

ENVIRONMENT

Avant Homes (England) Ltd
Calver Lane
Dodworth
Air Quality Assessment

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Dodworth
Air Quality Assessment

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EXECUTIVE SUMMARY

BWB Consulting Limited was appointed by Avant Homes (England) Ltd to undertake an air quality assessment for a proposed residential development, located at land off Calver Lane in Dodworth.

The proposed development Site is located within the administrative area of Barnsley Metropolitan Borough Council. The Site is located approximately 250m west of the Barnsley Air Quality Management Area No.1 and 1.4km south west of the Barnsley Air Quality Management Area No.2A, both of which were designated for the potential exceedance of the annual mean nitrogen dioxide (NO₂) air quality objective.

A qualitative construction phase dust assessment was undertaken in accordance with Institute of Air Quality Management guidance and measures were recommended for inclusion in a Dust Management Plan to minimise emissions during construction activities. With the implementation of these mitigation measures the impact of construction phase dust emissions was considered to be 'not significant' in accordance with Institute of Air Quality Management guidance.

A detailed operational phase road traffic emissions assessment was undertaken to consider the impact of development-generated road traffic on local air quality at identified existing receptor locations. Road traffic emissions were modelled using the dispersion model ADMS-Roads and concentrations of nitrogen dioxide and particulate matter (PM₁₀ and PM_{2.5}) were predicted at identified sensitive receptor locations. The modelling assessment was undertaken in accordance with Defra Local Air Quality Management Technical Guidance, Institute of Air Quality Management & Environmental Protection UK guidance and the Barnsley Metropolitan Borough Council Air Quality and Emissions Good Practice Planning Guidance. The development was not predicted to result in any new exceedances of the relevant air quality objectives and the impact of the development on local air quality was predicted to be 'negligible' in accordance with guidance.

Concentrations of NO₂, PM₁₀ and PM_{2.5} were also predicted across the proposed development Site and the suitability of the Site for the proposed residential use considered with regard to air quality. Pollutant concentrations were predicted to be below the relevant air quality objectives and the Site was therefore considered suitable for the proposed use with regard to the current air quality objectives.

In accordance with the Barnsley Metropolitan Borough Council Air Quality and Emissions Good Practice Planning Guidance, the proposed development was classified as 'medium'. The proposed development proposes mitigation measures suitable for a 'medium' development and therefore no further mitigation is considered necessary.

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1. INTRODUCTION

- 1.1 BWB Consulting Limited (BWB) was instructed by Avant Homes (England) Ltd (the Client) to undertake an air quality assessment for a proposed residential development, located at land off Calver Lane in Dodworth ('the Site').
- 1.2 The assessment considers construction phase dust impacts and operational phase road traffic emissions. A qualitative construction phase dust assessment was undertaken in accordance with relevant guidance. A detailed road traffic emissions assessment was undertaken to consider the impact of development-generated road traffic on local air quality at identified receptor locations. In addition, pollutant concentrations were predicted across the proposed development Site to consider the suitability of the Site for the proposed residential use with regard to the current air quality objectives.
- 1.3 This report is necessarily technical in nature so to assist the reader a glossary of air quality terminology can be found in **Appendix A**.

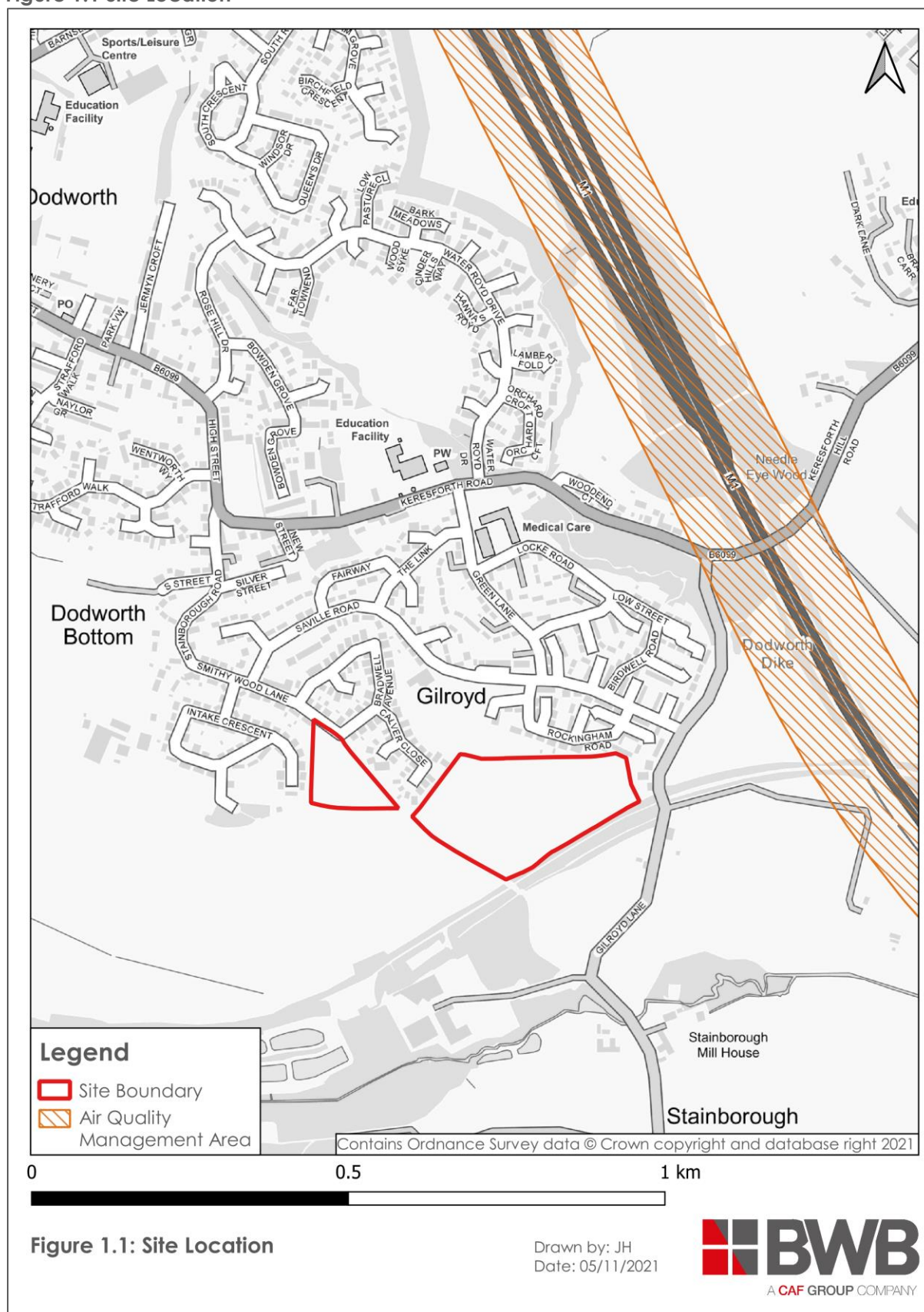
Site Setting

- 1.4 The Site comprises two parcels of land located off Calver Lane in Dodworth and lies within the administrative area of Barnsley Metropolitan Borough Council (BMBC).
- 1.5 **Figure 1.1** details the location of the proposed development. The Site currently comprises grassed land.
- 1.6 To the north of the Site lies residential dwellings. To the east lies Gilroyd Lane, with the M1 motorway and agricultural land located beyond. South of the Site lies a mixture of agricultural land, residential dwellings and woodland. To the west of the Site lies residential dwellings with agricultural land located beyond.
- 1.7 Principal air pollution sources in the vicinity of the Site are likely to comprise road traffic emissions. The Site is located approximately 250m west of the Barnsley AQMA No.1 and 1.4km south west of the Barnsley AQMA No.2A, both of which were designated for the potential exceedance of the annual mean nitrogen dioxide (NO₂) air quality objective.

Proposed Development

- 1.8 The proposed development comprises 198 residential dwelling and associated infrastructure. The proposed development masterplan is detailed in **Appendix B**.

Figure 1.1 Site Location



2. LEGISLATION, PLANNING POLICY & GUIDANCE

National Legislation and Planning Policy

2.1 The following national legislation and planning policy is relevant to air quality and was considered in the undertaking of the assessment. A summary of the relevant national legislation and planning policy is provided in **Appendix C**:

- European Parliament, EU 2008 ambient Air Quality Directive (2008)¹;
- HMSO, Air Quality (England) Regulations (2000)²;
- HMSO, Environment Act (1995)³;
- Department for Environment, Air Quality Strategy (1997)⁴;
- Department for the Environment, Food and Rural Affairs, Air Quality Strategy (2007)⁵;
- Ministry of Housing, Communities and Local Government, National Planning Policy Framework (NPPF) (2021)⁶; and
- Ministry for Housing, Communities and Local Government, Planning Practice Guidance (PPG) for air quality (2019)⁷.

Local Planning Policy

2.2 The following local and regional planning policy was considered in the undertaking of the assessment and a summary is provided in **Appendix C**:

- Barnsley Metropolitan Borough Council, Barnsley Local Plan (2019)⁸.

Air Quality Assessment Guidance

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

- Defra, Local Air Quality Management Technical Guidance (LAQM.TG(16)) (2021)⁹;
- Institute of Air Quality Management, Guidance on the assessment of dust from demolition and construction (2014)¹⁰;
- Institute of Air Quality Management and Environmental Protection UK, Land-Use Planning and Development Control: Planning for Air Quality (2017)¹¹; and
- Barnsley Metropolitan Borough Council, Air Quality And Emissions Good Practice Planning Guidance (2020)¹².

¹ European Parliament (2008) Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

² HMSO (2000) Statutory Instrument 2000 No. 928, The Air Quality (England) Regulations 2000 (as amended), London: HMSO

³ HMSO (1995) The Environment Act 1995, London: TSO

⁴ Department of the Environment (DoE) (1997) The UK National Air Quality Strategy, London: HMSO

⁵ Department of the Environment, Food and Rural Affairs (Defra) (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, London: HMSO

⁶ Ministry of Housing, Communities & Local Government (2021) National Planning Policy Framework, HMSO London

⁷ Ministry for Housing, Communities and Local Government (2019) Planning Practice Guidance Air Quality

⁸ Barnsley Metropolitan Borough Council (2019) Barnsley Local Plan

⁹ Defra (2021) Local Air Quality Management Technical Guidance LAQM.TG(16)

¹⁰ Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London

¹¹ Institute of Air Quality Management and Environmental Protection UK (2017) Land-Use Planning and Development Control: Planning for Air Quality

¹² Barnsley Metropolitan Borough Council (2020) Air Quality And Emissions Good Practice Planning Guidance

3. METHODOLOGY

Consultation with Barnsley Metropolitan Borough Council

3.1 Consultation was undertaken with the Regulatory Services department at BMBC in which the proposed assessment methodology was provided via email on 29th October 2021¹³ and a response was received on the 10th November 2021, agreeing to the proposed methodology.

3.2 The agreed assessment methodology is detailed below:

- Construction Phase - A construction phase dust assessment was undertaken and relevant measures to mitigate construction phase dust emissions were recommended. The assessment was undertaken in accordance with guidance provided by the Institute of Air Quality Management (IAQM)¹⁰.
- Operational Phase – A detailed operational phase road traffic emissions assessment was undertaken to consider the impact of development-generated traffic on local air quality and predict pollutant concentrations at the proposed development Site. The dispersion model ADMS-Roads was used to model concentrations of oxides of nitrogen (NOx) and particulate matter (PM₁₀ and PM_{2.5}) at identified existing receptor locations for both without and with development scenarios. The change in pollutant concentrations as a result of development-generated traffic was then calculated. The assessment was undertaken in accordance with Defra Local Air Quality Management Technical Guidance (LAQM.TG16)⁹, Institute of Air Quality Management and Environmental Protection UK (EPUK)¹¹ and BMBC Air Quality and Emissions Good Practice Planning Guidance¹². Pollutant concentrations were predicted across the Site to consider the suitability of the Site for residential use with regard to the current air quality objectives.
- Receptor locations – Detailed consultation was undertaken regarding the location of sensitive receptors. The agreed sensitive receptor locations are detailed in **Table 3.1** and **Figure 3.1**.
- Mitigation measures – The Regulatory Services department at BMBC requested that electric vehicle charging points be installed in accordance with the BMBC Sustainable Travel and Supplementary Planning Document¹⁴ and the BMBC Air Quality and Emissions Good Practice Planning Guidance¹². The mitigation measures proposed with the proposed development are detailed in paragraph 6.26 and 6.27.

