VALLEY ROAD, BARNSLEY

AIR QUALITY IMPACT ASSESSMENT

SEPTEMBER 2019

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CONTENTS

1.0 INTRODUCTION

This air quality assessment has been undertaken with the aim of predicting the potential impacts associated with a proposed residential development on land north east of Valley Road, Wombwell, Barnsley.

This report presents the air quality assessment undertaken in relation to air pollution and dust emissions from the development proposals, in addition to considering the impacts of existing air pollution in the area on the occupiers of the proposed scheme.

1.1 Development Description

The proposals comprise the development of up to 111 dwellings, public open space and associated access, infrastructure, landscape and ancillary works.

The site is located within the administrative boundary of Barnsley Metropolitan Borough Council (BMBC) to the north of the town of Wombwell. The larger town of Barnsley is approximately 5.8km to the north-west.

The site extends to approximately 3.84 hectares (ha) and comprises an area of unmanaged land. The south of the site is bound by Station Road which is populated by residential properties. Immediately west of the site is a small industrial estate, accessible via Valley Road. To the north of the site is a wooded area, beyond which is a secondary school known as Netherwood Academy and associated sports grounds. To the east of the site is Stonyford Road, along which are a number of residential dwellings and St Michael and All Angel's Primary School.

The area of development is shown in the drawings included within Appendix 1 of this report.

1.2 Report Context

This air quality and dust impact assessment has been produced in support of a planning application in order to provide information regarding the potential for air quality impacts from the construction of the development, in addition to the potential for vehicle pollution exposure on existing receptors close to the scheme and future occupiers of the residential dwellings.

1.3 Scope

The scope of this assessment is limited to the prediction of air quality and dust impacts associated with the construction and operation of the development and draws on existing information to determine whether this is likely to be significant.

1.4 Objectives

The objectives of the assessment are therefore as follows:

- To identify and assess the development construction impacts;
- To identify and assess the operational impacts of the proposed development (e.g. vehicle trips);
- To assess the significance of these impacts;
- To identify the potential for exposure of future occupants to poor air quality; and
- To identify further options for mitigation where required.

2.0 ASSESSMENT METHODOLOGY

A staged approach has been adopted; this ensures that the approach taken for the assessment of risk is proportional to the risk of an unacceptable impact being caused. As such, where a simple review of the situation shows that risk of a health or nuisance impact is negligible, this will be sufficient. In cases where the risk cannot be regarded as insignificant, a more detailed assessment may be required, such as a quantitative screening assessment or an advanced dispersion modelling exercise (as appropriate).

The following sections outline the methodology utilised throughout the assessment.

2.1 Consultation

The air quality assessment has been completed in accordance with standard UK best practice, as described by the Institute of Air Quality Management (IAQM) and Environmental Protection UK. This includes detailed modelling of baseline constraints and development impacts, as well as qualitative assessment of potential fugitive dust emission impacts during construction. No formal consultation has been undertaken in support of this air quality assessment.

2.2 Dust Assessment

Given the requirement for construction activities, there is a potential risk for the generation of dust. For such operations the common concern regarding dust emissions is their potential 'nuisance' effect.

A qualitative risk-screening assessment of the dust generation potential of the operations has been carried out using the method detailed in the 2014 IAQM document 'Assessment of dust from demolition and construction v1.1'.

2.3 Traffic Exhaust Emissions Impact Assessment

The development has the potential to affect existing air quality as a result of road traffic exhaust emissions associated with vehicles travelling to and from the site. Potential impacts have been defined by predicting nitrogen dioxide (NO_2) and particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}) concentrations at sensitive locations using dispersion modelling for the following scenarios:

- Scenario 0: Verification;
- Scenario 1: 2022 'do minimum' (DM) (predicted traffic flows in 2022, inclusive of anticipated growth and committed developments, should the proposals not proceed); and
- Scenario 2: 2022 'do something' (DS) (predicted traffic flows in 2022, inclusive of anticipated growth and committed developments, as well as trips associated with the completion of the proposals).

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.1.1.0).

In the case of significance criteria for the assessment of traffic emissions, the example criteria described within guidance issued by the IAQM[1] has been used as presented in Table 2-1. This terminology should be used where a quantitative assessment is undertaken (i.e. the vehicle trips exceed the screening threshold).

Table 2-1
Significance Criteria for Annual PM_{10} and NO_2

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

2.4 Future Exposure Risk Assessment

The proposed development has the potential to expose future users to poor air quality. In order to assess NO_2 and PM_{10} concentrations across the site, dispersion modelling was undertaken as described previously.

Results were compared with the relevant AQOs to determine the potential for exposure of future occupants to poor air quality.

2.5 Development Classification and Mitigation Specification

Barnsley Metropolitan Borough Council (BMBC) have produced Air Quality and Emissions Good Practice Planning Guidance[2] which includes direction on when an air quality assessment will be required, the associated scope of works and the level of mitigation necessary for inclusion within the proposals. The development was assessed against the screening methodology outlined in the guidance and relevant measures identified.

[1] Institute of Air Quality Management, Land-Use Planning & Development Control: Planning for Air Quality.

[2] Air Quality and Emissions Good Practice Planning Guidance, BMBC, 2018.

3.0 REGULATORY STANDARDS AND GUIDANCE

3.1 European Legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air quality objectives for fine particulates.

3.2 UK Legislation

3.2.1 Air Quality Standards

Current EU Air Quality limit values defined within the Directive have been transposed into UK legislation in the Air Quality Standards Regulations 2010, Statutory Instrument 2010 No. 1001.

3.2.2 Air Quality Strategy

The Air Quality Strategy (UKAQS) 2007 for England, Scotland, Wales and Northern Ireland[3] sets out the Government's policies aimed at delivering cleaner air in the UK. It sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency, local government, business, individuals and transport have in protecting and improving air quality.

The UKAQS actually includes more exacting objectives for some pollutants than required by EC legislation. This assessment refers only to UK air quality standards, as compliance with these standards will ensure that the less demanding European Air Quality limit values are also being met.

The Air Quality Strategy defines 'standards' and 'objectives' in paragraph 17:

> *'For the purposes of the strategy:*
>
> *standards are 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 assessment of the effects of each pollutant on human health including the effects on sensitive subgroups or on ecosystems;*
>
> *objectives are policy targets often expressed as a maximum ambient concentration not to be exceeded, either without exception or with a permitted number of exceedences, within a specified timescale.'*

[3] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007

The air quality Standards and Objectives considered within this air quality assessment are presented within Table 3-1.

Table 3-1
Air Quality Limit Values

Pollutant	Standard	Measured as	Equivalent percentile
NO_2	40µg/m^3	Annual mean	-
	200µg/m^3	1 hour mean	99.79th percentile of 1-hour-means (equivalent to 18 1-hour exceedences)
PM_{10} (gravimetric)	40µg/m^3	Annual mean	-
	50µg/m^3	24 hour mean	90.41th percentile of 24-hour-means (equivalent to 35 24-hour exceedences)

In accordance with DEFRA technical guidance Local Air Quality Management (TG16), the air quality objectives should be assessed at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective.

A summary of relevant exposure for the objectives presented in Table 3-1 are shown below in Table 3-2.

Table 3-2
Relevant Public Exposure

Objective Averaging Period	Relevant Locations	Objectives should apply at:	Objectives should not apply at:
Annual mean	Where individuals are exposed for a cumulative period of 6 months in a year;	Building facades of residential properties, schools, hospitals etc	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure if expected to be short term
1-hour mean	Where individuals might reasonably expected to spend one hour or longer	As above together with kerbside sites of regular access, car parks, bus stations etc	Kerbside sites where public would not be expected to have regular access

3.2.3 Local Authority Air Quality Review and Assessment

Local Authorities (LAs), including BMBC, have formal powers to control air quality through a combination of Local Air Quality Management (LAQM) and by use of their wider planning policies.

