Further Assessment of Air Quality in Merstham.

May 2008

Reigate and Banstead Borough Council, Environmental Health Services,
Town Hall, Castlefield Road, Reigate, Surrey, RH2 0SH. Telephone: 01737 276403 Fax: 01737 276404.

Document Control

Client	Reigate & Banstead Borough Council	Principal Contact	Leon Hibbs

Job Number	J741

Report Prepared By:	Dr Denise Welch

Document Status and Review Schedule

Issue No.	Report No.	Date	Status	Reviewed by
1	741/1/D1	9th April 2008	Draft Report	Prof. Duncan Laxen
2	741/1/F1	9th May 2008	Final Report	Prof. Duncan Laxen
3	741/1/F2	20th May 2008	Final Report	Dr Ben Marner

This report has been prepared by Air Quality Consultants Ltd on behalf of the Client, taking into account the agreed scope of works. Unless otherwise agreed, this document and all other Intellectual Property Rights remain the property of Air Quality Consultants Ltd.

In preparing this report, Air Quality Consultants Ltd has exercised all reasonable skill and care, taking into account the objectives and the agreed scope of works. Air Quality Consultants Ltd does not accept any liability in negligence for any matters arising outside of the agreed scope of works.

When issued in electronic format, Air Quality Consultants Ltd does not accept any responsibility for any unauthorised changes made by others.

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
12 Airedale Road, London SW12 8SF Tel: 0208 673 4313
aqc@aqconsultants.co.uk

Registered Office: 12 St Oswalds Road, Bristol, BS6 7HT
Companies House Registration No: 2814570

Contents

1 Introduction 2
2 AQMA Location 6
3 Developments Since the Declaration of the AQMA 7
4 Responses to Consultees Comments 7
5 New Monitoring and Modelling Data 8
6 Source Apportionment 16
7 Air Quality Improvements Required 20
8 Management Planning 21
9 Summary and Conclusion 23
10 Uncertainties 23
11 References 25
12 Glossary 26
13 Appendix 1 – Diffusion Tube Monitoring 27
14 Appendix 2 – Adjustment of Short-Term Data to Annual Mean 28
15 Appendix 3 – Dispersion Modelling Methodology 29

1 Introduction

1.1 This report sets out the Further Assessment of air quality in Merstham, within the Borough of Reigate & Banstead. It forms part of the air quality Review and Assessment process prescribed by Defra. Reigate & Banstead Borough Council are currently in the process of declaring the Merstham Air Quality Management Area (AQMA) for nitrogen dioxide (annual mean objective), shown in Figure 1. The AQMA will cover properties alongside the A23 including London Road South, High Street and London Road North.

Introduction to the Review and Assessment Process

1.2 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 developed in order to reduce pollutant emissions in pursuit of the objectives.

1.3 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 and second rounds of Review and Assessment, with the third round underway.

1.4 Technical Guidance for Local Air Quality Management (LAQM.TG(03)) (Defra, 2003) 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 (DA).

1.5 The purpose of the DA is to determine whether there is an exceedence of an air quality objective and the geographical extent of that exceedence. If the outcome of the DA 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 must be carried out to confirm that the AQMA declaration is justified and that the appropriate geographical area has been included; 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 the Air Quality Action Plan (AQAP), which will identify measures to improve local air quality.

The Air Quality Objectives

1.6 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. 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 Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (The Stationery Office, 2002). Table 1 summarises the objectives which are relevant to this report.

1.7 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.

1.8 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 (Laxen and Marner, 2003). Thus, potential exceedences of the 1-hour mean nitrogen dioxide objective need only be considered where the annual mean is predicted to be above 60 µg/m^3.

1.9 The European Union has also set limit values for nitrogen dioxide. Achievement of these values is a national obligation rather than a local one. The limit values for nitrogen dioxide are the same level as the UK objectives, but are to be achieved by 2010.

Table 1 Air Quality Objectives for Nitrogen Dioxide

Pollutant	Status	Time Period	Objective / Value	To be Achieved by[a]
Nitrogen Dioxide	Statutory UK Objective	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	2005
		Annual mean	40 µg/m^3	2005
	EU Limit Value	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	2010
		Annual mean	40 µg/m^3	2010

[a] The achievement dates for the UK objectives are the end of the specified year; achievement dates for the EU limit values are the start of the specified year.

Scope

1.10 Guidance available from the Review and Assessment Helpdesk website (Defra, 2008a) explains that a Further Assessment report allows authorities:

- to confirm their original assessment of air quality against the prescribed objectives, and thus ensure that they were right to designate the AQMA;
- to calculate more accurately how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;
- to refine their knowledge of the sources of pollution so that air quality action plans can be properly targeted;
- to take account of national policy developments that may come to light after the AQMA declaration;
- to take account, as far as possible, of any local policy developments that are likely to affect air quality by the relevant date, and which were not fully factored into earlier calculations;
- to carry out real-time monitoring where this has not been done previously;
- to carry out further monitoring in problem areas to check earlier findings;
- to corroborate other assumptions on which the designation of the AQMA has been based, and to check that the original designation is still valid, and does not need amending in any way;
- to respond to any comments made by statutory consultees in respect of local authorities' previous reports, particularly where these have highlighted that insufficient attention has been paid to, for example, the validation of modelled data.

Report Structure and Issues Addressed

1.11 Section 2 of this report introduces the AQMA which is to be declared within Merstham, and hence defines the study area. Section 3 describes new developments since the Detailed Assessment was produced in May 2007. Section 4 sets out responses to the consultation exercise carried out. Section 5 comprises a review of monitoring data collected since the Detailed Assessment was produced and the results of new detailed dispersion modelling that has been carried out. These data are then used to determine the likelihood of exceedences of the objectives within the AQMA. Section 6 estimates the relative contribution of the most significant pollution sources to pollutant concentrations. Sections 7 and 8 set out the Air Quality Improvements required to meet the objectives and some hypothetical measures to achieve this.

Key Findings of Previous Review and Assessment Reports

1.12 The Updating and Screening Assessment (USA) for Reigate & Banstead Borough Council, undertaken in May 2006 (RBBC, 2006) concluded that the objectives for six of the seven pollutants investigated (carbon monoxide, lead, 1,3-butadiene, benzene, sulphur dioxide and PM_{10}) would be achieved at relevant locations across the local authority. Routine monitoring of nitrogen dioxide concentrations on London Road, Merstham measured an exceedence of annual mean objective at a location of relevant exposure. It was therefore necessary to proceed to a Detailed Assessment for nitrogen dioxide at this location. One additional location outside of existing AQMAs was also identified, however this was already being investigated.

1.13 The Detailed Assessment subsequently carried out for Merstham (RBBC, 2007) concluded that there is a likely exceedence of the annual mean nitrogen dioxide objective for properties alongside London Road North, the High Street and properties close to the junction of London Road South/High Street and School Hill in 2006 and 2010. The AQMA has not yet been officially declared, however the proposed boundary is shown in section 2.

2 AQMA Location

2.1 The Merstham AQMA includes a number of properties located alongside London Road South, High Street and London Road North, Merstham, as shown in Figure 1.

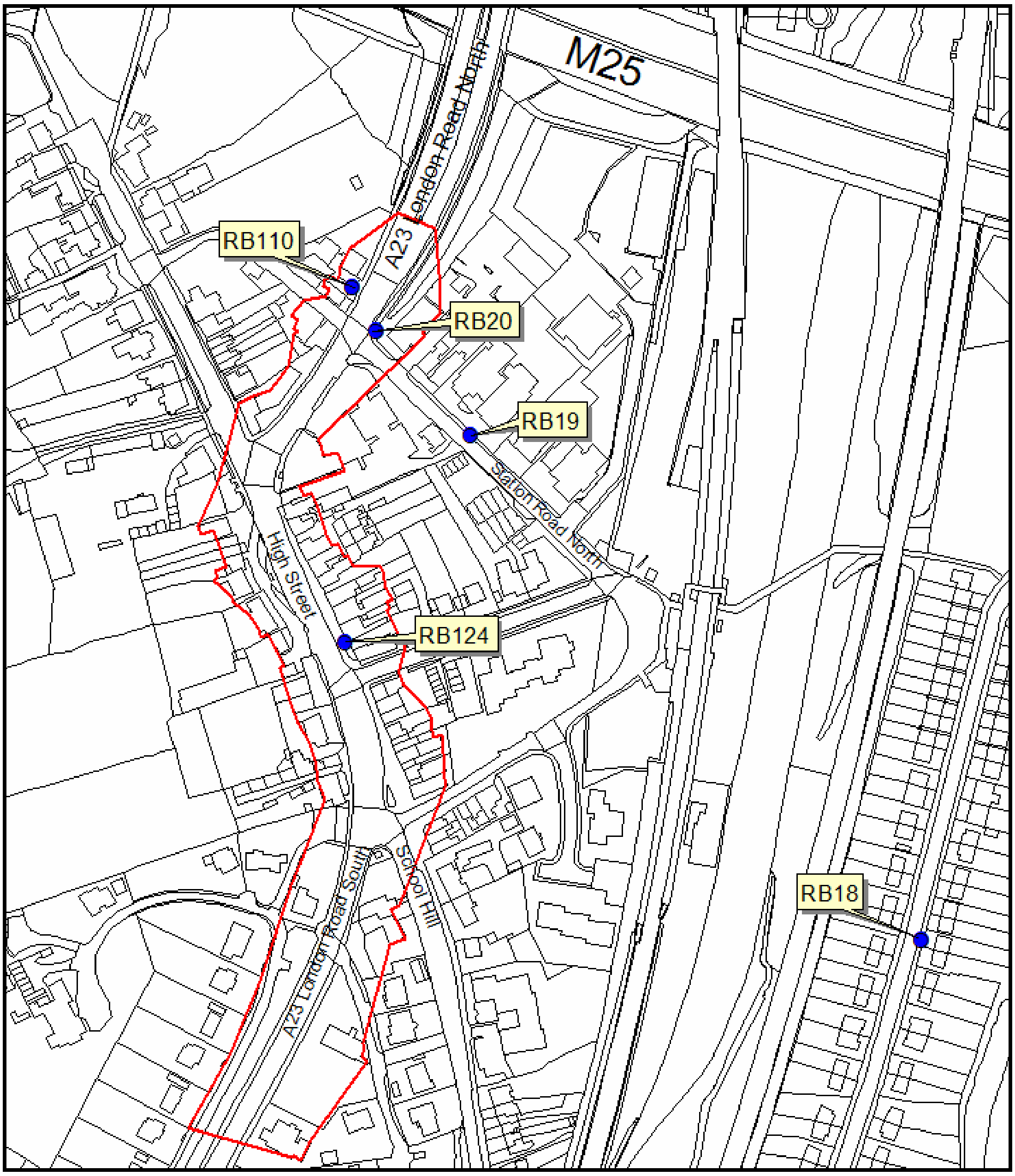

Figure 1: Merstham AQMA (red line). Blue Dots Show Diffusion Tube Monitoring Locations.

© Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405.

3 Developments Since the Declaration of the AQMA

New/Proposed Local Developments

3.1 There have been no new road or housing developments within close proximity to the proposed Merstham AQMA since the Detailed Assessment was carried out.

National Developments

3.2 The latest guidance from Defra (Defra, 2008d) has been followed regarding NOx to NO_2 relationships, along with the new NOx to NO_2 calculator, which has been available from the Air Quality Archive website since April 2007 (Defra, 2008b).

3.3 Defra revised the Air Quality Strategy in July 2007, but this has not changed the statutory objectives for nitrogen dioxide, against which local authorities have to carry out their Reviews and Assessments.

4 Responses to Consultees Comments

4.1 Defra's Appraisal Report accepted the conclusions reached within the Detailed Assessment. The Appraisal report made two comments:

- It is difficult to distinguish the 40 µg/m^3 nitrogen dioxide contour line in relation to the buildings in Figures 3, 4 and 5.
- It is noted that monitoring has been installed along High Street to assist in determining the extent of the AQMA.

4.2 The contour lines presented in this Further Assessment will be presented taking into account the clarity issue. Monitoring data for 2007, including the short-term data available for the new monitoring location in the High Street, Merstham are presented in Section 5.

4.3 Reigate & Banstead Borough Council carried out a consultation exercise to seek views of residents within the proposed Merstham AQMA. Residents of two properties within the area responded. They expressed concerns about the effect of air quality on their health and the effect on house prices. A number of traffic management improvements were also suggested.

4.4 Reigate & Banstead Borough Council also received a response from Croydon Council, who concurred with the findings of the Merstham Detailed Assessment. They did not, however, have any specific comments to make on the Detailed Assessment.

5 New Monitoring and Modelling Data

New Monitoring

5.1 Reigate & Banstead BC do not carry out any automatic monitoring within the Merstham AQMA. Monthly average nitrogen dioxide concentrations have been measured at five sites within the study area using diffusion tubes during 2007 (Figure 1 and Table 2). Diffusion tubes are a type of passive sampler, which absorb the pollutant to be monitored directly from the surrounding air with no need for a power supply. Passive samplers are easy to use and relatively inexpensive. Reigate & Banstead BC uses diffusion tubes prepared and analysed by Lambeth Scientific Services (50% TEA in acetone). All of the data presented in this report have been adjusted to account for diffusion tube bias using a locally derived factor of 1.128. The factor provided for 2007 on the Review and Assessment Helpdesk website (Defra, 2008a) is 0.99, based on 10 studies, which includes the 3 studies carried out by Reigate and Banstead BC (spreadsheet version 03/08). The local factor is higher than the national factor, and thus provides a worst-case assessment of the results. Full data for 2007 are included in Appendix 1, along with further details of the calculation of the local bias adjustment factor.

Table 2: Diffusion Tube Monitoring Locations in Merstham

Tube Ref	Location	Site Type[a]	Relevant Exposure
RB18	60, Brook Road	UB	Yes
RB19	Village Hall, Station Road North	UB	No
RB20	London Rd/Station Rd North	R	No
RB110	204 London Road	R	Yes
RB124	22, High Street	R	Yes

[a] UB – Urban Background; R – Roadside

5.2 Monitoring data since 2003 are presented in Table 3, where available. In all cases, data are bias adjusted, and where appropriate, adjusted to represent an annual mean (see Appendix 2 for details of the 2007 data adjustment factor). Concentrations for 2010 have been estimated from the 2007 measured concentrations, using future year projection factors available from Defra (2008b).

Table 3: Measured and Projected 2010 Annual Mean Concentrations at each Diffusion Tube Monitoring Site (µg/m^3).

Tube Ref	Location	2003[a]	2004[b]	2005[c]	2006[d]	2007[e]	2010
RB18	60, Brook Road	32.1	33.9	33.9	34.8	32.3	29.7
RB19	Village Hall, Station Road North	**46.0**	28.6	34.5	33.0	31.1	28.6
RB20	London Rd/Station Rd North	**51.2**	38.0	**44.0**	**47.8**	**46.4**	**41.5**
RB110	204 London Road	-	-	-	**43.8**[f]	**41.2**	36.9
RB124	22, High Street	-	-	-	-	**51.7**[g]	**46.3**

NOTES: Data in bold denote exceedences of the air quality objectives.
[a] Local bias adjustment factor of 1.29 applied.
[b] Local bias adjustment factor of 1.32 applied.
[c] Local bias adjustment factor of 1.349 applied.
[d] Local bias adjustment factor of 1.459 applied.
[e] Local bias adjustment factor of 1.128 applied (Appendix 1)
[f] Data represent the 2006 annual mean equivalent concentration.
[g] Data represent the 2007 annual mean equivalent concentration (Appendix 2).

5.3 The results indicate that the annual mean nitrogen dioxide objective is being exceeded at roadside locations alongside London Road and High Street. At the background monitoring locations, the annual mean objective is being met, however these locations are not representative of the worst-case residential exposure along the A23. Concentrations measured in 2007 fell relative to those measured in 2006 at all locations where monitoring data are available, however there appears to be no particular trend over the 5-year period.

New Modelling

5.4 Annual mean concentrations of nitrogen dioxide during 2007, 2010, 2015 and 2020 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads is one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003). The model has been run using a full year of meteorological data for 2007 from the meteorological station near Gatwick Airport, and explicitly includes the M25, the A23 and Station Road North. Concentrations have been modelled for specific worst-case relevant receptor locations and diffusion tube monitoring locations (Figure 2). Concentrations have also been modelled for locations surrounding the relevant receptors where exceedences of the air quality objective have been predicted. The modelling methodology, and the input data utilised are described in Appendix 3. The model has been verified against the diffusion tube measurements (excluding RB18, which is not adjacent to the road network) and adjusted accordingly. Further details of model verification and adjustment are also supplied in Appendix 3.

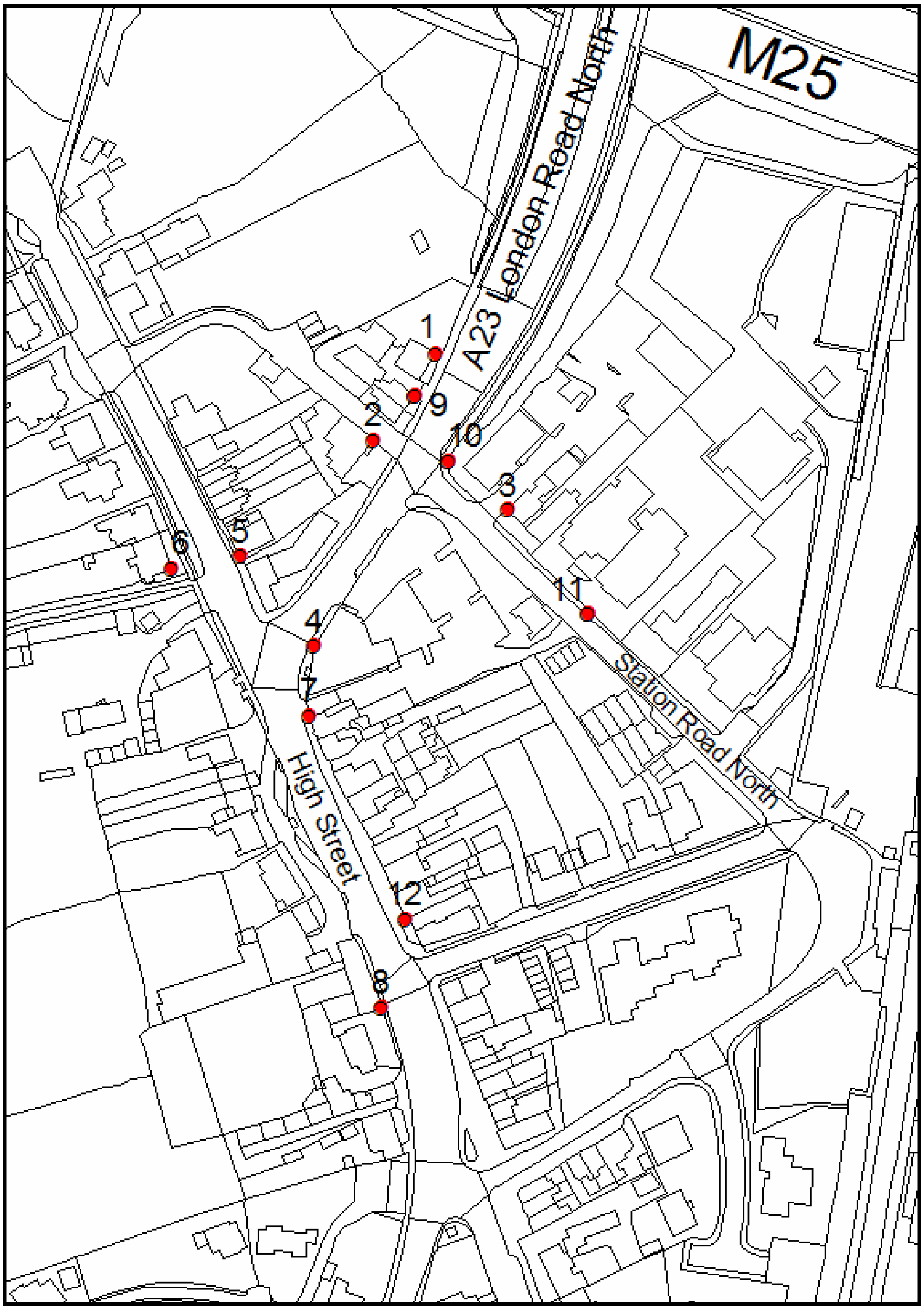

Figure 2: Specific Receptor Locations. © Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405

