Trafford Council

Air Quality Study for Davyhulme

Report for Trafford Council

Ricardo-AEA/R/ED59334
Issue Number 4
Date 18/08/2015

Customer:	Contact:
Trafford Council	Mark Broomfield Ricardo-AEA Ltd Gemini Building, Harwell, Didcot, OX11 0QR t: 01235 75 3493 e: mark.broomfield@ricardo-aea.com Ricardo-AEA is certificated to ISO9001 and ISO14001
Customer reference:	
ED59334	
Confidentiality, copyright & reproduction:	
This report is the Copyright of Ricardo-AEA Ltd and has been prepared by Ricardo-AEA Ltd under contract to Trafford Council dated 05/02/2014. The contents of this report may not be reproduced in whole or in part, nor passed to any organisation or person without the specific prior written permission of the Commercial Manager, Ricardo-AEA Ltd. Ricardo-AEA Ltd accepts no liability whatsoever to any third party for any loss or damage arising from any interpretation or use of the information contained in this report, or reliance on any views expressed therein.	**Author:** Tim Bevington **Approved By:** Dr Mark Broomfield **Date:** 18 August 2015 **Ricardo-AEA reference:** Ref: ED59334- Issue Number 4

Executive summary

Nitrogen dioxide levels are a key air quality issue for Trafford Council, and for the Greater Manchester area as a whole. Trafford Council has declared an Air Quality Management Area (AQMA) which covers the vicinity of the M60 through Davyhulme, on the basis of elevated levels of nitrogen dioxide. The Greater Manchester authorities are working together to improve air quality throughout the city region, although there is limited scope for the local authorities to influence traffic emissions, particularly in the vicinity of trunk roads and motorways.

It is important for the Council to be able to rely on robust data to avoid significant impacts on air quality, particularly in areas where levels of nitrogen dioxide are already close to or above the air quality objective. The aims of this study are as follows:

- To provide up-to-date and detailed local baseline levels of nitrogen dioxide.
- To provide forecast local baseline levels of nitrogen dioxide on the assumption that planned and proposed new development goes ahead.
- To provide an indication of the additional nitrogen dioxide levels which can be expected to result from planned and proposed new development

The overall approach taken to this assessment was as follows:

- Gather information on the existing sources of emission to air in the local area
- Collect information on existing, proposed or planned developments
- Collect and analyse traffic data
- Gather air quality monitoring data and background concentration data
- Construct an emissions model of the study area for 2012 and 2016
- Model the ambient concentrations of nitrogen dioxide for 2012 and 2016
- Produce contour plots of the modelled nitrogen dioxide concentrations supported by numerical predicted concentrations at specific relevant receptors within the study area
- Provide an interpretation of the modelled nitrogen dioxide concentrations

The study area covers the North of the borough of Trafford centred on the residential area of Davyhulme. The M60 motorway runs through the area approximately north to south. In the east of the study area is Trafford Park and the Trafford Centre retail park. The rest of the study area to the west consists predominately of the residential areas of Davyhulme and Urmston.

The modelled concentrations for 2012 indicate that levels of nitrogen dioxide were above the air quality objective at locations close to the M60 motorway. In 2016, the model results indicate that there would continue to be exceedances of the air quality objective at locations close to the M60. The model indicates that nitrogen dioxide concentrations will be higher in 2016 than in 2012 at the selected receptor locations. There is an increase in the area around the M60 and nearby major roads where levels of nitrogen dioxide are forecast to be above the objective in 2016 compared to 2012. However, the modelled levels in 2012 and 2016 are lower than the levels forecast in 2005 when the AQMA was declared.

There is a pattern of increased road NO_x contribution, and reduced point source NO_x contribution, between 2012 and 2016. This pattern is reproduced at all sites that are predicted to exceed NO_2 air quality annual mean objectives. The increase in traffic emissions is forecast to outweigh a reduction in the contribution to NO_2 concentrations from industrial point sources in the area.

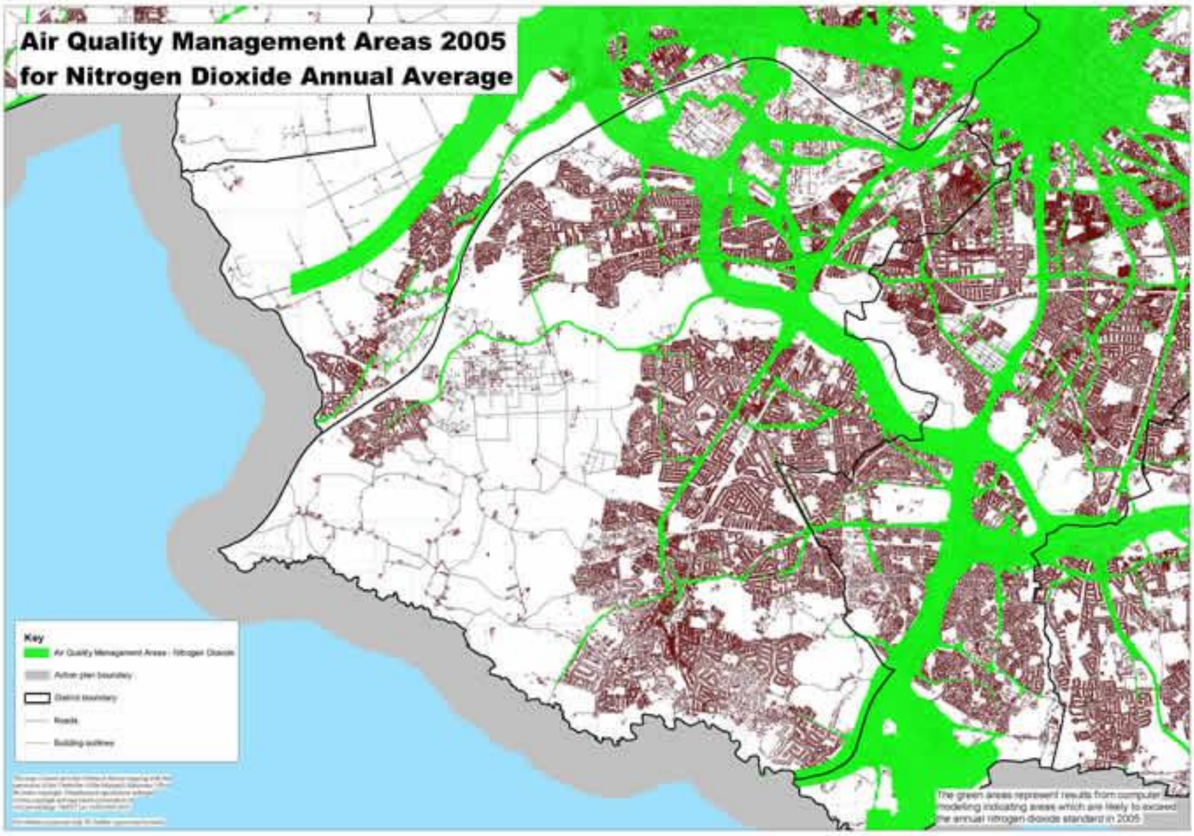
Table of contents

1 Introduction

1.1 Background

Nitrogen dioxide levels are a key air quality issue for Trafford Council, and for the Greater Manchester area as a whole. As shown in Figure 1, Trafford Council has declared an air quality management area which covers the vicinity of the M60 through Davyhulme on the basis of elevated levels of nitrogen dioxide.

Figure 1 Trafford AQMA declared in 2005



The Greater Manchester authorities are working together to improve air quality throughout the city. However, there is limited scope for the local authorities to influence traffic emissions, particularly in the vicinity of trunk roads and motorways. For example, a Low Emission Zone would not be an appropriate means of improving air quality in the Davyhulme area, where traffic using the M60 is the primary source of nitrogen dioxide.

Trafford Council has received and determined planning applications for a number of new developments in this area which will result in emissions to air of oxides of nitrogen. These include the Nexen coal bed methane plant; biogas engines at Davyhulme Sewage Works, the proposed Barton Renewable Energy plant, and gas-fired power stations in Carrington.

Further relevant developments include residential and commercial developments, such as the Trafford Waters development. It is important for the Council to be able to rely on robust data in addressing planning applications to ensure that their cumulative impact is properly taken into account, and to avoid significant impacts on air quality, particularly in areas where levels of nitrogen dioxide are already close to or above the air quality objective.

The Greater Manchester combined authorities are currently undertaking a Detailed Assessment of air quality across the Greater Manchester area, with the aim of updating the evidence base on levels of nitrogen dioxide and particulate matter. This combined assessment will support the evaluation and further development of air quality action plans.

1.2 Study Aims

Ricardo-AEA has recently provided support to Trafford in relation to the Barton Renewable Energy plant, the Nexen coal bed methane plant and the gas-fired power stations in Carrington. During the course of dealing with these applications, it became apparent that a study of air quality in the Davyhulme area would be very useful for Trafford Council. This report sets out the findings of the analysis of air quality in Davyhulme.

The aims of this study are as follows:

- To provide up-to-date and detailed local baseline levels of nitrogen dioxide.
- To provide forecast local baseline levels of nitrogen dioxide on the assumption that planned and proposed new development goes ahead.
- To provide an indication of the additional nitrogen dioxide levels which can be expected to result from planned and proposed new development, identifying any areas where the contribution(s) to baseline levels of airborne pollutants could result in exceedances of the air quality objective at new locations, or could significantly increase levels of nitrogen dioxide in areas where the standard is already forecast to be exceeded.

1.3 Policy Background

The Environment Act 1995 placed a responsibility on the UK Government to prepare an Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland. The most recent version of the strategy (2007) sets out the current UK framework for air quality management and includes a number of air quality objectives for specific pollutants.

The 1995 Act also requires that Local Authorities “Review and Assess” air quality in their areas following a prescribed timetable. The Review and Assessment process is intended to locate and spatially define areas where the AQS objectives are at risk of not being met. In such instances the Local Authority is required to declare an Air Quality Management Area (AQMA), carry out a Further Assessment of Air Quality, and develop an Air Quality Action Plan (AQAP) which should include measures to improve air quality so that the objectives may be achieved in the future. The timetables and methodologies for carrying out Review and Assessment studies are set out in Defra’s Technical Guidance LAQM.TG(09).[1]

Table 1 lists the objectives relevant to this assessment that are included in the Air Quality Standards Regulations 2010 (SI 2010 No 1001) for the purposes of Local Air Quality Management (LAQM).

