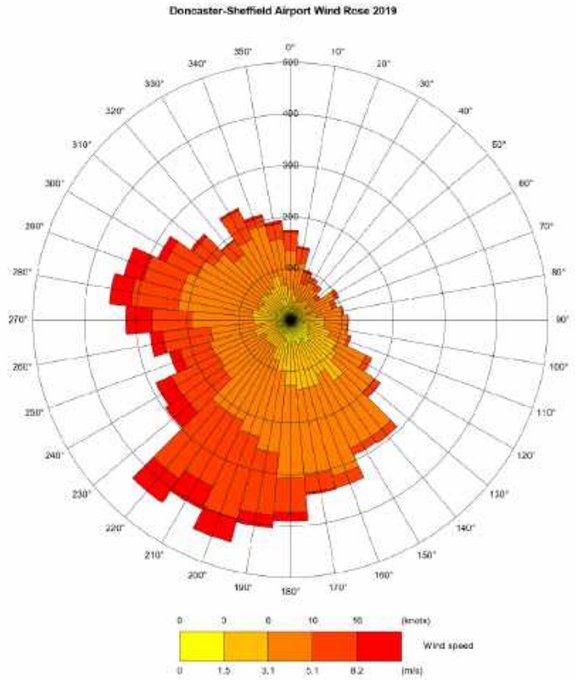
Sharpsmart Normanton, New Boiler
Air Quality Impact Assessment

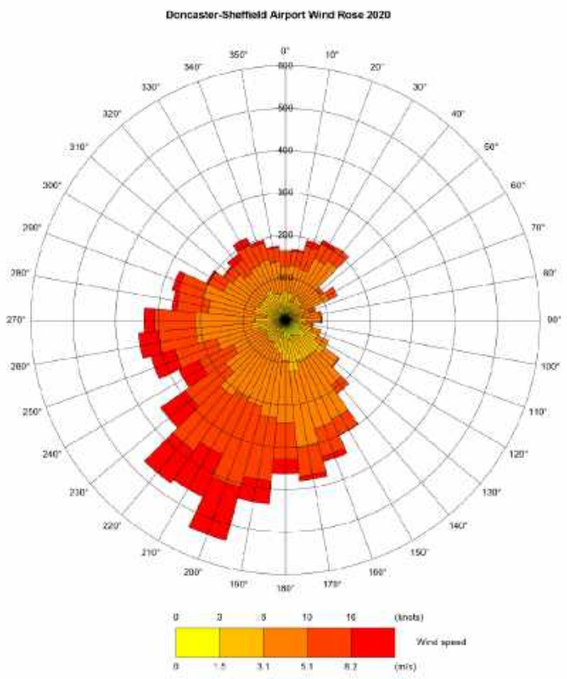
Drawing 2
Study Area, Modelled Buildings and Receptors

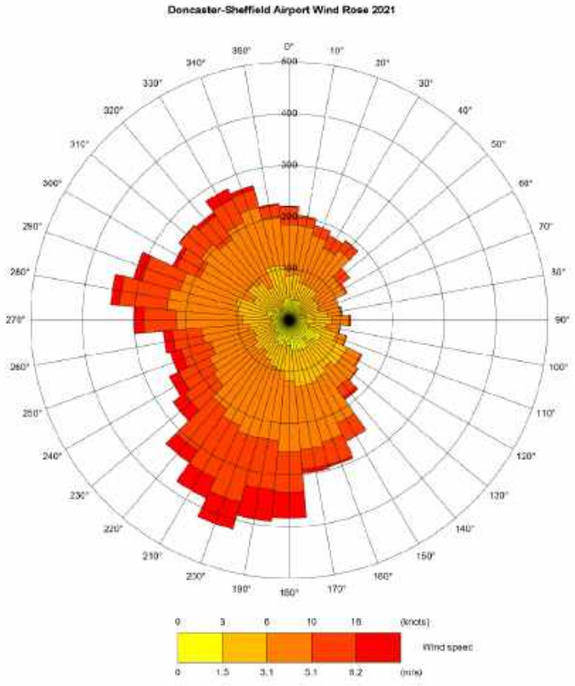
Date:	Lead:	Review:	Version:
14/04/2022	ER	AD	V1