5.5 Table 4 presents the concentrations predicted for specific receptor locations. The model under-predicts at some monitoring locations, and over-predicts at others. For instance, the estimated annual mean concentration at RB124 is 51.7 μg/m^3 (Table 3), compared with the modelled concentration (Receptor 12) of 41.9 μg/m^3. These differences will be due to uncertainties in both the monitored and modelled concentrations.

5.6 The highest predicted annual mean nitrogen dioxide concentration in 2007 is 50.9 µg/m^3 (at Receptor 4), which represents the Feathers Pub. The highest predicted concentration at a receptor representative of relevant exposure in 2007 is 49.6 µg/m^3 at Receptor 7. By 2020, annual mean nitrogen dioxide concentrations at all receptor locations are predicted to meet the objective.

5.7 At locations representing relevant exposure within the AQMA, the air quality objectives are breached until beyond 2015. There are, however, no predicted annual mean concentrations greater than 60 µg m^{-3} at relevant locations, and therefore it is unlikely that the 1-hour objective for nitrogen dioxide will be exceeded.

Table 4: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) Modelled for Specific Receptor Locations

Receptor number	Location	Relevant Exposure	2007	2010	2015	2020
1	206 London Road North	Yes	**46.4**	**42.1**	37.7	36.4
2	Flat above the Railway Arms	Yes	**41.0**	37.4	33.6	32.4
3	Closest residential properties to junction of Station Road North and London Road North	Yes	38.2	36.3	32.7	31.5
4	Feathers Pub	No	**50.9**	**46.2**	**41.5**	39.8
5	Closest property on east side of Quality Street to junction with London Road North/High Street	Yes	32.6	30.0	27.1	26.3
6	Closest property on west side of Quality Street to junction with London Road North/High Street	Yes	29.9	27.5	25.0	24.2
7	Closest property to junction of London Road North and High Street	Yes	**49.6**	**45.0**	**40.4**	38.9
8	Residential property on High Street	Yes	**43.0**	39.2	35.4	34.1
9	RB110, 204 London Road North	Yes	**44.9**	**40.8**	36.6	35.3
10	RB20, Corner London Road North and Station Road North	No	**46.4**	**42.9**	38.5	37.1
11	RB19, Village Hall, Station Road North	No	34.3	33.8	30.4	29.3
12	RB124, 22 High Street	Yes	**41.9**	38.2	34.4	33.2
Objective			**40**	**40**	**40**	**40**

5.8 Figure 3 indicates predicted exceedences of the annual mean nitrogen dioxide objective at locations of relevant exposure, however when compared with Figure 1, it is clear that properties within the area of predicted exceedence of the annual mean nitrogen dioxide objective (40 µg/m^3 contour) are all included within the proposed AQMA boundary. The 36 µg/m^3 contour, shown as the blue contour line, represents one standard deviation of the model, which takes into account the uncertainty inherent in the predicted results. Relevant exposure lies within the 36 µg/m^3 contour, and close to the M25, this includes properties which are not included in the proposed AQMA boundary.

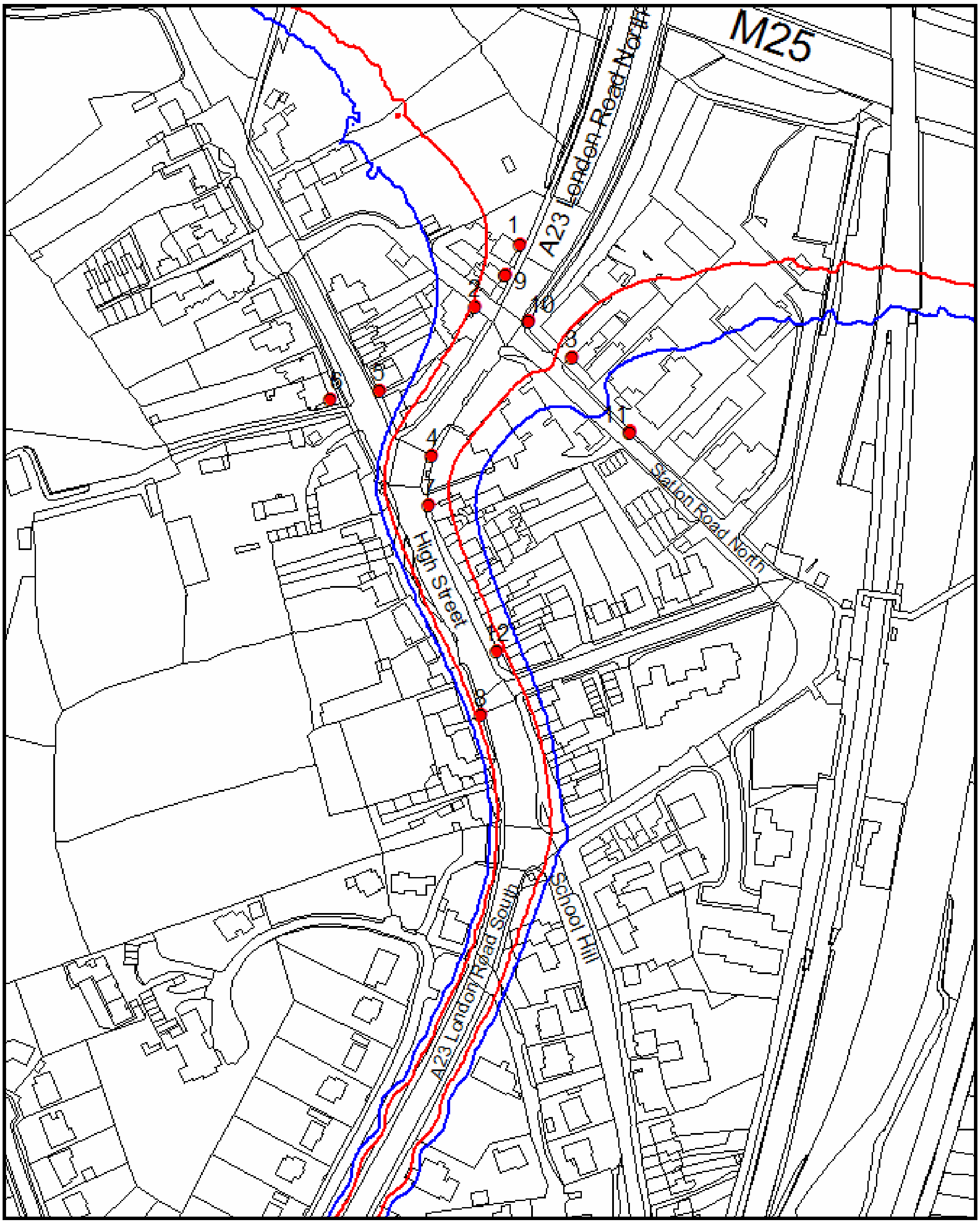

Figure 3: Modelled Annual Mean Nitrogen Dioxide Concentration Contours in 2007 around the Merstham AQMA. The red contour line represents 40 µg/m^3, whilst the blue contour line represents 36 µg/m^3. © Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405.

