Air Quality Assessment

Ruthin Road, Wrexham

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Executive Summary

Redmore Environmental Ltd was commissioned by Redrow Homes Limited to undertake an Air Quality Assessment in support of a residential led development on land off Ruthin Road, Wrexham.

The proposals have the potential to cause air quality impacts as a result of fugitive dust emissions during construction and road traffic exhaust emissions during operation, as well as expose future residents to any existing air quality issues at the site. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions, consider location suitability for the proposed end-use and assess potential effects as a result of the scheme.

Potential construction phase air quality impacts from fugitive dust emissions were assessed as a result of demolition, earthworks, construction and trackout activities. It is considered that the use of good practice control measures would provide suitable mitigation for a development of this size and nature and reduce potential impacts to an acceptable level.

Potential impacts during the operational phase of the proposals may occur due to road traffic exhaust emissions associated with vehicles travelling to and from the development. Additionally, future residents may be exposed to any existing air quality issues at the site. Dispersion modelling was therefore undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the local highway network both with and without the scheme in place. Results were subsequently verified using local monitoring data.

Review of the dispersion modelling results indicated that air quality impacts as a result of traffic generated by the development were not predicted to be significant at any sensitive location in the vicinity of the site.

The results of the assessment also demonstrated that predicted pollution levels were below the relevant air quality standards across the development. As such, the site is considered suitable for the proposed use from an air quality perspective.

Based on the assessment results, air quality factors are not considered a constraint to the development.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Redrow Homes Limited to undertake an Air Quality Assessment in support of a residential led development on land off Ruthin Road, Wrexham.

1.1.2 The proposals have the potential to cause air quality impacts during construction and operation, as well as expose future residents to any existing air quality issues at the site. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions, consider location suitability for the proposed end-use and assess potential effects as a result of the scheme.

1.2 Site Location and Context

1.2.1 The site is located on land off Ruthin Road, Wrexham, at approximate National Grid Reference (NGR): 331525, 349755. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The proposals comprise a residential development for up to 1520 dwellings, plus associated roads, open space, community facilities, a site for a primary school and a wastewater treatment plant (if necessary).

1.2.3 The development has the potential to cause air quality impacts at sensitive locations. These may include fugitive dust emissions associated with construction works and road traffic exhaust emissions from vehicles travelling to and from the scheme during the operational phase. Additionally, the proposals may introduce future residents to any existing air quality issues at the site. An Air Quality Assessment was therefore undertaken in order to determine baseline conditions, consider location suitability for the proposed end use and consider potential effects as a result of the proposals. This is detailed in the following report.

2.0 LEGISLATION AND POLICY

2.1 Legislation

2.1.1 The Air Quality Standards (Wales) Regulations (2010) and subsequent amendments include Air Quality Limit Values (AQLVs) for the following pollutants:

- Nitrogen dioxide (NO_2);
- Sulphur dioxide;
- Lead;
- Particulate matter with an aerodynamic diameter of less than 10µm (PM_{10});
- Particulate matter with an aerodynamic diameter of less than 2.5µm ($PM_{2.5}$);
- Benzene; and,
- Carbon monoxide.

2.1.2 Air Quality Target Values were also provided for several additional pollutants. It should be noted that the AQLV for $PM_{2.5}$ stated in the Air Quality Standards (Wales) Regulations (2010) was amended in the Environment (Miscellaneous Amendments) (EU Exit) Regulations (2020).

2.1.3 The Air Quality Strategy (AQS)[1] was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in July 2007. The document contains standards, objectives and measures for improving ambient air quality, including a number of Air Quality Objectives (AQOs). These are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.1.4 Table 1 presents the AQOs and AQLVs for pollutants considered within this assessment.

[1] The AQS for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

Table 1 Air Quality Objectives/ Air Quality Limit Values

Pollutant	Air Quality Objective/ Air Quality Limit Value	
	Concentration (µg/m³)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
PM_{10}	40	Annual mean
	50	24-hour mean, not to be exceeded on more than 35 occasions per annum
$PM_{2.5}$	20	Annual mean

2.1.5 The Environment Act (2021) was published on 9th November 2021 and makes provision for the setting of lower $PM_{2.5}$ targets. However, the AQLV outlined in Table 1 remains the adopted air quality standard within Wales until further legislation is implemented.

2.1.6 Table 2 summarises the advice provided in DEFRA guidance[2] on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean	All locations where the annual mean objective would apply, together with hotels Gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term

[2] Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

2.2 Local Air Quality Management

2.2.1 Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.3 Dust

2.3.1 The main requirements with respect to dust control from industrial or trade premises not regulated under the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments, such as construction sites, is that provided in Section 79 of Part III of the Environmental Protection Act (1990). The Act defines nuisance as:

> "any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance."

2.3.2 Enforcement of the Act, in regard to nuisance, is currently under the jurisdiction of the local Environmental Health Department, whose officers are deemed to provide an independent evaluation of nuisance. If the LA is satisfied that a statutory nuisance exists, or is likely to occur or happen again, it must serve an Abatement Notice under Part III of

the Environmental Protection Act (1990). The only defence is to show that the process to which the nuisance has been attributed and its operation are being controlled according to best practicable means.

2.4 National Planning Policy

2.4.1 Planning Policy Wales[3] was published in February 2021 and sets out the land use planning policies of the Welsh Government, including air quality. Chapter 6, Section 6.7 - Air Quality and Soundscape, provides a framework for addressing air quality and states that:

> "The planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution alongside action to tackle high pollution hotspots. In doing so, it should consider the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment and identify and pursue any opportunities to reduce, or at least, minimise population exposure to air and noise pollution, and improve soundscapes, where it is practical and feasible to do so.
>
> […]
>
> In proposing new development, planning authorities and developers must, therefore:
>
> • address any implication arising as a result of its association with, or location within, air quality management areas, noise action planning priority areas or areas where there are sensitive receptors;
> • not create areas of poor air quality or inappropriate soundscape; and,
> • seek to incorporate measures which reduce overall exposure to air and noise pollution and create appropriate soundscapes."

2.4.2 This has been considered throughout this assessment.

[3] Planning Policy Wales Edition 11, Welsh Assembly Government, 2021.

2.5 Local Planning Policy

2.5.1 The Wrexham Unitary Development Plan[4] (WUDP) 1996 - 2011 was adopted by Wrexham County Borough Council (WCBC) on 14th February 2005. A review of the WUDP identified the following policy of relevance to this assessment:

> "Policy GDP1
>
> All new development should:-
>
> […]
>
> f) Ensure the safety and amenity of the public and safeguard the environment from the adverse effects of pollution of water, land or air, hazards from industry and quarrying, and associated noise, odour or vibration arising from development.
>
> […]
>
> k) Secure the development of sustainable communities, through the promotion of the economic, social and environmental well-being of the area."

2.5.2 This policy has been considered throughout the undertaking of this assessment.

2.5.3 WCBC has been working on a replacement development plan for several years. The Deposit version was issued in March 2018[5] and has since been subject to Examination. In February 2023, the Inspector's issued their report which, subject to a number of changes, found the Plan sound. Review of the document indicated the following of relevance to this assessment:

> "Policy SP15: Natural Environment
>
> Development will only be supported where it protects, conserves and enhances the natural environment including:

[4] WUDP 1996 - 2011, WCBC, 2005.

[5] Wrexham Local Development Plan 2013 - 2028, WCBC, 2019.

[…]

• The quality of natural services including water, air and soils

[…]"

"Policy DM1: Development Management Considerations

Developments proposals, where relevant, must:

[…]

c) Safeguard the environment from the adverse effects of pollution of water, land, light or air, or land instability, arising from development;

[…]"

2.5.4 WCBC took the decision not to adopt the Wrexham Local Development Plan 2013 - 2028[6] on 19th April 2023. However, the above policies have been considered throughout the undertaking of this assessment in order to ensure a comprehensive approach was adopted.

6 Wrexham Local Development Plan 2013 - 2028, WCBC, 2019.

3.0 METHODOLOGY

3.1 Introduction

3.1.1 The proposed development has the potential to cause air quality impacts during the construction and operational phases, as well as expose future residents to any existing air quality issues at the site. These factors have been assessed in accordance with the following methodology, which was agreed with Paul Campini, Enforcement Officer at WC, on 28th June 2021.

3.2 Construction Phase Assessment

3.2.1 There is the potential for fugitive dust emissions to occur as a result of construction phase activities. These have been assessed in accordance with the methodology outlined within the Institute of Air Quality Management (IAQM) document 'Guidance on the Assessment of Dust from Demolition and Construction V1.1'[7].

3.2.2 Activities on the proposed construction site have been divided into four types to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and,
- Trackout.

3.2.3 The potential for dust emissions was assessed for each activity that is likely to take place and considered three separate dust effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and,
- The risk of health effects due to a significant increase in exposure to PM_{10}.

3.2.4 The assessment steps are detailed below.

[7] Guidance on the Assessment of Dust from Demolition and Construction V1.1, IAQM, 2016.

Step 1

3.2.5 Step 1 screens the requirement for a more detailed assessment. Should human receptors be identified within 350m from the boundary or 50m from the construction vehicle route up to 500m from the site entrance, then the assessment proceeds to Step 2. Additionally, should ecological receptors be identified within 50m of the site or the construction vehicle route up to 500m from the site entrance, then the assessment also proceeds to Step 2.

3.2.6 Should sensitive receptors not be present within the relevant distances then **negligible** impacts would be expected and further assessment is not necessary.

Step 2

3.2.7 Step 2 assesses the risk of potential dust impacts. A site is allocated a risk category based on two factors:

- The scale and nature of the works, which determines the magnitude of dust arising as: small, medium or large (Step 2A); and,
- The sensitivity of the area to dust impacts, which can be defined as low, medium or high sensitivity (Step 2B).

3.2.8 The two factors are combined in Step 2C to determine the risk of dust impacts without mitigation applied.

3.2.9 Step 2A defines the potential magnitude of dust emission through the construction phase. The relevant criteria are summarised in Table 3.

Table 3 Construction Dust - Magnitude of Emission

Magnitude	Activity	Criteria
Large	Demolition	• Total volume of building to be demolished greater than 50,000m^3 • Potentially dusty material (e.g. concrete) • On-site crushing and screening • Demolition activities more than 20m above ground level

Magnitude	Activity	Criteria
Large	Earthworks	• Total site area greater than 10,000m^2 • Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • More than 10 heavy earth moving vehicles active at any one time • Formation of bunds greater than 8m in height • More than 100,000 tonnes of material moved
	Construction	• Total building volume greater than 100,000m^3 • On site concrete batching • Sandblasting
	Trackout	• More than 50 Heavy Duty Vehicle (HDV) trips per day • Potentially dusty surface material (e.g. high clay content) • Unpaved road length greater than 100m
Medium	Demolition	• Total volume of building to be demolished between 20,000m^3 and 50,000m^3 • Potentially dusty construction material • Demolition activities 10m to 20m above ground level
	Earthworks	• Total site area 2,500m^2 to 10,000m^2 • Moderately dusty soil type (e.g. silt) • 5 to 10 heavy earth moving vehicles active at any one time • Formation of bunds 4m to 8m in height • Total material moved 20,000 tonnes to 100,000 tonnes
	Construction	• Total building volume 25,000m^3 to 100,000m^3 • Potentially dusty construction material (e.g. concrete) • On site concrete batching
	Trackout	• 10 to 50 HDV trips per day • Moderately dusty surface material (e.g. high clay content) • Unpaved road length 50m to 100m
Small	Demolition	• Total volume of building to be demolished less than 20,000m^3 • Construction material with low potential for dust release (e.g. metal cladding or timber) • Demolition activities less than 10m above ground and during wetter months

Magnitude	Activity	Criteria
	Earthworks	• Total site area less than 2,500m^2 • Soil type with large grain size (e.g. sand) • Less than 5 heavy earth moving vehicles active at any one time • Formation of bunds less than 4m in height • Total material moved less than 20,000 tonnes • Earthworks during wetter months
	Construction	• Total building volume less than 25,000m^3 • Construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	• Less than 10 HDV trips per day • Surface material with low potential for dust release • Unpaved road length less than 50m

3.2.10 Step 2B defines the sensitivity of the area around the development to potential dust impacts. The influencing factors are shown in Table 4.

Table 4 Construction Dust - Examples of Factors Defining Sensitivity of an Area

Receptor Sensitivity	Examples	
	Human Receptors	Ecological Receptors
High	• Users expect high levels of amenity • High aesthetic or value property • People expected to be present continuously for extended periods of time • Locations where members of the public are exposed over a time period relevant to the AQO for PM_{10}. e.g. residential properties, hospitals, schools and residential care homes	• Internationally or nationally designated site e.g. Special Area of Conservation
Medium	• Users would expect to enjoy a reasonable level of amenity • Aesthetics or value of their property could be diminished by soiling • People or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land e.g. parks and places of work	• Nationally designated site e.g. Sites of Special Scientific Interest

Receptor Sensitivity	Examples	
	Human Receptors	Ecological Receptors
Low	• Enjoyment of amenity would not reasonably be expected • Property would not be expected to be diminished in appearance • Transient exposure, where people would only be expected to be present for limited periods. e.g. public footpaths, shopping streets, playing fields, farmland, short term car parks and roads	• Locally designated site e.g. Local Nature Reserve

3.2.11 The guidance also provides the following factors to consider when determining the sensitivity of an area to potential dust impacts:

- Any history of dust generating activities in the area;
- The likelihood of concurrent dust generating activity on nearby sites;
- Any pre-existing screening between the source and receptors;
- Any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant the season during which works will take place;
- Any conclusions drawn from local topography;
- Duration of the potential impact, as a receptor may become more sensitive over time; and,
- Any known specific receptor sensitivities which go beyond the classifications given in the document.

3.2.12 These factors were considered in the undertaking of this assessment.

3.2.13 The criteria for determining the sensitivity of the area to dust soiling effects on people and property is summarised in Table 5.

Table 5 Construction Dust - Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		Less than 20	Less than 50	Less than 100	Less than 350
High	More than 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		Less than 20	Less than 50	Less than 100	Less than 350
	1 - 10	Medium	Low	Low	Low
Medium	More than 1	Medium	Low	Low	Low
Low	More than 1	Low	Low	Low	Low

3.2.14 Table 6 outlines the criteria for determining the sensitivity of the area to human health impacts.

Table 6 Construction Dust - Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Background Annual Mean PM_{10} Concentration	Number of Receptors	Distance from the Source (m)				
			Less than 20	Less than 50	Less than 100	Less than 200	Less than 350
High	Greater than 32µg/m^3	More than 100	High	High	High	Medium	Low
		10 - 100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28 - 32µg/m^3	More than 100	High	High	Medium	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	24 - 28µg/m^3	More than 100	High	Medium	Low	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	Less than 24µg/m^3	More than 100	Medium	Low	Low	Low	Low
		10 - 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Medium	Greater than 32µg/m^3	More than 10	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low

Receptor Sensitivity	Background Annual Mean PM_{10} Concentration	Number of Receptors	Distance from the Source (m)				
			Less than 20	Less than 50	Less than 100	Less than 200	Less than 350
	28 - 32µg/m^3	More than 10	Medium	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	24 - 28µg/m^3	More than 10	Low	Low	Low	Low	Low
		1 -10	Low	Low	Low	Low	Low
	Less than 24µg/m^3	More than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Low	-	1 or more	Low	Low	Low	Low	Low

3.2.15 Table 7 outlines the criteria for determining the sensitivity of the area to ecological impacts.

Table 7 Construction Dust - Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	Less than 20	Less than 50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

3.2.16 Step 2C combines the dust emission magnitude with the sensitivity of the area to determine the risk of unmitigated impacts.

