Further Assessment of the Hooley Air Quality Management Area.

February 2013

Reigate & Banstead
BOROUGH COUNCIL
Banstead | Horley | Redhill | Reigate

Document Control

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Job Number	J1516

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Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
1516/1/F2	22 February 2013	Final Report	Prof. Duncan Laxen

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1 Introduction

1.1 This report is the Further Assessment of nitrogen dioxide concentrations in Hooley. The report is one of a series produced by, and on behalf of, Reigate and Banstead Borough Council (RBBC), which periodically review and assess air quality within the Borough.

The Air Pollutant of Concern

1.2 Nitrogen dioxide is associated with adverse effects on human health. At high levels nitrogen dioxide causes inflammation of the airways. Long-term exposure may affect lung function and respiratory symptoms. Nitrogen dioxide also enhances the response to allergens in sensitive individuals (Defra, 2007).

The Air Quality Objectives

1.3 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002). The relevant objectives for this assessment are provided in Table 1.

Table 1: Relevant Air Quality Objectives

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 $\mu g/m^3$

1.4 The objectives for nitrogen dioxide were to be achieved by 2005, and continue to apply in all future years thereafter. 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 the annual mean objective, relevant exposure is mainly 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.

1.5 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level.

1.6 The European Union has also set limit values for nitrogen dioxide. Achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). The limit values for nitrogen dioxide are the same levels as the UK objectives, but applied from 2010 (The Air Quality Standards Regulations 2010 (No. 1001), 2010).

Introduction to Review and Assessment

1.7 The Air Quality Strategy (Defra, 2007) provides the policy framework for air quality management and assessment in the UK. As well as providing the air quality objectives listed above, it also sets out how the different sectors: industry, transport and local government can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular Reviews and Assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date.

1.8 Review and Assessment is carried out as a series of rounds. Local Air Quality Management Technical Guidance (LAQM.TG(09)) (Defra, 2009) sets out a phased approach to the current round of Review and Assessment. This prescribes an initial Updating and Screening Assessment (USA), which all 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.

1.9 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, 1) to confirm that the AQMA declaration is justified and that the appropriate area has been declared, 2) to ascertain the sources contributing to the exceedence, and 3) 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.

Key Findings of Previous Review and Assessment Reports

1.10 In the first round of review and assessment, potential exceedences of the annual mean nitrogen dioxide air quality objective were identified and a number of AQMAs were declared close to busy roads and to Gatwick Airport. Several of these AQMAs were subsequently revoked, leaving three AQMAs: one beside the M25, one beside the M23, and one in Horley, close to Gatwick Airport.

1.11 The Updating and Screening Assessment carried out at the start of the second round of Review and Assessment for Reigate and Banstead in 2003 indicated a further risk of exceeding the annual mean nitrogen dioxide and PM_{10} objectives at residential properties at the junction of Rushworth Road and the A217, and recommended a Detailed Assessment for this area.

1.12 The Detailed Assessment concluded that an AQMA was required at this location for nitrogen dioxide, but not for PM_{10}. It also investigated air quality within current AQMAs and at a number of locations where AQMAs had previously been in place, but which had been subsequently revoked. The most significant conclusions for these locations were that a previously revoked AQMA at the junction of the A23 and Dean Lane should be re-declared, and that the three remaining AQMAs should be retained.

1.13 The 2005 Progress Report presented monitoring data for 2004. Nitrogen dioxide concentrations predicted for 2005 from concentrations measured during 2004 within the newly declared Rushworth Road and re-declared Dean Lane AQMAs showed that the annual mean nitrogen dioxide objective would be met. However, the results were close to the objective and a Further Assessment of air quality at these locations was undertaken.

1.14 Routine monitoring of nitrogen dioxide concentrations elsewhere within the Borough identified a further three sites where the concentrations were likely to breach the annual mean objective. These included residential properties at the junction of the A240 Reigate Road and the A2022 Fir Tree Road (Drift Bridge), along Reigate High Street and Church Street (between the High Street and Bancroft Road) and a property on the A217 near Blackhorse Lane and the M25 junction 8 interchange. Following the completion of a detailed assessment in 2006 the Drift Bridge site was declared an AQMA, based on an exceedence of the annual average nitrogen dioxide objective. On Reigate High Street and at the Blackhorse Lane site, nitrogen dioxide concentrations were such that the Council declared the AQMAs without a Detailed Assessment, and proceeded direct to a Further Assessment. The Updating and Screening Assessment of 2006 concluded that there was a potential exceedence of the annual mean nitrogen dioxide objective in Merstham and a Detailed Assessment was subsequently undertaken along the A23 London Road North. This Detailed Assessment (2007) concluded that an AQMA was required in this location and further monitoring should be undertaken. The Further Assessment subsequently confirmed the need for an AQMA in this location.

1.15 By 2009 the increasing proportion of diesel vehicles in the UK fleet and associated increase in primary nitrogen dioxide emissions meant that the 2009 USA identified a number of sites outside the AQMAs where measured concentrations of nitrogen dioxide were above the objective. The USA concluded that a Detailed Assessment should be carried out for nitrogen dioxide for Redhill Town Centre and also for Reigate Hill.

1.16 The 2010 Detailed Assessment concluded that the Council should declare AQMAs for both Reigate Hill and Redhill. Further Assessments have been undertaken for both areas, which confirmed the requirement for AQMAs, and they have both subsequently been declared.

1.17 The 2010 Progress Report concluded that a Detailed Assessment should be undertaken for Hooley, which concluded that an AQMA for nitrogen dioxide is required for this location. In addition, the Progress Report concluded that three of the currently declared AQMAs (Dean Lane, M23 South and Rushworth Road) should be revoked.

1.18 The 2011 Progress Report concluded that ongoing monitoring supported the revocation of the AQMAs at Dean Lane, the M23 South and Rushworth Road, and that all other AQMAs should be retained.

Scope

1.19 Guidance within LAQM.TG(09) explains that a Further Assessment report allows authorities to:

- confirm their original assessment, and thus ensure they were correct to designate an AQMA in the first place;
- calculate more accurately what improvement in air quality, and corresponding reduction in emissions, would be required to attain the air quality objectives within the AQMA;
- refine their knowledge of sources of pollution, so that the air quality Action Plan may be appropriately targeted;
- take account of any new guidance issued by Defra and the Devolved Administrations, or any new policy developments that may have come to light since declaration of the AQMA;
- take account of any new local developments that were not fully considered within the earlier Review and Assessment work. This might, for example, include the implications of new transport schemes, commercial or major housing developments etc, that were not committed or known of at the time of preparing the Detailed Assessment;
- carry out additional monitoring to support the conclusion to declare the AQMA;
- corroborate the assumptions on which the AQMA has been based, and to check that the original designation is still valid, and does not need amending in any way; and

- respond to any comments made by statutory consultees in respect of the Detailed Assessment.

2 Study Area and AQMA Location

2.1 Hooley is a small village with a population of approximately 1,000. It is in the Borough of Reigate & Banstead, approximately 1 km north of the M23/A23 interchange, close to the northern boundary of the Borough. The A23 Brighton Road cuts through the village in a north/south orientation.

2.2 The Hooley AQMA has yet to be formally declared; however, the proposed AQMA will be based on the 32 $\mu g/m^3$ isopleth of annual mean nitrogen dioxide concentrations along the A23 in Hooley, as predicted in the 2011 Detailed Assessment (RBBC, 2011). The study area for this Further Assessment encompasses the area of the proposed AQMA and extends beyond it. The proposed AQMA and study area are shown in Figure 1.

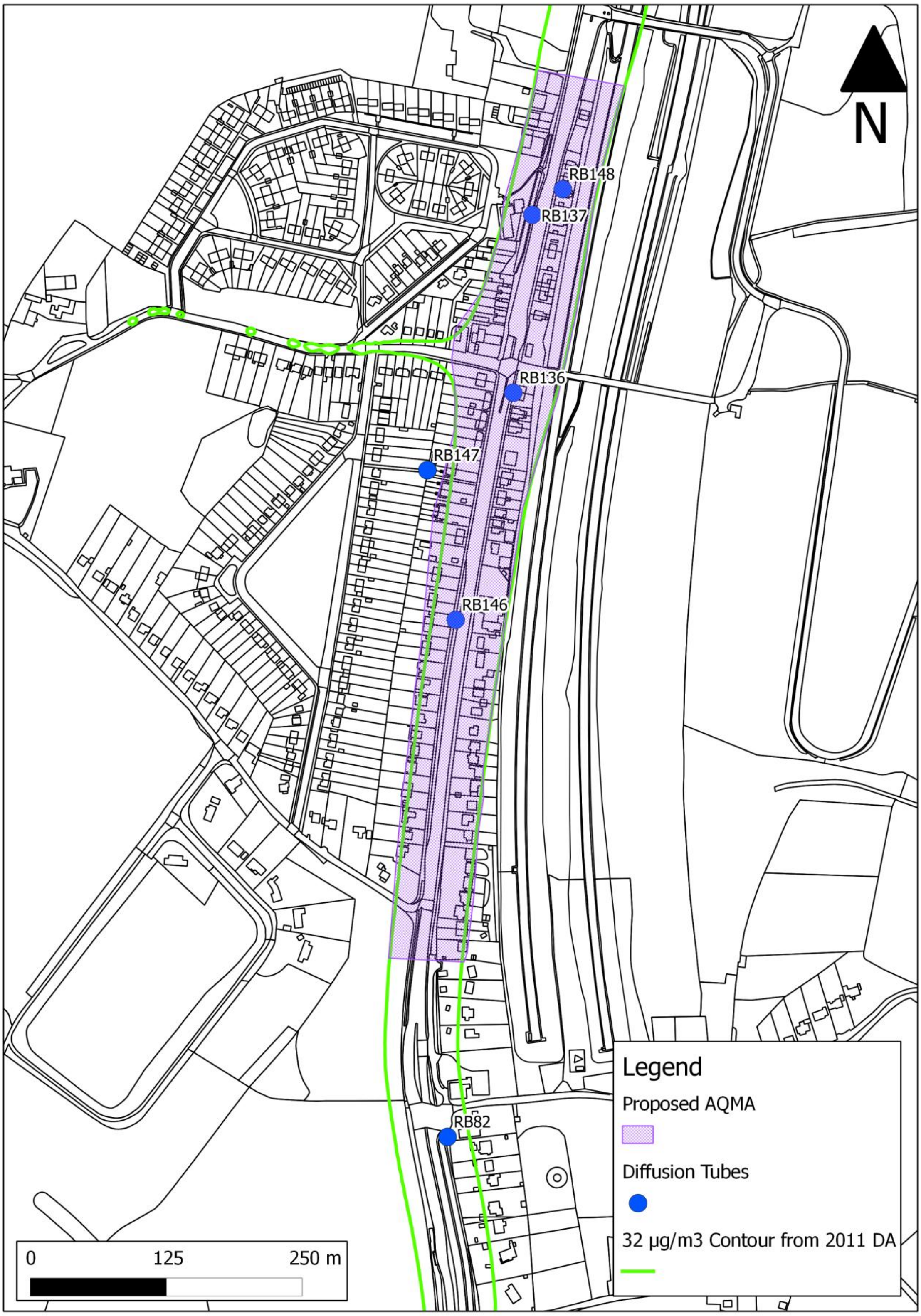

Figure 1: Proposed AQMA, the 32 µg/m^3 Isopleth from the 2011 Detailed Assessment and Monitoring Locations

3 Local Developments since Declaration of the AQMA

New and Proposed Local Developments

3.1 There have been no significant new developments since the Detailed Assessment was carried out.

National Developments

3.2 All the latest tools associated with the release of LAQM.TG(09) (Defra, 2009), and those subsequently updated, have been used for this assessment. The most recent version of ADMS-Roads (v3.1.2), has been used, and vehicle emissions have been calculated using Defra's latest emission factor toolkit (EFT) (Version 5.1.3). A further sensitivity test has been carried out for future predictions that involves assuming no reduction in emission factors for road traffic from the baseline year. This is to address the issue recently identified by Defra (Carslaw et al., 2011) that road traffic emissions have not been declining as expected (see later section on uncertainty). Nitrogen dioxide concentrations in 2015 and 2020 are thus presented for two scenarios: 'With Emissions Reduction' and 'Without Emissions Reduction'.

