Lidl

Former William Freeman Site, Wakefield Road, Mapplewell

Air Quality Assessment

Project No. 442852/AQ/01 (00)

DECEMBER 2017

RSK GENERAL NOTES

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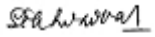
Signature		Signature	
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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Group plc.

Abbreviations

AQMA	Air Quality Management Area
AQOs	Air Quality Objectives
AQSs	Air Quality Standards
BMBC	Barnsley Metropolitan Borough Council
CO	Carbon Monoxide
COCP	Code of Construction Practice
DEFRA	Department of Environment, Food and Rural Affairs
EC	European Commission
EU	European Union
LDV	Light Duty Vehicle
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
NAQS	National Air Quality Strategy
NPPF	National Planning Policy Framework
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NRMM	Non Road Mobile Machinery
RSK	RSK Environment Limited
$PM_{2.5}$	Particulate matter of size fraction approximating to <2.5mm diameter
PM_{10}	Particulate matter of size fraction approximating to <10mm diameter

Contents

1 INTRODUCTION 6

2 LEGISLATION, PLANNING POLICY AND GUIDANCE 7

2.1 Air Quality Strategy 7

2.1.1 Air Quality Objectives and Standards 7

2.1.2 The Environment Act 8

2.2 Planning Policy and Guidance 8

2.2.1 National Planning Policy Framework 8

2.2.2 Guidance Document – Land-Use Planning & Development Control: Planning for Air Quality 8

2.2.3 Local Planning Policy 9

2.2.4 Local Planning Guidance 9

3 ASSESSMENT SCOPE AND METHOD 10

3.1 Overall Approach 10

3.2 Baseline Characterisation 10

3.3 Construction Phase 10

3.4 Operation Phase Impact Assessment 11

3.5 Pollutant Cost Calculation 11

4 BASELINE AIR QUALITY CHARACTERISATION 12

4.1 Air Quality Management Areas 12

4.2 Local Urban Background Monitoring 12

4.3 DEFRA Estimated Background Concentrations 13

4.4 Exhaust Emissions from Plant and Vehicles 14

4.5 Fugitive Dust Emissions 14

4.6 Construction Phase Dust Impact Risk 15

4.6.1 Potential Dust Emission Magnitude 15

4.6.2 Sensitivity of the Area (Pathway and Receptor) 16

4.6.3 Risk of Impacts 19

5 OPERATIONAL PHASE ASSESSMENT METHODOLOGY 20

5.1 Modelling Software 20

5.2 Modelling Scenarios and Traffic Data 20

5.3 Emission Factors 20

5.4 Committed and Consented Developments 20

5.5 Receptor Locations 21

5.6 Time-Varying Profile 24

5.7 Meteorological Data 24

5.8 Background Air Quality Data Used in the Modelling 25

5.9 Other Model Input Parameters 25

5.10 Interpretation of modelled NOx, PM_{10} and $PM_{2.5}$ concentrations 25

5.11 Assessment and comparison to air quality standards 26

6.12 Additional Uncertainties and Assumptions 26

6 IMPACT ASSESSMENT 28

6.1 Operational Phase Air Quality Assessment 28

6.1.1 Impacts of the Development on Local Air Quality 28
6.1.2 Impact of Future Air Quality on the Proposed Sensitive Receptors 33
6.2 Significance of Effects 33
7 MITIGATION MEASURES 34
7.1 Construction Phase 34
7.1.1 Fugitive Dust Control Measures 34
7.1.2 Exhaust Emissions from Plant and Vehicles 36
7.2 Operational Phase 37
8 CONCLUSIONS 38
9 References 40
Estimation of pollutant costs 58

APPENDICES

Appendix A Construction Dust Assessment Methodology 41
Appendix B Operation Impact Assessment Methodology 47
Appendix C Traffic data 48
Appendix D Modelling of Operational Phase – Verification Methodology and Model Results 52
Annex E - Pollutant Cost Calculation 58

1 INTRODUCTION

RSK Environment Ltd (RSK) was commissioned to undertake an assessment of the potential air quality impacts associated with the proposed Lidl store and associated car parking (approximately 139 spaces) at the former William Freeman site, Wakefield Road, Mapplewell. The proposed development falls within the jurisdiction of Barnsley Metropolitan Borough Council (BMBC).

This report presents the findings of an assessment of existing/baseline air quality conditions and the impact of ambient air quality on the surrounding area. The report also recommends mitigation measures as appropriate.

Figure 1.1 shows the location of the former William Freeman site. The proposed Lidl development would be located in the southern section of the site.

Figure 1.1: Proposed Development Site Location

2 LEGISLATION, PLANNING POLICY AND GUIDANCE

2.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The latest *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The EU (European Union) Air Quality Framework Directive (1996) established a framework under which the EU could set limit or target values for specified pollutants. The directive identified pollutants for which limit or target values have been, or will be set in subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

2.1.1 Air Quality Objectives and Standards

The air quality standards in the United Kingdom are derived from European Commission (EC) directives and are adopted into English law via the Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002. The Air Quality Limit Values Regulations 2003 and subsequent amendments implement the EU Air Quality Framework Directive into English Law. Directive 2008/50/EC was translated into UK law in 2010 via the Air Quality Standards Regulations 2010.

The relevant[1] air quality objectives and air quality standards (AQSs) for England and Wales to protect human health are summarised in Table 2.1. The standard for $PM_{2.5}$ is a target value and is not legally binding.

Table 2.1: Air Quality Objectives and standards relevant to the development

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (µg/m^3)
Nitrogen dioxide (NO_2)	1 calendar year	-	40
	1 hour	18	200
Particles (PM_{10})	1 calendar year	-	40
	24 hours	35	50
$PM_{2.5}$	1 year	N/A	25

[1] Relevance, in this case, is defined by the scope of the assessment.

2.1.2 The Environment Act

The set objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995). If exceedances are measured or predicted through the review and assessment process, the local authority must declare an air quality management area (AQMA) under Section 83 of the Act, and produce an air quality action plan to outline how air quality is to be improved.

2.2 Planning Policy and Guidance

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can be a material consideration in the determination of planning applications.

2.2.1 National Planning Policy Framework

In March 2012 The National Planning Policy Framework (NPPF) was published, superseding the bulk of previous Planning Policy Statements with immediate effect. The National Planning Policy Framework was intended to simplify the planning system and includes a presumption in favour of sustainable development.

Section 11 of the NPPF deals with Conserving and Enhancing the Natural Environment, and states that the intention is that the planning system should prevent '*development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability*' and goes on to state that '*new development* [should be] *appropriate for its location' and 'the effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account*.'

With specific regard to air quality, the NPPF states 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'.*

2.2.2 Guidance Document – Land-Use Planning & Development Control: Planning for Air Quality

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) jointly published a guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017. It provides a framework for air quality considerations within local development control processes, promoting a consistent approach to the treatment of air quality. The approach for assessing the significance of air quality impacts associated with a development is employed in this assessment, and is outlined

in Appendix B. The guidance note is widely accepted as the most appropriate reference method for this purpose.

2.2.3 Local Planning Policy

BMBC adopted its Core Strategy in 2011, a spatial strategy for the future development of Barnsley up to the year 2026.

Policy CSP 41 (Development in Air Quality Management Areas) is most relevant to this assessment and states:

"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."

2.2.4 Local Planning Guidance

BMBC published their *'Air Quality and Emissions: Good Practice Guidance'* in September 2014. The guidance provides a template for integrating air quality considerations into land-use planning and development management policies that can influence the reduction of road transport emissions.

The Guidance recommends that the air quality assessments follow a three stage process:

1. Determining the classification of the development proposal;
2. Assessing and quantifying the impact on local air quality;
3. Determining the level of a mitigation required by the proposal to meet Local Development Plan requirements.

3 ASSESSMENT SCOPE AND METHOD

3.1 Overall Approach

The approach taken for assessing the potential air quality impacts of the proposed development may be summarised as follows:

- characterisation of baseline characterisation of local air quality;
- advanced dispersion modelling assessment of air quality impacts of the proposed developments under the following scenarios:
  1. **Scenario 1 (S1):** Base case (2016);
  2. **Scenario 2 (S2):** Without development scenario (2018) - traffic during the anticipated year of proposed development operation/ year of maximum movements without the proposed development in place but with committed and consented developments (as described in section 6.4); and
  3. **Scenario 3 (S3):** With-development scenario (2018) - traffic during the anticipated year of proposed development operation/ year of maximum movements with the proposed development in place (as described in section 6.4).
- recommendation of mitigation measures, where appropriate, for any adverse effects on air quality, including a damage cost assessment; and,
- assessment of residual impacts resulting from the proposed development.

3.2 Baseline Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

A desk based study has been undertaken using data obtained from continuous and diffusion tube monitoring stations maintained by BMBC and from the LAQM (Local Air Quality Management) Support/ United Kingdom Atmospheric Information Resource (UK-AIR) website maintained by the Department for Environment, Food and Rural Affairs (Defra).

3.3 Construction Phase

Construction of the proposed development may have the potential to lead to the release of fugitive dust and PM_{10}. There are human receptors within 350m of the boundary of the site and within 50m of the trackout route; therefore, a full qualitative construction impact assessment has been undertaken.

Appendix A explains how the magnitude of impacts associated with demolition, earthworks, construction and trackout, is combined with the sensitivity of ecological receptors, and human receptors to particulate matter and dust nuisance, to determine the overall dust risk.

3.4 Operation Phase Impact Assessment

Dispersion modelling was undertaken to determine the impact of ambient air quality on receptors at and around the proposed development site. The method utilised to determine the significance of impacts associated with the proposed development was the EPUK-IAQM guidance (see Appendix B).

Section 6 identifies the methodology adopted to undertake the operational phase assessment.

3.5 Pollutant Cost Calculation

As requested by BMBC and in line with the 'Air quality and emissions: good practice planning guidance' (BMBC, 2014), a pollutant cost calculation has been undertaken in Appendix G. The pollutant cost calculation is an estimated monetary value based on pollutant emissions from operational phase traffic generated by the proposed development.

4 BASELINE AIR QUALITY CHARACTERISATION

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

The background concentration often represents a large proportion of the total pollution concentration, so it is important that the background concentration selected for the assessment is realistic. LAQM.TG16 recommends Defra mapped concentration estimates are used to inform background concentrations in air quality modelling and states that: *"Where appropriate these data can be supplemented by and compared with local measurements of background, although care should be exercised to ensure that the monitoring site is representative of background air quality"*.

For this assessment, the following public sources of information have been used to characterise the background air quality:

- Published results of local authority review and assessment studies of air quality, including local monitoring and modelling studies; and
- Estimated background concentrations in the UK-AIR/ LAQM Support website operated by Defra.

In the following paragraphs is a detailed description of how the baseline air quality has been characterised.

