12 AIR QUALITY

12.1 INTRODUCTION

12.1.1 This chapter documents the assessment of the likely significant effects of the Proposed Development in terms of air quality that may arise from the construction and operational phases.

12.1.2 The main air pollutants of concern related to construction are dust and fine particulate matter (PM_{10}), whilst for road traffic they are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$). For ecological habitats, the main pollutants of concern from road traffic emissions are oxides of nitrogen, with consequential nitrogen and acid deposition.

12.1.3 The Upper Heyford Sewerage Treatment Works (STW) is located approximately 175m south-east of the boundary of Parcel 17 within the Application Site. The STW is located further away from the Application Site than existing residential properties at Duvall Park on Camp Road. The closest of these properties is located approximately 35m north-east of the STW boundary. The STW is relatively small and, given the separation distance to the boundary of Parcel 17 and the location of existing residential properties, is unlikely to have a significant effect on the Application Site. The effects of odour on residential amenity have not been discussed further in this chapter.

12.1.4 An energy facility is proposed within the Application Site. The energy facility and associated infrastructure will form part of the energy strategy for the Proposed Development. The energy strategy is to be flexible to meet energy supply requirements depending on the best technology available at the time of the detailed design of the facilities. As no technology selection has been made at this time, an assessment of the likely significant effects resulting from an energy centre within the Application Site has not been included within this chapter. However, if an energy centre was incorporated within the development, emissions would need to comply with the requirements of the Medium Combustion Plant Directive. An appropriate stack height would be provided to adequately disperse emissions such that no significant air quality effects would result. This would be demonstrated by an air quality assessment which can be conditioned as part of a future Reserved Matters application.

12.1.5 This chapter describes: relevant legislation and planning policy, the assessment methodology; the baseline conditions at the Application Site and surroundings; the likely significant environmental effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after the mitigation measures have been employed, and the likely cumulative effects in conjunction with committed developments.

12.2 LEGISLATION AND PLANNING POLICY CONTEXT

National Legislation

12.2.1 The Air Quality Strategy (2007)[1] establishes the policy framework for ambient air quality management and assessment in the UK. The primary objective is to ensure that everyone can enjoy a level of ambient air quality which poses no significant risk to

[1] Department of the Environment, Transport and the Regions (DETR, 2007) in Partnership with the Welsh Office, Scottish Office and Department of the Environment for Northern Ireland (2007). The Air Quality Strategy for England, Scotland, Wales, Northern Ireland, HMSO, London

health or quality of life. The Strategy sets out the National Air Quality Objectives (NAQOs) and Government policy on achieving these objectives.

12.2.2 Part IV of the Environment Act 1995 introduced a system of Local Air Quality Management (LAQM). This requires local authorities to regularly and systematically review and assess air quality within their boundary, and appraise development and transport plans against these assessments. The relevant NAQOs for LAQM are prescribed in the Air Quality (England) Regulations 2000 and the Air Quality (Amendment) (England) Regulations 2002.

12.2.3 Where an objective is unlikely to be met, the local authority must designate an Air Quality Management Area (AQMA) and draw up an Air Quality Action Plan (AQAP) setting out the measures it intends to introduce in pursuit of the objectives within its AQMA.

12.2.4 The Local Air Quality Management Technical Guidance 2016[2] (LAQM.TG(16) issued by the Department for Environment, Food and Rural Affairs (Defra) for Local Authorities provides advice as to where the NAQOs apply. These include outdoor locations where members of the public are likely to be regularly present for the averaging period of the objective (which vary from 15 minutes to a year). Thus, for example, annual mean objectives apply at the façades of residential properties, whilst the 24-hour objective (for PM_{10}) would also apply within the garden. They do not apply to occupational, indoor or in-vehicle exposure.

EU Limit Values

12.2.5 The Air Quality Standards Regulations 2010[3] implements the European Union's Directive on ambient air quality and cleaner air for Europe (2008/50/EC), and includes limit values for nitrogen dioxide (NO_2). These limit values are numerically the same as the NAQO values but differ in terms of compliance dates, locations where they apply and the legal responsibility for ensuring that they are complied with. The compliance date for the NO_2 EU Limit Value was 1 January 2010, five years later than the date for the NAQO.

12.2.6 Directive 2008/50/EC consolidated the previous framework directive on ambient air quality assessment and management and its first three daughter directives. The limit values remained unchanged, but it now allows Member States a time extension for compliance, subject to European Commission (EC) approval.

12.2.7 Despite many areas of the UK not being compliant with the annual average NO_2 limit value, the UK has decided not to seek an extension to the compliance date for this pollutant. This was on the basis that it could not be guaranteed that the UK would be compliant by the latest date allowable under the Directive (1 January 2015).

12.2.8 The Directive limit values are applicable at all locations except:

- Where members of the public do not have access and there is no fixed habitation;
- On factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply; and
- On the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access.

2 Department of the Environment, Food and Rural Affairs (Defra) in partnership with the Scottish Executive, The National Assembly for Wales and the Department of the Environment for Northern Ireland (2016). 'Local Air Quality Management Technical Guidance, LAQM.TG(16)'. HMSO, London.

3 Statutory Instrument 2010, No. 1001, The Air Quality Standards Regulations 2010, HMSO, London

Habitats Legislation

12.2.9 Sites of national importance may be designated as Sites of Special Scientific Interest (SSSIs). Originally notified under the National Parks and Access to the Countryside Act 1949, SSSIs have been re-notified under the Wildlife and Countryside Act 1981. Improved provisions for the protection and management of SSSIs (in England and Wales) were introduced by the Countryside and Rights of Way (CROW) Act 2000. If a development is "likely to damage" a SSSI, the CROW Act requires that a relevant conservation body (i.e. Natural England) is consulted. The CROW Act also provides protection to local nature conservation sites, which can be particularly important in providing 'stepping stones' or 'buffers' to SSSIs and European sites. In addition, the Environment Act (1995) and the Natural Environment and Rural Communities Act (2006) both require the conservation of biodiversity.

Air Quality Objectives and Limit Values

Human Health

The NAQOs for NO_2 and PM_{10} set out in the Air Quality Regulations (England) 2000[4] and the Air Quality (England) (Amendment) Regulations 2002[5], are shown in **Table 12.1**.

Table 12.1: Nitrogen Dioxide and PM_{10} Objectives

Pollutant	Time Period	Objective
Nitrogen dioxide (NO_2)	1-hour mean	200µg/m^3 not to be exceeded more than 8 times a year
	Annual mean	40µg/m^3
Particulate Matter (PM_{10})	24-hour mean	50µg/m^3 not to be exceeded more than 35 times a year
	Annual mean	40µg/m^3

12.2.10 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. Analysis of long term monitoring data suggests that if the annual mean nitrogen dioxide concentration is less than 60µg/m^3 then the one-hour mean nitrogen dioxide objective is unlikely to be exceeded where road transport is the main source of pollution. This concentration is used to screen whether the one-hour mean objective is likely to be achieved[6].

12.2.11 The Air Quality Strategy (2007) includes an exposure reduction target for smaller particles known as $PM_{2.5}$ (DETR, 2007). These are an annual mean target of 25

[4] Statutory Instrument 2000, No 921, The Air Quality (England) Regulations 2000, HMSO, London

[5] Statutory Instrument 2002, No 3034, The Air Quality (England) (Amendment) Regulations 2002, HMSO, London

[6] Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011). Trends in NO_x and NO_2 emissions and ambient measurements in the UK. Available: http://uk-air.defra.gov.uk/library/reports?report_id=645.

μg/m^3 by 2022 and an average urban background exposure reduction target of 15% between 2010 and 2022.

12.2.12 A new air quality directive (2008/50/EC) was adopted in May 2008, and includes a national exposure reduction target, a target value, and a limit value for $PM_{2.5}$, shown in **Table 12.2**. The UK Government transposed this new directive into national legislation in June 2010.

Table 12.2: $PM_{2.5}$ Objectives

	Time Period	**Objective/Obligation**	**To be Achieved by**
UK Objectives	Annual mean	25μg/m^3	2020
	3 year running annual mean	15% reduction in concentrations measured at urban background sites	Between 2010 and 2020
European obligations	Annual mean	Target value of 25μg/m^3	2010
	Annual mean	Limit value of 25μg/m^3	2015
	Annual mean	Stage 2 indicative Limit value of 20μg/m^3	2020
	3 year Average Exposure Indicator (AEI) (a)	Exposure reduction target relative to the AEI depending on the 2010 value of the 3 year AEI (ranging from a 0% to a 20% reduction)	2020
	3 year Average Exposure Indicator (AEI)	Exposure concentration obligation of 20μg/m^3	2015

a) The 3-year annual mean or AEI is calculated from the $PM_{2.5}$ concentration averaged across all urban background monitoring locations in the UK e.g. the AEI for 2010 is the mean concentration measured over 2008, 2009 and 2010.

Ecological Habitats

12.2.13 Objectives for the protection of vegetation and ecosystems have been set by the UK Government and were to have been achieved by 2000. They are summarised in **Table 12.3** and are the same as the EU limit values. The objectives only strictly apply a) more than 20km from an agglomeration (about 250,000 people), and b) more than 5km from Part A industrial sources, motorways and built up areas of more than 5,000 people. However, Natural England has adopted a more precautionary approach and applies the objective to all internationally designated conservation sites and SSSIs. For the assessment of road schemes, Highways England follows this approach and requires an assessment of the impacts of road traffic emissions on conservation sites (Designated Sites) within 200m of a road[7]. When pollutant concentrations exceed a critical level it is considered that there is a risk of harmful effects.

Table 12.3: Vegetation and Ecosystems Objectives (Critical Levels)

Pollutant	Time Period	Objective
Nitrogen Oxides (expressed as NO_2)	Annual Mean	30µg/m^3

12.2.14 Critical loads for nitrogen deposition onto sensitive ecosystems have been specified by United Nations Economic Commission for Europe (UNECE). They are defined as the amount of pollutant deposited to a given area over a year, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Exceedance of a critical load is used as an indication of the potential for harmful effects to occur.

12.2.15 Statutory designated ecological sites (SACs, SPAs, SSSIs and RAMSAR sites) have been included in this assessment where they are within 200m of a road that has an increase in traffic of more than 1000 AADT resulting from the Development. This is in line with the Highway's Agency Design Manual for Roads and Bridges (DMRB)[7]. Following this criteria, the Ardley Cutting and Quarry SSSI has been identified as a site where assessment of impacts on ecological receptors is deemed necessary. The Ardley Cutting and Quarry SSSI is the nearest statutory designated site to the Application Site, approximately 120m west from the Site boundary. The SSSI borders the B430 Station Road to the east and west.

12.2.16 **Table 12.4** below shows the habitats within the SSSI most likely to be affected by road traffic emissions from Station Road and describes the critical loads for each of these habitats.

Table 12.4: Ecological Habitats and Critical Loads

Habitat	Critical Load	
	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Calcareous grassland (Bromus erectus-Brach podium pinnatum lowland calcareous grassland)	15 - 25	0.856 – 4.856
Calcareous grassland (Bromus erectus-lowland calcareous grassland)	15 - 25	0.856 – 4.856
Hamearis Lucina – Duke of Burgundy[a]	-	-
Invertebrate assemblage – Invertebrate Assemblage[b]	-	-

(a) No critical load for nitrogen deposition or acid deposition has been assigned for this habitat. Information retrieved from the Air Pollution Information System (APIS) website (2016).

(b) The habitat is sensitive to nitrogen deposition and acid deposition, however there is no comparable habitat with established critical load estimate available or acid class.

[7] The Highways Agency (2007). 'Design Manual for Roads and Bridges, Volume 11, Section 3, Part I, HA 207/07 Air Quality'. Available at: http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20707.pdf

National Planning Policy and Guidance

12.2.17 The National Planning Policy Framework (NPPF) was first published in March 2012. This sets out the Government's planning policies for England and how they are expected to be applied. In relation to conserving and enhancing the natural environment, paragraph 109 states that:

> **"The planning system should contribute to and enhance the natural and local environment by…. preventing both new and existing 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."**

12.2.18 Paragraph 124, also 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."**

12.2.19 Paragraph 203 goes on to say:

> **"Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."**

12.2.20 New national Planning Practice Guidance (PPG) was published and updated in March 2014 to support the NPPF. Paragraph 001, Reference 32-001-20, of the PPG provides a summary as to why air quality is a consideration for planning:

> **"…Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit…The local air quality management (LAQM) regime requires every district and unitary authority to regularly review and assess air quality in their area. These reviews identify whether national objectives have been, or will be, achieved at relevant locations, by an applicable date….If national objectives are not met, or at risk of not being met, the local authority concerned must declare an air quality management area and prepare an air quality action plan…..Air quality can also affect biodiversity and may therefore impact on our international obligations under the Habitats Directive…..Odour and dust can also be a planning concern, for example, because of the effect on local amenity."**

12.2.21 Paragraph 002, Reference 32-002-20140306, of the PPG concerns the role of Local Plans with regard to air quality:

> **"...Drawing on the review of air quality carried out for the local air quality management regime, the Local Plan may need to consider:**
>
> - **The potential cumulative impact of a number of smaller developments on air quality as well as the effect of more substantial developments;**
> - **The impact of point sources of air pollution...; and**
> - **Ways in which new development would be appropriate in locations where air quality is or likely to be a concern and not give rise to unacceptable risks from pollution. This could be through, for example, identifying measures for offsetting the impact on air quality arising from new development including supporting measures in an air quality action plan or low emissions strategy where applicable."**

12.2.22 Paragraph 005, Reference 32-005-20140306, of the PPG identifies when air quality could be relevant for a planning decision:

> **"....When deciding whether air quality is relevant to a planning application, considerations could include whether the development would:**
>
> - **Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more.**
> - **Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area.**
> - **Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.**
> - **Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations.**
> - **Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of**

the site, or does it otherwise affect biodiversity, particularly designated wildlife sites."

12.2.23 Paragraph 007, Reference 32-007-20140306, of the PPG provides guidance on how detailed an assessment needs to be:

"Assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and because of this are likely to be locationally specific."

