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ENVIRONMENT

BDW Trading Limited
Hither Green Lane
Redditch
Air Quality Assessment

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Air Quality Assessment

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Notice

EXECUTIVE SUMMARY

BWB Consulting Limited was appointed by BDW Trading Limited to undertake an air quality assessment for a proposed residential development at land off Hither Green Lane in Redditch.

The proposed development Site is located within the administrative area of Redditch Borough Council and lies west of Hither Green Lane and south of Dagnell End Road in Redditch. The Site is not located within, or in the vicinity of, an Air Quality Management Area.

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 (PM_{10} 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 Worcestershire Regulatory Services Technical Guidance Note for Planning. 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 NO_2, PM_{10} 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 current relevant air quality objectives and the Site was therefore considered suitable for the proposed use.

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APPENDICES

1. INTRODUCTION

1.1 BWB Consulting (BWB) was instructed by BDW Trading Limited (the Client) to undertake an air quality assessment for a proposed residential development at land off Hither Green Lane, Redditch ('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.

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 is located off Hither Green Lane and is located within the administrative area of Redditch Borough Council (RBC).

1.5 **Figure 1.1** details the location of the proposed development. The Site currently comprises open fields.

1.6 To the north of the Site lies existing residential dwellings along Dagnell End Road with open fields beyond. To the east of the Site lies existing residential dwellings on Hither Green Lane. To the south of the Site lies the River Arrow with open space and the A441 and Redditch Crematorium beyond. To the western boundary of the Site lies Meadow Farm Redditch Public House and Inn with the A441 beyond.

1.7 Principal air pollution sources in the vicinity of the Site are likely to comprise road traffic emissions. The Site is not located within or in the vicinity of an Air Quality Management Area (AQMA).

Proposed Development

1.8 The proposed development comprises 215 residential dwellings with associated car parking. The proposed development masterplan is detailed in **Appendix B**.

Figure 1.1 Site Location

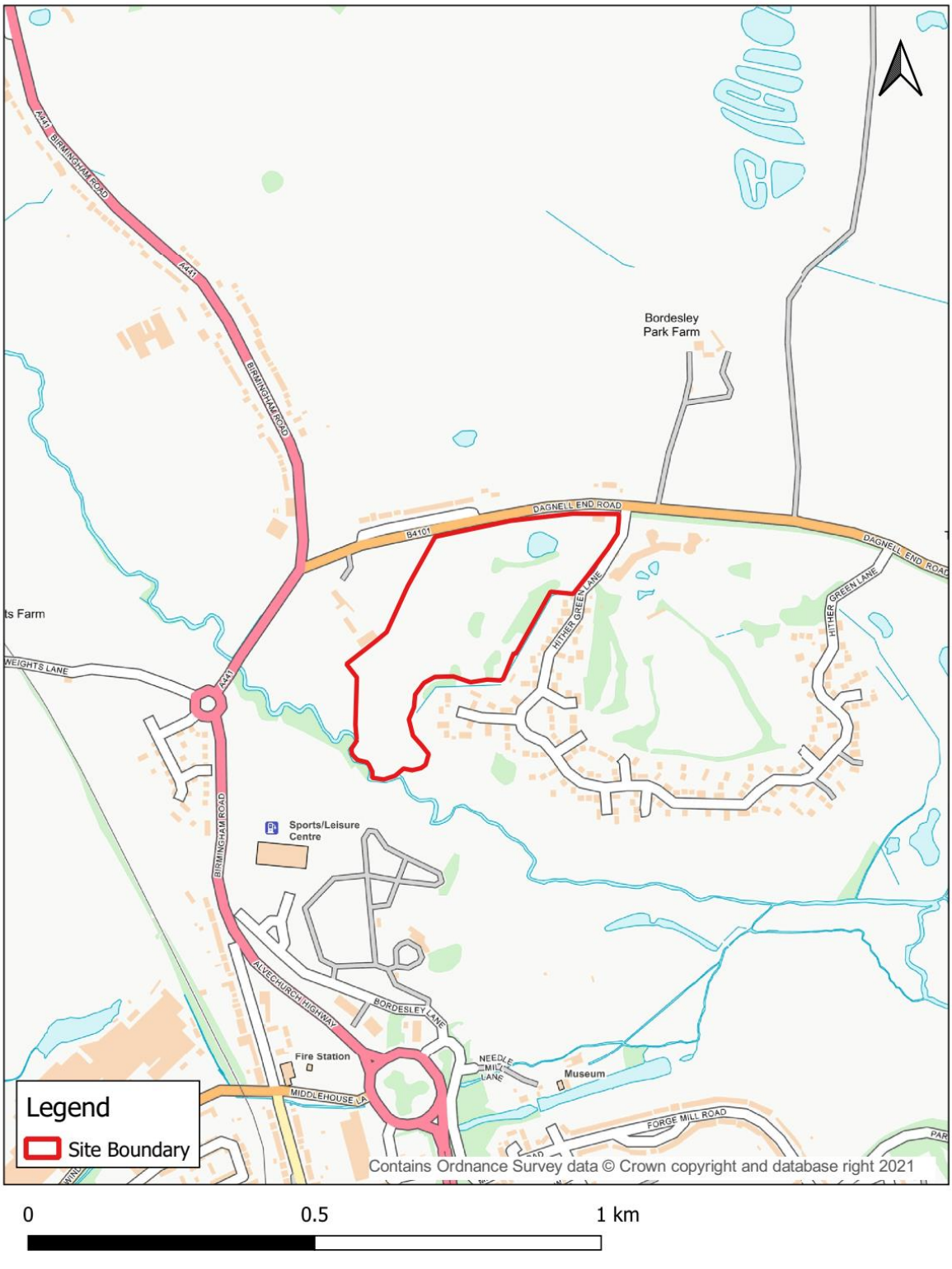

Figure 1.1: Site Location

Drawn by: JH
Date: 20/05/2021

2. LEGLISLATION, 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 planning policy was considered in the undertaking of the assessment and a summary is provided in **Appendix C**:

- Redditch Borough Council, Borough of Redditch Local Plan No. 4 (2017)[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
- Worcestershire Regulatory Services (2021) Technical Guidance Note for Planning[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] Redditch Borough Council (2017) Borough of Redditch 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] Worcestershire Regulatory Services (2021) Technical Guidance Note for Planning

3. METHODOLOGY

Consultation with Redditch Borough Council

3.1 Consultation was undertaken with Worcestershire Regulatory Services (WRS), the contracted Environmental Health consultants for RBC, in May 2021 and the methodology was agreed by email on 8th June 2021[13]. 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 – In accordance with the WRS Technical Guidance Note for Planning[12], 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 (PM_{10} 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. Pollutant concentrations were predicted across the Site to consider the suitability of the Site for residential use. 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 WRS Technical Guidance Note for Planning[12].

3.2 It was agreed with WRS to utilise 2018 monitoring data within the model verification, due to a low bias adjustment factor in 2019, which WRS do not consider representative.

3.3 Full details of the methodology used in the assessment are provided below.

3.4 WRS published the Technical Guidance Note for Planning[12] which sets out the information required by WRS to review air quality modelling. Detailed modelling parameters in accordance with this document are provided in **Appendix D**.

Construction Phase Dust Assessment

3.5 An assessment of the potential impacts arising from the construction of the proposed development was undertaken in accordance with IAQM Guidance[10]. The full assessment methodology is not reproduced within this report but a summary of the assessment steps are provided below:

- 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).

[13] Consultation was sent via email to WRS in May 2021 and a response was received on 8th June 2021

- 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

Air Dispersion Modelling

3.6 The air dispersion model ADMS-Roads, version 5.0.0.1 was utilised in the assessment to predict concentrations of NOx, PM_{10} and $PM_{2.5}$ at existing and proposed receptor locations.

3.7 The assessment was undertaken in accordance with Defra Local Air Quality Management Technical Guidance[9] and Institute of Air Quality Management and Environmental Protection UK guidance[11].

Assessment Scenarios and Traffic Data

3.8 The following scenarios were considered in the air dispersion modelling:

- Scenario 1: 2018 Verification Year;
- Scenario 2: 2021 Base Year;
- Scenario 3: 2022 Opening Year without development;
- Scenario 4: 2022 Opening Year with development;
- Scenario 5: 2022 Opening Year without development, sensitivity analysis; and
- Scenario 6: 2022 Opening Year with development, sensitivity analysis.

3.9 Traffic data were obtained from Mode Transport, 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:

- A441 Alvechurch Highway;
- A441 north of Weights Lane;
- A441 south of Middlehouse Lane;
- A441 north and south of A4023;
- Hither Green Lane;
- Dagnell End Road;
- Weights Lane; and
- Site access.

3.10 Traffic data for A4023 Coventry Highway and Redditch Ringway were obtained from Department for Transport (DfT)[14] for use in the verification of the ADMS-Roads model.

3.11 Traffic data for the roads adjacent to the air quality verification locations on Other Road, were taken from an adjacent planning application on Weights Lane (planning application 19/00976_HYB). This data was generated from the Detailed Assessment undertaken in 2009 for Other Road as part of RBC local air quality responsibilities. The 2009 AADT flows were factored forwards to 2018 for model verification purposes.

3.12 Consideration was given to the speeds at which vehicles are likely to travel within the study area. Free flowing speeds were modelled at speed limits and queuing sections, including the approach to all junctions were modelled at 10kph slower in accordance with Defra guidance[9].

3.13 Traffic data used in the air dispersion modelling are provided in **Appendix E** and the roads included in the ADMS-Roads model are illustrated in **Figure E1**.

ADMS-Roads Model Inputs

3.14 The following model inputs were utilised in the assessment:

- Emission Factors – emission factors were utilised from the Defra Emission Factor Toolkit[15] (EFT), version 10.1, for the years of assessment (2018, 2021 and 2022).
- Conversion of oxides of nitrogen – concentrations of NOx were predicted using the ADMS-Roads dispersion model. These concentrations were converted to nitrogen dioxide (NO_2) using the Defra NOx to NO_2 calculator[16], version 8.1.
- Meteorological Data – hourly sequential meteorological data for the verification year of assessment (2018) were obtained for the Pershore recording station. This is the closest, most representative recording station to the proposed development Site. The wind rose for 2018 is provided in **Appendix F**.
- Surface roughness and Monin-Obukhov length (MO) – Site – a surface roughness of 0.5 and an MO length of 30 were utilised in the air dispersion model to represent conditions at the Site and within the Study area. These are representative of the suburban conditions of the study area.
- Surface roughness and Monin-Obukhov length (MO) – Meteorological Station – a surface roughness of 0.3 and an MO length of 10 were utilised in the air dispersion model to represent conditions at the meteorological station. These were utilised as the meteorological station is located within an open agricultural area.
- Background pollutant concentrations – background concentrations of NO_2, PM_{10} and $PM_{2.5}$ for the study area were obtained from the pollutant concentrations maps[17] provided by Defra as a 1km x 1km grid of the UK, for the years of assessment (2018, 2021 and 2022).
- Model verification – model verification was undertaken using RBC monitoring data available for the study area. Full details of the verification procedure are provided in **Appendix G**. Model verification was undertaken for 2018, as requested by WRS, as the

[14] Department for Transport https://roadtraffic.dft.gov.uk/#6/55.254/-21.237/basemap-regions-countpoints (accessed August 2021)
[15] Defra (2020) Emission Factor Toolkit [https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html]
[16] Defra (2020) NOx to NO_2 Calculator [https://laqm.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/laqm-background-maps?year=2018]

bias adjustment factor for 2019 monitoring data was not considered representative by WRS.

