Air Quality Consultants

Detailed Assessment of Air Quality in Rayleigh for Rochford District Council

May 2011

Experts in air quality management & assessment

Document Control

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Job Number	J1202

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Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
1202/1/F1	12th May 2011	Final Report	Prof. Duncan Laxen

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Rochford District Council confirms that it accepts the recommendations made in this report.

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Rochford District Council to undertake a Detailed Assessment of air quality within Rayleigh. In 2009, Rochford District Council completed an Updating and Screening Assessment for air quality, which concluded that a Detailed Assessment was required as a result of measured exceedences of the nitrogen dioxide annual mean objective at the junction of Eastwood Road and High Street, Rayleigh.

1.2 The aim of this Detailed Assessment is to determine whether the annual mean nitrogen dioxide objective continues to be exceeded at relevant locations and, if so, the extent of exceedences and thus the boundary of the Air Quality Management Area (AQMA) required.

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 are expected to achieve 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 Review and Assessment is a long-term, ongoing process, structured as a series of 'rounds'. Local Authorities in England, Scotland and Wales have now completed the first, second and third rounds of Review and Assessment, with the fourth round underway.

1.5 Technical Guidance for Local Air Quality Management (LAQM.TG(09)) (Defra, 2009) sets out a phased approach to the Review and Assessment process. This prescribes an initial Updating and Screening Assessment (USA), which all local authorities must undertake. It is based on a checklist to identify any matters that have changed since the previous round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the previous round, then the Local Authority should progress to a Detailed Assessment.

1.6 The purpose of the Detailed Assessment is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the Detailed Assessment is that one or more of the air quality objectives are likely to be exceeded, then an Air Quality Management Area (AQMA) must be declared. Subsequent to the declaration of an AQMA, a Further Assessment should be carried out to confirm that the AQMA declaration is justified; and that the appropriate area has been declared; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an Air Quality Action Plan, which will identify measures to improve local air quality.

1.7 This report represents a Detailed Assessment in the fourth round of Review and Assessment, following the findings of Rochford District Council's USA published in 2009, which concluded that there were measured exceedences of the annual mean nitrogen dioxide objective at locations of relevant exposure (Rochford District Council, 2009). A automatic analyser began monitoring in September 2009, and closed in February 2011. The monitor was co-located with three diffusion tubes in order to calculate a local bias adjustment factor to inform the Detailed Assessment. Rochford District Council's Progress Report published in 2010, confirmed the findings of the 2009 USA, and the recommendation that a Detailed Assessment be undertaken in the Eastwood Road and High Street area, Rayleigh (Rochford District Council, 2010).

The Air Quality Objectives

1.8 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 (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (Stationery Office, 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 $\mu g/m^3$

1.9 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.

1.10 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 µg/m^3 (Defra, 2009). Thus exceedences of 60 µg/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 Methodology

Monitoring

2.1 Monitoring for nitrogen dioxide was carried out by Rochford District Council using one automatic site and four passive diffusion tubes sites in Rayleigh in 2010. The monitoring sites and study area are shown in Figure 1. 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. A bias adjustment factor for 2010 of 0.76 has been calculated from the local co-location study. The national bias adjustment factor from the database of national factors provided on the Review and Assessment Helpdesk website (spreadsheet version 04/11) was 0.83. This was based on three studies, one of which was Rochford District Council’s study. The local bias adjustment factor was considered more appropriate than the national factor as the local co-location study was carried out within the study area for this assessment.

