Air Quality Consultants

Air Quality Assessment: Development Associated with the Borough Plan, Nuneaton and Bedworth

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Executive Summary

Nuneaton and Bedworth Borough Council is currently preparing a new Borough Plan for Nuneaton and Bedworth, which will guide the area's future development for the next 14 years. The Plan process will consider various sources of evidence to inform the Council's emerging policies. Extensive analysis of the transport impacts of the proposals has already been undertaken using the S-Paramics model. This work involved calculating the impacts of the proposals on peak-hour traffic flows in Nuneaton and Bedworth, including within the Nuneaton Air Quality Management Areas (AQMAs). Air quality is an issue that has been identified as requiring further work to ascertain the impacts of development decisions on these areas in more detail. This report uses the outputs of the S-Paramics traffic model, to assess air quality impacts (in terms of concentrations) of the Borough Plan proposals in Nuneaton and Bedworth, paying particular attention to the AQMAs.

In 2016 there are exceedances of the annual mean nitrogen dioxide objective predicted by the model in Nuneaton and Bedworth, which reflects the outcomes of the Review and Assessment process. There is also an area where an exceedance of the nitrogen dioxide objective has been identified south of Bedworth which is not within a currently declared AQMA. For PM_{10} and $PM_{2.5}$, there are no exceedances of the objectives, either in 2016, or in any of the 2030 scenarios.

For all pollutants, there are much lower concentrations predicted in 2030 than in 2016. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 14 years' time Euro 6/VI vehicles will make up the majority of the fleet on the roads in the UK. Although there is still some uncertainty relating to the real world emissions of future Euro 6/VI vehicles, it is considered that considerable reductions in concentrations will occur by 2030.

The updated Borough Plan proposals will result in mostly negligible[1] changes in concentrations across the borough, including at town centre locations and within the AQMAs in Nuneaton. No exceedances of the air quality objectives are predicted for 2030. With the proposed updated Borough Plan, there will be good air quality conditions within Nuneaton and Bedworth in 2030, with pollutant concentrations well below the air quality objectives.

1 As defined in A1.16.

Contents

1 Introduction

1.1 Nuneaton and Bedworth Borough Council (NBBC) has identified locations with measured exceedances of the annual mean nitrogen dioxide objective. As a result, Air Quality Management Areas (AQMAs) have been declared in Nuneaton.

1.2 The spatial planning system has an important role to play in improving air quality and reducing exposure to air pollution both within these AQMAs and elsewhere in the district. In particular, the local planning policies set the framework for the determination of individual planning applications.

1.3 NBBC is currently preparing an updated Borough Plan[2] for Nuneaton and Bedworth, which will guide the area's future development for the next 14 years. The updated Borough Plan process will consider various sources of evidence to inform the Council's emerging policies. Extensive analysis of the transport impacts of the proposals has already been undertaken using the S-Paramics model. This work involved calculating the impacts of the proposals on peak-hour traffic flows in Nuneaton and Bedworth, including within the Nuneaton AQMAs. Air quality is an issue that has been identified as requiring further work to ascertain the impacts of development decisions on these areas in more detail. This report uses the outputs of the S-Paramics traffic model, to assess air quality impacts (in terms of concentrations) of the updated Borough Plan in Nuneaton and Bedworth, paying particular attention to the AQMAs.

1.4 The air quality impacts from development associated with the Borough Plan have previously been assessed (AQC, 2017a). The housing requirements within the Borough Plan have since changed and this report assesses the air quality impacts from changes in road traffic emissions associated with the updated Borough Plan. This report describes existing local air quality conditions (2016), which have also been used to verify the model, and the predicted air quality in 2030 assuming that the updated Borough Plan either does or does not proceed.

2 The Borough Plan (Publication Version) as updated by the Housing Topic Paper (Reference NBBC33 in the Borough Plan Examination Library).

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 of pollution on health and the sensitivity of the area and the development should be taken into account.

2.3 More specifically the NPPF makes clear that:

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

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that* *the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit".* The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*".

2.5 The PPG states that:

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

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

Local Policies

2.7 The publication version of the Nuneaton and Bedworth Council Borough Plan (Nuneaton and Bedworth Borough Council, 2017a) was submitted to the Secretary of State in June 2017 and is currently being examined by an independent inspector. The Plan aims to influence what development will take place, how much and where within the borough it will be located. The plan contains Objective 7, which is set out:

"To ensure that new development enhances and improves the quality and appearance of the existing urban area. In particular:

…c) Minimise the negative impact of development and make improvements where possible to air quality in Air Quality Management Areas".

2.8 Policy NB23, which supports Objective 7, which aims to help address air quality issues by:

"ensuring development is of a high quality, minimises the release of air pollutants into the atmosphere, is not unreasonably noisy or otherwise obtrusive, is accessible to local shops, services and public transportation, meets the existing or future circumstances of residents, workers and visitors, is safe, energy and water efficient and is equipped to adapt to climate change."

Assessment Criteria

2.9 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.10 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2016). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 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 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.11 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 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.

2.12 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). The Government assesses air quality compliance with the European Directive in 43 areas across the country using both monitoring and modelling. It uses Defra's Pollution Climate Mapping (PCM) model to forecast exceedances, which is adjusted based on the monitored data from the Automatic Urban and Rural Network. Defra's roadside annual mean nitrogen dioxide concentrations (Defra, 2017), 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 Nuneaton and Bedworth.

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

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

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

a A proxy value of 32 $\mu g/m^3$ 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, 2018a).

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.

Descriptors for Air Quality Impacts and Assessment of Significance

2.14 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 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[3] (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 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 The IAQM is the professional body for air quality practitioners in the UK.

3 Assessment Methodology and Baseline

Existing Conditions

3.1 Monitoring for nitrogen dioxide within the study area has been carried out by NBBC throughout Nuneaton and Bedworth for a number of years, using a large number of diffusion tubes sites and one real-time automatic monitoring station. NBBC deployed diffusion tubes prepared and analysed by Gradko International Ltd (using the 20% TEA in water method). This monitoring has been carried out in accordance with Defra's technical guidance (Defra, 2016), as part of NBBC's responsibilities under the LAQM regime. The monitoring sites and study area for Nuneaton and Bedworth are shown in Figure 1.

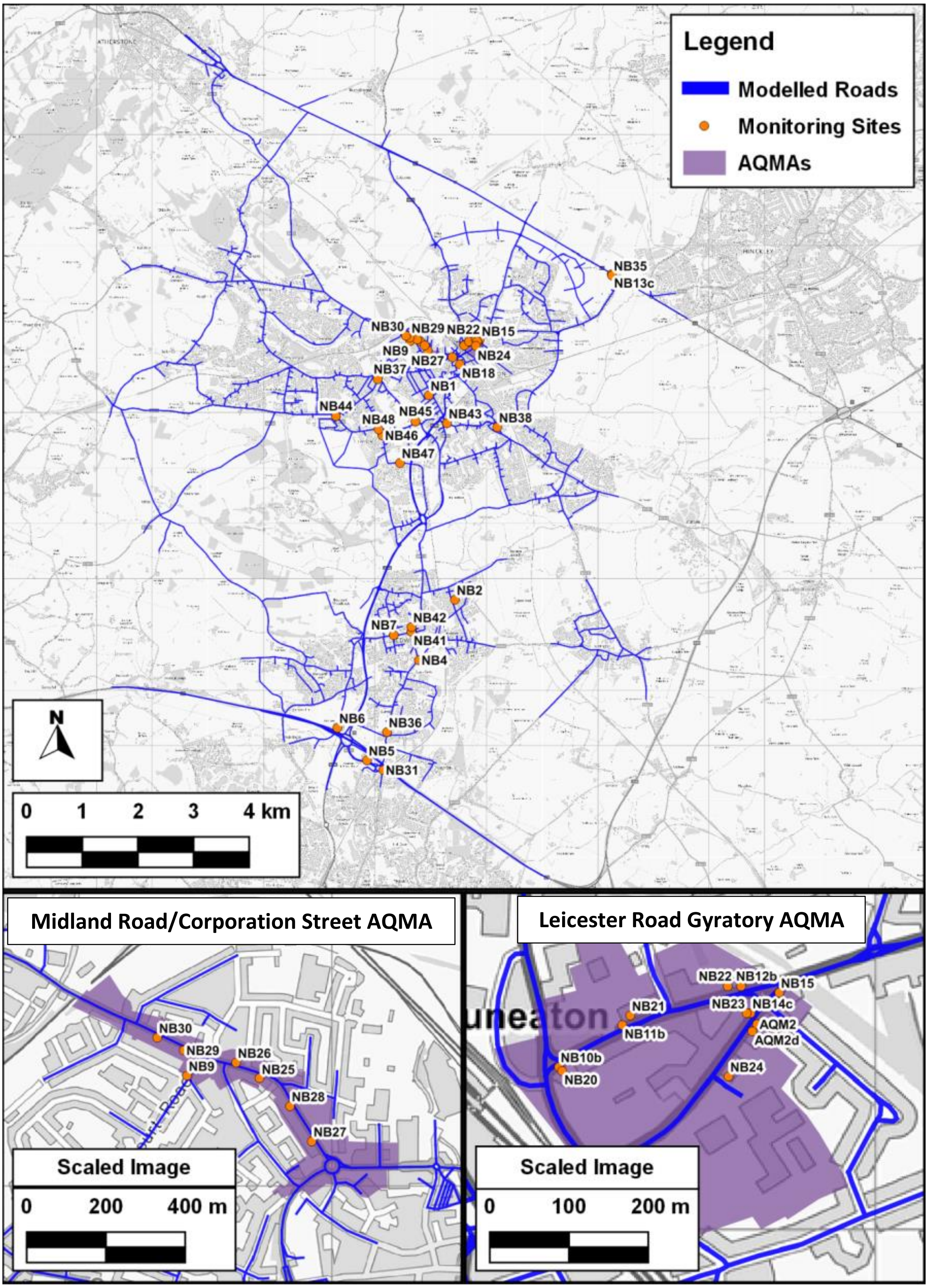

Figure 1: Nuneaton and Bedworth Updated Borough Plan Assessment Study Area, AQMAs and Monitoring Site Locations. Roads explicitly included in the model are shown in blue.