4 Responses to Consultees Comments

4.1 Defra's Appraisal Report accepted the conclusions reached in the Detailed Assessment. The Appraisal Report made the following six comments:

1. As each report in the Review & Assessment process is a stand-alone piece, it is recommended that details of previous rounds, information on the local authority area and full details of the study area are included in each report.
2. It is unclear from the report whether data capture for the diffusion tube monitoring was sufficient, or whether the data has been annualised, as this information has not been included. It is recommended that full details of all monitoring carried out within the study area are included in future reports.
3. As diffusion tube monitoring within the proposed AQMA has shown concentrations greater than 60µg/m^3, Reigate and Banstead may wish to consider undertaking automatic monitoring of nitrogen oxides to ensure compliance with the hourly mean objective, and for a greater confidence in results. Real time monitoring may also be beneficial to determine when peaks in concentrations occur, and could influence the focus of the action plan.
4. The report does not include an assessment of population exposure to the exceedences or the magnitude of reduction required. These issues will need to be considered within the Further Assessment.
5. In section 4.3 it states that "Reigate and Banstead Borough Council propose to declare the AQMA based on the 32 µg/m^3 isopleth. However, it is unclear from the report exactly where this is. If this is simply a reporting error, and it should read 36 µg/m^3 (as recommended by the consultant in section 4.2), then this should be updated.
6. It is recommended that full details of model adjustment and verification are included in future reports, for example, a comparison of raw and adjusted modelled and monitored results could be included for greater transparency.

4.2 Responses are as follows:

1. Details of previous rounds, information on the local authority area and full details of the study area are included in this report.
2. Unadjusted monitoring data and data capture at the diffusion tube monitoring locations referred to in this report are included in Appendix A1.
3. The benefit obtained from the additional data provided by continuous monitoring needs to be balanced against the cost of operating a continuous monitor in Hooley. Continuous monitoring would confirm whether the 1-hour objective for nitrogen dioxide was being exceeded in Hooley,

and provide information on when peaks in concentrations occur. However, a continuous monitor would be expensive to install and maintain, and would divert funds away from measures that could be taken to improve air quality. Also, the additional information from a continuous monitor would have no bearing on the Councils approach to air quality improvements in Hooley, as measures to reduce annual mean nitrogen dioxide concentrations will need to be introduced anyway. Therefore, the Council does not intend to undertake continuous monitoring in Hooley at the current time.

4. An assessment of population exposure is included in this report.
5. The AQMA will be declared based on the 32 $\mu g.m^3$ isopleth predicted in the Detailed Assessment, as shown in Figure 1.
6. Full details of the model adjustment and verification are included in Appendix A2.

5 Assessment Methodology

Monitoring

5.1 Monitoring for nitrogen dioxide is carried out using passive diffusion tubes at five locations in Hooley. Two of these sites (RB136 and RB137) have been operating since 2009; however, three of the sites (RB146, RB147 and RB148) started operating in 2012 and so have not produced enough data for inclusion in this report. The monitoring sites are shown in Figure 1. The diffusion tubes are prepared and analysed by Lambeth Scientific Services using 50% TEA in Acetone. It is necessary to adjust diffusion tube data to account for laboratory bias. RBBC has co-located triplicate diffusion tubes with three of its automatic monitoring sites: Michael Crescent (RG1), The Crescent (RG2), and Poles Lane (RG3). Results from these three local surveys have been combined using orthogonal regression[1]. The adjustment factor for 2011 calculated in this way was 0.949.

Modelling

5.2 Annual mean nitrogen dioxide concentrations have been assessed by detailed dispersion modelling (using ADMS-Roads v.3.1.2). The model outputs have been verified against the diffusion tube measurements described in Table 2. Full details of the modelling methodology are set out in Appendix A2.

5.3 Concentrations have been predicted for the years 2011, 2015 and 2020. Predictions have been made at each of the receptor locations shown in Figure 2. In addition, concentrations have been predicted across grids of receptors to allow concentration isopleths to be plotted.

1 Using the same method as is used in Defra's national co-location database.

Figure 2: Receptor Locations

Uncertainty

5.4 There are many components that contribute to the uncertainty of modelling predictions. The 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 the model is required to simplify real-world conditions into a series of algorithms. An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A2). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2011) concentrations.

5.5 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations, and vehicle emissions. Recently, a disparity between the road transport emission projections and measured annual mean concentrations of nitrogen oxides and nitrogen dioxide has been identified by Defra (Carslaw et al., 2011). This is evident across the UK, although the effect appears to be greatest in inner London; there is also considerable inter-site variation. Whilst the emission projections suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25% over the past 6 to 8 years, at many monitoring sites levels have remained relatively stable, or have even shown a slight increase.

5.6 This disparity led to a detailed review of the emission factors and fleet mix for UK conditions, and in July 2012, Defra issued a revised Emissions Factors Toolkit (ETFv5.1.3). The new EFT utilises revised nitrogen oxides emissions factors and also incorporates revised vehicle fleet composition data (Defra, 2012a). The new EFT goes some way to addressing the disparity between air quality measurements and emissions, but does not fully address it, and it is recognised that the forecast reductions may still be optimistic in the near-term (i.e. the next five years or so).

5.7 The reason for the disparity is thought to relate to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles is often no better than that of earlier models (Carslaw et al., 2011). The best current evidence is that, where previous standards have had limited on-road success, the ‘Euro VI’ and ‘Euro 6’ standards that new vehicles will have to comply with from 2013/15[2] will achieve the expected on-road improvements, as, for the first time, they will

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

require compliance with the World Harmonized Test Cycle which better represents real-world driving conditions and includes a separate slow-speed cycle for heavy duty vehicles.

5.8 As noted above, the new forecast reductions in nitrogen oxides emissions may still be optimistic in the near-term. To account for this uncertainty, a sensitivity test has been conducted assuming that the future (2015 and 2020) road traffic emissions per vehicle are unchanged from 2011 values. The predictions within this sensitivity test are likely to be over-pessimistic, as new, lower-emission Euro VI and Euro 6 vehicles will be on the road from 2013/15; by 2015 it is forecast that there will be a roughly 40-50% penetration of Euro VI HDVs and a roughly 5-10% penetration of Euro 6 LDVs, and by 2020 it is forecast that there will be a roughly 85-95% penetration of Euro VI HDVs and a roughly 50-55% penetration of Euro 6 LDVs. These new vehicles are expected to deliver real on-road reductions in nitrogen oxides emissions.

6 Results

Monitoring

6.1 Monitoring data for 2009 to 2011 for the two sites in Hooley are presented in Table 2. Data from these two monitoring sites have also been used to verify the model (see Appendix A2).

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring in Hooley (2009-2011) [a]

Site No.	Site Type	Location	Annual Mean Concentration (µg/m^3)		
			2009 [b]	2010 [c]	2011 [d]
RB136	Roadside	45 Brighton Road, Hooley	**66.3**	**64.8**	**50.5**
RB137	Roadside	23 Brighton Road, Hooley	**59.7**	**63.1**	**49.9**
Objective			**40**		

[a] Exceedences of the objectives are shown in bold

[b] Bias adjusted using a local factor of 1.014

[c] Bias adjusted using a local factor of 1.050

[d] Bias adjusted using a local factor of 0.949

6.2 The annual nitrogen dioxide objective has been exceeded at both monitoring sites in all years since 2009. Annual mean concentrations above 60 µg/m^3 have been measured at both sites, therefore there is a risk that the 1-hour objective for nitrogen dioxide has also been exceeded.

6.3 There are no clear trends in the monitoring results for the past three years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards. The implications for this were discussed earlier in Section 5 of this report.

Modelling

6.4 Predicted annual mean nitrogen dioxide concentrations in 2011, 2015 and 2020 at each of the receptor locations are summarised in Table 3. In 2011, the annual mean objective is predicted to have been exceeded at 20 of the 36 receptors. All predicted concentrations are below 60 µg/m^3 and therefore the hourly mean objective is unlikely to have been exceeded at any of these receptors in 2011.

6.5 The suite of tools that Defra currently provides to local authorities for use in their Review and Assessment reports predicts that technological improvements will reduce vehicle emissions such that total road traffic emissions will fall despite concurrent increases in traffic volumes. Defra also predicts reductions in emissions from other sectors which are included in its background pollution maps. Using Defra's methodology, concentrations in 2015 and 2020 are predicted to be markedly lower than those in 2011; however, exceedences of the annual mean nitrogen dioxide objective are still predicted in 2015 at receptors close to the junction of the A23 with Star Lane. By 2020 there are no exceedences predicted at any of the receptors.

6.6 Assuming no reduction in emissions, predicted annual mean nitrogen dioxide concentrations marginally increase at receptors close to the road in 2015, with an even greater increase in predicted concentrations at receptors close to the road in 2020.

