Mid Beds District Council

LAQM Detailed Assessment

Technical Report No: ADIX0562/BV/AQ

June 2008

DOCUMENT INFORMATION AND CONTROL SHEET

Report Title: Mid Beds District Council – LAQM Detailed Assessment

Report Ref: ADIX0562/BV/AQ

Client:

Environmental Services Mid Beds District Council Priory House Monks Walk Chicksands Shefford Beds. SG17 5TQ.	Project Manager Tel: Fax:	Alan Stone 01462 611388

Environmental Consultant:

Bureau Veritas Parklands 825A Wilmslow Road Didsbury Manchester M20 2RE	Project Manager Tel: Fax:	Sharon Atkins 0161 4464769

Project Team	Sharon Atkins	Principal Author	Sharon Atkins

Document Status and Approval Schedule

Issue	Status	Description	Prepared and authorised by: Sharon Atkins Principal Consultant Signed/Dated
1	Draft Report	Issued to client by Email	 14/05/08
2	Final Report	Issued to client by Email and hardcopy	 23/06/08

CONTENTS

DISCLAIMER

Bureau Veritas UK Limited completed this Report on the basis of a defined programme of work and terms and conditions agreed with the Client. We confirm that in preparing this Report, we have exercised all reasonable skill and care, taking into account the project objectives, the agreed scope of work, prevailing site conditions and the degree of manpower and resources allocated to the project.

Bureau Veritas UK parties whatsoever, following the issue of the Report, for any matters arising outside the agreed scope of the work.

This Report is issued in confidence to the Client and Bureau Veritas UK Limited has no responsibility to any third parties to whom this Report may be circulated, in part or in full, and any such parties rely on the contents of the report solely at their own risk.

Unless specifically assigned or transferred within the terms of the agreement, the consultant asserts and retains all Copyright, and other Intellectual Property Rights, in and over the Report and its contents.

Any questions or matters arising from this Report should be addressed in the first instance to the Project Manager.

EXECUTIVE SUMMARY

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area. For local authorities that have identified areas, within their Annual Progress Reports, where there is a potential risk of exceedence of Air Quality Strategy (AQS) objectives a Detailed Assessment is required. This Detailed Assessment is being undertaken, following the assessment of monitoring results for 2007 that indicated a risk of exceedences of air quality objectives for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) in the vicinity of the A1 Sandy roundabout, as part of the third round of review and assessment of air quality. The assessment has been undertaken in accordance with the Technical Guidance LAQM.TG (03).

The conclusions of the first round of local air quality review and assessment, commencing in 1998, were that all air quality objectives were expected to be met.

Following the outcome of the second round Updating and Screening Assessment (USA) in May 2003, Mid Beds District Council undertook a Detailed Assessment in 2004 for:

- NO_2 and PM_{10} around the Sandy roundabout on the A1 due to emissions from traffic and;
- Stewartby brickworks due to high sulphur dioxide concentrations.

This resulted in an Air Quality Management Area (AQMA) being declared in 2005 in the vicinity of the Stewartby brickworks that were predicted not to meet the 15 minute objective for sulphur dioxide. There was no requirement to declare an AQMA at the A1 Sandy roundabout at that time.

The third round USA concluded that all objectives would be met outside the Stewartby AQMA. A recommendation was made to continue to monitor nitrogen dioxide levels at the A1 Sandy roundabout.

Detailed dispersion modelling has been undertaken using the ADMS-Roads 2.3 dispersion model. NO_2 and PM_{10} concentrations have been modelled at specific receptors along the A1 Sandy, in particular adjacent to the junction with the B1042 and A603 and in the vicinity of the monitoring locations where exceedences have been monitored. The model has been verified against the continuous monitor (for PM_{10}) and NO_2 diffusion tube sites in the assessment area.

Based on this detailed assessment and review of the monitoring data within the areas under assessment, the following recommendations are made for Mid Beds District Council:

- To consider declaration of an Air Quality Management Area in the vicinity of the A1 Sandy, on the basis of NO_2, where exceedences of the annual mean objective are predicted at relevant receptor locations;
- To continue monitoring NO_2 and PM_{10} at the current monitoring locations in order to ensure that any future changes in air quality are detected, notably locations representative of relevant exposure, i.e. at the façade of residential properties.

1 Introduction

1.1 Project Background

Bureau Veritas UK Limited has been commissioned by Mid Beds District Council to undertake this Detailed Assessment based on the information provided by the local authority.

This Detailed Assessment for nitrogen dioxide (NO_2) and particulates (PM_{10}) is required following the conclusions of the APR undertaken in 2007 as part of the third round of review and assessment of air quality. The 2007 APR identified potential exceedences in the vicinity of the A1 Sandy roundabout.

1.2 Legislative Background

1.2.1 Air Quality Strategy Objectives

The latest Air Quality Strategy (AQS) released in July 2007 provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the Government to protect human health. The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide particulates - PM_{10} and $PM_{2.5}$- and ozone) have been prescribed within the Air Quality Strategy based on The Air Quality Standards (England) Regulations 2007. The Objectives set out in the AQS for the protection of human health are presented in Table 1.1.

The Air Quality Standards (England) Regulations 2007 came into force on 15th February 2007. This brings together in one statutory instrument the Government's requirements to fulfil separate EU Daughter Directives through a single consolidated statutory instrument, which is fully aligned with proposed new EU Air Quality Directive (CAFE – Clean Air For Europe). The Regulations 2007 include objectives for Arsenic, Cadmium and Nickel. These are required to be assessed by member states in response to the proposed new EU Air Quality Daughter Directive (CAFE), however, the AQS does not contain objectives for these pollutants and local authorities are not currently required to assess against these. The Environment Act 1995 gives local authorities duties and responsibilities that are designed to secure improvements in air quality, particularly at the local level. Part IV of the Act requires each local authority within the UK to periodically review and assess air quality in its area, and determine whether the prescribed objectives are likely to be achieved by the relevant future year.

The AQS objectives take into account EU Directives that set limit values which member states are legally required to achieve by their target dates. The UK's AQS objectives are equal to, or more stringent than, the EU limit values (no Member State may promulgate air quality standards that are weaker than the EU Limit Values).

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or manufactured structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer

period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

This detailed assessment considers the nitrogen dioxide and PM_{10} objectives.

