James Farm, Ruabon

Arbtech

Air Quality Assessment

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Executive Summary

Rappor Consultants Limited was appointed by Arbtech to undertake an air quality assessment for a proposed development at James Farm in Ruabon, Wrexham. The proposals are for the conversion of existing outbuildings to five dwellings. The Site is located in the administrative area of Wrexham County Borough Council.

The proposed development involves the conversion of the existing outbuildings and therefore very minimal external changes are required. The external works proposed are modest in nature and comprises alterations such as replacement glazing. Significant structural works are not proposed, nor are any earthworks or demolition activities outside of the buildings. Based on the nature of the proposals, consideration of construction dust impacts associated with construction phase activity was not required in accordance with Institute of Air Quality Management guidance, and the proposals can be considered to have an insignificant impact on local air quality and amenity during the conversion.

The Site is located close to the A483 which is a major arterial route in the Ruabon area. To consider the exposure of future occupiers of the outbuildings to air pollution, a detailed operational phase road traffic emissions assessment was undertaken to predict concentrations of NO_2, PM_{10} and $PM_{2.5}$ across the Site. Road traffic emissions were modelled using the dispersion model ADMS-Roads and concentrations of nitrogen dioxide and particulate matter (PM_{10} and $PM_{2.5}$) were predicted at identified sensitive receptor locations. The modelling assessment was undertaken in accordance with Welsh Government Local Air Quality Management Guidance and Institute of Air Quality Management & Environmental Protection UK guidance.

Concentrations of NO_2, PM_{10} and $PM_{2.5}$ predicted across the proposed development Site were identified to be below the current relevant air quality objectives. The Site was therefore considered suitable for the proposed use with no requirement for air quality mitigation. It is therefore considered that the air quality for future occupiers is suitable and air quality is not a constraint to development.

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1 Introduction

General

1.1 Rappor Consultants Limited was instructed by Arbtech to undertake an air quality assessment for a proposed residential development at James Farm in Ruabon, Wrexham ('the Site'). The proposals include the conversion of existing outbuildings into residential dwellings.

1.2 The assessment considers the potential impacts of the proposed development during both the construction and operational phases. A review of the development proposals was undertaken to consider the potential for dust and emissions to arise as a result of proposed conversion works. A detailed operational phase road traffic emissions assessment was undertaken to predicted pollutant concentrations across the Site and the suitability of the Site for the proposed use.

1.3 The assessment takes account of relevant local and national policy and guidance. A glossary of terms utilised in this report is provided in **Appendix A**.

Site Location

1.4 The Site is located within the James Farm Caravan Park on the southern edge of the town of Ruabon in Wrexham, Wales. The existing outbuildings that are proposed for conversion are currently unused and were formerly agricultural buildings. The Site is located in the administrative area of Wrexham County Borough Council (WCBC).

1.5 To the north, the Site is bound by woodland and the A539 with existing residential properties beyond. To the east of the Site lies the main farmhouse building with woodland and the A483 beyond. To the south of the Site are caravan pitches associated with the wider James Farm Caravan Park use. Agricultural land lies to the west with existing retail premises beyond. The Site is not located within, or in the vicinity of, an Air Quality Management Area (AQMA).