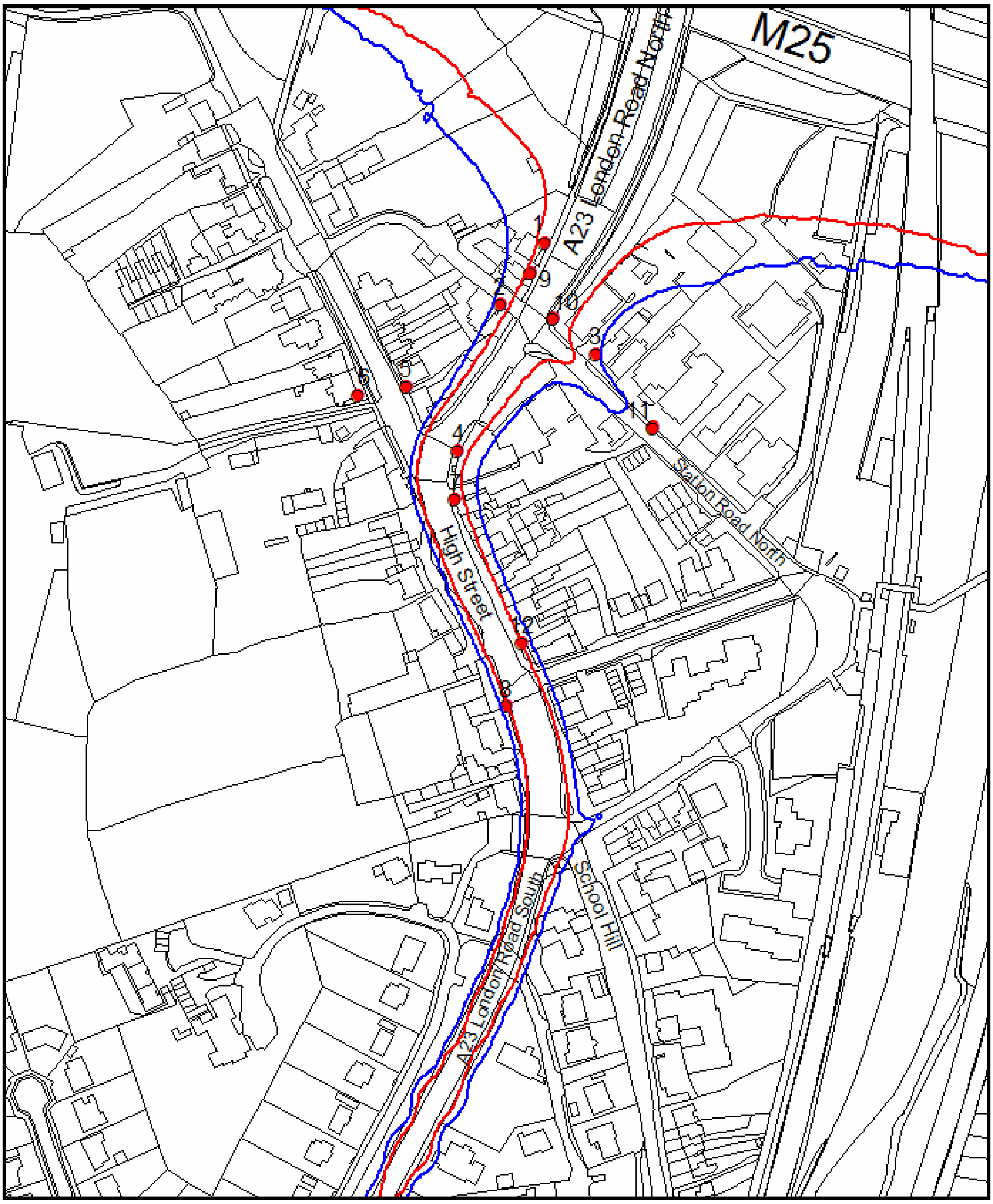

Figure 4: Modelled Annual Mean Nitrogen Dioxide Concentration Contours in 2010 around the Merstham AQMA. The red contour line represents 40 µg/m^3, whilst the blue contour line represents 36 µg/m^3. © Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405.

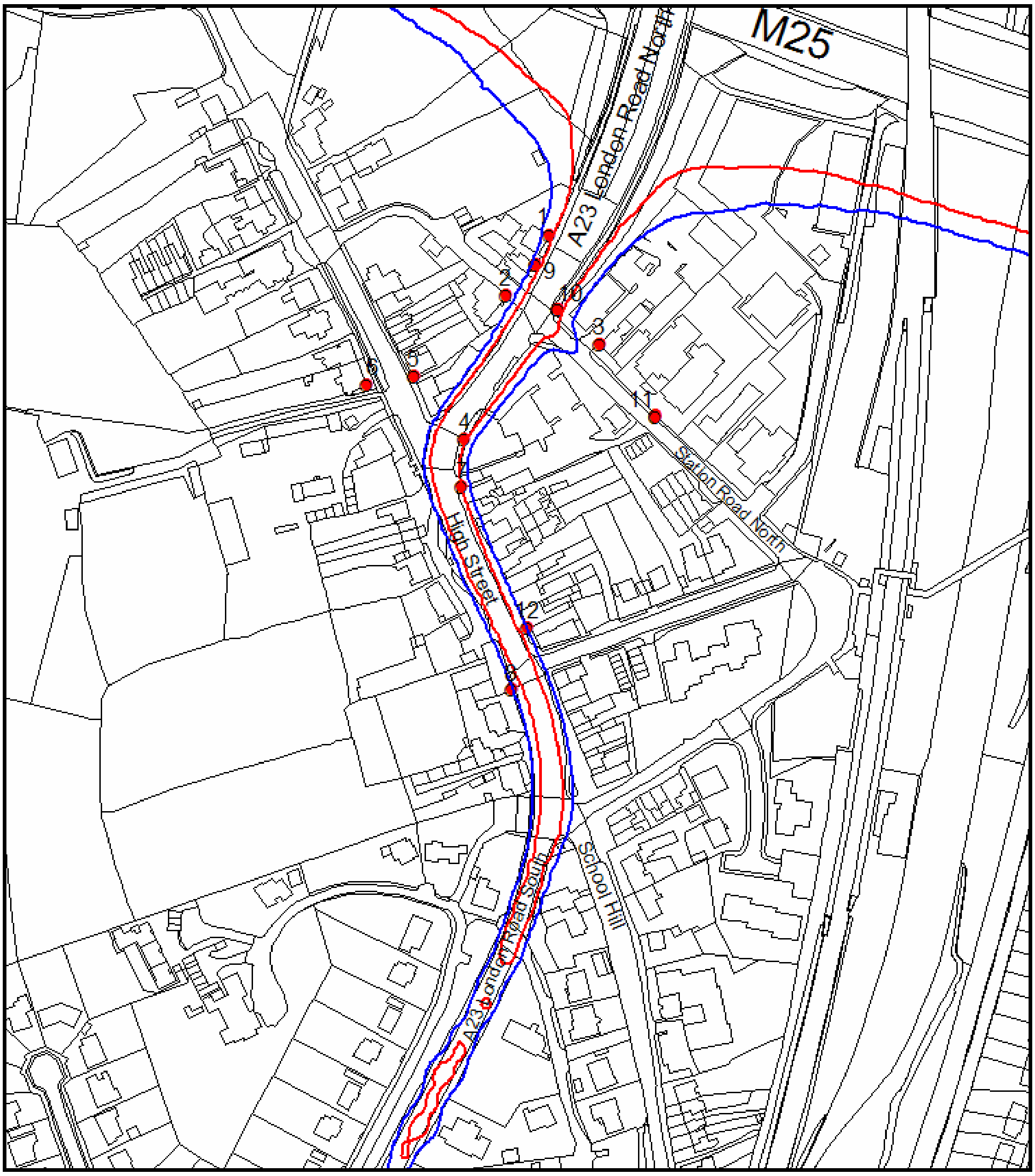

Figure 5: Modelled Annual Mean Nitrogen Dioxide Concentration Contours in 2015 around the Merstham AQMA. The red contour line represents 40 µg/m^3, whilst the blue contour line represents 36 µg/m^3. © Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405.

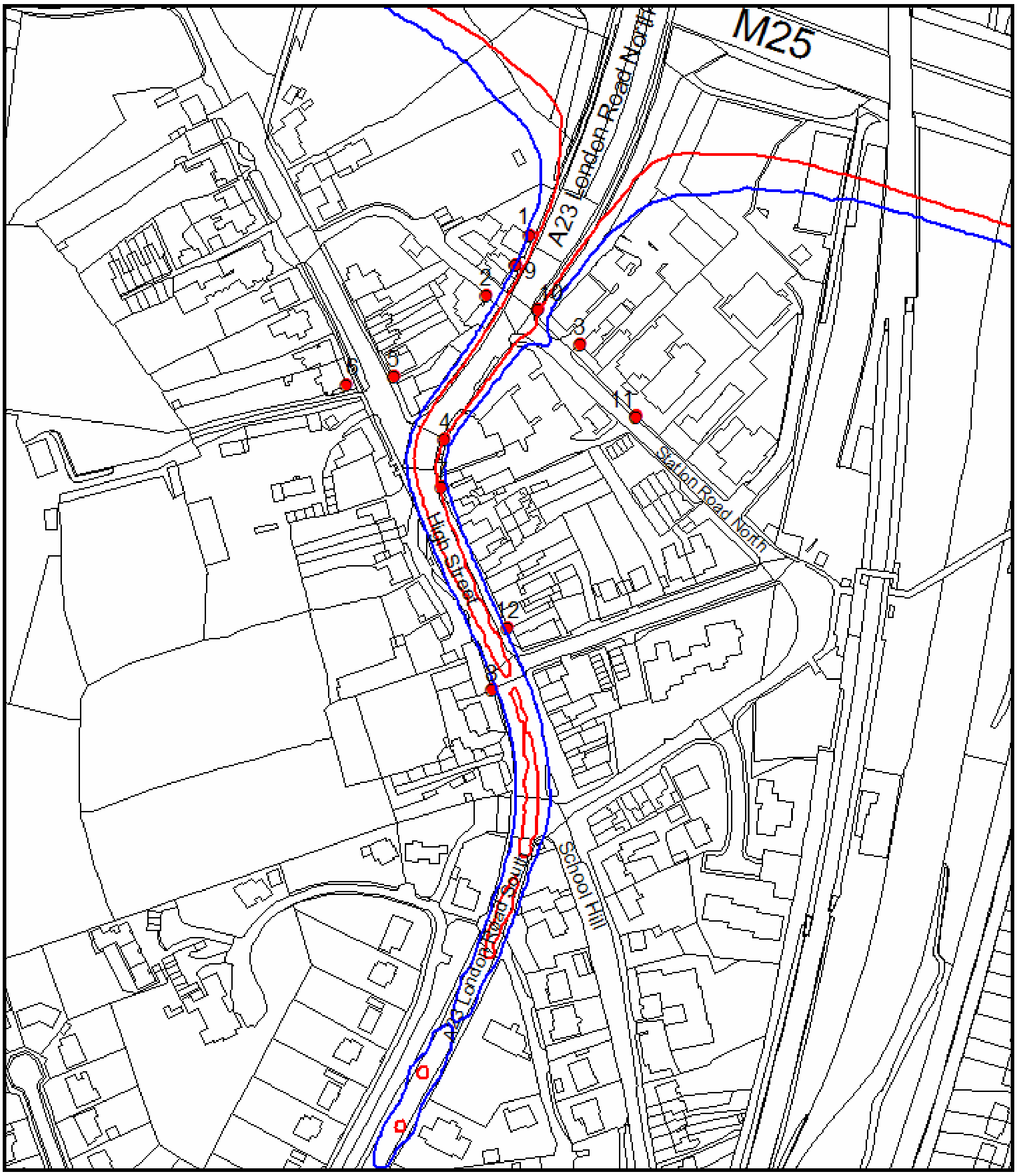

Figure 6: Modelled Annual Mean Nitrogen Dioxide Concentration Contours in 2020 around the Merstham AQMA. The red contour line represents 40 µg/m^3, whilst the blue contour line represents 36 µg/m^3. © Crown Copyright. Reigate & Banstead Borough Council. Licence no. 100019405.