3.2.17 Table 8 outlines the risk category from demolition activities.

Table 8 Construction Dust - Dust Risk Category from Demolition Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Medium
Medium	High	Medium	Low
Low	Low	Low	Negligible

3.2.18 Table 9 outlines the risk category from earthworks and construction activities.

Table 9 Construction Dust - Dust Risk Category from Earthworks and Construction Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

3.2.19 Table 10 outlines the risk category from trackout activities.

Table 10 Construction Dust - Dust Risk Category from Trackout Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Low	Negligible
Low	Low	Low	Negligible

Step 3

3.2.20 Step 3 requires the identification of site specific mitigation measures within the IAQM guidance[8] to reduce potential dust impacts based upon the relevant risk categories identified in Step 2. For sites with **negligible** risk, mitigation measures beyond those required by legislation are not required. However, additional controls may be applied as part of good practice.

Step 4

3.2.21 Once the risk of dust impacts has been determined and the appropriate mitigation measures identified, the final step is to determine the significance of any residual impacts. For almost all construction activity, the aim should be to control effects through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be **not significant**.

3.2.22 The determination of significance relies on professional judgement and reasoning should be provided as far as practicable. The IAQM guidance suggests the provision of details of the assessor's qualifications and experience. These are provided in Appendix 2.

3.3 Operational Phase Assessment

3.3.1 The development has the potential to affect existing air quality as a result of road traffic exhaust emissions associated with vehicles travelling to and from the site, as well as expose future residents to any existing air quality issues. Potential impacts have therefore been defined by predicting pollutant concentrations at sensitive locations using dispersion modelling for the following scenarios:

- 2019 - Verification;
- Opening year Do-Minimum (DM) (predicted traffic flows in 2028 should the proposals not proceed); and,
- Opening year Do-Something (DS) (predicted traffic flows in 2028 should the proposals be completed).

[8] Guidance on the Assessment of Dust from Demolition and Construction V1.1, IAQM, 2016.

3.3.2 Reference should be made to Appendix 1 for assessment input data and details of the verification process.

Road Vehicle Exhaust Emission Impacts

3.3.3 Locations sensitive to potential changes in off-site pollutant concentrations were identified within 200m of the highway network in accordance with the guidance provided within the Design Manual for Roads and Bridges (DMRB)[9] on the likely limits of pollutant dispersion from road sources. The criteria provided within DEFRA guidance[10] on where the AQOs apply, as summarised in Table 2, was utilised to determine worst-case receptor positions in the vicinity of links likely to be affected by changes in traffic flows as a result of the development.

3.3.4 The significance of predicted air quality impacts was determined in accordance with the guidance provided within the IAQM document 'Land-Use Planning & Development Control: Planning for Air Quality'[11]. Using this methodology impacts were defined based on the interaction between the predicted pollutant concentration from the DS scenario and the magnitude of change between the DM and DS scenarios, as outlined in Table 11.

Table 11 Significance of Operational Phase Road Vehicle Exhaust Emission Impacts

Concentration at Receptor in Assessment Year	Predicted Concentration Change as Proportion of AQO/ AQLV (%)			
	1	2 - 5	6 - 10	> 10
75% or less of AQO/ AQLV	Negligible	Negligible	Slight	Moderate
76 - 94% of AQO/ AQLV	Negligible	Slight	Moderate	Moderate
95 - 102% of AQO/ AQLV	Slight	Moderate	Moderate	Substantial
103 - 109% of AQO/ AQLV	Moderate	Moderate	Substantial	Substantial
110% or more of AQO/ AQLV	Moderate	Substantial	Substantial	Substantial

9 LA 105: Air Quality, Highways England, 2019.

10 Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

11 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

3.3.5 The matrix shown in Table 11 is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which makes it clearer which cell the impact falls within. It should be noted that changes of 0%, i.e. less than 0.5%, are described as **negligible**.

3.3.6 Following the prediction of impacts at discrete receptor locations, the IAQM document[12] provides guidance on determining the overall air quality impact significance of the operation of a development. The following factors are identified for consideration by the assessor:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and,
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

3.3.7 The IAQM guidance states that an assessment must reach a conclusion on the likely significance of the predicted impact. Where the overall effect is **moderate** or **substantial**, the effect is likely to be considered **significant**, whilst if the impact is **slight** or **negligible**, the impact is likely to be considered **not significant**. It should be noted that this is a binary judgement of either it is **significant** or it is **not significant**.

3.3.8 The determination of significance relies on professional judgement and reasoning has been provided as far as practicable. The IAQM guidance[13] suggests the provision of details of the assessor's qualifications and experience. These are provided in Appendix 2.

Potential Future Exposure

3.3.9 The proposals have the potential to expose future residents to any existing air quality issues. In order to assess NO_2, PM_{10} and $PM_{2.5}$ concentrations across the development site, detailed dispersion modelling was undertaken. The results were subsequently compared with the relevant AQOs and AQLV to determine any potential areas of exceedence and associated constraints to the proposed land use. Reference should be made to Appendix 1 for a full description of the assessment input data.

12 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

13 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

4.0 BASELINE

4.1 Introduction

4.1.1 Existing air quality conditions in the vicinity of the proposed development site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

4.2 Local Air Quality Management

4.2.1 As required by the Environment Act (1995), WCBC has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that concentrations of all pollutants considered within the AQS are currently below the relevant AQOs. As such, no AQMAs have been designated within the county.

4.3 Air Quality Monitoring

4.3.1 Monitoring of pollutant concentrations is undertaken by WCBC throughout their area of jurisdiction. Recent annual mean NO_2 concentrations recorded in the vicinity of the development are shown in Table 12.

Table 12 Monitoring Results - NO_2

Monitoring Site		Classification	Annual Mean NO_2 Concentration ($\mu g/m^3$)		
			2019	2020	2021
AURN	Victoria Road AURN	Roadside	16.0	13.0	14.7
AURN (triplicate)	Victoria Road 1	Roadside	16.1	12.0	13.9
38	Pentre Bach	Roadside	16.5	12.5	14.8
44	Cobden Road	Roadside	20.5	16.3	18.8
50	Llys Y Groes	Roadside	19.6	14.7	15.1

4.3.2 As shown in Table 12, annual mean NO_2 concentrations were below the AQO at all monitors in recent years.

4.3.3 Recent annual mean PM_{10} concentrations recorded in the vicinity of the development are shown in Table 13.

Table 13 Monitoring Results - PM_{10}

Monitoring Site		Classification	Annual Mean PM_{10} Concentration ($\mu g/m^3$)		
			2019	2020	2021
AURN	Victoria Road AURN	Roadside	12.0	11.0	11.0

4.3.4 As shown in Table 13, annual mean PM_{10} concentrations were below the AQO at the Victoria Road AURN monitor in recent years.

4.3.5 Recent annual mean $PM_{2.5}$ concentrations recorded in the vicinity of the development are shown in Table 14.

Table 14 Monitoring Results - $PM_{2.5}$

Monitoring Site		Classification	Annual Mean $PM_{2.5}$ Concentration ($\mu g/m^3$)		
			2019	2020	2021
AURN	Victoria Road AURN	Roadside	8.0	7.0	7.0

4.3.6 As shown in Table 14, annual mean $PM_{2.5}$ concentrations were below the AQLV at the Victoria Road AURN monitor in recent years.

4.3.7 Pollutant concentrations during 2020 and 2021 were lower than previous years due to a reduction in traffic and associated emissions caused by the COVID-19 pandemic. The results should therefore be viewed with caution.

4.3.8 Reference should be made to Figure 2 for a map of the survey locations.

4.4 Background Pollutant Concentrations

4.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist LAs in their Review and Assessment of air quality. The proposed development site is located in grid square NGR:

331500, 349500. Data for this location was downloaded from the DEFRA website[14] for the purpose of the assessment and is summarised in Table 15.

Table 15 Background Pollutant Concentration Predictions

Pollutant	Predicted Background Pollutant Concentration (µg/m³)		
	2019	2022	2028
NO_2	7.53	6.62	5.48
PM_{10}	11.40	10.96	10.58
$PM_{2.5}$	7.10	6.75	6.44

4.4.2 As shown in Table 15, predicted background concentrations are below the relevant AQOs and AQLV at the development site.

4.5 Sensitive Receptors

4.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality as a result of a development. These have been defined for dust and road vehicle exhaust emission impacts in the following Sections.

Construction Phase Sensitive Receptors

4.5.2 Receptors sensitive to potential dust impacts during demolition, earthworks and construction were identified from a desk-top study of the area up to 350m from the development boundary. These are summarised in Table 16.

Table 16 Demolition, Earthworks and Construction Dust Sensitive Receptors

Distance from Site Boundary (m)	Approximate Number of Human Receptors	Approximate Number of Ecological Receptors
Up to 20	10 - 100	0
Up to 50	10 - 100	0
Up to 100	More than 100	-

[14] http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018.

Distance from Site Boundary (m)	Approximate Number of Human Receptors	Approximate Number of Ecological Receptors
Up to 350	More than 100	-

4.5.3 Receptors sensitive to potential dust impacts from trackout were identified from a desk-top study of the area up to 50m from the road network within 500m of the site access. These are summarised in Table 17.

Table 17 Trackout Dust Sensitive Receptors

Distance from Site Access Route (m)	Approximate Number of Human Receptors	Approximate Number of Ecological Receptors
Up to 20	10 - 100	0
Up to 50	10 - 100	0

4.5.4 There are no ecological receptors within 50m of the development boundary or the access route within 500m of the site entrance. As such, ecological impacts have not been assessed further within this report.

4.5.5 Based on the criteria shown in Table 4, the sensitivity of the receiving environment to potential dust impacts was determined as **high**. This was because the identified receptors included residential properties.

4.5.6 The sensitivity of the receiving environment to specific potential dust impacts, based on the criteria shown in Section 3.2, is shown in Table 18.

Table 18 Sensitivity of the Surrounding Area to Potential Dust Impacts

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High
Human Health	Low	Low	Low	Low

Operational Phase Sensitive Receptors

4.5.7 Locations sensitive to potential operational phase road vehicle exhaust emission impacts were identified from a desk-top study and are summarised in Table 19. Receptor heights were selected based on the location of residential units to allow for less sensitive land uses, such as retail, at ground level.

Table 19 Operational Phase Road Vehicle Exhaust Emissions Sensitive Receptor Locations

Receptor		NGR (m)		Height (m)
		X	Y	
R1	Residential - Caravan Site	331096.3	350365.1	1.5
R2	Residential - Trem Y Lyn	331649.4	350163.1	1.5
R3	Residential - Trem Y Lyn	331715.9	350135.0	1.5
R4	Residential - Trem Y Lyn	331747.6	350121.5	1.5
R5	Residential - Croesnewydd Road	331787.5	350109.3	1.5
R6	Residential - Croesnewydd Road	331858.5	350182.5	1.5
R7	Residential - Croesnewydd Road	331855.1	350221.0	1.5
R8	Spire Yale Hospital	332016.6	350580.2	1.5
R9	Saplings Children's Nursery	332155.7	350747.2	1.5
R10	Residential - Bryn Coch	331883.8	350088.9	1.5
R11	Residential - Hirwaun	332145.3	350080.4	1.5
R12	Clywedog School	332247.3	350041.1	1.5
R13	Residential - Bryn Offa	332493.3	350023.1	1.5
R14	Residential - Ruthin Road	332866.8	349999.3	1.5
R15	Residential - Bradley Road	332878.2	350045.8	1.5
R16	Residential - Bradley Road	332933.0	350200.2	1.5
R17	Residential - Bradley Road	332928.3	350245.7	1.5
R18	Residential - Bradley Road	332967.5	350316.5	1.5
R19	Residential - Ruthin Road	333216.5	349847.7	4.0

Receptor		NGR (m)		Height (m)
		X	Y	
R20	Residential - Ruthin Road	333207.5	349873.9	1.5
R21	Residential - Pen-Y-Bryn	333235.1	349876.6	1.5
R22	Residential - Pen-Y-Bryn	333277.9	349902.6	1.5
R23	Residential - Pen-Y-Bryn	333343.9	350002.8	1.5
R24	Residential - Bersham Road	332899.6	349742.8	1.5
R25	Residential - Bersham Road	332834.0	349698.7	1.5
R26	Residential - Bersham Road	332142.0	349617.7	1.5
R27	Residential - Bersham Road	331775.5	349461.4	1.5
R28	Residential - Bersham Road	331353.2	349250.8	1.5
R29	Residential - Bersham Road	331076.4	349172.9	1.5
R30	Residential - Bersham Road	330961.2	349015.5	1.5
R31	Residential - Bersham Road	331230.5	349228.8	1.5
R32	Residential - Llys Y Groes	331858.3	350645.7	1.5
R33	Coleg Cambria	332571.4	349716.4	1.5
R34	Residential - Dolydd Road	332699.3	350376.4	1.5
R35	Wrexham Maelor Hospital	332336.3	350511.1	1.5

4.5.8 Reference should be made to Figure 3 for a map of the road vehicle exhaust emission sensitive receptor locations.

5.0 ASSESSMENT

5.1 Introduction

5.1.1 There is the potential for air quality impacts as a result of the construction and operation of the proposed development. These are assessed in the following Sections.

5.2 Construction Phase Assessment

Step 1

5.2.1 The undertaking of activities such as demolition, excavation, ground works, cutting, construction, concrete batching and storage of materials has the potential to result in fugitive dust emissions throughout the construction phase. Vehicle movements both on-site and on the local road network also have the potential to result in the re-suspension of dust from haul roads and highway surfaces.

5.2.2 The potential for impacts at sensitive locations depends significantly on local meteorology during the undertaking of dust generating activities, with the most significant effects likely to occur during dry and windy conditions.

5.2.3 The desk-study undertaken to inform the baseline identified a number of sensitive receptors within 350m of the site boundary. As such, a detailed assessment of potential dust impacts was required.

Step 2

Demolition

5.2.4 Demolition will be undertaken at the start of the construction phase and will involve clearance of existing buildings on site. It is estimated that the total building volume to be demolished is less than 20,000m^3. In accordance with the criteria outlined in Table 3, the magnitude of potential dust emissions from demolition is therefore **small**.

5.2.5 Table 18 indicates the sensitivity of the area to dust soiling effects on people and property is **high**. In accordance with the criteria outlined in Table 8, the development is considered to be a **medium** risk site for dust soiling as a result of demolition activities.

5.2.6 Table 18 indicates the sensitivity of the area to human health impacts is **low**. In accordance with the criteria outlined in Table 8, the development is considered to be a **negligible** risk site for human health impacts as a result of demolition activities.

Earthworks

5.2.7 Earthworks may involve excavating material, haulage, tipping and stockpiling. The area of the proposed development site is greater than 10,000m^2. In accordance with the criteria outlined in Table 3, the magnitude of potential dust emissions from earthworks is therefore **large**.

5.2.8 Table 18 indicates the sensitivity of the area to dust soiling effects on people and property is **high**. In accordance with the criteria outlined in Table 9, the development is considered to be a **high** risk site for dust soiling as a result of earthworks.

5.2.9 Table 18 indicates the sensitivity of the area to human health impacts is **low**. In accordance with the criteria outlined in Table 9, the development is considered to be a **low** risk site for human health impacts as a result of earthworks.

Construction

5.2.10 Due to the size of the proposals, the total building volume was estimated to be greater than 100,000m^3. In accordance with the criteria outlined in Table 3, the magnitude of potential dust emissions from construction is therefore **large**.

5.2.11 Table 18 indicates the sensitivity of the area to dust soiling effects on people and property is **high**. In accordance with the criteria outlined in Table 9, the development is considered to be a **high** risk site for dust soiling as a result of construction activities.

5.2.12 Table 18 indicates the sensitivity of the area to human health impacts is **low**. In accordance with the criteria outlined in Table 9, the development is considered to be a **low** risk site for human health impacts as a result of construction activities.

Trackout

5.2.13 Based on the site area, it is anticipated that the unpaved road length may be greater than 100m during certain stages of construction. In accordance with the criteria outlined in Table 3, the magnitude of potential dust emissions from trackout is therefore **large**.

