Air Quality Assessment:
Long Lawford Phase 4, Rugby

January 2018

Experts in air quality management & assessment
Document Control

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Executive Summary

The air quality impacts associated with the proposed mixed-use development of land adjacent to the A428 have been assessed. The proposal is known as Phase 4 of the Long Lawford development, and will consist of residential uses.

The A428 is a busy road leading into Rugby town centre, and the assessment has demonstrated that future residents of Long Lawford Phase 4 will experience acceptable air quality, with pollutant concentrations below the air quality objectives.

The development will generate additional traffic on the local road network, but the assessment has shown that there will be no significant effects at any existing, sensitive receptor.

Overall, the air quality effects of Long Lawford Phase 4 are judged to be ‘not significant’.
Contents
1 Introduction .............................................................................................................. 4
2 Policy Context and Assessment Criteria ................................................................. 5
3 Assessment Approach ............................................................................................ 12
4 Site Description and Baseline Conditions ............................................................... 18
5 Impact Assessment ................................................................................................ 26
6 Mitigation .................................................................................................................. 32
7 Conclusions .............................................................................................................. 33
8 References ............................................................................................................... 35
9 Glossary .................................................................................................................... 37
10 Appendices .............................................................................................................. 39
A1 EPUK & IAQM Planning for Air Quality Guidance .............................................. 40
A2 Professional Experience ....................................................................................... 47
A3 Modelling Methodology ...................................................................................... 49

Tables
Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and PM_{2.5} ....................... 10
Table 2: Summary of Nitrogen Dioxide (NO_{2}) Monitoring (2012-2016) \textsuperscript{a} ............ 20
Table 3: Summary of PM_{10} and PM_{2.5} Automatic Monitoring (2015-2016) ................. 22
Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2016 and 2021 (µg/m\textsuperscript{3}) ........................................................................................................... 23
Table 5: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m\textsuperscript{3}) 24
Table 6: Modelled Annual Mean Baseline Concentrations of PM_{10} and PM_{2.5} (µg/m\textsuperscript{3}) 24
Table 7: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2021 (µg/m\textsuperscript{3}) ........................................................................................................... 27
Table 8: Predicted Impacts on Annual Mean PM_{10} and PM_{2.5} Concentrations in 2021 (µg/m\textsuperscript{3}) ........................................................................................................... 28
Table 9: Predicted Concentrations of Nitrogen Dioxide (NO_{2}), PM_{10} and PM_{2.5} in 2021 for New Receptors in the Development Site ................................................................. 30

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants \textsuperscript{a} 45
Table A3.1: Summary of Traffic Data used in the Assessment (AADT Flows) .............. 50
Table A3.2: Background Concentrations used in the Verification for 2016 ................. 52
Table A3.3: 2016 AADT Traffic Data used in the Model Verification ......................... 53
Figures

Figure 1: Existing Receptor Locations ................................................................. 13
Figure 2: Development Receptor Locations ...................................................... 14
Figure 3: Declared AQMAs ............................................................................. 19
Figure 4: Monitoring Locations ....................................................................... 21

Figure A3.1: Modelled Road Network & Speed .................................................. 51
Figure A3.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25% ........................................ 54
Figure A3.3: Comparison of Measured Total NO₂ to Final Adjusted Modelled Total NO₂ Concentrations. The dashed lines show ± 25% ........................................ 54
1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed residential development at Long Lawford, west of Rugby. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Bloor Homes.

1.2 The proposed development will consist of up to 153 dwellings, including both houses and apartments. It lies within an Air Quality Management Area (AQMA) declared by Rugby Borough Council (RBC) for exceedances of the annual mean nitrogen dioxide objective. The development will lead to an increase in traffic on the local roads, which may impact on air quality at existing residential properties. The new residential properties will also be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter ($PM_{10}$ and $PM_{2.5}$).

1.3 This report describes existing local air quality conditions (base year 2016), and the predicted air quality in the future assuming that the proposed development does, or does not proceed. The assessment of traffic-related impacts focuses on 2021, which is the anticipated year of opening.

1.4 This report has been prepared taking into account all relevant local and national guidance and regulations.
2 Policy Context and Assessment Criteria

Air Quality Strategy

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

Planning Policy

National Policies

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

2.3 More specifically the NPPF makes clear that:

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

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2018), which includes guiding principles on how planning can take account of the impacts of new development on air
quality. The PPG states that “Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values” and “It is important that the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit”. The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans “identify measures that will be introduced in pursuit of the objectives”.

2.5 The PPG states that:

“Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation”.

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

**Local Transport Plan**

2.7 The third Warwickshire Local Transport Plan (LTP3) (Warwickshire County Council, 2011) covers Rugby and includes six policies referring to air quality:

- Policy AQA1: The contribution of air quality improvements to the national targets on greenhouse gases;
- Policy AQA2: Improving poor air quality through partnership working;
- Policy AQA3: Maintaining areas of good air quality;
- Policy AQA4: Education and information;
- Policy AQA5: Integration of air quality and transport planning; and
- Policy AQA6: Strategy review.

2.8 Policy AQA5 is of particular relevance, and states that:

“Through the planning process, the County Council and the five Warwickshire District/Borough Councils will take into account known and emerging air quality issues to ensure that new development:”
• Does not exacerbate an existing air quality problem, or trigger the declaration of a new Air
Quality Management Area;

• Is well served by public transport, walking and cycling facilities; and

• Is supported by measures such as Travel Plans to ensure that sustainable travel patterns
are maintained."

Local Policies

2.9 Rugby Borough Council issued a draft version (Rugby Borough Council, 2016) of its new Local
Plan for consultation in September of 2016. The draft Local Plan includes Policy HS5 on Traffic
Generation and Air Quality, which states that:

“Any development that results in significant negative impacts on health and wellbeing of people in
the area as a result of pollution, noise or vibration caused by traffic generation will not be permitted
unless effective mitigation can be achieved.

Any development that results in significant negative impacts on air quality within identified Air
Quality Management Areas or on the health and wellbeing of people in the area as a result of
pollution should be supported by an air quality assessment and, where necessary, a mitigation
plan to demonstrate practical and effective measures to be taken to avoid the adverse impacts.

All measures required in the Policy should take full account of the cumulative impact of all
development proposed in this Local Plan (and any other known developments) on traffic
generation and air quality”.

2.10 Until the new Local Plan is adopted, Rugby Borough Council’s Core Strategy (Rugby Borough
Council, 2011), adopted in June 2011, remains the key relevant planning policy document. It
includes Policy CS11 on Transport and New Development, which states that:

“Where development proposals fall within the designated Air Quality Management Area, the
transport assessment should set out how detrimental impacts on air quality will be mitigated.”

2.11 In March 2012, the Council adopted a Supplementary Planning Document (SPD) on Planning
 Obligations (Rugby Borough Council, 2012), which includes a section on air quality. The SPD
states that:

“The Council seeks to ensure that new development does not result in a significant increase in the
production of air pollutants that will hinder the achievement of its objectives set out in its Air Quality
Strategy.”

2.12 It also states that:
“An air quality assessment will be required where the development is anticipated to give rise to significant changes in air quality”.

2.13 It goes on to recommend that mitigation measures may be required in order to offset any increases in local pollutant emissions, such as:

- “Improved access to public transport;
- The provision of on and off site facilities for cycling and walking;
- The management of car parking;
- Traffic management;
- Road infrastructure improvements;
- Green Travel Plans; and
- Monitoring of air pollution”.

