AQMA Review for Tunbridge Wells Borough Council

October 2016

Experts in air quality
management & assessment

Document Control

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Contents

Tunbridge Wells Borough Council confirms that it accepts the recommendations made in this report.

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Tunbridge Wells Borough Council (TWBC) to review the extent of the Air Quality Management Area (AQMA) and to undertake a Source Apportionment Study. In 2004, Tunbridge Wells Borough Council declared an AQMA along the A26 in Tunbridge Wells (subsequently amended in 2011), for exceedences of the annual mean nitrogen dioxide objective. The extent of the AQMA is shown in Figure 1.

1.2 The aim of this study is to quantify the source contributions to exceedences of the annual mean nitrogen dioxide objective in the Tunbridge Wells AQMA, and to then quantify the improvements needed to meet the objective. These steps are intended to inform the action planning process. The study also reviews geographical extent of the exceedence area in Tunbridge Wells.

Background

1.3 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out a framework for air quality management, which includes a number of air quality objectives. National and international measures have achieved these objectives in most locations, but where areas of poor air quality remain, air quality management at a local scale has a particularly important role to play. Part IV of the Environment Act 1995 requires local authorities to periodically review and assess air quality in their areas. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved. These locations must be designated as AQMAs and a subsequent Air Quality Action Plan (AQAP) developed in order to reduce pollutant emissions in pursuit of the objectives.

1.4 Local Authorities in England are required to produce Annual Status Reports (ASR) detailing progress of Action Plan measures, air quality monitoring data and screening of changes to pollutant emissions within its administrative area.

1.5 Tunbridge Wells Borough Council developed an Air Quality Action Plan (AQAP) in 2009 (Tunbridge Wells Borough Council, 2009). This details measures to improve air quality including traffic management measures, improving public transport, parking measures, travel plans and cycling measures.

1.6 The purpose of source apportionment is to understand the contribution of all sources of emissions to exceedences of the air quality objectives. This determines the extent to which different key transport sources contribute to pollutant concentrations in order to assist in targeting measures within the AQAP.

The Air Quality Objectives

1.7 The Government's Air Quality Strategy (Defra, 2007) provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. The 'standards' are set as concentrations below which health 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 a particular 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 the costs, benefits, feasibility and practicality of achieving the standards. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. The objectives are prescribed within The Air Quality (England) Regulations 2000 (The Air Quality (England) Regulations, 2000, Statutory Instrument 928, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043, 2002). Table 1 summarises the objectives which are relevant to this report. Appendix 1 provides a brief summary of the health effects of nitrogen dioxide.

Table 1: Air Quality Objectives for Nitrogen Dioxide

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 $\mu g/m^3$

1.8 The air quality objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective (i.e. where people will be exposed to pollutants). For annual mean objectives, relevant exposure is limited to residential properties, schools and hospitals. The 1-hour objective applies at these locations as well as at any outdoor location where a member of the public might reasonably be expected to stay for 1 hour or more, such as shopping streets, parks and sports grounds, as well as bus stations and railway stations that are not fully enclosed.

1.9 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60 $\mu g/m^3$ (Defra, 2009). Thus exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration are used as an indicator of potential exceedences of the 1-hour nitrogen dioxide objective.

2 Assessment Approach

Monitoring

2.1 Tunbridge Wells Borough Council operates one automatic site measuring nitrogen dioxide and PM_{10} concentrations.

2.2 The Council also monitors nitrogen dioxide concentrations at 23 passive diffusion tubes sites within the Borough, nine of which are within the study area of this assessment. Diffusion tube monitoring results for 2015 have not been included within the study due to poor data capture. Diffusion tubes were prepared and analysed by Environmental Services Group (ESG) using the 50% TEA in acetone method. It is necessary to adjust diffusion tube data to account for laboratory bias; for 2014 a bias adjustment factor of 0.78 was used (Tunbridge Wells Borough Council, 2015). The monitoring sites and the AQMA boundary are shown in Figure 1.