5.2.14 Table 18 indicates the sensitivity of the area to dust soiling effects to people and property is **high**. In accordance with the criteria outlined in Table 10, the development is considered to be a **high** risk site for dust soiling as a result of trackout activities.

5.2.15 Table 18 indicates the sensitivity of the area to human health impacts is **low**. In accordance with the criteria outlined in Table 10, the development is considered to be a **low** risk site for human health impacts as a result of trackout activities.

Summary of the Risk of Dust Effects

5.2.16 A summary of the risk from each dust generating activity is provided in Table 20.

Table 20 Summary of Potential Unmitigated Dust Risks During Construction

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	High	High	High
Human Health	Negligible	Low	Low	Low

5.2.17 As indicated in Table 20, the potential risk of dust soiling is **high** from earthworks, construction and trackout and **medium** from demolition. The potential risk of human health impacts is **low** from earthworks, construction and trackout and **negligible** from demolition.

5.2.18 It should be noted that the potential for impacts depends significantly on the distance between the dust generating activity and receptor location. Risk was predicted based on a worst-case scenario of works being undertaken at the site boundary closest to each sensitive area. Therefore, actual risk is likely to be lower than that predicted during the majority of the construction phase.

Step 3

5.2.19 The IAQM guidance[15] provides potential mitigation measures to reduce impacts as a result of fugitive dust emissions during the construction phase. These have been adapted for the development site as summarised in Table 21. These may be reviewed prior to the commencement of construction works and incorporated into a Construction Environmental Management Plan or similar if required by the LA.

Table 21 Fugitive Dust Emission Mitigation Measures

Issue	Control Measure
Communications	• Develop and implement a stakeholder communications plan that includes community engagement before work commences on site • Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager • Display the head or regional office contact information • Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the LA
Site management	• Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken • Make the complaints log available to the LA upon request
Monitoring	• Carry out regular site inspections, record inspection results, and make an inspection log available to the LA upon request • Increase the frequency of site inspections when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions
Site preparation	• Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible • Fully enclose site or specific operations where there is a high potential for dust production and they are active for an extensive period • Erect solid screens or barriers around dusty activities or the site • Avoid site runoff of water or mud • Keep site fencing, barriers and scaffolding clean using wet methods • Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used • Cover, seed or fence stockpiles to prevent wind whipping

15 Guidance on the Assessment of Dust from Demolition and Construction V1.1, IAQM, 2016.

Issue	Control Measure
Operating vehicle/machinery and sustainable travel	• Ensure all vehicles switch off engines when stationary - no idling vehicles • Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable
Operations	• Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques • Ensure an adequate water supply on the site for effective dust suppression, using non-potable water where possible and appropriate • Use enclosed chutes and conveyors and covered skips • Minimise drop heights and use fine water sprays wherever appropriate • Ensure equipment is available to clean any dry spillages, and clean up spillages as soon as reasonably practicable using wet cleaning methods
Waste management	• Avoid bonfires or burning of waste materials
Demolition	• Ensure effective water suppression is used during demolition operations • Avoid explosive blasting, using appropriate manual or mechanical alternatives • Bag and remove any biological debris or damp down such material before demolition
Earthworks	• Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable • Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil as soon as practicable • Only remove the cover in small areas during work and not all at once
Construction	• Avoid scabbling (roughening of concrete surfaces) if possible • Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out • Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery
Trackout	• Use water-assisted dust sweeper on access and local roads, if required • Avoid dry sweeping of large areas • Ensure vehicles entering and leaving site are covered to prevent escape of materials • Implement a wheel washing system, if required • Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits • Access gates to be located at least 10m from receptors where possible

Step 4

5.2.20 Assuming the relevant mitigation measures outlined in Table 21 are implemented, the residual impacts from all dust generating activities is predicted to be **not significant**, in accordance with the IAQM guidance[16].

5.3 Operational Phase Assessment

5.3.1 Vehicle movements associated with the operation of the proposal will generate exhaust emissions on the local and regional road networks. An assessment was therefore undertaken using dispersion modelling in order to quantify potential changes in pollutant concentrations at sensitive locations in the vicinity of the site, as well as consider potential exposure of future residents to AQO and AQLV exceedences.

5.3.2 The assessment considered the following scenarios:

- 2019 - Verification;
- 2028 - DM; and,
- 2028 - DS.

5.3.3 The DM scenario (i.e. without development) included baseline traffic data, inclusive of anticipated growth and committed developments, for the relevant assessment year. The DS scenario (i.e. with development) included baseline traffic data, inclusive of anticipated growth and committed developments, in addition to predicted vehicle trips associated with the operation of the proposals.

5.3.4 For the purpose of the assessment traffic data for 2028 was utilised as the development opening year. Air quality is predicted to improve in the future. However, in order to provide a robust assessment, emission factors and background concentrations for 2019 were utilised within the dispersion model. The use of 2028 traffic data and 2019 emission factors and background concentrations is considered to provide a worst-case scenario and therefore predicted pollution concentrations are likely to overestimate actual levels during the operation of the development.

16 Guidance on the Assessment of Dust from Demolition and Construction V1.1, IAQM, 2016.

5.3.5 Reference should be made to Appendix 1 for full assessment input details.

Road Vehicle Exhaust Emission Impacts

Predicted Concentrations

5.3.6 Annual mean NO_2 concentrations were predicted at the sensitive receptor locations for the DM and DS scenarios. These are summarised in Table 22.

Table 22 Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 Concentration (µg/m³)		
		DM	DS	Change
R1	Residential - Caravan Site	19.77	19.99	0.22
R2	Residential - Trem Y Lyn	15.96	17.13	1.17
R3	Residential - Trem Y Lyn	16.99	17.93	0.94
R4	Residential - Trem Y Lyn	18.53	19.48	0.95
R5	Residential - Croesnewydd Road	17.55	18.28	0.73
R6	Residential - Croesnewydd Road	15.06	15.46	0.40
R7	Residential - Croesnewydd Road	14.80	15.17	0.37
R8	Spire Yale Hospital	15.66	16.05	0.39
R9	Saplings Children's Nursery	17.50	17.83	0.33
R10	Residential - Bryn Coch	15.81	16.31	0.50
R11	Residential - Hirwaun	14.82	15.21	0.39
R12	Clywedog School	13.85	14.13	0.28
R13	Residential - Bryn Offa	13.72	13.98	0.26
R14	Residential - Ruthin Road	20.48	21.14	0.66
R15	Residential - Bradley Road	16.56	16.77	0.21
R16	Residential - Bradley Road	15.98	16.10	0.12
R17	Residential - Bradley Road	16.18	16.30	0.12
R18	Residential - Bradley Road	17.91	18.07	0.16

Receptor		Predicted Annual Mean NO_2 Concentration (µg/m³)		
		DM	DS	Change
R19	Residential - Ruthin Road	14.16	14.35	0.19
R20	Residential - Ruthin Road	15.00	15.55	0.55
R21	Residential - Pen-Y-Bryn	15.90	16.52	0.62
R22	Residential - Pen-Y-Bryn	15.11	15.67	0.56
R23	Residential - Pen-Y-Bryn	14.76	15.29	0.53
R24	Residential - Bersham Road	15.60	15.87	0.27
R25	Residential - Bersham Road	12.85	13.02	0.17
R26	Residential - Bersham Road	12.39	12.55	0.16
R27	Residential - Bersham Road	12.68	12.88	0.20
R28	Residential - Bersham Road	12.90	13.07	0.17
R29	Residential - Bersham Road	14.57	14.66	0.09
R30	Residential - Bersham Road	21.68	21.98	0.30
R31	Residential - Bersham Road	13.19	13.34	0.15
R32	Residential - Llys Y Groes	18.36	18.79	0.43
R33	Coleg Cambria	12.68	12.88	0.20
R34	Residential - Dolydd Road	14.47	14.62	0.15
R35	Wrexham Maelor Hospital	13.00	13.11	0.11

5.3.7 As indicated in Table 22, predicted annual mean NO_2 concentrations were below the relevant AQO all sensitive receptors in both scenarios.

5.3.8 Reference should be made to Figures 4 and 5 for graphical representations of annual mean NO_2 concentrations across the assessment area for the DM and DS scenarios, respectively.

5.3.9 Annual mean PM_{10} concentrations were predicted at the sensitive receptor locations for the DM and DS scenarios. These are summarised in Table 23.

Table 23 Predicted Annual Mean PM_{10} Concentrations

Receptor		Predicted Annual Mean PM_{10} Concentration (µg/m³)		
		DM	DS	Change
R1	Residential - Caravan Site	12.61	12.64	0.03
R2	Residential - Trem Y Lyn	12.20	12.35	0.16
R3	Residential - Trem Y Lyn	12.23	12.34	0.11
R4	Residential - Trem Y Lyn	12.36	12.47	0.11
R5	Residential - Croesnewydd Road	12.29	12.37	0.08
R6	Residential - Croesnewydd Road	12.05	12.10	0.05
R7	Residential - Croesnewydd Road	12.02	12.07	0.04
R8	Spire Yale Hospital	12.12	12.17	0.05
R9	Saplings Children's Nursery	12.28	12.32	0.04
R10	Residential - Bryn Coch	12.14	12.20	0.06
R11	Residential - Hirwaun	12.02	12.07	0.05
R12	Clywedog School	11.91	11.94	0.03
R13	Residential - Bryn Offa	11.86	11.89	0.03
R14	Residential - Ruthin Road	12.55	12.63	0.07
R15	Residential - Bradley Road	12.20	12.23	0.02
R16	Residential - Bradley Road	12.16	12.17	0.01
R17	Residential - Bradley Road	12.18	12.20	0.01
R18	Residential - Bradley Road	12.32	12.34	0.02
R19	Residential - Ruthin Road	11.93	11.96	0.02
R20	Residential - Ruthin Road	12.03	12.09	0.06
R21	Residential - Pen-Y-Bryn	12.13	12.21	0.07
R22	Residential - Pen-Y-Bryn	12.05	12.11	0.07
R23	Residential - Pen-Y-Bryn	12.00	12.07	0.06
R24	Residential - Bersham Road	12.08	12.11	0.03
R25	Residential - Bersham Road	11.79	11.81	0.02

Receptor		Predicted Annual Mean PM_{10} Concentration (µg/m³)		
		DM	DS	Change
R26	Residential - Bersham Road	11.74	11.75	0.02
R27	Residential - Bersham Road	11.77	11.79	0.02
R28	Residential - Bersham Road	11.79	11.82	0.02
R29	Residential - Bersham Road	11.99	12.00	0.01
R30	Residential - Bersham Road	12.85	12.89	0.04
R31	Residential - Bersham Road	11.83	11.85	0.02
R32	Residential - Llys Y Groes	12.43	12.49	0.05
R33	Coleg Cambria	11.77	11.79	0.02
R34	Residential - Dolydd Road	11.98	12.00	0.02
R35	Wrexham Maelor Hospital	11.80	11.82	0.01

5.3.10 As indicated in Table 23, predicted annual mean PM_{10} concentrations were below the relevant AQO at all sensitive receptors in both scenarios.

5.3.11 Reference should be made to Figures 6 and 7 for graphical representations of annual mean PM_{10} concentrations across the assessment area for the DM and DS scenarios, respectively.

5.3.12 Annual mean $PM_{2.5}$ concentrations were predicted at the sensitive receptor locations for the DM and DS scenarios. These are summarised in Table 24.

Table 24 Predicted Annual Mean $PM_{2.5}$ Concentrations

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)		
		DM	DS	Change
R1	Residential - Caravan Site	8.38	8.40	0.02
R2	Residential - Trem Y Lyn	8.12	8.21	0.10
R3	Residential - Trem Y Lyn	8.15	8.22	0.07

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)		
		DM	DS	Change
R4	Residential - Trem Y Lyn	8.23	8.30	0.07
R5	Residential - Croesnewydd Road	8.18	8.23	0.05
R6	Residential - Croesnewydd Road	8.03	8.06	0.03
R7	Residential - Croesnewydd Road	8.01	8.04	0.03
R8	Spire Yale Hospital	8.08	8.11	0.03
R9	Saplings Children's Nursery	8.18	8.20	0.02
R10	Residential - Bryn Coch	8.09	8.12	0.04
R11	Residential - Hirwaun	8.01	8.04	0.03
R12	Clywedog School	7.94	7.96	0.02
R13	Residential - Bryn Offa	7.91	7.93	0.02
R14	Residential - Ruthin Road	8.35	8.40	0.05
R15	Residential - Bradley Road	8.13	8.14	0.01
R16	Residential - Bradley Road	8.10	8.11	0.01
R17	Residential - Bradley Road	8.11	8.12	0.01
R18	Residential - Bradley Road	8.20	8.21	0.01
R19	Residential - Ruthin Road	7.96	7.97	0.01
R20	Residential - Ruthin Road	8.02	8.06	0.04
R21	Residential - Pen-Y-Bryn	8.08	8.13	0.04
R22	Residential - Pen-Y-Bryn	8.03	8.07	0.04
R23	Residential - Pen-Y-Bryn	8.00	8.04	0.04
R24	Residential - Bersham Road	8.05	8.07	0.02
R25	Residential - Bersham Road	7.87	7.88	0.01
R26	Residential - Bersham Road	7.83	7.85	0.01
R27	Residential - Bersham Road	7.86	7.87	0.02
R28	Residential - Bersham Road	7.87	7.88	0.01
R29	Residential - Bersham Road	7.99	8.00	0.01

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)		
		DM	DS	Change
R30	Residential - Bersham Road	8.53	8.55	0.02
R31	Residential - Bersham Road	7.89	7.90	0.01
R32	Residential - Llys Y Groes	8.27	8.30	0.03
R33	Coleg Cambria	7.86	7.87	0.01
R34	Residential - Dolydd Road	7.99	8.00	0.01
R35	Wrexham Maelor Hospital	7.88	7.89	0.01

5.3.13 As indicated in Table 24, predicted annual mean $PM_{2.5}$ concentrations were below the relevant AQLV at all sensitive receptors in both scenarios.

5.3.14 Reference should be made to Figures 8 and 9 for graphical representations of annual mean $PM_{2.5}$ concentrations across the assessment area for the DM and DS scenarios, respectively.

Predicted Impacts

5.3.15 Predicted impacts on annual mean NO_2 concentrations at the sensitive receptor locations are summarised in Table 25.

Table 25 Predicted Impacts - NO_2

Receptor		Predicted Annual Mean NO_2 Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R1	Residential - Caravan Site	Below 75% of AQO	1	Negligible
R2	Residential - Trem Y Lyn	Below 75% of AQO	2 - 5	Negligible
R3	Residential - Trem Y Lyn	Below 75% of AQO	2 - 5	Negligible
R4	Residential - Trem Y Lyn	Below 75% of AQO	2 - 5	Negligible
R5	Residential - Croesnewydd Road	Below 75% of AQO	2 - 5	Negligible
R6	Residential - Croesnewydd Road	Below 75% of AQO	1	Negligible

Receptor		Predicted Annual Mean NO_2 Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R7	Residential - Croesnewydd Road	Below 75% of AQO	1	Negligible
R8	Spire Yale Hospital	Below 75% of AQO	1	Negligible
R9	Saplings Children's Nursery	Below 75% of AQO	1	Negligible
R10	Residential - Bryn Coch	Below 75% of AQO	1	Negligible
R11	Residential - Hirwaun	Below 75% of AQO	1	Negligible
R12	Clywedog School	Below 75% of AQO	1	Negligible
R13	Residential - Bryn Offa	Below 75% of AQO	1	Negligible
R14	Residential - Ruthin Road	Below 75% of AQO	2 - 5	Negligible
R15	Residential - Bradley Road	Below 75% of AQO	1	Negligible
R16	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R17	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R18	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R19	Residential - Ruthin Road	Below 75% of AQO	0	Negligible
R20	Residential - Ruthin Road	Below 75% of AQO	1	Negligible
R21	Residential - Pen-Y-Bryn	Below 75% of AQO	2 - 5	Negligible
R22	Residential - Pen-Y-Bryn	Below 75% of AQO	1	Negligible
R23	Residential - Pen-Y-Bryn	Below 75% of AQO	1	Negligible
R24	Residential - Bersham Road	Below 75% of AQO	1	Negligible
R25	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R26	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R27	Residential - Bersham Road	Below 75% of AQO	1	Negligible
R28	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R29	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R30	Residential - Bersham Road	Below 75% of AQO	1	Negligible
R31	Residential - Bersham Road	Below 75% of AQO	0	Negligible

Receptor		Predicted Annual Mean NO_2 Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R32	Residential - Llys Y Groes	Below 75% of AQO	1	Negligible
R33	Coleg Cambria	Below 75% of AQO	1	Negligible
R34	Residential - Dolydd Road	Below 75% of AQO	0	Negligible
R35	Wrexham Maelor Hospital	Below 75% of AQO	0	Negligible

5.3.16 As indicated in Table 25, impacts on annual mean NO_2 concentrations as a result of the proposed development were predicted to be **negligible** at all receptor locations.

