Appendix A – Land at Yarnton 2019 Air Quality Assessment

This appendix presents the full version of the previous Air Quality Assessment for the Proposed Development (dated March 2019) which was provided to CDC as part of the Development Brief Discussions.

Merton College

PR9, LAND AT YARNTON

Air Quality Assessment

70048642-001
MARCH 2019

PUBLIC

Merton College

PR9, LAND AT YARNTON

Air Quality Assessment

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70048642

OUR REF. NO. 70048642-001

DATE: MARCH 2019

Merton College

PR9, LAND AT YARNTON

Air Quality Assessment

WSP
Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

Phone: +44 113 395 6200

Fax: +44 113 395 6201

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft for client review			
Date	March 2019			
Prepared by	Joe Granelli			
Signature	Granelli, Joe Digitally signed by Granelli, Joe DN: cn=Granelli, Joe, ou=Manchester (The Victoria), email=Joe.Granelli@wsp.com Date: 2019.03.11 16:55:41 Z			
Checked by	Rebecca Shorrock			
Signature				
Authorised by	Stuart Bennett			
Signature	[redacted] Bennett, Stuart I am approving this document 2019.03.11 16:59:05 Z			
Project number	70048642			
Report number	001			
File reference	\\uk.wspgroup.com\central data\Projects\700486xx\70048642 - Land at Yarnton\02 WIP\AQ Air Quality\Report			

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EXECUTIVE SUMMARY

WSP was commissioned by Merton College to carry out an assessment of the potential air quality impacts arising from a proposed development at PR9 'Land West of Yarnton'. The development has been provisionally identified as a village extension comprising 530 dwellings and this assessment has been completed to support of a full planning application.

This report presents the findings of the assessment, which addresses the potential air quality impacts during both the construction and operational phases of the proposed development. For both phases, the type, source and significance of potential impacts were identified, and the measures that should be employed to minimise these proposed. An assessment of the suitability of the site for residential use was undertaken within the context of both the existing and future predicted air quality.

The assessment of construction phase impacts associated with fugitive dust and fine particulate matter (PM_{10} and $PM_{2.5}$) emissions has been undertaken with reference to the relevant Institute of Air Quality Management (IAQM) guidance. This identified that there is a **high to medium risk** of dust soiling impacts and a **low risk** of health impacts from increases in particulate matter concentrations due to demolition, earthworks, construction activities and trackout. However, through good site practice and the implementation of suitable mitigation measures, the effect of dust and particulate matter releases would be significantly reduced and the residual local air quality impacts will be **negligible**.

The assessment of operational phase impacts included detailed air quality modelling of emissions from traffic generated by the development proposals. This allowed the potential impacts on local air quality to be considered at existing receptors, whilst also assessing the suitability of the site for residential land use.

The outcomes of the dispersion modelling study demonstrated that the local air quality effects associated with the Proposed Development are predicted to be **negligible** at all identified existing and proposed sensitive receptor locations, prior to the implementation of mitigation measures.

The assessment results for the proposed residential receptors indicate that the pollutant concentrations on site will be below the respective health-based national objectives. As such, the site is **considered to be suitable for residential use**.

Based on the assessment results, it is considered that the proposed development complies with national, regional and local policy for air quality with no identified air quality constraints.

1. INTRODUCTION

1.1. INTRODUCTION

1.1.1. WSP was commissioned by Merton College to undertake an assessment in support of a full planning application for a proposed development on PR9 'Land West of Yarnton' (hereafter referred to as the ‘Proposed Development or ‘Application Site’).

1.1.2. This report provides a review of existing air quality conditions at, and in proximity to, the Application Site and presents the findings of an assessment of the potential impacts of the Proposed Development on local air quality during both the construction and operational phases. For both phases, the type, source and significance of potential impacts are identified, and the measures that should be employed to minimise these described. The assessment was undertaken in accordance with current technical guidance published by the Department of Environment Food and Rural Affairs (Defra) and other relevant guidance published by the Institute of Air Quality Management (IAQM).

1.1.3. Air pollution in urban areas is dominated by emissions from road vehicles. The main pollutants of health concern from road traffic exhaust releases are nitrogen dioxide (NO_2) and fine particulates assessed as the fraction of airborne particles of mean aerodynamic diameter less than ten micrometres (PM_{10}) and less than 2.5 micrometres ($PM_{2.5}$). These pollutants are most likely to approach their respective air quality objectives in proximity to major roads and in congested urbanised areas. As such, emissions of NO_2, PM_{10}, and $PM_{2.5}$ associated with the Proposed Development form the focus of this assessment.

1.1.4. This report also assesses the potential exposure of future residents of the Proposed Development to local pollution concentrations.

1.1.5. A glossary of terms used in this report is provided in **Appendix A.**

1.2. SITE DESCRIPTION AND SURROUNDING AREA

1.2.1. The Application Site lies within the administrative boundary of Cherwell District Council (CDC), 2 kilometres north of an Air Quality Management Area (AQMA) designated by the Oxford City Council (OCC). The Application Site is bordered to the north and east by the A44 and to the south by Cassington Road. The west of the Application Site is made up of greenfield land.

1.2.2. The area surrounding the Application Site consists of residential use to the east and greenfield land to the north, west and south. The location of the Application Site is shown in **Figure 1**.

1.3. DEVELOPMENT PROPOSALS

1.3.1. Following publication of the Oxfordshire Strategic Housing Market Assessment it has been agreed by the relevant councils, including CDC, that Oxford cannot fully accommodate its housing needs within its boundaries. In September 2016, therefore, a programme was established through the Oxfordshire Growth Board apportioning the agreed unmet need between the Oxfordshire district councils, so they could each then make provision in their local plans. The proposed apportionment for CDC is 4,400 dwellings.

1.3.2. We understand that the draft allocation of PR9 'Land West of Yarnton' comprises some 234 Hectares [578 Acres] of a Residentially Led Development Opportunity. The development has been provisionally identified as a village extension comprising 530 dwellings

2. LEGISLATION, POLICY AND GUIDANCE

2.1. AIR QUALITY LEGISLATION & POLICY

2.1.1. A summary of the relevant air quality legislation and policy is provided below.

UK AIR QUALITY STRATEGY

2.1.2. The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)[1]. The AQS[1] provides a framework for reducing air pollution in the UK with the aim of meeting the requirements of European Union legislation.

2.1.3. The AQS[1] also sets standards and objectives for nine key air pollutants to protect health, vegetation and ecosystems. These are benzene (C_6H_6), 1,3 butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), NO_2, PM_{10} and $PM_{2.5}$, sulphur dioxide (SO_2), ozone (O_3), and polycyclic aromatic hydrocarbons (PAHs). The standards and objectives for the pollutants considered in this assessment are given in **Appendix B**.

2.1.4. The air quality standards are levels recommended by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO) with regards to current scientific knowledge about the effects of each pollutant on health and the environment.

2.1.5. The air quality objectives are medium-term policy-based targets set by the Government, which consider economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

2.1.6. For the pollutants considered in this assessment, there are both long-term (annual mean) and short-term standards. In the case of NO_2, the short-term standard is for a 1-hour averaging period, whereas for PM_{10} it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants, for example temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road.

2.1.7. The AQS[1] contains a framework for considering the effects of a finer group of particles known as '$PM_{2.5}$' as there is increasing evidence that this size of particles can be more closely associated with observed adverse health effects than PM_{10}. Local Authorities are required to work towards reducing emissions/concentrations of particulate matter within their administrative area. However, there is no statutory objective given in the AQS[1] for $PM_{2.5}$ at this time.

[1] Department for Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2)

AIR QUALITY REGULATIONS

2.1.8. Many of the objectives in the AQS have been made statutory in England with the Air Quality (England) Regulations 2000[2] and the Air Quality (England) (Amendment) Regulations 2002[3] for Local Air Quality Management (LAQM).

2.1.9. These Regulations require that likely exceedances of the AQS objectives are assessed in relation to:

'…the quality of air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present…'

2.1.10. The Air Quality Standards Regulations 2010[4] (with minor amendment made in 2016[5]) transpose the European Union Ambient Air Quality Directive (2008/50/EC) into law in England. This Directive sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health such as PM_{10}, $PM_{2.5}$ and NO_2. The limit values for NO_2 and PM_{10} are the same concentration levels as the relevant AQS objectives and the limit value for $PM_{2.5}$ is a concentration of 25 µg/m^3.

ENVIRONMENTAL PROTECTION ACT 1990 – CONTROL OF DUST AND PARTICULATES ASSOCIATED WITH CONSTRUCTION

2.1.11. Section 79 of the Environmental Protection Act 1990 gives the following definitions of statutory nuisance relevant to dust and particles:

'Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises so as to be prejudicial to health or a nuisance'; and,

'Any accumulation or deposit which is prejudicial to health or a nuisance'.

2.1.12. Following this, Section 80 says that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.

2.1.13. There are no statutory limit values for dust deposition above which 'nuisance' is deemed to exist. Nuisance is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

ENVIRONMENT ACT 1995

2.1.14. Under Part IV of the Environment Act 1995, local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives defined in the Regulations.

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2 The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928
3 The Air Quality (England) (Amendment) Regulations 2002- Statutory Instrument 2002 No.3043
4 The Air Quality Standards Regulations 2010- Statutory Instrument 2010 No. 1001
5 The Air Quality Standards (Amendment) Regulations 2016- Statutory Instrument 2016 No. 1184

2.1.15. Where the objectives are not likely to be achieved, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality standards in the future.

CLEAN AIR STRATEGY (2019)

2.1.16. The Clean Air Strategy[6] outlines the Government's plan to tackle all sources of air pollution. The strategy sets out the comprehensive action that is required from across all parts of government and society. New legislation will create a stronger and more coherent framework for action to tackle air pollution. This will be underpinned by new England-wide powers to control major sources of air pollution, in line with the risk they pose to public health and the environment, plus new local powers to take action in areas with an air pollution problem. These will support the creation of Clean Air Zones to lower emissions from all sources of air pollution, backed up with clear enforcement mechanisms.

2.1.17. Relevant information contained within the Clean Air Strategy includes:

'Understanding the Problem

a) We (UK Government) are investing £10 million in improving our modelling, data and analytical tools to give a more precise picture of current air quality and the impact of policies on it in future.

b) We will increase transparency by bringing local and national monitoring data together into a single accessible portal for information on air quality monitoring and modelling, catalysing public engagement through citizen science.

Protecting the Nation's Health

c) We will provide a personal air quality messaging system to inform the public, particularly those who are vulnerable to air pollution, about the air quality forecast, providing clearer information on air pollution episodes and accessible health advice.

d) We will back these goals up with powers designed to enable targeted local action in areas with an air pollution problem.

e) We will work to improve air quality by helping individuals and organisations understand how they could reduce their contribution to air pollution, showing how this can help them protect their families, colleagues and neighbours.

f) We have published updated appraisal tools and accompanying guidance to enable the health impacts of air pollution to be considered in every relevant policy decision that is made.

g) We will progressively cut public exposure to particulate matter pollution as suggested by the World Health Organization. We will set a new, ambitious, long-term target to reduce people's exposure to $PM_{2.5}$ and will publish evidence early in 2019 to examine what action would be needed to meet the WHO annual mean guideline limit of 10 µg/m^3

h) By implementing the policies in this Strategy, we will reduce $PM_{2.5}$ concentrations across the UK, so that the number of people living in locations above the WHO guideline level of 10 µg/m^3 is reduced by 50% by 2025

6 Department for Environment, Food and Rural Affairs (Defra) – Clean Air Strategy 2019

i) *By taking action on air pollution we can help people live well for longer, as set out in the Department of Health and Social Care's recently published 'Prevention is Better than Cure' document, which sets the scene for the development of a prevention green paper*

Protecting the Environment

j) *We will monitor the impacts of air pollution on natural habitats and report annually so that we can chart progress as we reduce the harm air pollution does to the environment.*

k) *We will provide guidance for local authorities explaining how cumulative impacts of nitrogen deposition on natural habitats should be mitigated and assessed through the planning system.*

l) *We will commit to a new target for the reduction of damaging deposition of reactive forms of nitrogen and review what longer term targets should be to further tackle the environmental impacts of air pollution.*

Action to Reduce Emissions from Transport

m) *New legislation will enable the Transport Secretary to compel manufacturers to recall vehicles and non-road mobile machinery for any failures in their emissions control system, and to take effective action against tampering with vehicle emissions control systems.*

n) *We will reduce emissions from rail and reduce passenger and worker exposure to air pollution. By the spring 2019, the rail industry will produce recommendations and a route map to phase out diesel-only trains by 2040.*

o) *We are working with the Treasury to review current uses of red diesel and ensure its lower cost is not discouraging the transition to cleaner alternatives.*

p) *We will explore permitting approaches to reduce emissions from non-road mobile machinery, particularly in urban areas.'*

2.2. PLANNING POLICY

2.2.1. A summary of the national and local planning policy relevant to the Proposed Development and air quality is provided below.

NATIONAL PLANNING POLICY

National Planning Policy Framework

2.2.2. The Government's overall planning policies for England are described in the National Planning Policy Framework[7]. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

'…meeting the needs of the present without compromising the ability of future generations to meet their own needs'

2.2.3. One of the three overarching objectives of the NPPF is that planning should '…*contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land,*

7 Department for Communities and Local Government (2019) *National Planning Policy Framework.*

helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy…'.

2.2.4. In relation to air quality, the following paragraphs in the document are relevant:

- Paragraph 54 '…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.'
- Paragraph 103 '…Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health…';
- Paragraph 170 '…Planning policies and decisions should contribute to and enhance the natural and local environment by: …e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans…';
- Paragraph 180 '…Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development...';
- Paragraph 181 '…Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan...';
- Paragraph 183 '…The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.'

LOCAL PLANNING POLICY

Adopted Cherwell Local Plan 2011 – 2031 (Part 1)

2.2.5. This document[8] contains strategic planning policies for development and the use of land. It forms part of the statutory Development Plan for Cherwell to which regard must be given in the determination of planning applications.

2.2.6. The Plan was formally adopted by the Council on 20 July 2015. Policy Bicester 13 was re-adopted on 19 December 2016. CDC are currently preparing Part 2 to the Adopted Cherwell Local Plan 2011-2031 (Part 1) which will contain non-strategic site allocations and development management policies.

2.2.7. In relation to air quality, Policy ESD 10: Protection and Enhancement of Biodiversity and the Natural Environment, states:

'Air quality assessments will also be required for development proposals that would be likely to have a significant adverse impact on biodiversity by generating an increase in air pollution.'

2.2.8. Other information in the document relevant to air quality includes:

'Challenges and Objectives for Ensuring Sustainable Development – A need to consider the effects of development on air quality…

Duty to Cooperate – To work with Oxford City Council and West Oxfordshire Council to consider how best to address congestion and air quality…'

2.3. GUIDANCE

2.3.1. A summary of the publications referred to in completing this assessment is provided below.

LOCAL AIR QUALITY MANAGEMENT REVIEW AND ASSESSMENT TECHNICAL GUIDANCE

2.3.2. Defra has published technical guidance for use by local authorities in their review and assessment work[9]. This guidance, referred to in this document as LAQM.TG16[9], has been used where appropriate in the assessment presented herein.