- Calculation of short term PM_{10} concentrations – the following calculation, as detailed in Defra guidance[9], was utilised to calculate the number of exceedance of the 24-hour mean PM_{10} air quality objective:

  Number of 24-Hour Mean Exceedance = -18.5 + 0.00145 * Annual Mean^3 + (206 / Annual Mean)

- The IAQM released a position statement[18] in July 2018 regarding dealing with the uncertainty in vehicle NOx emissions within air quality assessments. This recommends that sensitivity analyses be undertaken and professional judgement be applied to consider the scenario where NOx emissions do not reduce as rapidly as shown by the EFT. Defra released new versions of the air quality assessment tools in August 2020, including updated versions of the background concentration maps, EFT and NOx to NO_2 Calculator. At the time of writing the IAQM had not published a revised position statement. As such, and to provide a conservative assessment, a sensitivity analysis was undertaken and emission factors, NOx to NO_2 calculator inputs and background concentrations were kept at base year (2021) levels. Details of the sensitivity analysis are provided in **Appendix H**.

Receptor Locations

Existing Sensitive Receptors

3.15 Existing receptor locations were identified within close proximity of the road links detailed in paragraph 3.9 and considered in the operational phase road traffic emissions assessment. Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted at the identified existing receptor locations for the assessment scenarios detailed in paragraph 3.8. 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.

3.16 Receptor heights were modelled at a height of 1.5m, with the exception of nursery schools and schools which were modelled at heights of 0.8m and 1.0m respectfully to represent the lower average breathing height of children.

3.17 Receptors relevant to the short term objectives are denoted in *italics* in **Table 3.1**. These receptors are identified where members of the public could be present for a period of time comparable to the short term air quality objectives, but unlikely to be present for extended periods of time, such as those representative of the annual air quality objectives. Such uses include hotels.

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

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

Table 3.1: Existing Sensitive Receptor Locations

Receptor	Grid Reference		Details	Height Modelled
	X	Y		(m)
Long Term Receptors				
R1	404674	269592	Residential dwelling on Dagnell End Road	1.5
R2	404619	269382	Residential dwelling on Hither Green Lane	1.5
R3	404589	269396	Residential dwelling on Hither Green Lane	1.5
R4	405061	269360	Residential dwelling on Hither Green Lane	1.5
R5	405039	269346	Residential dwelling on Hither Green Lane	1.5
R6	405437	269389	Residential dwelling on Dagnell End Road	1.5
R7	403962	269166	Residential dwelling on Millwood Meadows	1.5
R8	404882	267943	Residential dwelling on Dale Road	1.5
R9	404960	267445	Primary school and nursery on Stevenson Avenue	0.8
R10	404934	267204	Middle school on Holloway Lane	1.0
R11	404105	269588	Residential dwelling on Birmingham Road	1.5
R12	404125	269680	Residential dwelling on Birmingham Road	1.5
R13	403976	268839	Residential dwelling on Alvechurch Highway	1.5
R14	404479	268204	Residential dwelling on Lydham Close	1.5
R15	404579	268004	Residential dwelling on Lady Harriet's Lane	1.5
R16	40429	268152	College on Albert Street	1.5
R17	404227	269529	Residential dwelling on Dagnell End Road	1.5
Short Term Receptors				
ST1	*404661*	*269442*	*Hotel on Hither Green Lane*	*1.5*
ST2	*404183*	*268695*	*Hotel on Alvechurch Highway*	*1.5*

Figure 3.1: Existing Receptor Locations

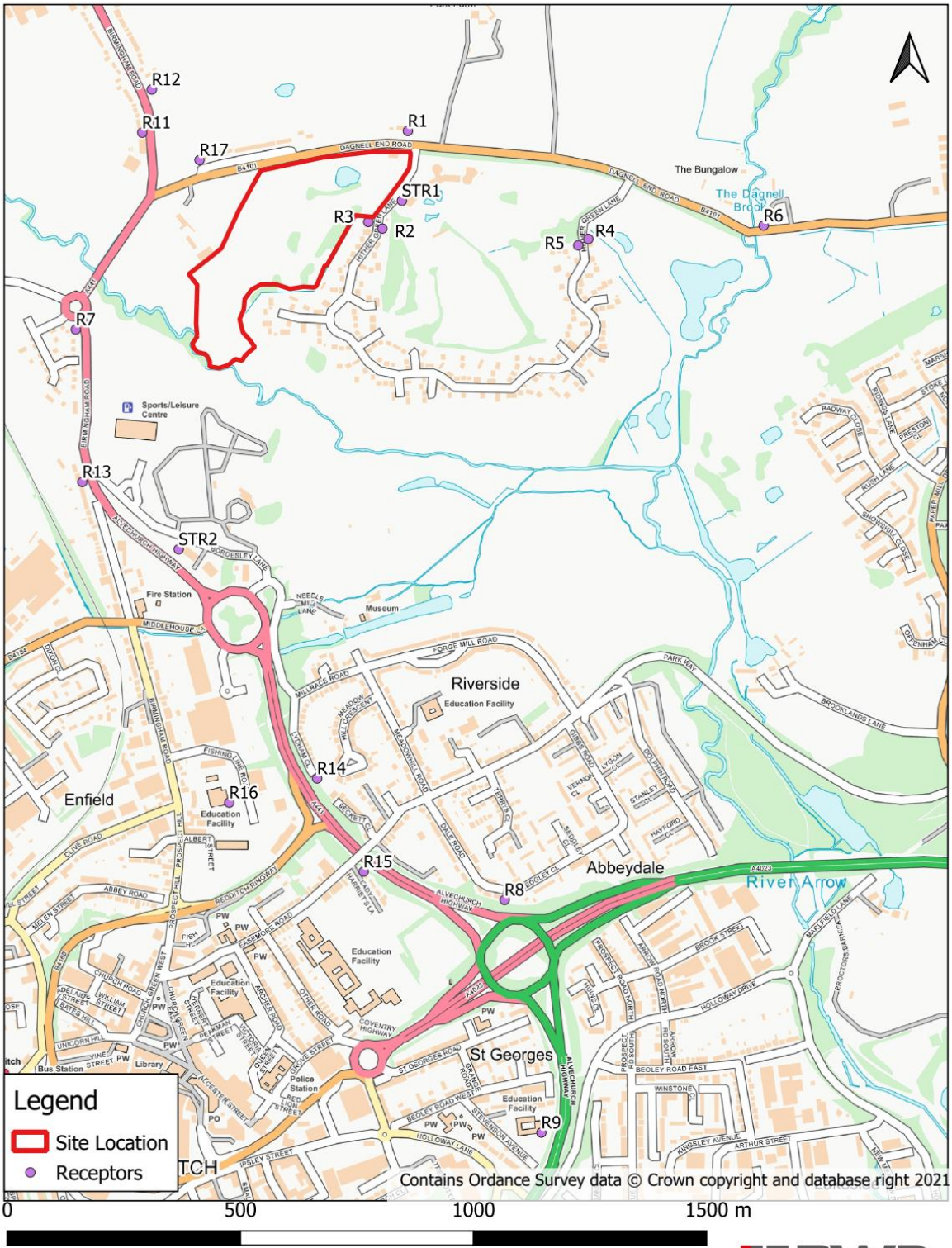

Figure 3.1: Operational Phase Road Traffic Impact Assessment - Existing Receptor Locations

Drawn by: RS
Date: 23/08/2021

Proposed Receptor Locations

3.19 To consider the suitability of the Site for the proposed use, a cartesian grid was modelled across the Site to predict the concentrations of NOx, PM_{10} and $PM_{2.5}$. The Cartesian grid was modelled from X coordinates 404139 to 404740 and Y coordinates 269060 to 269581 at a grid spacing of 10m intervals. The grid was modelled at 1.5m height.

Limitations and Assumptions

3.20 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.

3.21 The assessment is based on traffic data provided by Mode Transport, the transport consultants for the project. As such any assumptions made by the transport consultants will also influence the air quality assessment.

3.22 The transport consultants, Mode Transport were unable to provide the traffic data requirements for the model verification locations from data provided by WRS[13]. Traffic data for the verification locations on Other Road were therefore taken from an adjacent planning application (ref 19/00976_HYB). This data was generated from the Detailed Assessment undertaken in 2009 for Other Road as part of RBC local air quality responsibilities. The 2009 AADT flows were factored forwards to 2018 for model verification purposes.

3.23 In future years 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 EFT[15] to provide the most up to date estimate of current and future emission projections.

3.24 To reduce the uncertainty associated with predicted concentrations, model verification was carried out following guidance set out in Defra guidance[9]. As the models were verified using local monitoring data and adjusted accordingly, there can be reasonable confidence in the predicted concentrations.

Assessment Criteria

3.25 Predicted pollutant concentrations were compared to the relevant air quality objectives[4]. 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 ($\mu g.m^{-3}$)	Date to Achieve by
NO_2	Annual Mean	40	31 December 2005

Pollutant	Averaging Period	Air Quality Objective ($\mu g.m^{-3}$)	Date to Achieve by
	1-hour mean not to be exceeded more than 18 times per year	200	31 December 2005
PM_{10}	Annual Mean	40	31 December 2004
	24-hour mean not to be exceeded more than 35 times per year	50	31 December 2004
$PM_{2.5}$	Annual mean target (15% cut in annual mean (urban background exposure)	25	2010 - 2020

3.26 Guidance is provided by the Institute of Air Quality Management and Environmental Protection UK[11] 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 proposed development Site is not located within an AQMA; the closest AQMA to the Site is located 6.9km north of the Site in the neighbouring local authority of Birmingham City Council (BCC).

Local Air Quality Monitoring

Nitrogen Dioxide

4.2 RDC undertakes monitoring within its administrative boundary using a network of diffusion tubes. The closest monitoring locations to the Site are located along Other Road (diffusion tubes OR1, OR2, OR4-6).

4.3 Bias adjusted NO_2 monitoring results, for the locations in the vicinity of the proposed development Site, are detailed in **Table 4.1**.

Table 4.1: RDC NO_2 Monitoring Data in 2015 – 2019

Location and Reference	Grid Reference		Site Monitoring Type	Distance from and direction to Site boundary	Monitored Annual Average Concentration ($\mu g.m^{-3}$)				
					2015	2016	2017	2018	2019
OR1- Other Road	404599	267542	Roadside	1.5km south	31.8	35.4	30.1	35.1	29.4
OR2- Other Road	404620	267495	Roadside	1.6km south	35.0	38.2	28.9	38.2	31.8
OR4- Other Road	404629	267467	Roadside	1.6km south	32.0	36.1	28.3	36.1	28.5
OR5- Other Road	404629	267467	Roadside	1.6km south	32.7	36.2	27.0	35.7	28.7
OR6-Other Road	404629	267467	Roadside	1.6km south	32.6	31.2	28.6	36.9	28.5
SS-Summer Street	404376	267242	Suburban	1.8km south east	19.0	20.0	17.3	19.2	15.8

4.4 Monitored NO_2 concentrations in 2019 showed a large decrease compared to 2018 concentrations, due to a lower derived bias adjustment factor. WRS advised that the 2019 data is not considered representative and requested that model verification was undertaken utilising 2018 monitoring data.