Table 1-1 - AQS Objectives in Regulations for England

Pollutant	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
Benzene	16.25 μg/m^3	running annual mean	31st December 2003
	5 μg/m^3	running annual mean	31st December 2010
1,3-Butadiene	2.25 μg/m^3	running annual mean	31st December 2003
Carbon monoxide	10 mg/m^3	maximum daily running 8 hour mean	31st December 2003
Lead	0.5 μg/m^3	annual mean	31st December 2004
	0.25 μg/m^3	annual mean	31st December 2008
Nitrogen dioxide	200 μg/m^3, not to be exceeded more than 18 times a year	hourly mean	31st December 2005
	40 μg/m^3	annual mean	31st December 2005
Particles (PM_{10})	50 μg/m^3, not to be exceeded more than 35 times a year	24 hour mean	31st December 2004
	40 μg/m^3	annual mean	31st December 2004
Particles ($PM_{2.5}$)[a]	25 μg/m^3	Annual mean	2020
	Target of 15% reduction in concentrations at urban background[1]	annual mean	In urban areas between 2010 and 2020
Sulphur dioxide	266 μg/m^3, not to be exceeded more than 35 times a year	15 minute mean	31st December 2005
	350 μg/m^3, not to be exceeded more than 24 times a year	hourly mean	31st December 2004
	125 μg/m^3, not to be exceeded more than 3 times a year	24 hour mean	31st December 2004
Polycyclic aromatic hydrocarbons [a]	0.25 ng/m^3 B(a)P[2]	Annual average	31st December 2010
Ozone [a]	100 μg/m^3, not to be exceeded more than 10 times a year	8 hour mean	31 December 2005

[a] Not prescribed for Local Air Quality Management

1.2.2 Local Air Quality Management

Part IV of the Environment Act places a statutory duty on local authorities to periodically 'review and assess' the air quality within their area under the Local Air Quality Management (LAQM) regime. This involves consideration of present and likely future air quality against the AQS objectives prescribed within the Air Quality Regulations. Where the LAQM Review

[1] 25 μg/m^3 is a concentration cap combined with 15% reduction

[2] Benzo(a)Pyrene

and Assessment process finds that pollutant concentrations are unlikely to meet the AQS objectives by their target dates in areas where the AQS objectives apply, the Local Authority are required to declare an Air Quality Management Area (AQMA) under Section 83(1) of the Environment Act 1995. The areas in which the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period of the AQS objective.

Guidelines for the 'Review and Assessment' of local air quality were first published in the 1997 National Air Quality Strategy (NAQS)[3] along with associated policy guidance and technical guidance. The First Round of Review and Assessment recommended that local authorities fulfil their statutory duty under the LAQM regime by undertaking a three-stage assessment, increasing in detail at each stage.

In 2000, Government reviewed the NAQS and published the revised AQS, to which an addendum was issued in February 2003. Associated revised LAQM Technical Guidance (LAQM.TG(03))[4] and Policy Guidance (LAQM.PG(03))[5] were issued on behalf of DEFRA in January 2003. This guidance set the framework for the requirements of review and assessment for future years, taking account of experiences from the previous rounds of review and assessment. This current framework for review and assessment begins with an Updating and Screening Assessment (USA) that considers the likelihood of all the AQS objectives being achieved across the Local Authority's administrative area. If the USA identifies that an AQS objective may not be met, then the Local Authority must proceed to a Detailed Assessment for that pollutant. If the results of the Detailed Assessment confirm that, an AQS objective is unlikely to be met they are required to declare an AQMA.

Having declared an AQMA the authority is required to confirm the findings of the Detailed Assessment work through further monitoring or modelling assessments. This Further Assessment should provide information on the source-apportionment of the pollutant emissions in order to identify the level of pollutant reduction required for the attainment of relevant air quality objectives. Additionally, consideration should be made to evaluating local management practices that could be used to improve air quality, and feed into the formulation of an Action Plan.

The Second Round of Review and Assessment (2003-2005) provided an opportunity for local authorities to update the findings of their first round of review and assessment. In doing so, local authorities were to take into consideration changes in AQS Objectives and revised Technical Guidance (LAQM.TG(03)), new emission sources, and any significant proposed planning developments due to take place before the relevant AQS Objective target date.

Additional guidance was provided in the form of FAQs and updated LAQM tools in January 2006 to assist with Third Round of Review and Assessment (2006-2008). This included revised modelled background concentration maps for NO_X, NO_2 and PM_{10}, updated future year calculation tools and updates on the assessment of specific sources (rail, shipping, poultry farms). In addition, in 2007, a new NO_X: NO_2 calculator has been provided.

[3] DoE (1997) The United Kingdom Nation Air Quality Strategy The Stationery Office

[4] Defra (2003) Technical Guidance LAQM.TG(03), Part IV of the Environment Act 1995, Local Air Quality Management, The Stationery Office

[5] Defra (2003) Policy Guidance LAQM.PG(03), Part IV of the Environment Act 1995, Local Air Quality Management, The Stationery Office

At the time of writing the Review and Assessment process has culminated in the declaration of over 200 separate AQMAs across the UK. The results have shown that it is road traffic emissions that are the main cause of exceedences of two pollutants listed within the AQS. Namely, it is fine particulates (PM_{10}) and nitrogen dioxide (NO_2) that are the pollutants of most concern. Whilst other pollutants such as carbon monoxide (CO) and benzene are associated with road traffic emissions, the latest national perspective on the occurrence of each of these pollutants suggests that these are no longer a problem at roadside locations across the UK.

1.3 Summary of the Review and Assessment by Mid Beds District Council

The conclusions of the first round of local air quality review and assessment, commencing in 1998, were that all air quality objectives were expected to be met.

Following the outcome of the second round Updating and Screening Assessment (USA) in May 2003, Mid Beds District Council undertook a Detailed Assessment in 2004 for:

- Nitrogen dioxide and particulate matter (PM_{10}) around the Sandy roundabout on the A1 due to emissions from traffic and;
- Stewartby brickworks due to high sulphur dioxide concentrations.

This resulted in an Air Quality Management Area (AQMA) being declared on the 7th March 2005 for areas in the vicinity of the Stewartby brickworks that were predicted not to meet the 15 minute objective for this pollutant. There was no requirement to declare an AQMA at the A1 Sandy roundabout at that time.

The third round USA concluded that all objectives would be met outside the Stewartby AQMA. A recommendation was made to continue to monitor nitrogen dioxide levels at the A1 Sandy roundabout.

The Annual Progress Report (APR) for 2007 considered monitoring data for 2006. The conclusions of the APR were that the nitrogen dioxide and particulate objectives might not be met at the nearest receptors to the A1 in the vicinity of the A1 Sandy junction with the B1042 and A603. Bureau Veritas HS&E has been commissioned by Mid Beds District Council to provide a detailed assessment of air quality at this location.

