Detailed Assessment of Air Quality in North West Leicestershire

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Contents

1 Introduction

1.1 This report represents the Detailed Assessment of air quality in North West Leicestershire. It forms part of the air quality Review and Assessment process prescribed by Defra. North West Leicestershire District Council currently has two Air Quality Management Areas (AQMAs) for nitrogen dioxide (annual mean objective) in two locations, one in Kegworth and one along the M1. However, the Updating and Screening Assessment report submitted in 2006 identified a number of other monitoring sites that are currently exceeding the air quality objective, but are not within the designated AQMAs. This report therefore provides an assessment of nitrogen dioxide relating to traffic emissions at three locations:

- Bardon Road in Coalville
- Broom Leys Road Junction with the A511 (Stephenson Way/Broom Leys Road) in Coalville
- High Street in Castle Donington

1.2 The district of North West Leicestershire lies between the major urban areas of Leicester, Burton-on-Trent, Derby and Nottingham. Coalville is one of two principal towns within the district, the other being Ashby-de-la-Zouch. A number of major roads run through the district, including the M1 and M42/A42. Castle Donington is one of a number of large villages within the district.

Introduction to the Second and Third Rounds of Review and Assessment

1.3 The Government's most recent Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out a framework for air quality management, which includes a number of air quality objectives. National and international measures are expected to achieve these objectives in most locations, but where areas of poor air quality remain, air quality management at a local scale has a particularly important role to play. Part IV of the Environment Act 1995 requires local authorities to periodically review and assess the current, and likely future air quality in their areas. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved by the due date. These locations must be designated as AQMAs and a subsequent Action Plan developed in order to reduce pollutant emissions in pursuit of the objectives.

1.4 Review and Assessment is a long-term, ongoing process, structured as a series of 'rounds'. Local authorities in England, Scotland and Wales have now largely completed two rounds of Review and Assessment, with the third round underway.

1.5 Local Air Quality Management Technical Guidance (LAQM.TG(03)) (Defra, 2003) sets out a phased approach to the second and third rounds of Review and Assessment. This prescribes an initial Updating and Screening Assessment (USA), which all authorities must undertake. It is based on a checklist to identify any matters that have changed since the first round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the previous round, then the Local Authority should progress to a Detailed Assessment (DA).

1.6 The purpose of the DA is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the DA is that one or more of the air quality objectives is being, or is likely to be exceeded, then an Air Quality Management Area (AQMA) must be declared. Subsequent to the declaration of an AQMA, a Further Assessment should be carried out to confirm that the AQMA declaration is justified and that the appropriate area has been declared; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an Air Quality Action Plan, which will identify measures to improve local air quality.

1.7 This report represents a Detailed Assessment within the third Round of Review and Assessment, following findings from the Updating and Screening Assessment published in 2006.

The Air Quality Objectives

1.8 The Government's Air Quality Strategy (Defra, 2007) provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. The objectives are prescribed within The Air Quality (England) Regulations 2000 (The Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (The Stationery Office, 2002). This latter publication set more stringent objectives for benzene and carbon monoxide. The 'standards' are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date.

1.9 Table 1 summarises the objectives which are relevant to this report, which only covers nitrogen dioxide. Short-term exposure to high concentrations of nitrogen dioxide may cause inflammation of respiratory airways. Long-term exposure may affect lung function and enhance responses to allergens in sensitised individuals. The young, old and asthmatics will be particularly at risk.

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

1.11 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60µg/m^3 (Laxen and Marner, 2003). Thus, exceedences of 60µg/m^3, as an annual mean nitrogen dioxide concentration, may be used as an indicator of potential exceedences of the 1-hour mean nitrogen dioxide objective.

1.12 The European Union has also set limit values for nitrogen dioxide. Achievement of these values is a national obligation rather than a local one. The limit values for nitrogen dioxide are the same levels as the UK objective, but are to be achieved by 2010.

Table 1 Air Quality Objectives for Nitrogen Dioxide

Pollutant	Status	Time Period	Objective / Value	To be Achieved by[a]
Nitrogen Dioxide	Statutory UK Objective	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	2005
		Annual mean	40 µg/m^3	2005
	EU Limit Value	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	2010
		Annual mean	40 µg/m^3	2010

[a] The achievement dates for the UK objectives are the end of the specified year; achievement dates for the EU limit values are the start of the specified year.