Under Section 82 of the Environment Act 1995 (Part IV), LAs are required to periodically review and assess air quality within their area of jurisdiction under the system of LAQM. This review and assessment of air quality involves assessing present and likely future air quality

against the Objectives. If it is predicted that levels at the façade of buildings, in the instance of annual mean concentrations, where members of the public are regularly present (normally residential properties) are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the Objectives.

The results of BMBC's Review and Assessment of air quality are summarised in Section 4.3.1

3.3 National Planning Policy

The revised National Planning Policy Framework (NPPF) was published in February 2019 and sets out the Government's planning policies for England and how these are expected to be applied.

The purpose of the planning system is to contribute to the achievement of sustainable development. In order to ensure this, this NPPF recognises three overarching objectives, including the following of relevance to air quality:

> *"c) An environment objective - to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigation and adapting to climate change, including moving to a low carbon economy."*

Chapter 15 of the NPPF details objectives in relation to conserving and enhancing the natural environment. It 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 […]"*

The NPPF specifically recognises air quality as part of delivering sustainable development and states that:

> *"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."

The implications of the NPPF have been considered throughout this assessment.

3.4 Local Planning Policy

The Barnsley Local Plan[4] sets out the planning framework for the borough up to the year 2033.

Policy GD1 General Development refers to air quality:

"Proposals for development will be approved if:

[…]

Any adverse impact on the environment, natural resources, waste and pollution is minimised and mitigated;

[…]"

Policy Poll1 Pollution Control and Protection also refers to air quality:

"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 discusses development which may affect AQMAs:

"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

[4] Barnsley Local Plan, BMBC, 2019.

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."

3.5 Air Quality and Emissions Good Practice Planning Guidance

BMBC have produced Air Quality and Emissions Good Practice Planning Guidance[5] which includes direction on when an air quality assessment will be required, the associated scope of works and the level of mitigation necessary for inclusion within the proposals. The development was assessed against the screening methodology outlined in the guidance and relevant measures identified.

[5] Air Quality and Emissions Good Practice Planning Guidance, BMBC, 2018.

4.0 SITE SETTING

The following sections provide detail of the location of the site and the surrounding topography and receptors.

4.1 Site Location

The site is approximately 3.8 hectares (9.5 acres) in size and is on the southern edge of the village of Low Valley, to the north of Wombwell. The proposed development location comprises an unmanaged field.

The surrounding typology represents a mix of residential, industrial, education and agricultural land uses. Immediately west of the site is a small industrial estate, accessible via Valley Road. To the south is Station Road which is populated by residential properties. To the north of the site is a wooded area and to the east are residential properties and St Michael and All Angel's Primary School along Stonyford Road.

4.2 Sensitive Receptors

The term 'sensitive receptors' includes any persons, locations or systems that may be susceptible to changes as a consequence of the proposed development. This includes the future occupiers of the development themselves.

In relation to the Valley Road site, the key receptors will be:

- Construction dust: Local residential buildings, neighbouring industrial units and persons parking in the vicinity of the development;
- Existing receptors: residents of near-by properties, occupiers of residences alongside road links used by site traffic, local schools and medical care centres; and,
- New receptors: Occupiers of the new residential properties.

Discrete receptors sensitive to potential operational phase road vehicle exhaust emission impacts were identified from a desk-top study. These are summarised in Table 4-1, below. Receptor height was defined for the lowest level of sensitive land use at the specific location.

Table 4-1
Road Traffic Emissions Discrete Receptors

Receptor Location		OS GR (m)		Height (m)
		x	y	
R1	Residential - Pitt Street	440608.8	404055.8	1.5
R2	Residential - George Street	440774.1	404011.9	1.5
R3	Residential - George Street	440725.9	403882.5	1.5
R4	Residential - Stonyford Road	440618.4	403729.3	1.5
R5	Residential - Stonyford Road	440662.4	403556.4	1.5
R6	Residential - Station Road	440377.6	403298.4	1.5
R7	Residential - Mitchells Lane	440114.0	403104.5	1.5
R8	Residential - Mayflower Way	440167.9	403055.8	1.5

Receptor Location		OS GR (m)		Height (m)
		x	y	
R9	Residential - Barnsley Road	439184.6	403830.1	1.5
R10	Residential - Wombwell Lane	438434.9	404565.7	1.5
R11	Residential - Wombwell Lane	437566.1	405269.4	1.5
R12	Residential - Grange Lane	437246.4	405695.6	1.5
R13	Residential - Pitt Street	440518.4	404021.3	1.5
R14	Medical Care Centre - Valley Way	440323.0	402910.1	1.5
R15	Residential - Doncaster Road First Floor	437143.9	405628.3	4.5
R16	Residential Flat - Doncaster Road	437150.7	405536.2	1.5
R17	Residential - Snape Hill Road	441144.0	404174.3	1.5
R18	Residential - Danny Marr Road	441579.7	404776.3	1.5
R19	Residential - Doncaster Road	441574.0	404815.6	1.5
R20	Residential - Doncaster Road	438007.3	405662.7	1.5
R21	Residential - Doncaster Road	441275.9	404991.0	1.5

The assessed receptor locations are shown on the figure below.

Figure 4-1
Road Traffic Emissions Discrete Receptors

4.3 Existing Baseline Conditions

4.3.1 Local Authority Review and Assessment

As required under Section 82 of the Environment Act (1995) (Part IV), BMBC has conducted an ongoing exercise to review and assess air quality within their area of jurisdiction. This process, as reported in the BMBC 2018 Annual Status Report, has indicated that annual mean concentrations of NO_2 are above the relevant AQO at locations of relevant public exposure within BMBC's administrative area.

As such, there are currently six AQMAs in Barnsley; having been declared in respect of NO_2 resulting from road-traffic emissions. The closest of these to the development is AQMA No. 7. This is described as an area incorporating the southbound carriageway of the A61 Sheffield Road adjacent to the junction with A6133 Cemetery Road and is located approximately 5.7km north west of the site. It is considered unlikely that traffic associated with the Valley Road development would cause impacts over a distance of this magnitude. As such, the AQMA has not been considered further in the context of the assessment.

All other AQS pollutants were below the relevant AQOs at locations of relevant public exposure, and as such no further AQMAs have been declared within the Council's administrative area.

4.3.2 Monitoring

During 2017 BMBC operated a network of 2 automatic analysers and 55 NO_2 diffusion tubes. A summary of recent NO_2 monitoring results from the locations with most relevance to the application site is presented within Table 4-2, below.

Table 4-2
NO_2 Monitoring Results

Monitoring Location	Monitored NO_2 Concentration (µg/m^3)		
	2015	2016	2017
DT46 - Near to supermarket site, Wombwell Lane	47.6	46.7	48.1
DT49 - Doncaster Road, Ardsley	49.3	48.7	46.4
DT29 - Moor Lane, Birdwell	32.7	31.3	32.1

Table 4-2 indicates that the annual mean AQO of 40µg/m^3 was exceeded at both the DT46 - Wombwell Lane and DT49 - Doncaster Road monitors in recent years. As both tubes are located adjacent to A-roads, elevated results would be expected. Concentrations were below the AQO at the DT29 - Moor Lane monitor in recent years. This would be expected as the site is positioned at an urban background location.

BMBC do not undertake PM_{10} monitoring within the vicinity of the site.

4.3.3 National Air Quality Archive

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by the National Air Quality Information Archive (NAQIA) based upon the background mapping study undertaken by DEFRA and is routinely used to support LAQM and Air Quality Assessments. As

such, it is considered unlikely that traffic generated by the development will impact this sensitive area.

Mapped background concentrations of NO_2 and PM_{10} were downloaded for grid square x440500, y403500, which is the closest to the development site. This data is presented in Table 4-3, below.

