Detailed Assessment of Air Quality along A281, Shalford for Guildford Borough Council

February 2019

Experts in air quality management & assessment

Document Control

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

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Guildford Borough Council to undertake a Detailed Assessment of air quality along The Street (A281) in Shalford. Measurements in 2018 between January and September indicate that the annual mean nitrogen dioxide objective may be exceeded along this road. Guildford Borough Council has thus decided to undertake a Detailed Assessment of air quality within Shalford.

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

Background

1.3 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

1.4 Technical Guidance for LAQM (LAQM.TG16) (Defra, 2018a) sets out a streamlined approach to the Review and Assessment process. This prescribes the submission of a single Annual Status Report (ASR) which all local authorities in England must submit each year. It should identify new non-compliant areas and report progress made within existing AQMA's. When an exceedance has been identified, the local authority can either use the "Fast Track Option" and immediately declare an AQMA, or obtain further information and/or data before deciding on the declaration of an AQMA. The latter approach is being treated as a 'Detailed Assessment' for the purposes of this report[1].

1.5 The purpose of this Detailed Assessment is to determine whether an exceedance of an air quality objective is likely and the geographical extent of that exceedance, which will determine the extent

[1] Detailed Assessments were part of the previous approach to LAQM, but they are no longer required in current TG16 guidance.

of the AQMA that has to be declared. Subsequent to the declaration of an AQMA, an Air Quality Action Plan (AQAP) should ideally be prepared within one year and approved by Defra. The AQAP will identify measures to improve local air quality and to achieve the air quality objectives. In order to inform the Action Plan process, source apportionment should be undertaken to ascertain the sources contributing the exceedances, and the magnitude of reduction in emissions required to achieve the objective should also be calculated.

1.6 Guildford Borough Council's 2017 ASR found no exceedances within Shalford in 2016; however, monitoring was only carried out at one site, and only between June and December. Concentrations at this location were close to the objective. Monitoring was undertaken at an additional site in 2018, and concentrations measured at both sites in 2018 between January and September indicate that exceedances of the objective are likely. This report represents a Detailed Assessment, following these findings.

The Air Quality Objectives

1.7 The Government's Air Quality Strategy (Defra, 2007) provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. The 'standards' are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. The objectives are prescribed within The Air Quality (England) Regulations 2000 (2000) and The Air Quality (England) (Amendment) Regulations 2002 (2002). Table 1 summarises the objectives which are relevant to this report. Studies have shown associations of nitrogen dioxide in outdoor air with adverse health effects; respiratory and cardiovascular morbidity and mortality.

Table 1: Air Quality Objectives for Nitrogen Dioxide

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual mean	40 µg/m^3

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

1.9 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60 µg/m^3 (Defra, 2018a). Therefore, exceedances of 60 µg/m^3 as an annual mean nitrogen dioxide concentration are used as an indicator of potential exceedances of the 1-hour nitrogen dioxide objective.

2 Assessment Methodology

Monitoring

2.1 Monitoring of nitrogen dioxide was carried out by Guildford Borough Council at 2 locations on the A281 in Shalford using passive diffusion tube sites. One of these sites (SH1) is a long-term site with the second site (SH2) commencing in January 2018. The monitoring sites and study area are shown in Figure 1. The diffusion tubes were prepared and analysed by Lambeth Scientific Services using the 50% Triethanolamine (TEA) in acetone method. It is necessary to adjust diffusion tube data to account for laboratory bias. The national bias adjustment factor of 0.90 has been used. This factor was obtained from the database of national factors provided on the Review and Assessment Helpdesk website (spreadsheet version 03/18), and has been used for adjusting data presented on the Guildford Borough Council website.

