

Air Quality Impact Assessment
Heineken UK, Manchester

Client: Norder Design Associates Limited

Reference: 7630r1

Date: 29th February 2024



Report Issue

Report Title: Air Quality Impact Assessment - Heineken UK, Manchester

Report Reference: 7630

Field	Report Version			
	1	2	3	4
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Executive Summary

Redmore Environmental Ltd was commissioned by Norder Design Associates Ltd to undertake an Air Quality Impact Assessment in order to address a planning condition for a new ammonia ventilation system at Heineken UK, Manchester.

Emissions of ammonia from the system during emergency release events have the potential to cause air quality impacts on receptors within the vicinity of the site. An Air Quality Impact Assessment was therefore undertaken to quantify ammonia concentrations at sensitive locations and identify any requirement for mitigation to control impacts to an acceptable level.

Potential ammonia emissions were defined based on the size and nature of the proposed system. Impacts at sensitive receptors were quantified using dispersion modelling and the results compared with the relevant guideline levels.

Predicted ammonia concentrations during emergency release events were below the relevant guideline levels at all sensitive locations in the vicinity of the site for all modelling years. As such, mitigation measures are not required.

Based on the assessment results, it is recommended that the planning condition be discharged.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Norder Design Associates Limited to undertake an Air Quality Impact Assessment in order to address a planning condition for a new ammonia (NH₃) ventilation system at Heineken UK, Manchester.

1.1.2 Emissions of NH₃ during emergency release events have the potential to cause air quality impacts on receptors within the vicinity of the site. An Air Quality Impact Assessment was therefore undertaken to quantify NH₃ concentrations at sensitive locations and identify any requirement for mitigation to control impacts to an acceptable level.

1.2 Site Location and Context

1.2.1 The site is located with the existing Heineken UK facility off Denmark Road, Manchester, at approximate National Grid Reference (NGR): 383892, 395917. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 Planning consent for an NH₃ ventilation system comprising three extract vents, fans and associated services on the existing carbon dioxide (CO₂) recovery building was issued (reference: 138497/FO/2023) by Manchester City Council (MCC) on 2nd February 2024 subject to a number of pre-commencement conditions. These included the following of relevance to air quality:

"a. Prior to the commencement of the development, an air quality impact assessment together with any mitigation measures to safeguard local air quality shall be submitted and approved in writing by the City Council as local planning authority.

Reason: To secure a reduction in air pollution from traffic or other sources in order to protect existing and future residents from air pollution, pursuant to policies EN16, SP1 and DM1 of the Core Strategy "

1.2.3 Emissions of NH₃ from the ventilation system during emergency release events have the potential to cause impacts on receptors within the vicinity of the site. An Air Quality

Impact Assessment has therefore been undertaken in order to address the above condition. This is summarised in the following report.

- 1.2.4 It should be noted that the proposals are not anticipated to generate any traffic. As such, emissions from this source have not been considered further in the assessment.

2.0 **AIR QUALITY STANDARDS**

2.1 **Environmental Assessment Levels**

2.1.1 The Environment Agency (EA) have set Environmental Assessment Levels (EALs) for a number of species. These are defined as the concentration of a substance, which, in a particular environmental medium, the regulators regard as an appropriate value to enable a comparison between the environmental effects of different substances in that medium and between environmental effects in different media, enabling the summation of those effects.

2.1.2 Ideally EALs to fulfil this objective would be defined for each pollutant:

- Based on the sensitivity of particular habitats or receptors (in particular three main types of receptor should be considered, protection of human health, protection of natural ecosystems and protection of specific sensitive receptors, e.g. materials, commercial activities requiring a particular environmental quality);
- Be produced according to a standardised protocol to ensure that they are consistent, reproducible and readily understood;
- Provide similar measure of protection for different receptors both within and between media; and,
- Take account of habitat specific environmental factors such as pH, nutrient status, bioaccumulation, transfer and transformation processes where necessary.