5.3.17 Predicted impacts on annual mean PM_{10} concentrations at the sensitive receptor locations are summarised in Table 26.

Table 26 Predicted Impacts - PM_{10}

Receptor		Predicted Annual Mean PM_{10} Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R1	Residential - Caravan Site	Below 75% of AQO	0	Negligible
R2	Residential - Trem Y Lyn	Below 75% of AQO	0	Negligible
R3	Residential - Trem Y Lyn	Below 75% of AQO	0	Negligible
R4	Residential - Trem Y Lyn	Below 75% of AQO	0	Negligible
R5	Residential - Croesnewydd Road	Below 75% of AQO	0	Negligible
R6	Residential - Croesnewydd Road	Below 75% of AQO	0	Negligible
R7	Residential - Croesnewydd Road	Below 75% of AQO	0	Negligible
R8	Spire Yale Hospital	Below 75% of AQO	0	Negligible
R9	Saplings Children's Nursery	Below 75% of AQO	0	Negligible
R10	Residential - Bryn Coch	Below 75% of AQO	0	Negligible
R11	Residential - Hirwaun	Below 75% of AQO	0	Negligible
R12	Clywedog School	Below 75% of AQO	0	Negligible

Receptor		Predicted Annual Mean PM_{10} Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R13	Residential - Bryn Offa	Below 75% of AQO	0	Negligible
R14	Residential - Ruthin Road	Below 75% of AQO	0	Negligible
R15	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R16	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R17	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R18	Residential - Bradley Road	Below 75% of AQO	0	Negligible
R19	Residential - Ruthin Road	Below 75% of AQO	0	Negligible
R20	Residential - Ruthin Road	Below 75% of AQO	0	Negligible
R21	Residential - Pen-Y-Bryn	Below 75% of AQO	0	Negligible
R22	Residential - Pen-Y-Bryn	Below 75% of AQO	0	Negligible
R23	Residential - Pen-Y-Bryn	Below 75% of AQO	0	Negligible
R24	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R25	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R26	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R27	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R28	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R29	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R30	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R31	Residential - Bersham Road	Below 75% of AQO	0	Negligible
R32	Residential - Llys Y Groes	Below 75% of AQO	0	Negligible
R33	Coleg Cambria	Below 75% of AQO	0	Negligible
R34	Residential - Dolydd Road	Below 75% of AQO	0	Negligible
R35	Wrexham Maelor Hospital	Below 75% of AQO	0	Negligible

5.3.18 As indicated in Table 26, impacts on annual mean PM_{10} concentrations as a result of the proposed development were predicted to be **negligible** at all receptor locations.

5.3.19 Predicted impacts on annual mean $PM_{2.5}$ concentrations at the sensitive receptor locations are summarised in Table 27.

Table 27 Predicted Impacts - $PM_{2.5}$

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration	Predicted Concentration Change as Proportion of AQLV (%)	Impact Significance
R1	Residential - Caravan Site	Below 75% of AQLV	0	Negligible
R2	Residential - Trem Y Lyn	Below 75% of AQLV	0	Negligible
R3	Residential - Trem Y Lyn	Below 75% of AQLV	0	Negligible
R4	Residential - Trem Y Lyn	Below 75% of AQLV	0	Negligible
R5	Residential - Croesnewydd Road	Below 75% of AQLV	0	Negligible
R6	Residential - Croesnewydd Road	Below 75% of AQLV	0	Negligible
R7	Residential - Croesnewydd Road	Below 75% of AQLV	0	Negligible
R8	Spire Yale Hospital	Below 75% of AQLV	0	Negligible
R9	Saplings Children's Nursery	Below 75% of AQLV	0	Negligible
R10	Residential - Bryn Coch	Below 75% of AQLV	0	Negligible
R11	Residential - Hirwaun	Below 75% of AQLV	0	Negligible
R12	Clywedog School	Below 75% of AQLV	0	Negligible
R13	Residential - Bryn Offa	Below 75% of AQLV	0	Negligible
R14	Residential - Ruthin Road	Below 75% of AQLV	0	Negligible
R15	Residential - Bradley Road	Below 75% of AQLV	0	Negligible
R16	Residential - Bradley Road	Below 75% of AQLV	0	Negligible
R17	Residential - Bradley Road	Below 75% of AQLV	0	Negligible
R18	Residential - Bradley Road	Below 75% of AQLV	0	Negligible
R19	Residential - Ruthin Road	Below 75% of AQLV	0	Negligible
R20	Residential - Ruthin Road	Below 75% of AQLV	0	Negligible
R21	Residential - Pen-Y-Bryn	Below 75% of AQLV	0	Negligible
R22	Residential - Pen-Y-Bryn	Below 75% of AQLV	0	Negligible

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration	Predicted Concentration Change as Proportion of AQLV (%)	Impact Significance
R23	Residential - Pen-Y-Bryn	Below 75% of AQLV	0	Negligible
R24	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R25	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R26	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R27	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R28	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R29	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R30	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R31	Residential - Bersham Road	Below 75% of AQLV	0	Negligible
R32	Residential - Llys Y Groes	Below 75% of AQLV	0	Negligible
R33	Coleg Cambria	Below 75% of AQLV	0	Negligible
R34	Residential - Dolydd Road	Below 75% of AQLV	0	Negligible
R35	Wrexham Maelor Hospital	Below 75% of AQLV	0	Negligible

5.3.20 As indicated in Table 27, impacts on annual mean $PM_{2.5}$ concentrations as a result of the proposed development were predicted to be **negligible** at all receptor locations.

Potential Future Exposure

5.3.21 The proposals have the potential to cause the exposure of future residents to any existing air quality issues. Dispersion modelling was therefore undertaken with the inputs described in Appendix 1 to quantify air quality conditions at the site. Reference should be made to Figures 5, 7 and 9 for graphical representations of annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations across the development.

5.3.22 As shown in Figure 5, annual mean NO_2 concentrations were predicted to be below the AQO of 40µg/m^3 across the site. The maximum level at the boundary was 32.60µg/m^3.

5.3.23 As shown in Figure 7, annual mean PM_{10} concentrations were predicted to be below the AQO of 40µg/m^3 across the site. The maximum level at the boundary was 14.06µg/m^3.

5.3.24 As shown in Figure 9, annual mean $PM_{2.5}$ concentrations were predicted to be below the AQLV of 20µg/m^3 across the site. The maximum level at the boundary was 9.43µg/m^3.

5.3.25 Based on the assessment results, future residents are not predicted to be exposed to pollutant concentrations above the AQOs or AQLV. The site is therefore considered to be suitable for residential use from an air quality perspective.

Overall Impact Significance

5.3.26 The overall significance of operational phase road traffic emission impacts was determined as **negligible**. This was based on the overall predicted impacts at discrete receptor locations and the considerations outlined previously. Further justification is provided in Table 28.

Table 28 Overall Impact Significance of Road Vehicle Exhaust Emission Impacts

Guidance	Comment
The existing and future air quality in the absence of the development	Predicted annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations were below the relevant AQOs and AQLV at all locations in the DM scenario It is considered unlikely that future air quality conditions will change significantly in the absence of the development given the relatively established nature of the area
The extent of current and future population exposure to the impacts	The development is not predicted to affect the population exposed to exceedences of the AQOs
The influence and validity of any assumptions adopted when undertaking the prediction of impacts	The assessment assumed that background pollutant concentrations will not reduce in future years. This provides worst-case results when compared with DEFRA and National Highways methodologies Due to the adopted assumptions it is considered the presented results are sufficiently robust for an assessment of this nature

5.3.27 The IAQM guidance[17] states that only if the impact is greater than **slight**, the effect is considered **significant**. As impacts were predicted to be **negligible**, overall effects are considered **not significant**, in accordance with the stated methodology.

[17] Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by Redrow Homes Limited to undertake an Air Quality Assessment in support of a residential led development on land off Ruthin Road, Wrexham.

6.1.2 The proposals have the potential to cause air quality impacts during construction and operation, as well as expose future residents to any existing air quality issues at the site. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions, consider location suitability for the proposed end-use and assess potential effects as a result of the scheme.

6.1.3 During the construction phase of the development there is the potential for air quality impacts as a result of fugitive dust emissions from the site. These were assessed in accordance with the IAQM methodology. Assuming good practice dust control measures are implemented, the residual significance of potential air quality impacts from dust generated by demolition, earthworks, construction and trackout activities was predicted to be **not significant**.

6.1.4 Potential impacts during the operational phase of the proposals may occur due to road traffic exhaust emissions associated with vehicles travelling to and from the site. Dispersion modelling was therefore undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the local highway network both with and without the development in place. Results were subsequently verified using local monitoring data.

6.1.5 Review of the dispersion modelling results indicated that impacts on annual mean NO_2 PM_{10} and $PM_{2.5}$ concentrations as a result of traffic generated by the development were predicted to be **negligible** at all receptor locations.

6.1.6 The results of the dispersion modelling assessment also indicated that predicted annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations were below the relevant AQOs and AQLV at all locations across the development. The site is therefore considered suitable for the proposed use from an air quality perspective.

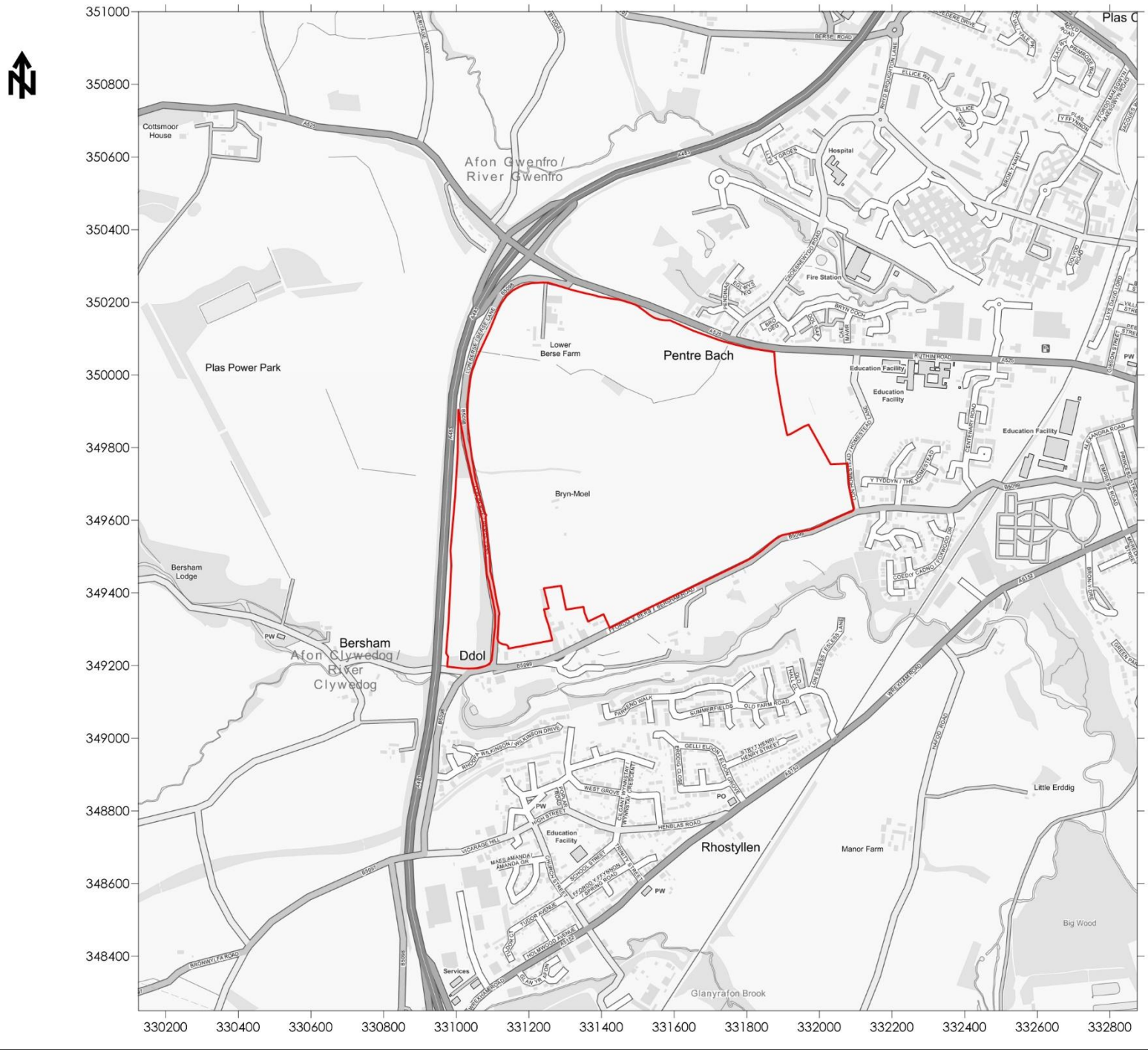
6.1.7 Following consideration of the relevant issues, residual impacts as a result of the operation of the development were considered to be **not significant**, in accordance with the IAQM guidance.

6.1.8 Based on the assessment results, air quality factors are not considered a constraint to planning consent for the development.