Table 4-3
Relevant Estimated Annual Mean Background Concentrations

Pollutant	Predicted Concentrations (µg/m^3)		
	2017	2019	2022
NO_2	13.36	12.36	11.11
PM_{10}	10.80	10.53	10.23

5.0 DUST ASSESSMENT

This dust assessment has been undertaken in accordance with the IAQM document '*Assessment of dust from demolition and construction v1.1'*.

The construction phases are broken down into 3 different activities with the potential to generate dust:

- Earthworks;
- Construction; and
- Trackout.

No demolition activities are required prior to construction and therefore have not been assessed.

It must be noted that the construction details are limited at this time given that this is an outline scheme. It is suggested that this indicative dust risk assessment is revised once further details are available in relation to the requirements for bunds etc.

5.1 STEP1: Screening

There are human receptors located within 50m of the boundary of the site and 50m of the route(s) used by construction vehicles, as shown in Drawing AQ1. There are however no notable ecological receptors close to the development site.

According to the IAQM Dust Guidance the risk cannot therefore be regarded as 'negligible' and an assessment is required.

5.2 STEP2a: Dust Emission Magnitude

5.2.1 Earthworks

The total site area is approximately 38,000m^2 and there may be the requirement for material movement from site during operations.

The potential (indicative) dust emission magnitude as a result of earthworks should be regarded as '**large**' in the absence of detailed information at this time.

5.2.2 Construction

Based on size of the proposed development, the new buildings are anticipated to have a total volume between 25,000m^3 and 100,000m^3.

The potential (indicative) dust emission magnitude as a result of construction should be regarded as '**medium**' in the absence of detailed information at this time.

5.2.3 Trackout

The final (detailed) construction scheme is not available at the time of writing. Based on the size of the development it is possible the unpaved road length may be greater than 100m at stages of the build.

The potential (indicative) dust emission magnitude as a result of trackout should be regarded as '**large**' in the absence of detailed information at this time.

5.3 STEP2b: Sensitivity of the Area

The closest receptors to the development are less than 10m from the southern site boundary. Hence the sensitivity of the area to dust soiling effects on people and property as a result of earthworks and construction activities is regarded as '**high**' in these locations.

There are a number of residential receptors within 20m of the anticipated site access route along Station Road. The sensitivity of the area to dust soiling effects on people and property as a result of trackout activities is therefore regarded as '**high**'.

Given the low baseline PM_{10} concentrations, the sensitivity of the area to human health impacts must be regarded as '**medium**'.

5.4 STEP2c: Risks

Based on the limited information available:

- the risk of dust soiling during earthworks should be regarded, during specific stage of site preparation, to be '**high risk**' at the closest receptors before mitigation is considered.
- The risk of human health impacts during earthworks must be regarded as '**high risk**' before mitigation is considered.
- The (indicative) risk of dust soiling during construction must be regarded as '**medium risk**' before mitigation is considered.
- The (indicative) risk of human health impacts during construction must be regarded as '**medium risk**' before mitigation is considered.
- The (indicative) risk of dust soiling impacts during trackout activities must be regarded as '**high risk**' before mitigation is considered.
- The (indicative) risk of human health impacts during trackout activities must be regarded as '**medium risk**' before mitigation is considered.

5.5 STEP3: Mitigation

The (indicative) risk of dust impacts at stages of the earthworks, construction and trackout must be regarded as '**high risk**', as the most significant risk rating, before mitigation is considered and therefore the mitigation measures detailed in section 8.2 of the IAQM

'*Guidance on the assessment of dust from demolition and construction v1.1*' should be considered in this case.

Specific measures would be detailed within a site Construction Environmental Management Plan which should be approved before potentially dusty activities commence on site. In particular it is critical that the potential for dust impacts from site access / egress by construction vehicles is mitigated through the use of wheel washing facilities and / or road sweeper throughout the build.

It is recommended that the risk assessment above is reviewed when more specific information is available relating to the construction processes and duration for this site.

5.6 STEP4: Effects

The IAQM document '*Assessment of dust from demolition and construction v1.1*' describes that, where suitable mitigation is applied, the residual effect will normally be 'not significant'. This is the case with the Valley Road scheme where robust mitigation measures are proposed. Full and final details of this mitigation should be provided to the Council before site works commence.

6.0 DISPERSION MODELLING ASSESSMENT

The development has the potential to affect existing air quality as a result of road traffic exhaust emissions associated with vehicles travelling to and from the site, as well as expose future occupants to elevated pollution levels. Potential impacts have been defined by predicting pollutant concentrations at sensitive locations using dispersion modelling for the following scenarios, as described in section 2.3:

- **Scenario 0**: Verification;
- **Scenario 1**: Opening year 'do minimum' (DM) (predicted traffic flows in 2022, inclusive of anticipated growth and committed developments, should the proposals not proceed); and
- **Scenario 2**: Opening year 'do something' (DS) (predicted traffic flows in 2022, inclusive of anticipated growth and committed developments, as well as trips associated with the completion of the proposals).

The relevant inputs are outlined in the following Sections.

6.1 Dispersion Model

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.1.1.0). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and DEFRA.

6.2 Assessment Area

Ambient concentrations were predicted over the area OS GR x437100, y402800 to x441600, y405800, at a height of 1.5m to represent breathing zone exposure.

One Cartesian grid was included within the model to produce data suitable for contour plotting using the Surfer software package.

6.3 Emission Factors

Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 9.0). This has been produced by DEFRA and incorporates updated COPERT 5 vehicle emission factors and fleet information.

6.4 Meteorological Data

Meteorological data used in the assessment was taken from Doncaster Sheffield Airport meteorological station over the period 1st January 2017 to 31st December 2017 (inclusive). Doncaster Sheffield Airport meteorological station is located at OS GR: x465930, y398920, which is approximately 25.9km south-east of the development.

6.5 Roughness Length

The roughness length is a modelling parameter applied to allow consideration of surface height roughness elements. Roughness lengths of 0.5m and 0.2m were used to describe the modelling extents and meteorological site, respectively.

6.6 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10m was used to describe the modelling extents and meteorological site.

6.7 Traffic Flow Data

Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as HDV proportion was provided by the Transport Consultant for the scheme. In total, the traffic data indicates a maximum of 256 AADT (one way) flows, or 513 AADT (two way flows) at the site access which will then disperse on the wider highways network meaning that the AADT flow an any one link is significantly below this figure.

Traffic data for a number of roads included within the assessment was not available from the Transport Consultant and was therefore supplemented with information from the Department for Transport (DfT)[6]. The DfT web tool enables the user to view and download traffic flows on every link of the 'A' road and motorway network, as well as selected minor roads, in Great Britain for the years 2000 to 2018. It should be noted that the DfT web tool is referenced in DEFRA guidance[7] as being a suitable source of data for air quality assessments and it is therefore considered to provide a reasonable estimate of traffic flows in the vicinity of the site.

It is proposed to submit a planning application for a residential development on land off Pitt Street approximately 300m north of the site. This will result in additional traffic on the local road network. As such, the number of vehicle trips associated with the scheme was obtained from the Transport Consultant and incorporated into the DM and DS scenarios where relevant, in order to provide a consideration of cumulative impacts from both developments.

A diurnal profile was included within the model to represent variations in traffic flow throughout the day. Separate inputs were provided for weekdays, Saturday and Sunday.

[6] https://roadtraffic.dft.gov.uk/#6/55.254/-6.053/basemap-regions-countpoints.

[7] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2016.

A summary of the traffic data used in the assessment is provided in Table 6-1, below.