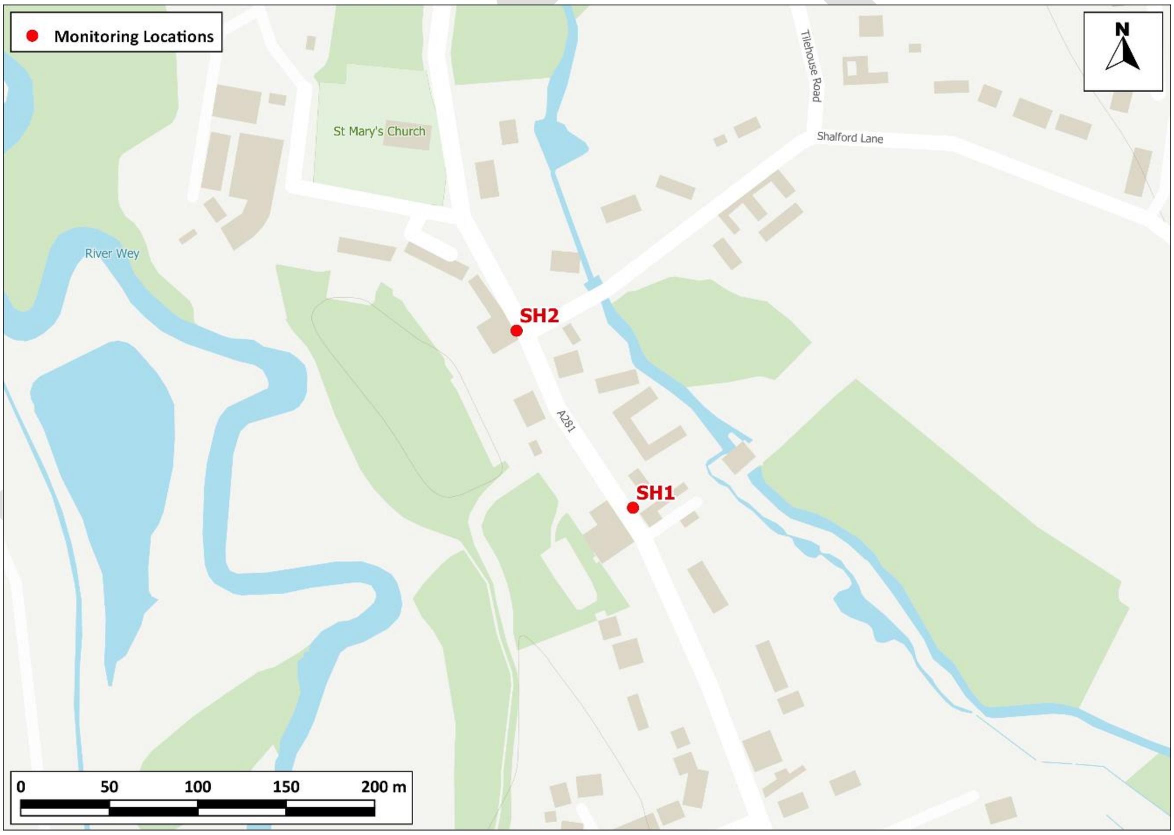

Figure 1: Monitoring Locations

Modelling

2.2 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (ADMS-Roads v4.1). The input data used are described in Appendix A1. The model outputs have been verified against data from the SH1 and SH2 diffusion tube monitoring sites; the 2018 SH2 monitoring data have been annualised to 2017 to be used in verification. Further details of model verification are supplied in Appendix A1.

2.3 Concentrations have been predicted at 14 specific receptors (modelled at 1.5 m, with the exception of receptor R11 which was modelled at the first floor height of 4 m) as shown in Figure 2. Receptors have been chosen to represent worst-case locations, in particular locations close to narrow sections of roads and in areas where dispersion is limited by buildings.

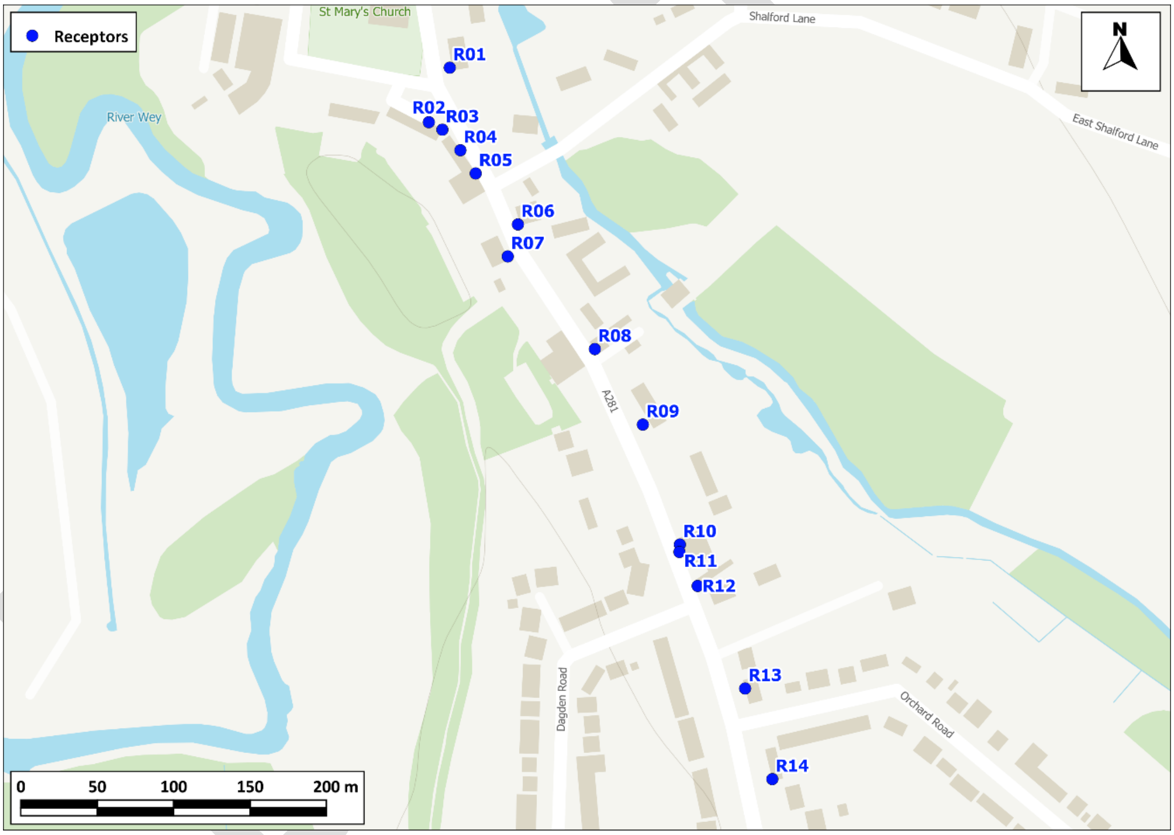

Figure 2: Receptor Locations

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National Background Pollution Maps

2.4 The 2017 nitrogen dioxide background concentrations across the study area have been defined using the national pollution maps published by Defra (Defra, 2017). These cover the whole country on a 1x1 grid. The backgrounds used within the detailed assessment are provided in Table 1. The derivation of background concentrations is described in Appendix A1.

Table 1: Estimated Annual Mean Background Pollutant Concentrations in 2017 (µg/m³) [a]

Year	NO_2
2017	10.6-11.2
Objectives	**40**

[a] The range of values is for the different 1x1 km grid squares covering the study area.

Uncertainty

2.5 Uncertainty is inherent in all measured and modelled data. All values presented in this report are the best possible estimates, but uncertainties in the results might cause over- or under-predictions. The model results rely on traffic data and any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that wind conditions measured at Farnborough meteorological station during 2017 will have occurred throughout the study area during 2017; and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. An important step in the assessment is verifying the dispersion model against the measured data. Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2017) concentrations.

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

3 Results

Monitoring

3.1 Monitoring data for 2016 to 2018 for the sites within the study area are summarised in Table 2.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2016-2018) [a, b]

Site No.	Site Type	Height of Tube (m)	Distance from Kerb (m)	Location	Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) [a,b] (Bias Adjustment Factor)		
					2016 (0.94)	2017 (0.90)	2018 [c] (N/A)
SH1	Roadside	2.4	1.2	A281, Shalford	37 [d]	35	**43**
SH2	Roadside	2.3	1.2	A281, Shalford	-	-	**47**
Objective					**40**		

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

[b] 2016 data have been taken from the 2017 Annual Status Report (Guildford Borough Council, 2017). 2017 and 2018 monitoring data have been provided by Guildford Borough Council.

[c] Only data up to September 2018 were available at the time of writing this report. The data presented have not been bias adjusted as no adjustment factor was available for 2018. The data presented in this table have not been annualised. These results should therefore be used with caution. For Lambeth tubes, previous years have been adjusted downwards. Data used to verify the model have been adjusted and annualised where necessary.

[d] Monitoring at SH1 commenced in June 2016. 2016 data have therefore been annualised by Guildford Borough Council.

3.2 Concentrations at diffusion tube SH1 were below the annual mean objective in 2016 and 2017. Concentrations measured between January and September of 2018 were above the objective without bias adjustment and annualisation. The bias adjustment factors in previous years are below 1, and with bias adjustment the 2018 measurements may below the objective. However, concentrations are generally higher in winter; in such a case the average concentrations across 12 months would be higher than those presented.

3.3 The 2018 data from SH2 have been adjusted to an equivalent annual mean for 2017 to be used for verification (see Appendix A2). With the 2017 bias adjustment factor of 0.90 applied, the 2017 annual mean concentration at this site has been calculated to be 48 µg/m^3, which is in exceedance of the objective.

3.4 There are no measured concentrations exceeding 60 µg/m^3, and thus exceedances of the 1-hour objective are unlikely at these locations.

Modelling

3.5 Annual mean nitrogen dioxide concentrations in 2017 have been predicted at ground- or first-floor level at each of the receptors shown in Figure 2, and the results are set out in Table 3.

Table 3: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors in 2017

Receptor	Height	Annual Mean ($\mu g/m^3$) [a]
R01	1.5	21.2
R02	1.5	13.9
R03	1.5	14.6
R04	1.5	**46.6**
R05	1.5	**48.1**
R06	1.5	32.5
R07	1.5	15.9
R08	1.5	32.4
R09	1.5	19.8
R10	1.5	23.7
R11	4.0	14.0
R12	1.5	23.2
R13	1.5	19.0
R14	1.5	18.2
Objective		**40**

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

3.6 Predicted concentrations exceed the annual mean objective at two receptors, R04 and R05. The highest modelled annual mean nitrogen dioxide concentration is 48.1 $\mu g/m^3$, predicted at receptor R05. Concentrations at all other receptors are below the objective.

3.7 It is recommended that an AQMA is declared to cover properties 24-38 on the west side of The Street, represented by receptors R04 and R05; concentrations at all other receptors are below 33 $\mu g/m^3$ and thus sufficiently low to discount the possibility of exceedances. The recommended AQMA is shown in Figure 3. For ease of administration the whole of any property is included. Figure A3.1 in Appendix A3 shows the 40 $\mu g/m^3$ contour in this area.

3.8 Concentrations are below 60 $\mu g/m^3$ at every receptor and it is therefore unlikely that the 1-hour mean nitrogen dioxide objective is being exceeded.

Figure 3: Recommended AQMA

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Population Exposure

3.9 Objective exceedances are predicted at eight residential properties. Assuming that each property has, on average, two occupants, this equates to approximately 16 residents.

Air Quality Improvements Required

3.10 The degree of improvement needed in order for the annual mean nitrogen dioxide objective to be achieved is defined by the difference between the highest measured or predicted concentration and the objective level (40 µg/m^3).

3.11 In terms of describing the reduction in emissions required, it is more useful to consider nitrogen oxides (NO_x). The required reduction in local nitrogen oxides emission has been calculated in line with guidance presented in LAQM.TG16 (Defra, 2018a). Table 4 sets out the required reduction in local emissions of NO_x that would be required at each of the receptor locations where an exceedance is predicted, in order for the annual mean objective to be achieved.