4.5 The monitored concentrations of NO_2 were below the annual mean air quality objective for NO_2 of $40\mu g.m.^{-3}$ at all monitoring locations in **Table 4.1** between 2015 and 2018.

There is no clear trend in NO_2 concentrations at any of the monitoring sites detailed in **Table 4.1**.

4.6 The monitoring locations detailed in **Table 4.1** are located within the area of Redditch town centre where queuing traffic is considered to give rise to elevated pollutant concentrations. The proposed development is located in a more suburban area with lower traffic levels and congestion and therefore the monitoring locations detailed in **Table 4.1** were not considered representative of conditions at the Site.

4.7 Diffusion tubes on Other Road (OR1-2, OR4-6) were used within the model verification. The remaining monitoring location detailed in **Table 4.1** was not used within the model verification as traffic data for the adjacent road link was unavailable. Full details of the verification process are provided in **Appendix F**.

Particulate Matter (PM_{10} and $PM_{2.5}$)

4.8 RBC does not undertake any monitoring of particulate matter within its administrative boundary.

Background Pollutant Concentrations

4.9 No representative background air quality monitoring is undertaken by RBC within the study area. Background pollutant concentrations were therefore obtained from the latest Defra background concentration maps[17], 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 NO_2, PM_{10} and $PM_{2.5}$ were obtained for the grid squares covering the study area for the years of assessment (2018, 2021 and 2022). 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})		
			2018	2021	2022
Monitoring Locations Used in Verification					
NO_2	404500 267500	OR1, OR2, OR4-6	13.8	Data not required for these scenarios	
Receptors					
NO_2	404500 269500	R1-R3, R11, R12, STR1 Proposed Receptor Cartesian Grid	Backgrounds not required for this year for operational	9.3	8.9
PM_{10}				11.6	11.5

Pollutant	Grid Square	Monitoring Locations / Receptors	Concentration (µg.m^{-3})		
			2018	2021	2022
$PM_{2.5}$			road traffic assessment	7.8	7.7
NO_2	405500 269500	R4-R6	Backgrounds not required for this year for operational road traffic assessment	9.6	9.2
PM_{10}				12.1	12.0
$PM_{2.5}$				8.0	7.7
NO_2	403500 269500	R7	Backgrounds not required for this year for operational road traffic assessment	9.4	9.0
PM_{10}				11.9	11.8
$PM_{2.5}$				7.8	7.7
NO_2	404500 267500	R8-R10	Backgrounds not required for this year for operational road traffic assessment	12.2	11.7
PM_{10}				12.7	12.5
$PM_{2.5}$				8.4	7.7
NO_2	403500 268500	R13	Backgrounds not required for this year for operational road traffic assessment	11.1	10.7
PM_{10}				12.1	12.0
$PM_{2.5}$				8.0	7.7
NO_2	404500 268500	R14-R16	Backgrounds not required for this year for operational road traffic assessment	11.0	10.6
PM_{10}				12.1	12.0
$PM_{2.5}$				8.0	7.7
NO_2	404500 268695	STR2	Backgrounds not required for this year for operational road traffic assessment	11.0	10.6
PM_{10}				12.1	12.0
$PM_{2.5}$				8.1	7.7

4.10 2018, 2021 and 2022 background concentrations are below the relevant annual mean air quality objectives for NO_2, PM_{10} and $PM_{2.5}$. A review of Defra background concentration maps highlighted a significant contribution or residual and secondary particulate matter towards the total background PM_{10} concentration. It is likely that this contributed towards background PM_{10} concentrations exceeding NO_2 concentrations.

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 demolition, 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 guidance[10] 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) website[19], 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 Hither Green Lane. 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 guidance[10] as detailed in **Table 5.1**. Demolition is not proposed as part of the development and therefore wasn't considered further in the assessment.

[19] 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
Demolition	Large	Total building volume >50,000m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20m above ground level.
	Medium	Total building volume 20,000m^3 – 50,000m^3, potentially dusty construction material, demolition activities 10 - 20m above ground level.
	Small	Total building volume <20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
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 is greater than 10,000m^2 and therefore, the dust emissions magnitude for construction was defined as **Large**.
- Construction – The total building volume is greater than 100,000m^3 and therefore, the dust emission magnitude for construction was defined as **Large**.
- Trackout – There is anticipated to be between 10 and 50 HDV outward movements in any one day 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

Activity	Dust Emissions Magnitude
Construction	Large
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 PM_{10} and site-specific factors. **Figure 5.1** was utilised to determine the number of receptors located within the distance bands provided in the IAQM guidance[10] for determining receptor sensitivity.

Figure 5.1: Construction Phase Assessment Dust Distance Buffers

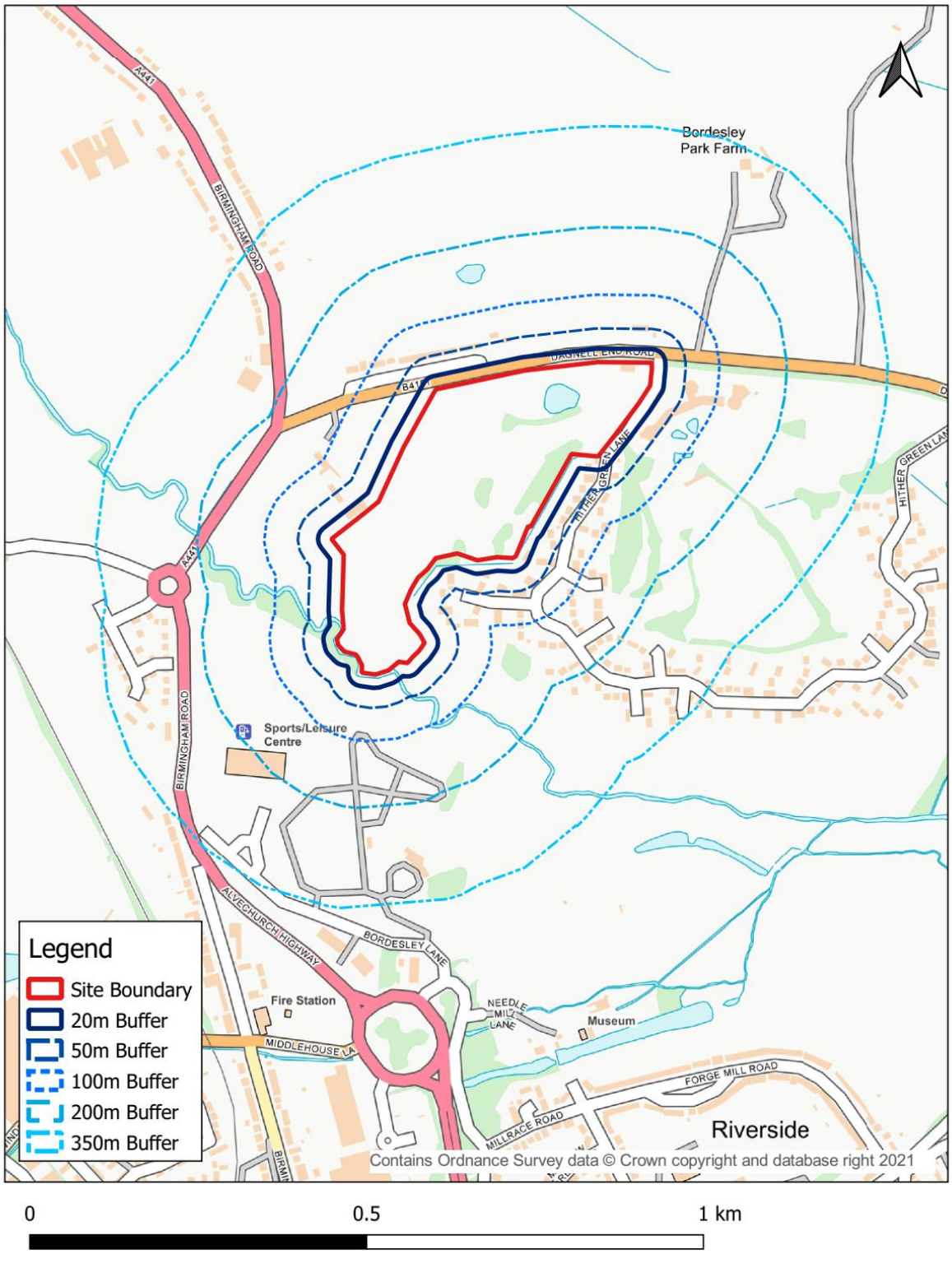

Figure 5.1: Construction Phase Dust Assessment Buffers

Drawn by: JH
Date: 20/04/2021

5.10 The sensitivity of the area is defined below, in accordance with IAQM criteria[10] and summarised in **Table 5.3**.

- Dust Soiling – There are between 1-10 highly sensitive residential receptors located within 20m of the proposed Site boundary. In addition, there are between 10- 100 highly sensitive residential receptors located within 50m of the Site boundary. Therefore the sensitivity of the area to dust soiling is defined as '**Medium**'.
- Human Health – There are between 1-10 highly sensitive residential receptors located within 20m of the proposed Site boundary. In addition, there are between 10- 100 highly sensitive residential receptors located within 50m of the Site boundary. The 2021 background concentration of PM_{10} is less than 24µg.m^{-3}. Therefore, the sensitivity of the area to human health is defined as '**Low**'.

Table 5.3: Determination of the Sensitivity of the Area

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

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	Medium	Medium Risk
Construction	Large	Medium	Medium Risk
Trackout	Medium	Medium	Low Risk
Human Health Impacts			
Earthworks	Large	Low	Low Risk
Construction	Large	Low	Low Risk
Trackout	Medium	Low	Low Risk

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 guidance[10] 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 guidance[10]. The highest risk category identified was 'Medium Risk' and the recommended mitigation taken from the IAQM guidance[10] is detailed in **Table 5.5** and **Table 5.6**.

Table 5.5: Mitigation Measures for a Medium Risk Site

Category	Mitigation Measures for a Medium 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 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.	
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.	
Monitoring	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.	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
	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.	

Category	Mitigation Measures for a Medium Risk Site	
	Highly Recommended	**Desirable**
		cleaning to be provided as necessary.
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.	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 and with the agreement of the local authority, where appropriate).
	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	None
	Ensure an adequate water supply on site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	

Category	Mitigation Measures for a Medium Risk Site	
	Highly Recommended	**Desirable**
	Use enclosed 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 (Medium Risk Site)	None	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
		Use Hessian, mulches or tackifiers 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.
	Record all inspections of haul routes and any subsequent action in a site log book.	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
	Access gates to be located at least 10m from receptors where possible.	
Trackout (Low Risk Site)	None	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.
		Avoid dry sweeping of large areas.
		Ensure vehicles entering and leaving the sites are covered to prevent escape of materials during transport.
		Record all inspections of haul routes and any subsequent action in a site log book.