LAND-USE PLANNING & DEVELOPMENT CONTROL: PLANNING FOR AIR QUALITY

2.3.3. Environmental Protection UK (EPUK) and the IAQM have published guidance[10] that offers comprehensive advice on: when an air quality assessment may be required; what should be included in an assessment; how to determine the significance of any air quality impacts associated with a

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8 Cherwell District Council, *The Cherwell Local Plan 2011-2031 - Part 1 Adopted 20 July 2015*

9 Defra (2018) *Local Air Quality Management Technical Guidance LAQM.TG16*

10 Environmental Protection UK and Institute of Air Quality Management (Version 1.2 Updated January 2017) *Land Use Planning & Development Control: Planning for Air Quality*

development; and, the possible mitigation measures that may be implemented to minimise these impacts.

GUIDANCE ON THE ASSESSMENT OF DUST FROM DEMOLITION AND CONSTRUCTION

2.3.4. This document[11] was published by the IAQM to provide guidance to developers, consultants and environmental health officers on assessing the impacts arising from construction activities. The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM_{10} impacts on public exposure and impact upon sensitive ecological receptors) and to identify mitigation measures appropriate to the level of risk identified.

NATIONAL PLANNING PRACTICE GUIDANCE – AIR QUALITY

2.3.5. This guidance[12] provides principles on how the planning process can consider the impact of new development on air quality, and explains how much detail air quality assessments need to include for proposed developments, and how impacts on air quality can be mitigated. The practice guidance provides information on how air quality is considered by Local Authorities in both the wider planning context of Local Plans and neighbourhood planning, and in individual cases where air quality is a consideration in a planning decision.

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[11] Institute of Air Quality Management (Version 1.1 Updated June 2016) *Guidance on the Assessment of Dust from Demolition and Construction*

[12] Department of Communities and Local Government (DCLG) (March 2014) *National Planning Practice Guidance*

3. SCOPE AND METHODOLOGY

3.1. SCOPE

3.1.1. The scope of the assessment was determined through completion of the following tasks:

- A review of CDC's latest review and assessment reports and air quality data for the area surrounding the Application Site, including data sources from Defra.
- A desk study to confirm the location of nearby existing receptors that may be sensitive to changes in local air quality and a review of the masterplan for the Proposed Development to establish the location of new sensitive receptors; and,
- A review of the baseline and future opening year (*without* and *with* development) traffic data relating to the Proposed Development, as provided by the Project Transport Consultant.

3.1.2. The assessment has focussed on the potential impacts on local air quality associated with:

- Dust and particulate matter generated by on-site activities during the construction phase;
- Increases in pollutant concentrations because of exhaust emissions arising from construction traffic and plant;
- Increases in pollutant concentrations because of exhaust emissions arising from traffic generated by the Proposed Development once operational'; and,
- The potential exposure of future residents of the Proposed Development to poor air quality (i.e. suitability of the Application Site for residential land use).

3.2. METHODOLOGY

CONSTRUCTION PHASE

3.2.1. Dust comprises particles typically in the size range 1-75 micrometres (µm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials. The large dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited near the source of emissions. Dust therefore is unlikely to cause long-term or widespread change to local air quality; however, its deposition on property and cars can cause 'soiling' and discolouration. This may result in complaints of nuisance through amenity loss or perceived damage caused, which is usually temporary.

3.2.2. The smaller particles of dust (less than 10µm in aerodynamic diameter) are known as particulate matter (PM_{10}) and represent only a small proportion of total dust released; this includes a finer fraction, known as $PM_{2.5}$ (with an aerodynamic diameter less than 2.5µm). As these particles are at the smaller end of the size range of dust particles they remain suspended in the atmosphere for a longer period than the larger dust particles, and can therefore be transported by wind over a wider area. PM_{10} and $PM_{2.5}$ are small enough to be drawn into the lungs during breathing, which could have a potential impact on human health.

3.2.3. An assessment of the likely significant impacts on local air quality due to the generation and dispersion of dust and PM_{10} during the construction phase has been undertaken using: the relevant assessment methodology published by the IAQM[11]; the available information for this phase of the Proposed Development provided by the Project Team; and, professional judgement.

3.2.4. The IAQM methodology assesses the risk of potential dust and PM_{10} impacts from the following four sources: demolition; earthworks; general construction activities and track-out. It considers the nature and scale of the activities undertaken for each source and the sensitivity of the area to an increase in deposited dust and ambient PM_{10} concentrations to assign a level of risk. Risks are described in terms of there being a low, medium or high risk of dust impacts. Once the level of risk has been ascertained, then site specific mitigation proportionate to the level of risk is identified, and the significance of residual effects determined. A summary of the IAQM assessment methodology is provided in **Appendix C**.

3.2.5. In addition to impacts on local air quality due to on-site construction activities, exhaust emissions from construction vehicles and plant may have an impact on local air quality adjacent to the routes used by these vehicles to access the Application Site and near the Application Site itself. As information on the number of vehicles and plant associated with the construction phase was not available at the time of writing, a qualitative assessment of their impact on local air quality has been undertaken using professional judgement and by considering the following:

- The number of type of construction traffic and plant likely to be generated by this phase of the Proposed Development;
- The number and proximity of sensitive receptors to the Application Site and along the likely routes to be used by construction vehicles; and,
- The likely duration of the construction phase and the nature of the construction activities undertaken.

OPERATIONAL PHASE

3.2.6. Of the pollutants included in the AQS, concentrations of NO_2 and particulate matter (PM_{10} and $PM_{2.5}$) have been considered in this assessment as road traffic is a major source of these pollutants. Concentrations of these pollutants are more likely to be close to, or in exceedance of, the objectives in urban locations.

3.2.7. For the prediction of impacts due to emissions arising from road traffic during the operation of the Proposed Development, the dispersion model ADMS Roads (version 4.1.1.0) has been used. This model uses detailed information regarding traffic flows on the local road network, surface roughness, and local meteorological conditions to predict pollutant concentrations at specific receptor locations, as determined by the user.

3.2.8. Meteorological data, such as wind speed and direction, is used by the model to determine pollutant transportation and levels of dilution by the wind. Hourly sequential meteorological data was obtained from the nearest meteorological observation station (Brize Norton) to the Application Site for 2017 and used within the model. This station is considered to provide representative data for the assessment.

3.2.9. A summary of traffic data and pollutant emissions factors used in the assessment is provided in **Appendix D**. It includes details of the Annual Average Daily Traffic (AADT) flows, vehicle speeds (km/h) and the percentage of Heavy Duty Vehicles (HDVs) for the local road network modelled in all assessment years considered. Traffic speeds were reduced at junctions with reference to guidance provided in LAQM.TG16, and using professional judgement.

3.2.10. For the assessment, four scenarios were modelled, as follows:

- 2017 – Model Verification;
- 2017 – Base Year
- 2025 – Opening Year 'Without Development'; and
- 2025 – Opening Year 'With Development'.

3.2.11. 2017 is the most recent year for which monitoring data and meteorological data are available to enable verification of the model results. 2025 is the anticipated opening year of the Proposed Development.

Traffic Data

3.2.12. Traffic count data was provided by Vectos – Transport Planning Specialists. They provided data for the 2017 base year and for both 2025 scenarios. The traffic flows for the 'Without Development' scenarios include flows for committed developments in the locality of the Application Site but do not include any contribution to road traffic from the Proposed Development itself. The traffic flows for the 'With Development' scenarios include contributions to road traffic from the Proposed Development and the nearby committed developments.

Vehicle Emission Factors

3.2.13. Vehicle emission factors for use in the assessment have been obtained using Emission Factor Toolkit (EFT) version 8.0.1 (published in December 2017) available on the Defra website. The EFT allows for the calculation of emission factors arising from road traffic for all years between 2015 and 2030. For the predictions of future year emissions, the toolkit considers factors such as anticipated advances in vehicle technology and changes in vehicle fleet composition, such that vehicle emissions are assumed to reduce over time. Due to the uncertainty in the rate of vehicle technology advancement and fleet composition, emission factors for 2017 have been used for the future assessment year of 2025. This represents a conservative approach to the assessment.

Selection of background concentrations

3.2.14. Background air pollutant concentrations used in the assessment have been taken from the national maps provided on the Defra website[13], where background concentrations of those pollutants included within the AQS[1] have been mapped at a grid resolution of 1km x 1km for the whole of the UK. Estimated background concentrations are available for all years between 2015 and 2030.

3.2.15. The maps assume that background concentrations will improve (i.e. reduce) over time, in line with the predicted reduction in vehicle emissions, and emissions from other sources. Due to the uncertainty in the rate of background concentration improvements, 2017 background concentrations for NO_x, NO_2,

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[13] Defra (2018) *Background Mapping data for local authorities – 2015* [online] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015

PM_{10} and $PM_{2.5}$ have been utilised in this assessment for the anticipated opening year of the Proposed Development. This represents a conservative approach to the assessment.

Model Verification and Result Processing

3.2.16. The ADMS Roads dispersion model has been widely validated for this type of assessment and is fit for purpose. Model validation undertaken by the software developer will not have included validation near the Proposed Development.

3.2.17. To determine the performance of the model at a local level, a comparison of modelled results with the results of monitoring carried out within the study area was undertaken. This process of verification aims to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results. Verification was carried out following the methodology specified in Chapter 7, Section 4, of LAQM.TG16.

3.2.18. The NO_2 diffusion tube monitoring results (see **Table 3** and **Appendix E**) were used to determine the baseline annual mean NO_2 concentrations within the vicinity of the Application Site and the 2017 NO_2 data was used to facilitate model verification. The location of the diffusion tube monitoring sites are shown on **Figure 3.** The monitoring was carried out by the air quality team at WSP and it was our scope to collect, annualise and bias correct the data observed.

3.2.19. Details of the adjustment factor calculations are presented in **Appendix F**. A factor of **3.72** was obtained during the verification process, which indicated that the model was under-predicting. This factor was applied to the model road-NO_x (oxides of nitrogen) outputs prior to conversion to annual mean NO_2 concentrations utilising the NO_x to NO_2 calculator (version 6.1, 17 October 2017) provided by Defra[14].

3.2.20. As local roadside monitoring data were not available for PM_{10} or $PM_{2.5}$, the modelled road-PM_{10} and road $PM_{2.5}$ components have been adjusted by the verification factor obtained for NO_x before adding to the appropriate background concentration. The number of days with PM_{10} concentrations greater than 50µg/m^3 was then estimated using the relationship with the annual mean concentration described in LAQM.TG16[9], which states '*Previous research carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60µg/m^3*'. .

3.2.21. Once processed, the predicted concentrations were compared against the relevant AQS objective levels for NO_2, PM_{10} and $PM_{2.5}$, as set out in **Appendix B**.

SELECTION OF SENSITIVE RECEPTORS

3.2.22. Sensitive locations are places where the public or sensitive ecological habitats may be exposed to pollutants resulting from activities associated with the Proposed Development. These will include locations sensitive to an increase in dust deposition and PM_{10} exposure because of on-site construction activities, and locations sensitive to exposure to gaseous pollutants emitted from the

14 Defra NO_x to NO_2 Calculator (v6.1) [online] Available at: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector [Accessed 10/02/2019].

exhausts of construction and operational traffic associated with the Proposed Development. Deposition of Nitrogen compounds is also an issue for some ecological sites.

Construction Phase

3.2.23. An IAQM assessment is undertaken where there are:

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

3.2.24. It is within these distances that the impacts of exhaust gases, dust soiling and increased particulate matter in ambient air will have the greatest impact on local air quality at sensitive receptors.

Operational Phase

3.2.25. Locations that are sensitive to pollutants emitted from engine exhausts, include places where members of the public are likely to be regularly present over the relevant period of time, as prescribed in the AQS. For instance, on a footpath where exposure will be transient (for the duration of passage along that path) comparison with a short-term standard (i.e. 15-minute mean or 1 hour mean) may be relevant. At a school or adjacent to a private dwelling, where exposure may be for longer periods, comparison with a long-term standard (such as daily mean or annual mean) may be more appropriate. Box 1.1 of LAQM.TG16 provides examples of the locations where the air quality objectives should/should not apply.

3.2.26. To complete the assessment of operational phase impacts, a number of 'receptors' representative of locations of relevant public exposure were identified at which pollution concentrations were predicted. Receptors have been located adjacent to the roads that are likely to experience the greatest change in traffic flows or composition, and therefore NO_2 and particulate matter concentrations, due to the Proposed Development.

3.2.27. The locations of the assessment receptors are shown on **Figure 4** and listed in **Table 1**.

Table 1 - Receptor Locations Used in this Assessment

Receptor	Description	OS Grid Reference (m)		Height Above Ground Level (m)
		X	Y	
Existing Sensitive Receptor Locations				
R1	29 Park St, Bladon, Woodstock	444811.0	214718.0	1.5
R2	92 Grove Rd, Bladon, Woodstock	445231.0	215440.0	1.5
R3	45 Bladon Rd, Bladon, Woodstock	445732.0	215593.0	1.5
R4	21 Upper Campsfield Rd, Woodstock	445941.0	215743.0	1.5

Receptor	Description	OS Grid Reference (m)		Height Above Ground Level (m)
		X	Y	
R5	A4095, Kidlington, Woodstock	446404.0	216310.0	1.5
R6	23 Evenlode Cres, Kidlington	447321.0	214793.0	1.5
R7	2 Woodstock Rd, Begbroke, Kidlington	447048.0	213835.0	1.5
R8	The Royal Sun PH, Kidlington	447092.0	213910.0	1.5
R9	Sandy Lane, Yarnton, Kidlington	447366.0	213081.0	1.5
R10	186 Woodstock Rd, Yarnton, Kidlington	447518.0	213008.0	1.5
R11	48 Aysgarth Rd, Yarnton, Kidlington	447653.0	212758.0	1.5
R12	43 Meadow Way, Yarnton, Kidlington	448026.0	212470.0	1.5
R13	2 Cassington Rd, Yarnton, Kidlington	448248.0	212249.0	1.5
R14	13 Cresswell Cl, Yarnton, Kidlington	448190.0	212051.0	1.5
R15	150 Cassington Rd, Yarnton, Kidlington	447784.0	211982.0	1.5
R16	188 Cassington Rd, Yarnton, Kidlington	447504.0	212028.0	1.5
R17	Woodstock Rd, Kidlington	448855.0	211698.0	1.5
R18	A44, Oxford	449197.0	211156.0	1.5
R19	28A Spring Hill Rd, Begbroke, Kidlington	446716.0	213806.0	1.5
R20	192 Woodstock Rd, Yarnton, Kidlington	447476.0	213066.0	1.5
R21	2 Livingstone Cl, Yarnton, Kidlington	447764.0	213148.0	1.5
R22	1 Cassington Rd, Yarnton, Kidlington	448303.0	212191.0	1.5
R23	204 Cassington Rd, Yarnton, Kidlington	447276.0	212003.0	1.5
R24	3 Rectory Cottages, Worton, Witney	446469.0	211440.0	1.5
Proposed Receptor Locations				
PR1	Proposed Receptor	447078.4	213529.6	1.5
PR2	Proposed Receptor	447108.2	213439.4	1.5
PR3	Proposed Receptor	447153.0	213335.2	1.5
PR4	Proposed Receptor	447135.9	213372.4	1.5
PR5	Proposed Receptor	447144.7	213350.8	1.5
PR6	Proposed Receptor	447207.3	213234.6	1.5

Receptor	Description	OS Grid Reference (m)		Height Above Ground Level (m)
		X	Y	
PR7	Proposed Receptor	447314.6	213080.6	1.5
PR8	Proposed Receptor	447380.2	212961.1	1.5
PR9	Proposed Receptor	447390.4	212873.5	1.5
PR10	Proposed Receptor	447398.8	212843.4	1.5
PR11	Proposed Receptor	447407.0	212641.9	1.5

3.2.28. To complete the exposure assessment, pollution concentrations were predicted at several locations within the Application Site. These are labelled 'PR' in Table 1 above.