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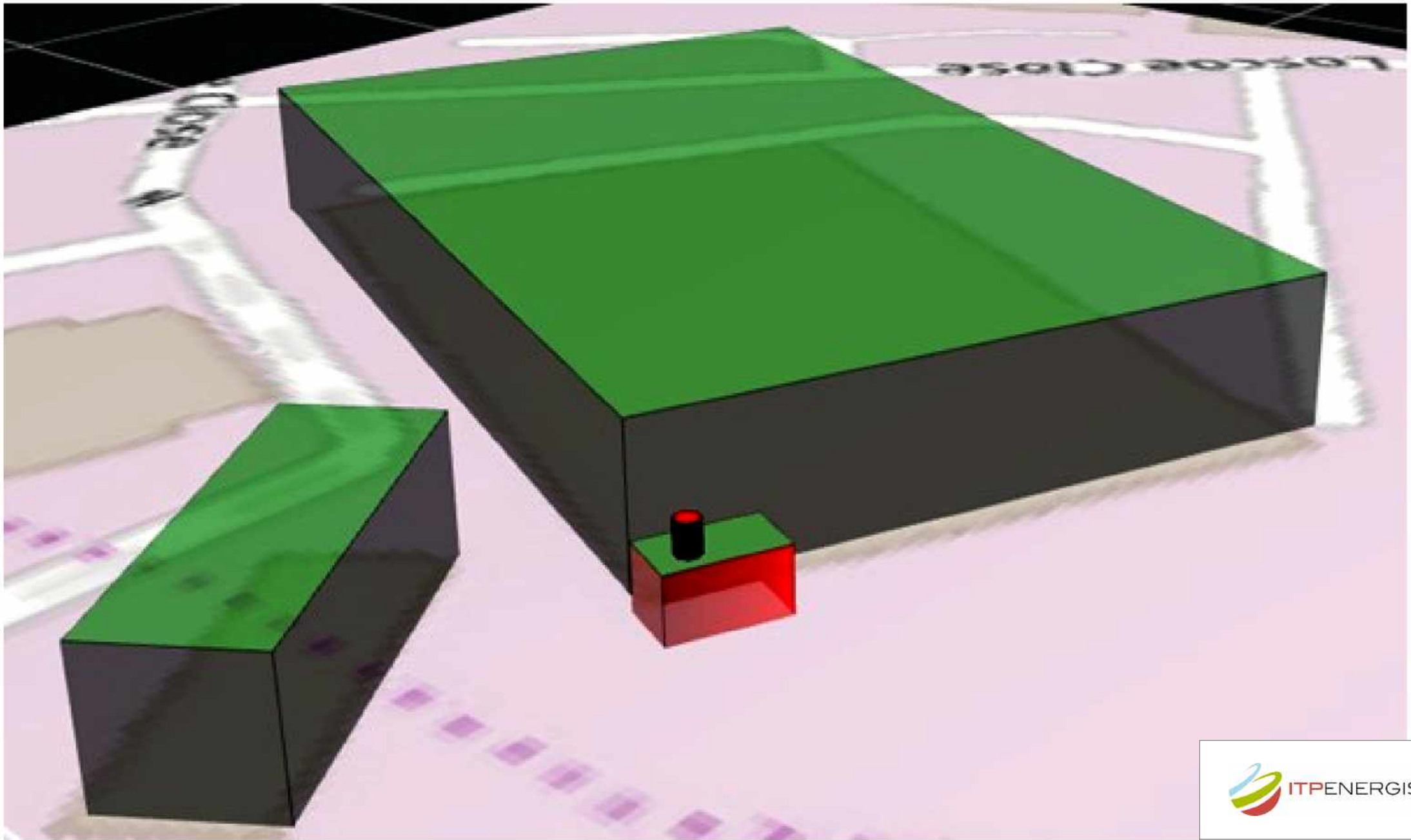
Sharpsmart Normanton, New Boiler
Air Quality Impact Assessment