Table 3: Modelled Annual Mean Concentrations of Nitrogen Dioxide (µg/m^3) at Worst Case Receptors in Hooley in 2011, 2015 and 2020 [a]

Receptor	2011	2015		2020	
		With 'Official' Emissions Reduction [b]	Without Emissions Reduction [c]	With 'Official' Emissions Reduction [b]	Without Emissions Reduction [c]
1	**51.5**	**44.3**	**51.5**	31.4	**54.2**
2	**51.5**	**44.3**	**51.6**	31.4	**54.3**
3	**56.3**	**48.8**	**56.5**	34.5	**59.6**
4	**54.9**	**47.3**	**55.1**	33.4	**58.1**
5	**53.2**	**45.5**	**53.3**	32.2	**56.2**
6	**49.4**	**41.6**	**49.4**	29.2	**51.9**
7	**43.6**	36.4	**43.5**	25.7	**45.5**
8	**47.0**	39.9	**47.0**	28.2	**49.3**
9	**48.5**	**41.3**	**48.5**	29.2	**50.9**
10	**51.5**	**44.2**	**51.6**	31.2	**54.3**
11	**51.4**	**44.2**	**51.5**	31.2	**54.2**
12	**40.4**	34.3	**40.3**	24.4	**41.9**
13	**40.8**	34.7	**40.6**	24.8	**42.3**
14	**50.6**	**43.7**	**50.7**	31.0	**53.3**
15	**49.2**	**42.3**	**49.3**	30.0	**51.7**
16	**49.3**	**42.3**	**49.3**	30.0	**51.8**
17	**46.5**	39.5	**46.4**	28.0	**48.6**
18	**44.4**	37.4	**44.3**	26.5	**46.2**
19	31.8	26.6	31.3	19.2	31.9
20	32.2	27.0	31.8	19.5	32.4
21	32.6	27.4	32.2	19.8	32.8

Receptor	2011	2015		2020	
		With 'Official' Emissions Reduction [b]	Without Emissions Reduction [c]	With 'Official' Emissions Reduction [b]	Without Emissions Reduction [c]
22	32.9	27.8	32.5	20.1	33.2
23	33.6	28.4	33.2	20.5	34.0
24	33.9	28.7	33.5	20.7	34.3
25	26.8	22.6	26.2	16.7	26.1
26	29.5	25.1	29.0	18.5	29.3
27	**44.8**	37.0	**44.7**	26.0	**46.8**
28	**45.0**	37.1	**44.9**	26.1	**47.0**
29	32.0	26.4	31.6	19.0	32.2
30	30.8	25.4	30.3	18.3	30.8
31	**44.1**	36.4	**44.0**	25.6	**46.0**
32	**44.8**	36.9	**44.7**	26.0	**46.7**
33	30.6	25.1	30.1	18.1	30.5
34	34.7	28.4	34.3	20.3	35.2
35	32.8	26.8	32.5	19.2	33.2
36	38.9	31.8	38.6	22.5	40.1
Objective	**40**				

[a] Exceedences are shown in bold.

[b] This assumes vehicle emission factors reduce into the future at the current 'official' rates.

[c] This assumes vehicle emission factors in 2015 and 2020 remain the same as in 2011.

6.7 Figure 3 shows the concentration isopleths along Brighton Road in 2011. The annual mean nitrogen dioxide objective is predicted to be exceeded at properties along Brighton Road, in particular dwellings close to the junction with Star Lane, and to the east of Brighton Road, i.e. downwind of Brighton Road, with regard to the prevailing wind (see Figure A2.1).

6.8 Figure 4 and Figure 5 show the concentration isopleths along Brighton Road in 2015 and 2020 respectively, assuming emissions reduce in line with 'official' estimates. The isopleths show the area of exceedence of the annual mean nitrogen dioxide objective decreasing in future years, with no relevant receptors within the 40 µg/m^3 isopleth by 2020.

6.9 Figure 6 and Figure 7 show that the area of exceedence of the annual mean nitrogen dioxide objective is predicted to increase in future years, assuming traffic emissions remain the same as in 2010.

6.10 Predicted concentrations are slightly lower than those predicted in the Detailed Assessment (RBBC, 2011). However, given that there is a risk that the area of exceedence of the annual mean nitrogen dioxide objective may increase in future years, the decision to set the AQMA boundary at the 32 $\mu g/m^3$ isopleth predicted in the Detailed Assessment remains appropriate.

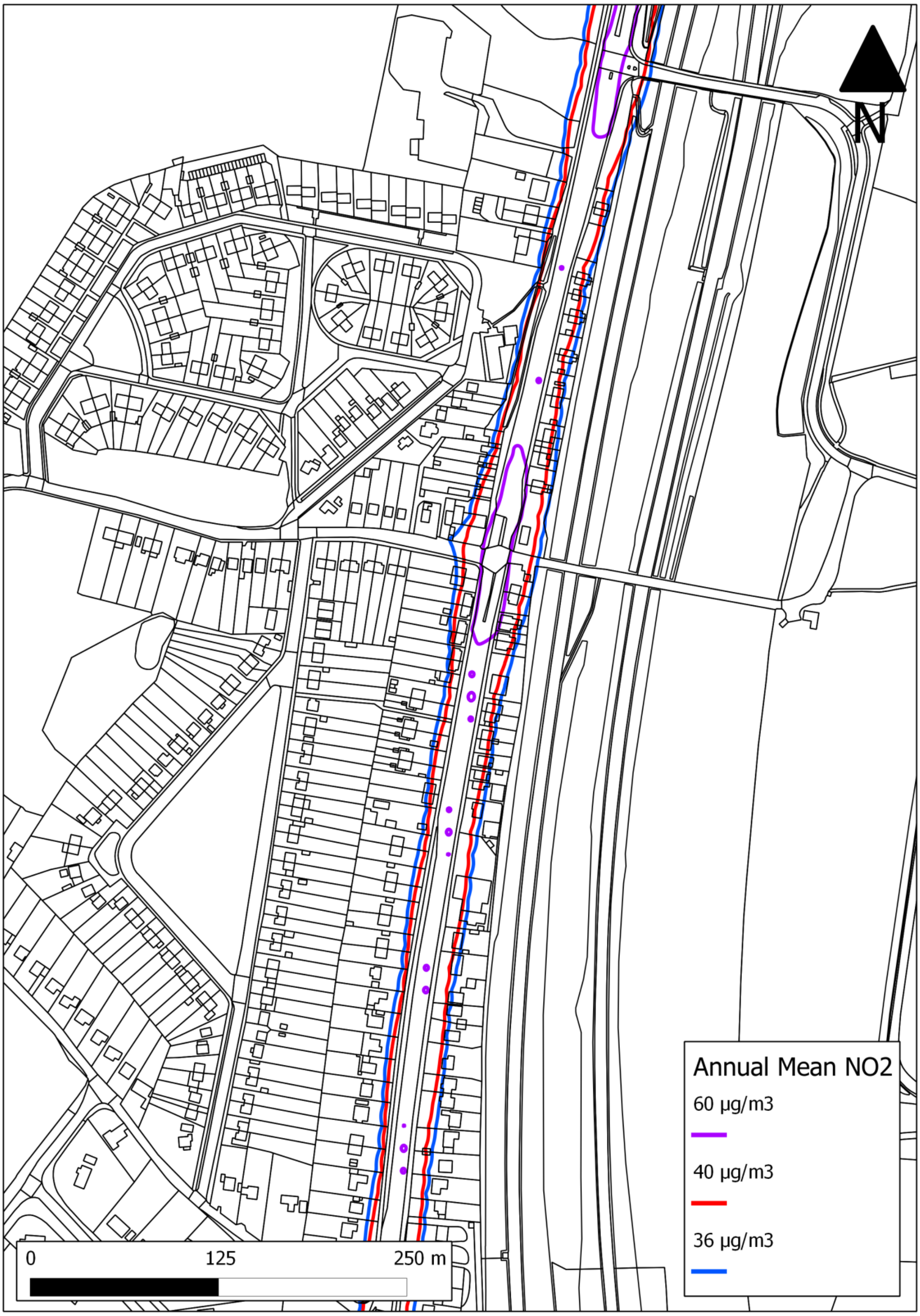

Figure 3: Annual Mean Nitrogen Dioxide Concentration Isopleths 2011

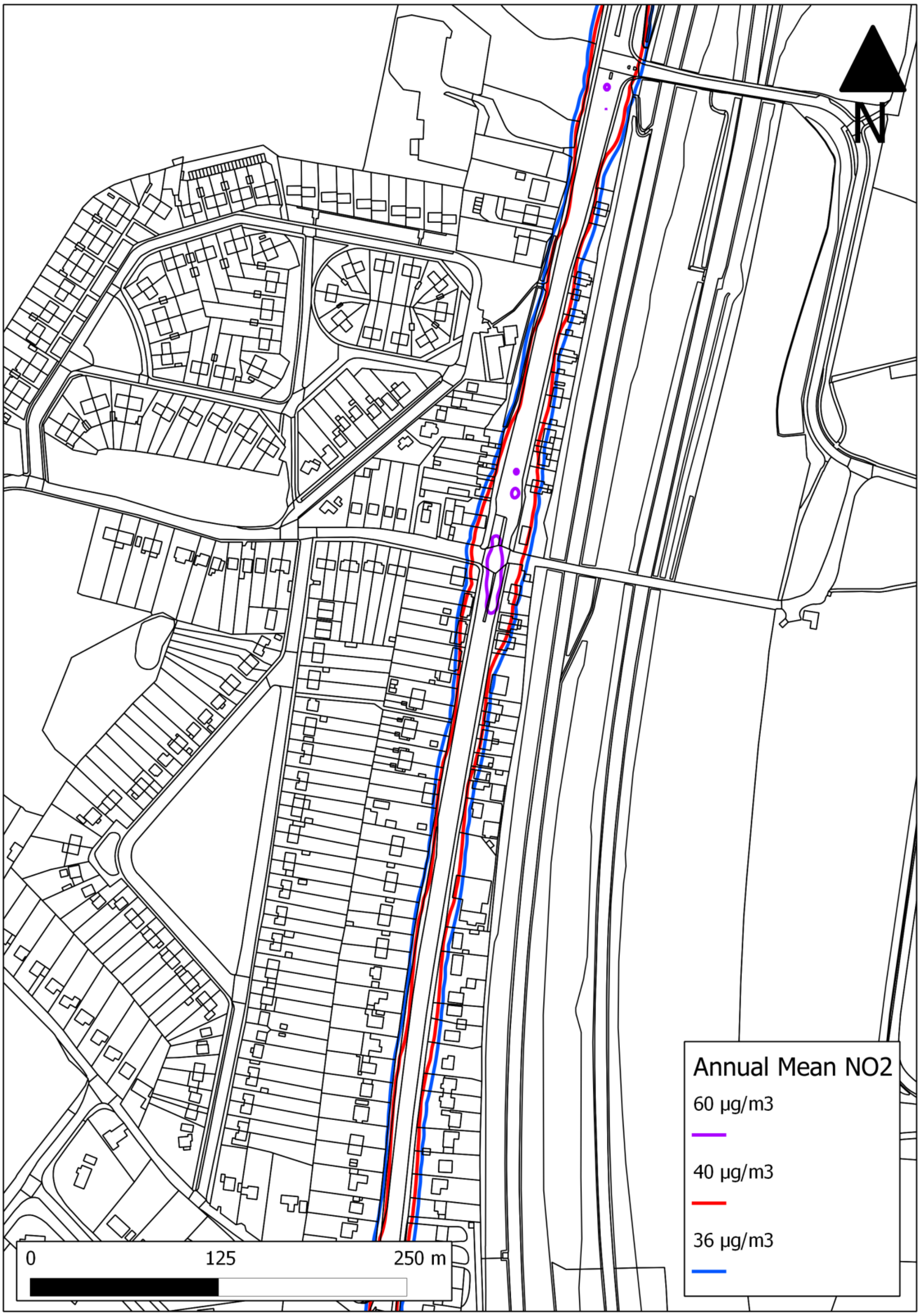

Figure 4: Annual Mean Nitrogen Dioxide Concentration Isoplethss 2015 (With 'Official' Emissions Reduction)