12.2.24 Paragraph 008, Reference 32-008-20140306, of the PPG provides guidance on how an impact on air quality can be mitigated:

"Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact...Examples of mitigation include:

- **The design and layout of development to increase separation distances from sources of air pollution;**
- **Using green infrastructure, in particular trees, to absorb dust and other pollutants;**
- **Means of ventilation;**
- **Promoting infrastructure to promote modes of transport with low impact on air quality;**
- **Controlling dust and emissions from construction, operation and demolition; and**
- **Contributing funding to measures, including those identified in air quality action plans and low emission strategies, designed to offset the impact on air quality arising from new development."**

12.2.25 Paragraph 009, Reference 32-009-20140306, of the PPG provides guidance on how considerations about air quality fit into the development management process by means of a flowchart. The final two stages in the process deal with the results of the assessment:

"Will the proposed development (including mitigation) lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or national objectives for pollutants or fail to comply with the requirements of the Habitats Regulations." If Yes:

"Consider how proposal could be amended to make it acceptable or, where not practicable, consider whether planning permission should be refused."

Local Planning Policy

12.2.26 The Cherwell Local Plan (2011 – 2031), adopted in 2016, sets out the local development policies for the Council[8]. It considers Policy ESD 10 'Protection and Enhancement of Biodiversity and the Natural Environment', which states:

> **"Development which would result in damage to or loss of a site of biodiversity or geological value of national importance will not be permitted unless the benefits of the development clearly outweigh the harm it would cause to the site and the wider national network of SSSI's, and the loss can be mitigated to achieve a net gain in biodiversity/geodiversity…Air quality assessments will also be required for development proposals that would be likely to have a significantly adverse impact on biodiversity by generating an increase in air pollution"**

12.2.27 The Cherwell District Council (CDC) Draft Planning Obligations Supplementary Planning Document (SPD)[9] provides guidance on the level of contribution which will be required in order to compensate for loss or damage created by a development, or to mitigate a development's impact. It sets out the range of mitigation measures which may be required, as well as the means of calculating financial contributions towards measures or monitoring, based on the cost of Air Quality Action Plan measures. An AQMA comprising North Bar Street, Horse Fair Street, South Bar, Oxford Street, High Street, Bloxham Road, Warwick Road and Southam Road was declared 29th October 2014; Cherwell District Council has not yet prepared an Air Quality Action Plan for its existing AQMAs (Hennef Way and North Bar/Horse Fair/South Bar Street). None of the mentioned AQMAs are in close proximity to the Application Site.

12.3 ASSESSMENT METHODOLOGY

Study Area

Construction

12.3.1 The Construction Study Area extends to 350m from the Application Site boundary, shown in **Figure 12.1**.

Operation

Residential Receptor Locations

12.3.2 The assessment covers the air quality impacts at existing properties along the road links provided in **Appendix 12.2** that might be affected by an increase in road traffic.

12.3.3 The Operational Study Area extends to where there are significant changes in traffic (more than 500 vehicle movements per day outside of an Air Quality Management Area (AQMA), and more than 100 vehicle movements per day within an AQMA). The roads modelled in this assessment are shown in **Figure 12.1**.

[8] Cherwell District Council (2015) *'Cherwell Local Plan (2011-2031)'*. Available at: https://www.cherwell.gov.uk/info/83/local-plans/376/adopted-cherwell-local-plan-2011-2031-part-1

[9] Cherwell District Council (2011) *'Planning Obligations Draft Supplementary Planning Document'*. Available at: https://www.cherwell.gov.uk/downloads/download/458/planning-obligationsdeveloper-contributions-in-preparation

12.3.4 Within the study area, relevant sensitive locations have been identified. These locations are described in **Table 12.4**, and shown in **Figure 12.2**. The method used to identify these locations is described in **Paragraph 12.3.24**.

Ecological Receptor Locations

12.3.5 The Ardley Cutting and Quarry SSSI has been included in this assessment in accordance with the DMRB guidance criteria[7]. The SSSI is within 200m of Station Road which has an increase in traffic of more than 1000 AADT resulting from the Application. Therefore, the Ardley Cutting and Quarry SSSI has been identified as a site where assessment of impacts on ecological receptors is deemed necessary.

Surveys

Baseline Data Collection

12.3.6 Information on existing air quality has been obtained by collating the results of monitoring carried out by CDC. Background concentrations for the study area have been defined using the national pollution maps published by Defra. These cover the whole country on a 1x1 km grid[10].

12.3.7 Existing nitrogen and acid deposition rates for habitats within the study area were determined from the Air Pollution Information System (APIS) website[11].

Consultation

12.3.8 Consultation has been carried out with CDC Environmental Protection Officer, Sean Gregory by email on 7th September 2017 to obtain the latest air quality monitoring data for the District.

Significance Criteria and Methodology

Construction

12.3.9 During construction, the main potential effects are dust annoyance and locally elevated concentrations of PM_{10}. The suspension of particles in the air is dependent on surface characteristics, weather conditions and on-site activities. Impacts have the potential to occur when dust generating activities coincide with dry, windy conditions, and where sensitive receptors are located downwind of the dust source.

12.3.10 Separation distance is also an important factor. Large dust particles (greater than 30μm), responsible for most dust annoyance, will largely deposit within 100m of sources. Intermediate particles (10-30μm) can travel 200-500m. Consequently, significant dust annoyance is usually limited to within a few hundred metres of its source. Smaller particles (less than 10μm) are deposited slowly and may travel up to 1km; however, the impact on the short-term concentrations of PM_{10} occurs over a shorter distance. This is due to the rapid decrease in concentrations with distance from the source due to dispersion.

12.3.11 The Institute of Air Quality Management (IAQM, 2016)[12] has issued revised guidance on the assessment of dust from demolition and construction. The IAQM

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[10] Department of the Environment, Food and Rural Affairs (Defra) (2017). 2015 Based Background Maps for NO_x, NO_2, PM_{10} and $PM_{2.5}$. Available at: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015

[11] Air Pollution Information System (APIS) (2017). Available at: http://www.apis.ac.uk/

guidance recommends that the risk of dust generation is combined with the sensitivity of the area surrounding the site to determine the risk of dust impacts from construction and demolition activities. Depending on the level of risk (high, medium, low or negligible) for each activity, appropriate mitigation is selected. Note, the assessment methodology is aimed at identifying the level of mitigation required. With the mitigation in place, the significance of construction dust effects is not significant. This is a binary judgement, there are no degrees of significance.

12.3.12 In accordance with the IAQM 2016 guidance, the dust emission magnitude is defined as either large, medium or small (**Table 12.5**) taking into account the general activity descriptors on site and professional judgement.

12.3.13 The sensitivity of the study area to construction dust impacts is defined based on the examples provided within the IAQM 2016 guidance (**Table 12.6**), taking into account professional judgement.

Table 12.5: Risk Criteria for Dust Emission Magnitude

Dust Emission Magnitude	Activity
Large	**Demolition** >50,000m^3 building demolished, dusty material (e.g. concrete), on-site crushing/screening, demolition >20m above ground level
	Earthworks >10,000m^2 site area, dusty soil type (e.g. clay), >10 earth moving vehicles active simultaneously, >8m high bunds formed, >100,000 tonnes material moved
	Construction >100,000m^3 building volume, on site concrete batching, sandblasting
	Trackout >50 HDVs out / day, dusty soil type (e.g. clay), >100m unpaved roads
Medium	**Demolition** 20,000 - 50,000m^3 building demolished, dusty material (e.g. concrete) 10-20m above ground level
	Earthworks 2,500 - 10,000m^2 site area, moderately dusty soil (e.g. silt), 5-10 earth moving vehicles active simultaneously, 4m - 8m high bunds, 20,000 -100,000 tonnes material moved
	Construction 25,000 - 100,000m^3 building volume, on site concrete batching
	Trackout 10 - 50 HDVs out / day, moderately dusty surface material, 50 - 100m unpaved roads

[12] Institute of Air Quality Management (2016) Assessment of Dust from Demolition and Construction, IAQM, London

Dust Emission Magnitude	Activity
Small	**Demolition** <20,000m^3 building demolished, non-dusty material, <10m above ground level, work in winter
	Earthworks <2,500m^2 site area, non-dusty soil, <5 earth moving vehicles active simultaneously, <4m high bunds, <20,000 tonnes material moved
	Construction <25,000m^3, non-dusty material
	Trackout <10 HDVs out / day, non-dusty soil, < 50m unpaved roads

Table 12.6: Area Sensitivity Definitions

Area Sensitivity	People and Property Receptors
High	>100 dwellings, hospitals, schools, care homes within 50m 10 – 100 dwellings within 20m Museums, car parks, car showrooms within 50m PM_{10} concentrations approach or are above the daily mean objective.
Medium	>100 dwellings, hospitals, schools, care homes within 100m 10 – 100 dwellings within 50m Less than 10 dwellings within 20m Offices/shops/parks within 20m PM_{10} concentrations below the daily mean objective.
Low	>100 dwellings, hospitals, schools, care homes 100 - 350m away 10 – 100 dwellings within 50 – 350m Less than 10 dwellings within 20 - 350m Playing fields, parks, farmland, footpaths, short term car parks, roads, shopping streets PM_{10} concentrations well below the daily mean objective.

12.3.14 Based on the dust emission magnitude and the area sensitivity, the risk of dust impacts is then determined (**Table 12.7**), taking into account professional judgement.

Table 12.7: Risk of Dust Impacts

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

12.3.15 Based on the risk of dust impacts, appropriate mitigation is selected from the IAQM 2016 guidance using professional judgement.

12.3.16 The guidance recommends that no assessment of the significance of effects is made without mitigation in place, as mitigation is assumed to be secured by planning conditions, legal requirements or required by regulations. By determining the risk of dust impacts, appropriate mitigation can then be selected which corresponds to the level of risk. As noted in **paragraph 12.3.11**, with appropriate mitigation in place, and in accordance with the IAQM guidance, the residual effect of construction activities on air quality is assessed as not significant.

<u>Operation</u>

12.3.17 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1.1). The model requires the user to provide various input data, including the Annual Average Daily Traffic (AADT) flow, the proportion of heavy duty vehicles (HDVs), road characteristics (including road width and street canyon height, where applicable), and the vehicle speed. It also requires meteorological data suitable for the area of the study.

12.3.18 Existing AADT flows, and the proportions of HDVs have been derived from the TA (see ES Chapter 6). Traffic data has been provided for the following scenarios:

- Base Year 2016 (Baseline Scenario);
- Reference Case 2031:
  - includes consented development;
  - includes committed Local Plan/third party development sites;
- Application Test Case 2031:
  - includes consented Heyford Park development;
  - includes committed Local Plan/third party development sites;
  - 1,110 residential units and 1,500 jobs from the Heyford Park application.
- Allocation Test Case 2031 (cumulative scenario):
  - As above in the Application Test Case but includes the full Heyford Park allocation (1,600 residential units, 1,500 jobs).

12.3.19 More detailed information about the traffic data used in this assessment is provided in **Chapter 6 – Transport and Access**. Traffic data used in this assessment are summarised in **Appendix 12.2** in the ES.

12.3.20 Traffic data has been combined with 2021 emission factors and background concentrations to provide a conservative assessment of likely significant effects. Meteorological data for 2016 from the Brize Norton monitoring station was used in the assessment, as it is considered suitable for this area and is the closest meteorological station to the Application Site, approximately 28km away.

12.3.21 Emissions were calculated using the recently released Emission Factor Toolkit (EFT) v8.0, which utilises NO_x emission factors taken from the European

Environment Agency COPERT 5 emission tool. The traffic data was entered into the EFT, along with speed data to provide combined emission rates for each of the road links entered into the model.

12.3.22 The first year of occupation of the Application Site is anticipated to be 2021, with approximately 6% occupation in this year. Therefore, the future year assessment has been carried out for this year using 2031 full development traffic flows for the Application Test Case and Allocation Test Case, combined with 2021 emission factors and background concentrations.

12.3.23 An additional scenario has also been assessed which uses the same 2031 Application and Allocation Test Case traffic, but is combined with 2022 emission factors and background concentrations. This additional scenario has been used to assess the effect of a change in emission factors on predicted concentrations, and to judge the likelihood of the predicted impacts occurring.

12.3.24 Nitrogen deposition has been calculated from the predicted nitrogen dioxide concentrations using a deposition velocity of 1.5mm/s for grassland habitats.

Human Health Receptors – Sensitive Locations

12.3.25 Relevant sensitive locations are places where members of the public might be expected to be regularly present over the averaging period of the objectives. For the annual mean and daily mean objectives that are the focus of this assessment, sensitive receptors will generally be residential properties, schools, nursing homes, etc. When identifying 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.

12.3.26 Based on the above criteria, eighteen existing properties have been identified as receptors for the assessment. These locations are described in **Table 12.8** and shown in **Figure 12.2**. Receptors were modelled at a height of 1.5m representing ground floor exposure.

12.3.27 Concentrations have also been predicted at the roadside diffusion tubes located in close proximity to the Application Site, in order to verify the modelled results (see **Appendix 12.1** for further details on the verification method).

Table 12.8: Description of Receptor Locations

Receptor	Location
R1	The White House, A4260, Hopcrofts Holt
R2	20 Bromeswell Close, Lower Heyford
R3	143 Freehold Street, Lower Heyford
R4	Cosie Cotte, Somerton Road, Upper Heyford
R5	Cotswold Lodge, Orchard Lane, Upper Heyford
R6	1 Ardley Road, Middleton Stoney
R7	Stonecroft, Station Road, Ardley
R8	2 Jersey Cottages, Station Road, Ardley
R9	Old Post Office, Heyford Road, Middleton Stoney
R10	Tinkers, Bicester Road, Middleton Stoney

Receptor	Location
R11	Corner Cottage Ardley Road, Middleton Stoney
R12	West of Ardley Road, Middleton Stoney
R13	2 Knowle Lane, Weston the Green
R14	The Darling, Rousham
R15	2, The Cottages, Oxford Road, North Aston
R16	The Fox, Oxford Road, North Aston
R17	Oxford Lodge, Tusmore
R18	66 Shannon Road, Bicester

Ecological Receptors – Sensitive Locations

12.3.28 The Ardley Cutting and Quarry SSSI is located adjacent to, and either side of the B430 Station Road north east of the Application Site. Two transects of receptors representing increasing distances (50-200m) from the B430 have been modelled, one to the east (E1) and one to the west (E2) of the road. These receptor locations are shown in **Figure 12.2**

12.3.29 Concentrations of nitrogen oxides are predicted, and deposition calculated, at a range of receptors at increasing distances from the B430 (**Figure 12.2**) in order to indicate whether or not critical level and critical loads are being exceeded in the habitat.