Drawing 3
Doncaster-Sheffield Airport
Hourly Meteorological Data 2017-2021

Date:	Drawn by:	Checked by:	Version:
14/04/2022	ER	AD	V1

Project Number: 5221

N



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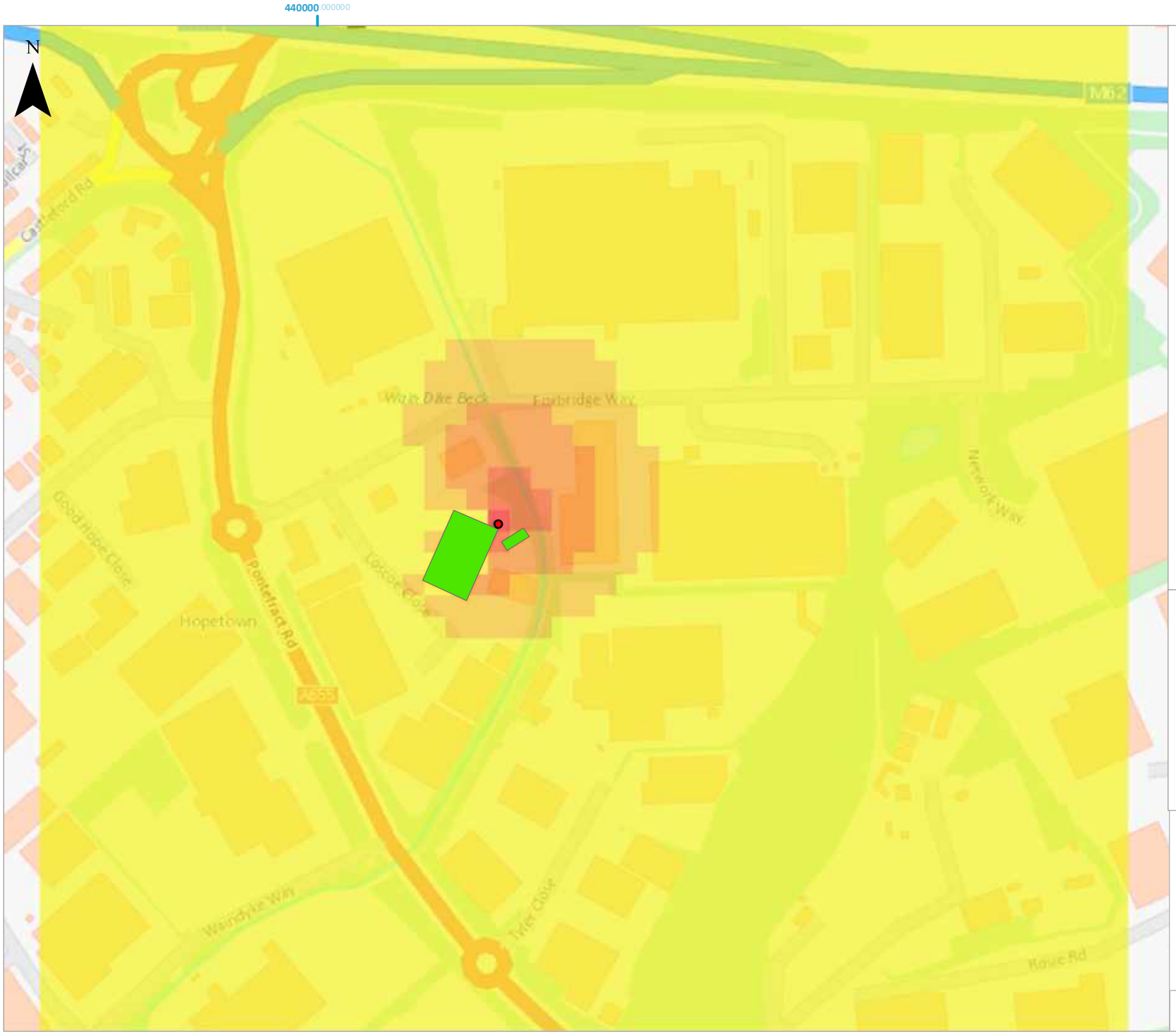
Sharpsmart Normanton, New Boiler
Air Quality Impact Assessment

Drawing 4
3D Representation of Buildings and Stack

Date:	Drawn by:	Checked by:	Version:
14/04/2022	ER	AD	V1

Project Number: 5221

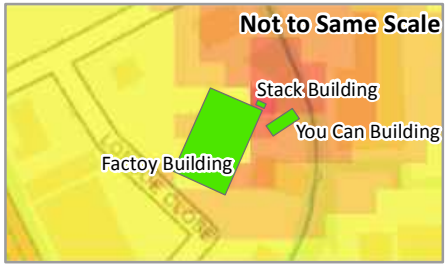


KEY

- Buildings
- Stack

NO_2 PC Concentration
µg/m³

- < 0.4 (< 1%)
- 0.4 - 0.8 (1 - 2%)
- 0.8 - 2.0 (2 - 5%)
- 2.0 - 4.0 (5 - 10%)
- >4.0 (>10%)



Coordinate System: British National Grid
Projection: Transverse Mercator

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020; Historic Environment Scotland and Ordnance Survey data ©