Table 1: Air quality objectives for nitrogen dioxide

Pollutant	Air Quality Objective	
	Concentration	Measured as
Nitrogen dioxide	200 $\mu g.m^{-3}$ not to be exceeded more than 18 times a year	1 hour mean
	40 $\mu g.m^{-3}$	annual mean

[1] Defra, “Local Air Quality Management: Technical Guidance LAQM.TG(09),” February 2009

1.4 Locations where the Air Quality Objectives apply

Studies such as this normally focus on areas where the public are likely to be regularly present and are likely be exposed over the averaging period of the objective. Although this report is not for Review and Assessment purposes, the same objectives are used as environmental quality standards. Table 2 summarises examples of where air quality objectives for NO_2 should and should not apply.[1]

Table 2: Examples of where the NO_2 Air Quality Objectives should and should not apply

Examples of where the Air Quality Objectives should/should not apply		
Averaging Period	**Objectives *should* apply at …**	**Objectives should *not* generally apply at …**
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1 hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks and railway stations etc. which are not fully enclosed. Any outdoor locations to which the public might reasonably be expected to have access.	Kerbside sites where the public would not be expected to have regular access.

1.5 Overview of Approach Taken

The overall approach taken to this assessment was as follows:

- Gather information on the existing sources of emission to air in the local area based on the Greater Manchester Emissions Inventory EMIGMA[2]
- Collect information on existing, proposed or planned developments from data submitted to Trafford Council as part of the planning process
- Collect and analyse all available traffic data with a preference to use the road network as modelled for the current Detailed Assessment of Greater Manchester
- Gather air quality monitoring data and background concentration data
- Construct an oxides of nitrogen emissions model of the study area using national emissions factors, existing industrial point sources and traffic activity data that is validated against local monitoring data
- Construct an oxides of nitrogen emissions model based on modelled traffic data for 2016 and the existing and proposed industrial sources in the study area
- Model the dispersion and atmospheric conversion of oxides of nitrogen, and the resulting ambient concentrations of nitrogen dioxide for 2012 and 2016

[2] http://www.greatairmanchester.org.uk/whatarewedoing/emigma.aspx

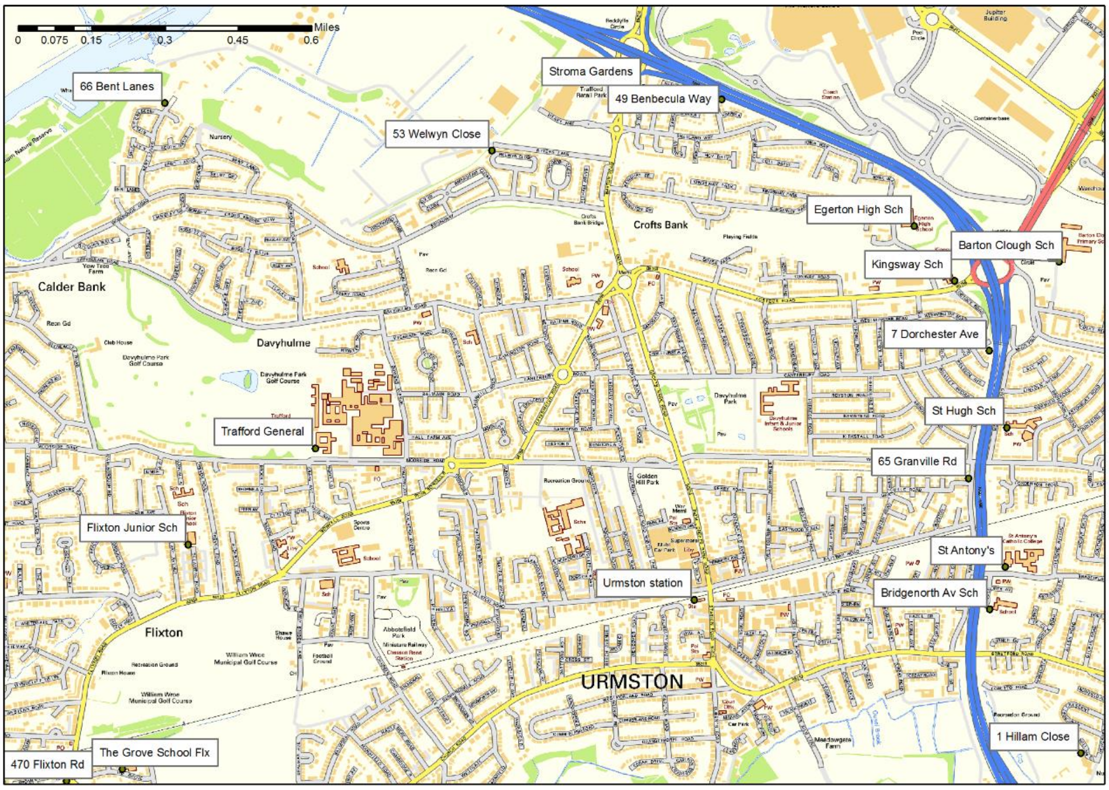
- Produce contour plots of the modelled nitrogen dioxide concentrations supported by numerical predicted concentrations at specific relevant receptors within the study area
- Provide an interpretation of the modelled nitrogen dioxide concentrations

2 Location context

2.1 Study Area

The study area covers the North of the borough of Trafford centred on the residential area of Davyhulme, as shown in Figure 2.

Figure 2 Study area and selected receptor locations



The M60 motorway runs through the area approximately north to south. The M60 is an orbital route that encompasses Greater Manchester with annual average weekday traffic flows over 200,000 and is often congested at peak times. In the east of the study area is Trafford Park and the Trafford Centre shopping and leisure complex. The rest of the study area to the west consists predominately of the residential areas of Davyhulme and Urmston.

2.2 Review and Assessment

2.2.1 Trafford Council Detailed Assessment

The declaration of the AQMA by Trafford Council was supported by a Detailed Assessment report[3]. This highlighted the area within which nitrogen dioxide levels could potentially exceed the air quality standard. These areas were focused around the major road links in the borough.

A new Detailed Assessment is currently in progress for the whole of Greater Manchester. This report will re-assess the current boundaries of the existing AQMA based on new dispersion modelling and monitoring results.

[3] 2004 Detailed Assessment (ARIC, 2004b) http://www.trafford.gov.uk/residents/environment/pollution/air-quality/air-quality.aspx

2.2.2 Air quality management area

Following the completion of the Detailed Assessment, the Trafford Air Quality Management Area (AQMA) was extended in 2005 to the extent shown in Figure 1. The AQMA covers a significant part of the north of the Borough, and includes parts of Trafford Park, Stretford, central Altrincham and Sale and the areas around the major road networks including the M60 motorway and A56.

2.2.3 2013/14 Air Quality Progress Report for Greater Manchester

A draft Progress Report on air quality in Greater Manchester was issued in 2014.[4] This study drew the following conclusions:

> "*Long term trends show that there has been an improvement in air quality but areas still remain above the air quality objective for the annual mean nitrogen dioxide. The assessment of monitoring data shows that real time monitoring data for the nitrogen dioxide annual mean objective broadly confirms the existing AQMA boundaries. Exceedences were noted at several roadside monitoring sites. Measurements from Greater Manchester's diffusion tube network confirms there are locations that continue to be above the annual mean nitrogen dioxide. There are no exceedences of the hourly nitrogen dioxide objective. Real time monitoring data for particulate matter (less than 10 microns) shows that annual average objectives are not exceeded and are following a downward trend. No sites had more than 35 occurrences of the daily mean particulate objective and therefore this objective is met.*"

This report confirms that the key air quality issue in Trafford and throughout Greater Manchester is annual mean nitrogen dioxide levels.

[4] Greater Manchester Authorities (2014), draft Air Quality Progress Report 2013/14

3 Information used to support this assessment

3.1 Maps

Trafford Council provided the road centreline data to accompany the traffic data provided by Transport for Greater Manchester (TfGM; see Section 3.3). All maps in this document are reproduced using Ordinance Survey Street View Opendata (© Crown copyright and database right 2014).

3.2 Meteorological Data

Hourly sequential meteorological data (wind speed, direction etc.) for 2012 Manchester Airport meteorological measurement site was used for the modelling assessment. The meteorological measurement site is located approximately 12 km to the south east of the study area and has good data quality for the period of interest.

3.3 Road traffic data

3.3.1 Transport for Greater Manchester traffic model data

The traffic data used to compile the model was derived from data provided by Transport for Greater Manchester (TfGM). Two sets of traffic data were provided: 2011 traffic flows (used for the development of the 2012 baseline) and 2016 (used for the future projection component of the study).

The traffic model data was derived from the highway networks and travel demand matrices used during the 2010 and 2016 (2016 road data) updates of the Emissions Inventory for Greater Manchester (EMIGMA). This traffic data was preferred over other sources as it forms the basis of the Greater Manchester Detailed Assessment, 2015.

The data from each year was mapped using GIS to a road network provided by TfGM.

The traffic data file included the following information, which was included in the dispersion model:

- Modelled road width (m)
- Total Car flow
- Percentage Car flow
- Total LGV flow
- Percentage LGV flow
- Total Rigid HGV flow
- Percentage Rigid HGV flow
- Total Articulated HGV flow
- Percentage Articulated HGV flow

- Total Bus flow
- Percentage Bus flow
- Total Vehicle flow
- Flow-weighted network speed (kph, including junction delays)

3.3.2 TEMPRO factor

Trip End Model Presentation Program (TEMPRO)[5] and the National Trip End Model (NTEM) forecasts are used for transport planning purposes. The TEMPRO model can produce simple traffic growth factors alongside various other forecast and analysis factors.

To project the 2011 traffic model data received from TfGM to the model base year of 2012 a local TEMPRO growth factor of 1.00755 was applied across all road sections.

3.3.3 Emissions factors

The most recent version of the Emissions Factors Toolkit[6] (EfT V4.2) was used in this assessment and the factors derived were used in the ADMS-Roads Extra 3.1 model. Parameters such as traffic volume, speed and fleet composition are entered into the EfT, and an emissions factor in grams/kilometre/second of NO_x or PM_{10} is generated for input into the dispersion model.

For the purposes of this study the most advanced options available in the EfT were utilised. At the most basic level the tool can calculate emissions based only on study year, traffic flow, speed and % heavy vehicles. The next level of complexity involves characterising the proportion of different vehicle types and using UK assumptions on the Euro classification within each class.