4.1 Air Quality Management Areas

The local authority, Barnsley Metropolitan Borough Council (BMBC), has designated six Air Quality Management Areas (AQMAs) due to elevated concentrations of nitrogen dioxide (NO_2) attributable to road traffic emissions.

The Application Site is not located within or close to any of the six designated AQMAs.

4.2 Local Urban Background Monitoring

Monitors at urban background locations measure concentrations away from the local influence of emission sources and are therefore broadly representative of residential areas within large conurbations. Monitoring at local urban background locations is considered an appropriate source of data for the purposes of describing baseline air quality for this Proposed Development site.

There is one local monitoring station where urban background concentrations of NO_2 are measured using continuous automatic instruments: Barnsley Gawber (CM3). The

most recently measured annual-mean concentrations are presented in Table 4.1. There are no urban background monitoring stations which measure PM_{10} in the vicinity of the site.

Table 4.1: Automatically Monitored Urban Background Annual-Mean NO_2 Concentrations

Monitor Name (Code)	Approx distance from proposed devt. (km)	Concentration (µg/m^3)				
		2012	2013	2014	2015	2016
Barnsley Gawber (CM3)	2.8	21.0	22.0	19.0	19.0	19.0

In addition, BMBC manually monitors NO_2 concentrations at a number of urban background locations using passive diffusion tubes and the most measured annual-mean concentrations are presented in Table 4.2.

Table 4.2: Passively Monitored Urban Background Annual-Mean NO_2 Concentrations

Monitor Name (Code)	Approx distance from proposed devt. (km)	Concentration (µg/m^3)				
		2012	2013	2014	2015	2016
Lansdowne Crescent, Darton (DT10)	3.2	31.6	28.8	30.3	29.6	29.1

4.3 DEFRA Estimated Background Concentrations

In addition to local monitoring data, estimated background air quality data are available from the LAQM Support website operated by Defra. The website provides estimated annual average background concentrations of nitrogen oxides (NO_x), NO_2, PM_{10} and $PM_{2.5}$ on a 1 km^2 grid basis. Table 4.2 reproduces estimated annual average background NO_2, PM_{10} and $PM_{2.5}$ concentrations for the 1km^2 containing the proposed development site for the years 2015 through to 2018.

In 2015, no exceedances of the annual mean AQSs for these pollutants is anticipated at background locations within the square, with concentrations estimated to decrease year on year until 2018.

Table 4.3: Estimated Background Annual Average NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Proposed Development Site

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Support Website		
	Annual Average NO_2 ($\mu g/m^3$)	Annual Average PM_{10} ($\mu g/m^3$)	Annual Average $PM_{2.5}$ ($\mu g/m^3$)
2015	13.9	11.8	7.9
2016	13.4	11.7	7.8
2017	13.0	11.6	7.7
2018	12.4	11.5	7.6
Air Quality Standard	**40**	**40**	**25**

Notes: Presented concentrations for 1 km^2 grid centered on 434500,409500.

Atmospheric emissions from construction activities will depend on a combination of the potential for emissions (the type of activity and prevailing conditions) and the effectiveness of control measures. In general terms, there are two sources of emissions that will need to be controlled to minimise the potential for adverse environmental effects:

- exhaust emissions from site plant, equipment and vehicles; and
- fugitive dust emissions from site activities.

4.4 Exhaust Emissions from Plant and Vehicles

The operation of vehicles and equipment powered by internal combustion engines results in the emission of exhaust gases containing the pollutants oxides of nitrogen (NOx), PM_{10}, volatile organic compounds, and carbon monoxide (CO). The quantities emitted depend on factors such as engine type, service history, pattern of usage and fuel composition.

Vehicle and plant movements will result in emissions to atmosphere of exhaust gases, but vehicle movements to and from the site will be on a temporary basis and can be mitigated following the implementation of construction phase travel plans and construction logistics plans, and plant emissions are unlikely to be significant when compared to background NO_2 and PM_{10} concentrations.

4.5 Fugitive Dust Emissions

Fugitive dust emissions arising from construction activities are likely to be variable in nature and will depend upon the type and extent of the activity, soil type and moisture, road surface conditions and weather conditions. Periods of dry weather combined with higher than average wind speeds have the potential to generate more dust.

Construction activities that are considered to be the most significant potential sources of fugitive dust emissions include:

- Earthworks – removal of any remaining surface hard standing and subsurface features, piling works, haulage and stockpiling;
- Construction – use of materials including concrete with potential to generate dust in the construction of the building; and,
- Trackout – movement of vehicles and plant to and from site.

Fugitive dust arising from construction phase activities is mainly of a particle size greater than the PM_{10} fraction (that which can potentially impact upon human health), however it is noted that construction related activities may contribute to local PM_{10} concentrations. Appropriate dust control measures can be highly effective for controlling emissions from potentially dust generating activities identified above, and adverse effects can be greatly reduced or eliminated.

See Appendix A for further explanation of the tendency of dust to remain airborne.

4.6 Construction Phase Dust Impact Risk

The IAQM 2014 guidance establishes a method for assessing the risk of dust and emissions affecting sensitive receptors in the area around the proposed development site, based on the 'area sensitivity' and the magnitude of emissions from each of the following four types of construction activity:

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

In this case, demolition works are not to be undertaken and therefore demolition activities have not been included in this assessment.

For each activity, the risk of site-derived dust and emissions affecting local sensitive receptors is determined as either negligible, low, medium or high risk. The risk category may be different for each of the activities and depends on the potential emissions magnitude and the sensitivity of the area. Three different types of impact are considered:

- disamenity due to dust soiling;
- the risk of health effects due to an increase in exposure to PM_{10}; and
- harm to ecological receptors.

Appendix A sets out the construction dust assessment methodology in further detail.

4.6.1 Potential Dust Emission Magnitude

With reference to the IAQM 2014 guidance criteria reproduced in Appendix B, the dust emissions magnitudes for earthworks and trackout activities are summarised in Table 5.1 to Table 5.3. Demolition works are not proposed and therefore this has not been considered within this assessment.

Table 4.4: Summary of Dust Emissions Magnitude of Earthworks Activities (Before mitigation)

Earthworks Criteria	Dust Emissions Class	Basis of Classification
Total site area	Small	2,500 m^2
Earth moving vehicles at any one time	Small	<5
Height of stockpiles	Small	< 4 m
Total material moved	Small	<20,000 Tonnes
Overall Rating	**Small**	Conservative rating

Table 4.5: Summary of Dust Emissions Magnitude of Construction Activities (Before mitigation)

Construction Criteria	Dust Emissions Class	Evaluation
Total building volume	Small	<25,000 m^3
On-site concrete batching or sandblasting proposed	Small	None proposed
Overall Rating	**Small**	Conservative rating

Table 4.6: Summary of Dust Emissions Magnitude of Trackout Activities (Before mitigation)

Trackout Criteria	Dust Emissions Class	Basis of Classification
Number of HDV>3.5t per day	Small	<10
Length of unpaved road	Small	<50m
Overall Rating	**Small**	Conservative rating

On the basis of the above, the emissions magnitudes associated with earthworks, construction and trackout are likely small.

4.6.2 Sensitivity of the Area (Pathway and Receptor)

4.6.2.1 Baseline PM_{10} Concentrations

There are no statutory standards for 'disamenity dust' in the UK, and SODC does not monitor particulate matter (PM_{10}). On this basis, estimated background concentrations of PM_{10}, published by the Department of Environment, Food and Rural Affairs (Defra), have been reviewed. The findings of this review are shown in

Table 4.7 below.

Table 4.7: Estimated Defra Background Annual-Mean PM_{10} Concentration at Application Site

Year	Concentration (µg/m^3)
2015	11.8
2016	11.7
2017	11.6
2018	11.5

The Defra Background annual-mean PM_{10} concentrations at the Application Site are all below 24 µg/m^3.

4.6.2.2 Sensitivity of Area for Earthworks and Construction

All earthworks and construction activities are assumed to occur within the site boundary. The sensitivity of the area has been classified and the results are provided in Table 4.8 below.

Table 4.8: Sensitivity of the Surrounding Area for Earthworks and Construction

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity / Classification
Dust Soiling	**Medium**	Between 1 and 10 high sensitivity receptors located within 20 m of the site boundary
Human Health	**Low**	Between 1 and 10 high sensitivity receptors located within 20 m of the site boundary Background PM_{10} concentrations below 24 µg/m^3
Ecological	**Negligible**	No ecological receptors within the relevant screening distance

4.6.2.3 Sensitivity of Area for Trackout

The dust emission magnitude for trackout is classified as medium (Table 4.6). IAQM Guidance however notes that for a small magnitude, trackout may occur on roads up to 50 m from the site exit. The major routes within 50 m of the site exit are Wakefield Road (A61). The sensitivity of the area has been classified and the results are provided in Table 6.6.

Table 4.9: Sensitivity of the Surrounding Area for Trackout

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity / Classification
Dust Soiling	**Medium**	Between 10 and 100 high sensitivity receptors located within 20 m of Wakefield Road.
Human Health	**Low**	Between 10 and 100 high sensitivity receptors located within 20 m of Wakefield Road. Background PM_{10} concentrations below 24 µg/m^3
Ecological	**Negligible**	No ecological receptors within the relevant screening distance

4.6.3 Risk of Impacts

The dust emission magnitude is combined with the sensitivity of the area to determine the risk of impacts of construction activities before mitigation; based on the matrices presented in Tables A5 to A7 in Appendix A. The risk of dust impacts from the construction activities are identified in Table 4.10.

Mitigation measures to reduce potential impacts, based on this assessment, are defined in Section 7.

Table 4.10: Summary of the Dust Risk from Construction Phase Activities

Potential Impact	Dust Risk Impact			
	Demolition	Earthworks	Construction	Trackout
Dust soiling	-	Low Risk	Low Risk	Negligible Risk
Human health	-	Negligible Risk	Negligible Risk	Negligible Risk
Ecological	-	Negligible Risk		

It can be seen that the risk of dust impacts has been assessed as a maximum of 'low risk' at the proposed development.

5 OPERATIONAL PHASE ASSESSMENT METHODOLOGY

The following subsections provide further information regarding input to the dispersion model including traffic emissions sources, meteorological data and receptors included, and the outcomes of the assessment.

5.1 Modelling Software

ADMS-Roads Extra (Version 4.1.1) was used for assessing the air quality impacts of road traffic emissions sources during the operational phase of the proposed development.

5.2 Modelling Scenarios and Traffic Data

The transport consultants for the scheme, Bryan G Hall, provided the annual average daily traffic (AADT) flows for all links except Link 19, which was derived from traffic counts available on the Department for Transport (DfT) website.

RSK reviewed the 2017 base year data provided and applied TEMPro growth factors to adjust to 2016 and 2018 base year data for the purposes of modelling S1, S2 and S3.