3.3. SIGNIFICANCE CRITERIA

CONSTRUCTION PHASE

3.3.1. The IAQM assessment methodology recommends that significance criteria are only assigned to the identified risk of dust impacts occurring from a construction activity with appropriate mitigation measures in place. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual effect will normally be negligible.

3.3.2. For the assessment of the impact of exhaust emissions from plant used on-site and construction vehicles accessing and leaving the Application Site on local pollutant (NO_2 and particulate matter) concentrations, the significance of residual effects have been determined using professional judgement and the principles outlined in the EPUK/IAQM guidance for the operational phase as described below.

OPERATIONAL PHASE

3.3.3. The approach provided in the EPUK/IAQM guidance has been used within this assessment to assist in describing the air quality effects of additional emissions from traffic generated by the Proposed Development once operational.

3.3.4. This guidance recommends that the degree of an impact is described by expressing the magnitude of incremental change in pollution concentration as a proportion of the relevant assessment level and examining this change in the context of the new total concentration and its relationship with the assessment criterion. This is summarised in **Table 2**.

Table 2 - Impact Descriptors for Individual Receptors

Annual Mean Concentration at Receptors in Assessment Year	% Change in Concentration Relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

AQAL = air quality assessment Level, which for this assessment related to the UK Air Quality Strategy objectives.
Where the %change in concentrations is <0.5%, the change is described as 'Negligible' regardless of the concentration.
When defining the concentration as a percentage of the AQAL, 'without development' concentration should be used where there is a decrease in pollutant concentration and the 'with development;' concentration where there is an increase. Where concentrations increase, the impact is described as adverse, and where it decreases as beneficial.

3.3.5. The EPUK/IAQM guidance notes that the criteria in **Table 2** should be used to describe impacts at individual receptors and should be considered as a starting point to make a judgement on significance of effects, as other influences may need to be considered. The EPUK/IAQM guidance states that the assessment of overall significance should be based on professional judgement, considering several factors, including:

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

3.3.6. The EPUK/IAQM guidance states that for most road transport related emissions, long-term average concentrations are the most useful for evaluating the impacts. The guidance does not include criteria for determining the significance of the effect on hourly mean NO_2 concentrations or daily mean PM_{10} concentrations. The significance of effects of hourly mean NO_2 and daily mean PM_{10} concentrations arising from the operational phase have therefore been determined qualitatively using professional judgement and the principles described above.

3.3.7. The EPUK/IAQM guidance states that '*Where the air quality is such that an air quality objective at the building facade is not met, the effect on residents or occupants will be judged as significant, unless provision is made to reduce their exposure by some means. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.*'

3.4. LIMITATIONS

3.4.1. There are uncertainties associated with both measured and predicted concentrations. The model (ADMS Roads) used in this assessment relies on input data (including predicted traffic flows), which are subject to uncertainty such as:

- The model itself simplifies complex physical systems into a range of algorithms;
- Local micro-climatic conditions may affect the concentrations of pollutants that the ADMS Roads model will not consider;

3.4.2. To reduce the uncertainty associated with predicted concentrations, model verification has been carried out following guidance set out in LAQM.TG16 (**Appendix F**). As the model has been verified against local monitoring data and adjusted accordingly, there can be reasonable confidence in the predicted concentrations.

3.4.3. As detailed information regarding the nature and duration of the activities that would be undertaken during the construction phase of the Proposed Development was not available, assumptions as to the likely scale and nature of the works were made. Thereafter, professional judgement has been used in the completion of this part of the assessment.

3.4.4. Due to the uncertainty surrounding the accuracy of future year vehicle emissions and background concentrations, a precautionary approach has been taken whereby for 2025, an assumption of no improvement in vehicle emissions or background concentrations with time from 2017 has been adopted. This approach is considered to provide a conservative assessment.

4. BASELINE CONDITIONS

4.1. REVIEW & ASSESSMENT OF AIR QUALITY

4.1.1. The Application Site is located within the boundary of two local councils, CDC and West Oxfordshire District Council (WODC), with a third, Oxford City Council (OCC), also nearby. All three local councils have designated Air Quality Management Areas (AQMAs) due to measured exceedances of the annual mean NO_2 objective at local roadside monitoring sites:

- CDC – There are four designated AQMAs, these areas have higher levels of air pollution due to increased road traffic. AQMA No.1 is an area around Hennef Way, Banbury. AQMA No.2 is an area between Southam Road and Oxford Road, Banbury, including some of High Street. AQMA No.3 is an area of Bicester Road, Kidlington. AQMA No.4 is an area around Kings End, Queens Avenue, Field Street and St Johns, Bicester.
- WODC – Two AQMAs were declared on 1st March 2005 in Witney and Chipping Norton because after detailed investigation it was concluded these areas would fail the Government's objective for the nitrogen dioxide annual mean concentration.
- OCC – In September 2010 the City Council made an Air Quality Management Order declaring the whole of the city as an AQMA, to include the 7 localised hotspots where pollution levels of nitrogen dioxide have exceeded national objectives.

4.1.2. The Annual Status Report (ASR)[15] for 2018, developed by CDC, provides a detailed overview of air quality in the area during 2017. The ASR states that, '*The monitoring results in 2017 showed that background NO_2 concentrations dropped to around 2015 levels (there was a general increase in 2016) although this has not been observed in all monitoring locations.*

- *In AQMA No.1 (Hennef Way, Banbury) concentrations increased which did not follow the general trend described above.*
- *In AQMA No.2 (Central Banbury), only the Oxford Road /South Bar monitoring location followed the general trend described above. The other monitoring locations within the AQMA all showed increased concentrations of NO_2 from 2016, although the annual mean objective for NO_2 was only exceeded at the 'Horsfair' location.*
- In AQMA No.3 (*Bicester Road, Kidlington), concentrations increased and discontinued their downward trend. It rose above the annual mean objective in 2017 having fallen below the objective in 2016.*
- *In AQMA No.4 (Bicester) the annual mean NO_2 concentration at the highest recorded location actually fell although remains above the objective level. This is the only location in this AQMA where the annual mean objective is being exceeded.*

Overall the general trend in NO_2 concentrations across the district was downwards but the monitoring supports the retention of the AQMAs'

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15 Cherwell District Council, North Oxfordshire – Air Quality Annual Status Report (2018)

4.1.3. The Annual Status Report (ASR)[16] for 2018, developed by WODC, provides a detailed overview of air quality in the area during 2017. The ASR states that, '*The main air quality issues in the West Oxfordshire District area are related to vehicular density within relatively congested urban areas, thus nitrogen dioxide is the main pollutant of concern. The 2017 monitoring survey shows nitrogen dioxide levels slightly decreased compared to 2016 results. The variation between the years is thought likely to be attributable to slightly improved meteorological conditions in 2017 which aids dispersion and dilution of traffic exhaust emissions. Current AQMAs are located within the two largest towns within the District – Witney (Bridge Street and area) and Chipping Norton (Horsefair and area). They continue to experience nitrogen dioxide levels that exceed the national objective of 40 µg/m^3, which was set to protect health.*

4.2. LOCAL EMISSION SOURCES

4.2.1. The Application Site is situated in an area where air quality is mainly influenced by emissions from road transport utilising the A44, Yarnton Road and Cassington Road.

4.2.2. There are no industrial pollution sources identified in the immediate vicinity of the site that would influence local air quality.

4.3. LOCAL AUTHORITY AIR QUALITY MONITORING DATA

4.3.1. A summary of the annual mean NO_2 concentrations obtained from passive LAQM monitoring networks in the vicinity of the Application Site are provided in **Table 3**. These can also be seen in **Figure 3**

4.3.2. A project specific NO_2 passive diffusion tube monitoring program was completed to establish baseline concentrations at the site. The three-month program began in November 2018 and finished in February 2019. The locations of the monitoring sites selected can also be seen in **Figure 3**. These data have been used to facilitate verification of the atmospheric dispersion modelling undertaken in this assessment. This involved annualising the collected data to obtain a representative value for 2017 (**Appendix E**).

Table 3 - Local Authority Air Quality Monitoring Data – Annual Mean NO_2

Site Name	Distance to Site (km)	Council /WSP	Site Type	Annual Mean Concentration (µg/m^3)				
				2013	2014	2015	2016	2017
MC01	1.4	WSP	Roadside					17.1
MC02	1.0	WSP	Roadside					18.5
MC03	0.8	WSP	Roadside					19.4
MC04	0.7	WSP	Roadside					16.3
MC05	0.7	WSP	Roadside					13.9

16 West Oxfordshire District Council – Air Quality Annual Status Report (2018)

Site Name	Distance to Site (km)	Council /WSP	Site Type	Annual Mean Concentration (µg/m^3)				
				2013	2014	2015	2016	2017
MC06	0.8	WSP	Roadside					23.0
MC07	0.1	WSP	Urban Background					12.9
DT25	4.2	OCC	Roadside	-	-	**40.0**	**48.0**	35.0
DT26	4.2	OCC	Roadside	-	-	**42.0**	**40.0**	**41.0**
DT27	3.7	OCC	Roadside	-	-	39.0	34.0	29.0
DT28	3.8	OCC	Roadside	-	-	34.0	32.0	26.0
DT71	3.6	OCC	Roadside	-	-	**44.0**	-	**41.0**
DT29	3.2	OCC	Roadside	-	-	38.0	36.0	28.0
Bicester Road (2)	3.6	CDC	Roadside	**44.6**	**42.0**	**41.1**	39.6	**41.0**
Oxford Road	2.7	CDC	Roadside	31.1	29.6	28.3	30.5	28.8
Bramley Close	3.6	CDC	Roadside	29.6	29.9	29.5	28.5	26.7
Benmead Road	3	CDC	Urban Background	16.3	14.1	12.4	13.5	12.6
25 (S10)	4.7	WODC	Roadside	33.9	30.2	27.5	32.1	24.2
30 (S9)	3.1	WODC	Roadside	25.8	21.9	24.6	25.0	-
31 (S8)	2.5	WODC	Roadside	12.0	10.4	10.1	12.5	10.4
39 (S7)	3	WODC	Roadside	31.1	31.8	31.1	32.0	28.9

Exceedance of the annual mean AQS objective of 40µg/m^3 in **bold**

4.3.3. Annual mean NO_2 concentrations are either within 90% of the objective (36µg/m^3), or exceeded the objective of 40ug/m^3 at three of the sites in 2017. Concentrations of 41.0µg/m^3 were measured at DT26, DT71 and Bicester Road (2), which exceeds the annual mean AQS objective of 40.0µg/m^3.

4.4. BACKGROUND AIR QUALITY DATA

4.4.1. **Table 4** summarises the background pollutant concentrations of NO_x, NO_2, PM_{10} and $PM_{2.5}$ in the areas surrounding the Application Site. The annual mean background concentrations are all below the relevant objectives.

Table 4 - Background Concentrations (µg/m^3) – 2017

Grid Square (Centre on OS Grid Reference)	NO_x*	NO_2	PM_{10}	$PM_{2.5}$
450500, 210500	20.2	14.7	14.9	10.1
449500, 210500	24.0	17.2	16.3	10.6
450500, 213500	14.1	14.1	15.8	10.5
449500, 213500	12.4	12.4	14.0	9.7
449500, 214500	11.3	11.3	13.8	9.7
444500, 216500	8.5	8.5	12.3	8.5
444500, 214500	8.1	8.1	12.9	8.7
445500, 214500	7.9	7.9	13.2	8.8
Air Quality Objective* (µg/m^3)	**30**	**40**	**40**	**25**

*Set for the protection of vegetation and ecosystems

4.5. SUMMARY

4.5.1. The Application Site is not within an existing AQMA. The nearest AQMA is designated by OCC and its closest boundary is approximately 2 km away.

4.5.2. The closest monitoring sites to the proposed development are 31 (S8) and Oxford Road (**Table 3**). Oxford Road is located in Kidlington town centre, whereas 31 (S8) is located in the more rural Baldon. 31 (S8) has recorded very low concentrations of nitrogen dioxide, Oxford Road has recorded larger concentrations, although both are well within the required objectives. In general, air quality in the area is good, with the three sites that produce exceedances located nearby to main road links into Oxford and Kidlington where elevated traffic volumes are experienced. Urban background sites are further away from busy roads than urban traffic sites, therefore they will produce lower concentrations.

4.5.3. The project specific monitoring set up by WSP has produced low concentrations of NO_2 at all seven locations. MC06 produces the highest concentration, although this is still well below the air quality objective. MC07 is an urban background site, hence produces the lowest concentration of NO_2.

4.5.4. Mapped background air pollutant concentrations for NO_2, PM_{10} and $PM_{2.5}$ reported by Defra (**Table 4**) for 2017 are below the respective annual mean AQS objectives.

5. ASSESSMENT OF IMPACTS

5.1. CONSTRUCTION PHASE

DUST AND PM_{10} ARISING FROM ON-SITE ACTIVITIES

5.1.1. Construction activities that have the potential to generate and/or re-suspend dust and PM_{10} include:

- Site clearance, including vegetation and tree removal, and removal of existing below ground services and structures;
- Earthworks and surface re-profiling/sub-base works to obtain required finished floor levels;
- Foundation construction (at this stage it is assumed that raft foundations would be required);
- Materials handling, storage, stockpiling, spillage and disposal;
- Movement of vehicles and construction traffic within the Site (including excavators and dumper trucks);
- Use of crushing and screening equipment/plant;
- Exhaust emissions from site plant, especially when used at the extremes of their capacity and during mechanical breakdown;
- Construction of buildings, roads and areas of hardstanding alongside fabrication processes;
- Internal and external finishing and refurbishment; and
- Site landscaping after completion.

5.1.2. The majority of the releases are likely to occur during the ‘working week’. However, for some potential release sources (e.g. exposed soil produced from significant earthwork activities) in the absence of dust control mitigation measures, dust generation has the potential to occur 24 hours per day over the period during which such activities are to take place.

ASSESSMENT OF POTENTIAL DUST EMISSION MAGNITUDE

5.1.3. The IAQM assessment methodology has been used to determine the potential dust emission magnitude for the following four different dust and PM_{10} sources: demolition, earthworks, construction and trackout. The findings of the assessment are presented below.

Demolition

5.1.4. There are no notable standing structures that upon demolition would cause any significant contribution to dust concentrations. As such, demolition activities do not need to be considered further in the assessment.

Earthworks

5.1.5. The total area of the Application Site is assumed to be greater than 10,000m^2 which falls within the IAQM range for large sites. Therefore, the potential dust emission magnitude is considered to be **large** for construction activities.

Construction

5.1.6. The total volume of building work to be constructed on the Application Site is assumed to be between 25,000 - 100,000m^3. Therefore, the potential dust emission magnitude is considered to be **medium** for construction activities.

Trackout

5.1.7. For a Proposed Development of this size, it is estimated that there will be between 10-50 outward HDV movements in any one day. It is considered that the potential dust emission is **medium** for trackout.

5.1.8. **Table 5** provides a summary of the potential dust emission magnitude determined for each construction activity considered.