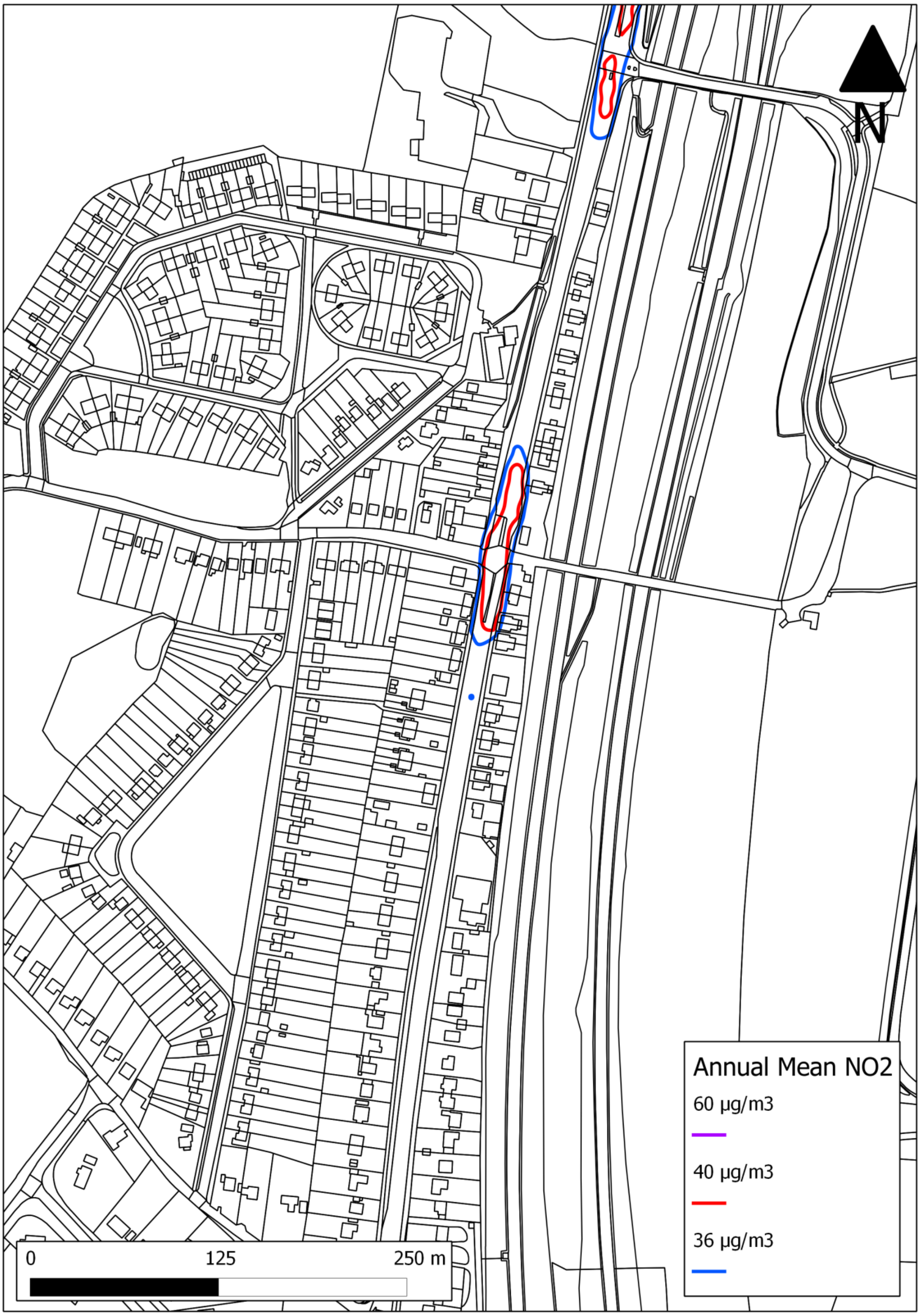

Figure 5: Annual Mean Nitrogen Dioxide Concentration Isopleths 2020 (With 'Official' Emissions Reduction)

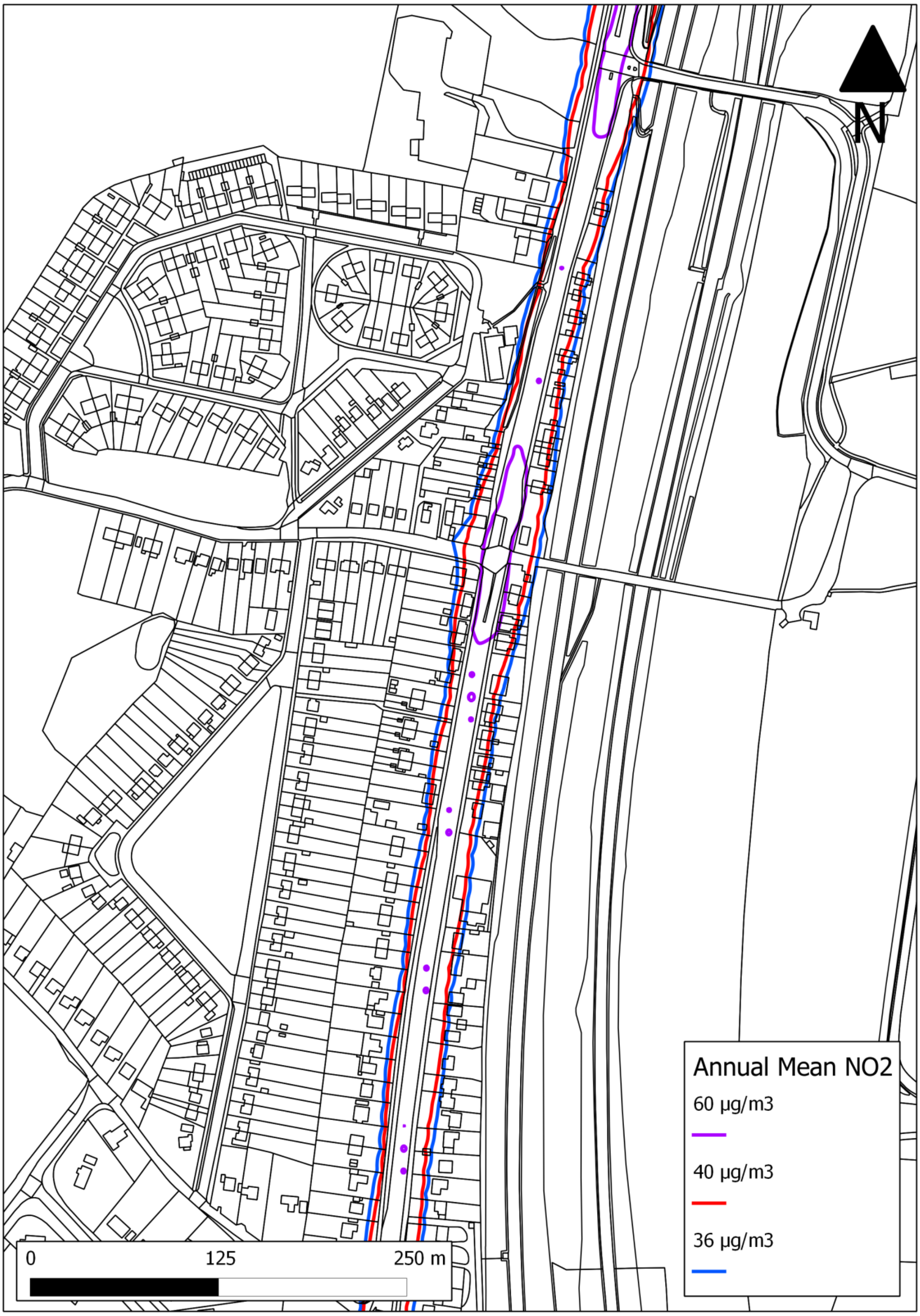

Figure 6: Annual Mean Nitrogen Dioxide Concentration Isopleths 2015 (Without Emissions Reduction)

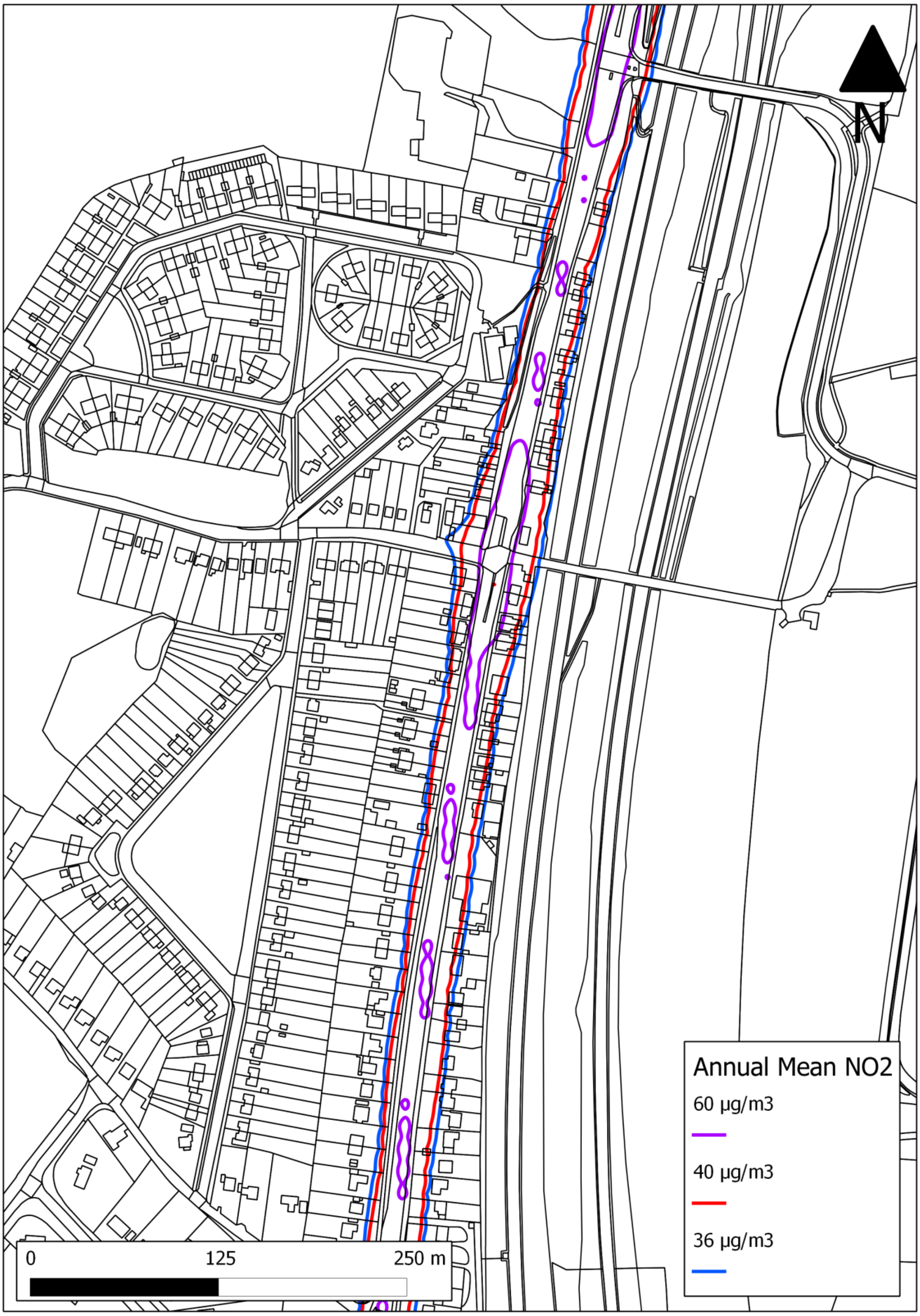

Figure 7: Annual Mean Nitrogen Dioxide Concentration Isopleths 2020 (Without Emissions Reduction)

Population Exposure

6.11 Up to 52 residential properties lie within the predicted 40 µg/m^3 isopleth in 2011. The average household size in Hooley during the 2001 census was 2.52 (Surrey County Council, 2006). Thus, approximately 131 residents are exposed to nitrogen dioxide concentrations greater than the annual objective.