3.2 The results for nitrogen dioxide diffusion tube monitoring and real-time monitoring between 2011 and 2016 are presented in Table 2. There have been a number of exceedances of the annual mean nitrogen dioxide objective level in Nuneaton and Bedworth over the last 6 years[4].

Table 2: Results of Nitrogen Dioxide Monitoring: Comparison with the Annual Mean Objective (2011 – 2016) [ab]

Site ID.	Site Type	Location	Within AQMA?	2011	2012	2013	2014	2015	2016
Automatic Monitor - Annual Mean (µg/m^3)									
AQM2	Roadside	Leicester Road	Y	-	39.6	33.5	37.7	32.4	36.2
Objective			**40**						
Automatic Monitor - No. of Hours > 200 µg/m^3									
AQM2	Roadside	Leicester Road	Y	-	0 (121.7)	0	0	0	0
Objective			**18 (200 – 99.79th Percentile if low data capture) [c]**						
Diffusion Tubes - Annual Mean (µg/m^3)									
NB1	Urban Background	Norman Avenue	N	21.0	22.7	21.0	19.9	20.2	20.4
NB2	Urban Background	Conifer Close	N	21.8	24.3	20.5	19.7	19.6	19.2
NB4	Roadside	Coventry Road	N	35.1	34.7	35.5	32.4	33.3	33.9
NB5	Kerbside	Mc Donnell Drive	N	31.0	34.0	33.2	31.2	31.9	30.9
NB6	Kerbside	Tudor Court	N	34.7	36.2	34.0	33.7	34.6	34.9
NB7	Kerbside	Newdegate Road	N	33.0	36.2	33.5	34.4	31.9	31.9
NB9	Kerbside	Manor Court Road	N	31.1	31.5	30.6	31.0	29.5	30.3
NB10	Kerbside	17 Old Hinckley Road	N	31.5	33.3	33.8	30.0	30.3	-
NB11	Roadside	34 Old Hinckley Road	N	**43.4**	**46.6**	**43.1**	**42.4**	**43.2**	**-**
NB12	Roadside	64 Old Hinckley Road	N	35.4	36.0	35.8	35.3	32.8	-

4 An exceedance of the objective level does not necessarily mean that an AQMA should have been declared. An AQMA only needs to be declared where an exceedance of the objective is identified (i.e. at locations of relevant exposure, such as building façades of residential properties, schools, hospitals and care homes).

Site ID.	Site Type	Location	Within AQMA?	2011	2012	2013	2014	2015	2016
NB13	Kerbside	64 Watling Street	N	36.3	38.4	37.0	37.4	34.2	37.4
NB14	Roadside	Leicester Road	N	**41.1**	39.8	35.0	37.5	36.9	36.0
NB15	Kerbside	Bridge Grove, Leics Road	N	30.7	33.2	31.5	28.6	30.3	29.8
NB17	Roadside	Bond Gate	N	36.1	39.1	35.9	32.8	33.4	32.5
NB18	Kerbside	Wheat Street	N	37.9	38.9	34.3	30.9	31.9	32.8
NB20	Roadside	17 Old Hinckley Road	Y	29.8	29.8	29.6	27.6	25.9	28.5
NB21	Roadside	36 Old Hinckley Road	Y	32.9	32.3	29.6	30.6	29.4	30.0
NB22	Roadside	62 Old Hinkley Road	Y	28.4	28.9	24.8	25.2	25.2	24.9
NB23	Roadside	46 Leicester Road	Y	35.2	35.7	31.4	33.2	32.0	32.9
NB24	Roadside	31 Leicester Road	Y	26.7	28.9	31.4	22.8	23.3	24.5
NB25	Roadside	25 Central Avenue	Y	34.5	36.9	25.0	31.0	31.7	32.2
NB26	Roadside	26 Central Avenue	Y	30.3	33.4	31.1	28.7	29.6	31.4
NB27	Roadside	90 Corporation Street	Y	39.5	**44.3**	37.4	37.2	**40.3**	39.9
NB28	Roadside	138 Corporation Street	Y	39.3	**41.8**	37.1	36.5	36.3	36.7
NB29	Roadside	16 Midland Road	Y	**41.8**	**45.8**	**40.7**	**41.6**	**43.0**	**43.8**
NB30	Roadside	50 Midland Road	Y	**42.5**	**46.0**	37.8	**40.9**	**41.4**	40.0
NB31	Roadside	376 Longford Road	N	32.8	36.2	37.1	34.2	33.4	34.3
NB35	Roadside	62 Watling Street	N	26.1	28.2	26.2	24.8	24.8	24.8
NB36	Roadside	78 Bayton Road	N	35.1	39.1	38.1	35.0	36.5	37.6
NB37	Roadside	Jewsons (19 Croft Road)	N	31.6	33.2	32.0	31.6	31.8	33.0
NB38	Roadside	115 Highfield Road	N	28.6	33.9	29.6	28.6	27.4	30.5

Site ID.	Site Type	Location	Within AQMA?	2011	2012	2013	2014	2015	2016
NB41	Roadside	61 Mill Street	N	-	35.2	34.8	31.4	32.1	31.2
NB42	Roadside	18 George Street	N	-	29.2	28.7	30.4	28.2	28.1
NB43	Roadside	42 Hanover Glebe	N	-	-	-	-	27.4	26.9
NB44	Roadside	503 Heath End Road	N	-	-	-	-	30.1	30.5
NB45	Roadside	1 Heath End Road	N	-	-	-	-	26.3	29.6
NB46	Roadside	30 Bermuda Road	N	-	-	-	-	-	19.8
NB47	Roadside	6 The Bridleways	N	-	-	-	-	-	18.9
NB48	Roadside	288 Heath End Road	N	-	-	-	-	-	25.2
Objective Level			**40**						

[a] Exceedances of the objective level are shown in bold. An exceedance of the objective level does not necessarily mean that an AQMA should have been declared. An AQMA only needs to be declared where an exceedance of the objective is identified (i.e. at locations of relevant exposure, such as building façades of residential properties, schools, hospitals and care homes).

[b] 2011 to 2016 data have been taken from the 2017 Air Quality Annual Status Report (ASR) (Nuneaton and Bedworth Borough Council, 2017b). Means for diffusion tubes have been corrected for bias by the Council. All means have been 'annualised' by the Council as per Technical Guidance LAQM.TG16 if valid data capture for the full calendar year is <75%.

[c] Values in brackets are 99.79th percentiles, which are presented where data capture is <75%.

Modelling Road Traffic Impacts

3.3 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (ADMS-Roads v4). The input data used and the model verification are described in Appendix 2. The model outputs have been verified against the monitoring data presented above, as described in Appendix A2 (paragraph A3.7).

Sensitive Locations

3.4 Concentrations have been predicted at a number of worst-case receptor locations representing existing residential properties within Nuneaton and Bedworth, as shown in Figure 2. When selecting these receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, and where there is a combined effect of several road links. The receptors have been located on the façades of the properties closest to the sources.