3.3 Full details of the methodology used in the assessment, as agreed with BMBC, are provided below.

Construction Phase Dust Assessment

3.4 An assessment of the potential impacts arising from the construction of the proposed development was undertaken in accordance with IAQM Guidance¹⁰. The full assessment methodology is not reproduced within this report but a summary of the assessment steps are provided below:

¹³ Consultation request email issued to BMBC on 29/10/2021 and a response was received on 10/11/2021.

¹⁴ Barnsley Metropolitan Borough Council (2019) Sustainable Travel Supplementary Planning Document

- Step 1 – screen the requirement for a more detailed assessment. No assessment is required if there are no receptors within a certain distance of the works.
- Step 2 – assess the risk of dust impacts separately for each of the four activities considered (demolition, earthworks, construction and trackout).
 - Step 2A – determine the potential dust emission magnitude for each of the four activities;
 - Step 2B – determine the sensitivity of the area;
 - Step 2C – determine the risk of dust impacts by combining the findings of steps 2A and 2B.
- Step 3 – determine the site-specific mitigation for each of the four activities; and
- Step 4 – examine the residual effects and determine significance.

Operational Phase Road Traffic Emissions – Detailed Assessment

Barnsley Metropolitan Borough Council, Air Quality and Emissions Good Practice Planning Guidance

- 3.5 BMBC has adopted the Air Quality and Emissions Good Practice Planning Guidance¹². Therefore, the development classification process detailed in the Air Quality and Emissions Good Practice Planning Guidance¹² was undertaken and mitigation measures recommended accordingly.
- 3.6 The Air Quality and Emissions Good Practice Planning Guidance¹² provides a three stage assessment process as follows:
- Stage 1 – determining the classification of the development proposal;
 - Stage 2 – assessing and quantifying the impact on local air quality;
 - Stage 3 – establishing the level of mitigation required by the proposal to meeting National Planning Policy and Local Development Plan requirements.
- 3.7 This three stage process was undertaken and the classifications for each stage were agreed with BMBC during the consultation process.
- 3.8 The classification process undertaken, as detailed in Section 6 of this report, identified that detailed road traffic emissions dispersion modelling was required to assess the suitability of the Site for the proposed residential use.
- 3.9 In addition, the proposed development trip generation was screened using the IAQM and EPUK guidance¹¹ thresholds and was identified to exceed the criteria for sites outside an AQMA. In accordance with the guidance¹¹, a detailed road traffic emissions assessment was required to determine the significance of impacts on local air quality.

Air Dispersion Modelling

- 3.10 The air dispersion model ADMS-Roads, version 5.0.0.1 was utilised in the assessment to predict concentrations of NO_x, PM₁₀ and PM_{2.5} at existing receptor locations and across the Site.

- 3.11 The assessment was undertaken in accordance with Defra Local Air Quality Management Technical Guidance⁹ and Institute of Air Quality Management and Environmental Protection UK guidance¹¹.

Assessment Scenarios and Traffic Data

- 3.12 The following scenarios were considered in the air dispersion modelling:

- Scenario 1: 2019 Verification Year;
- Scenario 2: 2021 Base Year;
- Scenario 3: 2023 Opening Year without development; and
- Scenario 4: 2023 Opening Year with development.

- 3.13 Traffic data were obtained from Optima Highways, the Transport Consultants for the project. 24-hour Annual Average Daily Traffic Data (AADT) and Heavy Duty Vehicle (HDV) proportions were provided for the following roads for use in the assessment:

- M1 Motorway;
- A628 Dodworth Road;
- A6133 Broadway;
- B6099 High Street;
- B6449 Barnsley Road;
- Gilroyd Lane;
- Smithy Wood Lane; and
- Stainborough Road.

- 3.14 Consideration was given to the speeds at which vehicles are likely to travel within the study area. Free-flowing traffic conditions were modelled at the relevant speed limit. Queuing sections were modelled in accordance with the principles set out in Defra guidance⁹.

- 3.15 Sections of the A628 Whiby Road/Dodworth are elevated relative to the M1 motorway. As accurate information on the height of the elevations was not available, all road links were modelled at 0m to provide a conservative assessment.

- 3.16 Traffic data used in the air dispersion modelling are provided in **Appendix D** and the road network modelled is illustrated in **Figure D1**.

ADMS-Roads Model Inputs

- 3.17 The following model inputs were utilised in the assessment:

- Emission Factors – emission factors were utilised from the Defra Emission Factor Toolkit¹⁵ (EFT), version 10.1, for the years of assessment (2019, 2021 and 2023).

¹⁵ Defra (2020) Emission Factor Toolkit [<https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>]

- Conversion of oxides of nitrogen – concentrations of NO_x were predicted using the ADMS-Roads dispersion model. These concentrations were converted to nitrogen dioxide (NO₂) using the Defra NO_x to NO₂ calculator¹⁶, version 8.1.
- Meteorological Data – hourly sequential meteorological data for the verification year of assessment (2019) were obtained for the Emley Moor recording station. This is the closest most representative recording station. The wind rose for 2019 is provided in **Appendix E**.
- Surface roughness and Monin-Obukhov length (MO) – Site – a surface roughness of 0.5m and an MO length of 30 were utilised in the air dispersion model to represent the suburban conditions at the Site and the study area.
- Surface roughness and Monin-Obukhov length (MO) – Meteorological Station – a surface roughness of 0.03m and an MO length of 10 were utilised in the air dispersion model to represent the rural conditions at the meteorological station.
- Background pollutant concentrations – background concentrations of NO₂, PM₁₀ and PM_{2.5} for the study area were obtained from the pollutant concentration maps¹⁷ provided by Defra as a 1km x 1km grid of the UK, for the years of assessment (2019, 2021 and 2023).
- Model verification – model verification was undertaken using BMBC monitoring data available for the study area. Full details of the verification procedure are provided in **Appendix F**.
- Calculation of short term PM₁₀ concentrations – the following calculation, as detailed in Defra guidance⁹, was utilised to calculate the number of exceedances of the 24-hour mean PM₁₀ air quality objective:

$$\text{Number of 24-Hour Mean Exceedance} = -18.5 + 0.00145 * \text{Annual Mean}^3 + (206 / \text{Annual Mean})$$

- The IAQM released a position statement¹⁸ regarding dealing with the uncertainty in vehicle NO_x emissions within air quality assessments. This recommends that sensitivity analyses be undertaken and professional judgement be applied to consider the scenario where NO_x emissions do not reduce as rapidly as shown by the EFT. The IAQM position statement¹⁸ has now been withdrawn as there is now a growing body of evidence to suggest that the latest vehicle emission factors reflect the real-world NO_x emissions more accurately. Therefore, a sensitivity analysis assessment was not undertaken.

Receptor Locations

Existing Sensitive Receptors

- 3.18 Existing receptor locations were identified within close proximity of the road links detailed in paragraph 3.13 and considered in the operational phase road traffic emissions assessment. Concentrations of NO₂, PM₁₀ and PM_{2.5} were predicted at the identified existing receptor locations for the assessment scenarios detailed in paragraph 3.12. Where possible the closest receptors to those road links were considered, as these receptors are likely to experience the greatest change in pollutant concentrations as a result of the proposed development.

¹⁶ Defra (2020) NO_x to NO₂ Calculator [<https://iaqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc>]

¹⁷ Defra (2020) background pollutant concentration maps [<https://uk-air.defra.gov.uk/data/iaqm-background-maps?year=2018>]

¹⁸ Institute of Air Quality Management (2018) Position Statement: Dealing with Uncertainty in Vehicle NO_x Emissions within Air Quality Assessments, Version 1.1

- 3.19 Receptor heights were modelled at 1.5m to represent the average breathing height at ground floor, apart from secondary and primary schools, which were modelled at 1.0m and 0.8m respectively to represent the lower than average child breathing height.

Local air quality monitoring locations

- 3.20 Pollutant concentrations were also predicted at local air quality monitoring locations to assess the impact of the proposed development on local air quality. Monitoring locations were modelled at the heights detailed in the latest BMBC Air Quality Annual Status Report¹⁹ as detailed in **Table 3.1**.

- 3.21 The existing receptor locations are detailed in **Table 3.1** and **Figure 3.1**.

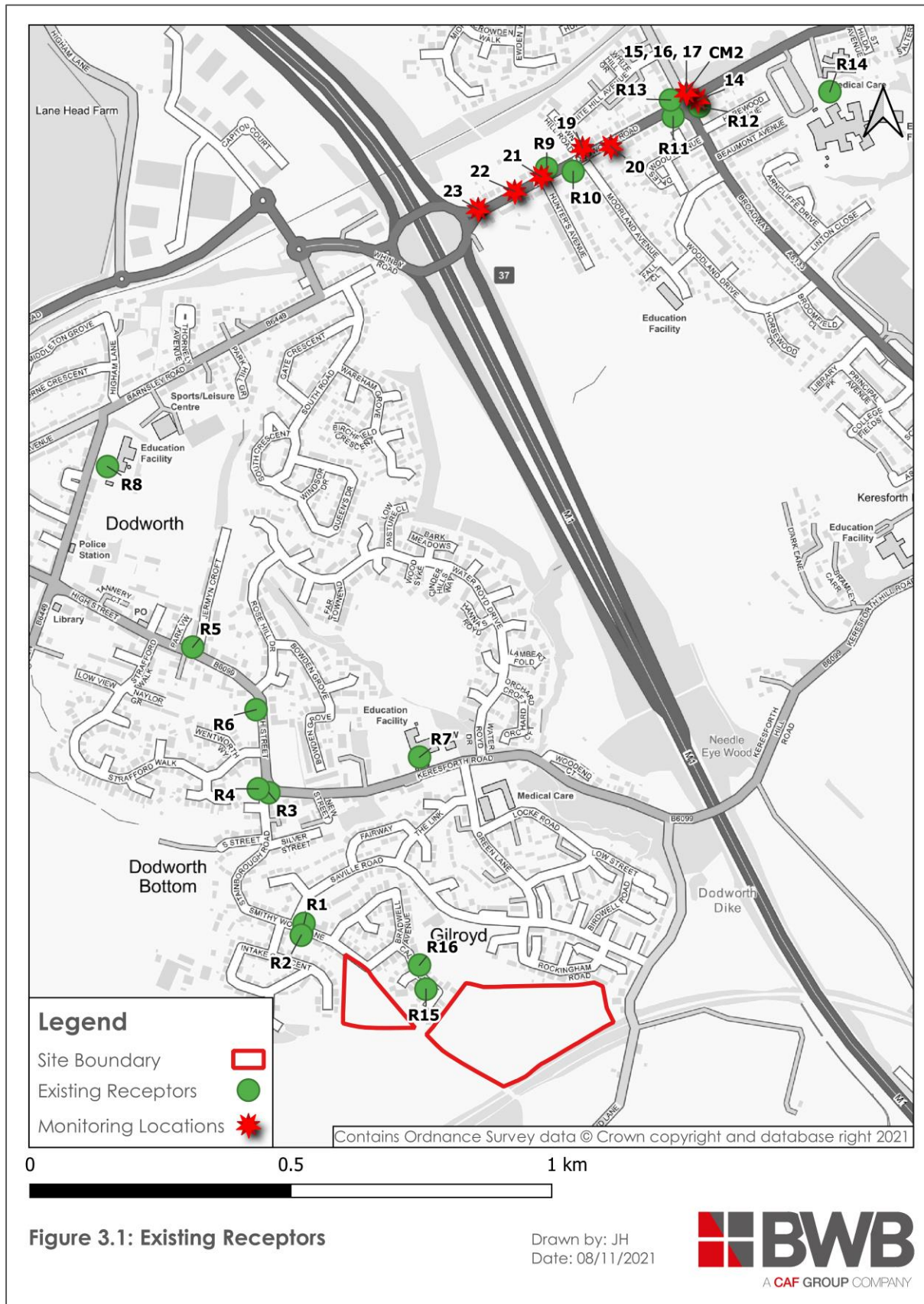
Table 3.1: Existing Sensitive Receptor and Local Monitoring Locations