2.1.3 EALs used in this assessment were obtained from EA guidance 'Air emissions risk assessment for your environmental permit'¹ and are summarised in Table 1.

Table 1 Environmental Assessment Levels

Pollutant	1-Hour Environmental Assessment Level (mg/m ³)
NH ₃	2.5

¹ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.

2.2 Acute Exposure Guideline Levels

2.2.1 The United States Environmental Protection Agency (US EPA) have developed Acute Exposure Guideline Levels (AEGLs) which are used by emergency planners and responders worldwide as guidance in dealing with rare, usually accidental, releases of chemicals into the air. AEGLs are expressed as specific concentrations of airborne pollutants at which health effects may occur. They are designed to protect the elderly and children, and other individuals who may be susceptible and are sensitive to atmospheric pollution.

2.2.2 AEGLs are calculated for five short exposure periods with 'levels' ranging from 1 to 3 based on the severity of the toxic effects caused by the exposure. These are described as follows:

- Level 1: Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure;
- Level 2: Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape; and,
- Level 3: Life-threatening health effects or death.

2.2.3 The AEGLs for NH₃ are summarised in Table 2.

Table 2 Acute Exposure Guideline Levels for NH₃

Acute Exposure Guideline Level for NH ₃ (mg/m ³)					
Level	Averaging Period				
	10-minutes	30-minutes	60-minutes	4-hours	8-hours
1	21	21	21	21	21
2	154	154	112	77	77
3	1,888	1,119	769	385	273

3.0 **METHODOLOGY**

3.1 **Introduction**

3.1.1 Emissions of NH₃ from the ventilation system during emergency release events have the potential to cause air quality impacts on receptors within the vicinity of the site. These have been quantified through dispersion modelling in accordance with the following methodology, which was agreed with Lisa Jones, Environmental Protection Officer at MCC, on 28th February 2024.

3.2 **Dispersion Model**

3.2.1 Dispersion modelling was undertaken using ADMS-6.0 (v6.0.0.1), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

3.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

3.3 **Modelling Scenarios**

3.3.1 The scenarios considered in the modelling assessment are summarised in Table 3.

Table 3 Modelling Scenarios

Parameter	Modelled As
NH ₃	100 th percentile (%ile) 10-minute mean
	100 th %ile 8-hour mean
	100 th %ile 1-hour mean

Parameter	Modelled As
	100 th %ile 4-hour mean
	100 th %ile 30-minute mean

3.3.2 The %iles shown in Table 3 were selected to derive the maximum NH₃ concentration for relevant averaging period and allow direct comparison with the corresponding EAL and AEGL.

3.4 Assessment Area

3.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 383640, 395670 to 384270, 396300. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

3.4.2 Reference should be made to Figure 2 for a graphical representation of the assessment grid extents.

3.5 Sensitive Receptors

3.5.1 A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 4.

Table 4 Sensitive Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Arnott Crescent	383935.5	396240.1
R2	Place of Worship - Greenheys Lane	384176.1	396176.3
R3	Police Station - Charles Halle Road	384060.3	396075.5
R4	Residential - Denmark Road	384074.7	396007.7
R5	Residential - St Bees Close	384068.7	395944.4

Receptor		NGR (m)	
		X	Y
R6	Residential - Lagos Close	384044.0	395899.9
R7	Residential - Lagos Close	384037.2	395841.2
R8	Place of Worship - Westwood Street	383971.3	395770.5
R9	Residential - Barnhill Street	383879.7	395738.3
R10	Express English College - Princess Road	383804.8	395829.2
R11	Hospital - Princess Road	383814.3	395930.5
R12	Asda - Radnor Street	383797.4	396018.4
R13	Workplace - Greenheys Lane	383786.0	396256.6

3.5.2 Reference should be made to Figure 3 for a map of the sensitive receptor locations.

3.6 Process Conditions and Emissions

3.6.1 A summary of the model inputs is provided in Table 5. These were provided by Norder Design Associates Ltd. It should be noted that identical parameters were used to represent all three extract vents.

