Air Quality CONSULTANTS

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Peel Centre, Barnsley

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Experts in air quality management & assessment

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Executive Summary

The air quality impacts associated with the construction and operation of the proposed new infill unit on the site of the existing garden centre of The Range, and the variation to the goods permitted to be sold from the existing units occupied by Halfords, Bathstore, Barnsley Tile and Bathroom, The Range, Pets at Home, Maplin, Argos and Currys at the Peel Centre in Barnsley have been assessed.

Existing air quality conditions have been described using the results of monitoring carried out by Barnsley Metropolitan Borough Council, information published by Defra and the Environment Agency, and detailed baseline dispersion modelling. The potential dust impacts arising during the construction phase have been assessed using an approach recommended by the Institute of Air Quality Management, taking into account the sensitivity of the local area and the nature and duration of the works. The operational road traffic impacts have been assessed using detailed dispersion modelling. Concentrations of the key air pollutants associated with road traffic, i.e. nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$), have been determined with and without the development. The predicted concentrations have been compared with air quality objectives set by the Government to protect human health.

Existing conditions within the study area show poor air quality in places, with concentrations of nitrogen dioxide exceeding the annual mean objective along Harborough Hill Road adjacent to the development site. This road has been declared an Air Quality Management Area.

During construction it will be necessary to apply a package of mitigation measures to minimise dust emissions. IAQM guidance makes clear that, with the mitigation measures in place, the overall impacts during construction will not be significant.

The additional traffic generated by the proposed development will affect air quality at existing properties along the local road network. The assessment has demonstrated that there will be no significant increase in concentrations of PM_{10} and $PM_{2.5}$ at relevant locations; concentrations will remain well below the objectives and the impacts will all be *negligible*. In the case of nitrogen dioxide, the rounded percentage increases are predicted to be no greater than 1%; annual mean concentrations at worst-case receptors will remain above the objective, but the impacts will be mostly *negligible*. Adverse impacts will only occur at a maximum of six residential properties, and only if there is no reduction in vehicle emissions between 2013 and the opening year of the development; this is considered unlikely given the downward trend in measured concentrations in the area over recent years.

Barnsley Metropolitan Borough Council's Air Quality and Emissions Good Practice Planning Guidance (Barnsley Metropolitan Borough Council, 2014) requires damage costs to be defined, with these costs determining the level of mitigation compensation required to offset the impact of

the development. Measures have been set out that are considered sufficient to meet the damage costs calculated and offset the impact of the development.

Overall, the construction and operational air quality impacts of the proposed development are judged to be insignificant.

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed retail development at the Peel Centre, Dryden Road, Barnsley. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Peel.

1.2 The proposed development involves a variation to the goods permitted to be sold from the existing units occupied by Halfords, Bathstore, Barnsley Tile and Bathroom, The Range, Pets at Home, Maplin, Argos and Currys, with the only new development being the addition of a new retail unit on the site of the existing garden centre of The Range. The retail park lies adjacent to an Air Quality Management Area (AQMA) declared by Barnsley Metropolitan Borough Council for exceedences of the annual mean nitrogen dioxide objective. The development will lead to an increase in traffic on the local roads, which may impact on air quality at existing residential properties. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 This report describes existing local air quality conditions (2013), and the predicted air quality in the future assuming that the proposed development does, or does not proceed. The assessment of traffic-related impacts focuses on 2016, which is the earliest possible year of opening of the single additional unit.

1.4 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with Barnsley Metropolitan Borough Council.

2 Policy Context and Assessment Criteria

Air Quality Strategy

2.1 The Air Quality Strategy published by the Department for Environment, Food, and Rural Affairs (Defra) provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Planning Policy

National Policies

2.2 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for England in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should *"contribute to…reducing pollution"*. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location. The NPPF states that the effects of pollution on health and the sensitivity of the area and the development should be taken into account.

2.3 More specifically the NPPF makes clear that: *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan"*.

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that the potential impact of new development on air quality is taken into account … where the national*

assessment indicates that relevant limits have been exceeded or are near the limit". The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*".

2.5 The PPG states that *"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)".*

2.6 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact"*.

Local Transport Plan

2.7 The Sheffield City Region Transport Strategy (South Yorkshire Integrated Transport Authority, 2011) includes a section on air quality. This outlines the health impacts of poor air quality, the existing AQMAs in the area, and a policy to deal with the issue:

"Policy V: To improve air quality, especially in designated AQMA areas"

2.8 This policy focusses on managing vehicle flow to reduce stop-start conditions, and accelerating the take-up of cleaner bus and HGV engines.

Barnsley Local Development Framework Core Strategy

2.9 The Barnsley Local Development Framework (LDF) is a portfolio of documents that ties together all planning policy and the spatial planning strategy for the borough, up to 2026. The key document within the LDF is the Core Strategy (Barnsley Metropolitan Borough Council, 2011), which sets out the key elements of planning framework for Barnsley and includes a series of core policies to guide development proposals in the borough. The Core Strategy includes two policies relevant to air pollution; CSP 40 pertains to pollution control and states:

"CSP40 Pollution Control and Protection

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

development where existing air pollution, noise, smell, dust, vibration, light or other pollution levels are unacceptable and there is no reasonable prospect that these can be mitigated against. Developers will be expected to minimise the effects of any possible pollution and provide mitigation measures where appropriate."

2.10 Core policy CSP 41 also relates to air quality specifically within Air Quality Management Areas:

"CSP 41 Development in Air Quality Management Areas

Development 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), or that any such harmful effects can be mitigated against. We will only allow residential development in air quality management areas, where the developer provides an assessment that shows living conditions will be acceptable for future residents. We will only allow development in air quality management areas which could cause more air pollution, where the developer provides an assessment that shows there will not be a significantly harmful effect on air quality."

Air Quality and Emissions Good Practice Planning Guidance

2.11 Barnsley Metropolitan Borough Council has issued planning guidance (Barnsley Metropolitan Borough Council, 2014) that sets out the assessment methods expected within an air quality assessment to be submitted to the Council. The document also sets out a method for calculating damage costs applicable to major developments such as that covered by this assessment. The pollution damage costs attributed to the proposed development's emission changes determine the level of mitigation compensation required to offset the impact of the development.

Air Quality Action Plan

2.12 The Barnsley Air Quality Action Plan (Barnsley Metropolitan Borough Council, 2013) details 22 measures to be taken to improve air quality in the borough. These are primarily targeted at the borough's 7 AQMAs, declared along busy roads where road traffic emissions are the principal pollution source.

Assessment Criteria

2.13 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air

Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.14 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level.

2.15 Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2009). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.16 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.17 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

2.18 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m^3
Fine Particles (PM_{10})	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3 [b]
Fine Particles ($PM_{2.5}$) [a]	Annual Mean	25 µg/m^3

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

[b] A proxy value of 32µg/m^3 as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedences of the 24-hour mean PM_{10} objective are possible (Defra, 2009).

Construction Dust Criteria

2.19 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the Institute of Air Quality Management[1] (IAQM) (2014), has been used. Full details of this approach are provided in Appendix A1.

Descriptors for Air Quality Impacts and Assessment of Significance

Construction Dust Significance

2.20 Guidance from the IAQM (Institute of Air Quality Management, 2014) is that, with appropriate mitigation in place, the impacts of construction dust will not be significant. The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that impacts will normally not be significant.

Operational Significance

2.21 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the IAQM (EPUK & IAQM, 2015) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of

[1] The IAQM is the professional body for air quality practitioners in the UK.

the EPUK/IAQM approach are provided in Appendix A2. The approach includes elements of professional judgement, and the professional experience of the consultants preparing the report is therefore set out in Appendix A3.

3 Assessment Approach

Consultation

3.1 The assessment follows a methodology agreed with Barnsley Metropolitan Borough Council via a telephone discussion between Chris Shields (Air Quality Officer at Barnsley Metropolitan Borough Council) and Penny Wilson (Air Quality Consultants) held on 24 April 2015.

Existing Conditions

3.2 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2015b) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2015). Local sources have also been identified through discussion with Barnsley Metropolitan Borough Council's Regulatory Services Team, as well as through examination of the Council's Air Quality Review and Assessment reports.

3.3 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015a). These cover the whole country on a 1x1 km grid. Current exceedences of the annual mean EU limit value for nitrogen dioxide have been identified using the maps of roadside concentrations published by Defra (2015c). These are the maps, currently based on 2012 data, used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU.

Construction Impacts

3.4 The construction dust assessment considers the potential for impacts within 350 m of the site boundary; or within 50 m of roads used by construction vehicles. The assessment methodology is that provided by the IAQM (Institute of Air Quality Management, 2014). This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A1 explains the approach in more detail.