5.9 Figures 4, 5 and 6 indicate that by 2020, there will be no properties within the 40 µg/m^3 contour, and therefore there are no predicted exceedences of the annual mean objective at locations of relevant exposure.

6 Source Apportionment

6.1 In order to develop an appropriate action plan it is necessary to identify the sources contributing to the objective exceedences at locations within the AQMAs. The data presented here could be used to inform any future traffic management decisions. Figures 7 and 8, and Tables 5 and 6 set out the source contributions of traffic related sources, which have been apportioned to the following categories:

Table 5 (and Figure 7):

- Cars;
- Light Goods Vehicles;
- Heavy Goods Vehicles;
- Buses;
- Motorcycles; and
- Ambient Background.

Table 6 (and Figure 8):

- Non-M25; and
- M25

6.2 The twelve specific receptor locations shown in Figure 2 have been chosen to provide an overview of source contributions at these different locations. They represent worst-case locations for nitrogen dioxide concentrations, as well as a geographical spread across the modelled area.

6.3 Table 5 (and Figure 7) shows that for each receptor, the most significant proportion of the locally-generated road component can be attributed to emissions from cars. HGVs also contribute a significant proportion despite making up a relatively small proportion of the total traffic volume (around 5%). In most cases, the background concentration contributes the largest proportion to the overall concentration.

Table 5: Modelled Annual Mean (2007) Nitrogen Dioxide Concentrations at the Worst-Case Receptors and the Contribution of Each Source (Vehicle) Type to the Total.

Receptor	Annual Mean Concentration (µg/m³)						
	Background	Cars	LGVs	HGVs	Buses	MCL	Total
1	17.4	16.6	0.4	11.8	<0.01	0.2	**46.4**
2	17.4	13.5	0.3	9.7	<0.01	0.2	**41.0**
3	17.4	11.8	0.2	8.7	<0.01	0.2	38.2
4	17.4	17.4	0.4	15.5	<0.01	0.2	**50.9**
5	17.4	9.0	0.2	6.0	<0.01	0.1	32.6
6	17.4	7.5	0.2	4.7	<0.01	0.1	29.9
7	17.4	16.7	0.4	15.0	<0.01	0.2	**49.6**
8	17.4	13.5	0.3	11.8	<0.01	0.2	**43.0**
9	17.4	15.6	0.3	11.4	<0.01	0.2	**44.9**
10	17.4	16.0	0.3	12.5	<0.01	0.2	**46.4**
11	17.4	9.5	0.2	7.2	<0.01	0.1	34.3
12	17.4	12.8	0.3	11.4	<0.01	0.2	**41.9**
	% Contribution to Total						
	Background	Cars	LGVs	HGVs	Buses	MCL	Total
1	37.4	35.8	0.8	25.5	<0.01	0.4	100 %
2	42.4	33.0	0.7	23.6	<0.01	0.4	100 %
3	45.4	30.8	0.6	22.7	<0.01	0.4	100 %
4	34.1	34.3	0.7	30.5	<0.01	0.4	100 %
5	53.2	27.4	0.6	18.5	<0.01	0.3	100 %
6	58.1	25.2	0.5	15.8	<0.01	0.3	100 %
7	35.0	33.7	0.7	30.2	<0.01	0.4	100 %
8	40.4	31.3	0.7	27.3	<0.01	0.4	100 %
9	38.7	34.8	0.7	25.3	<0.01	0.4	100 %
10	37.4	34.5	0.7	26.9	<0.01	0.4	100 %
11	50.6	27.6	0.6	20.9	<0.01	0.4	100 %
12	41.4	30.5	0.6	27.1	<0.01	0.4	100 %

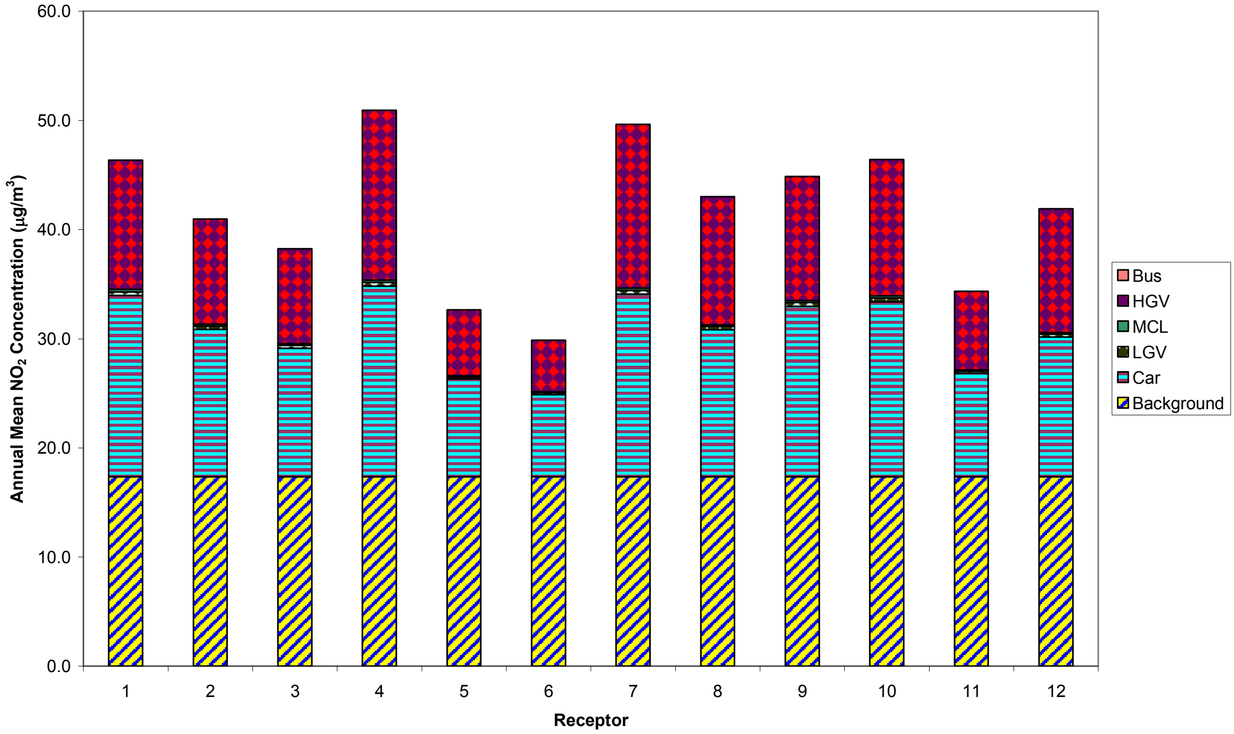

Figure 7: Relative Contribution of Each Source (Vehicle) Type to the Total Modelled Annual Mean Nitrogen Dioxide Concentration (µg/m^3) at Worst Case Receptor Locations within the Merstham AQMA.