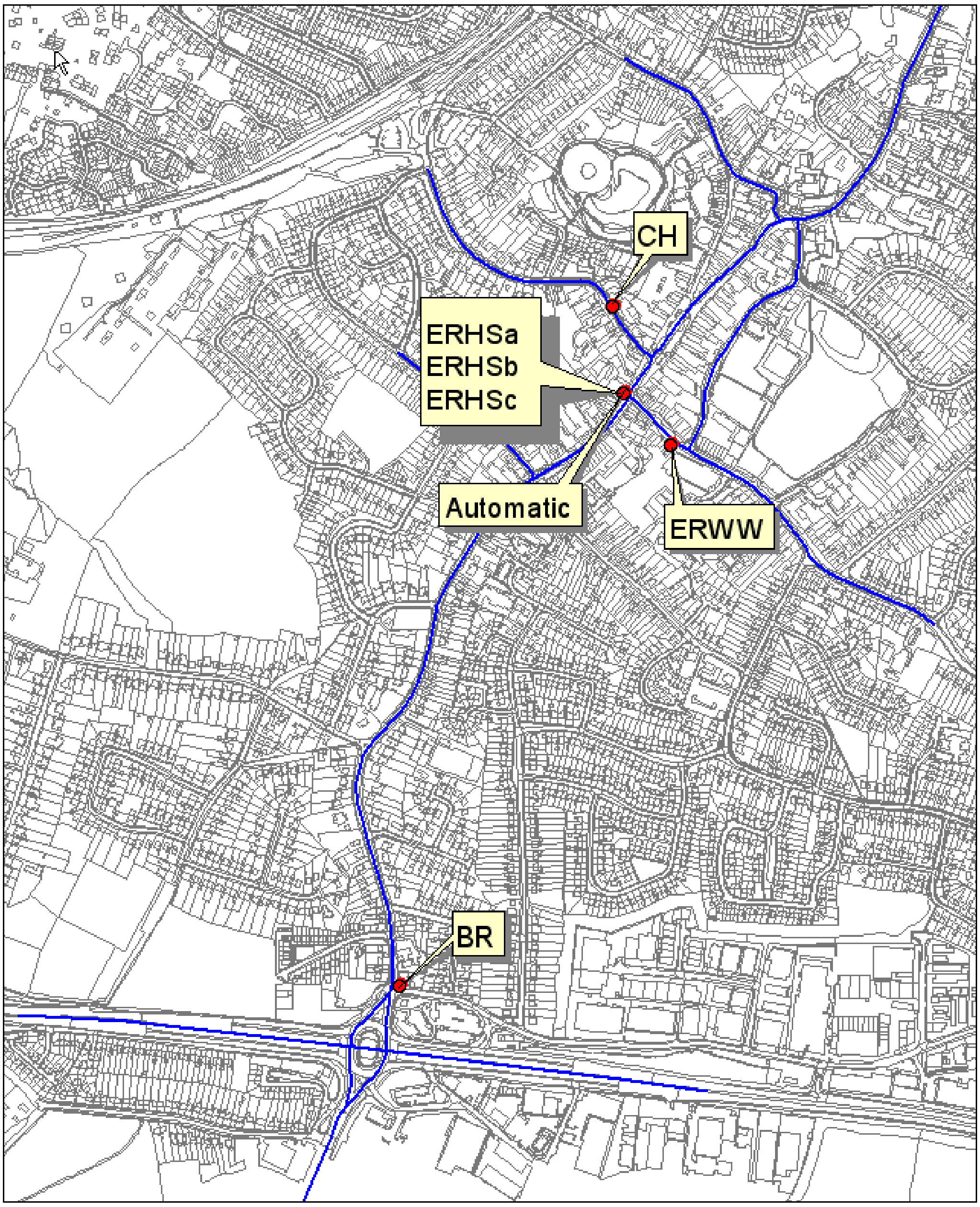

Figure 1 Detailed Assessment Study Area and Monitoring Locations. Roads explicitly included in the model shown in blue.

Modelling

2.2 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (ADMS-Roads v3). The input data used are described in Appendix 2. The model outputs have been verified against the monitoring data described in paragraph 2.1. Further details of model verification are also supplied in Appendix 2. Concentrations have been predicted for a grid of receptors across the study area to allow concentration isopleths to be plotted. In addition, concentrations have been predicted at a number of worst-case receptor locations (Figure 2). The worst-case receptors have been modelled at either ground or first floor, depending on the height of relevant exposure.