The traffic data (including % heavy duty vehicle / HDV movements) used in the modelling are presented in Appendix E. The road network included in the dispersion model is presented in Figure 5.1. Speed data for all road links are based on speed limits, with speeds slowed at junctions using professional judgment and with reference to TG(16)..

5.3 Emission Factors

Nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) emission factors have been obtained from the Defra EFT (v8.0) including use of future predicted emission factors. A factor for the 2016 base case year was used in all scenarios, for a conservative assessment.

5.4 Committed and Consented Developments

Bryan G Hall included two consented developments scheduled to be opened prior to 2018:

- The consented Wakefield Road development of 250 residences (ref. 2014/0249); and
- The consented Lee Lane development of 200 residences (ref. 2013/0932).

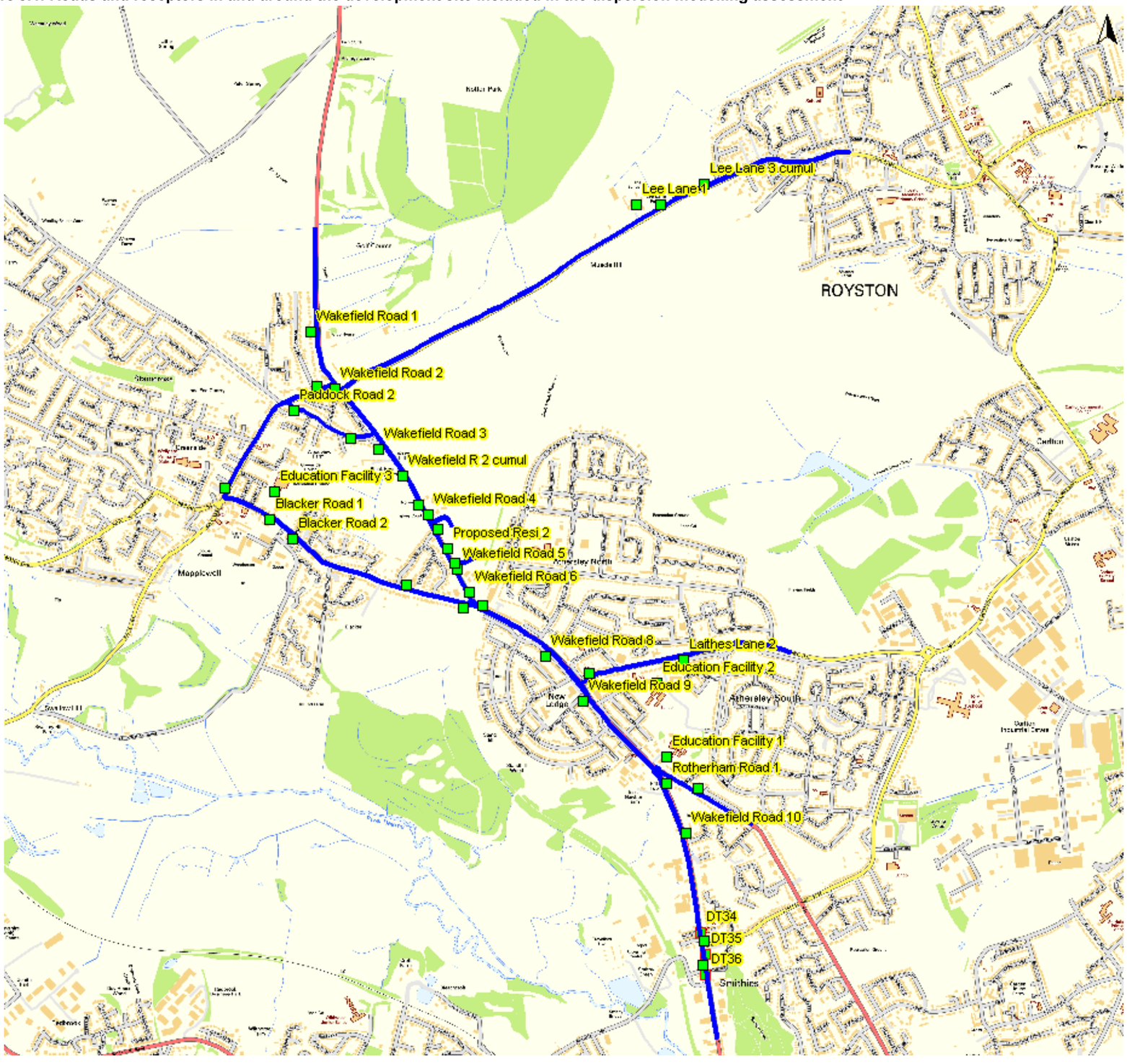
A third consented development of 325 residences, Gawber North (2014/0452), is to open in 2023. A fourth residential development is proposed on land adjacent to the

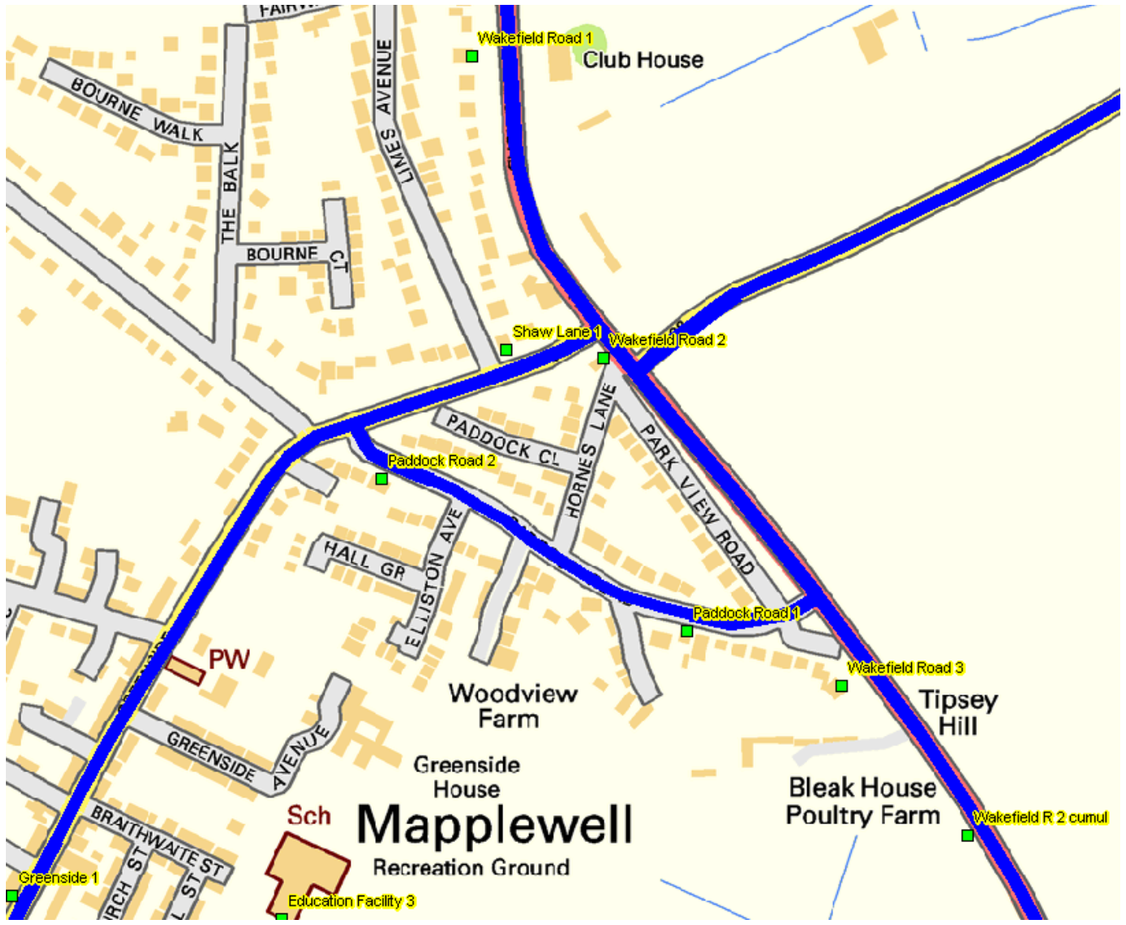
proposed Lidl development site, also with an opening year of 2023. Environmental Health has therefore requested that 2023 be modelled as a sensitivity test to take these developments into account. RSK have requested that this 2023 sensitivity test be submitted as an Addendum.

5.5 Receptor Locations

Pollutant concentrations were predicted at a number of receptors in and around the development site. Details of all specific receptors included in the modelling study (and hence the air quality impacts assessed) are summarised in Appendix F. The locations of all assessed receptors are shown in Figure 5.1.

Figure 5.1: Roads and receptors in and around the development site included in the dispersion modelling assessment




Wakefield Road 1
Club House
BOURNE WALK
THE BALK
BOURNE CT
LIMES AVENUE
Shaw Lane 1
Wakefield Road 2
PADDOCK CL
HORNES LANE
PARK VIEW ROAD
Paddock Road 2
HALL GR
ELLISTON AVE
Paddock Road 1
Wakefield Road 3
PW
Woodview
Farm
Tipsey
Hill
GREENSIDE AVENUE
Greenside
House
Sch
Mapplewell
Recreation Ground
Bleak House
Poultry Farm
Wakefield R 2 cumul
BRAITHWAITE ST
Greenside 1
Education Facility 3

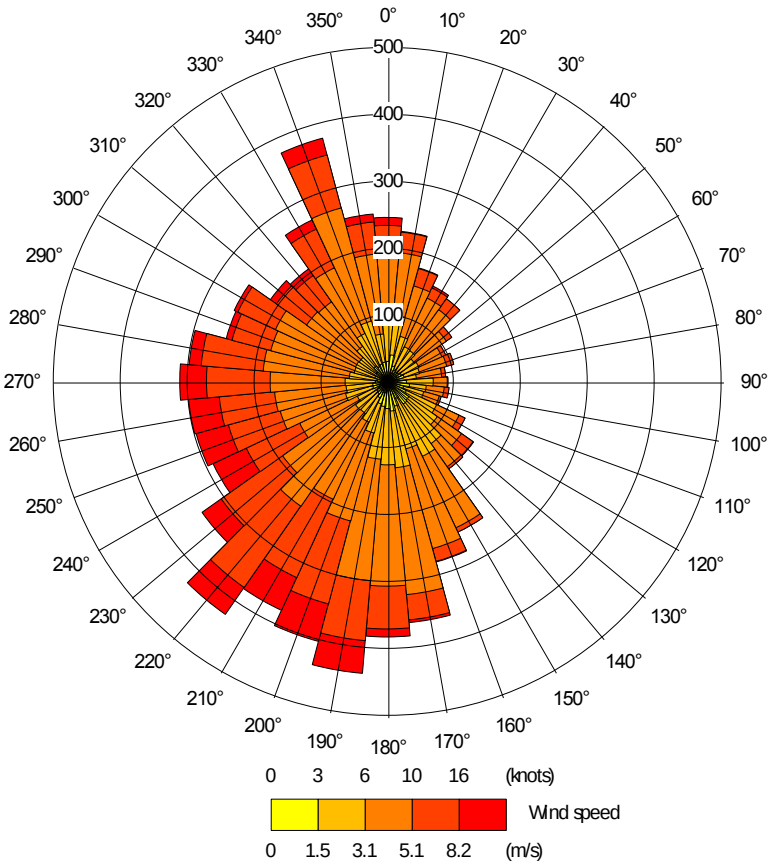
5.6 Time-Varying Profile

Vehicle movements and emissions from the proposed plant may vary with time. The national diurnal traffic profile for 2016 obtained from the DfT website was used for this assessment. The applied road emissions profiles are displayed in Figure C1 in Appendix C.