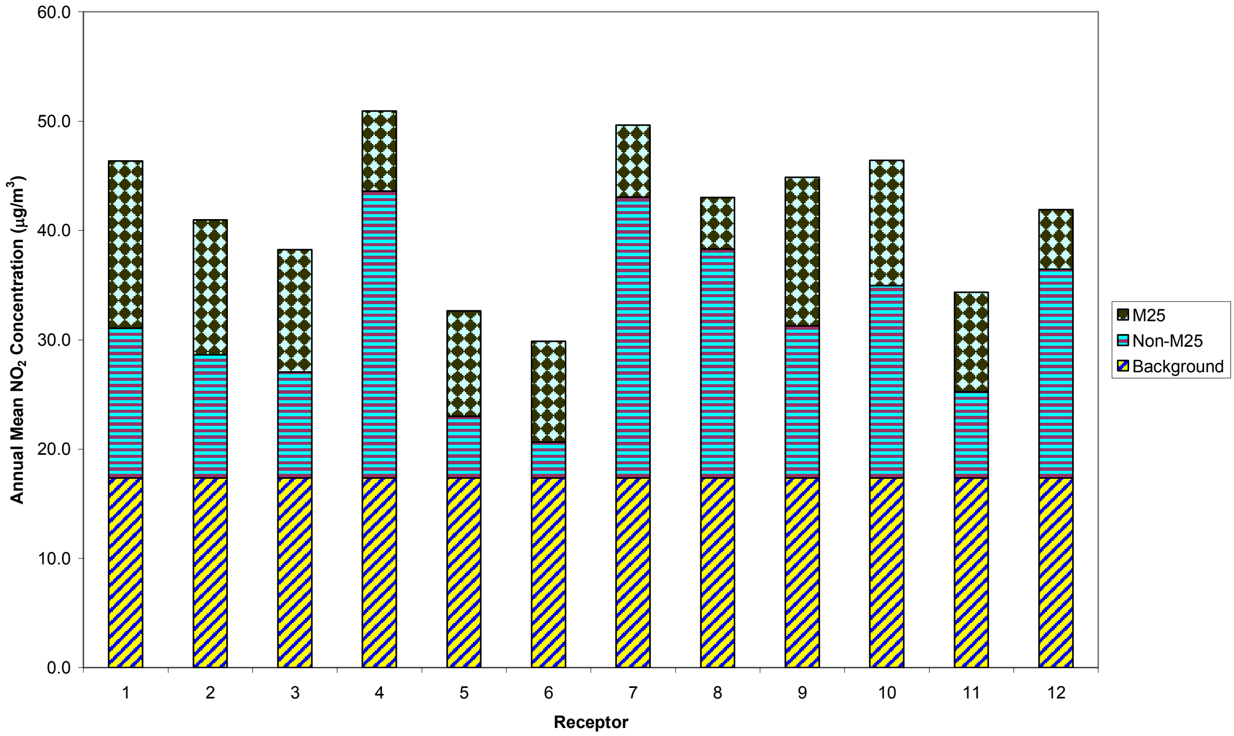

Figure 8: Relative Contribution of Each Source (Road) to the Total Modelled Annual Mean Nitrogen Dioxide Concentration (µg/m^3) at Worst Case Receptor Locations within the Merstham AQMA.

Table 6: Modelled Annual Mean (2007) Nitrogen Dioxide Concentrations at the Worst-Case Receptors and the Contribution of Each Source (Road) to the Total.

Receptor	Annual Mean Concentration (µg/m^3)			
	Background	Non-M25	M25	Total
1	17.4	13.7	15.3	**46.4**
2	17.4	11.3	12.4	**41.0**
3	17.4	9.7	11.2	38.2
4	17.4	26.2	7.3	**50.9**
5	17.4	5.7	9.6	32.6
6	17.4	3.3	9.2	29.9
7	17.4	25.7	6.6	**49.6**
8	17.4	20.9	4.7	**43.0**
9	17.4	13.9	13.6	**44.9**
10	17.4	17.6	11.5	**46.4**
11	17.4	7.9	9.1	34.3
12	17.4	19.1	5.4	**41.9**
	% Contribution to Total			
	Background	Non-M25	M25	Total
1	37.4	29.5	33.0	100 %
2	42.4	27.5	30.1	100 %
3	45.4	25.4	29.2	100 %
4	34.1	51.5	14.4	100 %
5	53.2	17.3	29.5	100 %
6	58.1	10.9	30.9	100 %
7	35.0	51.8	13.3	100 %
8	40.4	48.7	11.0	100 %
9	38.7	31.0	30.3	100 %
10	37.4	37.9	24.7	100 %
11	50.6	22.9	26.5	100 %
12	41.4	45.6	13.0	100 %

6.4 Table 6 (and Figure 8) shows that the M25 motorway contributes to between 11 and 33 % of the annual mean nitrogen dioxide concentration at each receptor, roughly relating to the distance between the receptor and the M25 (Receptor 1 – 33%; Receptor 8 – 11%).

7 Air Quality Improvements Required

7.1 The degree of improvement needed in order for the annual mean objective for nitrogen dioxide to be achieved is defined by the difference between the highest predicted concentration in 2007 and the objective level (40 $\mu g/m^3$). The highest predicted concentration within the proposed Merstham AQMA is at Receptor 4 (50.9 $\mu g/m^3$) requiring a reduction of around 10.9 $\mu g/m^3$ in order for the objective to be achieved (see Table 4; modelling includes all road sources as described in Appendix 3).

7.2 In terms of describing the reduction in emissions that is required it is more useful to consider nitrogen oxides (NOx). Table 7 sets out the required reduction in local emissions of NOx that would be required at each receptor where an exceedence has been predicted in order for the annual mean objective to be achieved in 2007. At Receptor 4, local emissions would need to fall by over 39%.

7.3 Table 8 sets out the required reduction in local emissions of NOx that would be required, at receptor locations where exceedences have been predicted in 2010 and 2015, in order for the annual mean objective to be achieved. At Receptor 4 in 2015, local emissions would still need to fall by 7%.

Table 7: Improvement in Annual Mean Nitrogen Dioxide Concentrations and in Emissions of Oxides of Nitrogen at the Worst-Case Representative Receptors in 2007.

Receptor	Required reduction in annual mean nitrogen dioxide concentration ($\mu g/m^3$)	Required reduction in emissions of oxides of nitrogen from local roads (%)
1	6.4	26.6
2	1.0	5.1
4	10.9	39.1
7	9.6	36.0
8	3.0	14.4
9	4.9	21.5
10	6.4	26.8
12	1.9	9.6

Table 8: Improvement in Annual Mean Nitrogen Dioxide Concentrations and in Emissions of Oxides of Nitrogen at the Worst-Case Representative Receptors in 2010 and 2015.

	Required reduction in annual mean nitrogen dioxide concentration ($\mu g/m^3$)		Required reduction in emissions of oxides of nitrogen from local roads[a] (%)	
	2010	**2015**	**2010**	**2015**
1	2.1	-	9.7	
4	6.2	1.5	25.3	7.0
7	5.0	0.4	21.4	2.3
9	0.8	-	3.8	
10	2.9	-	13.3	

[a] Including the contribution from the M25.

7.4 However, it is very important to stress that these anticipated improvements do not take specific account of local factors. Furthermore, there is evidence at a national level, that concentrations at some roadside sites have not followed predicted trends. This has been explored by the Government's expert advisory panel AQEG (2007); one contributing factor has been the increased permeation of diesel vehicles into the national fleet, which emit a higher proportion of primary NO_2. New guidance from Defra (Defra, 2008d) regarding NOx to NO_2 relationships has been followed, however, there is still uncertainty as to whether these relationships will continue to apply in 2010, 2015 and 2020.

8 Management Planning

8.1 In the Merstham AQMA, pollutant concentrations are influenced by vehicle flow patterns, including acceleration, deceleration, and any congestion along the High Street, or queuing at the pedestrian crossing. Action Plan measures to reduce concentrations are likely to include traffic management measures. However, in order to inform the focus of potential measures within the action plan, a number of simple and hypothetical measures to deliver the required NOx reductions at the representative receptor locations have been explored. The measures that have been examined involve stepped reductions in emissions from each of the vehicle categories defined in Section 7 (buses have been excluded as they were predicted to contribute <0.01% at each receptor). It is not within the remit of this report to speculate on how these reductions might be achieved, and the intention is simply to inform future management decisions. Tables 9 sets out the results.

Table 9: Modelled Annual Mean Nitrogen Dioxide Concentration During 2007 Assuming Hypothetical Emission Reductions from Different Vehicle Classes.

Vehicle Type	% Reduction in Emissions	Predicted Annual Mean Concentration (µg/m³)[a]											
		1	2	3	4	5	6	7	8	9	10	11	12
Car	1%	**46.2**	**40.9**	38.1	**50.8**	32.6	29.8	**49.5**	**42.9**	**44.7**	**46.3**	34.3	**41.8**
	5%	**45.7**	**40.4**	37.7	**50.2**	32.3	29.5	**49.0**	**42.5**	**44.2**	**45.8**	33.9	**41.4**
	10%	**45.0**	39.9	37.2	**49.6**	31.9	29.2	**48.3**	**41.9**	**43.6**	**45.1**	33.5	**40.9**
	25%	**43.0**	38.2	25.7	**47.5**	30.7	28.2	**46.3**	**40.3**	**41.7**	**43.2**	32.3	39.3
	50%	39.5	35.2	33.1	**43.8**	28.6	26.4	**42.8**	37.4	38.3	39.8	30.2	36.5
LGV	1%	**46.4**	**41.0**	38.2	**50.9**	32.6	29.9	**49.6**	**43.0**	**44.9**	**46.4**	34.3	**41.9**
	5%	**46.3**	**41.0**	38.2	**50.9**	32.6	29.8	**49.6**	**43.0**	**44.9**	**46.4**	34.3	**41.9**
	10%	**46.3**	**40.9**	38.2	**50.9**	32.6	29.8	**49.6**	**43.0**	**44.8**	**46.4**	34.3	**41.9**
	25%	**46.3**	**40.9**	38.2	**50.9**	32.6	29.8	**49.6**	**43.0**	**44.8**	**46.4**	34.3	**41.9**
	50%	**46.2**	**40.9**	38.1	**50.8**	32.6	29.8	**49.5**	**42.9**	**44.7**	**46.3**	34.2	**41.8**
HGV	1%	**46.3**	**40.9**	38.2	**50.8**	32.6	29.8	**49.5**	**42.9**	**44.8**	**46.3**	34.3	**41.8**
	5%	**45.9**	**40.6**	37.9	**50.3**	32.4	29.6	**49.1**	**42.5**	**44.4**	**45.9**	34.0	**41.5**
	10%	**45.4**	**40.2**	37.5	**49.7**	32.1	29.4	**48.5**	**42.1**	**44.0**	**45.4**	33.7	**41.0**
	25%	**44.0**	39.0	36.4	**47.9**	31.3	28.8	**46.7**	**40.6**	**42.6**	**43.9**	32.8	39.6
	50%	**41.5**	36.9	34.5	**44.7**	30.0	27.7	**43.6**	38.1	**40.2**	**41.3**	31.2	37.1
MCL	1%	**46.4**	**41.0**	38.2	**50.9**	32.6	29.9	**49.6**	**43.0**	**44.9**	**46.4**	34.3	**41.9**
	5%	**46.4**	**41.0**	38.2	**50.9**	32.6	29.9	**49.6**	**43.0**	**44.9**	**46.4**	34.3	**41.9**
	10%	**46.3**	**41.0**	38.2	**50.9**	32.6	29.8	**49.6**	**43.0**	**44.8**	**46.4**	34.3	**41.9**
	25%	**46.3**	**40.9**	38.2	**50.9**	32.6	29.8	**49.6**	**43.0**	**44.8**	**46.4**	34.3	**41.9**
	50%	**46.3**	**40.9**	38.2	**50.8**	32.6	29.8	**49.6**	**43.0**	**44.8**	**46.3**	34.3	**41.9**
All Vehicles	1%	**46.1**	**40.8**	38.1	**50.7**	32.5	29.7	**49.4**	**42.8**	**44.6**	**46.2**	34.2	**41.7**
	5%	**45.2**	40.0	37.4	**49.6**	32.0	29.3	**48.4**	**42.0**	**43.8**	**45.3**	33.6	**40.9**
	10%	**44.0**	39.0	36.5	**48.3**	31.3	28.7	**47.1**	**40.9**	**42.6**	**44.1**	32.9	39.9
	25%	**40.4**	36.0	33.7	**44.1**	29.2	27.0	**43.1**	37.6	39.1	**40.4**	30.6	36.7
	50%	33.8	30.5	28.9	36.6	25.6	24.0	35.8	31.7	32.9	33.8	26.6	31.1
Do Nothing[b]	-	**46.4**	**41.0**	38.2	**50.9**	32.6	29.9	**49.6**	**43.0**	**44.9**	**46.4**	34.3	**41.9**