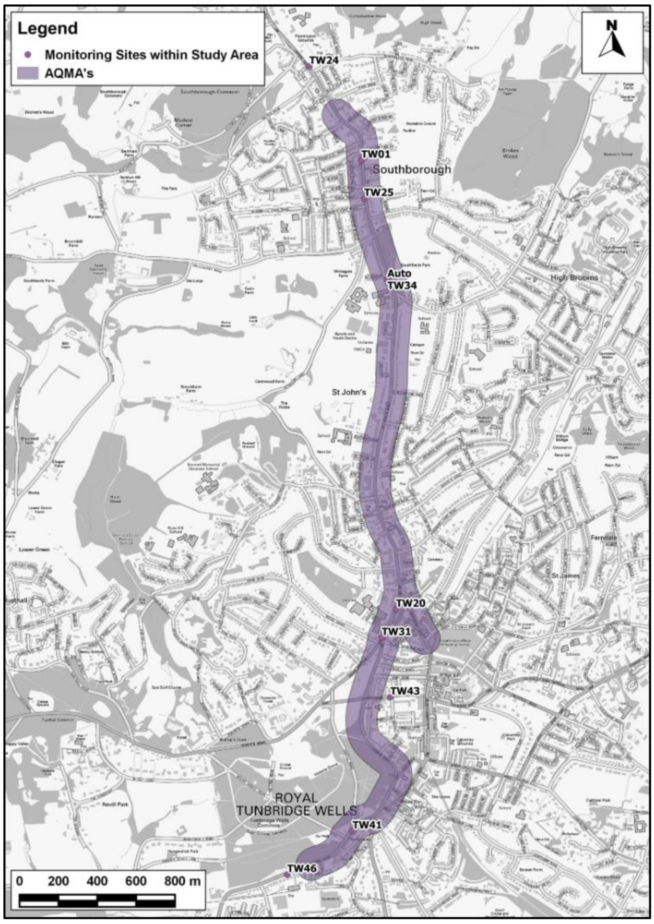

Figure 1: Monitoring Locations and AQMA Boundary

Modelling

2.3 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (using ADMS-Roads v4.1). Modelling and verification has been undertaken for 2014, as the diffusion tube monitoring sites have poor data capture for 2015. Details of the model inputs and the model verification are provided in Appendix A2, together with the method used to derive the current background nitrogen dioxide concentrations. Concentrations have been predicted across a gridded area at ground-floor (1.5 m) level, as well as at 13 specific receptors as shown in Figure 2.

2.4 Specific receptors have been modelled at 1.5 m or 4.5 m height, depending on the location of relevant exposure.

Figure 2: Selected Receptors

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Traffic Data

2.5 Traffic data for the assessment have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2016) supplemented by data collected by Kent County Council. Further details of the traffic data used in this assessment are provided in Appendix A2.

Uncertainty in Road Traffic Modelling Predictions

2.6 There are many components that contribute to the uncertainty of modelling predictions. All values presented in this report are the best possible estimates, but uncertainties in the results might cause over- or under-predictions. All of the measured concentrations presented have an intrinsic margin of error. (Defra, 2016) suggest that this is of the order of plus or minus 20% for diffusion tube data.

2.7 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. For example, it has been assumed that wind conditions measured at Gatwick Airport during 2014 will have occurred throughout the study area during 2014 and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain.

2.8 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 (2014) concentrations. Data available for 2015 from the automatic monitor suggest 2014 may be relatively worst case.

2.9 The limitations to the assessment should be borne in mind when considering the results set out in the following sections. Whilst the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. The results are ‘best estimates’ and have been treated as such in the outcomes that have been drawn.

2.10 The professional experience of the consultants preparing the report is set out in Appendix A1.

3 Results

Monitoring

3.1 Monitoring data (2010 to 2015) for the 10 sites within the study area are summarised in Table 2. Diffusion tube monitoring results for 2015 have not been included due to poor data capture.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2010-2015) [a] [b]

Site Name	Site Type	Location	2010	2011	2012	2013	2014	2015
Automatic Monitor - Annual Mean (µg/m^3)								
A26 Roadside	Roadside	A26 St John's Road, Southborough	**59**	**43**	**48**	**47**	**48**	**44**
Objective			40					
Automatic Monitor - No. of Hours > 200 µg/m^3								
A26 Roadside	Roadside	A26 St John's Road, Southborough	1	0	1	0	0	0
Objective			18					
Diffusion Tubes - Annual Mean (µg/m^3)								
TW01	Roadside	62 London Road, Southborough	**53**	36	**46**	**41**	**42**	n/a
TW20	Roadside	Mount Ephraim	**57**	38	**47**	**44**	**43**	n/a
TW24	Roadside	Still Lane, 22/24 London Road Southborough	37	25	32	30	29	n/a
TW25	Roadside	Flying Dutchman	**54**	34	40	36	37	n/a
TW31	Roadside	London Road/ Mount Ephraim Junction	**59**	**41**	**46**	**45**	**42**	n/a
TW34	Roadside	AQ Station, The Cutout St John's Road	**58**	**41**	**49**	**47**	**49**	n/a
TW41	Roadside	London Rd (38 The Pantiles/London Road)	**71**	**50**	**50**	**51**	**54**	n/a
TW43	Roadside	Church Road/Clarence Road	**44**	32	36	35	36	n/a
TW46	Roadside	A26 Eridge Road	N/A	30	33	36	31	n/a
Objective			40					

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

[b] Data for taken from the 2015 Updating and Screening Assessment (Tunbridge Wells Borough Council, 2015) with the exception of data for 2015 which was downloaded from KentAir Website.

3.2 The annual mean objective was exceeded at five monitoring locations in 2014 (the TW34 diffusion site is collocated with the automatic monitor). The majority of the diffusion tubes are attached to lamp posts or signposts on pavements, and are therefore expected to measure higher concentrations than at the façades of the properties. There are no measured concentrations exceeding 60 µg/m^3, and thus exceedences of the 1-hour mean objective are unlikely.

Modelling

3.3 Predicted annual mean nitrogen dioxide concentrations in 2014 at each of the receptor locations shown in Figure 2, are set out in Table 3. Predicted concentrations exceed the annual mean objective at Receptors 3, 5, 7, 8, 11, 12 and 13; these are locations closest to the roads and where traffic is slowest, and, in particular, within street canyons.

3.4 The highest modelled annual mean nitrogen dioxide concentration is 51.2 µg/m^3, predicted at Receptor 11 (8 Edridge Road). There are no predicted annual mean concentrations above 60 µg/m^3, and thus exceedences of the 1-hour mean objective are unlikely.

Table 3: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors

Receptor	Location	Height	2014 (µg/m^3)[a]
1	56a London Road	1.5	27.5
2	138 London Road	4.5	36.4
3	162 London Road	4.5	**41.1**
4	220 St John's Road	1.5	23.6
5	50 St John's Road	1.5	**40.6**
6	12 St John's Road	1.5	38.9
7	71 Grosvenor Road	1.5	**45.3**
8	8 Mount Ephraim	1.5	**42.9**
9	58 Grosvenor Road	1.5	37.0
10	1 London Road	4.5	36.5
11	8 Edridge Road	4.5	**51.2**
12	38 Edridge Road	1.5	**45.9**
13	48 Mount Ephraim	1.5	**44.5**
Objective		**40**	

[a] Values in bold are exceedences of the objective.