Report Structure and Issues Addressed

1.13 Section 2 details the new locations covered by this Detailed Assessment. Section 3 comprises of a review of monitoring data and the results of detailed dispersion modelling for the new locations. These data are then used to determine the likelihood of exceedences of the objectives within the study area. Conclusions and recommendations are provided in Section 4.

Key Findings of the Updating and Screening Assessment and previous R&A Work

1.14 North West Leicestershire DC completed the first round of air quality assessment in 2001, which resulted in 6 individual Air Quality Management Areas (AQMAs) being designated for the annual mean nitrogen dioxide objective. Following the official designation of the AQMAs, the Council undertook a Further Assessment (Stage 4 Assessment) of local air quality within the AQMAs designated to ascertain whether the AQMAs were necessary. Recommendations following the completion of the Further Assessment were that 2 of the 6 AQMAs should remain, and the 4 other AQMAs should be revoked. The two AQMAs remaining are shown in Figures 1 and 2.

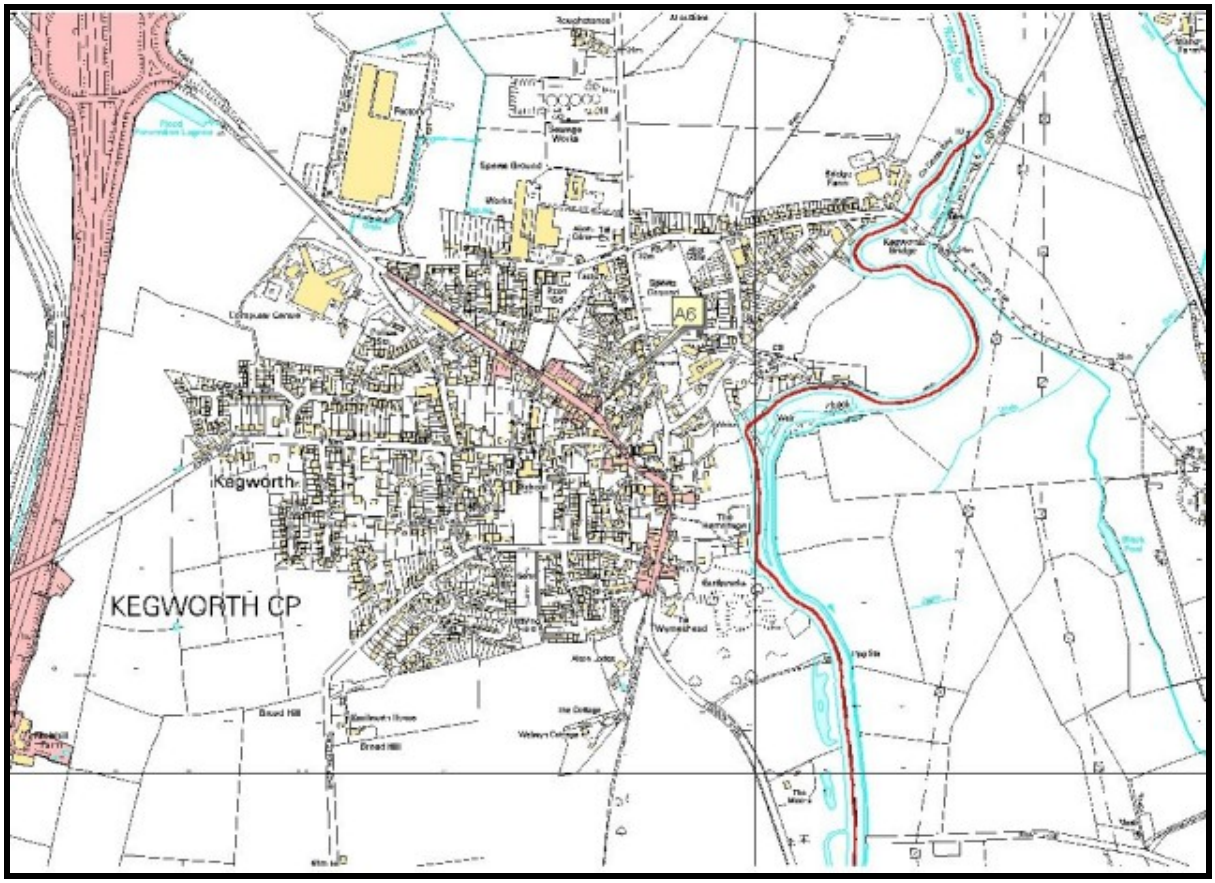

Figure 1 Kegworth AQMA (highlighted in pink). © Crown Copyright. All rights reserved. Licence number 100019329.