3.12 The highest nitrogen dioxide concentration has been predicted at receptor R05 (48.1 µg/m^3), requiring a reduction of 8.1 µg/m^3 in order for the objective to be achieved. Table 4 shows that at this location a reduction of 19.7 µg/m³ in NO_x emissions would be required in order to achieve the objective. This equates to a reduction of 25.0% in local road traffic emissions at this receptor location.

Table 4: Improvements in Annual Mean Nitrogen Dioxide Concentrations and Nitrogen Oxides Concentrations Required in 2017 to Meet the Objective

Receptor	Required reduction in annual mean nitrogen dioxide (NO_2)		Required reduction in road nitrogen oxides (NO_x) emissions	
	µg/m³	% of total predicted NO_2	µg/m³	% reduction in road NO_x
R04	6.6	14.1	15.9	21.1
R05	8.1	16.9	19.7	25.0

4 Source Apportionment

4.1 In order to develop appropriate measures to improve air quality along the A281 in Shalford and inform the action plan, it is necessary to identify the sources contributing to the objective exceedances within the study area. Source apportioned nitrogen dioxide concentrations have been calculated. The different proportions have been calculated in-line with guidance provided in LAQM.TG16 (Defra, 2018a).

4.2 The following categories have been included in the source apportionment:

- Regional background;
- Local background;
- Cars;
- Lights Good Vehicles (LGV);
- Buses (PSVs);
- Heavy Goods Vehicles (HGVs); and
- Motorcycles (MCs).

4.3 Table 5 and Figure 4 show the contribution from each of the different categories to total predicted annual mean nitrogen dioxide concentrations at each of the receptors assessed.

4.4 Table 6 and Figure 5 show the percentage contributions of each category to total predicted annual mean nitrogen dioxide concentrations. At the majority of receptors, including those where exceedances are predicted, emissions from cars contribute the largest proportion to the overall concentration (13.7-52.9%). Local background concentrations (14.1-48.8%), regional background concentrations (9.1-31.7%), and emissions from LGVs (3.2-11.4%) and HGVs (2.5-10.6%) also contribute significant proportions to the overall concentrations.

Table 5: Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) in 2017

Receptor	Annual Mean Contribution (µg/m^3)						
	Regional Background	Local Background	MC	Car	LGV	HGV	PSV
R01	4.4	6.8	0.1	6.9	1.7	1.2	0.2
R02	4.4	6.8	0.0	1.9	0.4	0.3	0.1
R03	4.4	6.8	0.0	2.3	0.5	0.4	0.1
R04	4.4	6.8	0.1	24.4	5.2	4.9	0.8
R05	4.4	6.8	0.1	25.4	5.5	5.1	0.8
R06	4.5	6.1	0.1	15.1	3.3	3.0	0.5
R07	4.4	6.8	0.0	3.3	0.8	0.6	0.1
R08	4.5	6.1	0.1	15.2	3.6	2.5	0.4
R09	4.5	6.1	0.0	6.4	1.6	1.1	0.2
R10	4.5	6.1	0.1	9.0	2.2	1.6	0.3
R11	4.5	6.1	0.0	2.4	0.6	0.4	0.1
R12	4.5	6.1	0.1	8.7	2.1	1.5	0.2
R13	4.5	6.1	0.0	5.8	1.4	1.0	0.2
R14	4.5	6.1	0.0	5.3	1.3	0.9	0.1
Objective	40						

