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 15 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 included 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 2015 there are exceedences of the annual mean nitrogen dioxide objective predicted in Nuneaton and Bedworth, which reflects the outcomes of the Review and Assessment process. There is also an identified nitrogen dioxide exceedence south of Bedworth which is not within a currently declared AQMA. For PM_{10} and $PM_{2.5}$, there are no exceedences of the objectives, either in 2015, or in any of the 2030 scenarios.

For all pollutants, there are much lower concentrations in 2030 than in 2015. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 15 years' time the 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.

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

Contents

1 Introduction

1.1 Nuneaton and Bedworth Borough Council (NBBC) has identified locations with measured exceedences 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 a new Borough Plan for Nuneaton and Bedworth, which will guide the area's future development for the next 15 years. The 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 included 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 Borough Plan in Nuneaton and Bedworth, paying particular attention to the AQMAs.

1.4 This report describes existing local air quality conditions (2015), which have also been used to verify the model, and the predicted air quality in 2030 assuming that the Borough Plan either does, or does not proceed.

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 consultation draft of the Nuneaton and Bedworth Council Borough Plan (Nuneaton and Bedworth Borough Council, 2015) was issued in 2015, with a revised submission to be consulted on in early 2017. 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: Enabling Maintainable Evolution', 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, 2016a). 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, 2016a). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence 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, 2016a). 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). 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.

2.13 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, exceedences of the 24-hour mean PM_{10} objective are possible (Defra, 2016a).

[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.

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). The monitoring sites and study area for Nuneaton and Bedworth are shown in Figure 1.

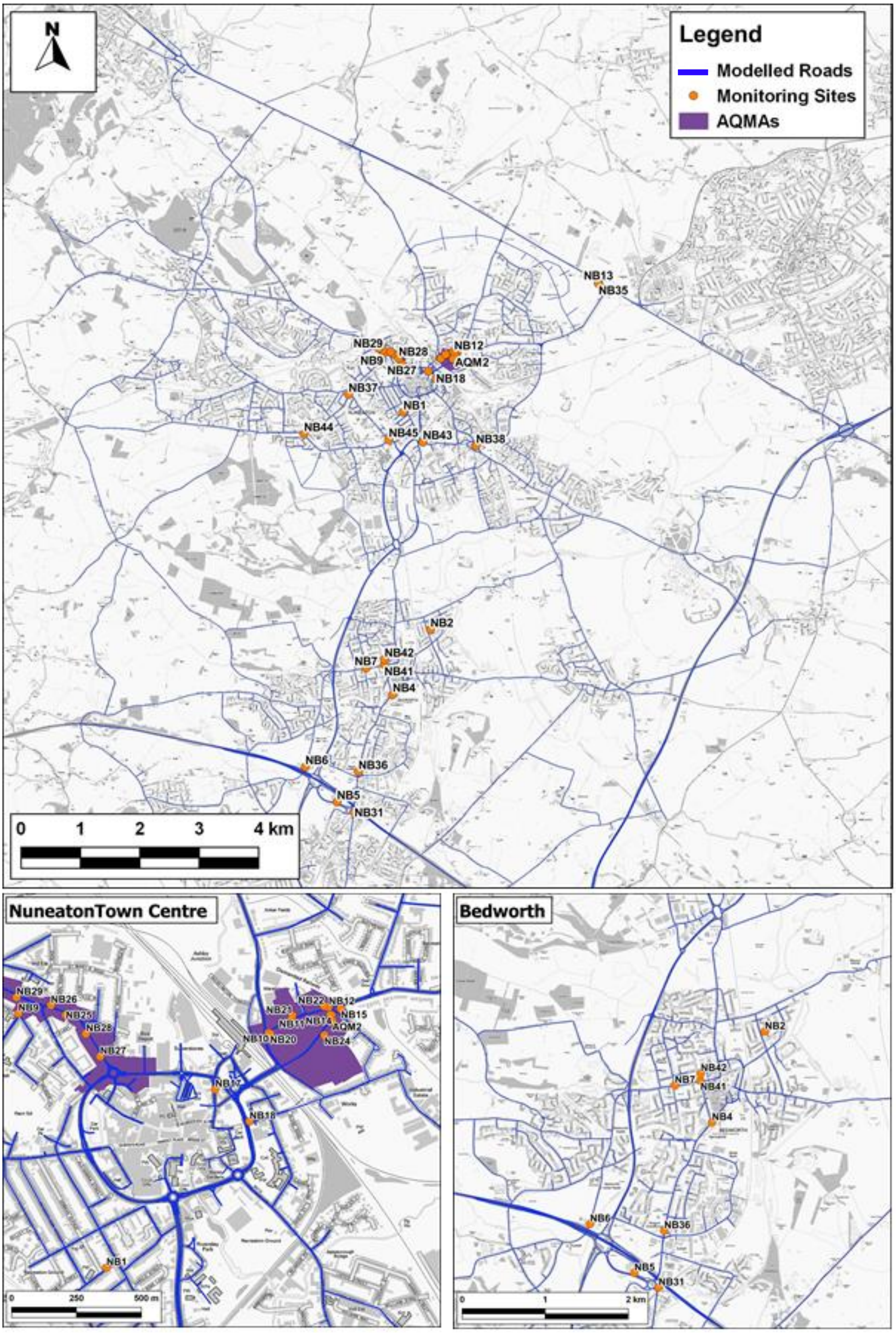

Figure 1: Nuneaton and Bedworth Planning Assessment Study Area, AQMAs and Monitoring Site Locations. Roads explicitly included in the model are shown in blue.

3.2 The results for nitrogen dioxide diffusion tube monitoring and real-time monitoring between 2011 and 2015 are presented in Table 2. There have been a number of exceedences of the annual mean nitrogen dioxide objective in Nuneaton and Bedworth over the last 5 years.