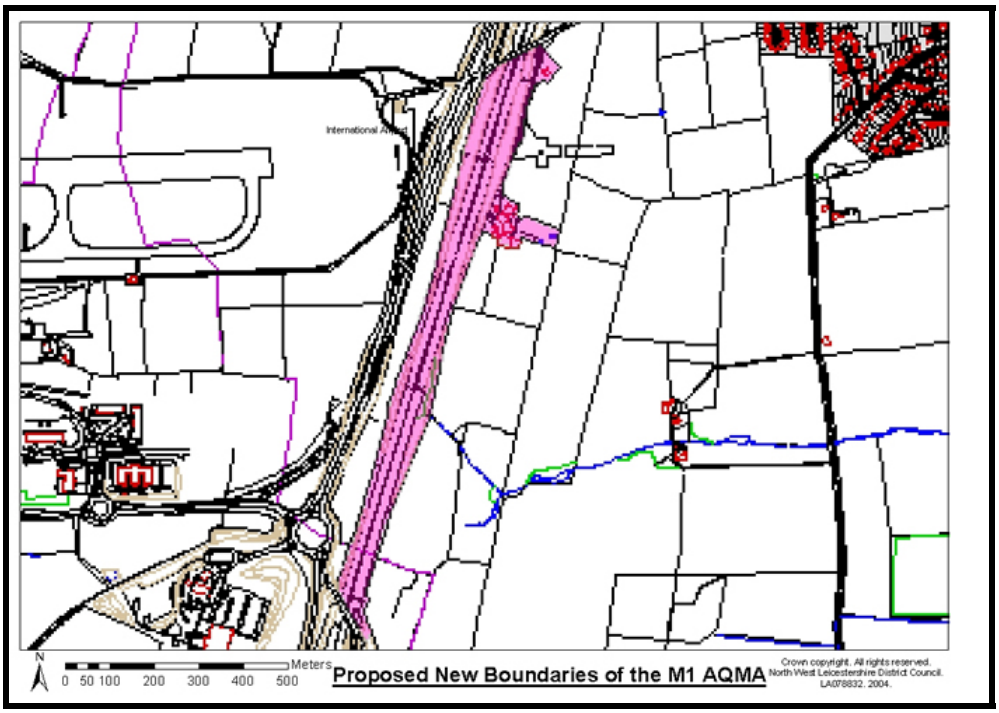

Figure 2 M1 AQMA (highlighted in pink). © Crown Copyright. All rights reserved. Licence number 100019329.

1.15 The second Round of Review and Assessment consisted initially of an Updating and Screening Assessment (June 2003), which concluded that one location, in the vicinity of Tillson House, Greenhill Estate, Coalville was identified as an area where the PM_{10} objective may not be met due to the proximity of mineral extraction processes. The Detailed Assessment produced in April 2005 concluded that the 50µg/m^3 24-hour mean was not exceeded more than 35 times in a year, therefore an Air Quality Management Area was not required.

1.16 In the third round, the Updating and Screening Assessment has identified three locations relating to traffic emissions for which a Detailed Assessment is required for nitrogen dioxide alone. This report represents the third round Detailed Assessment.

2 Locations being Assessed in this Report

2.1 This report covers areas identified within the second Updating and Screening Assessment (North West Leicestershire District Council, 2006) highlighted by diffusion tube monitoring. The areas investigated in this report include Bardon Road and Broom Leys Junction (A511/Broom Leys Road) in Coalville and High Street in Castle Donington (see Figures 3 and 4).

2.2 To further illustrate the study area, photographs of Bardon Road and Broom Leys Junction in Coalville and the High Street in Castle Donington are provided in Figures 5 to 9.