0 0.025 0.05 0.1 0.15 0.2
Kilometers

1:5,000

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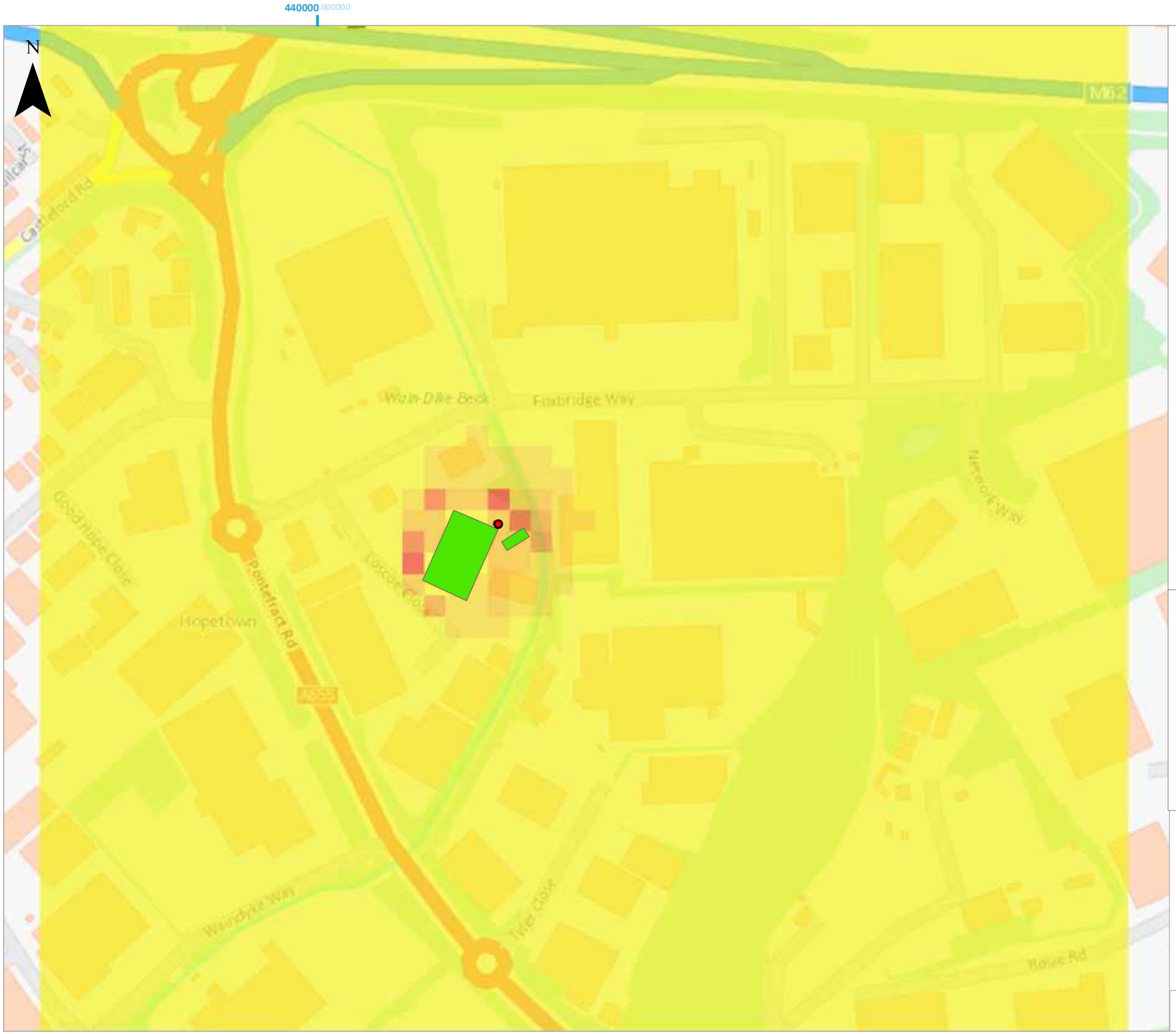
Sharpsmart Normanton, New Boiler
Ai Quality Impact Assessment

Drawing 5

NO_2 Annual Mean

PC Mean Contour Plot (2020)

Date: 19/04/2022	Lead: ER	Review: AD	Version: V1



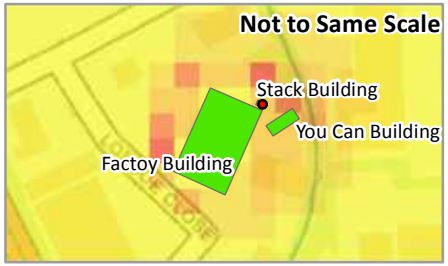
KEY

- Buildings
- Stack

NO_2 PC Concentration

µg/m³

- 0 - 4 (<2%)
- 4 - 8 (<4%)
- 8 - 12 (<6%)
- 12 - 16 (<8%)
- 16 - 20 (<10%)
- 20 - 24 (<12%)
- 24 - 28 (<14%)
- 28 - 32 (<16%)
- >32 (>16%)