Receptor	Grid Reference		Details	Height Modelled
	X	Y		(m)
Monitoring Locations				
CM2	432680	406174	Barnsley A628	1.7
14,	432702	406160	Dodworth Road	2.7
15, 16, 17	432680	406174	Pogmoor Crossroads	1.7
19	432481	406068	Crown Hill Rd	2.8
20	432535	406071	Dodworth Road, Pogmoor	3
21	432402	406013	Dodworth Road, Pogmoor	2.9
22	432351	405985	Dodworth Road, Pogmoor	2.9
23	432281	405951	Dodworth Road, Pogmoor	3
Long Term Receptors				
R1	431947	404584	Residential dwelling on Smithywood Lane	1.5
R2	431942	404562	Residential dwelling on Smithywood Lane	1.5
R3	431880	404835	Residential dwelling on Stainborough Road	1.5
R4	431860	404842	Residential dwelling on Stanborough Road	1.5

¹⁹ Barnsley Metropolitan Borough Council (2021) 2021 Air Quality Annual Status Report

Receptor	Grid Reference		Details	Height Modelled
	X	Y		(m)
R5	431734	405113	Residential dwelling on High Street	1.5
R6	431856	404993	Residential dwelling on High Street	1.5
R7	432169	404903	Primary school on Keresforth Road	0.8
R8	431571	405459	Primary school on Barnsley Road	0.8
R9	432412	406029	Residential dwelling on Dodworth Road	1.5
R10	432463	406023	Residential dwelling on Dodworth Road	1.5
R11	432655	406128	Residential dwelling on Dodworth Road	1.5
R12	432705	406148	Residential dwelling on Broadway	1.5
R13	432649	406160	Residential dwelling on Dodworth Road	1.5
R14	432955	406176	Secondary school off Dodworth Road	1.0
R15	432181	404459	Residential dwelling on Calver Close	1.5
R16	432169	404505	Residential dwelling on Calver Close	1.5

Figure 3.1: Existing Receptor Locations



Proposed Receptor Locations

- 3.22 The proposed development proposes sensitive use and therefore NO₂ PM₁₀ and PM_{2.5} concentrations were predicted across the Site to consider the suitability of the proposed development with regard to the current air quality objectives. A Cartesian grid was modelled from X coordinates 431879 to 404146 and Y coordinates 432904 to 404731. The grid was modelled at a height of 1.5m to represent average breathing height. Pollutant concentrations were predicted across the Site for Scenario 4: 2023 Opening Year with development.

Limitations and Assumptions

- 3.23 There are uncertainties associated with both measured and predicted pollutant concentrations. The model (ADMS-Roads) used in this assessment relies on input data, which are also subject to uncertainty. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS-Roads model will not take into account.
- 3.24 The assessment is based on traffic data provided by Optima Highways, the transport consultants for the project. As such any assumptions made by the transport consultants may also influence the air quality assessment.
- 3.25 In future year scenarios, uncertainty relates to the projection of vehicle emissions and, in particular the rate at which emissions per vehicle will improve over time. This assessment utilised the most recent version of the Defra EFT¹⁵ to provide the most up to date estimate of current and future emission projections.
- 3.26 To reduce the uncertainty associated with predicted concentrations, model verification was carried out following guidance set out in Defra guidance⁹. As the models were verified using local monitoring data and adjusted accordingly, there can be reasonable confidence in the predicted concentrations.

Assessment Criteria

- 3.27 Predicted pollutant concentrations were compared to the relevant air quality objectives⁴. The current relevant air quality standards and objectives are detailed in **Table 3.2**.

Table 3.2: Air Quality Standards and Objectives (England)

Pollutant	Averaging Period	Air Quality Objective (µg.m ⁻³)	Date to Achieve by
NO ₂	Annual Mean	40	31 December 2005
	1-hour mean not to be exceeded more than 18 times per year	200	31 December 2005
PM ₁₀	Annual Mean	40	31 December 2004

Pollutant	Averaging Period	Air Quality Objective ($\mu\text{g.m}^{-3}$)	Date to Achieve by
	24-hour mean not to be exceeded more than 35 times per year	50	31 December 2004
PM _{2.5}	Annual mean target (15% cut in annual mean (urban background exposure))	25	2010 - 2020

- 3.28 Guidance is provided by the Institute of Air Quality Management and Environmental Protection UK¹¹ to determine the significance of the impact of development-generated road traffic emissions on local air quality. The impact descriptors at receptor locations are detailed in **Table 3.3**. These impact descriptors consider the predicted magnitude of change in pollutant concentrations and the concentration in relation to the relevant air quality objectives.

Table 3.3: Impact Descriptors for Individual Receptors

Long Term Average Concentration at Receptor in Assessment Year	% Change in Concentration Relative to Air Quality Assessment Level (AQAL)			
	1%	2 – 5%	6 – 10%	>10%
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: Figures rounded up to the nearest whole number, therefore any value less than 1% after rounding (effectively less than 0.5%) will be described as negligible.

4. BASELINE CONDITIONS

Local Air Quality Management

- 4.1 The Site is located approximately 250m west of the Barnsley AQMA No.1 and 1.4km south east of the Barnsley AQMA No.2A, both of which were designated for the potential exceedance of the annual mean NO₂ air quality objective.

Local Air Quality Monitoring

Nitrogen Dioxide (NO₂)

- 4.2 BMBC undertakes NO₂ monitoring within its administrative boundary using a network of automatic monitoring locations and diffusion tubes. The closest monitoring location to the proposed development is located adjacent to the A628, Dodworth Road (diffusion tube 23) approximately 1.5km north east from the Site.
- 4.3 Bias adjusted NO₂ monitoring results, for the locations in the vicinity of the proposed development Site, are detailed in **Table 4.1**. Exceedances are highlighted in bold.
- 4.4 Although monitoring data for 2020 was available for review, due to the COVID-19 pandemic and associated national lockdowns in place during the 2020 calendar year, monitoring results for 2020 were not considered to be representative of normal conditions, given the significant decrease in traffic levels.
- 4.5 In addition, the IAQM released a position statement¹⁸ in August 2021 with regards to the use of 2020 and 2021 monitoring data and the COVID-19 pandemic. Until the impact of the pandemic on air quality is fully understood, the IAQM's advice is to use 2019 monitoring data as the last typical year for monitoring data.

Table 4.1: BMBC NO₂ Monitoring Data in 2015 – 2020

Location and Reference	Grid Reference		Site Monitoring Type	Distance from and direction to Site boundary	Monitored Annual Average Concentration (µg.m ⁻³)					
					2015	2016	2017	2018	2019	2020
CM2, Barnsley A628	432680	406174	Roadside	1.7km north east	-	36.0	35.0	32.0	32.0	25.0
14, Dodworth Road	432702	406160	Roadside	1.7km north east	49.8	49.2	44.4	39.4	40.5	26.6
15, 16, 17, Pogmoor Crossroads	432680	406174	Roadside	1.7km north east	-	37.8	32.6	33.6	31.9	24.6
18, Pogmoor Road	432603	406312	Roadside	1.8km north east	44.4	36.9	34.1	27.6	30.3	16.2

Location and Reference	Grid Reference		Site Monitoring Type	Distance from and direction to Site boundary	Monitored Annual Average Concentration ($\mu\text{g.m}^{-3}$)					
					2015	2016	2017	2018	2019	2020
19, Crown Hill Rd	432481	406068	Roadside	1.6km north east	30.9	28.1	28.7	25.7	27.2	18.1
20, Dodworth Road - Pogmoor	432535	406071	Roadside	1.6km north east	44.7	43.4	40.9	37	39.6	29.3
21, Dodworth Road, Pogmoor	432402	406013	Roadside	1.5km north east	58.1	51.1	49.1	45.8	46.2	29.5
22, Dodworth Road, Pogmoor	432351	405985	Kerbside	1.5km north east	53.2	52.7	50.0	44.2	48.1	32.6
23, Dodworth Road, Pogmoor	432281	405951	Roadside	1.5km north east	49.8	50.0	52.0	43.4	47.0	28.9

- data not available

- 4.6 Monitored annual mean NO_2 concentrations between 2015 and 2019 were above the annual mean NO_2 objective of $40\mu\text{g.m}^{-3}$ at monitoring locations; 14, 18, 20, 21, 22 and 23. These monitoring locations are located within the Barnsley AQMA No.2A which encompasses the A628 Dodworth Road. A review of real-world imagery identified that the A628 Dodworth Road experiences significant levels of congestion likely to be caused by the A628 Dodworth Road / A6133 Broadway junction, which is considered to give rise to the elevated levels of pollution.
- 4.7 Monitored NO_2 concentrations at the monitoring locations detailed in **Table 4.1** declined between 2015 and 2019, followed by a significant decrease between 2019 and 2020 which was likely to be a result of lockdown restrictions influencing traffic levels during the COVID-19 pandemic in 2020.
- 4.8 The monitoring locations detailed in **Table 4.1** were not considered representative of conditions of the Site. The monitoring locations are located within an AQMA and adjacent to a heavily trafficked A road. Whereas the Site is located in a more suburban area away from the major road network and therefore pollutant concentrations within the Site are anticipated to be lower than those at the roadside monitoring locations detailed in **Table 4.1**.
- 4.9 The monitoring locations detailed in **Table 4.1** were used within the model verification, with the exception of monitoring location 18, as traffic data for the adjacent road link was unavailable. Details of the verification process are provided in **Appendix F**.

Particulate Matter (PM₁₀)

- 4.10 BMBC also undertakes monitoring of PM₁₀ concentrations at the automatic monitor CM1, located along the A635 Doncaster Road approximately 4km east of the Site. Monitored annual mean PM₁₀ concentrations between 2015 and 2020 were well below the annual mean PM₁₀ objective of 40µg.m⁻³. Pollutant concentrations at CM1 are not considered representative of conditions at the Site as it is located adjacent to an A road, which experiences higher levels of traffic than the minor roads surrounding the Site. Therefore, it was considered that PM₁₀ concentrations at the Site would be below the annual mean PM₁₀ objective.

Particulate Matter (PM_{2.5})

- 4.11 No PM_{2.5} monitoring is undertaken in the administrative area of BMBC.

Background Pollutant Concentrations

- 4.12 No background air quality monitoring is undertaken by BMBC within the study area. Background pollutant concentrations were therefore obtained from the latest Defra background concentration maps¹⁷, which are provided for the UK as a 1km x 1km grid network. The latest maps are based on 2018 monitoring and meteorological data. Background concentrations of NO₂, PM₁₀ and PM_{2.5} were obtained for the grid squares covering the study area for the years of assessment (2019, 2021 and 2023). The background concentrations used in the assessment are detailed in **Table 4.2**.

Table 4.2: Background Pollutant Concentrations used in the Assessment

Pollutant	Grid Square	Monitoring Locations / Receptors	Concentration (µg.m ⁻³)		
			2019	2021	2023
Monitoring Locations Used in Verification					
NO ₂	432500, 406500	14, 15,16, 17, 19, 20 and 21	13.5	12.2	11.2
PM ₁₀			11.5	11.2	11.0
PM _{2.5}			7.4	7.2	7.0
NO ₂	432500, 405500	22 and 23	16.7	15.0	13.5
PM ₁₀			13.2	12.8	12.6
PM _{2.5}			8.1	7.8	7.6
Receptors					
NO ₂	431500, 404500	R1 – R4, R6		8.6	8.1

Pollutant	Grid Square	Monitoring Locations / Receptors	Concentration (µg.m ⁻³)		
			2019	2021	2023
PM ₁₀			Data not required for these scenarios	10.2	10.0
PM _{2.5}				6.4	6.2
NO ₂				10.6	9.8
PM ₁₀	431500, 405500	R5 and R8		10.4	10.2
PM _{2.5}				6.7	6.5
NO ₂				12.1	11.0
PM ₁₀	432500, 404500	R7, R15 and R16		12.4	12.2
PM _{2.5}				7.4	7.2
NO ₂				12.2	11.2
PM ₁₀	432500, 406500	R9 – R14		11.2	11.0
PM _{2.5}				7.2	7.0
NO ₂			431500, 404500	Proposed Receptor Cartesian Grid	9.4
PM ₁₀	10.5				
PM _{2.5}	6.6				
NO ₂	432500, 404500	Proposed Receptor Cartesian Grid	Data not required for these scenarios	13.4	
PM ₁₀				12.7	
PM _{2.5}				7.6	

- 4.13 2019, 2021 and 2023 background concentrations are below the relevant annual mean air quality objectives for NO₂, PM₁₀ and PM_{2.5}. A review of Defra background concentration maps¹⁷ highlighted a significant contribution of residual and secondary particulate matter towards the total background PM₁₀ concentration. It is likely that this contributes towards background PM₁₀ concentrations exceeding background NO₂ concentrations in some grid squares.