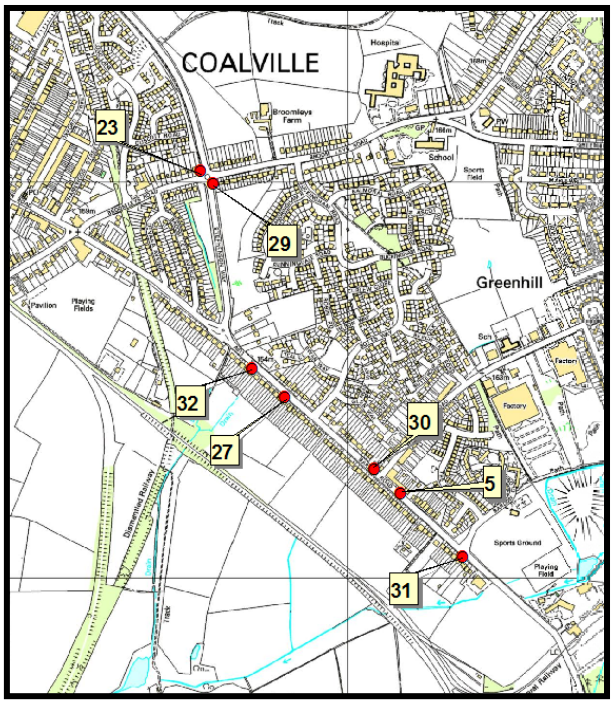

Figure 3 Coalville Study Area, showing Diffusion Tube Locations (red dots, labelled with diffusion tube site reference numbers)

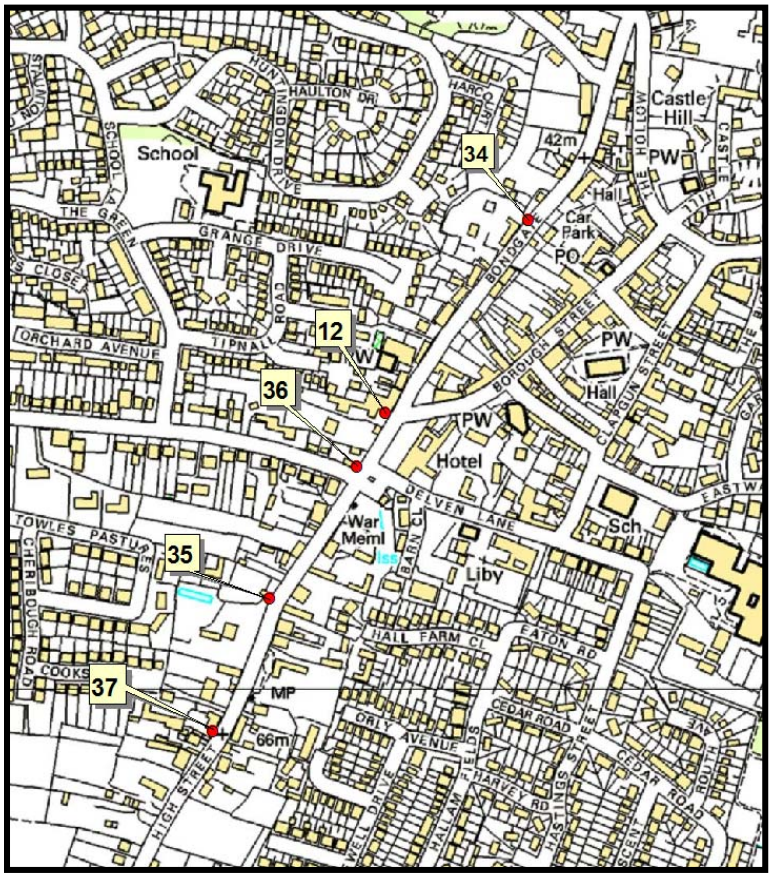

Figure 4 Castle Donington Study Area, showing Diffusion Tube Locations (red dots, labelled with diffusion tube site reference numbers)

Figure 5 Bardon Road looking north-west towards Coalville

Figure 6 Broom Leys Junction (A511/Broom Leys Road) illustrating the location of Diffusion Tube 23

Figure 7 Broom Leys Junction (A511/Bromleys Road) illustrating the location of Diffusion Tube 29

Figure 8 High Street in Castle Donington

Figure 9 Bondgate in Castle Donington illustrating the width of the road.

3 New Monitoring and Modelling Data

New Monitoring

3.1 North West Leicestershire District Council has a widespread monitoring network including one real time monitor for nitrogen dioxide and 26 diffusion tubes. However, the real time analyser is not situated within any of the three study areas in question, and therefore this assessment will rely on diffusion tube data.