Category	Mitigation Measures	
	Highly Recommended	Desirable
		Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

Step 4: Determine Significant Effects

5.13 In accordance with IAQM guidance[10], 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 locations using the dispersion model ADMS-Roads. Predicted pollutant concentrations for Scenario 2: 2021 Base Year and Scenario 3: 2022 Opening Year without development are detailed in **Table 6.1.**

Table 6.1: Predicted Annual Mean Pollutant Concentrations for Scenario 2: 2021 Base Year and Scenario 3: 2022 Opening Year Without Development at Existing Receptor Locations

Receptor	Scenario 2: 2021 Base Year (µg.m^{-3})			Scenario 3: 2022 Opening Year Without Development (µg.m^{-3})		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
R1	12.4	12.3	8.2	11.8	12.2	8.0
R2	11.2	12.1	8.0	10.7	12.0	7.9
R3	10.8	12.0	8.0	10.3	11.8	7.9
R4	11.6	12.6	8.2	11.1	12.4	7.9
R5	11.2	12.5	8.2	10.7	12.3	7.9
R6	14.8	13.2	8.6	13.9	13.1	8.3
R7	19.5	14.4	9.2	18.2	14.3	9.1
R8	19.4	14.4	9.4	18.2	14.3	8.6
R9	22.4	14.5	9.5	20.8	14.4	8.7
R10	20.0	14.1	9.2	18.7	13.9	8.5
R11	15.7	13.2	8.7	14.7	13.1	8.6
R12	16.0	13.3	8.7	15.0	13.2	8.6
R13	17.9	13.8	9.0	16.8	13.6	8.6
R14	18.8	14.0	9.2	17.6	13.9	8.8
R15	18.0	13.8	9.1	16.9	13.7	8.6

Receptor	Scenario 2: 2021 Base Year (µg.m^{-3})			Scenario 3: 2022 Opening Year Without Development (µg.m^{-3})		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
R16	12.4	12.4	8.3	11.9	12.3	7.9
R17	13.1	12.5	8.3	12.3	12.4	8.2
STR1	*11.1*	*12.0*	*8.0*	*10.6*	*11.9*	*7.9*
STR2	*18.1*	*13.8*	*9.0*	*17.0*	*13.6*	*8.6*

**Receptors in italics denote short term receptors*

6.2 The predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are below the respective annual mean air quality objectives at all receptors in both Scenario 2: 2021 Base Year and Scenario 3: 2022 Opening Year without development.

6.3 With regard to short term air quality objectives for NO_2 and PM_{10}, the predicted annual mean NO_2 concentrations are less than 60µg.m^{-3} and therefore in accordance with Defra guidance[9] it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.14 was used to determine potential exceedance of the 24-hour PM_{10} short term objective; no exceedances were predicted.

Impact Assessment

Detailed Operational Phase Road Traffic Emissions Assessment

6.4 Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted at identified existing receptor locations for Scenario 4: 2022 Opening Year with development, to consider the impact of development-generated vehicles on local air quality.

6.5 Predicted pollutant concentrations are detailed in **Table 6.2**, **Table 6.3** and **Table 6.4** for NO_2, PM_{10} and $PM_{2.5}$ respectively together with Scenario 3: 2022 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.

Table 6.2: Predicted Annual Mean NO_2 Concentrations and Development Impact at Existing Receptor Locations

Receptor	Predicted NO_2 Concentration ($\mu g.m^{-3}$)				
	Scenario 3: 2022 Without Development ($\mu g.m^{-3}$)	Scenario 4: 2022 With Development ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	11.8	12.2	+0.5	1	Negligible
R2	10.7	11.0	+0.3	1	Negligible
R3	10.3	10.6	+0.4	1	Negligible
R4	11.1	11.1	0.0	0	Negligible
R5	10.7	10.7	0.0	0	Negligible
R6	13.9	14.0	+0.1	0	Negligible
R7	18.2	18.5	+0.3	1	Negligible
R8	18.2	18.3	+0.1	0	Negligible
R9	20.8	20.9	+0.1	0	Negligible
R10	18.7	18.8	+0.1	0	Negligible
R11	14.7	15.1	+0.4	1	Negligible
R12	15.0	15.3	+0.3	1	Negligible
R13	16.8	17.0	+0.2	0	Negligible
R14	17.6	17.8	+0.2	0	Negligible
R15	16.9	17.0	+0.1	0	Negligible
R16	11.9	11.9	0.0	0	Negligible
R17	12.3	12.7	+0.4	1	Negligible
ST1	*10.6*	*11.3*	*+0.7*	*2*	*Negligible*
ST2	*17.0*	*17.2*	+0.2	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denote short term receptors*

Table 6.3: Predicted Annual Mean PM_{10} Concentrations and Development Impact at Existing Receptor Locations

Receptor	Predicted PM_{10} Concentration ($\mu g.m^{-3}$)				
	Scenario 3: 2022 Without Development ($\mu g.m^{-3}$)	Scenario 4: 2022 With Development ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	12.2	12.3	+0.1	0	Negligible
R2	12.0	12.0	+0.1	0	Negligible
R3	11.8	11.9	+0.1	0	Negligible
R4	12.4	12.5	0.0	0	Negligible
R5	12.3	12.4	0.0	0	Negligible
R6	13.1	13.1	0.0	0	Negligible
R7	14.3	14.3	+0.1	0	Negligible
R8	14.3	14.3	0.0	0	Negligible
R9	14.4	14.4	0.0	0	Negligible
R10	13.9	13.9	0.0	0	Negligible
R11	13.1	13.2	+0.1	0	Negligible
R12	13.2	13.3	+0.1	0	Negligible
R13	13.6	13.7	0.0	0	Negligible
R14	13.9	14.0	0.0	0	Negligible
R15	13.7	13.7	0.0	0	Negligible
R16	12.3	12.3	0.0	0	Negligible
R17	12.4	12.5	+0.1	0	Negligible
ST1	*11.9*	*12.1*	*+0.2*	*0*	*Negligible*

Receptor	Predicted PM_{10} Concentration ($\mu g.m^{-3}$)				
	Scenario 3: 2022 Without Development ($\mu g.m^{-3}$)	Scenario 4: 2022 With Development ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
ST2	*13.6*	*13.7*	*0.0*	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denote short term receptors*

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

Receptor	Predicted $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)				
	Scenario 3: 2022 Without Development ($\mu g.m^{-3}$)	Scenario 4: 2022 With Development ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	8.0	8.1	+0.1	0	Negligible
R2	7.9	8.0	0.0	0	Negligible
R3	7.9	7.9	0.0	0	Negligible
R4	7.9	7.9	0.0	0	Negligible
R5	7.9	7.9	0.0	0	Negligible
R6	8.3	8.3	0.0	0	Negligible
R7	9.1	9.1	0.0	0	Negligible
R8	8.6	8.6	0.0	0	Negligible
R9	8.7	8.7	0.0	0	Negligible
R10	8.5	8.5	0.0	0	Negligible
R11	8.6	8.6	+0.1	0	Negligible
R12	8.6	8.7	0.0	0	Negligible
R13	8.6	8.6	0.0	0	Negligible

Receptor	Predicted $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)				
	Scenario 3: 2022 Without Development ($\mu g.m^{-3}$)	Scenario 4: 2022 With Development ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R14	8.8	8.8	0.0	0	Negligible
R15	8.6	8.7	0.0	0	Negligible
R16	7.9	7.9	0.0	0	Negligible
R17	8.2	8.2	0.0	0	Negligible
ST1	*7.9*	*8.0*	*+0.1*	*0*	*Negligible*
ST2	*8.6*	*8.6*	*0.0*	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denote short term receptors*

6.6 The predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ for scenario 3: 2022 Opening Year without development and Scenario 4: 2022 Opening Year with development are below the annual mean air quality objectives at all receptors.

6.7 The proposed development does not lead to any new exceedances of the annual mean air quality objective.

6.8 Predicted changes in NO_2, PM_{10} 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 guidance[11].

6.9 With regard to short term air quality objectives for NO_2 and PM_{10}, the predicted annual mean NO_2 concentrations are less than $60\mu g.m^{-3}$ and therefore in accordance with Defra guidance[9] it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.14 was used to determine potential exceedance of the 24-hour PM_{10} short term objective; no exceedances were predicted.

Impact Significance Summary

6.10 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 undertaken by a full member of the Institute of Air Quality Management. A summary of the impact significance and justification of this are provided below.

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

- Consideration was given to local planning policy[8] and the development proposals are considered to be in accordance with this policy with regard to air quality.
- Existing concentrations of NO_2, PM_{10} and $PM_{2.5}$ in the study area are predicted to be below the relevant air quality objectives.
- The air quality assessment undertaken utilised robust model inputs including slowing down sections at junctions, appropriate meteorological data and surface roughness.
- The impact of development-generated road traffic on local air quality is defined as negligible in accordance with IAQM and EPUK guidance[11].
- In addition, a sensitivity analysis was undertaken and provided in **Appendix H** considering the conservative scenario of NOx concentrations not decreasing from baseline levels in line with projected emission factors. The findings of this sensitivity analysis also predict the impact of development-generated road traffic on local air quality as Negligible in accordance with IAQM and EPUK guidance[11].

Site Suitability Assessment

6.12 Concentrations of NO_2, PM_{10} 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.

6.13 A Cartesian grid was modelled across the Site, using a gridline boundary closest to existing road sources for Scenario 4: 2022 Opening Year with development. **Figures 6.1-6.3** illustrate annual mean pollutant concentration contours for NO_2, PM_{10} and $PM_{2.5}$ respectively across the Site.