7 Source Apportionment

7.1 In order to develop an appropriate action plan, it is necessary to identify the sources contributing to the objective exceedences within the AQMA. These data can be used to inform future traffic management decisions. Source apportioned nitrogen dioxide concentrations have been calculated taking account of the different proportions of primary nitrogen dioxide (f-NO_2) emitted by different vehicle types. The methodology is explained in Appendix A2.

7.2 The following vehicle categories have been included in the source apportionment:

- Ambient Background, background sources excluding domestic heating and hot water (Bkgd);
- Background attributed to domestic heating and hot water (DH);
- Cars;
- Light Goods Vehicles (LGV);
- Buses;
- Heavy Goods Vehicles (HGV); and
- Motorcycles (MC).

7.3 Table 4 and Figure 8 show the contribution from different vehicle types to total predicted annual mean nitrogen dioxide concentrations at each of the worst case receptors assessed, and at each diffusion tube monitoring locations in Hooley. Table 5 and Figure 9 show percentage contribution of each vehicle type to total predicted annual mean nitrogen dioxide concentrations.

Table 4: Predicted Annual Mean Concentrations of Nitrogen Dioxide (µg/m^3) by Source at Worst Case Receptors in Hooley in 2011

Receptor	Annual Mean Concentration (µg/m^3)						
	DH	Bkgd	Car	LGV	HGV	Bus	MC
1	1.0	16.8	11.5	7.2	12.7	2.2	0.1
2	1.0	16.8	11.5	7.2	12.7	2.2	0.1
3	1.0	16.8	13.0	8.4	14.5	2.5	0.1
4	1.0	16.8	12.7	8.1	13.9	2.4	0.1
5	1.0	16.8	12.2	7.7	13.1	2.2	0.1
6	1.0	16.8	11.3	7.0	11.3	1.9	0.1
7	1.0	16.8	9.3	5.6	9.3	1.6	0.1
8	1.0	16.8	10.2	6.2	10.8	1.9	0.1
9	1.0	16.8	10.6	6.5	11.5	2.0	0.1
10	1.0	16.8	11.5	7.2	12.7	2.2	0.1
11	1.0	16.8	11.5	7.2	12.7	2.2	0.1
12	1.0	16.8	8.1	4.7	8.3	1.4	0.0
13	1.0	16.8	8.4	4.9	8.2	1.4	0.0
14	1.0	16.8	11.3	7.0	12.3	2.1	0.1
15	1.0	16.8	10.8	6.7	11.8	2.1	0.1
16	1.0	16.8	10.8	6.7	11.8	2.1	0.1
17	1.0	16.8	10.0	6.1	10.6	1.8	0.1
18	1.0	16.8	9.5	5.7	9.6	1.7	0.1
19	1.0	16.8	5.2	2.9	5.0	0.9	0.0
20	1.0	16.8	5.3	3.0	5.2	0.9	0.0
21	1.0	16.8	5.4	3.1	5.3	0.9	0.0
22	1.0	16.8	5.5	3.1	5.5	1.0	0.0
23	1.0	16.8	5.7	3.3	5.7	1.0	0.0
24	1.0	16.8	5.8	3.3	5.8	1.0	0.0
25	1.0	16.8	3.6	1.9	2.9	0.5	0.0
26	1.0	16.8	5.1	2.7	3.4	0.6	0.0
27	1.0	16.8	10.0	6.0	9.3	1.5	0.1
28	1.0	16.8	10.1	6.1	9.3	1.6	0.1
29	1.0	16.8	5.3	3.0	5.0	0.8	0.0

Receptor	Annual Mean Concentration (µg/m³)						
	DH	Bkgd	Car	LGV	HGV	Bus	MC
30	1.0	16.8	4.9	2.7	4.5	0.8	0.0
31	1.0	16.8	9.8	5.9	9.0	1.5	0.1
32	1.0	16.8	10.0	6.1	9.2	1.5	0.1
33	1.0	16.8	4.9	2.7	4.4	0.7	0.0
34	1.0	16.8	6.4	3.7	5.7	1.0	0.1
35	0.8	17.1	5.7	3.2	5.1	0.9	0.0
36	1.0	16.8	7.9	4.6	7.2	1.2	0.1
RB136	1.0	16.8	13.3	8.6	14.9	2.6	0.1
RB137	1.0	16.8	8.4	4.9	7.7	1.3	0.1
RB82	0.8	17.1	6.0	3.4	4.7	0.8	0.1
RB146	1.0	16.8	9.4	5.6	8.5	1.4	0.1
RB147	1.0	16.8	2.7	1.4	2.4	0.4	0.0
RB148	1.0	16.8	8.4	4.9	7.7	1.3	0.1
Objective	40						

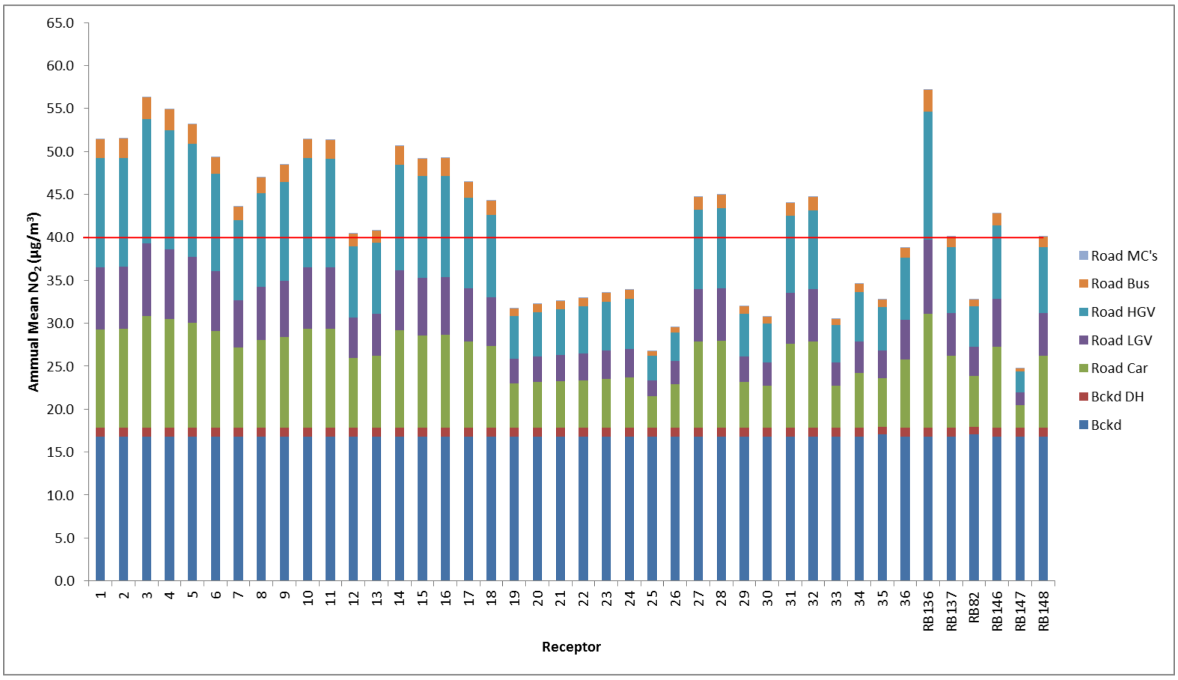

Figure 8: Contribution of Each Source to the Total Predicted Annual Mean Nitrogen Dioxide Concentration (µg/m³) in 2011

Table 5: Percentage Contribution from Each Source to the Total Predicted Annual Mean Concentration of Nitrogen Dioxide at Worst Case Receptors in Hooley in 2011

Receptor	Contribution to Total Predicted Annual Mean Concentration (%)						
	DH	Bkgd	Car	LGV	HGV	Bus	MC
1	1.9%	32.7%	22.3%	14.0%	24.7%	4.3%	0.1%
2	1.9%	32.7%	22.3%	14.0%	24.7%	4.3%	0.1%
3	1.8%	29.9%	23.1%	14.9%	25.7%	4.4%	0.1%
4	1.8%	30.6%	23.1%	14.8%	25.2%	4.3%	0.1%
5	1.9%	31.7%	22.9%	14.5%	24.7%	4.2%	0.1%
6	2.0%	34.1%	22.8%	14.1%	22.9%	3.9%	0.2%
7	2.3%	38.6%	21.3%	12.7%	21.3%	3.6%	0.1%
8	2.1%	35.8%	21.7%	13.3%	23.1%	4.0%	0.1%
9	2.1%	34.7%	21.9%	13.5%	23.7%	4.1%	0.1%
10	1.9%	32.7%	22.3%	14.0%	24.7%	4.2%	0.1%
11	1.9%	32.8%	22.3%	13.9%	24.7%	4.2%	0.1%
12	2.5%	41.7%	20.0%	11.7%	20.5%	3.5%	0.1%
13	2.4%	41.3%	20.6%	12.0%	20.2%	3.4%	0.1%
14	2.0%	33.3%	22.3%	13.9%	24.3%	4.2%	0.1%
15	2.0%	34.2%	21.9%	13.6%	24.0%	4.2%	0.1%
16	2.0%	34.2%	21.9%	13.6%	24.0%	4.2%	0.1%
17	2.1%	36.2%	21.6%	13.2%	22.7%	3.9%	0.1%
18	2.2%	38.0%	21.4%	12.9%	21.6%	3.7%	0.1%
19	3.1%	53.0%	16.2%	9.1%	15.7%	2.7%	0.1%
20	3.1%	52.3%	16.4%	9.3%	16.0%	2.8%	0.1%
21	3.1%	51.6%	16.6%	9.4%	16.4%	2.9%	0.1%
22	3.0%	51.1%	16.7%	9.5%	16.6%	2.9%	0.1%
23	3.0%	50.1%	17.0%	9.7%	17.0%	3.0%	0.1%
24	2.9%	49.7%	17.2%	9.8%	17.2%	3.0%	0.1%
25	3.7%	62.9%	13.5%	7.1%	10.8%	1.8%	0.1%
26	3.4%	57.1%	17.2%	9.0%	11.4%	1.9%	0.1%
27	2.2%	37.6%	22.4%	13.5%	20.6%	3.5%	0.2%
28	2.2%	37.4%	22.5%	13.5%	20.7%	3.5%	0.2%
29	3.1%	52.7%	16.6%	9.3%	15.6%	2.6%	0.1%