3.5 Isopleth maps of the modelled annual mean nitrogen dioxide concentrations at ground-floor level are presented in Figures 3 and 4. These show that the annual mean objective is likely to be exceeded alongside the London Road/Eridge Road/St Johns Road (A26) and a small section of Grosvenor Road and A267 at relevant receptor locations.

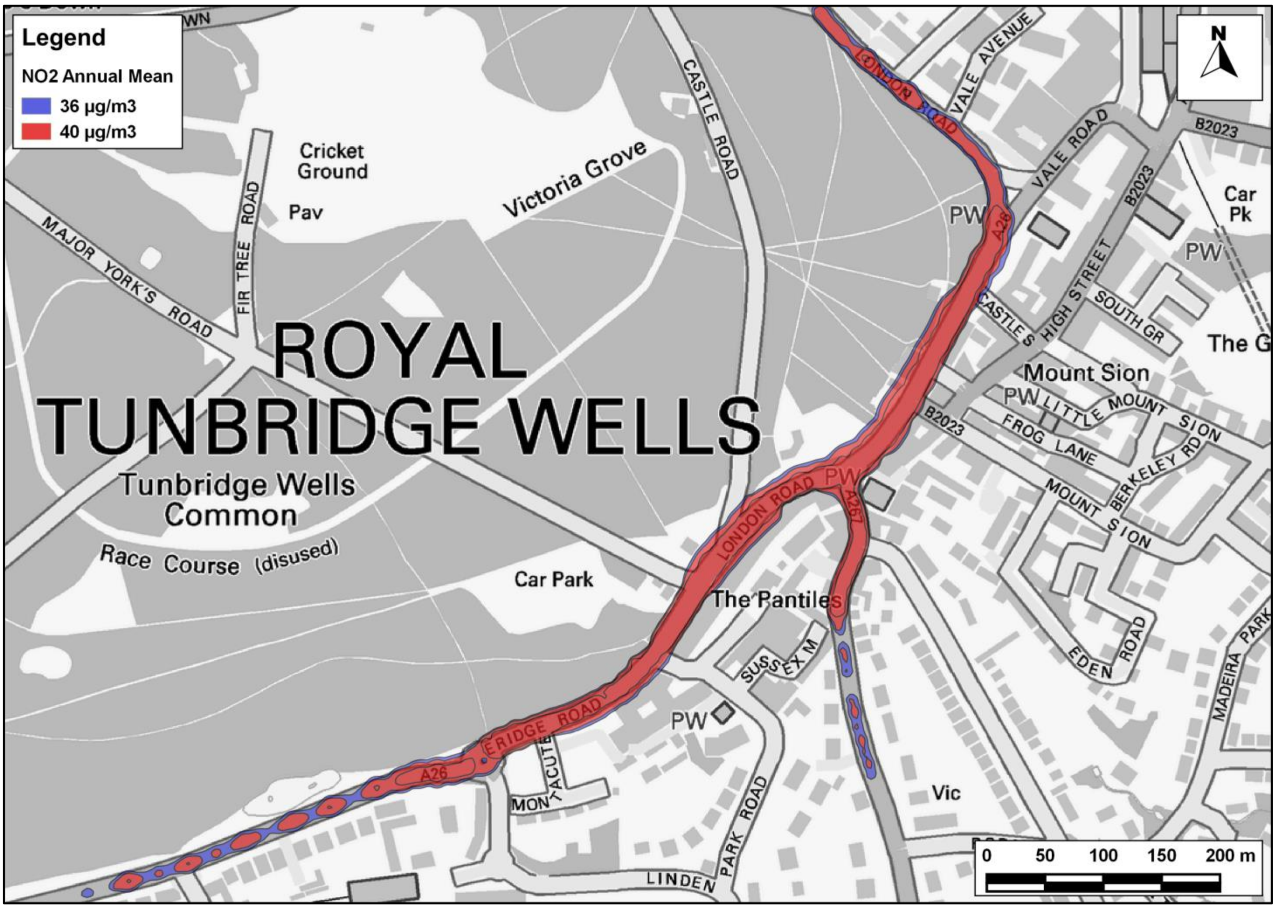

Figure 3: Extent of the Modelled 40 µg/m³ Contour (red) and 36 µg/m³ (blue) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5m) in southern section of AQMA