Coordinate System: British National Grid
Projection: Transverse Mercator

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020; Historic Environment Scotland and Ordnance Survey data ©

0 0.025 0.05 0.1 0.15 0.2 Kilometers

1:5,000

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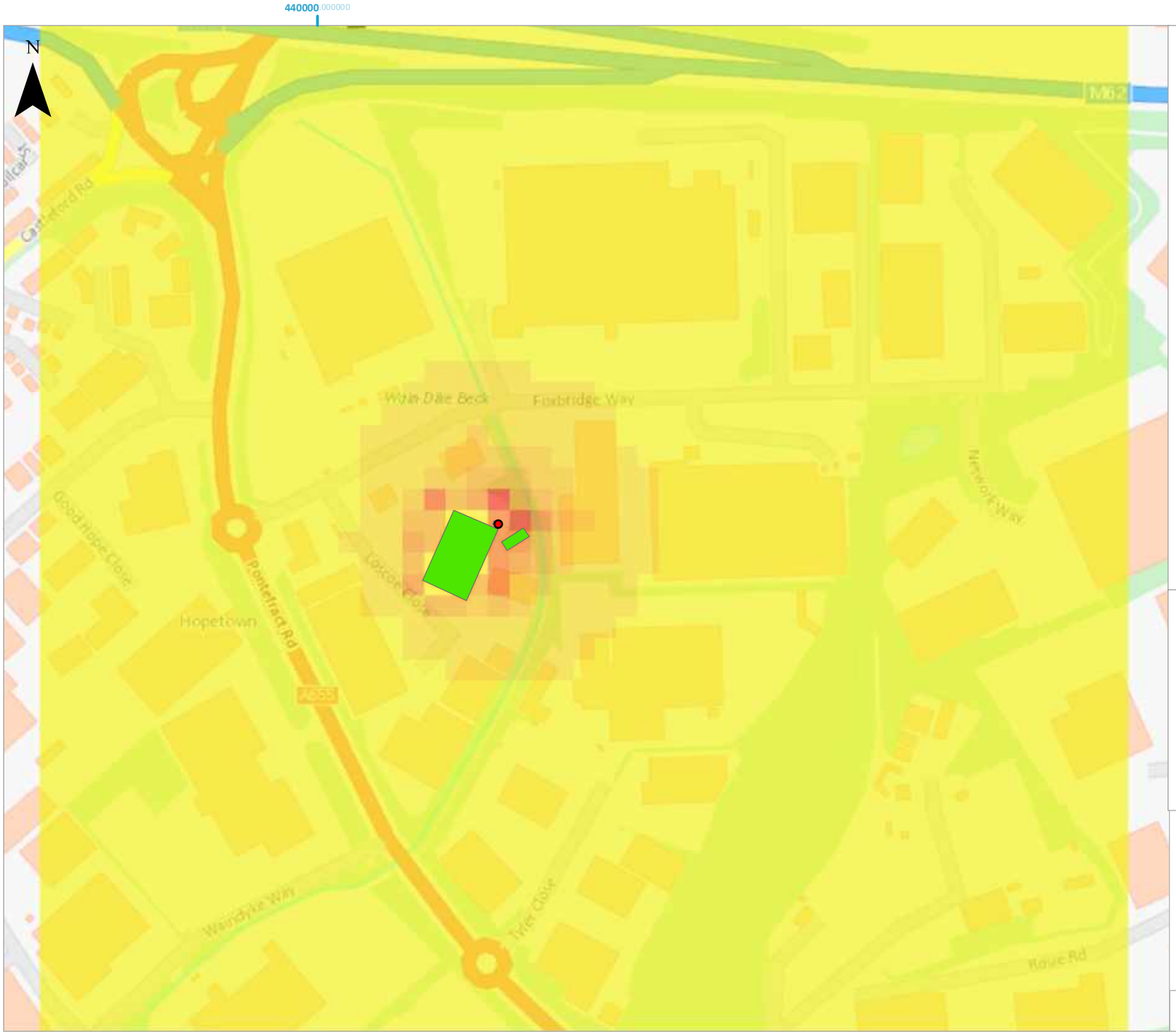
Sharpsmart Normanton, New Boiler
Ai Quality Impact Assessment

Drawing 6

NO_2 100th PC Mean Contour Plot (2020)