12.3.30 The Critical Load Function Tool available in APIS was used to determine whether the acid deposition loads are exceeded.

Human Health Receptors – Significance

12.3.31 There is no official guidance in the UK on how to assess the significance of air quality impacts of existing sources on a new development. The approach developed by the Institute of Air Quality Management[13], and incorporated in Environmental Protection UK's guidance document on planning and air quality[14], has therefore been used.

12.3.32 The guidance sets out three stages: determining the magnitude of change at each receptor, describing the impact, and assessing the overall significance. Impact magnitude relates to the change in pollutant concentration; the impact description relates this change to the air quality objective.

12.3.33 **Table 12.9** sets out the impact magnitude descriptors, whilst **Table 12.10** sets out the impact descriptors.

[13] Institute of Air Quality Management, 2009. Position on the Description of Air Quality Impacts and the Assessment of their Significance, November 2009. The IAQM is the professional body for air quality practitioners in the UK.

[14] EPUK, 2017. Development Control: Planning for Air Quality (2017 Update)

Table 12.9: Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude (Change in Concentration)	Annual Mean NO_2 and PM_{10}	Annual Mean $PM_{2.5}$	Annual Mean of 32 µg/m^3 equating to 35 days above 50 µg/m^3 for PM_{10}
Very Large	>3.8µg/m^3	> 2.375µg/m^3	> 3.04µg/m^3
Large	>2.2 – ≤3.8µg/m^3	>1.375 – ≤2.375µg/m^3	>1.76 – ≤3.04µg/m^3
Medium	>0.6 – ≤2.2µg/m^3	>0.375 – ≤1.375µg/m^3	>0.48 - ≤1.76µg/m^3
Small	>0.2 - ≤0.6 µg/m^3	>0.125 - ≤0.375µg/m^3	>0.16 - ≤0.48 µg/m^3
Imperceptible	≤0.2µg/m^3	< 0.125µg/m^3	≤0.16µg/m^3

Table 12.10: Impact Descriptor for Changes in Concentrations at a Receptor

Concentration with Development in place in relation to Objective / Limit Value	Change in concentration				
	Imperceptible	Small	Medium	Large	Very Large
> 110 % (a)	Negligible	Moderate	Major	Major	Major
>102% - ≤110% (b)	Negligible	Moderate	Moderate	Major	Major
>95% - ≤102% (c)	Negligible	Minor	Moderate	Moderate	Major
>75% - ≤95% (d)	Negligible	Negligible	Minor	Moderate	Moderate
≤75% (e)	Negligible	Negligible	Negligible	Minor	Moderate

Where concentrations increase the impact is described as adverse and where it decreases as beneficial.

(a) NO_2 or PM_{10}: >44 µg/m^3 annual mean; $PM_{2.5}$ >27.5 µg/m^3 annual mean; PM_{10} >35.2 µg/m^3 annual mean (days)

(b) NO_2 or PM_{10}: >40.8 – ≤ 44 µg/m^3 annual mean; $PM_{2.5}$ > 25.5 – ≤27.5 µg/m^3 annual mean; PM_{10} >32.6 – ≤35.2 µg/m^3 annual mean (days)

(c) NO_2 or PM_{10}: >38 – 40.8 µg/m^3 annual mean; $PM_{2.5}$ >23.75 – ≤25.5 µg/m^3 of annual mean; PM_{10} >30.4 – ≤32.6 µg/m^3 annual mean (days)

(d) NO_2 or PM_{10}: >30 - ≤38 µg/m^3 annual mean; $PM_{2.5}$ >18.75 - ≤23.6 µg/m^3 annual mean; PM_{10} <24 - ≤ 30.4 µg/m^3 annual mean (days)

(e) NO_2 or PM_{10}: ≤30 µg/m^3 annual mean; $PM_{2.5}$ ≤18.75 µg/m^3; annual mean; PM_{10} ≤24 µg/m^3 annual mean (days)

12.3.34 The guidance states that the assessment of significance should be based on professional judgement, taking into account the following factors:

- Number of properties affected by minor, moderate or major air quality impacts and a judgement on the overall balance.
- The magnitude of the changes and the descriptions of the impacts at the receptors i.e. **Tables 12.9** and **Table 12.10** findings;
- Whether or not an exceedance of an objective or limit value is predicted to arise in the study area where none existed before or an exceedance area is substantially increased;
- Whether or not the study area exceeds an objective or limit value and this exceedance is removed or the exceedance area is reduced;

- Uncertainty, including the extent to which worst-case assumptions have been made; and
- The extent to which an objective or limit value is exceeded.

12.3.35 Where impacts can be considered in isolation at an individual receptor, moderate or major impacts (i.e. per **Table 12.10**) may be considered to be a significant environmental effect, whereas negligible or minor impacts would not be considered significant. The overall effect however, needs to be considered in the round taking into account the changes at all of the modelled receptor locations, with a judgement made as to whether the overall air quality effect of the development is 'significant' or 'not significant', which is a binary judgement.

12.3.36 The significance of impacts within the development site is based on whether the NAQOs for each pollutant are exceeded or not.

Ecological Receptors – Significance

12.3.37 Where critical loads are already exceeded, an increase of more than 1% of the critical load is an indication of potentially significant effects which would trigger the need for further, more detailed assessment. It should be noted that an increase in deposition of more than 1% is not, per se, an indication that a significant effect exists, only the possibility of one. Depending on a more detailed assessment which would take account of the actual ecological conditions at the location under consideration and the dose response relationship of the habitat, an increase of more than 1% can be acceptable.

Assumptions and Limitations

12.3.38 There are many components that contribute to the uncertainty in predicted concentrations. 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 is then additional uncertainty as the model is required to simplify real-world conditions into a series of algorithms.

12.3.39 A disparity between the national road transport emission projections and measured annual mean concentrations of nitrogen oxides and NO_2 has been identified in recent years[15]. Whilst projections suggest that both annual mean nitrogen oxides and nitrogen dioxide concentrations from road traffic emissions should have fallen by around 15-25% over the past 6 to 8 years, at many monitoring sites levels have remained relatively stable, or have even shown a slight increase. The monitoring carried out by CDC shows relatively stable concentrations in Ardley during the 2010-2016 period; the fact that concentrations have not fallen as rapidly as was previously anticipated is likely to be due to the real world performance of emissions from diesel cars.

12.3.40 The real-world performance of diesel cars in terms of NO_x emissions has now been incorporated into the latest version of the Defra Emission Factor Toolkit. The uncertainty regarding future emissions therefore surrounds how successful real-world emissions testing will be in improving the performance of Euro 6 diesel cars in the future. There is a residual uncertainty regarding this point, and some degree of caution is required in the assessment process.

12.3.41 The first year of occupation of the Application Site is anticipated to be 2021, with approximately 6% occupation in this year. The traffic flows for the Application

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[15] Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011). Trends in NO_x and NO_2 emissions and ambient measurements in the UK. Available: http://uk-air.defra.gov.uk/library/reports?report_id=645

Site have been predicted for 2031 when the development is expected to be fully built out and occupied. The future year traffic modelling has been based on 2021 emission factors and background concentrations whilst utilising 2031 traffic flows. The assessment is therefore considered conservative, which is further illustrated by the sensitivity test carried out using 2022 background concentrations and emission factors. Further information on the selection of future year emission factors is provided in **Appendix 12.3**.

12.4 BASELINE CONDITIONS

Baseline Survey Information

LAQM

12.4.1 Cherwell District Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. To date, three AQMAs have been declared within the district. None of them are in close proximity to the Application Site, the closest being located approximately 16km away.

Monitoring

12.4.2 The Council operates an automatic monitoring station alongside Hennef Way, which is not in close proximity to the Application Site. The Council also deploys NO_2 diffusion tubes at a number of locations, the closest ones being located in Ardley, Middleton Stoney and Camp Road. Data for these sites are presented in **Table 12.11** and locations are shown in **Figure 12.3**.

Table 12.11: Measured Nitrogen Dioxide Concentrations, 2012-2016

Site ID	Site Type	Within AQMA	Annual Mean (µg/m³)				
			2012	2013	2014	2015	2016
Ardley*	Roadside	N	30.9	26.9	30.7	29.6	28.7
Middleton Stoney*	Kerbside	N	-	-	34.1	32.4	33.3
Camp Road	Kerbside	N	-	-	15.8	14.1	14.9
Objective			**40**				

2010 – 2013 Data taken from the 2014 Air Quality Progress Report Cherwell District Council[16].

2014 and 2015 data taken from the 2016 Annual Status Report[17]

2016 data obtained via email consultation on the 7th September 2017 with Cherwell District Council Environmental Health Officer (EHO).

* Used in model verification

12.4.3 The measured concentrations of NO_2 have been below the objectives at all three sites during the 2012-2016 period.

12.4.4 There is no PM_{10} monitoring carried out in close proximity to the Application Site.

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[16] Cherwell District Council (2014) 'Air Quality Progress Report for Cherwell District Council'.

17 Cherwell District Council (2017). *'Annual Air Quality Status Report for 2016'*. Available at: https://www.cherwell.gov.uk/downloads/69/pollution

Background Concentrations

12.4.5 In addition to measured concentrations, estimated background concentrations for the Application Site and surrounding area have been obtained from the national maps published by Defra (**Table 12.12**). The background concentrations were all well below the relevant objectives in 2016.

Table 12.12: Estimated Annual Mean Background Concentrations

Grid Square	NO_x		NO_2		PM_{10}		$PM_{2.5}$	
	2016	2021[b]	2016	2021[b]	2016	2021[b]	2016	2021[b]
455_230	14.1	10.7	10.6	8.2	15.2	14.7	9.9	9.4
446_228	9.1	7.5	7.0	5.8	13.4	12.9	8.9	8.5
446_229	9.0	7.4	6.9	5.7	13.3	12.9	8.8	8.5
447_223	9.3	7.6	7.2	5.9	13.0	12.6	8.7	8.3
449_224	10.2	8.3	7.8	6.4	13.9	13.4	9.2	8.8
449_225	10.1	8.2	7.7	6.3	12.8	12.4	8.7	8.3
450_225*	9.7	7.8	7.4	6.1	13.4	13.0	8.9	8.5
451_225*	9.9	8.0	7.6	6.2	13.6	13.2	9.1	8.7
452_226*	10.1	8.0	7.7	6.2	12.7	12.2	8.5	8.1
453_218	13.6	10.7	10.2	8.2	13.5	13.1	9.2	8.7
453_223	12.2	9.6	9.3	7.4	13.5	13.0	8.8	8.4
454_227	21.4	16.0	15.6	12.0	16.3	15.8	10.5	10.0
Objective	**30[a]**		**40**		**40**		**25**	

a) NO_x objective in relation to ecological receptors only;

b) 2021 data has been used for the assessment of the impact of full development traffic in 2031;

* within Application Site.

Baseline Deposition

12.4.6 The three-year average (2013 – 2015) nitrogen and acid deposition rates for Ardley Cutting and Quarry SSSI sensitive to either nitrogen or acid deposition are presented in **Table 12.13**; data have been taken from the APIS website. The APIS data does not include future year predictions and therefore in a conservative basis, the APIS baseline is assumed constant for the future year assessments.

Table 12.13: Baseline Deposition Rates

Habitat	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition	
		keqN/ha/yr	keqS/ha/yr
Calcareous grassland (Bromus erectus- Brach podium pinnatum lowland calcareous grassland)	21.14	1.51	0.19
Calcareous grassland (Bromus erectus- lowland calcareous grassland)	21.14	1.51	0.19
Critical Level	**15 - 25**	**0.856 – 4.856**	**4.0**

Predicted Baseline Concentrations

Existing Residential Receptors

12.4.7 The ADMS-Roads model has been run to predict NO_2, PM_{10} and $PM_{2.5}$ concentrations at each of the existing and proposed receptor locations identified in **Table 12.4** (see also **Table 12.8** and **Figure 12.2** for receptor locations) for baseline years 2016 and 2031. The results are presented in **Table 12.14**.

Table 12.14: Predicted Baseline Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Existing Receptor Locations in 2016 and 2021

Receptor	Baseline 2016			Future Baseline 2031		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R1	21.4	14.9	9.9	17.3	14.5	9.4
R2	13.2	14.5	9.6	11.2	14.1	9.2
R3	13.5	14.5	9.6	11.3	14.2	9.2
R4	13.3	13.4	9.1	12.0	13.2	8.8
R5	10.7	13.1	8.9	8.9	12.8	8.5
R6	37.3	16.4	10.8	32.9	16.4	10.5
R7	28.1	18.0	11.6	24.5	17.9	11.2
R8	27.5	17.9	11.5	23.8	17.8	11.2
R9	28.5	15.8	10.4	26.0	15.9	10.1
R10	27.7	15.6	10.2	27.6	16.0	10.2
R11	**42.6**	17.0	11.2	39.2	17.4	11.1

Receptor	Baseline 2016			Future Baseline 2031		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R12	27.4	15.7	10.2	24.2	15.6	10.0
R13	15.8	14.3	9.6	13.4	13.9	9.2
R14	8.2	13.2	8.8	7.4	12.8	8.4
R15	20.9	15.0	10.0	17.4	14.6	9.5
R16	18.9	14.8	9.8	15.7	14.4	9.4
R17	**41.2**	19.0	12.3	33.5	18.5	11.7
R18	17.1	14.5	9.7	18.4	14.6	9.5
Obj	**40**	**40**	**25**	**40**	**40**	**25**

Annual mean expressed in $\mu g/m^3$

Obj=Objective

Exceedances highlighted in bold.

12.4.8 The annual mean objective for NO_2 is not predicted to be exceeded at any of the existing receptors locations in 2016 and 2031, with the exception of R11 and R17 where the objective is exceeded in 2016. Predicted baseline concentrations of PM_{10} and $PM_{2.5}$ are well below the objectives at all receptor locations for both years.