Table 5 Process Conditions and Emissions

Parameter	Unit	Value Per Extract Vent
Extract vent height ^(a)	m	9.0 ^(a)
Extract vent diameter	m	0.4
Exhaust gas temperature	-	Ambient
Exhaust gas efflux velocity	m/s	16.71
NH ₃ emission rate	g/s	0.954

Note: (a) Above ground level.

3.6.2 Reference should be made to Figure 2 for a map of the extract vent locations.

3.7 **Building Effects**

3.7.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

3.7.2 Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 6.

Table 6 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
CO ₂ Recovery Building	383888.6	395925.8	8.0	8.3	23.5	151.8
Facility Building 1	383893.7	395916.8	14.5	7.3	22.8	152.2
Facility Building 2	383872.0	395916.5	16.5	12.8	5.7	151.9
Facility Building 3	383901.4	395899.2	11.5	30.2	27.9	151.4
Facility Building 4	383933.0	395919.0	11.5	61.9	43.9	151.1
Facility Building 5	383856.1	395901.7	16.5	11.5	32.1	116.1

3.7.3 Reference should be made to Figure 2 for a map of the building locations.

3.8 **Meteorological Data**

3.8.1 Meteorological data used in the assessment was taken from Manchester Airport meteorological station over the period 1st January 2018 to 31st December 2022 (inclusive). This observation station is located at NGR: 381792, 384116, which is approximately 12.0km south of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

3.8.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 4 for wind roses of the utilised meteorological records.

3.9 Roughness Length

3.9.1 Roughness length (z_0) is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.5m was used to describe the modelling extents. This value is considered appropriate for the morphology of the modelling area and is suggested within ADMS-6 as being suitable for 'parkland, open suburbia'.

3.9.2 A z_0 of 0.2m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-6 as being suitable for 'agricultural areas (min)'.

3.10 Monin-Obukhov Length

3.10.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-6 as being suitable for 'cities and large towns'.

3.11 Terrain Data

3.11.1 Inclusion of terrain data is recommended within the ADMS-6 user guide if the gradient within a modelling area varies by more than 10% (1 in 10). Assessment of changes in elevation throughout the modelling extents using Google Earth indicated the maximum gradient was less than 10%. As such, terrain data was not included within the model.

3.12 Background Concentrations

3.12.1 An annual mean NH_3 concentration of 0.00217mg/m³ obtained from the UK Air Pollution Information System (APIS)² website was utilised to represent baseline levels throughout the assessment extents.

² UK APIS, www.apis.ac.uk.

3.13 Assessment Criteria

3.13.1 Predicted NH₃ concentrations were compared against the relevant EALs and AEGLs. Any exceedence would indicate a requirement of mitigation.

3.14 Modelling Uncertainty

3.14.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

3.14.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from an observation station local to the site to account for inter-year variability. The assessment was based on the worst-case year to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC;
- Background concentrations - Background NH₃ levels were obtained from the APIS website. These are considered representative of baseline conditions at sensitive locations within the vicinity of the site;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,

- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

3.14.3 Results were considered in the context of the relevant EAL and AEGLs. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.0 **RESULTS**

4.1 **Introduction**

4.1.1 Dispersion modelling was undertaken with the inputs described in Section 3.0. The results are outlined below. It should be noted that these include NH₃ contributions from the facility during emergency release events, in addition to existing baseline levels.

4.2 **Maximum Ammonia Concentrations**

4.2.1 The maximum predicted total NH₃ concentrations for any meteorological data set at any location within the modelling extents are summarised in Table 7.

Table 7 Maximum Predicted NH₃ Concentrations

Pollutant	Concentration (mg/m ³)				
	10-Minutes	30-Minutes	1-Hour	4-Hours	8-Hours
NH ₃	2.35	2.17	2.10	1.82	1.46

4.2.2 As shown in Table 7, there were no predicted exceedences of the EAL or any AEGL at any location within the modelling extents.