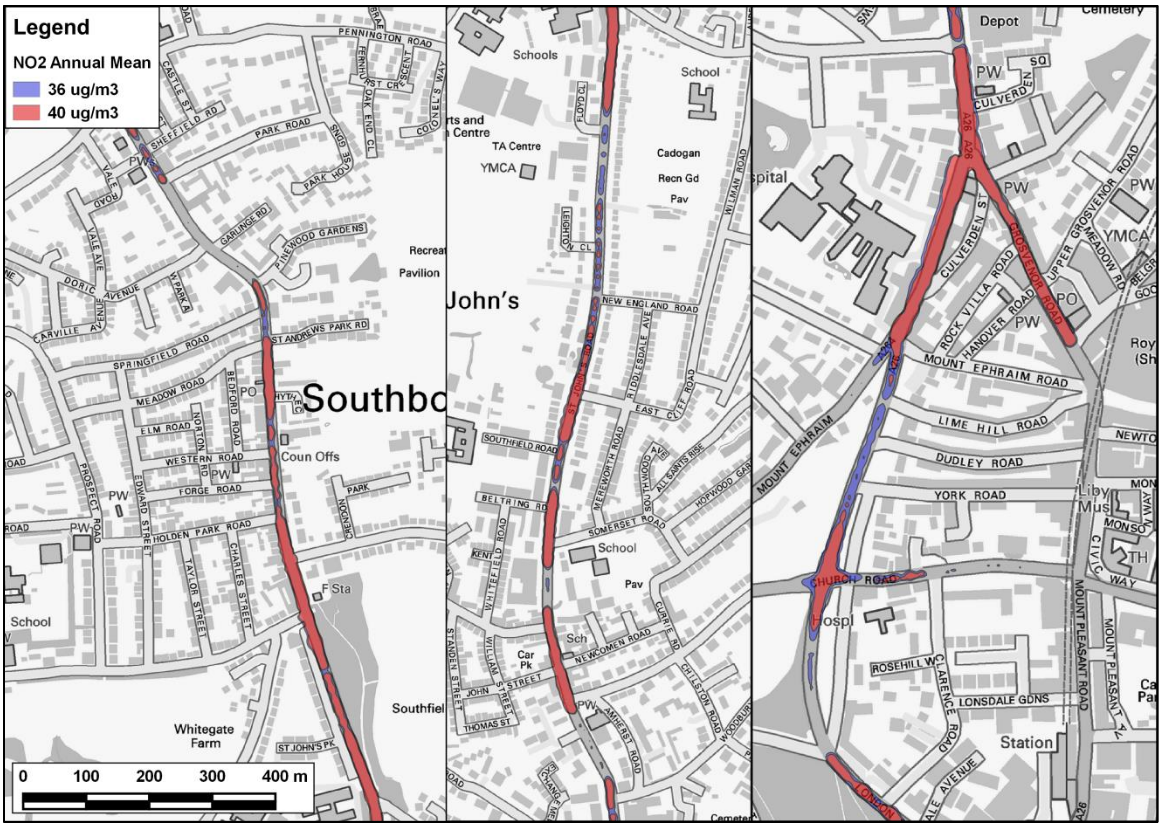

Figure 4: Extent of the Modelled 40 µg/m³ Contour (red) and 36 µg/m³ (blue) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5m) from Southborough to Church Road

3.6 The predicted area of exceedence is smaller than the current AQMA boundary. The areas of exceedence at relevant receptor locations are predominately within four locations:

- the area around the junction of A26, Speldhurst Road and Yew Tree Road;
- the area around Mount Ephiram roundabout;
- the area around the A26 and Newcomen Road; and
- the junction of the A267 and A26.

3.7 There are a small number of receptors on the A267, outside of the AQMA, where concentrations are predicted to exceed the objective. The model may be over-predicting concentrations at this location due to gradient included within the model. It is recommended that a diffusion tube is installed at this location to clarify monitored concentrations at a site of relevant exposure.

3.8 There is some uncertainty regarding both the measured and modelled concentrations. However, the AQMA boundary could be amended in the following ways:

- based on the 36 $\mu g/m^3$ contour; or
- based on those areas within the 36 $\mu g/m^3$ contour where relevant exposure exists.

3.9 The latter approach will result in four smaller, more discrete AQMAs than the current AQMA boundary. There are pros and cons to each of these approaches. A larger AQMA may be simpler from an administrative perspective, and is likely to be more straightforward in relation to the planning system. The second approach would provide a more focussed set of AQMAs by which actions can more easily be directed on locations of relevant exposure.

4 Source Apportionment

4.1 The traffic sources contributing to the objective exceedences have been identified. These data can be used to help develop an appropriate Action Plan and to inform future traffic management decisions. They have been calculated in line with guidance provided in LAQM.TG(16) (Defra, 2016).

4.2 Figure 5 and Table 4 set out the relative contributions of traffic emissions. The following categories have been included in the source apportionment:

- Regional Background (Reg Bkgd);
- Local Background (Local Bkgd)
- Motorcycles (MCL);
- Cars;
- Light Goods Vehicles (LGV);
- Buses;
- Rigid Heavy Goods Vehicles (Rigid); and
- Articulated Heavy Good Vehicles (Artic).

4.3 The 13 receptor locations previously identified have been used to provide an overview of source contributions. Table 4 and Figure 5 show that the most significant local road traffic component at all receptors are emissions from cars (although not shown, diesel cars will have a greater contribution than petrol cars). For Receptors 7, 9, 11 and 12 the relative contribution from buses is higher than at other locations.