Table 6-1
Traffic Data

Road Link		AADT Flow			HDV Prop. (%)		
		2017 Sc0	2022 Sc1	2022 Sc2	2017 Sc0	2022 Sc1	2022 Sc2
L1	Pitt Street East of Access	3779	4354	4354	0.32	0.28	0.28
L2	Pitt Street East of Access Slow	3779	4354	4354	0.32	0.28	0.28
L3	Pitt Street West of Access	3779	4354	4354	0.32	0.28	0.28
L4	Snape Hill Road	7303	7933	7933	0.52	0.48	0.48
L5	Doncaster Road	15604	16951	16951	4.10	3.78	3.78
L6	A635	14456	15704	15704	3.44	3.17	3.17
L7	Doncaster Road Westbound	7228	7852	7852	3.44	3.17	3.17
L8	Grange Lane Slow	21513	23494	23622	3.19	2.92	2.91
L9	Grange Lane	21513	23494	23622	3.19	2.92	2.91
L10	Doncaster Road West Slow	19692	21516	21644	4.10	3.76	3.73
L11	Doncaster Road West	19692	21516	21644	4.10	3.76	3.73
L12	Doncaster Road Roundabout	33682	36713	36970	3.64	3.34	3.31
L13	Wombwell Lane Southbound	9466	10407	10535	3.73	3.40	3.36
L14	Wombwell Lane Slow	18931	20814	21070	3.73	3.40	3.36
L15	Wombwell Lane	18931	20814	21070	3.73	3.40	3.36
L16	Barnsley Road	18931	20814	21070	3.73	3.40	3.36
L17	Barnsley Road Slow	18931	20814	21070	3.73	3.40	3.36
L18	White Rose Roundabout	18931	20689	20946	3.73	3.42	3.38
L19	Mitchells Way	18931	20565	20821	3.73	3.44	3.40
L20	Mitchells Way Roundabout	18931	20565	20821	3.73	3.44	3.40
L21	Mitchells Way	18931	20565	20821	3.73	3.44	3.40
L22	Mitchells Way Slow	18931	20565	20821	3.73	3.44	3.40
L23	Station Road Roundabout	17049	18644	18901	3.19	2.92	2.88
L24	Valley Way	15166	16724	16980	2.52	2.28	2.25
L25	Station Road Slow	7303	8182	8695	0.52	0.46	0.44
L26	Station Road South of Access	7303	8182	8695	0.52	0.46	0.44
L27	Stonyford Road North of Access	7303	8182	8182	0.52	0.46	0.46
L28	B6096	6487	7047	7047	1.62	1.49	1.49
L29	Mayflower Way Slow	6487	7047	7047	1.62	1.49	1.49
L30	Bleachcroft Way	9466	10407	10535	3.73	3.40	3.36
L31	Doncaster Road	14456	15704	15704	3.44	3.17	3.17
L32	Barnsley Road	18931	20814	21070	3.73	3.40	3.36
L33	Doncaster Road Slow Westbound	7228	7852	7852	3.44	3.17	3.17
L34	Doncaster Road Slow Eastbound	7228	7852	7852	3.44	3.17	3.17
L35	Doncaster Road Eastbound	7228	7852	7852	3.44	3.17	3.17

Road widths were estimated from aerial photography and UK highway design standards. The assessment area featured irregular topography. As such, road gradients were determined

using the elevation profile function in Google Earth Pro[8] and included in the calculation of link emissions. A summary of the relevant parameters is shown in Table 6-2, below.

Table 6-2
Link Parameters

Road Link		Average Vehicle Speed (km/h)	Road Width (m)	Road Gradient (%)
L1	Pitt Street East of Access	45	6.4	0.0
L2	Pitt Street East of Access Slow	25	7.8	0.0
L3	Pitt Street West of Access	45	7.6	3.6
L4	Snape Hill Road	45	7.8	5.7
L5	Doncaster Road	60	9.3	4.6
L6	A635	60	9.5	3.2
L7	Doncaster Road Westbound	60	8.7	4.1
L8	Grange Lane Slow	20	13.7	0.0
L9	Grange Lane	60	9.2	0.0
L10	Doncaster Road West Slow	20	20.7	5.9
L11	Doncaster Road West	45	16.8	5.9
L12	Doncaster Road Roundabout	20	12.6	0.0
L13	Wombwell Lane Southbound	25	7.7	0.0
L14	Wombwell Lane Slow	15	11.3	2.5
L15	Wombwell Lane	60	9.2	0.0
L16	Barnsley Road	60	7.0	0.0
L17	Barnsley Road Slow	25	12.6	0.0
L18	White Rose Roundabout	25	11.8	0.0
L19	Mitchells Way	45	6.8	3.2
L20	Mitchells Way Roundabout	25	7.6	0.0
L21	Mitchells Way	45	7.6	3.3
L22	Mitchells Way Slow	25	8.7	2.9
L23	Station Road Roundabout	25	11.7	0.0
L24	Valley Way	80	8.2	0.0
L25	Station Road Slow	25	8.7	3.8
L26	Station Road South of Access	45	6.6	3.8
L27	Stonyford Road North of Access	45	10.7	0.0
L28	B6096	45	8.4	6.3
L29	Mayflower Way Slow	25	9.8	9.0
L30	Bleachcroft Way	25	16.3	3.8
L31	Doncaster Road	70	8.9	2.5
L32	Barnsley Road	45	10.8	3.1
L33	Doncaster Road Slow Westbound	15	7.7	7.7
L34	Doncaster Road Slow Eastbound	15	8.8	9.1
L35	Doncaster Road Eastbound	60	8.4	3.8

[8] Google Earth Prop, Google LLC, 2019.

A map of the model inputs is shown in Figure 6-1, below.

Figure 6-1
ADMS-Inputs

6.8 Background Concentrations

An annual mean concentration of 32.1µg/m^3 was used in the assessment to represent existing NO_2 levels throughout the dispersion modelling extents without the contribution from road vehicles during 2017. This value was obtained from the DT29 - Moor Lane, Birdwell, urban background monitoring site and is higher than the value obtained from the DEFRA mapping study, as shown in Table 4-2. Use of the data is therefore considered to provide a worst case assessment. The annual mean PM_{10} concentration for use in the assessment was taken from the grid square containing the site, as shown in Table 4-2.

Data produced by National Statistics[9], in association with DEFRA, has shown that background concentrations have been decreasing in the UK over recent years. The ratio between 2017 and 2022 background concentrations for the grid square containing the DT29 - Moor Lane, Birdwell, was therefore calculated. This indicated that a reduction factor of 0.7847 should be applied to the 2017 concentration, to give a 2022 baseline NO_2 level of 25.2µg/m^3.

6.9 NO_x to NO_2 Conversion

Predicted annual mean NO_x concentrations were converted to NO_2 concentrations using the spreadsheet (version 7.1) provided by DEFRA, which is the method detailed within DEFRA guidance LAQM(TG16).

6.10 Verification

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons. Model verification is the process by which these uncertainties are investigated and where possible minimised.

For the purpose of the assessment model verification was undertaken for 2017 using traffic data, meteorological data and monitoring results from this year.

BMBC undertook monitoring of NO_2 concentrations at two roadside locations within the modelling extents during 2017. Results were obtained and the road contributions to total NO_x concentrations calculated following the methodology contained within DEFRA guidance LAQM(TG16). The monitored annual mean NO_2 concentrations and calculated road NO_x concentrations are summarised in Table 6-3.

Table 6-3
Verification - Monitoring Results

Monitoring Location	Monitored NO_2 Concentration (µg/m^3)	Calculated Road NO_x Concentration (µg/m^3)
DT46 - Near to supermarket site, Wombwell Lane	48.1	34.53
DT49 - Doncaster Road, Ardsley	46.4	30.60

The annual mean road NO_x concentrations predicted from the dispersion model and the 2017 monitoring results are summarised in Table 6-4.