5. CONSTRUCTION PHASE DUST ASSESSMENT

- 5.1 The construction phase of the proposed development will involve a number of activities which have the potential to impact on local air quality. These include emissions of dust generated through excavation, construction, earthworks and trackout activities, exhaust pollutant emissions from construction traffic on the local highways network, and exhaust emissions from non-road mobile machinery (NRMM) within the construction site itself.
- 5.2 The location of sensitive receptors in relation to construction activities will affect the potential for such construction activities to cause dust soiling, nuisance and local air quality impacts. Meteorological conditions and the use of control measures will also contribute to the effects experienced.

Step 1: Screen the Need for a Detailed Assessment

- 5.3 Step 1 of the IAQM guidance¹⁰ involves a screening assessment to consider whether a more detailed construction phase dust assessment is required.
- 5.4 In accordance with the guidance, a detailed assessment is required if:
- Human receptors are located within 350m of the boundary of the site or 50m of routes used by construction vehicles on the public highways, up to 500m from the site entrances; or
 - Ecological receptors are located within 50m of the boundary of the site or 50m of routes used by construction vehicles on the public highways, up to 500m from the site entrances.
- 5.5 From a review of the Multi Agency Geographic Information for the Countryside (MAGIC) website²⁰, no ecological designations were identified within the above screening distance and therefore the impact on ecological designations was not considered further. However human receptors are located within the above screening distances, with the closest of these receptors located off Calver Close. A construction phase assessment was therefore undertaken.

Step 2: Assess the Risk of Dust Impacts

Step 2A: Define the Potential Dust Emission Magnitude

- 5.6 The dust emission magnitudes for the construction activities were defined using the criteria detailed in the IAQM guidance¹⁰ as detailed in **Table 5.1**. Demolition is not proposed as part of the development and therefore wasn't considered further in the assessment.

²⁰ Defra, Multi Agency Geographic Information for the Countryside (MAGIC) [<http://magic.defra.gov.uk/>]

Table 5.1: Dust Emission Magnitude Criteria and Definition

Activity	IAQM Dust Emission Magnitude	IAQM Dust Emission Magnitude Criteria
Earthworks	Large	Total site area >10,000m ² , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.
	Medium	Total site area 2,500m ² – 10,000m ² , moderately dusty soil type (e.g. silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4m - 8m in height, total material moved 20,000 tonnes – 100,000 tonnes.
	Small	Total site area <2,500m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Large	Total building volume >100,000m ³ , on site concrete batching, sandblasting.
	Medium	Total building volume 25,000m ³ – 100,000m ³ , potentially dusty construction material (e.g. concrete), on site concrete batching.
	Small	Total building volume <25,000m ³ , construction material with low potential for dust release (e.g. metal cladding or timber).
Trackout	Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m.
	Medium	10 - 50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100m.
	Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50m.

5.7 The following dust emissions magnitudes were defined for the proposed development:

- Earthworks – The total site area is greater than 10,000m² and therefore the dust emissions magnitude for earthworks was defined as **Large**.
- Construction – The total building volume is between 25,000m³ and 100,000m³ and therefore the dust emissions for construction was defined as **Medium**.
- Trackout – There is anticipated to be between 10 and 50 HDV outward movements in any one day during the construction phase and therefore the dust emissions magnitude for trackout was defined as **Medium**.

5.8 A summary of the defined dust emissions magnitudes for the development are provided in **Table 5.2**.

Table 5.2: Summary of Project Defined Dust Emissions Magnitudes

Activity	Dust Emissions Magnitude
Earthworks	Large
Construction	Medium
Trackout	Medium

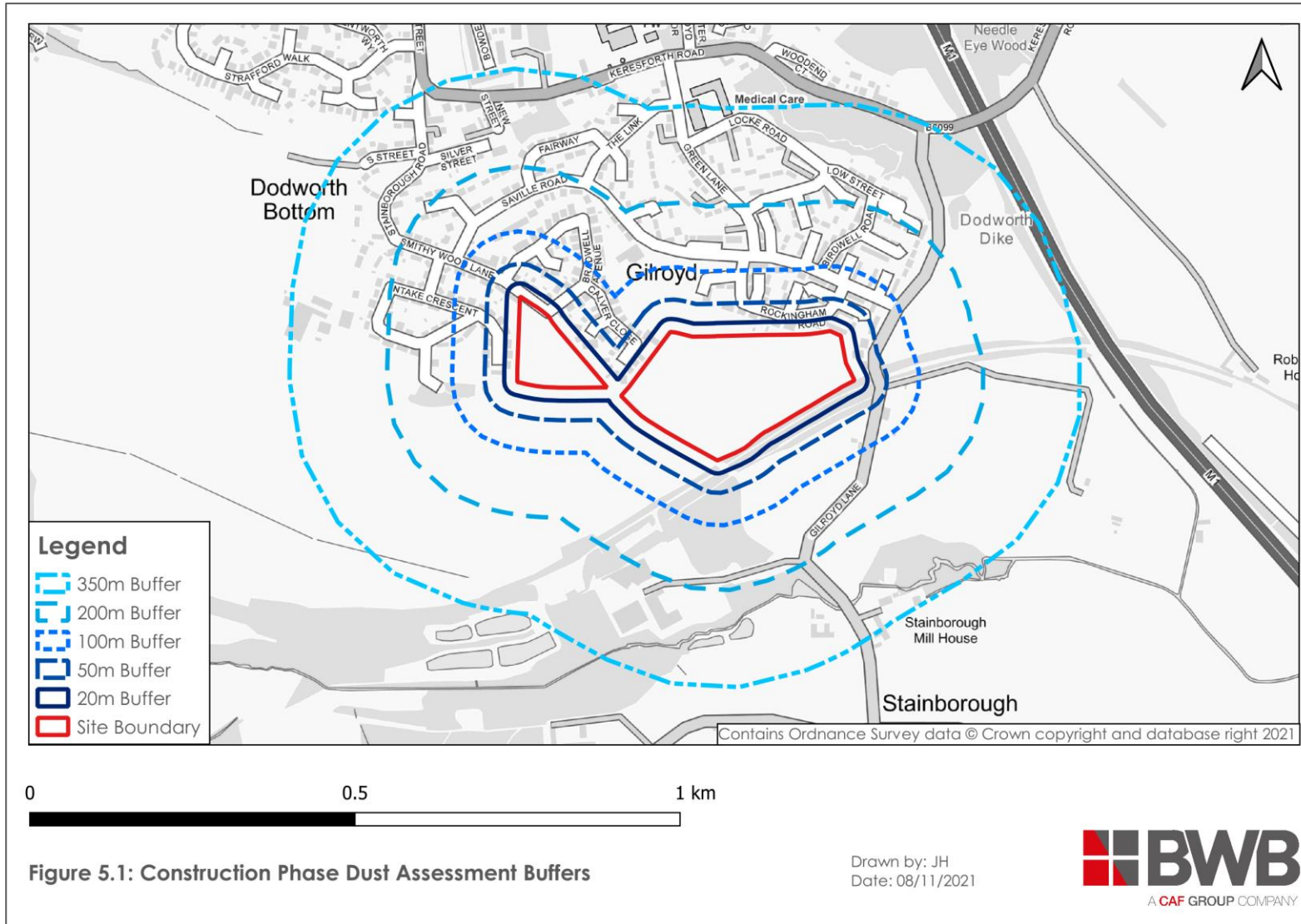
Step 2B: Define the Sensitivity of the Area

- 5.9 The assessment requires the determination of the sensitivity of the area for the purposes of dust soiling and human health. The sensitivity of the study area takes into account the specific receptors in the vicinity of the Site, the proximity and number of those receptors, the local background concentration of PM₁₀ and site-specific factors. **Figure 5.1** was utilised to determine the number of receptors located within the distance bands provided in the IAQM guidance¹⁰ for determining receptor sensitivity.
- 5.10 The sensitivity of the area is defined below, in accordance with IAQM criteria¹⁰ and summarised in **Table 5.3**.
- Dust Soiling – There are between 10 - 100 highly sensitive residential receptors located within 20m of the proposed Site boundary. Therefore, the sensitivity of the area to dust soiling is defined as '**High**'.
 - Human Health – There are between 10 - 100 highly sensitive human receptors located within 20m of the proposed Site boundary and the 2021 background concentration of PM₁₀ is less than 24 µg.m⁻³. Therefore, the sensitivity of the area to human health effects is defined as '**Low**'.

Table 5.3: Determination of the Sensitivity of the Area

Potential Impact	Sensitivity		
	Earthworks	Construction	Trackout
Dust Soiling	High	High	High
Human Health	Low	Low	Low

Figure 5.1: Construction Phase Assessment Dust Distance Buffers



Step 2C: Define the Risk of Impacts

- 5.11 The dust emission magnitude determined in Step 2A is then combined with the sensitivity of the area determined in Step 2B to define the risk of dust impacts with no mitigation applied. The results of this assessment are detailed in **Table 5.4**.

Table 5.4: Summary Dust Risk Table to Define Site Specific Risk

Activity	Step 2A: Dust Emission Magnitude	Step 2B: Sensitivity of the Area	Step 2C: Risk of Dust Impacts
Dust Soiling Effects on People and Property			
Earthworks	Large	High	High Risk
Construction	Medium	High	Medium Risk
Trackout	Medium	High	Medium Risk
Human Health Impacts			
Earthworks	Large	Low	Low Risk
Construction	Medium	Low	Negligible
Trackout	Medium	Low	Negligible

Step 3: Site-Specific Mitigation

- 5.12 The risk of dust impacts, defined in Step 2C of the assessment, is used to determine the mitigation measures required to minimise the emission of dust during construction phase activities. The IAQM guidance¹⁰ provides details of highly recommended and desirable mitigation measures which are commensurate with the risk of dust impacts defined in Step 2C for construction, earthworks and trackout activities. Where the mitigation measures are general in nature, the highest risk category was applied in accordance with the guidance¹⁰. The highest risk category identified was 'High Risk' and the recommended mitigation taken from the IAQM guidance¹⁰ is detailed in **Table 5.5** and **Table 5.6**.

Table 5.5: Mitigation Measures for a High Risk Site

Category	Mitigation Measures for a High Risk Site	
	Highly Recommended	Desirable
Communication	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	None
	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may	

Category	Mitigation Measures for a High Risk Site	
	Highly Recommended	Desirable
	be the environmental 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 Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London's guidance. The DMP may include monitoring of dust deposition, dust flux, real-time PM ₁₀ continuous monitoring and/or visual inspections.	
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.	None
	Make the complaints log available to the local authority when asked.	
	Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.	
	Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.	
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of the site boundary, with cleaning to be provided as necessary.	None
	Carry out regular site inspections to monitor compliance with the DMP, record inspections results, and make an inspection log available to the local authority when asked.	

Category	Mitigation Measures for a High Risk Site	
	Highly Recommended	Desirable
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	
Preparing and maintaining the site	Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	None
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extended period.	
	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 on site. If they are being re-used on-site cover as described below.	
	Cover, seed or fence stockpiles to prevent wind whipping.	
Operating vehicle/ machinery and sustainable travel	Ensure all vehicles switch off engines when stationary – no idling vehicles.	None
	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	
	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable control measures provided, subject to the approval of the nominated undertaker with the agreement of the local authority, where appropriate).	
	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	
	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).	
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with	None

Category	Mitigation Measures for a High Risk Site	
	Highly Recommended	Desirable
	suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	
	Ensure an adequate water supply on site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	
	Used enclose chutes and conveyors and covered skips.	
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	
	Ensure equipment is readily available on site to clean and dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	
Waste Management	Avoid bonfires and burning of waste materials.	None

Table 5.6: Mitigation Measures Specific to Earthworks, Construction and Trackout

Category	Mitigation Measures	
	Highly Recommended	Desirable
Earthworks (High Risk Site)	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	None
	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 (Medium Risk Site)	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	Avoid scabbling (roughening of concrete surfaces) if possible.
		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.
		For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
Trackout (Medium Risk Site)	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any materials tracked out of the site. This may require the sweeper being continuously in use.	None
	Avoid dry sweeping of large areas.	