5.7 Meteorological Data

Hourly sequential meteorological data were employed in the dispersion model. Data for 2016 from the Doncaster Robin Hood Airport meteorological monitoring station was utilised. The windrose derived from the meteorological data is presented in Figure 6.2, below.

Figure 5.2: Windrose from the Doncaster Robin Hood Airport meteorological station in 2016



5.8 Background Air Quality Data Used in the Modelling

The CM3 urban background monitor is located in the northwest of Barnsley, located 2.3km from the proposed development site, in a more densely populated area with a larger number of minor roads. Moreover, DT10 is located in close proximity to the M1 and therefore may be unduly influenced by this road source. Therefore, it is considered that background air quality at the site may be best represented by estimated concentrations represented in the UK-AIR background maps.

5.9 Other Model Input Parameters

The modelling input parameters for the dispersion modelling assessment are presented in Table 5.1.

Table 5.1: Summary of remaining inputs to the Dispersion Model

Parameter	Brief Description	Input into model
Road elevation	Elevation of road above ground level	No terrain file used
Road width	Width of road (m)	Road widths determined based on approximate measurement of roads (internet).
Canyon heights	Height of canyons effects turbulent flow patterns; these are greater with larger canyon heights	No canyons included.
Road type	Selection of different types of road to be assessed, inputted into the emission factor toolkit calculations	Urban (not London) settings used
Road speeds	Speed of the road effects the vehicle emissions to air	Based on speed limits on roads modelled. Reduced speeds have been used at junctions.
Meteorology	Representative hourly sequential meteorological data	Doncaster Robin Hood 2016
Latitude	Allows the location of the model area to be determined	53.5°
Surface roughness	This defines the surface roughness of the model area	0.4m (0.4m at dispersion site)
Monin-Obukhov length	A boundary layer parameter required to precisely describe the atmospheric stability conditions and to predict dispersion of pollutants released from road traffic	30m at modelled site and dispersion site

5.10 Interpretation of modelled NOx, PM_{10} and $PM_{2.5}$ concentrations

The following method was used to estimate total annual mean concentrations:

- Modelled road NOx, PM_{10} or $PM_{2.5}$ concentrations were verified using the method set out in Appendix E of this report and as per LAQM TG.16;

- For NOx only, the road source NO_2 at each receptor was estimated from the modelled NOx concentration using version 6.1 of the NOx to NO_2 calculator (Barnsley);
- These results were added to background concentrations.

Annual mean PM_{10} and $PM_{2.5}$ concentrations represent the summation of background and road source impacts.

5.11 Assessment and comparison to air quality standards

To calculate the number of days per annum where the daily mean PM_{10} AQS may be exceeded, the following formula, derived from the Local Air Quality Management Technical Guidance (2016), has been used: =-18.5+0.00145*([N] ^3)+(206/[N]), where [N] is the predicted annual mean concentration at each receptor location.

The magnitude of changes in annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations associated with the proposed development was assessed in accordance with the EPUK-IAQM 2017 guidance. Significance of effects was determined using professional judgement, based on the impact magnitudes assigned. The EPUK-IAQM method used is summarised in Appendix B of this report.

The results of the dispersion modelling are presented in section 6.2 and Appendix E.

6.12 Additional Uncertainties and Assumptions

- No on-site background monitoring was undertaken and therefore it is assumed that background data used are likely to reasonably represent conditions at site. Similarly, model verification has been undertaken using nearby roadside monitoring locations in a similarly built up urban area, but local conditions may mean that the model has been verified at locations which may not accurately represent conditions at site. It is assumed that the same model adjustment factor is applicable to the results generated at all modelled locations;
- Emissions from the average vehicle fleet using the local road network cannot be known, and therefore it is assumed those generated by the EfT (as appropriate) provided an accurate representation of emissions generated by vehicles which currently and will use the modelled roads;
- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Doncaster Robin Hood Airport in 2016 are representative of wind conditions at the site. Furthermore, it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain in order to simplify the real-world dilution and dispersion conditions;
- The national diurnal profiles have been assumed to be applicable for the roads assessed;

- There is an element of uncertainty in all measured and modelled data. All values presented in this chapter are best possible estimates.

6 IMPACT ASSESSMENT

6.1 Operational Phase Air Quality Assessment

Detailed dispersion modelling has been undertaken with the use of the ADMS-Roads dispersion model software, following guidance in accordance with TG(16) and the EPUK & IAQM (2017) guidance.

The modelled concentrations have been verified using monitoring data. For reference, the methodology for this has been described in Appendix E. Table E5 and Table E6 in Appendix E presents the predicted long- and short-term NO_2 and PM_{10} concentrations at each of the receptor locations under the assessment scenarios.

6.1.1 Impacts of the Development on Local Air Quality

Annual mean Nitrogen Dioxide (NO_2)

Table 7.1 presents the predicted annual mean NO_2 concentrations under the S2 and S3 scenarios. As per the EPUK-IAQM guidance, the impact of the development on local air quality was assessed as 'negligible' at 33 of the 35 modelled existing receptor locations and 'slight adverse' at 2 locations. However, the development did not expose any new receptors to annual mean NO_2 concentrations exceeding the annual mean NO_2 AQS.

Table7.1: Comparison of Predicted annual mean NO_2 Concentrations between the 'S2 Without Development' and S3 'With Development' Scenarios

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Wakefield Road 1	16.3	16.4	0.1	41	0	Negligible
Wakefield Road 2	24.2	24.4	0.2	61	1	Negligible
Wakefield Road 3	18.1	18.3	0.2	45	1	Negligible
Wakefield Road 4	28.2	28.7	0.5	71	1	Negligible
Wakefield Road 5	30.9	31.7	0.9	77	2	Slight adverse
Wakefield Road 6	33.5	34.0	0.5	84	1	Negligible
Wakefield Road 7	38.6	39.2	0.5	97	1	Slight adverse
Wakefield Road 8	22.6	22.8	0.2	57	1	Negligible
Wakefield Road 9	22.5	22.7	0.2	56	1	Negligible
Wakefield Road 10	23.9	24.2	0.2	60	1	Negligible
Rotherham Road 1	28.5	28.8	0.3	71	1	Negligible
Rotherham Road 2	22.5	22.6	0.1	56	0	Negligible
Education Facility 1	20.0	20.2	0.1	50	0	Negligible
Education Facility	16.4	16.4	0	41	0	Negligible

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
2						
Laithes Lane 1	27.1	27.2	0.2	68	1	Negligible
Laithes Lane 2	20.2	20.3	0.1	51	0	Negligible
Bar Lane 1	22.6	22.8	0.2	57	1	Negligible
Bar Lane 2	20.6	20.8	0.2	52	1	Negligible
Paddock Road 1	16.5	16.7	0.1	41	0	Negligible
Paddock Road 2	17.7	17.8	0.1	44	0	Negligible
Shaw Lane 1	21.3	21.4	0.1	53	0	Negligible
Proposed Resi 1	25.0	25.4	0.4	63	1	Negligible
Proposed Resi 2	26.1	26.5	0.5	65	1	Negligible
Lee Lane 1	12.8	12.8	0	32	0	Negligible
Lee Lane 2 cumul	20.2	20.3	0	51	0	Negligible
Lee Lane 3 cumul	21.2	21.3	0	53	0	Negligible
Wakefield R. 1 cumul	23.7	24.0	0.3	59	1	Negligible
Wakefield R 2 cumul	22.4	22.7	0.3	56	1	Negligible
Blacker Road 1	22.6	22.8	0.2	57	1	Negligible
Blacker Road 2	20.8	21.0	0.1	52	0	Negligible
Education Facility 3	14.7	14.8	0	37	0	Negligible
Greenside 1	21.7	21.7	0	54	0	Negligible
Wakefield Road 11	33.4	33.7	0.2	84	1	Negligible
Wakefield Road 12	36.9	36.9	0	92	0	Negligible

Note: AQAL – Air Quality Action Level, i.e. annual mean NO_2 AQS.

Annual mean Particulate Matter (PM_{10})

Table 7.2 presents the predicted annual mean PM_{10} concentrations under the S2 and S3 scenarios. As per the EPUK-IAQM guidance, the impact of the development on local air quality was assessed as 'negligible' at all of the modelled existing receptor locations.

Table 7.2: Comparison of Predicted annual mean PM_{10} Concentrations between the 'S2 without Development' and S3 'With Development' Scenarios

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Wakefield Road 1	12.7	12.7	0.0	32	0	Negligible
Wakefield Road 2	14.1	14.2	0.0	35	0	Negligible
Wakefield Road 3	13.0	13.1	0.0	33	0	Negligible

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Wakefield Road 4	14.9	15.0	0.1	37	0	Negligible
Wakefield Road 5	14.6	14.8	0.2	37	1	Negligible
Wakefield Road 6	15.0	15.1	0.1	38	0	Negligible
Wakefield Road 7	15.9	16.0	0.1	40	0	Negligible
Wakefield Road 8	13.2	13.3	0.0	33	0	Negligible
Wakefield Road 9	13.1	13.2	0.0	33	0	Negligible
Wakefield Road 10	13.9	13.9	0.0	35	0	Negligible
Rotherham Road 1	14.6	14.7	0.1	37	0	Negligible
Rotherham Road 2	13.2	13.2	0.0	33	0	Negligible
Education Facility 1	12.7	12.8	0.0	32	0	Negligible
Education Facility 2	12.2	12.2	0.0	30	0	Negligible
Laithes Lane 1	13.8	13.9	0.0	35	0	Negligible
Laithes Lane 2	12.8	12.8	0.0	32	0	Negligible
Bar Lane 1	13.1	13.1	0.0	33	0	Negligible
Bar Lane 2	13.2	13.2	0.0	33	0	Negligible
Paddock Road 1	12.7	12.7	0.0	32	0	Negligible
Paddock Road 2	12.9	12.9	0.0	32	0	Negligible
Shaw Lane 1	13.5	13.5	0.0	34	0	Negligible
Proposed Resi 1	14.1	14.2	0.1	35	0	Negligible
Proposed Resi 2	14.4	14.5	0.1	36	0	Negligible
Proposed Lidl 1	14.4	14.6	0.2	36	1	Negligible
Lee Lane 1	12.5	12.5	0.0	31	0	Negligible
Lee Lane 2 cumul	13.8	13.8	0.0	34	0	Negligible
Lee Lane 3 cumul	13.2	13.2	0.0	33	0	Negligible
Wakefield R. 1 cumul	14.1	14.2	0.1	35	0	Negligible
Wakefield R 2 cumul	13.9	13.9	0.1	35	0	Negligible

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Blacker Road 1	13.3	13.3	0.0	33	0	Negligible
Blacker Road 2	13.1	13.1	0.0	33	0	Negligible
Education Facility 3	12.4	12.4	0.0	31	0	Negligible
Greenside 1	13.6	13.6	0.0	34	0	Negligible
Wakefield Road 11	14.7	14.8	0.0	37	0	Negligible
Wakefield Road 12	15.0	15.0	0.0	38	0	Negligible

Note: AQAL – Air Quality Action Level (i.e. the annual mean AQS).