Figure 6.1: Predicted Annual Mean NO_2 Concentrations across the Site

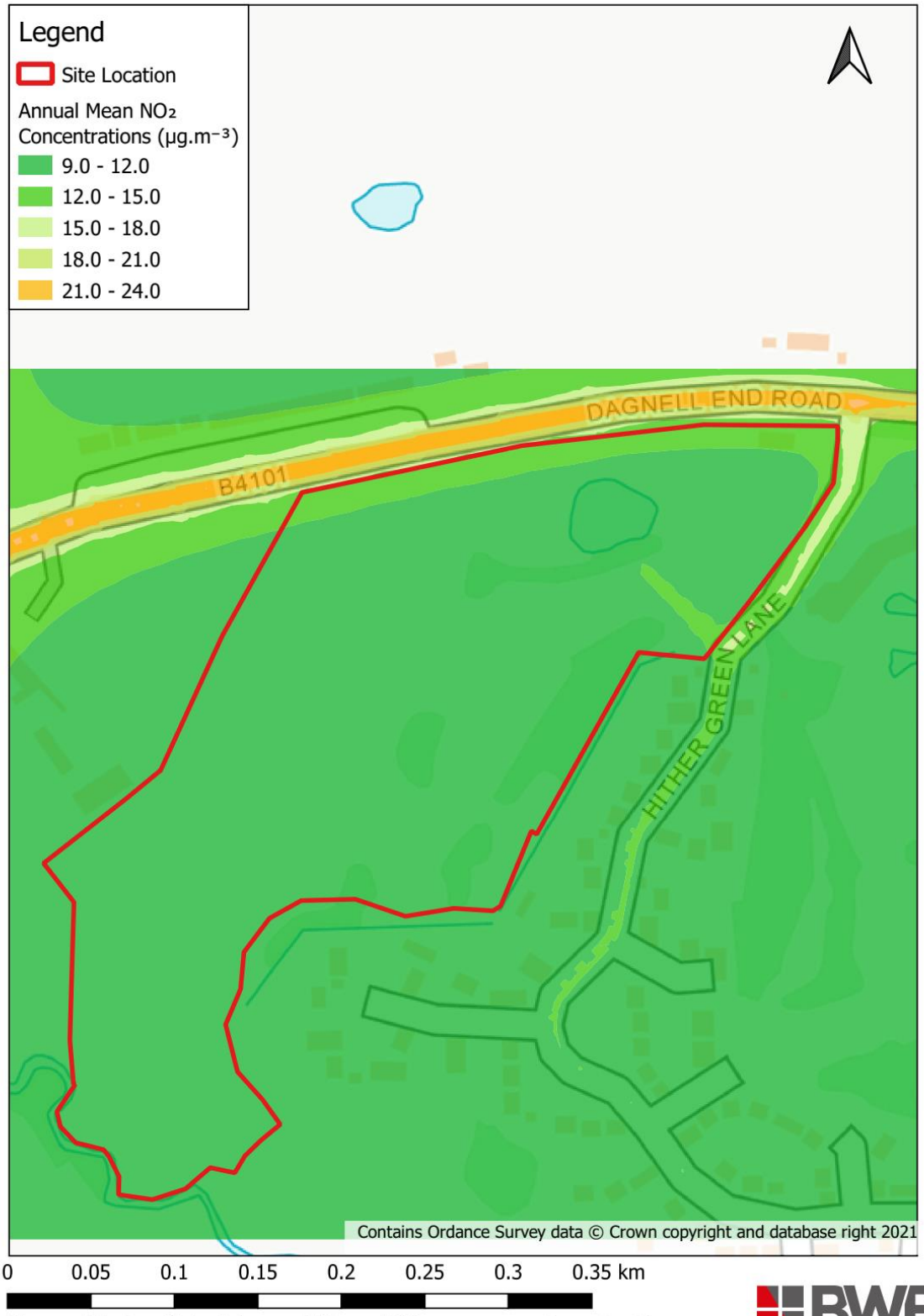

Figure 6.1: Predicted Annual Mean NO_2 Concentrations (µg.m⁻³) across the Site

Drawn by: RS
Date: 23/08/2021

Figure 6.2: Predicted Annual Mean PM_{10} Concentrations across the Site

Figure 6.2: Predicted Annual Mean PM_{10} Concentrations (µg.m⁻³) across the Site

Drawn by: RS
Date:23/08/2021

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

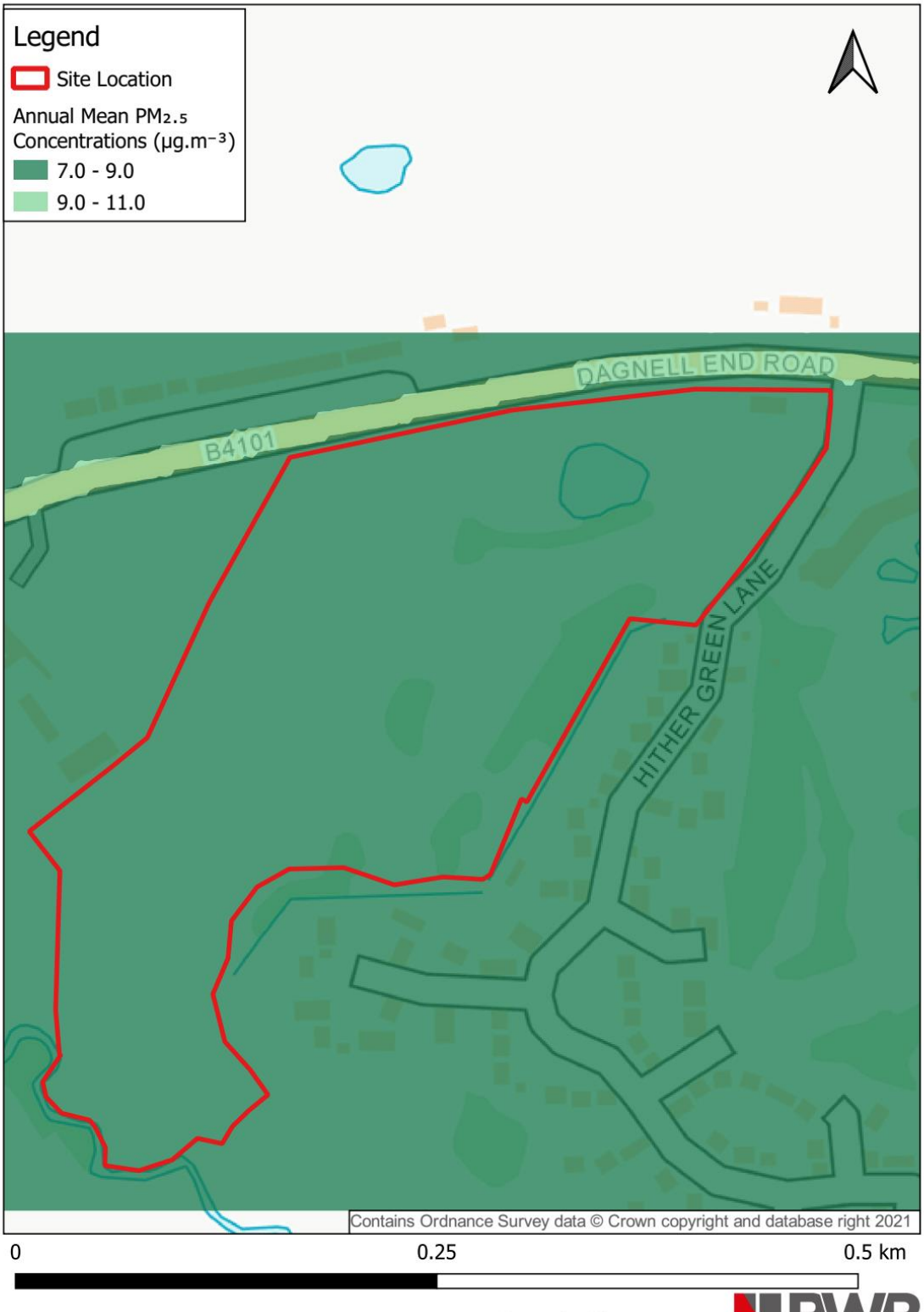

Figure 6.3: Predicted Annual Mean $PM_{2.5}$ Concentrations (µg.m⁻³) across the Site

Drawn by: RS
Date:23/08/2021

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6.14 The predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations for Scenario 4: 2022 Opening Year with development, indicate that pollutant concentrations at the proposed residential development will be below the respective air quality objectives in 2022 with the development in place.

6.15 With regard to short term air quality objectives for NO_2 and PM_{10} at the residential development, the predicted annual mean NO_2 concentrations are less than 60µg.m^{-3} and therefore in accordance with Defra guidance[9] it may be assumed that exceedance of the 1-hour mean NO_2 objective are unlikely. The calculation detailed in paragraph 3-11 was used to determine potential exceedance of the 24-hour PM_{10} short term objective; no exceedances were predicted.

6.16 The Site was therefore considered suitable for the proposed use with regard to the current air quality objectives.

Mitigation

6.17 The proposed development will result in minimal increases in pollutant concentrations and no new exceedances of the relevant air quality objectives are predicted.

6.18 Whilst the proposed development is not considered to significantly influence local air quality, a Travel Plan will support the scheme which will promote the use of sustainable transport methods such as public transport, walking and cycling.

7. CONCLUSION

7.1 An air quality impact assessment was undertaken for the proposed residential development on land off Hither Green Lane.

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 guidance[10].

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 NO_2, PM_{10} 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[9] and WRS technical guidance[12]. 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 guidance[11].

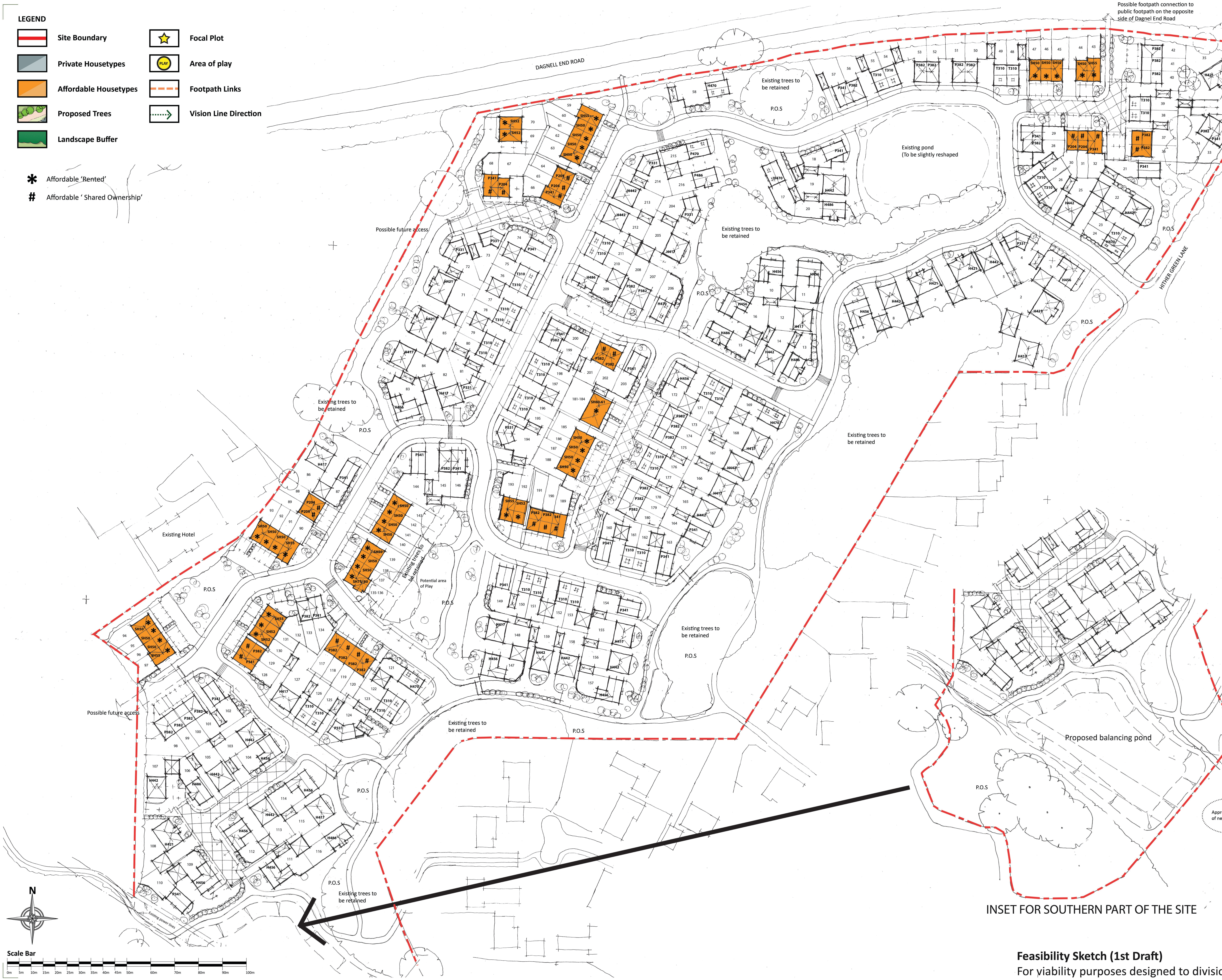
7.4 Pollutant concentrations were also predicted across the proposed development Site. Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were all predicted to be below the relevant air quality objectives and therefore the Site was considered to be suitable for the proposed residential use with regard to air quality.