Table 5 - Potential Dust Emission Magnitudes

Activity	Dust Emission Magnitude
Demolition	N/A
Earthworks	Large
Construction Activities	Medium
Trackout	Medium

ASSESSMENT OF THE SENSITIVITY OF THE STUDY AREA

5.1.9. A wind rose generated from the meteorological data used for the dispersion modelling of operational phase impacts is provided in **Appendix G.** This shows that the prevailing wind direction is from the south-west. Therefore, receptors located to the north-east of the Application Site are more likely to be affected by dust and particulate matter emitted and re-suspended during the construction phase.

5.1.10. Under low wind speed conditions, it is likely that dust would be deposited in the area immediately surrounding the source. The area surrounding the Application Site consists of residential use to the east and south, with greenfield land to the north and west. There are between 10-100 residential receptors within 20m of the Application Site boundary. These receptors are likely to be affected by trackout dust, as some are along potential trackout routes.

5.1.11. Taking the above into account and following IAQM assessment methodology, the sensitivity of the area to changes in dust and PM_{10} has been derived for each of the construction activities considered. The results are shown in Table 6.

Table 6 - Sensitivity of the Study Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout

Dust Soiling	N/A	High	High	High
Human Health	N/A	Low	Low	Low

5.1.12. There are no nearby ecological receptors that would be affected by the construction phase of the Proposed Development.

RISK OF IMPACTS

5.1.13. The predicted dust emission magnitude has been combined with the defined sensitivity of the area to determine the risk of impacts during the construction phase, prior to mitigation. **Table 7** below provides a summary of the risk of dust impacts for the Proposed Development. The risk category identified for each construction activity has been used to determine the level of mitigation required.

Table 7 - Summary Dust Risk Table to Define Site Specific Mitigation

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	N/A	High	Medium	Medium
Human Health	N/A	Low	Low	Low

5.1.14. The dust soiling risk is high to medium, as can be seen in **Table 7**, however the risks for human health are low due to the low background concentrations of PM_{10} locally.

CONSTRUCTION VEHICLES AND PLANT

5.1.15. The greatest impact on air quality due to emissions from vehicles and plant associated with the construction phase will be in the areas immediately adjacent to the Site access and egress.

5.1.16. Final details of the exact plant and equipment likely to be used on Site will be determined by the appointed contractor but are considered likely to comprise a range of vehicles tracked excavators, diesel generators, and cranes. The number of plant and their location within the Site are likely to be variable over the construction period.

5.1.17. Based on the current local air quality in the area, the proximity of sensitive receptors to the roads likely to be used by construction vehicles and the likely numbers of construction vehicles and plant that will be used, the impacts are of **negligible** significance according to EPUK/IAQM guidance[10].

5.2. OPERATIONAL PHASE

5.2.1. Full results of the dispersion modelling are presented in **Appendix H** and a summary is provided below.

ANNUAL MEAN NO_2 CONCENTRATIONS

5.2.2. The AQS[1] objective for annual mean NO_2 concentrations is a concentration of 40 µg/m^3. By 2025, the opening year of the Proposed Development, all of the concentrations at the receptor locations are below the relevant objective. The highest concentrations are predicted at Receptor R18, where they are 30.9 µg/m^3 in the 'Without Development' scenario and 31.3 µg/m^3 in the 'With Development' scenario.

5.2.3. The largest increase in annual mean NO_2 concentrations between the 'With' and 'Without Development' scenarios are predicted to occur at Receptor R10. The increase is predicted to be 0.39 µg/m^3, with a value of 21.4 µg/m^3 in the 'Without Development' scenario and 21.8 µg/m^3 in the 'With Development' scenario. The predicted increase equates to 1.0% of the AQS[1] objective however, given that this receptor is not in exceedance of the objective in both scenarios, represents a 'negligible' local air quality impact as per the EPUK/IAQM[10] criteria (see **Table 2**).

5.2.4. The predicted impacts of the Proposed Development on annual mean NO_2 at all remaining receptors included in the model equate to a 'negligible' local air quality impact in accordance with the EPUK/IAQM[10] criteria.

5.2.5. Taking the predicted impacts into account at each of the existing modelled receptors included in the study, the changes in annual mean NO_2 attributed to the operation of the Proposed Scheme are considered to be **negligible**. In accordance with the EPUK/IAQM[10] guidance, the impact of the development on annual mean NO_2 concentrations is **negligible**.

HOURLY MEAN NO_2 CONCENTRATIONS

5.2.6. The annual mean NO_2 concentrations predicted by the model were all below 60 µg/m^3, and therefore hourly mean NO_2 concentrations are unlikely to cause a breach of the hourly mean AQS[1] objective.

5.2.7. This is in line with the guidance provided within LAQM.TG16[9], which states '*Previous research carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60µg/m^3'*. The impact of the Proposed Development on hourly mean NO_2 concentrations at existing sensitive receptors is **negligible**.

ANNUAL MEAN PM_{10} CONCENTRATIONS

5.2.8. The AQS objective for annual mean PM_{10} concentrations is a concentration of 40 µg/m^3. Predicted concentrations of PM_{10} are well below the annual mean objective at all receptors in each of the modelled 2025 scenarios. The highest concentrations are predicted at Receptors R18, where a concentration of 18.8 µg/m^3 is predicted in the 'With Development' scenario and 18.7 µg/m^3 in the 'Without Development' scenario.

5.2.9. The predicted changes in annual mean PM_{10} concentrations due to development traffic are all less than 0.5% of the relevant AQS[1] objective. Based on the EPUK/IAQM[10] guidance, the impact of the Proposed Development on annual mean PM_{10} concentrations is **negligible**.

DAILY MEAN PM_{10} CONCENTRATIONS

5.2.10. The AQS[1] objective for daily mean PM_{10} concentrations is 50 µg/m^3 to be exceeded no more than 35 times a year. Exceedances are predicted at five of the modelled receptors, however the greatest number of daily exceedances predicted is two at Receptor R18. The impact of the Proposed Development on daily mean PM_{10} concentrations at existing sensitive receptors is therefore **negligible.**

ANNUAL MEAN $PM_{2.5}$ CONCENTRATIONS

5.2.11. Predicted annual mean concentrations of $PM_{2.5}$ in 2025 are all well below the AQS[1] objective of 25 µg/m^3 in all modelled scenarios. The highest modelled concentrations are predicted at Receptor R18, where a concentration of 12.1 µg/m^3 is predicted in the 'With Development' scenario and 12.0 µg/m^3 in the 'Without Development' scenario.

5.2.12. All changes in $PM_{2.5}$ because of increased traffic associated with the Proposed Development are less than 0.5% of the relevant AQS[1] objective and therefore, based on the EPUK/IAQM[10] guidance, the Proposed Development is considered to have a **negligible** impact on annual mean $PM_{2.5}$ concentrations.

EXPOSURE OF THE UPCOMING COMMITTED RESIDENTIAL DEVELOPMENT

5.2.13. Predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ are all below the relevant objectives at all proposed receptor locations within the Application Site boundary in the 'With Development' scenario. Therefore, the site is suitable for residential development.

5.2.14. The highest predicted annual mean concentrations for NO_2, was predicted at Receptor PR4, with a modelled concentration of 14.6 µg/m^3. The highest predicted annual mean concentrations for PM_{10} and $PM_{2.5}$ at relevant proposed residential sensitive receptors were predicted at Receptor PR8, with concentrations modelled at 14.6 µg/m^3 and 9.8 µg/m^3 respectively. However, all three predicted concentrations are well below the relevant Air Quality Objectives. For NO_2, PR4 is predicted to produce a concentration that is 36.6% of the relevant Air Quality Objective.

6. MITIGATION AND RESIDUAL EFFECTS

6.1. CONSTRUCTION PHASE

MITIGATION

6.1.1. Based on the assessment results, mitigation will be required during the construction phase. Recommended mitigation measures are given below. These mitigation measures correspond to 'High Risk' sites as the risk of dust soiling due to earthworks is assessed as 'High'. It should also be noted that these classifications are based on conservative assumptions in the absence of specific construction information.

General Communication

- A stakeholder communications plan that includes community engagement before work commences on site should be developed and implemented.
- The name and contact details of person(s) accountable for air quality and dust issues should be displayed on the site boundary. This may be the environment manager/engineer or the site manager. The head or regional office contact information should also be displayed.

General Dust Management

- A Dust Management Plan (DMP), which may include measures to control other emissions, in addition to the dust and PM_{10} mitigation measures given in this report, should be developed and implemented, and approved by the Local Authority.

Site Management

- All dust and air quality complaints should be recorded and causes identified. Appropriate remedial action should be taken in a timely manner with a record kept of actions taken including of any additional measures put in-place to avoid reoccurrence.
- The complaints log should be made available to the local authority on request.
- Any exceptional incidents that cause dust and/or air emissions, either on- or off- site should be recorded, and then the action taken to resolve the situation recorded in the log book.

Monitoring

- Daily on-site and off-site inspections should be undertaken, where receptors (including roads) are nearby to monitor dust. The inspection results should be recorded and made available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
- The frequency of site inspections should be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

Preparing and Maintaining the Site

- Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as is practicable.
- Where practicable, erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Where practicable, 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 runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover appropriately.
- Where practicable, cover, seed or fence stockpiles to prevent wind whipping.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all vehicle operators switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
- A Construction Logistics Plan should be produced to manage the sustainable delivery of goods and materials.

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Earthworks

- Stockpile surface areas should be minimised (subject to health and safety and visual constraints regarding slope gradients and visual intrusion) to reduce area of surfaces exposed to wind pick-up.
- Where practicable, windbreak netting/screening should be positioned around material stockpiles and vehicle loading/unloading areas, as well as exposed excavation and material handling operations, to provide a physical barrier between the Site and the surroundings.
- Where practicable, stockpiles of soils and materials should be located as far as possible from sensitive properties, taking account of the prevailing wind direction.

- During dry or windy weather, material stockpiles and exposed surfaces should be dampened down using a water spray to minimise the potential for wind pick-up.

Measures Specific to Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
- All construction plant and equipment should be maintained in good working order and not left running when not in use.
- Avoid scabbling (roughening of concrete surfaces) if possible.

6.1.2. Detailed mitigation measures to control construction traffic should be discussed with CDC to establish the most suitable access and haul routes for the site traffic. The most effective mitigation will be achieved by ensuring that construction traffic does not pass along sensitive roads (residential roads, congested roads, via unsuitable junctions, etc.) where possible, and that vehicles are kept clean (through the use of wheel washers, etc.) and sheeted when on public highways. Timing of large-scale vehicle movements to avoid peak hours on the local road network will also be beneficial.

RESIDUAL EFFECTS

6.1.3. The residual effects of dust and PM_{10} generated by construction activities following the application of the mitigation measures described above and good site practice will be **negligible.**

6.1.4. The residual effects of emissions to air from construction vehicles and plant on local air quality will be **negligible.**

6.2. OPERATIONAL PHASE

MITIGATION

6.2.1. The changes in pollutant concentrations attributable to traffic emissions associated with the operational phase of the Proposed Development (i.e. impacts on local air quality) are predicted to be **negligible** overall. Future residents and users of the Proposed Development will not be exposed to concentrations that exceed any of the relevant air quality objectives.

6.2.2. A residential Travel Plan is advised for the Proposed Development. The Travel Plan aims to encourage residents to change their travel behaviour in favour of sustainable travel modes such as public transport, which therefore would be of benefit with respect to local air quality.

RESIDUAL EFFECTS

6.2.3. The residual effects of the Proposed Development on local air quality will be **negligible** overall.

7. CONCLUSIONS

7.1.1. A qualitative assessment of the potential impacts on local air quality from construction activities has been carried out for this phase of the Proposed Development using the IAQM methodology. This identified that there is a **high to medium risk** of dust soiling impacts and a **low risk** of health impacts because of increases in particulate matter concentrations due to construction activities.

7.1.2. However, through good site practice and the implementation of suitable mitigation measures, the effect of dust and PM_{10} releases would be significantly reduced. The residual effects of dust and PM_{10} generated by construction activities on air quality are therefore considered to be negligible. The residual effects of emissions to air from construction vehicles and plant on local air quality will be negligible.

7.1.3. A quantitative assessment of the potential impacts during the operational phase was undertaken using ADMS Roads to predict the changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations that would occur due to traffic generated by the Proposed Development. To minimise the inherent uncertainty in the assessment process, a conservative approach to the assessment was undertaken. The results show that the Proposed Development would cause a **negligible** effect on local air quality.

7.1.4. The results of the operational phase assessment show that future residents of the Proposed Development would not be subject to concentrations that would exceed the statutory objectives for those pollutants considered in this assessment.

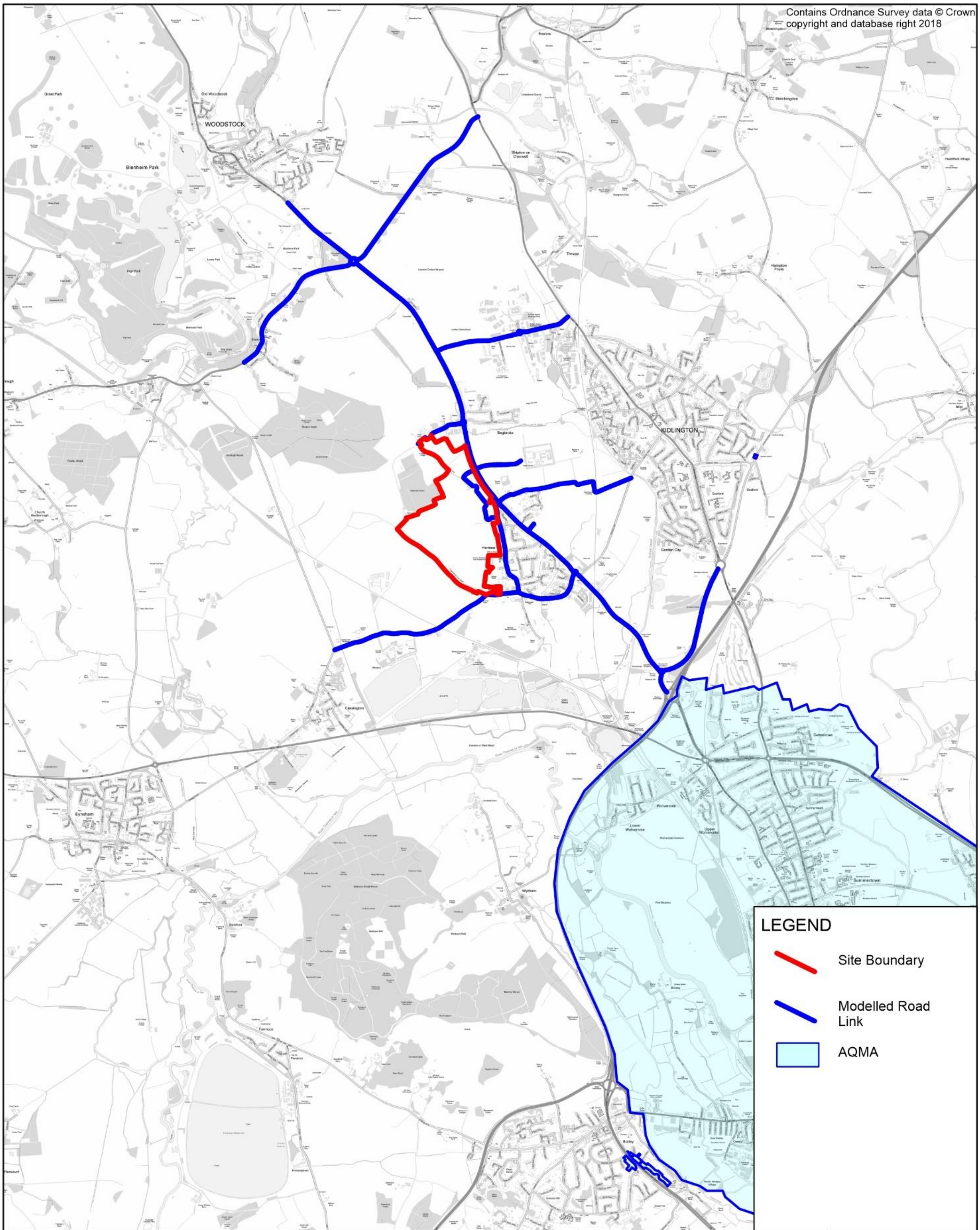
7.1.5. A residential Travel Plan is advised for the development, which aims to reduce the number of vehicle trips associated with the Proposed Development. This will have a beneficial effect in reducing the impact of the development on local air quality.

7.1.6. The development proposals comply with national and local policy for air quality and is considered **suitable for residential land use**.

FIGURES AND APPENDICES

Figure 1 – Site Location

Drawn By: JG Date Modified: 31/01/2019



PROJECT TITLE:
PR9, Land at Yarnton
PROJECT No: 70048642

FIGURE 1 - Site Location

Figure 2 – Proposed Development

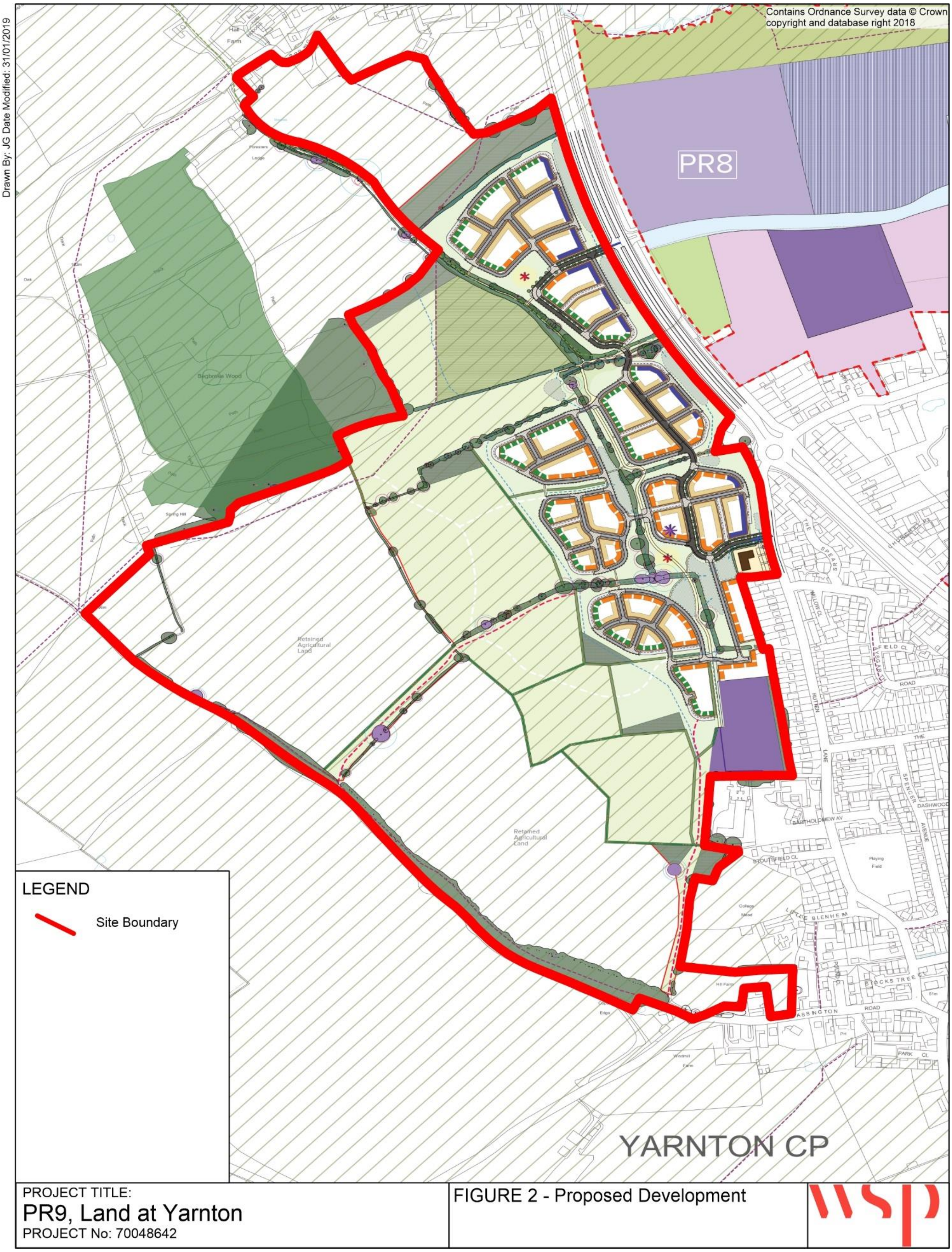
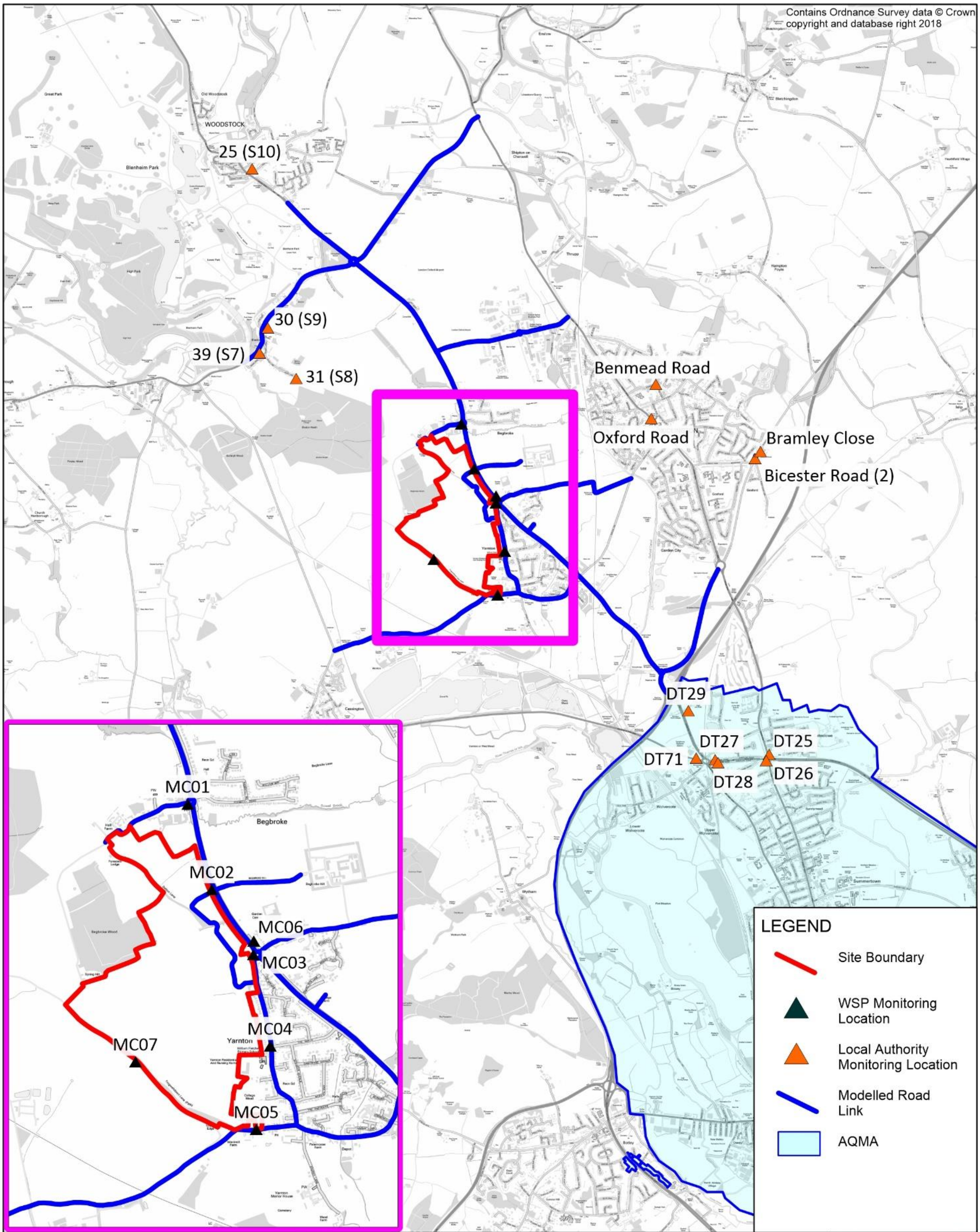


Figure 3 – Monitoring Location Plan

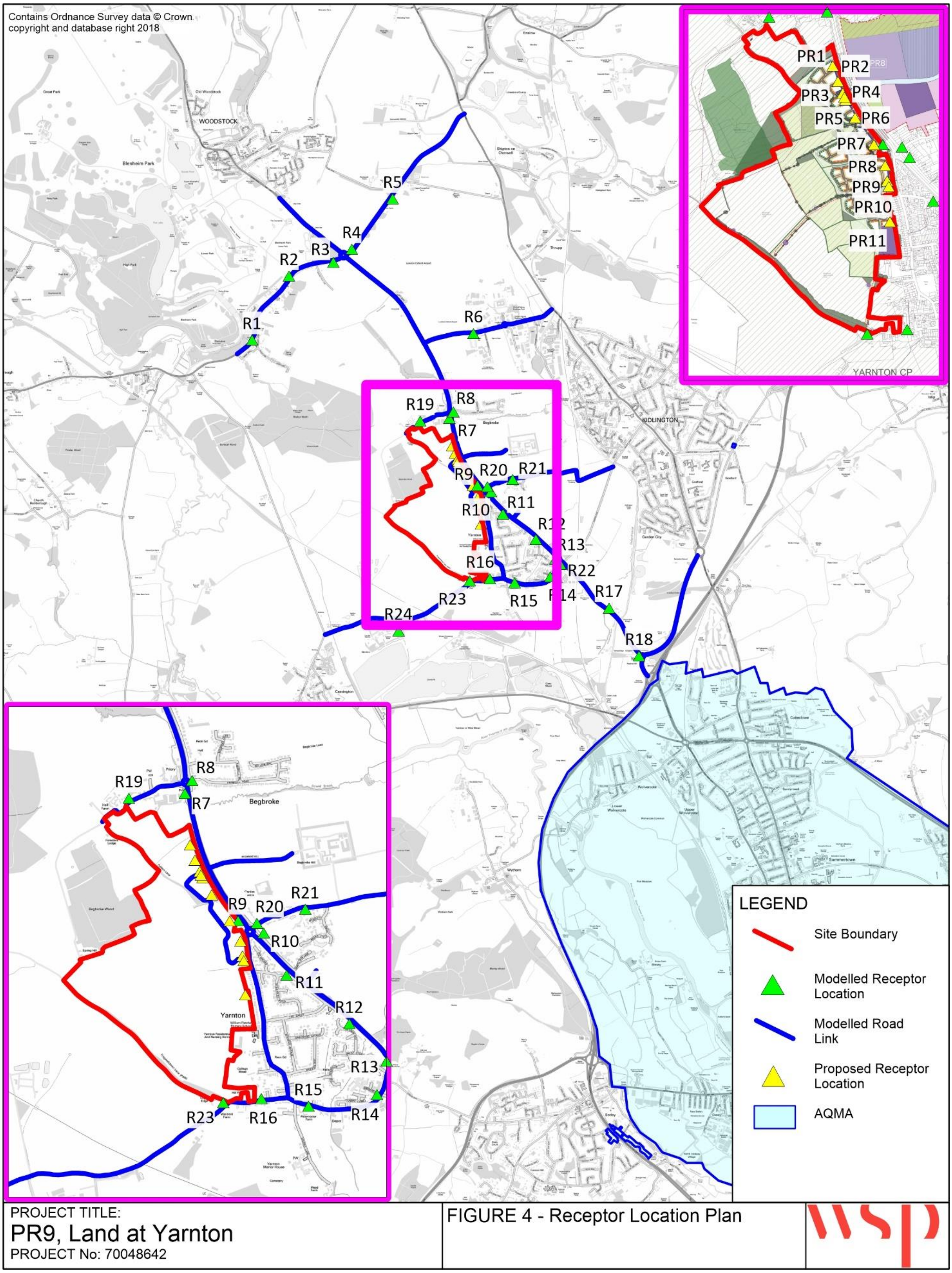
Drawn By: JG Date Modified: 31/01/2019



PROJECT TITLE:
PR9, Land at Yarnton
PROJECT No: 70048642

FIGURE 3 - Monitoring Location Plan

Figure 4 – Receptor Location Plan



Appendix A

GLOSSARY

GLOSSARY

Term	Definition
AADT Annual Average Daily Traffic	A daily total traffic flow (24hrs), expressed as a mean daily flow across all 365 days of the year.
Adjustment	Application of a correction factor to modelled results to account for uncertainties in the model
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
AQMA	Air Quality Management Area.
AQO	Air Quality Objective
AURN	Automatic Urban and Rural (air quality monitoring) Network, managed by contractors on behalf of Defra
CDC	Cherwell District Council
Conservative	Tending to over-predict the impact rather than under-predict.
Data capture	The percentage of all the possible measurements for a given period that were validly measured.
Defra	Department for Environment, Food and Rural Affairs.
DfT	Department for Transport.
EFT	Emissions Factor Toolkit
Emission rate	The quantity of a pollutant released from a source over a given period.
EPUK	Environmental Protection (UK)
Exceedance	A period where the concentrations of a pollutant is greater than the appropriate air quality standard.
HDV/HGV	Heavy Duty Vehicle/Heavy Goods Vehicle.
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management.
Model adjustment	Following model verification, the process by which modelled results are amended. This corrects for systematic error.

Term	Definition
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
OCC	Oxford City Council
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
Road link	A length of road which is considered to have the same flow of traffic along it. Usually, a link is the road from one junction to the next.
$\mu g/m^3$ microgrammes per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of $1\mu g/m^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.
WODC	West Oxfordshire District Council
$\mu g/m^3$	Microgrammes per cubic metre.

Appendix B

RELEVANT UK AIR QUALITY STRATEGY OBJECTIVES

National Air Quality Objectives and European Directive Limit Values for the Protection of Human Health						
Nitrogen dioxide (NO_2)	UK	200µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005	200µg/m^3 not to be exceeded more than 18 times a year	01.01.2010
Particulate Matter (PM_{10}) (gravimetric)[A]	UK	40µg/m^3	annual mean	31.12.2005	40µg/m^3	01.01.2010
	UK (except Scotland)	40µg/m^3	annual mean	31.12.2004	40µg/m^3	01.01.2005
Particulate Matter ($PM_{2.5}$)	UK (except Scotland)	50µg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004	50µg/m^3 not to be exceeded more than 35 times a year	01.01.2005
	UK (except Scotland)	25µg/m^3	annual mean	2020	Target value 25µg/m^3	2010

[A] Measured using the European gravimetric transfer sampler or equivalent

µg/m^3 = microgram per cubic metre

Appendix C

IAQM CONSTRUCTION ASSESSMENT METHODOLOGY

STEP 1 – SCREENING THE NEED FOR A DETAILED ASSESSMENT

An assessment will normally be required where there are:

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

Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is 'negligible'.