1.6 The Site location is illustrated in **Figure 1.1**.

Figure 1.1 Site Location

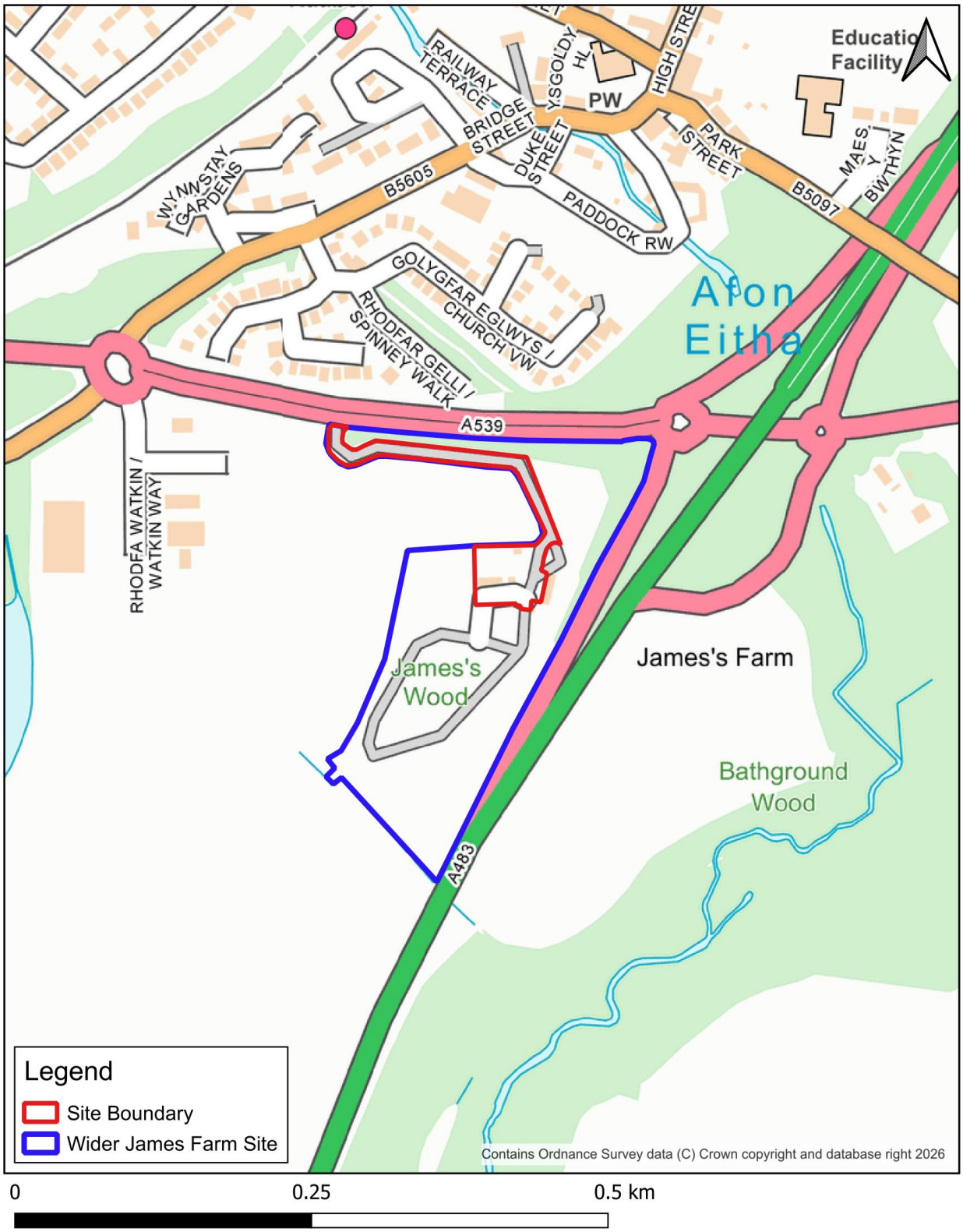


Figure 1.1: Site Location

2 Relevant Policy and Guidance

National Legislation and Planning Policy

2.1 The following national legislation and planning policy is relevant to air quality and was considered throughout this air quality assessment:

- European Parliament, EU 2008 Ambient Air Quality Directive (2008)[1];
- HMSO, Air Quality (Wales) Regulations (2000)[2];
- Welsh Government, Planning Policy Wales Edition 12 (2024)[3]; and
- Welsh Government, Future Wales: The National Plan 2040 (2021)[4].

Local Planning Policy

2.2 The following local planning policy was reviewed with regards to air quality and a summary of any relevant policies in provided in **Appendix B**:

- Wrexham County Borough Council, Wrexham Unitary Development Plan 1996 – 2011[5].

Air Quality Guidance

2.3 The following air quality guidance was utilised in the air quality assessment:

- Welsh Government, Local Air Quality Management in Wales Policy Guidance (2017)[6];
- Welsh Government, The Local Air Environment Local Air Quality and Soundscapes Management in Wales 2025 (2025)[7];
- Institute of Air Quality Management (IAQM), Guidance on the assessment of dust from demolition and construction (2024)[8]; and
- IAQM and Environmental Protection UK (EPUK), Land-Use Planning and Development Control: Planning for Air Quality (2017)[9].

[1] European Parliament (2008) Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe
[2] HMSO (2000) Statutory Instrument 2000 No. 928, The Air Quality (Wales) Regulations 2000 (as amended), London: HMSO
[3] Welsh Government (2024) Planning Policy Wales Edition 12
[4] Welsh Government (2021) Future Wales National Plan 2040
[5] Wrexham County Borough Council (2005) Wrexham Unitary Development Plan
[6] Welsh Government (2017) Local Air Quality Management in Wales Policy Guidance
[7] Welsh Government (2025) The Local Air Environment Local Air Quality and Soundscapes Management in Wales 2025
[8] Institute of Air Quality Management (2024) Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London
[9] Institute of Air Quality Management and Environmental Protection UK (2017) Land-Use Planning and Development Control: Planning for Air Quality

3 Assessment Methodology

3.1 WCBC provided comments from the Public Protection Service Manager in relation to air quality, stating:

> *"The development site is in close proximity to the A483. It is therefore likely that some areas of the site may be exposed to poorer air quality through traffic emissions. No part of the development shall commence until an air quality assessment for the road traffic pollutants nitrogen dioxide (NO_2) and particulate matter (PM_{10}) has been carried out, submitted to and approved in writing by the Local Planning Authority. The assessment shall use appropriate modelling methods as described in Local Air Quality Management Technical Guidance LAQM TG (16)."*

3.2 This air quality assessment has been prepared in response to the above comments to consider the pollutant concentrations across the Site, and determine whether future users may be exposed to elevated pollutant levels, and identify any mitigation measures that may be required.