Air Quality Action Plans

National Air Quality Plan

2.14 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017b). Alongside a package of national measures, the Plan requires those Local Authorities that are predicted to have exceedances of the limit values beyond 2020 to produce local action plans by March 2018. These plans must have measures to achieve the statutory limit values within the shortest possible time. There is currently no practical way to take account of the effects of the national Plan in the modelling undertaken for this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the Air Quality Plan.

Local Air Quality Action Plan

2.15 Rugby Borough Council declared an AQMA for nitrogen dioxide that covers the entire Rugby urban area in 2004. In 2010 the Council published its current Air Quality Action Plan (Rugby Borough Council, 2010). This sets out a range of proposed actions by which the Council aims to improve air quality in Rugby, most of which focus on transport emissions.

Assessment Criteria

2.16 The Government has established a set of air quality standards and objectives to protect human health. The ‘standards’ are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small.
They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The ‘objectives’ set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002).

2.17 The objectives for nitrogen dioxide and PM$_{10}$ were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The PM$_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded at roadside locations where the annual mean concentration is below 60 µg/m$^3$ (Defra, 2016). Measurements have also shown that the 24-hour PM$_{10}$ objective could be exceeded at roadside locations where the annual mean concentration is above 32 µg/m$^3$ (Defra, 2016). The predicted annual mean PM$_{10}$ concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM$_{10}$ objective. Where predicted annual mean concentrations are below 32 µg/m$^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.18 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2016). The annual mean objectives for nitrogen dioxide and PM$_{10}$ are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM$_{10}$ is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

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

2.20 The relevant air quality criteria for this assessment are provided in Table 1.
### Table 1: Air Quality Criteria for Nitrogen Dioxide, PM$_{10}$ and PM$_{2.5}$

<table>
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<tr>
<th>Pollutant</th>
<th>Time Period</th>
<th>Objective</th>
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<tbody>
<tr>
<td>Nitrogen Dioxide</td>
<td>1-hour Mean</td>
<td>200 µg/m$^3$ not to be exceeded more than 18 times a year</td>
</tr>
<tr>
<td></td>
<td>Annual Mean</td>
<td>40 µg/m$^3$</td>
</tr>
<tr>
<td>Fine Particles (PM$_{10}$)</td>
<td>24-hour Mean</td>
<td>50 µg/m$^3$ not to be exceeded more than 35 times a year</td>
</tr>
<tr>
<td></td>
<td>Annual Mean</td>
<td>40 µg/m$^3$                                  a</td>
</tr>
<tr>
<td>Fine Particles (PM$_{2.5}$)</td>
<td>Annual Mean</td>
<td>25 µg/m$^3$                                  b</td>
</tr>
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</table>

a A proxy value of 32 µg/m$^3$ as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM$_{10}$ objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM$_{10}$ objective are possible (Defra, 2016).

b The PM$_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

### Screening Criteria for Road Traffic Assessments

2.21 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) recommend a two-stage screening approach (Moorcroft and Barrowcliffe et al, 2017) to determine whether emissions from road traffic generated by a development have the potential for significant air quality impacts. The approach, as described in Appendix A1, first considers the size and parking provision of a development; if the development is residential and is for fewer than ten homes or covers less than 0.5 ha, or is non-residential and will provide less than 1,000 m$^2$ of floor space or cover a site area of less than 1 ha, and will provide ten or fewer parking spaces, then there is no need to progress to a detailed assessment. The second stage then compares the changes in vehicle flows on local roads that a development will lead to against specified screening criteria. Where these criteria are exceeded, a detailed assessment is required, although the guidance advises that “the criteria provided are precautionary and should be treated as indicative”, and “it may be appropriate to amend them on the basis of professional judgement”.

### Descriptors for Air Quality Impacts and Assessment of Significance

2.22 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by EPUK and the IAQM (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air

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1 The IAQM is the professional body for air quality practitioners in the UK.
quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A1. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A2.
3 Assessment Approach

Existing Conditions

3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra’s Pollutant Release and Transfer Register (Defra, 2018c). Local sources have also been identified through examination of the Council’s Air Quality Review and Assessment reports.

3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. Background concentrations have been defined using the national pollution maps published by Defra (2018a). These cover the whole country on a 1x1 km grid.

3.3 Exceedances of the annual mean EU limit value for nitrogen dioxide in the study area have been identified using the maps of roadside concentrations published by Defra (2017a) as part of its 2017 Air Quality Plan for the baseline year 2015 and for the future years 2017 to 2030. These maps are used by the UK Government, together with the results from national Automatic Urban and Rural Network (AURN) monitoring sites that operate to EU data quality standards, to report exceedances of the limit value to the EU. The national maps of roadside PM$_{10}$ and PM$_{2.5}$ concentrations (Defra, 2018b), which are available for the years 2009 to 2015, show no exceedances of the limit values anywhere in the UK in 2015.

Road Traffic Impacts

Screening

3.4 The first step in considering the road traffic impacts of the proposed development has been to screen the development and its traffic generation against the criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017), as described in Paragraph 2.21 and detailed further in Appendix A1. Where impacts can be screened out there is no need to progress to a more detailed assessment. The following sections describe the approach to dispersion modelling of road traffic emissions, which has been required for this project.

Sensitive Locations

3.5 Concentrations of nitrogen dioxide, PM$_{10}$ and PM$_{2.5}$ have been predicted at a number of locations both within, and close to, the proposed development. Receptors have been identified to represent a range of exposure within the development, including the worst-case locations (these being at the façades of the residential properties closest to the sources). When selecting receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become...
congested and where there is a combined effect of several road links, and close to those roads where the traffic increases as a result of the proposed development will be greatest.

3.6 Nine existing residential properties have been identified as receptors for the assessment, shown in Figure 1. Receptors have also been identified at 14 locations within the new development (Figure 2) which represent exposure to existing sources. In addition, concentrations have been modelled at diffusion tube monitoring sites S15, S20 and S26 in order to verify the model outputs (see Appendix A3 for verification method).

Figure 1: Existing Receptor Locations
Assessment Scenarios

3.7 Nitrogen dioxide, PM$_{10}$ and PM$_{2.5}$ concentrations have been predicted for a base year (2016) and the proposed year of opening (2021). For 2021, predictions have been made assuming both that the development does proceed (With Scheme), and does not proceed (Without Scheme). In addition to the set of ‘official’ predictions, a sensitivity test has been carried out for nitrogen dioxide that involves assuming higher nitrogen oxides emissions from some diesel vehicles than have been predicted by Defra, using AQC’s Calculator Using Realistic Emissions for Diesels (CURED v3A) tool (AQC, 2017b).

Modelling Methodology

3.8 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in Appendix A3, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.
Traffic Data

3.9 Traffic data for the assessment have been provided by Travis Baker, who have undertaken the Transport Assessment for the proposed development. Additionally, traffic data for Newbold Road and Lawford Road (A428) east of Parkfield Road (A4071) have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2018). Further details of the traffic data used in this assessment are provided in Appendix A3.

Uncertainty in Road Traffic Modelling Predictions

3.10 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

3.11 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2016) concentrations.

3.12 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

3.13 European type approval (‘Euro’) standards for vehicle emissions apply to all new vehicles manufactured for sale in Europe. These standards have, over many years, become progressively more stringent and this is one of the factors that has driven reductions in both predicted and measured pollutant concentrations over time.