Annual mean Particulate Matter ($PM_{2.5}$)

Table 7.3 presents the predicted annual mean $PM_{2.5}$ concentrations under the S2 and S3 scenarios. As per the EPUK-IAQM guidance, the impact of the development on local air quality was assessed as 'negligible' at all of the modelled existing receptor locations.

Table 7.3: Comparison of Predicted annual mean PM2.5 Concentrations between the 'S2 without Development' and S3 'With Development' Scenarios

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Wakefield Road 1	8.3	8.3	0	33	0	Negligible
Wakefield Road 2	9.1	9.1	0	36	0	Negligible
Wakefield Road 3	8.4	8.5	0	34	0	Negligible
Wakefield Road 4	9.6	9.6	0	38	0	Negligible
Wakefield Road 5	9.5	9.6	0	38	0	Negligible
Wakefield Road 6	9.8	9.8	0	39	0	Negligible
Wakefield Road 7	10.3	10.4	0	41	0	Negligible
Wakefield Road 8	8.7	8.7	0	35	0	Negligible
Wakefield Road 9	8.6	8.7	0	35	0	Negligible
Wakefield Road 10	9.0	9.0	0	36	0	Negligible
Rotherham Road 1	9.4	9.5	0	38	0	Negligible
Rotherham Road 2	8.7	8.7	0	35	0	Negligible
Education Facility 1	8.4	8.4	0	34	0	Negligible
Education Facility 2	8.1	8.1	0	32	0	Negligible

Receptor	S2 (µg/m^3)	S3 (µg/m^3)	Change (µg/m^3)	% of AQAL	% change in AQAL	Significance
Laithes Lane 1	9.0	9.1	0	36	0	Negligible
Laithes Lane 2	8.4	8.4	0	34	0	Negligible
Bar Lane 1	8.6	8.6	0	34	0	Negligible
Bar Lane 2	8.6	8.6	0	34	0	Negligible
Paddock Road 1	8.3	8.3	0	33	0	Negligible
Paddock Road 2	8.4	8.4	0	33	0	Negligible
Shaw Lane 1	8.7	8.7	0	35	0	Negligible
Proposed Resi 1	9.1	9.2	0	36	0	Negligible
Proposed Resi 2	9.2	9.3	0.1	37	0	Negligible
Proposed Lidl 1	9.3	9.4	0.1	37	0	Negligible
Lee Lane 1	8.1	8.1	0	32	0	Negligible
Lee Lane 2 cumul	8.8	8.8	0	35	0	Negligible
Lee Lane 3 cumul	8.6	8.6	0	34	0	Negligible
Wakefield R. 1 cumul	9.1	9.1	0	36	0	Negligible
Wakefield R 2 cumul	8.9	9.0	0	36	0	Negligible
Blacker Road 1	8.6	8.7	0	35	0	Negligible
Blacker Road 2	8.5	8.5	0	34	0	Negligible
Education Facility 3	8.0	8.1	0	32	0	Negligible
Greenside 1	8.8	8.8	0	35	0	Negligible
Wakefield Road 11	9.6	9.6	0	38	0	Negligible
Wakefield Road 12	9.8	9.8	0	39	0	Negligible

Note: AQAL – Air Quality Action Level (i.e. the annual mean AQS).

Hourly mean nitrogen dioxide, and particulate matter

The number of exceedances of the daily mean PM_{10} AQS was less than the permissible 35 at all of the receptor locations, and no receptors were predicted to be exposed to concentrations of PM_{10} or $PM_{2.5}$ exceeding the applicable annual mean AQSs.

In addition, the development has not been predicted to expose any of the modelled discrete receptors to concentrations of the annual mean NO_2 AQS exceeding 60µg/m^3. As per LAQM TG.16, it is consequently unlikely that the development would cause new receptors to be exposed to concentrations of NO_2 exceeding the hourly mean NO_2 AQS on more than the permissible number of occasions each year.

6.1.2 Impact of Future Air Quality on the Proposed Sensitive Receptors

As shown in Table E5 and Table E6 of Appendix E, the proposed development is not predicted to expose any of the modelled on-site discrete receptors to annual mean NO_2, PM_{10} or $PM_{2.5}$ concentrations or daily mean PM_{10} concentrations, exceeding the applicable AQSs, with the development in place. In addition, the development has not been predicted to expose any of the modelled discrete receptors to concentrations of the annual mean NO_2 AQS exceeding 60µg/m^3. As per LAQM TG.16, it is consequently unlikely that the development would cause new receptors to be exposed to concentrations of NO_2 exceeding the hourly mean NO_2 AQS on more than the permissible number of occasions each year. As a result, future ambient air quality at the proposed development site is likely to be acceptable.

6.2 Significance of Effects

This assessment has identified that the development may cause up to a maximum of 'slight' adverse impacts (due to changes in annual mean NO_2 concentrations) at any of the modelled discrete receptor locations. However, the development was not identified as having significant effects on local air quality in terms of annual mean PM_{10} and $PM_{2.5}$, hourly mean NO_2, or daily mean PM_{10}, concentrations, and receptors modelled at the proposed development site were not predicted to be exposed to any of the assessed AQSs with the development in place. Therefore, it is not considered that the development is not associated with any significant air quality effects, although a selection of best practice mitigation measures could be utilised to reduce the slight effect on air quality.

7 MITIGATION MEASURES

7.1 Construction Phase

7.1.1 Fugitive Dust Control Measures

Mitigation measures recommended in the IAQM guidance are divided into 'general measures', applicable to all sites and measures specific to earthworks, construction and trackout. Depending on the level of risk assigned to each site, different mitigation is recommended. Appropriate dust control measures have been listed for low risk construction works. There are no dust control measures for low risk earthworks, or negligible risk trackout.

For those mitigation measures that are general, the highest risk assessed has been applied. In this case, the 'low risk' site mitigation measures have been applied, as determined by the dust risk assessment section. Two categories of mitigation measure are described in the IAQM guidance – 'highly recommended' and 'desirable', which are indicated according to the dust risk level identified. Best practice will be used to control potential fugitive emissions at the site, and therefore it is recommended that all of the mitigation listed in Table 7.1 below is applied, as appropriate.

Table 7.1: IAQM Highly Recommended and Desirable Control Measures for Construction-Phase Dust

Dust Control Measure	Highly Recommended (H) or Desirable (D)
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 environment manager/engineer or the site manager.	H
Display the head or regional office contact information.	H
Dust Management Plan	
Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition, dust flux, real-time PM_{10} continuous monitoring and/or visual inspections.	D
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.	H
Make the complaints log available to the local authority when asked.	H
Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H

Dust Control Measure	Highly Recommended (H) or Desirable (D)
Monitoring	
Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.	D
Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H
Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
Preparing and maintaining the site	
Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	H
Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period.	D
Avoid site runoff of water or mud.	H
Keep site fencing, barriers and scaffolding clean using wet methods.	D
Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site.	D
Cover, seed or fence stockpiles to prevent wind whipping.	D
Operating vehicle/machinery and sustainable travel	
Ensure all vehicles switch off engines when stationary - no idling vehicles.	H
Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	H
Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate)	D
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.	H
Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	H
Use enclosed chutes and conveyors and covered skips.	H
Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	H
Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D
Waste Management	
Avoid bonfires and burning of waste materials.	H
Measures specific to construction	
Avoid scabbling (roughening of concrete surfaces) if possible	D
Ensure sand and other aggregates are stored in bunded areas and are not	D

Dust Control Measure	Highly Recommended (H) or Desirable (D)
allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	

7.1.2 Exhaust Emissions from Plant and Vehicles

7.1.2.1 Reducing Emissions from Site Plant and Vehicle Movements

As indicated above, mitigation measures can be applied to reduce emissions from plant and vehicles associated with site works. It is recommended that an appropriate selection of the following is implemented as far as reasonably practicable:

7.1.2.1.1 Non Road Mobile Machinery (NRMM)

NRMM is defined as any mobile machine, item of transportable industrial equipment, or vehicle - with or without bodywork - that is:

- Not intended for carrying passengers or goods on the road; or,
- Installed with a combustion engine - either an internal spark ignition petrol engine, or a compression ignition diesel engine.

In London, NRMM are required to meet the NOx, PM and CO emissions standards specified in the EU Directive 97/68/EC and subsequent amendments as a minimum, where they have net power of between 37kW and 560kW. The emissions standards vary depending on the net power the engine produces. It is recommended that these emissions standards are also applied on site. The following actions can be taken to enable compliance:

- Reorganising the fleet;
- Replacing equipment if required;
- Installing retrofit abatement technology (such as by diesel particulate filters in existing NRMM); and,
- ‘Re-engining’.

7.1.2.1.2 Construction Logistics Planning and Travel Planning

A construction phase travel plan could be prepared for the site. This would enable the Applicant to give consideration to ways in which deliveries can be consolidated so that fewer journeys are needed. A travel plan could also be developed to encourage on-site employees to use modes of transport alternative to private vehicle usage, such as local bus or railway services.

7.1.2.2 Reducing Vehicle Idling

The site should be managed so that vehicles do not have to wait to park safely. However, should vehicles have to wait they should not idle. Generally, if a vehicle is

stationary for more than a minute, turning off the engine will reduce emissions and fuel costs.

7.2 Operational Phase

As indicated in section 7.3, the development may have a slight adverse effect on local air quality. A selection of the following best practice mitigation measures could therefore be implemented to reduce or minimise the adverse effects identified:

- Selection of 'ultra low' NOx boilers, wherever used throughout the development. Boilers installed in domestic buildings should achieve a NOx rating of 40mg NOx/kWh;
- Provision of on-site 'rapid charge' electric vehicle charging points, which should be maintained in good condition. As a guide, the EPUK-IAQM guidance recommends that one is installed per 10 residential dwellings, or where on-site parking is available, one could be made available for each parking space; and,
- Implementation of measures facilitating modal shift, discouraging the use of driving and encouraging waking, cycling, public transport and/or car sharing. These could be facilitated through the preparation of a travel plan. Such measures may include the promotion of car share schemes and provision of up-to-date public transport information (i.e. timetables, bus maps and routes, etc.) to residents; the development of a designated car sharing scheme, cycle bank scheme; subsidised cycling proficiency testing; subsidised discounted cycling equipment; and the provision of on-site cycle parking.