Construction Phase - Dust Assessment

3.3 The proposed development involves the conversion of the existing outbuildings and therefore very minimal external changes are required. The external works proposed are modest in nature and comprises alterations such as replacement glazing. Significant structural works are not proposed, nor are any significant earthworks or demolition activities outside of the buildings. Based on the nature of the proposals, consideration of construction dust impacts associated with construction phase activity was not required in accordance with Institute of Air Quality Management (IAQM) guidance[8], and the proposals can be considered to have an insignificant impact on local air quality and amenity during the conversion.

Operational Phase Exposure Assessment

Air Dispersion Modelling

3.4 Air dispersion modelling software ADMS-Roads, version 5.1.0.2, was utilised to predict concentrations of NOx and particulate matter (PM_{10} and $PM_{2.5}$) at identified sensitive human receptor locations. The assessment was undertaken in accordance with the principles set out in LAQM guidance[6,7] and the IAQM and EPUK guidance[9].

Assessment, Scenarios, Study Area and Sensitive Receptors

3.5 The following assessment scenarios were considered in the assessment:

- Scenario 1: 2024 Model Verification; and
- Scenario 2: 2026 Opening Year with Development.

3.6 Traffic data were obtained for the above scenarios for the study area listed below:

- A539;
- A483;
- A5152;

- B5007;
- B5605; and
- High Street.

3.7 Traffic data used in the assessment are detailed in **Appendix C**.

3.8 A Cartesian grid was run across the Site from co-ordinates X 329573, Y 343762 to X 330959, Y 342866 at a height of 1.5m.

Dispersion Model Inputs

3.9 A summary of the model inputs utilised in the air dispersion modelling is provided below, with full details provided in **Appendix D**, alongside all relevant assumptions and limitations.

- Emission Factors Toolkit version 13.1[10] was utilised to obtain traffic data emissions for the years of assessment;
- NOx – NO_2 Calculator version 9.1[11] was utilised to convert oxides of nitrogen to NO_2;
- Background concentrations were obtained from the Defra background maps[12] for the years of assessment, in the absence of any representative background monitoring data in the study area;
- Meteorological data from the Shawbury recording station was utilised in the assessment for the 2024 year, to align with the model verification year. This recording station was considered the most representative to conditions in the study area due to other closer recording stations experiencing coastal and valley influences. The windrose is presented in **Appendix E**;
- Model verification was undertaken utilising local representative monitoring data from monitoring locations operated by WCBC. Full details of the model verification process are detailed in **Appendix F**.

Assessment Criteria

3.10 Predicted pollutant concentrations were compared to the current relevant air quality objectives detailed in **Table 3.1**.

Table 3.1: Relevant Air Quality Standards and Objectives utilised in the Assessment

Pollutant	Averaging Period	Air Quality Objective (µg.m^{-3})	Date to Achieve by
NO_2	Annual Mean	40	31 December 2005
	1-hour mean not to be exceeded more than 18 times per year	200	31 December 2005
PM_{10}	Annual Mean	40	31 December 2004
	24-hour mean not to be exceeded more than 35 times per year	50	31 December 2004
$PM_{2.5}$	Annual Mean	25	1 January 2020

[10] Defra (2025) Emission Factor Toolkit [https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html]
[11] Defra (2024) NOx to NO2 Calculator [https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc]
[12] Defra (2024) background pollutant concentration maps [https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2021]

4 Baseline Conditions

Introduction

4.1 Baseline air quality conditions in the study area were defined based on a review of the following sources of data:

- Defra's Local Air Quality Management support pages;
- WCBC's Local Air Quality Management reports[13] and monitoring data; and
- Aerial imagery, maps and plans of the Site and study area.

Local Air Quality Management and Monitoring

4.2 The Site is not located within or in the vicinity of an AQMA. WCBC undertakes monitoring of NO_2 within its administrative area. The closest, most representative monitoring locations to the Site are detailed in **Table 4.1** below. Due to the influence of the COVID-19 pandemic and subsequent lockdowns, monitoring data up to 2019 are considered the 'pre-pandemic baseline' whilst monitoring data for 2022 onwards represent the 'post-pandemic baseline. Monitoring data recorded in 2020 and 2021 are considered atypical due to the influence of lockdown restrictions on road traffic levels and emissions, in accordance with the IAQM position statement[14].

Table 4.1: Local Air Quality Monitoring Data (µg.m^{-3})

Site ID	X	Y	Site Type	Monitored Concentration					
				2019	2020	2021	2022	2023	2024
30	330950	348170	Roadside	31.7	26.3	29.5	28.6	27.4	24.7
36	327630	342990	Roadside	17.7	12.2	14.3	12.9	15.4	12.8
51	330125	346099	Suburban	16.8	136	15.5	15.2	15.5	9.4

4.3 The monitored annual mean NO_2 concentrations recorded at the closest monitoring locations to the Site, detailed in **Table 4.1**, were below the current objective of 40µg.m^{-3} in all years for which data were available for review. The data also demonstrate a downward trend in concentrations, illustrating that air quality is improving locally.