3.14 Historically, the emissions tests used for type approval were carried out within laboratories and were quite simplistic. They were thus insufficiently representative of emissions when driving in the real world. For a time, this resulted in a discrepancy, whereby nitrogen oxides emissions from new diesel vehicles reduced over time when measured within the laboratory, but did not fall in the real world. This, in turn, led to a discrepancy between models (which predicted improvements in nitrogen dioxide concentrations over time) and measurements (which very often showed no improvements year-on-year).

3.15 Recognition of these discrepancies has led to changes to the type approval process. Vehicles are now tested using a more complex laboratory drive cycle and also through ‘Real Driving Emissions’ (RDE) testing, which involves driving on real roads while measuring exhaust emissions. For Heavy Duty Vehicles (HDVs), the new testing regime has worked very well and NOx emissions...
from the latest vehicles (Euro VI\textsuperscript{2}) are now very low when compared with those from older models (ICCT, 2017).

3.16 For Light Duty Vehicles (LDVs), while the latest (Euro 6) emission standard has been in place since 2015, the new type-approval testing regime only came into force in 2017. Despite this delay, earlier work by AQC (2016) showed that Euro 6 diesel cars manufactured prior to 2017 tend to emit significantly less NOx than previous (Euro 5 and earlier) models. Given the changes to the testing regime, it is reasonable to expect that diesel cars and vans registered for type approval since 2017 will, on average, generate even lower NOx emissions.

3.17 As well as reviewing information on the emissions from modern diesel vehicles in the real world (AQC, 2016), AQC has also reviewed the assumptions contained within Defra’s latest Emission Factor Toolkit (EFT) (v8.0.1) (AQC, 2018a). One point of note is that the EFT makes a range of assumptions, which appear to be very conservative, regarding the continued use of diesel cars into the future and the relatively slow uptake of non-conventional (e.g. electric) vehicles (AQC, 2018a). Thus, despite previous versions of Defra’s EFT being over-optimistic regarding future-year predictions, it is not unreasonable to consider that EFT v8.0.1 might under-state the scale of reductions over coming years (i.e. over-predict future-year traffic emissions).

3.18 Overall, it is considered that, for assessment years prior to 2020, the EFT provides a robust method of calculating emissions. While there is still some uncertainty regarding any predictions of what will occur in the future, there are no obvious reasons to expect predictions made using the EFT to under-predict concentrations in the future up to and including 2019.

3.19 For assessment years beyond 2020, EFT v8.0.1 makes additional assumptions regarding the expected performance of diesel cars and vans registered for type approval beyond this date, reflecting further planned changes to the type approval testing. While there is currently no reason to disbelieve these assumptions, it is sensible to consider the possibility that this future-year technology might be less effective than has been assumed. A sensitivity test has thus been carried out using AQC’s CURED v3A model (AQC, 2017b), which assumes that this, post-2020, technology does not deliver any benefits. Further details of CURED v3A are provided in a supporting report prepared by AQC (2018a). CURED v3A is considered to provide a worst-case assessment.

**Railway Impacts**

3.20 Diesel or coal fired stationary locomotives can give rise to elevated levels of sulphur dioxide close to the point of emission. In addition, large numbers of moving diesel locomotives can give rise to high levels of nitrogen dioxide close to the track (Defra, 2009).

\textsuperscript{2} Euro VI refers to HDVs while Euro 6 refers to LDVs.
3.21 Defra guidance (Defra, 2009) outlines an approach to assess the potential for exceedence of the nitrogen dioxide and sulphur dioxide objectives as a result of emissions from diesel and steam locomotives. Outdoor areas within 15 m of railway lines where trains may be stationary for 15 minutes or more may experience elevated sulphur dioxide concentrations. Residential properties within 30 m of railway lines where there are large numbers of diesel locomotive movements (identified in the Defra guidance), and where backgrounds nitrogen dioxide concentrations are greater than 25 µg/m³, may be at risk of elevated nitrogen dioxide concentrations. Only locations which meet these criteria require further assessment.
4 Site Description and Baseline Conditions

4.1 The proposed development site is located approximately 3 km to the west of Rugby town centre, to the north of Coventry Road, Long Lawford. The site currently consists of agricultural land with new residential estates on land to the north and east.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2018a) has not identified any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality. The Rugby Cement Plant, located on Lawford Road is approximately 1 km from the proposed development. Emissions of particulate matter from the cement works have been included in this study through consideration of Defra's Background Maps (Defra, 2018a), however it is unlikely that particulate matter emissions from the works will have a significant impact on future occupants of the proposed development. An existing residential estate occupies land between the works and the proposed development.

Air Quality Management Areas

4.3 Rugby Borough Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. In 2004 an Air Quality Management Area (AQMA) was declared covering the Rugby urban area for exceedances of the nitrogen dioxide objective. The AQMA covers the whole Rugby area including rural and suburban spaces where exceedances of the objectives are less likely. The proposed development site is within this area. The declared AQMA is shown in Figure 3.

4.4 In terms of PM$_{10}$, the Council concluded that there are no exceedences of the objectives. It is therefore highly unlikely that current PM$_{10}$ levels will exceed the objectives within the study area.
Local Air Quality Monitoring

4.5 Rugby Borough Council operates one automatic monitoring station within its area which measures for particulate matter, and no automatic monitors which measure for nitrogen dioxide. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Environmental Services Group (ESG) Didcot (using the 50% TEA in acetone method). These include one deployed on School Street, one on Parkfield Road, one at Avon Valley School, one on West Field Road, two on Lawford Road, one on Avenue Road, and one on Newbold Road. Results for the years 2012 to 2016 are summarised in Table 2 and the monitoring locations are shown in Figure 4.
Table 2: Summary of Nitrogen Dioxide (NO₂) Monitoring (2012-2016) a

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Site Type</th>
<th>Location</th>
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<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
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<tr>
<td>S3</td>
<td>Urban Background</td>
<td>69 School Street</td>
<td>16</td>
<td>18.3</td>
<td>15.5</td>
<td>15.6</td>
<td>15.5</td>
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<td>S6</td>
<td>Urban Background</td>
<td>2 West Field Road</td>
<td>17.2</td>
<td>17.9</td>
<td>15.7</td>
<td>17.3</td>
<td>16.3</td>
</tr>
<tr>
<td>S15</td>
<td>Kerbside</td>
<td>Lawford Road / Jubilee Street</td>
<td>28.2</td>
<td>28.9</td>
<td>28.9</td>
<td>30.9</td>
<td>28.3</td>
</tr>
<tr>
<td>S20</td>
<td>Roadside</td>
<td>Newbold Road</td>
<td>30.8</td>
<td>31.6</td>
<td>32.6</td>
<td>30.9</td>
<td>32.4</td>
</tr>
<tr>
<td>S26</td>
<td>Near-road</td>
<td>Lawford Road (former Simms Scrap Yard)</td>
<td>20.7</td>
<td>21.8</td>
<td>21</td>
<td>20.3</td>
<td>22.4</td>
</tr>
<tr>
<td>S27</td>
<td>Roadside</td>
<td>Avenue Road /Campbell Street</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27.5</td>
</tr>
<tr>
<td>S28</td>
<td>Roadside</td>
<td>256 Parkfield Road</td>
<td>19.5</td>
<td>20.3</td>
<td>19.7</td>
<td>20.9</td>
<td>19.7</td>
</tr>
<tr>
<td>S29</td>
<td>Urban Background</td>
<td>Avon Valley School</td>
<td>22.6</td>
<td>23.5</td>
<td>23</td>
<td>24.9</td>
<td>21.7</td>
</tr>
</tbody>
</table>

Objective 40

a Data have been taken from the 2017 Air Quality Annual Status Report (Rugby Borough Council, 2017).