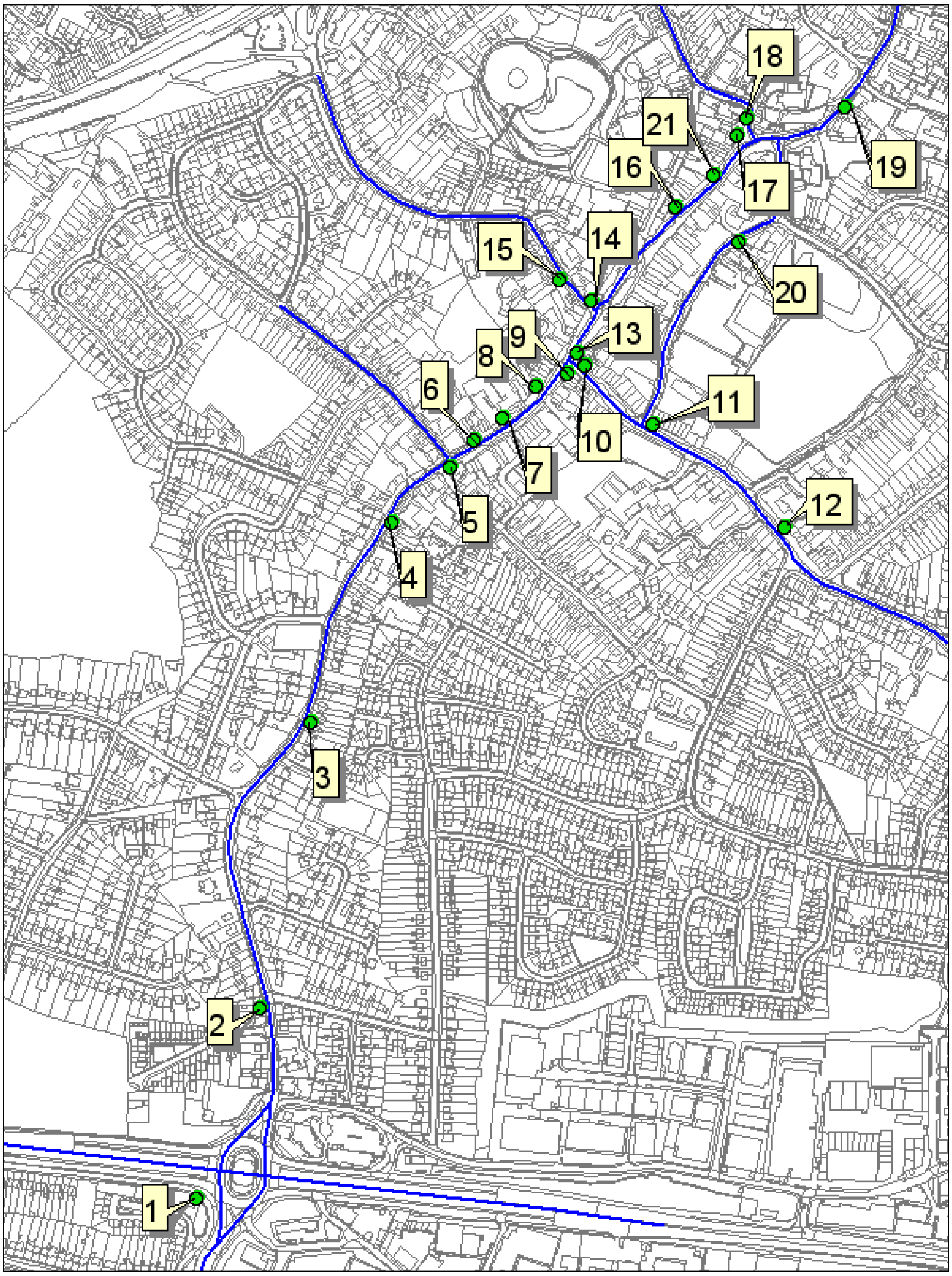

Figure 2 Specific Receptor Locations

Uncertainty

2.3 Uncertainty is inherent in all measured and modelled data. 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 (2011) suggests that this is of the order of plus or minus 20% for diffusion tube data and plus or minus 10% for automatic measurements. The model results rely on traffic data determined from the interactive web-based map provided by the Department for Transport (DfT, 2011) and data provided by Rochford District Council, and any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that wind conditions measured at Southend Airport during 2010 will have occurred throughout the study areas during 2010; and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. An important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, and correcting for the apparent under-prediction of the model, the uncertainties can be reduced.

2.4 The limitations to the assessment should be borne in mind when considering the results set out in the following sections. While 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 discussion.

3 Results

Monitoring

3.1 Monitoring data for the sites within the study area (Figure 1) are summarised in Table 2.

Table 2: Annual Mean Nitrogen Dioxide Concentrations Measured within Rayleigh (µg/m^3)

Site	Site Type	Site Description	2008[a]	2009[b]	2010[c]
Automatic					
Automatic[d]	Roadside	Eastwood Road/ High Street	n/a	n/a	**46.0**
Diffusion Tubes					
BR[e]	Roadside	Rayleigh Weir (Brook Road)	n/a	**44.5**	38.4
ERHS (a,b,c)	Roadside	Eastwood Road/ High Street	**43.9**	**41.9**	**46.2**
CR[e]	Roadside	Crown Hill	n/a	**44.8**	**44.1**
ERWW[e]	Roadside	Eastwood Road/Websters Way	n/a	**46.4**	**48.6**
Objective			**40**	**40**	**40**

[a] As reported in Rochford District Council's 2009 Updating and Screening Assessment (Rochford District Council, 2009).

[b] As reported in Rochford District Council's 2010 Progress Report (Rochford District Council, 2010). Data have been bias adjusted by the Council using the Gradko, 50% TEA in acetone national factor (0.92).

[c] Data have been bias adjusted using the local factor (0.76).

[d] Monitoring began September 2009

[e] Monitoring began March 2009. The 2009 results have been annualised by the Council to allow for the incomplete years monitoring data.

3.2 The annual mean objective was exceeded at four of the monitoring locations in 2010. The majority of the diffusion tubes are attached to lamp posts or sign posts on the pavements and are therefore expected to measure higher concentrations than at the façades of the properties, however none of the monitoring locations are within street canyons, where concentrations are expected to be higher. There are no measured concentrations exceeding 60 µg/m^3, and thus exceedences of the 1-hour objective are unlikely.

Modelling

3.3 Predicted annual mean nitrogen dioxide concentrations in 2010 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 1 – 4, 7 – 9, 11, 13, 15 and 19. The receptors where no exceedences are predicted are either on roads with lower traffic flows or are outside of canyons.

3.4 The highest modelled annual mean nitrogen dioxide concentration is 52.7 µg/m^3, predicted at Receptor 1. The results at Receptor 1 may be slightly overestimated as the Southend Arterial Road

(A127) is in a cutting at this location, and it has not been possible to take this into account within the model. There are no predicted annual mean concentrations greater than 60 µg/m^3, and thus exceedences of the 1-hour objective are unlikely.

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

Receptor	Location	Height	2010 (µg/m^3)[a]
1	The Weir House	1.5	**52.7**
2	86 High Road	1.5	**43.0**
3	61 High Road	1.5	**40.2**
4	1 High Road	1.5	**41.9**
5	161 High Street	4.5	34.3
6	144 High Street	5.0	39.6
7	136 High Street	4.5	**40.8**
8	128 High Street	4.5	**40.8**
9	107 High Street	4.5	**40.9**
10	5 Eastwood Rd	4.5	39.1
11	37 Eastwood Rd	4.5	**43.8**
12	King George's Court	1.5	34.3
13	101 High Street	4.5	**41.5**
14	84 High Street	4.5	38.0
15	1 Crown Hill	1.5	**41.5**
16	38 High St	4.5	27.2
17	4 High St	1.5	28.7
18	5 Church St	1.5	29.4
19	22 Hockley Road	1.5	**40.5**
20	Webster's Court	1.5	38.6
21	22-24 High Street	5.0	27.0
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 Southend Arterial Road (A127), High Street, Eastwood Road, and a small section of Crown Hill and Hockley Road. There is no residential exposure at ground floor along Websters Way.

3.6 The isopleths show the 40 µg/m^3 contour in red, as well as the 36 µg/m^3 contour in blue. There is some uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that an AQMA is declared to include, as a minimum, those residential properties which lie within the 36 µg/m^3 contour, in order to be precautionary.

3.7 No exceedences of 60 µg/m^3 as an annual mean nitrogen dioxide concentration have been identified at locations of relevant exposure, and thus exceedences of the 1-hour objective are unlikely.