Table 4: Predicted Annual Mean Nitrogen Dioxide Concentrations (2014) and the Contribution of Each Source Type to the Total

Receptor	Annual Mean Concentration (µg/m^3)								
	Reg Bkgd	Local Bkgd	MCL	Car	LGV	Bus	Rigid	Artic	Total
1	6.6	3.9	0.04	8.1	3.1	2.3	2.3	1.1	27.5
2	6.6	5.1	0.04	11.2	3.9	3.8	3.8	1.9	36.4
3	6.6	5.1	0.05	13.6	4.6	4.4	4.5	2.2	**41.1**
4	6.6	5.1	0.02	5.3	1.9	1.8	1.9	0.9	23.6
5	6.5	6.6	0.05	12.2	4.4	4.3	4.3	2.2	**40.6**
6	6.5	6.6	0.04	11.5	4.0	4.2	4.0	2.0	38.9
7	6.4	8.9	0.04	11.4	2.9	11.3	4.0	0.3	**45.3**
8	6.4	8.9	0.04	12.9	4.3	4.7	4.2	1.5	**42.9**
9	6.4	8.9	0.04	8.6	2.4	7.7	2.7	0.2	37.0
10	6.5	5.9	0.03	8.6	2.7	5.3	4.9	2.5	36.5
11	6.5	5.9	0.04	17.8	4.2	8.0	5.5	3.3	**51.2**
12	6.5	5.9	0.03	15.6	3.6	6.9	4.6	2.8	**45.9**
13	6.4	8.9	0.07	15.5	5.8	2.1	4.3	1.5	**44.5**
Receptor	**% Contribution to Total**								
	Reg Bkgd	**Local Bkgd**	**MCL**	**Car**	**LGV**	**Bus**	**Rigid**	**Artic**	**Total**
1	24.1	14.3	0.2	29.5	11.4	8.3	8.4	3.8	100
2	18.1	14.1	0.1	30.8	10.7	10.5	10.4	5.3	100
3	16.0	12.5	0.1	33.1	11.1	10.7	11.0	5.4	100
4	27.9	21.8	0.1	22.3	8.2	7.8	7.9	4.0	100
5	16.0	16.4	0.1	30.1	10.8	10.7	10.5	5.4	100
6	16.7	17.1	0.1	29.6	10.4	10.7	10.3	5.0	100
7	14.0	19.7	0.1	25.2	6.5	24.9	8.7	0.8	100
8	14.8	20.8	0.1	30.0	10.0	11.0	9.8	3.5	100
9	17.2	24.2	0.1	23.4	6.4	20.9	7.4	0.6	100
10	17.8	16.1	0.1	23.5	7.5	14.5	13.5	7.0	100
11	12.7	11.5	0.1	34.8	8.1	15.6	10.7	6.4	100
12	14.2	12.8	0.1	34.0	7.8	15.0	10.1	6.1	100
13	14.3	20.1	0.1	34.8	12.9	4.6	9.7	3.3	100

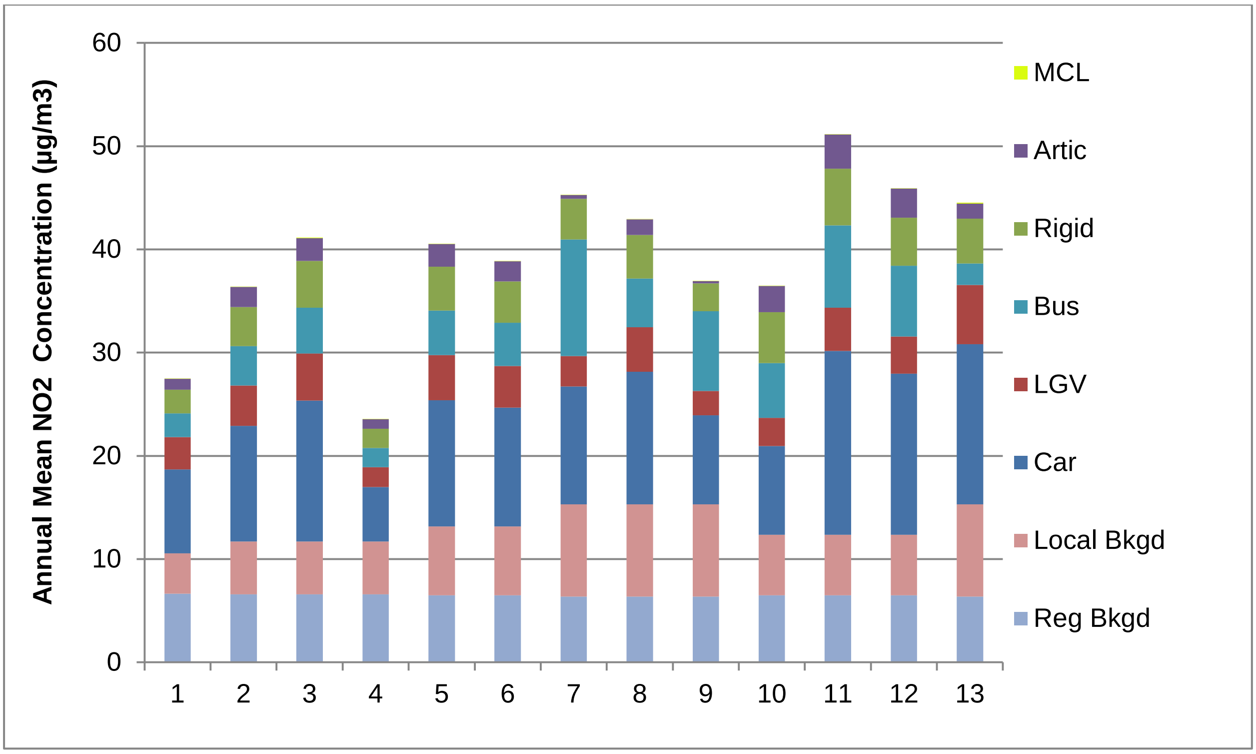

Figure 5: Relative Contribution of Each Source Type to the Total Predicted Annual Mean Nitrogen Dioxide Concentration at Receptor Locations (µg/m^3)

5 Air Quality Improvements Required

5.1 Calculation of the reduction in pollutant emissions required to attain the objective has been undertaken for the highest modelled concentrations at locations of relevant exposure. Due to the non-linear relationship between NOx and NO_2 concentrations the emissions reduction required is expressed in terms of the required percentage reduction in emissions of NOx.