STEP 2A – DEFINE THE POTENTIAL DUST EMISSION MAGNITUDE

The following are examples of how the potential dust emission magnitude for different activities can be defined. (Note that not all the criteria need to be met for a class). Other criteria may be used if justified in the assessment.

Table C1 - Examples of Human Receptor Sensitivity to Construction Phase Impacts

Dust Emission Magnitude	Activity	Criteria
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 surface material (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, dusty material e.g. concrete, on site concrete batching
	Trackout	10 - 50 HDVs out / day, moderately dusty surface material (e.g. clay), 50 -100m unpaved roads
Small	Demolition	<20,000m^3 building demolished, non-dusty material (e.g metal cladding), <10m above ground level, work during wetter months

Dust Emission Magnitude	Activity	Criteria
	Earthworks	<2,500m^2 site area, soil with large grain size (e.g. sand), <5 earth moving vehicles active simultaneously, <4m high bunds, <20,000 tonnes material moved, earthworks during wetter months
	Construction	<25,000m^3, non-dusty material (e.g. metal cladding or timber)
	Trackout	<10 HDVs out / day, non-dusty soil, < 50m unpaved roads

STEP 2B – DEFINE THE SENSITIVITY OF THE AREA

The tables below present the IAQM assessment methodology[11] to determine the sensitivity of the area to dust soiling, human health and ecological impacts respectively. The IAQM guidance provides guidance to allow the sensitivity of individual receptors to dust soiling and health effects to assist in the assessment of the overall sensitivity of the study area.

Table C2- Sensitivity of the Area to Dust Soiling Effects

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

Table C3 - Sensitivity of the Area to Human Health Impacts

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

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

Table C4 - Sensitivity of the Area to Ecological Impacts

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

STEP 2C – DEFINE THE RISK OF IMPACTS

The dust emissions magnitude determined at Step 2A should be combined with the sensitivity of the area determined at Step 2B to determine the risk of impacts without mitigation applied. For those cases where the risk category is ‘negligible’ no mitigation measures beyond those required by legislation will be required.

Table C5 - Risk of Dust Impacts

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

STEP 3 – SITE SPECIFIC MITIGATION

Having determined the risk categories for each of the four activities it is possible to determine the site-specific measures to be adopted. These measures will be related to whether the site is a low, medium or high-risk site. The IAQM guidance[11] details the mitigation measures required for high, medium and low risk sites as determined in Step 2C.

STEP 4 – DETERMINE SIGNIFICANT EFFECTS

Once the risk of dust impacts has been determined in Step 2C and the appropriate dust mitigation measures identified in Step 3, the final step is to determine whether there are significant effects arising from the construction phase. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual effect will normally be negligible.

Appendix D

TRAFFIC DATA

APPENDIX TITLE

Table D1 – 2017 Verification Traffic Data

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
01	Begbroke Hill (Science Park) (Junction Approach)	15	530	0	0.00319	0.00022	0.00013
02	Begbroke Hill (Science Park)	48	530	0	0.00215	0.00020	0.00012
03	A44 - North of Begroke Hill (Junction Approach)	15	11415	0.095	0.06942	0.00474	0.00287
04	A44 - North of Begroke Hill	80	11415	0.095	0.04504	0.00443	0.00257
05	A44 - South of Spring Hill Road (Junction Approach)	15	11415	0.095	0.06942	0.00474	0.00287
06	A44 - South of Begbroke Hill (Junction Approach)	15	11635	0.095	0.07075	0.00483	0.00292
07	A44 - South of Begbroke Hill	80	11635	0.095	0.04590	0.00451	0.00262
08	A44 - North of Rutten Lane (Junction Approach)	15	11635	0.095	0.07075	0.00483	0.00292
09	Rutten Lane - South of Access (Junction Approach)	15	1848	0	0.01113	0.00076	0.00046
10	Rutten Lane - South of Access	48	1848	0	0.00750	0.00071	0.00041
11	Rutten Lane - North of Cassington Road (Junction Approach)	15	1848	0	0.01113	0.00076	0.00046
12	Rutten Lane - North of Access (Junction Approach)	15	1848	0	0.01113	0.00076	0.00046
13	Sandy Lane East of A44 (Junction Approach)	15	1887	0	0.01136	0.00078	0.00047
14	Sandy Lane East of A44	48	1887	0	0.00766	0.00073	0.00042
15	Sandy Lane West of Yarnton Road (Junction Approach)	15	1887	0	0.01136	0.00078	0.00047
16	A44 - South of Sandy Lane (Junction Approach)	15	11446	0.095	0.06960	0.00475	0.00288
17	A44 - South of Sandy Lane	80	11446	0.095	0.04516	0.00444	0.00258
18	A44 - North of PR8 Access (Junction Approach)	15	11446	0.095	0.06960	0.00475	0.00288
19	A44 - South of PR8 Access (Junction Approach)	15	11446	0.095	0.06960	0.00475	0.00288
20	A44 - South of PR8 Access	80	11446	0.095	0.04516	0.00444	0.00258
21	A44 - North of Cassington Road (Junction Approach)	15	11446	0.095	0.06960	0.00475	0.00288

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
22	Cassington Road West of A44 (Junction Approach)	15	3209	0.010	0.01934	0.00133	0.00080
23	Cassington Road West of A44	48	3209	0.010	0.01303	0.00124	0.00072
24	Cassington Road East of Ruten Lane (Junction Approach)	15	3209	0.010	0.01934	0.00133	0.00080
25	Cassington Road West of Ruten Lane (Junction Approach)	15	3209	0.010	0.01934	0.00133	0.00080
26	Cassington Road West of Ruten Lane	48	3209	0.010	0.01303	0.00124	0.00072
27	A44 - South of Cassington Lane (Junction Approach)	15	13614	0.051	0.08242	0.00564	0.00341
28	A44 - South of Cassington Lane	80	13614	0.051	0.05364	0.00527	0.00306
29	A44 - North of Frieze Way (Junction Approach)	15	13614	0.051	0.08242	0.00564	0.00341
30	A4260 Frieze Way East of A44 (Junction Approach)	15	6399	0.029	0.03865	0.00265	0.00160
31	A4260 Frieze Way East of A44	112	6399	0.029	0.03773	0.00263	0.00159
32	A4260 Frieze Way West of Oxford Road (Junction Approach)	15	6399	0.029	0.03865	0.00265	0.00160
33	A44 - South of Frieze Way (Junction Approach)	15	15147	0.051	0.09170	0.00628	0.00380
34	A44 - South of Frieze Way	112	15147	0.051	0.08934	0.00624	0.00376
35	A44 - North of Western By Pass Road (Junction Approach)	15	15147	0.051	0.09170	0.00628	0.00380
36	Spring Hill Road (Junction Approach)	15	475	0	0.00286	0.00020	0.00012
37	Spring Hill Road	48	475	0	0.00193	0.00018	0.00011
38	A44 - North of Spring Hill Road (Junction Approach)	15	11413	0.095	0.06940	0.00474	0.00287
39	A44 - North of Spring Hill Road	48	11413	0.095	0.04656	0.00442	0.00256
40	A44 - South of Langford Lane (Junction Approach)	15	11413	0.095	0.06940	0.00474	0.00287
41	Langford Lane (Junction Approach)	15	6278	0.036	0.03795	0.00260	0.00157
42	Langford Lane West of Langford Hall	96	6278	0.036	0.02869	0.00249	0.00147
43	Langford Lane East of Langford Hall	96	6278	0.036	0.02869	0.00249	0.00147

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
44	A44 - North of Langford Lane (Junction Approach)	15	11181	0.095	0.06799	0.00464	0.00281
45	A44 - North of Langford Lane	80	11181	0.095	0.04411	0.00434	0.00252
46	A44 - South of Grove Road (Junction Approach)	15	11181	0.095	0.06799	0.00464	0.00281
47	A4095 Grove Road (Junction Approach)	15	8170	0.051	0.04946	0.00339	0.00205
48	A4095 Grove Road	48	8170	0.051	0.03325	0.00316	0.00183
49	A4095 Upper Campsfield Road (Junction Approach)	15	5232	0.073	0.03174	0.00217	0.00131
50	A4095 Upper Campsfield Road	96	5232	0.073	0.02393	0.00208	0.00123
51	A44 - North of Grove Road (Junction Approach)	15	7056	0.095	0.04291	0.00293	0.00177
52	A44 - North of Grove Road	80	7056	0.095	0.02784	0.00274	0.00159
53	A44 Site Access to Rutten Lane Site Access	48	0	0	-	-	-
54	A44 Site Access (Junction Approach)	15	0	0	-	-	-
55	Rutten Lane Site Access (Junction Approach)	15	0	0	-	-	-
56	Proposed PR8 Access (Junction Approach)	15	0	0	-	-	-

Table D2 – 2025 Without Development Traffic Data

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
01	Begbroke Hill (Science Park) (Junction Approach)	15	3010	0	0.01813	0.00124	0.00075
02	Begbroke Hill (Science Park)	48	3010	0	0.01222	0.00116	0.00067
03	A44 - North of Begroke Hill (Junction Approach)	15	16792	0.075	0.10190	0.00697	0.00422
04	A44 - North of Begroke Hill	80	16792	0.075	0.06621	0.00651	0.00378
05	A44 - South of Spring Hill Road (Junction Approach)	15	16792	0.075	0.10190	0.00697	0.00422
06	A44 - South of Begbroke Hill (Junction Approach)	15	17907	0.071	0.10863	0.00743	0.00449
07	A44 - South of Begbroke Hill	80	17907	0.071	0.07060	0.00694	0.00403
08	A44 - North of Rutten Lane (Junction Approach)	15	17907	0.071	0.10863	0.00743	0.00449
09	Rutten Lane - South of Access (Junction Approach)	15	2245	0	0.01352	0.00093	0.00056
10	Rutten Lane - South of Access	48	2245	0	0.00911	0.00087	0.00050
11	Rutten Lane - North of Cassington Road (Junction Approach)	15	2245	0	0.01352	0.00093	0.00056
12	Rutten Lane - North of Access (Junction Approach)	15	2374	0	0.01430	0.00098	0.00059
13	Sandy Lane East of A44 (Junction Approach)	15	2188	0	0.01318	0.00090	0.00055
14	Sandy Lane East of A44	48	2188	0	0.00888	0.00084	0.00049
15	Sandy Lane West of Yarnton Road (Junction Approach)	15	2188	0	0.01318	0.00090	0.00055
16	A44 - South of Sandy Lane (Junction Approach)	15	17688	0.071	0.10730	0.00734	0.00444
17	A44 - South of Sandy Lane	80	17688	0.071	0.06973	0.00685	0.00398
18	A44 - North of PR8 Access (Junction Approach)	15	17688	0.071	0.10730	0.00734	0.00444
19	A44 - South of PR8 Access (Junction Approach)	15	18302	0.069	0.11099	0.00759	0.00459
20	A44 - South of PR8 Access	80	18302	0.069	0.07215	0.00709	0.00412
21	A44 - North of Cassington Road (Junction Approach)	15	18302	0.069	0.11099	0.00759	0.00459

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
22	Cassington Road West of A44 (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
23	Cassington Road West of A44	48	3737	0.010	0.01518	0.00144	0.00084
24	Cassington Road East of Ruten Lane (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
25	Cassington Road West of Ruten Lane (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
26	Cassington Road West of Ruten Lane	48	3737	0.010	0.01518	0.00144	0.00084
27	A44 - South of Cassington Lane (Junction Approach)	15	20799	0.039	0.12575	0.00862	0.00521
28	A44 - South of Cassington Lane	80	20799	0.039	0.08191	0.00805	0.00468
29	A44 - North of Frieze Way (Junction Approach)	15	20799	0.039	0.12575	0.00862	0.00521
30	A4260 Frieze Way East of A44 (Junction Approach)	15	8346	0.026	0.05039	0.00346	0.00209
31	A4260 Frieze Way East of A44	112	8346	0.026	0.04920	0.00344	0.00207
32	A4260 Frieze Way West of Oxford Road (Junction Approach)	15	8346	0.026	0.05039	0.00346	0.00209
33	A44 - South of Frieze Way (Junction Approach)	15	23127	0.039	0.13983	0.00958	0.00580
34	A44 - South of Frieze Way	112	23127	0.039	0.13638	0.00952	0.00574
35	A44 - North of Western By Pass Road (Junction Approach)	15	23127	0.039	0.13983	0.00958	0.00580
36	Spring Hill Road (Junction Approach)	15	550	0	0.00331	0.00023	0.00014
37	Spring Hill Road	48	550	0	0.00223	0.00021	0.00012
38	A44 - North of Spring Hill Road (Junction Approach)	15	16795	0.075	0.10192	0.00697	0.00422
39	A44 - North of Spring Hill Road	48	16795	0.075	0.06845	0.00650	0.00377
40	A44 - South of Langford Lane (Junction Approach)	15	16795	0.075	0.10192	0.00697	0.00422
41	Langford Lane (Junction Approach)	15	8223	0.032	0.04968	0.00341	0.00206
42	Langford Lane West of Langford Hall	96	8223	0.032	0.03757	0.00326	0.00193
43	Langford Lane East of Langford Hall	96	8223	0.032	0.03757	0.00326	0.00193

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
44	A44 - North of Langford Lane (Junction Approach)	15	15582	0.079	0.09460	0.00646	0.00391
45	A44 - North of Langford Lane	80	15582	0.079	0.06145	0.00604	0.00351
46	A44 - South of Grove Road (Junction Approach)	15	15582	0.079	0.09460	0.00646	0.00391
47	A4095 Grove Road (Junction Approach)	15	10488	0.046	0.06346	0.00435	0.00263
48	A4095 Grove Road	48	10488	0.046	0.04268	0.00405	0.00235
49	A4095 Upper Campsfield Road (Junction Approach)	15	9309	0.048	0.05634	0.00386	0.00233
50	A4095 Upper Campsfield Road	96	9309	0.048	0.04256	0.00370	0.00218
51	A44 - North of Grove Road (Junction Approach)	15	9964	0.078	0.06048	0.00413	0.00250
52	A44 - North of Grove Road	80	9964	0.078	0.03929	0.00386	0.00224
53	A44 Site Access to Rutten Lane Site Access	48	0	0	-	-	-
54	A44 Site Access (Junction Approach)	15	0	0	-	-	-
55	Rutten Lane Site Access (Junction Approach)	15	0	0	-	-	-
56	Proposed PR8 Access (Junction Approach)	15	0	0	-	-	-