3.8 The area of exceedence alongside the Southend Arterial Road (A127) extends beyond the study area. There is no relevant exposure to the west of the study area, however, there are residential properties over 2.5 km to the east in Eastwood, which are located close to the A127. It is recommended that monitoring is carried out at worst-case locations of relevant exposure in Eastwood alongside the A127.

Population Exposure

3.9 Objective exceedences are predicted at approximately 100 residential properties. Assuming that each property has on average two occupants, this equates to approximately 200 residents.

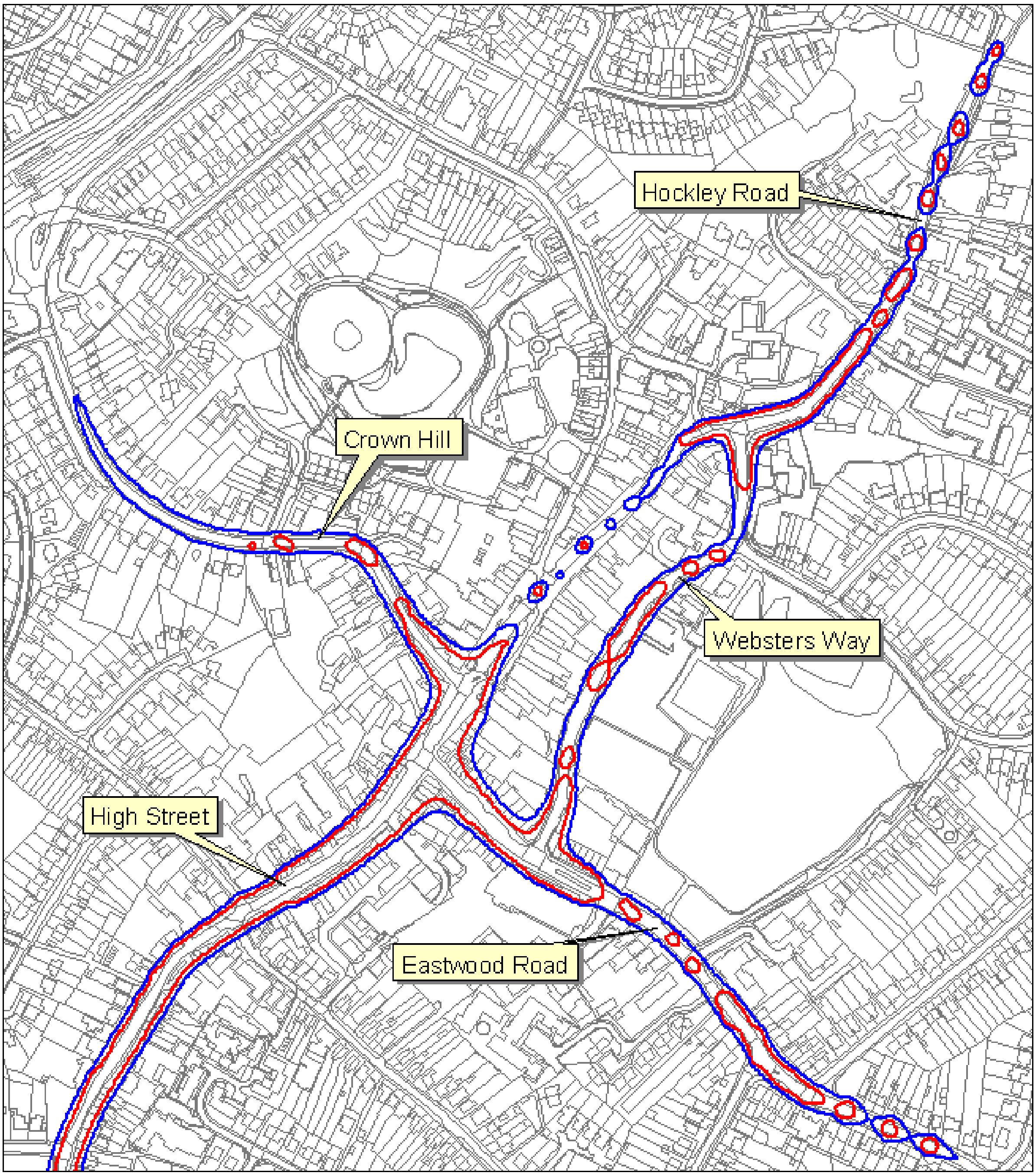

Figure 3 Extent of the Modelled 40μg/m^3 Contour (red line) and 36 μg/m^3 Contour (blue line) of Annual Mean Nitrogen Dioxide Concentrations in 2010 (modelled at 1.5 m).