7.0 ABBREVIATIONS

AADT	Annual Average Daily Traffic
ADM	Atmospheric Dispersion Modelling
AQAP	Air Quality Action Plan
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DM	Do-Minimum
DMP	Dust Management Plan
DMRB	Design Manual for Roads and Bridges
DS	Do-Something
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
LA	Local Authority
LAQM	Local Air Quality Management
NGR	National Grid Reference
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5µm
WCBC	Wrexham County Borough Council
WUDP	Wrexham Unitary Development Plan
z_0	Roughness length

Figures



Legend

Site Boundary

Title
Figure 1 - Site Location

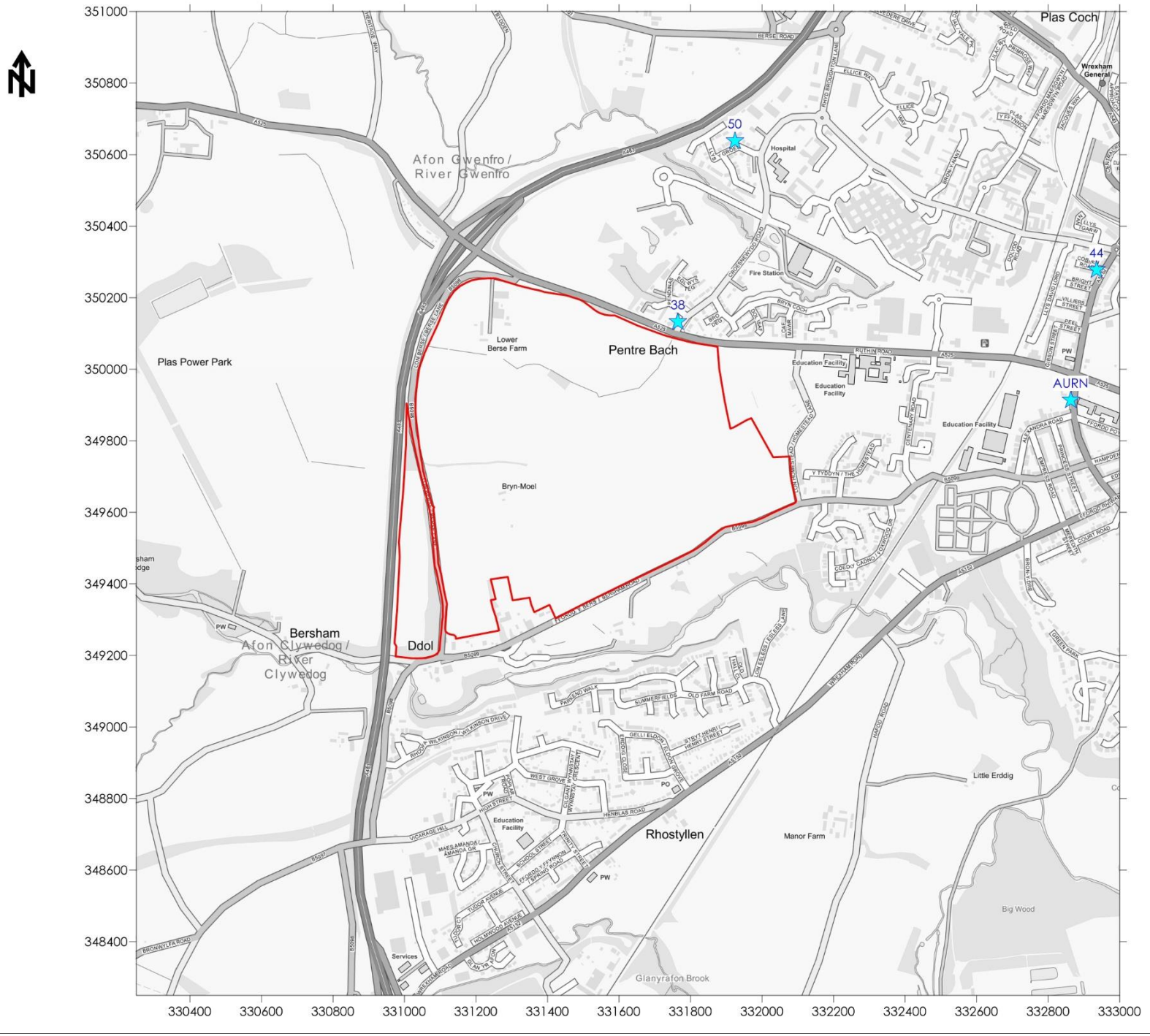
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Project Reference
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Legend

Site Boundary

Monitor

Title
Figure 2 - Monitoring Locations

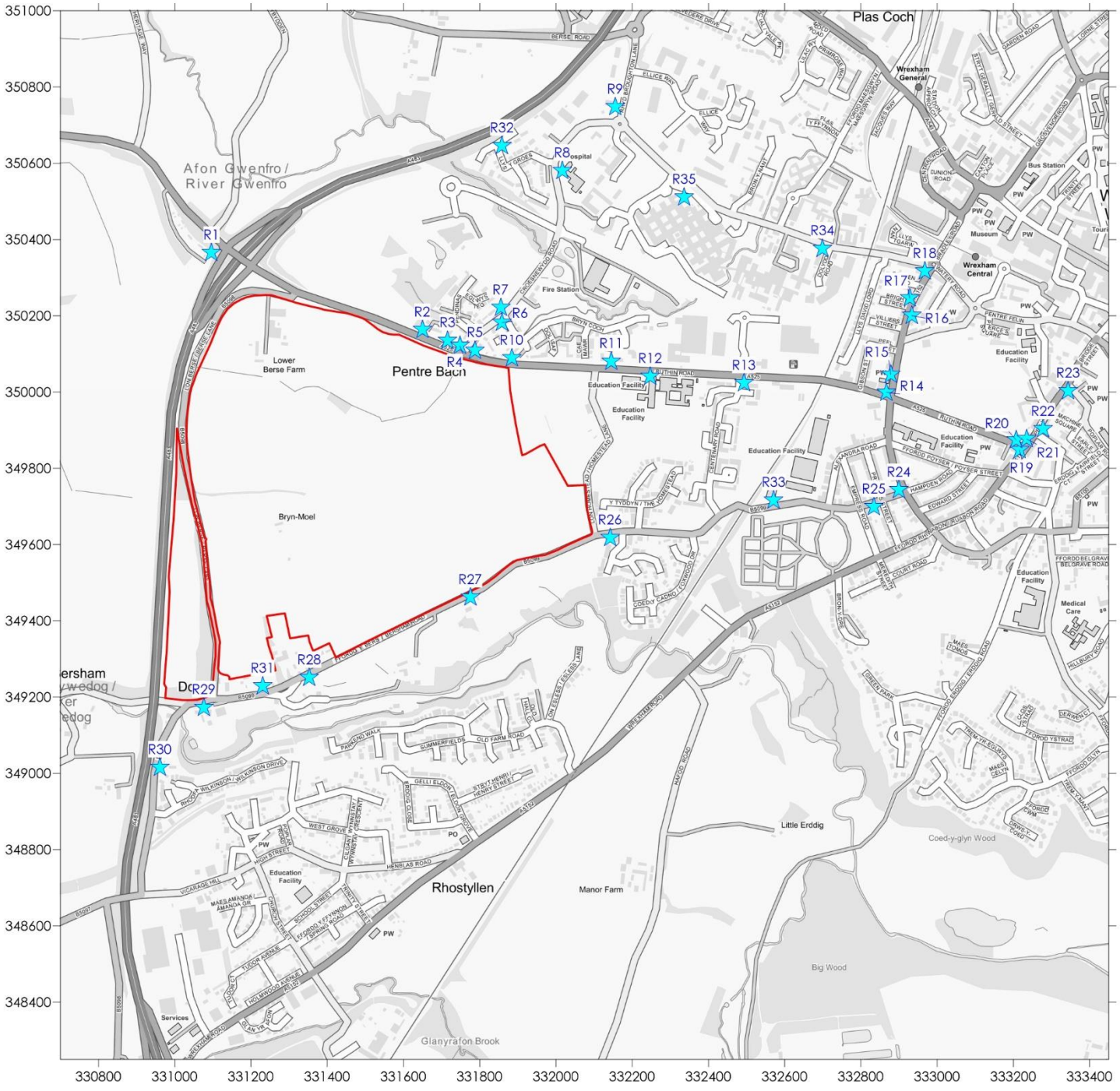
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Site Boundary

Receptor

Title

Figure 3 - Operational Phase Road Vehicle Exhaust Emissions Sensitive Receptors

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Ruthin Road, Wrexham

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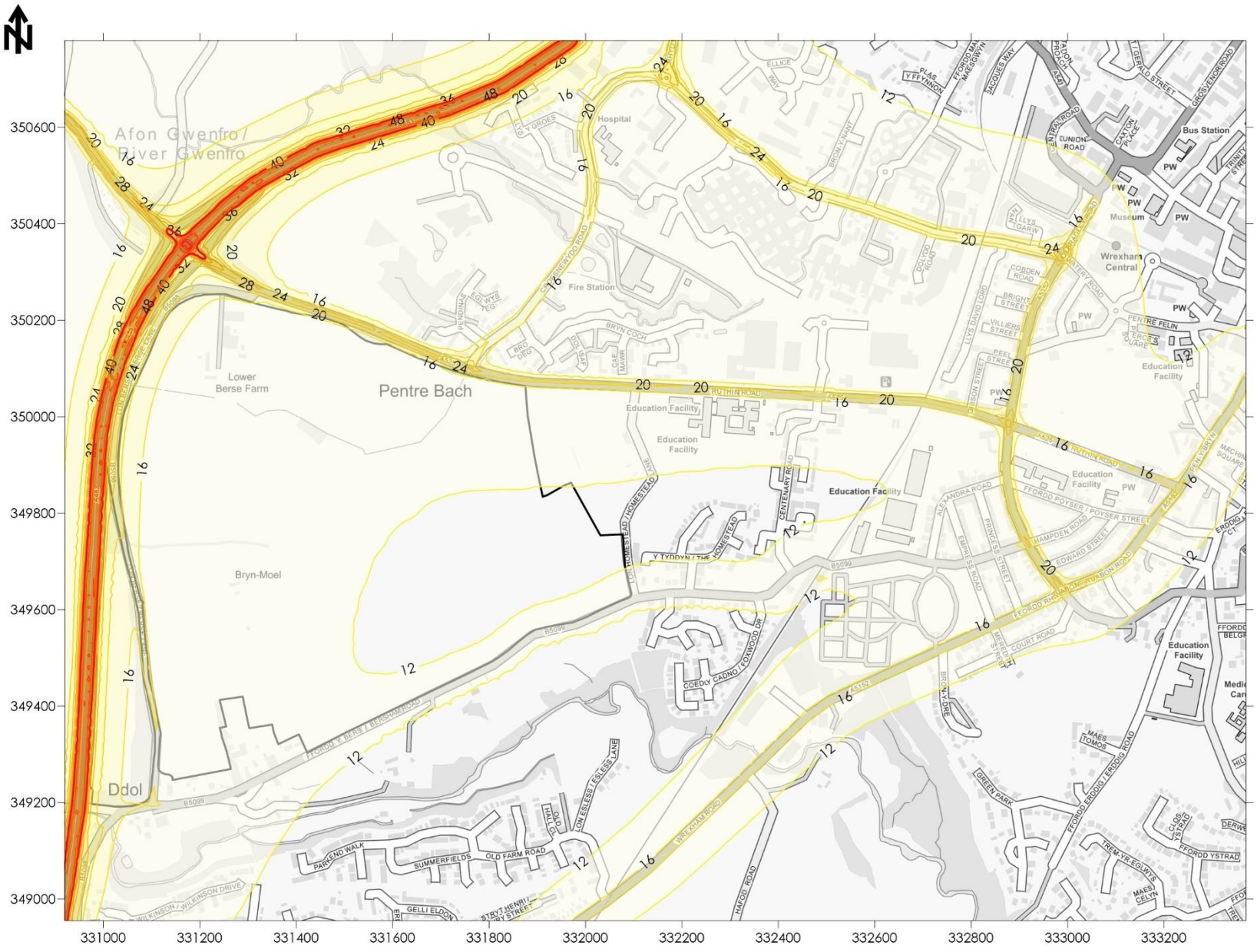
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Legend

Site Boundary

Annual Mean NO_2 Concentration ($\mu g/m^3$)

60
56
52
48
44
40
36
32
28
24
20
16
12

Title

Figure 4 - Predicted Annual Mean NO_2 Concentrations ($\mu g/m^3$)
Do-Minimum

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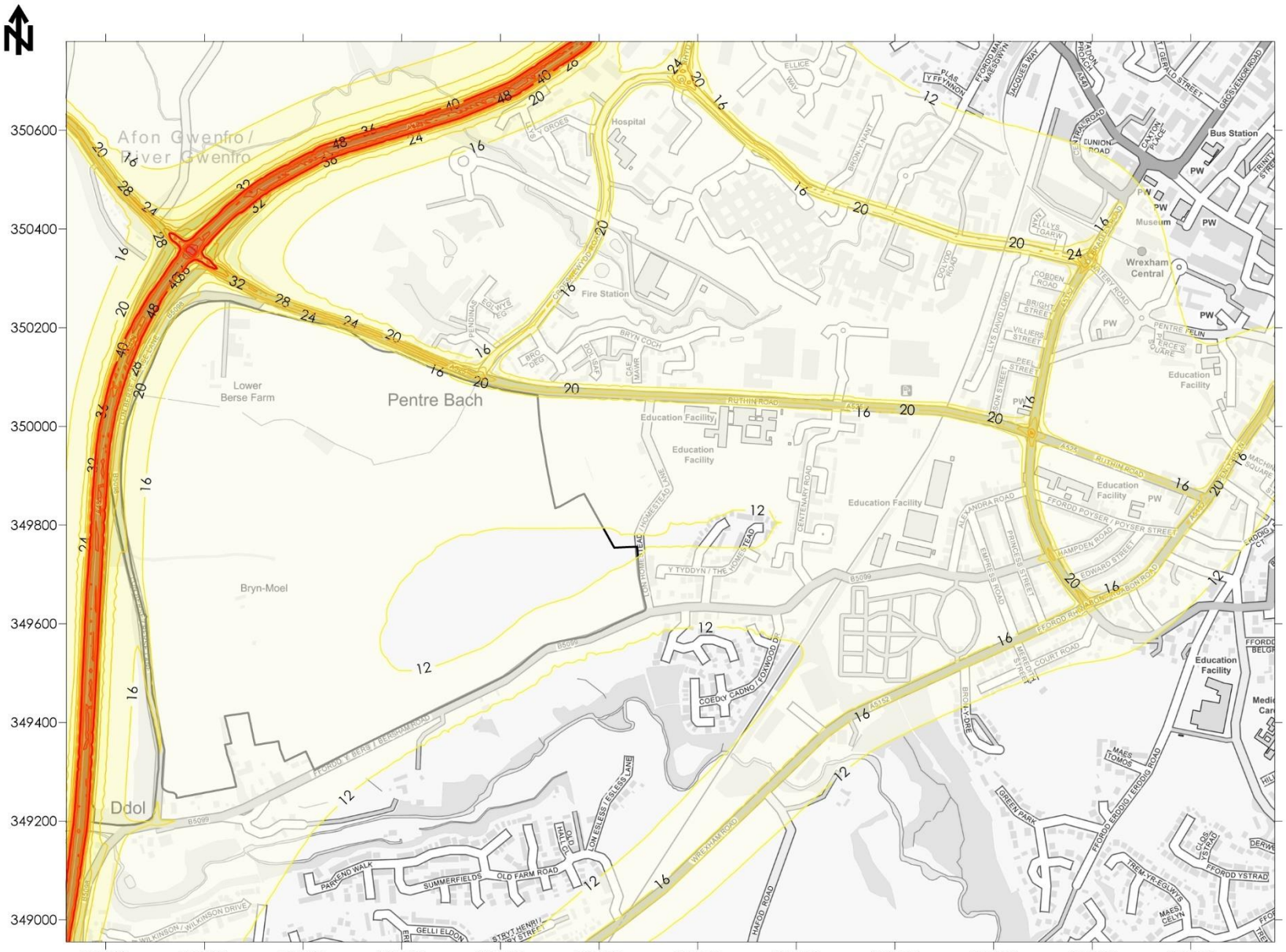
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Legend

Site Boundary

60
56
52
48
44
40
36
32
28
24
20
16
12

Annual Mean NO_2 Concentration ($\mu g/m^3$)