[a] Modelling carried out includes all road sources within the study area, including the M25 (see Appendix 3).

[b] Results from Table 4.

8.2 The results presented in Table 9 highlight that targeting vehicle types in isolation would achieve very little. The only effective measure for improving air quality would be to reduce total vehicle emissions by 50%. This is the only measure that, in 2007, would reduce the concentrations at the all locations where exceedences have been predicted, to a level where the annual mean air quality objective would be met.

9 Summary and Conclusion

9.1 Nitrogen dioxide concentrations within and around the Merstham AQMA have been assessed through diffusion tube monitoring and detailed dispersion modelling. The results indicate that the annual mean nitrogen dioxide objective was exceeded in 2007 within the AQMA, and that it will continue to be exceeded until 2015 if no action is taken.

9.2 The results of the detailed modelling predict exceedences within the Merstham AQMA. At relevant locations in close proximity to the AQMA, the annual mean nitrogen dioxide objective is predicted to be met. It is therefore recommended that:

- The Merstham AQMA should remain in its present form and monitoring should continue.

9.3 Source apportionment of the local traffic emissions has been undertaken to inform the action plan. This shows that emissions from cars contribute the largest proportion to the locally-generated road component. It also shows that HGVs make a significantly higher local contribution to emissions than might be expected from the vehicle numbers and proportions. This highlights the importance of keeping all sources under consideration when contemplating measures to include within the action plan.

9.4 When considering local road sources, the M25 contributes between 11 and 33% to the concentrations predicted at receptors within the AQMA.

9.5 A reduction in the volume of traffic around the AQMA is predicted to result in a decrease in the concentrations of nitrogen dioxide within the AQMA, however a reduction in total vehicle emissions of greater than 50% would be required to achieve the annual mean air quality objective at all modeled receptor locations in 2007.

10 Uncertainties

10.1 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 (2008c) suggest 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 future year traffic data determined from modelled data provided by Surrey County 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 during each year, the vehicle fleet within the study area will conform to the national (UK) average composition; it has been assumed the emissions per vehicle conform to the factors published in DMRB 11.3; it has been assumed that wind conditions measured near Gatwick Airport during 2007 will occur throughout the study area during 2007, 2010, 2015 and 2020; and it has been assumed that the subsequent 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.

10.2 The UK Government's Air Quality Expert Group (AQEG) has published a report on trends in primary nitrogen dioxide in the UK (AQEG, 2007). This examines evidence that shows that while NOx emissions have fallen in line with predictions made a decade previously, the composition of NOx has, in some urban environments, changed. This may have caused nitrogen dioxide levels at some locations to fall less rapidly than was expected. The latest guidance from Defra (Defra, 2008d) has been followed regarding NOx to NO_2 relationships but there is still uncertainty as to whether these relationships will continue to apply in 2010, 2015 and 2020. The implications for the conclusions of this assessment are judged to be negligible in 2007.

10.3 The limitations to the assessment should be borne in mind when considering the results set out in preceding sections. While the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. Clearly in future years the uncertainties are likely to be greater than they are now. The results are 'best estimates' and have been treated as such in the discussion.

11 References

Air Quality Expert Group, 2007. Trends in Primary Nitrogen Dioxide in the UK. December 2007.

Defra, 2003. Review & Assessment: Technical Guidance LAQM.TG(03).

Defra, 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007.

Defra, 2008a. Air Quality Review and Assessment Helpdesk website. Available at: www.uwe.ac.uk/aqm/review/

Defra, 2008b. Air Quality Archive via the internet www.airquality.co.uk.

Defra, 2008c. National Atmospheric Emissions Inventory. www.naei.org.uk

Defra, 2008d. FAQ - Is there a new NO_x to NO_2 calculator available to allow for the recent increase in primary NO_2 from traffic? Available at www.uwe.ac.uk/aqm/review

DfT, 2007. Modelling and Forecasting using the National Transport Model. Further information available at: http://www.dft.gov.uk/pgr/economics/ntm/

DfT, 2008. Annual Average Daily Flows available at http://www.dft.gov.uk/matrix/

Laxen and Marner, 2003. Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. Available from Defra, 2007b.

RBBC, 2006. Updating and Screening Assessment. May 2006.

RBBC, 2007. Detailed Assessment of Air Quality in Merstham. May 2007.

Stationery Office, 2000. Air Quality Regulations, 2000, Statutory Instrument 928.

Stationery Office, 2002. The Air Quality (England) (Amendment) Regulations 2002. Statutory Instrument 3043.

12 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.
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometers in aerodynamic diameter.
NOx	Nitrogen oxides
NO_2	Nitrogen dioxide.
$\mu g/m^3$	Microgrammes per cubic metre.
Urban Background	An urban location away from the immediate effect of local sources and therefore broadly representative of city-wide background conditions (Defra, 2003).
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, 2003).
HGV	Heavy Goods Vehicle
LGV	Light Goods Vehicle
LDV	Light Duty Vehicles (taken as all vehicles excluding HDVs)
HDV	Heavy Duty Vehicle (HGVs + Buses)
MCL	Motorcycle

13 Appendix 1 – Diffusion Tube Monitoring

Table A1.1: Results of Diffusion Tube Monitoring 2007

Tube No	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Ann Mean	Bias adjust	No of Mnths
RB18	26	35	-	-	16	17	31	24	30	35	31	41	28.6	32.3	10
RB19	28	26	27	16	15	17	39	21	29	37	35	41	27.6	31.1	12
RB20	39	40	48	-	24	32	41	31	39	57	46	55	41.1	**46.4**	11
RB110	33	23	34	43	22	27	59	30	40	41	42	44	36.5	**41.2**	12
RB124	-	-	-	-	-	28	55	44	42	58	52	56	47.9	**54.0**	7

13.1 Diffusion tubes are known to exhibit bias when compared to results from automatic analysers. Therefore diffusion tube results need to be adjusted to account for this bias. One of the main factors influencing diffusion tube performance is thought to be the laboratory that supplies and analyses the tubes. In 2007, Reigate and Banstead Borough Council used diffusion tubes supplied and analysed by Lambeth Scientific Services (50% TEA in acetone).

13.2 In order to determine the bias exhibited by these tubes, studies are carried out using triplicate tubes collocated with each of the three automatic monitors within the Borough of Reigate and Banstead (data capture 75% or greater). All 2007 diffusion tube data (Table A1.1) presented in this report have been adjusted using the overall factor calculated from the data presented in Table A1.2, with the optimum relationship defined using orthogonal regression.

Table A1.2: Results of Diffusion Tube and Continuous Monitor Collocation Studies in 2007

AQMS	Diffusion Tube	Automatic	Adjustment Factor
Michael Crescent, Horley	24.3	28.9	1.19
74 The Crescent, Horley	33.1	34.3	1.04
Poles Lane Pumping Station, Crawley	17.9	20.8	1.16
Overall Factor			**1.128**

14 Appendix 2 – Adjustment of Short-Term Data to Annual Mean

14.1 An additional diffusion tube monitoring site was established on the lamp post outside 22 High Street, Merstham (RB124) at the end of May 2007. As a result, data for this site do not represent a full calendar year. Therefore, in accordance with the guidance in LAQM.TG(03), the data have been adjusted to an annual mean, based on the ratio of concentrations during the short-term monitoring period (7 months; 29/5/07 – 2/1/08) to those over a full calendar year at three sites where long-term data are available. Triplicate diffusion tubes are exposed at all three sites, and the average of the three tubes has been taken for each month. Each of the three diffusion tubes at each of the three sites have 100% data capture during 2007.

14.2 The annual mean nitrogen dioxide concentrations and the period means for each of the three monitoring sites from which adjustment factors have been calculated are presented in Table A2.1, along with the Overall Factor. Applying this factor to the average concentration over the seven month period at RB124 (see table A1.1) results in a fully adjusted 2007 annual mean concentration of 51.7 µg/m^3 at this location.