1.4 Scope and Methodology of the Detailed Assessment

The scope of this assessment is to predict NO_2 and PM_{10} concentrations at relevant receptor locations along the A1, near the A1 Sandy junction with the B1042 and A603. Mid Beds identified in the 2007 Annual Progress Report as having potential exceedences of NO_2 and PM_{10} objectives. The purpose of the detailed assessment is to provide the local authority with an opportunity to supplement the information they have gathered in their earlier review and assessment work and more accurately assess the impact of pollution sources on local receptors at identified hotspots through detailed dispersion modelling. Dispersion modelling can be used to predicted concentrations over a wider area than can be monitored. It is important to ensure, as far as possible, that the results of modelling reflect the results from local monitoring sites across the assessment area and allow comparison of pollutant concentrations against the AQS objectives. This Detailed Assessment will identify with reasonable certainty whether or not pollutant concentrations are likely to exceed the AQS objectives and, if so, define the extent and magnitude of the exceedences.

Detailed dispersion modelling has been undertaken using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads 2.3 dispersion model using the latest vehicle emission factors released in 2002[6].

Concentrations of NO_2 and PM_{10}, measured at continuous monitoring and diffusion tubes locations within the assessment areas in 2007 have been used to verify the model results.

Concentrations of NO_2 and PM_{10} have been predicted for 2007, 2008 and for 2010, the date when the EU Limit Values are expected to be met. The Detailed Assessment has been undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM. TG (03))[4].

2 Baseline Information

2.1 Traffic Data

Mid Beds District Council and Bedfordshire County Council have provided the annual average daily traffic flow (AADT) data used in this assessment. A new count was undertaken at the junction in April 2008, which included turning count movements. The 2008 AADT data has been projected to 2007 and 2010 using growth factors from Tempro[7] and NRTF[8] (National Road Traffic Forecasts) adjusted for the Mid Beds area.

Where speed data has not been made available, speeds have been based on speed limits, modified according to local conditions to take account of congestion and stop/start vehicle movements at junctions. Speeds were reduced at busy junctions to 20kph to reflect the higher emissions of queuing traffic.

The AADT (Annual Average Daily Traffic) data, speeds and vehicle split for 2007, 2008 and 2010 are shown in Table 2-1.

Table 2-1 - AADT and vehicle split on relevant roads for 2007, 2008 and 2010

Location	Direction	Year	AADT 24 Hour flow	Mean Speed (kph)	% HGV	2007 AADT	2008 AADT	2010 AADT
A1 north of roundabout	Northbound	2008	17141	80	11.2	17021	17141	17381
A1 north of roundabout	Southbound	2008	18921	80	10.8	18789	18921	19186
A1 south of roundabout	Northbound	2008	17675	80	10.9	17551	17675	17922
A1 south of roundabout	Southbound	2008	21425	80	10.6	21275	21425	21725
B1042 east of roundabout	Eastbound	2008	7055	48	3.5	6963	7055	7238
B1042 east of roundabout	Westbound	2008	6198	48	4.3	6117	6198	6359
A603 west of roundabout	Eastbound	2008	8158	48	6.6	8052	8158	8370
A603 west of roundabout	Westbound	2008	5341	48	6.3	5271	5341	5480

[6] Released by NETCEN for the National Atmospheric Emissions Inventory in consultation with TRL.

[7] Tempro (Trip End Model Presentation Program) version 5.0 , dataset version 061005_53, Department for Transport

[8] DETR, National Road Traffic Forecasts (Great Britain) 1997

2.2 Air Quality Monitoring

There is currently continuous monitoring of nitrogen dioxide undertaken by Mid Beds District Council at one location in the A1 Sandy area. The A1 Sandy Roadside site is part of the Herts and Beds air quality monitoring network and monitors NO_2 and PM_{10} concentrations. NO_2 concentrations are measured using a chemiluminescent analyser and PM_{10} concentrations are measured using a TEOM analyser (NB. PM_{10} data is reported as gravimetric equivalent). The Council calibrates the sites every two weeks and the network managers Kings College ERG ratify the data. The Quality Assurance/Quality Control (QA/QC) procedures for the Herts and Beds network are equivalent to the UK Automatic Urban and Rural Network (AURN) procedures. There are triplicate NO_2 diffusion tubes co-located at the A1 Sandy site, which provides data for the bias adjustment of diffusion tubes.

Table 2.2 Continuous monitoring results for 2006 and 2007 in µg/m^3

Location	X	Y	Year	NO_2 Annual Mean	No. exceedences of hourly mean NO_2 >200µg/m^3	% Data capture	PM_{10} Annual Mean	No. exceedences of 24 hour mean PM_{10} >50µg/m^3	% Data capture
A1 Sandy Roadside	516436	249599	2006	51	3	(75)	22	0	(6)
A1 Sandy Roadside	516436	249599	2007	38	0	(57)	25	9	97

* Data from February 2007 is provisionally ratified only. Data capture less than the recommended 90% shown in brackets.

Outside the continuous monitoring network, Mid Beds District Council undertook monitoring at 18 NO_2 diffusion tubes sites in 2007, 9 of which are sites within the detailed assessment modelled area and have been used for model verification. The diffusion tubes are supplied and analysed by Gradko utilising the 20% Triethanolamine (TEA) in water preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO_2 diffusion tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO_2 concentrations reported are of a high calibre.

With regard to the application of a bias adjustment factor for the diffusion tubes, the technical guidance LAQM.TG (03) and Review and Assessment Helpdesk[9] recommends use of a local bias adjustment factor where available and relevant to diffusion tube sites. Mid Beds District Council has triplicate co-located diffusion tubes at the A1 Sandy continuous monitoring station, but data capture has been low in 2006 and 2007. In the absence of a robust local co-location study, the Review and Assessment Helpdesk bias factors for this laboratory methodology has been utilised. The bias in 2006 is 0.98 and in 2007 0.89.

The corrected data for local NO_2 diffusion tube monitoring sites in 2006 - 2007 in the assessment area are shown in Table 2-3. There are exceedences of the annual mean objective in 2006 and 2007 at roadside sites in the A1 Sandy area. Monitoring data at

[9] www.uwe.ac.uk/aqm/review

relevant diffusion tube roadside and façade sites in the A1 Sandy modelled assessment area have been used for model verification purposes (see Appendix 1).