Receptor	Contribution to Total Predicted Annual Mean Concentration (%)						
	DH	Bkgd	Car	LGV	HGV	Bus	MC
30	3.2%	54.7%	15.9%	8.8%	14.7%	2.5%	0.2%
31	2.3%	38.2%	22.2%	13.3%	20.3%	3.4%	0.2%
32	2.2%	37.6%	22.4%	13.5%	20.6%	3.4%	0.2%
33	3.3%	55.1%	15.9%	8.9%	14.2%	2.4%	0.2%
34	2.9%	48.6%	18.4%	10.6%	16.6%	2.8%	0.2%
35	2.5%	52.1%	17.4%	9.8%	15.5%	2.6%	0.1%
36	2.6%	43.3%	20.5%	11.9%	18.5%	3.1%	0.2%
RB136	1.7%	29.4%	23.1%	15.1%	26.0%	4.5%	0.1%
RB137	2.5%	41.9%	20.9%	12.2%	19.1%	3.2%	0.2%
RB82	2.5%	52.1%	18.1%	10.3%	14.4%	2.4%	0.2%
RB146	2.3%	39.3%	21.9%	13.0%	19.9%	3.3%	0.2%
RB147	4.0%	67.9%	10.7%	5.7%	9.9%	1.7%	0.1%
RB148	2.5%	41.9%	20.8%	12.3%	19.1%	3.2%	0.2%

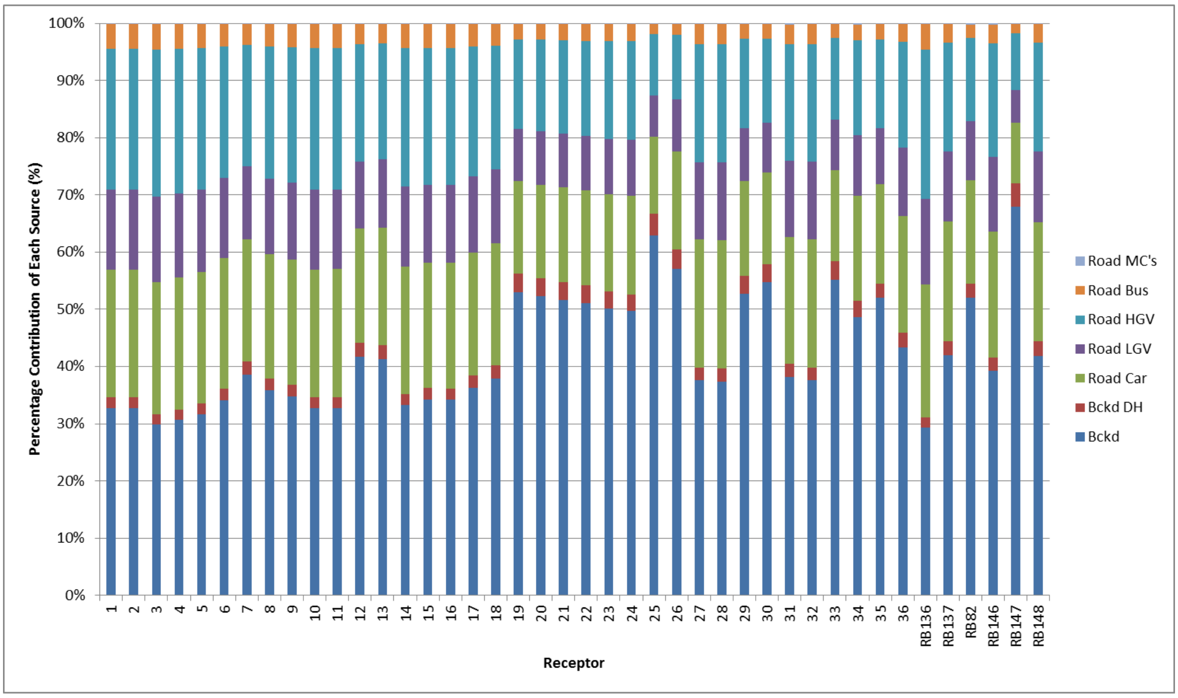

Figure 9: Percentage Contribution of Each Source to the Total Predicted Annual Mean Nitrogen Dioxide Concentration in 2011

8 Air Quality Improvements Required

8.1 The degree of improvement needed in order for the annual mean objective to be achieved is defined by the difference between the highest measured or predicted annual mean concentration and the 40 µg/m^3 objective level. The highest nitrogen dioxide concentration is that predicted at Receptor 3 (56.3 µg/m^3), requiring a reduction of 16.3 µg/m^3 in order for the objective to be achieved.

8.2 It is conventional to consider the improvement required in terms of the nitrogen oxides (NOx). Different vehicle types are characterised by different f-NO2 values, and so the reduction in NOx required to achieve the nitrogen dioxide objective depends on the types of vehicle being managed. For example, the degree of reduction required will be different if it is brought about through reducing car emissions than if it is achieved through reducing bus emissions. For the purposes of calculating the indicative data in Table 6 it has been assumed that any emission reductions are achieved without altering the composition of the vehicle fleet (which is unlikely in practice). Table 6 shows that, at Receptor 3, a reduction of 47.3 µg/m^3 in NOx emissions would be required in order to achieve the objective. This equates to a reduction of 48.8% in road traffic emissions at the receptor location.

Table 6: Improvement in Annual Mean Nitrogen Dioxide and Nitrogen Oxides Concentrations Required in 2011

Receptor	Required reduction in annual mean nitrogen dioxide (NO_2) concentration		Required reduction in road nitrogen oxides (NOx) emissions	
	µg/m^3	% of total predicted NO_2	µg/m^3	% reduction in road NOx
1	11.5	22.3%	32.09	39.3%
2	11.5	22.4%	32.34	39.5%
3	16.3	29.0%	47.3	48.8%
4	14.9	27.2%	42.88	46.4%
5	13.2	24.8%	37.38	43.0%
6	9.4	19.0%	25.13	33.6%
7	3.6	8.3%	9.53	16.1%
8	7.0	15.0%	19.12	27.8%
9	8.5	17.5%	23.22	31.9%
10	11.5	22.3%	32.22	39.4%
11	11.4	22.2%	31.94	39.2%
12	0.4	1.1%	1.12	2.2%
13	0.8	1.9%	2.06	4.0%
14	10.6	21.0%	29.63	37.4%
15	9.2	18.7%	25.43	33.9%
16	9.3	18.8%	25.58	34.0%
17	6.5	13.9%	17.5	26.1%
18	4.4	9.8%	11.62	19.0%
27	4.8	10.8%	12.87	20.6%
28	5.0	11.1%	13.39	21.3%
31	4.1	9.3%	10.88	18.0%
32	4.8	10.6%	12.7	20.4%

9 Management Planning

9.1 In order to inform the focus of potential measures within the Action Plan, a number of simple and hypothetical measures to deliver the required reductions at each receptor have been explored. The measures that have been examined involve stepped reductions in emissions from each of the vehicle categories defined in Section 7. 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. The results are set out in Table 7.

Table 7: Predicted Annual Mean Nitrogen Dioxide Concentrations in 2011 Assuming Hypothetical Emission Reductions from Different Vehicle Classes

Vehicle Type	Reduction in NO_x Emissions (%)	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$) [a]										
		Receptor										
		1	2	3	4	5	6	7	8	9	10	11
All	10	**48.7**	**48.8**	**53.3**	**52.0**	**50.4**	**46.8**	**41.4**	**44.6**	**45.9**	**48.8**	**48.7**
	25	**44.4**	**44.5**	**48.5**	**47.3**	**45.9**	**42.7**	38.0	**40.8**	**42.0**	**44.5**	**44.4**
	50	36.7	36.7	39.7	38.8	37.8	35.4	32.0	34.0	34.9	36.7	36.7
Car	10	**50.5**	**50.6**	**55.2**	**53.9**	**52.2**	**48.4**	**42.8**	**46.1**	**47.6**	**50.5**	**50.4**
	25	**49.0**	**49.1**	**53.6**	**52.2**	**50.6**	**46.9**	**41.5**	**44.8**	**46.2**	**49.0**	**48.9**
	50	**46.4**	**46.5**	**50.7**	**49.4**	**47.9**	**44.4**	39.4	**42.5**	**43.8**	**46.4**	**46.4**
LGV	10	**51.0**	**51.1**	**55.8**	**54.4**	**52.7**	**48.9**	**43.2**	**46.6**	**48.0**	**51.0**	**51**
	25	**50.3**	**50.4**	**55.0**	**53.7**	**52.0**	**48.2**	**42.6**	**46.0**	**47.4**	**50.3**	**50.3**
	50	**49.1**	**49.2**	**53.7**	**52.4**	**50.7**	**47.1**	**41.6**	**44.9**	**46.3**	**49.2**	**49.1**
HGV	10	**50.4**	**50.5**	**55.2**	**53.8**	**52.1**	**48.4**	**42.8**	**46.1**	**47.5**	**50.4**	**50.4**
	25	**48.8**	**48.9**	**53.4**	**52.1**	**50.5**	**47.0**	**41.6**	**44.7**	**46.0**	**48.8**	**48.8**
	50	**46.1**	**46.1**	**50.3**	**49.1**	**47.7**	**44.6**	39.5	**42.3**	**43.5**	**46.1**	**46**
Bus	10	**51.3**	**51.3**	**56.1**	**54.7**	**53.0**	**49.2**	**43.5**	**46.9**	**48.3**	**51.3**	**51.2**
	25	**51.0**	**51.1**	**55.8**	**54.4**	**52.7**	**49.0**	**43.2**	**46.6**	**48.0**	**51.0**	**50.9**
	50	**50.5**	**50.6**	**55.2**	**53.9**	**52.2**	**48.5**	**42.9**	**46.2**	**47.6**	**50.5**	**50.4**
MC	10	**51.5**	**51.5**	**56.3**	**54.9**	**53.2**	**49.4**	**43.6**	**47.0**	**48.5**	**51.5**	**51.4**
	25	**51.4**	**51.5**	**56.3**	**54.9**	**53.2**	**49.4**	**43.6**	**47.0**	**48.5**	**51.5**	**51.4**
	50	**51.4**	**51.5**	**56.3**	**54.9**	**53.2**	**49.3**	**43.6**	**47.0**	**48.4**	**51.5**	**51.4**
No Change		**51.5**	**51.5**	**56.3**	**54.9**	**53.2**	**49.4**	**43.6**	**47.0**	**48.5**	**51.5**	**51.4**

[a] Exceedences are shown in bold.