Category	Mitigation Measures	
	Highly Recommended	Desirable
	Ensure vehicles entering and leaving the sites are covered to prevent escape of materials during transport.	
	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	
	Record all inspections of haul routes and any subsequent action in a site log book.	
	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	
	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: Determine Significant Effects

- 5.13 In accordance with IAQM guidance¹⁰, with the implementation of the mitigation measures detailed in Step 3, the residual impacts from the construction phase are considered to be 'not significant'.

6. OPERATIONAL PHASE ROAD TRAFFIC EMISSIONS ASSESSMENT

Baseline Assessment

- 6.1 Pollutant concentrations were predicted at the identified existing sensitive receptor and local monitoring locations using the dispersion model ADMS-Roads. Predicted pollutant concentrations for Scenario 2: 2021 Base Year and Scenario 3: 2023 Opening Year without development are detailed in **Table 6.1**. Exceedances of the relevant air quality objectives are detailed in bold.

Table 6.1: Predicted Annual Mean Pollutant Concentrations for Scenario 2: 2021 Base Year and Scenario 3: 2023 Opening Year Without Development at Existing Receptor and Monitoring Locations

Receptor/Monitoring Location	Scenario 2: 2021 Base Year ($\mu\text{g.m}^{-3}$)			Scenario 3: 2023 Opening Year Without Development ($\mu\text{g.m}^{-3}$)		
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
14	30.6	15.1	9.4	26.4	14.9	9.2
15/16/17	31.3	15.2	9.5	27.0	15.0	9.3
19	28.9	14.6	9.1	24.9	14.4	8.9
20	34.5	16.2	10.0	29.6	16.0	9.8
21	35.5	16.1	10.0	30.4	15.9	9.8
22	40.7	18.2	10.9	34.8	18.0	10.7
23	47.1	19.1	11.5	40.1	18.8	11.2
R1	11.5	10.6	6.6	10.4	10.4	6.5
R2	10.8	10.5	6.6	9.8	10.3	6.4
R3	14.7	11.4	7.1	13.1	11.2	6.9
R4	13.1	11.0	6.8	11.7	10.8	6.7
R5	20.9	12.6	8.0	18.3	12.4	7.8
R6	16.3	11.8	7.3	14.4	11.6	7.1
R7	17.4	13.3	8.0	15.3	13.1	7.8
R8	14.8	11.1	7.1	13.2	10.9	7.0

Receptor/Monitoring Location	Scenario 2: 2021 Base Year ($\mu\text{g.m}^{-3}$)			Scenario 3: 2023 Opening Year Without Development ($\mu\text{g.m}^{-3}$)		
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
R9	32.5	15.3	9.6	27.9	15.1	9.4
R10	34.7	16.1	10.0	29.8	15.8	9.8
R11	35.0	16.2	10.0	30.1	15.9	9.8
R12	28.8	14.6	9.1	24.9	14.4	8.9
R13	29.7	14.8	9.3	25.6	14.6	9.1
R14	16.8	12.0	7.6	14.9	11.7	7.4
R15	14.5	12.8	7.6	12.9	12.6	7.5
R16	15.0	12.9	7.7	13.4	12.7	7.5

- 6.2 The predicted concentrations of NO₂ are below the annual mean NO₂ objective at all receptor locations and monitoring locations with the exception of monitoring locations 23 in Scenario 2 and Scenario 3 and monitoring location 22 in Scenario 2.
- 6.3 Monitoring locations 22 and 23 are located within the Barnsley AQMA No.2A along the A628 Dodworth Road. Monitored concentrations are recorded above the annual mean NO₂ objective between 2015 and 2019. In addition, monitoring locations 22 and 23 are located within 2.5m of the A628 Dodworth Road. A review of online ariel imagery indicates that existing sensitive receptors along the A628 Dodworth Road are set at a distance back from the road where pollutant concentrations are expected to be lower than those recorded at the monitoring locations. R9 is located in close proximity to monitoring locations 22 and 23. This receptor is set approximately 11m back from the road and pollutant concentrations at R9 are predicted to be well below the relevant air quality objectives as detailed in **Table 6.1**. Therefore, monitoring locations 22 and 23 are not considered representative of sensitive receptors along the A628 Dodworth Road.
- 6.4 The predicted concentrations of PM₁₀ and PM_{2.5} for Scenario 2: 2021 Base Year and Scenario 3: 2023 Opening Year Without Development are below the respective annual mean air quality objectives at all existing sensitive receptors and monitoring locations considered.
- 6.5 With regard to short term air quality objectives for NO₂ and PM₁₀, the predicted annual mean NO₂ concentrations are less than 60 $\mu\text{g.m}^{-3}$ and therefore in accordance with Defra guidance⁹ it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.17 was used to determine potential exceedance of the 24-hour PM₁₀ short term objective; no exceedances were predicted.

Impact Assessment

Barnsley Metropolitan Borough Council, Air Quality and Emissions Good Practice Planning Guidance

- 6.6 BMBC has adopted the Air Quality and Emissions Good Practice Planning Guidance¹². The three stage process detailed in the guidance¹² was undertaken and the classifications for each stage were agreed with BMBC during the consultation process.

Stage 1: Development Type Classification

- 6.7 The proposed development comprises 189 residential dwellings which exceeds the 50 dwellings threshold detailed in Table 3 of the Air Quality and Emissions Good Practice Planning Guidance¹². The development does not meet any of the additional criteria set out in Table 4 of the guidance document and therefore the development is classified as a 'medium' development in accordance with this guidance¹².

Stage 2: Air Quality Assessment

- 6.8 The proposed development proposes sensitive use in an area adjacent to an AQMA and therefore a detailed operational phase exposure assessment was required in accordance with the BMBC Air Quality and Emissions Good Practice Planning Guidance¹².

IAQM and Environmental Protection UK Guidance

- 6.9 The proposed development trip generation was screened using the IAQM and EPUK guidance¹¹ thresholds and was identified to exceed the criteria for sites outside of an AQMA. Therefore, a detailed operational phase road traffic impact assessment was required.

Detailed Operational Phase Road Traffic Emissions Assessment

- 6.10 Concentrations of NO₂, PM₁₀ and PM_{2.5} were predicted at identified existing receptor and local monitoring locations for Scenario 4: 2023 Opening Year with development, to consider the impact of development-generated vehicles on local air quality.
- 6.11 Predicted pollutant concentrations are detailed in **Table 6.2**, **Table 6.3** and **Table 6.4** for NO₂, PM₁₀ and PM_{2.5} respectively together with Scenario 3: 2023 Opening Year without development concentrations for comparison purposes. The predicted change in pollutant concentrations resulting from development-generated traffic, and the associated impact are also provided.
- 6.12 Exceedances of the relevant air quality objective are highlighted in bold.

Table 6.2: Predicted Annual Mean NO₂ Concentrations and Development Impact at Existing Receptor and Monitoring Locations

Receptor	Predicted NO ₂ Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
14	26.4	26.5	+0.1	0	Negligible
15/16/17	27.0	27.1	+0.1	0	Negligible
19	24.9	25.0	+0.1	0	Negligible
20	29.6	29.8	+0.1	0	Negligible
21	30.4	30.6	+0.1	0	Negligible
22	34.8	34.9	+0.1	0	Negligible
23	40.1	40.3	+0.2	0	Negligible
R1	10.4	11.1	+0.8	2	Negligible
R2	9.8	10.3	+0.4	1	Negligible
R3	13.1	14.0	+0.9	2	Negligible
R4	11.7	12.2	+0.5	1	Negligible
R5	18.3	18.9	+0.6	1	Negligible
R6	14.4	14.8	+0.4	1	Negligible
R7	15.3	15.5	+0.2	0	Negligible
R8	13.2	13.4	+0.2	0	Negligible
R9	27.9	28.0	+0.1	0	Negligible
R10	29.8	29.9	+0.1	0	Negligible
R11	30.1	30.2	+0.1	0	Negligible
R12	24.9	25.0	+0.1	0	Negligible

Receptor	Predicted NO ₂ Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R13	25.6	25.7	+0.1	0	Negligible
R14	14.9	14.9	0.0	0	Negligible
R15	12.9	13.4	+0.4	1	Negligible
R16	13.4	14.0	+0.7	2	Negligible

* Discrepancies in changes due to rounding effects

Table 6.3: Predicted Annual Mean PM₁₀ Concentrations and Development Impact at Existing Receptor and Monitoring Locations

Receptor	Predicted PM ₁₀ Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
14	14.9	14.9	0.0	0	Negligible
15/16/17	15.0	15.0	0.0	0	Negligible
19	14.4	14.4	0.0	0	Negligible
20	16.0	16.0	0.0	0	Negligible
21	15.9	15.9	0.0	0	Negligible
22	18.0	18.0	0.0	0	Negligible
23	18.8	18.9	+0.1	0	Negligible
R1	10.4	10.6	+0.2	1	Negligible
R2	10.3	10.4	+0.1	0	Negligible
R3	11.2	11.4	+0.2	1	Negligible
R4	10.8	10.9	+0.1	0	Negligible

Receptor	Predicted PM ₁₀ Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R5	12.4	12.6	+0.2	0	Negligible
R6	11.6	11.7	+0.1	0	Negligible
R7	13.1	13.2	+0.1	0	Negligible
R8	10.9	11.0	+0.1	0	Negligible
R9	15.1	15.1	0.0	0	Negligible
R10	15.8	15.9	0.0	0	Negligible
R11	15.9	16.0	0.0	0	Negligible
R12	14.4	14.4	0.0	0	Negligible
R13	14.6	14.6	0.0	0	Negligible
R14	11.7	11.8	0.0	0	Negligible
R15	12.6	12.7	+0.1	0	Negligible
R16	12.7	12.9	+0.2	0	Negligible

* Discrepancies in changes due to rounding effects

Table 6.4: Predicted Annual Mean PM_{2.5} Concentrations and Development Impact at Existing Receptor and Monitoring Locations

Receptor	Predicted PM _{2.5} Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
14	9.2	9.2	0.0	0	Negligible
15/16/17	9.3	9.3	0.0	0	Negligible
19	8.9	8.9	0.0	0	Negligible

Receptor	Predicted PM _{2.5} Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
20	9.8	9.8	0.0	0	Negligible
21	9.8	9.8	0.0	0	Negligible
22	10.7	10.7	0.0	0	Negligible
23	11.2	11.3	0.0	0	Negligible
R1	6.5	6.6	+0.1	0	Negligible
R2	6.4	6.5	+0.1	0	Negligible
R3	6.9	7.0	+0.1	1	Negligible
R4	6.7	6.8	+0.1	0	Negligible
R5	7.8	7.9	+0.1	0	Negligible
R6	7.1	7.2	+0.1	0	Negligible
R7	7.8	7.8	+0.0	0	Negligible
R8	7.0	7.0	0.0	0	Negligible
R9	9.4	9.4	0.0	0	Negligible
R10	9.8	9.8	0.0	0	Negligible
R11	9.8	9.8	0.0	0	Negligible
R12	8.9	9.0	0.0	0	Negligible
R13	9.1	9.1	0.0	0	Negligible
R14	7.4	7.4	0.0	0	Negligible
R15	7.5	7.5	+0.1	0	Negligible

Receptor	Predicted PM _{2.5} Concentration (µg.m ⁻³)				
	Scenario 3: 2023 Without Development (µg.m ⁻³)	Scenario 4: 2023 With Development (µg.m ⁻³)	Concentration Change* (µg.m ⁻³)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R16	7.5	7.6	+0.1	0	Negligible

* Discrepancies in changes due to rounding effects

- 6.13 The predicted NO₂ concentrations for Scenario 3: 2023 Opening Year without development and Scenario 4: 2023 Opening Year with development are below the relevant annual mean air quality objective for all existing receptor and monitoring locations considered. The exception to this is monitoring location 23 where an exceedance of the annual mean NO₂ objective is predicted in both Scenario 3: Opening Year Without Development and Scenario 4: Opening Year With Development.
- 6.14 Monitoring location 23 recorded exceedances above the annual mean NO₂ objective between 2015 and 2019. In addition, monitoring location 23 is located 2m from the A628 Dodworth Road and is therefore not representative of existing receptors in the vicinity, as these are located further back from the road where pollutant concentrations are lower. Therefore, monitoring location 23 is not considered representative of sensitive uses.
- 6.15 The predicted PM₁₀ and PM_{2.5} concentrations for Scenario 3: 2022 Opening Year Without Development and Scenario 4: 2022 Opening Year With Development are below the relevant annual mean air quality objectives for all the receptors and monitoring locations considered.
- 6.16 The proposed development does not lead to any new exceedances of the annual mean air quality objectives.
- 6.17 Predicted changes in NO₂, PM₁₀ and PM_{2.5} concentrations were compared to the assessment criteria detailed in **Table 3.3** and are considered to be negligible in accordance with IAQM and EPUK guidance¹¹.
- 6.18 With regard to short term air quality objectives for NO₂ and PM₁₀, the predicted annual mean NO₂ concentrations are less than 60µg.m⁻³ and therefore in accordance with Defra guidance⁹ it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.17 was used to determine potential exceedance of the 24-hour PM₁₀ short term objective; no exceedances were predicted.