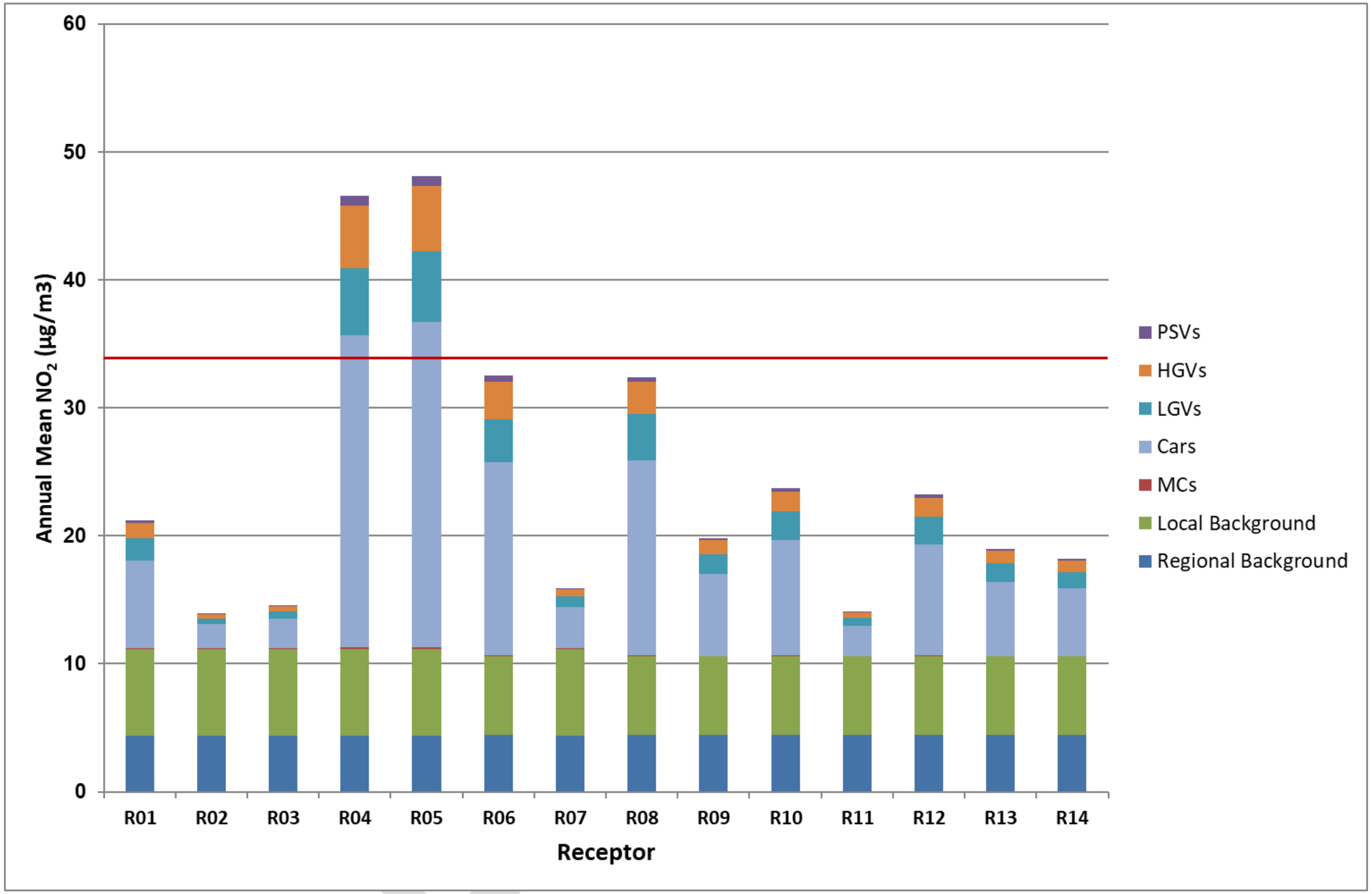

Figure 4: **Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentration (µg/m^3) at Each Receptor in 2017**

Table 6: Percentage Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations in 2017

Receptor	Percentage Contribution (%)						
	Regional Background	Local Background	MC	Car	LGV	HGV	PSV
R1	20.7	32.0	0.2	32.4	8.0	5.8	0.9
R2	31.4	48.8	0.1	13.7	3.2	2.5	0.4
R3	30.1	46.7	0.1	16.1	3.7	2.9	0.5
R4	9.4	14.6	0.3	52.4	11.2	10.5	1.6
R5	9.1	14.1	0.3	52.9	11.4	10.6	1.7
R6	13.7	18.8	0.3	46.5	10.2	9.1	1.4
R7	27.5	42.7	0.1	20.5	4.9	3.6	0.6
R8	13.8	18.8	0.3	47.0	11.1	7.8	1.2
R9	22.5	30.8	0.2	32.1	7.9	5.6	0.9
R10	18.8	25.8	0.3	38.1	9.4	6.6	1.1
R11	31.7	43.5	0.1	17.1	4.1	2.9	0.5
R12	19.2	26.3	0.3	37.5	9.2	6.5	1.1
R13	23.5	32.2	0.2	30.5	7.5	5.3	0.9
R14	24.5	33.5	0.2	28.9	7.1	5.0	0.8