The next level of complexity involves characterising the proportion of different vehicle types and using UK assumptions on the Euro classification within each class. This study used the Euro classification provided by TfGM that accompanied their traffic models for both 2011 and 2016 that characterised cars, commercial and bus fleets. This enabled the use of the most advanced method available within the EfT and adds a higher degree of local specificity to the study and should improve the robustness of the results- particularly in terms of source apportionment.

The version of the EfT used incorporates the latest emission factors published in 2009 by Department for Transport. The assessment is carried out on the basis that the emissions factors contained in the EfT are accurate and representative of the Trafford fleet.

3.4 Point source data

3.4.1 EMIGMA

EMIGMA is the Greater Manchester Emissions Inventory. The inventory database contains information on the emissions of pollutants identified in the UK's AIR Quality Strategy from all identifiable sources in Greater Manchester. All stationary point sources within the study area where sufficient information was contained in EMIGMA, were included in the model for both the baseline in 2012 and the projection to 2016.

Sources where there was insufficient information were not included in the study. These included:

- Haughton Vaughan Plc, Beacon Road (377300, 397500)

[5] https://www.gov.uk/government/collections/tempro
[6] http://laqm1.defra.gov.uk/documents/tools/EFT_Version_4_2.zip

- Thurroclean, Thompson Road (377002, 397400)

3.4.2 Air Quality Assessments

Trafford Council identified both recent and proposed developments within, and surrounding, the study area to include in the study. Trafford Council provided the most recent Air Quality assessment for each development to provide the required inputs for the study and to enable emissions from recent and proposed developments to be included.

As a result of this, emissions from 6 developments were included in the model study for 2012, as shown in Table 3. Emissions from 8 developments were included in the study for 2016, as shown in Table 4.

Trafford Power applied for planning permission to increase the capacity of the proposed power station. Therefore, to allow assessment of any change of impact between the two proposals the values from the amended air quality assessment were used in the model for 2016.

The study has taken a conservative approach by using the highest emission rates stated in air quality assessments when more than one is available.

Table 3: Emissions data for new developments used in the model for 2012

Site	Stack	X (m)	Y (m)	Height (m)	Diameter (m)	Velocity (m/s)	Temp (ºC)	Emission rate (g/s)
Nexen CBM	1	375785	396653	6.7	0.36	27.5	15	1.249
Tenax Rd Biomass	1	378752	397659	20	1	17.04	159.85	0.55
Davyhulme WWTW	1	375479	396535	21	0.706	14.3	215	1.35
	2	375476	396527	21	0.706	14.3	215	1.35
	3	375476	396528	21	0.706	14.3	215	1.01
	4	375476	396529	21	0.706	14.3	215	1.01
	Boiler	375476	396526	21	0.706	3.7	254	0.095
Tenmat	1	377700	397300	10	0.9	15	18.85	1
Carrington Power	1	372782	393486	75	7	17.3	86	31.7
	2	372840	393442	75	7	17.3	86	31.7
Trafford Power	OCGT Unit 1	372516	392973	75	12.41	25	95	105.37
	OCGT Unit 2	372564	392940	75	12.41	25	95	105.37
	BDL CCGT Unit 1	372850	393400	75	7.09	25	95	34.33
	BDL CCBT Unit 2	372900	393362	75	7.09	25	95	34.33

Table 4: Emissions data for new developments used in the model for 2016

Site	Stack	X (m)	Y (m)	Height (m)	Diameter (m)	Velocity (m/s)	Temp (ºC)	Emission rate (g/s)
Nexen CBM	1	375785	396653	6.7	0.36	27.5	15	1.249
Tenax Rd Biomass	1	378752	397659	20	1	17.04	159.85	0.55
Davyhulme WWTW	1	375479	396535	21	0.706	14.3	215	1.35
	2	375476	396527	21	0.706	14.3	215	1.35
	3	375476	396528	21	0.706	14.3	215	1.01
	4	375476	396529	21	0.706	14.3	215	1.01
	Boiler	375476	396526	21	0.706	3.7	254	0.095
Tenmat	1	377700	397300	10	0.9	15	18.85	1
Carrington Power	1	372782	393486	75	7	17.3	86	31.7
	2	372840	393442	75	7	17.3	86	31.7
Trafford Power	CCGT Comb	372638	393192	85	13.86	17.3	82	123
	OCGT Comb	372560	392969	40	6.85	40.9	436	29
Barton Renewable Plant	1	375290	396711	44.23	18	18	140	5.194
UK Power Reserve Ltd	1	372482	392207	12.6	0.5	39	418	0.47
	2	372482	392208	12.6	0.5	39	418	0.47
	3	372482	392209	12.6	0.5	39	418	0.47
	4	372482	392210	12.6	0.5	39	418	0.47
	5	372482	392211	12.6	0.5	39	418	0.47
	6	372482	392212	12.6	0.5	39	418	0.47
	7	372482	392213	12.6	0.5	39	418	0.47
	8	372482	392214	12.6	0.5	39	418	0.47

3.5 Study Limitations

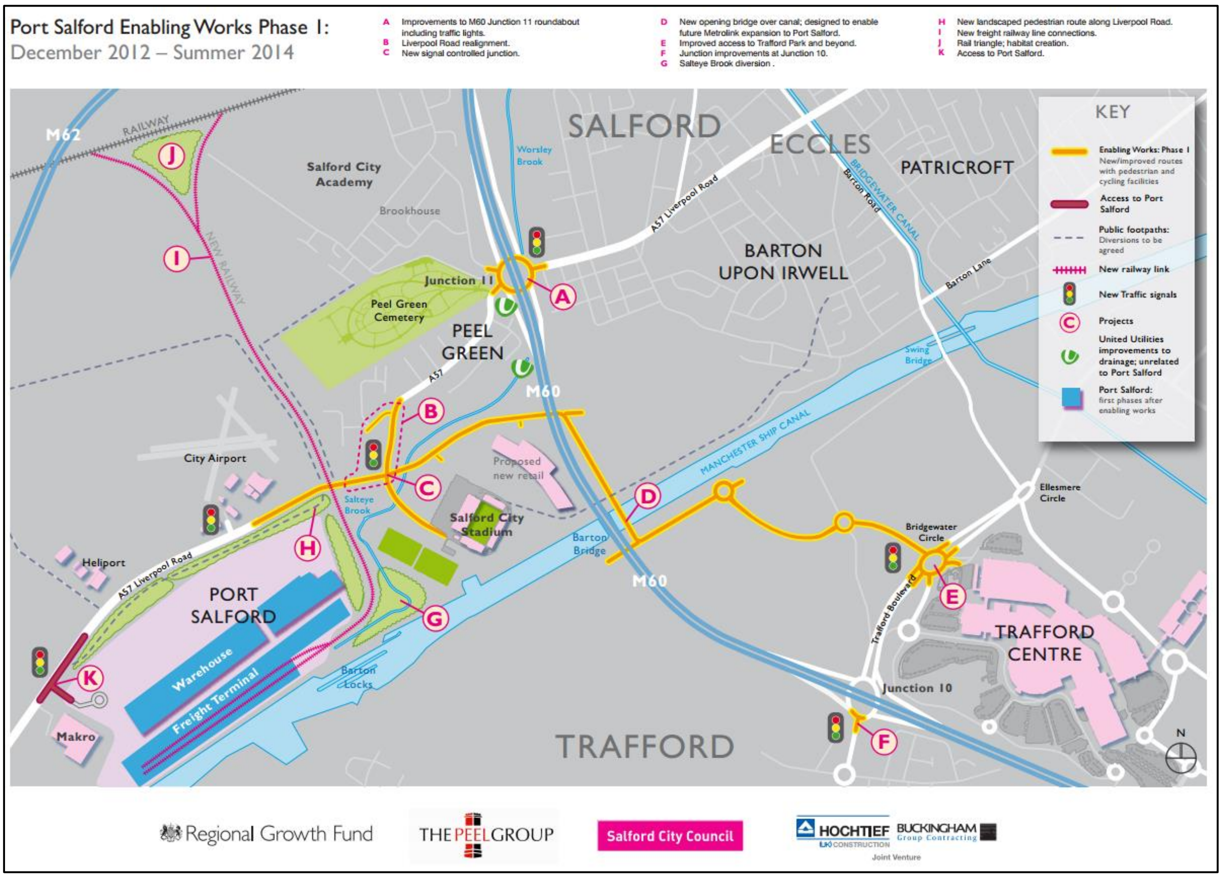
3.5.1 Trafford Waters Development

A significant new development is taking place in the Trafford Waters area in the north-east of the study area. As well as existing commercial, retail and entertainment development, this development includes substantial planned residential development. Following discussion with TfGM, traffic movements associated with the Trafford Waters development are not reflected in the 2016 traffic data provided by TfGM.

A new crossing over the Manchester Ship Canal is due to be constructed, as part of the enabling works for the Port Salford development on the north side of the Manchester Ship Canal.[7] As shown in Figure 3, this would potentially provide an alternative route for residents and visitors to the Trafford Waters area which would not require vehicles to travel via the M60 Junction 10.

[7] See http://www.peel.co.uk/media/Key%20Projects/A57_Road_Improvements_Scheme_Factsheet_Phase_1.pdf

Figure 3: Planned new bridge construction (Peel Group; Ref. 7)



3.5.2 North West Quadrant Study

A further limitation of this study is that the potential benefits of the North West Quadrant study were not taken into account. Any reduction in vehicle movements on the M60 and surrounding road network would tend to have a beneficial impact on air quality.

The Road Investment Strategy published by the Department for Transport in March 2015 sets out the terms for a study in to the North West Quadrant of the M60 between junctions 8 and 18. This Strategy document states: "*To prevent the M60 becoming a block on Manchester's growth, more transport capacity must be provided in the area. This study will look at the options for improving the transport network around the north-west quadrant. It will need to consider a range of different modal options, to make sure that the local road network and public transport options play their part. If major enhancements to the SRN [Strategic Road Network] are a part of the solution, they will also need to be considered*."