4.4 The monitoring locations are located close to the roads that also pass by the Site and are therefore considered representative of conditions at the Site. Therefore, the monitoring locations detailed in **Table 4.1** were utilised in model verification. The full model verification process is detailed in **Appendix F**.

[13] Wrexham County Borough Council (2025) 2025 Annual Status Report
[14] Institute of Air Quality Management (2023) Position Statement: The Use of 2020 and 2021 Monitoring Datasets Version 2.1

5 Operational Phase Exposure Assessment

5.1 As the Site does not currently include any sensitive uses within the proposed buildings for conversion, consideration was given to the suitability of the Site for the proposed sensitive use with regard to the current relevant air quality objectives.

5.2 **Table 5.1** details the highest predicted annual mean NO_2, PM_{10} and $PM_{2.5}$ concentration within the Site and **Figures 5.1**, **5.2** and **5.3** illustrate annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations across the Site respectively.

Table 5.1: Highest Predicted Annual Mean NO_2, PM_{10} and $PM_{2.5}$ Concentration across the Site ($\mu g.m^{-3}$)

Annual Mean NO_2	Annual Mean PM_{10}	Annual Mean $PM_{2.5}$
11.4	11.9 (2 days)	6.3

5.3 As detailed in **Table 5.1**, annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ across the Site were below the current relevant annual mean objectives. With regard to the hourly mean NO_2 objective, as the highest predicted annual mean NO_2 concentration was significantly less than $60\mu g.m^{-3}$, in accordance with guidance[6], exceedances of the hourly mean NO_2 objective are unlikely. With regard to the daily mean PM_{10} objective, the greatest number of days predicted to experience PM_{10} concentrations above $50\mu g.m^{-3}$ was two, which is well below the 35 days set out in the objective.

5.4 Whilst Wales has not adopted the Environmental Improvement Plan $PM_{2.5}$ interim and future objectives, consideration was also given to these in the assessment. The highest annual mean $PM_{2.5}$ concentration predicted within the Site was well below the EIP interim target of $12\mu g.m^{-3}$ and the future objective of $10\mu g.m^{-3}$.

5.5 It is therefore considered that the Site is suitable for the proposed use with regards to the current relevant air quality objectives.