5.2 The calculated emission reduction required for the three highest receptors is presented in Table 5. To achieve the objective at all locations a reduction in local traffic emissions of 33% is required.

Table 5: Air Quality Improvements Required to Meet the AQO

Receptor	Concentration (µg/m^3)			% Reduction of local traffic emissions required
	Modelled Road NOx	Target Road NOx[a]	NOx Reduction required	
7	67.0	53.5	13.5	20%
11	89.8	59.9	29.9	33%
12	75.3	59.9	15.4	20%

[a] Target concentration calculated using NOx to NO_2 calculator based on backgrounds concentrations for relevant receptors

6 Conclusions and Recommendations

6.1 A review of the AQMA in Tunbridge Wells has been carried out. The assessment has been undertaken using a combination of 2014 monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2014 using the ADMS-Roads dispersion model. The model has been verified against measurements made at a number of nitrogen dioxide diffusion tube monitoring locations, and at an automatic site.

6.2 The assessment has identified that the annual mean nitrogen dioxide objective is exceeded at locations of relevant exposure, but not as extensively as defined by the current AQMA. There is an opportunity to reduce the size of the AQMA to help focus on those areas with poor air quality. Any adjustment of the AQMA should take account of the uncertainty surrounding both the measured and modelled concentrations. To allow for this it is recommended that any adjustments to the AQMA should include areas within the 36 $\mu g/m^3$ contour, where there is relevant exposure.

6.3 There are two main options for adjustments of the AQMA. The revised AQMA could be based on the entire area within the 36 $\mu g/m^3$ contour, or it could be based on those areas within the 36 $\mu g/m^3$ contour where relevant exposure exists. This latter approach will result in a number of smaller, more discrete AQMAs. A slightly wider AQMA has the advantage of ensuring that new exposure is not introduced into areas of poor air quality. The second approach provides a more focussed basis for Air Quality Action Planning.

6.4 The source apportionment study has identified the most significant contribution to be the ambient (regional plus local) background concentration, followed by emissions from cars. The contribution from buses and HGV's is also important. To achieve the objective at all locations a reduction in local traffic emissions of 33% is required.

6.5 It is recommended that Tunbridge Wells Borough Council continues monitoring nitrogen dioxide at the existing monitoring locations. It is also recommended that a monitoring site be installed on the A267, at a site of relevant exposure where exceedences have been predicted outside of the AQMA, to determine actual concentrations.

7 References

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8 Glossary

AADT Annual Average Daily Traffic

ADMS-Roads Atmospheric Dispersion Modelling System model for Roads

AQC Air Quality Consultants

AQMA Air Quality Management Area

Defra Department for Environment, Food and Rural Affairs

DfT Department for Transport

EFT Emission Factor Toolkit

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)

HGV Heavy Goods Vehicle

LAQM Local Air Quality Management

µg/m^3 Microgrammes per cubic metre

NO Nitric oxide

NO_2 Nitrogen dioxide

NOx Nitrogen oxides (taken to be NO_2 + NO)

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

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

TEA Triethanolamine – used to absorb nitrogen dioxide

9 Appendices

A1 Professional Experience

Stephen Moorcroft, BSc (Hons) MSc DIC MIEnvSc MIAQM CEnv

Mr Moorcroft is a Director of Air Quality Consultants, and has worked for the company since 2004. He has over thirty-five years' postgraduate experience in environmental sciences. Prior to joining Air Quality Consultants, he was the Managing Director of Casella Stanger, with responsibility for a business employing over 100 staff and a turnover of £12 million. He also acted as the Business Director for Air Quality services, with direct responsibility for a number of major Government projects. He has considerable project management experience associated with Environmental Assessments in relation to a variety of development projects, including power stations, incinerators, road developments and airports, with particular experience related to air quality assessment, monitoring and analysis. He has contributed to the development of air quality management in the UK, and has been closely involved with the LAQM process since its inception. He has given expert evidence to numerous public inquiries, and is frequently invited to present to conferences and seminars. He is a Member 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.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

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

Lucy Hodgins, BSc (Hons) MIEnvSc MIAQM

Miss Hodgins is a Consultant with AQC, with over 6 years' experience in the field of air quality. She has been involved in the assessment of air quality impacts for a range of industrial, commercial and residential projects using qualitative and quantitative methods, including dispersion modelling, utilising a variety of models including ADMS Roads, Breeze Roads and Breeze Aermod. She has undertaken numerous operational dust assessments for mineral and waste facilities, as well as assessments of construction dust emissions. She has also undertaken assessments for energy from waste and anaerobic digestion facilities for a range of air pollutants, along with nuisance dust and odour. She has also been responsible for the preparation of road traffic emissions assessments for residential and industrial developments. Miss Hodgins has extensive experience in nuisance dust and ambient air quality monitoring and the interpretation of monitoring data. She is a Member of the Institute of Air Quality Management and the Institution of Environmental Sciences.

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

A2 Modelling Methodology

Background Concentrations

9.1 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 2013 until 2030. The background maps for 2014 have been calibrated against concurrent measurements from national monitoring sites. This has resulted in slightly higher predicted concentrations for the future assessment year than that derived from the Defra maps (AQC, 2016c).