Table 2: Results of Nitrogen Dioxide Monitoring: Comparison with the Annual Mean Objective (2011 – 2015) [ab]

Site ID.	Site Type	Location	Within AQMA?	2011	2012	2013	2014	2015
Automatic Monitor - Annual Mean (µg/m^3)								
AQM2	Roadside	Leicester Road	Y	-	39.6	33.5	37.7	32.4
Objective			**40**					
Automatic Monitor - No. of Hours > 200 µg/m^3								
AQM2	Roadside	Leicester Road	Y	-	0 (121.7)	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
NB2	Urban Background	Conifer Close	N	21.8	24.3	20.5	19.7	19.6
NB4	Roadside	Coventry Road	N	35.1	34.7	35.5	32.4	33.3
NB5	Kerbside	Mc Donnell Drive	N	31.0	34.0	33.2	31.2	31.9
NB6	Kerbside	Tudor Court	N	34.7	36.2	34.0	33.7	34.6
NB7	Kerbside	Newdegate Road	N	33.0	36.2	33.5	34.4	31.9
NB9	Kerbside	Manor Court Road	N	31.1	31.5	30.6	31.0	29.5
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
NB13	Kerbside	64 Watling Street	N	36.3	38.4	37.0	37.4	34.2
NB14	Roadside	Leicester Road	N	**41.1**	39.8	35.0	37.5	36.9
NB15	Kerbside	Bridge Grove, Leics Road	N	30.7	33.2	31.5	28.6	30.3
NB17	Roadside	Bond Gate	N	36.1	39.1	35.9	32.8	33.4
NB18	Kerbside	Wheat Street	N	37.9	38.9	34.3	30.9	31.9
NB20	Roadside	17 Old Hinckley Road	Y	29.8	29.8	29.6	29.6	25.9

Site ID.	Site Type	Location	Within AQMA?	2011	2012	2013	2014	2015
NB21	Roadside	36 Old Hinckley Road	Y	32.9	32.3	29.6	29.6	29.4
NB22	Roadside	62 Old Hinkley Road	Y	28.4	28.9	24.8	24.8	25.2
NB23	Roadside	46 Leicester Road	Y	35.2	35.7	31.4	31.4	32.0
NB24	Roadside	31 Leicester Road	Y	26.7	28.9	31.4	31.4	23.3
NB25	Roadside	25 Central Avenue	Y	34.5	36.9	25.0	25.0	31.7
NB26	Roadside	26 Central Avenue	Y	30.3	33.4	31.1	31.1	29.6
NB27	Roadside	90 Corporation Street	Y	39.5	**44.3**	37.4	37.2	**40.3**
NB28	Roadside	138 Corporation Street	Y	39.3	**41.8**	37.1	36.5	36.3
NB29	Roadside	16 Midland Road	Y	**41.8**	**45.8**	**40.7**	**41.6**	**43.0**
NB30	Roadside	50 Midland Road	Y	**42.5**	**46.0**	37.8	**40.9**	**41.4**
NB31	Roadside	376 Longford Road	N	32.8	36.2	37.1	34.2	33.4
NB35	Roadside	62 Watling Street	N	26.1	28.2	26.2	24.8	24.8
NB36	Roadside	78 Bayton Road	N	35.1	39.1	38.1	35.0	36.5
NB37	Roadside	Jewsons (19 Croft Road)	N	31.6	33.2	32.0	31.6	31.8
NB38	Roadside	115 Highfield Road	N	28.6	33.9	29.6	28.6	27.4
NB41	Roadside	61 Mill Street	N	-	35.2	34.8	31.4	32.1
NB42	Roadside	18 George Street	N	-	29.2	28.7	30.4	28.2
NB43	Roadside	42 Hanover Glebe	N	-	-	-	-	27.4
NB44	Roadside	503 Heath End Road	N	-	-	-	-	30.1
NB45	Roadside	1 Heath End Road	N	-	-	-	-	26.3
Objective				**40**				

[a] Exceedences of the objectives are shown in bold.

[b] 2011 to 2015 data have been taken from the 2016 Air Quality Annual Status Report (ASR) (Nuneaton and Bedworth Borough Council, 2016). 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 A2.6).

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.

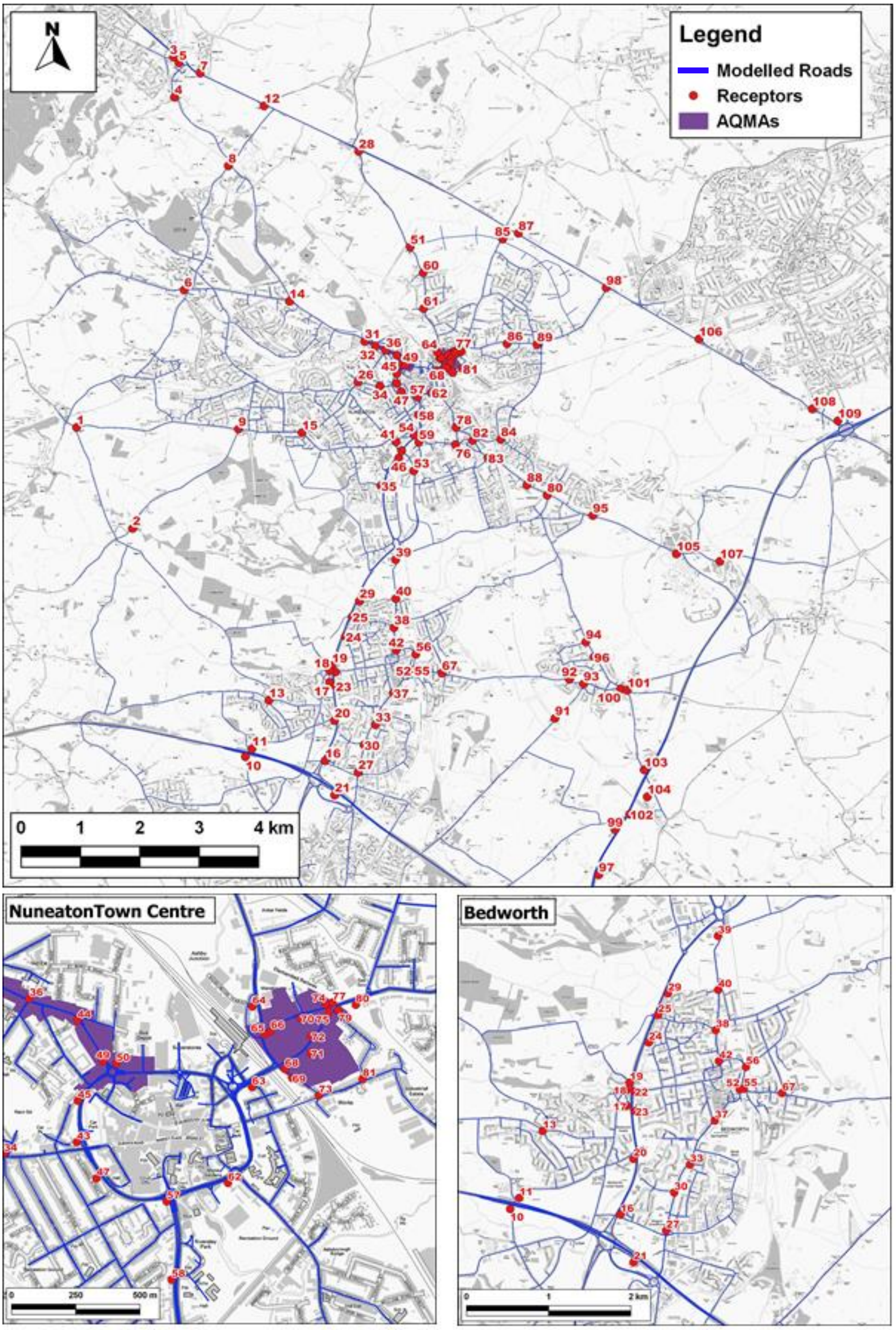

Figure 2: AQMAs and Receptor Locations in Nuneaton and Bedworth

Assessment Scenarios

3.5 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2015), and for a future year (2030)[1]. For 2030, scenarios have been modelled assuming that the Borough Plan, does proceed ('Borough Plan Model'), or does not proceed ('Reference Case').