Figure 5.1: Annual Mean NO_2 Concentrations across the Site

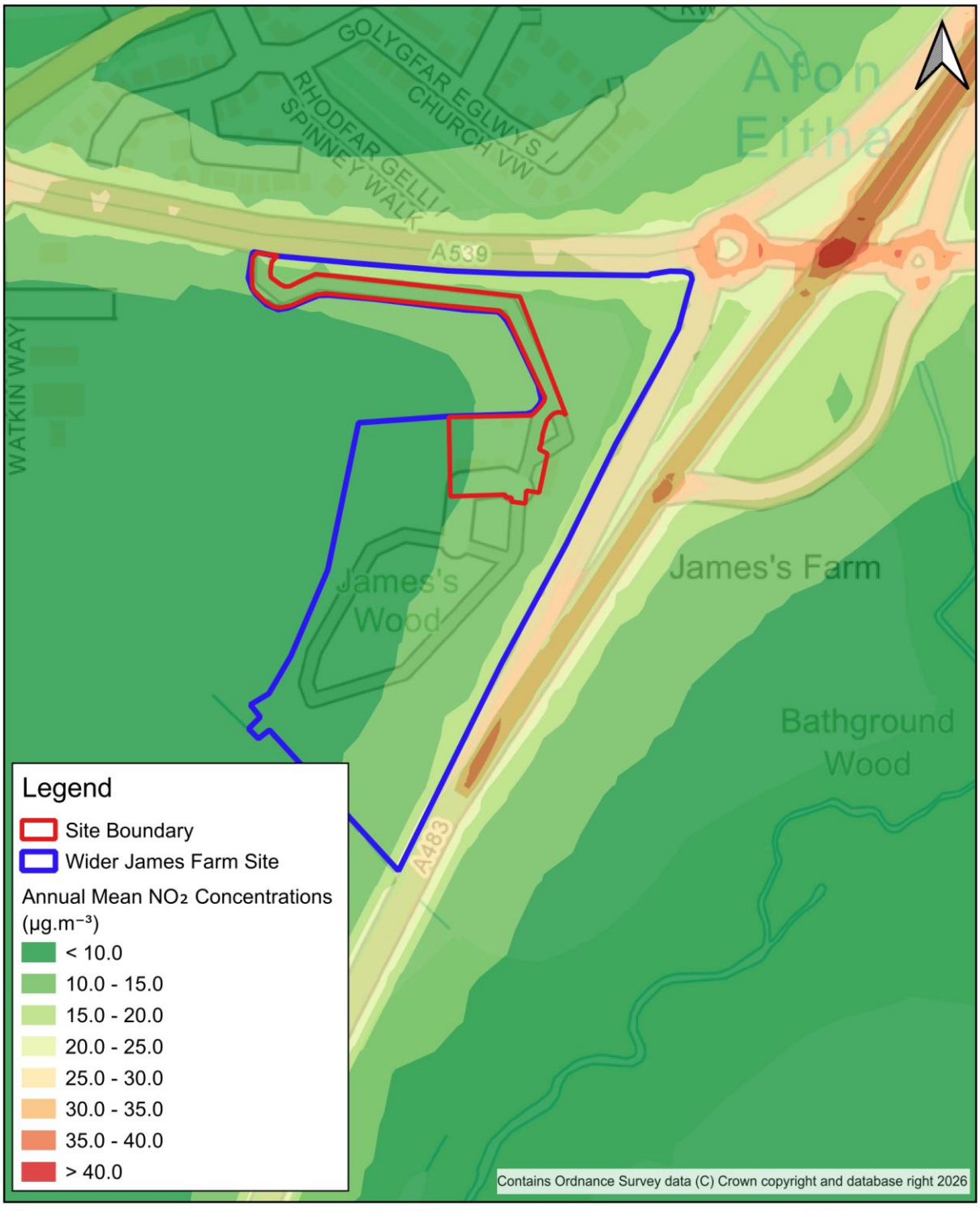


Figure 5.1: Annual Mean NO_2 Contour at the Site

Figure 5.2: Annual Mean PM_{10} Concentrations across the Site

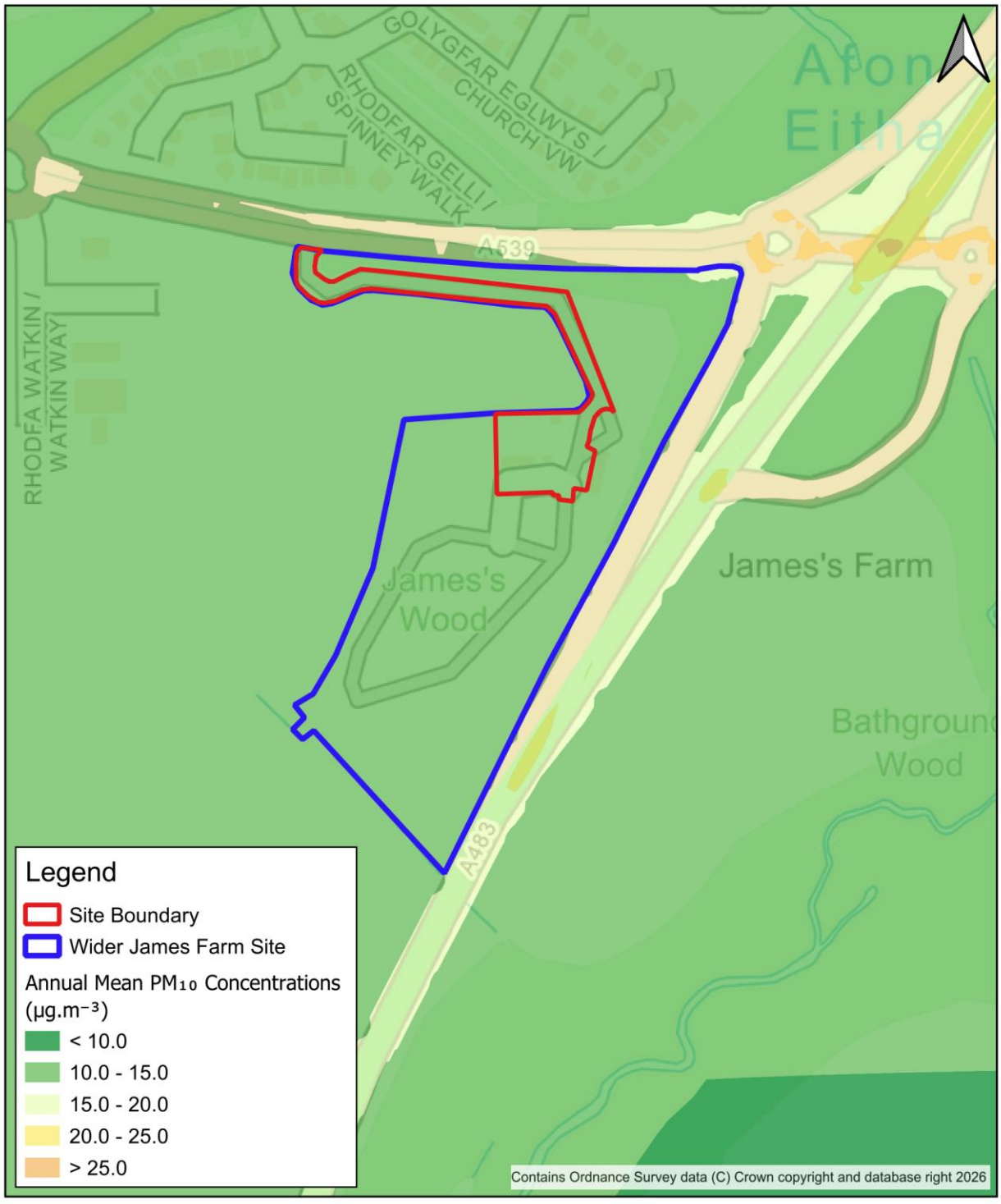


Figure 5.2: Annual Mean PM_{10} Concentrations at the Site

Figure 5.3: Annual Mean $PM_{2.5}$ Concentrations across the Site

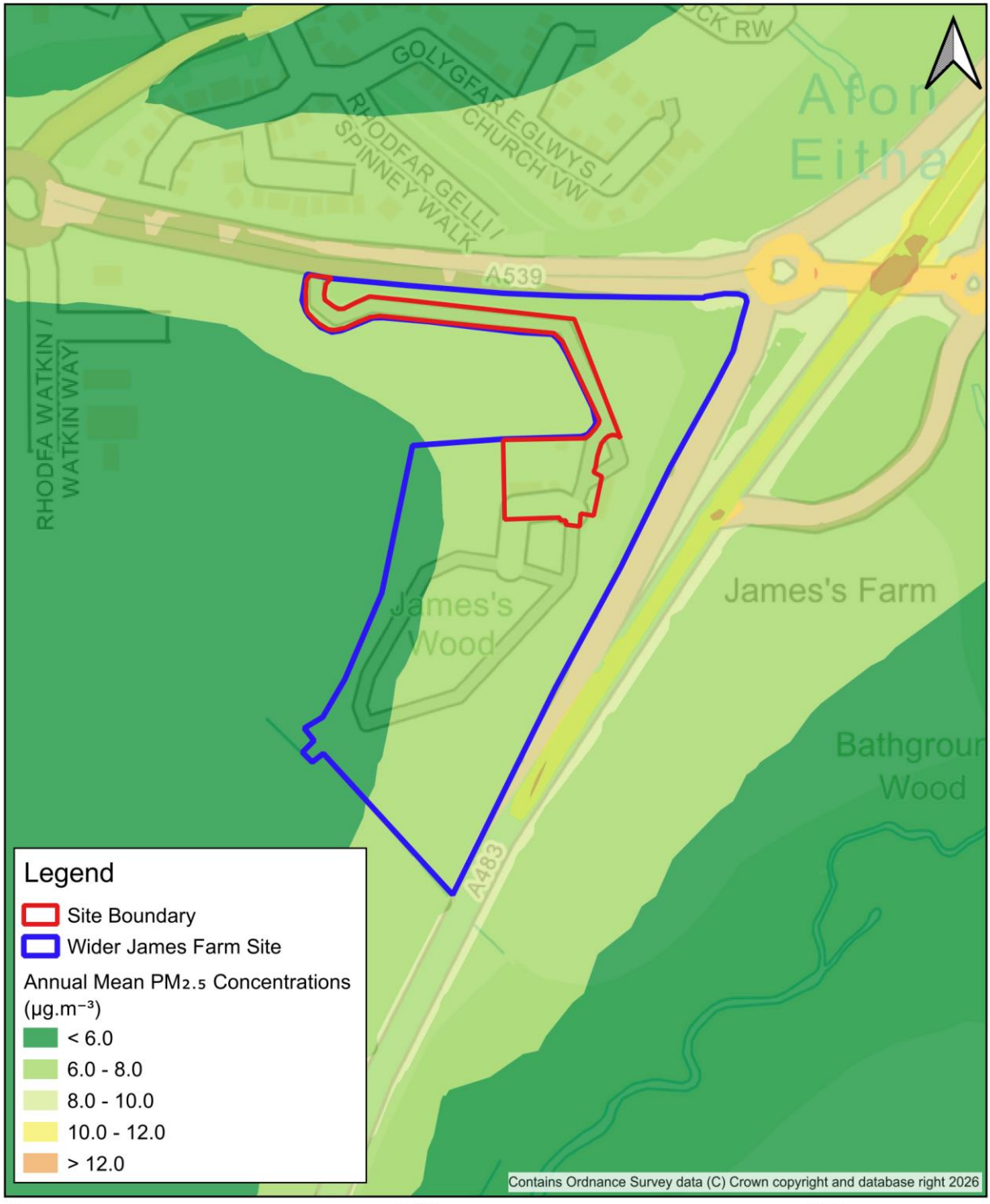


Figure 5.3: Annual Mean $PM_{2.5}$ Concentrations at the Site

6 Summary and Conclusions

6.1 Rappor was instructed by Arbtech to undertake an air quality assessment for submission with a planning application for a proposed conversion of agricultural outbuildings to residential dwellings. The Site is located in the wider James Farm Caravan Park in Ruabon, Wrexham.

6.2 As the proposals do not include any significant construction or demolition works, the proposals were considered to have an insignificant impact on local air quality as a result of dust and emissions associated with the construction phase.