Table 2-3 NO_2 Diffusion Tube Monitoring Site Results 2006-7

Location	X	Y	Site type	Annual Mean NO_2 2006 in $\mu g/m^3$	Annual Mean NO_2 2007 in $\mu g/m^3$
A1 Sandy	516482	249212	Roadside	**44.6**	**50.7**
Rose Lane, Biggleswade	519161	244651	Roadside	34.7	28.7
High Street, Biggleswade	518991	244596	Roadside	36.4	**42.4**
A1 Beeston	517162	248188	Roadside	39.8	**49.0**
M1, Tingrith	501043	232825	Roadside	29.6	27.2
Station Road A1, Tempsford	516277	253855	Roadside	**47.2**	**53.9**
Bedford Road, Sandy	516619	249100	Roadside	**40.3**	**40.2**
Highfield Crescent, Brogborough	496330	238300	Roadside	**41.3**	**47.0**
Warren Farm (M1)	500200	234519	Roadside	36.3	37.1
A1, Hunts Car Company	516448	249685	Roadside	38.1	**50.0**
A1, Hunts Car Company 2	516479	249704	Roadside	26.8	31.2
Market Square, Sandy	517310	249228	Roadside	31.2	28.2
A1 Sandy NOx Analyser (triplicate)	516436	249599	Roadside	32.7	**40.1**
Rural Background, Battlesden	495944	229121	Rural background	15.3	14.8
Bedford Road South 1, Sandy	516593	249083	Roadside	37.2	**42.3**
Bedford Road South 2, Sandy	516569	249074	Roadside	**48.3**	**49.7**
Eddies Cottage, Sandy	516579	249072	Façade	37.7	38.6
Doorway, Sandy	516582	249078	Façade	34.5	39.6

* Sites used in verification are highlighted in grey.

2.3 Background Concentrations

For the NO_X/NO_2 and PM_{10} assessment, background concentrations for 2007 have been derived from the monitored background concentrations from the continuous background monitoring site at neighbouring North Herts Breachwood Green in the Herts and Beds monitoring network. Concentrations for 2010 have been projected from 2007 data using the most recently released LAQM.TG (03) calculator. The background NO_2 and NO_x concentrations for 2007, 2008 and 2010 are shown in Table 2-4.

Table 2-4 – NO_2/ NO_x and PM_{10} background concentrations in μg/m^3

Pollutant	2007	2008	2010
NO_X	24.6	23.6	21.5
NO_2	18.3	17.8	16.8
PM_{10}	19.4	19.0	18.3

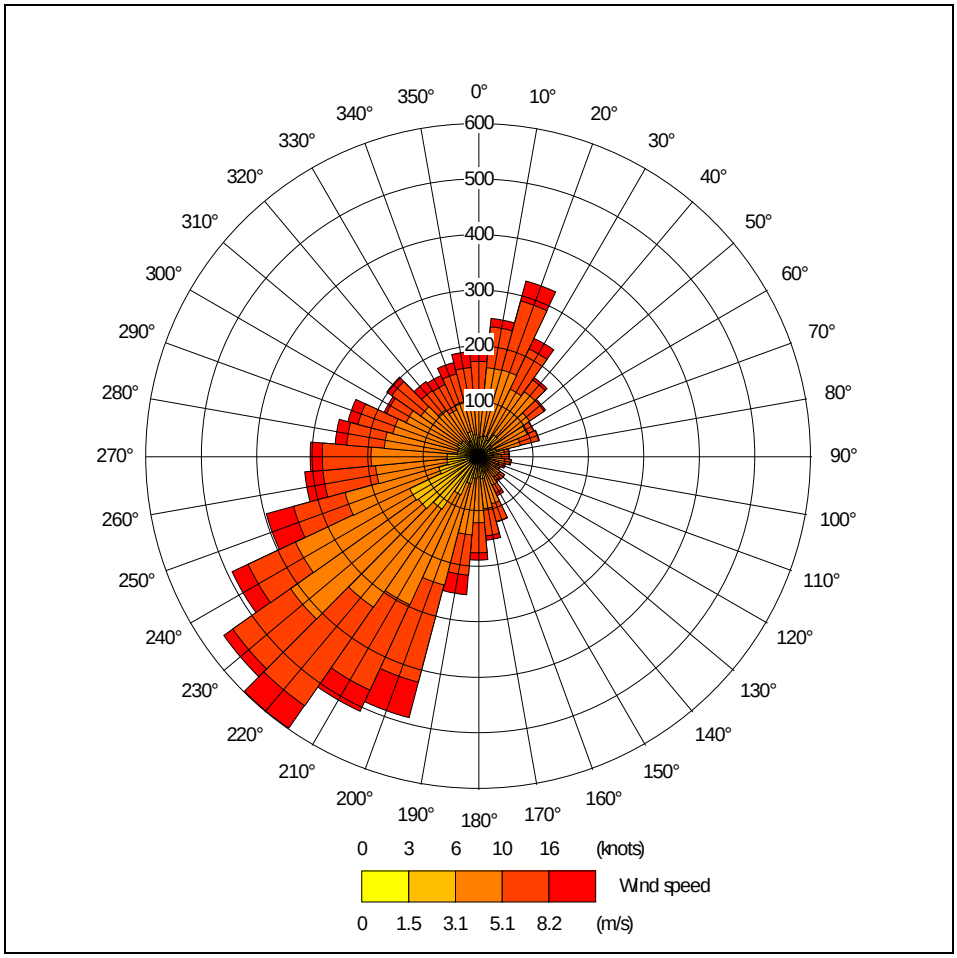
3 Dispersion Modelling Methodology

Detailed dispersion modelling of NO_2 was undertaken using the Cambridge Environmental Research Consultants (CERC) Ltd ADMS-Roads advanced Gaussian air dispersion model. ADMS-Roads can model up to 150 road sources and 7 industrial sources at any one time. The model is used extensively in local air quality management, and has formed the basis for many AQMA declarations. A considerable number of validation studies have been completed, showing overall excellent agreement between model outputs and observations at continuous monitoring sites. ADMS-Roads has integrated modules to take into the account the effects of street canyons and plume chemistry. Details of the model inputs are provided below.

3.1 Meteorological Data

The meteorological data for 2007 used is from Bedford weather station. The wind rose for the Bedford weather station data is given below. It shows that the dominant wind direction is southwesterly.

Figure 3-1 – Wind rose for 2007 Bedford meteorological data



3.2 Model Set up

Figure 3-2 shows the location of roads, receptors and monitoring sites modelled in the assessment.