Title

Figure 5 - Predicted Annual Mean NO_2 Concentrations ($\mu g/m^3$) Do-Something

Project

Air Quality Assessment
Ruthin Road, Wrexham

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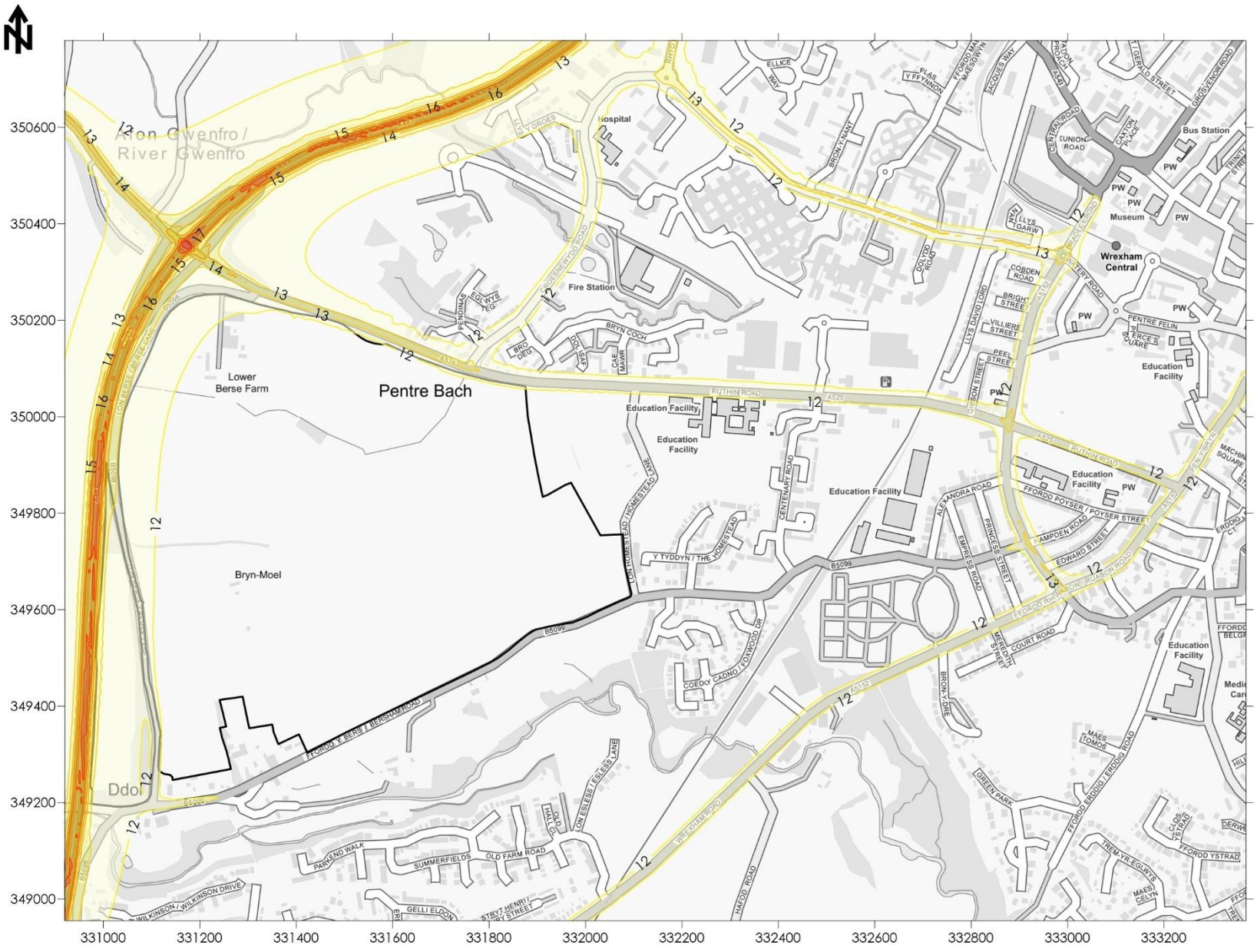
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Legend

Site Boundary

Annual Mean PM_{10} Concentration ($\mu g/m^3$)

18
17
16
15
14
13
12

Title

Figure 6 - Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$) Do-Minimum

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Ruthin Road, Wrexham

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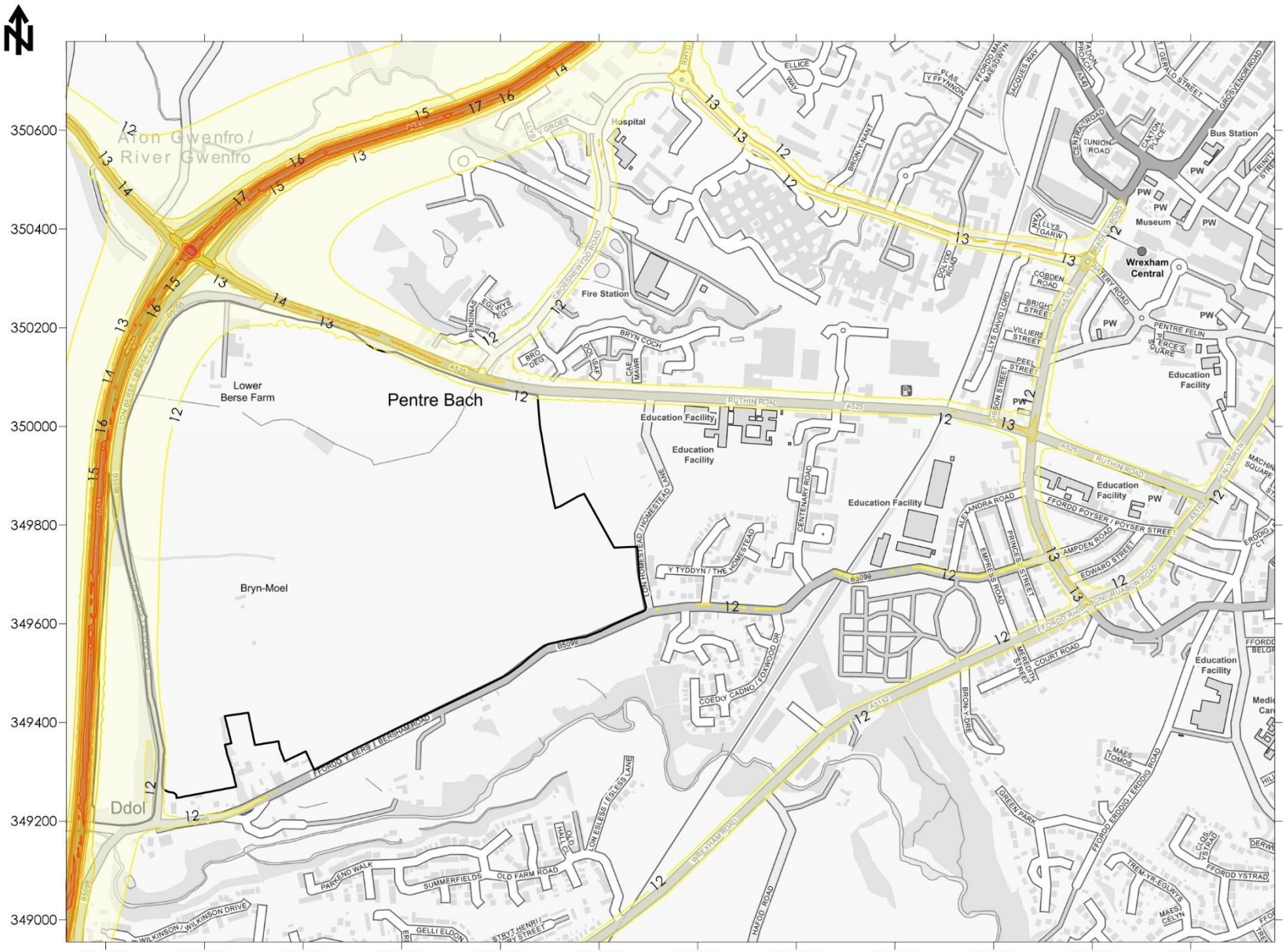
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Legend

Site Boundary

Annual Mean PM_{10} Concentration ($\mu g/m^3$)

18
17
16
15
14
13
12

Title

Figure 7 - Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$) Do-Something

Project

Air Quality Assessment
Ruthin Road, Wrexham

Project Reference

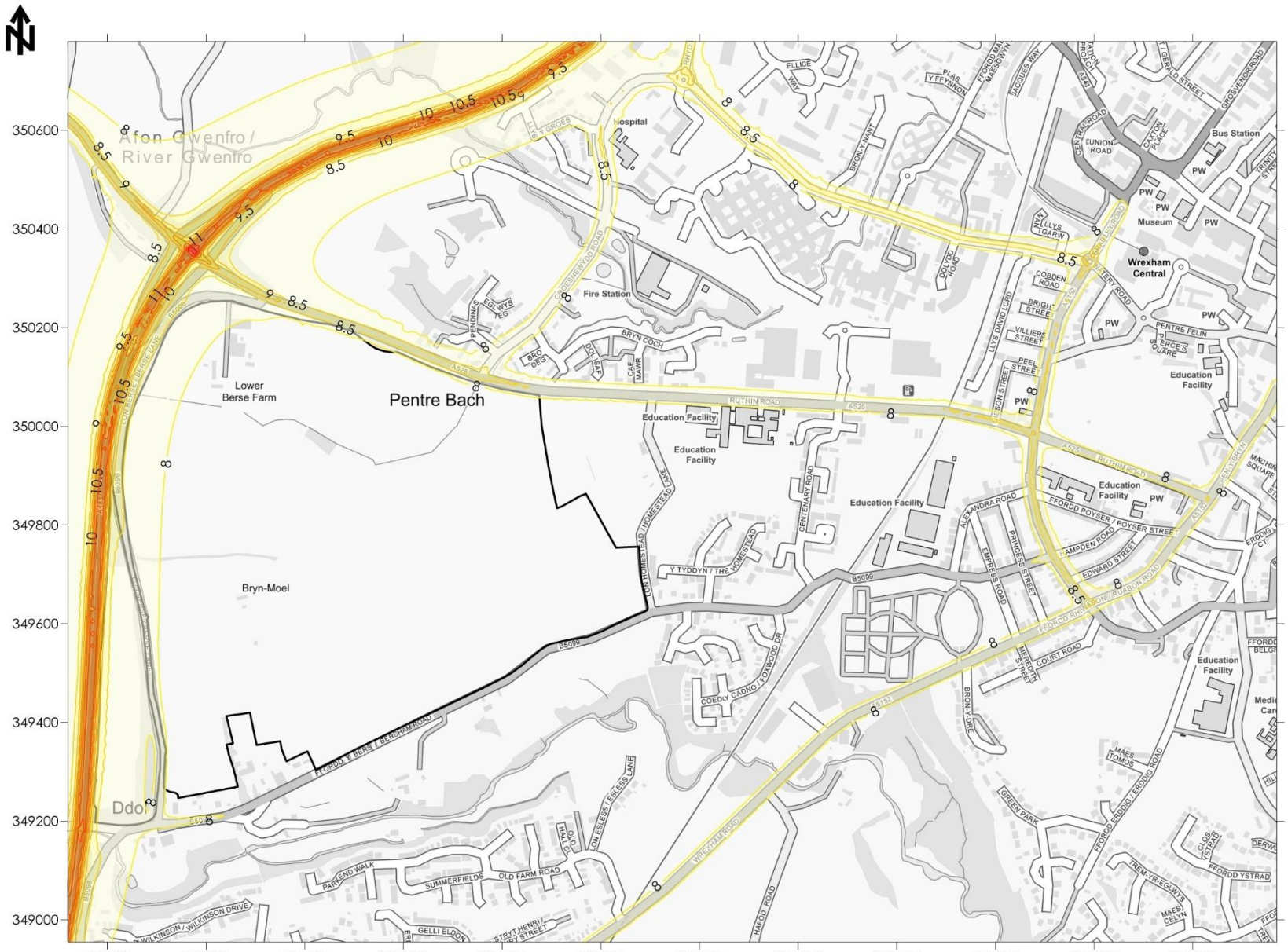
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Legend

Site Boundary

Annual Mean $PM_{2.5}$ Concentration ($\mu g/m^3$)

12
11.5
11
10.5
10
9.5
9
8.5
8

Title

Figure 8 - Predicted Annual Mean $PM_{2.5}$ Concentrations ($\mu g/m^3$) Do-Minimum

Project

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Ruthin Road, Wrexham

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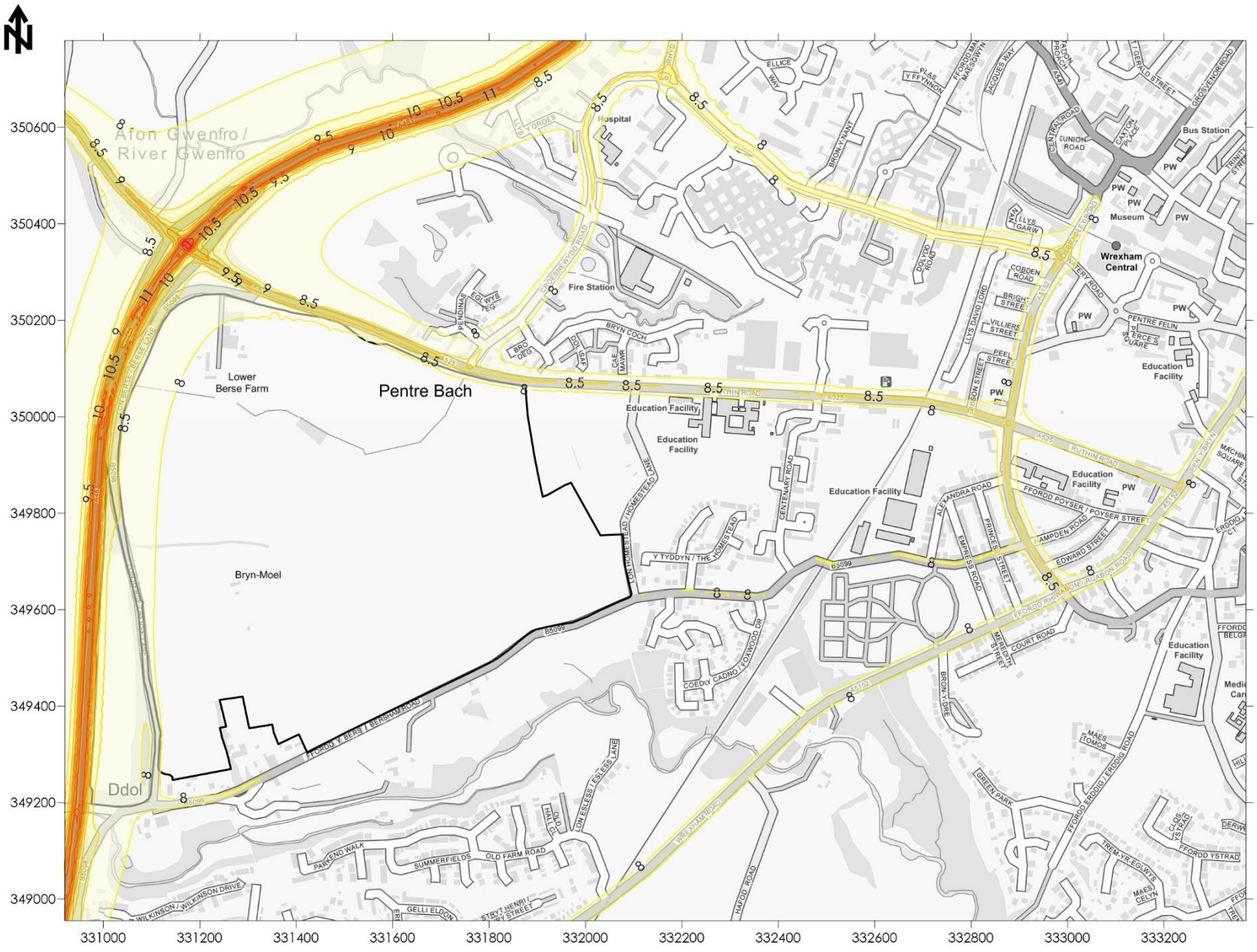
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Legend

Site Boundary

Annual Mean $PM_{2.5}$ Concentration ($\mu g/m^3$)

12
11.5
11
10.5
10
9.5
9
8.5
8

Title

Figure 9 - Predicted Annual Mean $PM_{2.5}$ Concentrations ($\mu g/m^3$) Do-Something