Vehicle Type	Reduction in NOx Emissions (%)	Predicted Annual Mean NO_2 Concentration (µg/m^3) [a]										
		Receptor										
		12	13	14	15	16	17	18	27	28	31	32
All	10	38.5	38.8	**48.0**	**46.7**	**46.7**	**44.1**	**42.1**	**42.6**	**42.7**	**41.9**	**42.5**
	25	35.5	35.8	**43.8**	**42.6**	**42.7**	**40.4**	38.6	39.0	39.2	38.4	39.0
	50	30.2	30.4	36.2	35.4	35.4	33.7	32.5	32.7	32.8	32.3	32.7
Car	10	39.7	40.0	**49.7**	**48.3**	**48.3**	**45.6**	**43.5**	**43.9**	**44.1**	**43.2**	**43.9**
	25	38.6	38.9	**48.2**	**46.9**	**46.9**	**44.3**	**42.2**	**42.6**	**42.7**	**41.9**	**42.5**
	50	36.7	36.9	**45.7**	**44.5**	**44.5**	**42.0**	**40.1**	**40.2**	**40.4**	39.6	**40.2**
LGV	10	**40.1**	**40.5**	**50.2**	**48.8**	**48.8**	**46.1**	**44.0**	**44.4**	**44.6**	**43.7**	**44.3**
	25	39.6	39.9	**49.5**	**48.1**	**48.2**	**45.4**	**43.4**	**43.8**	**44.0**	**43.1**	**43.7**
	50	38.7	39.0	**48.3**	**47.0**	**47.0**	**44.4**	**42.4**	**42.7**	**42.9**	**42.0**	**42.6**
HGV	10	39.7	**40.1**	**49.6**	**48.2**	**48.3**	**45.6**	**43.5**	**44.0**	**44.2**	**43.3**	**44.0**
	25	38.6	39.0	**48.1**	**46.7**	**46.8**	**44.2**	**42.3**	**42.8**	**43.0**	**42.2**	**42.8**
	50	36.7	37.2	**45.4**	**44.2**	**44.2**	**41.9**	**40.2**	**40.8**	**41.0**	**40.2**	**40.8**
Bus	10	**40.3**	**40.7**	**50.5**	**49.1**	**49.1**	**46.3**	**44.2**	**44.7**	**44.9**	**44.0**	**44.6**
	25	**40.1**	**40.5**	**50.2**	**48.8**	**48.8**	**46.1**	**44.0**	**44.5**	**44.7**	**43.8**	**44.4**
	50	39.8	**40.2**	**49.7**	**48.3**	**48.4**	**45.6**	**43.6**	**44.1**	**44.3**	**43.4**	**44.1**
MC	10	**40.4**	**40.8**	**50.6**	**49.2**	**49.3**	**46.5**	**44.4**	**44.8**	**45.0**	**44.1**	**44.7**
	25	**40.4**	**40.8**	**50.6**	**49.2**	**49.3**	**46.5**	**44.3**	**44.8**	**45.0**	**44.1**	**44.7**
	50	**40.4**	**40.8**	**50.6**	**49.2**	**49.2**	**46.4**	**44.3**	**44.8**	**45.0**	**44.1**	**44.7**
No Change		**40.4**	**40.8**	**50.6**	**49.2**	**49.3**	**46.5**	**44.4**	**44.8**	**45.0**	**44.1**	**44.8**

[a] Exceedences are shown in bold.

9.2 The results presented in Table 7 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 48.8%. This is the only measure that, in 2011, would reduce the concentrations to a level where the annual mean objective for nitrogen dioxide would be met.

10 Summary and Conclusions

10.1 Nitrogen dioxide concentrations within Hooley have been assessed through diffusion tube monitoring and dispersion modelling. The results indicate that the annual mean nitrogen dioxide objective continues to be exceeded within the proposed AQMA, but that there are no exceedences outside of the proposed AQMA. It is therefore recommended that the AQMA, as proposed, is appropriate, and should be declared as soon as possible.

10.2 It has been shown that ambient background concentrations contribute the largest individual proportion to existing nitrogen dioxide concentrations, followed by emissions from cars and HGVs on local roads.

10.3 A reduction in the volume of traffic along Brighton Road would result in a decrease in the concentrations of nitrogen dioxide. However, assuming no change in the vehicle fleet composition, a reduction in total vehicle emissions of 48.8% would be required to achieve the annual mean nitrogen dioxide objective at the worst-case locations.

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12 Glossary

AADT Annual Average Daily Traffic

ADMS-Roads Atmospheric Dispersion Modelling System

AQMA Air Quality Management Area

AURN Automatic Urban and Rural Network

Defra Department for Environment, Food and Rural Affairs

DfT Department for Transport

EFT Emissions 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)

LDV Light Duty Vehicles (<3.5 tonnes)

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

13 Appendices

A1 Unadjusted Monitoring Data and Data Capture

Table A1.1: Unadjusted Diffusion Tube Monitoring Data 2009 - 2011

Site No.	2009		2010		2011	
Month	RB136	RB137	RB136	RB137	RB136	RB137
Data Capture (%)	100	83	100	100	100	100
Unadjusted Annual Mean (µg/m^3)	65.4	58.9	61.7	60.1	53.2	52.6
Bias Adjustment Factor	1.014		1.050		0.949	
Bias Adjusted Annual Mean (µg/m^3)	66.3	59.7	64.8	63.1	50.5	49.9

A2 Modelling Methodology

Background Concentrations

A2.1 The background concentrations across the study area have been defined using the national pollution maps published by Defra (2012c). These cover the whole country on a 1x1 km grid and are published for each year from 2010 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. As noted in Paragraph 5.5, there are some concerns that Defra may have over-predicted the rate at which road traffic emissions of nitrogen oxides will fall in the future. The maps currently in use were verified against measurements made during 2010 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2010. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A2.2 In order to calculate background nitrogen dioxide and nitrogen oxides concentrations in 2011, it is assumed that there was no reduction in the road traffic component of backgrounds between 2010[3] and 2011. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2012c). For each grid square, the road traffic component has been held constant at 2010 levels, while 2011 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the nitrogen dioxide background sector tool which Defra (2012c) publishes to accompany the maps. The result is a set of 'adjusted 2011 background' concentrations.

A2.3 Two separate sets of 2015 and 2020 background nitrogen dioxide and nitrogen oxides concentrations have been used for the future-year assessment. The 2015 and 2020 background 'without emissions reduction' has been calculated using the same approach as described for the 2011 data: the road traffic component of background nitrogen oxides has been held constant at 2010 values, while 2015 and 2020 data are taken for the other components. Nitrogen dioxide has then been calculated using Defra's nitrogen dioxide background sector tool. The 2015 and 2020 background 'with emissions reduction' assumes that Defra's predicted reductions occur from 2011 onward. This dataset has been derived first by calculating the ratio of the unadjusted mapped value for 2011 to the unadjusted mapped value for 2015 and 2020. This ratio has then been applied to the adjusted 2011 value (as derived in paragraph A2.2).

A2.4 The background concentrations used in this assessment are shown in Table A2.1.

3 This approach assumes that has been no reduction in emissions per vehicle but also that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. Overall, this discrepancy is unlikely to influence the overall conclusions of the assessment.

Table A2.1: Estimated Annual Mean Background Pollutant Concentrations within the Study Area (µg/m³)

Year		NOx	NO_2
2011 [a]		26.0 – 26.1	17.8 – 17.9
2015	Without Reductions in Traffic Emissions [b]	24.4 – 24.5	17.0 – 17.1
	With Reductions in Traffic Emissions [c]	20.9 – 21.1	14.9 – 15.3
2020	Without Reductions in Traffic Emissions [d]	22.2 – 22.4	15.7 – 15.8
	With Reductions in Traffic Emissions [c]	15.6 – 15.8	11.4 – 11.8

[a] This assumes vehicle emission factors in 2011 remain the same as 2010.

[b] This assumes vehicle emission factors in 2015 remain the same as in 2010.

[c] This assumes vehicle emission factors reduce into the future at the current ‘official’ rates.

[d] This assumes vehicle emission factors in 2020 remain the same as in 2010.

Meteorological Data

A2.5 A full years hour-by-hour meteorological data from Gatwick Airport 2011 were used in the model. These data are summarised in Figure A2.1.

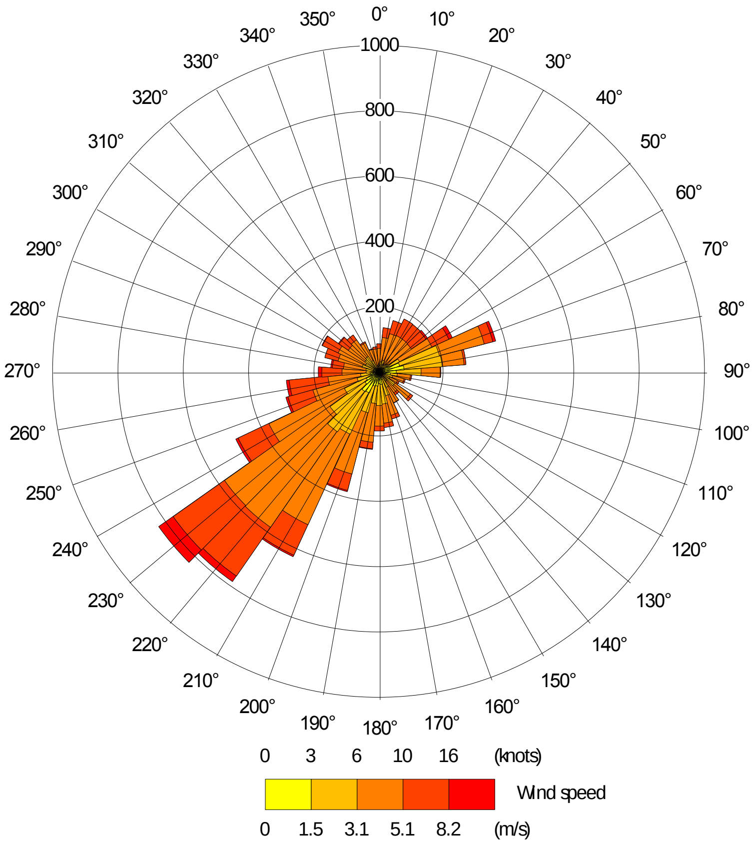

Figure A2.1: Wind Rose for Gatwick Airport 2011

Emissions Data

A2.6 Predictions have been carried out using the ADMS-Roads dispersion model (v3.1). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristic (including road width and street canyon height, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed using the Emission Factor Toolkit (Version 5.1.3) published by Defra (Defra, 2012c). Future-year concentrations have been predicted once using year-specific emission factors from the EFT and once using emission factors for 2011[4], which is the year for which the model has been verified.

Traffic Data

A2.7 AADT flows and vehicle fleet composition data for Brighton Road have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2012). The 2010 AADT flows were factored forwards to the assessment years of 2011, 2015 and 2020 using growth factors derived from the National Transport Model and associated guidance (DfT, 2009), adjusted to local conditions using the TEMPRO System v6.2 (DfT, 2011). Speeds have been estimated from local speed restrictions, and take account of the proximity to a junction. The traffic data used in this assessment are summarised in Table A2.2, with the vehicle proportions summarised in Table A2.3.