12.4.9 Whilst an exceedance of the annual mean NO_2 objective is predicted at R11 and R17 in 2016, there are no AQMAs at these locations which may mean that the modelling is overpredicting baseline concentrations at these locations.

Ecological Receptors

12.4.10 The results for the predicted baseline concentrations at ecological receptors are provided in **Table 12.15**. The location of the ecological receptors are shown in **Figure 12.2**.

Table 12.15: Predicted Baseline Concentrations at Ecological Receptors in 2016 and 2031

Receptor and Distance in Habitat	Distance from Kerb (m)	Total NO_x ($\mu g/m^3$)		Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keqN/ha/yr)	
		2016	2031	2016	2031	2016	2031
Ardley Cutting and Quarry SSSI Transect E1							
E1 0m	0	**30.5**	24.2	**21.7**	**21.7**	1.737	1.738
E1 5m	5	**30.8**	24.5	**21.7**	**21.7**	1.739	1.740
E1 10m	10	**31.2**	24.9	**21.7**	**21.7**	1.741	1.742

Receptor and Distance in Habitat	Distance from Kerb (m)	Total NO_x ($\mu g/m^3$)		Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keqN/ha/yr)	
		2016	2031	2016	2031	2016	2031
E1 15m	15	**31.4**	25.1	**21.7**	**21.7**	1.742	1.743
E1 20m	20	**31.4**	25.1	**21.7**	**21.7**	1.742	1.743
E1 30m	30	**31.3**	25.0	**21.7**	**21.7**	1.741	1.742
E1 40m	40	**30.9**	24.6	**21.7**	**21.7**	1.739	1.740
E1 50m	50	**30.5**	24.3	**21.7**	**21.7**	1.737	1.738
E1 75m	75	29.6	23.4	**21.6**	**21.6**	1.733	1.733
E1 100m	100	28.9	22.7	**21.5**	**21.6**	1.729	1.729
E1 125m	125	28.4	22.2	**21.5**	**21.5**	1.726	1.727
E1 150m	150	28.0	21.7	**21.5**	**21.5**	1.724	1.724
E1 175m	175	27.7	21.4	**21.4**	**21.5**	1.722	1.723
E1 200m	200	27.4	21.1	**21.3**	**21.4**	1.721	1.721
Critical Level /Load		**30**		**15 – 25**		**0.856 – 4.856**	
Ardley Cutting and Quarry SSSI Transect E2							
E2 0m	0	**30.1**	23.8	**21.6**	**21.6**	1.735	1.736
E2 5m	5	**30.0**	23.7	**21.6**	**21.6**	1.734	1.735
E2 10m	10	29.9	23.6	**21.6**	**21.6**	1.734	1.735
E2 15m	15	29.7	23.5	**21.6**	**21.6**	1.733	1.734
E2 20m	20	29.5	23.3	**21.6**	**21.6**	1.732	1.733
E2 30m	30	29.2	22.9	**21.6**	**21.6**	1.730	1.731
E2 40m	40	28.8	22.5	**21.5**	**21.5**	1.728	1.729
E2 50m	50	28.4	22.2	**21.5**	**21.5**	1.726	1.727
E2 75m	75	27.7	21.5	**21.5**	**21.5**	1.722	1.723
E2 100m	100	27.2	21.0	**21.4**	**21.4**	1.719	1.720
E2 125m	125	15.0	12.4	**21.4**	**21.4**	1.718	1.718
E2 150m	150	14.8	12.1	**21.4**	**21.4**	1.716	1.717
E2 175m	175	14.5	11.9	**21.4**	**21.4**	1.715	1.715

Receptor and Distance in Habitat	Distance from Kerb (m)	Total NO_x (µg/m^3)		Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keqN/ha/yr)	
		2016	2031	2016	2031	2016	2031
E2 200m	200	14.3	11.7	**21.3**	**21.3**	1.714	1.714
Critical Level /Load		**30**		**15 - 25**		**0.856 – 4.856**	

12.4.11 For Transect E1, to the east of Station Road (see **Figure 12.2**), the NO_x critical level is predicted to be exceeded from 0m up to 50m from Station Road in 2016, whilst in 2031 the NO_x critical level is not predicted to be exceeded. The nitrogen deposition critical load is predicted to be exceeded at all receptor locations in 2016 and 2031. There are no predicted exceedances of the critical loads of acid deposition within the habitat in 2016 or 2031.

12.4.12 For Transect E2, to the west of Station Road, the NO_x critical level is predicted to be exceeded from 0m and 5m from Station Road in 2016, whilst in 2031 the NO_x critical level is not predicted to be exceeded. The nitrogen deposition critical load is predicted to be exceeded at all distances from Station Road in 2016 and 2031. There are no predicted exceedances of the critical loads of acid deposition within the habitats in 2016 and 2031.

12.4.13 The decrease in concentrations and deposition between 2016 and 2031 is a result of vehicle emissions reducing at a greater rate than baseline traffic levels increase over the same time period, notwithstanding the fact that vehicle emission factors for 2021 have been used for the full year assessment.

12.5 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

Effects During Construction

12.5.1 The main potential effects during construction are dust deposition and elevated PM_{10} concentrations. The following activities have the potential to cause emissions of dust:

- site preparation including delivery of construction material, erection of fences and barriers;
- demolition of existing buildings on site;
- earthworks including digging foundations and landscaping;
- materials handling such as storage of material in stockpiles and spillage;
- construction and fabrication of units; and
- disposal of waste materials off-site.

12.5.2 Typically, the main cause of unmitigated dust generation on construction sites is from demolition and vehicles using unpaved haul roads, and off-site from the suspension of dust from mud deposited on local roads by construction traffic. The main determinants of unmitigated dust annoyance are the weather and the distance to the nearest receptor.

12.5.3 Based on the IAQM criteria (**Table 12.5**), the risk of dust emissions is considered to be large due to the size of the Application Site. The study area is considered to be of high sensitivity (**Table 12.6**), due to existing adjacent residential receptors and automobile business on land next to the Application Site. Appropriate mitigation corresponding to a high risk site is therefore required during the construction phase when work is being undertaken close to existing receptors. Mitigation is discussed later in this ES chapter.

12.5.4 During the construction period, the increase in HDV movements on the road network is predicted to be 8 AADT. This is below the threshold of 100 movements per day outside an AQMA for an assessment to be necessary according to the EPUK and IAQM guidance. The construction traffic impacts are therefore considered to be insignificant, and have been scoped out of this assessment.

Effect Significance

12.5.5 In accordance with the IAQM criteria, with the mitigation in place, the effect of construction phase dust is not significant.

Effects During Operation

Existing Receptors

12.5.6 Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ at existing receptors in 2031 both with and without the Application in place are presented in **Table 12.16**. The 2031 future year Application assessment has been carried out using the 2031 Application Test Case traffic data described in **Paragraph 12.3.18** combined with 2021 vehicle emission factors.

Table 12.16: Predicted Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Existing Receptors in 2031.

Receptor	2031 Without Development			2031 With Development		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R1	17.3	14.5	9.4	18.1	14.6	9.5
R2	11.2	14.1	9.2	13.4	14.5	9.4
R3	11.3	14.2	9.2	13.3	14.5	9.4
R4	12.0	13.2	8.8	16.6	13.9	9.2
R5	8.9	12.8	8.5	10.2	12.9	8.6
R6	32.9	16.4	10.5	34.1	16.6	10.6
R7	24.5	17.9	11.2	28.8	18.7	11.7
R8	23.8	17.8	11.2	28.0	18.6	11.6
R9	26.0	15.9	10.1	30.0	16.6	10.5
R10	27.6	16.0	10.2	29.5	16.3	10.4
R11	39.2	17.4	11.1	**42.2**	17.8	11.3
R12	24.2	15.6	10.0	25.1	15.8	10.1

Receptor	2031 Without Development			2031 With Development		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R13	13.4	13.9	9.2	14.1	14.0	9.3
R14	7.4	12.8	8.4	9.0	13.1	8.6
R15	17.4	14.6	9.5	18.7	14.8	9.6
R16	15.7	14.4	9.4	16.8	14.5	9.5
R17	33.5	18.5	11.7	35.1	18.7	11.8
R18	18.4	14.6	9.5	19.3	14.7	9.6
Obj	**40**	**40**	**25**	**40**	**40**	**25**

Exceedances highlighted in bold
Annual mean expressed in µg/m^3
(Obj=Objective

12.5.7 **Table 12.16** shows that predicted concentrations are below the objectives in 2031 with and without the Application in place at all receptor locations, with the exception of R11 (Corner Cottage, Middleton Stoney). At R11, an exceedance of the objective is predicted in 2031 with the Application in place.

12.5.8 The changes in annual mean concentrations between no development and the Application being built are presented in **Table 12.17**, based on unrounded numbers.

Table 12.17: Change in Predicted Concentration brought about by the Application in 2031

Receptor	NO_2 (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
R1	0.8	0.1	0.1
R2	2.2	0.3	0.2
R3	2.0	0.3	0.2

Receptor	NO_2 (µg / m³)	PM_{10} (µg / m³)	$PM_{2.5}$ (µg / m³)
R4	4.6	0.7	0.4
R5	1.3	0.2	0.1
R6	1.3	0.2	0.1
R7	4.3	0.8	0.5
R8	4.2	0.7	0.4
R9	3.9	0.7	0.4
R10	1.9	0.3	0.2
R11	3.0	0.5	0.3
R12	0.9	0.1	0.1
R13	0.7	0.1	0.1
R14	1.6	0.2	0.1
R15	1.3	0.2	0.1
R16	1.1	0.2	0.1
R17	1.6	0.2	0.1
R18	0.9	0.1	0.1

12.5.9 Based on the impact magnitude descriptors in **Table 12.9**, the changes in annual mean NO_2 concentrations range from medium to very large. The following receptors are predicted to have a very large change in NO_2 concentrations: R4, R7, R8 and R9, whilst a large change in concentrations is predicted at R2 and R11. For the remaining receptors, a medium change in annual mean NO_2 concentrations is predicted.

12.5.10 The changes in PM_{10} concentrations range from imperceptible to medium. A medium change in PM_{10} concentrations is predicted at the following receptors: R4, R7, R8 and R9. Receptors R2, R3, R10, R11, R14, R17 are all predicted to experience a small change in concentrations. An imperceptible change in concentrations is predicted at the remaining receptors.

12.5.11 Changes in $PM_{2.5}$ concentrations are predicted to range from imperceptible to medium. A medium change is predicted at R4, R7, R8 and R9 and a small change at R2, R3, R10, R11, R14. An imperceptible change is predicted at the remaining receptors.

12.5.12 Using the criteria set out in **Table 12.10**, the impacts on NO_2 concentrations at R11 are described as major adverse due to the exceedance of the objective as a result of full Application traffic. The impacts at R4, R7, R8 and R9 are described as moderate adverse, whilst at R2, R6 and R17, the impacts are described as minor adverse. Impacts on the remaining receptors are described as negligible. Impacts on PM_{10} and $PM_{2.5}$ concentrations at all receptor locations are all described as negligible.

12.5.13 As shown in **Appendix 12.3**, NO_x emissions from the vehicle fleet will reduce very significantly in the future due to a higher proportion of lower emission vehicles. The selection of the vehicle emission year therefore has a very significant impact on the predicted concentrations. An additional set of modelling has been undertaken as a sensitivity test to assess this effect.

12.5.14 The sensitivity test modelling uses the same 2031 Application Test Case traffic data, but applies 2022 emission factors and background concentrations instead of 2021 emission factors and background concentrations. In essence, this illustrates the sensitivity of the results to the emission factor year, but also how rapidly the reductions in vehicle emissions counteract the effect of the development traffic. The results of the 2022 sensitivity test modelling are shown in **Table 12.18**, compared to the 2021 baseline concentrations.

Table 12.18: Effect of Change in Emission Factor Years

Receptor	2031 Without Development (2021 Emission factors)			2031 With Development (2022 Emission Factors)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R1	17.3	14.5	9.4	16.7	14.5	9.4
R2	11.2	14.1	9.2	12.5	14.4	9.4
R3	11.3	14.2	9.2	12.5	14.4	9.4
R4	12.0	13.2	8.8	15.4	13.8	9.1
R5	8.9	12.8	8.5	9.6	12.9	8.5
R6	32.9	16.4	10.5	31.4	16.5	10.5
R7	24.5	17.9	11.2	26.7	18.6	11.6
R8	23.8	17.8	11.2	26.0	18.5	11.5
R9	26.0	15.9	10.1	27.7	16.5	10.5
R10	27.6	16.0	10.2	27.3	16.3	10.3
R11	39.2	17.4	11.1	38.9	17.7	11.2
R12	24.2	15.6	10.0	23.1	15.7	10.0
R13	13.4	13.9	9.2	13.2	14.0	9.2
R14	7.4	12.8	8.4	8.6	13.0	8.5
R15	17.4	14.6	9.5	17.3	14.7	9.5
R16	15.7	14.4	9.4	15.6	14.5	9.4
R17	33.5	18.5	11.7	32.3	18.6	11.7
R18	18.4	14.6	9.5	18.0	14.6	9.6

Receptor	2031 Without Development (2021 Emission factors)			2031 With Development (2022 Emission Factors)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
Obj	**40**	**40**	**25**	**40**	**40**	**25**

Exceedances highlighted in bold
Annual mean expressed in µg/m^3
Obj=Objective

12.5.15 **Table 12.18** shows that with the Application in place the predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are below the objectives in 2031 at all receptor locations assuming 2022 vehicle emission factors.

12.5.16 In addition, the predicted concentration at R11 is lower than the baseline with 2021 emission factors and background concentrations. Even with full Application traffic, the impact at R11 is reversed in less than a year. As full Application traffic will not be on the network when the Application Site opens in 2021, the predicted exceedance at R11 is unlikely to occur in practice.

Proposed Receptors

12.5.17 Concentrations at proposed receptor locations within the Application Site in place in 2021 are presented in **Table 12.19**. The locations of these proposed receptors are shown on **Figure 12.2.**

Table 12.19: Predicted Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Proposed Receptors in 2031.