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 ($\mu g.m^{-3}$)	A measure of concentration in terms of mass per unit volume. A concentration of $1\mu g.m^{-3}$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.

APPENDIX B: PROPOSED DEVELOPMENT MASTERPLAN



Schedule of Accommodation		01/04/2021	ME-24-20 A
Private house types	No.	Sq. Ft.	Total Sq. Ft.
H421	7	1765	12355
H417	12	1434	17208
H442	17	1354	23018
H486	7	1220	8540
T310	35	1089	38115
P382	25	832	20800
P341	19	1001	19019
H456	14	1491	20874
Core: 92%	136		
H470	7	1364	9548
P331	8	1001	8008
Occasional: 8%	15		
Total	151		177485
Affordable 30%			
Shared Ownership types #	No.	Sq. Ft.	Total Sq. Ft.
P204	7	620	4340
P382	11	832	9152
P341	5	1001	5005
Total	23		18497
Affordable rent types *	No.	Sq. Ft.	Total Sq. Ft.
SH75	1	465	465
SH80	1	645	645
SF60 (Ground floor)	2	448	896
SF61 (First floor)	2	465	930
SH55	6	958	5748
SH50	25	750	18750
SH52	5	930	4650
Total	42		32084
Totals	216		228066
Nett site area	14.58		
Density / Acre	15		
Density / Hectare	37		
SQFT per acre			15642

Feasibility Sketch (1st Draft)

For viability purposes designed to divisional brief

Rev	Description	Date	Drawn	Chk'd
A.	Layout amended to include balancing pond and divisional changes	01-04-21	SW	

Urban Design
Barratt House
Forest Business Park
Bardon Hill
Leicestershire
LE67 1UB

01530 276276

Project
Hither Green
Land off Hither Green Lane
Redditch

Drawing Title
Feasibility Plan

Scale
1:500 @ A0

Date
29-03-2021

Drawn By
SW

DAVID WILSON HOMES
WHERE QUALITY LIVES

ME-24-20 A

BARRATT HOMES

* When printing to scale, please ensure that your printer settings are set to Page Scaling = None. Do not allow any 'fit to page' settings as this will alter the scale of the drawing. You can use the scale bar or grid to check the printed drawing.

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 Directive[1] sets limits for ambient concentrations of air pollutants including nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$). The air quality standards and objectives are prescribed through the Air Quality (England) Regulations 2000[2], as amended, for the purpose of the Local Air Quality Management Framework.

The UK Government are required under the Environment Act 1995[3] to produce a national Air Quality Strategy (AQS). The AQS was first published in 1997[4] and was most recently reviewed and updated in 2007[5]. 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 Act[3] 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 NPPF[6] 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 NPPF[6] 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 quality[7] 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 PPG[7] 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 PPG[7] 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 PPG[7] 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 PPG[7] 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 PPG[7] 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

Redditch Local Plan

The Borough of Redditch Local Plan (2017-2030) sets out policies and proposals for the use and development of land and buildings. Policy 19 Sustainable Travel and Accessibility is particularly relevant to air quality and is detailed below.

"Policy 19 Sustainable Travel and Accessibility

[…]

viii. Providing measures which reduce the impact of the environmental problems (including potential Air Quality Management Areas) associated with transport growth and bring forward environmental improvements particularly along major transport routes."

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

APPENDIX D: AIR QUALITY DISPERSION MODELLING PARAMETERS

WRS published the Air Quality Technical Guidance Note for Planning which details information which should be provided to WRS regarding the assessment undertaken. The model parameters utilised in the assessment are detailed in **Table D1** below.

Table D1: Modelling Parameters utilised in the Assessment

WRS Parameter	BWB Response
Proposed Development Details	A location plan detailing the site location is provided in Figure 1.1 of the main report.
	Details of the development proposals are provided in paragraph 1.8 of the main report.
Model	The dispersion model ADMS-Roads was utilised in the assessment and was agreed with WRS in consultation detailed in paragraphs 3.1-3.3 of the main report.
Monitoring	Monitoring was not undertaken as part of the air quality assessment for the proposed development. Model verification was undertaken utilising monitoring undertaken by RDC in the study area. Model verification was undertaken in accordance with the process detailed in Defra guidance.
	Details of monitoring locations utilised in model verification are detailed in Appendix G.
Model Input Data	Co-ordinates of receptor locations utilised in dispersion modelling are detailed in Table 3.2 and Figure 3.1 of the report.
	Details of background pollutant concentrations utilised in the assessment are provided in Table 4.2 of the main report.
	Details of the meteorological dataset utilised in the assessment are provided in paragraph 3.13 and a wind rose for the meteorological station is provided in Appendix F.
	Traffic data utilised in the assessment are detailed in Appendix E. Details of modelled scenarios and the roads included in the study area are provided in paragraphs 3.7-3.12 of the main report. Traffic data were provided by Mode Transport, the Project Transport Consultants, and details of the method of obtaining the data are set out in the supporting Transport Assessment.
	Traffic speeds within the model were based on speed limits and the approach to all junctions were modelled at 10kph slower in accordance with Defra guidance.
	A link image identifying the roads included in dispersion modelling is provided in Appendix E.
	The latest version of the Defra NOx-NO_2 Calculator was utilised in the assessment. The parameter selected as 'all other urban UK roads' to reflect the location of the site outside of London and away from motorways.
Model Scenarios	Details of the modelled scenarios utilised in the assessment are provided in paragraph 3.7 of the main report.
	A sensitivity analysis scenario was modelled in accordance with the IAQM position statement, WRS guidance and as agreed in consultation with WRS.
Model Accuracy Verification	Details of the model verification process are provided in Appendix G. The Root Mean Square Error is also provided.
Assessment of Impacts	The proposed development will generate sufficient traffic to trigger the relevant criteria set out in IAQM and EPUK guidance. An assessment of impact of development- generated traffic on local air quality was therefore undertaken.
	Pollutant concentrations were predicted across the proposed development site to assess the suitability of the site for the proposed residential use.
Mitigation Measures	Mitigation measures are recommended within section 5 and 6 of the main report.

APPENDIX E: TRAFFIC DATA UTILISED IN THE AIR QUALITY ASSESSMENT

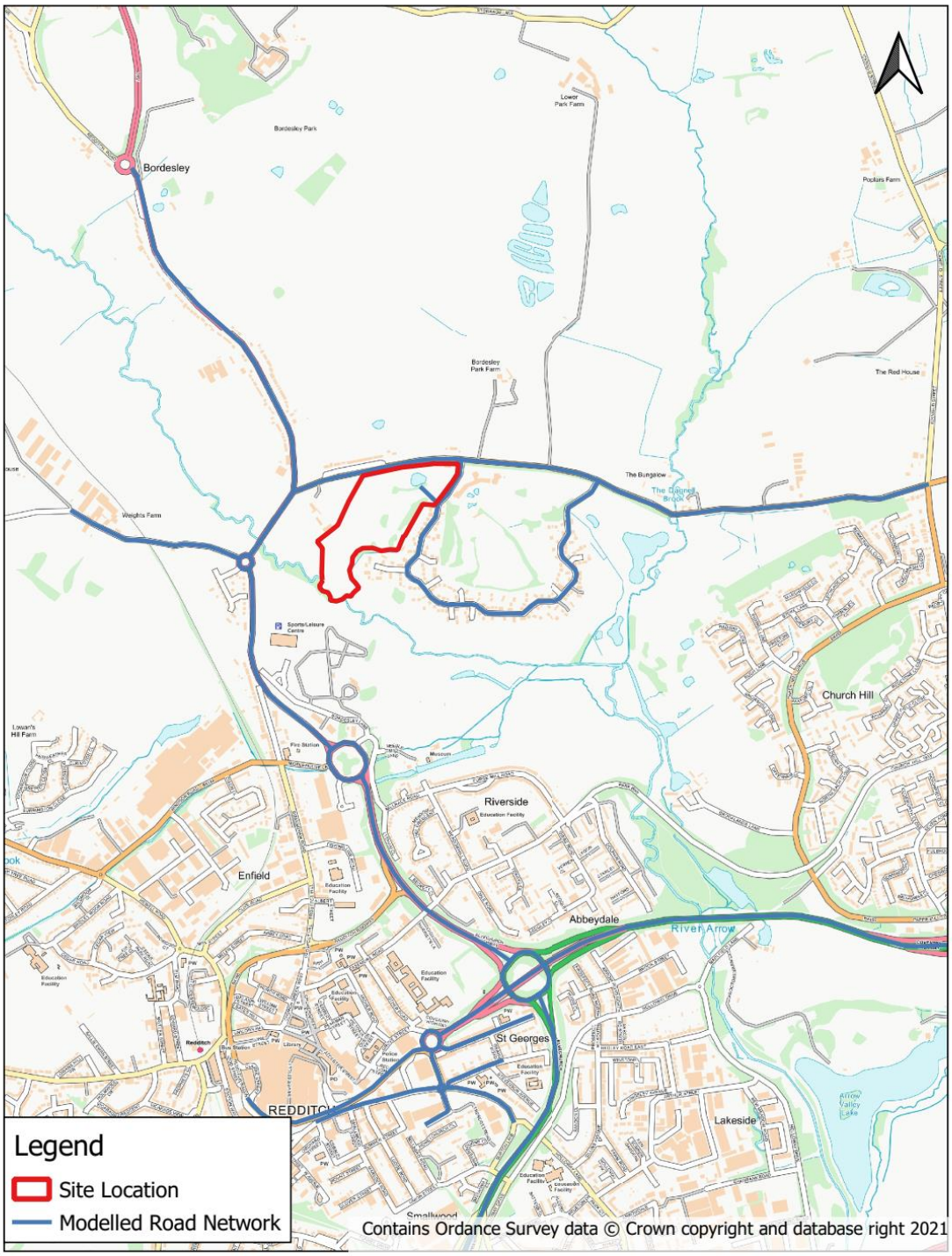
Table E1: Traffic Data Utilised in the Air Dispersion Modelling Assessment