Impact Significance Summary

- 6.19 Relevant guidance, legislation and professional judgement was utilised to determine the significance of the findings of the air quality assessment. The air quality assessment was supervised by a full member of the Institute of Air Quality Management. A summary of the impact significance and justification of this are provided below.

6.20 The impact of the proposed development on air quality is considered to be 'Negligible':

- Consideration was given to local planning policy⁸ and the development proposals are considered to be in accordance with this policy with regard to air quality.
- The air quality assessment undertaken utilised robust model inputs including slowing traffic sections at junctions, appropriate meteorological data and surface roughness.
- Existing concentrations of NO₂, PM₁₀ and PM_{2.5} in the study area are predicted to be below the relevant air quality objectives at existing sensitive receptor locations. There are predicted to be exceedances of the NO₂ air quality objective at monitoring locations 22 and 23 in Scenario 2: 2021 Base Year. However, as detailed in Section 5 of this report, these monitoring locations are not considered to be representative of sensitive receptor locations due to the differing distances from the A628 Dodworth Road.
- Future concentrations of NO₂, PM₁₀ and PM_{2.5} in 2023 for both without and with development scenarios in the study area are predicted to be below the relevant air quality objectives at existing sensitive receptor locations. There are predicted to be exceedances of the NO₂ air quality objective at monitoring location 23 in Scenario 3: 2023 Opening Year without development and Scenario 4: Opening Year with development. However, monitoring location 23 is not considered to be representative of sensitive receptor locations as detailed previously.
- The impact of development-generated road traffic on local air quality is defined as negligible in accordance with IAQM and EPUK guidance¹¹.

Site Suitability Assessment

- 6.21 Concentrations of NO₂, PM₁₀ and PM_{2.5} were predicted across the proposed development Site to consider the exposure of future residents of the proposed development to air pollution.
- 6.22 A Cartesian grid was modelled across the Site, using a gridline boundary closest to existing road sources for Scenario 4: 2023 Opening Year with development. **Figures 6.1 – 6.3** illustrate annual mean pollutant concentration contours for NO₂, PM₁₀ and PM_{2.5} respectively across the Site.

Figure 6.1: Predicted Annual Mean NO₂ Concentrations across the Site

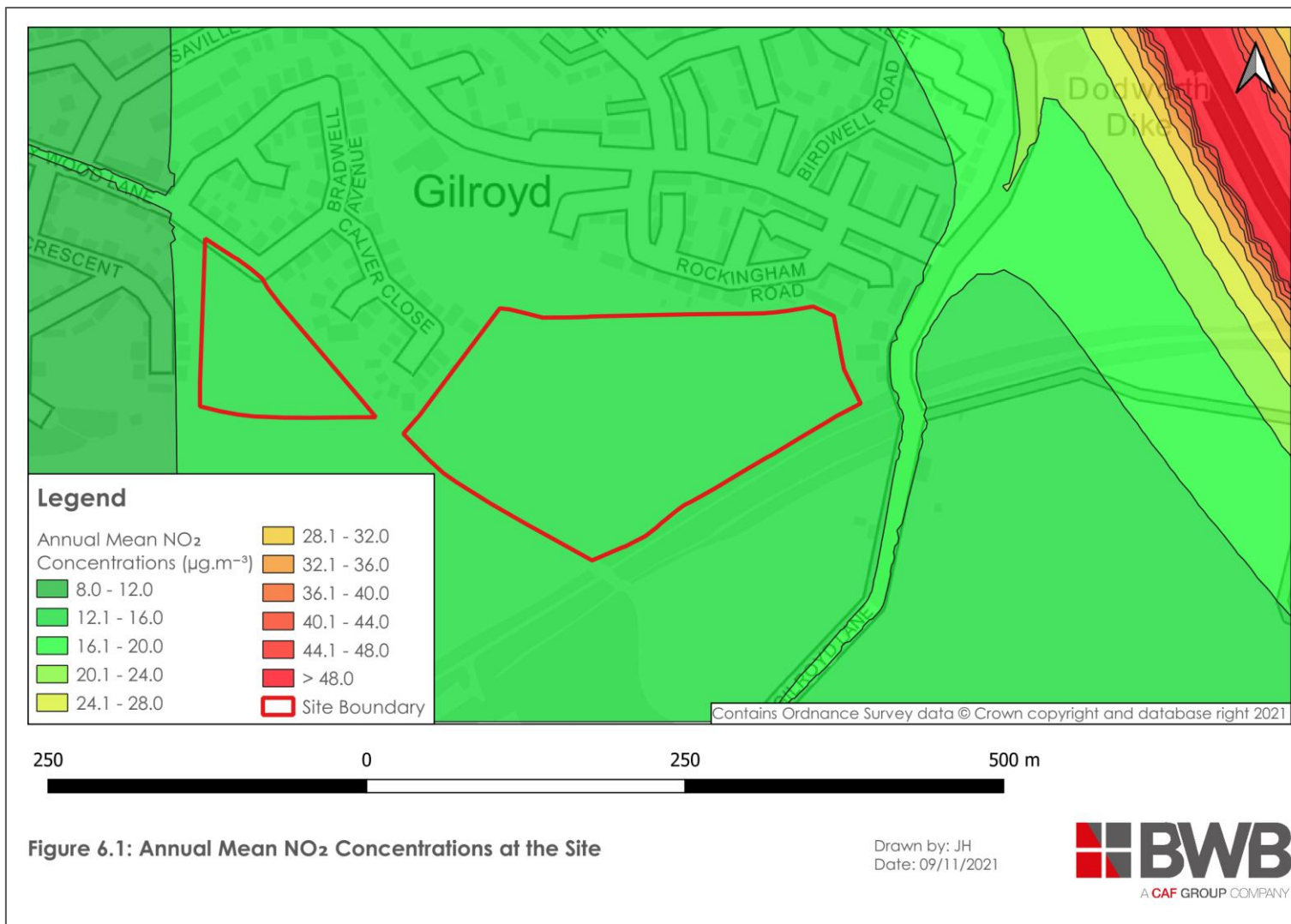


Figure 6.2: Predicted Annual Mean PM₁₀ Concentrations across the Site

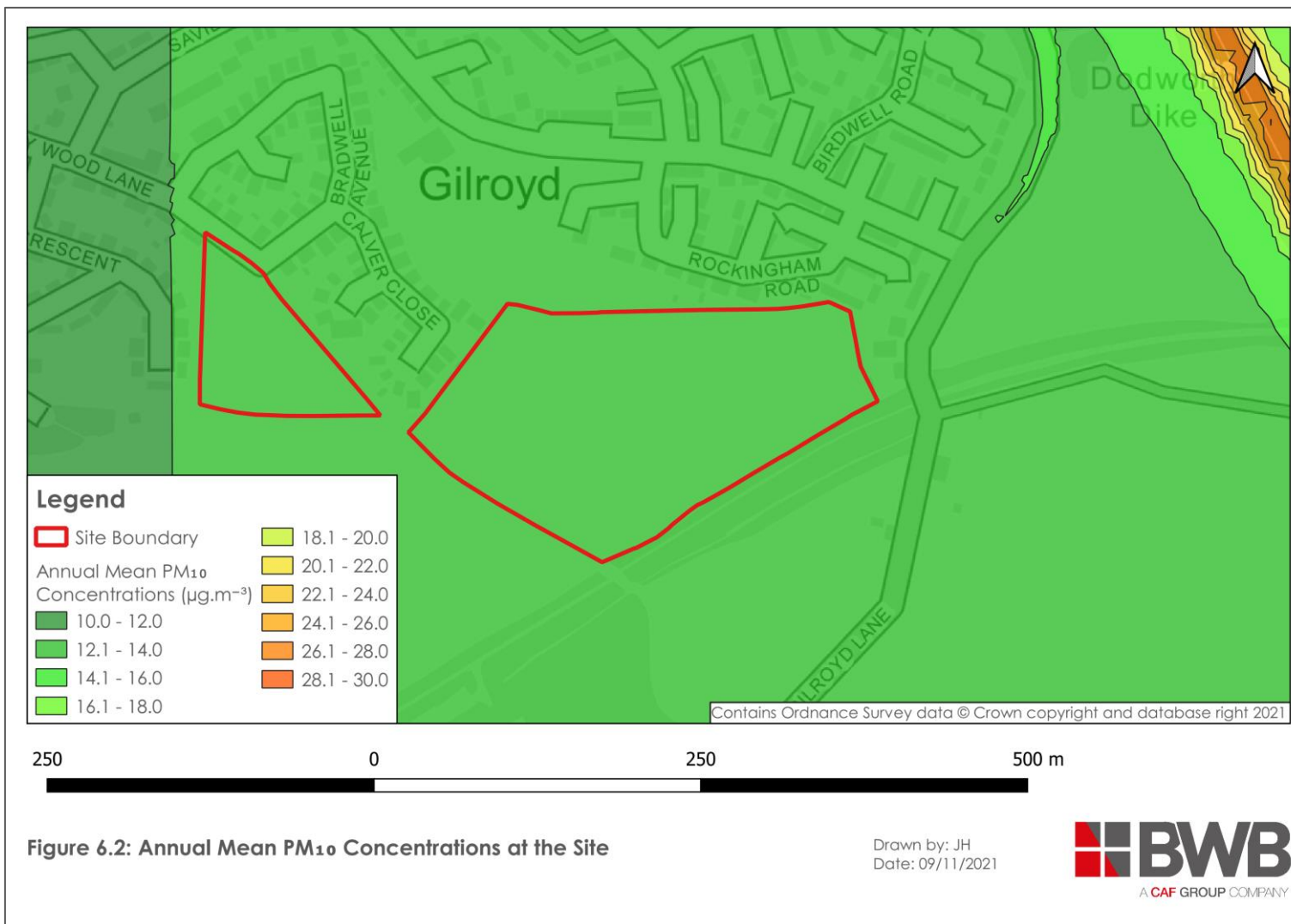
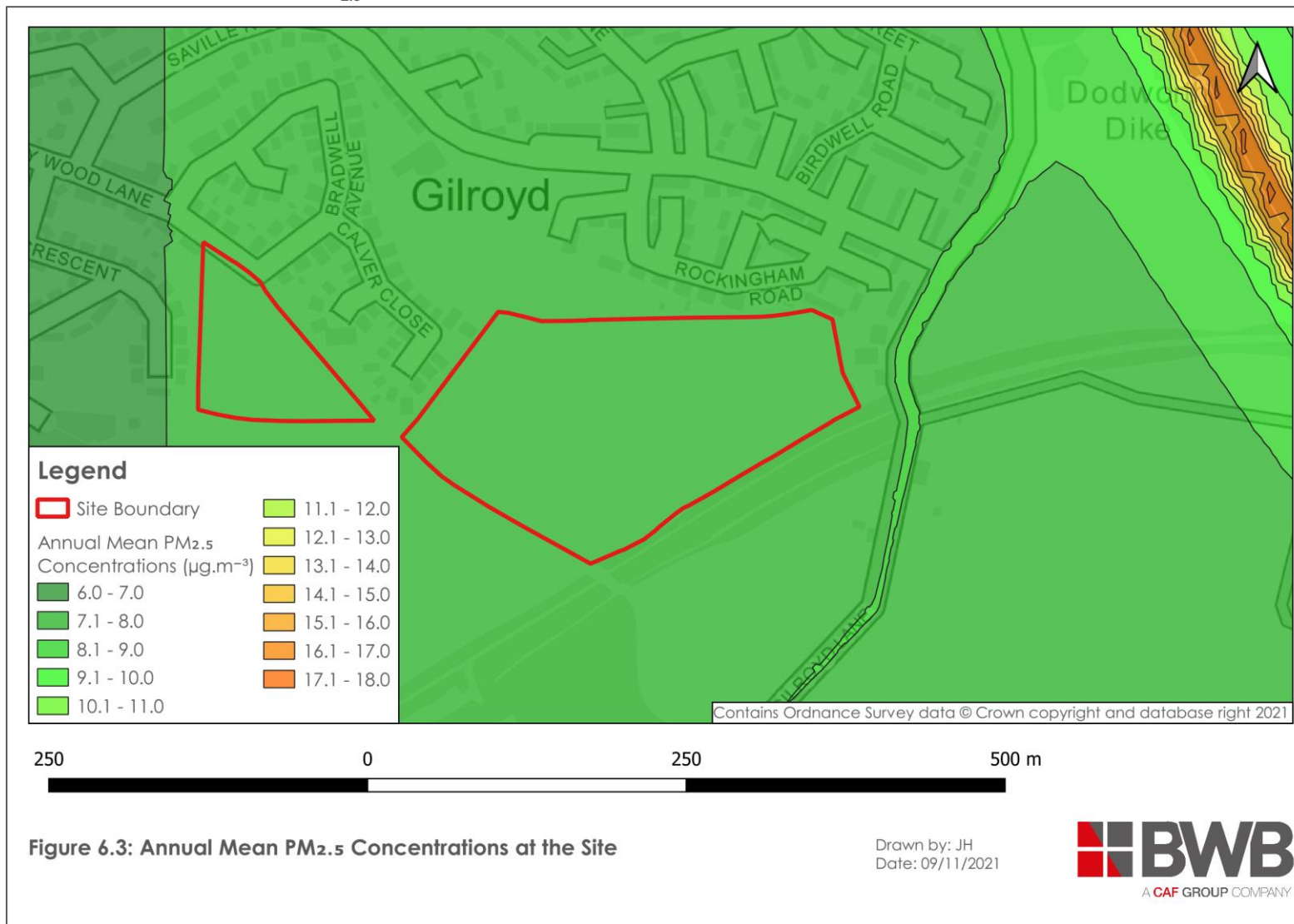