Baseline Concentrations

3.6 Baseline concentrations for nitrogen dioxide in Nuneaton and Bedworth for 2015 are illustrated in Figure 3. There is a modelled exceedence south of Bedworth which is not within a currently declared AQMA. Baseline concentrations in 2030 ('Reference Case') are illustrated in Figure 4. No exceedences of objectives are predicted in 2030.

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

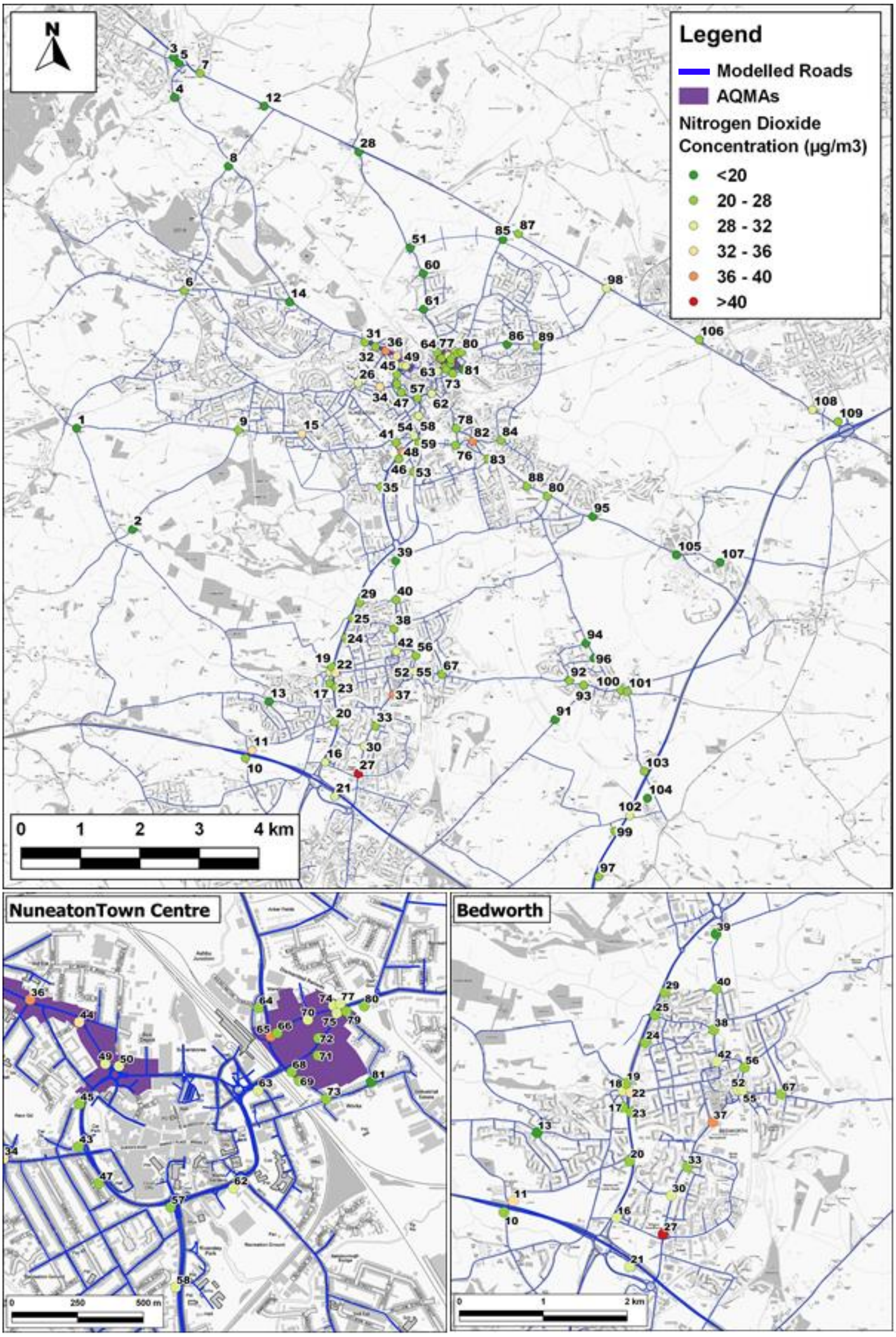

Figure 3: 2015 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth

The numbers on the maps are the receptor numbers.