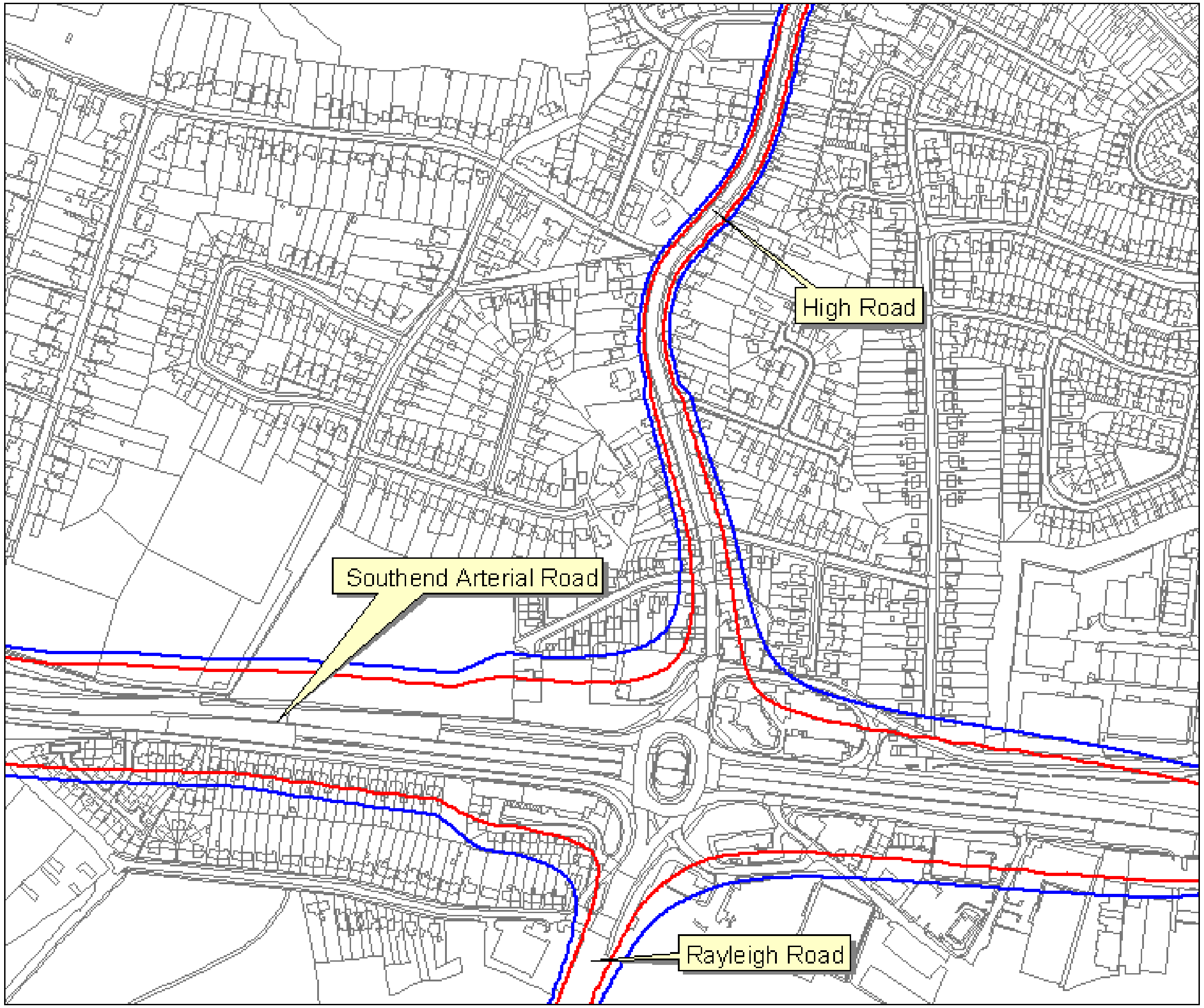

Figure 4 Extent of the Modelled 40μg/m^3 Contour (red line) and 36 μg/m^3 Contour (blue line) of Annual Mean Nitrogen Dioxide Concentrations in 2010 (modelled at 1.5 m).

4 Source Apportionment

4.1 In order to inform the Action Plan, the sources contributing to the objective exceedences have been identified. The data presented here can be used to develop an appropriate Action Plan and inform future traffic management decisions, and have been calculated in line with guidance provided in LAQM.TG(09) (Defra, 2009).

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:

- Ambient Background (Bkgd);
- Motorcycle (MCL);
- Cars;
- Light Goods Vehicles (LGV);
- Bus;
- Heavy Goods Vehicles (HGV);

4.3 Eleven receptor locations identified previously as exceeding the objective have been used to provide an overview of source contributions. Table 4 and Figure 5 show, the most significant component at all receptors is the ambient background concentration, followed by emissions from cars. At Receptor 1, a significant component is from HGVs on the Southend Arterial Road (A127), and at Receptor 11, buses make up a large proportion of the overall concentration.

Table 4: Predicted Annual Mean (2010) Nitrogen Dioxide Concentrations and the Contribution of Each Source Type to the Total

Receptor	Annual Mean Concentration (µg/m^3)						
	Bkgd	MCL	Car	LGV	Bus	HGV	Total
1	23.3	0.1	11.5	5.5	1.1	11.2	52.7
2	23.3	0.1	9.0	4.1	2.0	4.5	43.0
3	19.9	0.1	9.5	4.2	2.3	4.1	40.2
4	19.9	0.1	10.4	4.6	2.6	4.3	41.9
7	19.9	0.1	9.7	4.2	2.7	4.2	40.8
8	19.9	0.1	9.4	4.1	3.0	4.3	40.8
9	19.9	0.1	9.4	3.9	3.3	4.4	40.9
11	19.9	0.1	10.3	3.5	5.2	4.9	43.8
13	19.9	0.1	9.5	4.0	3.5	4.6	41.5
15	19.9	0.0	9.4	4.4	2.6	5.2	41.5
19	19.9	0.0	8.4	3.2	2.4	6.5	40.5
	% Contribution to Total						
	Bkgd	MCL	Car	LGV	Bus	HGV	Total
1	44.3	0.3	21.8	10.5	2.0	21.2	100.0
2	54.2	0.2	21.0	9.4	4.6	10.6	100.0
3	49.6	0.2	23.7	10.6	5.9	10.1	100.0
4	47.5	0.2	24.8	11.0	6.3	10.3	100.0
7	48.8	0.2	23.7	10.3	6.7	10.3	100.0
8	48.8	0.2	23.0	10.0	7.5	10.6	100.0
9	48.6	0.2	22.8	9.5	8.1	10.8	100.0
11	45.5	0.1	23.5	7.9	11.8	11.1	100.0
13	48.0	0.2	22.9	9.7	8.3	11.0	100.0
15	47.9	0.1	22.7	10.5	6.2	12.6	100.0
19	49.2	0.1	20.8	7.9	6.0	16.0	100.0