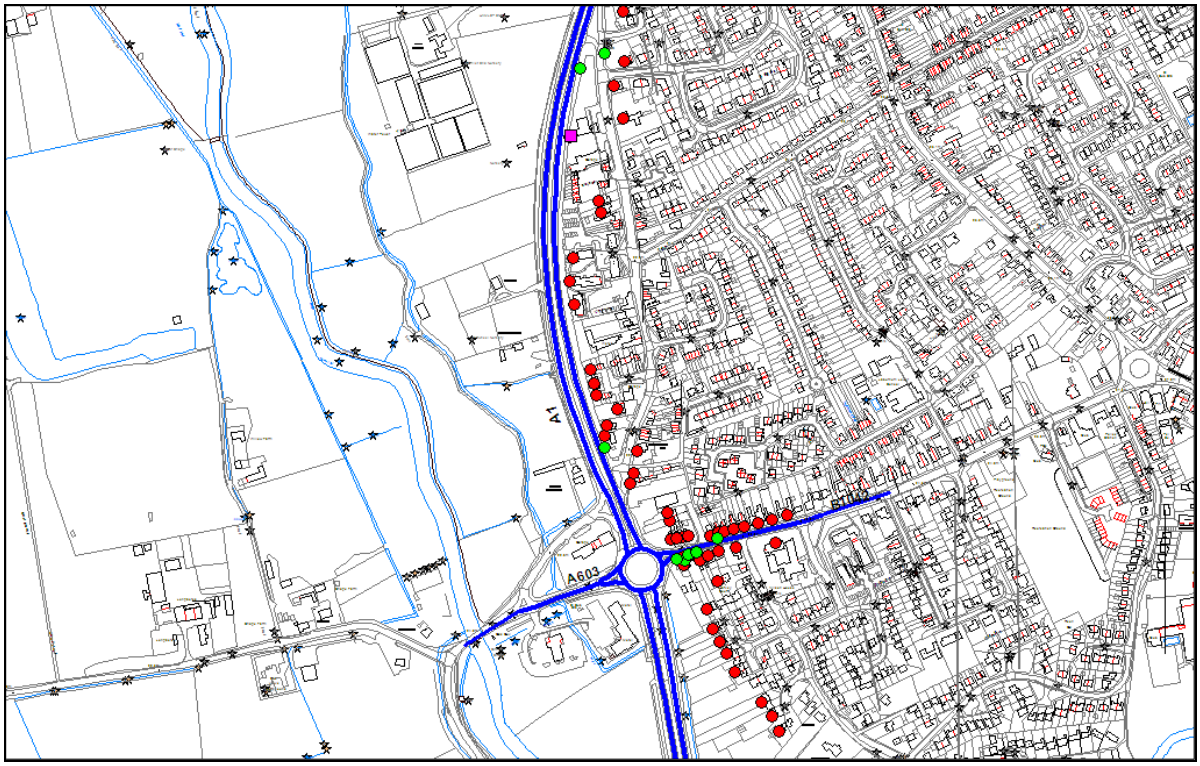


Figure 3-2 – Roads, receptors and monitoring sites modelled

- Receptor
- Diffusion tube
- Continuous Analyser
- Roads modelled in the assessment

3.3 Emissions Factors

The emissions factors incorporated into ADMS-Roads were used to calculate the NO_x and PM_{10} emissions for each road link in the assessment. These emission factors are the most up-to-date emission factors available. These factors, released in 2002 by Defra and Department for Transport (D*f*T), are the same as those calculated with the Emission Factors Toolkit[10] and the DMRB[11] widely used throughout the UK. The emissions factors are available for three different road types which act as a proxy for the differences in fleet composition of traffic in different conditions; urban, rural and motorway. For this assessment urban was selected to represent the type of road.

[10] Emission Factor Toolkit developed by Casella Stanger for Defra. http://www.casellastanger.com/JointProjects/default.asp
[11] Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality. The Highways Agency, February 2003.

For the primary NO_2 emissions, the default value in the model is 10%. However, many recent studies have pointed that the proportion of primary NO_2 might be significantly higher[12]. The AQEG (Air Quality Expert Group) report[13] analyses why the recent drops in annual mean NO_x concentrations have not translated in the similar reduction of NO_2 concentrations. The report concludes that monitoring and modelling results suggest that the proportion of primary NO_2 is higher than 10%, currently used in the model. For this assessment, rather than using predicted modelled NO_2 concentrations, NO_X model output has been converted to NO_2 using the latest 2007 NO_X:NO_2 calculator provided by Defra.

3.4 Background Concentrations

Background concentrations, as described in Section 2.3, have been incorporated into the model.

3.5 Model Input Parameters

Atmospheric chemical reactions have been incorporated into the modelling. The chemical reaction scheme module of ADMS-Roads 2.3 was selected for this assessment. A minimum Monin-Obukhov length of 10m was selected to represent the stability of the atmosphere due to the characteristics of the local area. The model considers this the minimum height above ground level above which vertical turbulence is inhibited. A surface roughness length of 0.5 was assigned in the model for the area.

3.6 Model Output

The ADMS-Roads dispersion model produces modelled concentrations of NO_X and PM_{10} at specific receptors, identified for the prediction of air quality impacts.

The link to a geographic information system (GIS) for mapping purposes provides the best method of analysing the pollution output. Maps have been produced illustrating NO_2 and PM_{10} concentrations predicted at selected properties in the vicinity of the roads modelled. In those areas where predicted NO_2 and PM_{10} concentrations at properties are likely to exceed the AQS objectives, GIS tools have been used to draw detailed concentrations contours of concentrations from the model output to allow the areas of exceedence to be identified.

3.7 Model Verification

The model has been used to predict concentrations of PM_{10} at the A1 Sandy continuous monitoring location and NO_2 at the continuous monitoring and diffusion tube monitoring locations in the area assessed, in order to verify the model against monitored concentrations. The following are the main objectives of the model verification:

- to evaluate model performance,
- to show that the baseline is well established and
- to provide confidence in the assessment results

[12] Carslaw DC *et al*. Atmospheric Environment, 39 (2005) 167-177.
[13] Defra (2007). AQEG Report 'Trends in Primary Nitrogen Dioxide in the UK'

Table 3-1 compares the modelled and monitored annual mean NO_2 and PM_{10} concentrations for 2007. The full verification procedure is shown in Appendix 1.