Project

Air Quality Assessment
Ruthin Road, Wrexham

Project Reference

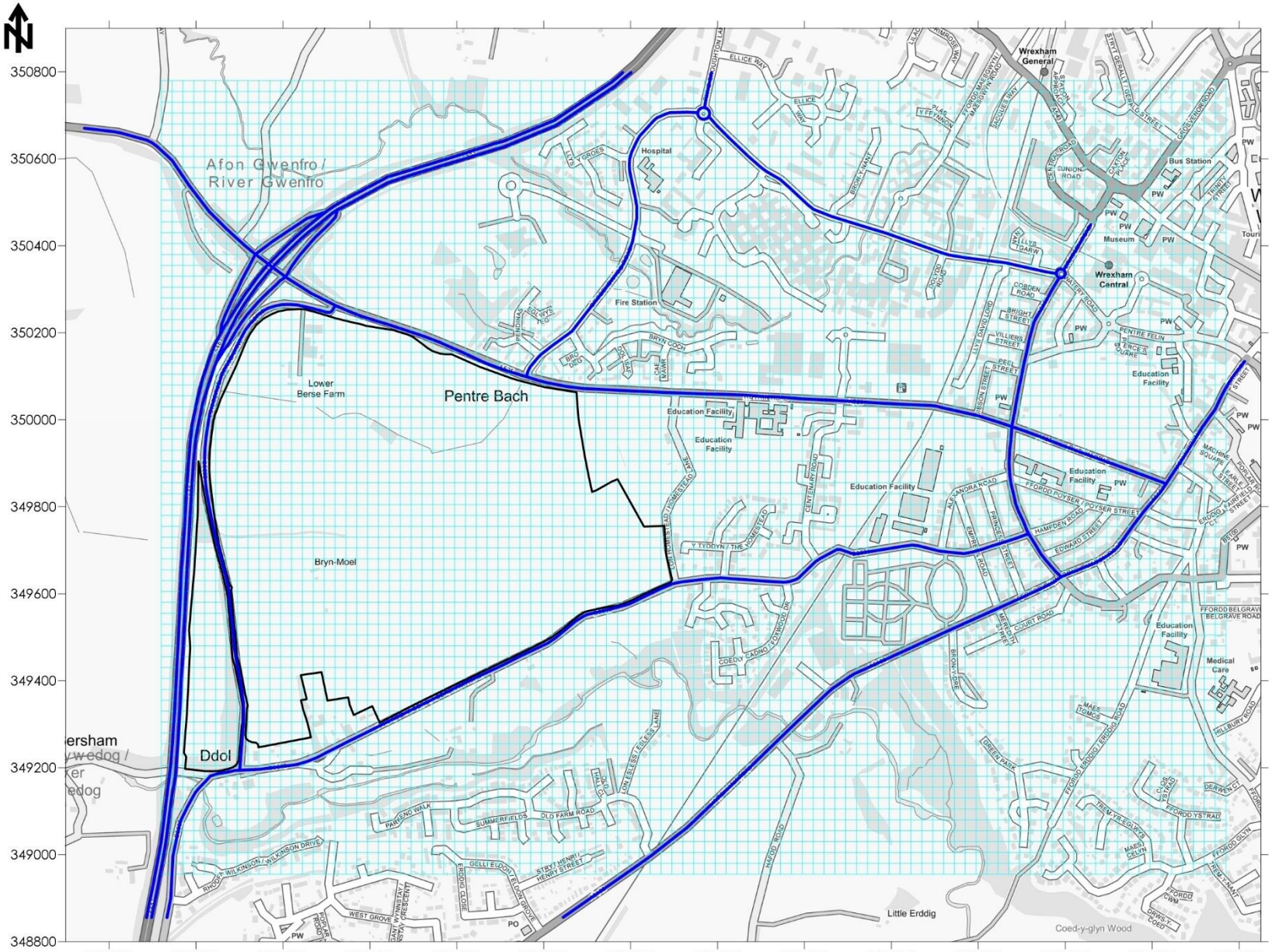
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Legend

Site Boundary

Road Link

Output Grid

Title
Figure 10 - ADMS-Roads Inputs

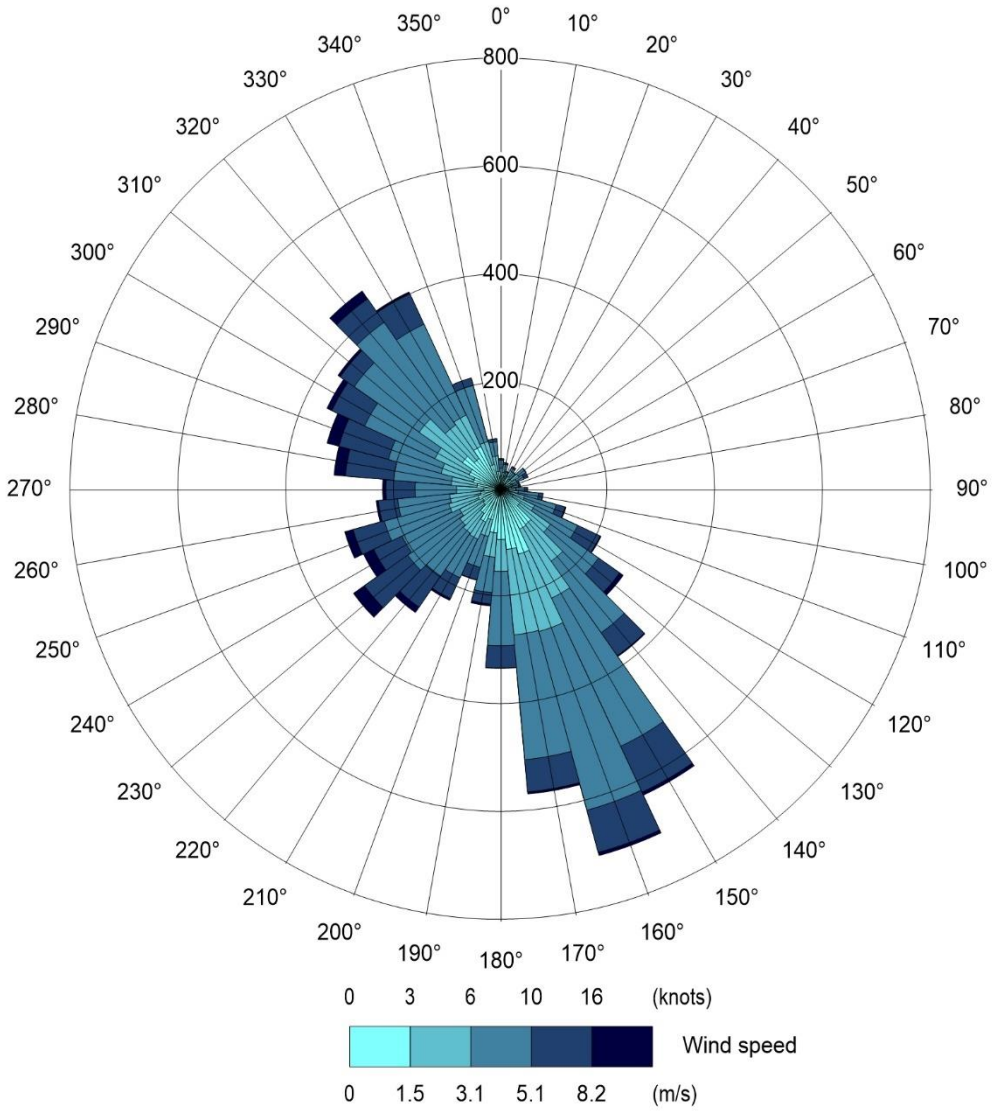
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Legend

Title
Figure 11 - Wind Rose of 2019
Hawarden Meteorological Data

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Appendix 1 - Assessment Input Data

Introduction

The proposals have the potential to cause air quality impacts as a result of exhaust emissions associated with vehicles travelling to and from the development, as well as expose future residents to any existing air quality issues at the site. In order to assess NO_2, PM_{10} and $PM_{2.5}$ concentrations at sensitive locations, detailed dispersion modelling was undertaken in accordance with the following methodology.

Dispersion Model

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 5.0.1.3). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by Natural Resources Wales and DEFRA.

The model requires input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

The relevant inputs are detailed in the following Sections.

Assessment Area

Ambient concentrations were predicted over the area NGR: 330920, 348955 to 333370, 350780. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

Reference should be made to Figure 10 for a graphical representation of the assessment grid extents.

Receptors potentially sensitive to changes in pollutant concentrations were included in the assessment as outlined in the main report text.

Traffic Flow Data

Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as HDV proportion, was provided by SCP, the Transport Consultants for the project.

Data for the A483 was unavailable from SCP and was therefore obtained from the Department for Transport (DfT)[18]. The DfT web tool enables the user to view and download traffic flows on every link of the 'A' road and motorway network, as well as selected minor roads, in Great Britain for the years 1999 to 2021. It should be noted that the DfT web tool is referenced in DEFRA guidance[19] as a suitable source of data for air quality assessments and it is therefore considered to provide a reasonable estimate of traffic flows on the A483.

Road widths and vehicle speeds were estimated from aerial photography and UK highway design standards. A summary of the traffic data used in the assessment is provided in Table A1.1.

Table A1.1 Traffic Data

Link		24-hour AADT Flow			HDV Proportion (%)		
		2019	2028 DM	2028 DS	2019	2028 DM	2028 DS
L1	A483 northbound, south of A525	25,999	28,985	29,322	5.92	5.92	5.92
L2	A483 northbound, interjunction	25,999	28,985	29,322	5.92	5.92	5.92
L3	A483 northbound, north of A525	28,911	32,568	34,666	5.52	5.52	5.52
L4	A483 southbound, north of A526	28,911	32,568	34,314	5.52	5.52	5.52
L5	A483 southbound, interjunction	25,999	28,985	29,322	5.92	5.92	5.92

[18] https://roadtraffic.dft.gov.uk/#6/55.254/-11.107/basemap-regions-countpoints.

[19] Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

Link		24-hour AADT Flow			HDV Proportion (%)		
		2019	2028 DM	2028 DS	2019	2028 DM	2028 DS
L6	A483 southbound, south of A526	25,999	28,985	29,390	5.92	5.92	5.92
L7	A525, west of A483	15,083	18,429	18,682	2.62	2.36	2.33
L8	A525, west of A484, junction	15,083	18,429	18,682	2.62	2.36	2.33
L9	A525. interjunction	15,083	18,429	18,682	2.62	2.36	2.33
L10	A525, east of A484, junction	12,478	16,704	21,542	1.31	1.08	0.84
L11	A525, west of Berse Lane	12,478	16,704	21,542	1.31	1.08	0.84
L12	A525, east of Berse Lane	11,923	14,253	19,091	1.33	1.23	0.92
L13	A525, east of site access	11,923	14,253	19,091	1.33	1.23	0.92
L14	A525, west of Croesnewydd Road	11,991	14,328	16,449	1.33	1.22	1.06
L15	Ruthin Road, east of Croesnewydd Road, junction	9,395	9,676	10,873	1.64	1.76	1.57
L16	Ruthin Road, east of Croesnewydd Road	9,395	9,676	10,873	1.64	1.76	1.57
L17	Ruthin Road/ Centenary Road junction	9,395	9,676	10,873	1.64	1.76	1.57
L18	Ruthin Road, east of Centenary Road	9,395	9,676	10,873	1.64	1.76	1.57
L19	Ruthin Road, west of A5152	9,395	9,676	10,873	1.64	1.76	1.57
L20	Ruthin Road, east of A5152, junction	2,733	3,949	4,988	0.66	0.51	0.40
L21	Ruthin Road, east of A5152	2,733	3,949	4,988	0.66	0.51	0.40
L22	Ruthin Road, west of Ruabon Road	2,733	3,949	4,988	0.66	0.51	0.40
L23	Pen-Y-Bryn	7,721	9,440	10,999	0.71	0.64	0.55
L24	Ruabon Road	7,721	9,440	9,440	0.71	0.64	0.55
L25	Ruabon Road, east of A5152	7,721	9,440	9,440	0.71	0.64	0.55
L26	Ruabon Road, west of A5153, junction	7,721	9,440	9,440	0.71	0.64	0.55
L27	Ruabon Road, west of A5153	7,721	9,440	9,440	0.71	0.64	0.55
L28	A5152, north of Ruabon Road, junction	8,258	9,676	9,676	2.97	2.79	2.75
L29	A5152, north of Ruabon Road	8,258	9,676	9,676	2.97	2.79	2.75
L30	A5152, south of Ruthin Road	8,258	9,676	9,676	2.97	2.79	2.75

Link		24-hour AADT Flow			HDV Proportion (%)		
		2019	2028 DM	2028 DS	2019	2028 DM	2028 DS
L31	A5152, north of Ruthin Road, junction	8,258	9,676	9,833	2.97	2.79	2.75
L32	A5152, north of Ruthin Road	8,258	9,676	9,833	2.97	2.79	2.75
L33	A5152, south of Watery Road	8,258	9,676	9,833	2.97	2.79	2.75
L34	Bradley Road, junction	8,258	9,676	9,833	2.97	2.79	2.75
L35	Bradley Road	8,258	9,676	9,833	2.97	2.79	2.75
L36	Croesnewydd Road, north of Ruthin Road, junction	6,289	8,588	9,512	0.51	0.41	0.37
L37	Croesnewydd Road, north of Ruthin Road	6,289	8,588	9,512	0.51	0.41	0.37
L38	Croesnewydd Road, west of Rhyd Broughton Lane	6,289	8,588	9,512	0.51	0.41	0.37
L39	Croesnewydd Road, east of Rhyd Broughton Lane, junction	9,868	11,130	11,592	2.16	2.11	2.03
L40	Croesnewydd Road, east of Rhyd Broughton Lane	9,868	11,130	11,592	2.16	2.11	2.03
L41	Watery Road, west of Bradley Road	9,868	11,130	11,592	2.16	2.11	2.03
L42	Bersham Road, west of A5152, junction	2,360	2,597	3,117	0.58	0.58	0.48
L43	Bersham Road, west of A5152	2,360	2,597	3,117	0.58	0.58	0.48
L44	Bersham Road, west of site access	2,360	2,597	3,085	0.58	0.58	0.49
L45	Bersham Road, west of Berse Lane	2,205	2,427	2,648	0.21	0.21	0.19
L46	Bersham Road, south of Plas Buckley Road	2,597	2,858	3,345	0.35	0.35	0.30
L47	Rhyd Broughton Lane, junction	11,787	14,131	14,593	2.04	1.88	1.82
L48	Rhyd Broughton Lane	11,787	14,131	14,593	2.04	1.88	1.82
L49	Berse Lane, south of A525, junction	1,805	1,987	1,987	0.75	0.76	0.76
L50	Berse Lane	1,805	1,987	1,987	0.75	0.76	0.76
L51	Berse Lane, north of Bersham Road	1,805	1,987	1,987	0.75	0.76	0.76
L52	A483 northbound, slip off	4,811	5,665	6,002	1.51	1.41	1.33
L53	A483 northbound, slip on	3,824	4,893	6,991	1.78	1.53	1.07

Link		24-hour AADT Flow			HDV Proportion (%)		
		2019	2028 DM	2028 DS	2019	2028 DM	2028 DS
L54	A483 southbound, slip off	5,516	6,820	8,566	1.24	1.10	0.88
L55	A483 southbound, slip on	3,088	3,734	4,138	1.91	1.74	1.57
L56	Watery Road/ A5152 roundabout	9,063	10,403	10,713	2.57	2.45	2.39
L57	Croesnewydd Road/ Rhyd Broughton Lane roundabout	9,038	11,359	12,053	1.27	1.14	1.09

A summary of the road parameters used in the assessment is provided in Table A1.2.