Figure 6.3: Predicted Annual Mean PM_{2.5} Concentrations across the Site



- 6.23 The predicted NO₂, PM₁₀ and PM_{2.5} concentrations for Scenario 4: 2023 Opening Year With Development, indicate that pollutant concentrations at the proposed residential development will be below the respective air quality objectives in 2023 with the development in place.
- 6.24 With regard to short term air quality objectives for NO₂ and PM₁₀ at the residential development, the predicted annual mean NO₂ concentrations are less than 60µg.m⁻³ and therefore in accordance with Defra guidance⁹ it may be assumed that exceedance of the 1-hour mean NO₂ objective are unlikely. The calculation detailed in paragraph 3.17 was used to determine potential exceedance of the 24-hour PM₁₀ short term objective; no exceedances were predicted.

Mitigation

Barnsley Metropolitan Borough Council, Air Quality and Emissions Good Practice Planning Guidance

Stage 3: Mitigation

- 6.25 The proposed development is classified as 'medium' in accordance with Air Quality and Emissions Good Practice Planning Guidance¹². Type 1 and 2 mitigation is therefore required.
- 6.26 Type 1 mitigation will be provided as one Electric Vehicle (EV) charging space per dwelling. The Air Quality and Emissions Good Practice Planning Guidance¹² requires that the minimum specification for EV charging points are "mode 3" with a minimum 7 kW (32 AMP) charge point.
- 6.27 Type 2 mitigation measures will be provided in the form of a Travel Plan which will promote walking, cycling and public transport use, encourage car sharing and will involve the implantation of a Travel Plan Coordinator to promote sustainable travel.
- 6.28 In addition, the proposed development proposes cycle storage sheds for each individual dwelling.

7. CONCLUSION

- 7.1 An air quality impact assessment was undertaken for the proposed residential development located at land off Calver Lane in Dodworth.
- 7.2 A qualitative construction phase assessment was undertaken and measures were recommended for inclusion in a DMP to minimise emissions during construction activities. With the implementation of these mitigation measures the impact of construction phase dust emissions is considered to be 'not significant' in accordance with IAQM guidance¹⁰.
- 7.3 A detailed road traffic emissions assessment was undertaken to consider the impact of development-generated road traffic on local air quality at identified existing receptor locations. Road traffic emissions were modelled using the dispersion model ADMS-Roads and concentrations of NO₂, PM₁₀ and PM_{2.5} were predicted at identified sensitive receptor and monitoring locations. The modelling assessment was undertaken in accordance with Defra Local Air Quality Management Technical Guidance⁹. The development was not predicted to result in any new exceedances of the relevant air quality objectives and the impact of the development on local air quality was predicted to be 'negligible' in accordance with IAQM and EPUK guidance¹¹.
- 7.4 Pollutant concentrations were also predicted across the proposed development Site. Concentrations of NO₂, PM₁₀ and PM_{2.5} were all predicted to be below the relevant air quality objectives and therefore the Site was considered to be suitable for the proposed residential use with regard to air quality.
- 7.5 Consideration was also given to the BMBC Air Quality and Emissions Good Practice Planning Guidance¹² and the development was categorised and mitigation recommended in accordance with the guidance. Mitigation measures comprise the provision of a Travel Plan and Electric Vehicle charging points.

APPENDICES

APPENDIX A: GLOSSARY OF TERMS

Term	Definition
AADT	Annual Average Daily Traffic flow.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between two years, which is useful for pollutants that have higher concentrations during the winter months.
AQAP	Air Quality Action Plan.
AQMA	Air Quality Management Area.
AQS	Air Quality Strategy.
Defra	Department for Environment, Food and Rural Affairs.
EPUK	Environmental Protection UK.
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
HDV	Heavy Duty Vehicles (HGVs + buses and coaches)
HGV	Heavy Goods Vehicles.
IAQM	Institute of Air Quality Management.
LAQM	Local Air Quality Management.
LDV	Light Duty Vehicles (motorbikes, cars, vans and small trucks)
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO ₂	Nitrogen dioxide.
NO _x	Nitrogen oxides.
Percentile	The percentage of results below a given value.
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
PM _{2.5}	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
micrograms per cubic metre (µg.m ⁻³)	A measure of concentration in terms of mass per unit volume. A concentration of 1µg.m ⁻³ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.

APPENDIX B: PROPOSED DEVELOPMENT MASTERPLAN

APPENDIX C: PLANNING POLICY AND LEGISLATION

National Legislation and Planning Policy

The UK Air Quality Strategy

European Union (EU) legislation forms the basis of air quality policy and legislation in the UK. The EU 2008 ambient Air Quality Directive¹ sets limits for ambient concentrations of air pollutants including nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}). The air quality standards and objectives are prescribed through the Air Quality (England) Regulations 2000², as amended, for the purpose of the Local Air Quality Management Framework.

The UK Government are required under the Environment Act 1995³ to produce a national Air Quality Strategy (AQS). The AQS was first published in 1997⁴ and was most recently reviewed and updated in 2007⁵. The AQS provides an overview of the Government's ambient air quality policy and sets out the air quality standards and objectives to be achieved and measures to improve air quality.

Part IV of the Environment Act³ requires local authorities in the UK to review local air quality within their administrative area and, if relevant air quality standards and objectives are likely to be exceeded, designate Air Quality Management Areas (AQMAs). Following the designation of an AQMA, local authorities are required to publish an Air Quality Action Plan (AQAP) detailing measures to be taken to improve local air quality and work towards meeting the relevant air quality standards and objectives.

National Planning Policy Framework

The National Planning Policy Framework (NPPF)⁶ was amended in July 2021 and sets out the Government's planning policies for England and how these are expected to be applied.

The NPPF⁶ recognises air quality within Section 15: Conserving and enhancing the natural environment, and states that:

"Planning policies and decisions should contribute to and enhance the natural and local environment by:

[...]

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

[...]

Ground conditions and pollution

[...]

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.

[...]

Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

With regard to assessing cumulative effects the NPPF⁶ states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.

[...]"

Planning Practice Guidance

The Planning Practice Guidance (PPG) for air quality⁷ was updated in November 2019 and provides guiding principles on how the planning process can take account of the impacts of new development on air quality.

The PPG⁷ sets out the following with regard to air quality and planning:

- *"What air quality considerations does planning need to address;*
- *What is the role of plan-making with regard to air quality;*
- *Air quality concerns relevant to neighbourhood planning;*
- *What information is available about air quality;*
- *When could air quality considerations be relevant to the development management process;*
- *What specific issues may need to be considered when assessing air quality impacts;*
- *How detailed does an air quality assessment need to be; and*
- *How can an impact on air quality be mitigated".*

The PPG⁷ sets out the pollutants for which there are legally binding limits for concentrations and those which the UK also has national emissions reduction commitments.

The PPG⁷ states that development plans may need to consider:

- *“what are the observed trends shown by recent air quality monitoring data and what would happen to these trends in light of proposed development and / or allocations;*
- *the impact of point sources of air pollution (pollution that originates from one place);*
- *the potential cumulative impact of a number of smaller developments on air quality as well as the effect of more substantial developments, including their implications for vehicle emissions;*
- *ways in which new development could be made appropriate in locations where air quality is or is likely to be a concern, and not give rise to unacceptable risks from pollution. This could, for example, entail identifying measures for offsetting the impact on air quality arising from new development including supporting measures in an air quality action plan or low emissions strategy where applicable; and*
- *opportunities to improve air quality or mitigate impacts, such as through traffic and travel management and green infrastructure provision and enhancement”.*

The PPG⁷ also states what may be considered relevant to determining a planning application and these include whether a development would:

- *“Lead to changes (including any potential reductions) in vehicle-related emissions in the immediate vicinity of the proposed development or further afield. This could be through the provision of electric vehicle charging infrastructure; altering the level of traffic congestion; significantly changing traffic volumes, vehicle speeds or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; could add to turnover in a large car park; or involve construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more;*
- *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; biomass boilers or biomass-fuelled Combined Heat and Power plant; centralised boilers or plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; or extraction systems (including chimneys) which require approval or permits under pollution control legislation;*
- *Expose people to harmful concentrations of air pollutants, including dust. This could be by building new homes, schools, workplaces or other development in places with poor air quality;*
- *Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations;*

- *Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value".*

The PPG⁷ provides guidance regarding what should be included within an air quality assessment. Examples of potential air quality mitigation measures are also provided.

Local Planning Policy

Barnsley Local Plan

The Barnsley Local Plan was adopted in January 2019 and sets out the policies for development in Barnsley up until 2033. The following policies relate to air quality:

"Policy Poll1 Pollution Control and Protection

Development will be expected to demonstrate that it is not likely to result, directly or indirectly, in an increase in air, surface water and groundwater, noise, smell, dust, vibration, light or other pollution which would unacceptably affect or cause a nuisance to the natural and built environment or to people.

We will not allow development of new housing or other environmentally sensitive development where existing air pollution, noise, smell, dust, vibration, light or other pollution levels are unacceptable and there is no reasonable prospect that these can be mitigated against.

Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate."

[...]

Policy AQ1 Development in Air Quality Management Areas

Development which impacts on areas sensitive to air pollution in air quality management areas will be expected to demonstrate that it will not have a harmful effect on the health or living conditions of any future users of the development in terms of air quality (including residents, employees, visitors and customers), taking into account any suitable and proportionate mitigation required for the development.

We will only allow residential development which impacts on areas sensitive to air pollution, where the developer provides an assessment that shows living conditions will be acceptable for future residents, subject to any required mitigation.

We will only allow development which impacts on areas sensitive to air pollution which could cause more air pollution, where the developer provides an assessment that shows there will not be a significantly harmful effect on air quality, subject to any required mitigation.

Furthermore, development which impacts on areas sensitive to air pollution due to traffic emissions will be expected to demonstrate

suitable and proportionate mitigation relative to the increased traffic emissions generated by the development.

[...]"

The above policies were taken into consideration throughout the undertaking of the assessment.

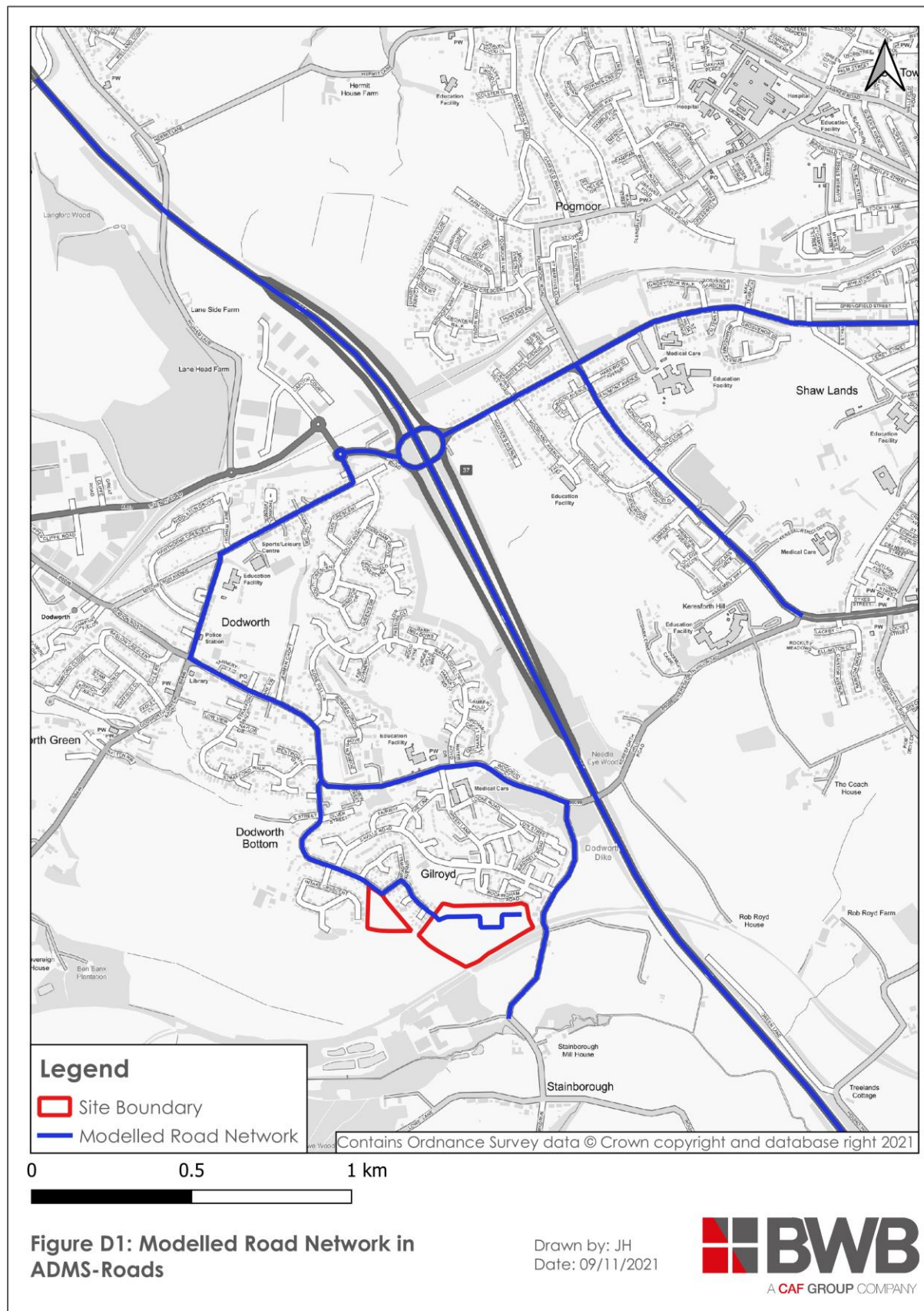
APPENDIX D: TRAFFIC DATA UTILISED IN THE AIR QUALITY ASSESSMENT

Table D1: Traffic Data Utilised in the Air Dispersion Modelling Assessment

Road Link	Speed	Scenario 1: 2019 Verification Year		Scenario 2: 2021 Base Year		Scenario 3: 2023 Opening Year Without Development		Scenario 4: 2023 Opening Year With Development	
	Km.hr ⁻¹	24 hour AADT Total Flow	HDV Flow	24 hour AADT Total Flow	HDV Flow	24 hour AADT Total Flow	HDV Flow	24 hour AADT Total Flow	HDV Flow
Smithy Wood Lane	48	1,270	32	1,298	33	1,323	34	2,299	46
Stainborough Road	48	1,270	32	1,298	33	1,323	34	2,049	42
B6099 High Street	48	9,053	147	9,252	150	9,428	153	10,154	161
B6449 Barnsley Road (North of High Street)	48	7,162	159	7,319	162	7,458	165	8,152	172
B6449 Barnsley Road (West of Mitchelson Avenue)	48	7,346	223	7,508	228	7,651	232	8,345	239
M1 (South of Whinby Road)	112 (96 for HDVs)	101,773	10,844	104,012	11,083	105,988	11,293	106,173	11,295
M1 (North of Whinby Road)	112 (96 for HDVs)	102,026	10,619	104,271	10,853	106,252	11,059	106,397	11,060
A628 Dodworth Road (West of Broadway)	48	27,271	992	27,871	1,014	28,401	1,033	28,627	1,035
A6133 Broadway	48	10,644	289	10,878	295	11,085	301	11,085	301
A628 Dodworth Road (East of Broadway)	48	15,684	474	16,029	484	16,334	494	16,488	496
Gilroyd Lane	48	3,014	120	3,080	123	3,139	125	3,175	125

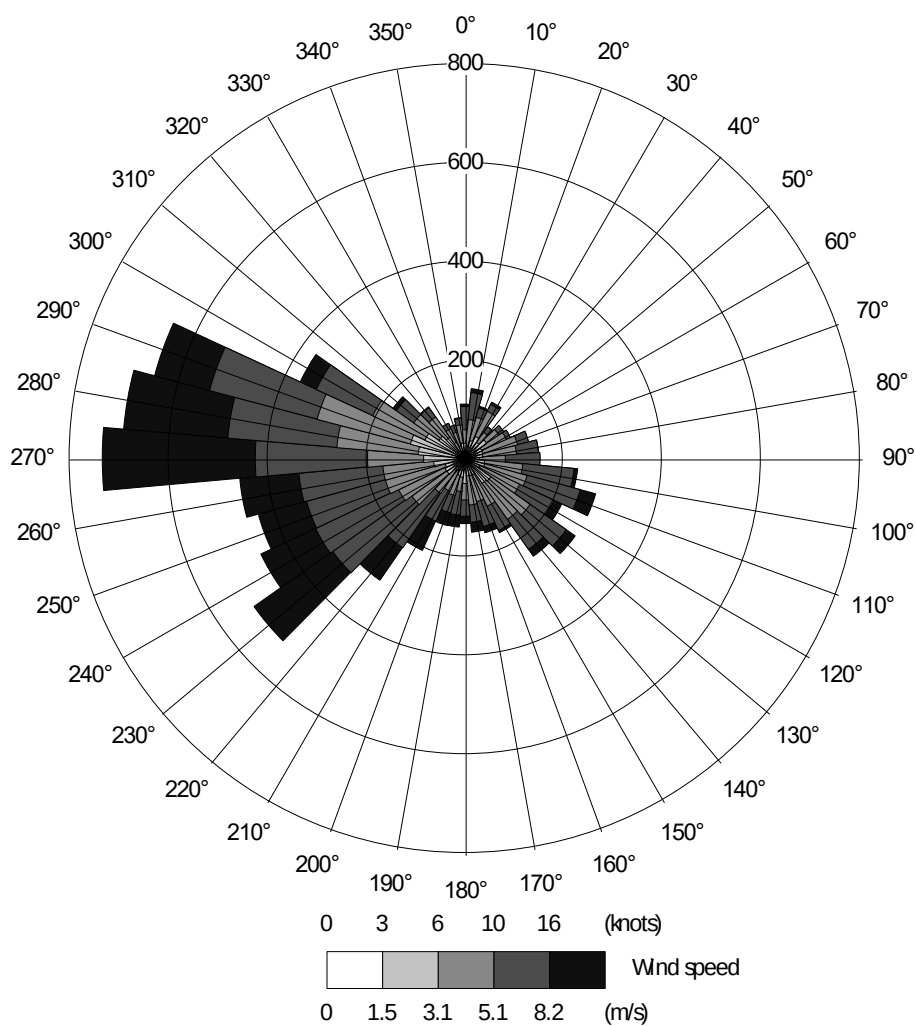
An illustration of the road links included in the ADMS-Roads model is provided in **Figure D1**.

Figure D1: Road Links Included in the ADMS-Roads Model



APPENDIX E: WIND ROSE FOR 2019 FOR EMLEY MOOR METEOROLOGICAL RECORDING STATION

Meteorological data for the 2019 Verification Year scenario for the Emley Moor recording station was obtained for use in the air dispersion modelling assessment. The wind rose for 2019 is detailed below and illustrates a predominant wind direction from the west.



APPENDIX F: MODEL VERIFICATION

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

The model was run for Scenario 1: 2019 Verification Year to predict the 2019 annual mean road contributions of NO₂ at the monitoring locations in the study area. The model NO₂ outputs at these locations were compared to the 2019 monitored concentrations to provide adjustment factors. **Table F1** presents the verification process for NO_x and **Figure F1** details the monitoring locations utilised in the model verification.

Monitoring location 18 was excluded from model verification as traffic data for the adjacent road link was unavailable.

No monitoring of PM₁₀ or PM_{2.5} is undertaken within the study area. Therefore the adjustment factor calculated during the NO_x verification process was utilised to adjust predicted concentrations of PM₁₀ and PM_{2.5}.

Table F1: NO_x Verification Process

Model Verification Steps	14	15/16/17	19	20	21	22	23	24
2019 monitored total NO ₂ (µg.m ⁻³)	40.5	31.9	27.2	39.6	46.2	48.1	47.0	32.0
2019 background NO ₂ concentration (µg.m ⁻³)	13.5	13.5	13.5	13.5	13.5	16.7	16.7	13.5
Monitored road contribution NO _x (µg.m ⁻³)	55.2	36.2	26.4	53.2	68.7	66.4	63.7	36.4
Modelled road contribution NO _x (µg.m ⁻³)	12.4	12.9	11.2	15.3	16.1	18.2	19.2	12.9
Ratio of monitored road NO _x to modelled road NO _x	4.5	2.8	2.4	3.5	4.3	3.6	3.3	2.8
Adjustment factor for modelled road contribution NO_x	3.4688							
Adjusted modelled road contribution NO _x (µg.m ⁻³)	43.0	44.8	38.8	53.2	55.9	63.2	66.7	44.8
Modelled total NO ₂ concentration (µg.m ⁻³)	35.1	35.9	33.1	39.6	40.8	46.8	48.2	35.9
Monitored total NO ₂ concentration (µg.m ⁻³)	40.5	31.9	27.2	39.6	46.2	48.1	47.0	32.0
% difference between modelled and monitored total NO ₂ concentration	-15.5	11.1	17.9	0.0	-13.3	-2.8	2.5	10.8

Model Verification Steps	14	15/16/17	19	20	21	22	23	24
RMSE % (should be less than 25% and ideally less than 10%)	8.7							

** Road-NO_x component, determined from NO_x to NO₂ calculator*

A road-NO_x factor of **3.4688** was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero. This factor was then applied to the modelled road-NO_x concentration at each receptor, before conversion to NO₂ concentrations using the NO_x to NO₂ calculator provided by Defra and the adjusted NO₂ background concentration.

Statistical analysis undertaken for the results in **Table F1** demonstrate that the RMSE is within the acceptable range. Given the number of monitoring sites in the study area and the extent of the modelled road network, the RMSE value is considered to represent an acceptable level of average uncertainty within the air quality model.

Figure F1: Monitoring Locations Utilised in the ADMS-Roads Model Verification Process