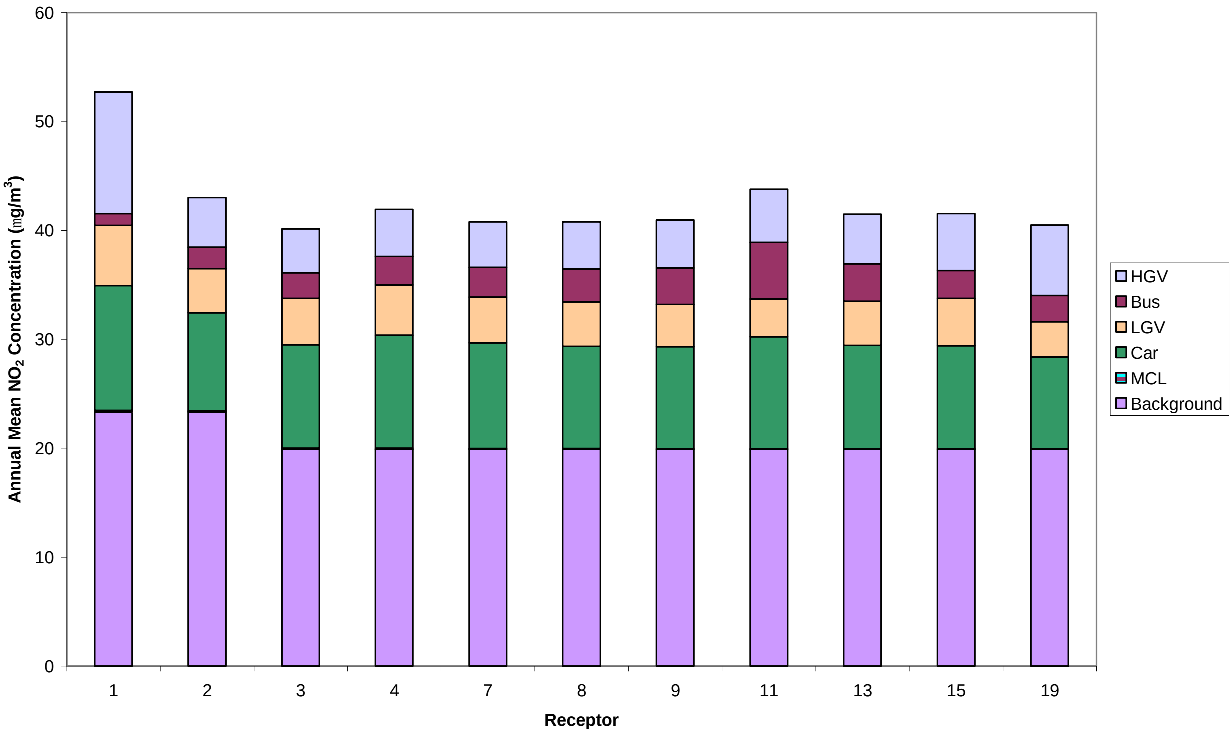

Figure 5: Relative Contribution of Each Source Type to the Total Predicted Annual Mean Nitrogen Dioxide Concentration (µg/m^3) at Receptor Locations.

5 Conclusions and Recommendations

5.1 A Detailed Assessment has been carried out for nitrogen dioxide within Rayleigh. This area was identified as being at risk of exceeding the annual mean air quality objective for nitrogen dioxide in Rochford District Council's 2009 USA.

5.2 The Detailed Assessment has been carried out using a combination of monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2010 using the ADMS-Roads dispersion model. The model has been verified against measurements made at the automatic monitor and the four nitrogen dioxide diffusion tube monitoring locations which lie adjacent to the road network included in the model.

5.3 The assessment has identified that the annual mean nitrogen dioxide objective is being exceeded at a number of relevant locations alongside many of the main roads. No exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration have been identified at locations of relevant exposure, and thus exceedences of the 1-hour objective are unlikely.

5.4 There is some uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that an AQMA is declared to include, as a minimum, those residential properties that lie within the 36 $\mu g/m^3$ contour to be precautionary.

5.5 It is also recommended that Rochford District Council continues monitoring nitrogen dioxide at the existing monitoring locations, and expand the network where possible, particularly into areas which are 'canyon' like. Monitoring results can then be used to inform the Further Assessment. It is also recommended that monitoring is carried out at worst-case locations of relevant exposure alongside the Southend Arterial Road (A127) to the east of the study area.

5.6 Source apportionment of the local traffic emissions has been undertaken. This shows that, in the majority of cases, ambient background concentrations contribute the largest proportion to the overall concentration, followed by emissions from cars on the local roads. In a number of cases, emissions from HGVs and buses also contribute a significant proportion to the overall concentration.

5.7 Finally, Rochford District Council should proceed with the completion of a Further Assessment for air quality in Rayleigh within 12 months of the declaration of an AQMA.