Road Traffic Impacts

Sensitive Locations

3.5 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations close to the proposed development. Receptors have been identified to represent worst-case exposure close to busy roads that will be affected by the traffic generation of the proposed development. When selecting these receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, and where there is a combined effect of several road links. The receptors have been located on the façades of the properties closest to the sources.

3.6 Nine existing residential properties have been identified as receptors for the assessment. These locations are shown in Figure 1. In addition, concentrations have been modelled at seven diffusion tube monitoring sites located along local roads, in order to verify the modelled results (see Appendix A4 for verification method).

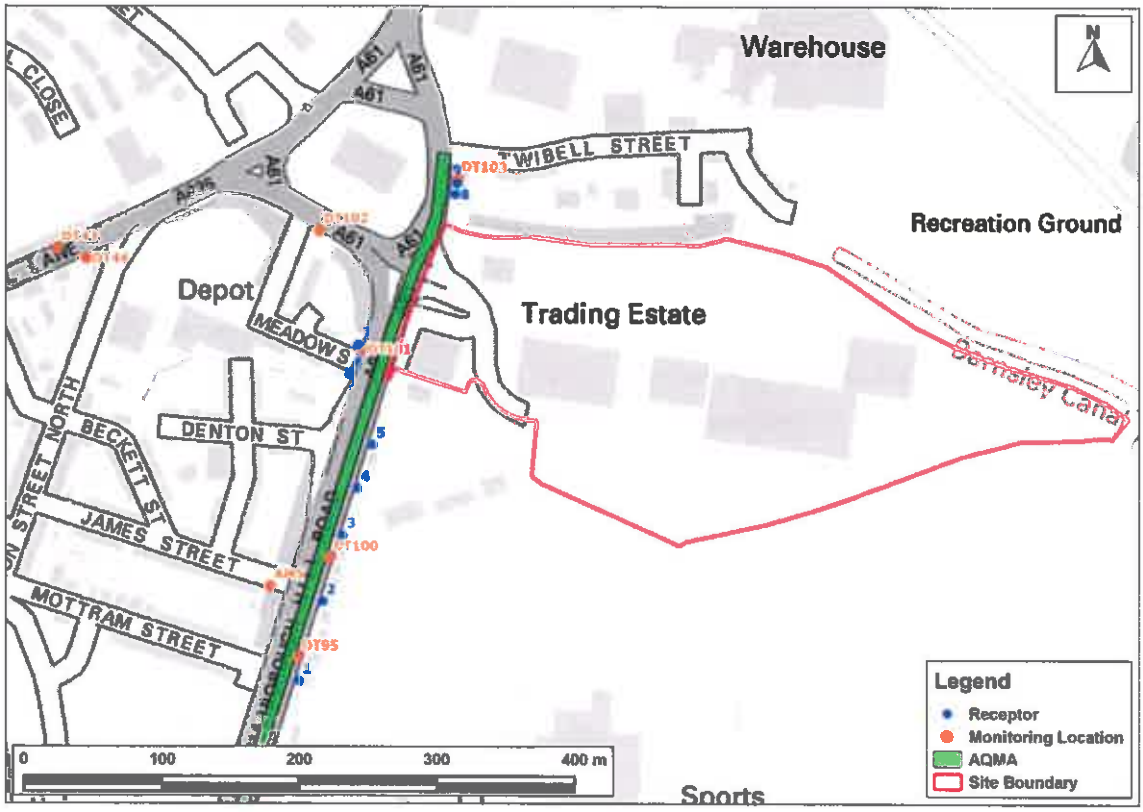


Figure 1: Receptor and Monitoring Locations

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Assessment Scenarios

3.7 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2013), and the earliest possible year of opening of the single additional unit (2016). For 2016, predictions have been made assuming both that the development does proceed (With Scheme), and does not proceed (Without Scheme). A further 2016 sensitivity test has been carried out for nitrogen dioxide that involves assuming no reduction in emission factors for road traffic from the baseline year. This is to address the issue identified by Defra (Carslaw et al., 2011) that road traffic emissions have not been declining as expected (see later section on uncertainty). Nitrogen dioxide concentrations in 2016 with and without the scheme are thus presented for two scenarios: 'With Emissions Reduction' and 'Without Emissions Reduction'.

Modelling Methodology

3.8 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs and the model verification are provided in Appendix A4, together with the method used to derive current and future year background nitrogen dioxide concentrations.

4 Site Description and Baseline Conditions

4.1 The proposed development site is located approximately 750 m to the north east of Barnsley town centre. It forms part of the Peel Centre retail park.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2015b) and Environment Agency's 'what's in your backyard' (Environment Agency, 2015) websites did not identify any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Review and Assessment

4.3 Barnsley Metropolitan Borough Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. Seven AQMAs have been declared in the area. The closest AQMA is located on Harborough Hill Road, adjacent to the proposed development site. The AQMA is shown in Figure 1.

Local Air Quality Monitoring

4.4 Barnsley Metropolitan Borough Council operates five automatic monitoring stations within its area. One of these is close to the proposed development site, being set back some 15 m from Harborough Hill Road. Despite being close to the road Barnsley Metropolitan Borough Council class this as an urban background site. The site had some data capture issues in the past, but performed better in 2012 and 2013.

4.5 The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by South Yorkshire Air Quality Samplers (using the 50% TEA in acetone method). These include three deployed along Harborough Hill Road, two along Old Mill Lane and two adjacent to the gyratory to the north of the development site (the monitoring locations are shown in Figure 1). Results for the years 2009 to 2013 are summarised in Table 2. Data for these sites have been taken from Barnsley Metropolitan Borough Council's 2014 Air Quality Progress Report (Barnsley Metropolitan Borough Council, 2014).

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2009-2013) [a]

Site No.	Site Type	Location	2009	2010	2011	2012	2013
Automatic Monitor - Annual Mean (µg/m³) [a]							
AM5	Urban Background [b]	James Street	31	21.1 [c]	n/a	26.3	24.3
Objective			**40**				
Automatic Monitor - No. of Hours > 200 µg/m³							
AM5	Urban Background [b]	James Street	10	0 [c]	n/a	0	0
Objective			**18 [c]**				
Diffusion Tubes - Annual Mean (µg/m³) [d]							
DT43	Kerbside	Old Mill Lane / Honeywell Street	**46.5**	**45.7**	**40.5**	**42.3**	38.8
DT44	Kerbside	Old Mill Lane / Eldon Street	38.0	37.7	37.6	36.1	33.2
DT95	Roadside	40 Harborough Hill Road	**69.1**	**66.5**	**66.0**	**69.0**	**56.9**
DT100	Roadside	Harborough Hill Road – Bakery	**67.9**	**67.3**	**66.6**	**67.1**	**60.1**
DT101	Roadside	Harborough Hill Road / Meadow Street	**40.1**	38.1	36.3	36.7	35.3
DT102	Roadside	Harborough Hill Road / Redfearn Street	37.5	39.6	37.0	39.6	34.3
DT103	Roadside	113 Harborough Hill Road	**46.9**	**45.8**	**44.6**	**44.7**	**40.6**
Objective			**40**				

[a] Exceedences of the objectives are shown in bold

[b] Site AM5 is described by Barnsley Metropolitan Borough Council as being an urban background site, but it would be more appropriately described as being near-road, lying some 15 m from Harborough Hill Road.

[c] 61.1% data capture.

4.6 The results of local monitoring indicate that the annual mean objective is being exceeded along a number of local roads. Along the eastern side of Harborough Hill Road, in particular, concentrations are well above the objective. The data do, however, show a downward trend in measured concentrations in this area of Barnsley over the past five years.

4.7 There are no monitors measuring PM_{10} or $PM_{2.5}$ concentrations close to the proposed development.

Exceedences of EU Limit Value

4.8 There are no AURN monitoring sites within 1 km of the development site with which to identify exceedences of the annual mean nitrogen dioxide limit value. The national map of roadside annual mean nitrogen dioxide concentrations (Defra, 2015c), used to report exceedences of the limit value to the EU, identifies exceedences of the limit value along Harborough Hill Road and along Old Mill Lane either side of the gyratory. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations show no exceedences of the limit values anywhere in the UK. These maps are for 2012 concentrations; detailed maps of predicted future year exceedences are not available.

Background Concentrations

4.9 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2013 and the earliest possible opening year of 2016 (Table 3). While the development site, receptors and monitoring sites lie across four of the 1x1 km grid squares in Defra's background maps, the background concentrations used in this assessment have been taken from the grid square centred at 435500 m E, 406500 m N. These concentrations are considered the most suitable to use, as they are the highest of the three squares in which concentrations are lower than those measured at automatic monitoring site AM5. It would not be appropriate to use background concentrations higher than those measured at AM5. In the case of nitrogen dioxide, two sets of future-year backgrounds are presented to take into account uncertainty in future year vehicle emission factors. The derivation of background concentrations is described in Appendix A4. The background concentrations are all well below the objectives.