Receptor	2031 With Development		
	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean[a]	Annual Mean[a]	Annual Mean[a]
PR1	12.0	14.3	9.3
PR2	22.8	16.9	10.8
PR3	13.7	13.8	9.0
Obj	**40**	**40**	**25**

Exceedances highlighted in bold
Annual mean expressed in µg/m^3
Obj=Objective

12.5.18 Predicted concentrations in 2031 at proposed receptor locations within the Application Site are well below the relevant objectives. The Application Site is therefore considered suitable for the proposed mixed-use development.

Effect Significance

12.5.19 The predicted full Application traffic NO_2 concentrations with emission factors one year later than the opening year are lower than the opening year baseline concentrations at a number of receptor locations, and in particular at R11. Taking into account the temporary nature of the effect, and the use of traffic for the full Application for the opening year of the assessment, the air quality effects of road traffic generated by the Application are considered to be not significant. This judgement is also based upon the assessment criteria set out in **paragraph 12.3.34**, in particular, that a conservative assessment has been carried out.

Ecological Receptors

12.5.20 Predicted concentrations and deposition rates without and with the Application in place in 2031 are contained in **Table 12.20**.

Table 12.20: Predicted Concentrations at Ecological Receptors in 2021 With and Without the Application in Place

Receptor and Distance in Habitat	2031 Without Development			2031 With Development		
	Total NO_x (µg/m³)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)	Total NO_x (µg/m³)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Ardley Cutting and Quarry SSSI Transect E1						
E1 0m	24.2	**21.7**	1.738	27.0	**21.9**	1.753
E1 5m	24.5	**21.7**	1.740	27.4	**21.9**	1.755
E1 10m	24.9	**21.7**	1.742	27.9	**22.0**	1.758
E1 15m	25.1	**21.7**	1.743	28.2	**22.0**	1.759
E1 20m	25.1	**21.7**	1.743	28.3	**22.0**	1.760
E1 30m	25.0	**21.7**	1.742	28.0	**22.0**	1.759
E1 40m	24.6	**21.7**	1.740	27.5	**21.9**	1.756
E1 50m	24.3	**21.7**	1.738	27.0	**21.9**	1.753
E1 75m	23.4	**21.6**	1.733	25.8	**21.8**	1.747
E1 100m	22.7	**21.6**	1.729	24.9	**21.7**	1.741
E1 125m	22.2	**21.5**	1.727	24.1	**21.7**	1.737
E1 150m	21.7	**21.5**	1.724	23.6	**21.6**	1.734
E1 175m	21.4	**21.5**	1.723	23.1	**21.6**	1.732
E1 200m	21.1	**21.4**	1.721	22.7	**21.6**	1.730
Critical Level / Load	**30**	**15 - 25**	**0.856 – 4.856**	**30**	**15 - 25**	**0.856 – 4.856**
Ardley Cutting and Quarry SSSI Transect E2						
E2 0m	23.8	**21.6**	1.736	26.4	**21.8**	1.750

Receptor and Distance in Habitat	2031 Without Development			2031 With Development		
	Total NO_x (µg/m³)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)	Total NO_x (µg/m³)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
E2 5m	23.7	**21.6**	1.735	26.3	**21.8**	1.749
E2 10m	23.6	**21.6**	1.735	26.1	**21.8**	1.748
E2 15m	23.5	**21.6**	1.734	25.9	**21.8**	1.747
E2 20m	23.3	**21.6**	1.733	25.7	**21.8**	1.746
E2 30m	22.9	**21.6**	1.731	25.1	**21.7**	1.743
E2 40m	22.5	**21.5**	1.729	24.6	**21.7**	1.740
E2 50m	22.2	**21.5**	1.727	24.1	**21.7**	1.738
E2 75m	21.5	**21.5**	1.723	23.2	**21.6**	1.732
E2 100m	21.0	**21.4**	1.720	22.5	**21.5**	1.728
E2 125m	12.4	**21.4**	1.718	13.7	**21.5**	1.726
E2 150m	12.1	**21.4**	1.717	13.3	**21.5**	1.724
E2 175m	11.9	**21.4**	1.715	13.0	**21.4**	1.722
E2 200m	11.7	**21.3**	1.714	12.8	**21.4**	1.720
Critical Level / Load	**30**	**15 - 25**	**0.856 – 4.856**	**30**	**15 - 25**	**0.856 – 4.856**

12.5.21 The changes in the total NO_x nitrogen deposition and acid deposition brought about by the Application are presented in **Table 12.21**.

Table 12.21: Predicted Application Contribution in 2031

Receptor and Distance in Habitat	2031 Development Contribution					
	Total NO_x		Nitrogen Deposition		Acid Deposition	
	(µg/m³)	%	(kgN/ha/yr)	%	(keq/ha/yr)	%
Ardley Cutting and Quarry SSSI Transect E1						
E1 0m	2.8	9.2	0.21	1.4	0.015	0.3
E1 5m	2.9	9.7	0.22	1.5	0.016	0.3
E1 10m	3.0	10.1	0.23	1.5	0.016	0.3
E1 15m	3.1	10.3	0.23	1.6	0.017	0.3
E1 20m	3.1	10.3	0.24	1.6	0.017	0.3

Receptor and Distance in Habitat	2031 Development Contribution					
	Total NO_x		Nitrogen Deposition		Acid Deposition	
	(μg/m³)	%	(kgN/ha/yr)	%	(keq/ha/yr)	%
E1 30m	3.0	10.1	0.23	1.5	0.016	0.3
E1 40m	2.9	9.7	0.22	1.5	0.016	0.3
E1 50m	2.8	9.2	0.21	1.4	0.015	0.3
E1 75m	2.4	8.1	0.19	1.2	0.013	0.3
E1 100m	2.2	7.2	0.17	1.1	0.012	0.2
E1 125m	2.0	6.6	0.15	1.0	0.011	0.2
E1 150m	1.8	6.0	0.14	0.9	0.010	0.2
E1 175m	1.7	5.6	0.13	0.9	0.009	0.2
E1 200m	1.6	5.2	0.12	0.8	0.009	0.2
Ardley Cutting and Quarry SSSI Transect E2						
E2 0m	2.6	8.8	0.20	1.3	0.014	0.3
E2 5m	2.6	8.6	0.20	1.3	0.014	0.3
E2 10m	2.5	8.5	0.19	1.3	0.014	0.3
E2 15m	2.5	8.3	0.19	1.3	0.014	0.3
E2 20m	2.4	8.0	0.18	1.2	0.013	0.3
E2 30m	2.2	7.5	0.17	1.1	0.012	0.3
E2 40m	2.1	7.0	0.16	1.1	0.012	0.2
E2 50m	2.0	6.6	0.15	1.0	0.011	0.2
E2 75m	1.7	5.7	0.13	0.9	0.009	0.2
E2 100m	1.5	5.0	0.12	0.8	0.008	0.2
E2 125m	1.4	4.5	0.11	0.7	0.008	0.2
E2 150m	1.2	4.2	0.10	0.7	0.007	0.1
E2 175m	1.2	3.9	0.09	0.6	0.007	0.1
E2 200m	1.1	3.6	0.09	0.6	0.006	0.1

12.5.22 For both transects E1 and E2, the nitrogen deposition critical load is predicted to be exceeded at all distances from Station Road with the Application in place. For transect E1, the increase in nitrogen deposition is 1% of the critical load from 0-100m from the road. For transect E2, the increase in nitrogen deposition is 1% of the critical load from 0-40m from the road. Therefore, the increase in nitrogen deposition is potentially significant across these short distances for E1 and E2. However, the maximum increase in deposition is only 1.6% of the critical load and the area across E1 and E2 combined where the increase is above 1% of the critical load is only approximately 2.4% of the total area of the habitat in the SSSI.

12.5.23 There are no predicted exceedances of the critical level for NO_x or critical load for acid deposition within the habitat in 2031 with the Application in place.

12.5.24 The assessment has been undertaken assuming that background deposition rates remain unchanged from current rates. Future reductions in vehicle emissions are expected to reduce background deposition rates more than the predicted development contributions.

Effect Significance

12.5.25 On ecological habitats, air quality effects of road traffic generated by the Application are considered to be not significant as the increase of nitrogen deposition is a maximum of 1.6% of the critical load, and more than 1% for only 2.4% of the total habitat area. In addition, the deposition is dominated by the assumed baseline rate. This judgement is made based on the assessment criteria set out in **Paragraph 12.3.37**, in particular, that a conservative assessment has been carried out.

Summary of Significance of Effects (Before Mitigation)

12.5.26 A summary of the significance of effects is provided in **Table 12.22**. For the air quality assessment, all of the assessed receptor locations are sensitive receptors.

Table 12.22: Significance of Effects (before Mitigation)

Environmental Effect	Sensitivity of Receptor	Impact Magnitude	Nature of Impact (Permanent / Temporary)	Significance of Effect
Construction Dust	NA	NA	Temporary	NA
Road traffic emissions on human health receptors	NA	Not significant	Permanent	Not significant
Road traffic emissions on Ardley Cutting and Quarry SSSI	NA	Not significant	Permanent	Not significant

12.5.27 Following the assessment, there have been minor changes to traffic internal to the site. These changes in traffic are not significant and will not affect the results or significance of the effects outlined above.

12.6 SCOPE OF MITIGATION AND ENHANCEMENT

Construction

12.6.1 A Construction Environmental Management Plan (CEMP) will be prepared in advance of construction (as described in Chapter 2 of the ES) that sets out measures to manage the construction works. The following standard mitigation measures from the IAQM 2016 guidance to address potential high risk effects are recommended, and would be included within the CEMP and agreed with CDC.

Communication

- Develop and implement a stakeholder communications plan.
- Display the name and contact details of persons accountable on the site boundary.
- Display the head or regional office information on the site boundary.

Management

- Develop and implement a dust management plan.
- Record all dust and air quality complaints, identify causes and take measures to reduce emissions.
- Record exceptional incidents and action taken to resolve the situation.
- Carry out regular site inspections to monitor compliance with the dust management plan and record results.
- Increase site inspection frequency during prolonged dry or windy conditions and when activities with high dust potential are being undertaken.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary at least as high as any stockpile on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site run off of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove potentially dusty materials from site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary.
- Avoid the use of diesel or petrol powered generators where possible.
- Produce a Construction Logistics Plan to manage the delivery of goods and materials.
- Only use cutting, grinding and sawing equipment with dust suppression equipment.
- Ensure an adequate supply of water on site for dust suppressant.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use water sprays on such equipment where appropriate.
- Ensure equipment is readily available on site to clean up spillages of dry materials.
- No on-site bonfires and burning of waste materials on site.

Demolition

- Incorporate soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Ensure water suppression is used during demolition operation.
- Avoid explosive blasting, using appropriate manual and mechanical alternatives.

- Bag and remove any biological debris or damp down such material before demolition.

Earthworks

- Re-vegetate earthworks and exposed areas /soil stockpiles to stabilise surfaces as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

Trackout

- Use water assisted dust sweepers on the site access and local roads.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials.
- Record inspection of on-site haul routes and any subsequent action, repairing as soon as reasonably practicable.
- Install hard surfaced haul routes which are regularly damped down.
- Install a wheel wash with a hard-surfaced road to the site exit where site layout permits.
- The site access gate to be located at least 10m from receptors where possible.

12.6.2 With these mitigation measures in place, construction effects are considered to be not significant.

Operation

12.6.3 The effects of Application traffic on residential and ecological receptors are judged to be not significant. No further traffic mitigation above and beyond that described in **Chapter 6: Transport and Access** is therefore proposed to control the direct effects of the development.

12.6.4 Transport mitigation will be incorporated within the Application Site as outlined in **Chapter 6: Transport and Access**. This will reduce the traffic generation that has been assessed in the ES and therefore the predicted impacts, as well as reducing emissions from the Application.

Table 12.23: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Construction Phase Mitigation in CEMP	-	-	X
2	Operational Phase Mitigation	-	-	X

12.7 RESIDUAL EFFECTS ASSESSMENT

12.7.1 Both the construction and operational effects of the Application pre-mitigation are not significant. The residual effects of the Application are therefore also not significant. The residual effects are summarised in **Table 12.24**.

Table 12.24: Residual Significance of Effects Assessment

Effect	Sensitivity of Receptor	Impact Magnitude	Nature of Impact (Permanent / Temporary)	Mitigation	Geographical Importance	Residual Effect
Construction Dust	NA	NA	Temporary	CEMP	Local	Not Significant
Road traffic emissions on human health receptors	NA	Not significant	Permanent	Travel Plan	Local	Not significant
Road traffic emissions on Ardley Cutting and Quarry SSSI	NA	Not significant	Permanent	Travel Plan	Local	Not significant

12.8 CUMULATIVE AND IN-COMBINATION EFFECTS

12.8.1 The cumulative developments included in the assessment of cumulative and in-combination effects are described in **Table 2.5** of **Chapter 2** of this ES.

<u>Construction Effects</u>

12.8.2 Cumulative construction dust effects could potentially occur should construction of the cumulative schemes in the vicinity of the Application Site occur at the same time. However, significant cumulative effects are unlikely to occur as each development is anticipated to employ similar dust mitigation techniques such that the individual construction phase effect is not significant, alone or in combination with other schemes.

<u>Road Traffic Effects</u>

12.8.3 The 2031 Application Test Case traffic data, used in the future year air quality assessment for the Application, takes into account cumulative development in the area. However, an additional traffic scenario has been used to assess the cumulative air quality effects of the full Heyford Park Allocation, in addition to the Application Site. Modelling of the effects of the Allocation has been based on the cumulative 2031 Allocation Test Case traffic data which includes the following:

- Appropriate levels of background growth;
- Consented Heyford Park development (1,178 residential units and 1,700 jobs);
- Committed Local Plan/third party development sites (North West Bicester, Kingsmere, Network Bicester, and Bicester Gateway); and
- The full Site Allocation (1,600 residential units, 1,500 jobs).

<u>Existing Receptors</u>

12.8.4 Concentrations have been predicted at existing receptor locations in 2031 with the Allocation in place and without either the Allocation or the Application in place (2031 without development). The results are presented in **Table 12.26**.