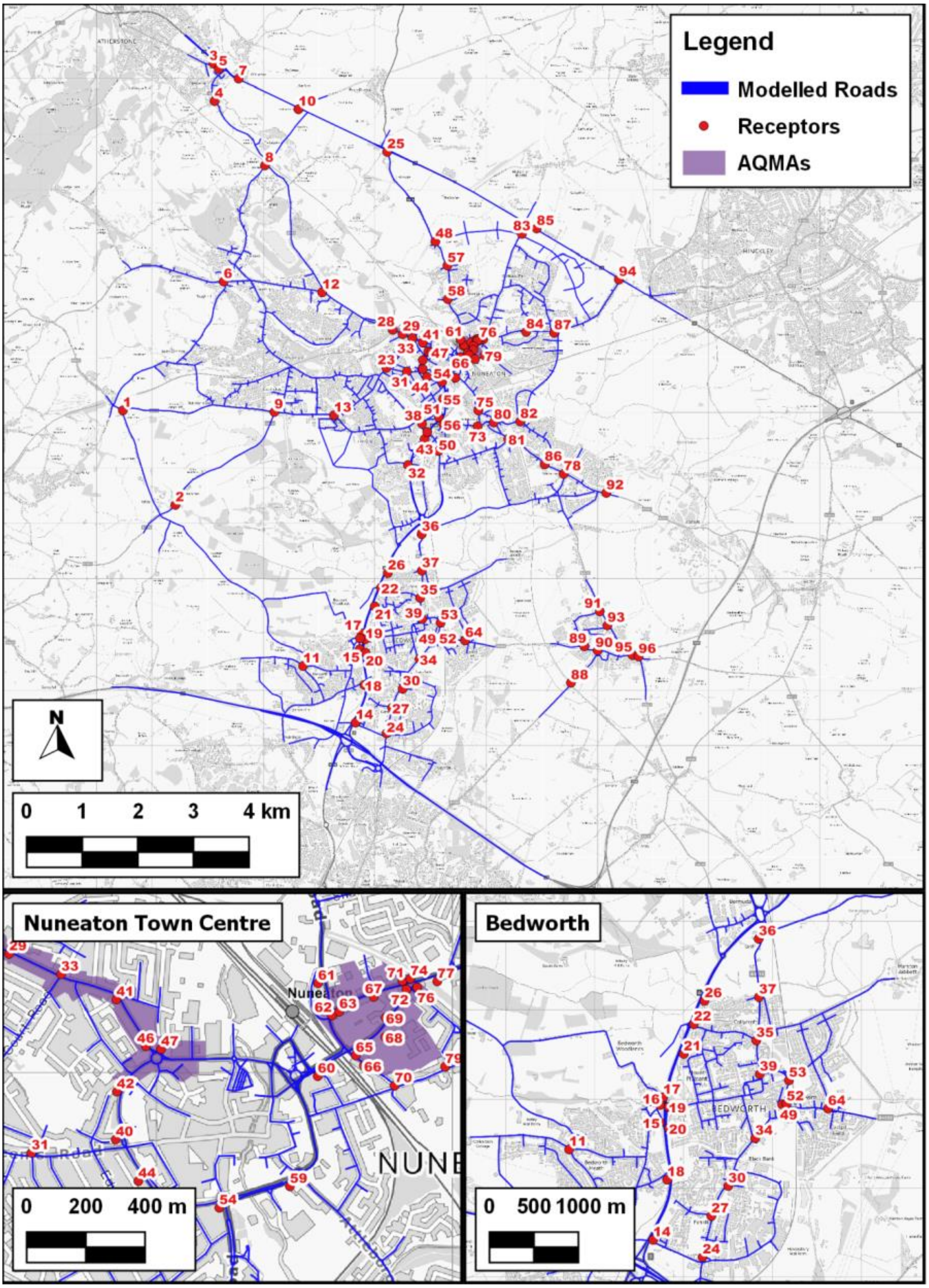

Figure 2: AQMAs and Receptor Locations in Nuneaton and Bedworth

Assessment Scenarios

3.5 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2016), and for a future year (2030)[5]. For 2030, scenarios have been modelled assuming that the updated Borough Plan, does proceed ('Borough Plan Model'), or does not proceed ('Reference Case'). The reference case includes all known growth (i.e. committed developments) and an element of as yet unplanned growth across the borough informed by National Trip End Model forecasts.

3.6 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).

Baseline Concentrations

3.7 Baseline concentrations for nitrogen dioxide in Nuneaton and Bedworth for 2016 are illustrated in Figure 3. There are two modelled exceedances in the south of Bedworth which are not within a currently declared AQMA. As discussed in paragraph A3.11, the model is potentially overstating concentrations close to the M6; there is thus some uncertainty in these exceedances. Baseline concentrations in 2030 ('Reference Case') are illustrated in Figure 4. No exceedances of objectives are predicted in 2030.

5 Although traffic was modelled for 2031 which is the end date of the updated Borough Plan, 2030 has been used because emissions factors and background concentrations are only currently projected to 2030.

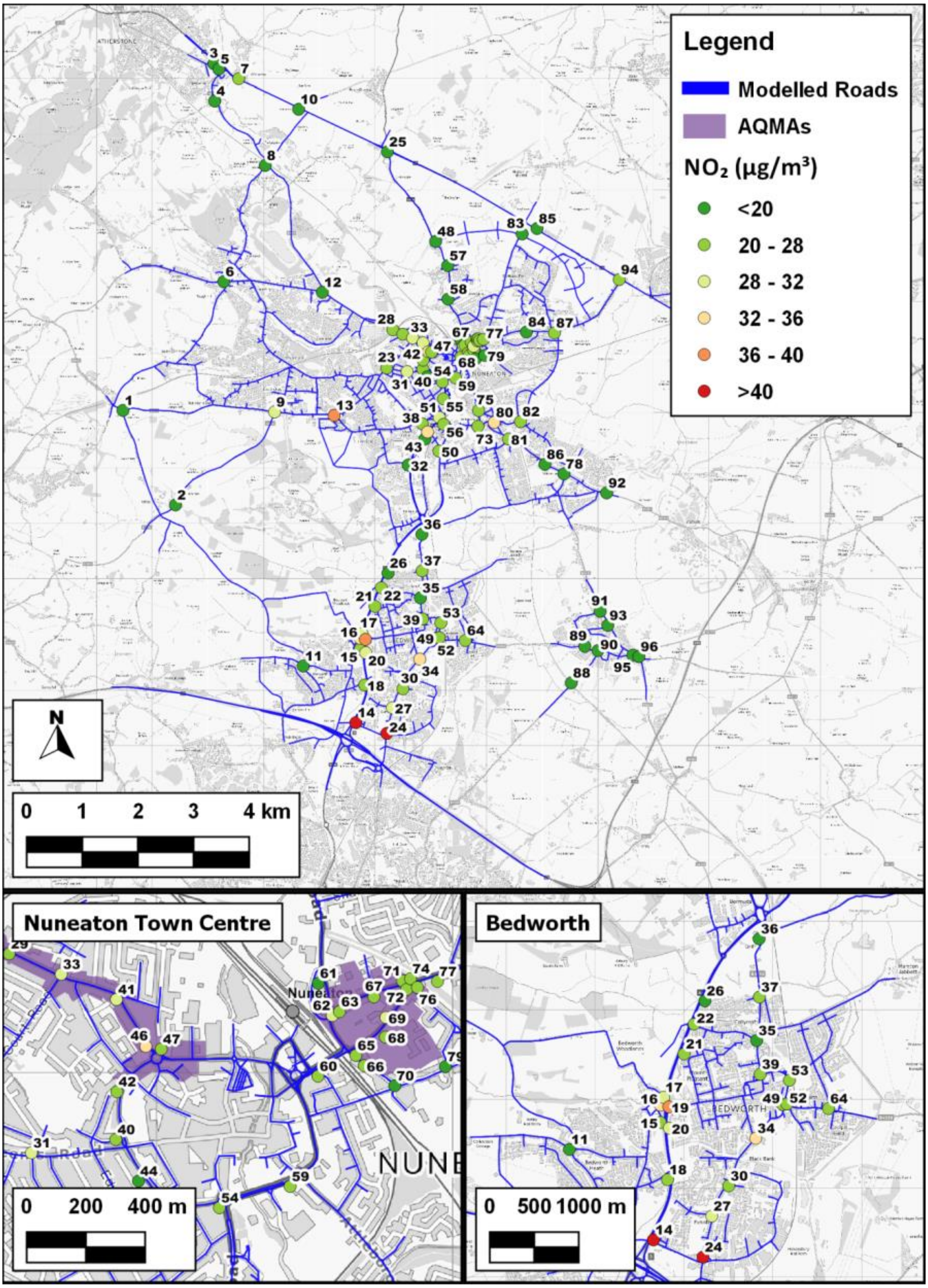

Figure 3: 2016 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth

The numbers on the maps are the receptor numbers. Contains Ordnance Survey data © Crown copyright and database right 2018

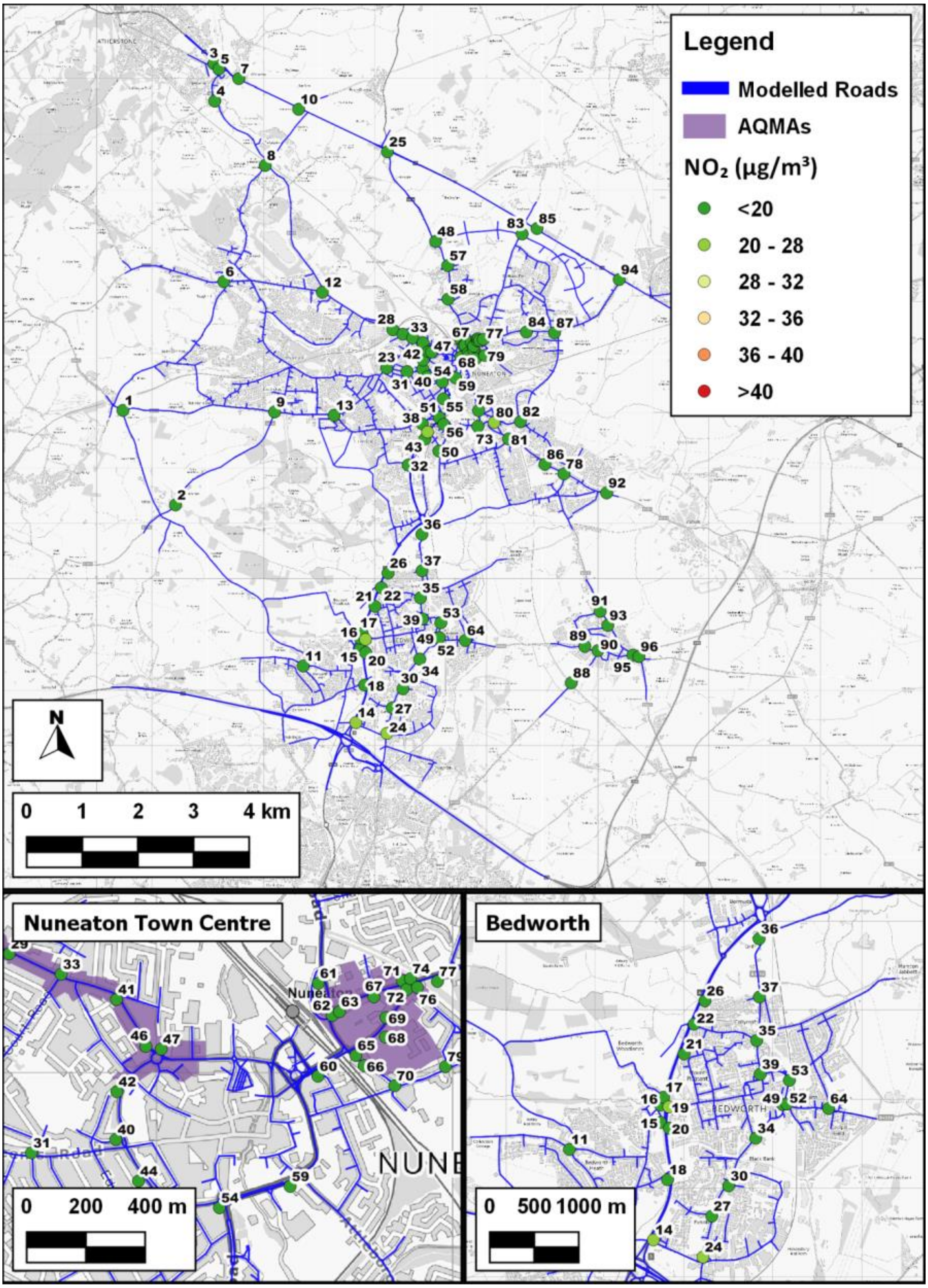

Figure 4: 2030 Reference Case Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth

The numbers on the maps are the receptor numbers. Contains Ordnance Survey data © Crown copyright and database right 2018

4 Impacts of the Borough Plan

4.1 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are set out in Appendix A4 for the "Borough Plan Model" and "Reference Case" scenarios. Results of the sensitivity test are presented in Appendix A5. Results are summarised below.