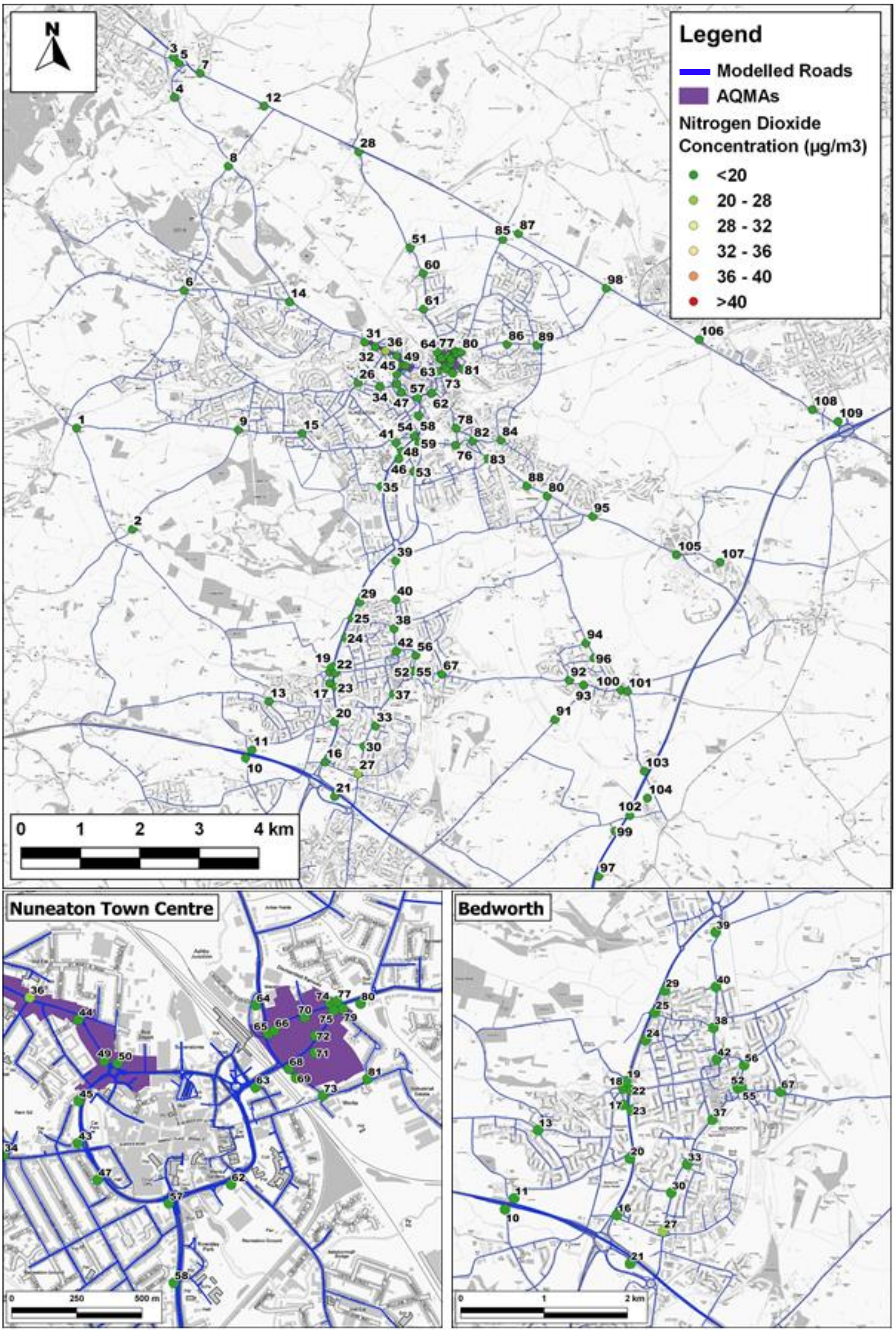

Figure 4: 2030 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth

The numbers on the maps are the receptor numbers. Contains Ordnance Survey data © Crown copyright and database right 2016

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 A3 for the "Borough Plan Model" and "Reference Case" scenarios. 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 2015. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 15 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 15 years' time, due to reductions in various contributing sectors.

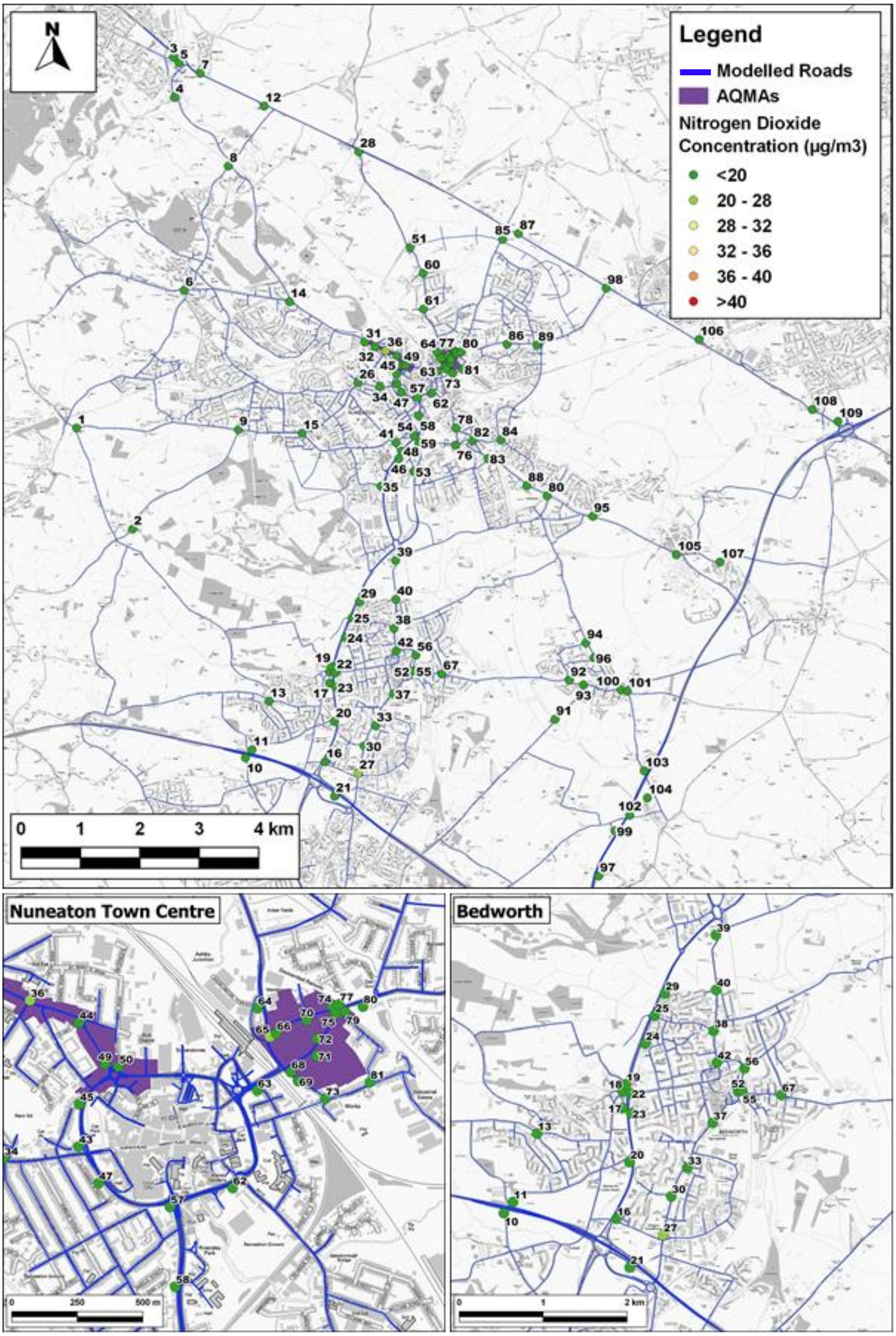

Figure 5: 2030 Nitrogen Dioxide Annual Mean Concentrations in Nuneaton and Bedworth with the 'Borough Plan Model' Implemented

The numbers on the maps are the receptor numbers. Contains Ordnance Survey data © Crown copyright and database right 2016

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). There are more negative changes than positive. Negative changes are identified within currently declared AQMAs and more widely within the town centres of Nuneaton and Bedworth. While most changes are negligible, at two receptors (25 and 41) there will be an increase of up to 3.2 µg/m^3, which would be classed as a slight adverse impact using the criteria set out in the approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[2] (EPUK & IAQM, 2015). These two receptors are both located adjacent to junction improvements (A444/Sutherland Drive and B4112/Bull Ring), where road traffic will be moved slightly closer to the receptors in the Borough Plan Model. Beneficial impacts are mainly seen along the motorways and arterial roads.