4.6 The monitoring data for the past five years have been consistently below the annual mean nitrogen dioxide objective at all monitoring locations proximal to the proposed development site. Due to the location of site S26 on the same road as the proposed development site and away from any major junctions, monitored concentrations at S26 are considered most representative of conditions at the proposed development site.

4.7 There are no clear trends in monitoring results for the past five years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards (the implications of this are discussed in Section 3 of this report).
4.8 The OSR1 roadside automatic monitoring station, located on Parkfield Road 1.6 km north east of the proposed development site, is the closest station which measured PM$_{10}$ concentrations in 2016. PM$_{2.5}$ concentrations are also measured at the OSR1 monitor. Results for 2015 and 2016 are presented in Table 3. Measured concentrations are well below relevant objectives.
Table 3: Summary of PM$_{10}$ and PM$_{2.5}$ Automatic Monitoring (2015-2016)

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Site Type</th>
<th>Location</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PM$_{10}$ Annual Mean ($\mu$g/m$^3$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSR1</td>
<td>Roadside</td>
<td>Parkfield Road</td>
<td>12.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
<td></td>
<td></td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PM$_{10}$ No. Days &gt;50 $\mu$g/m$^3$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSR1</td>
<td>Roadside</td>
<td>Parkfield Road</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
<td></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PM$_{2.5}$ Annual Mean ($\mu$g/m$^3$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSR1</td>
<td>Roadside</td>
<td>Parkfield Road</td>
<td>6.6</td>
<td>5.9</td>
</tr>
<tr>
<td>Objective</td>
<td></td>
<td></td>
<td></td>
<td>25$,^a$</td>
</tr>
</tbody>
</table>

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

Exceedances of EU Limit Value

There are no AURN monitoring sites within 1 km of the development site with which to identify exceedances of the annual mean nitrogen dioxide limit value. Defra's roadside annual mean nitrogen dioxide concentrations (Defra, 2017a), which are used to report exceedances of the limit value to the EU, and which have been updated to support the 2017 Air Quality Plan, do not identify any exceedances within 1 km of the development site in 2015. Defra’s predicted concentrations for 2021, presented for three scenarios (‘baseline’, ‘with Clean Air Zones’ and ‘with Clean Air Zones and additional actions’ – the latter two taking account of the measures contained in its 2017 Air Quality Plan (Defra, 2017b)), also do not identify any exceedances within 1 km of the development site in any scenario. As such, there is considered to be no risk of a limit value exceedance in the vicinity of the proposed development by the time that it is operational.

Background Concentrations

Estimated background concentrations in the study area have been determined for 2016 and the opening year 2021 using Defra’s background maps (Defra, 2018a). The background concentrations are set out in Table 4 and have been derived as described in Appendix A3. The background concentrations are all well below the objectives.
Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2016 and 2021 (µg/m³)

<table>
<thead>
<tr>
<th>Year</th>
<th>NO₂</th>
<th>PM₁₀</th>
<th>PM₂.₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>12.8</td>
<td>13.4</td>
<td>9.1</td>
</tr>
<tr>
<td>2021 a</td>
<td>10.5</td>
<td>12.9</td>
<td>8.6</td>
</tr>
<tr>
<td><strong>2021 Sensitivity Test b</strong></td>
<td>10.7</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td>40</td>
<td>40</td>
<td>25 c</td>
</tr>
</tbody>
</table>

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

a In line with Defra’s forecasts.
b Assuming higher emissions from modern diesel vehicles as described in Appendix A3.
c The PM₂.₅ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Baseline Dispersion Model Results

4.11 Baseline concentrations of nitrogen dioxide, PM₁₀ and PM₂.₅ have been modelled at each of the existing receptor locations (see Figure 1 for receptor locations). The results, which cover both the existing (2016) and future year (2021) baseline (Without Scheme), are set out in Table 5 and Table 6. The predictions for nitrogen dioxide include a sensitivity test which accounts for the potential under-performance of emissions control technology on modern diesel vehicles. In addition, the modelled road components of nitrogen oxides, PM₁₀ and PM₂.₅ have been increased from those predicted by the model based on a comparison with national measurements (see Appendix A3 for the verification methodology).
Table 5: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m³)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>2016</th>
<th>2021 Without Scheme</th>
<th>Sensitivity Test</th>
<th>2016</th>
<th>2021 Without Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>14.2</td>
<td>11.6</td>
<td>14.2</td>
<td>11.9</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>17.9</td>
<td>14.4</td>
<td>17.9</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>16.1</td>
<td>13.1</td>
<td>16.1</td>
<td>13.4</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>17.8</td>
<td>14.4</td>
<td>17.8</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>16.2</td>
<td>13.0</td>
<td>16.2</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>E6</td>
<td>15.1</td>
<td>12.3</td>
<td>15.1</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>E7</td>
<td>14.7</td>
<td>12.0</td>
<td>14.7</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>E8</td>
<td>23.9</td>
<td>19.1</td>
<td>23.9</td>
<td>19.8</td>
<td></td>
</tr>
<tr>
<td>E9</td>
<td>25.5</td>
<td>20.2</td>
<td>25.5</td>
<td>21.1</td>
<td></td>
</tr>
</tbody>
</table>

Objective 40

- **a** In line with Defra’s forecasts.
- **b** Assuming higher emissions from modern diesel vehicles as described in Paragraph A3.6 in Appendix A3.
- **c** The methodology for the sensitivity test uses different traffic emissions and required a separate verification (see Appendix A3), which leads to slightly different 2016 values.

Table 6: Modelled Annual Mean Baseline Concentrations of PM₁₀ and PM₂.₅ (µg/m³)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>PM₁₀</th>
<th>PM₂.₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>13.6</td>
<td>13.1</td>
</tr>
<tr>
<td>E2</td>
<td>14.1</td>
<td>13.5</td>
</tr>
<tr>
<td>E3</td>
<td>13.9</td>
<td>13.4</td>
</tr>
<tr>
<td>E4</td>
<td>16.2</td>
<td>15.9</td>
</tr>
<tr>
<td>E5</td>
<td>13.9</td>
<td>13.3</td>
</tr>
<tr>
<td>E6</td>
<td>13.8</td>
<td>13.2</td>
</tr>
<tr>
<td>E7</td>
<td>13.7</td>
<td>13.2</td>
</tr>
<tr>
<td>E8</td>
<td>15.2</td>
<td>14.7</td>
</tr>
<tr>
<td>E9</td>
<td>15.4</td>
<td>14.9</td>
</tr>
</tbody>
</table>

Objective / Criterion 32 **a**

- **a** While the annual mean PM₁₀ objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedance of the 24-hour mean PM₁₀ objective is possible, as outlined in LAQM.TG16 (Defra, 2016). A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM₁₀ objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

- **b** The PM₂.₅ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.
2016 Baseline

4.12 The predicted annual mean concentrations of nitrogen dioxide, PM$_{10}$ and PM$_{2.5}$ are below the corresponding annual mean objectives in 2016 at all receptors. The annual mean PM$_{10}$ concentrations are below 32 µg/m$^3$ and it is, therefore, unlikely that the 24-hour mean PM$_{10}$ objective will be exceeded.