Nitrogen Dioxide

4.2 Predicted concentrations of nitrogen dioxide in Nuneaton and Bedworth, with the 'Borough Plan Model', are illustrated in Figure 5.

4.3 Concentrations of nitrogen dioxide are predicted to be much lower in 2030 than in 2016. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 14 years' time these vehicles (Euro 6/VI) will make up the majority of the fleet on the roads in the UK. Background concentrations are also predicted to be substantially lower in 14 years' time, due to reductions in various contributing sectors.

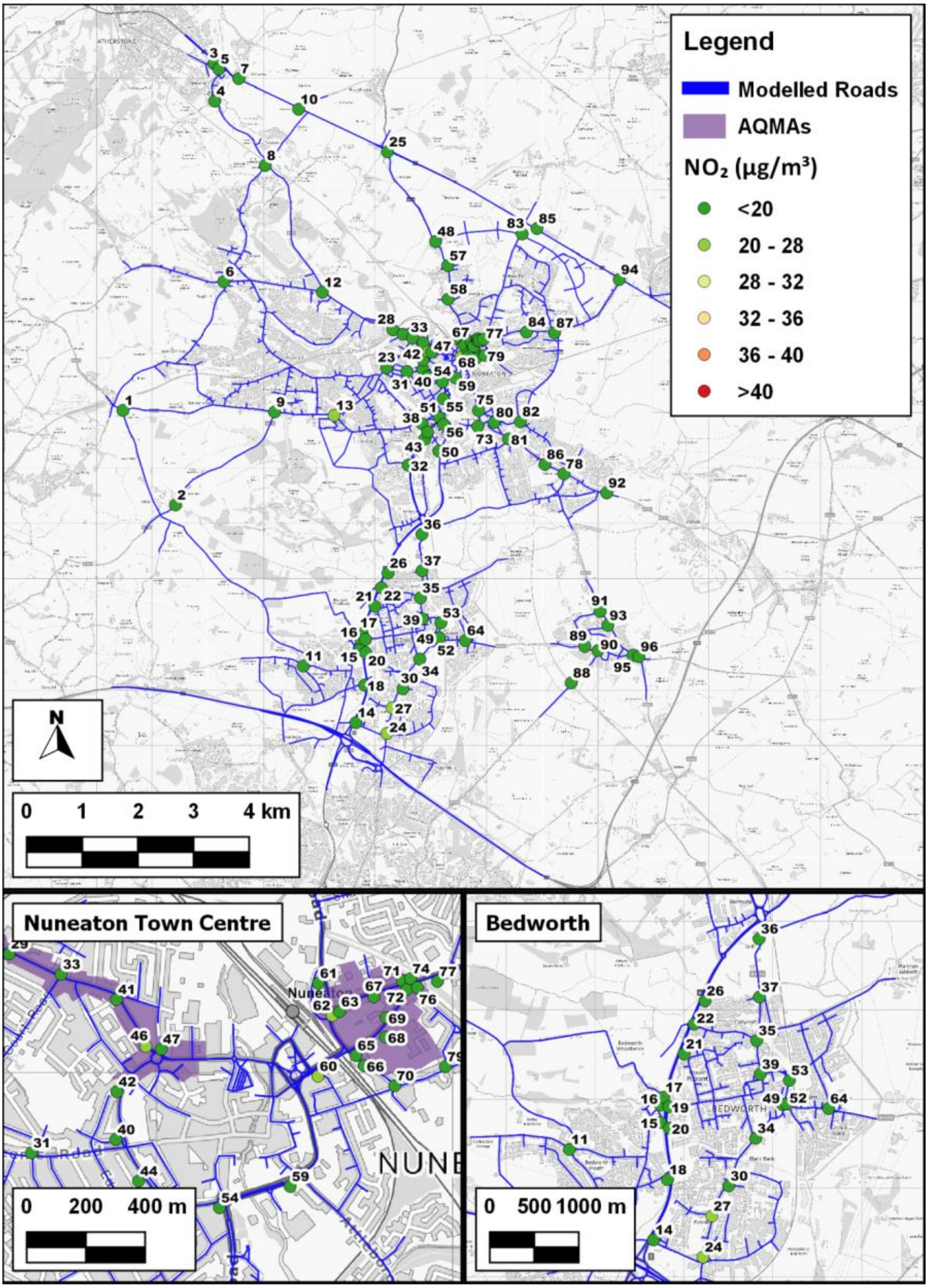

Figure 5: **2030 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth with the 'Borough Plan Model' Implemented**

The numbers on the maps are the receptor numbers. Contains Ordnance Survey data © Crown copyright and database right 2018

4.4 When comparing the 'Borough Plan Model' with the 'Reference Case', there will be improvements in concentrations of nitrogen dioxide at some locations and dis-benefits at others. Figure 6 shows the difference between the two scenarios at each of the receptors (both positive and negative). A negative value represents a reduction in nitrogen dioxide concentration and thus an improvement in air quality, whereas a positive value indicates an air quality dis-benefit. There are more dis-benefits than improvements. Dis-benefits are identified within currently declared AQMAs and more widely within the town centres of Nuneaton and Bedworth. While the changes are negligible at 81 of the receptors, at six receptors there will be an increase up to 4 $\mu g/m^3$ and at four receptors there will be an increase up to 5.9 $\mu g/m^3$, which would be classed as slight and moderate adverse impacts, respectively, using the criteria set out in the approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[6] (Moorcroft and Barrowcliffe et al, 2017). These receptors are mainly located within Nuneaton town centre, Bedworth and adjacent to the arterial roads, where traffic volumes are the largest. Beneficial impacts are mainly seen along more minor roads.

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

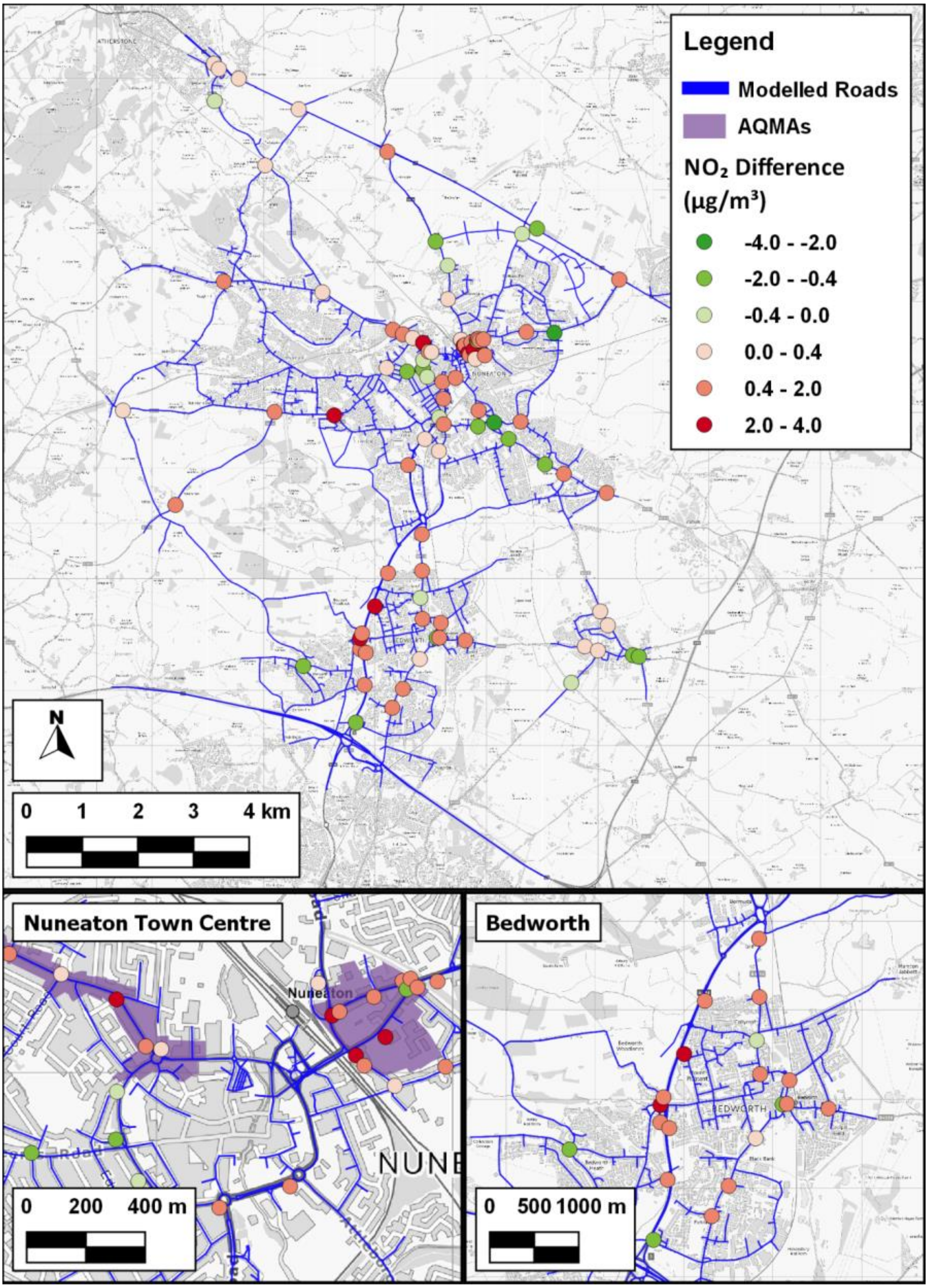

Figure 6: 2030 Difference in Nitrogen Dioxide Concentrations between the Reference Case and the Borough Plan Model in Nuneaton and Bedworth

PM_{10} and $PM_{2.5}$

4.5 The PM_{10} and $PM_{2.5}$ values are all well below the objectives at all receptors, in both 2016 and in 2030 for both scenarios. The patterns of impact of the scheme are the same for PM_{10} and $PM_{2.5}$ as they are for nitrogen dioxide (i.e. in terms of positive and negative impacts).