4.2.3 Reference should be made to Figures 5 to 9 for graphical representations of predicted NH₃ concentrations, inclusive of background levels, throughout the assessment extents for each averaging period. It should be noted that the data shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration. For example, the maximum 10-minute concentration was predicted using the 2021 meteorological data set. As such, the contours shown in Figure 5 were produced from the 2021 model output.

4.3 **Sensitive Receptors**

4.3.1 The maximum predicted total NH₃ concentration, inclusive of background levels, for any meteorological data set at each sensitive receptor location is summarised in Table 8.

Table 8 Predicted NH₃ Concentrations

Receptor		NH ₃ Concentration (mg/m ³)				
		10-Minutes	30-Minutes	1-Hour	4-Hours	8-Hours
R1	Residential - Arnott Crescent	0.42	0.33	0.27	0.26	0.22
R2	Place of Worship - Greenheys Lane	0.64	0.50	0.40	0.39	0.33
R3	Police Station - Charles Halle Road	1.02	0.82	0.68	0.62	0.49
R4	Residential - Denmark Road	0.88	0.72	0.59	0.53	0.47
R5	Residential - St Bees Close	0.74	0.58	0.47	0.41	0.36
R6	Residential - Lagos Close	0.86	0.70	0.57	0.37	0.29
R7	Residential - Lagos Close	0.96	0.78	0.64	0.56	0.49
R8	Place of Worship - Westwood Street	1.24	1.30	1.25	0.83	0.77
R9	Residential - Barnhill Street	1.03	0.86	0.72	0.66	0.58
R10	Express English College - Princess Road	0.92	0.75	0.61	0.50	0.51
R11	Hospital - Princess Road	0.38	0.30	0.25	0.23	0.20
R12	Asda - Radnor Street	0.92	0.74	0.61	0.57	0.39
R13	Workplace - Greenheys Lane	0.34	0.26	0.22	0.20	0.16

4.3.2 As shown in Table 8, there were no predicted exceedences of the EAL or any AEGL at any receptor location. As such, mitigation measures to reduce NH₃ levels are not required.

5.0 CONCLUSION

- 5.1.1 Redmore Environmental Ltd was commissioned by Norder Design Associates Ltd to undertake an Air Quality Impact Assessment in order to address a planning condition for a new NH₃ ventilation system at Heineken UK, Manchester.
- 5.1.2 Emissions of NH₃ from the system during emergency release events have the potential to cause impacts on receptors within the vicinity of the site. An Air Quality Impact Assessment was therefore undertaken to quantify NH₃ concentrations at sensitive locations and identify any requirement for mitigation to control impacts to an acceptable level.
- 5.1.3 Potential NH₃ emissions were defined based on the size and nature of the proposed system. Impacts at sensitive receptors were quantified using dispersion modelling and the results compared with the relevant guideline levels.
- 5.1.4 Predicted NH₃ concentrations during emergency release events were below the relevant EAL and AEGLs at all locations in the vicinity of the site for all modelling years. As such, mitigation measures are not required.
- 5.1.5 Based on the assessment results, it is recommended that the planning condition be discharged.

6.0 **ABBREVIATIONS**

AEGL	Acute Exposure Guideline Level
APIS	Air Pollution Information System
CO ₂	Carbon Dioxide
CERC	Cambridge Environmental Research Consultants
EA	Environment Agency
EAL	Environmental Assessment Level
MCC	Manchester City Council
NGR	National Grid Reference
US EPA	United States Environmental Protection Agency
z ₀	Roughness length
%ile	Percentile