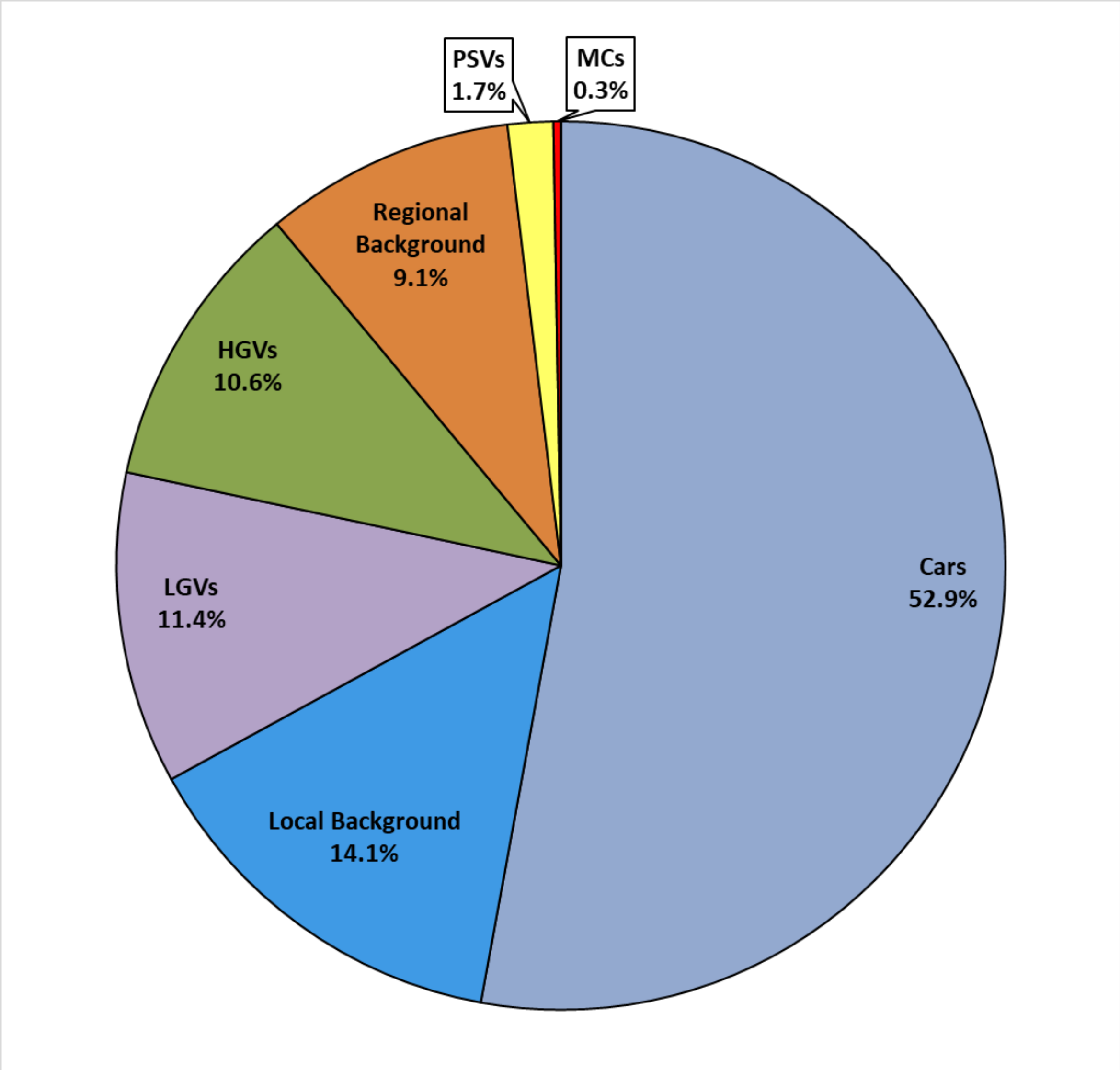

Figure 5: Percentage Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations at Receptor R4 in 2017

5 Conclusions and Recommendations

5.1 A Detailed Assessment has been carried out for nitrogen dioxide along the A281 in Guildford. This area was identified as being at risk of exceeding the annual mean air quality objective for nitrogen dioxide based on local monitoring data in 2018.

5.2 The Detailed Assessment has been carried out using a combination of monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2017 using the ADMS-Roads dispersion model. The model has been verified against measurements made at two nitrogen dioxide diffusion tube monitoring locations which lie adjacent to the road network included in the model.

5.3 The assessment has identified that the annual mean nitrogen dioxide objective is being exceeded at a small number of relevant locations alongside the A281. Concentrations are below 60 $\mu g/m^3$ at all locations and it is therefore unlikely that the 1-hour mean nitrogen dioxide objective is being exceeded.

5.4 It is recommended that Guildford Borough Council declare an AQMA along the A281 for property numbers 24-38, as shown in Figure 3. The modelled results reflect the monitoring which is showing exceedances on the façade of a property at this location. It is also recommended that Guilford Borough Council continues monitoring nitrogen dioxide at the existing locations.

5.5 Source apportionment of the local traffic emissions has been undertaken. This shows that in locations where exceedances are predicted, emissions from cars on the A281 contribute the largest proportion to the overall concentration. Local and regional backgrounds and emissions from LGVs and HGVs also contribute significant proportions to the overall concentrations.

5.6 A reduction in traffic emissions along the A281 would result in a decrease in the concentrations of nitrogen dioxide. Reductions in vehicle emissions from local traffic of up to 25.0% would be required to achieve the annual mean nitrogen dioxide objective where the highest concentrations are predicted to occur.

6 References

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7 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
Exceedance	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
HMSO	Her Majesty's Stationery Office
HGV	Heavy Goods Vehicle
kph	Kilometres Per hour
LAQM	Local Air Quality Management
LGV	Light Goods Vehicles (<3.5 tonnes)
$\mu g/m^3$	Microgrammes per cubic metre
MC	Motorcycle
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	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
PSV	Public Service Vehicle
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

8 Appendices

A1 Dispersion Modelling Methodology

Model Inputs

Road Traffic

A1.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 8.0.1) published by Defra (2018b).

A1.2 Hourly sequential meteorological data from Farnborough for 2017 have been used in the model. The Farnborough meteorological monitoring station is located approximately 16 km to the northwest of the A281 study area. It is deemed to be the nearest monitoring station representative of meteorological conditions in the study area; both the study area and the Farnborough meteorological monitoring station are located in the south of England where they will be influenced by the effects of inland meteorology.

A1.3 For the purposes of modelling it has been assumed that two sections of the A281 are within street canyons formed by adjacent buildings and walls, the first between 24 and 31 The Street, and the second along the length of The Seahorse pub. The dispersion of traffic emissions within street canyons is reduced, which can lead to concentrations of pollutants being higher than they would be in areas with greater dispersion. These sections have therefore been modelled as street canyons using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from local mapping and photographs.

A1.4 AADT flows, speeds and vehicle fleet composition data have been derived from a traffic survey undertaken by Surrey County Council between 17 and 30 September 2018. The traffic data used in this assessment are summarised in Table A1.1. Some traffic speeds have been adjusted from those measured in the traffic survey based on professional judgement, taking into account the road layout. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2017).

Table A1.1: Summary of Traffic Data used in the Assessment (AADT Flows) [a]

Road Link	AADT	% Car	% LGV	% HGV	% Bus/ Coach	% Motor Cycle
A281	22,474	89.1	6.7	2.6	0.2	1.3

A1.5 Figure A1.1 shows the road network and traffic speeds included within the model and defines the study area.

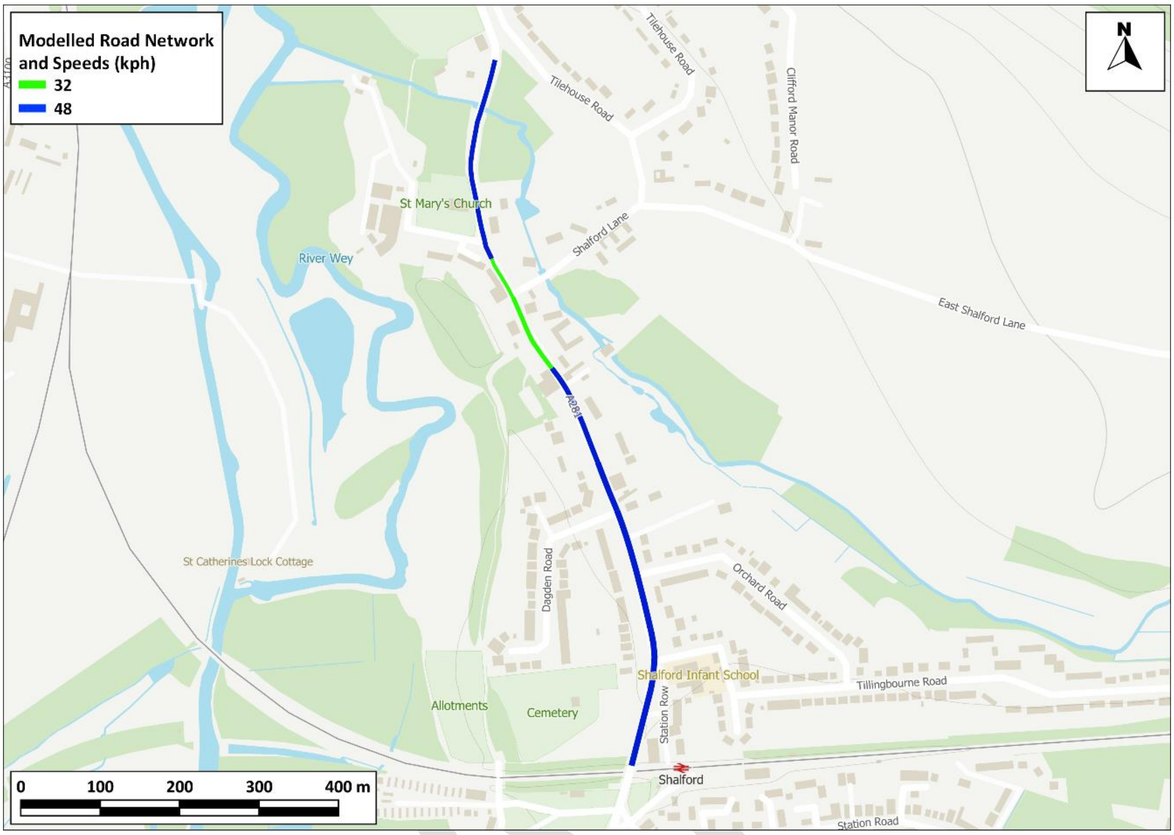

Figure A1.1: Modelled Road Network

Background Concentrations

A1.6 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2018b). These cover the whole country on a 1x1 km grid and are published for each year from 2015 until 2030. The background maps for 2017 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2018).

A1.7 For the purposes of the source apportionment study the local and regional components of the background concentrations have been derived using the methodology outlined in LAQM.TG16. The local background NO_x component was derived by total background NO_x minus regional background NO_x (represented by rural column in background maps). The local and regional NO_x proportions were then used to apportion the total background NO_2 concentrations.

Model Verification

A1.8 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

A1.9 Most nitrogen dioxide (NO_2) is produced in the atmosphere by a reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NO_x = NO + NO_2). The model has been run to predict the annual mean NO_x concentrations during 2017 at the SH1 and SH2 diffusion tube monitoring sites. Concentrations have been modelled at 2.4 m and 2.3 m, the heights of the respective diffusion tubes.

A1.10 The model output of road-NO_x (i.e. the component of total NO_x coming from road traffic) has been compared with the 'measured' road-NO_x. Measured road-NO_x has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NO_x from NO_2 calculator (Version 5.1) available on the Defra LAQM Support website (Defra, 2017). Monitoring data from site SH2 were only available for January to September 2018, and these data have been adjusted to a 2017 annual mean equivalent (see Section A2).

A1.11 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A1.2). The calculated adjustment factor of 1.0505 has been applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations.

A1.12 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO_2 concentration within the NO_x to NO_2 calculator. Figure A1.3 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

A1.13 The results imply that the model has under predicted the road-NO_x contribution. This is a common experience with this and most other road traffic emissions dispersion models.

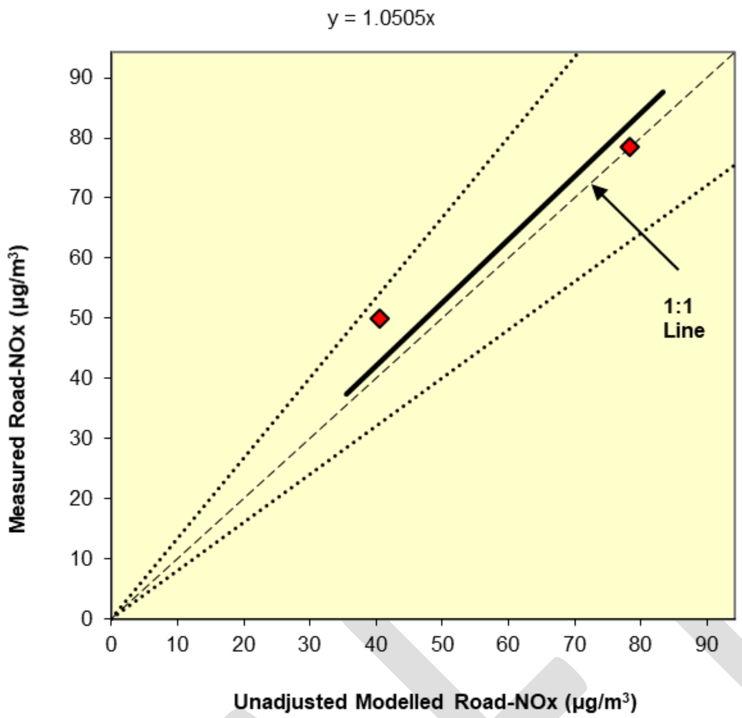

Figure A1.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

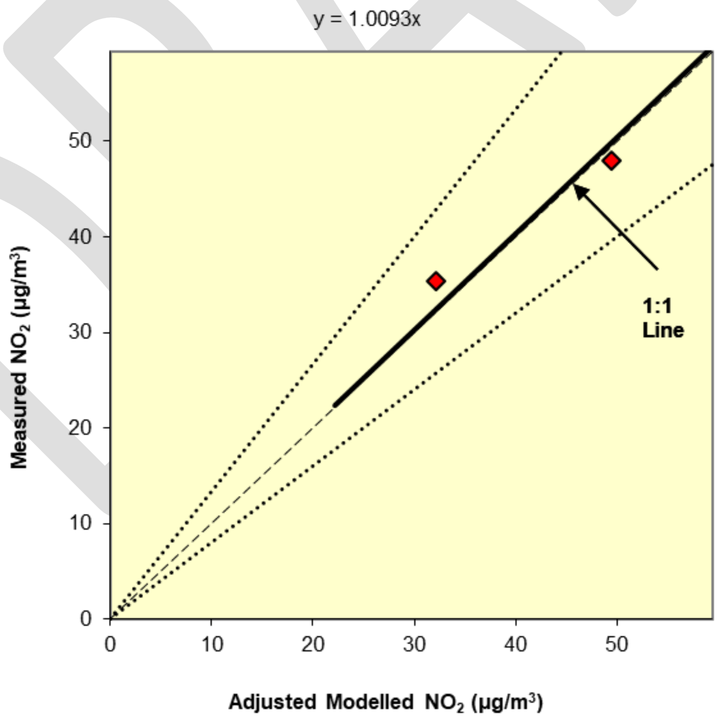

Figure A1.3: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

Model Post-processing

A1.14 The model predicts road-NO_x concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NO_x to NO_2 calculator available on the Defra LAQM Support website (Defra, 2017). The traffic mix within the calculator has been set to "All non-urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NO_x and the background NO_2.

A2 Adjustment of Short-Term 2018 Data to 2017 Annual Mean

A2.1 The SH2 diffusion tube monitoring site was established at the beginning of January 2018. Data have been provided by Guildford Borough Council for this site up to and including September 2018. In order to be used in the model verification these data have been adjusted to a 2017 annual mean equivalent based on the ratio of concentrations during the short-term monitoring period (9 months; Jan – Sep 2018) to those over the 2017 calendar year at two background sites operated as part of the Automatic Urban and Rural Network (AURN). This follows the guidance set out in Box 7.9 of LAQM.TG16.

A2.2 The annual mean nitrogen dioxide concentrations and the period means for each of the two monitoring sites from which adjustment factors have been calculated are presented in Table A2.1, along with the Overall Factor.

Table A2.1: Data used to Adjust Short-term Monitoring Data from SH2 to 2017 Annual Mean Equivalent

Monitoring Site	Period Mean Concentration ($\mu g/m^3$)		Adjustment Factor	Overall Factor
	2017 Calendar	Jan-Sep 2018 [a]		
Reading New Town AURN	28.7	25.6	1.123	1.131
Hillingdon AURN	53.1	46.6	1.139	

[a] Specifically 1 January 2018 to 30 September 2018.

A3 Figure of 40 µg/m³ Contour in the vicinity of the recommended AQMA

Figure A3.1: Predicted Annual Mean Nitrogen Dioxide Concentration shown as a contour