Road Link	Speed	Scenario 1: 2018 Verification Year		Scenario 2: 2021 Base Year		Scenario 3: 2022 Opening Year Without Development		Scenario 4: 2022 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
A441 north of Dagnell End Road	64	13,374	358	13,806	370	13,928	373	14,628	373
Dagnell End Road (east of A441)	64	6,158	89	6,357	92	6,413	93	7,702	93
Dagnell End Road (west of Hither Green Lane)	96	6,843	62	7,003	63	7,053	64	8,342	64
Dagnell End Road (east of Hither Green Lane)	64	6,090	66	6,232	68	6,277	68	6,359	68
Hither Green Lane (north of Site access)	48	1,281	13	1,311	13	1,320	13	2,692	13
Site Access	48	0	0	0	0	0	0	1,372	0
Hither Green Lane (south of Site access)	48	1,281	13	1,311	13	1,320	13	1,320	13
A441 (north of Weights Lane)	64	19,075	429	19,520	442	19,659	442	20,249	442
Weights Lane	64	4,719	88	4,829	91	4,863	91	4,863	91
A441 (south of Weights Lane)	64	18,742	516	19,179	532	19,316	532	19,906	532
A441 (north of Middlehouse Lane)	48	18,705	537	19,141	554	19,278	554	19,868	554
A441 (south of Middlehouse Lane)	64	22,601	446	22,576	460	22,737	460	23,258	460
A441 (south of A4023)	112 LDV 96 HDV	22,084	418	22,800	435	22,998	435	23,519	435
A441 (north of A4023)	64	29,840	519	30,808	541	31,076	541	31,295	541
A4023 Coventry Highway	64	24,484	236	For use in the Scenario 1: 2018 Model Verification only					

Road Link	Speed	Scenario 1: 2018 Verification Year		Scenario 2: 2021 Base Year		Scenario 3: 2022 Opening Year Without Development		Scenario 4: 2022 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
A4023 Coventry Highway	64	35,780	552						
B4160 Redditch Ringway	64	7,318	44						
Other Road	38	12,081	362						
Ipsley Road	48	6,572	591						
Beoley Road West	48	860	9						
Trescott Road	48	4,732	95						
Holloway Lane	48	7,732	619						
St Georges Road	48	1,401	0						

An illustration of the road links included in the ADMS-Roads model is provided in **Figure E1**.

Figure E1: Road Links Included in the ADMS-Roads Model

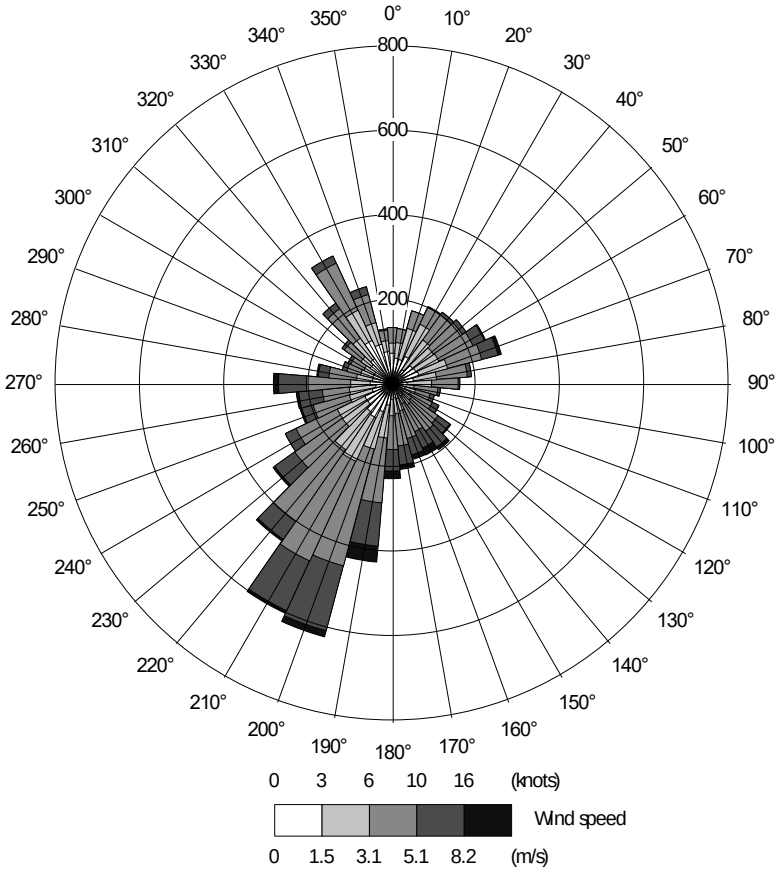


Drawn by: RS
Date: 23/08/2021

Figure E1: Modelled Road Network

APPENDIX F: WIND ROSE FOR 2018 FOR PERSHORE METEOROLOGICAL RECORDING STATION

Meteorological data for 2018 Verification Year scenario for the Pershore recording station was obtained for use in the air dispersion modelling assessment. The wind rose for 2018 is detailed below and illustrates a predominant wind direction from the southwest.



APPENDIX G: 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: 2018 Verification Year to predict the 2018 annual mean road contributions of NOx at the monitoring locations in the study area. The model NOx outputs at this location were compared to the 2018 monitored concentrations to provide adjustment factors. **Table G1** presents the verification process for NOx. **Figure G1** details the monitoring locations utilised in the model verification.

The remaining monitoring location detailed within **Table 4.1** was not used within the model verification as traffic data for the adjacent road links was unavailable.

No monitoring of PM_{10} or $PM_{2.5}$ is undertaken within the study area. Therefore the adjustment factor calculated during the NOx verification process was utilised to adjust predicted concentrations of PM_{10} and $PM_{2.5}$.

Table G1: NOx Verification Process

Model Verification Steps	OR1	OR2	OR4	OR5	OR6
2018 monitored total NO_2 ($\mu g.m^{-3}$)	35.1	38.2	36.1	35.7	36.9
2018 background NO_2 concentration ($\mu g.m^{-3}$)	13.8	13.8	13.8	13.8	13.8
Monitored road contribution NOx ($\mu g.m^{-3}$)	42.5	49.4	44.7	43.8	46.5
Modelled road contribution NOx ($\mu g.m^{-3}$)	14.1	12.9	14.2	14.2	14.2
Ratio of monitored road NOx to modelled road NOx	3.0	3.8	3.1	3.1	3.3
Adjustment factor for modelled road contribution NOx	**3.2458**				
Adjusted modelled road contribution NOx ($\mu g.m^{-3}$)	45.8	42.0	46.1	46.1	46.1
Modelled total NO_2 concentration ($\mu g.m^{-3}$)	36.6	34.9	36.8	36.8	36.8
Monitored total NO_2 concentration ($\mu g.m^{-3}$)	35.1	38.2	36.1	35.7	36.9
% difference between modelled and monitored total NO_2 concentration	+4.1	-9.5	+1.8	+2.9	-0.4
RMSE % (should be less than 25% and ideally less than 10%)	4.3				

** Road-NOx component, determined from NOx to NO_2 calculator*

A road-NOx factor of **3.2458** 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-NOx concentration at each receptor, before conversion to NO_2 concentrations using the NO_x to NO_2 calculator provided by Defra and the adjusted NO_2 background concentration.

Statistical analysis undertaken for the results in **Table G1** demonstrate that the RMSE value is within the ideal 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 G1: Monitoring Locations Utilised in the ADMS-Roads Model Verification Process

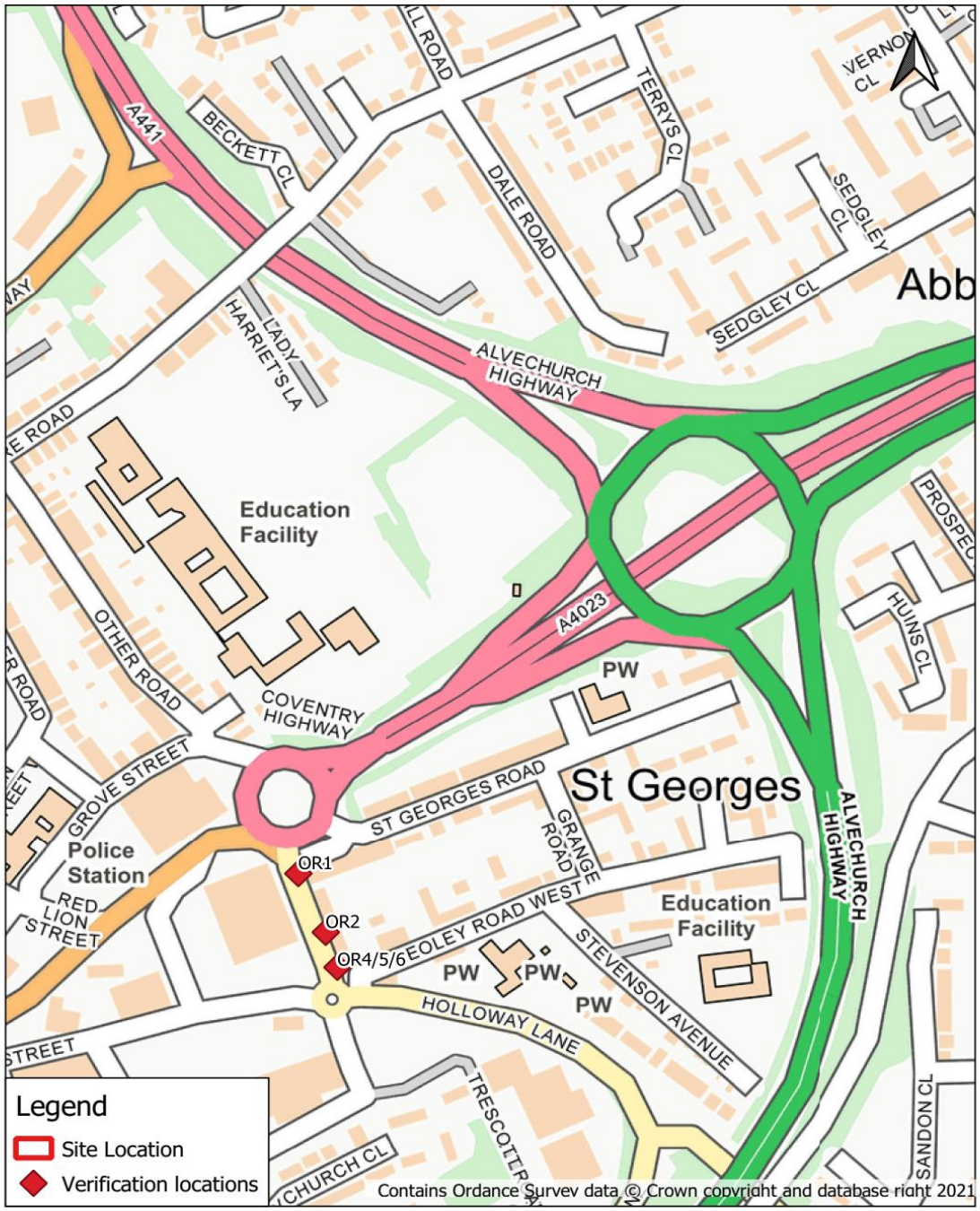


Figure G1: Model Verification Location

Drawn by: RS
Date: 23/08/2021

APPENDIX H: SENSITIVITY ANALYSIS

SENSITIVITY ANALYSIS

A sensitivity analysis was undertaken to consider a scenario where pollutant background concentrations do not decrease with future years. Therefore base year (2021) background concentrations, NOx to NO_2 calculator inputs and emission factors were utilised for the 2022 Opening Year with development scenario. The results of the assessment for the existing receptor locations and proposed receptor locations identified are provided in **Tables H1 – H4**.