[2] The IAQM is the professional body for air quality practitioners in the UK.

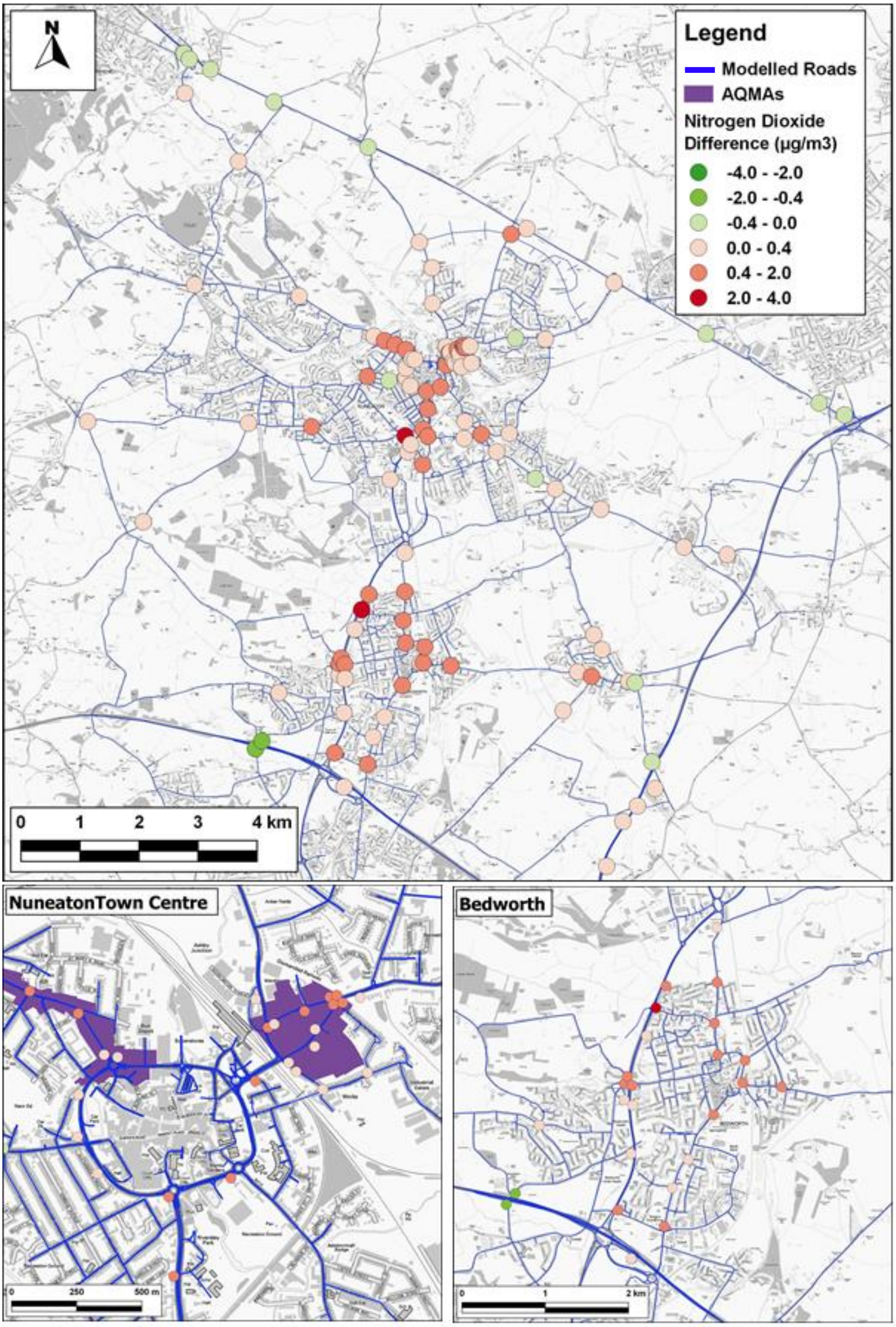

Figure 6: 2030 Difference in Nitrogen Dioxide Concentrations between the Reference Case and the Borough Plan Model in Nuneaton and Bedworth

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 2015 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 A2). 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 A2). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2015) 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 Historically, large reductions in nitrogen oxides emissions have been projected, which has led to significant reductions in nitrogen dioxide concentrations from one year to the next being predicted. Over time, it was found that trends in measured concentrations did not reflect the rapid reductions that Defra and DfT had predicted (Carslaw, Beevers, Westmoreland, & Williams, 2011). This was evident across the UK, although the effect appeared to be greatest in Inner London; there was also considerable inter-site variation. Emission projections over the 6 to 8 years prior to 2009 suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25%, whereas monitoring data showed that concentrations remained relatively stable, or even showed a slight increase. Analysis of more recent data for 23 roadside sites in London covering the period 2003 to 2012 showed a weak downward trend of around 5% over the ten years (Carslaw & Rhys-Tyler, 2013), but this still falls short of the improvements that had been predicted at the start of this period. This pattern of no clear, or limited, downward trend is mirrored in the monitoring data assembled for this study, as set out earlier in Paragraph 3.2.

4.10 The reason for the disparity between the expected concentrations and those measured relates to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have had to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles has often been no better than that of earlier models. This has been compounded by an increasing proportion of nitrogen dioxide in the nitrogen oxides emissions, i.e. primary nitrogen dioxide, which has a significant effect on roadside concentrations (Carslaw, Beevers, Westmoreland, & Williams, 2011) (Carslaw & Rhys-Tyler, 2013).

4.11 A detailed analysis of emissions from modern diesel vehicles has been carried out (AQC, 2016a). This shows that although previous standards had limited on-road success, the ‘Euro VI’ and ‘Euro 6’ standards that new vehicles have had to comply with from 2013/16[3] are delivering real on-road improvements. By 2030, these vehicles will make up the majority of the fleet on the roads in the UK, which will lead to much lower pollutant concentrations.