Date: 14/04/2022	Lead: ER	Review: AD	Version: V1

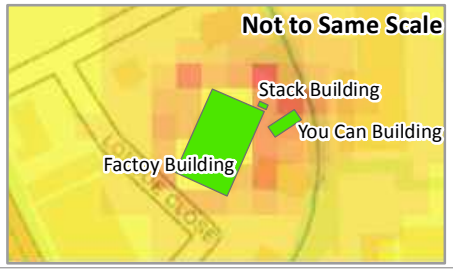


KEY

- Buildings
- Stack

NO_2 PC Concentration
µg/m³

- 0 - 2 (<1%)
- 2 - 4 (<2%)
- 4 - 6 (<3%)
- 6 - 8 (<4%)
- 8 - 10 (<5%)
- 10 - 12 (<6%)
- 12 - 14 (<7%)
- 14 - 16 (<8%)
- 16 - 18 (<9%)
- >18 (>9%)



Coordinate System: British National Grid
Projection: Transverse Mercator

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020; Historic Environment Scotland and Ordnance Survey data ©

0 0.025 0.05 0.1 0.15 0.2
Kilometers

1:5,000

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Sharpsmart Normanton, New Boiler
Ai Quality Impact Assessment

Drawing 7

NO_2 99.79th PC Mean Contour Plot (2020)

Date: 14/04/2022	Lead: ER	Review: AD	Version: V1

Appendix A Emission Data Model Inputs

Table A-1 – Stack and Emission Data Model Inputs

Stack and Emission Parameters			
Grid Location (X & Y)	440170	&	423287
Stack Height (m)	6		
Effective Internal Diameter (m)	0.42		
Stack Area (m^2)	0.14		
Normal Conditions			
Normal Temperature of Exhaust Gas (°C)	0	in K:	273.15
Normal % O_2	3		
Normal % H_2O	0		
Normal Volume Flow Rate (Nm^3/s)	0.6		
Normal Pollutant Emission Concentration (Nmg/m^3)			
NO_x	100		
Total Pollutant Mass Emission Rate (g/s)			
NO_x	0.06		
Actual Conditions			
Actual Exit Velocity (m/s)	9.5		
Actual Temperature of Exhaust Gas (°C)	180	in K:	453.15
Actual % O_2	5.9		
Actual % H_2O	10		
Actual Volume Flow Rate (m^3/s)	1.32		
Actual Pollutant Emission Concentration (mg/m^3)			
NO_x	45.5		
Total Pollutant Mass Emission Rate (g/s)			
NO_x	0.06		

Appendix B Sensitivity Assessment Results

Table B-1 – Sensitivity Analysis for Surface Roughness with 2020 Doncaster-Sheffield Meteorological Data - 99.79thth Percentile of 1 Hour mean- Total NO_x

SENSITIVITY Surface Roughness 1hour 99.79th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Surface Roughness Sensitivity*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Surface Roughness							
ID	Receptors	0.5	1				AQS	MAX	Difference
MAX Grid									
1	R1	1.15	1.18				200.00	1.18	0.03
2	R2	2.26	2.28				200.00	2.28	0.03
3	R3	1.00	0.94				200.00	1.00	0.06
4	R4	0.84	0.82				200.00	0.84	0.03
5	R5	1.02	1.05				200.00	1.05	0.03
6	R6	0.80	0.82				200.00	0.82	0.02
7	E1	0.47	0.43				200.00	0.47	0.03
8	E2	0.77	0.71				200.00	0.77	0.05
9	E3	0.89	0.79				200.00	0.89	0.10
10		0.75	0.80				200.00	0.80	0.05

Table B-2 – Sensitivity Analysis for Surface Roughness with 2020 Doncaster-Sheffield Meteorological Data - 100th Percentile of 1 Hour mean- Total NO_x

SENSITIVITY Surface Roughness 1hour 100th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Surface Roughness Sensitivity*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Surface Roughness							
ID	Receptors	0.5	1				AQS	MAX	Difference
MAX Grid									-
1	R1	1.69	1.60				200.00	1.69	0.09
2	R2	2.38	2.32				200.00	2.38	0.05
3	R3	1.22	1.21				200.00	1.22	0.02
4	R4	1.10	1.05				200.00	1.10	0.04
5	R5	1.23	1.11				200.00	1.23	0.12
6	R6	0.95	0.90				200.00	0.95	0.05
7	E1	0.65	0.56				200.00	0.65	0.09
8	E2	0.80	0.88				200.00	0.88	0.08
9	E3	0.94	0.96				200.00	0.96	0.02
10		0.91	0.93				200.00	0.93	0.02