Figures



Legend



Site Boundary

Title

Figure 1 - Site Location Plan

Project

Air Quality Impact Assessment
Hieneken UK, Manchester

Project Reference

7630

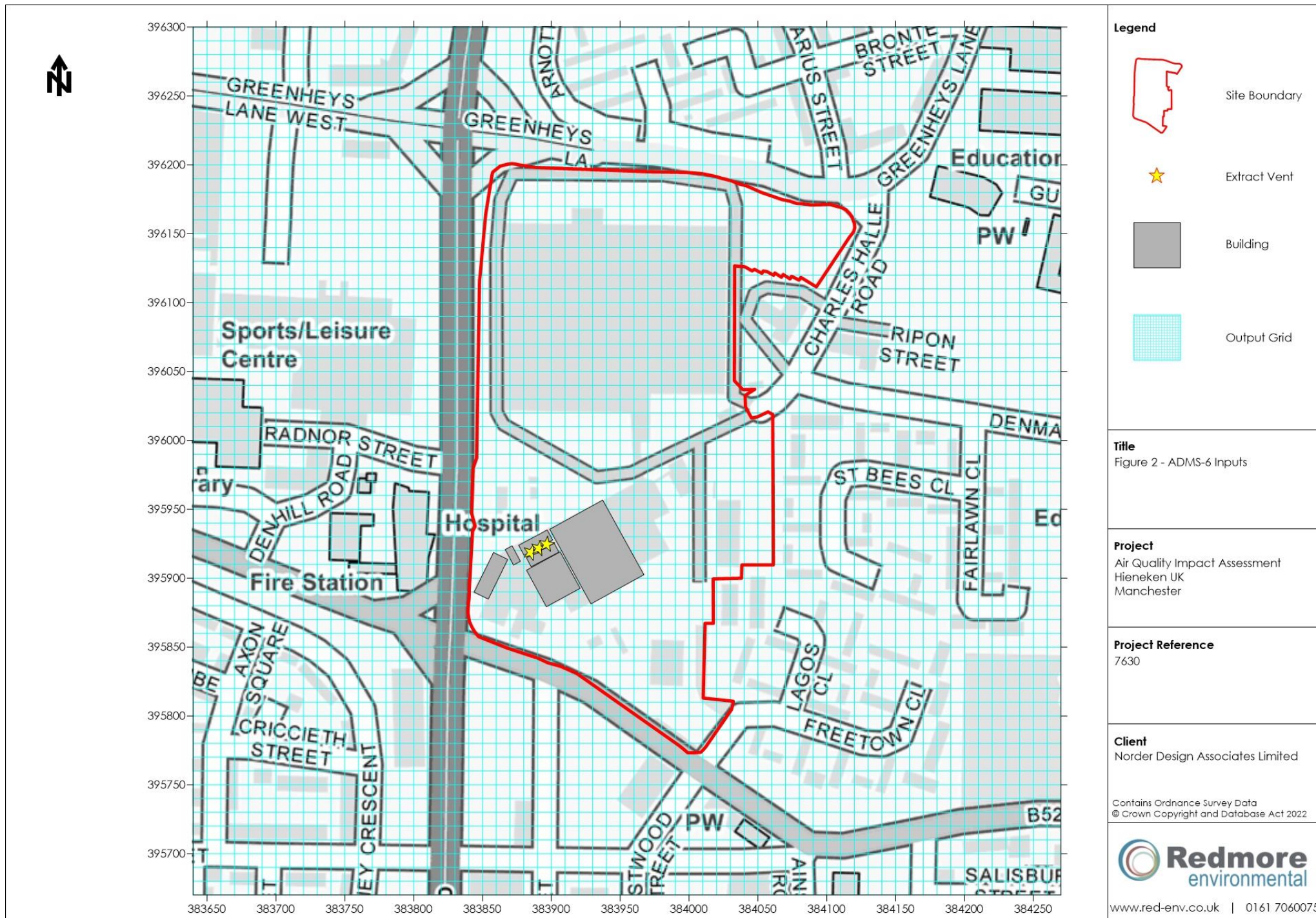
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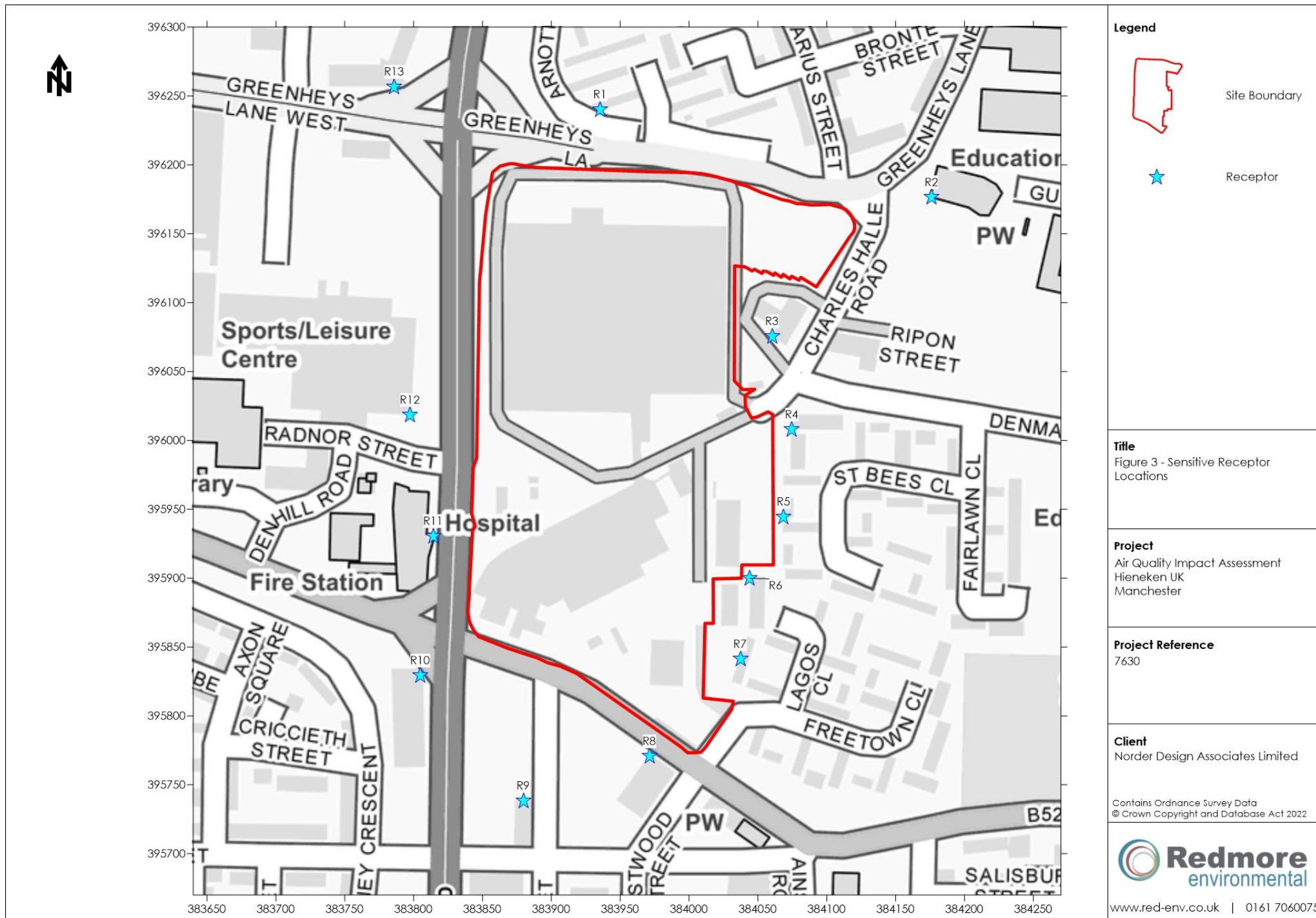
Norder Design Associates Limited