9.2 Additionally the maps have been calibrated against local measurement made at the TW02 and TW06 background monitoring site. The measured nitrogen dioxide concentration at these sites in 2014 was 11.7 and 11.2 μg/m^3 respectively, while the mapped background was 12.4 and 11.9 μg/m^3 respectively. All mapped background nitrogen dioxide concentrations have therefore been calibrated by applying the average factor of 0.94.

Model Inputs

9.3 Predictions have been carried out using the ADMS-Roads dispersion model (v4.0). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity, where applicable. Vehicle emissions have been calculated based on vehicle flow, composition, speed data, as well as the influence of gradient, using the EFT (Version 7.0) published by Defra (2016b) and LAQM TG(16).

9.4 The model has been run using the full year of meteorological data that correspond to the most recent set of nitrogen dioxide monitoring data (2014). The meteorological data have been taken from the monitoring station located at Gatwick Airport, which is considered suitable for this area.

9.5 For the purposes of modelling, it has been assumed that a street canyon is formed by the buildings or trees along the majority of the A26, A267, A264, Yew Tree Road, Speldhurst Road and Grosvenor Road. 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. These roads have therefore, been modelled as a street canyon using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from plans, on-site measurements, local mapping and photographs.

9.6 AADT flows and vehicle fleet composition data have been sourced from the Department for Transport (DfT, 2016), and manual traffic counts undertaken by Kent County Council. Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A2.1.

Table A2.1: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link		Count Point	AADT	%Car	%LGV	%Rigid	%Artic	%Bus	%MCL
1	A26 Southborough to Mount Ephraim Rdbt	26293	18359	80.6	0.0	14.0	2.1	0.8	1.4
2	Grosvenor Road	6288	9758	83.9	0.0	9.8	1.6	0.0	3.6
3	A26 Mount Ephraim Rdbt to A264	56878	20512	81.5	0.0	14.2	2.1	0.6	0.7
4	A264 Mount Ephraim	57785	8378	85.5	0.0	12.1	1.6	0.0	0.2
5	A26 Mount Ephraim to A264 Church Road	48363	15947	83.1	0.0	11.7	2.7	1.1	0.7
6	A264 Church Road East of A26	28325	10569	84.3	0.0	11.6	1.7	0.4	0.9
7	A26 A264 Church Road to A26 Vale Road	18281	15068	81.8	0.0	12.9	2.3	1.0	0.9
8	A26 Vale Road to A267	56266	25817	79.7	0.0	12.7	3.0	1.2	2.3
9	A26 La Boundary to A267	28686	24061	85.6	0.0	9.4	1.8	0.8	1.8
10	A267 Frant Road	26859	13428	82.4	0.0	13.3	2.5	0.5	0.8
11	A264 Church Road West of A26	7825	8593	87.5	0.0	10.6	1.2	0.1	0.2

Traffic data for Links 12 and 13 provided by Kent County Council

9.7 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

9.8 Roads within the study area where gradients exceed 2.5% have been within the model. Emissions from HDV's have been adjusted to account for increased exhaust emissions in accordance with Defra (Defra, 2016a).