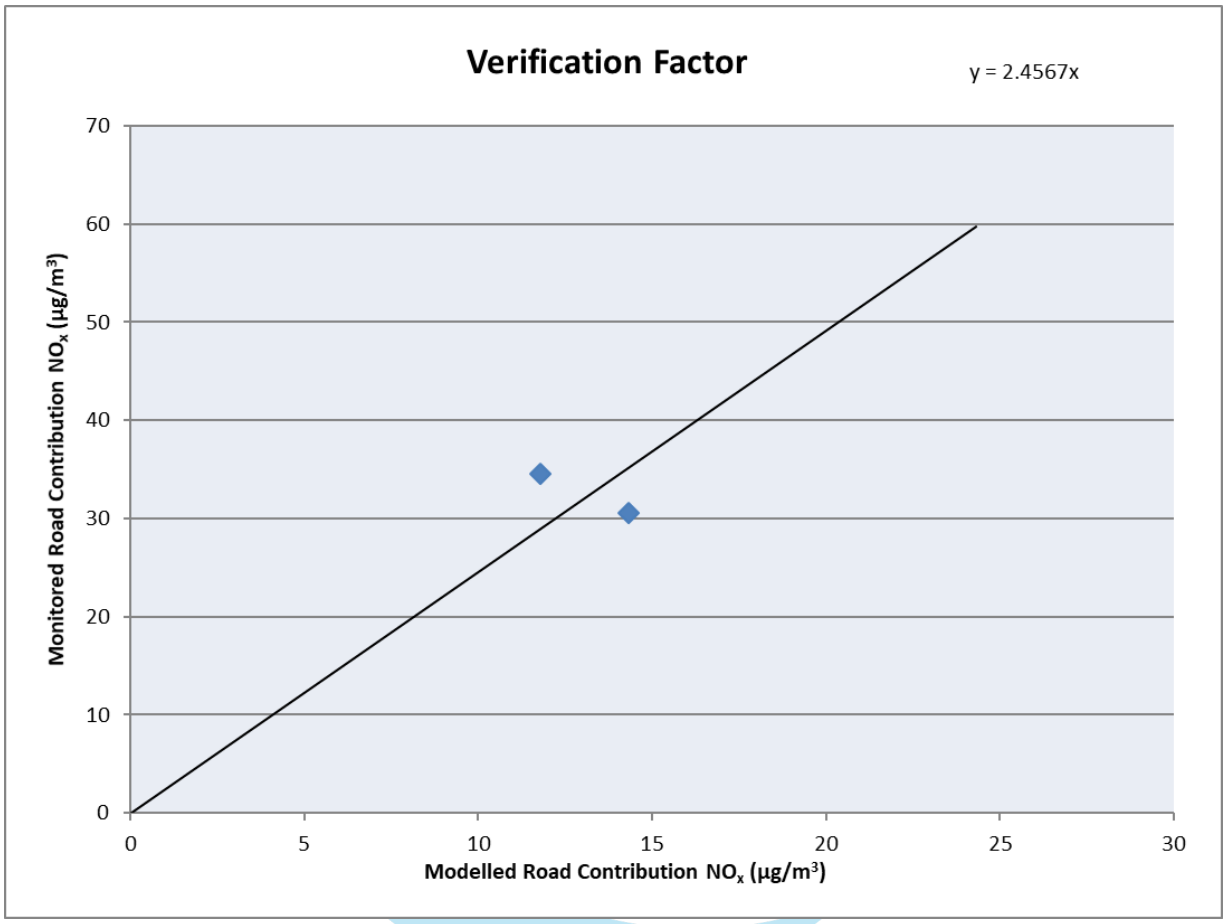
Table 6-4
Verification - Modelling Results

Monitoring Location	Calculated Road NO_x Concentration (µg/m^3)	Modelled Road NO_x Concentration (µg/m^3)
DT46 - Near to supermarket site, Wombwell Lane	34.53	11.80
DT49 - Doncaster Road, Ardsley	30.60	14.32

[9] DEFRA National Statistics Release, Air Quality Statistics in the UK 1987 to 2018, DEFRA and National Statistics, 2019.

The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression through zero calculated. This indicated that a verification factor of 2.4567 was required to be applied to all modelling results, as shown in Graph 6-1.

Graph 6-1
NO_x Verification Factor



Monitoring of PM_{10} concentrations is not undertaken within the assessment extents. The NO_x verification factor was therefore used to adjust PM_{10} model predictions in lieu of more accurate data in accordance with the guidance provided within DEFRA guidance LAQM (TG16).

7.0 ASSESSMENT OF AIR QUALITY IMPACTS & CONSTRAINTS

7.1 Development Trips

Vehicle movements associated with the operation of the proposal will generate exhaust emissions on the local and regional road networks. An assessment was therefore undertaken using dispersion modelling in order to quantify potential changes in pollutant concentrations at sensitive locations.

Annual mean NO_2 concentrations were predicted at the sensitive receptor locations for scenarios 1 and 2. These are summarised in Table 7-1, below.

Table 7-1
Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)		
		Sc1	Sc2	Change
R1	Residential - Pitt Street	28.27	28.28	0.01
R2	Residential - George Street	30.93	30.93	0.00
R3	Residential - George Street	28.77	28.78	0.01
R4	Residential - Stonyford Road	28.73	28.74	0.01
R5	Residential - Stonyford Road	30.08	30.10	0.02
R6	Residential - Station Road	29.74	29.96	0.22
R7	Residential - Mitchells Lane	29.16	29.21	0.05
R8	Residential - Mayflower Way	34.55	34.63	0.08
R9	Residential - Barnsley Road	28.42	28.45	0.03
R10	Residential - Wombwell Lane	29.75	29.80	0.05
R11	Residential - Wombwell Lane	35.58	35.69	0.11
R12	Residential - Grange Lane	36.47	36.53	0.06
R13	Residential - Pitt Street	27.64	27.64	0.00
R14	Medical Care Centre - Valley Way	26.96	26.98	0.02
R15	Residential - Doncaster Road First Floor	30.81	30.84	0.03
R16	Residential Flat - Doncaster Road	29.97	30.00	0.03
R17	Residential - Snape Hill Road	29.71	29.71	0.00
R18	Residential - Danny Marr Road	29.01	29.01	0.00
R19	Residential - Doncaster Road	28.82	28.82	0.00
R20	Residential - Doncaster Road	33.58	33.59	0.01
R21	Residential - Doncaster Road	28.76	28.76	0.00

As indicated in Table 7-1, predicted annual mean NO_2 concentrations were below the relevant AQO at all receptors during both scenarios.

Reference should be made to Figure A-1 and Figure A-2 (appendix A) for graphical representations of annual mean NO_2 concentrations across the assessment area for scenarios 1 and 2, respectively.

Annual mean PM_{10} concentrations were predicted at the sensitive receptor locations for scenarios 1 and 2. These are summarised in Table 7-2, below.

Table 7-2
Predicted Annual Mean PM_{10} Concentrations

Receptor		Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)		
		Sc1	Sc2	Change
R1	Residential - Pitt Street	10.38	10.38	0.00
R2	Residential - George Street	10.81	10.81	0.00
R3	Residential - George Street	10.47	10.47	0.00
R4	Residential - Stonyford Road	10.46	10.46	0.00
R5	Residential - Stonyford Road	10.69	10.69	0.00
R6	Residential - Station Road	10.63	10.66	0.04
R7	Residential - Mitchells Lane	10.49	10.49	0.01
R8	Residential - Mayflower Way	11.28	11.29	0.01
R9	Residential - Barnsley Road	10.37	10.38	0.01
R10	Residential - Wombwell Lane	10.73	10.74	0.01
R11	Residential - Wombwell Lane	11.17	11.18	0.01
R12	Residential - Grange Lane	11.79	11.80	0.01
R13	Residential - Pitt Street	10.28	10.28	0.00
R14	Medical Care Centre - Valley Way	10.18	10.18	0.00
R15	Residential - Doncaster Road First Floor	10.76	10.76	0.00
R16	Residential Flat - Doncaster Road	10.59	10.59	0.00
R17	Residential - Snape Hill Road	10.62	10.62	0.00
R18	Residential - Danny Marr Road	10.52	10.52	0.00
R19	Residential - Doncaster Road	10.52	10.52	0.00
R20	Residential - Doncaster Road	11.41	11.41	0.00
R21	Residential - Doncaster Road	10.52	10.52	0.00

As indicated in Table 7-2, predicted annual mean PM_{10} concentrations were below the relevant AQO at all receptors in both scenarios.