Table D3 – 2025 With Development Traffic Data

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
01	Begbroke Hill (Science Park) (Junction Approach)	15	3153	0	0.01899	0.00130	0.00079
02	Begbroke Hill (Science Park)	48	3153	0	0.01280	0.00122	0.00071
03	A44 - North of Begroke Hill (Junction Approach)	15	17195	0.073	0.10433	0.00713	0.00432
04	A44 - North of Begroke Hill	80	17195	0.073	0.06780	0.00666	0.00387
05	A44 - South of Spring Hill Road (Junction Approach)	15	17195	0.073	0.10433	0.00713	0.00432
06	A44 - South of Begbroke Hill (Junction Approach)	15	18223	0.070	0.11053	0.00756	0.00457
07	A44 - South of Begbroke Hill	80	18223	0.070	0.07184	0.00706	0.00410
08	A44 - North of Rutten Lane (Junction Approach)	15	18223	0.070	0.11053	0.00756	0.00457
09	Rutten Lane - South of Access (Junction Approach)	15	2315	0	0.01394	0.00096	0.00058
10	Rutten Lane - South of Access	48	2315	0	0.00940	0.00089	0.00052
11	Rutten Lane - North of Cassington Road (Junction Approach)	15	2315	0	0.01394	0.00096	0.00058
12	Rutten Lane - North of Access (Junction Approach)	15	2693	0	0.01622	0.00111	0.00067
13	Sandy Lane East of A44 (Junction Approach)	15	2188	0	0.01318	0.00090	0.00055
14	Sandy Lane East of A44	48	2188	0	0.00888	0.00084	0.00049
15	Sandy Lane West of Yarnton Road (Junction Approach)	15	2188	0	0.01318	0.00090	0.00055
16	A44 - South of Sandy Lane (Junction Approach)	15	18251	0.069	0.11069	0.00757	0.00458
17	A44 - South of Sandy Lane	80	18251	0.069	0.07195	0.00707	0.00411
18	A44 - North of PR8 Access (Junction Approach)	15	18251	0.069	0.11069	0.00757	0.00458
19	A44 - South of PR8 Access (Junction Approach)	15	18865	0.067	0.11438	0.00782	0.00473
20	A44 - South of PR8 Access	80	18865	0.067	0.07436	0.00731	0.00425
21	A44 - North of Cassington Road (Junction Approach)	15	18865	0.067	0.11438	0.00782	0.00473

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
22	Cassington Road West of A44 (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
23	Cassington Road West of A44	48	3737	0.010	0.01518	0.00144	0.00084
24	Cassington Road East of Ruten Lane (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
25	Cassington Road West of Ruten Lane (Junction Approach)	15	3737	0.010	0.02253	0.00155	0.00094
26	Cassington Road West of Ruten Lane	48	3737	0.010	0.01518	0.00144	0.00084
27	A44 - South of Cassington Lane (Junction Approach)	15	21362	0.038	0.12915	0.00885	0.00535
28	A44 - South of Cassington Lane	80	21362	0.038	0.08413	0.00827	0.00480
29	A44 - North of Frieze Way (Junction Approach)	15	21362	0.038	0.12915	0.00885	0.00535
30	A4260 Frieze Way East of A44 (Junction Approach)	15	8348	0.026	0.05041	0.00346	0.00209
31	A4260 Frieze Way East of A44	112	8348	0.026	0.04922	0.00344	0.00207
32	A4260 Frieze Way West of Oxford Road (Junction Approach)	15	8348	0.026	0.05041	0.00346	0.00209
33	A44 - South of Frieze Way (Junction Approach)	15	23687	0.038	0.14320	0.00981	0.00594
34	A44 - South of Frieze Way	112	23687	0.038	0.13968	0.00975	0.00588
35	A44 - North of Western By Pass Road (Junction Approach)	15	23687	0.038	0.14320	0.00981	0.00594
36	Spring Hill Road (Junction Approach)	15	550	0	0.00331	0.00023	0.00014
37	Spring Hill Road	48	550	0	0.00223	0.00021	0.00012
38	A44 - North of Spring Hill Road (Junction Approach)	15	17071	0.073	0.10358	0.00708	0.00428
39	A44 - North of Spring Hill Road	48	17071	0.073	0.06957	0.00660	0.00383
40	A44 - South of Langford Lane (Junction Approach)	15	17071	0.073	0.10358	0.00708	0.00428
41	Langford Lane (Junction Approach)	15	8369	0.031	0.05056	0.00347	0.00210
42	Langford Lane West of Langford Hall	96	8369	0.031	0.03824	0.00332	0.00196
43	Langford Lane East of Langford Hall	96	8369	0.031	0.03824	0.00332	0.00196

Road Link	Name	Speed (km/h)	AADT (Total vehicles)	% HDV	NO_x Emission Factor (g/km/s)	PM_{10} Emission Factor (g/km/s)	$PM_{2.5}$ Emission Factor (g/km/s)
44	A44 - North of Langford Lane (Junction Approach)	15	15712	0.078	0.09538	0.00652	0.00394
45	A44 - North of Langford Lane	80	15712	0.078	0.06196	0.00609	0.00354
46	A44 - South of Grove Road (Junction Approach)	15	15712	0.078	0.09538	0.00652	0.00394
47	A4095 Grove Road (Junction Approach)	15	10526	0.046	0.06369	0.00436	0.00264
48	A4095 Grove Road	48	10526	0.046	0.04284	0.00407	0.00236
49	A4095 Upper Campsfield Road (Junction Approach)	15	9309	0.048	0.05634	0.00386	0.00233
50	A4095 Upper Campsfield Road	96	9309	0.048	0.04256	0.00370	0.00218
51	A44 - North of Grove Road (Junction Approach)	15	10055	0.077	0.06103	0.00417	0.00252
52	A44 - North of Grove Road	80	10055	0.077	0.03965	0.00390	0.00226
53	A44 Site Access to Rutten Lane Site Access	48	560	0	0.00227	0.00022	0.00013
54	A44 Site Access (Junction Approach)	15	560	0	0.00337	0.00023	0.00014
55	Rutten Lane Site Access (Junction Approach)	15	372	0	0.00224	0.00015	0.00009
56	Proposed PR8 Access (Junction Approach)	15	2006	0	0.01208	0.00083	0.00050

Appendix E

SCHEME SPECIFIC MONITORING

INTRODUCTION

7.1.7. A project specific NO_2 passive diffusion tube monitoring programme was completed by WSP to establish baseline concentrations for the whole study area. The three-month programme began in November 2018 and ended February 2019.

7.1.8. Details of the 7 monitoring site locations are presented in **Table E1**. Where site conditions allowed, the monitoring locations were not located in proximity (within 10m) to the following localised sources or sinks of air pollutants, and areas that could cause undue disturbance to free flow air flow around the diffusion tubes:

- Heater flues (particularly low level balanced flues;
- Trees and other vegetation;
- Extractor vents; and/or,
- Underground ventilation shafts

Table E1 - Scheme Specific Monitoring Site Locations and Details

SITE ID	OS X	OS Y	LOCATION	HEIGHT (M)
MC01	447033	213888	2 Woodstock Rd, Begbroke, Kidlington	2.0
MC02	447173	213395	A44, Kidlington	2.0
MC03	447412	213018	194 Woodstock Rd, Yarnton, Kidlington	2.0
MC04	447509	212490	107 Rutten Ln, Yarnton, Kidlington	2.0
MC05	447430	212008	190 Cassington Rd, Yarnton, Kidlington	2.0
MC06	447415	213096	209 Woodstock Rd, Yarnton, Kidlington	2.0
MC07	446731	212399	Spring Hill Rd, Kidlington	2.0

NO_2 DIFFUSION TUBE MONITORING RESULTS

BIAS ADJUSTMENT PERIOD MEAN CONCENTRATIONS

7.1.9. Diffusion tubes are affected by several sources of interference which can cause substantial under or over estimation of concentrations. This is often referred to as bias, when compared to concentrations measured by the more accurate chemiluminescent analysers referred to as continuous monitors.

7.1.10. As a result, Defra advises applying an appropriate bias adjustment factor to measured diffusion tube concentrations. The bias adjustment factor used in this study was obtained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet[17]. This is formulated by data collected by local

17 https://laqm.defra.gov.uk/document/Diffusion_Tube_Bias_Factors_v04_11_v6.xls

authorities throughout the country as they locate diffusion tubes in the vicinity of a continuous monitor and compare the results. By inputting the chosen analyser, the method of analysis and the year into the spreadsheet, an average of the relevant bias factors across the country can be obtained. This was found to be **0.87**. This bias factor was applied to the annualised diffusion tube data from the monitoring survey to calculate the final concentration for the monitoring locations.

ANNUALISATION

7.1.11. All monitoring results were adjusted based upon the methodology contained within Box 7.9 of LAQM.TG (16). In this procedure, data from nearby (within 50 miles) continuous monitoring sites with annual datasets are used to generate a factor to convert period data into annual data. Two AURN 'Urban' sites (AURN) were used for annualisation:

- Oxford St Ebbes
- Reading New Town

7.1.12. The period mean for these two sites was calculated to match the period of time that monitoring was undertaken by WSP. The annual mean for both of these sites was also calculated for 2017, the year of verification. The ratio of the annual mean to the period mean was then calculated, the average of this value is the annualisation factor. This factor is applied to the monitoring period mean to obtain a value for the 2017 annual mean at these monitoring locations. A summary of this data can be seen in **Tables E2**, **E3** and **E4**.

Table E2 – Diffusion Tube and AURN Monitoring Results 2017

Site ID	Monthly Measurements (µg/m³)			Period Mean (µg/m³)
	7/11/18 – 3/12/18	3/12/18 – 3/1/19	3/1/19 – 5/2/19	
MC01	25.3	21.6	21.0	22.7
MC02	26.9	23.3	23.3	24.5
MC03	30.3	23.8	23.3	25.8
MC04	23.7	21.4	19.6	21.6
MC05	18.5	18.4	18.2	18.4
MC06	29.8	31.5	30.1	30.5
MC07	17.4	17.8	16.0	17.1
Oxford St Ebbes	16.1	15.5	15.8	15.8
Reading New Town	7.5	14.2	11.7	11.1

Table E3 – Annualisation Factor

Site ID	AURN Period Mean (µg/m³)	AURN 2017 Annual Mean (µg/m3)	AM/PM
Oxford St Ebbes	15.8	13.3	0.84
Reading New Town	11.1	9.9	0.89
Average (Annualisation Factor)			**0.87**

Table E4 - Bias Adjusted Annual Mean Diffusion Tube Monitoring Results 2017

Site ID	Period Mean (µg/m^3)	2017 Annualised Mean (Annualisation Factor – 0.87) (µg/m^3)	2017 Bias Adjusted Annual Mean (Bias Factor – 0.87) (µg/m^3)
MC01	22.7	19.6	17.1
MC02	24.5	21.2	18.5
MC03	25.8	22.3	19.4
MC04	21.6	18.7	16.3
MC05	18.4	15.9	13.9
MC06	30.5	26.4	23.0
MC07	17.1	14.8	12.9

Appendix F

MODEL VERIFICATION

INTRODUCTION

The comparison of modelled concentrations with local monitored concentrations is a process termed "verification". Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- Estimates of background pollutant concentrations;
- Meteorological data uncertainties;
- Traffic data uncertainties;
- Model input parameters, such as 'roughness length'; and,
- Overall limitations of the dispersion model.

NITROGEN DIOXIDE (NO_2)

Most nitrogen dioxide (NO_2) 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 the primary pollutant emissions of nitrogen oxides ($NO_x = NO + NO_2$), in line with the guidance provided within LAQM.TG16.

The model has been run to predict the 2017 annual mean road-NO_x contribution at the diffusion tubes within the modelled road network. The model outputs of road-NO_x have been compared with the 'measured' road-NO_x, which was determined from the NO_2 concentrations measured using diffusion tubes at the monitoring locations, utilising the NO_x from NO_2 calculator provided by Defra and the NO_2 background concentration (from the Defra background maps).

In this assessment, there were six monitoring sites used for verification. The initial model verification exercise showed that the difference between the total modelled NO_2 and total monitored NO_2 at one of the six local authority diffusion tube monitoring locations was above 25%. As such, this was discounted from the verification procedure.

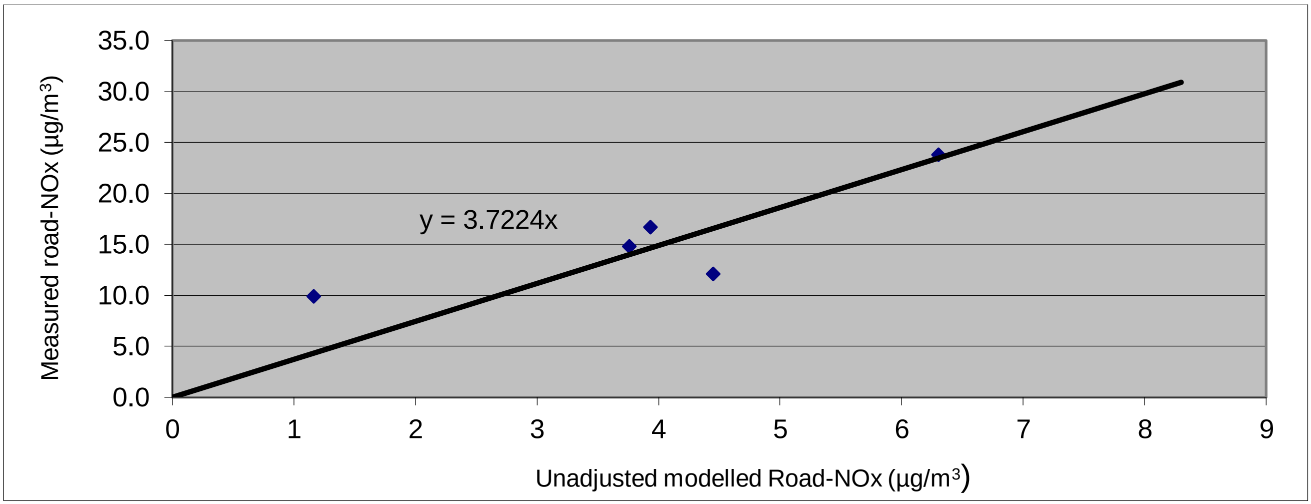
Table F1 - Model Verification Study – Road NO_x Adjustment

Model Verification – Road NO_x	Monitoring Sites - NO_2 ($\mu g/m^3$)				
	MC01	MC02	MC03	MC04	MC06
2017 Background NO_X	14.2	14.2	14.2	14.7	14.2
2017 Background NO_2	10.6	10.6	10.6	11.0	10.6
2017 Monitored Total NO_2	17.1	18.5	19.4	16.3	23.0
2017 Monitored Road NO_2	6.5	7.8	8.8	5.3	12.3
Monitored Road NO_x (from NO_x to NO_2 Calculator for Diffusion tubes)	12.1	14.8	16.7	9.9	23.8
Modelled Road Contribution NO_x (from ADMS Roads)	4.4	3.8	3.9	1.2	6.3
Modelled Total NO_2 ***Before Adjustment*** (from NO_x to NO_2 calculator)	13.0	12.7	12.8	11.6	14.0

Model Verification – Road NO_x	Monitoring Sites - NO_2 ($\mu g/m^3$)				
	MC01	MC02	MC03	MC04	MC06
% Difference ((Modelled - Monitored / Monitored) x 100) ***Before Adjustment***	**-23.7**	**-31.4**	**-34.4**	**-28.6**	**-38.9**
Ratio of Monitored to Modelled Road Contribution NO_x	2.7	3.9	4.2	8.5	3.8
Adjustment Factor (modelled versus monitored road-NO_x)	**3.72 (3.7224)**				
Adjusted Modelled Road Contribution NO_x	16.6	14.0	14.6	4.3	23.5
Adjusted Modelled Total NO_x	30.7	28.2	28.8	19.0	37.7
Adjusted Modelled Total NO_2 (from NO_x to NO_2 calculator)	19.4	18.0	18.4	13.3	22.8
% Difference ((Modelled - Monitored / Monitored) x 100) ***After Adjustment***	**13.3**	**-2.3**	**-5.4**	**-18.1**	**-0.7**

The road-NO_x 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 F1). This factor was then applied to the modelled road-NO_x concentration for each monitoring site to provide adjusted modelled road-NOx concentrations.