Uncertainty in Road Traffic Modelling Predictions

4.6 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.

4.7 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). The level of confidence in the verification process is necessarily enhanced when data from an automatic analyser have been used, as has been the case for this assessment (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2016) concentrations.

4.8 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.

4.9 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.

4.10 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).

4.11 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[7]) are now very low when compared with those from older models (ICCT, 2017).

4.12 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.

4.13 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, 2018). 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, 2018). 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).

4.14 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.

4.15 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 (2018). CURED v3A is considered to provide a worst-case assessment.

7 Euro VI refers to HDVs while Euro 6 refers to LDVs.

5 Summary and Conclusions

5.1 In 2016 there are measured exceedances of the annual mean nitrogen dioxide objective predicted in Nuneaton and Bedworth, which reflects the outcomes of the Review and Assessment process. For PM_{10} and $PM_{2.5}$, there are no exceedances of the objectives, either in 2016, or in any of the 2030 scenarios.

5.2 For all pollutants, there are much lower concentrations in 2030 than in 2016. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 14 years' time Euro 6/VI vehicles will make up the majority of the fleet on the roads in the UK. Although there is still some uncertainty relating to the real-world emissions of Euro 6/VI vehicles, it is considered that considerable reductions in concentrations will occur by 2030. Nevertheless, a sensitivity test has been carried out which considers the potential under-performance of emissions control technology on future diesel cars and vans.

5.3 The updated Borough Plan proposals will result in mostly negligible changes in concentrations across the borough, including at town centre locations and within the AQMAs in Nuneaton. No exceedances of the air quality objectives are predicted for 2030. With the proposed updated Borough Plan, there will be good air quality conditions within Nuneaton and Bedworth in 2030, with pollutant concentrations well below the air quality objectives.

5.4 In general, the 'Borough Plan Model' scenario is predicted to give rise to 'negligible' increases throughout Nuneaton and Bedworth. This is because the future concentrations are predicted to be well below the objectives. Ten adverse increases and five beneficial reductions of the annual mean nitrogen dioxide have been identified. The same patterns are apparent for PM_{10}, although the magnitudes of change are smaller.

5.5 The assessment of the previous Borough Plan (AQC, 2017a) also demonstrated mainly 'negligible' increases throughout Nuneaton and Bedworth, with some 'slight adverse' impacts, and that all concentrations would be well below the objectives in the future. The updated Borough Plan results in more impacts, both beneficial and adverse, with slightly more adverse impacts than beneficial. The increase in the number of impacts is, however, likely to be due to a better understanding of vehicle emissions, such that this assessment has assumed higher emissions from vehicles than those used in the previous assessment. Overall, in both assessments, the air quality impacts are judged to be 'not significant'.

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7 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
Exceedance	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. An exceedance of the objective level does not necessarily mean that an AQMA should have been declared. An AQMA only needs to be declared where an exceedance of the objective is identified (i.e. at locations of relevant exposure, such as building façades of residential properties, schools, hospitals and care homes).
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
LAQM	Local Air Quality Management
$\mu g/m^3$	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

8 Appendices

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 m^2 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 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

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 m^2 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/Nm^3.

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 [a]

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

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

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

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

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

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

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

Dr Clare Beattie, BSc (Hons) MSc PhD CSci MIEnvSc MIAQM

Dr Beattie is an Associate Director with AQC, with more than 20 years' relevant experience. She has been involved in air quality management and assessment, and policy formulation in both an academic and consultancy environment. She has prepared air quality review and assessment reports, strategies and action plans for local authorities and has developed guidance documents on air quality management on behalf of central government, local government and NGOs. Dr Beattie has appraised local authority air quality assessments on behalf of the UK governments, and provided support to the Review and Assessment helpdesk. She has also provided support to the integration of air quality considerations into Local Transport Plans and planning policy processes. She has carried out numerous assessments for new residential and commercial developments, including the negotiation of mitigation measures where relevant. She has carried out BREEAM assessments covering air quality for new developments. Clare has worked closely with Defra and has recently managed the Defra Air Quality Grant Appraisal contract over a 4-year period. She is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Austin Cogan, MPhys (Hons) PhD MIEnvSc MIAQM

Dr Cogan has over nine years' experience in environmental sciences, is a Senior Consultant with AQC and has over five years' experience in the fields of air quality modelling, monitoring and assessment, having been involved in over 200 projects. Prior to this he studied at the University of Leicester, gaining two years' experience of scientific instrument design and spent four years' pioneering research in satellite observations of carbon dioxide, including data validation, model comparisons, bias correction and software development. He has since been involved in air quality, odour and climate change assessments of residential and commercial developments, road schemes, airports, waste management processes, and industrial processes. Dr Cogan has also been involved in the analysis and interpretation of air quality data and the preparation of review and assessment reports for local authorities. He has also undertaken a number of large scale modelling projects for local authorities investigating the impacts of action plan measures and Local Plan development, using the outputs from microsimulation models to assess the air quality impacts at relevant locations. Dr Cogan has published seven scientific papers and given numerous presentations at conferences. He is also a Member of the Institute of Air Quality Management.

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

A3 Modelling Methodology

Background Concentrations

A3.1 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2018b). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. They include contributions from a number of different sources, including road traffic emissions. The contribution of minor roads, primary roads, trunk roads and motorways have been removed from the background concentrations to avoid any double counting from road traffic emissions.

Model Inputs

A3.2 Predictions have been carried out using the ADMS-Roads dispersion model (v4). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width and street canyon height, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 8.0.1) published by Defra (2018b).

A3.3 Hourly sequential meteorological data from Coleshill for 2016 have been used in the model. The Coleshill meteorological monitoring station is located approximately 11 km to the west of Nuneaton and Bedworth, with the Coleshill meteorological monitoring station located at flat-lying inland locations in the midlands where they will be influenced by the effects of inland meteorology on flat-lying topography. Coleshill meteorological monitoring station is therefore deemed to be the nearest[8] monitoring station, with data available, representative of meteorological conditions in Nuneaton and Bedworth.

A3.4 For the purposes of modelling, it has been assumed that the front façades of existing properties along a number of road links are within street canyons formed by the buildings along those road links. These road links include parts of Coleshill Road, Midland Road, Central Corporation Street, Manor Court Road, Heath End Road, Croft Road, Queen’s Road, Bond Street, Regent Street, Old Hinckley Road, Leicester Road, Oaston Road, Coton Road, Attleborough Road, Coventry Road, College Street, Highfield Road, Newtown Road, Mill Street, Rye Piece Ringway, Bulkington Road, Cedars Road, Hayes Lane, Coventry Road Exhall, Smorral Lane and Goodyers End Lane. These roads have a number of canyon-like features which reduce dispersion of traffic emissions and can therefore lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion. As a precautionary measure, these roads have been assumed to be canyons

[8] Although there is a meteorological station at Coventry Airport that is nearer to the Borough, there was poor data capture at this station in 2016.

and ADMS-Roads may therefore have over predicted concentrations at the façades of existing properties along these roads.

A3.5 AADT flows, proportions of HDVs and speeds have been provided by NBBC. These were derived from the S-Paramics Micro-simulation traffic model[9]. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (DfT, 2011).

A3.6 As explained in paragraph 4.15, 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 (2018).

Model Verification

A3.7 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. The verification methodology is described below.

A3.8 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2016 at all Nuneaton and Bedworth monitoring sites close to roads which have been included in the model. Diffusion tube monitoring site NB47 was not included in the model verification as no base year traffic data was available for the road adjacent to the monitor.

A3.9 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 6.1) available on the Defra LAQM Support website (Defra, 2018a).

A3.10 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 A3.1). The calculated adjustment factor was determined to be less than 1, indicating that the model is over-predicting concentrations at the monitors overall. It is, however, acknowledged that the model is

[9] This model did not include as many roads as the previous assessment. Only the roads with traffic data provided could thus be included in the air quality modelling and concentrations could only be predicted at the receptors and monitoring sites that are located along these roads.

also under-predicting concentrations at some monitors. As such, the worst-case approach has been taken to leave the model unadjusted.

A3.11 The total nitrogen dioxide concentrations have then been determined by combining the modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A3.2 compares final modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows a 1:1 relationship for Nuneaton and Bedworth. There are a few outliers; NB5, NB13, NB23 and NB24. None of these monitors measured exceedances of the objectives. The model is under-predicting concentrations at NB13; this monitor is located on Watling Street close to NB35. The model is over-predicting at the other three outliers. NB23 and NB24 are both located on Leicester Road within the AQMA, and NB5 is located near the M6. The model will thus be overstating impacts at these locations. While some locations may be over-predicted or under-predicted, the overall conclusions are considered to be representative of Nuneaton and Bedworth.