4.13 These results indicate a good level of air quality in the study area despite the area being designated as an AQMA.

2021 Baseline

4.14 The predicted annual mean concentrations of nitrogen dioxide are well below the annual mean objective at all receptor locations. All of the predictions for PM$_{10}$ and PM$_{2.5}$ are well below the objectives. The annual mean PM$_{10}$ concentrations are below 32 µg/m$^3$ and it is, therefore, unlikely that the 24-hour mean PM$_{10}$ objective will be exceeded.

Worst-case Sensitivity Test for Nitrogen Dioxide

4.15 The results from the upper-bound sensitivity test are not materially different from those derived using the ‘official’ predictions.
5 Impact Assessment

Impacts at Existing Receptors

Initial Screening Assessment of Development-Generated Road Traffic Emissions

5.1 The trip generation of the proposed development on local roads (as provided by Travis Baker) has initially been compared to the screening criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017) (see Paragraphs A1.7 to A1.10 in Appendix A1). The proposed development will increase Annual Average Daily Traffic (AADT) flows by more than 100 vehicles along several nearby roads, including the A428, Back Lane and Bilton Lane. Dispersion modelling of road traffic emissions have therefore been undertaken.

Detailed Assessment of Development-Generated Road Traffic Emissions

5.2 Predicted annual mean concentrations of nitrogen dioxide, PM$_{10}$ and PM$_{2.5}$ in 2021 for existing receptors are set out in Table 7 and Table 8 for both the “Without Scheme” and “With Scheme” scenarios. These tables also describe the impacts at each receptor using the impact descriptors given in Appendix A1. For nitrogen dioxide, results are presented for two scenarios so as to include a sensitivity test.
Table 7: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2021 (µg/m³)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Without Scheme</th>
<th>With Scheme</th>
<th>% Change</th>
<th>Impact Descriptor</th>
<th>Without Scheme</th>
<th>With Scheme</th>
<th>% Change</th>
<th>Impact Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>11.6</td>
<td>11.7</td>
<td>0</td>
<td>Negligible</td>
<td>11.9</td>
<td>11.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E2</td>
<td>14.4</td>
<td>13.3</td>
<td>-3</td>
<td>Negligible</td>
<td>14.8</td>
<td>13.7</td>
<td>-3</td>
<td>Negligible</td>
</tr>
<tr>
<td>E3</td>
<td>13.1</td>
<td>13.2</td>
<td>0</td>
<td>Negligible</td>
<td>13.4</td>
<td>13.5</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E4</td>
<td>14.4</td>
<td>14.5</td>
<td>0</td>
<td>Negligible</td>
<td>14.8</td>
<td>14.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E5</td>
<td>13.0</td>
<td>13.2</td>
<td>0</td>
<td>Negligible</td>
<td>13.5</td>
<td>13.5</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E6</td>
<td>12.3</td>
<td>12.4</td>
<td>0</td>
<td>Negligible</td>
<td>12.7</td>
<td>12.8</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E7</td>
<td>12.0</td>
<td>12.1</td>
<td>0</td>
<td>Negligible</td>
<td>12.3</td>
<td>12.4</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E8</td>
<td>19.1</td>
<td>19.3</td>
<td>0</td>
<td>Negligible</td>
<td>19.8</td>
<td>20.0</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E9</td>
<td>20.2</td>
<td>20.5</td>
<td>1</td>
<td>Negligible</td>
<td>21.1</td>
<td>21.3</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>Objective</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

a  In line with Defra’s forecasts.
b % changes are relative to the objective and have been rounded to the nearest whole number.
c Assuming higher emissions from modern diesel vehicles as described in Paragraph A3.6 in Appendix A3.
Table 8: Predicted Impacts on Annual Mean PM$_{10}$ and PM$_{2.5}$ Concentrations in 2021 ($\mu$g/m$^3$)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Without Scheme</th>
<th>With Scheme</th>
<th>% Change $^a$</th>
<th>Impact Descriptor</th>
<th>Without Scheme</th>
<th>With Scheme</th>
<th>% Change $^a$</th>
<th>Impact Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>13.1</td>
<td>13.1</td>
<td>0</td>
<td>Negligible</td>
<td>8.7</td>
<td>8.7</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E2</td>
<td>13.5</td>
<td>13.4</td>
<td>0</td>
<td>Negligible</td>
<td>9.0</td>
<td>8.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E3</td>
<td>13.4</td>
<td>13.4</td>
<td>0</td>
<td>Negligible</td>
<td>8.9</td>
<td>8.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E4</td>
<td>15.9</td>
<td>15.9</td>
<td>0</td>
<td>Negligible</td>
<td>9.3</td>
<td>9.4</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E5</td>
<td>13.3</td>
<td>13.4</td>
<td>0</td>
<td>Negligible</td>
<td>8.9</td>
<td>8.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E6</td>
<td>13.2</td>
<td>13.3</td>
<td>0</td>
<td>Negligible</td>
<td>8.9</td>
<td>8.9</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E7</td>
<td>13.2</td>
<td>13.2</td>
<td>0</td>
<td>Negligible</td>
<td>8.8</td>
<td>8.8</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E8</td>
<td>14.7</td>
<td>14.7</td>
<td>0</td>
<td>Negligible</td>
<td>9.5</td>
<td>9.5</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>E9</td>
<td>14.9</td>
<td>14.9</td>
<td>0</td>
<td>Negligible</td>
<td>9.6</td>
<td>9.6</td>
<td>0</td>
<td>Negligible</td>
</tr>
<tr>
<td>Criterion</td>
<td>32 $^b$</td>
<td>-</td>
<td>-</td>
<td>25 $^c$</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ % changes are relative to the criterion and have been rounded to the nearest whole number.

While the annual mean PM$_{10}$ objective is 40 µg/m$^3$, 32 µg/m$^3$ is the annual mean concentration above which an exceedance of the 24-hour mean PM$_{10}$ objective is possible, as outlined in LAQM.TG16 (Defra, 2016). A value of 32 µg/m$^3$ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM$_{10}$ objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

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

Nitrogen Dioxide

The annual mean nitrogen dioxide concentrations are well below the objective at all receptors.

The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 0% at seven of the receptors, -3% at one receptor, and 1% at one receptor. Using the matrix in Table A1.1 (Appendix A1), these impacts are all described as negligible.

The reduction in concentrations at receptor E2 is due to road realignment which moves a large portion of existing traffic a few meters further away from this property.

The annual mean nitrogen dioxide concentrations are below 60 µg/m$^3$ at every receptor; it is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded (see Paragraph 2.17).
**Sensitivity Test**

5.8 The results from the sensitivity test are not materially different from those derived using the ‘official’ predictions.

**PM$_{10}$ and PM$_{2.5}$**

5.9 The annual mean PM$_{10}$ and PM$_{2.5}$ concentrations are well below the relevant criteria at all receptors, with or without the proposed development. Furthermore, as the annual mean PM$_{10}$ concentrations are below 32 µg/m$^3$, it is unlikely that the 24-hour mean PM$_{10}$ objective will be exceeded at any of the receptors.

5.10 The percentage changes in both PM$_{10}$ and PM$_{2.5}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be 0% at all of the receptors. Using the matrix in Table A1.1 (Appendix A1), these impacts are described as *negligible*.

**Impacts of Existing Sources on Future Residents of the Development**

**Initial Screening Assessment of Traffic Emissions**

5.11 The proposed development is located within an AQMA, adjacent to the busy A428, thus a detailed assessment of the air quality conditions at the site, using dispersion modelling, is required.