Table 3: Estimated Annual Mean Background Pollutant Concentrations in 2013 and 2016 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2013 [a]	22.3	18.0	11.9
2016 – Without Reductions in Traffic Emissions [b]	21.1	n/a	n/a
2016 – With Reductions in Traffic Emissions [c]	20.6	17.2	11.1
Objectives	**40**	**40**	**25**

n/a = not applicable

[a] This assumes that road vehicle emission factors in 2013 remain the same as in 2011 (See Appendix A4).

[b] This assumes that road vehicle emission factors in 2016 remain the same as in 2011.

[c] This assumes that road vehicle emission factors reduce between 2013 and 2016 at the current 'official' rates.

Baseline Dispersion Model Results

4.10 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations (see Figure 1). The results, which cover both the existing (2013) and future year (2016) baseline (Without Scheme), are set out in Table 4 and Table 5. The future baseline for nitrogen dioxide covers the two scenarios: with the official reductions in vehicle emission factors and without these reductions. The modelled road components of nitrogen oxides concentrations have been adjusted by factors of 1.924 for receptors 1 to 5 and 1.090 for receptors 6 to 9, which were derived during the model verification process (see Appendix A4 for details of the model verification). The total NO_2 has been adjusted by secondary verification factors of 1.000 for receptors 1 to 5 and 1.004 for receptors 6 to 9. PM_{10} and $PM_{2.5}$ concentrations at all receptors have been adjusted by the higher primary NOx verification factor of 1.924.

Table 4: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m^3) at Existing Receptors

Receptor	2013	2016 Without Scheme	
		With 'Official' Emissions Reduction [a]	Without Emissions Reduction [b]
1	49.2	41.8	48.4
2	51.1	43.3	50.3
3	51.2	43.5	50.4
4	50.6	43.1	49.8
5	49.3	42.0	48.5
6	36.1	31.6	35.1
7	36.3	31.8	35.3
8	44.9	38.5	44.0
9	44.2	37.9	43.3
Objective	40		

[a] This assumes that road vehicle emission factors reduce between 2013 and 2016 at the current 'official' rates.

[b] This assumes that road vehicle emission factors in 2016 remain the same as in 2013.

Table 5: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors (µg/m^3)

Receptor	PM_{10} [a]		$PM_{2.5}$	
	2013	2016 Without Scheme	2013	2016 Without Scheme
1	20.1	19.1	13.3	12.2
2	20.2	19.2	13.4	12.3
3	20.3	19.2	13.4	12.3
4	20.4	19.3	13.4	12.4
5	20.3	19.2	13.4	12.3
6	20.2	19.2	13.4	12.3
7	20.2	19.2	13.4	12.3
8	21.1	19.9	13.9	12.7
9	21.0	19.8	13.9	12.7
Objective / Criterion	32 [a]		25	

[a] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG(09) (Defra, 2009). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

4.11 The predicted annual mean concentrations of nitrogen dioxide are above the objective at receptors 1 to 5 in every baseline scenario. Concentrations are below the objective at receptors 6 and 7 in every scenario. For receptors 8 and 9, concentrations are above the objective in the 2013 and 2016 without emissions reduction baseline scenarios, but, with the 'official' emissions reduction, baseline concentrations will be below the objective in 2016.

4.12 It is worth noting that the 2013 baseline concentrations at receptors 8 and 9 are considerably higher than those measured at nearby diffusion tube monitoring site DT103 in 2013 (see Table 2). This suggests that the model may be over-predicting concentrations in this area.

4.13 Annual mean concentrations of PM_{10} and $PM_{2.5}$ are well below the objectives in both baseline scenarios. The baseline annual mean PM_{10} concentrations are well below 32 µg/m^3, indicating that the 24-hour mean PM_{10} objective is very unlikely to be exceeded at any receptor.

5 Construction Phase Impact Assessment

5.1 The construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway. The construction dust assessment only considers the impacts from the construction of the new retail unit, as the change of use of the other units is not expected to involve significant construction works.

Potential Dust Emission Magnitude

Demolition

5.2 Demolition works will be fairly minimal, involving the removal of the fences and walls around the existing garden centre, then the breaking up and removal of the concrete floor slab (which could be considered part of the earthworks). The demolition works are not expected to last for more than a month. Based on the example definitions set out in Table A1.1, the dust emission class for demolition is considered to be *small*.

Earthworks

5.3 The site covers some 1,200 m^2 and most of this will be subject to earthworks, involving the breaking up and removal of the existing concrete slab (considered part of the demolition works for this assessment), the provision of appropriate drainage and service connections and the laying of a new concrete floor slab. The earthworks will last for approximately 1 month. Based on the example definitions set out in Table A1.1, the dust emission class for earthworks is considered to be *small*.

Construction

5.4 Construction will consist of a steel portal frame retail warehouse unit with composite steel cladding to walls and roof, with a volume of around 9,000 m^3. The construction will take place over a 7-month period. Based on the example definitions set out in Table A1.1, the dust emission class for construction is considered to be *small*.

Trackout

5.5 The number of vehicles accessing the site, which may track out dust and dirt, is currently unknown, but given the small size of the site it is likely that there will be no more than 10 outward heavy vehicle movements per day. Based on the example definitions set out in Table A1.1, the dust emission class for trackout is considered to be *small*.

5.6 Table 6 summarises the dust emission magnitude for the proposed development.

Table 6: Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	Small
Earthworks	Small
Construction	Small
Trackout	Small

Sensitivity of the Area

5.7 This assessment step combines the sensitivity of individual receptors to dust effects with the number of receptors in the area and their proximity to the site. It also considers additional site-specific factors such as topography and screening, and in the case of sensitivity to human health effects, baseline PM_{10} concentrations.

Sensitivity of the Area to Effects from Dust Soiling

5.8 The IAQM guidance explains that residential properties are 'high' sensitivity receptors to dust soiling, while retail units and short-term car parks, such as those on the Peel Centre, are of 'low' to 'medium' sensitivity (Table A1.2). There are no residential properties within 100 m of the site, but the new unit will be built adjacent to existing retail units and the Peel Centre car park (see Figure 2). Using the matrix set out in Table A1.3, the area surrounding the onsite works is of 'low' sensitivity to dust soiling.

5.9 Table 6 shows that dust emission magnitude for trackout is 'small' and Table A1.3 thus explains that there is a risk of material being tracked 50 m from the site exit. As such, material will not be tracked beyond the access roads to the Peel Centre, and will not be tracked onto the public highway, or close to any receptors other than those on the Peel Centre. Table A1.3 thus indicates that the area is of 'low' sensitivity to dust soiling due to trackout.

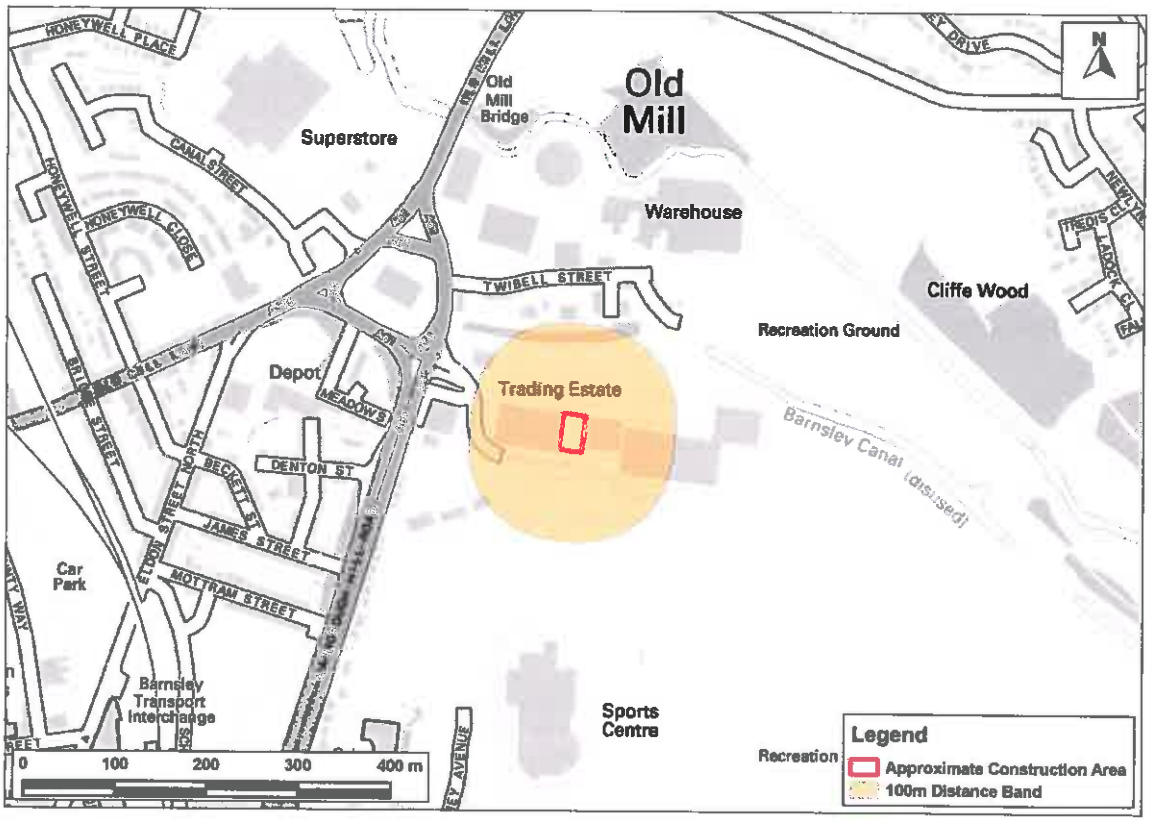


Figure 2: 100 m Distance Band around Construction Area

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Sensitivity of the Area to any Human Health Effects