Table A2.1: Data used to Adjust Short-term Monitoring Data to 2007 Annual Mean

Period Mean Concentration (µg/m^3)	Michael Crescent, Horley	The Crescent, Horley	Poles Lane, Crawley	Overall Factor
2007	24.3	32.0	17.9	-
29/5/07 – 2/1/08	25.2	34.0	18.5	-
Adjustment Factor	**0.963**	**0.939**	**0.969**	**0.957**

15 Appendix 3 – Dispersion Modelling Methodology

15.1 Annual mean concentrations of nitrogen dioxide during 2007, 2010, 2015 and 2020 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads if one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003).

Meteorological Data:

15.2 The model has been run using a full year of meteorological data for 2007 from the meteorological station near Gatwick Airport, which is approximately 15 km south of the study area.

Horizontal Road Alignment:

15.3 Road alignment was based around Ordnance Survey road centreline data. Each carriageway of each road was entered into the model separately, where data were available. Those roads not explicitly included have been accounted for via the background component of the modelled results.

Traffic Data:

15.4 Traffic data for London Road/High Street (A23) have been determined from counts carried out on London Road South in 2007, and from modelled traffic flows provided by Surrey County Council for a number of future years (2016 and 2021). A linear increase in traffic flows has been assumed between 2007 and 2016, and 2016 and 2021 in order to estimate the traffic flows for the assessment years of 2010, 2015 and 2020. In addition, 2006 AADT traffic flows (and the proportion of HDVs) for the M25 close to Merstham have been determined from the interactive web-based map of traffic counts, provided by the Department for Transport (DfT, 2008). These data have been factored forward to each assessment year using forecast information determined from the National Transport Model and associated guidance (DfT, 2007). Traffic count data are not available for Station Road North. Here, a flow has been estimated based on local knowledge. The speeds and road characteristics assumed for each section of road entered into the model are presented in Table A3.1. The associated flows in each assessment year are presented in Table A3.2.

Table A3.1: Summary of Road Characteristic Data

Link	Description	Road width (m)	Speed (kph)[a]
London Road North Northbound A	Northbound carriageway of the A23, north of Merstham heading over the M25.	19	55
London Road North Southbound A	Southbound carriageway of the A23, north of Merstham heading over the M25.	19	55
London Road North Northbound B	Northbound carriageway of the A23, north of the High Street, Merstham.	11	50
London Road North Southbound B	Southbound carriageway of the A23, north of the High Street, Merstham.	11	50
High Street Northbound A	Northern section of northbound carriageway of the A23 High Street.	14	30
High Street Southbound A	Northern section of southbound carriageway of the A23 High Street.	14	30
High Street Northbound B	Central section of northbound carriageway of the A23 High Street.	11	30
High Street Southbound B	Central section of southbound carriageway of the A23 High Street.	11	30
High Street Northbound C	Southern section of northbound carriageway of the A23 High Street.	13	30
High Street Southbound C	Southern section of southbound carriageway of the A23 High Street.	13	30
London Road South Northbound	Northbound carriageway of the A23, south of the High Street, Merstham.	8	50
London Road South Southbound	Southbound carriageway of the A23, south of the High Street, Merstham.	8	50
M25	The M25 north of Merstham.	37	100/115
Station Road North	Station Road North, between London Road North and London Road South.	7	40

[a] Average speed rounded to nearest 5 kph. Where two speeds are presented, the lower speed represents the speed assumed for HDVs, whilst the higher speed that assumed for LDVs.

Table A3.2: Summary of Traffic Flows used in Assessment[a]

	2007		2010		2015		2020	
	LDV AAHT	HDV AAHT	LDV AAHT	HDV AAHT	LDV AAHT	HDV AAHT	LDV AAHT	HDV AAHT
A23[b] North-bound	435.7	22.9	465.1	24.5	514.3	27.1	535.4	28.2
A23[b] South-bound	435.7	22.9	465.1	24.5	514.3	27.1	535.4	28.2
M25	6220.0	673.8	6542.6	708.8	7121.6	771.5	7440.1	806.0
Station Road North	206.3	9.5	217.0	10.0	236.2	10.9	246.8	11.4

[a] AAHT – Annual Average Hourly Traffic flow
[b] The A23 includes London Road North, the High Street and London Road South.

Background Concentrations:

15.5 Background concentrations of nitrogen dioxide have been taken from the national maps of background concentrations available from the Air Quality Archive (Defra, 2008b). However, to avoid double counting the effect of the M25 motorway, the background concentrations have been derived following the procedure set out in Box 1.5 of LAQM.TG(03) (Defra, 2003). This involves taking the average background concentration of the fourth grid square either side of the M25. The background concentrations used in the assessment are therefore the average of those calculated from grid squares 526500, 155500 and 529500, 150500. The background concentrations derived from this procedure are presented in Table A3.3.

Table A3.3: Background Concentrations used to determine those appropriate for use in the Assessment

	Grid square	NOx	Average NOx	NO_2	Average NO_2
2007	526500, 155500	20.2	21.9	16.6	17.4
	529500, 150500	23.5		18.2	
2010	526500, 155500	17.5	20.2	15.5	16.8
	529500, 150500	22.8		18.0	
2015	526500, 155500	15.7	18.0	14.6	15.8
	529500, 150500	20.4		16.9	
2020	526500, 155500	15.0	17.2	14.3	15.5
	529500, 150500	19.5		16.7	

Model Verification:

15.6 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of NOx with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions. The model has been run to predict annual mean road-NOx concentrations during 2007 at each diffusion tube location within the study area.

15.7 The model outputs of road-NOx (i.e. the component of total NOx coming from road traffic) have been compared with the measured road-NOx. Total measured NOx was calculated from the measured NO_2 concentrations at each of the three monitoring locations using the recently updated NOx from NO_2 calculator[1] available on the Air Quality Archive website (Defra, 2008b). The measured road-NOx contribution was then calculated as the difference between the total and the background value (determined as described in the previous section).

15.8 A weighted primary adjustment factor was then determined as the inverse of the best fit line between the calculated (measured) road contribution and the model derived road contribution. Each diffusion tube measurement was weighted according to its perceived relative accuracy – concentrations measured at RB19, RB20 and RB110 were given a weighting of one, as these monitoring sites are long term sites, with between 10 and 12 months of data available, respectively. Monitoring at RB124 began in May 2007, and therefore only 7 months of data are available, and this location was given half the weighting.

[1] http://www.airquality.co.uk/archive/laqm/tools/NOxfromNO2calculator2007.xls

15.9 The primary adjustment factor was then applied to each modelled road-NOx concentration to provide an adjusted modelled road-NOx concentration. The background concentration was added to these concentrations to determine the adjusted total modelled NOx concentration. The road contribution to the total annual mean nitrogen dioxide concentration was then determined from these adjusted modelled concentrations, following the method set out by Defra (2003), taking into account the most recent guidance (Defra, 2008d):

$$NO_2\ (road) = NOx\ (road) \times (-0.0719*LN(NOx(total)) + 0.6248$$

15.10 The total nitrogen dioxide concentration was then determined by adding the background NO_2 concentration (determined as described above) to this calculated road contribution. A secondary adjustment factor was finally calculated as the inverse of the best fit line applied to the adjusted data.

15.11 Primary and secondary adjustment factors have been applied to all modelled data presented in this report.

Primary adjustment factor : 4.23

Secondary adjustment factor: 0.98

15.12 The results imply that the model was under-predicting the road NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustments are minor. Figure A3.1 compares the modelled concentrations at each diffusion tube, after all adjustments have been made, to the measured concentrations at these locations.

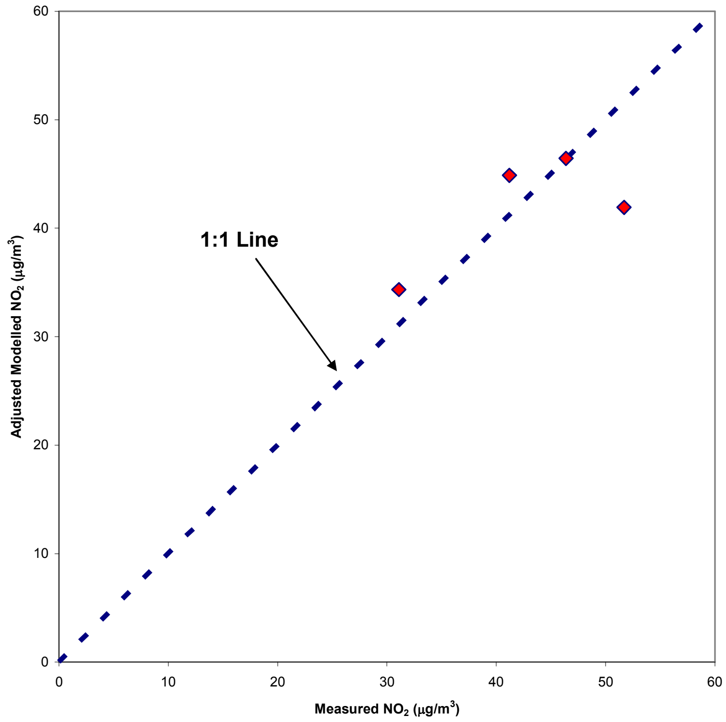

Figure A3.1: Comparison of Measured NO_2 to Fully Adjusted Modelled NO_2 Concentrations

Source Apportionment:

15.13 The model has been used to determine the proportion of emissions at the twelve receptor locations within the Merstham AQMA for each of the following vehicle categories:

- Ambient Background
- Cars
- Light Goods Vehicles (LGVs)
- Heavy Goods Vehicles (HGVs)
- Buses
- Motorcycles

15.14 Concentrations at each receptor have been modelled for each vehicle category independently. The total NO_2 concentration was initially apportioned to background and road components. The road NO_2 component was then further apportioned into source categories according to the relative contribution of each source to the total road NOx.

15.15 The relative contribution on the M25 to the total modelled NO_2 concentration at each receptor was also determined.