9.9 Figure A2.1 shows the road network included within the model and defines the study area.

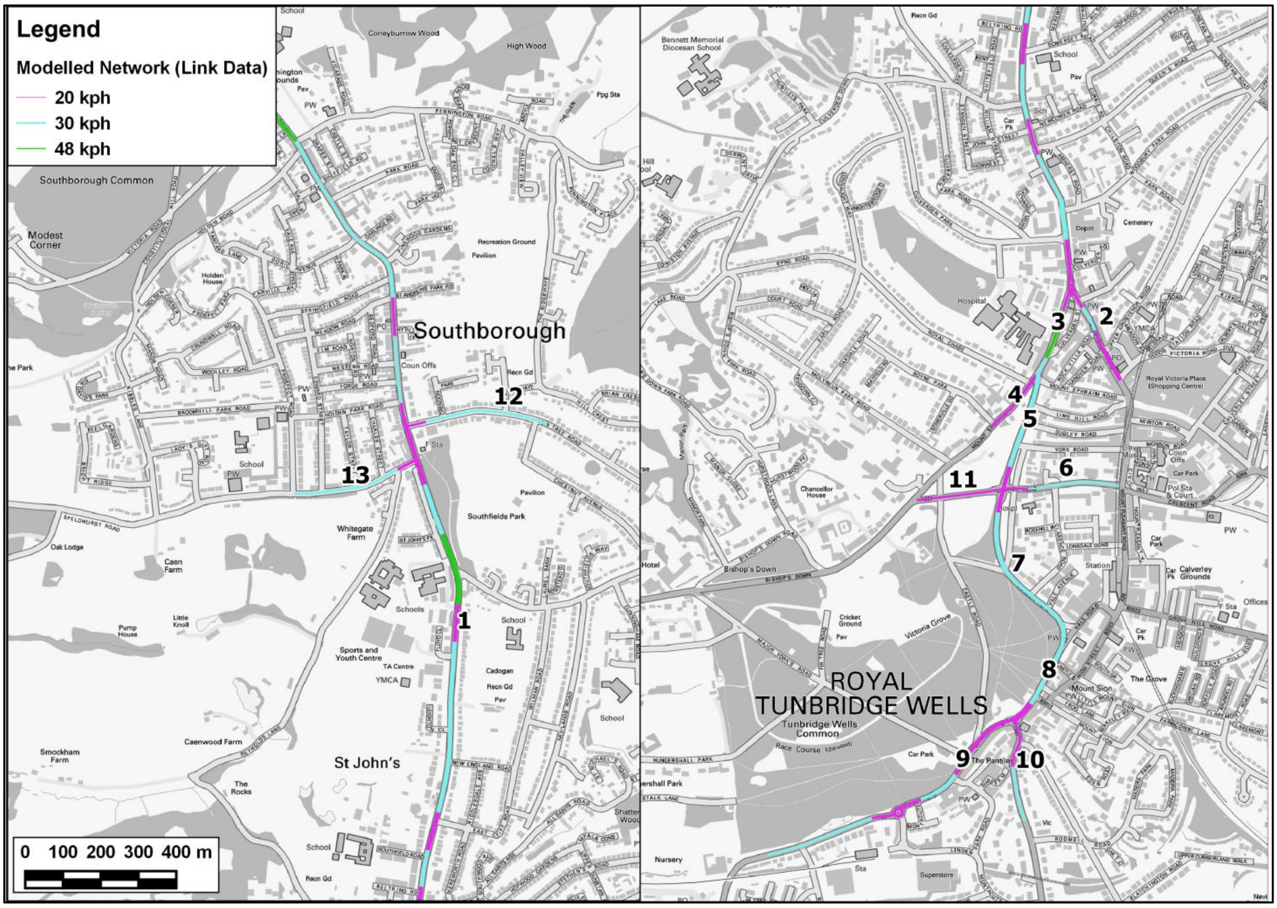

Figure A2.1: Modelled Road Network

Model Verification

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

9.11 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 2014 at TW01, TW20, TW24, TW25, TW31, TW41, TW43, TW46 diffusion tube monitoring sites and the automatic monitor[1]. Concentrations have been modelled at the height of the monitors.

9.12 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 5.1) available on the Defra LAQM Support website (Defra, 2016b).

9.13 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 A2.2). The calculated adjustment factor of 2.18 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

9.14 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 A2.3 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

9.15 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

[1] Co-location diffusion tube monitoring site TW34 was not included in the verification as the more accurate automatic monitor was used.

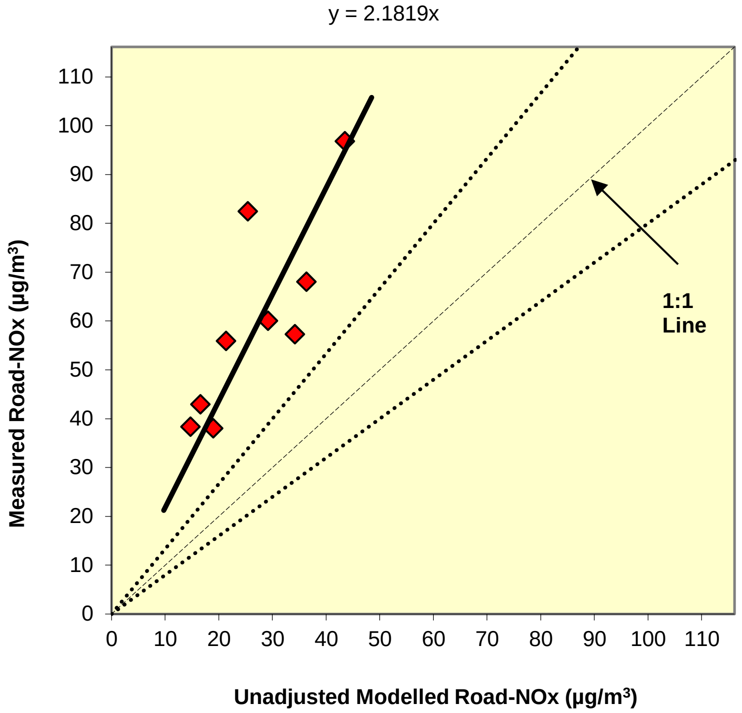

Figure A2.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

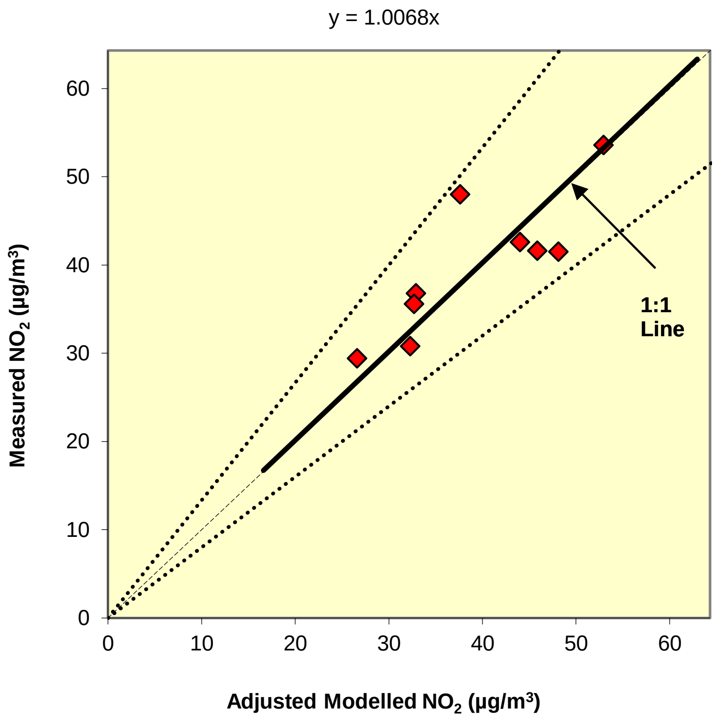

Figure A2.3: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

Model Post-processing

9.16 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2016b). The traffic mix within the calculator has been set to "All non-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.