6.3 At the request of WCBC, a detailed operational phase road traffic emissions exposure assessment was undertaken to consider the influence of local road traffic sources on pollutant concentrations in the Site, and determine the suitability of the Site for residential use. The assessment identified that concentrations of NO_2, PM_{10} and $PM_{2.5}$ were all below the relevant air quality objectives. The Site was therefore considered to be suitable for the proposed residential use with regards to air quality and no mitigation is required.

Appendix A – Glossary

Term	Definition
AADT	Annual Average Daily Traffic flow.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between two years, which is useful for pollutants that have higher concentrations during the winter months.
AQAP	Air Quality Action Plan.
AQMA	Air Quality Management Area.
AQS	Air Quality Strategy.
Defra	Department for Environment, Food and Rural Affairs.
EPUK	Environmental Protection UK.
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
HDV	Heavy Duty Vehicles (HGVs + buses and coaches)
HGV	Heavy Goods Vehicles.
IAQM	Institute of Air Quality Management.
LAQM	Local Air Quality Management.
LDV	Light Duty Vehicles (motorbikes, cars, vans and small trucks)
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NOx	Nitrogen oxides.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
micrograms per cubic metre ($\mu g.m^{-3}$)	A measure of concentration in terms of mass per unit volume. A concentration of 1μg.m-3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.

Appendix B – Local Planning Policy

Wrexham Unitary Development Plan 1996 - 2011

The following policies are contained in the Unitary Development Plan relevant to air quality:

> *"Policy GDP1*
>
> *All relevant development should:*
>
> *[…]*
>
> *f. Ensure the safety and amenity of the public and safeguard the environment frm the adverse effects o pollution of water, land or air, hazards from industry and quarrying, and associated noise, odour or vibration arising from development.*
>
> *[…]"*

Appendix C – Traffic Data

Table C1: Traffic Data used in Air Dispersion Modelling

Road	2024 Verification Year		2026 Base Year	
	AADT	HDV	AADT	HDV
A539	17428	439	17796	448
A483 South of Ruabon	27761	2299	28348	2348
A483 North of Ruabon	42291	2533	43185	2587
A539 East of A483	4173	252	4261	257
High Street	297	2	303	2
B5007 Park Street	1102	12	1125	12
A539 Llangollen Road	8968	222	9157	227
B5605	3690	130	3768	133
B5605 Ruabon Road	6346	272	6480	278
B5426 Bangor Road	6220	325	6351	332
A5152 Wrexham Road	11916	370	12168	378
A483 Rhostylien	53741	2752	54876	2810

Appendix D – Dispersion Model Inputs

The following inputs were utilised in the atmospheric dispersion modelling undertaken as part of the air quality assessment:

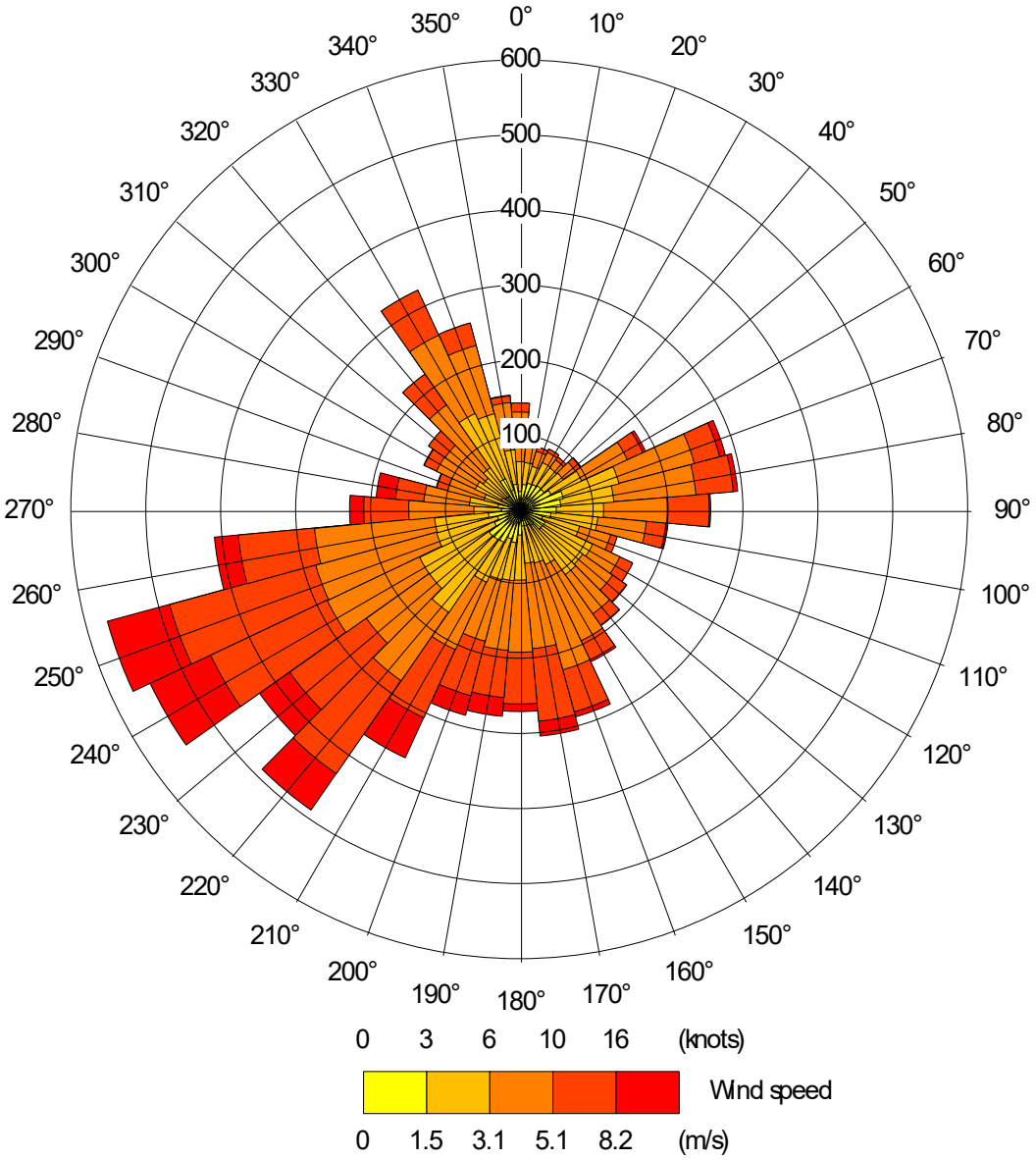
- The atmospheric dispersion modelling software ADMS-Roads version 5.1.0.2 was utilised in the assessment;
- Emission Factor Toolkit version 13.1 was utilised to obtain emission factors for the years of assessment (2024 and 2026);
- NOx-NO_2 Calculator version 9.1 was utilised to derive NO_2 concentrations from modelled Road NOx concentrations. The input parameter 'All other urban UK roads' was utilised to represent the roads included in the study area, which is located in an urban setting and does not include roads within London, or any motorways;
- Meteorological data from the Shawbury recording station was utilised in the air dispersion model for the verification year of 2024. A surface roughness of 0.5m and a Monin-Obhukov length of 10m were utilised for the Site to represent the conditions in the study area which is located on the edge of Ruabon which is a small town with parkland and suburban uses; and
- Following the withdrawal of the IAQM position statement regarding sensitivity analyses, no sensitivity analysis scenario was included within the assessment.