Table H1: Predicted Annual Mean NO_2 Concentrations and Development Impact at Existing Receptor Locations – Sensitivity Analysis

Receptor	Predicted NO_2 Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	12.4	13.0	+0.5	1	Negligible
R2	11.2	11.5	+0.3	1	Negligible
R3	10.8	11.2	0.4	1	Negligible
R4	11.7	11.7	0.0	0	Negligible
R5	11.2	11.2	0.0	0	Negligible
R6	14.9	14.9	+0.1	0	Negligible
R7	19.6	19.9	+0.3	1	Negligible
R8	19.4	19.6	+0.1	0	Negligible
R9	22.5	22.5	+0.1	0	Negligible
R10	20.1	20.1	+0.1	0	Negligible
R11	15.8	16.1	+0.4	1	Negligible
R12	16.1	16.4	+0.3	1	Negligible
R13	17.9	18.1	+0.2	0	Negligible
R14	18.8	19.0	+0.2	0	Negligible
R15	18.0	18.2	+0.2	0	Negligible
R16	12.4	12.5	0.0	0	Negligible

Receptor	Predicted NO_2 Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R17	*13.1*	*13.5*	*+0.4*	*1*	Negligible
STR1	*11.1*	*11.9*	*+0.8*	*2*	*Negligible*
STR2	*18.2*	*18.4*	*+0.2*	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denotes a short term receptor*

Table H2: Predicted Annual Mean PM_{10} Concentrations and Development Impact at Existing Receptor Locations – Sensitivity Analysis

Receptor	Predicted PM_{10} Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	12.3	12.4	+0.1	0	Negligible
R2	12.1	12.2	+0.1	0	Negligible
R3	12.0	12.1	+0.1	0	Negligible
R4	12.6	12.6	0.0	0	Negligible
R5	12.5	12.5	0.0	0	Negligible
R6	13.2	13.3	0.0	0	Negligible
R7	14.4	14.5	+0.1	0	Negligible
R8	14.4	14.4	0.0	0	Negligible
R9	14.5	14.5	0.0	0	Negligible
R10	14.1	14.1	0.0	0	Negligible
R11	13.3	13.4	+0.1	0	Negligible

Receptor	Predicted PM_{10} Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R12	13.3	13.4	+0.1	0	Negligible
R13	13.8	13.8	0.0	0	Negligible
R14	14.1	14.1	0.0	0	Negligible
R15	13.9	13.9	0.0	0	Negligible
R16	12.4	12.5	0.0	0	Negligible
R17	12.5	12.6	+0.1	0	Negligible
STR1	*12.1*	*12.2*	*+0.2*	*0*	*Negligible*
STR2	*13.8*	*13.8*	*0.0*	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denotes a short term receptor*

Table H3: Predicted Annual Mean $PM_{2.5}$ Concentrations and Development Impact at Existing Receptor Locations – Sensitivity Analysis

Receptor	Predicted $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R1	8.2	8.2	+0.1	0	Negligible
R2	8.0	8.0	0.0	0	Negligible
R3	8.0	8.0	+0.1	0	Negligible
R4	8.2	8.2	0.0	0	Negligible
R5	8.2	8.2	0.0	0	Negligible
R6	8.6	8.6	0.0	0	Negligible

Receptor	Predicted $PM_{2.5}$ Concentration ($\mu g.m^{-3}$)				
	Scenario 5: 2022 Without Development Sensitivity Analysis ($\mu g.m^{-3}$)	Scenario 6: 2022 With Development Sensitivity Analysis ($\mu g.m^{-3}$)	Concentration Change* ($\mu g.m^{-3}$)	Change in Concentration Relative to Air Quality Assessment Level (%)	Impact
R7	9.3	9.3	0.0	0	Negligible
R8	9.4	9.4	0.0	0	Negligible
R9	9.5	9.5	0.0	0	Negligible
R10	9.2	9.2	0.0	0	Negligible
R11	8.7	8.7	0.0	0	Negligible
R12	8.7	8.7	0.0	0	Negligible
R13	9.0	9.0	0.0	0	Negligible
R14	9.2	9.2	0.0	0	Negligible
R15	9.1	9.1	0.0	0	Negligible
R16	8.3	8.3	0.0	0	Negligible
R17	8.3	8.3	*+0.1*	0	Negligible
STR1	*8.0*	*8.0*	*+0.1*	*0*	*Negligible*
STR2	*9.0*	*9.0*	*0.0*	*0*	*Negligible*

** Discrepancies in changes due to rounding effects. Receptors in italics denotes a short term receptor*

The predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are below the annual mean air quality objectives at all receptors. There are no exceedances of the annual mean air quality objectives with the development in place.

The impact of the development on the existing sensitive receptors in the study area is 'negligible' in accordance with the IAQM and EPUK guidance at all receptors.

With regard to short term air quality objectives for NO_2 and PM_{10}, the predicted annual mean NO_2 concentrations are less than $60\mu g.m^{-3}$ and therefore in accordance with Defra guidance it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.14 was used to determine potential exceedance of the 24-hour PM_{10} short term objective; no exceedances were predicted.

Site Suitability

Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted across the proposed development Site. Predicted pollutant concentrations are shown in **Figures H1-H3**.

Figure H1: Annual Mean NO_2 Concentrations across the Site

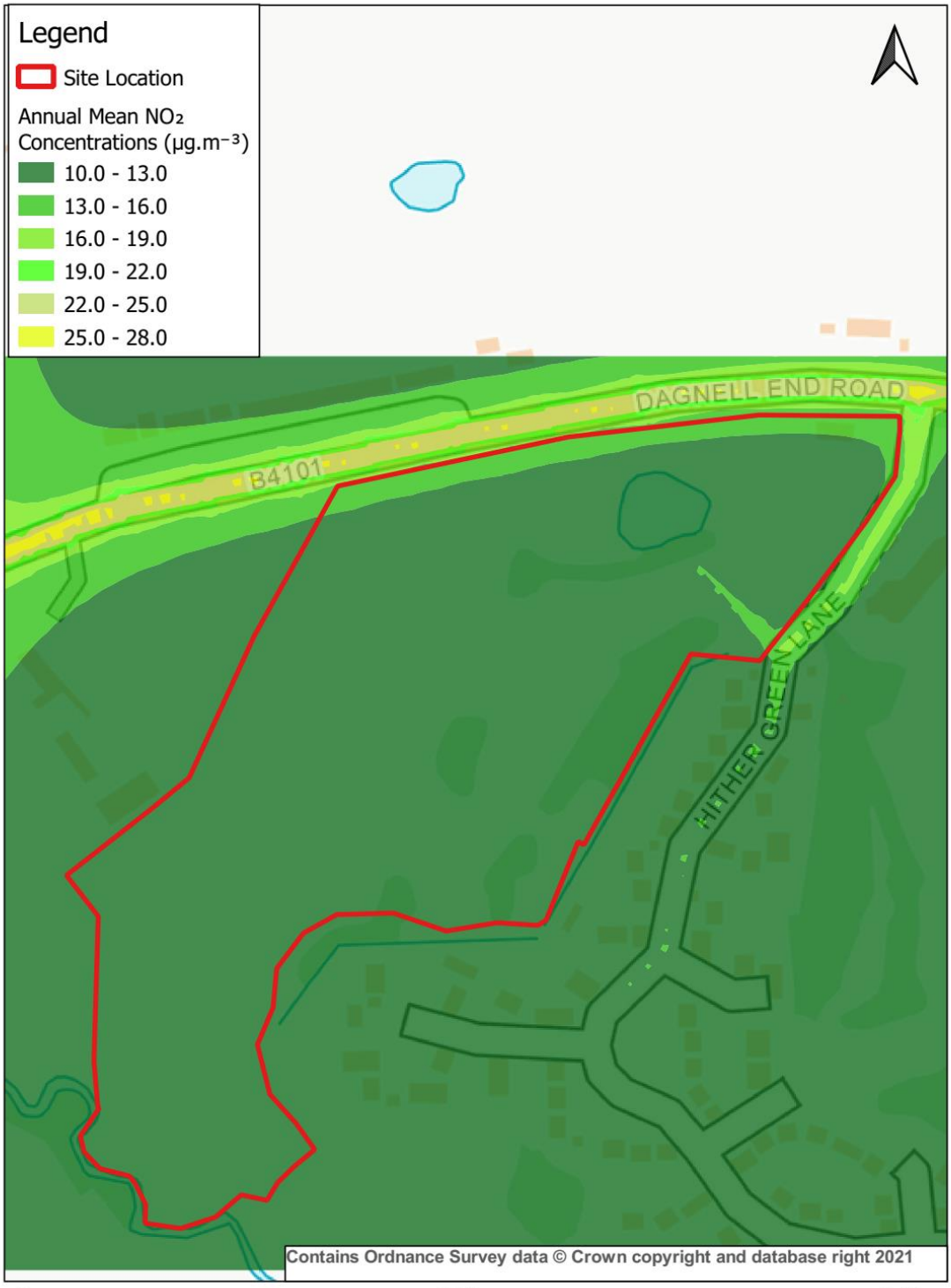


Figure H1: Predicted Annual Mean NO_2 Concentrations across the Site - Sensitivity Analysis

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Figure H2: Annual Mean PM_{10} Concentrations across the Site

Figure H2: Predicted Annual Mean PM_{10} Concentrations across the Site- Sensitivity Analysis

Drawn by: RS
Date: 23/08/2021

Figure H3: Annual Mean $PM_{2.5}$ Concentrations across the Site

Figure H3: Predicted Annual Mean $PM_{2.5}$ Concentrations across the Site - Sensitivity Analysis

Drawn by: RS
Date: 23/08/2021

Figure H1, **H2** and **H3** detail the concentrations of NO_2, PM_{10} and $PM_{2.5}$ across the Site at a height of 1.5m. Modelled concentrations of NO_2, PM_{10} and PM2.5 were predicted to be below the relevant annual mean air quality objectives across the Site.

With regard to short term air quality objectives for NO_2 and PM_{10}, the predicted annual mean NO_2 concentrations are less than 60µg.m^{-3} and therefore in accordance with Defra guidance it may be assumed that exceedance of the 1-hour mean objective is unlikely. The calculation detailed in paragraph 3.14 was used to determine potential exceedance of the 24-hour PM_{10} short term objective; no exceedances were predicted.

The Site is therefore considered suitable for its proposed residential use with regard to the current air quality objectives.

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