Figure F1 - Comparison of Measured Road-NO_x with Unadjusted Modelled Road-NO_x



The results of the model verification process reported in the table above demonstrate that, prior to model adjustment, the difference between the monitored and modelled total NO_2 concentrations was relatively high with the disparity at the sites outside of +/-20%. However, the model adjustment process has markedly improved the difference between modelled and monitored values, reducing the adjusted modelled NO_2 to be within +/-20% of the monitored equivalent.

Given the outcomes of this exercise, the road-NO_x adjustment factor of **3.72** was applied to the modelled road-NO_x concentrations applicable to all receptors modelled in the 'without' and 'with' Proposed Development opening year scenarios.

PM_{10} and $PM_{2.5}$

Given the absence of particulates monitoring within the study area, the road-NO_x verification factor determined has been applied to the predicted road-PM_{10} and road-$PM_{2.5}$ contributions, consistent with guidance set out in LAQM.TG16[9].

MODEL UNCERTAINTY

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG16[9] identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty.

These include:

a) Root mean square error (RMSE);
b) Fractional bias (FB); and
c) Correlation coefficient (CC).

These parameters estimate how the model results agree or diverge from the observations. These calculations can be carried out prior to, and after adjustment, or based on different options for adjustment, and can provide useful information on model improvement. A brief for explanation of each statistic is provided in Table E2, and further details can be found in Box 7.17 of LAQM.TG16.

Table E2 – Methods for describing model uncertainty

Statistical Parameter	Comments	Ideal value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40 µg/m^3, if an RMSE of 10µg/m^3 or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m^3 for the annual mean NO_2 objective.	0.01
Fractional Bias	It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.00
Correlation Coefficient	It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

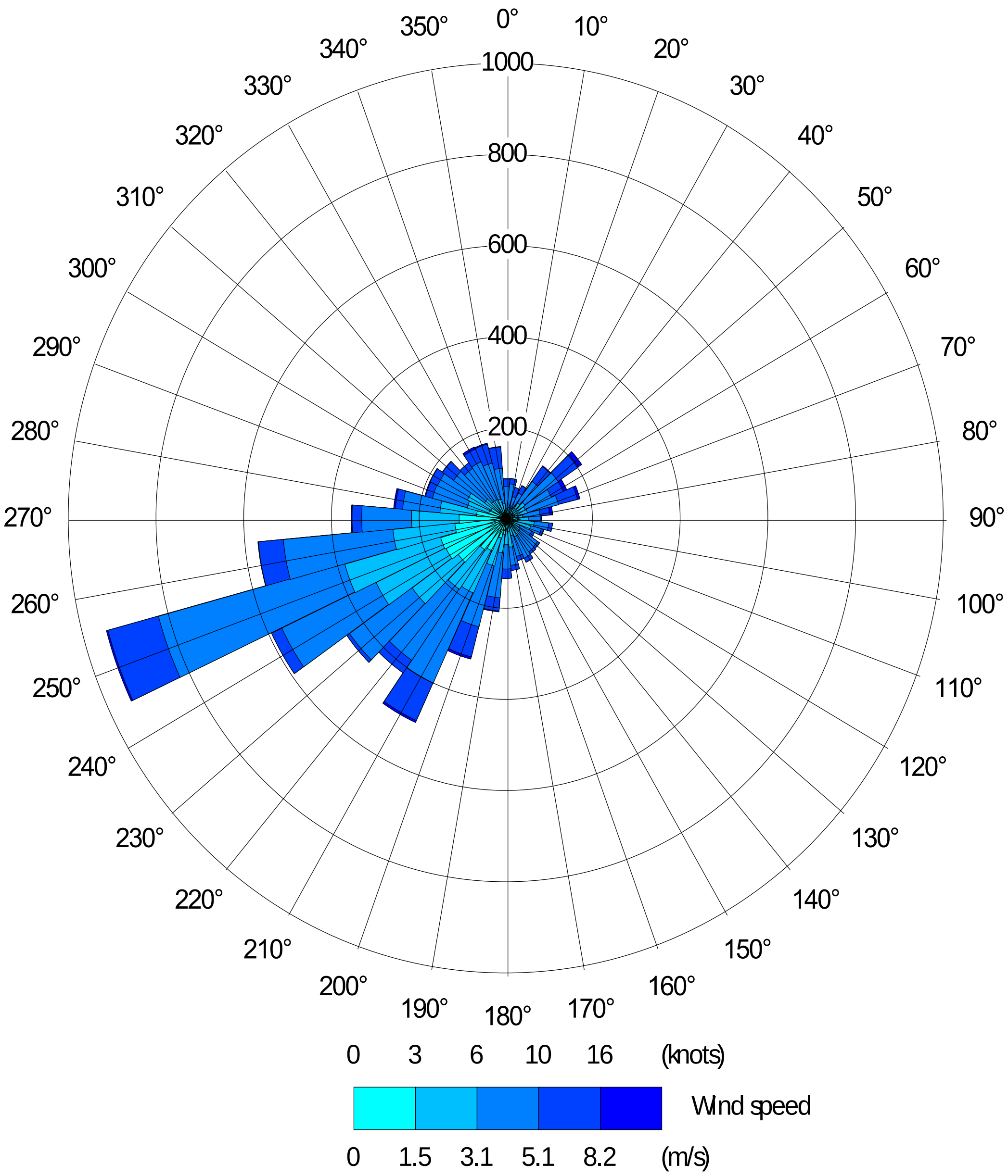
To assess the uncertainty of a model, the RMSE is the simplest parameter to calculate providing an estimate of the average error of the model in the same units as the modelled predictions. It is also often easier to interpret the RMSE than the other statistical parameters and therefore it has been calculated in this assessment to understand the model uncertainty.

The RMSE value calculated before model adjustment was 6.26µg/m^3, whereas post-adjustment it was 1.74µg/m^3. This highlights the improvement in the model post-adjustment and confirms that the air quality model utilised for the project is appropriate for its intended use.

Appendix G

WIND ROSE

WIND ROSE FOR BRIZE NORTON METEOROLOGICAL STATION 2017



Appendix H

MODEL RESULTS

Table H1 - Annual Mean NO_2 Concentrations (µg/m^3)

Receptor	2017 Base (µg/m^3)	2025 Without (µg/m^3)	2025 With Dev (µg/m^3)	% of AQAL	Change (µg/m^3)	% Change of AQO	Impact (EPUK / IAQM)
Existing Sensitive Receptors							
R1	24.3	28.4	28.5	71.1	0.1	0.2	Negligible
R2	14.1	15.6	15.6	39.0	<0.1	0.1	Negligible
R3	13.5	15.0	15.0	37.5	<0.1	<0.5	Negligible
R4	17.6	22.3	22.3	55.8	<0.1	0.1	Negligible
R5	14.1	16.9	16.9	42.2	<0.1	<0.5	Negligible
R6	19.4	21.7	21.9	54.6	0.2	0.4	Negligible
R7	15.9	18.3	18.5	46.1	0.2	0.4	Negligible
R8	26.3	32.8	33.2	83.0	0.4	0.9	Negligible
R9	15.2	17.5	17.8	44.5	0.3	0.7	Negligible
R10	17.9	21.4	21.8	54.4	0.4	1.0	Negligible
R11	14.4	16.1	16.3	40.7	0.2	0.4	Negligible
R12	17.1	19.1	19.2	48.1	<0.1	0.4	Negligible
R13	20.8	24.3	24.6	61.5	0.3	0.7	Negligible
R14	16.3	17.0	17.0	42.5	<0.1	0.1	Negligible
R15	13.6	14.2	14.2	35.6	<0.1	<0.5	Negligible
R16	15.9	16.8	16.8	41.9	<0.1	<0.5	Negligible
R17	24.1	29.0	29.4	73.4	0.4	1.0	Negligible
R18	26.4	30.9	31.3	78.1	0.4	0.8	Negligible
R19	9.4	9.6	9.6	24.1	<0.1	<0.5	Negligible
R20	20.3	24.2	24.6	61.4	0.4	0.8	Negligible
R21	13.4	14.3	14.4	35.9	<0.1	0.2	Negligible
R22	19.1	21.5	21.7	54.2	0.2	0.4	Negligible
R23	13.1	13.5	13.5	33.7	<0.1	<0.5	Negligible
R24	9.5	9.6	9.6	24.0	<0.1	<0.5	Negligible
Proposed Receptors							
PR1		-	13.1	32.7	-	-	-

PR2		-	13.4	33.4	-	-	-
PR3		-	13.9	34.7	-	-	-
PR4		-	14.6	36.6	-	-	-
PR5		-	14.3	35.7	-	-	-
PR6		-	13.5	33.7	-	-	-
PR7		-	13.7	34.2	-	-	-
PR8		-	14.2	35.6	-	-	-
PR9		-	13.5	33.6	-	-	-
PR10			13.2	33.1			
PR11			12.0	29.9			

Table H2 - Annual Mean PM_{10} Concentrations ($\mu g/m^3$)

Receptor	2017 Base ($\mu g/m^3$)	2025 Without ($\mu g/m^3$)	2025 With Dev ($\mu g/m^3$)	% of AQAL	Change ($\mu g/m^3$)	% Change of AQO	Impact (EPUK / IAQM)
Existing Sensitive Receptors							
R1	15.8	16.7	16.7	41.7	<0.1	<0.5	Negligible
R2	14.2	14.5	14.5	36.3	<0.1	<0.5	Negligible
R3	14.1	14.3	14.3	35.9	<0.1	<0.5	Negligible
R4	14.6	15.4	15.4	38.5	<0.1	<0.5	Negligible
R5	14.3	14.7	14.7	36.8	<0.1	<0.5	Negligible
R6	16.3	16.7	16.7	41.7	<0.1	<0.5	Negligible
R7	14.7	15.1	15.1	37.8	<0.1	<0.5	Negligible
R8	16.1	17.1	17.1	42.9	<0.1	<0.5	Negligible
R9	14.6	15.0	15.1	37.7	<0.1	<0.5	Negligible
R10	15.0	15.5	15.6	39.0	<0.1	<0.5	Negligible
R11	14.7	15.0	15.0	37.5	<0.1	<0.5	Negligible
R12	15.0	15.4	15.4	38.5	<0.1	<0.5	Negligible
R13	15.4	15.9	16.0	39.9	<0.1	<0.5	Negligible
R14	14.9	15.0	15.0	37.4	<0.1	<0.5	Negligible
R15	15.4	15.5	15.5	38.8	<0.1	<0.5	Negligible
R16	15.0	15.2	15.2	37.9	<0.1	<0.5	Negligible
R17	15.6	16.6	16.7	41.7	<0.1	<0.5	Negligible
R18	18.1	18.7	18.8	47.0	<0.1	<0.5	Negligible
R19	12.8	12.8	12.8	32.1	<0.1	<0.5	Negligible
R20	15.3	15.8	15.9	39.7	<0.1	<0.5	Negligible
R21	14.4	14.5	14.5	36.3	<0.1	<0.5	Negligible
R22	15.3	15.6	15.7	39.2	<0.1	<0.5	Negligible
R23	14.5	14.6	14.6	36.5	<0.1	<0.5	Negligible
R24	14.1	14.1	14.1	35.2	<0.1	<0.5	Negligible
Proposed Receptors							
PR1		-	14.3	14.3	-	-	-

PR2		-	14.3	14.3	-	-	-
PR3		-	14.3	14.4	-	-	-
PR4		-	14.3	14.5	-	-	-
PR5		-	14.3	14.4	-	-	-
PR6		-	14.3	14.4	-	-	-
PR7		-	14.3	14.4	-	-	-
PR8		-	14.6	14.6	-	-	-
PR9		-	14.4	14.5	-	-	-
PR10			14.4	14.5			
PR11			14.3	14.3			

Table H3 - Daily PM_{10} (no. of days of exceedance)

Receptor	2025 Without (Days)	2025 With Dev (Days)	Change
Existing Sensitive Receptors			
R1	1	1	<1
R2	0	0	<1
R3	0	0	<1
R4	0	0	<1
R5	0	0	<1
R6	1	1	<1
R7	0	0	<1
R8	1	1	<1
R9	0	0	<1
R10	0	0	<1
R11	0	0	<1
R12	0	0	<1
R13	0	0	<1
R14	0	0	<1
R15	0	0	<1
R16	0	0	<1
R17	1	1	<1
R18	2	2	<1
R19	0	0	<1
R20	0	0	<1
R21	0	0	<1
R22	0	0	<1
R23	0	0	<1
R24	0	0	<1
Proposed Receptors			
PR1	-	0	-

PR2	-	0	-
PR3	-	0	-
PR4	-	0	-
PR5	-	0	-
PR6	-	0	-
PR7	-	0	-
PR8	-	0	-
PR9	-	0	-
PR10		0	
PR11		0	

Table H4 - Annual Mean $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Receptor	2017 Base ($\mu g/m^3$)	2025 Without ($\mu g/m^3$)	2025 With Dev ($\mu g/m^3$)	% of AQAL	Change ($\mu g/m^3$)	% Change of AQO	Impact (EPUK / IAQM)
Existing Sensitive Receptors							
R1	10.4	10.9	10.9	43.6	<0.1	<0.5	Negligible
R2	9.5	9.6	9.6	38.4	<0.1	<0.5	Negligible
R3	9.4	9.5	9.5	38.1	<0.1	<0.5	Negligible
R4	9.7	10.2	10.2	40.6	<0.1	<0.5	Negligible
R5	9.5	9.8	9.8	39.1	<0.1	<0.5	Negligible
R6	11.4	11.7	11.7	46.7	<0.1	<0.5	Negligible
R7	9.8	10.1	10.1	40.3	<0.1	<0.5	Negligible
R8	10.7	11.3	11.3	45.3	<0.1	<0.5	Negligible
R9	9.8	10.0	10.1	40.3	<0.1	<0.5	Negligible
R10	10.0	10.3	10.4	41.5	<0.1	<0.5	Negligible
R11	9.8	10.0	10.0	40.0	<0.1	<0.5	Negligible
R12	10.1	10.3	10.3	41.2	<0.1	<0.5	Negligible
R13	10.3	10.6	10.6	42.6	<0.1	<0.5	Negligible
R14	10.0	10.0	10.0	40.2	<0.1	<0.5	Negligible
R15	9.7	9.7	9.7	38.9	<0.1	<0.5	Negligible
R16	10.0	10.1	10.1	40.3	<0.1	<0.5	Negligible
R17	10.4	10.9	11.0	43.9	<0.1	<0.5	Negligible
R18	11.6	12.0	12.1	48.3	<0.1	<0.5	Negligible
R19	8.7	8.7	8.7	34.9	<0.1	<0.5	Negligible
R20	10.2	10.5	10.6	42.3	<0.1	<0.5	Negligible
R21	9.6	9.7	9.7	38.9	<0.1	<0.5	Negligible
R22	10.2	10.4	10.5	41.8	<0.1	<0.5	Negligible
R23	9.7	9.7	9.7	39.0	<0.1	<0.5	Negligible
R24	9.3	9.3	9.3	37.4	<0.1	<0.5	Negligible
Proposed Receptors							
PR1		-	9.6	38.5	-	-	-

PR2		-	9.6	38.5	-	-	-
PR3		-	9.7	38.7	-	-	-
PR4		-	9.7	38.9	-	-	-
PR5		-	9.7	38.8	-	-	-
PR6		-	9.7	38.6	-	-	-
PR7		-	9.7	38.7	-	-	-
PR8		-	9.8	39.1	-	-	-
PR9		-	9.7	38.9	-	-	-
PR10			9.7	38.8			
PR11			9.6	38.3			

Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

wsp.com