The pollutant cost calculation shown in Appendix E (Table E2 is recommended) can be used as a means to estimate the amount which could be spent on mitigation.

Although the air quality effects of the development in the absence of mitigation are likely to be insignificant, it is considered that, following the implementation of an appropriate selection of mitigation measures, the impacts of the development on local air quality is negligible.

8 CONCLUSIONS

An air quality assessment for the proposed Lidl development at the former William Freeman site, Mapplewell, has been prepared with reference to existing air quality in the area and relevant air quality legislation, policy and guidance.

Construction phase impacts of the proposed development on local air quality may have the potential to occur, due to dust and PM emissions during the period of construction. The potential risk of dust impacts was predicted to be a maximum of 'low risk' during the construction phase. Site specific mitigation measures have been recommended to reduce the risk for general site activities and construction activity-specific activities. If appropriate mitigation, such as those measures recommended in this report are implemented, the residual impact of construction phase air quality impacts is likely to be 'not significant'.

Regarding operational phase air quality impacts, an assessment of the impact of existing sources of relevant air pollutants in the local area on receptors to be introduced at the proposed development site, and of the impacts of the proposed development on local air quality, has been undertaken based on detailed dispersion modelling using ADMS Roads.

The relevant air pollutants of concern for operational phase impacts are considered to be NO_2, PM_{10} and $PM_{2.5}$. In order to quantify potential air quality impacts at receptor locations during the operational phase of the development, the following three scenarios were modelled:

- **S1:** 'Base Case' scenario representing the existing (2016) air quality situation;
- **S2:** Without development scenario (2018) - traffic during the anticipated year of proposed development operation/ year of maximum movements without the proposed development in place but with committed and consented developments (as described in section 6.4); and
- **S3:** With-development scenario (2018) - traffic during the anticipated year of proposed development operation/ year of maximum movements with the proposed development in place (as described in section 6.4).

The proposed development is not predicted to expose any of the modelled on-site discrete receptors to annual mean NO_2, PM_{10} or $PM_{2.5}$ concentrations or daily mean PM_{10} concentrations, exceeding the applicable AQSs, with the development in place. In addition, the development has not been predicted to expose any of the modelled discrete receptors to concentrations of the annual mean NO_2 AQS exceeding 60µg/m^3. As per LAQM TG.16, it is consequently unlikely that the development would cause new receptors to be exposed to concentrations of NO_2 exceeding the hourly mean NO_2 AQS on more than the permissible number of occasions each year. As a result, future ambient air quality at the proposed development site is likely to be acceptable.

Regarding the operational phase of the development, no exceedances of the annual mean PM_{10} or $PM_{2.5}$ standards, or the short-term PM_{10} AQSs, were predicted at any of the modelled receptor locations in any of the modelled scenarios.

This assessment has identified that the development may cause up to a maximum of 'slight' adverse impacts (due to changes in annual mean NO_2 concentrations) at any of the modelled discrete receptor locations. However, the development was not identified as having significant effects on local air quality in terms of annual mean PM_{10} and $PM_{2.5}$, hourly mean NO_2, or daily mean PM_{10}, concentrations, and receptors modelled at the proposed development site were not predicted to be exposed to any of the assessed AQSs with the development in place. Therefore, it is not considered that the development is not associated with any significant air quality effects, although a selection of best practice mitigation measures (as recommended in Section 7) could be utilised to reduce the slight effect on air quality.

Although the air quality effects of the development in the absence of mitigation are likely to be insignificant, it is considered that, following the implementation of an appropriate selection of mitigation measures, the impacts of the development on local air quality is negligible.

9 REFERENCES

- Air Quality (England) Regulations 2000, 928. London, Her Majesty's Stationery Office.
- Air Quality (England) (Amendment) Regulations 2002, 3043. London, Her Majesty's Stationery Office.
- BMBC, 2011, Core Strategy (online] Available at: https://www.barnsley.gov.uk/media/3093/core-strategy.pdf
- BMBC, 2014, Air Quality and Emissions: Good Practice Guidance.
- Council Directive (EC) 2008/50 of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe entered into force on 11 June 2008. Official Journal of the European Union, L152/1.
- Department of Communities and Local Government, 2012. National Planning Policy Framework, London: Crown.
- Department of Environment, Food and Rural Affairs, 2003. Part IV of the Environment Act 1995: Local Air Quality Management: Technical Guidance LAQM.TG (03), London: Crown.
- Department of Environment, Food and Rural Affairs, 2007a. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1). London, Her Majesty's Stationary Office.
- Department of Environment, Food and Rural Affairs, 2007b. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 2). London, Her Majesty's Stationary Office.
- Department for Environment, Food and Rural Affairs, 2016. *Part IV of the Environment Act 1995: London Local Air Quality Management: Technical Guidance LLAQM.TG (16)*, London: Crown.
- Department for Environment, Food and Rural Affairs, 2017. *LAQM Support* [online] Available at: http://laqm.defra.gov.uk
- Department for Environment, Food and Rural Affairs, 2017. *MAGIC Map* [online] Available at: http://magic.defra.gov.uk
- Environment Act 1995. London, Her Majesty's Stationery Office.
- Health and Safety Executive, 2010. *Dust control on cut-off saws used for stone or concrete cutting.* Health and Safety Executive.
- Her Majesty's Stationery Office, 2010. *Environmental Protection: The Air Quality Standards Regulations 2010*, [online] Available at: http://www.legislation.gov.uk/uksi/2010/1001/pdfs/uksi_20101001_en.pdf
- Institute of Air Quality Management, 2014. *Guidance on the assessment of dust from demolition and construction.* [online] Available at: http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf
- Institute of Air Quality Management, 2017. *Land Use Planning & Development Control: Planning for Air Quality.* [online] Available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

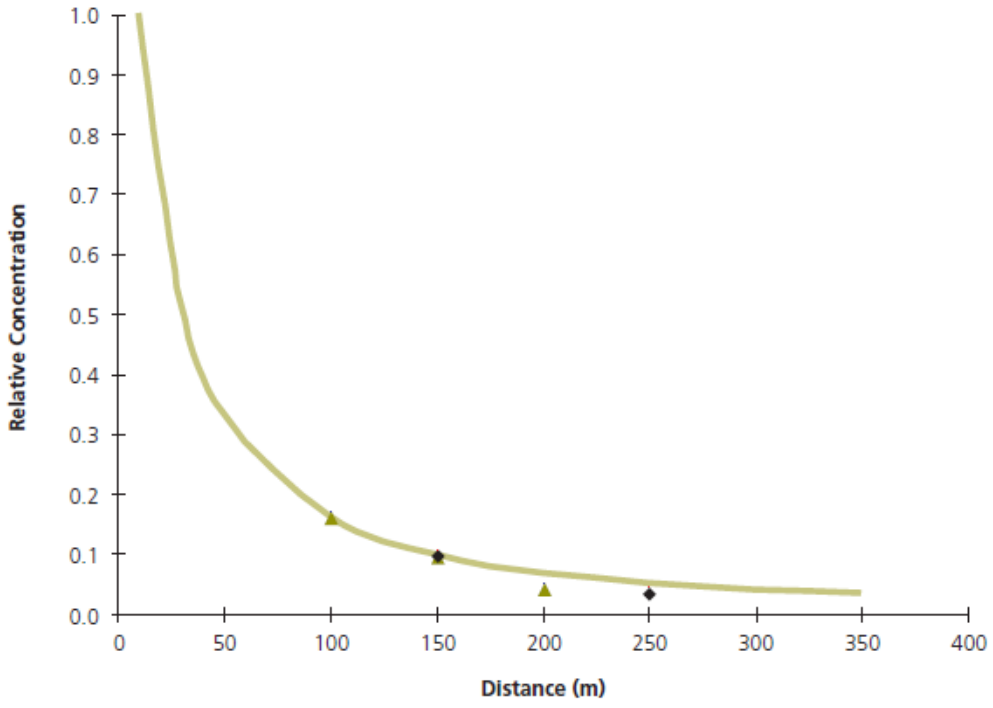
APPENDIX A
CONSTRUCTION DUST ASSESSMENT METHODOLOGY

This appendix contains the construction dust assessment methodology used in the assessment. To assess the potential impacts, construction activities are divided into deition, earthworks, construction and trackout. The descriptors included in this section are based upon the IAQM 2014 guidance. The assessment follows the steps recommended in the guidance.

Step 1 and Step 2 methods from the IAQM 2014 guidance are described in this Appendix to assign dust risk categories for each of the construction activities.

The tendency of dust to remain airborne is determined by the particle size and weather conditions. Eventually, particles will drop from suspension as a deposit. The previous Local Air Quality Management Technical Guidance document (LAQM.TG(03))[2] identifies that PM_{10} concentrations fall-off rapidly with distance from source. Figure B1 shows the fall-off in PM_{10} concentration from source for a typical wind speed of 6m/s. At 100m from source, the PM_{10} concentration is predicted to be less than 20% of that at the point of generation.

Figure A1: Typical Fall-off in PM_{10} Concentration with Distance from Source



[2] LAQM TG (03). The Local Air Quality Management Technical Guidance Note published by the Department for Food and Rural Affairs in 2003. This guidance note is revised in 2009 and is available as LAQM TG(09).

Step 1: Screen the requirement for assessment

The first step is to screen out the requirement for a construction dust assessment; this is usually a somewhat conservative level of screening. An assessment is usually required where there is:

- a 'human receptor' within:
    - 350m of the boundary of the site; or
    - 50m of the route used by construction vehicles onto the public highway, up to 500m from the site entrance(s).
- an 'ecological receptor':
    - 50m of the boundary of the site; or
    - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

Step 2A: Defining the Potential Dust Emission Magnitude

Deition

The dust emission magnitude category for deition is varied for each site in terms of timing, building type, duration and scale. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total building volume >50,000m^3, potentially dusty construction material, on-site crushing and screening, deition activities >20m above ground level;
- **Medium**: Total building volume 20,000m^3 – 50,000m^3, potentially dusty construction material, deition activities 10m – 20m above ground level; and,
- **Small**: Total building volume <20,000m^3, construction material with low potential for dust release, deition activities <10m above ground, deition during wetter months.

Earthworks

The dust emission magnitude category for earthworks is varied for each site in terms of timing, geology, topography and duration. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total site area >10,000m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes;
- **Medium**: Total site area 2,500 – 10,000m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes; and,
- **Small**: Total site area < 2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.