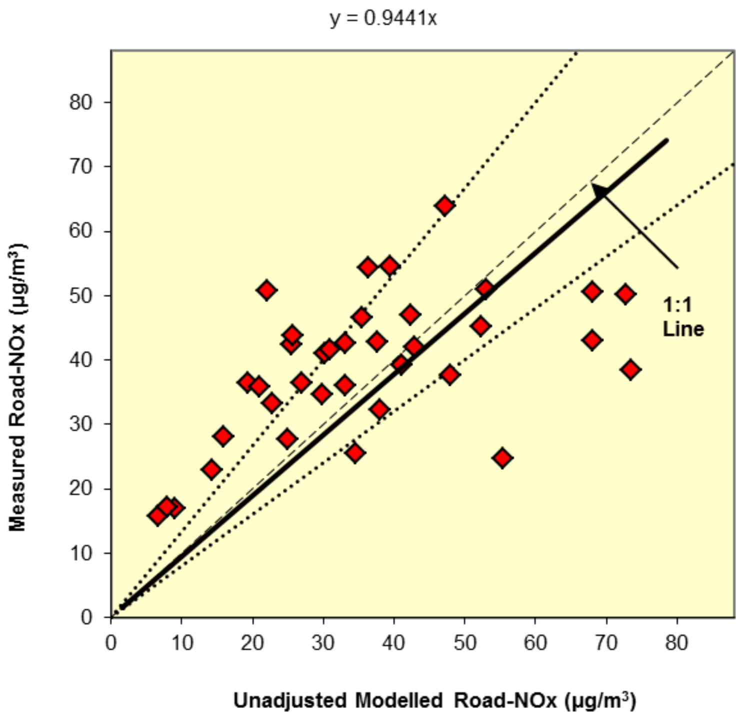

Figure A3.1: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

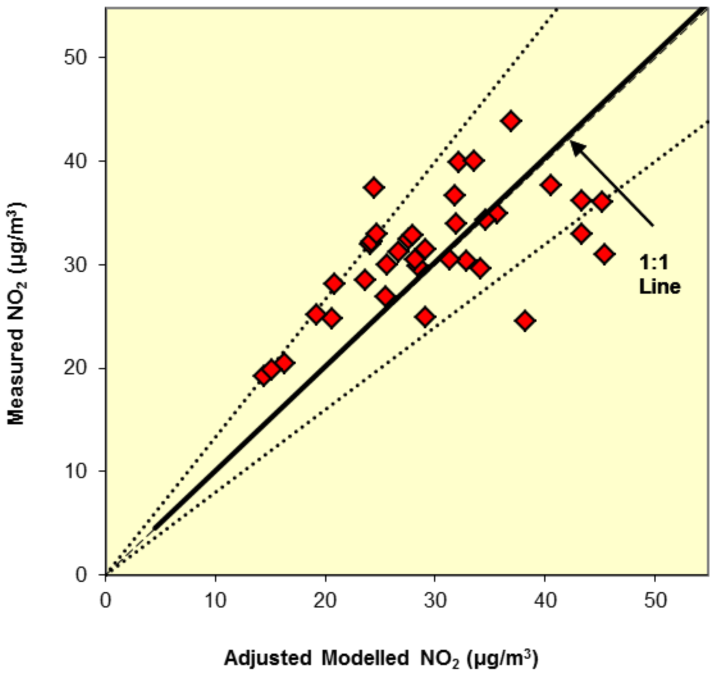

Figure A3.2: Comparison of Measured Total NO_2 to Final Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A3.12 There are no PM_{10} or $PM_{2.5}$ monitors within the modelled study areas. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. Since the model outputs of road-NOx have been left unadjusted, the same approach has been used for the model outputs of road-PM_{10} and road-$PM_{2.5}$.

Model Post-processing

A3.13 The model predicts road-NOx concentrations at each receptor location. These concentrations have then, along with the background NO_2, been processed through the NOx from NO_2 calculator available on the Defra LAQM Support website (Defra, 2018a). The traffic mix within the calculator was 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.

A4 Predicted Concentrations

Table A4.1: Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Receptors

Receptor	2016	2030 Reference Case	2030 Borough Plan Model	Sensitivity Test	
				2030 Reference Case	2030 Borough Plan Model
1	14.0	9.0	9.3	9.9	10.3
2	14.2	8.4	9.0	9.4	10.2
3	16.2	9.7	9.9	10.8	11.1
4	16.4	10.3	10.2	11.9	11.7
5	17.0	10.0	10.2	11.2	11.5
6	19.9	10.2	11.0	11.8	13.0
7	22.2	12.0	12.2	14.4	14.7
8	15.5	10.1	10.3	11.2	11.6
9	31.0	14.8	15.6	17.5	18.3
10	15.4	9.0	9.2	10.2	10.5
11	16.4	12.2	11.2	13.8	12.7
12	17.1	11.2	11.4	12.1	12.5
13	38.8	17.1	20.2	21.9	26.1
14	**48.0**	20.3	18.7	25.1	22.0
15	24.8	11.5	12.8	13.2	15.1
16	32.9	14.0	16.0	17.1	20.2
17	29.5	12.1	13.7	14.5	17.0
18	22.0	12.1	13.2	13.8	15.3
19	37.2	22.1	16.8	27.0	21.3
20	28.9	12.9	14.4	15.4	17.5
21	21.4	9.6	13.0	10.3	15.1
22	21.8	9.7	14.0	10.3	16.2
23	26.5	15.0	15.1	18.0	18.2
24	**43.7**	22.3	27.4	26.0	32.2
25	17.6	13.2	13.8	14.9	16.0
26	19.0	10.8	12.4	11.9	14.4

Receptor	2016	2030 Reference Case	2030 Borough Plan Model	Sensitivity Test	
				2030 Reference Case	2030 Borough Plan Model
27	31.3	19.3	20.5	21.9	23.1
28	21.5	13.3	14.4	14.3	15.9
29	22.6	13.3	14.9	14.2	16.7
30	21.0	11.8	13.2	13.1	14.9
31	31.0	16.5	16.2	20.5	20.0
32	17.0	10.0	11.0	10.6	12.1
33	31.4	18.2	18.3	21.4	21.8
34	33.9	16.6	16.8	20.0	20.4
35	19.0	12.2	11.9	14.1	13.8
36	15.9	9.8	10.8	10.8	12.3
37	22.6	12.2	12.7	14.3	15.1
38	25.0	16.5	12.0	20.4	13.8
39	24.4	12.6	13.2	14.9	15.8
40	25.1	14.6	13.5	17.1	15.8
41	28.3	13.6	16.8	14.7	19.7
42	21.6	13.3	13.1	15.2	15.1
43	19.4	11.4	11.8	12.4	13.3
44	19.3	12.2	12.2	13.7	13.7
45	35.9	22.6	12.1	27.3	13.9
46	35.2	18.6	20.3	22.4	25.0
47	24.0	14.1	14.4	16.5	17.1
48	12.2	9.8	8.3	10.8	9.2
49	24.8	15.1	14.2	17.7	16.4
50	22.4	14.9	15.0	16.8	17.3
51	30.7	17.8	17.6	20.2	20.8
52	27.3	14.2	15.3	16.3	18.0
53	25.1	13.3	14.4	15.5	17.2
54	23.3	14.1	14.8	16.1	17.2
55	25.7	15.0	16.0	17.6	19.3

Receptor	2016	2030 Reference Case	2030 Borough Plan Model	Sensitivity Test	
				2030 Reference Case	2030 Borough Plan Model
56	26.4	15.2	16.1	17.1	18.8
57	15.8	10.7	10.4	12.2	11.8
58	15.9	9.8	10.1	10.9	11.3
59	25.9	15.0	16.9	17.5	20.4
60	26.9	15.5	21.3	18.2	26.1
61	19.5	12.3	12.8	13.8	14.5
62	31.7	17.5	20.3	21.7	25.8
63	22.7	13.4	14.7	15.5	17.5
64	25.8	13.5	14.7	15.5	17.3
65	25.5	13.4	15.7	15.4	18.7
66	20.3	12.1	13.2	13.4	15.1
67	26.1	14.7	16.2	17.3	19.7
68	22.1	11.5	14.0	12.5	16.1
69	28.5	12.0	17.0	13.1	20.2
70	19.5	12.3	12.5	13.4	13.9
71	27.6	15.7	16.4	18.5	20.0
72	27.8	15.6	15.1	18.4	18.1
73	23.3	16.4	14.8	18.3	17.0
74	25.8	14.8	16.0	17.4	19.4
75	25.7	13.8	14.9	15.7	17.6
76	24.3	14.1	14.8	16.3	17.6
77	21.7	13.1	14.8	14.9	17.5
78	17.7	9.5	10.8	10.5	12.5
79	18.3	11.4	12.3	12.2	13.7
80	32.1	20.9	17.2	24.9	21.2
80	21.1	13.5	12.9	15.9	15.0
81	23.0	11.4	13.1	12.6	15.2
82	14.4	8.7	8.6	9.6	9.7
83	17.8	10.7	11.3	11.8	12.7

Receptor	2016	2030 Reference Case	2030 Borough Plan Model	Sensitivity Test	
				2030 Reference Case	2030 Borough Plan Model
84	18.2	10.0	9.7	11.5	11.3
85	17.6	12.1	10.6	14.3	12.2
86	24.4	15.8	12.1	18.9	14.0
87	12.3	8.3	8.3	8.7	8.6
88	13.4	8.8	9.0	9.5	9.7
89	13.4	11.6	11.9	13.4	13.9
91	12.3	8.2	8.3	8.8	9.0
92	13.8	7.9	8.8	8.2	9.7
93	11.8	8.0	8.1	8.4	8.6
94	25.3	14.4	16.3	16.0	18.9
95	12.7	11.0	9.8	12.7	11.0
96	13.4	11.0	10.3	12.6	11.7
Objective	**40**				