Table 3-1 - Comparison of corrected modelled and monitored 2007 annual mean NO_2 and PM_{10} concentrations, µg/m^3

Monitoring site	Location		Monitored NO_2, µg/m^3 2007	Modelled NO_2, µg/m^3 2007	Difference Modelled/ Monitored NO_2
	X	Y			
A1 Sandy	516478	249212	50.7	50.2	-1.1%
Bedford Road, Sandy	516619	249100	40.2	36.7	-8.8%
A1, Hunts Car Company	516448	249685	50.0	48.5	-2.9%
A1, Hunts Car Company 2	516479	249704	31.2	34.5	10.5%
A1 Sandy NOx Analyser (triplicate)	516436	249599	40.1	43.5	8.6%
Bedford Road South 1, Sandy	516593	249083	42.3	40.9	-3.3%
Bedford Road South 2, Sandy	516569	249074	49.7	46.8	-5.9%
Eddies Cottage, Sandy	516579	249072	38.6	41.5	7.6%
Doorway, Sandy	516582	249078	39.6	42.1	6.4%
Monitoring site	**X**	**Y**	**Monitored PM_{10}, µg/m^3 2007**	**Modelled PM_{10}, µg/m^3 2007**	**Difference Modelled/ Monitored PM_{10}**
A1 Sandy TEOM PM_{10} Analyser	516436	249599	25	25	0%

During the verification process, Bureau Veritas aim for all final modelled NO_2 concentrations to be within 25% of the monitored NO_2 concentrations. The comparison of the monitored and modelled data shows reasonable agreement between the datasets. Where discrepancies do exist, these could be due to a variety of reasons, for example:

- Uncertainty in traffic data (flows, speeds or fleet composition)
- Model set up (road widths, elevations and receptor locations)
- Model limitations (treatment of roughness and meteorological data)
- Uncertainty in monitoring data, such as use of diffusion tubes (notably where singly located) and application of bias adjustment factor for diffusion tubes
- Uncertainty in background concentrations

4 Results

Annual average concentrations for NO_2 and PM_{10} are predicted using the ADMS-Roads 2.3 model at relevant receptors for the baseline year 2007, 2008 and 2010. The results are shown in Appendices 2 and 3.

Receptors have been selected at the façades of buildings near the modelled road links. The selected receptors represent locations with relevant exposure for the NO_2 and PM_{10} objectives. All predicted results are produced using the methodology described in Section 3 of this report. The predicted NO_2 and PM_{10} concentrations at specific receptors for 2007 - 2010 and are shown in Appendix 2.

The predicted concentrations for NO_2 at modelled receptors in the Sandy area show the AQS objective to be exceeded in all modelled years, 2007 – 2010, along the A1 and at the junction with the A603 and B1042. The roadside diffusion tube monitoring along the A1 and near the A1 Sandy roundabout, which shows exceedences of the annual mean objective in 2006 and 2007, supports this, although the two façade based diffusion tubes receptors adjacent to the roundabout are marginally below the annual mean objective. The predicted concentrations for 2010 are systematically lower than in previous years, due to expected reductions in background concentrations and improvements in vehicle emissions through implementation of national policies. By 2010, the area of exceedence is predicted to be limited to a small number of receptors immediately adjacent to the A1 in Sandy.

The contours of predicted 2007 annual mean NO_2 concentrations in the vicinity of the A1 Sandy are shown in Appendix 3. The contour map displays the area in which the AQS annual mean objective is predicted to exceed and provides an indication of where the AQMA should be located.

The predicted concentrations for PM_{10} at modelled receptors in the Sandy area show the AQS objective to be met in all modelled years, 2007 – 2010, along the A1 and at the junction with the A603 and B1042.

5 Conclusions and Recommendations

A detailed assessment has been carried out for the A1 Sandy area that has been identified in the 2007 Annual Progress Report of Mid Beds District Council as having a potential risk of exceedence of the NO_2 and PM_{10} objectives. NO_2 and PM_{10} concentrations have been predicted at relevant receptors adjacent to the A1 at Sandy, in particular adjacent to the junction with the B1042 and A603.

The model results have been verified against continuous monitoring data for PM_{10} and NO_2 diffusion tube sites within the vicinity of the modelled road links.

The model results suggest that the annual mean objective for NO_2 is not likely to be met at the worst-case receptors in 2007 and subsequent years modelled. The objectives for PM_{10} are predicted to be met at modelled receptors in all years modelled.

5.1 Recommendations

Based on this detailed assessment and review of the monitoring data the following recommendations are made for Mid Beds District Council:

- To consider declaration of an Air Quality Management Area in the vicinity of the A1 Sandy, on the basis of NO_2, where exceedences of the annual mean objective are predicted at relevant receptor locations;
- To continue monitoring NO_2 and PM_{10} at the current monitoring locations in order to ensure that any future changes in air quality are detected, notably locations representative of the relevant exposure, i.e., at the façade of residential properties.

6 APPENDICES

APPENDIX 1 Model Verification (2007)

Site Location	Monitor Type	Site Type	Monitored Total NO_2	Monitored Total Nox	Background NO_2	Background Nox	Monitored Roadside NO_2	Monitored Roads NOx	Modelled Road Contribution Nox	NO_X Roads Correction factor	Corrected Modelled Road Contribution NOx **	Corrected Total NOx	Modelled Road NO_2	Modelled Total NO_2	Percentage Difference Modelled/ Monitored NO_2
A1 Sandy	DT	R	50.7	146.2	18.3	24.6	32.4	121.6	50.9	2.4	119.0	143.6	31.9	50.2	-1.1%
Bedford Road, Sandy	DT	R	40.2	98.9	18.3	24.6	21.9	74.3	25.7	2.9	60.2	84.8	18.4	36.7	-8.8%
A1, Hunts Car Company	DT	R	50	142.8	18.3	24.6	31.7	118.2	47.6	2.5	111.3	135.9	30.2	48.5	-2.9%
A1, Hunts Car Company 2	DT	R	31.2	64.2	18.3	24.6	12.9	39.6	22.1	1.8	51.6	76.2	16.2	34.5	10.5%
A1 Sandy NOx Analyser (triplicate)	DT	R	40.1	98.5	18.3	24.6	21.8	73.9	37.9	2.0	88.6	113.2	25.2	43.5	8.6%
Bedford Road South 1, Sandy	DT	R	42.3	107.8	18.3	24.6	24	83.2	33.1	2.5	77.4	102.0	22.6	40.9	-3.3%
Bedford Road South 2, Sandy	DT	R	49.7	141.4	18.3	24.6	31.4	116.8	44.1	2.7	103.2	127.8	28.5	46.8	-5.9%
Eddies Cottage, Sandy	DT	F	38.6	92.4	18.3	24.6	20.3	67.8	34.2	2.0	80.0	104.6	23.2	41.5	7.6%
Doorway, Sandy	DT	F	39.6	96.4	18.3	24.6	21.3	71.8	35.3	2.0	82.5	107.1	23.8	42.1	6.4%