3.2 Diffusion tubes are a type of passive sampler, which absorb the pollutant to be monitored directly from the surrounding air with no requirement for a power supply. Passive samplers are easy to use and relatively inexpensive, so they can be deployed in large numbers over a wide area, giving good spatial coverage. Ideally they should be used to complement more expensive automatic monitoring techniques, or at locations where it would not be feasible to install an automatic monitor. They consist of a small plastic tube, which during sampling, has one end open and the other closed. The closed end contains an absorbent for nitrogen dioxide. After exposure for a month at a time, the tubes are returned to the laboratory for analysis.

Bias Adjustment of Diffusion Tubes

3.3 Diffusion tube measurements may exhibit substantial bias compared to the reference method for measuring nitrogen dioxide. In situations where diffusion tube results are compared with air quality objectives, adjustments may need to be made to the data. Diffusion tubes analysed by different laboratories may exhibit very different bias, even when the tube preparation technique, tube materials and analytical techniques are broadly the same. The reasons for this are still not fully understood and are currently under investigation by the LAQM support helpdesk[1].

3.4 As a result, Defra's Technical Guidance LAQM.TG(03) recommends that local authorities making use of nitrogen dioxide diffusion tubes in their Review and Assessment should apply a 'bias adjustment factor', which is calculated by undertaking a collocation study with a real time (reference method) analyser. If this cannot be undertaken within the local authority area, then a default factor, made available within a spreadsheet on the Review and Assessment helpdesk website, should be used[2]. North West Leicestershire District Council use Gradko laboratories for analysis of diffusion tubes using 50% TEA in acetone. For this report, the database factors (spreadsheet version 03/07) have been used to adjust the tube results.

[1] www.laqmsupport.org.uk
[2] For more information about diffusion tube bias adjustment see http://www.uwe.ac.uk/aqm/review/guidance.html

Adjustment of Short-Period Data

3.5 Ideally monitoring should be carried out for a calendar year for direct comparison with the objectives. Where this is not possible, and where less than 9 months data are available, short-term periods of monitoring have been adjusted to allow for seasonal effects. The adjustment is based on the fact that patterns in pollutant concentrations usually affect a wide region. If a three month period is above average at one place it will almost certainly be above in another. For full details of the adjustment methodology see TG(03) Box 5.5, p 6-8 (Defra, 2003b). Details of the adjustment factors applied are set out in Appendix 1.

Diffusion Tube Data

3.6 Diffusion tube locations within each of the study areas are shown in Figures 3 and 4 (page 8). The monitoring data are presented in Table 2. In all cases, data are bias adjusted, and where appropriate, seasonally adjusted to represent an annual mean.

Table 2 Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) Measured using Diffusion Tubes within the Study Areas

Site Reference	Type of Site[a]	Site	2004[c]	2005[d]	2006[e]
Coalville					
5	**R**	Bardon Road	**42.7**	**45.7**	**41.2**[f]
23	**R**	Broom Leys 1	**44.1**	**46.4**	**41.5**
27	**R**	Bardon Road West	**-**	**47.2**	**43.5**
29	**R**	Broom Leys 2	**-**	**47.1**	38.7
30	**R**[b?]	155 Bardon Road	-	-	**45.5**[f]
31	**R**	242 Bardon Road	-	-	29.0[f]
32	**R**[b?]	66 Bardon Road	-	-	37.8[f]
Castle Donington					
12	**R**[b]	High Street	**40.4**	**40.5**	37.0
34	**R**[b?]	Bondgate	-	-	33.0[f]
35	**R**[b?]	34 High Street	-	-	**42.2**[f]
36	**R**	Park Road opp. High Street	-	-	**41.8**[f]
37	**UB**[b?]	56 High Street	-	-	**44.5**[f]
Objective			-	**40**	**40**

[a] **R**= Roadside site (i.e. a site sampling between 1m of the kerbside of a busy road and the back of the pavement – typically this will be within 5m of the road, but could be up to 15m); **UB**= Urban Background (i.e. an urban location distanced from sources and therefore broadly representative of city-wide background condition e.g. urban residential areas).
[b] relevant location in terms of relevant exposure
[c] Bias adjusted using a bias adjustment factor of 1.10, taken from the database of factors provided on the Review and Assessment Helpdesk website (spreadsheet version 03/07).
[d] Bias adjusted using a bias adjustment factor of 1.10, taken from the database of factors provided on the Review and Assessment Helpdesk website (spreadsheet version 03/07).
[e] Bias adjusted using a bias adjustment factor of 1.04, taken from the database of factors provided on the Review and Assessment Helpdesk website (spreadsheet version 03/07).
[f] Annual mean equivalent concentration (see Appendix 1).