Table A4.2: Predicted Annual Mean PM_{10} Concentrations (µg/m^3) at Receptors

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
1	14.4	13.6	13.6
2	14.5	13.5	13.7
3	14.3	13.5	13.6
4	14.4	13.7	13.7
5	14.4	13.7	13.7
6	14.6	13.4	13.8
7	15.2	14.5	14.5
8	13.7	13.0	13.0
9	15.3	13.8	13.7
10	15.2	14.5	14.5
11	14.9	14.3	14.3
12	13.7	12.9	13.0
13	17.5	15.8	16.5

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
14	21.4	19.7	17.9
15	16.5	15.2	15.7
16	17.9	16.1	17.0
17	16.6	14.9	15.7
18	16.1	15.2	15.5
19	18.4	17.7	17.5
20	17.2	15.8	16.5
21	15.3	13.7	14.8
22	15.2	13.7	14.7
23	15.6	14.8	14.9
24	21.4	20.0	20.8
25	14.7	14.1	14.4
26	14.8	13.9	14.5
27	19.6	19.0	19.1
28	14.6	13.4	13.9
29	14.7	13.3	14.1
30	15.5	14.5	14.9
31	16.4	15.4	15.3
32	14.2	13.1	13.6
33	15.7	14.9	15.0
34	17.2	16.3	16.4
35	15.0	14.5	14.6
36	14.7	14.0	14.3
37	15.7	14.7	15.1
38	15.4	15.3	13.9
39	15.6	14.8	14.9
40	15.3	14.5	14.3
41	15.6	13.4	14.8
42	15.0	14.3	14.3
43	14.6	13.5	13.8
44	14.6	13.9	13.9

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
45	16.8	16.1	14.0
46	16.8	15.5	16.2
47	15.1	14.3	14.5
48	13.5	13.0	12.9
49	15.5	15.3	14.8
50	16.1	15.3	15.7
51	17.0	15.7	16.3
52	15.9	14.9	15.2
53	15.6	14.5	14.8
54	15.5	14.8	15.0
55	16.2	15.5	16.0
56	16.5	15.4	15.9
57	13.6	13.2	13.2
58	13.6	12.8	13.0
59	15.9	15.1	15.7
60	15.9	15.2	16.5
61	14.5	13.8	13.9
62	16.4	15.7	16.6
63	14.9	14.2	14.5
64	16.1	14.9	15.4
65	14.9	14.0	14.7
66	14.4	13.6	13.9
67	15.4	14.6	15.1
68	14.5	13.4	14.0
69	15.1	13.5	14.6
70	15.0	14.3	14.3
71	15.5	14.7	15.1
72	15.3	14.5	14.7
73	16.4	15.4	15.8
74	15.3	14.6	15.0
75	16.2	14.9	15.5

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
76	15.1	14.3	14.6
77	14.8	14.0	14.4
78	14.5	13.3	13.8
79	14.2	13.2	13.7
80	16.4	15.8	15.8
80	15.1	14.7	14.6
81	15.3	13.9	14.6
82	14.4	13.7	13.7
83	14.0	13.1	13.4
84	14.9	14.1	14.2
85	14.8	14.5	14.1
86	15.4	15.0	14.2
87	13.8	13.1	13.0
88	13.9	13.2	13.2
89	13.8	13.5	13.5
91	13.6	12.9	12.9
92	13.8	12.7	13.1
93	13.5	12.8	12.8
94	16.7	15.5	16.1
95	13.7	13.4	13.2
96	13.8	13.4	13.3
Objective	40		

Table A4.3: Predicted Annual Mean $PM_{2.5}$ concentrations ($\mu g/m^3$) at Receptors

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
1	9.9	9.1	9.2
2	9.7	8.9	8.9
3	9.8	9.0	9.0
4	9.7	9.0	9.0
5	9.8	9.0	9.1
6	9.9	8.8	9.0
7	10.3	9.5	9.5
8	9.4	8.6	8.6
9	10.4	9.0	9.0
10	10.1	9.3	9.4
11	9.9	9.3	9.3
12	9.4	8.6	8.6
13	11.5	10.1	10.5
14	13.8	12.2	11.2
15	10.9	9.7	10.0
16	11.7	10.3	10.7
17	11.0	9.6	10.0
18	10.6	9.7	9.9
19	12.1	11.1	11.0
20	11.3	10.1	10.4
21	10.3	8.9	9.6
22	10.2	8.9	9.5
23	10.5	9.6	9.7
24	14.3	13.0	13.5
25	9.9	9.2	9.4
26	9.9	9.0	9.4
27	13.2	12.5	12.5
28	9.9	8.9	9.2
29	10.0	8.8	9.2
30	10.4	9.5	9.7

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
31	11.0	9.9	9.9
32	9.6	8.7	8.9
33	10.6	9.7	9.8
34	11.5	10.4	10.5
35	10.1	9.4	9.4
36	9.8	9.1	9.2
37	10.4	9.5	9.7
38	10.4	9.9	9.1
39	10.4	9.6	9.6
40	10.3	9.4	9.3
41	10.5	8.9	9.6
42	10.1	9.3	9.3
43	9.9	8.9	9.0
44	9.9	9.1	9.1
45	11.2	10.3	9.1
46	11.2	10.0	10.4
47	10.2	9.4	9.5
48	9.2	8.7	8.6
49	10.5	10.0	9.7
50	10.6	9.8	10.0
51	11.2	10.0	10.4
52	10.7	9.8	9.9
53	10.5	9.5	9.7
54	10.4	9.6	9.7
55	10.8	10.0	10.3
56	10.9	9.9	10.1
57	9.3	8.8	8.7
58	9.3	8.5	8.6
59	10.6	9.8	10.1
60	10.7	9.8	10.5
61	9.8	9.1	9.2

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
62	11.0	10.2	10.6
63	10.1	9.3	9.5
64	10.8	9.8	10.0
65	10.1	9.2	9.6
66	9.8	9.0	9.1
67	10.4	9.5	9.8
68	9.9	8.8	9.2
69	10.3	8.9	9.6
70	10.1	9.3	9.3
71	10.4	9.6	9.8
72	10.4	9.5	9.6
73	10.7	9.9	10.1
74	10.4	9.5	9.7
75	10.8	9.6	10.0
76	10.2	9.4	9.5
77	10.0	9.2	9.4
78	9.8	8.8	9.0
79	9.7	8.8	9.0
80	10.9	10.2	10.2
80	10.2	9.6	9.5
81	10.3	9.1	9.5
82	9.7	9.0	9.0
83	9.6	8.7	8.9
84	10.0	9.2	9.3
85	9.9	9.4	9.2
86	10.3	9.8	9.3
87	9.3	8.7	8.6
88	9.4	8.7	8.7
89	9.4	8.9	8.9
91	9.2	8.5	8.6
92	9.4	8.4	8.7

Receptor	2016	2030 Reference Case	2030 Borough Plan Model
93	9.2	8.5	8.5
94	11.1	10.1	10.4
95	9.3	8.8	8.7
96	9.4	8.8	8.8
Objective	**25**		