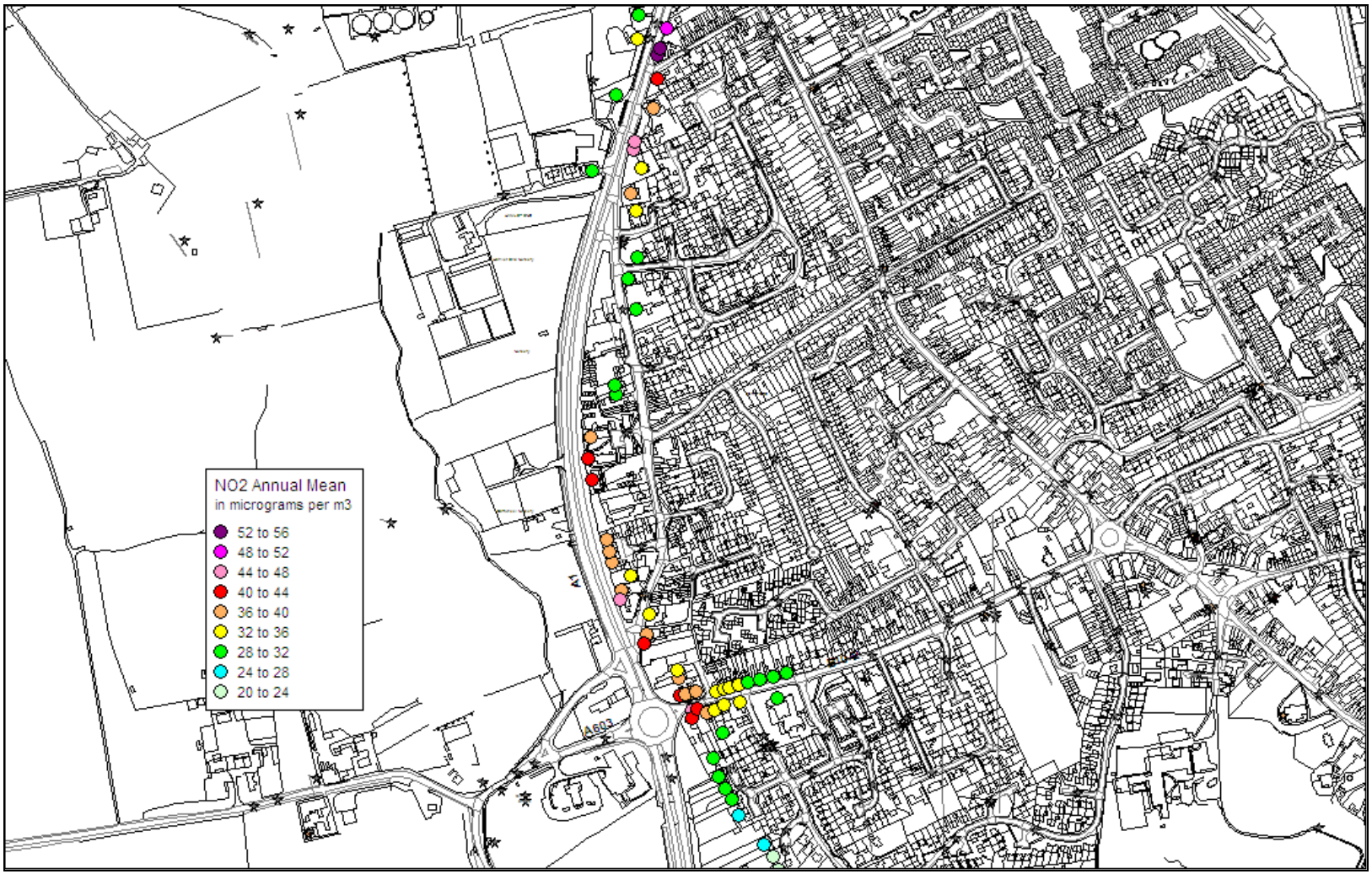
DT= Diffusion tube; R=Roadside ;F=Façade. **Regression (Roads NO_X) Correction Factor = 2.3. RMSE ($\mu g/m^3$) =2.64.

PM_{10} Model Verification

Receptor name	X(m)	Y(m)	Modelled PM_{10} in $\mu g/m^3$	PM_{10} Modelled Road contribution	Monitored PM_{10} in $\mu g/m^3$	Monitored road contribution	Roads correction factor	Corrected roads PM_{10}	Corrected total PM_{10}	Background PM_{10} in $\mu g/m^3$
Sandy TEOM Analyser	516436	249599	20.4	1.0	25.0	5.6	5.5	5.6	25.0	19.4

APPENDIX 2 ADMS-Roads Modelled Results in µg/m^3 at Specific Receptor Locations

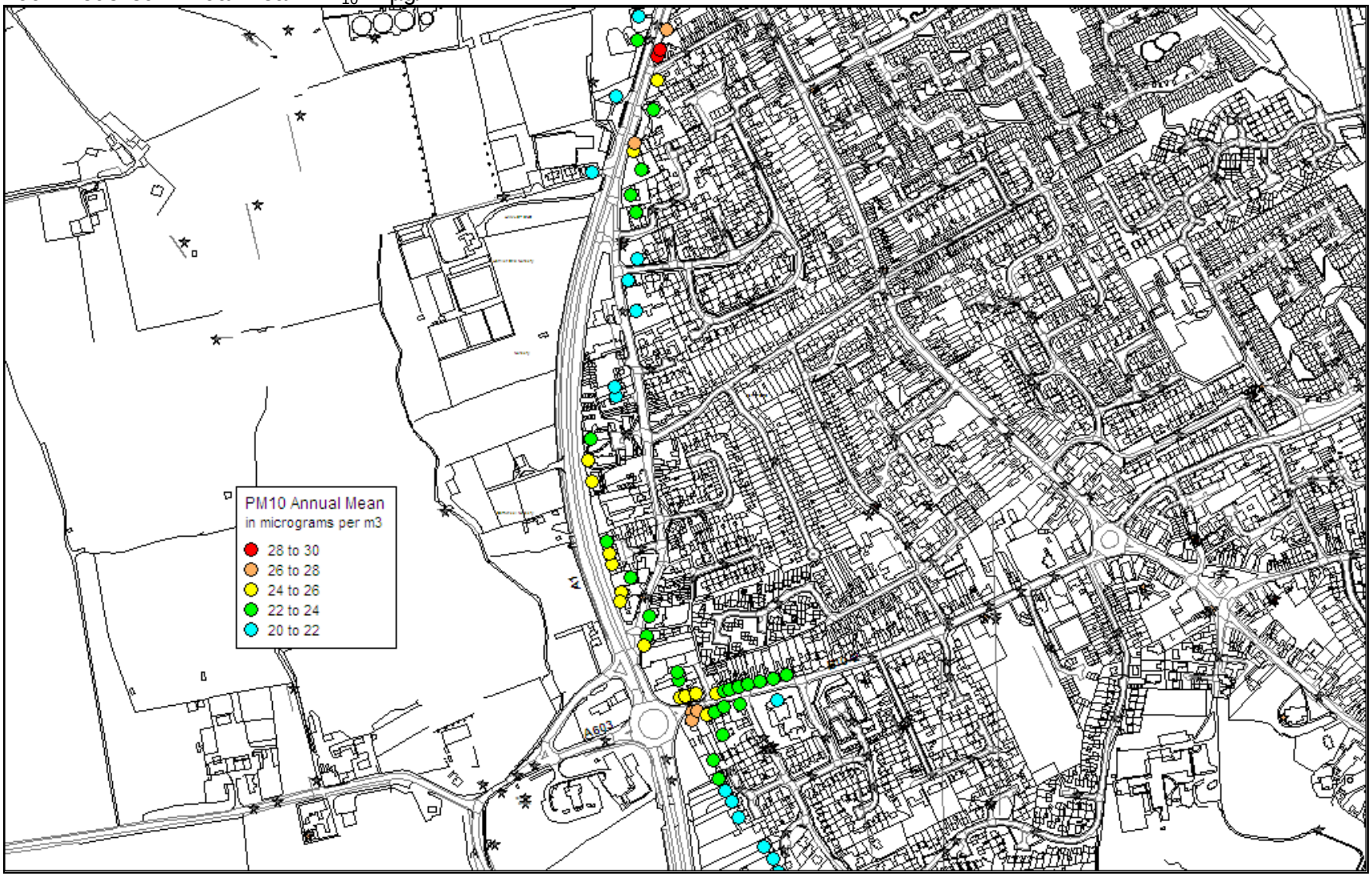
2007 Modelled Annual Mean NO_2 in µg/m^3



2008 Modelled Annual Mean NO_2 in $\mu g/m^3$

2010 Modelled Annual Mean NO_2 in $\mu g/m^3$

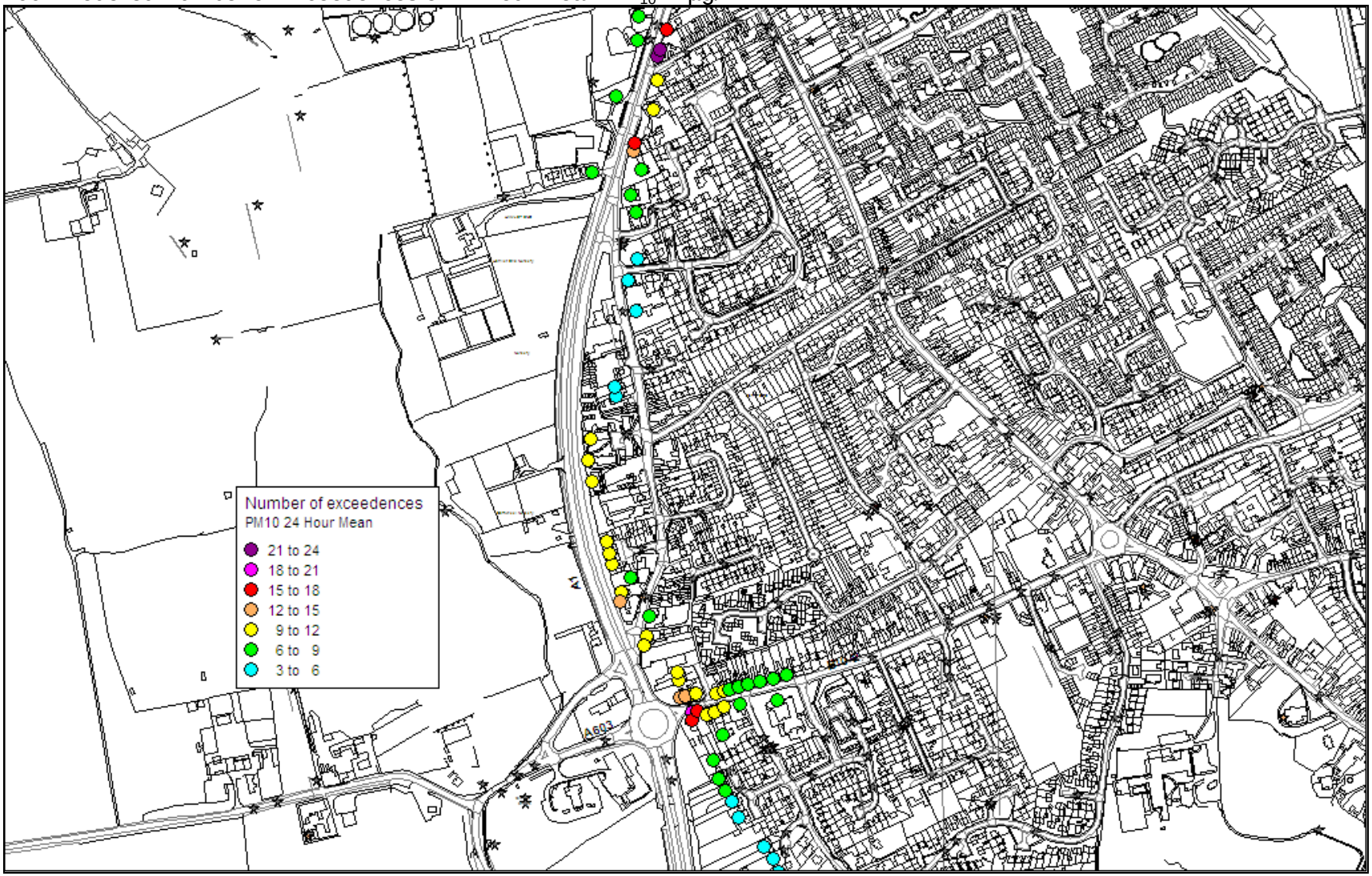
2007 Modelled Annual Mean PM_{10} in $\mu g/m^3$



2008 Modelled Annual Mean PM_{10} in $\mu g/m^3$

2010 Modelled Annual Mean PM_{10} in $\mu g/m^3$

2007 Modelled Number of Exceedences of 24 Hour Mean PM_{10} in µg/m^3



2008 Modelled Number of Exceedences of 24 Hour Mean PM_{10} in µg/m^3

2010 Modelled Number of Exceedences of 24 Hour Mean PM_{10} in $\mu g/m^3$

APPENDIX 3 Mapped Contours of ADMS-Roads Modelled Results in µg/m^3

2007 Modelled Annual Mean NO_2 in µg/m^3