3 Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

5 Summary and Conclusions

5.1 In 2015 there are measured exceedences of the annual mean nitrogen dioxide objective predicted in Nuneaton and Bedworth, which reflects the outcomes of the Review and Assessment process. There is also an identified modelled exceedence south of Bedworth which is not within a currently declared AQMA. For PM_{10} and $PM_{2.5}$, there are no exceedences of the objectives, either in 2015, or in any of the 2030 scenarios.

5.2 For all pollutants, there are much lower concentrations in 2030 than in 2015. This reduction is associated with the introduction of more stringent emissions controls on new vehicles via Euro standards; in 15 years' time the 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.

5.3 The Borough Plan proposals will result in negligible changes in concentrations across the borough, including at town centre locations and within the AQMAs in Nuneaton. No exceedences of the air quality objectives are predicted for 2030. With the proposed 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. Two 'slight adverse' increases for annual mean nitrogen dioxide have been identified, where junction improvements within the Borough Plan Model move traffic slightly closer to sensitive locations. It is thus recommended that detailed assessments are carried out for these two junction improvements before any highway works begin. The same patterns are apparent for PM_{10}, although the magnitudes of change are smaller.

6 References

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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
Exceedence	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
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 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

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

Dr Beattie is a Principal Consultant with AQC, with more than fifteen 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 AMIEnvSc MIAQM

Dr Cogan is a Senior Consultant with AQC and has over four years' experience in the fields of air quality modelling, monitoring and assessment. Prior to this he studied at the University of Leicester, gaining 2 years' experience of scientific instrument design and spent 4 years' pioneering research in satellite observations of carbon dioxide, including data validation, model comparisons, bias correction and software development. He now works in the field of air quality assessment and has 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.

Nicole Holland, BSc (Hons) AIEMA

Miss Holland is an Assistant Consultant. Since joining AQC in March 2016, Nicole has gained experience in the assessment of air quality impacts for a range of residential and commercial projects using qualitative and quantitative methods, including dispersion modelling using ADMS-5 and ADMS-Roads. Nicole has also gained significant experience in undertaking construction dust risk assessments and Air Quality Neutral assessments, and in preparing local authority Annual Status Reports (ASRs). Prior to joining AQC, Nicole worked as an Environmental Consultant at RSK, where she was responsible for the development of a variety of environmental and social management documents for Environmental and Social Management Systems (ESMSs) and Environmental and Social Impact Assessments (ESIAs).

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

A2 Modelling Methodology

Background Concentrations

A2.1 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2016b). 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 primary roads, trunk roads and motorways have been removed from the background concentrations to avoid any double counting from road traffic emissions.

Model Inputs

A2.2 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 7) published by Defra (2016b).

A2.3 Hourly sequential meteorological data from Coventry for 2015 have been used in the model. The Coventry meteorological monitoring station is located at Coventry Airport, approximately 10 km to the south of Nuneaton and Bedworth, with the Coventry 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. Coventry meteorological monitoring station is therefore deemed to be the nearest monitoring station representative of meteorological conditions in Nuneaton and Bedworth.

A2.4 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 and ADMS-roads may therefore have over predicted concentrations at the façades of existing properties along these roads.

A2.5 AADT flows, proportions of HDVs and speeds have been provided by NBBC. These were derived from the S-Paramics Micro-simulation traffic model. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (DfT, 2011).

Model Verification

A2.6 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.

A2.7 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 2015 at all Nuneaton and Bedworth monitoring sites.

A2.8 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 4.1) available on the Defra LAQM Support website (Defra, 2016b).

A2.9 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 A2.1). The calculated adjustment factor of 1.676 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A2.10 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A2.2 compares final adjusted 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, the main ones being the three monitoring sites within the Midland Road/Corporation Street AQMA that are exceeding the annual mean objective level (NB27, NB29 and NB30). The final adjusted modelled total NO_2 at these three monitoring sites are below the objective level, leading to an under-prediction of concentrations at these locations. Conversely, the final adjusted modelled total NO_2 at other monitoring sites are over-predicted. Notably, the concentrations at five monitoring sites are above the objective level (NB4, NB6, NB9, NB10 and NB36), while the measured concentrations are below. This includes two monitoring sites within the AQMA (NB9 and NB10). While some locations may be over-predicted or under-predicted, the overall conclusions are considered to be representative of Nuneaton and Bedworth.