6 References

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7 Glossary

Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal.
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, taking into account costs, benefits, feasibility and practicality. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides.
Exceedence	A period of time where the concentration of a pollutant is greater than the appropriate air quality objective.
AQMA	Air Quality Management Area
ADMS Roads	Atmospheric Dispersion Modelling System for Roads.
NO_X	Nitrogen oxides (taken as NO + NO_2)
NO	Nitric Oxide
NO_2	Nitrogen dioxide.
$\mu g/m^3$	Microgrammes per cubic metre.
Roadside	A site sampling between 1 m of the kerbside of a busy road and the back of the pavement. Typically this will be within 5 m of the road, but could be up to 15 m (Defra, 2009).
HDV	Heavy Duty Vehicle
LDV	Light Duty Vehicle
MCL	Motorcycles
AADT	Annual Average Daily Traffic flows

A1 Appendix 1 – Summary of Health Effects of Nitrogen Dioxide

Table A1.1: Summary of Health Effects of Nitrogen Dioxide

Pollutant	Main Health Effects
Nitrogen Dioxide	Short-term exposure to high concentrations may cause inflammation of respiratory airways. Long term exposure may affect lung function and enhance responses to allergens in sensitised individuals. Asthmatics will be particularly at risk (Defra, 2007).

A2 Appendix 2 – Dispersion Modelling Methodology

Meteorological Data

A2.1 The model has been run using a full year of meteorological data for 2010 from the meteorological station near Southend Airport. Cloud-cover data were missing for 25% of the time and these were therefore provided using data from London City Airport.

Background Concentrations:

A2.2 Background concentrations of nitrogen dioxide have been taken from the national maps of background concentrations published by Defra (Defra, 2011). The background concentrations used in the modelling are presented in Table A2.1.

Table A2.1: Background Concentrations (μg/m^3)[a]

	NOx	NO_2
2010	24.7 – 36.1	17.0 – 23.3

[a] The area lies within a number of grid squares

Traffic Data

A2.3 The ADMS Roads model requires the user to provide various input data, including the Annual Average Daily Traffic (AADT) flow, the proportion of heavy duty vehicles (HDVs), road characteristics (including road width and street canyon height, where applicable), and the vehicle speed.

A2.4 Annual Average Daily Traffic (AADT) flows, and the flows split into a number of vehicle classes, have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2011). The 2009 AADT flows were factored forwards to the assessment year of 2010 using growth factors derived from the National Transport Model and associated guidance

(DfT, 2007), adjusted to local conditions using the TEMPRO System v6.2 (DfT, 2009). Traffic flows for Hockley Road, Church Street and Love Lane were provided by the Council as they were not available on the DfT website. Traffic flows for Hockley Road and Church Street were provided as 12 hour flows for 2008, these were converted to 24 hour flows using a ratio calculated from 24 hour traffic data provided by the Council for Station Road, and then converted to 2010 using the National Transport Model and TEMPRO. The traffic data for Love Lane were provided as a five day average daily flow for 2006, Love Lane is a very small residential road and therefore the five day average daily flow was assumed to be the same as the average daily flow. The 2006 flows were factored forwards to 2010 using the National Transport Model and TEMPRO. The traffic data for Love Lane did not provide flows split into different vehicle class, and therefore the vehicle split from Church Street (also a small residential road) was applied to the Love Lane flows. Traffic speeds have been estimated from local speed restrictions and take account of the proximity to junctions. The traffic data used in this Detailed Assessment are presented in Table A2.2.

Table A2.2: Summary of AADT Flows (2010)

	MCL	Cars	LGV	BUS	HGV	Total
Eastwood Road (west of Websters Way)	118	12,192	1,516	149	235	14,211
Eastwood Road (east of Websters Way)	118	12,192	1,516	149	236	14,212
Southend Arterial Road (A127 west of roundabout)[a]	695	58,291	10,292	126	3,620	73,024
Southend Arterial Road (A127 east of roundabout)[a]	604	48,513	9,790	121	2,656	61,684
London Road (Crown Hill)	102	12,430	2,227	92	304	15,156
High Street (Centre)	248	17,664	2,988	167	333	21,401
High Road (South of Eastwood Rd)	249	17,664	2,988	167	333	21,402
Rayleigh Road	232	15,044	2,078	145	269	17,768
High Street (north of Eastwood Road)	57	4,000	639	194	116	5,006
Websters Way	30	7,631	902	246	141	8,949
Rayleigh Road (west/east) (A127 roundabout access)	116	7,522	1,039	72	135	8,884
High St (west/east) (A127 roundabout access)	125	8,832	1,494	84	167	10,701
Church Street	13	2,208	219	10	40	2,492
Hockley Road	65	10,317	1,493	94	393	12,362
Love Lane	9	1,470	146	7	27	1,658

[a] Section of road closest to the roundabout is in a cutting, as a worst-case assessment it has been assumed to be at ground level, i.e. at the same level as the surrounding houses.

Model Verification

A2.5 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 ($NO_X = NO + NO_2$). The model has been run to predict the annual mean road-NO_X concentration during 2010 at the automatic site and the four diffusion tube monitoring sites described in Table 2, which lie alongside the roads included in the model.

A2.6 The model output of road-NO_X (i.e. the component of total NO_X coming from road traffic) has been compared with the 'measured' road-NO_X. Measured road-NO_X for the diffusion tube sites was calculated from the measured NO_2 concentration and the predicted background NO_2 concentration using the NO_X from NO_2 calculator available on the LAQM Support website (Defra, 2011).