5.10 Residential properties are also classified as being of 'high' sensitivity to human health effects. The matrix in Table A1.4 requires information on the baseline annual mean PM_{10} concentration in the area. Receptors 4 to 9 in Figure 1 are all within 200 m of the site. The maximum predicted baseline PM_{10} concentration at these receptors is 19.9 µg/m^3 (Table 5), and this is considered a suitably worst-case value to use. Using the matrix in Table A1.4, the area surrounding the onsite works is of 'low' sensitivity to human health effects, as is the area surrounding roads along which material may be tracked from the site.

Sensitivity of the Area to any Ecological Effects

5.11 The guidance only considers designated ecological sites within 50 m to have the potential to be impacted by the construction works. There are no designated ecological sites within 50 m of the site boundary or those roads along which material may be tracked, thus ecological impacts will not be considered further.

5.12 The sensitivity of the area surrounding the site is summarised in Table 7.

Table 7: Summary of the Area Sensitivity

Effects Associated With:	Sensitivity of the Surrounding Area	
	On-site Works	Trackout
Dust Soiling	Low Sensitivity	Low Sensitivity
Human Health	Low Sensitivity	Low Sensitivity

Risk and Significance

5.13 The dust emission magnitudes in Table 6 have been combined with the sensitivities of the area in Table 7 using the matrix in Table A1.6 in Appendix A1, in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 8. These risk categories have been used to determine the appropriate level of mitigation as set out in Section 7.

Table 8: Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling	Human Health
Demolition	Negligible	Negligible
Earthworks	Negligible	Negligible
Construction	Negligible	Negligible
Trackout	Negligible	Negligible

5.14 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally not be significant (Institute of Air Quality Management, 2014).

6 Operational Phase Impact Assessment

Road Traffic Impacts

6.1 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are set out in Table 9, Table 10 and Table 11 for both the "Without Scheme" and "With Scheme" scenarios. These tables also describe the impacts at each receptor using the impact descriptors given in Appendix A2. For nitrogen dioxide, results are presented for two scenarios to reflect current uncertainty in Defra's future-year vehicle emission factors.

Table 9: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2016 (µg/m^3)

Receptor	With 'Official' Emissions Reduction [a]				Without Emissions Reduction [b]			
	Without Scheme	With Scheme	% Change	Impact Descriptor	Without Scheme	With Scheme	% Change	Impact Descriptor
1	41.8	41.9	0	Negligible	48.4	48.6	0	Negligible
2	43.3	43.4	0	Negligible	50.3	50.5	0	Negligible
3	43.5	43.6	0	Negligible	50.4	50.6	0	Negligible
4	43.1	43.2	0	Negligible	49.8	49.9	0	Negligible
5	42.0	42.1	0	Negligible	48.5	48.6	0	Negligible
6	31.6	31.7	0	Negligible	35.1	35.2	0	Negligible
7	31.8	31.8	0	Negligible	35.3	35.4	0	Negligible
8	38.5	38.7	0	Negligible	44.0	44.2	1	Moderate Adverse
9	37.9	38.1	0	Negligible	43.3	43.5	1	Moderate Adverse
Objective	40		-	-	40		-	-

[a] This assumes that road vehicle emission factors reduce between 2013 and 2016 at the current 'official' rates.

[b] This assumes that road vehicle emission factors in 2016 remain the same as in 2013.

Table 10: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2016 ($\mu g/m^3$)

Receptor	Annual Mean PM_{10} ($\mu g/m^3$)			
	Without Scheme	With Scheme	% Change	Impact Descriptor
1	19.1	19.1	0	Negligible
2	19.2	19.2	0	Negligible
3	19.2	19.2	0	Negligible
4	19.3	19.3	0	Negligible
5	19.2	19.2	0	Negligible
6	19.2	19.2	0	Negligible
7	19.2	19.2	0	Negligible
8	19.9	19.9	0	Negligible
9	19.8	19.8	0	Negligible
Criterion	32 [a]		-	-

[a] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG(09) (Defra, 2009). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

Table 11: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2016 ($\mu g/m^3$)

Receptor	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)			
	Without Scheme	With Scheme	% Change	Impact Descriptor
1	12.2	12.2	0	Negligible
2	12.3	12.3	0	Negligible
3	12.3	12.3	0	Negligible
4	12.4	12.4	0	Negligible
5	12.3	12.3	0	Negligible
6	12.3	12.3	0	Negligible
7	12.3	12.3	0	Negligible
8	12.7	12.8	0	Negligible
9	12.7	12.7	0	Negligible
Objective	25		-	-

Nitrogen Dioxide With 'Official' Emissions Reduction

6.2 The annual mean nitrogen dioxide concentrations are above the objective at receptors 1 to 5 with or without the development. Concentrations at receptors 6 to 9 are below the objective with or without the development.

6.3 The rounded percentage changes in concentrations relative to the air quality objective are predicted to be 0% at all receptors. Using the matrix in Table A2.1 (Appendix A2), these impacts are thus described as all being *negligible*.

Nitrogen Dioxide Without Emissions Reduction

6.4 The annual mean nitrogen dioxide concentrations are above the objective at receptors 1 to 5 and 8 and 9, with or without the development, while concentrations at receptors 6 and 7 are below the objective.

6.5 The rounded percentage changes in concentrations relative to the air quality objective are predicted to be 1% at receptors 8 and 9, while the percentage change at receptors 1 to 7 is 0%. Using the matrix in Table A2.1 (Appendix A2), these impacts are described as *moderate adverse* at receptors 8 and 9, and *negligible* at receptors 1 to 7.

6.6 As identified in paragraph 4.12, the model appears to be over-predicting concentrations at receptors 8 and 9, and thus the impacts as described above are likely to be exaggerated.

PM_{10} and $PM_{2.5}$

6.7 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the annual mean objectives at all receptors, with or without the scheme. Furthermore, as the annual mean PM_{10} concentrations are well below 32 $\mu g/m^3$, it is highly unlikely that the 24-hour mean PM_{10} objective will be exceeded at any receptor.

6.8 The rounded percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the air quality criterion/objective, are predicted to be 0% at all receptors. Using the matrix in Table A2.1 (Appendix A2), these impacts are all described as *negligible*.

Uncertainty in Road Traffic Modelling Predictions

6.9 There are many components that contribute to the uncertainty of modelling predictions. The model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as the model is required to simplify real-world conditions into a series of algorithms. An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A4). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2013) concentrations.

6.10 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations, and vehicle emissions. A disparity between the road transport emission projections and measured annual mean concentrations of nitrogen oxides and nitrogen dioxide has been identified by Defra (Carslaw et al., 2011). This is evident across the UK, although the effect appears to be greatest in inner London; there is also considerable inter-site variation. Whilst the emission projections suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25% over the 6 to 8 years prior to 2009, at many monitoring sites levels remained relatively stable, or even showed a slight increase.

6.11 The reason for the disparity is thought to relate to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles is often no better than that of earlier models (Carslaw et al., 2011). The best current evidence is that, where previous standards have had limited on-road success, the 'Euro VI' and 'Euro 6' standards that new vehicles will have to comply with from 2013/15[2] will achieve the expected on-road improvements, as, for the first time, they will require compliance with the World Harmonized Test Cycle, which better represents real-world driving conditions[3] and includes a separate slow-speed cycle for heavy duty vehicles.

6.12 The forecast reductions in nitrogen oxides emissions may still be optimistic in the near-term. To account for this uncertainty, a sensitivity test has been conducted assuming that the future (2016) road traffic emissions per vehicle are unchanged from 2013 values. The predictions within this sensitivity test are likely to be over-pessimistic, as new, lower-emission Euro VI and Euro 6 vehicles will be on the road from 2013/15; according to Defra's Emission Factors Toolkit (Defra, 2015a), by 2016 it is forecast that there will be a roughly 51% penetration of Euro VI HDVs and a roughly 21% penetration of Euro 6 LDVs. These new vehicles are expected to deliver real on-road reductions in nitrogen oxides emissions.

6.13 It should also be borne in mind that the assessment is worst-case in terms of the applied assumption that all of the development traffic will be on the roads in 2016. In reality, the new infill unit may not open until later, and it is highly unlikely that the variation to the goods permitted to be sold from the existing units will have been applied to all of the units. In reality some units may

2 Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

3 The test cycle for real-world emissions for Euro 6 vehicles will not be implemented until about 2017. However, there is still expected to be a substantial improvement in NOx emissions from Euro 6 vehicles (as compared with Euro 5) from 2015 onwards.

never be occupied by retailers who would need the variation in order to be able to trade. As such the assessment is likely to have over-predicted the impacts of the development in 2016.

Significance of Operational Air Quality Impacts

6.14 The operational air quality impacts without mitigation are judged to be *not significant*. This professional judgement is made in accordance with the methodology set out in Appendix A2, and also takes into account the uncertainty over future projections of traffic-related nitrogen dioxide concentrations, which may not decline as rapidly as expected. The latter has been addressed by giving consideration to both sets of modelled results for nitrogen dioxide; those with and without reductions in traffic emissions. It is expected that concentrations will fall in the range between the two sets of results, although in 2016 the impacts are likely to be closer to the 'without reduction' results than the 'with reduction' results.

6.15 More specifically, the judgement that the air quality impacts will be *not significant* without mitigation takes account of the assessment that, despite several receptors experiencing concentrations above the objective, most of the impacts of the scheme will be *negligible*. The *moderate adverse* impacts will also only affect a maximum of six properties in one small terrace.

6.16 *Moderate adverse* impacts will only occur if emissions do not decrease between 2013 and 2016, which seems unlikely given the general downward trend in the monitoring data from this area of Barnsley identified in paragraph 4.6. The only adverse impacts predicted also occur in a location where the model has been identified as likely over-predicting concentrations somewhat, thus these adverse impacts may be exaggerated.

7 Mitigation

Construction Impacts

7.1 Measures to mitigate dust emissions will be required during the construction phase of the development in order to reduce impacts upon nearby sensitive receptors.

7.2 The site has been identified as a *Negligible* Risk site as set out in Table 8, but appropriate best practice mitigation should still be applied to minimise dust emissions. Comprehensive guidance has been published by IAQM (Institute of Air Quality Management, 2014) that describes measures that should be employed, as appropriate, to reduce construction dust impacts. This reflects best practice experience and has been used, together with the professional experience of the consultant and the findings of the dust impact assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A5.

7.3 Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Road Traffic Impacts

7.4 The assessment has shown that the proposed development will have an insignificant impact on local air quality. It is thus considered unnecessary to recommend mitigation for air quality reasons. However, the Air Quality and Emissions Good Practice Planning Guidance (Barnsley Metropolitan Borough Council, 2014) issued by Barnsley Metropolitan Borough Council requires damage costs to be defined. The pollution damage costs attributed to the proposed development's emission changes determine the level of mitigation compensation required to offset the impact of the development. The parameters used to calculate the damage cost, and the total damage costs themselves, are presented in Table 12.

Table 12: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2016 ($\mu g/m^3$)

Item	Parameter
EFT Inputs	
Area	England (Not London)
Year	2016
Development Trip Generation	982 trips per day
%HDV	3.6%
Speed	50 kph
No. of Hours	24
Link Length	10 km
EFT Outputs (Annual Link Emissions)	
NOx (Tonnes/Year)	1.425
PM_{10} (Tonnes/Year)	0.135
Defra IGCB Damage Costs	
NOx (per tonne)	£955
PM_{10} (per tonne)	£48,517
Development Damage Costs	
NOx	£1,361.17 (1 year) £6,805.84 (5 years)
PM_{10}	£6,536.25 (1 year) £32,681.24 (5 years)
Total 5 Year Development Damage Costs	**£39,487.08**

7.5 Mitigation measures proposed as part of the development include:

- The preparation and implementation of a Travel Plan to reduce the reliance on the private car and improve awareness and usage of alternative travel, including car sharing, walking, cycling and public transport. A key target of the Travel Plan will be to reduce the frequency of single occupancy car trips;
- The installation of two electric vehicle charging points; and
- The installation of at least five new cycle parking spaces.

7.6 These mitigation measures are considered sufficient to meet the damage costs outlined in Table 12, to offset the impact of the development. The intention is that the above measures will be

implemented upon occupation of the new retail unit, with only the Travel Plan applying to the variation to the goods permitted to be sold in the other units.

8 Residual Impacts

Construction

8.1 The IAQM guidance is clear that, with appropriate mitigation in place, the residual effect will normally be 'not significant'. The mitigation measures set out in Section 7 and Appendix A5 are based on the IAQM guidance. With these measures in place and effectively implemented the residual effects are judged to be *insignificant*.

8.2 The IAQM guidance does, however, recognise that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. During these events, short-term dust annoyance may occur, however, the scale of this would not normally be considered sufficient to change the conclusion that overall the effects will be *insignificant*.

Road Traffic Impacts

8.3 The assessment has concluded that the proposed development will have an insignificant impact on air quality, so no direct mitigation is proposed. As such, the residual impacts will be the same as those identified in Section 6.

9 Conclusions

9.1 The construction works have the potential to create dust. During construction it will therefore be necessary to apply a package of mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be 'not significant'. However, the guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will not be significant.

9.2 The operational impacts of increased vehicle emissions arising from the additional traffic on local roads, due to the development, have been assessed. Concentrations have been modelled for nine worst-case receptors, representing existing properties where impacts are expected to be greatest. In the case of nitrogen dioxide, the modelling has been carried out assuming both that vehicle emissions decrease (using 'official' emission factors), and that they do not decrease in future years. This is to allow for uncertainty over emission factors for nitrogen oxides identified by Defra (Carslaw et al., 2011).

9.3 It is concluded that concentrations of PM_{10} and $PM_{2.5}$ will remain well below the objectives at all existing receptors in 2016, whether the scheme is developed or not. The impacts at the selected receptors will all be *negligible*.

9.4 In the case of nitrogen dioxide, the annual mean concentrations will remain below the objective at receptors 6 and 7 in 2016, whether the scheme is developed or not, and whether or not a reduction in vehicle emissions of nitrogen oxides is assumed. Concentrations will remain above the objective at receptors 1 to 5, whether the scheme is developed or not, and whether or not a reduction in vehicle emissions of nitrogen oxides is assumed. For receptors 8 and 9, concentrations will be below the objective if a reduction in vehicle emissions of nitrogen oxides is assumed, but will be above the objective if no reduction in vehicle emissions of nitrogen oxides is assumed, whether the scheme is developed or not.

9.5 The assessment has demonstrated that there will be no significant increase in concentrations of PM_{10} and $PM_{2.5}$ (rounded changes are all 0%), but that there will be an increase of up to 1% in concentrations of nitrogen dioxide. The resulting impacts will be mostly *negligible*. *Moderate adverse* impacts will only occur if there is no reduction in vehicle emissions of nitrogen oxides between 2013 and the year of opening of the proposed development, which seems unlikely given the downward trend in local monitored concentrations over recent years. *Moderate adverse* impacts would also only affect a maximum of six properties, with all other properties in the local area experiencing *negligible* impacts.

9.6 The overall operational air quality impacts of the development are judged to be *insignificant*. This conclusion, which takes account of the uncertainties in future projections, in particular for nitrogen dioxide, is based on the impacts at almost all local receptors being *negligible*.

9.7 Given that the operational impacts have been judged to be insignificant, no mitigation is considered necessary for air quality reasons. However, Barnsley Metropolitan Borough Council's Air Quality and Emissions Good Practice Planning Guidance (Barnsley Metropolitan Borough Council, 2014) requires damage costs to be defined, with these costs determining the level of mitigation compensation required to offset the impact of the development. The scheme design incorporates the preparation and implementation of a Travel Plan, the provision of two electric vehicle charging points and the provision of at least five new cycle parking spaces. These measures are considered sufficient to meet the damage costs calculated and thus offset the impact of the development.

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11 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDF	Local Development Framework
LDV	Light Duty Vehicles (<3.5 tonnes)
µg/m^3	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides

PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide

12 Appendices

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A1 Construction Dust Assessment Procedure

A1.1 The criteria developed by IAQM, divide the activities on construction sites into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

A1.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

A1.3 An assessment is required where there is a human receptor within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A1.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will not be significant. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

A1.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

A1.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

A1.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM explains that this classification should be based on professional judgement, but provides the examples in Table Table A1.1.

Table A1.1: Examples of How the Dust Emission Magnitude Class May be Defined

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

[a] These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

A1.8 The sensitivity of the area is defined taking account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentration; and
- site-specific factors, such as whether there are natural shelters to reduce the risk of wind-blown dust.

A1.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM recommends that this should be based on professional judgment, taking account of the principles in Table A1.2. These receptor sensitivities are then used in the matrices set out in Table A1.3, Table A1.4 and Table A1.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

A1.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the *risk* of impacts with no mitigation applied. The IAQM provides the matrix in Table A1.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

A1.11 The IAQM provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided by the IAQM has been used as the basis for the requirements set out in Appendix A5.

STEP 4: Determine Significant Effects

A1.12 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally not be significant (Institute of Air Quality Management, 2014).

A1.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will not be significant.

Table A1.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	users can reasonably expect enjoyment of a high level of amenity; or the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected a to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or the appearance, aesthetics or value of their property could be diminished by soiling; or the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; or there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land	playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM_{10}		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	locations with an international or national designation and the designated features may be affected by dust soiling; or locations where there is a community of a particularly dust sensitive species	Special Areas of Conservation with dust sensitive features
Medium	locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or locations with a national designation where the features may be affected by dust deposition	Sites of Special Scientific Interest with dust sensitive features
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table A1.3: Sensitivity of the Area to Effects on People and Property from Dust Soiling [4]

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A1.4: Sensitivity of the Area to Human Health Effects [4]

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

[4] For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table A1.5: Sensitivity of the Area to Ecological Effects [4]

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

Table A1.6: Defining the Risk of Dust Impacts

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

A2 EPUK & IAQM Planning for Air Quality Guidance

A2.1 The guidance issued by EPUK and IAQM[5] (EPUK & IAQM, 2015) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air quality as a material consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A2.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A2.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1ha or more.

A2.4 The good practice principles are that:

[5] The IAQM is the professional body for air quality practitioners in the UK.

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A2.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

A2.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A2.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the follow apply:

- 10 or more residential units or a site area of more than 0.5ha residential use;
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1ha.

A2.8 Coupled with any of the following:

- the development has more than 10 parking spaces;
- the development will have a centralised energy facility or other centralised combustion process.

A2.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, the criteria for which are set out below. The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria is likely to be more appropriate.

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights, or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor;
- the development will have one or more substantial combustion processes where the combustion unit is:
    - any centralised plant using bio fuel;
    - any combustion plant with thermal input >400kW; or
    - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used >18 hours a year).

A2.10 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area.

A2.11 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A2.12 There is no official guidance in the UK on how to describe the nature of air quality impacts, nor how to assess their significance. The approach developed by EPUK and IAQM[6] (EPUK & IAQM, 2015) has therefore been used. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A2.13 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A2.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A2.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

[6] The IAQM is the professional body for air quality practitioners in the UK.

Assessment of Significance

A2.14 The IAQM guidance (EPUK & IAQM, 2015) is that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either significant or not significant. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as 'slight' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a 'moderate' or 'substantial' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A2.15 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A2.16 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A3.

A3 Professional Experience

Stephen Moorcroft, BSc (Hons) MSc DIC MIEnvSc MIAQM CEnv

Mr Moorcroft is a Director of Air Quality Consultants, and has worked for the company since 2004. He has over thirty-five years' postgraduate experience in environmental sciences. Prior to joining Air Quality Consultants, he was the Managing Director of Casella Stanger, with responsibility for a business employing over 100 staff and a turnover of £12 million. He also acted as the Business Director for Air Quality services, with direct responsibility for a number of major Government projects. He has considerable project management experience associated with Environmental Assessments in relation to a variety of development projects, including power stations, incinerators, road developments and airports, with particular experience related to air quality assessment, monitoring and analysis. He has contributed to the development of air quality management in the UK, and has been closely involved with the LAQM process since its inception. He has given expert evidence to numerous public inquiries, and is frequently invited to present to conferences and seminars. He is a Member of the Institute of Air Quality Management.

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is a Principal Consultant with AQC, with more than fifteen years' relevant experience in the field of air quality. She has been responsible for air quality assessments of a wide range of development projects, covering retail, housing, roads, ports, railways and airports. She has also prepared air quality review and assessment reports and air quality action plans for local authorities and appraised local authority assessments and air quality grant applications on behalf of the UK governments. Ms Wilson has arranged air quality and dust monitoring programmes and carried out dust and odour assessments. She has provided expert witness services for planning appeals and is a Chartered Scientist and Member of the Institute of Air Quality Management.

Ricky Gellatly, BSc (Hons) AMIEnvSc AMIAQM

Mr Gellatly is a Senior Consultant with AQC with over three years' relevant experience. Prior to joining AQC he worked as an air quality consultant at Odournet UK Ltd. He has also worked as an oceanographer, and holds a first class degree in meteorology and oceanography from the University of East Anglia. He has undertaken air quality assessments for a wide range of projects, assessing many different pollution sources using both qualitative and quantitative methodologies, with most assessments having included dispersion modelling (using a variety of models). He has assessed road schemes, energy from waste facilities, anaerobic digesters, poultry farms, urban extensions, rail freight interchanges, energy centres, waste handling sites, sewage works and shopping and sports centres, amongst others. He also has experience in ambient air quality

monitoring, the analysis and interpretation of air quality monitoring data, monitoring and assessment of nuisance odours and the monitoring and assessment of construction dust.

Full CVs are available at www.aqconsultants.co.uk.

A4 Modelling Methodology

Background Concentrations

A4.1 The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015a). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. As noted in Paragraph 6.10, there is evidence that the current 'official' emissions factors published by Defra may over-predicted the rate at which road traffic emissions of nitrogen oxides will fall in the future. The maps currently in use were verified against measurements made during 2011 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2011. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A4.2 In order to calculate background nitrogen dioxide and nitrogen oxides concentrations in 2013, it is assumed that there was no reduction in the road traffic component of backgrounds between 2011[7] and 2013. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2015a). For each grid square, the road traffic component has been held constant at 2011 levels, while 2013 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2015a) publishes to accompany the maps. The result is a set of 'adjusted 2013 background' concentrations.

A4.3 Two separate sets of 2016 background nitrogen dioxide and nitrogen oxides concentrations have been used for the future-year assessment. The 2016 background 'without emissions reduction' has been calculated using the same approach as described for the 2013 data: the road traffic component of background nitrogen oxides has been held constant at 2011 values, while 2016 data are taken for the other components. Nitrogen dioxide has then been calculated using Defra's background nitrogen dioxide calculator. The 2016 background 'with emissions reduction' assumes that Defra's revised predicted reductions occur from 2013 onward. This dataset has been derived first by calculating the ratio of the unadjusted mapped value for 2016 to the unadjusted mapped value for 2013. This ratio has then been applied to the adjusted 2013 value (as derived in Paragraph A4.2).

A4.4 For PM_{10} and $PM_{2.5}$, there is no strong evidence that Defra's predictions are unrealistic and so the year-specific mapped concentrations have been used in this assessment.

[7] This approach assumes that there has been no reduction in emissions per vehicle, but that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. This discrepancy is unlikely to influence the overall conclusions of the assessment.

Model Inputs

Road Traffic

A4.5 Predictions have been carried out using the ADMS-Roads dispersion model (v3.4). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.2) published by Defra (2015a). For nitrogen dioxide, future-year concentrations have been predicted once using year-specific emission factors from the EFT, and once using emission factors for 2013[8], which is the year for which the model has been verified.

A4.6 The model has been run using the full year of meteorological data that corresponds to the most recent set of nitrogen dioxide monitoring data (2013). The meteorological data has been taken from the monitoring station located at Church Fenton, which is considered suitable for this area. Barnsley Metropolitan Borough Council requested that either Church Fenton or Finningley be used, and the site at Church Fenton is considered more representative of the area around the proposed development, as there are more buildings around the measurement site.

A4.7 AADT flows, diurnal flow profiles and %HDV data have been provided by TTHC Ltd. Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A4.1. Figure A4.1 shows the road network included within the model, labelled by road link, along with the colour-coded modelled speeds (kph) along each link, and defines the study area.

[8] i.e. combining current-year emission factors with future-year traffic data.

Table A4.1: Summary of Traffic Data used in the Assessment (AADT)

Road Link	2013		2016 (Without Scheme)		2016 (With Scheme)	
	AADT	%HDV	AADT	%HDV	AADT	%HDV
1	13,217	7.3%	13,351	7.3%	13,485	7.3%
2	13,217	7.3%	13,351	7.3%	13,485	7.3%
3	13,217	7.3%	13,351	7.3%	13,485	7.3%
4	11,392	7.6%	11,490	7.6%	11,576	7.6%
5	11,392	7.6%	11,490	7.6%	11,576	7.6%
6	11,392	7.6%	11,490	7.6%	11,576	7.6%
7	11,392	7.6%	11,490	7.6%	11,576	7.6%
8	13,217	7.3%	13,351	7.3%	13,485	7.3%
9	1,972	3.3%	1,972	3.3%	2,209	3.3%
10	1,972	3.3%	1,972	3.3%	2,209	3.3%
11	11,663	6.9%	11,737	6.9%	11,740	6.9%
12	11,245	8.0%	11,380	8.0%	11,276	8.0%
13	4,025	3.6%	4,025	3.6%	4,533	3.6%
14	26,933	6.9%	27,142	6.9%	27,549	6.8%
15	13,634	6.0%	13,709	6.0%	13,949	6%
16	26,185	6.9%	26,380	6.9%	26,706	6.8%
17	15,788	6.5%	15,988	6.5%	16,159	6.4%
18	15,788	6.5%	15,988	6.5%	16,159	6.4%
19	33,160	6.4%	33,559	6.4%	33,815	6.4%
20	17,372	6.3%	17,571	6.3%	17,656	6.3%
21	11,445	6.8%	11,458	6.8%	11,686	6.7%
22	28,068	6.9%	28,277	6.9%	28,618	6.8%
23	20,796	6.9%	21,018	6.9%	21,117	6.9%
24	9,505	6.9%	9,609	6.9%	9,651	6.9%
25	16,776	6.8%	16,868	6.8%	17,145	6.8%
26	11,292	6.9%	11,409	6.9%	11,466	6.9%
27	20,796	6.9%	21,018	6.9%	21,117	6.9%

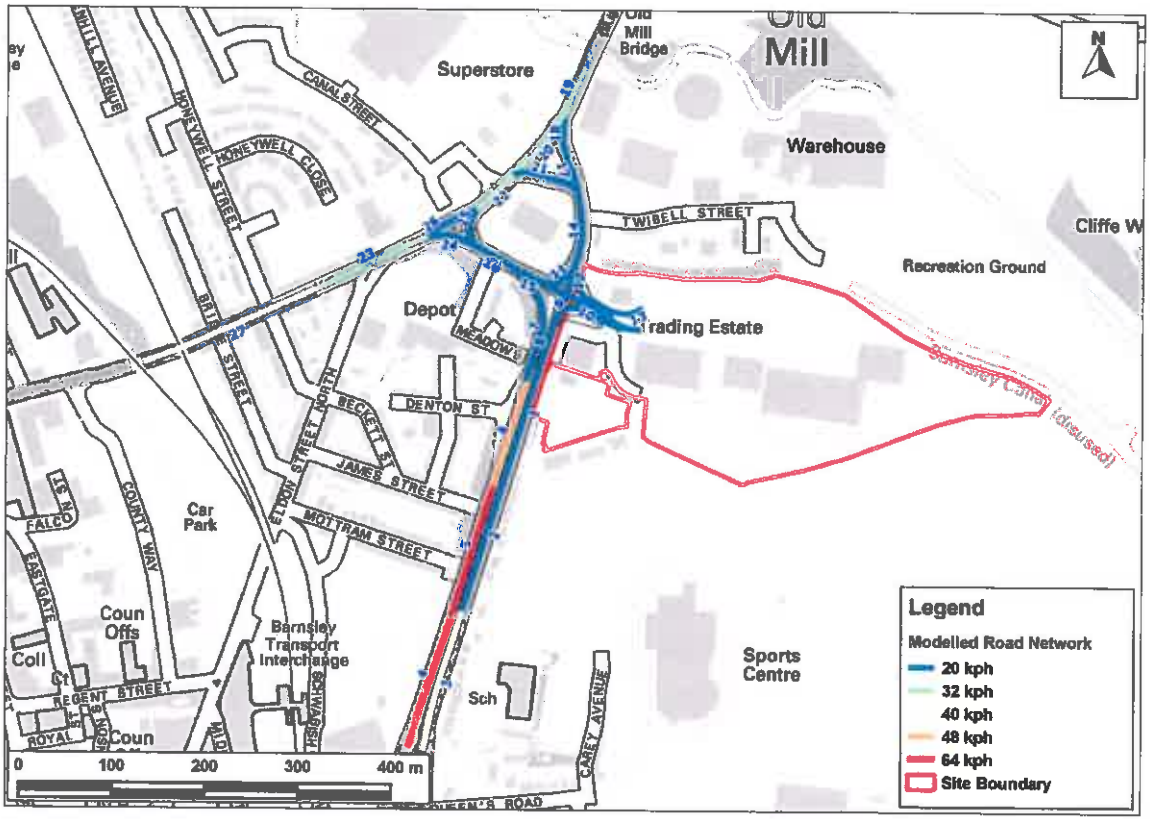


Figure A4.1: Modelled Road Network

Contains Ordnance Survey data © Crown copyright and database right 2015

A4.8 Where roads are on gradients, an adjustment has been made to the HDV emissions as recommended by Defra (Defra, 2009). Gradients have been calculated from freely available gridded Ordnance Survey Panorama data at 50 m resolution.

Model Verification

A4.9 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. The verification methodology is described below.

A4.10 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2013 at seven nearby diffusion tube monitoring sites.

A4.11 Two separate verification factors have been applied, based on the settings of receptors and monitors. One has been used for receptors adjacent to the southbound carriage of Harborough Hill Road (those worst affected by traffic pollution due to vehicles travelling uphill on this carriage), and another for all other locations. Diffusion tube sites DT95 and DT100 have been used for the

Harborough Hill Southbound verification, while diffusion tube sites DT43, DT44, DT101, DT102 and DT103 for the verification for all other locations.

A4.12 For each scenario, the model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 4.1) available on the Defra LAQM Support website (Defra, 2015a).

A4.13 A primary adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A4.2 and Figure A4.3). This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. A secondary adjustment factor has finally been calculated as the slope of the best-fit line applied to the adjusted data and forced through zero (Figure A4.4 and Figure A4.5).

A4.14 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

- Primary adjustment factor (Harborough Hill Road Southbound): 1.924
- Primary adjustment factor (All other locations): 1.099
- Secondary adjustment factor (Harborough Hill Road Southbound): 1.000
- Secondary adjustment factor (All other locations): 1.004

A4.15 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

A4.16 Figure A4.6 and Figure A4.7 compare final adjusted modelled total NO_2 concentrations at each of the monitoring sites to measured total NO_2, and shows a 1:1 relationship.

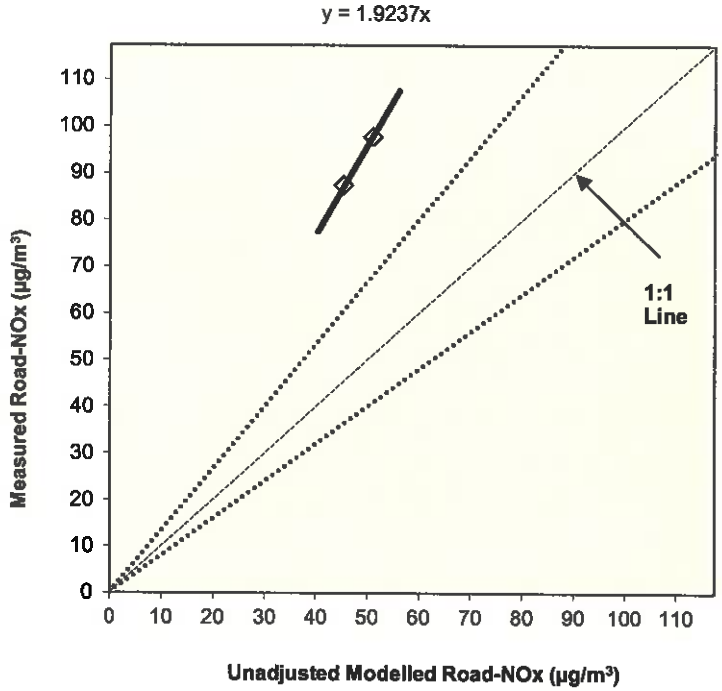


Figure A4.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations (Harborough Hill Road Southbound). The dashed lines show ± 25%.

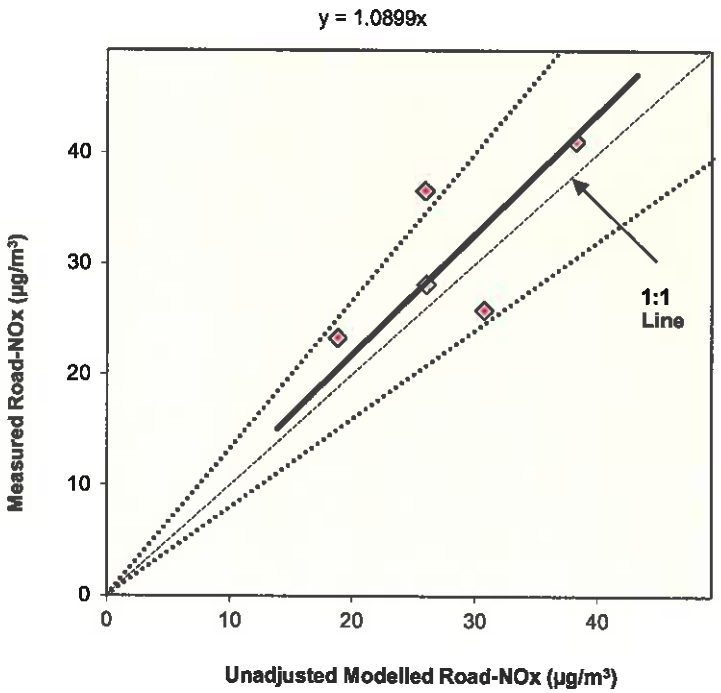


Figure A4.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations (All Other Locations). The dashed lines show ± 25%.

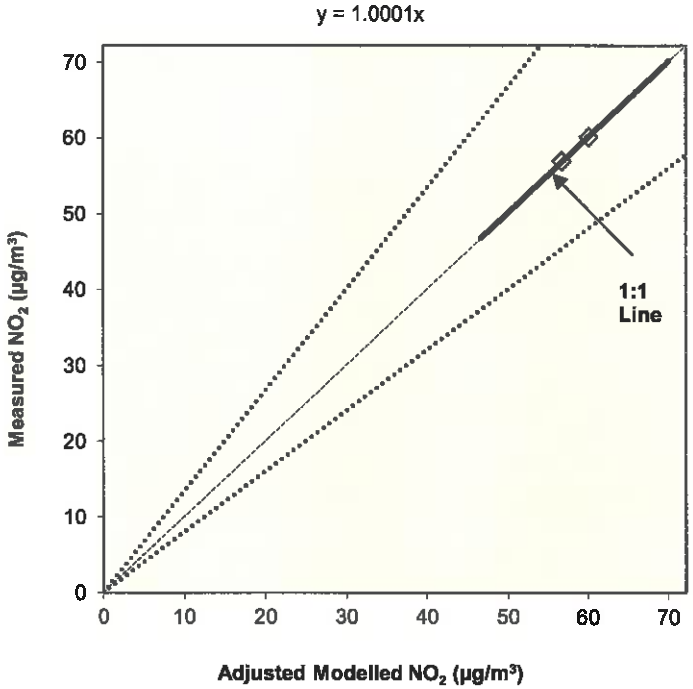


Figure A4.4: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations (Harborough Hill Road Southbound). The dashed lines show ± 25%.

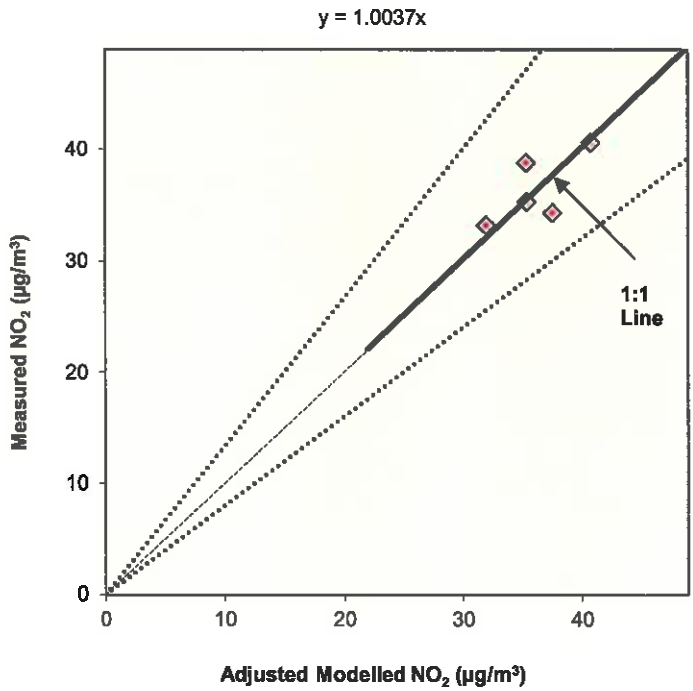


Figure A4.5: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations (All Other Locations). The dashed lines show ± 25%.

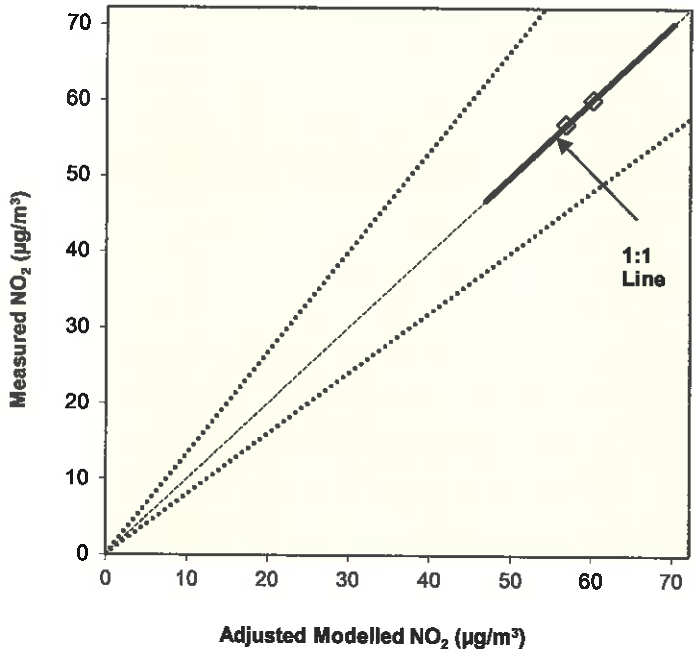


Figure A4.6: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations (Harborough Hill Road Southbound). The dashed lines show ± 25%.

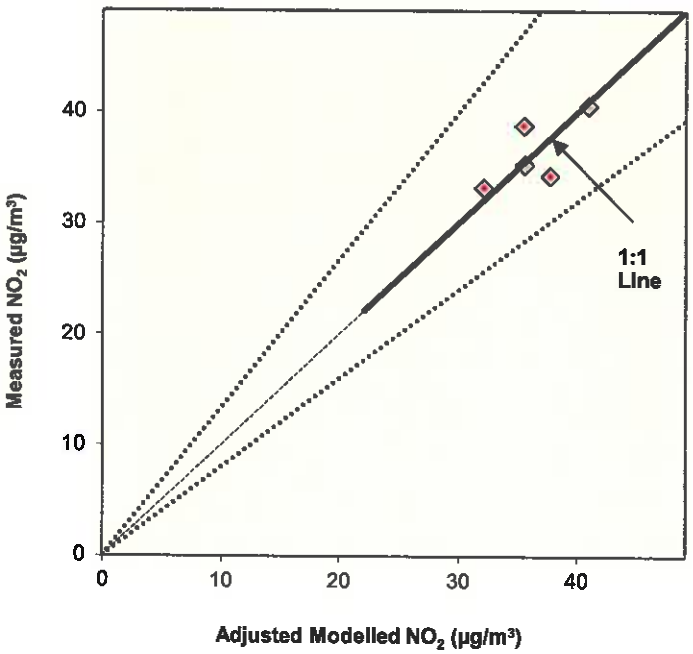


Figure A4.7: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations (All Other Locations). The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A4.17 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the primary adjustment factor calculated for road NOx. In order to be conservative the higher primary verification factor calculated for Harborough Hill Road Southbound has been applied at all receptors.

Model Post-processing

A4.18 The model predicts road-NOx concentrations at each receptor location. These concentrations have then been adjusted using the primary adjustment factor, which, along with the background NO_2, is processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2015a). The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. This is then adjusted by the secondary adjustment factor to provide the final predicted concentrations.

A5 Construction Mitigation

A5.1 The following is a set of measures that should be incorporated into the specification for the works:

Communications

- 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; and
- display the head or regional office contact information.

Site Management

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken;
- make the complaints log available to the local authority when asked; and
- 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.

Preparing and Maintaining the Site

- avoid site runoff of water or mud.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all vehicles switch off their engines when stationary – no idling vehicles; and
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable.

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems; and
- ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground;
- avoid explosive blasting, using appropriate manual or mechanical alternatives; and
- bag and remove any biological debris or damp down such material before demolition.