Construction

The dust emission magnitude category for construction is varied for each site in terms of timing, building type, duration, and scale. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: Total building volume >100,000m^3, piling, on site concrete batching;
- **Medium**: Total building volume 25,000 – 100,000m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching; and,

- **Small**: Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout

Factors which determine the dust emission magnitude class of trackout activities are vehicle size, vehicle speed, vehicle number, geology and duration. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: >100 HDV (3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m;
- **Medium**: 25 – 100 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100m; and,
- **Small**: <25 HDV (<3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50m.

Step 2B: Defining the Sensitivity of the Area

The sensitivity of the area is defined for dust soiling, human health and ecosystems. The sensitivity of the area takes into account the following 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 here are natural shelters such as trees, to reduce the risk of wind-blown dust.

Table A1 has been used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.

Table A1: Sensitivity of Individual receptors in the area surrounding the Site

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
High	• Users can reasonably expect a enjoyment of a high level of amenity. • The appearance, aesthetics or value of their property would be diminished by soiling, and • The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.	• Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day) • Examples include residential properties, hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• Locations with an international or national designation *and* the designated features may be affected by dust soiling. • Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. • Examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the deition of a large site containing concrete (alkali) buildings.
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. • The appearance, aesthetics or value of their property could be diminished by soiling. • 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. • Examples include parks and places of work.	• Locations where the people exposed are workers and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • Examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	• Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown. • Locations with a national designation where the features may be affected by dust deposition. • Example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
Low	• The enjoyment of amenity would not reasonably be expected. • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling. • 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. • Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.	• Locations where human exposure is transient. • Indicative examples include public footpaths, playing fields, parks and shopping streets.	• Locations with a local designation where the features may be affected by dust deposition. • Example is a local Nature Reserve with dust sensitive features.

Based on the sensitivities assigned of the different types of receptors surrounding the site and numbers of receptors within certain distances of the site, a sensitivity classification for the area can be defined for each. Tables A2 to A4 indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

For trackout, as per the guidance, it is only considered necessary to consider trackout impacts up to 50m from the edge of the road.

Table A2: Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distances 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	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A3: Sensitivity of the area to Human Health Impacts (from the IAQM 2014 guidance)

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

Receptor Sensitivity	Annual Mean	Number of Receptors	Distances from the Source (m)				
Low	-	>1	Low	Low	Low	Low	Low

Table A4: Sensitivity of the area to Ecological Impacts

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

<u>Step 2C</u>: Defining the Risk of Impacts

The final step is to use both the dust emission magnitude classification with the sensitivity of the area, to determine a potential risk of impacts for each construction activity, before the application of mitigation. Tables A5 to A7 indicate the method used to assign the level of risk for each construction activity.

Table A5: Risk of Dust Impacts from Deition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A6: Risk of Dust Impacts from Earthworks/Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A7: Risk of Dust Impacts from Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

APPENDIX B
OPERATION IMPACT ASSESSMENT METHODOLOGY

This appendix contains the methodology used in the assessment for the operational impact assessment to include reference to EPUK-IAQM guidance.

The impacts of a development are usually assessed at selected 'receptors'. The magnitude of impacts is derived by the percentage of change in pollutant concentration relative to an Air Quality Assessment Level (AQAL) and long term average pollutant concentration at receptor, as presented in Table B1. The significance of effects is then determined using professional judgement.

Table B1: Impact Descriptors for Individual Receptors

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
79 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: AQAL – air quality assessment level, such as the annual mean NO_2, PM_{10} or $PM_{2.5}$ AQS.

The EPUK/IAQM guidance notes that the criteria in Table C1 should be used to describe impacts at individual receptors and should only be considered as a starting point to make a judgement on significance of effects, as other influences may need to be accounted for. The EPUK/IAQM guidance states that the assessment of overall significance should be based on professional judgement, taking into account several factors, including:

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

The EPUK/IAQM guidance states that for most road transport related emissions, long-term average concentrations are the most useful for evaluating the severity of impacts.

APPENDIX C
TRAFFIC DATA

This appendix contains the traffic data used in the dispersion modelling assessment. Included are traffic flow data in AADT, percentage Heavy Duty Vehicle (HDV) and the speed for each road link.

Table C1 AADT Traffic Flows for Model Scenarios used in the dispersion modelling assessment

Table C2 Heavy Duty Vehicle Composition and Speed data used in the dispersion modelling assessment

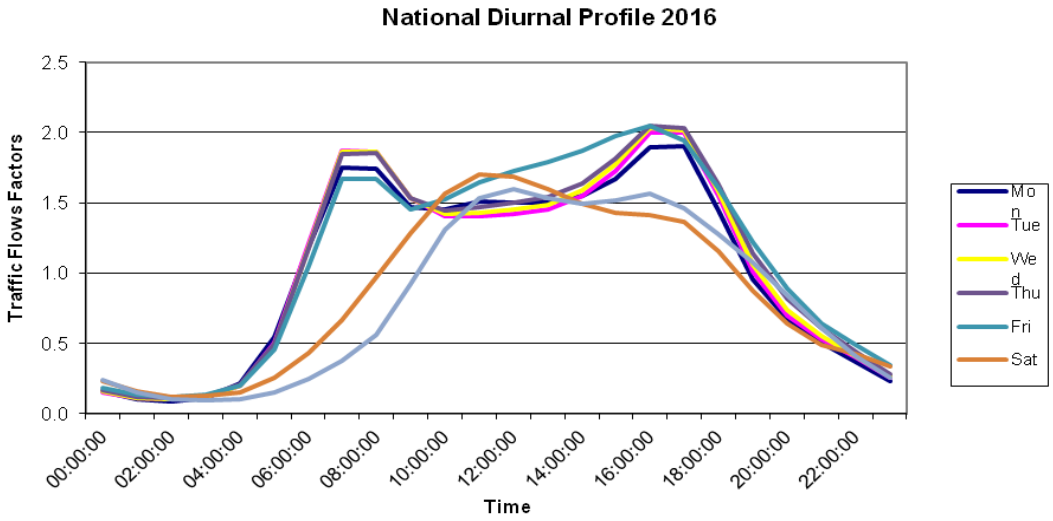
Figure C1 National diurnal Profile for other roads utilised in modelling assessment

Table C1: AADT Traffic Flows for Model Scenarios used in the dispersion modelling assessment

Ref	Road Link	Source of Data	S1 – without development		S2 – with development		S3 –with development	
			AADT	%HGV	AADT	%HGV	AADT	%HGV
1	Wakefield Road - North of Lee Lane / Shaw Lane	Bryan G Hall	7785	3.4	8783	3.1	9039	3.0
2	Shaw Lane / Greenside	Bryan G Hall	9184	1.5	9876	1.4	9876	1.4
3	Lee Lane	Bryan G Hall	8367	1.3	9692	1.2	9731	1.2
4	Wakefield Road - North of Paddock Road	Bryan G Hall	8995	3.0	10710	2.6	11004	2.6
5	Paddock Road	Bryan G Hall	3312	0.8	3513	0.8	3682	0.8
6	Wakefield Road - North of Proposed Residential Development Site Access	Bryan G Hall	11252	2.6	13142	2.3	13605	2.3
7	Proposed Residential Development Site Access	Bryan G Hall	0	0.0	0	0.0	0	0.0
8	Wakefield Road - North of Proposed Lidl Site Access	Bryan G Hall	11252	2.6	13093	2.3	13556	2.3
9	Proposed Lidl Site Access	Bryan G Hall	0	0.0	0	0.0	1275	0.1
10	Wakefield Road - North of Bar Lane / Blacker Road	Bryan G Hall	11249	2.6	13142	2.3	13530	2.2
11	Bar Lane / Blacker Road	Bryan G Hall	9329	3.5	9661	3.5	9858	3.5
12	Wakefield Road - North of	Bryan G	19771	3.0	21881	2.8	22497	2.7

Ref	Road Link	Source of Data	S1 – without development		S2 – with development		S3 –with development	
	Newstead Road	Hall						
13	Wakefield Road - North of Laithes Lane	Bryan G Hall	19843	3.1	21956	2.9	22571	2.9
14	Laithes Lane	Bryan G Hall	9129	5.4	9413	5.4	9480	5.4
15	Wakefield Road - South of Laithes Lane	Bryan G Hall	16725	3.3	18740	3.0	19289	2.9
16	Wakefield Road - South of New Lodge Crescent	Bryan G Hall	17531	3.0	19571	2.8	20121	2.7
17	Rotherham Road	Bryan G Hall	8488	1.3	8752	1.3	8921	1.3
18	Wakefield Road - South of Rotherham Road fork	Bryan G Hall	11717	4.1	13577	3.7	13957	3.6
19	Wakefield Road - South of Carlton Road	DfT	16203	4.9	16707.54	4.9	9039	3.0

Figure C1: Diurnal Profile for Road Sources Included in the Dispersion Modelling Assessment



APPENDIX D
MODELLING OF OPERATIONAL PHASE – VERIFICATION METHODOLOGY AND MODEL RESULTS

The dispersion model results were verified following the relevant guidance in the Local Air Quality Management Technical Guidance (2016) (LAQM.TG(16)). Predicted results from a dispersion model may differ from measured concentrations for a variety of reasons; these are identified in TG(16) to include:

- Estimates of background concentrations;
- Meteorological data uncertainties;
- Uncertainties in source data for example, traffic flow data, stack emissions and emission factors;
- Model input parameters such as roughness length, minimum Monin-Obukhov and overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

Annual mean NO_2 data collected at DT34, DT35 and DT36 have been used to verify the dispersion model, as detailed in Section 5.

A comparison of modelled versus monitored NO_2 concentrations at the Upton Gardens site is presented in Table D1. They show that the model underpredicted road traffic concentrations by more than 25%. Therefore, model verification has been undertaken as per the procedure in LAQM TG.16.

Table D1 Modelled versus Monitored NO_2 Concentrations

Site	Background NO_2	Monitored total NO_2	Modelled total NO_2	% Difference [(modelled – monitored)/monitored]x100
DT34	14.74	29.30	17.97	-38.7
DT35	14.74	40.70	20.82	-48.8
DT36	14.74	34.80	20.86	-40.1

Modelled versus measured road NOx data at the diffusion tube sites are shown in Table F2. The model as a whole underpredicted road NOx concentrations by a factor of 4.18; this factor has been applied to model results.

Table D2 Modelled versus Monitored NO_x/NO_2

Site	Background NO2	Monitored NO_2	Monitored Road Contribution NO_2	Monitored Road Contribution NOx	Modelled road contribution NOx	Ratio of Modelled and Measured Road NOx
DT34	14.74	29.30	14.56	29.13	6.12	4.76
DT35	14.74	40.7	25.96	55.10	11.68	4.72
DT36	14.74	34.8	20.06	41.27	11.76	3.51

The verified annual average modelled road contribution NO_x concentrations were used to estimate the annual average road NO_2 by using the DEFRA NO_x to NO_2 spreadsheet; a comparison of monitored and model adjusted total NO_2 is presented in Table D3 for the three diffusion tube results used for verification.