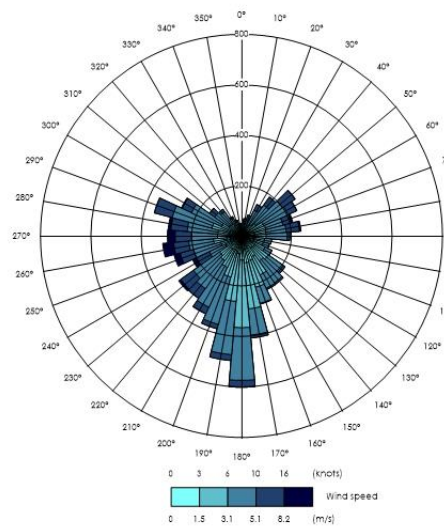
Contains Ordnance Survey Data
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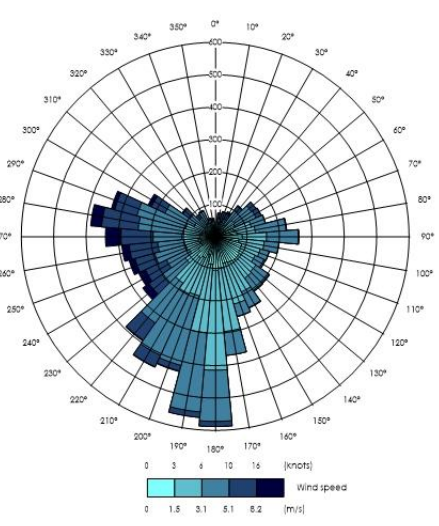
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2018 Meteorological Data