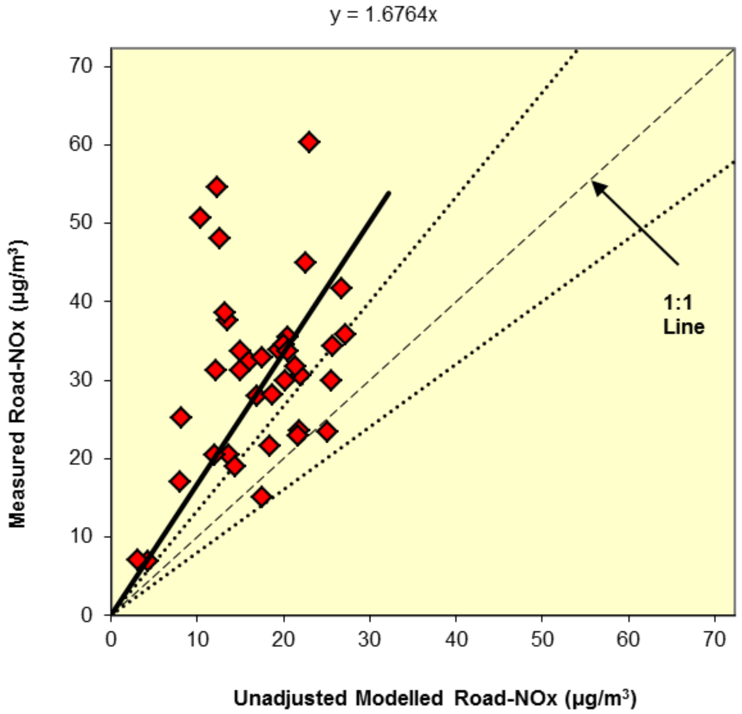

Figure A2.1: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

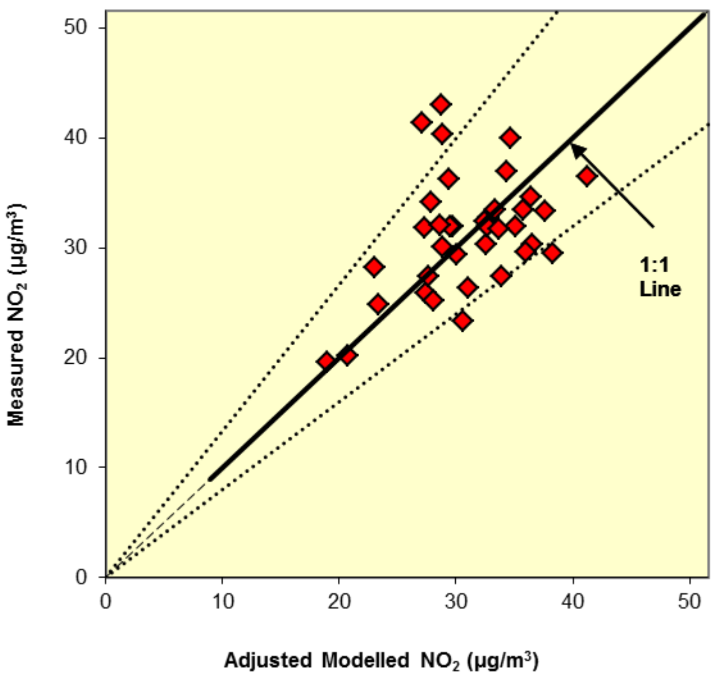

Figure A2.2: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A2.11 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 $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factors calculated for road NO_x.

Model Post-processing

A2.12 The model predicts road-NOx concentrations at each receptor location. These concentrations have then been adjusted using the primary adjustment factor, which, along with the background NO_2, is processed through the NOx from NO_2 calculator available on the Defra LAQM Support website (Defra, 2016c). The traffic mix within the calculator was set to “All 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. This is then adjusted by the secondary adjustment factor to provide the final predicted concentrations.

A3 Predicted Concentrations

Table A3.1: Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Receptors

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
1	17.1	10.4	10.5
2	16.6	10.3	10.3
3	19.4	11.0	11.0
4	19.7	11.4	11.5
5	18.6	10.8	10.8
6	24.8	13.2	13.4
7	24.5	13.1	13.0
8	18.6	11.7	11.9
9	23.5	13.5	13.8
10	26.4	14.5	12.8
11	34.1	17.7	15.8
12	17.8	10.4	10.3
13	19.2	11.3	11.3
14	19.8	12.9	12.9
15	34.9	16.6	18.5
16	31.5	16.1	16.7
17	23.7	13.0	13.3
18	31.6	15.9	16.8
19	25.7	13.2	13.8
20	24.0	13.2	13.5
21	31.3	16.9	17.0
22	34.7	16.7	17.4
23	27.8	14.3	14.6
24	22.4	12.8	13.1
25	25.2	13.9	17.1
26	30.5	16.9	17.3
27	43.5	22.4	22.9

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
28	18.9	11.2	11.1
29	21.0	11.8	12.2
30	31.9	18.2	18.2
31	23.5	15.4	15.7
32	27.7	17.1	17.6
33	24.7	13.8	13.8
34	34.1	18.4	18.3
35	20.7	12.5	12.9
36	37.3	20.6	21.3
37	39.1	18.2	18.8
38	24.3	13.6	14.3
39	19.9	11.4	11.7
40	24.8	13.2	13.9
41	27.9	15.1	17.4
42	28.5	14.8	15.6
43	26.5	15.4	15.4
44	33.2	19.2	19.7
45	24.0	14.6	14.8
46	25.5	14.4	14.8
47	22.5	14.0	14.1
48	38.5	18.9	19.2
49	31.1	18.0	18.3
50	29.3	16.2	16.4
51	16.1	9.7	9.9
52	28.8	15.4	15.7
53	23.0	14.4	15.1
54	30.6	17.2	18.1
55	30.6	15.8	16.2
56	27.8	15.4	16.0
57	26.5	15.7	16.1
58	28.7	16.8	17.7

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
59	27.3	15.4	16.2
60	19.6	12.0	12.2
61	18.2	11.3	11.4
62	29.6	16.9	17.7
63	31.2	17.3	17.8
64	22.9	13.7	14.0
65	36.6	19.7	20.7
66	26.2	15.1	15.5
67	28.0	14.7	15.3
68	25.8	15.0	15.4
69	21.7	13.3	13.6
70	29.6	16.7	17.2
71	22.7	13.8	14.1
72	27.1	15.7	16.1
73	21.2	13.6	13.8
74	29.3	16.5	17.2
75	28.2	15.9	16.3
76	26.2	15.2	15.6
77	28.5	16.1	16.8
78	27.8	16.2	16.3
79	26.2	15.1	15.6
80	24.0	14.3	14.7
80	21.4	12.3	12.6
81	19.6	12.6	12.7
82	37.2	17.7	18.4
83	24.0	14.0	14.3
84	26.5	14.3	14.7
85	16.0	9.9	11.2
86	19.6	11.9	11.9
87	21.4	11.7	11.9
88	20.3	11.9	11.7

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
89	22.5	12.6	12.7
91	17.6	11.0	11.2
92	20.1	11.6	11.9
93	24.4	12.9	13.5
94	17.1	10.3	10.6
95	17.8	10.7	10.7
96	16.7	10.2	10.3
97	24.2	13.7	13.7
98	30.3	16.9	17.0
99	24.5	13.9	14.0
100	21.8	12.1	12.2
101	24.4	12.8	12.8
102	29.5	16.2	16.2
103	23.3	13.1	13.1
104	17.9	11.0	11.0
105	15.8	10.1	10.1
106	26.3	15.0	15.0
107	17.0	10.3	10.4
108	30.9	15.5	15.4
109	26.6	13.2	13.1
Objective		**40**	

Table A3.2: Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$) at Receptors

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
1	15.7	14.7	14.7
2	16.0	15.1	15.1
3	16.2	15.2	15.2
4	16.2	15.2	15.2
5	16.2	15.2	15.2
6	17.0	15.7	15.8

7	17.1	16.1	16.1
8	15.5	14.5	14.5
9	16.2	15.0	15.0
10	19.6	18.6	18.3
11	20.6	19.4	19.1
12	16.8	15.9	15.9
13	16.8	15.8	15.8
14	15.4	14.5	14.5
15	18.5	17.1	17.6
16	21.1	20.1	20.3
17	17.9	16.9	17.0
18	19.3	18.1	18.5
19	17.7	16.6	16.9
20	18.0	17.0	17.1
21	20.2	19.0	19.1
22	19.8	18.6	18.9
23	18.7	17.5	17.7
24	16.8	15.8	16.0
25	17.4	16.3	17.4
26	17.8	16.5	16.6
27	23.9	22.5	22.4
28	16.4	15.5	15.5
29	16.8	15.9	16.1
30	21.9	20.7	20.7
31	16.3	15.2	15.3
32	16.9	15.8	16.1
33	17.3	16.2	16.3
34	18.4	17.0	17.0
35	16.4	15.3	15.5
36	18.2	17.0	17.3
37	19.4	18.0	18.2
38	17.1	16.0	16.3