Table A2.2: Summary of Traffic Data used in the Assessment (AADT)

Road Link	2011	2015	2020
Brighton Road north of Star Lane	29,371	30,280	34,736
Brighton Road south of Star Lane	32,280	33,279	38,177

Table A2.3: Summary of Vehicle Proportions used in the Assessment

Road Link	Vehicle Proportions (%)					
	Car	LGV	HGV	Bus	Motorcycle	Total
Brighton Road north of Star Lane	77.8	15.2	4.9	0.7	1.3	100.0
Brighton Road south of Star Lane	77.8	15.2	4.9	0.7	1.3	100.0

4 i.e. combining current-year emission factors with future-year traffic data.

Model Verification

A2.8 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. The verification methodology is described below.

A2.9 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 2011 at the RB136 and RB137 diffusion tube monitoring sites.

A2.10 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 was calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator available on the Defra LAQM Support website (Defra, 2012c).

A2.11 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 A2.2). This factor was then applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx 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 A2.3).

Table A2.4: Data Used to Produce the Graphs for the Verification

Monitor	Measured NO_2	Background NO_2	Measured Road NOx [a]	Modelled Road NOx	Total Modelled NO_2 [b]
RB136	50.5	17.8	78.6	35.9	57.3
RB137	49.9	17.8	77.0	17.8	40.2

[a] Calculated using the NO_2 to NOx calculator

[b] Calculated using the NOx to NO_2 calculator

A2.12 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

- Primary adjustment factor : 2.614
- Secondary adjustment factor: 1.035

A2.13 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 adjustment is minor.

A2.14 Figure A2.4 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows a 1:1 relationship.

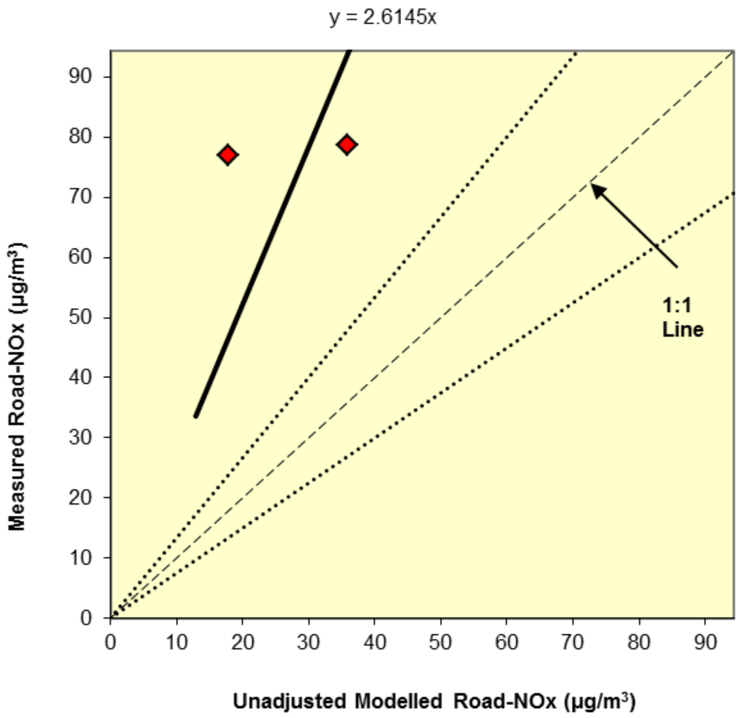

Figure A2.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

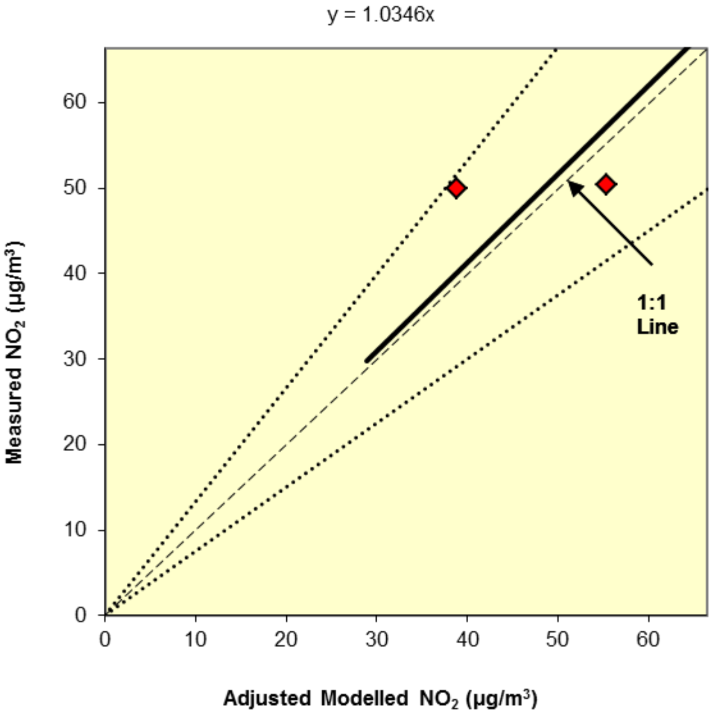

Figure A2.3: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

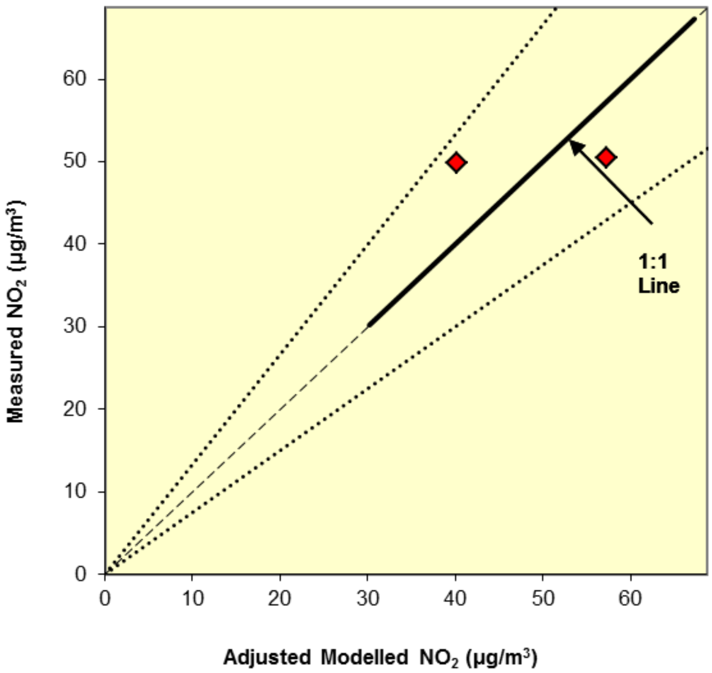

Figure A2.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

Source Apportionment

A2.15 The model was run for each vehicle type separately. The relative contribution from each source to road-NOx concentrations was thus implicit in the model results. The source apportionment calculation has also taken account of the different proportions of primary NO_2 (f-NO_2) emitted by different vehicle types, following the method developed for a report on Local Measures for NO_2 Hotspots in London (AQC & TRL, 2010). A disaggregated f-NO_2 database (which matches the breakdown of vehicle types available to this assessment) was obtained from the NAEI (Defra, 2012b). The method relies on removing the NOx contribution from each vehicle type in turn and then recalculating the f-NO_2 for the remaining vehicle mix (Table A2.5) and using the NOx to NO_2 calculator to derive a new NO_2 concentration. The difference between this NO_2 concentration and the total NO_2 concentration derived from the calculator is then assigned to the vehicle type. The results for each vehicle types calculated in this way are then summed. This sum was then scaled to match the measured road NO_2 (total minus background) and this factor used to adjust the contribution from each vehicle type.

Table A2.5: Receptor-Specific f-NO_2 Values Used for Source-Apportionment

Receptor	f-NO_2 Values (2011)					
	All vehicles	All Vehicles Except Listed Vehicle Types				
		Cars	LGV	HGV	Bus	MC
1	0.25	0.18	0.17	0.15	0.24	0.25
2	0.25	0.18	0.17	0.15	0.24	0.25
3	0.25	0.18	0.17	0.15	0.24	0.25
4	0.25	0.18	0.17	0.15	0.24	0.25
5	0.25	0.18	0.17	0.16	0.24	0.25
6	0.25	0.18	0.17	0.16	0.24	0.25
7	0.25	0.18	0.17	0.16	0.24	0.25
8	0.25	0.18	0.17	0.16	0.24	0.25
9	0.25	0.18	0.17	0.15	0.24	0.25
10	0.25	0.18	0.17	0.15	0.24	0.25
11	0.25	0.18	0.17	0.15	0.24	0.25
12	0.25	0.18	0.17	0.16	0.24	0.25
13	0.25	0.17	0.17	0.16	0.24	0.25
14	0.25	0.18	0.17	0.15	0.24	0.25
15	0.25	0.18	0.17	0.15	0.24	0.25
16	0.25	0.18	0.17	0.15	0.24	0.25
17	0.25	0.18	0.17	0.16	0.24	0.25
18	0.25	0.18	0.17	0.16	0.24	0.25
19	0.25	0.18	0.17	0.16	0.24	0.25
20	0.25	0.18	0.17	0.16	0.24	0.25
21	0.25	0.18	0.17	0.16	0.24	0.25
22	0.25	0.18	0.17	0.16	0.24	0.25
23	0.25	0.18	0.17	0.16	0.24	0.25
24	0.25	0.18	0.17	0.16	0.24	0.25
25	0.25	0.17	0.17	0.17	0.24	0.25
26	0.25	0.16	0.16	0.18	0.25	0.25
27	0.25	0.17	0.17	0.17	0.24	0.25
28	0.25	0.17	0.17	0.16	0.24	0.25
29	0.25	0.17	0.17	0.16	0.24	0.25

Receptor	f-NO_2 Values (2011)					
	All vehicles	All Vehicles Except Listed Vehicle Types				
		Cars	LGV	HGV	Bus	MC
30	0.25	0.17	0.17	0.16	0.24	0.25
31	0.25	0.17	0.17	0.17	0.24	0.25
32	0.25	0.17	0.17	0.17	0.24	0.25
33	0.25	0.17	0.17	0.17	0.24	0.25
34	0.25	0.17	0.17	0.17	0.24	0.25
35	0.25	0.17	0.17	0.17	0.24	0.25
36	0.25	0.17	0.17	0.17	0.24	0.25
RB136	0.25	0.18	0.17	0.15	0.24	0.25
RB137	0.25	0.17	0.17	0.16	0.24	0.25
RB82	0.25	0.17	0.17	0.17	0.24	0.25
RB146	0.25	0.17	0.17	0.17	0.24	0.25
RB147	0.25	0.17	0.17	0.16	0.24	0.25
RB148	0.25	0.17	0.17	0.17	0.24	0.25