Table A1.2 Road Parameters

Link		Avg. Vehicle Speed (km/h)	Road Width (m)
L1	A483 northbound, south of A525	100	7.3
L2	A483 northbound, interjunction	100	7.3
L3	A483 northbound, north of A525	100	7.3
L4	A483 southbound, north of A526	100	7.3
L5	A483 southbound, interjunction	100	7.3
L6	A483 southbound, south of A526	100	7.3
L7	A525, west of A483	80	8.4
L8	A525, west of A484, junction	25	14.1
L9	A525. interjunction	30	12.9
L10	A525, east of A484, junction	25	11.8
L11	A525, west of Berse Lane	70	9.4
L12	A525, east of Berse Lane	70	7.5
L13	A525, east of site access	70	7.3
L14	A525, west of Croesnewydd Road	25	11.8
L15	Ruthin Road, east of Croesnewydd Road, junction	25	9.8
L16	Ruthin Road, east of Croesnewydd Road	45	9.4

Link		Avg. Vehicle Speed (km/h)	Road Width (m)
L17	Ruthin Road/ Centenary Road junction	25	9.4
L18	Ruthin Road, east of Centenary Road	45	7.4
L19	Ruthin Road, west of A5152	25	10.0
L20	Ruthin Road, east of A5152, junction	25	7.3
L21	Ruthin Road, east of A5152	45	7.3
L22	Ruthin Road, west of Ruabon Road	25	7.3
L23	Pen-Y-Bryn	40	7.3
L24	Ruabon Road	40	6.7
L25	Ruabon Road, east of A5152	25	7.5
L26	Ruabon Road, west of A5153, junction	25	9.4
L27	Ruabon Road, west of A5153	45	7.3
L28	A5152, north of Ruabon Road, junction	25	10.2
L29	A5152, north of Ruabon Road	40	8.8
L30	A5152, south of Ruthin Road	25	8.8
L31	A5152, north of Ruthin Road, junction	25	7.3
L32	A5152, north of Ruthin Road	45	7.3
L33	A5152, south of Watery Road	25	7.3
L34	Bradley Road, junction	25	9.6
L35	Bradley Road	45	7.3
L36	Croesnewydd Road, north of Ruthin Road, junction	25	8.7
L37	Croesnewydd Road, north of Ruthin Road	45	7.3
L38	Croesnewydd Road, west of Rhyd Broughton Lane	25	11.4
L39	Croesnewydd Road, east of Rhyd Broughton Lane, junction	25	11.4
L40	Croesnewydd Road, east of Rhyd Broughton Lane	45	7.3
L41	Watery Road, west of Bradley Road	25	11.3
L42	Bersham Road, west of A5152, junction	25	6.7
L43	Bersham Road, west of A5152	45	7.1

Link		Avg. Vehicle Speed (km/h)	Road Width (m)
L44	Bersham Road, west of site access	45	7.3
L45	Bersham Road, west of Berse Lane	45	7.3
L46	Bersham Road, south of Plas Buckley Road	45	7.3
L47	Rhyd Broughton Lane, junction	25	13.1
L48	Rhyd Broughton Lane	45	8.2
L49	Berse Lane, south of A525, junction	25	11.7
L50	Berse Lane	45	6.6
L51	Berse Lane, north of Bersham Road	25	6.8
L52	A483 northbound, slip off	40	7.3
L53	A483 northbound, slip on	40	7.3
L54	A483 southbound, slip off	40	7.3
L55	A483 southbound, slip on	40	7.3
L56	Watery Road/ A5152 roundabout	35	7.4
L57	Croesnewydd Road/ Rhyd Broughton Lane roundabout	35	7.4

Reference should be made to Figure 10 for a graphical representation of the road link locations.

Emission Factors

Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 11.0). This has been produced by DEFRA and incorporates COPERT 5.3 vehicle emission factors and fleet information.

There is current uncertainty over NO_2 concentrations within the UK, with the implementation of new vehicle emission standards not resulting in the previously expected reduction in roadside levels. Therefore, 2019 emission factors were utilised in preference to the development opening year in order to provide robust model outputs. As predictions for 2019 were verified, it is considered the results are a robust indication of worst case concentrations for the future year.

Meteorological Data

Meteorological data used in the assessment was taken from Hawarden meteorological station over the period 1st January 2019 to 31st December 2019 (inclusive). Hawarden observation site is located at NGR: 334586, 364102, which is approximately 15.1km north-east of the development. 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.

All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 11 for a wind rose of utilised meteorological data.

Roughness Length

The 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 and meteorological site. This is considered appropriate for the morphology of both areas and is suggested within ADMS-Roads as being suitable for 'parkland, open suburbia'.

Monin-Obukhov Length

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 the meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

Background Concentrations

Annual mean NO_2, PM_{10} and $PM_{2.5}$ background concentrations for use in the assessment were taken from the grid square containing the 38 - Pentre Bach monitor, NGR: 331500, 350500. These are shown in Table A1.3.

Table A1.3 Background Concentrations - Modelling Extents

Pollutant	Predicted 2019 Background Pollutant Concentration (µg/m^3)
NO_2	11.07

Pollutant	Predicted 2019 Background Pollutant Concentration (µg/m^3)
PM_{10}	11.84
$PM_{2.5}$	7.41

The values shown in Table A1.3 were chosen to represent concentrations throughout the dispersion modelling extents without the contribution from road vehicles as they were higher than the DEFRA background for the grid square containing the site, as shown in Table 15.

Similarly to emission factors, background concentrations from 2019 were utilised in preference to the future year. This provided a robust assessment and is likely to overestimate pollutant concentrations during the operation of the proposal.

NO_x to NO_2 Conversion

Predicted annual mean NO_x concentrations were converted to NO_2 concentrations using the spreadsheet (version 8.1) provided by DEFRA, which is the method detailed within DEFRA guidance[20].

Verification

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including:

- Estimates of background concentrations;
- Uncertainties in source activity data such as traffic flows and emission factors;
- Variations in meteorological conditions;
- Overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

[20] Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

For the purpose of the assessment, model verification was undertaken for 2019 using traffic data, meteorological data and monitoring results from this year. The choice of 2019 as the verification year aligns with the IAQM position statement 'Use of 2020 and 2021 Monitoring Datasets'[21], which states:

> "If you are carrying out an air quality study that includes validation against monitoring data, use 2019 monitoring data as the last typical year."

Verification - NO_x

Monitoring of NO_2 concentrations was undertaken at two locations in the vicinity of roads included within the model during 2019. The results were obtained and the road contributions to total NO_x concentrations calculated following the methodology contained within DEFRA guidance[22]. The monitored annual mean NO_2 concentrations and calculated road NO_x concentrations are summarised in Table A1.4.

Table A1.4 NO_x Verification - Monitoring Results

Monitoring Location		Monitored NO_2 Concentration (µg/m³)	Calculated Road NO_x Concentration (µg/m³)
AURN	Victoria Road AURN	16.0	9.04
38	Pentre Bach	16.5	9.98

The annual mean road NO_x concentrations predicted from the dispersion model and the 2019 road NO_x concentrations calculated from the monitoring results are summarised in Table A1.5.

Table A1.5 Verification - Modelling Results

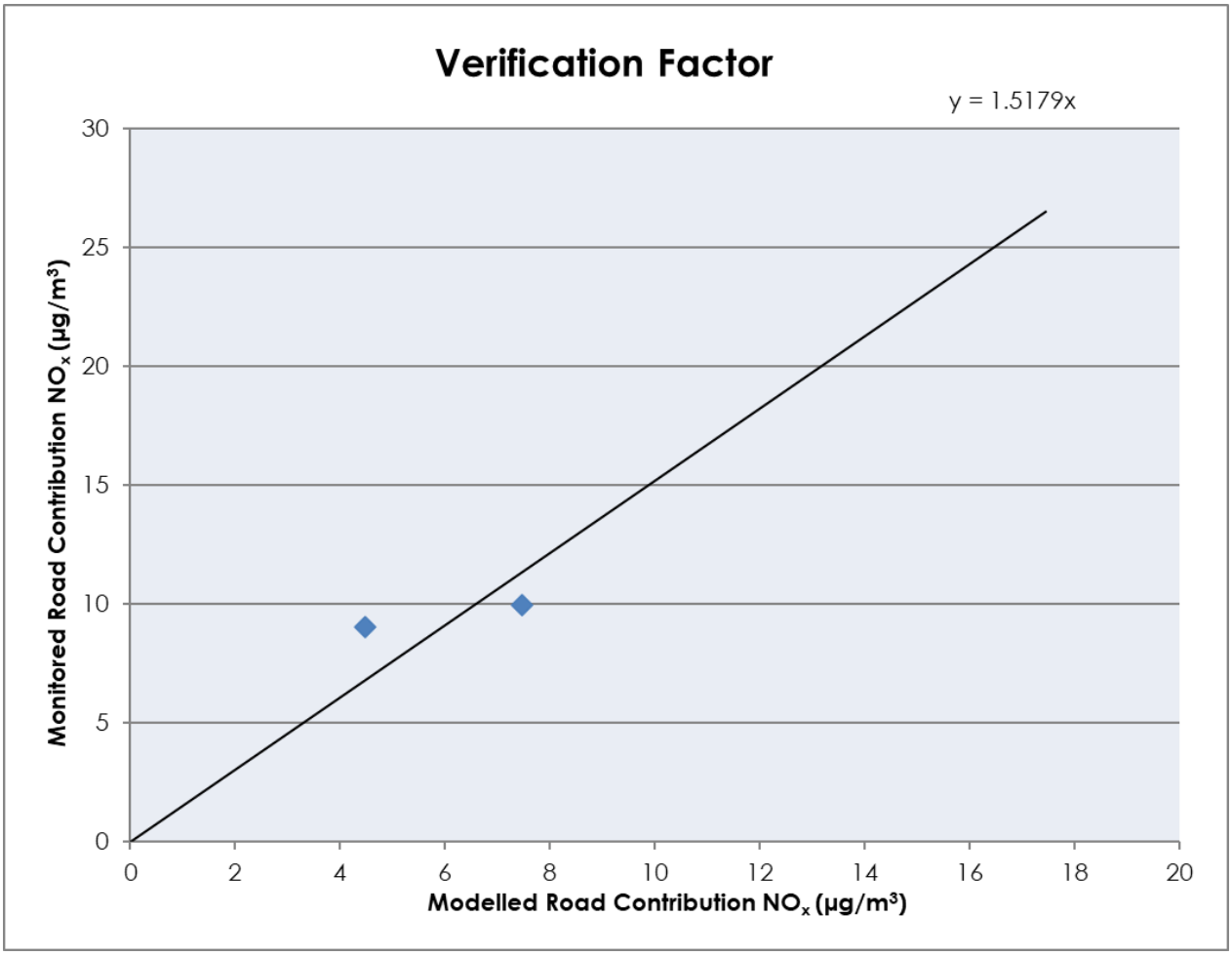
Monitoring Location		Calculated Road NO_x Concentration (µg/m³)	Modelled Road NO_x Concentration (µg/m³)
AURN	Victoria Road AURN	9.04	4.47
38	Pentre Bach	9.98	7.46

21 Use of 2020 and 2021 Monitoring Datasets, IAQM, 2021.

22 Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression through zero calculated. This indicated that a verification factor of 1.5179 was required to be applied to all road NO_x modelling results, as shown in Graph 1.

Graph 1 NO_x Verification Factor



Verification - PM_{10}

Monitoring of PM_{10} concentrations was undertaken at one location within the vicinity of roads included within the model during 2019. The monitored annual mean PM_{10} concentration and modelled PM_{10} concentration is shown in Table A1.6.

Table A1.6 PM_{10} Verification - Modelling Result

Monitoring Location		Monitored PM_{10} Concentration ($\mu g/m^3$)	Modelled PM_{10} Concentration ($\mu g/m^3$)
AURN	Victoria Road AURN	12.0	12.3

The monitored and modelled PM_{10} concentrations were compared to calculate the associated ratio. This indicated a verification factor of 0.9781 was required to be applied to all modelling results.

Verification - $PM_{2.5}$

Monitoring of $PM_{2.5}$ concentrations was undertaken at one location within the vicinity of roads included within the model during 2019. The monitored annual mean $PM_{2.5}$ concentration and modelled $PM_{2.5}$ concentration is shown in Table A1.7.

Table A1.7 $PM_{2.5}$ Verification - Modelling Result

Monitoring Location		Monitored $PM_{2.5}$ Concentration ($\mu g/m^3$)	Modelled $PM_{2.5}$ Concentration ($\mu g/m^3$)
AURN	Victoria Road AURN	8.0	7.7

The monitored and modelled $PM_{2.5}$ concentrations were compared to calculate the associated ratio. This indicated a verification factor of 1.0443 was required to be applied to all modelling results.

Appendix 2 - Curricula Vitae

JETHRO REDMORE

Director

BEng (Hons), MSc, MIAQM, MIEnvSc, PIEMA, CEnv

KEY EXPERIENCE:

Jethro is a Chartered Environmentalist and Director of Redmore Environmental with specialist experience in the air quality and odour sectors. His key capabilities include:

- Production and management of Air Quality, Dust and Odour Assessments for a wide-range of clients from the retail, residential, infrastructure, commercial and industrial sectors.
- Production and co-ordination of Environmental Permit applications for a variety of industrial sectors.
- Detailed dispersion modelling of road vehicle and industrial emissions using ADMS-Roads, ADMS-5, AERMOD-PRIME and BREEZE-ROADS. Studies have included impact assessment of ground level pollutant and odour concentrations and assessment of suitability of development sites for proposed end-use.
- Project management and co-ordination of Environmental Impact Assessments and scoping reports for developments throughout the UK.
- Provision of expert witness services at Planning Inquiries.
- Design and project management of pollutant monitoring campaigns.
- Co-ordination and management of large-scale multi-disciplinary projects and submissions.
- Provision of expert advice to local government and international environmental bodies, as well as involvement in production of industry guidance.

SELECT PROJECTS SUMMARY:

Industrial

Shanks Waste Management - Odour Assessments of two waste management facilities to support Environmental Permit Applications.

Tatweer Petroleum - dispersion modelling of Bahrain oil field.

Doha South Sewage Treatment Works - AQA for works extension in Qatar.

IRIS Environmental Appraisal Report Reviews, Isle of Man Government - odour assessment reviews.

Lankem, Greater Manchester - Environmental Permit Application for chemical manufacturing plant.

Newport Docks Bulk Drying, Pelleting and CHP Facility - air quality EIA for gas CHP.

Springshades, Leicester - Environmental Permit Variation Application for textile manufacturing plant.

Valspar, Chester - Odour Assessment and production of Odour Management Plan for a paint manufacturing plant in response to neighbour complaints.

Agrivert - dispersion modelling of odour and CHP emissions from numerous AD plants.

James Cropper Paper Mill, Cumbria - air quality EIA, Environmental Permit Variation and Human Health Risk Assessment for new biomass boiler adjacent to SSSI.

Rigg Approach, Leyton - Air Quality Assessment in support of waste transfer site.

Lynchford Lane Waste Transfer Station - biomass facility energy recovery plant.

Barnes Wallis Heat and Power, Cobham - biomass facility adjacent to AQMA.

Residential

Wood St Mill, Bury - residential development adjacent to scrap metal yard.

Hyams Lane, Holbrook - Odour Assessment to support residential development adjacent to sewage works.

North Wharf Gardens, London - peer review of EIA undertaken for large residential development.

Loxford Road, Alford - Air Quality EIA for residential development, included consideration of impacts from associated package sewage works

Elephant and Castle Leisure Centre - baseline AQA for redevelopment.

Carr Lodge, Doncaster - EIA for large residential development.

Queensland Road, Highbury - residential scheme including CHP.

Bicester Ecotown - dispersion modelling of energy centre.

Castleford Growth Delivery Plan - baseline air quality constraints assessment for town redevelopment.

York St, Bury - residential development adjacent to AQMA.

Temple Point Leeds - residential development adjacent to M1.

Commercial and Retail

Etihad Stadium - Air Quality EIA for the extension to the capacity of the Etihad Stadium, Manchester.

Wakefield College - redevelopment of city centre campus in AQMA.

Manchester Airport Cargo Shed - commercial development.

Manchester Airport Apron Extension - EIA including aircraft emission modelling.

National Youth Theatre, Islington - redevelopment to provide new arts space and accommodation.