A5 Nitrogen Dioxide Sensitivity Test Results

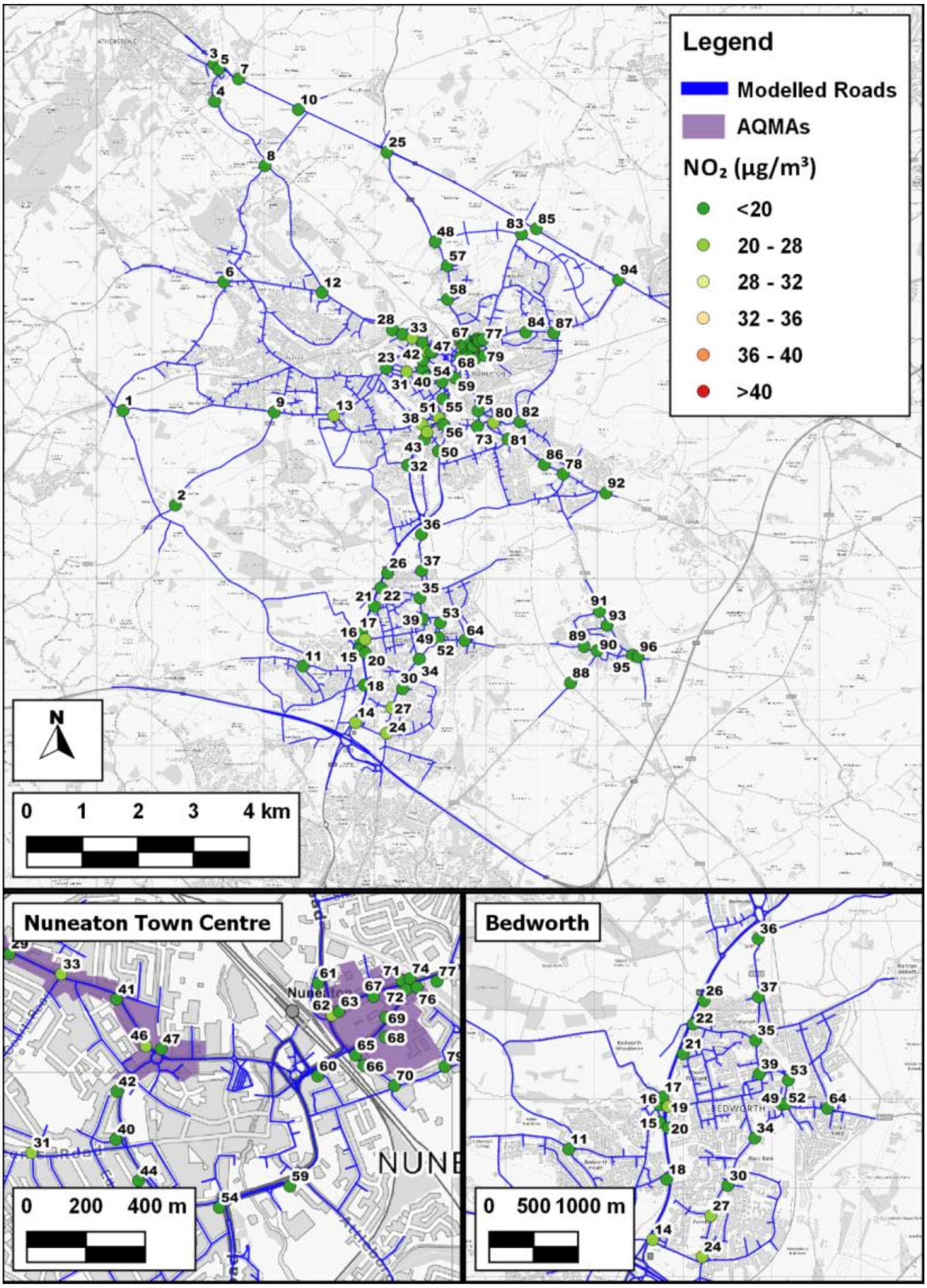

Figure A5.1: 2030 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth in the Reference Case in the Worst-case Sensitivity Test

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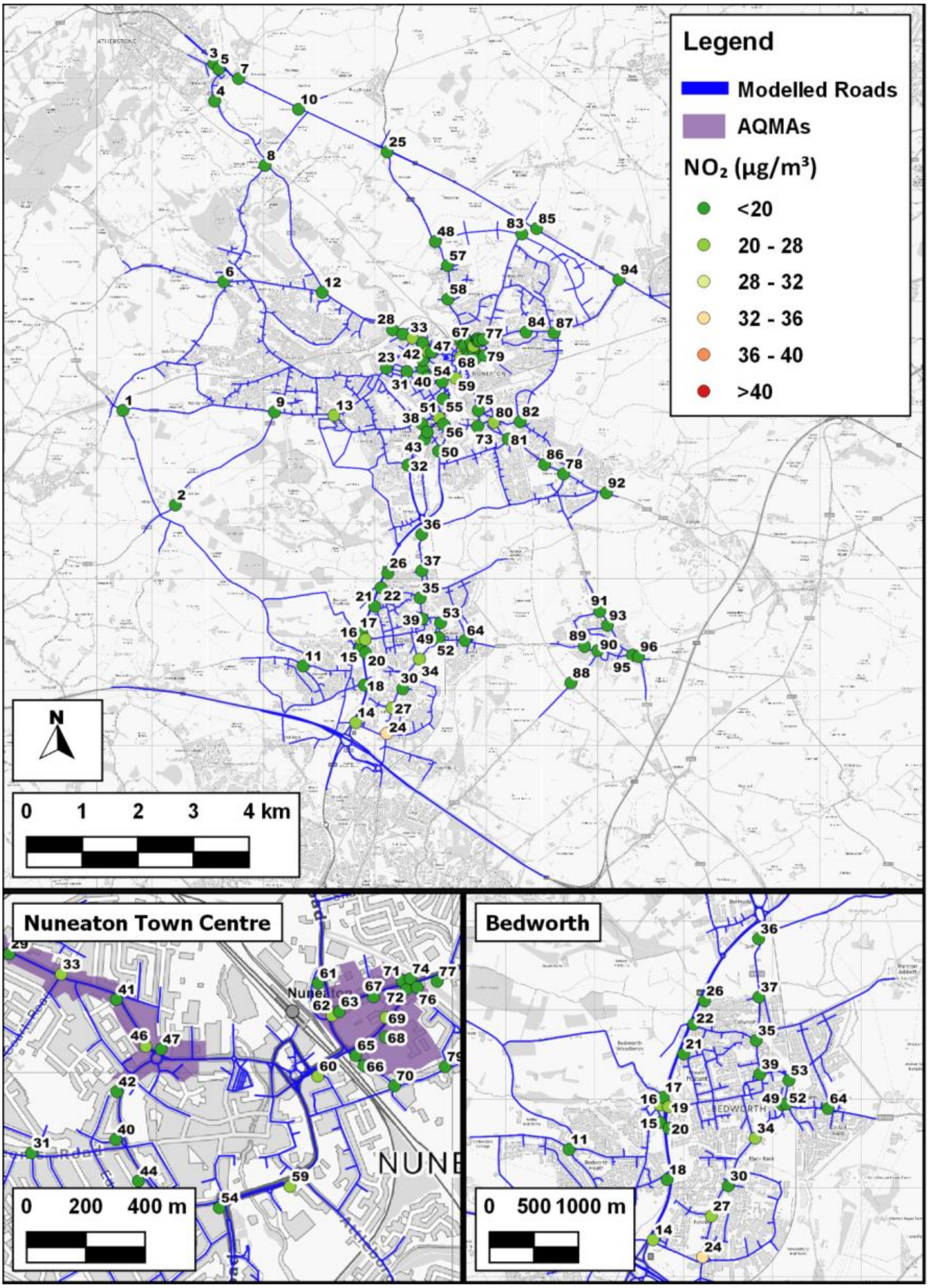

Figure A5.2: 2030 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth with the 'Borough Plan Model' implemented in the Worst-case Sensitivity Test

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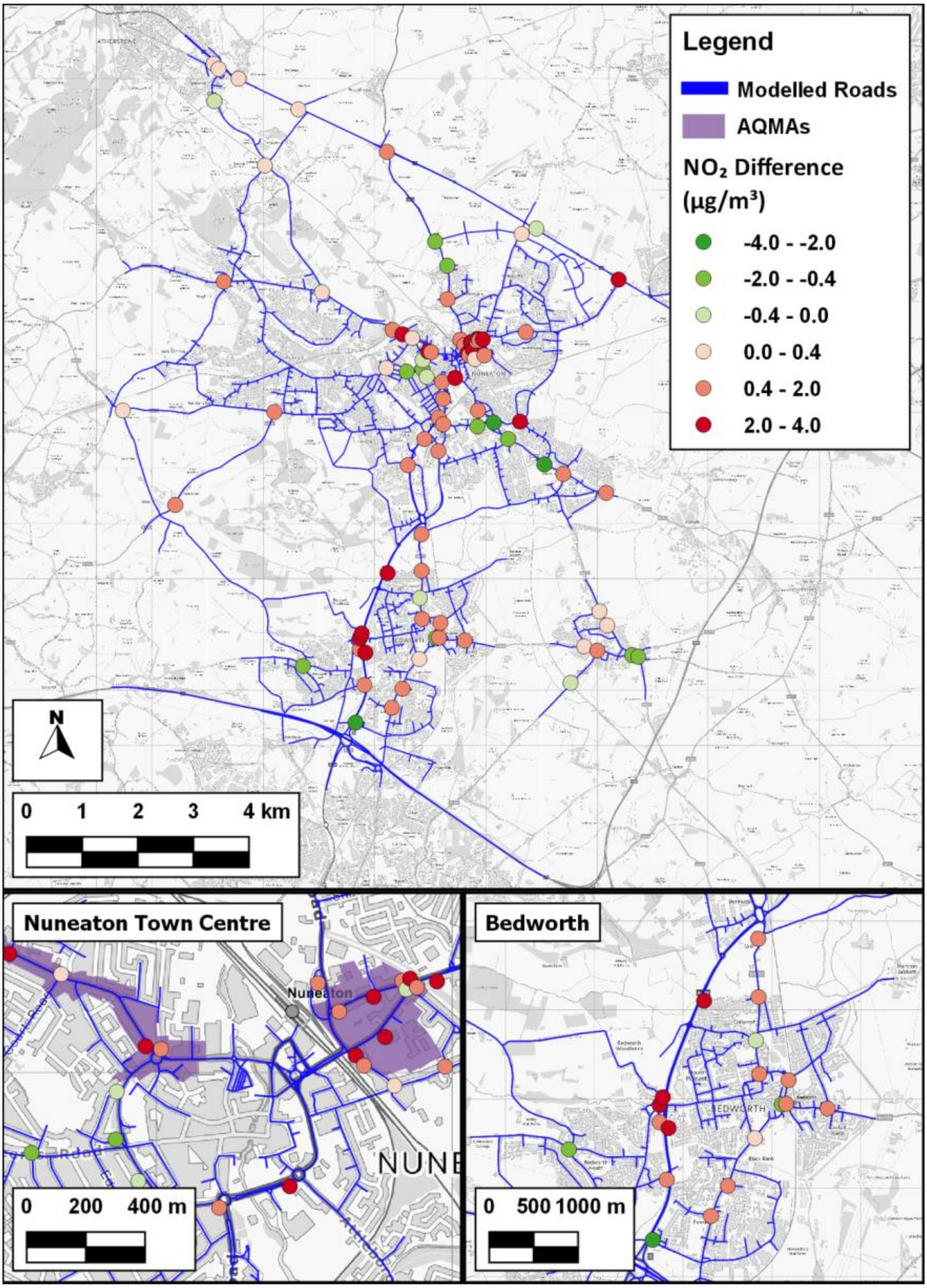

Figure A5.3: 2030 Difference in Nitrogen Dioxide Concentrations between the Reference Case and the Borough Plan Model in Nuneaton and Bedworth in the Worst-case Sensitivity Test

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