39	16.6	15.6	15.8
40	17.5	16.4	16.7
41	17.6	16.3	17.0
42	17.5	16.4	16.7
43	17.0	15.9	15.9
44	17.9	16.8	16.9
45	16.8	15.8	15.8
46	17.3	16.2	16.3
47	16.5	15.4	15.5
48	19.2	17.8	17.8
49	17.4	16.2	16.3
50	17.4	16.3	16.4
51	15.3	14.3	14.4
52	17.6	16.3	16.4
53	17.6	16.5	16.8
54	18.7	17.6	17.9
55	17.9	16.5	16.6
56	17.3	16.2	16.4
57	17.5	16.4	16.6
58	18.2	17.2	17.6
59	18.2	16.9	17.2
60	15.6	14.7	14.7
61	15.2	14.3	14.3
62	18.0	16.9	17.2
63	18.0	16.9	17.1
64	16.4	15.3	15.4
65	18.7	17.7	18.0
66	16.9	15.9	16.0
67	17.9	16.3	16.5
68	16.8	15.8	15.9
69	16.1	15.1	15.2
70	17.7	16.8	16.7

71	16.3	15.4	15.4
72	17.1	16.2	16.3
73	16.7	15.6	15.7
74	17.6	16.6	16.6
75	17.2	16.2	16.3
76	18.2	16.9	17.1
77	17.4	16.5	16.4
78	18.0	16.8	16.9
79	16.9	16.0	16.0
80	16.6	15.6	15.6
80	16.1	15.0	15.1
81	15.8	14.8	14.9
82	18.4	17.0	17.2
83	16.8	15.8	15.9
84	17.1	15.9	16.0
85	15.9	15.2	15.6
86	15.6	14.6	14.5
87	16.7	15.8	15.8
88	16.3	15.2	15.1
89	16.6	15.6	15.6
91	15.8	14.8	14.9
92	16.1	14.9	15.0
93	16.3	15.1	15.2
94	15.5	14.4	14.5
95	15.6	14.5	14.5
96	15.4	14.4	14.4
97	18.4	17.3	17.3
98	18.7	17.7	17.7
99	18.4	17.3	17.3
100	16.0	14.9	14.9
101	16.2	15.1	15.1
102	19.0	17.8	17.8

103	18.8	17.7	17.7
104	16.2	15.2	15.2
105	16.0	15.0	15.0
106	18.3	17.3	17.3
107	17.3	16.3	16.4
108	18.4	17.5	17.5
109	17.5	16.4	16.4
Objective	**40**		

Table A3.3: Predicted Annual Mean $PM_{2.5}$ concentrations (µg/m^3) at Receptors

Receptor	2015	2030 Reference Case	2030 Borough Plan Model
1	11.2	10.3	10.3
2	11.3	10.4	10.4
3	11.7	10.8	10.8
4	11.6	10.6	10.7
5	11.7	10.8	10.8
6	12.3	11.1	11.2
7	12.3	11.3	11.3
8	11.1	10.1	10.2
9	11.8	10.7	10.7
10	13.5	12.5	12.3
11	14.2	13.0	12.8
12	11.7	10.8	10.8
13	11.9	11.0	11.0
14	11.2	10.3	10.3
15	12.9	11.6	11.9
16	14.3	13.2	13.4
17	12.6	11.6	11.6
18	13.4	12.2	12.4
19	12.3	11.3	11.4
20	12.6	11.6	11.7
21	13.9	12.7	12.7

22	13.8	12.5	12.7
23	13.1	11.9	12.0
24	12.0	11.0	11.1
25	12.3	11.3	11.9
26	12.8	11.6	11.7
27	16.4	15.0	15.0
28	11.5	10.7	10.7
29	11.8	10.9	11.0
30	15.2	14.0	14.0
31	11.8	10.9	10.9
32	12.2	11.2	11.3
33	12.3	11.3	11.3
34	13.2	11.9	11.9
35	11.8	10.8	10.9
36	13.0	11.8	12.0
37	13.7	12.3	12.4
38	12.2	11.1	11.3
39	11.7	10.8	10.8
40	12.2	11.2	11.4
41	12.5	11.3	11.7
42	12.4	11.3	11.5
43	12.3	11.3	11.3
44	12.8	11.7	11.8
45	12.2	11.2	11.2
46	12.3	11.2	11.3
47	12.0	11.0	11.0
48	13.5	12.1	12.1
49	12.5	11.4	11.5
50	12.4	11.3	11.4
51	10.9	10.0	10.0
52	12.5	11.4	11.4
53	12.4	11.4	11.6

54	13.1	12.0	12.2
55	12.7	11.5	11.5
56	12.4	11.3	11.4
57	12.5	11.4	11.5
58	12.9	11.8	12.1
59	12.8	11.6	11.8
60	11.2	10.3	10.4
61	11.0	10.1	10.1
62	12.8	11.7	11.8
63	12.8	11.7	11.8
64	11.8	10.8	10.9
65	13.2	12.1	12.3
66	12.1	11.1	11.2
67	12.7	11.3	11.5
68	12.0	11.0	11.1
69	11.6	10.7	10.7
70	12.6	11.6	11.6
71	11.8	10.8	10.9
72	12.2	11.3	11.3
73	12.0	11.0	11.0
74	12.5	11.5	11.5
75	12.3	11.3	11.3
76	12.7	11.6	11.7
77	12.4	11.4	11.4
78	12.8	11.6	11.7
79	12.1	11.1	11.2
80	11.9	10.9	11.0
80	11.5	10.5	10.5
81	11.5	10.5	10.6
82	13.0	11.7	11.8
83	12.0	11.0	11.0
84	12.2	11.1	11.1

85	11.2	10.4	10.7
86	11.2	10.3	10.3
87	11.7	10.8	10.8
88	11.5	10.6	10.5
89	11.7	10.8	10.8
91	11.3	10.4	10.4
92	11.5	10.5	10.5
93	11.6	10.5	10.6
94	11.0	10.1	10.1
95	11.1	10.1	10.1
96	11.0	10.1	10.1
97	12.7	11.6	11.7
98	13.1	12.0	12.0
99	12.7	11.6	11.6
100	11.4	10.4	10.4
101	11.6	10.5	10.5
102	13.1	11.9	11.9
103	12.9	11.8	11.8
104	11.4	10.5	10.5
105	11.3	10.5	10.5
106	12.7	11.8	11.8
107	11.9	11.1	11.1
108	12.8	11.7	11.7
109	12.2	11.2	11.2
Objective		**25**	