Z_0 = 1 m selected

Table B-3 – Sensitivity Analysis for 2017-2021 Doncaster-Sheffield Airport Meteorological Data – 99.79thth Percentile of 1 Hour mean-Total NO_x

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SENSITIVITY Met 1hour 99.79th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Met Sensitivity Runs*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Scenarios							
ID	Receptors	2017	2018	2019	2020	2021	AQS	MAX	Difference
MAX Grid								-	-
1	R1	1.01	1.28	1.28	1.15	1.28	200.00	1.28	0.27
2	R2	2.09	2.23	1.95	2.26	2.07	200.00	2.26	0.31
3	R3	1.01	0.91	0.93	1.00	0.95	200.00	1.01	0.10
4	R4	0.52	0.71	0.80	0.84	0.82	200.00	0.84	0.32
5	R5	1.22	1.05	1.13	1.02	1.03	200.00	1.22	0.20
6	R6	0.81	0.80	0.80	0.80	0.83	200.00	0.83	0.03
7	R7	0.41	0.45	0.42	0.47	0.47	200.00	0.47	0.06
8	E1	0.77	0.73	0.77	0.77	0.77	200.00	0.77	0.04
9	E2	0.90	0.77	0.84	0.89	0.88	200.00	0.90	0.13
10	E3	0.76	0.78	0.88	0.75	0.82	200.00	0.88	0.13

Table B-4 – Sensitivity Analysis for 2017-2021 Doncaster-Sheffield Airport Meteorological Data –100th Percentile of 1 Hour mean- Total NO_x

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SENSITIVITY Met 1hour 100th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Met Sensitivity Runs*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Scenarios							
ID	Receptors	2017	2018	2019	2020	2021	AQS	MAX	Difference
MAX Grid								-	-
1	R1	1.57	1.61	1.60	1.69	1.61	200.00	1.69	0.12
2	R2	2.37	2.37	2.37	2.38	2.38	200.00	2.38	0.01
3	R3	1.18	1.17	1.25	1.22	1.17	200.00	1.25	0.08
4	R4	1.02	1.10	1.01	1.10	1.09	200.00	1.10	0.09
5	R5	1.24	1.27	1.24	1.23	1.23	200.00	1.27	0.04
6	R6	0.96	0.97	0.96	0.95	0.96	200.00	0.97	0.02
7	R7	0.63	0.61	0.62	0.65	0.62	200.00	0.65	0.04
8	E1	0.80	0.81	0.81	0.80	0.79	200.00	0.81	0.02
9	E2	0.99	0.94	0.97	0.94	0.97	200.00	0.99	0.05
10	E3	0.91	0.91	0.91	0.91	0.91	200.00	0.91	0.01

Met Year Selected: 2020

Table B-5 – Sensitivity Analysis for Main Building – 99.79thth Percentile of 1 Hour mean – Total NO_x

SENSITIVITY Buildings 1 hour 99.79th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Building Sensitivity Runs*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Scenarios							
ID	Receptors	Stack Building	Factory Building				AQS	MAX	Difference
MAX Grid								-	-
1	R1	1.01	1.04				200.00	1.04	0.03
2	R2	2.09	2.09				200.00	2.09	-
3	R3	1.01	1				200.00	1.01	0.01
4	R4	0.52	0.48				200.00	0.52	0.04
5	R5	1.22	1.07				200.00	1.22	0.15
6	R6	0.81	0.71				200.00	0.81	0.10
7	R7	0.41	0.41				200.00	0.41	-
8	E1	0.77	0.66				200.00	0.77	0.11
9	E2	0.9	0.77				200.00	0.90	0.13
10	E3	0.76	0.72				200.00	0.76	0.04

Table B-6 – Sensitivity Analysis for Main Building – 100th Percentile of 1 Hour mean-Total NO_x

SENSITIVITY Buildings 1hour 100th

FILES: *F:\AQ Modelling Files\Sharpsmart Normanton\00 Model Files\Building Sensitivity Runs*

Pollutant: NOx **Averaging Period:** 1 hour **AQS:** 200

		Scenarios							
ID	Receptors	Stack Building	Factory Building				AQS	MAX	Difference
MAX Grid								-	-
1	R1	1.57	1.49				200.00	1.57	0.08
2	R2	2.37	2.37				200.00	2.37	-
3	R3	1.18	1.16				200.00	1.18	0.02
4	R4	1.02	0.97				200.00	1.02	0.05
5	R5	1.24	1.1				200.00	1.24	0.14
6	R6	0.96	1.01				200.00	1.01	0.05
7	R7	0.63	0.63				200.00	0.63	-
8	E1	0.80	0.8				200.00	0.80	-
9	E2	0.99	1				200.00	1.00	0.01
10	E3	0.91	0.74				200.00	0.91	0.17