Table D3 Modelled versus Monitored NO_2 Concentrations

Site	Background NO_2	Monitored NO_2	Modelled total NO_2 after adjustment	% Difference [(modelled – monitored)/monitored]x100
DT34	14.73518	29.3	27.66	-5.6
DT35	14.73518	40.7	38.10	-6.4
DT36	14.73518	34.8	38.24	9.9

In the absence of local monitoring locations measuring data for PM_{10} or $PM_{2.5}$ within the vicinity of the site, verification for PM_{10} and $PM_{2.5}$ has been undertaken using the NOx adjustment factor.

A list of the receptor locations included in the dispersion model is displayed in Table D4.

Table D4 Receptors Included in the Dispersion Modelling Assessment

Receptor ID	X	Y	Z
Wakefield Road 1	433387.72	410770.81	1.5
Wakefield Road 2	433488.62	410538	1.5
Wakefield Road 3	433673	410286.62	1.5
Wakefield Road 4	433879.25	410015.34	1.5
Wakefield Road 5	434000	409787.88	1.5
Wakefield Road 6	434050.41	409692.06	1.5
Wakefield Road 7	434103.69	409634.94	1.5
Wakefield Road 8	434367.44	409426.44	1.5
Wakefield Road 9	434522.88	409237.78	1.5
Wakefield Road 10	434949.75	408691.19	1.5
Rotherham Road 1	434869.88	408896.22	1.5
Rotherham Road 2	435000.38	408877.41	1.5
Education Facility 1	434869.62	409009.69	1.5
Education Facility 2	434826.72	409314.78	1.5

Receptor ID	X	Y	Z
Laithes Lane 1	434544.53	409353.03	1.5
Laithes Lane 2	434940.72	409410.06	1.5
Bar Lane 1	434021.78	409624.41	1.5
Bar Lane 2	433788.53	409721.09	1.5
Paddock Road 1	433553.66	410328.28	1.5
Paddock Road 2	433318.53	410446	1.5
Shaw Lane 1	433414.16	410544.94	1.5
Proposed Resi 1	433916.28	409950.91	1.5
Proposed Resi 2	433956.25	409873.34	1.5
Proposed Lidl 1	433988.72	409813.28	1.5
Lee Lane 1	434741.47	411301.69	1.5
Lee Lane 2 cumul	434842.09	411299.53	1.5
Lee Lane 3 cumul	435022.22	411385.59	1.5
Wakefield R. 1 cumul	433838.31	410053.75	1.5
Wakefield R 2 cumul	433769.97	410171.94	1.5
Blacker Road 1	433218.12	409994.72	1.5
Blacker Road 2	433316.38	409914.5	1.5
Education Facility 3	433241.12	410107.12	1.5
Greenside 1	433033.19	410125.53	1.5
Wakefield Road 11	435022.56	408243.88	1.5
Wakefield Road 12	435018.06	408144.56	1.5
DT34	435011	408281	3.5
DT35	435027	408190	2.8
DT36	435027	408104	2.7

Model results for long-term and short-term $PM_{10,}$ and long-term NO_2 and $PM_{2.5}$, concentrations at receptors are presented in Table F5 and Table F6, for all modelling scenarios.

Table D5: Predicted Pollutant Concentrations at Modelled Receptor Locations – part 1

Receptor ID	Long-term NO_2 Annual Average Concentrations ($\mu g/m^3$)			Long-term PM_{10} Annual Average Concentrations ($\mu g/m^3$)			Long-term PM_{10} Annual Average Concentrations ($\mu g/m^3$)		
	Background	S2	S3	Background	S2	S3	Background	S2	S3
Wakefield Road 1	12.1	16.3	16.4	12.0	12.7	12.7	7.8	8.3	8.3
Wakefield Road 2	12.1	24.2	24.4	12.0	14.1	14.2	7.8	9.1	9.1
Wakefield Road 3	12.1	18.1	18.3	12.0	13.0	13.1	7.8	8.4	8.5
Wakefield Road 4	12.1	28.2	28.7	12.0	14.9	15.0	7.8	9.6	9.6
Wakefield Road 5	13.4	30.9	31.7	11.7	14.6	14.8	7.8	9.5	9.6
Wakefield Road 6	13.4	33.5	34.0	11.7	15.0	15.1	7.8	9.8	9.8
Wakefield Road 7	13.4	38.6	39.2	11.7	15.9	16.0	7.8	10.3	10.4
Wakefield Road 8	13.4	22.6	22.8	11.7	13.2	13.3	7.8	8.7	8.7
Wakefield Road 9	13.4	22.5	22.7	11.7	13.1	13.2	7.8	8.6	8.7
Wakefield Road 10	13.0	23.9	24.2	12.1	13.9	13.9	7.9	9.0	9.0
Rotherham Road 1	13.0	28.5	28.8	12.1	14.6	14.7	7.9	9.4	9.5
Rotherham	14.7	22.5	22.6	11.9	13.2	13.2	7.9	8.7	8.7

Receptor ID	Long-term			Long-term			Long-term		
	NO_2 Annual Average Concentrations ($\mu g/m^3$)			PM_{10} Annual Average Concentrations ($\mu g/m^3$)			PM_{10} Annual Average Concentrations ($\mu g/m^3$)		
	Background	S2	S3	Background	S2	S3	Background	S2	S3
Road 2									
Education Facility 1	13.4	20.0	20.2	11.7	12.7	12.8	7.8	8.4	8.4
Education Facility 2	13.4	16.4	16.4	11.7	12.2	12.2	7.8	8.1	8.1
Laithes Lane 1	13.4	27.1	27.2	11.7	13.8	13.9	7.8	9.0	9.1
Laithes Lane 2	13.4	20.2	20.3	11.7	12.8	12.8	7.8	8.4	8.4
Bar Lane 1	13.4	22.6	22.8	11.7	13.1	13.1	7.8	8.6	8.6
Bar Lane 2	11.8	20.6	20.8	11.7	13.2	13.2	7.7	8.6	8.6
Paddock Road 1	12.1	16.5	16.7	12.0	12.7	12.7	7.8	8.3	8.3
Paddock Road 2	12.1	17.7	17.8	12.0	12.9	12.9	7.8	8.4	8.4
Shaw Lane 1	12.1	21.3	21.4	12.0	13.5	13.5	7.8	8.7	8.7
Proposed Resi 1	11.8	25.0	25.4	11.7	14.1	14.2	7.7	9.1	9.2
Proposed Resi 2	11.8	26.1	26.5	11.7	14.4	14.5	7.7	9.2	9.3
Proposed Lidl 1	11.8	26.9	27.9	11.7	14.4	14.6	7.7	9.3	9.4
Lee Lane 1	10.3	12.8	12.8	12.1	12.5	12.5	7.8	8.1	8.1

Receptor ID	Long-term NO_2 Annual Average Concentrations (µg/m^3)			Long-term PM_{10} Annual Average Concentrations (µg/m^3)			Long-term PM_{10} Annual Average Concentrations (µg/m^3)		
	Background	S2	S3	Background	S2	S3	Background	S2	S3
Lee Lane 2 cumul	10.3	20.2	20.3	12.1	13.8	13.8	7.8	8.8	8.8
Lee Lane 3 cumul	11.6	21.2	21.3	11.5	13.2	13.2	7.6	8.6	8.6
Wakefield R. 1 cumul	12.1	23.7	24.0	12.0	14.1	14.2	7.8	9.1	9.1
Wakefield R 2 cumul	12.1	22.4	22.7	12.0	13.9	13.9	7.8	8.9	9.0
Blacker Road 1	11.8	22.6	22.8	11.7	13.3	13.3	7.7	8.6	8.7
Blacker Road 2	11.8	20.8	21.0	11.7	13.1	13.1	7.7	8.5	8.5
Education Facility 3	12.1	14.7	14.8	12.0	12.4	12.4	7.8	8.0	8.1
Greenside 1	12.1	21.7	21.7	12.0	13.6	13.6	7.8	8.8	8.8
Wakefield Road 11	14.7	33.4	33.7	11.9	14.7	14.8	7.9	9.6	9.6
Wakefield Road 12	14.7	36.9	36.9	11.9	15.0	15.0	7.9	9.8	9.8

Notes: Results in **bold** exceed the relevant AQS.

ANNEX E - POLLUTANT COST CALCULATION

An air quality pollutant cost assessment was requested by BMBC during the consultation stage. It was agreed that the assessment should be included in the air quality impact assessment to be submitted with the planning application. **Due to the variation between the DEFRA calculation method and the BMBC method, it is recommended that the DEFRA method is applied.** This is because it takes into account inflation (using the CPIH) from the 2015 base case values to 2018 (the proposed development opening year), takes account of the anticipated drop-off in pollutant concentrations in each year, and multiplies the calculated damage costs back to 2017 values (to obtain a net present value). However for completeness, this report has also made reference to the BMBC calculations.

Estimation of pollutant costs

To estimate the annual emissions from the additional traffic generated by the proposed developments the below assumptions were made:

- A total number of 1,276 vehicles were assumed to be generated due to the proposed development daily;
- The average trip length of each movement was assumed to be 10km;
- The average speed was assumed to be 50km/hour;
- The HDV percentage of the additional traffic was assumed to be 0.07% (as per the remainder of the model);
- No point source emissions are included as it is anticipated that significant point sources are not proposed;
- Only NO_x and PM_{10} emissions are expected to be significant; and,
- The method used to estimate pollutant damage costs have been assessed in accordance with the BMBC AQ guidance, Appendix 3. However, it should be noted that this differs from the current prevailing guidance recommended by Defra for air pollution benefits recommended for policies aimed at improving air quality, and therefore the values presented in Table G1 below can be presented as conservative.

Table E1: Pollutant Cost Calculation Results – BMBC method

Year	NOx Emissions Factor (kg/ annum)	PM_{10} Emissions Factor (kg/ annum)	EFT (current year emissions factors) case NOx and EFT v8 PM_{10} annual emissions costs	
			Central NOx damage cost	Central PM_{10} damage cost
2018 to 2022	1.53	0.15	£160,693	£44,324
Total Emissions Calculations (£/ tonne)			**£205,018**	

Table E2: Pollutant Cost Calculation Results – DEFRA IGCB method

Year	NOx Emissions Factor (tonne/ annum)	PM_{10} Emissions Factor (tonne/ annum)	EFT (current year emissions factors) case NOx and EFT v8 PM_{10} annual emissions costs	
			Central NOx damage cost	Central PM_{10} damage cost
2019	1.53	0.15	£32,560	£8,981
2020	1.44	0.15	£30,300	£8,707
2021	1.34	0.15	£27,804	£8,458
2022	1.23	0.15	£25,115	£8,254
2023	1.12	0.15	£22,623	£8,071
Total Emissions Calculations (£/ tonne)			**£180,873**	