Table 12.26: Predicted Concentrations of NO_2, PM_{10} and $PM_{2.5}$

Receptor	2031 Without Development			2031 With Allocation		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R1	17.3	14.5	9.4	18.2	14.6	9.5
R2	11.2	14.1	9.2	13.8	14.5	9.4
R3	11.3	14.2	9.2	13.7	14.5	9.4
R4	12.0	13.2	8.8	17.5	14.0	9.2
R5	8.9	12.8	8.5	10.4	13.0	8.6
R6	32.9	16.4	10.5	34.4	16.7	10.6
R7	24.5	17.9	11.2	29.6	18.9	11.8
R8	23.8	17.8	11.2	28.8	18.7	11.7
R9	26.0	15.9	10.1	31.0	16.8	10.6
R10	27.6	16.0	10.2	30.0	16.4	10.4
R11	39.2	17.4	11.1	**42.9**	18.0	11.4
R12	24.2	15.6	10.0	25.3	15.8	10.1
R13	13.4	13.9	9.2	14.3	14.0	9.3
R14	7.4	12.8	8.4	9.5	13.1	8.6
R15	17.4	14.6	9.5	18.9	14.8	9.6
R16	15.7	14.4	9.4	16.9	14.5	9.5
R17	33.5	18.5	11.7	35.3	18.7	11.8
R18	18.4	14.6	9.5	19.5	14.7	9.6
Obj[b]	**40**	**40**	**25**	**40**	**40**	**25**

Exceedances highlighted in bold
Annual mean expressed in $\mu g/m^3$
Obj=Objective

12.8.5 The changes in annual mean concentrations between no development and Allocation being in place are presented in **Table 12.27**, based on unrounded numbers.

Table 12.27: Change in Predicted Concentration brought about by the Allocation

Receptor	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean (µg / m^3)	Annual Mean (µg / m^3)	Annual Mean (µg / m^3)
R1	0.9	0.1	0.1
R2	2.6	0.4	0.2
R3	2.4	0.4	0.2
R4	5.5	0.8	0.5
R5	1.5	0.2	0.1
R6	1.6	0.2	0.1
R7	5.2	0.9	0.5
R8	5.0	0.9	0.5
R9	5.0	0.8	0.5
R10	2.4	0.4	0.2
R11	3.7	0.6	0.4
R12	1.1	0.2	0.1
R13	0.9	0.1	0.1
R14	2.1	0.3	0.2
R15	1.5	0.2	0.1
R16	1.2	0.2	0.1
R17	1.8	0.2	0.1
R18	1.1	0.2	0.1

12.8.6 Based on the impact magnitude descriptors in **Table 12.9**, the changes in annual mean NO_2 concentrations range from medium to very large. The following receptors are predicted to have a very large change in nitrogen dioxide concentrations: R4, R7, R8 and R9, whilst a large change in concentrations is predicted at R2, R3, R10 and R11. A medium change in NO_2 concentrations is predicted at the remaining receptors.

12.8.7 The changes in PM_{10} concentrations range from imperceptible to medium. A medium change in PM_{10} concentrations is predicted at the following receptors: R4, R7, R8, R9. Receptors R2, R3, R5, R6, R10, R11, R14, R15 and R17 are predicted to experience a small change in PM_{10} concentrations. The remaining receptors are predicted to experience an imperceptible change in PM_{10} concentrations.

12.8.8 Changes $PM_{2.5}$ concentrations are predicted to range from imperceptible to medium. A medium change is predicted at R4, R7, R8 and R9 and a small change at R2, R3, R6, R10, R11, R14, R15 and R17. An imperceptible change is predicted at the remaining receptors.

12.8.9 Using the criteria set out in **Table 12.10,** the impacts on NO_2 concentrations at R11 are described as **major adverse** due to the exceedance of the objective as a result of development traffic. The impacts at R4, R7, R8 and R9 are described as **moderate adverse,** whilst at R2, R3, R6, R10 and R17 the impacts are described as minor adverse. Impacts on the remaining receptors are described as negligible. Impacts on PM_{10} and $PM_{2.5}$ concentrations at all receptor locations are all described as negligible.

12.8.10 An additional set of modelling has been undertaken as part of the sensitivity test to illustrate the effects of changes in vehicle emission factors on the predicted concentrations. The sensitivity test modelling uses the same 2031 Allocation Test Case traffic data, but instead uses 2022 emission factors and background concentrations. The results of the cumulative scenario sensitivity test are shown in **Table 12.28**.

Table 12.28: Effect of Change in Emission Factor Years

Receptor	2031 Without Development (2021 Emission Factors)			2031 With Allocation (2022 Emission Factors)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R1	17.3	14.5	9.4	16.8	14.5	9.4
R2	11.2	14.1	9.2	12.9	14.5	9.4
R3	11.3	14.2	9.2	12.8	14.5	9.4
R4	12.0	13.2	8.8	16.3	14.0	9.2
R5	8.9	12.8	8.5	9.8	12.9	8.6
R6	32.9	16.4	10.5	31.7	16.6	10.5
R7	24.5	17.9	11.2	27.5	18.8	11.7
R8	23.8	17.8	11.2	26.7	18.6	11.6
R9	26.0	15.9	10.1	28.7	16.7	10.6
R10	27.6	16.0	10.2	27.7	16.3	10.4
R11	39.2	17.4	11.1	39.6	17.9	11.3
R12	24.2	15.6	10.0	23.4	15.7	10.0
R13	13.4	13.9	9.2	13.4	14.0	9.3
R14	7.4	12.8	8.4	9.0	13.1	8.6
R15	17.4	14.6	9.5	17.5	14.8	9.6

Receptor	2031 Without Development (2021 Emission Factors)			2031 With Allocation (2022 Emission Factors)		
	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean	Annual Mean
R16	15.7	14.4	9.4	15.7	14.5	9.4
R17	33.5	18.5	11.7	32.5	18.7	11.7
R18	18.4	14.6	9.5	18.1	14.7	9.6
Objective	**40**	**40**	**25**	**40**	**40**	**25**

Exceedances highlighted in bold
Annual mean expressed in µg/m³

12.8.11 **Table 12.28** shows that with the Allocation in place the predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are below the objectives in 2031 at all receptor locations assuming 2022 vehicle emission factors.

12.8.12 As with the assessment of Application traffic, the predicted exceedance at R11 is unlikely to occur in practice as all of the Allocation traffic will not be on the road network in 2021.

Proposed Receptors

12.8.13 Concentrations at proposed receptor locations within the Application Site in 2031 are presented in **Table 12.29**.

Table 12.29: Predicted Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Proposed Receptors with the Allocation in Place

Receptor	2031 with Allocation		
	NO_2	PM_{10}	$PM_{2.5}$
	Annual Mean[a]	Annual Mean[a]	Annual Mean[a]
PR1	12.6	14.4	9.3
PR2	24.4	17.2	11.0
PR3	13.8	13.8	9.0
Obj[b]	**40**	**40**	**25**

Exceedances highlighted in bold
a) Annual mean expressed in µg/m³
b) Obj=Objective

12.8.14 Predicted concentrations in 2031 at receptor locations within the Application Site are well below the relevant objectives with the Allocation in place. The Application Site is therefore considered suitable for the proposed mixed-use development.

Effect Significance

12.8.15 The predicted full Allocation traffic NO_2 concentrations with emission factors one year later than the opening year are all lower than the air quality objectives. Taking into account the temporary nature of the effect, and the use of full Allocation traffic for the opening year of the assessment, the air quality effects of road traffic generated by the Allocation are considered to be not significant. This judgement is also based upon the assessment criteria set out in **paragraph 12.3.37**, in particular, that a conservative assessment has been carried out.

Ecological Receptors

12.8.16 Predicted concentrations and deposition rates without the development in place, and with the Allocation in place, are contained in **Table 12.30**.

Table 12.30: Predicted Concentrations at Ecological Receptors in 2031

Receptor and Distance in Habitat	2031 Without Development			2031 with Allocation		
	Total NO_x ($\mu g/m^3$)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)	Total NO_x ($\mu g/m^3$)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Ardley Cutting and Quarry SSSI Transect E1						
E1 0m	24.2	**21.7**	1.738	27.5	**21.9**	1.756
E1 5m	24.5	**21.7**	1.740	28.0	**22.0**	1.758
E1 10m	24.9	**21.7**	1.742	28.5	**22.0**	1.761
E1 15m	25.1	**21.7**	1.743	28.8	**22.0**	1.763
E1 20m	25.1	**21.7**	1.743	28.8	**22.0**	1.763
E1 30m	25.0	**21.7**	1.742	28.6	**22.0**	1.762
E1 40m	24.6	**21.7**	1.740	28.1	**22.0**	1.759
E1 50m	24.3	**21.7**	1.738	27.5	**21.9**	1.756
E1 75m	23.4	**21.6**	1.733	26.3	**21.8**	1.749
E1 100m	22.7	**21.6**	1.729	25.3	**21.8**	1.744
E1 125m	22.2	**21.5**	1.727	24.5	**21.7**	1.739
E1 150m	21.7	**21.5**	1.724	23.9	**21.6**	1.736
E1 175m	21.4	**21.5**	1.723	23.4	**21.6**	1.734
E1 200m	21.1	**21.4**	1.721	23.0	**21.6**	1.731
Critical Level / Load	**30**	**15 - 25**	**0.856 – 4.856**	**30**	**15 - 25**	**0.856 – 4.856**

Receptor and Distance in Habitat	2031 Without Development			2031 with Allocation		
	Total NO_x (µg/m^3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)	Total NO_x (µg/m^3)	Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keqN/ha/yr)
Ardley Cutting and Quarry SSSI Transect E2						
E2 0m	23.8	**21.6**	1.736	26.9	**21.9**	1.753
E2 5m	23.7	**21.6**	1.735	26.8	**21.9**	1.752
E2 10m	23.6	**21.6**	1.735	26.6	**21.9**	1.751
E2 15m	23.5	**21.6**	1.734	26.4	**21.8**	1.750
E2 20m	23.3	**21.6**	1.733	26.1	**21.8**	1.748
E2 30m	22.9	**21.6**	1.731	25.6	**21.8**	1.745
E2 40m	22.5	**21.5**	1.729	25.0	**21.7**	1.742
E2 50m	22.2	**21.5**	1.727	24.5	**21.7**	1.739
E2 75m	21.5	**21.5**	1.723	23.5	**21.6**	1.734
E2 100m	21.0	**21.4**	1.720	22.7	**21.6**	1.730
E2 125m	12.4	**21.4**	1.718	14.0	**21.5**	1.727
E2 150m	12.1	**21.4**	1.717	13.6	**21.5**	1.725
E2 175m	11.9	**21.4**	1.715	13.2	**21.5**	1.723
E2 200m	11.7	**21.3**	1.714	13.0	**21.4**	1.722
Critical Level / Load	**30**	**15 - 25**	**0.856 – 4.856**	**30**	**15 - 25**	**0.856 – 4.856**

12.8.17 The changes in the total NO_x nitrogen deposition and acid deposition brought about by the Allocation are presented in **Table 12.31**.

Table 12.31: Predicted Allocation Contribution in 2031

Receptor and Distance in Habitat	2031 Allocation Contribution					
	Total NO_x		Nitrogen Deposition		Acid Deposition	
	($\mu g/m^3$)	%	(kgN/ha/yr)	%	(keq/ha/yr)	%
Ardley Cutting and Quarry SSSI Transect E1						
E1 0m	3.3	11.0	0.25	1.7	0.018	0.4
E1 5m	3.5	11.5	0.26	1.7	0.019	0.4
E1 10m	3.6	12.0	0.27	1.8	0.020	0.4
E1 15m	3.7	12.3	0.28	1.9	0.020	0.4
E1 20m	3.7	12.3	0.28	1.9	0.020	0.4
E1 30m	3.6	12.0	0.27	1.8	0.020	0.4
E1 40m	3.4	11.5	0.26	1.7	0.019	0.4
E1 50m	3.3	10.9	0.25	1.7	0.018	0.4
E1 75m	2.9	9.6	0.22	1.5	0.016	0.3
E1 100m	2.6	8.6	0.20	1.3	0.014	0.3
E1 125m	2.3	7.8	0.18	1.2	0.013	0.3
E1 150m	2.1	7.2	0.17	1.1	0.012	0.2
E1 175m	2.0	6.6	0.15	1.0	0.011	0.2
E1 200m	1.9	6.2	0.14	1.0	0.010	0.2
Ardley Cutting and Quarry SSSI Transect E2						
E2 0m	3.1	10.4	0.24	1.6	0.017	0.4
E2 5m	3.1	10.2	0.23	1.6	0.017	0.3
E2 10m	3.0	10.1	0.23	1.5	0.016	0.3
E2 15m	2.9	9.8	0.22	1.5	0.016	0.3
E2 20m	2.9	9.5	0.22	1.5	0.016	0.3
E2 30m	2.7	8.9	0.20	1.4	0.015	0.3
E2 40m	2.5	8.3	0.19	1.3	0.014	0.3
E2 50m	2.3	7.8	0.18	1.2	0.013	0.3
E2 75m	2.0	6.7	0.16	1.0	0.011	0.2
E2 100m	1.8	5.9	0.14	0.9	0.010	0.2

Receptor and Distance in Habitat	2031 Allocation Contribution					
	Total NO_x		Nitrogen Deposition		Acid Deposition	
	(µg/m^3)	%	(kgN/ha/yr)	%	(keq/ha/yr)	%
E2 125m	1.6	5.4	0.13	0.9	0.009	0.2
E2 150m	1.5	4.9	0.12	0.8	0.008	0.2
E2 175m	1.4	4.6	0.11	0.7	0.008	0.2
E2 200m	1.3	4.3	0.10	0.7	0.007	0.2

12.8.18 For both transects E1 and E2, the nitrogen deposition critical load is predicted to be exceeded at all distances from Station Road with the Allocation in place. For transect E1, the increase in nitrogen deposition is 1% of the critical load from 0-150m from the road. For transect E2, the increase in nitrogen deposition is 1% of the critical load from 0-50m from the road. Therefore, the increase in nitrogen deposition is potentially significant across these distances for E1 and E2. However, the maximum increase in deposition is only 1.9% of the critical load, and the area across E1 and E2 combined where the increase is above 1% of the critical load is only approximately 3.4% of the total area of the habitat.