Reference should be made to Figure A-3 and Figure A-4 (appendix A) for graphical representations of annual mean PM_{10} concentrations across the assessment area for scenarios 1 and 2, respectively.

Predicted impacts on annual mean NO_2 concentrations at the sensitive receptor locations are summarised in Table 7-3, below.

Table 7-3
Predicted Impacts on Annual Mean NO_2 Concentrations

Receptor		Predicted Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R1	Residential - Pitt Street	Below 75% of AQO	0	Negligible
R2	Residential - George Street	76 - 94% of AQO	0	Negligible
R3	Residential - George Street	Below 75% of AQO	0	Negligible
R4	Residential - Stonyford Road	Below 75% of AQO	0	Negligible
R5	Residential - Stonyford Road	76 - 94% of AQO	0	Negligible
R6	Residential - Station Road	Below 75% of AQO	1	Negligible
R7	Residential - Mitchells Lane	Below 75% of AQO	0	Negligible
R8	Residential - Mayflower Way	76 - 94% of AQO	0	Negligible
R9	Residential - Barnsley Road	Below 75% of AQO	0	Negligible
R10	Residential - Wombwell Lane	Below 75% of AQO	0	Negligible
R11	Residential - Wombwell Lane	76 - 94% of AQO	0	Negligible
R12	Residential - Grange Lane	76 - 94% of AQO	0	Negligible
R13	Residential - Pitt Street	Below 75% of AQO	0	Negligible
R14	Medical Care Centre - Valley Way	Below 75% of AQO	0	Negligible
R15	Residential - Doncaster Road First Floor	76 - 94% of AQO	0	Negligible
R16	Residential Flat - Doncaster Road	76 - 94% of AQO	0	Negligible
R17	Residential - Snape Hill Road	Below 75% of AQO	0	Negligible
R18	Residential - Danny Marr Road	Below 75% of AQO	0	Negligible
R19	Residential - Doncaster Road	Below 75% of AQO	0	Negligible
R20	Residential - Doncaster Road	76 - 94% of AQO	0	Negligible
R21	Residential - Doncaster Road	Below 75% of AQO	0	Negligible

As indicated in Table 7-3, impacts on annual mean NO_2 concentrations as a result of the proposed development were predicted to be negligible at all receptors.

Predicted impacts on annual mean PM_{10} concentrations at the sensitive receptor locations are summarised in Table 7-4, below.

Table 7-4
Predicted Impacts on Annual Mean PM_{10} Concentrations

Receptor		Predicted Concentration	Predicted Concentration Change as Proportion of AQO (%)	Impact Significance
R1	Residential - Pitt Street	Below 75% of AQO	0	Negligible
R2	Residential - George Street	Below 75% of AQO	0	Negligible
R3	Residential - George Street	Below 75% of AQO	0	Negligible
R4	Residential - Stonyford Road	Below 75% of AQO	0	Negligible
R5	Residential - Stonyford Road	Below 75% of AQO	0	Negligible
R6	Residential - Station Road	Below 75% of AQO	0	Negligible
R7	Residential - Mitchells Lane	Below 75% of AQO	0	Negligible
R8	Residential - Mayflower Way	Below 75% of AQO	0	Negligible
R9	Residential - Barnsley Road	Below 75% of AQO	0	Negligible
R10	Residential - Wombwell Lane	Below 75% of AQO	0	Negligible
R11	Residential - Wombwell Lane	Below 75% of AQO	0	Negligible
R12	Residential - Grange Lane	Below 75% of AQO	0	Negligible
R13	Residential - Pitt Street	Below 75% of AQO	0	Negligible
R14	Medical Care Centre - Valley Way	Below 75% of AQO	0	Negligible
R15	Residential - Doncaster Road First Floor	Below 75% of AQO	0	Negligible
R16	Residential Flat - Doncaster Road	Below 75% of AQO	0	Negligible
R17	Residential - Snape Hill Road	Below 75% of AQO	0	Negligible
R18	Residential - Danny Marr Road	Below 75% of AQO	0	Negligible
R19	Residential - Doncaster Road	Below 75% of AQO	0	Negligible
R20	Residential - Doncaster Road	Below 75% of AQO	0	Negligible
R21	Residential - Doncaster Road	Below 75% of AQO	0	Negligible

As indicated in Table 7-4, impacts on annual mean PM_{10} concentrations as a result of the proposed development were predicted to be negligible at all receptors.

7.2 Baseline Constraints

The new development must be suitable for its setting in air quality terms. As the development includes residential units, this means that, where it is predicted that occupiers may be exposed to levels of air quality below those which are necessary for the protection of human health, mitigation options must be considered.

This assessment relies on the results of a dispersion modelling study, as described previously. Annual mean NO_2 concentrations were predicted across the development, as shown in Figure A-2 (appendix A). Annual mean NO_2 concentrations are predicted to be below the AQO of 40µg/m^3 at all locations across the site.

Annual mean PM_{10} concentrations were predicted across the development, as shown in Figure A-4. Annual mean PM_{10} concentrations are predicted to be below the AQO of 40µg/m^3 at all locations across the site.

Based on the dispersion modelling results, future residents are not predicted to be exposed to exceedences of the relevant AQOs. As such, the site is considered suitable for the proposed land use.

8.0 MITIGATION

BMBC have produced Air Quality and Emissions Good Practice Planning Guidance[10] which includes direction on when an air quality assessment will be required and the associated scope of works. The recommendations outlined in the document were applied as necessary throughout the assessment.

The BMBC guidance provides a methodology for determining the scale of a development as minor, medium or major and the required air quality mitigation for the relevant banding. Review of the relevant criteria indicated the proposals were classified as **medium** as although they include over 50 dwellings, they do not meet the following additional criteria:

- Where the proposed development falls within the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 2011 and includes air quality and/or transport as a specific likely impact;
- Proposals located within an AQMA;
- Proposals that could increase the existing traffic flow on roads > 10000 AADT by 5% or more*;
- Proposals that increase traffic by 5% or more on road canyons with an AADT > 5,000;
- Proposals that could introduce or significantly alter congestion (DfT congestion) and includes the introduction of substantial road infrastructure changes;
- Proposals that reduce average speeds by more than 10 kph;
- Proposals that include additional HGV movements by more than 10% of total trips;
- Where significant demolition works are proposed; and
- Where significant construction works are proposed.

[*As noted in section 6.7 above, the traffic data indicates a maximum of 256 AADT (one way) flows, or 513 AADT (two way flows) at the site access which will then disperse on the wider highways network meaning that the AADT flow an any one link with an existing flow of >10000 AADT is significantly below this figure.]

The BMBC guidance provides a number of mitigation options that should be considered for inclusion within **medium** developments. The following measures were identified of relevance to the proposals:

- Provision of Electric Vehicle (EV) charging points;
- Production of a full Travel Plan to encourage the use of non-transport modes and assist with the reduction of development transport related emissions;
- A site layout designed to encourage walking; and,
- Cycle paths to link to the local cycle network.

[10] Air Quality and Emissions Good Practice Planning Guidance, BMBC, 2018.

Where a development is classified as a major proposal (i.e. not 'medium'), the BMBC guidance states that a pollutant emission costs calculation is required. The calculation uses the Emissions Factor Toolkit (EFT) to calculate the amount of transport related pollutant emissions the development is likely to produce. The output is then multiplied by the Interdepartmental Group on Costs and Benefits damage costs for the key pollutants NO_x and $PM_{2.5}$ for each year for a total of five years. The calculation should be undertaken using the most recent damage costs released by DEFRA in January 2019[11] using the 'Road Transport - Central' values. There is no requirement for a pollutant emission costs calculation in this case, based on the BMBC guidance criteria.