2019 Meteorological Data

Legend

Title

Figure 4 - Wind Roses of 2018 to 2022
Manchester Airport Meteorological
Data

Project

Air Quality Impact Assessment
Hieneken UK
Manchester

Project Reference

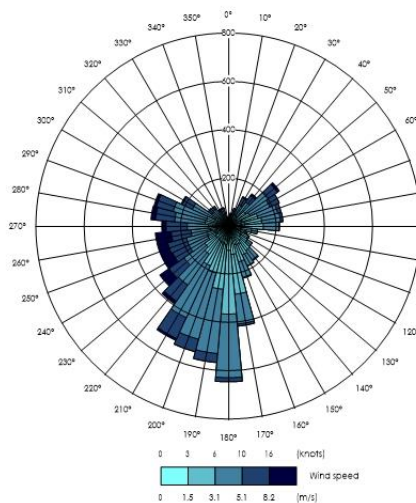
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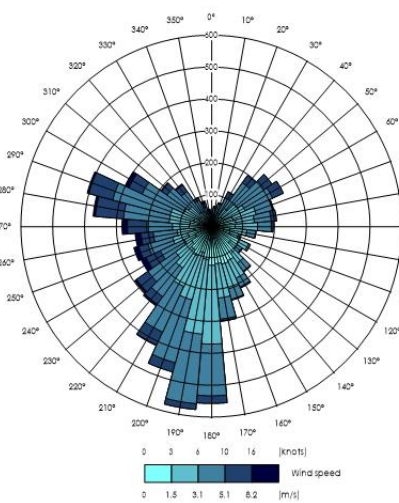
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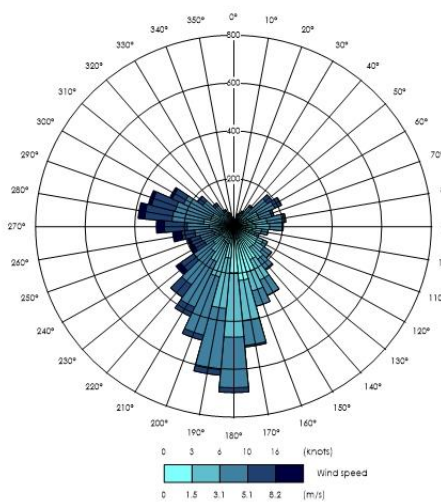
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2020 Meteorological Data



2021 Meteorological Data



2022 Meteorological Data