12.8.19 There are no predicted exceedances of the critical level for NO_x or critical load for acid deposition within the habitat in 2031 with the Allocation in place.

12.8.20 The assessment has been undertaken assuming that background deposition rates remain unchanged from current rates. Future reductions in vehicle emissions are expected to reduce background deposition rates.

Effect Significance

12.8.21 On ecological habitats, air quality effects of road traffic generated by the Allocation are considered to be not significant as the increase of nitrogen deposition is a maximum of 1.9% of the critical load, and only more than 1% for 3.4% of the total habitat area. In addition, the deposition is dominated by the assumed baseline rate. This judgement is made based on the assessment criteria set out in **paragraph 12.3.38**, in particular, that a conservative assessment has been carried out.

12.9 MONITORING

12.9.1 No monitoring is deemed necessary to ensure that effective mitigation is maintained.

12.10 CONCLUSIONS

12.10.1 The assessment has demonstrated that with the use of appropriate mitigation measures, the Application Site is suitable for development and would not result in any significant air quality effects.

12.11 REFERENCES

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Table 12.32: Summary of Effects

Receptor / Receiving Environment	Description of Effect	Nature of Effect	Sensitivity Value	Magnitude of Effect	Geographical Importance	Significance of Effects	Mitigation / Enhancement Measures	Residual Effects
Construction								
Existing residential receptors	Dust deposition and elevated PM_{10} concentrations.	Temporary	NA	NA	L	NA	Standard high risk mitigation measures from the IAQM 2016 guidance to be applied	Not significant
Operation								
Existing and proposed residential receptors	Elevated NO_2, PM_{10} and $PM_{2.5}$ concentrations from operational traffic	Permanent	NA	Not significant	L	Not significant	Mitigation as per Transport Chapter	Not significant
Ecological receptors	Elevated NO_x and acid deposition from operational traffic	Permanent	NA	Not significant	L	Not significant	Mitigation as per Transport Chapter	Not significant
Cumulative and In-combination								
Operational								
Emissions of NO_2, PM_{10} and $PM_{2.5}$ from operational traffic	Elevated NO_2, PM_{10} and $PM_{2.5}$ concentrations from operational traffic	Permanent	NA	Not significant	L	Not significant	Mitigation as per Transport Chapter	Not significant
Ecological receptors	Elevated NO_x and acid deposition	Permanent	NA	Not significant	L	Not significant	Mitigation as per Transport	Not significant

	from operational traffic						Chapter	

APPENDIX 12.1 – VERIFICATION

Nitrogen Dioxide

Most nitrogen dioxide is produced in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emission of nitrogen oxides (NO_x = NO + NO_2). The model has been run to predict the 2016 annual mean road-NOx contribution at two roadside diffusion tubes (identified in **Table 12.11**).

The model output of road-NO_x has been compared with the 'measured' road-NO_x, which was calculated from the measured NO_2 concentrations and the adjusted background NO_2 concentrations within the NO_x from NO_2 calculator.

A primary adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (**Figure 12.1.1**). This factor was then applied to the modelled road-NO_x concentration for each monitoring site to provide adjusted modelled road-NO_x concentrations. The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO_2 concentration within the NO_x from NO_2 calculator. A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero (**Figure 12.1.2**).

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

Primary adjustment factor: 1.7523

Secondary adjustment factor: 1.0007

The results imply that overall, the model was under-predicting the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

Figure 12.1.3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows the 1:1 relationship, as well as ±10% and ±25% of the 1:1 line. All of the monitoring sites lie within the ±25% line.

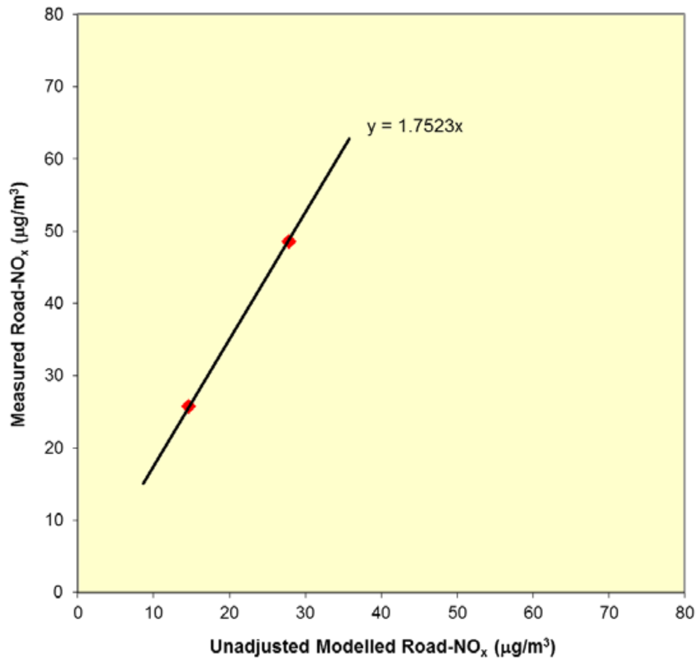


Figure 12.1.1: Comparison of Measured Road-NOx with Unadjusted Modelled Road-NO_x Concentrations

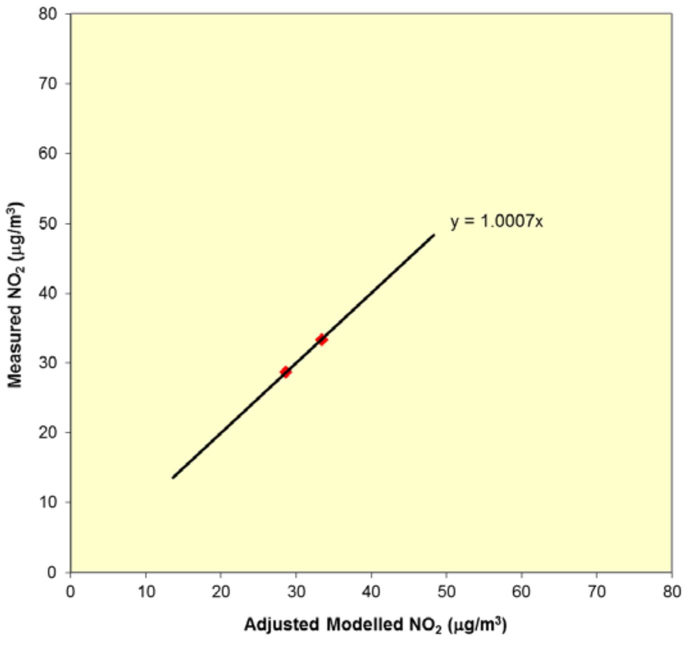


Figure 12.1.2: Comparison of Measured Road-NO_x with Adjusted Modelled Road-NO_x Concentrations

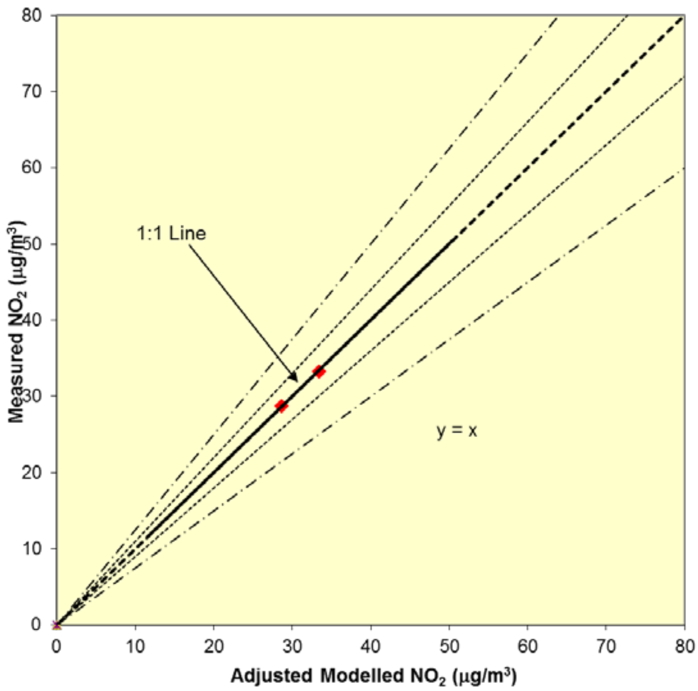


Figure 12.1.3: Comparison of Final Adjusted NO_2 with Measured NO_2 Concentrations

<u>PM_{10} and $PM_{2.5}$</u>

There is no PM_{10} or $PM_{2.5}$ monitoring in close proximity to the proposed development site. Therefore, the primary adjustment factor calculated for NO_2 concentrations has been applied to the modelled road-PM_{10} concentrations.

APPENDIX 12.2 – TRAFFIC DATA

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
1	A260 Oxford Road	10002	4.67%	11931	4.55%	13454	4.25%	13716	4.19%
2	B430	4333	2.86%	5155	2.81%	5859	2.67%	5959	2.64%
3	Station Road	5253	5.59%	6847	5.10%	9745	4.05%	10222	3.91%
4	A260 Banbury Road	10433	4.41%	11988	4.41%	11997	4.41%	11999	4.41%
5	Station Road	2728	6.49%	4625	4.82%	9184	3.15%	10126	2.94%
6	B4030 Lower Heyford Road (west)	4673	3.57%	5368	3.56%	5368	3.56%	5368	3.56%
7	Water Street	2441	5.35%	2806	5.34%	2891	5.22%	2891	5.22%
8	Camp Road (west of Kirtlington Road)	2082	8.69%	3457	6.56%	6784	4.29%	7455	4.02%
9	Kirtlington Road	539	1.35%	717	1.33%	969	1.33%	1034	1.31%
10	Port Way	2316	1.98%	2759	1.95%	3004	1.90%	3069	1.88%
12	B4030 Lower Heyford Road (east)	4368	3.24%	5017	3.24%	5021	3.24%	5021	3.24%
15	Unnamed Road (north of	3623	3.81%	5400	3.20%	8437	2.60%	9243	2.45%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
	B4030)								
16	B4030 (south)	8075	3.09%	11286	2.88%	14338	2.55%	15143	2.46%
17	Unnamed Road (west of B430)	1942	9.32%	4050	5.89%	9223	4.10%	10249	3.79%
18	M40 Junction 10 Northbound Slip A	31371	10.72%	39344	9.89%	45108	8.85%	46158	8.67%
19	M40 Junction 10 Northbound Slip B	26310	12.60%	31218	12.47%	33129	11.85%	33590	11.70%
20	B430 Ardley Road North	11809	5.64%	17580	4.67%	24590	3.77%	25968	3.62%
21	B430 Ardley Road South	8760	5.55%	12230	4.56%	12230	4.56%	12230	4.56%
22	B4030 Bicester Road	7392	5.34%	13905	4.22%	15444	3.94%	15783	3.88%
23	B430 Oxford Road	9570	4.04%	11990	3.77%	13487	3.49%	13954	3.40%
24	B4030 South of Lower Heyford Road	7898	3.59%	10277	3.31%	13329	2.85%	14134	2.74%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
27	Camp Road (east of Kirtlington Road)	2415	7.65%	3827	5.91%	7270	4.19%	7988	3.93%
29	Unnamed Road (East of A4260 Banbury Road)	561	1.26%	1286	1.21%	2795	1.25%	3232	1.21%
37	A4260 (north of Somerton / North Ashton Roads)	10659	4.47%	12686	4.37%	14209	4.10%	14471	4.04%
38	North Ashton Road	1507	1.26%	1730	1.26%	1730	1.26%	1730	1.26%
39	Somerton Road	1418	3.01%	1629	3.01%	1629	3.01%	1629	3.01%
47	B430 Northampton Road	7762	4.00%	10502	3.47%	11999	3.19%	12465	3.11%
60	A43 east of B4110	45584	11.05%	55418	10.47%	59368	9.89%	60014	9.80%
67	Middleton Stoney Road	7145	2.70%	14762	1.54%	16114	1.53%	16405	1.52%
70	Camp Road (east of gate	3411	9.22%	5235	7.24%	7847	4.89%	8745	4.52%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
	7)								
71	Development Access 2	0	0.00%	0	0.00%	424	1.24%	897	1.24%
72	Camp Road (west of Development Access 2a)	3673	9.56%	5589	7.75%	8362	5.26%	9440	4.80%
73	Development Access 2a	0	0.00%	0	0.00%	281	1.24%	281	1.24%
74	Camp Road (east of Development Access 2a)	3672	9.57%	5583	7.76%	8473	5.21%	9551	4.77%
75	Development Access 3 South	188	0.63%	346	0.91%	346	0.91%	818	1.10%
76	Camp Road (East of Development Access 3 South)	3742	9.40%	5717	7.60%	8608	5.14%	9865	4.65%
77	Access 3a	0	0.00%	0	0.00%	281	1.24%	281	1.24%
78	Camp Road (East of Development	3739	9.40%	5720	7.59%	8718	5.09%	9975	4.61%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
	Access 3a)								
86	Development Access 7	1113	0.63%	1963	0.89%	1963	0.89%	1963	0.89%
87	Development Access 8	575	4.10%	1157	2.66%	5061	0.88%	5219	0.89%
88	Camp Road (East of Development Access 8)	4458	8.22%	7251	6.34%	10821	4.40%	12139	4.06%
90	Camp Road (East of Development Access 9)	4537	8.05%	7464	6.18%	11063	4.32%	12380	3.99%
91	Development Access 10	970	0.00%	1404	0.38%	2341	0.23%	2498	0.29%
92	Camp Road (East of Development Access 10)	4777	7.21%	7895	5.56%	11481	3.97%	12859	3.68%
93	Development Access 11	307	0.00%	445	0.39%	445	0.39%	445	0.39%
96	Camp Road (East of Development Access 11a)	4983	7.33%	8168	5.68%	11751	4.09%	13128	3.79%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
97	Development Access 11b	63	0.63%	63	0.63%	211	1.06%	211	1.06%
98	Camp Road (East of Development Access 11b)	5006	7.31%	8260	5.62%	11899	4.05%	13276	3.76%
99	Development Access 12 North	264	0.63%	349	0.78%	349	0.78%	349	0.78%
100	Camp Road (East of Development Access 12 North and South)	5127	7.14%	8419	5.53%	12058	4.00%	13435	3.72%
101	Development Access 12 South	63	0.63%	63	0.63%	63	0.63%	63	0.63%
102	Development Access 13 North	92	0.63%	350	1.08%	373	1.09%	607	1.15%
103	Camp Road (East of Development Access 13 North and South)	5250	6.97%	8665	5.38%	12369	3.92%	13835	3.63%

Link Number	Location	2016 Baseline		2031 Baseline		2031 With Development		2031 Cumulative Scenario	
		AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
104	Development Access 13 South	226	0.63%	226	0.63%	374	0.87%	374	0.87%
106	Camp Road (East of Development Access 14)	5264	6.94%	8697	5.35%	12401	3.90%	13867	3.62%
108	Camp Road (East of Development Access 15)	4504	5.95%	7824	4.52%	11528	3.41%	13134	3.12%
109	Chilgrove Drive	0	0.00%	0	0.00%	10665	4.88%	10665	4.88%
110	Unnamed Road South of Chilgrove Drive	3623	3.81%	5400	3.20%	8437	2.60%	9243	2.45%

APPENDIX 12.3 – FUTURE YEAR EMISSIONS CALCULATIONS

Introduction

Atmospheric dispersion modelling is used to determine the effect of future development traffic on local air quality. The modelling utilises predictions of the composition and emissions profile of the vehicle fleet which are produced by Defra in the emissions factor toolkit (EFT). The composition and emissions profiles are provided on a year by year basis from 2013 to 2030, with the database being periodically updated.