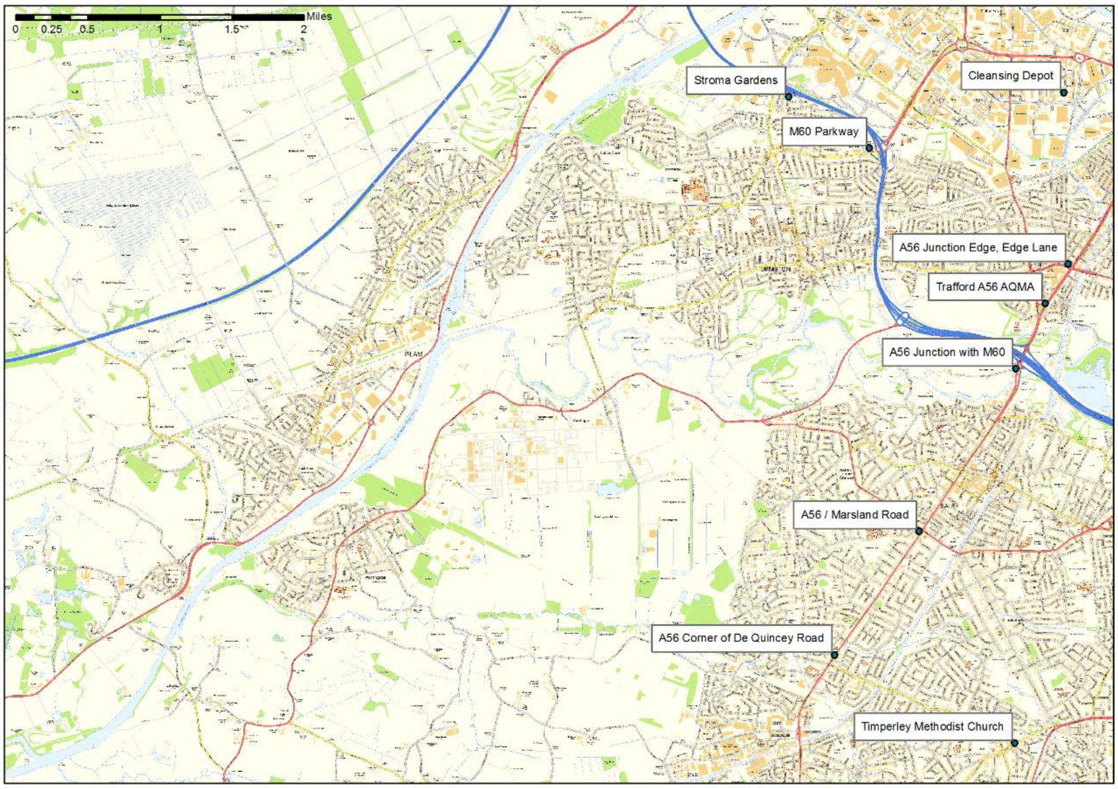
Future improvements to the transport network would potentially reduce the number of vehicles on the M60 and surrounding road network in the study area, and in particular Junctions 8 to 10.

4 Monitoring

This section describes the monitoring data used to support this modelling assessment. Full information on the monitoring campaigns, including QA/QC procedures is available in Trafford Council's air quality reports.

Trafford Council currently monitors nitrogen dioxide levels within the study area using automatic analysers at A56 and Moss Park, together with a widespread programme of monitoring using passive diffusion tubes. The monitoring data used in the assessment spans the period January 2010 to December 2012. A map of monitoring locations is provided in Figure 4.

Figure 4: Map of nitrogen dioxide monitoring locations



4.1 Automatic monitoring of nitrogen dioxide

Details of the automatic monitoring stations are provided in Table 5.

Table 5: Automatic monitoring stations

Site Code	Site Name	Type	X	Y	Data Capture (%) in 2012	Annual Mean NO_2 in 2012 ($\mu g\ m^{-3}$)
TRAF	Trafford (Moss Park)	Urban Background	378783	394726	87%	26
TRF2	Trafford A56	Roadside	379413	394014	99%	49

Both site achieved more than 75% data capture, and therefore there was no requirement to adjust the annual mean level to reflect seasonal variability.

More information on these automatic monitoring sites and those found in the rest of Greater Manchester can be found in the review and assessment progress report 2013/2014.[4]

4.2 Diffusion tubes

Diffusion tube monitoring can be affected by a range of factors and consequently nitrogen dioxide concentrations measured using diffusion tubes are adjusted by reference to results from tubes co-located with a continuous NO2 analyser.

Bias adjustment factors can be calculated based on duplicate or triplicate diffusion tubes co-located with a local monitoring site, or by using Defra's national database[8] of similar co-located sites that use the same laboratory and analysis method. There are no duplicate or triplicate diffusion tubes co-located with the two automatic monitoring sites within Trafford. Therefore the national bias adjustment factor database was used to calculate the factor used. This is the approach that was applied by the Greater Manchester Combined Authority (GMCA) for the 2012, 2013 and 2014 review and assessment progress reports. Details on how the bias adjustment factor was calculated, and a comparison with a local bias adjustment factor (calculated with the 6 co-location studies in Greater Manchester), can be found in the latest review and assessment report.[4]

For the diffusion tubes co-located with the two automatic monitoring sites the annual mean concentration from the automatic monitoring sites was used due to the lower margin of error in the results.

Details of the diffusion tubes in the study area are provided in Table 6.

Table 6: Diffusion tubes in the study area

Site Code	Site Name	Type	X	Y	Data Capture (%)	Annual Mean NO_2 ($\mu g\ m^{-3}$)[9]
19	Moss Park School	Urban Background	378783	394726	100	22.6
20	Trafford A56 AQMA	Roadside	379413	394014	100	36.2
21w	Cleansing Depot	Roadside	379619	396371	100	27.9
22w	A56 Corner of De Quincey Road	Kerbside	377061	390086	100	**40.4**
14	A56 Junction Edge, Edge Lane	Urban Centre	379669	394452	100	35.6
15	A56 Junction with M60	Urban Centre	379083	393283	100	35.1
16	M60 Parkway	Urban Centre	377447	395749	92	33.1
17	A56 / Marsland Road	Roadside	378004	391466	100	31.3
18	Timperley Methodist Church	Urban Background	379073	389099	100	21.3
23	Stroma Gardens	Urban Centre	376541	396321	92	**45.6**

[8] National Bias Adjustment Spreadsheet: http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html
[9] Bias Adjustment factor of 0.86 based on National Bias Adjustment Factor spreadsheet v06_14

4.3 Selection of baseline year

Normally, the most recent baseline monitoring data would be selected as the baseline year for the study. However, monitoring results from across England in 2013 indicate that concentration can be seen to be reduced compared to longer term trends. This is evident across most months but is particularly evident in December 2013.

An analysis of monitoring data in Trafford was carried out to verify whether the situation in Trafford reflected the observed pattern for England as a whole.

4.3.1 Openair analysis of monitoring data

Openair[1] is a tool that has been recently developed for interrogation of air quality data sets. The tool uses the statistical software "R" as a platform and provides a convenient method for assessing the relationship between parameters such as wind direction and speed and pollutant concentrations measured at an automatic monitoring station. The software also allows patterns and trends to be extracted from long time series of air pollution measurements.

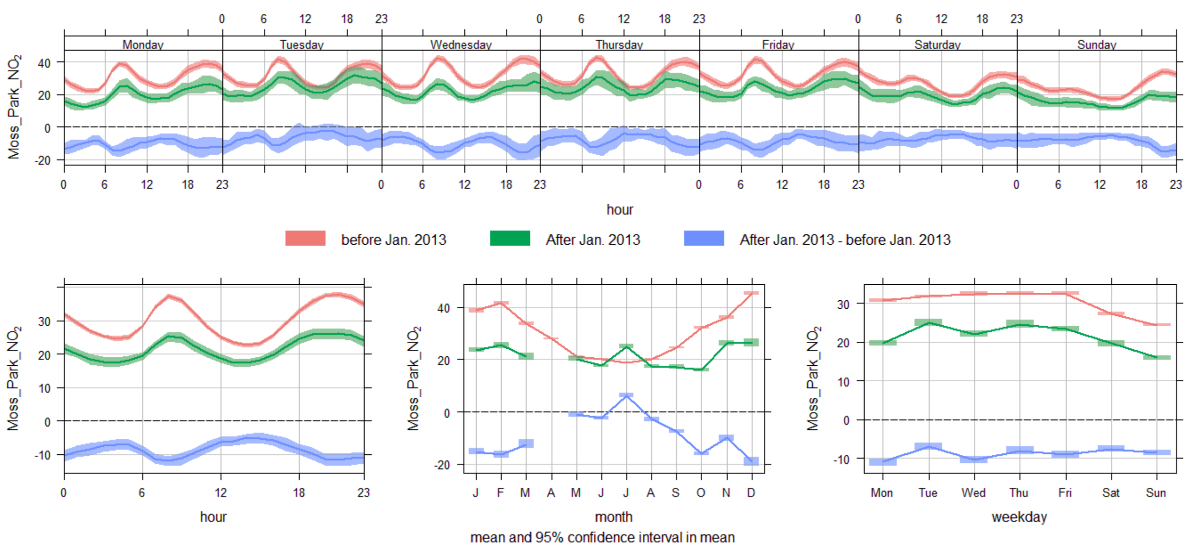
Openair was used to look at diurnal patterns and trends in the measurements, and specifically to establish if 2013 was an unusual year for air quality in Trafford and whether there are any discernible trends in the data since 2005.

Although the outputs of Openair are not utilised directly in the modelling process, they can provide useful information at the inception of a study when it is important to identify the key sources of impacts on local air quality. To support this study, an Openair analysis at both automatic monitoring stations in Trafford was carried out. Due to the lower data capture at the Trafford A56 site, data from the Salford M60 was also analysed. This site is located to the North of the study location, close to the M60 motorway. It was selected to be included in the analysis as it is a roadside site (as is Trafford A56), in a similar location to the diffusion tubes that measured the highest concentrations in the study area and it is also the closest automatic monitoring site to the study area.

4.3.2 Trafford Moss Park

A comparison of the measured concentrations at Trafford Moss Park School from 2005 to 2012 with concentrations from 2013 show that levels in 2013 were significantly below the long term trend.