Building Choice: Stack Building

Appendix C Assessment Results

Table C – 1 – Maximum Model Predicted (2020) Annual Mean NO_2 Concentrations at Human Receptors Relevant for Long Term Exposure

Receptor ID	Background Concentration (µg/m³)	AQS (µg/m³)	NO_x PC (µg/m³)	NO_2 PC (µg/m³)	PC as % of AQS	NO_2 PEC (µg/m³)	PEC as % of AQS
R1	17.06	40	0.0169	0.012	0.03%	17.1	43%
R2	17.06	40	0.0526	0.037	0.09%	17.1	43%
R3	12.00	40	0.0175	0.012	0.03%	12.0	30%
R4	12.00	40	0.0198	0.014	0.03%	12.0	30%
R5	12.68	40	0.0512	0.036	0.09%	12.7	32%
R6	12.68	40	0.0302	0.021	0.05%	12.7	32%
R7	9.53	40	0.0090	0.006	0.03%	9.5	24%

Table C – 2 – Maximum Model Predicted (2020) 1-Hour Mean NO_2 Concentrations at Human Receptors relevant for Short-Term Exposure

Receptor ID	Background Concentration (µg/m³)	AQS (µg/m³)	99.79th Percentile					100th Percentile		
			NO_x PC (µg/m³)	NO_2 PC (µg/m³)	PC as % of AQS	NO_2 PEC* (µg/m³)	PEC as % of AQS	NO_x PC (µg/m³)	NO_2 PC (µg/m³)	PC as % of AQS
R1	17.06	200	1.2	0.4	0.21%	34.5	17.3%	1.6	0.6	0.28%
R2	17.06	200	2.3	0.8	0.40%	34.9	17.5%	2.3	0.8	0.41%
R3	12.00	200	0.9	0.3	0.16%	24.3	12.2%	1.2	0.4	0.21%
R4	12.00	200	0.8	0.3	0.14%	24.3	12.1%	1.1	0.4	0.18%
R5	12.68	200	1.0	0.4	0.18%	25.7	12.9%	1.1	0.4	0.19%
R6	12.68	200	0.8	0.3	0.14%	25.7	12.8%	0.9	0.3	0.16%
R7	9.53	200	0.4	0.2	0.08%	19.2	9.6%	0.6	0.2	0.10%

*PEC is PC plus 2 x background for short -term average calculations

Table C – 3 – Maximum Model Predicted (2020) NO_x Annual Mean and 24-Hour Mean NO_x Concentrations at Ecological Receptor

Receptor ID	Background Concentration NO_x (µg/m³)	Annual Mean					24-Hour Mean				
		AQS (µg/m³)	NO_x PC (µg/m³)	NO_x PC as % of AQS	NO_x PEC (µg/m³)	NO_x PEC as % of AQS	AQS (µg/m³)	NO_x PC (µg/m³)	NO_x PC as % of AQS	NO_x PEC (µg/m³)	NO_x PEC as % of AQS
E1	20.49	30	0.02	0.07%	20.51	68%	75	0.02	0.026%	20.51	27%
E2	20.49	30	0.03	0.09%	20.52	68%	75	0.03	0.037%	20.52	27%
E3	20.49	30	0.02	0.08%	20.51	68%	75	0.02	0.032%	20.51	27%

Table C – 4 Model Predicted (2020) Nutrient Nitrogen Deposition at Specified Ecological Receptors

Receptor ID	PC Nitrogen Deposition (kg N/ha/yr)	Lowest APIS Critical Load (kg N/ha/yr)	Maximum APIS Critical Load (kg N/ha/yr)	Recommended APIS Screening Critical Load (kg N/ha/yr)	PC as Percentage of the Screening Critical Load
E1	0.00196	10	20	20	0.02%
E2	0.00277	10	20	20	0.003%
E3	0.00241	10	20	20	0.02%

Table C – 5 – Model Predicted (2020) Acid Deposition at Specified Ecological Receptors

Receptor ID	Current APIS Acid Deposition N (keq/ha/yr)	PC Acid Deposition N (keq/ha/yr)	APIS CLminN (keq/ha/yr)	Lowest APIS CLmaxN (keq/ha/yr)	PC Total Acid Deposition as % of CL function (CLmaxN)
E1	2.85	0.00014	0.357	2.878	0.005%
E2	2.85	0.00020	0.357	2.878	0.01%
E3	2.85	0.00017	0.357	2.878	0.01%

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