The main issue with regard to the modelling of future traffic impacts is the choice of emission factors to use given that there is a degree of uncertainty as to the accuracy of the emission factors, as well as uncertainty introduced by the modelling process and the traffic data on which the predictions are based. This has become more important in recent years as it has been realised that previous versions of the EFT were likely to have significantly underestimated the real world emissions of the vehicle fleet, as well as the more recent revelations concerning the use of 'defeat devices' on VW group vehicles.

This note therefore sets out PBAs approach to the choice of vehicle emission factors for future year assessments. The note has been revised following updating of the Defra Emissions Factor Toolkit in November 2017.

Modelling Methodology

As a prelude to the discussion of emission factors, it is useful to recap on the general methodology that is used for dispersion modelling of road traffic emissions:

- Traffic data is entered into the dispersion model to represent the baseline situation and the model is used to predict how NO_x emissions are dispersed in the environment.
- The dispersion modelling predictions are compared to monitoring data to obtain a verification factor; the factor by which the predicted road traffic concentration must be multiplied by to agree with the monitored concentration.
- The modelling is repeated for the future year situation; with traffic data representing the situation without the development in place (the 'without' scheme scenario) and with the development in place ('with' scheme). In both cases, the verification factor obtained from the baseline modelling is used to multiply the model results by, in essence assuming that the model is equally as accurate in the future as it was for the baseline scenario.

The verification factor is one of the key elements in the discussion regarding vehicle emission factors. One element of uncertainty in the modelling is the degree to which the emission factors in the EFT are different to actual emissions of the vehicle fleet on the local road network. The use of the verification factor for the future year predictions essentially assumes that the difference between the EFT emission factors and real world emissions is the same in the future as it was in the baseline year. In other words, unless there is some reason to believe that the future year emission factors are less accurate than the baseline year emission factors, the degree to which the EFT emission factors and real world emission factors differ is taken into account in the modelling by the use of the verification factor. This is discussed further in the following sections.

Emission Factor Toolkit

The EFT contains estimates of the future composition of the vehicle fleet in terms of the age and type of vehicles. The composition of the vehicle fleet is primarily related to the age of the vehicles (in terms of their emissions class) and the fuel that they use (i.e. petrol or diesel). In general terms, the majority of new vehicles replace much older vehicles, and as the emissions performance of vehicles is generally taken to improve over time, both current and historical versions of the EFT predict very large reductions in NO_x emissions in the future. It is also obvious that the further one looks into the future, the more uncertain the predictions become as they depend on the rate of vehicle renewal and the size and fuel mix of the vehicles bought; which are all estimates.

The emissions performance of the vehicles is classified in terms of Euro type approval testing; Euro 1 to 6 concerning light duty vehicles and Euro I to VI heavy duty vehicles. Whilst the introduction of each Euro class has generally seen a tightening of emission standards, the standards up until now have been based on laboratory testing of vehicles. The emissions performance of the vehicles in real world driving conditions has been higher than the laboratory testing results, especially for diesel vehicles. This factor was not recognised in earlier versions of the EFT, and combined with the fact that diesel vehicles have much higher NO_x emissions than petrol vehicles and there has been a very large increase in the number of diesel vehicles on the road, has meant that the NO_x emissions and NO_2 concentrations have not reduced as previously predicted.

The trends in NO_x emissions in the vehicle fleet, especially diesel vehicles and the accuracy of the current version of the EFT, is therefore critical in terms of the choice of emission factors in modelling.

Trends in NO_x emissions

For light duty vehicles, the latest Euro standard is Euro 6, which was introduced from September 2015 (with a derogation in the UK for the registration of new vehicles until September 2016).

The emissions standards currently relate to a laboratory test whereby the average emission rate is calculated over an idealised drive cycle. The cycle used is the New European Drive Cycle (NEDC) and there has been extensive criticism that the drive cycle does not represent real world driving conditions. It has therefore been agreed that a new drive cycle will be introduced, the World Light-duty Test Cycle (WLDTC), as well as an on-road test termed Real Driving Emissions (RDE).

Up until September 2017, Euro 6 vehicles were only tested in the laboratory against the NEDC, and these vehicles are termed Euro 6ab. However, from September 2017, new models are tested against the WLDTC and will also have a RDE test. The initial introduction of the RDE test will allow vehicles to have average RDE test emissions of 2.1 times the WLDTC test standard. The 2.1 factor is termed the conformity factor and will apply to new vehicle models from September 2017 and all new vehicles from September 2019. From January 2020, the conformity factor will reduce to 1.5 for new vehicle models (January 2021 for all new vehicles).

Air Quality Consultants undertook some research into the performance of diesel vehicles to support a methodology that they have adopted for undertaking air quality assessments[18]. As part of the analysis, they compared the real word test results of current Euro 6ab diesel vehicles and calculated an average conformity factor of 3.9 from the tests that were assessed. This work led to AQC publishing the CURED v2A calculator which attempted to take account of the real-world emissions performance of diesel vehicles. The approach using CURED v2A was generally accepted to be conservative when considering developments a long time in the future.

[18] Emissions of Nitrogen Oxides from Modern Diesel Vehicles. AQC January 2016

Subsequently, the Department for Transport have undertaken testing of Euro 5 and 6ab diesel vehicles and found that the average NO_x emissions were 1135 mg/km for Euro 5 vehicles and 500 mg/km for Euro 6ab vehicles[19]. These work out to be a conformity factor of 6.30 and 6.25 for Euro 5 and Euro 6ab respectively. Adding in the DfTr results to the AQC results gives an overall average conformity factor for Euro 6ab vehicles tested of 4.1.

A paper presented by Dr Marc Stettler at the recent Westminster Energy, Environment & Transport Forum[20] included results of RDE testing of existing Euro 6ab vehicles. Whilst there was wide range in the results, a number of the vehicles tested did already comply with the Euro 6c standard.

Similar results have been reported in a study led by Rosalind O'Driscoll of Imperial College[21]. This showed that the average NO_x emissions were 4.5 times higher than the Euro 6 limit, with an average NO_2 percentage of 44%.

From the emissions testing work undertaken to date on Euro 6ab vehicles it is clear that the NO_x emissions performance of Euro 6ab vehicles is significantly better than Euro 5 vehicles, although not in line with the laboratory standards. The introduction of Euro 6 should therefore see a significant reduction in NO_x emissions in the future, as outlined in the following table.

Emission Standard	Real Driving Emissions NO_x mg/km
Euro 5, DfTr testing	1135
Euro 6ab, DfTr testing	500
Euro 6c, September 2017 models	168
Euro 6c, January 2020 models	120

Further testing of vehicles is ongoing, with Emissions Analytics regularly publishing the results of real world emissions testing on vehicles[22]. Also, in the November 2017 budget, the government announced a one-off tax on new diesel cars not meeting Euro 6c standards. Both of these factors should help put pressure on vehicle manufacturers to meet the RDE standards. In the longer term, there is also the move to electric vehicles which will gather pace.

Emissions in the EFT

As noted in Section 3, the EFT contains estimates of vehicle emissions by Euro Class. The database was updated in November 2017 from v7.0 to v8.0. It now uses NO_x emissions factors for the vehicles taken from the European Environment Agency's COPERT 5 database, compared to the previous COPERT 4 version v11. In the November 2015 submissions to the European Union for compliance against EU Limit Values, Defra used COPERT 4 v11 factors without taking account of the real-world performance of the vehicle fleet to data.

The EFT now takes account of the real-world performance of Euro 6ab diesel cars, applying a high conformity factor to these vehicles. For Euro 6c vehicles, it assumes

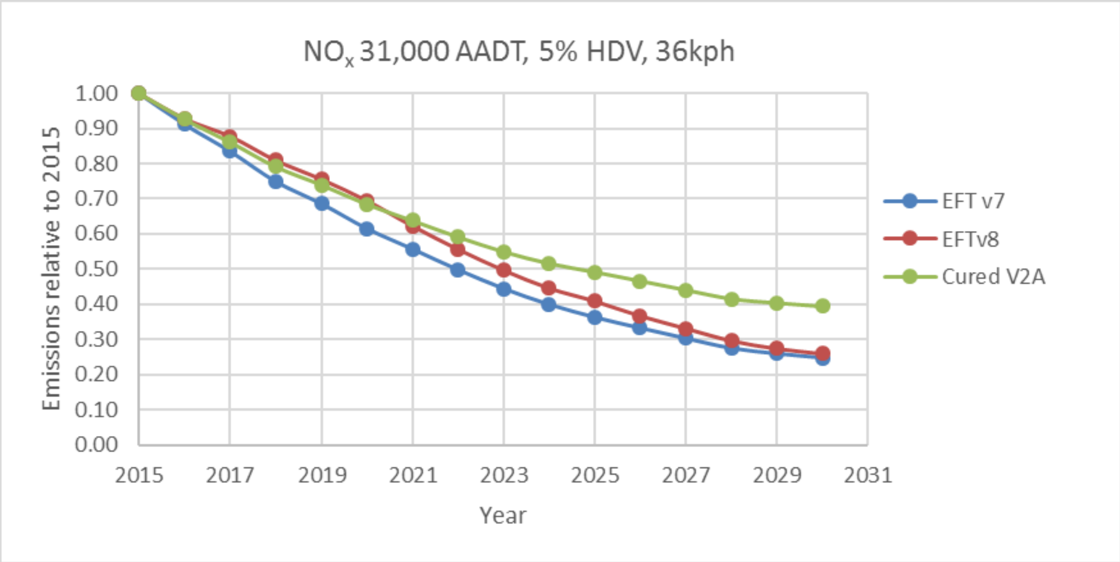
[19] Vehicle Emissions Testing Programme DfTr Cm 9259 April 2016

[20] Priorities for reducing air quality impacts of road vehicles. Dr Marc Stettler 17th May 2016

[21] A Portable Emissions Measurement System (PEMS) study of NO_x and primary NO_2 emissions from Euro 6 diesel passenger cars and comparison with COPERT emission factors. Rosalind O'Driscoll. September 2016

[22] http://equaindex.com/equa-air-quality-index/

that the RDE will be effective in bringing down vehicle emissions. The following graph shows the relative decline in vehicle NO_x emissions predicted for a road in outer London with 5% Heavy Duty Vehicle traffic travelling at 36kph. As air quality models are verified against historic data, the emissions decline is shown relative to 2015.



For emission years prior to 2021, the CURED v2A methodology is likely to give similar results to using the EFT v8.0 data. Post 2021, when the introduction of Euro 6c begins to take effect, then CURED v2A and the EFT v8.0 begin to diverge.

Future Year Assessment Methodology

The selection of emission factors for a future year assessment depends partly on the situation regarding the assessment to be undertaken. Where pollutant concentrations are low and are unlikely to exceed threshold levels, then one may take a conservative approach and keep emission factors at current levels. This will produce a conservative result, but as the result will be ‘acceptable’ in terms of leading to no exceedances of National Air Quality Strategy Objectives, then it is a reasonable approach to adopt as it avoids uncertainty as to whether there will be exceedances in the future.

In contrast, where pollutant concentrations are high, then a different approach to uncertainty is required. In addition, for a formal Environmental Impact Assessment the legal requirement is to assess ‘likely significant effects’. This is not ‘worst case’ significant effects, but ‘likely’ significant effects and therefore must allow for a degree of uncertainty in the predictions.

As discussed in Section 2, the use of the verification factor in the modelling takes account, amongst other things, of the difference in the real-world emissions performance of vehicles in the fleet. For developments up until 2021, the current EFT should be reasonably accurate as to NO_x emissions as the problem with the performance of diesel vehicles has been recognised. As such, one is justified in using the emission factors for the year of the assessment as the uncertainty in the emission factors is taken account of by using the verification factor.

Developments post 2021 will increasingly be influenced by the assumption that the RDE testing of diesel vehicles is effective, which may or may not turn out to be the case. In essence, the result is likely to lie between the green and red curves of the previous graph. This is likely to become less important as the actual levels of emissions is significantly reduced in the future. If a conservative approach is warranted, one could follow the green curve, the effect of which is outlined in the table below.

Assessment Year	Emission Factor Year
2015	2015
2016	2016
2017	2017
2018	2018
2019	2019
2020	2020
2021	2021
2022	2021
2023	2022
2024	2022
2025	2023
2026	2023
2027	2024
2028	2024
2029	2025
2030	2025
Beyond 2030	2025

In the case of a large development with a completion year a long time into the future, then if only completion year traffic data is available, it is likely to be appropriate to assume that the completed year traffic data occurs at the opening year of the development. As appropriate, change in emission year in accordance with the above table may be considered.

Figure 12.1

Construction and Operational Effects Study Area

Figure 12.2

Air Quality Receptors

Figure 12.3

Monitoring Locations