**Assessment of Railway Locomotive Emissions**

5.12 Defra guidance (Defra, 2016) outlines that there is only the potential for an exceedance of the annual mean nitrogen dioxide objective where there is long-term exposure within 30 m of railway lines, these lines see a high volume of diesel passenger trains and the annual mean background concentration of nitrogen dioxide is above 25 µg/m$^3$. At its closest, the development is within approximately 100 m of the nearest railway line and therefore falls outside these criteria. It can, therefore, be concluded that there is no risk of an objective exceedance within the proposed development as a result of emission from locomotives using the nearby railway line.

**Detailed Assessment of Air Quality at Receptors Within the Development**

5.13 Predicted air quality conditions for future residents of the proposed development, taking account of emissions from the adjacent road network, are set out in Table 9 (see Figure 1 for receptor locations). All of the values are below the objectives. Air quality for future residents within the development will thus be acceptable.
Table 9:  Predicted Concentrations of Nitrogen Dioxide (NO₂), PM₁₀ and PM₂.₅ in 2021 for New Receptors in the Development Site

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Annual Mean NO₂ (µg/m³)</th>
<th>Annual Mean PM₁₀ (µg/m³)</th>
<th>Annual Mean PM₂.₅ (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘Official’ Prediction a</td>
<td>Sensitivity Test b</td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>13.7</td>
<td>14.1</td>
<td>13.4</td>
</tr>
<tr>
<td>R2</td>
<td>14.3</td>
<td>14.7</td>
<td>13.5</td>
</tr>
<tr>
<td>R3</td>
<td>11.8</td>
<td>12.0</td>
<td>13.1</td>
</tr>
<tr>
<td>R4</td>
<td>11.5</td>
<td>11.7</td>
<td>13.1</td>
</tr>
<tr>
<td>R5</td>
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<td>13.6</td>
</tr>
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<td>R6</td>
<td>13.3</td>
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<td>R14</td>
<td>13.3</td>
<td>13.6</td>
<td>13.4</td>
</tr>
<tr>
<td>Objective / Criterion</td>
<td>40</td>
<td>32 c</td>
<td>25 d</td>
</tr>
</tbody>
</table>

a In line with Defra’s forecasts.
b Assuming higher emissions from modern diesel vehicles as described in Paragraph A3.6 in Appendix A3.
c While the annual mean PM₁₀ objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedance of the 24-hour mean PM₁₀ objective is possible, as outlined in LAQM.TG16 (Defra, 2016). A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM₁₀ objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).
d The PM₂.₅ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

**Significance of Operational Air Quality Effects**

5.14 The operational air quality effects without mitigation are judged to be ‘not significant’. This professional judgement is made in accordance with the methodology set out in Appendix A1, and also takes into account the results of the sensitivity test for nitrogen dioxide.

5.15 More specifically, the judgement that the air quality effects will be ‘not significant’ without mitigation takes account of the assessment that:

- pollutant concentrations at worst-case locations within the proposed development will all be well below the objectives, thus future residents will experience acceptable air quality;
• pollutant concentrations at all of the selected worst-case existing receptors along the local road network will be well below the air quality objectives, and all of the impacts are predicted to be *negligible*; and

• there is no risk of an exceedance of the objectives as a result of the emissions from locomotives using the nearby railway lines.
6 Mitigation

6.1 The EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. The proposed development incorporates good design and best practice measures by setting back of the development buildings from roads by at least 10 m.

6.2 The assessment has demonstrated that the proposed development will not cause any exceedances of the air quality objectives and that the overall effect of the proposed development will be 'not significant'. It is, therefore, not considered necessary to propose further mitigation measures for this development.

6.3 Measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation (which is written into UK law). The Council’s Air Quality Action Plan will also be helping to deliver improved air quality. In this regard, it is expected that developments which may have a significant impact on air quality or which will be in an area where existing air quality is poor, will make a financial contribution towards implementation of the Action Plan.
7 Conclusions

7.1 The operational impacts of increased traffic emissions arising from the additional traffic on local roads, due to the development, have been assessed. Concentrations have been modelled for nine worst-case receptors, representing existing properties where impacts are expected to be greatest. In addition, the impacts of traffic emissions from local roads on the air quality for future residents have been assessed at 14 worst-case locations within the new development itself. In the case of nitrogen dioxide, a sensitivity test has also been carried out which considers the potential under-performance of emissions control technology on modern diesel vehicles.

7.2 It is concluded that concentrations of PM$_{10}$ and PM$_{2.5}$ will remain below the objectives at all existing receptors in 2021, with or without the proposed development. This conclusion is consistent with the outcomes of the reviews and assessments prepared by Rugby Borough Council, which show that exceedances of the PM$_{10}$ objective are unlikely at any location.

7.3 In the case of annual mean nitrogen dioxide, concentrations remain below the objective at all existing receptors in 2021, with or without the proposed development, and taking account of the sensitivity test.

7.4 The additional traffic generated by the proposed development will affect air quality at existing properties along the local road network. The assessment has demonstrated that the changes in annual mean concentrations of PM$_{10}$ and PM$_{2.5}$ at relevant locations, relative to the objectives, will be 0% (when rounded) and the impacts will all be negligible. In the case of annual mean nitrogen dioxide, the percentage changes are predicted to range from -3% to 1%, and the impacts will all be negligible.

7.5 The effects of local traffic on the air quality for residents living in the proposed development have been shown to be acceptable at the worst-case locations assessed, with concentrations being well below the air quality objectives. The effects of emissions from locomotives on the adjacent/nearby rail line have been shown to be ‘not significant’.

7.6 The overall operational air quality effects of the development are judged to be ‘not significant’. This conclusion, which takes account of the uncertainties in future projections, in particular for nitrogen dioxide, is based on the concentrations at existing receptors being well below the objectives and impacts all being negligible, while concentrations for future residents of the development will be below the objectives.

7.7 The development will have no adverse effects on local air quality conditions, and does not introduce new exposure within an area of poor air quality, thus no additional mitigation has been proposed for the operational impacts.
7.8 The proposed development is consistent with the NPPF. Furthermore, the proposed development does not conflict with the requirements of Policy HS5 of the draft Local Plan or Policy CS11 of the Core Strategy, nor does it conflict with, or render unworkable, any elements of the Air Quality Action Plan.
8 References


Defra (2018c) UK Pollutant Release and Transfer Register, [Online], Available: prtr.defra.gov.uk.


## Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic</td>
</tr>
<tr>
<td>ADMS-Roads</td>
<td>Atmospheric Dispersion Modelling System model for Roads</td>
</tr>
<tr>
<td>AQC</td>
<td>Air Quality Consultants</td>
</tr>
<tr>
<td>AQAL</td>
<td>Air Quality Assessment Level</td>
</tr>
<tr>
<td>AQMA</td>
<td>Air Quality Management Area</td>
</tr>
<tr>
<td>AURN</td>
<td>Automatic Urban and Rural Network</td>
</tr>
<tr>
<td>CURED</td>
<td>Calculator Using Realistic Emissions for Diesels</td>
</tr>
<tr>
<td>DCLG</td>
<td>Department for Communities and Local Government</td>
</tr>
<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DfT</td>
<td>Department for Transport</td>
</tr>
<tr>
<td>EFT</td>
<td>Emission Factor Toolkit</td>
</tr>
<tr>
<td>EPUK</td>
<td>Environmental Protection UK</td>
</tr>
<tr>
<td>Exceedance</td>
<td>A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure</td>
</tr>
<tr>
<td>HDV</td>
<td>Heavy Duty Vehicles (&gt; 3.5 tonnes)</td>
</tr>
<tr>
<td>HMSO</td>
<td>Her Majesty’s Stationery Office</td>
</tr>
<tr>
<td>HGV</td>
<td>Heavy Goods Vehicle</td>
</tr>
<tr>
<td>IAQM</td>
<td>Institute of Air Quality Management</td>
</tr>
<tr>
<td>kph</td>
<td>Kilometres Per hour</td>
</tr>
<tr>
<td>LAQM</td>
<td>Local Air Quality Management</td>
</tr>
<tr>
<td>LDV</td>
<td>Light Duty Vehicles (&lt;3.5 tonnes)</td>
</tr>
<tr>
<td>LGV</td>
<td>Light Goods Vehicle</td>
</tr>
<tr>
<td>μg/m³</td>
<td>Microgrammes per cubic metre</td>
</tr>
<tr>
<td>NO</td>
<td>Nitric oxide</td>
</tr>
<tr>
<td>NO₂</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>NOₓ</td>
<td>Nitrogen oxides (taken to be NO₂ + NO)</td>
</tr>
<tr>
<td>NPPF</td>
<td>National Planning Policy Framework</td>
</tr>
</tbody>
</table>
Objectives

A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides.

PM$_{10}$
Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter.

PM$_{2.5}$
Small airborne particles less than 2.5 micrometres in aerodynamic diameter.

PPG
Planning Practice Guidance

SPG
Supplementary Planning Guidance

SPD
Supplementary Planning Document

Standards

A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal.

TEA
Triethanolamine – used to absorb nitrogen dioxide.

TEMPro
Trip End Model Presentation Program.
10 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance.................................................40
A2 Professional Experience.........................................................................................47
A3 Modelling Methodology .........................................................................................49
A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

**Air Quality as a Material Consideration**

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

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

**Recommended Best Practice**

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

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

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m² of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

- New developments should not contravene the Council’s Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new “street canyon”, as this inhibits pollution dispersion;

- Delivering sustainable development should be the key theme of any application;

- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;

- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 m² of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;

- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;

- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;

- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm³;
  - Compression ignition engine: 400 mgNOx/Nm³;
  - Gas turbine: 50 mgNOx/Nm³.

- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm³ and 25 mgPM/Nm³.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

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

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to
offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

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

**Screening**

**Impacts of the Local Area on the Development**

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

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

**Impacts of the Development on the Local Area**

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m² of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

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

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

• the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
• the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
• the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
• the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
• the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
• the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor; and

A1.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A1.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

“Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm³.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent
buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A1.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

“The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive ‘trigger’ for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality”.

A1.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

“The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer”.

A1.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A1.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

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

A1.16 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A1.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants

<table>
<thead>
<tr>
<th>Long-Term Average Concentration At Receptor In Assessment Year</th>
<th>Change in concentration relative to AQAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>75% or less of AQAL</td>
<td>Negligible</td>
</tr>
<tr>
<td>76-94% of AQAL</td>
<td>Negligible</td>
</tr>
<tr>
<td>95-102% of AQAL</td>
<td>Negligible</td>
</tr>
<tr>
<td>103-109% of AQAL</td>
<td>Negligible</td>
</tr>
<tr>
<td>110% or more of AQAL</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

a Values are rounded to the nearest whole number.
b This is the “Without Scheme” concentration where there is a decrease in pollutant concentration and the “With Scheme” concentration where there is an increase.
c AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency ‘Environmental Assessment Level (EAL)’.

Assessment of Significance

A1.17 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either ‘significant’ or ‘not significant’. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as ‘slight’ individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a ‘moderate’ or ‘substantial’
impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and

- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.18 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.19 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.
A2 Professional Experience

Chris Whall, BSc (Hons) MSc CEnv MIEnvSc MIAQM

Mr Whall is a Director of Air Quality Consultants. He has 18 years’ experience in environmental consulting with multi-sector EIA experience and technical expertise in air quality and emissions management, emissions quantification, ambient air quality monitoring and impact assessment. Mr Whall’s work has included the provision of air quality advice and the delivery of impact assessments for UK and international developments including airports, road, rail, power stations, energy from waste, mining and other major regeneration schemes. He has contributed to the air quality components of major Environmental Statements for airports including Heathrow, Gatwick and Stansted in the UK and has provided strategic air quality advice to the European Investment Bank in relation to international airport expansion. Mr Whall also provided overall technical direction to the air quality team delivering the Environmental Statements for the Hinkley Point C nuclear power station Development Consent Order (DCO), on behalf of EDF Energy. Recently Mr Whall led the air quality assessment to support the ending of the Cranford Agreement at Heathrow Airport to introduce full runway alternation during easterly operation; he appeared as an Expert Witness on behalf of Heathrow Airport Limited at the Public Inquiry in 2015. For several years Mr Whall has been working with Heathrow Airport Limited in the development of its masterplan for a third runway and he led Heathrow’s air quality submissions to the Airports Commission.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with twelve years’ experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Aidan Farrow, BSc (Hons) PhD

Dr Farrow is a Consultant with AQC, having joined the company in 2016. He previously worked for four years as a research scientist at the University of Hertfordshire’s Centre for Atmospheric and Instrumentation Research. There he was responsible for the National Centre for Atmospheric Science Air Quality Forecast, as well as working on research projects with a variety of Climate,
Weather and Air Quality models. He is now gaining experience in the field of air quality assessment.

Marko Ristic-Smith, BA (Hons) MSc DIC AMIEnvSc AMIAQM

Mr Ristic-Smith is an Assistant Consultant with AQC, having joined the company in September 2016. He is gaining experience of air quality assessments for a range of developments using air quality monitoring and modelling techniques. Prior to joining AQC he completed his MSc in Environmental Technology, with his thesis examining the air quality and health impacts of transport policy scenarios in London. He is an Associate Member of the Institute of Air Quality Management.

Full CVs are available at www.aqconsultants.co.uk.
A3 Modelling Methodology

Model Inputs

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 8.0) published by Defra (2018a).

A3.2 Hourly sequential meteorological data from Church Lawford for 2016 have been used in the model. The Church Lawford meteorological monitoring station is located approximately 2 km to the southwest of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the development site and the Church Lawford meteorological monitoring station are located in the West Midlands where they will be influenced by the effects of inland meteorology over generally flat-lying topography.

A3.3 AADT flows, diurnal flow profiles, speeds, and vehicle fleet composition data have been provided by Travis Baker, who have undertaken the transport assessment work for the proposed development. In addition, AADT flows, and the proportions of HDVs, for Lawford Road (A428) east of Parkfield Road (A4071) have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2018). The 2016 AADT flows have been factored forwards to the assessment year of 2021 using growth factors derived using the TEMPro System v7.2 (DfT, 2017b). Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A3.1. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2017a).