The following limitations and assumptions are applicable to the air quality assessment:

- There are uncertainties associated with both measured and predicted concentrations. The model relies on input data (including projected traffic flows), which also have uncertainties associated with them. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS Roads model will not take into account.
- To reduce the uncertainty associated with predicted concentrations, model verification has been carried out following guidance set out in LAQM.TG(22), which recommends the use of roadside monitoring for this process. As the model has been verified against 2024 measured concentrations and has been adjusted to take account of the apparent under-prediction, there can be reasonable confidence in the predicted concentrations.

Appendix E – Wind Rose

The 2024 wind rose for the Shawbury meteorological recording station is illustrated below. The prevailing wind direction is from the southwest.



Appendix F – Model Verification

Whilst ADMS Roads is widely validated for use in this type of assessment, model verification for the area around the Site will not have been included. To determine model performance at a local level, a comparison of modelled results with monitored results in the study area was done in line with methodology specific in LAQM.TG(22). This process of verification aims to minimise modelling uncertainty by correcting modelled results by an adjustment factor to give greater confidence to the results.

The model was run to predict the 2024 annual mean road-NOx contributions at the WCBC monitoring locations. The model outputs of road-NOx were compared to the 2024 'measured' road-NOx, which was determined from the nitrogen dioxide concentrations measured at the monitoring locations, utilising the NOx from NO_2 calculator provided by Defra and the NO_2 background concentration.

Table F1 details the model verification process.

Table F1: Model Verification Process (µg.m^{-3})

Verification Step	36	51	30
2024 monitored NO_2	12.8	9.4	24.7
2024 background NO_2	6.1	6.0	6.2
Monitored road NOx	14.1	6.9	42.7
Modelled road NOx	6.9	8.0	18.9
Ratio between monitored and modelled road NOx	2.0	0.9	2.3
Adjustment factor	2.0485		
Adjusted modelled road NOx	14.1	16.3	38.7
Modelled total NO_2	12.8	13.8	23.2
% RMSE	6.7		

A road-NOx adjustment factor of **2.0485** was determined as the ratio of the 'measured' road contribution and the model derived road contribution. This factor was then applied to the modelled road-NOx concentration at each receptor, before conversion to NO_2 concentrations using the NOx to NO_2 calculator provided by Defra, and the NO_2 background concentration. An RMSE% or 6.7 was derived which is within the ideal 10% range and therefore there is statistical confidence in the modelling outputs.

As there are no PM_{10} or $PM_{2.5}$ monitoring locations within the study area, the predicted road-PM_{10} and road-$PM_{2.5}$ components have been adjusted using the road-NOx factor before adding the appropriate background concentration.

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