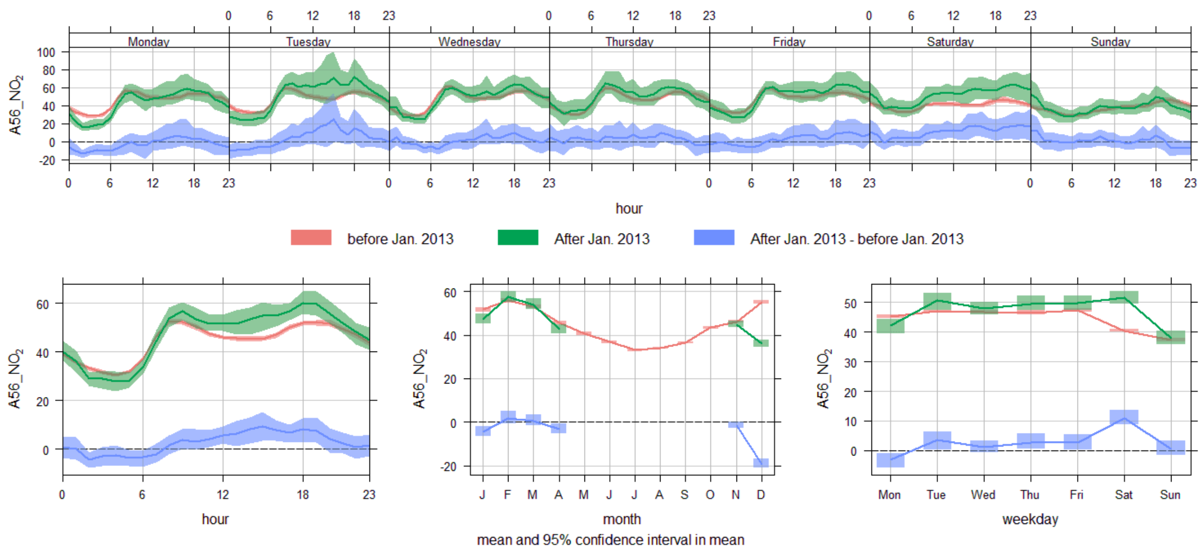
Figure 5: Measured concentrations at Trafford Moss Park



4.3.3 Trafford A56

The comparison with Trafford A56 is less evident than Trafford Moss Park due to the lower data capture during 2013. January to April follow the long term trend but there is a significant difference in the results from December compared to the longer term trend.

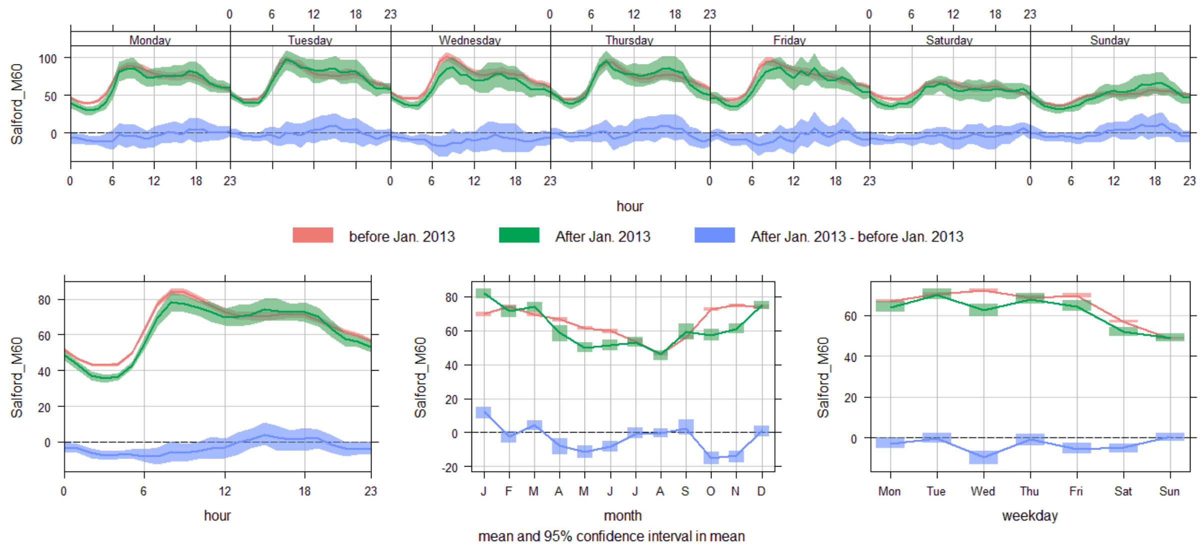
Figure 6: Measured concentrations at Trafford A56



4.3.4 Salford M60

As discussed, Salford M60 has also been included in the analysis due to the poor data capture at Trafford A56 during 2013. At this site, concentrations were significantly lower than the long term average during April to June and October to November 2013.

Figure 7: Measured concentrations at Salford M60



4.3.5 Summary

Based on this analysis results from 2013 are not considered to be representative of the long term trend. As this model compares results from the baseline to 2016 a conservative approach is adapted using monitoring results from 2012 for validation of the model.

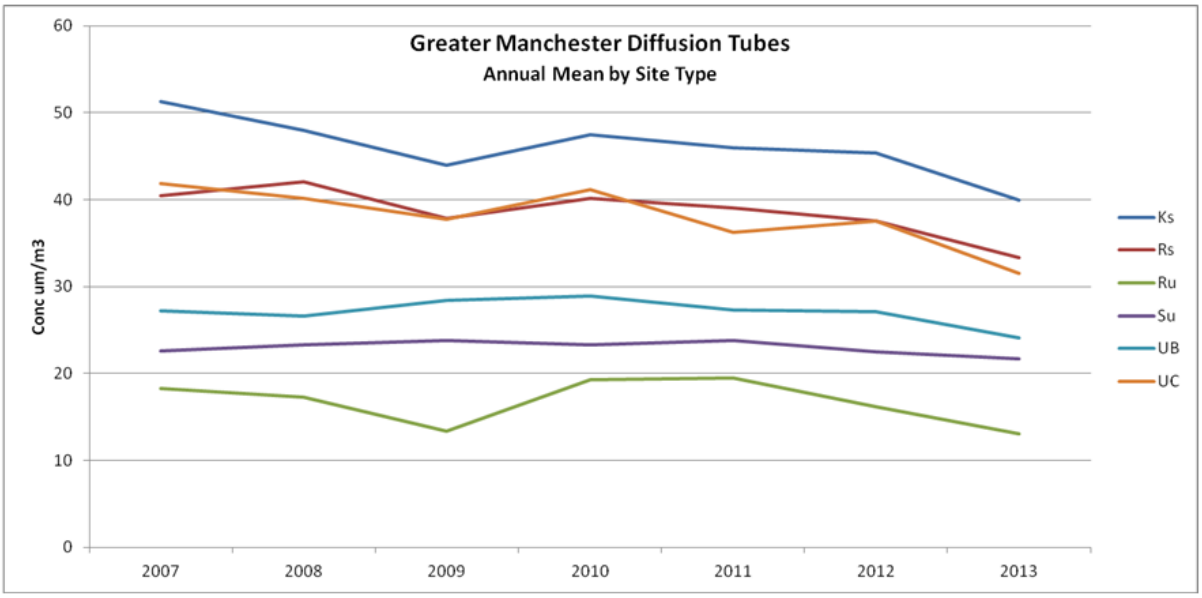
4.4 Diffusion tube data analysis

The findings of the Openair analysis were substantiated by comparing the monthly concentrations recorded at the diffusion tube sites in Trafford from 2011 to 2013.

The plots use non bias adjusted data. They are presented to compare the annual trend in monitored NO_2 concentrations within Trafford.

Figure 8 shows the trend in annual mean NO_2 concentrations measured at diffusion tube monitoring sites across Greater Manchester. This indicates that levels in 2013 may have been relatively low compared to the levels over the period 2007 to 2012.

Figure 8 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites



5 Modelling

5.1 Modelling methodology

Annual mean concentrations of NO_2 for the period January to December 2012 and January to December 2016 were modelled using AMDS Roads (version 3.2.4) and ADMS 5 (version 2.26).

The number and complexity of the industrial point sources were too great to be modelled using ADMS Roads. Therefore these sources were modelled separately then combined with spatially with the output of the ADMS Roads model.

The roads model was verified and outputs were adjusted by comparing the modelled predictions for road NO_x with local monitoring results. The monitoring data shown in Table 6 were used to verify the model. Further information on model verification is provided in Appendix 2.

5.1.1 Meteorology and other model parameters

Hourly sequential meteorological data for the period January to December 2012 for Manchester Airport (approx 10 km from the study area) was found to be of good quality and so was used in the model.

A surface roughness of 1.0 m was used to represent the urban conditions in the model domain. Similarly, a limit for the Monin-Obukhov length of 30 m was applied in the model. A surface albedo value of 0.23 and a Priestley-Taylor parameter value of 1 was used.

The intelligent gridding option was used in ADMS-Roads, which provides concentrations at high spatial resolution along the roadside, with a wider grid spaced at approximately 50 m being used to represent concentrations further away from the roads. These predictions were added to ArcGIS 10 and values between grid points are derived using interpolation in the Spatial Analyst tool. This allows contour maps of modelled concentrations to be produced and superimposed on the base map provided by Trafford Council.

5.1.2 Background concentrations

Background concentrations of NO_x were derived from the Defra maps[10]. A CSV file containing concentrations across Trafford was obtained. These provided a 1x1km grid of background values across the study area. As the modelled area was large the background values were assigned to the model concentration spatially. The assessment assumes that the background value is accurate although this introduces uncertainty into the overall predictions.

As local point sources were modelled in this study their contribution was removed before combining the background with the modelled concentration to avoid double counting.

5.1.3 Treatment of modelled NOx road contribution

It is necessary to convert the modelled NO_x concentrations to NO_2 for comparison with the relevant objectives. The Defra NO_x/NO_2 model[11] was used to calculate NO_2 concentrations from the NO_x concentrations predicted by ADMS-Roads. The model requires input of the background NO_x, the modelled road contribution and the proportion of NO_x released as primary NO_2. For the purposes of this assessment, it was assumed that around 20% of NO_x is released as primary NO_2 – the value associated with the "UK Traffic" option in the model.

---

[10] http://uk-air.defra.gov.uk/data/laqm-background-home
[11] http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php

The NO_x/NO_2 model was then used to convert the monitored NO_2 back to NO_x to allow comparison of modelled and monitored NO_x.

When the model predictions were compared with the local measurements, the modelled Road NOx component over predicted by a factor of 0.72. The under prediction in Road NOx translated to NO_2 being overestimated by about 27% across the model. Therefore all Road NOx components were adjusted by a factor of 0.72 to account for the NO_2 underestimate. A full description of the verification process and the calculations therein is contained in Appendix 2.

5.1.4 Validation of ADMS-Roads

Validation of the model is the process by which the model outputs are tested against monitoring results at a range of locations and the model suitability for use in specific applications is judged.

The model developers CERC have carried out extensive validation of ADMS applications by comparing modelled results with standard field, laboratory and numerical data sets, participating in EU workshops on short range dispersion models, comparing data between UK M4 and M25 motorway field monitoring data, carrying out inter-comparison studies alongside other modelling solutions such as DMRB and CALINE4, and carrying out comparison studies with monitoring data collected in cities throughout the UK using the extensive number of studies carried out on behalf of local authorities and DEFRA.

5.2 Model results for 2012

This section presents the results of the modelling assessment of NO_2 for the study area in 2012. Results are presented both numerically and as contour plots of concentrations across Trafford. A discussion is provided in chapter 6.

5.2.1 Numerical results

Table 7 below shows the modelled nitrogen dioxide concentration at each of the receptor points in the study area alongside the modelled NO_x contribution from point sources and road traffic. Modelled nitrogen dioxide concentrations above the air quality objective of 40 µg m^3 are highlighted in bold.

Table 7: Modelled concentrations for 2012

Receptor	Modelled Total NO_x (µg m^{-3})	Modelled Road NO_x (µg m^{-3})	Modelled Point Source NO_x (µg m^{-3})	Modelled NO_2 Concentration (µg m^{-3})
470 Flixton Road	43.12	9.15	4.42	26.43
67 Dunster Drive	29.94	0.56	4.20	21.65
Bosdin Road East	31.70	1.20	4.03	22.40
Urmston station	42.31	6.85	3.56	26.49
Trafford General	38.08	4.29	3.53	24.94
1 Hillam Close	47.05	4.30	3.68	29.26
Stroma Gardens	76.31	12.92	5.02	**41.79**
49 Benbecula Way	87.03	20.86	4.71	**44.20**
66 Bent Lanes	39.94	1.85	5.16	26.32
53 Welwyn Close	42.60	4.45	4.21	27.10
Barton Clough School	59.97	11.46	3.28	33.94

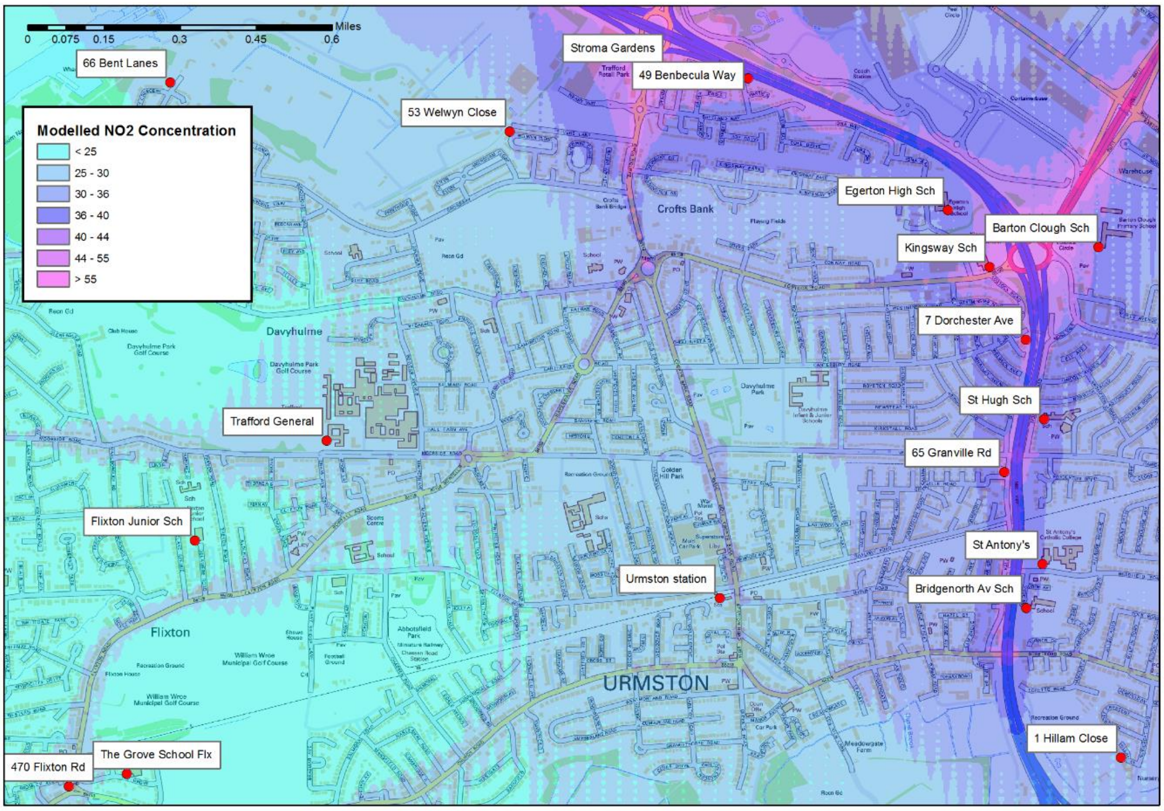
Receptor	Modelled Total NO_x ($\mu g\ m^{-3}$)	Modelled Road NO_x ($\mu g\ m^{-3}$)	Modelled Point Source NO_x ($\mu g\ m^{-3}$)	Modelled NO_2 Concentration ($\mu g\ m^{-3}$)
Egerton High School	63.31	13.64	3.59	35.05
Kingsway School	90.63	33.43	3.43	**43.21**
7 Dorchester Ave	88.80	32.19	3.32	**42.68**
St Hugh School	69.01	17.95	3.31	36.80
65 Granville Road	89.05	32.35	3.35	**42.75**
St Antony's	63.14	16.06	3.44	34.49
48 Moss Vale Road	86.37	32.79	3.43	**41.48**
Bridgenorth Av School	68.78	20.07	3.51	36.27
34 Compton Close	29.96	0.57	4.21	21.66
Flixton Junior School	32.49	1.99	3.74	22.64
Wellacre College	30.46	0.93	4.21	21.84
The Grove School Flixton	32.66	1.70	4.31	22.78

5.2.2 Contour plot

Figure 9 shows a contour plot of the estimated NO_2 annual average concentrations during 2012 within the study area alongside the receptor locations.

The model results for 2012 are consistent with the findings of indicative air monitoring which indicates that the annual average objective for nitrogen dioxide was exceeded at some locations with relevant exposure within the study area. These locations are in the near vicinity of the M60 motorway.

Figure 9 Annual mean modelled NO_2 concentrations, 2012



5.3 Model results for 2016

5.3.1 Numerical results

Table 8 below shows the modelled concentration at each of the receptor points in the study. Modelled nitrogen dioxide concentrations above the air quality objective of 40 µg m^3 are highlighted in bold.

Table 8: Modelled concentrations for 2016

Receptor	Modelled Total NO_x (µg m^{-3})	Modelled Road NO_x (µg m^{-3})	Modelled Point Source NO_x (µg m^{-3})	Modelled NO_2 Concentration (µg m^{-3})
470 Flixton Road	52.72	16.31	4.07	29.57
67 Dunster Drive	30.36	0.80	4.28	21.81
Bosdin Road East	32.48	1.94	3.79	22.64
Urmston station	43.03	7.70	3.10	26.67
Trafford General	41.70	7.15	3.18	26.14
1 Hillam Close	48.19	5.54	3.10	29.57
Stroma Gardens	82.58	17.68	4.68	**42.89**
49 Benbecula Way	98.35	29.25	4.38	**47.38**
66 Bent Lanes	40.46	2.50	4.77	26.44
53 Welwyn Close	44.49	6.07	3.84	27.7

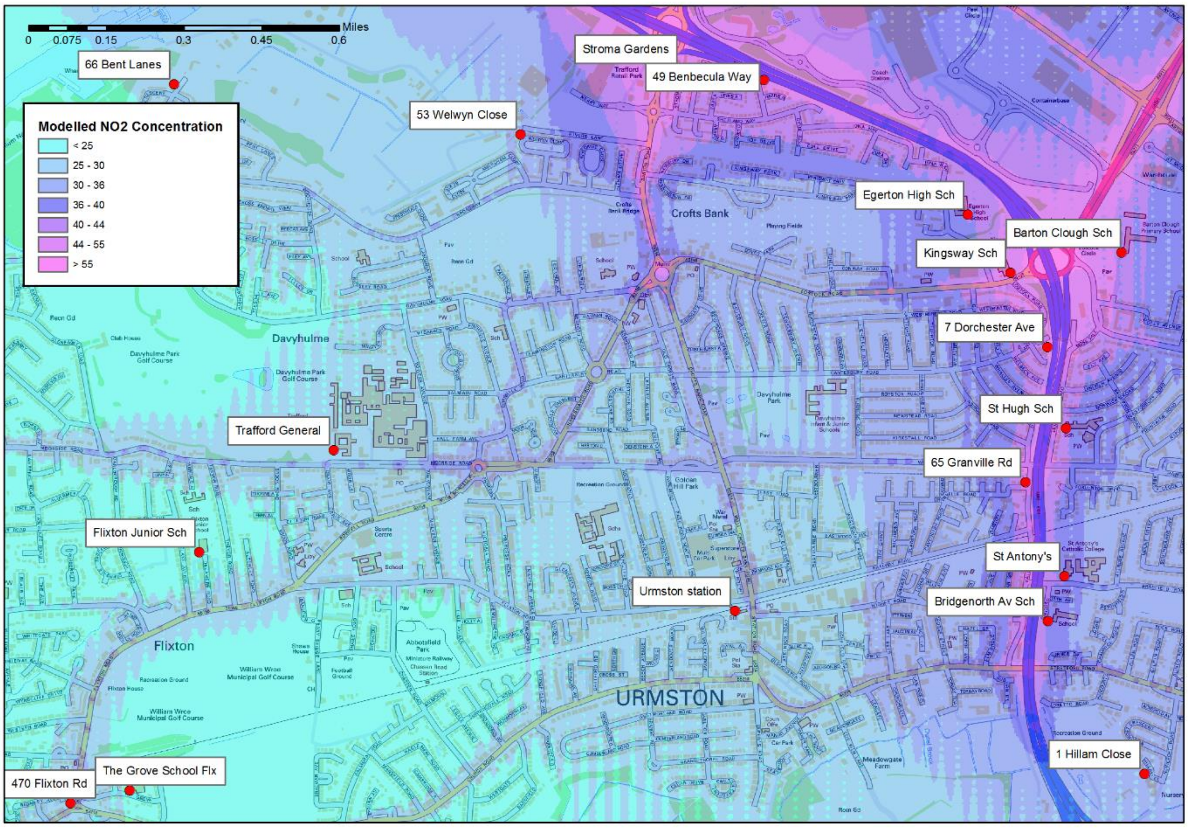
Receptor	Modelled Total NO_x (µg m^{-3})	Modelled Road NO_x (µg m^{-3})	Modelled Point Source NO_x (µg m^{-3})	Modelled NO_2 Concentration (µg m^{-3})
Barton Clough School	65.02	15.31	2.99	35.51
Egerton High School	68.83	17.85	3.28	36.74
Kingsway School	99.87	40.32	3.09	**45.72**
7 Dorchester Ave	100.46	40.84	2.98	**45.86**
St Hugh School	77.71	24.48	2.94	39.39
65 Granville Road	102.41	42.25	2.96	**46.39**
St Antony's	71.20	22.17	3.00	36.93
48 Moss Vale Road	100.25	43.09	3.01	**45.28**
Bridgenorth Av School	76.92	26.26	3.05	38.67
34 Compton Close	30.37	0.81	4.28	21.82
Flixton Junior School	33.69	3.09	3.41	23.02
Wellacre College	30.93	1.41	4.01	21.98
The Grove School Flixton	33.85	2.83	3.93	23.15

5.3.2 Contour plot

Figure 10 shows a contour plot of the estimated NO_2 annual average concentrations during January to December 2016 within the study area alongside the receptor locations.

As shown, the model indicates that the NO_2 annual average objectives will continue to be exceeded at locations with relevant exposure within the study area, in the vicinity of the M60 motorway.

Figure 10 Annual mean NO_2 modelled concentrations, 2016



6 Discussion

This study was undertaken to provide a local baseline of NO_2 levels and then to compare the results with a projected NO_2 baseline based on planned and proposed developments. The comparison would be used to establish whether the planned and proposed development could result in exceedances of the air quality objectives at new locations, or could significantly increase levels of nitrogen dioxide in areas where exceedances are already forecast.

6.1 Nitrogen dioxide concentrations

The existing 2005 AQMA in Trafford extends along the M60 motorway and major A-roads in the borough with the major contribution to NO_2 concentrations resulting from road transport sources. This is supported by the monitored NO_2 concentrations at Stroma Gardens and the A56 (Corner of De Quincey Road), at which exceedances of the air quality objective were recorded 2012.

The modelled concentrations for 2012 also indicate NO_2 exceedances at relevant receptor locations close to the M60 motorway. This includes forecast exceedances at a number of the selected receptor points:

- Stroma Gardens (41.79 µg m^{-3})
- 49 Benbecula Way (44.20 µg m^{-3})
- Kingsway School (43.21 µg m^{-3})
- 7 Dorchester Ave (42.68 µg m^{-3})
- 65 Granville Rd (42.75 µg m^{-3})
- 48 Moss Vale Rd (41.48 µg m^{-3})

All of these locations are in the near vicinity of the M60 motorway.

The 2016 modelled concentrations are based on projected traffic flows provided by TfGM and include emissions from planned and proposed industrial point sources. As with the estimated concentrations from 2012, the model predicts that there will continue to be NO_2 objective exceedances along the M60 motorway corridor. The receptors at which exceedances are forecast to occur are

- Stroma Gardens (42.89 µg m^{-3})
- 49 Benbecula Way (47.38 µg m^{-3})
- Kingsway School (45.72 µg m^{-3})
- 7 Dorchester Ave (45.86 µg m^{-3})
- 65 Granville Rd (46.39 µg m^{-3})
- 48 Moss Vale Rd (45.28 µg m^{-3})

The model indicates that nitrogen dioxide concentrations will be higher in 2016 than in 2012 at the selected receptor locations but does not predict a new exceedance at a previously compliant receptor location. A comparison of the contour plots shows that there is an increase in the area around the M60 and nearby major roads where an exceedance is predicted. Consequently, there is an increase in the number of residential properties where the air quality objectives are forecast not to be achieved between 2012 and 2016.

The modelled levels in both 2012 and 2016 are lower than the levels forecast in 2005 when the AQMA was declared, as shown in Figure 1. The areas of Davyhulme where nitrogen dioxide levels are forecast to be exceeded are now limited to the vicinity of the M60 motorway.

6.2 Comparison of NOx contributions at points of exceedance

The contour plots and the location of the receptors at which high levels of nitrogen dioxide are forecast indicate that the major source of NO_2 within the study area is road traffic. To help assess the impact of the 2016 point sources on increase in NO_2 concentrations predicted at the receptor locations we can compare the modelled NO_x contributions.

At Stroma Gardens, for example, the NO_2 concentrations are estimated to increase from 41.79 µg m^{-3} in 2012 to 42.89 µg m^{-3} in 2016, with road NOx increasing from 12.92 µg m^{-3} to 17.68 µg m^{-3}. At the same time, the point source NOx contribution decreases from 5.02 µg m^{-3} in 2012 to 4.68 µg m^{-3} in 2016.

Similarly, the NO_2 concentration at 29 Benbecula Way is estimated to increase from 44.20 µg m^{-3} to 47.38 µg m^{-3}. At this location the road NO_x contribution is 20.68 µg m^{-3} with the point source contribution at 4.71 µg m^{-3}. In 2016 the road NOx contribution is estimated to increase to 29.25 µg m^{-3} whilst the point source NO_x reduces to 4.38 µg m^{-3}.

At Kingsway School the NOx contribution from roads was 33.43 µg m^{-3} in 2012 and 40.32 µg m^{-3} in 2016 whilst the industrial NOx estimate in 2012 is 3.43 µg m^{-3} and 3.09 µg m^{-3} in 2016.

Hence, there is a pattern of increased road NO_x contribution, and reduced point source NO_x contribution, between 2012 and 2016. This pattern is reproduced at all sites that are predicted to exceed NO_2 air quality annual mean objectives.

6.3 Comparison of traffic input data at key locations

As road traffic has the largest impact on NO_2 concentrations, a comparison of the model traffic input data for key locations in the study area is provided in Table 9.

Table 9 Traffic input data for selected study area locations

	2012					2016				
Location	**AADT**	**% Car**	**% LGV**	**%HGV**	**% Bus**	**AADT**	**% Car**	**% LGV**	**%HGV**	**% Bus**
M60 South nr St Antony's	57342	78.20	13.11	8.69	0.00	67283	75.96	13.99	5.71	4.34
M60 North nr St Antony's	61128	77.52	13.58	8.90	0.00	68308	73.75	13.44	6.88	5.93
B5158 Lostock Rd East	7656	83.05	8.97	7.98	0.00	9097	75.35	13.26	1.90	9.48
B5158 Lostock Rd West	10860	87.47	10.42	2.11	0.00	10097	81.65	12.40	2.97	2.98
M60 Junction 10 North	46167	75.49	13.93	10.58	0.00	54655	72.92	13.72	7.46	5.89
M60 Junction 10 South	46759	76.63	13.83	9.55	0.00	54286	73.04	14.44	6.95	5.56
B5214 nr Stroma Gardens North	13034	84.79	10.82	4.42	0.00	16112	76.53	12.87	5.82	4.78

B5214 nr Stroma Gardens South	12183	81.14	12.85	5.31	0.70	13612	82.11	12.69	3.10	2.06

The selected modelled traffic forecasts provided by TfGM shown in Table 9 indicate that traffic is expect to increase from 2012 to 2016 in nearly all locations. As the AADT increases the composition of the vehicles types is expected to change. At all sampled locations the percentage of cars is expected to decrease with the percentage of light and heavy goods vehicles increasing. The 2016 data also includes a breakdown of the number of buses within the fleet mix, although this is reflected in a lower percentage of HGVs.

This combination of increased AADT and increased percentage of HGVs results in an increase in NO_x emissions from road traffic between 2012 and 2016, as seen in the modelled concentrations. Despite the improvements in vehicle technology through compliance to higher Euro standards, NO_2 emissions are forecast to rise from the base year.

6.4 Conclusions

This study has assessed concentrations of NO_2 for a baseline of 2012 and projected to 2016 taking into account proposed and planned developments in the study area. The modelling has made use of traffic models provided by TfGM and point source information from air quality assessments and the EMIGMA database.

The study covers a diverse area with a range of emissions sources contributing to levels of nitrogen dioxide. Through both monitoring and modelling, which led to the declaration of an AQMA, levels of nitrogen dioxide in some parts of the study area exceed the national annual mean air quality objective. The highest concentrations are forecast to occur in locations close to the M60 motorway and major A-roads.

The modelling study indicates that NO_2 concentrations will rise as a result of road traffic predicted by the TfGM traffic models between 2012 and 2016. This is forecast to outweigh a reduction in the contribution to NO_2 concentrations from industrial point sources in the area.

Appendices

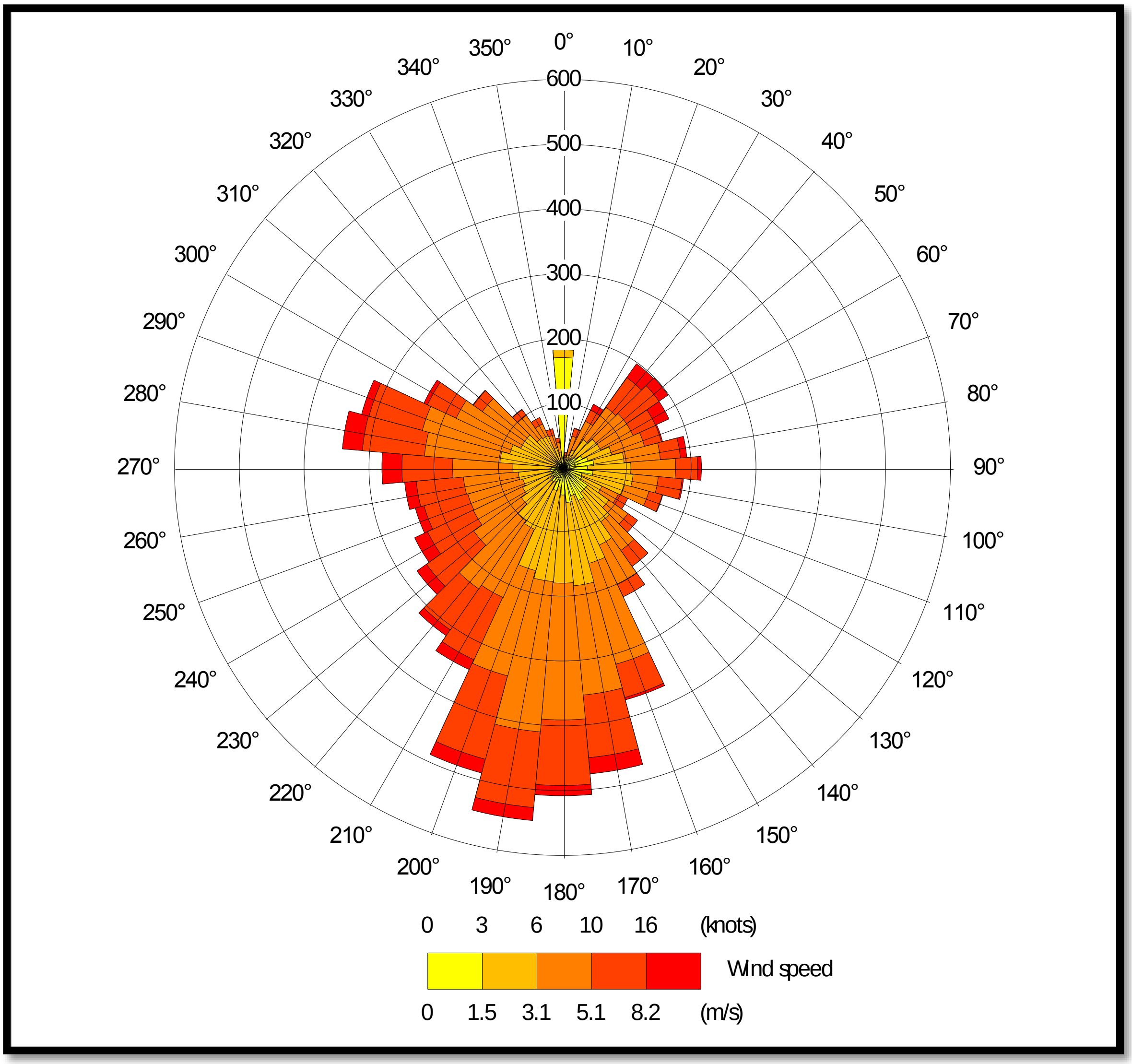
Appendix 1: Wind rose

Appendix 2: Model verification

Appendix 1 – Wind rose

The Wind Rose for the 2012 Manchester Airport meteorological dataset is presented in Figure 11.

Figure 11 Manchester airport Wind Rose 2012



Appendix 2 – Model verification

It is appropriate to verify the ADMS-Roads model in terms of primary pollutant emissions of nitrogen oxides ($NO_x = NO + NO_2$). The model has been run to predict annual mean road NO_x concentrations during the 2012 calendar year at the automatic monitoring and diffusion tube sites within the study area and surrounding locations.

The model output of Road NO_x (the total NO_x originating from road traffic) has been compared with the measured Road NO_x, where the measured Road NO_x contribution is calculated as the difference between the total NO_x and the background NO_x value. Total measured NO_x for each location was calculated from the measured NO_2 concentration using the September 2012 version of the Defra NO_x/NO_2 calculator.

A linear regression plot comparing modelled and monitored Road NOx concentrations is presented in Figure A2.1. The regression coefficient of 0.72 was applied to all predictions to bring the NO_2 concentrations to good agreement with monitoring data.

Figure A2.1 Comparison of modelled Road NO_x Vs Measured Road NO_x

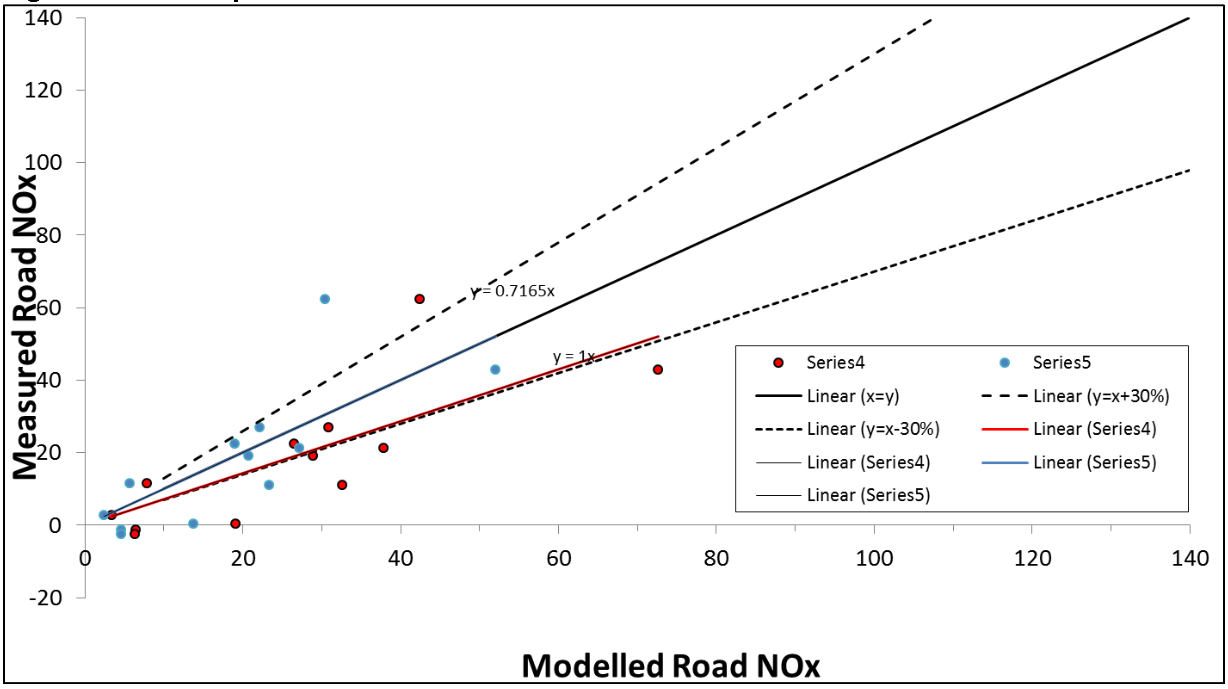
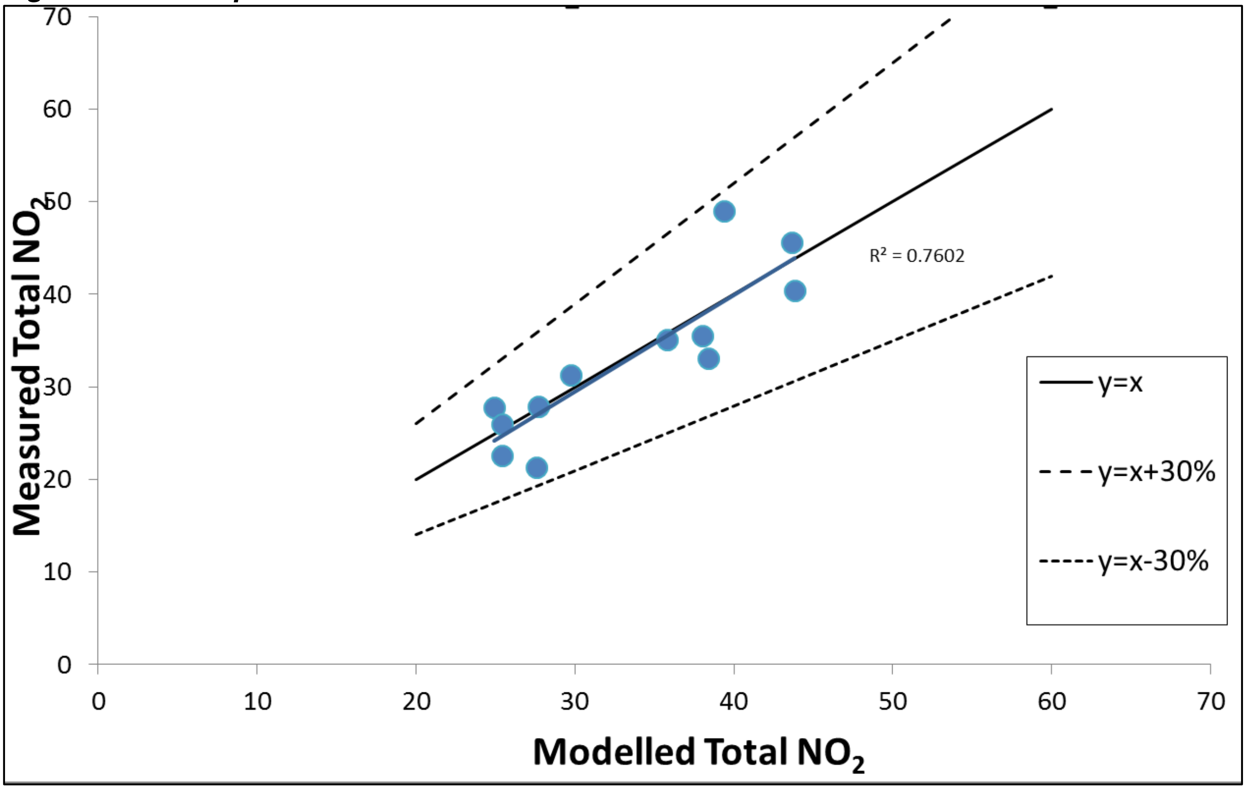


Figure A2.2 Comparison of modelled NO_2 Vs Measured NO_2



To evaluate the model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(09), Box A3.7, Appendix 3.

It is recommended that the RMSE is below 25% of the objective that the model is being compared against, and ideally under 10% of the objective i.e. 4 $\mu g.m^{-3}$ (based on NO_2 annual mean objective of 40 $\mu g\ m^{-3}$). In this case the RMSE is calculated at 3.67 $\mu g.m^{-3}$. This represents a good result for a large scale model such as this, and the model uncertainty is therefore considered acceptable.

RICARDO-AEA

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR

Tel: 01235 75 3000
Web: www.ricardo-aea.com