A3.4 The worst-case assumption has been made that all development-related traffic travelling east along Lawford Road (A428) will continue straight across the Parkfield Road (A4071) junction. This will over-predict the overall impact of the proposed development.
### Table A3.1: Summary of Traffic Data used in the Assessment (AADT Flows)

<table>
<thead>
<tr>
<th>Road Link</th>
<th>2016 AADT</th>
<th>%HDV</th>
<th>2021 (Without Scheme) AADT</th>
<th>%HDV</th>
<th>2021 (With Scheme) AADT</th>
<th>%HDV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back Lane south of Tee Tong Road</td>
<td>2,821</td>
<td>3.8</td>
<td>3,008</td>
<td>3.9</td>
<td>3,808</td>
<td>4.1</td>
</tr>
<tr>
<td>Coventry Road west of Back Lane</td>
<td>7,906</td>
<td>2.7</td>
<td>8,428</td>
<td>2.7</td>
<td>8,653</td>
<td>2.8</td>
</tr>
<tr>
<td>Bilton Lane</td>
<td>4,122</td>
<td>2.0</td>
<td>4,394</td>
<td>2.0</td>
<td>4,619</td>
<td>2.1</td>
</tr>
<tr>
<td>Lawford Road east of Back Lane</td>
<td>6,858</td>
<td>3.0</td>
<td>7,311</td>
<td>3.0</td>
<td>7,671</td>
<td>3.1</td>
</tr>
<tr>
<td>The Green</td>
<td>1,993</td>
<td>3.8</td>
<td>2,125</td>
<td>3.9</td>
<td>2,165</td>
<td>3.9</td>
</tr>
<tr>
<td>Coventry Road west of The Green</td>
<td>7,623</td>
<td>2.0</td>
<td>8,126</td>
<td>2.0</td>
<td>8,336</td>
<td>2.1</td>
</tr>
<tr>
<td>Lawford Heath Lane</td>
<td>1,485</td>
<td>3.9</td>
<td>1,583</td>
<td>4.0</td>
<td>1,638</td>
<td>4.0</td>
</tr>
<tr>
<td>Coventry Road east of The Green</td>
<td>7,960</td>
<td>2.5</td>
<td>8,486</td>
<td>2.5</td>
<td>8,711</td>
<td>2.6</td>
</tr>
<tr>
<td>Townsend Lane</td>
<td>2,961</td>
<td>3.5</td>
<td>3,156</td>
<td>3.5</td>
<td>3,156</td>
<td>3.5</td>
</tr>
<tr>
<td>Lawford Road west of Townsend Lane</td>
<td>6,858</td>
<td>2.8</td>
<td>7,311</td>
<td>2.8</td>
<td>7,671</td>
<td>2.9</td>
</tr>
<tr>
<td>Lawford Road east of Townsend Lane</td>
<td>8,577</td>
<td>2.9</td>
<td>9,143</td>
<td>2.9</td>
<td>9,503</td>
<td>3.0</td>
</tr>
<tr>
<td>Back Lane north of Tee Tong Road</td>
<td>1,624</td>
<td>2.2</td>
<td>1,732</td>
<td>2.2</td>
<td>1,777</td>
<td>2.3</td>
</tr>
</tbody>
</table>

A3.5 Figure A3.1 shows the road network included within the model, along with the speed at which each link was modelled, and defines the study area.
Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A3.6 As explained in Section 3, AQC has carried out a detailed analysis which showed that, whereas previous standards had had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the ‘Euro VI’ and ‘Euro 6’ standards are delivering real on-road improvements (AQC, 2016). Defra’s EFT v8.0.1 takes account of these observed improvements, but also makes additional assumptions regarding the performance of diesel cars and vans that will be produced in the future. In particular, it assumes that diesel cars and vans registered for type approval after 2020 will, on average, emit significantly less NOx than earlier models. A sensitivity test has been carried out using AQC’s CURED v3A model (AQC, 2017b), which assumes that this post-2020 technology does not deliver any benefits (as a worst-case assumption). Further details of CURED v3A are provided in the supporting report prepared by AQC (2018a).

Background Concentrations

A3.7 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (Defra, 2018a). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030. The background maps for 2016...
have been calibrated against concurrent measurements from national monitoring sites (AQC, 2017a). The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted concentrations for the future assessment year than those derived from the Defra maps.

**Background NO\textsubscript{2} Concentrations for Sensitivity Test**

A3.8 The road-traffic components of nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2018b).

**Model Verification**

A3.9 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

**Background Concentrations**

A3.10 Background concentrations of nitrogen dioxide for the verification sites have been derived from the national maps, having been calculated using the same approach as described in Paragraph A3.7. The background concentrations for the verification sites are presented in Table A3.2.

**Table A3.2: Background Concentrations used in the Verification for 2016**

<table>
<thead>
<tr>
<th>Year</th>
<th>NO\textsubscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>14.5 – 20.3</td>
</tr>
<tr>
<td>Objectives</td>
<td>40</td>
</tr>
</tbody>
</table>

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

\(^a\) In line with Defra’s forecasts.

\(^b\) Assuming higher emissions from modern diesel vehicles as described in Appendix A3.

\(^c\) The PM\textsubscript{2.5} objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

**Traffic Data**

A3.11 AADT flows, and the proportions of HDVs, for Newbold Road adjacent to monitoring site S20, have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2018). Traffic data used in the model verification are summarised in Table A3.3.
Table A3.3: 2016 AADT Traffic Data used in the Model Verification

<table>
<thead>
<tr>
<th>Road Link</th>
<th>AADT</th>
<th>%HDV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newbold Road</td>
<td>26,225</td>
<td>4.4</td>
</tr>
</tbody>
</table>

**Nitrogen Dioxide**

A3.12 Most nitrogen dioxide (NO₂) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO₂). The model has been run to predict the annual mean NOx concentrations during 2016 at monitoring sites S15, S20 and S26 (see Figure 4 for receptor locations). Concentrations have been modelled at 2.5 m, the height of the monitors.

A3.13 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the ‘measured’ road-NOx. Measured road-NOx has been calculated from the measured NO₂ concentrations and the predicted background NO₂ concentration using the NOx from NO₂ calculator (Version 6.1) available on the Defra LAQM Support website (Defra, 2018a).

A3.14 An adjustment factor has been determined as the slope of the best-fit line between the ‘measured’ road contribution and the model derived road contribution, forced through zero (Figure A3.2). The calculated adjustment factor of 1.419 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A3.15 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO₂ concentration within the NOx to NO₂ calculator. Figure A3.3 compares final adjusted modelled total NO₂ at each of the monitoring sites to measured total NO₂, and shows a close agreement.

A3.16 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.
Figure A3.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

Figure A3.3: Comparison of Measured Total NO₂ to Final Adjusted Modelled Total NO₂ Concentrations. The dashed lines show ± 25%.
**Model Verification for NOx and NO₂ Sensitivity Test**

A3.17 The approach set out above has been repeated using the predicted road-NOx and background concentrations specific to the sensitivity test. This has resulted in an adjustment factor of 1.419, which has been applied to all modelled road-NOx concentrations within the sensitivity test.

**PM\(_{10}\) and PM\(_{2.5}\)**

A3.18 There are no nearby PM\(_{10}\) or PM\(_{2.5}\) monitors. It has therefore not been possible to verify the model for PM\(_{10}\) or PM\(_{2.5}\). The model outputs of road-PM\(_{10}\) and road-PM\(_{2.5}\) have therefore been adjusted by applying the adjustment factor calculated for road NOx.

**Model Post-processing**

A3.19 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO\(_2\), has been processed through the NOx to NO\(_2\) calculator available on the Defra LAQM Support website (Defra, 2018a). The traffic mix within the calculator has been set to “All other urban UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO\(_2\) based on the adjusted road-NOx and the background NO\(_2\).