Taking into account the above information, the proposals are considered to address the requirements of the BMBC air quality guidance.

[11] Air Quality Damage Cost Guidance, DEFRA, 2019.

9.0 CONCLUSIONS

This air quality assessment has been undertaken with the aim of predicting the potential impacts associated with a proposed residential development on land east of Valley Road, Wombwell, Barnsley.

This report presents the air quality assessment undertaken in relation to air pollution and dust emissions from the development proposals. According to BMBC Air Quality and Emissions Good Practice Planning Guidance the scale of the development is 'medium'.

The conclusions of the assessment are as follows:

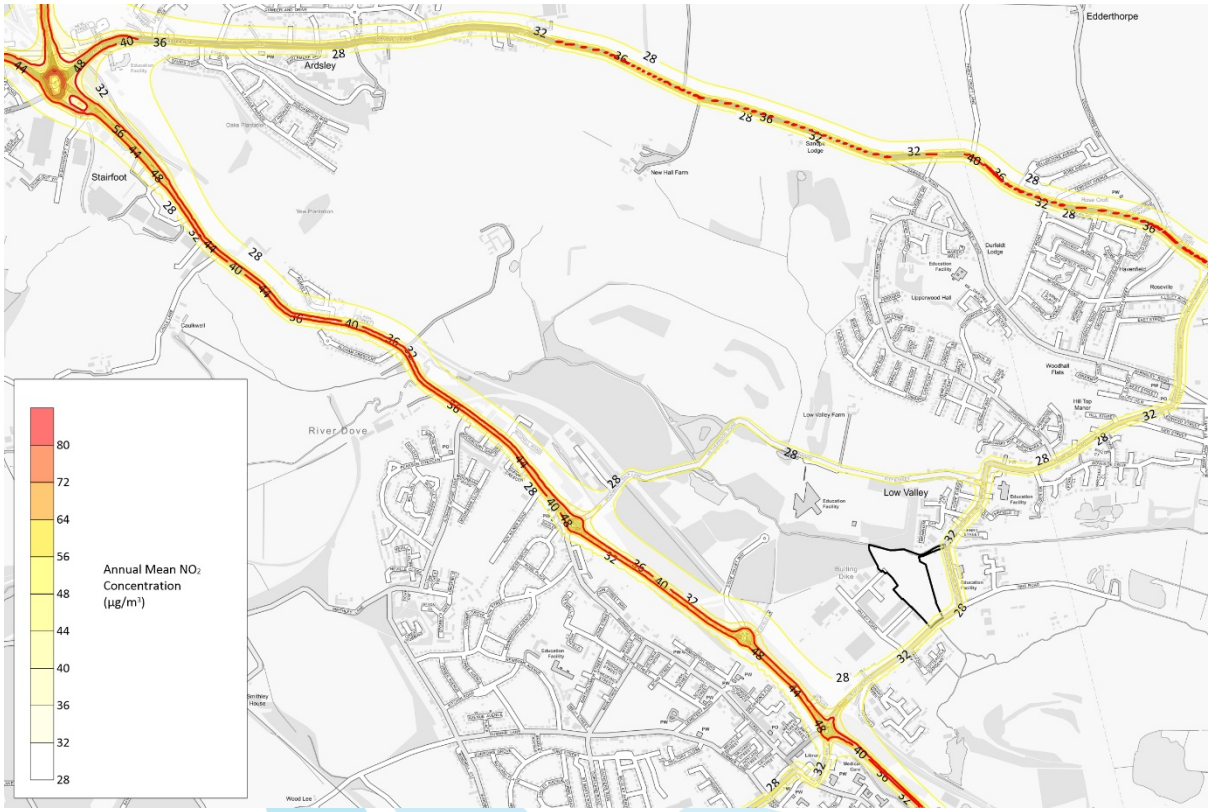
1. Robust mitigation against dust impacts should be adopted throughout the construction phase. These are likely to be detailed in a Construction Environmental Management Plan, or similar;
2. Based on the results of a dispersion modelling assessment, potential impacts on annual mean NO_2 and PM_{10} concentrations associated with additional vehicle emissions from the development are predicted to be negligible at all receptors. As such, impacts are not significant according to IAQM criteria; and
3. Based on the location of the development site and the results of a dispersion modelling study, it is considered highly unlikely that future occupiers will be exposed to levels of NO_2 and PM_{10} above limit values.

As such, the proposed development does not conflict with the NPPF or policy GD1, Poll1 or AQ1 of the Barnsley Local Plan.

APPENDIX A

Annual mean NO_2 concentrations were predicted throughout the assessment extents. The results scenario 1 are shown in Figure A-1, below.

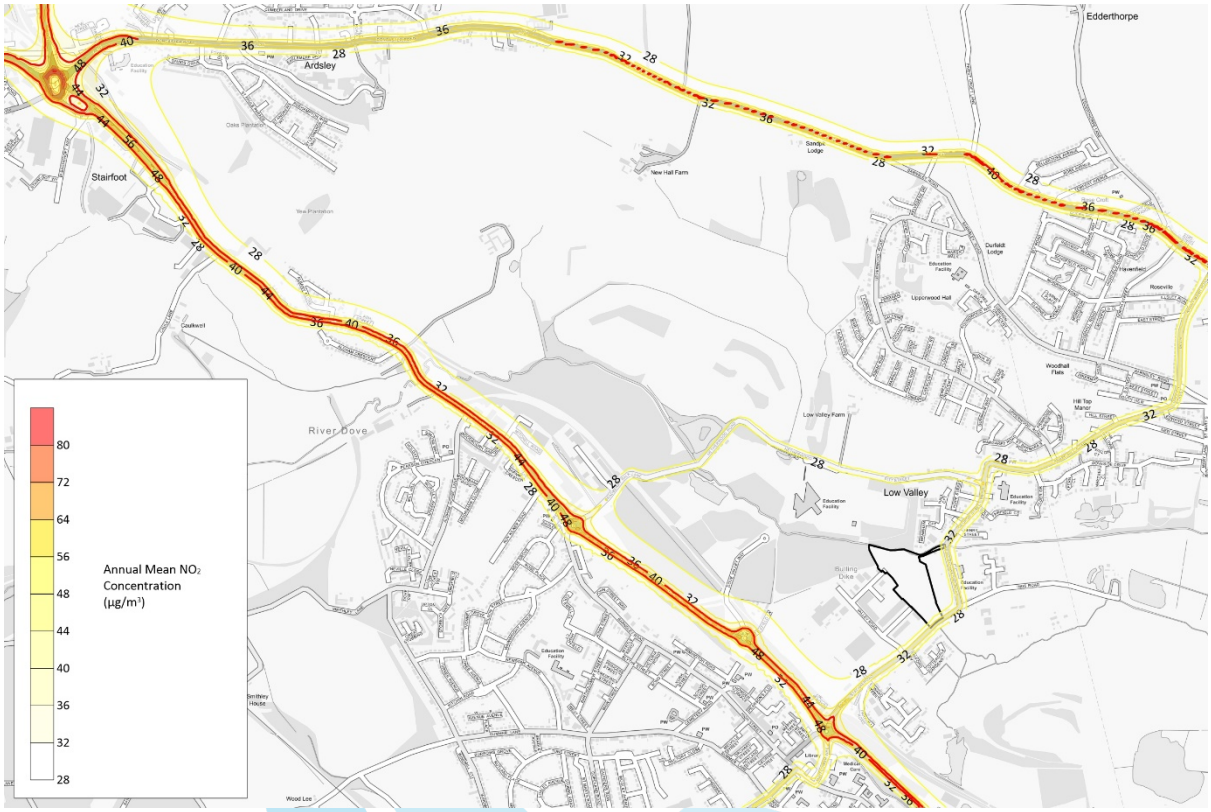
Figure A-1
Predicted Annual Mean NO_2 Concentrations – Sc1



As shown in Figure A-1, annual mean NO_2 concentrations are predicted to be below the AQO of 40µg/m^3 across all of the proposed development site in scenario Sc1.