A2.7 A primary adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A2.1). This factor was then applied to the modelled road-NO_X concentration for each receptor to provide adjusted modelled road-NO_X concentrations. The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NO_X concentrations with the predicted background NO_2 concentration within the NO_X from NO_2 calculator. A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero (Figure A2.2).

A2.8 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

- Primary adjustment factor : 4.803
- Secondary adjustment factor: 0.953

A2.9 The results imply that the model was under-predicting the road-NO_X contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

A2.10 Figure A2.3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows a 1:1 relationship.

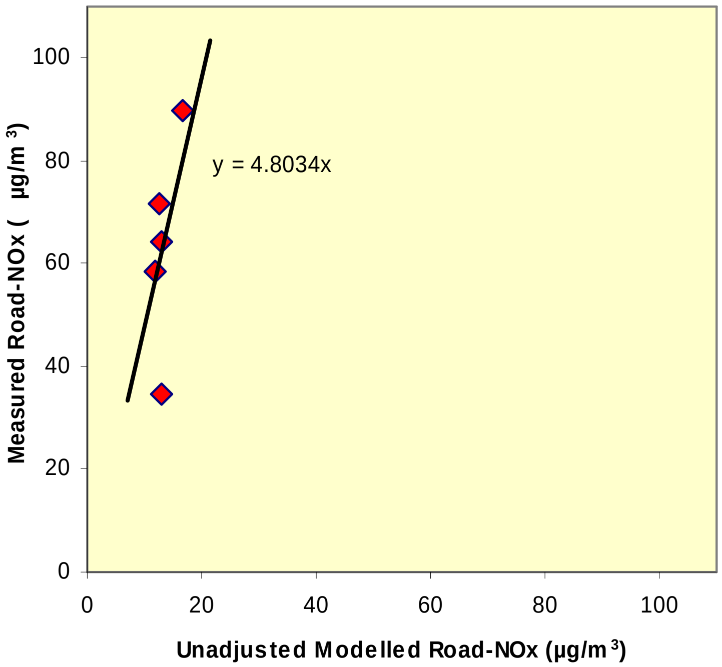

Figure A2.1: Comparison of Measured Road-NO_X to Unadjusted Modelled Road NO_X Concentrations

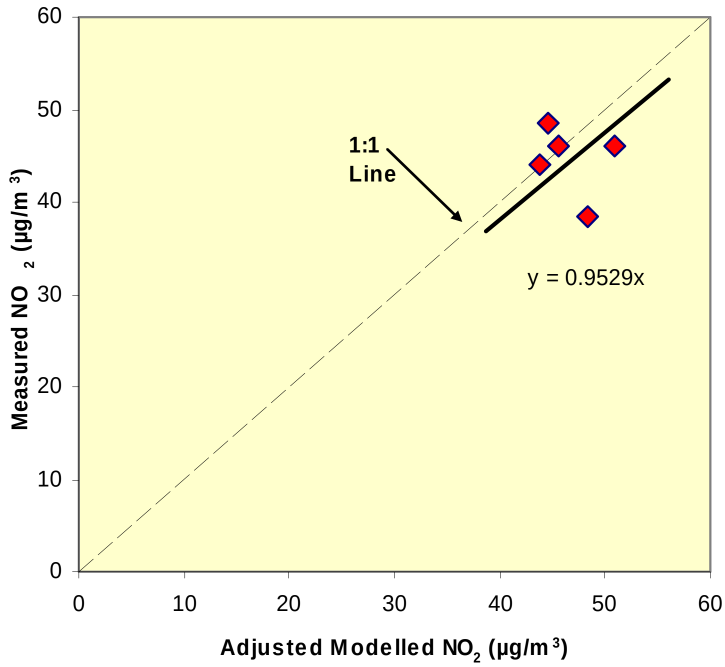

Figure A2.2: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations

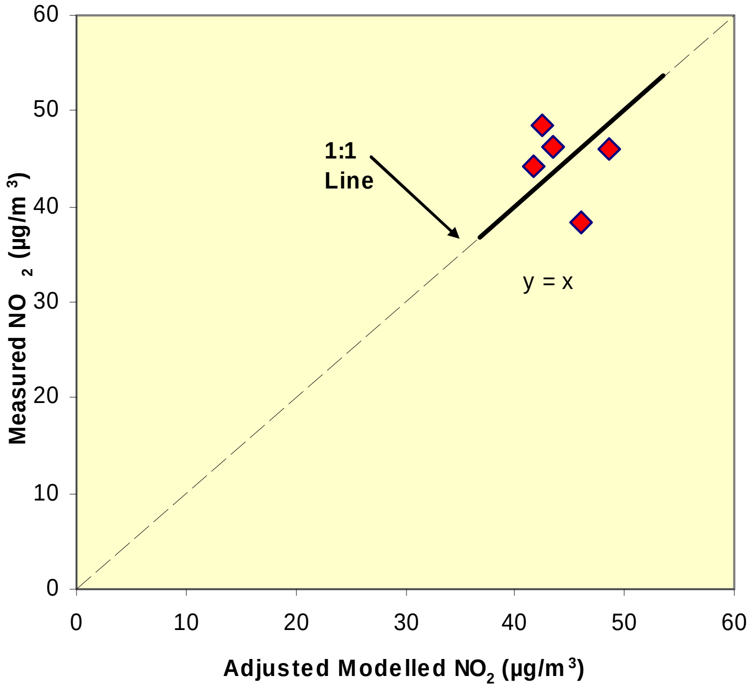

Figure A2.3: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations