Assessment of Uttlesford District's Local Plan on Air Quality in Saffron Walden

Nitrogen Dioxide Dispersion Modelling Report

October 2013

INTERIM

JACOBS

Document Control Sheet

BPP 04 F8
Version 15 March 2013

Project:	Assessment of Uttlesford District's Local Plan on Air Quality in Saffron Walden		
Client:	Essex County Council	Project No:	B3553018
Document title:	Nitrogen Dioxide Dispersion Modelling Report		
Ref. No:			

	Originated by	Checked by	Reviewed by
ORIGINAL	NAME **Nigel Bellamy**	NAME **Ruth Pears**	NAME **Richard Hill**
Approved by	NAME **Una Wheeler**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE **14-3-13**	**Document status: Draft for Comment**		

REVISION	NAME **Ruth Pears**	NAME **Nigel Bellamy**	NAME **Nigel Bellamy**
Approved by	NAME **Una Wheeler**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE **6-8-13**	**Document status:**		

REVISION	NAME **Anthony Dixon**	NAME **Andy Smith**	NAME **Nigel Bellamy**
Approved by	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE	**Document status**		

REVISION	NAME	NAME	NAME
Approved by	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
DATE	**Document status**		

INTERIM

Jacobs U.K. Limited

This document has been prepared by a division, subsidiary or affiliate of Jacobs U.K. Limited ("Jacobs") in its professional capacity as consultants in accordance with the terms and conditions of Jacobs' contract with the commissioning party (the "Client"). Regard should be had to those terms and conditions when considering and/or placing any reliance on this document. No part of this document may be copied or reproduced by any means without prior written permission from Jacobs. If you have received this document in error, please destroy all copies in your possession or control and notify Jacobs.

Any advice, opinions, or recommendations within this document (a) should be read and relied upon only in the context of the document as a whole; (b) do not, in any way, purport to include any manner of legal advice or opinion; (c) are based upon the information made available to Jacobs at the date of this document and on current UK standards, codes, technology and construction practices as at the date of this document. It should be noted and it is expressly stated that no independent verification of any of the documents or information supplied to Jacobs has been made. No liability is accepted by Jacobs for any use of this document, other than for the purposes for which it was originally prepared and provided. Following final delivery of this document to the Client, Jacobs will have no further obligations or duty to advise the Client on any matters, including development affecting the information or advice provided in this document.

This document has been prepared for the exclusive use of the Client and unless otherwise agreed in writing by Jacobs, no other party may use, make use of or rely on the contents of this document. Should the Client wish to release this document to a third party, Jacobs may, at its discretion, agree to such release provided that (a) Jacobs' written agreement is obtained prior to such release; and (b) by release of the document to the third party, that third party does not acquire any rights, contractual or otherwise, whatsoever against Jacobs and Jacobs, accordingly, assume no duties, liabilities or obligations to that third party; and (c) Jacobs accepts no responsibility for any loss or damage incurred by the Client or for any conflict of Jacobs' interests arising out of the Client's release of this document to the third party.

Contents

INTERIM

1 Introduction

Jacobs has been commissioned by Essex County Council (ECC) to undertake an air quality assessment of the effects of proposed developments in the Uttlesford District Council's (UDC) Local Plan on nitrogen dioxide (NO_2) concentrations. This assessment is aimed at identifying whether mitigation is required and/or possible in the opening year. Local Air Quality Management (LAQM) assessments conducted by UDC have identified that only NO_2 represents a risk of exceeding air quality standards.

This assessment involved an update of an existing air quality model for Saffron Walden, to incorporate revised traffic data and the latest emission factors and air quality tools released by Defra in 2012/13.

Modelling of air quality at four key junctions was undertaken for the proposed development scenario opening years of 2018 and 2026 to determine whether air quality was expected to comply with the air quality standards for NO_2 in the relevant opening years, and to assess the significance of changes in air quality by comparing a "do-minimum" and "full" schemes in each year.

INTERIM

2 Legislative and Policy Framework

2.1 Air Quality Legislation

The Government's Air Quality Strategy (Defra, 2007) provides air quality standards (AQS) 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 'standards' include a date by which compliance is required as specified in the EU directive on Clean Air For Europe (CAFE). The standards were prescribed within The Air Quality (England) Regulations 2000 (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (Stationery Office, 2002), and were replaced by the Air Quality Standards Regulations 2010 (Stationary Office, 2010). Table 2-A summarises the standards which are relevant to this report.

The AQSs only apply where members of the public are likely to be regularly present for the averaging time of the standard (i.e. where people will be exposed to pollutants). For annual mean standards, relevant exposure is limited to residential properties, schools and hospitals. The 1-hour standard 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.

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

Pollutant	Air Quality Standard		Achievement Date
	Concentration	Measured as	
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times/yr (99.79th percentile)	1 hour mean	1-1-2010
	40 µg/m^3	Annual mean	1-1-2010

Table 2-A: Air Quality Standards

2.2 Local Air Quality Management

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out a framework for Local Air Quality Management (LAQM), which includes a number of AQSs. National and international measures are expected to achieve these standards 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 AQSs will be achieved. These locations must be designated as Air Quality Management Areas (AQMA) and a subsequent Air Quality Action Plan (AQAP) developed in order to reduce pollutant emissions in pursuit of the standards.

3 Methodology

3.1 Introduction

The assessment of air quality for the Saffron Walden Local Plan developments was undertaken using the ADMS-Roads Air Dispersion Modelling Software.

ADMS Roads is a recognised tool for carrying out air quality impact assessments and has been comprehensively validated by both the manufacturers and independently. Version 3.1 (released August 2011) was used for this study.

Dispersion models combine estimates of emissions of pollutants from road traffic with information on meteorological data and the surrounding environment to calculate pollutant concentrations. The estimates produced while appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty.

A summary of the assessment methodology is provided below.

3.2 Traffic Data and Vehicle Emissions

Traffic data were provided by Essex Highways, based on count data and queue lengths from surveys undertaken in 2012. This was considered to be representative of typical average traffic conditions in 2011, the Base year for this air quality assessment.

The traffic data covered four key junctions where poor air quality has been measured and predicted by UDC in their LAQM assessments[1]. These data comprised directional information for each hour of the day for weekdays, Saturdays and Sundays. Data were provided specifying total vehicle flow, Heavy Duty Vehicle (HDV) flow and average speed.

In addition the average maximum queue length was also specified for the weekday. The traffic team identified that the average queue length observed outside the morning and evening rush hour, could be considered to be representative of queues on a Saturday between 11:00 and 14:00. No queues were considered to occur on a Sunday. Queues were represented following guidance issued by the ADMS Roads model developer[2], for hours containing the typical maximum queue length and the typical average queue length.

Traffic queue length data were incorporated in to the model at the following locations, for the base year and future year scenarios:

J1: B184 Thaxted Road / East Street / B1053 Radwinter Road / Chaters Hill:
East Street approach
B1053 Radwinter Road approach
B184 Thaxted Road approach

---

[1] UDC, 2012 Air Quality Updating and Screening Assessment for Uttlesford District Council, 2012

[2] CERC, Modelling Queuing Traffic – Helpdesk Note 60, 2004

INTERIM

J2: B1052 London Road mini-roundabout junction with Debden Road:
All three approaches were assessed for queues

J3: B1052 High Street / B184 George Street / Abbey Lane / Hill Street:
Both High Street approaches were assessed for queues

J4: B184 Bridge Street / Castle Street / Myddylton Place:
Both Bridge Street approaches were assessed for queues

Modelled road links and the locations of queues in the study area are presented in Figure 6-A.

Emissions were calculated using Defra's Emissions Factor Toolkit Version 5.1.3 (August 2012). The traffic data for each hour were used to calculate the emission rate for each road link and queue. Full details of data for traffic modelling can be found in Appendix C.

3.3 Assessment Scenarios

Traffic data were supplied that included specific developments from the UDC Local Plan. UDCs Local Plan (Public Participation on Development Plan Document, Consultation on Proposals for a Draft Local Plan, June 2012) contains three policies:

1) Policy development 1 involves the provision of a minimum of 800 residential dwellings and 6 hectares of employment land on the land to the east of Saffron Walden, plus a link road between Thaxted Road and Radwinter Road.

   As part of this policy development a number of junction improvements have been specified as follows:

   J1: Priority junction layout would replace existing signalised arrangment.

   J2: Priority junction layout would replace existing mini-roundabout arrangment.

   J3: Bringing forward the stop line and moving back the pedestrian crossing on the Hight Street North approach. Provision of two full northbound approach lanes to the junction, which would involve the removal of car parking on the western side of High Street south.

   J4: No mitigation measures.

2) Policy development 2 is for a minimum of 60 residential dwellings on Radwinter Road.

3) Policy development 3 is for a minimum of 20 residential dwellings west of Debden Road.

The modelling assessment considered the following scenarios:

INTERIM

- A base year scenario of 2011 which was also used to define model adjustment factors for the future year scenarios.
- An opening year of 2018 “do minimum” scenario containing committed developments, excluding proposed AQAP improvements.
- An opening year of 2018 “full scheme” scenario containing both policy developments 2 & 3 and proposed AQAP improvements.
- An opening year of 2026 “do minimum” scenario containing committed developments, excluding proposed junction improvements.
- An opening year of 2026 “full scheme” scenario containing policy developments 1, 2 & 3, including proposed junction improvements.

It should be noted that ECC do not expect the change to location of the High Street north approach stop line, which is included as a mitigation measure in the modelled scenario, to be implemented by 2026. Therefore the “full scheme” results for High Street North do not include this mitigation measure.

3.4 Receptors

The assessment covers representative residential properties and other sensitive properties and calculations are made at the nearest façade to the modelled junctions. Receptors have been selected and presented Figure 6-B.

3.5 Background Concentrations

Defra provides empirically-derived national background maps, which provide estimates of background pollutant concentrations on a 1km x 1km grid square resolution. This model relates the National Atmospheric Emissions Inventory to the national network of pollution measurements.

The data for NO_x, NO_2 and PM_{10} have recently been updated, with a base year of 2010 from which future years can be projected. Defra have stated that 2010 was an unusually high year for NO_x and NO_2, and that in order to correct the background maps to other years, the NO_x concentrations should be reduced by 15%; this process has been applied in the assessment.

A comparison of the 2011 mapped total NO_x and NO_2 concentrations was undertaken against measured data from monitoring locations in background locations. It was found that, the estimates from the background maps were in good agreement with the measured data and there was no need for adjustment.

The ‘in-grid square’ contribution from the minor road sector has been removed from the background annual mean NO_x concentration estimates, and background annual mean NO_2 estimates have been corrected using Defra’s Background NO_2 Calculator[3]. This process has been undertaken to avoid double counting of road traffic emissions. The predicted background pollutant concentrations in the study area are significantly below the AQSs.

[3] Defra, NO_2 Background Sector Tool - for Source Apportioned Background NO_x v3.2

INTERIM

3.6 Meteorological Data

The meteorological data site considered to be most representative of conditions within the study area was Stansted Airport, which is located 13 km south of Saffron Walden. Meteorological data for 2011 was supplied by ADM Ltd, with 15% missing cloud data for 2011 taken from Mildenhall. A roughness length of 0.2 m was applied in the analysis of the meteorological data and a roughness length of 0.5 m was applied in the dispersion analysis following recommendations by the suppliers of the meteorological data and also the model developers. The meteorological data used in this assessment are presented as a windrose in Appendix B.

3.7 Prediction of Environmental Concentrations including Adjustment for Long Term Trends (LTT) in NO_x and NO_2

The model was used to predict the road traffic contributions to NO_x concentrations at specified receptors. Adjustments are applied to the model predictions based on a comparison against measured NO_2 concentrations, in a process known as model verification and adjustment. The modelled road contributions of NO_x and NO_2 were adjusted to correct them against measured road components derived from monitoring data, following an adjustment method set out in Defra's Technical Guidance LAQM TG(09)[4]. NO_x and NO_2 concentrations were calculated using the NO_x from NO_2 calculator (version 3.2) available on the Defra website. A total environmental concentration is then produced by addition of the adjusted road contribution to the background concentration. Further detail on the verification and adjustment process is provided in Appendix A.

For the future year predictions, a further adjustment step is then undertaken, to account for the observed trends in ambient roadside NO_x and NO_2.

In July 2011 Defra published a report[5] examining the long term air quality trends in NO_x and NO_2 concentrations. This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter, NO_2 concentrations have stabilised with little to no reduction between 2004 and 2010. Defra's report presents a similar pattern for the change in NO_x concentrations over the same time period. The consequence of the conclusions of Defra's advice on long term trends is that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, which are built into the vehicles emission factors, the projected background maps and the NO_x to NO_2 calculator.

The Highways Agency (HA) has developed the LTT Gap Analysis methodology[6] to adjust model predictions based on the method in LAQM TG(09) to account for the long term NO_x and NO_2 profiles. This uses the relationship between the base year vehicle emission rates and the future year vehicle emission rates, and the measured trends in roadside NO_2 concentrations to uplift future year predicted concentrations to align them better with the long term trends of NO_x and NO_2.

---

[4] Defra, Local Air Quality Management Technical Guidance LAQM TG(09), 2009

[5] Defra, Trends in NO_x and NO_2 emissions and ambient measurements in the UK, July 2011

[6] HA, Interim Advice Note Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 Air Quality

INTERIM

The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. New vehicles will need to comply with the more stringent Euro VI emissions standards from September 2014 onwards. Vehicles complying with the Euro VI emissions standard are not yet on the road network, and therefore the performance of these vehicles is not present in the long term air quality monitoring trends. If the Euro VI fleet emissions perform as predicted, then this should lead to substantial reductions in predicted future roadside air quality concentrations.

However, because the likely impacts of Euro VI vehicles on air quality are yet to be fully understood, the HA's advice is that a long term trend based on the existing fleet is assumed to be linear and continue at this projected rate of decrease into the future. Given the relatively low penetration of Euro VI into the fleet prior to 2018 and their contribution to total emission rates, it is deemed that the LTT methodology could be considered reliable up to this point. Beyond 2018, the LTT projections are expected to be conservative as the fleet penetration of Euro VI increases, and as more information becomes available the LTT projections will be reviewed and the HA's Interim Advice Note updated accordingly.

When forming a judgement on the significance of the impacts, both the projections based on LAQM TG(09) and those based on the LTT method should be provided. A justification statement, setting out the reasons for selecting the results, should be used to inform the judgement on significance. After 2015, actual future year concentrations would be expected to fall somewhere between the calculated results for the two methods.

For this project, the 2018 scenario is only shortly after the start of Euro VI uptake and it is likely that the roadside NO_x and NO_2 concentrations will be influenced more by the existing trends in emissions from the pre-Euro VI vehicles, which will still form the majority of the fleet, than the Euro VI vehicles. A precautionary approach is applied here, where the LTT method representing long term trends provides the predicted NO_2 concentrations in 2018, and thus the basis for judgements.

Predictions for future year of 2026 using the LTT projection method maybe overly conservative, and the predictions for NO_2 using the LAQM TG(09) method (which may be overly optimistic) are also used in the final assessment to provide context for the uncertainty in model predictions.

3.8 Impact Significance

When judging the significance of the impacts, both the projections based on LAQM TG(09) and the projections based on the LTT method should be provided. To be able to draw comparisons between the effects of different schemes it is necessary to use a consistent approach to describe the impacts. Environmental Protection UK (EPUK) has recommended an approach to defining the magnitude of changes and describing the air quality impacts at specific receptors[7]. These criteria are defined as a percentage of the assessment level with magnitudes set at 1%, 5% and 10%.of the assessment level. The resulting concentration change levels for NO_2 are set out in Table 3-A.

[7] Environmental Protection UK (2010), Development Control: Planning for Air Quality (Update)

INTERIM

Magnitude of change	NO_2 Concentration
Large	Increase/decrease > 4µg/m^3
Medium	Increase/decrease 2 - 4µg/m^3
Small	Increase/decrease 0.4 - 2µg/m^3
Imperceptible	Increase/decrease < 0.4µg/m^3

Table 3-A: Definition of impact magnitude

When describing an air quality impact at a specific receptor, the absolute concentration should be taken into account, in combination with the magnitude of change, using the approach set out in Table 3-B. These descriptors can then be used to evaluate the overall significance of a development.

Absolute Concentration in Relation to Objective/Limit value	Change in concentration		
	Small	Medium	Large
Increase with Scheme			
Above objective/Limit value *With* Scheme (>40 µg/m^3)	Slight adverse	Moderate adverse	Substantial adverse
Just below Objective/Limit Value *With* Scheme (36 – 40 µg/m^3)	Slight adverse	Moderate adverse	Moderate adverse
Below Objective/Limit Value *With* Scheme (30 – 36 µg/m^3)	Negligible	Slight adverse	Slight adverse
Well Below Objective/Limit Value *With* Scheme (<30 µg/m^3)	Negligible	Negligible	Slight adverse
Decrease with Scheme			
Above objective/Limit value *Without* Scheme (>40 µg/m^3)	Slight beneficial	Moderate beneficial	Substantial beneficial
Just below Objective/Limit Value *Without* Scheme (36 – 40 µg/m^3)	Slight beneficial	Moderate beneficial	Moderate beneficial
Below Objective/Limit Value *Without* Scheme (30 – 36 µg/m^3)	Negligible	Slight beneficial	Slight beneficial
Well Below Objective/Limit Value *Without* Scheme (<30 µg/m^3)	Negligible	Negligible	Slight beneficial

Table 3-B: Air quality impact descriptors for changes to annual mean NO_2 concentrations at receptors

4 Baseline Conditions

4.1 Local Air Quality Monitoring Data

Air quality monitoring is undertaken by UDC in Saffron Walden, and data from 2007-2011 is summarised in Table 4-A and Table 4-B, and the monitoring locations are shown in Figure 6-C. Exceedences of the annual mean AQSs are shown in bold. The number of exceedences of the NO_2 1 hour standard are shown in brackets.

Ref	x	y	Pollutant	2008	2009	2010	2011
Saffron Walden CM *	553823	238408	NO_x	no data	no data	no data	35.4
			NO_2	27.7 (2)	24.7 (0)	30.1 (13)	22.3 (0)

Table 4-A: Continuous Analyser Monitoring Data (2008-2011 Annual Mean) (µg/m^3)

Ref	x	y	2007	2008	2009	2010	2011
Walden 1 – PO High Street *	553710	238415	37.1	**42.9**	**40.0**	**47.2**	36.6
Walden 3 – Gibson Gardens **	553552	238219	16.0	17.9	18.0	20.3	14.1
Walden 4 – YHA *	553594	238599	36.2	**45.2**	**44.0**	**48.6**	38.4
Walden 5 – Thaxted Road *	554332	238450	**42.9**	**53.4**	**50.0**	**57.7**	**43.1**
Walden 11 – 33 High Street *	553697	238452	34.6	37.1	37.0	**41.5**	30.7
Walden 12 - Town Hall **	553878	238509	27.6	25.0	22.0	25.4	18.2
Walden 16 – London Road *	553751	238086	-	**47.7**	**43.0**	**50.0**	**40.7**
Walden 17 – Debden Road *	553770	238076	-	-	-	32.8	23.0
Walden 18 – Friends School	553875	237763	-	-	-	37.0	25.3

**** Used in ADMS model verification***

***** Used in Defra background map verification***

Table 4-B: NO_2 Diffusion Tube Monitoring Data (2007-2011 Annual Mean) (µg/m^3)

There are two locations where the NO_2 annual mean AQS is exceeded in 2011, but since 2007 five sites have recorded exceedences in at least one year. Concentrations recorded at the continuous analyser are well within the air quality standard for NO_2.

The trend in measured NO_2 concentrations in Saffron Walden indicates that there has been no significant reduction in concentration between 2007 and 2011. This is consistent with the conclusions of the Defra report on long term trends in NO_2.

4.2 Background Concentrations

Annual mean concentrations at 1x1 km grid squares covering the study area were obtained to provide background concentrations for the relevant receptors to be modelled. These are presented in TTable 4-C.

1x1 km Grid Square	2011		2018		2026	
	NO_x	NO_2	NO_x	NO_2	NO_x	NO_2
553500, 237500	19.2	11.2	14.2	8.6	11.8	7.3
553500, 238500	19.0	11.0	14.2	8.5	11.9	7.2
554500, 238500	21.9	12.6	16.2	9.7	13.9	8.4

Table 4-C: Sector Removed Background Concentrations across the Study Area (µg/m^3)

4.3 AQMAs

UDC has declared a large area within Saffron Walden as an Air Quality Management Area (AQMA) because of poor air quality resulting from high levels of NO_2 at particular road junctions. Due to exceedences of the NO_2 annual mean concentration recorded in 2010, a revised AQMA replaced the three original AQMAs. The four junctions included in this assessment all lie within the revised AQMA boundary. The location of the AQMA boundary is shown in Figure 6-B.

UDC's AQAP[8] has identified a number of actions which are anticipated to improve air quality in the town and work towards achieving the national air quality standards. The mitigation measures included in this assessment are all put in place between 2018 and 2026.

4.4 Base Model Results

The results of the base model for 2011 are presented in Table 4-D, with modelled concentrations shown in Figure 6-D. The modelled results for the base year do not need to have adjustment to account for long term trends applied because there is no projection of modelled results to a future year.

Junction	Max. NO_2 Concentration
J1: B184 Thaxted Road / East Street / B1053 Radwinter Road / Chaters Hill	**55.2**
J2: B1052 London Road / Debden Road	**41.3**
J3: B1052 High Street / B184 George Street / Abbey Lane / Hill Street	**54.8**
J4: B184 Bridge Street / Castle Street / Myddylton Place	36.4

Table 4-D: Base 2011 – Maximum Modelled NO_2 Concentrations at each Junction (µg/m^3)

The modelled results show that exceedence of the NO_2 annual mean AQS of 40 µg/m^3 is predicted to occur at three of the modelled junctions in 2011. None of the receptors are predicted to exceed the equivalent NO_2 1 hour mean AQS of 60 µg/m^3 (expressed as an annual mean equivalent concentration).

[8] UDC, Air Quality Action Plan 2009 - Saffron Walden Air Quality Management Areas, 2009

INTERIM

5 Future Year Scenario Results

5.1 2018 Scenario

The results of the 2018 “do minimum” and “full scheme” scenarios are presented in Table 5-A with modelled concentrations shown in Figure 6-E - Figure 6-H. Both the LAQM TG(09) and the LTT methodology results are presented in the figures and the results table.

Junction	Do minimum		Full scheme	
	LAQM TG(09)	LTT	LAQM TG(09)	LTT
J1: B184 Thaxted Road / East Street / B1053 Radwinter Road / Chaters Hill	**41.4**	**56.3**	37.4	**50.9**
J2: B1052 London Road / Debden Road	31.7	**44.2**	31.5	**43.9**
J3: B1052 High Street / B184 George Street / Abbey Lane / Hill Street	**46.8**	***66.3***	**47.1**	***66.7***
J4: B184 Bridge Street / Castle Street / Myddylton Place	25.6	37.3	25.4	37.0

Table 5-A: 2018 Scenario – Maximum Modelled NO_2 Concentrations at each Junction ($\mu g/m^3$)

The modelled results for the “do minimum“ scenario show that exceedence of the NO_2 annual mean AQS of 40 $\mu g/m^3$ is predicted to occur at three of the modelled junctions in 2018 based on the LTT methodology. Concentrations at one or more receptors at one of the junctions is predicted to exceed the NO_2 1 hour mean AQS of 60 $\mu g/m^3$ (expressed as an annual mean equivalent concentration).

The modelled “do minimum” results for the LAQM TG(09) methodology show two junctions with a receptor in exceedence of the NO_2 annual mean AQS of 40 $\mu g/m^3$. None of the receptors are predicted to exceed the NO_2 1 hour mean AQS of 60 $\mu g/m^3$ (as an annual mean equivalent concentration).

The modelled results for the “full scheme“ scenario show that exceedence of the NO_2 annual mean AQS of 40 $\mu g/m^3$ is predicted to occur at three of the modelled junctions in 2018 based on the LTT methodology, and one of the junctions are predicted to exceed the NO_2 1 hour mean AQS of 60 $\mu g/m^3$ (as an annual mean equivalent concentration).

The modelled results for the LAQM TG(09) methodology show only one junction with a receptor in exceedence of the NO_2 annual mean AQS of 40 $\mu g/m^3$, and none of the receptors are predicted to exceed the NO_2 1 hour mean AQS of 60 $\mu g/m^3$ (as an annual mean equivalent concentration).

The 2018 “Do-minimum” scenario does not contain any mitigation measures at the modelled junctions, but does include increases in traffic due to committed developments. There are exceedences of the air quality standard for both the LAQM TG(09) and LTT projection methods. The “Full scheme” includes Policy developments 2 and 3 and also improvements included as part of the AQAP, and these appear to reduce the peak concentrations seen at three of the four junctions using both assessment methodologies.

INTERIM

The 2018 scenario is only shortly after the start of Euro VI uptake and it is likely that the roadside NO_2 concentrations will be influenced more by the existing trends in emissions from the pre-Euro VI vehicles, which will still form the majority of the fleet, than the Euro VI vehicles. Therefore, the results from the LTT projection methodology would be considered more representative than those using the LAQM TG(09) projection method.

5.2 2018 Scenario – Impact Significance

The future predictions of modelled pollutant concentrations at each receptor were assessed for the 2018 scenario using the EPUK impact significance methodology described in Section 3.8. In brief, the significance is assessed against the difference between the "Full scheme" and the "Do minimum" scenarios, expressed as various percentages of the AQS.

Table 5-B shows the variation in the significance of impacts at each of the 140 receptor locations at which air concentrations are predicted in this assessment. Figure 6-I and Figure 6-J show the geographic distribution of the significance rating at each receptor.

Impact	LAQM TG(09)					LTT				
	J1	J2	J3	J4	**Total**	J1	J2	J3	J4	**Total**
Substantial Adverse	0	0	0	0	0	0	0	4	0	4
Moderate Adverse	0	0	1	0	1	0	0	1	0	1
Slight Adverse	0	0	11	0	11	0	0	19	0	19
Negligible	17	32	40	35	124	11	32	21	35	99
Slight Beneficial	1	0	2	0	3	3	0	6	0	9
Moderate Beneficial	1	0	0	0	1	3	0	2	0	5
Substantial Beneficial	0	0	0	0	0	2	0	1	0	3

Table 5-B: Impact significance for 2018 scenario (results show number of receptors in each category)

When using the LAQM TG(09) projection methodology the majority of the indicated impacts are "Negligible". Eleven "slight adverse" and one "moderate adverse" impacts are predicted at Junction 3. Three "Slight beneficial" and one "moderate beneficial" impacts are predicted between Junction 1 and Junction 3.

There is greater variation in the indicated range of impacts when using the LTT methodology. "Substantial Adverse" impacts are predicted at four of the receptors, all of which are associated with Junction 3. In addition, there are one "moderate adverse" and nineteen "slight adverse" impacts indicated for receptors associated with Junction 3. One "substantial beneficial", two "moderate beneficial" and six "slight beneficial" impacts are predicted for receptors at Junction 3. "Slight", "moderate" and "substantial" benefits are predicted at Junction 1.

INTERIM

5.3 2026 Scenario

The results of the 2026 "do minimum" and "full scheme" scenario are presented in Table 5-C with modelled concentrations shown in Figure 6-K - Figure 6-N. Both the projections based on the LAQM TG(09) and the LTT methodologies are presented in the results table.

Junction	Do minimum		Full scheme	
	LAQM TG(09)	LTT	LAQM TG(09)	LTT
J1: B184 Thaxted Road / East Street / B1053 Radwinter Road / Chaters Hill	27.1	**53.4**	16.2	31.9
J2: B1052 London Road / Debden Road	21.6	**44.2**	21.9	**44.8**
J3: B1052 High Street / B184 George Street / Abbey Lane / Hill Street	28.2	***63.6***	32.7	***69.1***
J4: B184 Bridge Street / Castle Street / Myddylton Place	16.3	35.0	17.8	38.2

Table 5-C: 2026 Scenario – Maximum Modelled NO_2 Concentrations at each Junction (µg/m^3)

The modelled results for the "do minimum" scenario show that exceedence of the NO_2 annual mean AQS of 40 µg/m^3 is predicted to occur at three of the modelled junctions in 2026 based on the LTT projection methodology. Concentrations at one of the junctions is predicted to exceed the NO_2 1 hour mean standard as annual mean concentrations were above 60 µg/m^3.

The modelled "do minimum" results for the LAQM TG(09) projection methodology show no junctions with a receptor in exceedence of the NO_2 annual mean AQS of 40 µg/m^3.

The modelled results for the "full scheme" scenario show that exceedence of the NO_2 annual mean AQS of 40 µg/m^3 is predicted to occur at two of the modelled junctions in 2026 based on the LTT projection methodology. Concentrations at receptors at one of the junctions are predicted to exceed 60 µg/m^3 suggesting that there could also be exceedences of the 1-hour standard.

The modelled "full scheme" scenario results for the LAQM TG(09) projection methodology show no junctions with a receptor in exceedence of the NO_2 annual mean AQS of 40 µg/m^3.

The modelled 2026 "full scheme" scenario contains mitigation measures and resulting changes to traffic queue lengths compared to the "do minimum" scenario". The number of hours experiencing queues is reduced between the 2018 and 2026 scenarios at the B1052 London Road / Debden Road junction and B184 Thaxted Road / B1053 Radwinter Road junction, despite increases in traffic due to new developments. The mitigation measures at the B1052 High Street / B184 George Street junction do not decrease queuing when comparing the 2018 and 2026 traffic data, but this may be because the influence of traffic growth between 2018 and 2026 outweighs the improvements to flow through the junction due to mitigation.

There are large differences between the predicted concentrations using the LAQM TG(09) and LTT projection methods in 2026 which reflects the uncertainty associated with predicting air quality many years in to the future. There are exceedences predicted at two of the four junctions when using the LTT projection

INTERIM

method, whilst none of the junctions show exceedences when using the LAQM TG(09) method. If a conservative approach is taken and the LTT results are used then the developments may have adverse impacts on air quality with exceedences of the NO_2 annual mean AQS at the B1052 High Street / B184 George Street junction. If the LAQM TG(09) results are used then there are no properties in exceedence in 2026.

5.4 2026 Scenario – Impact Significance

The future predictions of modelled pollutant concentrations at each receptor were assessed for the 2026 scenario using the EPUK impact significance methodology described in Section 3.8.

Table 5-D shows the variation in the significance of impacts at each of the 140 receptor locations at which air concentrations are predicted in this assessment. Figure 6-O - Figure 6-P show the geographic distribution of these significance tests amongst junctions and receptors.

Impact	LAQM TG(09)					LTT				
	J1	J2	J3	J4	**Total**	J1	J2	J3	J4	**Total**
Substantial Adverse	0	0	0	0	**0**	0	1	14	0	**15**
Moderate Adverse	0	0	0	0	**0**	0	9	12	3	**24**
Slight Adverse	0	0	4	0	**4**	0	11	4	3	**18**
Negligible	5	32	50	35	**122**	0	11	15	29	**55**
Slight Beneficial	14	0	0	0	**14**	19	0	6	0	**25**
Moderate Beneficial	0	0	0	0	**0**	0	0	2	0	**2**
Substantial Beneficial	0	0	0	0	**0**	0	0	1	0	**1**

Table 5-D: Impact significance for 2026 scenario (results show number of receptors in each category)

When using the LAQM TG(09) projection methodology the majority of the indicated impacts are “Negligible”, with some “Slight Beneficial” impacts indicated at Junction 1 and some “Slight Adverse” impacts indicated at Junction 3.

There is substantial variation in the indicated range of impacts when using the LTT methodology. “Substantial Adverse” impacts are predicted at 15 of the receptors, the majority of which are associated with Junction 3. In addition, a “Substantial Beneficial” impact is indicated for a receptor associated with Junction 3 as well as several “Slight” or “Moderate Beneficial” impacts. Impacts at 19 receptors associated with Junction 1 are indicated as “Slight Beneficial”. No beneficial impacts are indicated at Junctions 2 and 4 using the LTT methodology.

INTERIM

6 Summary and Conclusions

A summary of the concentration results from each of the assessment scenarios is provided in Table 6-A.

	Base 2011	2018 "Do minimum" Scenario		2018 "Full scheme" Scenario		2026 "Do minimum" Scenario		2026 "Full scheme" Scenario	
	LAQM TG(09)	LAQM TG(09)	LTT	LAQM TG(09)	LTT	LAQM TG(09)	LTT	LAQM TG(09)	LTT
No. Properties with NO_2 Exceedences	30	11	41	10	39	0	42	0	38
Junctions with Properties in Exceedence of NO_2 Annual Mean AQSs									
J1: B184 Thaxted Road / East Street / B1053 Radwinter Road / Chaters Hill	YES	YES	YES	NO	YES	NO	YES	NO	NO
J2: B1052 London Road / Debden Road	YES	NO	YES	NO	YES	NO	YES	NO	YES
J3: B1052 High Street / B184 George Street / Abbey Lane / Hill Street	YES	YES	YES	YES	YES	NO	YES	NO	YES
J4: B184 Bridge Street / Castle Street / Myddylton Place	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 6-A: Summary of Modelled NO_2 Results at each Junction (µg/m^3)

The prediction of NO_2 concentrations beyond 2018 is subject to considerable uncertainty due to the difference between the model outputs using the Defra emissions data and tools which underpin the LAQM TG(09) methodology, and the long term trends in NO_2 which are utilised in the LTT methodology. The rate of growth in traffic flows predicted in the traffic data used for this assessment is greater than the rate of reduction shown in monitoring trends in NO_2. Due to this, modelled NO_2 concentrations using the LTT methodology increase into the future and therefore the number of properties predicted to be in exceedence of NO_2 AQSs also increases.

The 2018 "Do-minimum" scenario does not contain any mitigation measures at the modelled junctions, and only contains increases in traffic due to national traffic growth and committed developments. There are exceedences of the annual average NO_2 air quality standard in both the LAQM TG(09) and LTT methods. The "Full scheme" includes the policy developments and improvements included as part of the AQAP, and these appear to reduce the peak concentrations seen at three of the four junctions using both assessment methodologies.

The 2026 "Full scheme" scenario does contain mitigation measures with traffic queue lengths and periods being reduced between the 2018 and 2026 scenarios at two junctions despite increases in traffic.

There are significant differences between the predicted concentrations from the LAQM TG(09) and LTT projection methods in 2026, with exceedences predicted at three junctions for the "Do-minimum" scenario and at two junctions for the "Full scheme" when using the LTT methods, and none of the junctions when using the LAQM TG(09) method. This reflects the uncertainty associated with predicting air quality many years in to the future.

A summary of the significance assessment based upon the EPUK methodology is shown in Table 6-B.

	2018 LAQM TG(09)	2018 LTT	2026 LAQM TG(09)	2026 LTT
Substantial Adverse	0	4	0	15
Moderate Adverse	1	1	0	24
Slight Adverse	11	19	4	18
Negligible	124	99	122	55
Slight Beneficial	3	9	14	25
Moderate Beneficial	1	5	0	2
Substantial Beneficial	0	3	0	1

Table 6-B: Summary of Impact significance for all scenarios

Using the LAQM TG(09) methodology it can be seen there are no Substantial adverse impacts, with the assessment showing a balance of moderate and slight Beneficial and Adverse effects when comparing the "Do minimum" with the "Full" schemes in 2018 and 2026. From Table 5-B and Table 5-D it can be seen these are associated mainly with the B1052 High Street / B184 George Street junction.

For the LTT methodology, it can be seen that the higher predicted NO_2 concentrations are also expressed as increased numbers of receptor with significant impacts. Four substantial adverse impacts are seen when comparing the 2018 scenarios and 15 substantial adverse impacts are seen comparing the 2026 scenarios. From Table 5-B and Table 5-D it can again be seen that the majority of these substantial adverse impacts are associated with the B1052 High Street / B184 George Street junction but some impacts are also seen at the B1052 London Road mini-roundabout junction with Debden Road. From Table 5-D it can be seen that there are a number of beneficial impacts seen at receptors associated with these junctions as well.

The assessment of Substantial adverse impacts within an existing AQMA suggests that further work on mitigation measures is required, especially for the B1052 High Street / B184 George Street junction. Figure 6-J and Figure 6-P show that the majority of the adverse impacts associated with Junction 3 appear to be to the north of the Junction.

Whilst it may appear counter-intuitive that in a comparison of a "Full scheme" scenario which includes junction improvements with a "Do-minimum" scenario without these improvements that the Full scheme has higher impacts, this can be explained by comparison of the traffic data for the two scenarios. For the three major approaches to the B1052 High Street / B184 George Street junction (from N, E and S) it can be seen that the 2-way AADT flow on each link is ~20% higher in the "Full" scheme than in the "Do-minimum" scheme in 2026. In 2018, the flows for the two scenarios are broadly comparable. For 2026, this may be as a result of improvements at other junctions resulting in higher traffic flows at this junction and may bear further analysis.

INTERIM

It should be noted that ECC do not expect the change to location of the High Street north approach stop line, which is included as a mitigation measure in the modelled scenario, to be implemented by 2026. Therefore the results for High Street North in the “Full scheme” do not include this measure.

INTERIM

JACOBS

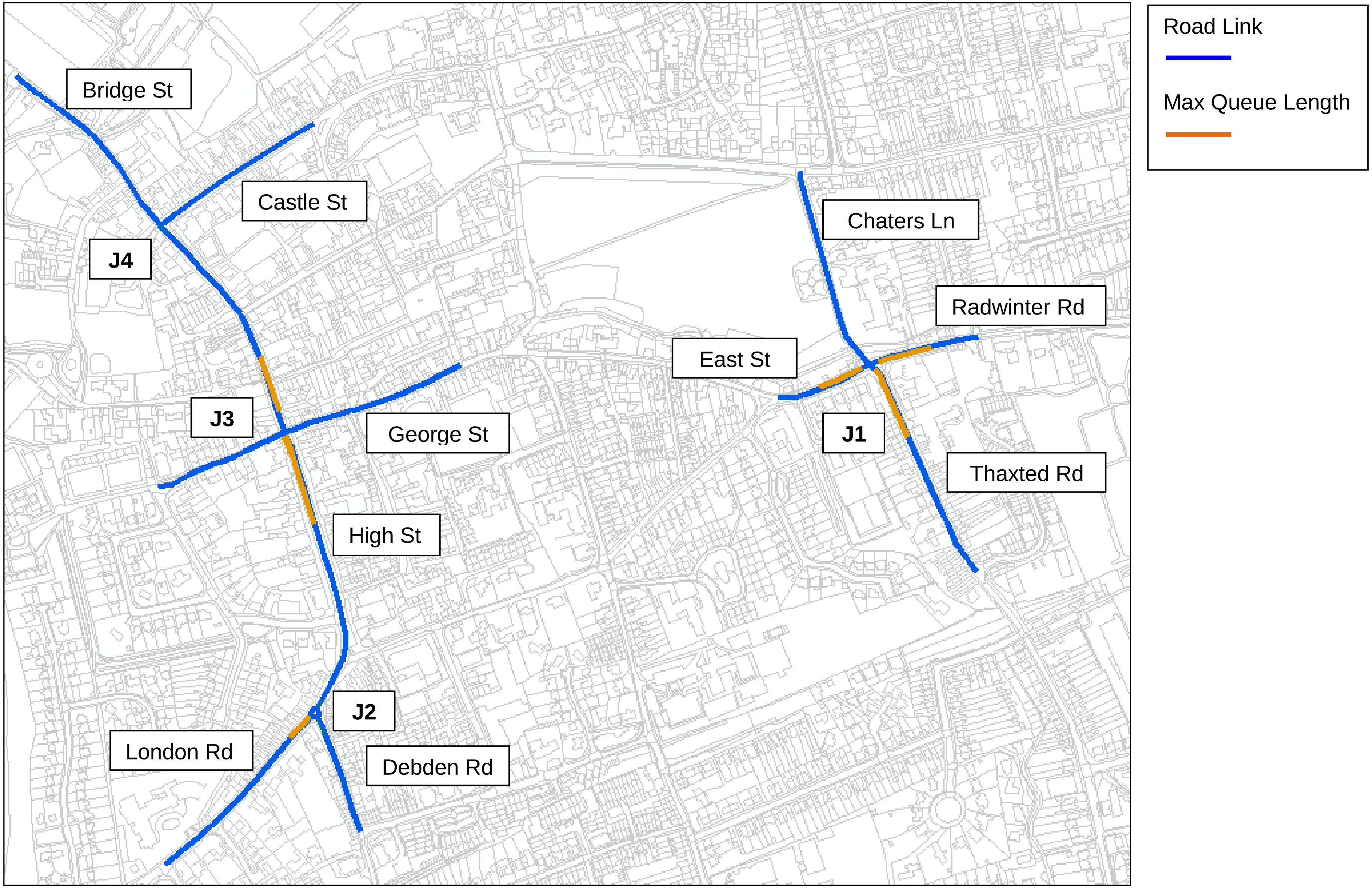


Figure 6-A: Modelled Road Links and the Maximum Queue Lengths – Base 2011

JACOBS

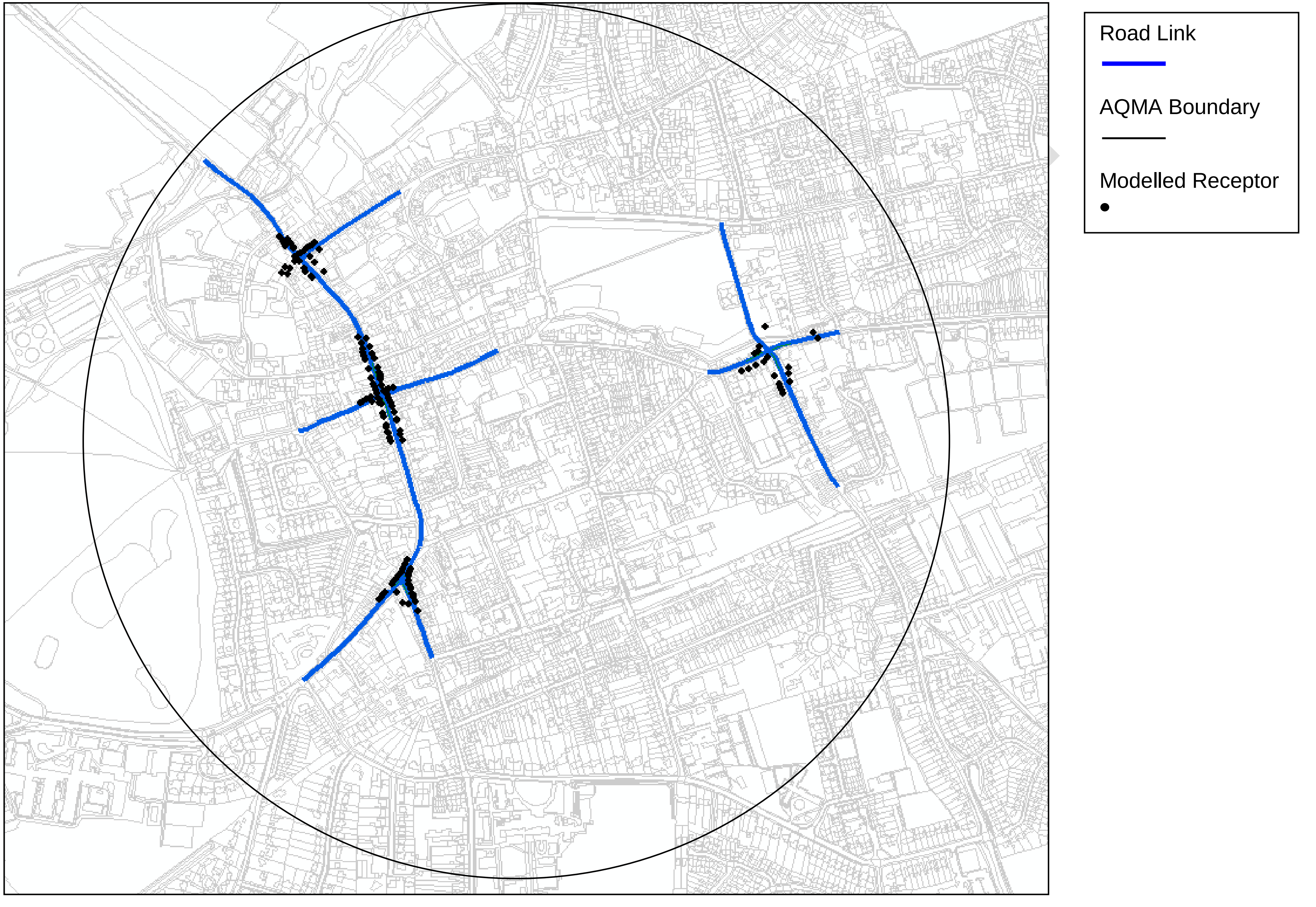


Figure 6-B: Modelled Receptors and AQMA Boundary

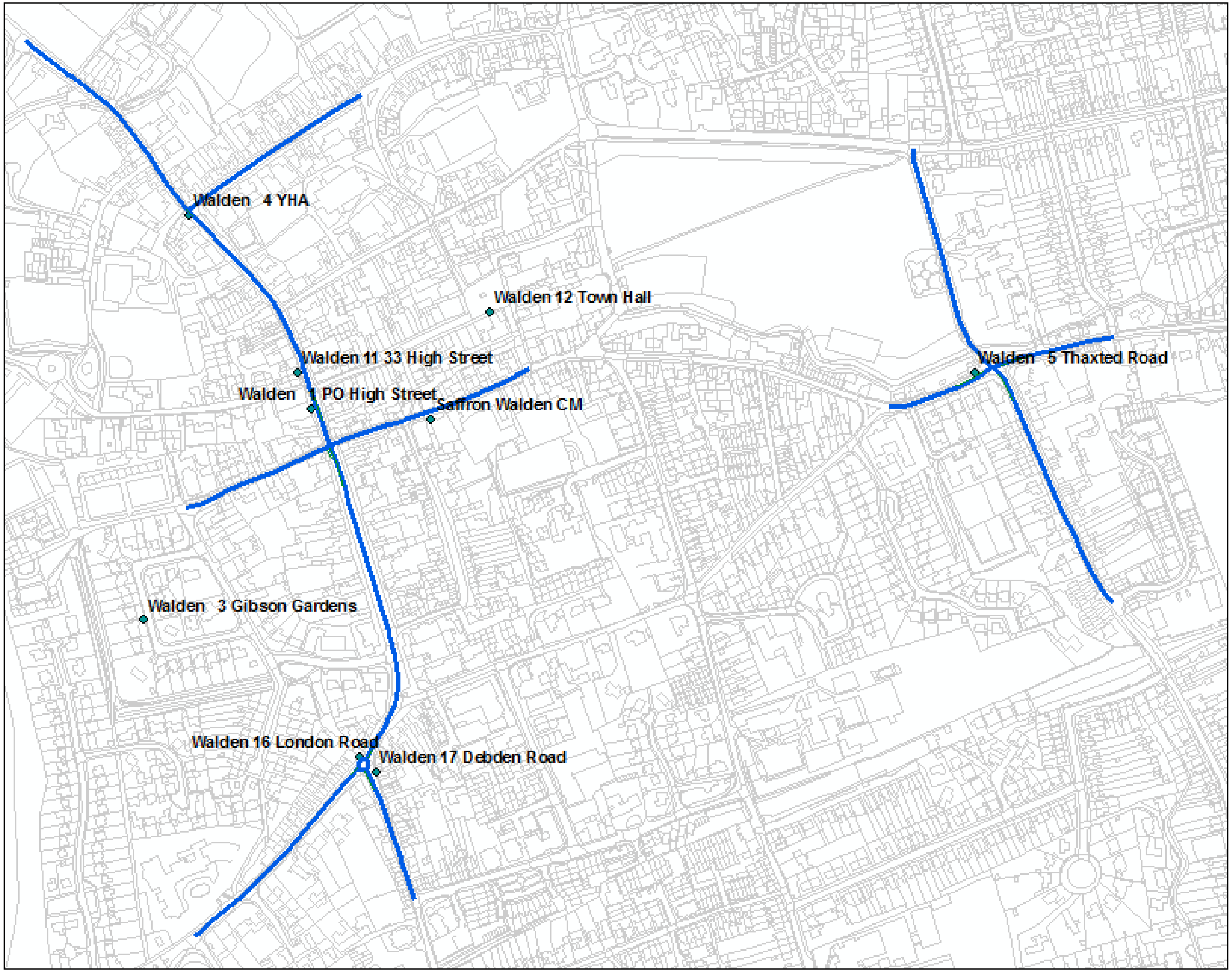


Figure 6-C: Monitoring Locations

NO_2 Concentration Range ($\mu g/m^3$)
10 to <20
20 to <30
30 to <40
40 to <50
50 to <60
60 to <70
70 to <80

Figure 6-D: Base 2011 – Modelled Annual Mean NO_2 Concentrations

Figure 6-E: 2018 Do Minimum Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LAQM TG09 Methodology)

NO₂ Concentration Range (µg/m³)	
	10 to <20
	20 to <30
	30 to <40
	40 to <50
	50 to <60
	60 to <70
	70 to <80

Figure 6-F: 2018 Do Minimum Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LTT Methodology)

Figure 6-G: 2018 Full Scheme Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LAQM TG09 Methodology)

JACOBS

NO2 Concentration Range (µg/m3)	
	10 to <20
	20 to <30
	30 to <40
	40 to <50
	50 to <60
	60 to <70
	70 to <80

Figure 6-H: 2018 Full Scheme Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LTT Methodology)

JACOBS

Figure 6-I: 2018 Impact Significance Scenario (based on the LAQM TG09 Methodology)

Figure 6-J: 2018 Impact Significance Scenario (based on the LTT Methodology)

Figure 6-K: 2026 Do Minimum Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LAQM TG09 Methodology)

NO_2 Concentration Range ($\mu g/m^3$)	
(dark green)	10 to <20
(light green)	20 to <30
(yellow)	30 to <40
(orange)	40 to <50
(pink)	50 to <60
(red)	60 to <70
(purple)	70 to <80

Figure 6-L: 2026 Do Minimum Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LTT Methodology)

NO₂ Concentration Range (µg/m³)	
(dark green)	10 to <20
(light green)	20 to <30
(yellow)	30 to <40
(orange)	40 to <50
(pink)	50 to <60
(red)	60 to <70
(purple)	70 to <80

Figure 6-M: 2026 Full Scheme Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LAQM TG09 Methodology)

Figure 6-N: 2026 Full Scheme Scenario – Modelled Annual Mean NO_2 Concentrations (based on the LTT Methodology)

Figure 6-O: 2026 Impact Significance Scenario (based on the LAQM TG09 Methodology)

Figure 6-P: 2026 Impact Significance Scenario (based on the LTT Methodology)

Appendix A

Introduction

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- Estimates of background pollutant concentrations;
- Meteorological data uncertainties;
- Traffic data uncertainties;
- Model input parameters, such as 'roughness length'; and
- Overall limitations of the dispersion model.

Model Precision

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period.

Model Performance

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG(09) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess uncertainty. The statistical parameters used in this assessment are:

- Root mean square error (RMSE);
- Fractional bias (FB); and
- Correlation coefficient (CC).

A brief for explanation of each statistic is provided in Table 6-C, and further details can be found in LAQM TG(09) Box A3.7.

INTERIM

Statistical Parameter	Comments	Ideal value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the standard being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 AQS of 40 µg/m^3, if an RMSE of 10 µg/m^3 or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the AQS would be derived, which equates to 4 µg/m^3 for the annual mean NO_2 AQS.	0.01
FB	FB is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.0
CC	CC is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.0
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the standard being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 AQS of 40 µg/m^3, if an RMSE of 10 µg/m^3 or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the AQS would be derived, which equates to 4 µg/m^3 for the annual mean NO_2 AQS.	0.01

Table 6-C: Description of Model Performance Statistics

These parameters estimate how the model results agree or diverge from the observations.

These calculations have been carried out prior to, and after adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results.

INTERIM

Alternatively, the model may perform poorly against the monitoring data, in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented by the air quality modelling process. Where all input data, such as traffic data, emissions rates and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to improve alignment with the monitoring data. This adjustment may be either using by a single verification adjustment factor to be applied to the modelled concentrations across the study area or a range of different adjustment factors to account for different situations in the study area.

Verification Methodology

The verification method followed the process detailed in LAQM TG(09). An initial comparison of the modelled versus monitored results indicated that model tended to under-predict against the monitored concentrations. Additionally, there was a high degree of uncertainty or scatter in the model predictions. Model verification adjustment therefore focussed on reducing the under-prediction and uncertainty associated with the modelled results.

The first stage of verification was undertaken by comparing the modelled versus monitored Road NO_x. Concentrations of "Road NO_x" measured by the diffusion tubes were calculated using the latest Defra NO_x to NO_2 calculator, because diffusion tubes only measure NO_2 and do not directly measure NO_x.

Once the modelled Road NO_x component had been adjusted, this value was used in the Defra NO_x to NO_2 calculator, and the calculated Road NO_2 component was adjusted following comparison with the monitored Road NO_2.

Verification Summary

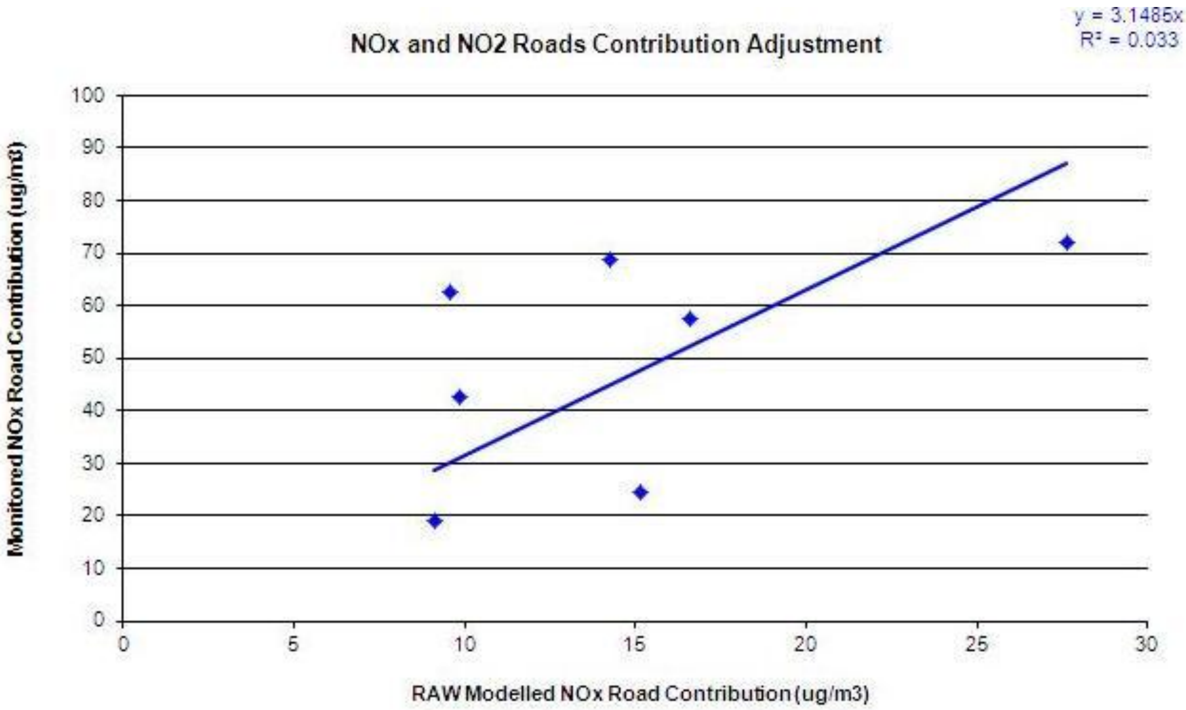
The summary results and model performance statistics defined in LAQM TG(09) are provided in Table 6-D. The statistics support the methodology adopted. The statistics show that the RMSE and FB are improved when the model adjustment process is applied to the raw model results.

Parameter	No adjustment	With adjustment
No. of monitoring sites	7	7
NO_x road adjustment factor	-	3.149
NO_2 road adjustment factor	-	1.022
RMSE	16.5	7.6
FB	0.6	0.0
CC	0.53	0.53
No. sites within +/- 10%	0	1
No. sites within +/- 25%	1	5
No. sites outside +/- 25%	6	2

Table 6-D: Model Performance Statistics

Regression analysis for the NOx road adjustment factor is shown below.

INTERIM

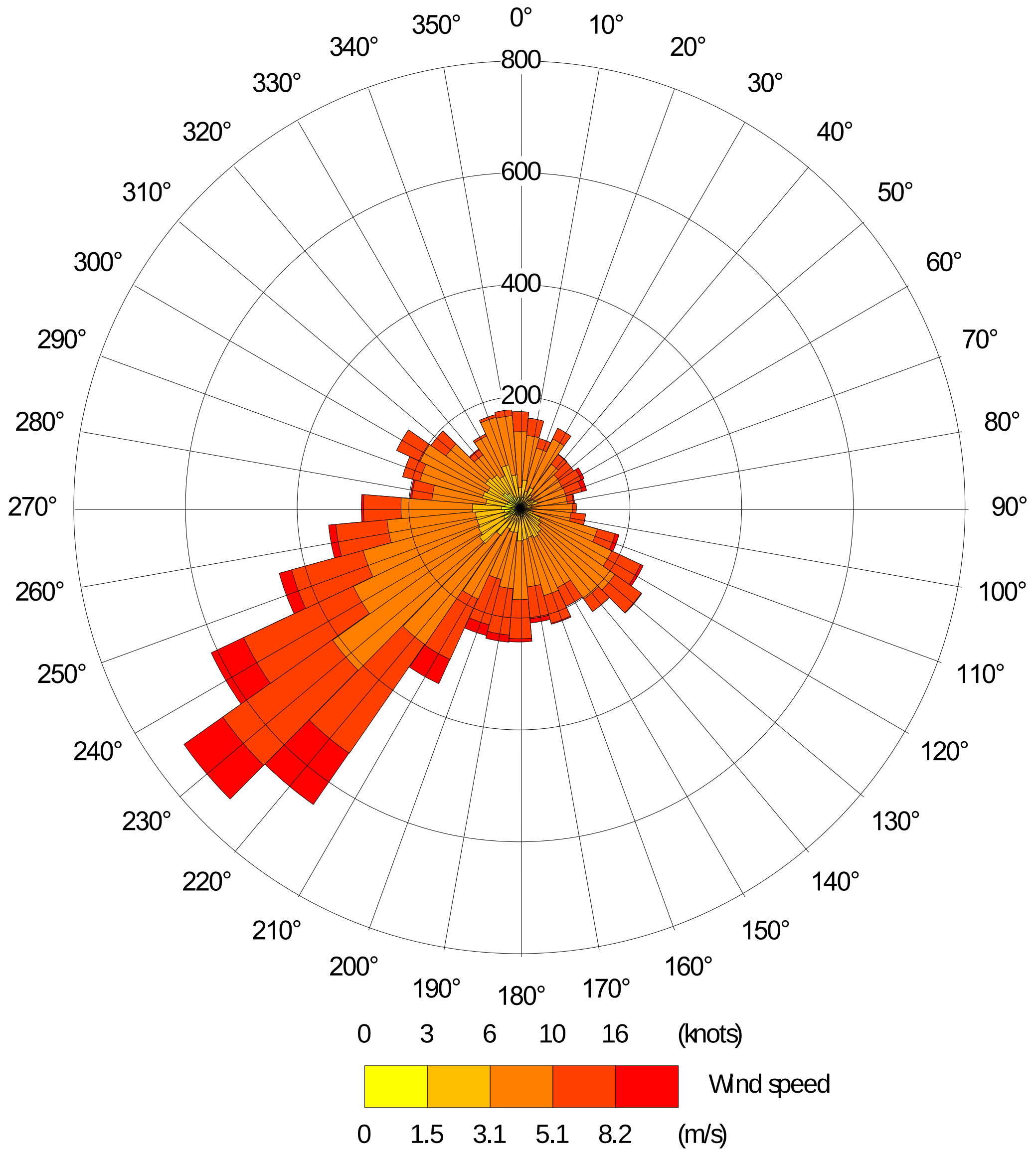


y = 3.1485x
R² = 0.033
NOx and NO2 Roads Contribution Adjustment
Monitored NOx Road Contribution (ug/m3)
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
RAW Modelled NOx Road Contribution (ug/m3)

INTERIM

Appendix B Meteorological Data

The meteorological data from Stansted Airport for 2011 is presented as a windrose below.



Appendix C Traffic Data

PROVIDED SEPARATELY

INTERIM