Annual mean NO_2 concentrations were predicted throughout the assessment extents. The results for scenario Sc2 are shown in Figure A-2, below.

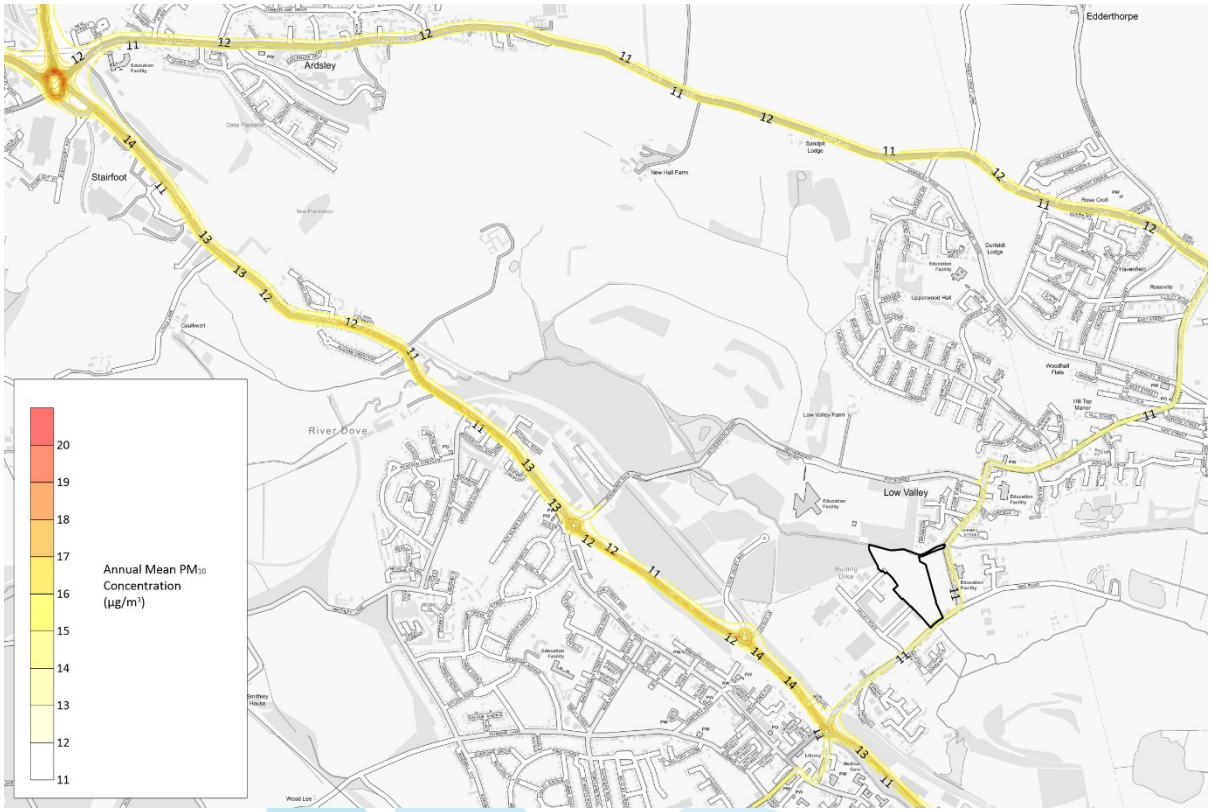
Figure A-2
Predicted Annual Mean NO_2 Concentrations – Sc2



As shown in Figure A-2, annual mean NO_2 concentrations are predicted to be below the AQO of 40µg/m^3 across all of the proposed development site in scenario Sc2.

Annual mean PM_{10} concentrations were predicted throughout the assessment extents. The results for scenario Sc1 are shown in Figure A-3, below.

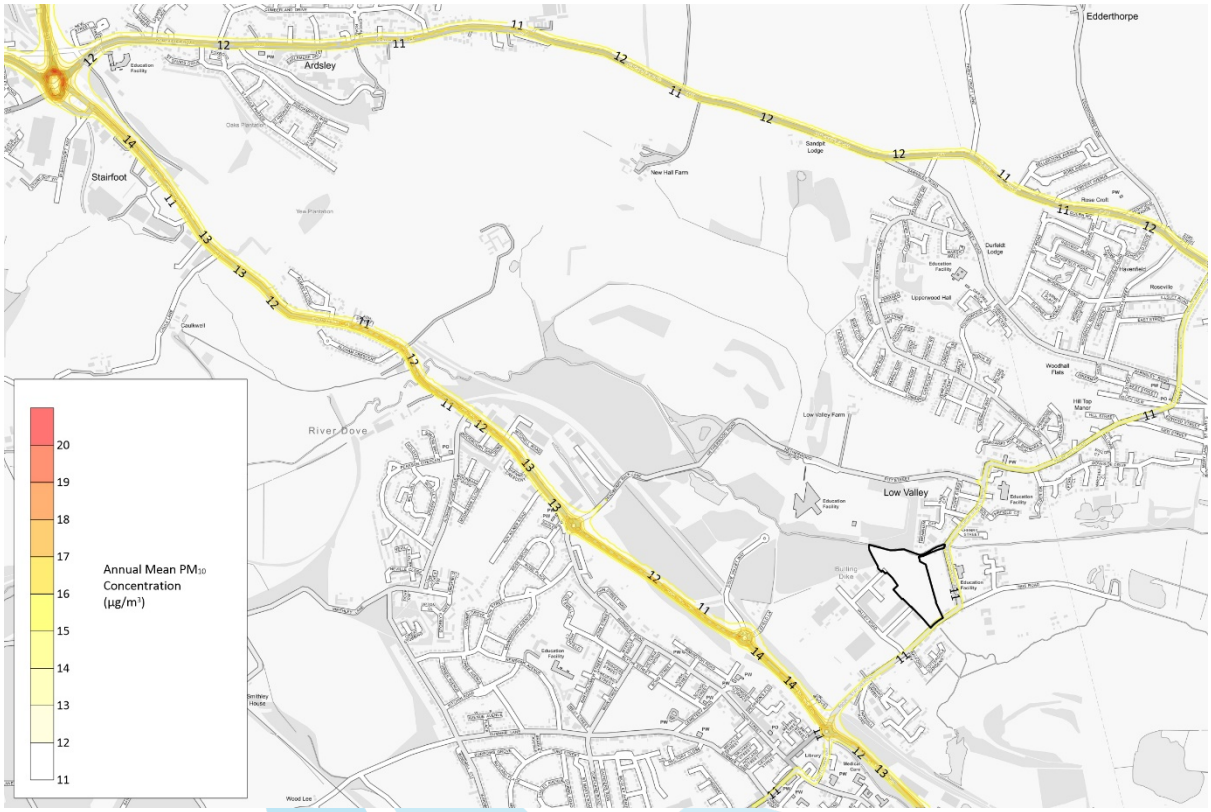
Figure A-3
Predicted Annual Mean PM_{10} Concentrations – Sc1



As shown in Figure A-3, annual mean PM_{10} concentrations are predicted to be below the AQO of 40µg/m^3 at all locations across the development site in scenario Sc1.

Annual mean PM_{10} concentrations were predicted throughout the assessment extents. The results for the scenario Sc2 are shown in Figure A-4, below.

Figure A-4
Predicted Annual Mean PM_{10} Concentrations – Sc2



As shown in Figure A-4, annual mean PM_{10} concentrations are predicted to be below the AQO of 40µg/m^3 at all locations across the development site in scenario Sc2.

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