3.7 Diffusion tube monitoring data from Bardon Road (Site 5) and Broom Leys Junction (Site 23) have indicated exceedences of the annual mean objective for each of the years between 2004 and 2006, with monitoring at new sites within the same locations (Site 27 and 29) indicating similar exceedences in 2005 and 2006. Only one diffusion tube (Site 31), positioned towards the south of Bardon Road, has shown results that are significantly below the annual mean nitrogen dioxide objective of 40μgm^{-3} in 2006.

3.8 Monitoring results along the High Street in Castle Donington have indicated annual mean exceedences between 2004 and 2006. The one diffusion tube (Site 12) located along the High Street before 2006 indicated exceedences in 2004 and 2005, but did not indicate an exceedence in 2006. However, diffusion tube monitoring initiated in 2006 indicates that the annual mean objective was exceeded elsewhere along the High Street.

New Modelling

3.9 Annual mean concentrations of nitrogen dioxide during 2006 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads is one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003b). The model has been run using a full year of meteorological data for 2006 from the meteorological station in Church Lawford, which lies approximately 38km south of the study areas. The modelling methodology, and the input data utilised are described in Appendix 2. The model has been verified against the diffusion tube measurements and adjusted accordingly.

Modelled Concentrations

3.10 Modelled concentration contours for each of the study areas are presented for Castle Donington in Figure 10, and for Coalville in Figures 11 and 12. Contours representing the 40µg/m^3 objective are illustrated in red. Contours representing 36µg/m^3 (i.e. representing 40µg/m^3 minus 1 standard deviation for the model) are illustrated in blue.

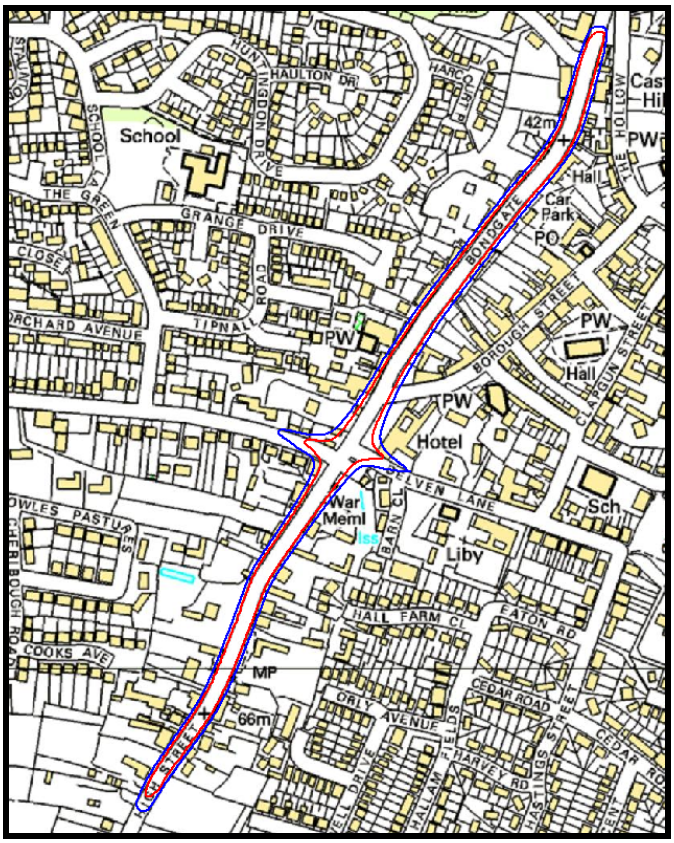

Figure 10 Annual Mean Nitrogen Dioxide Concentration Contours in 2006. The Red Contour represents the 40µg/m^3 Contour, whilst the Blue Contour represents the 36µg/m^3 Contour.

3.11 In Castle Donington, the modelling contours, illustrated in Figure 10, indicate that exceedences are experienced only at those properties located next to the carriageway along the High Street and along Bondgate, and in particular the properties located at the junction with Delven Lane. However, if a precautionary approach is taken, whereby the 36µg/m^3 contour is considered, then the properties where 36µg/m^3 is experienced extends to the Hotel along Delven Lane and to properties along Park Lane, to the immediate west of the Delven Lane junction.

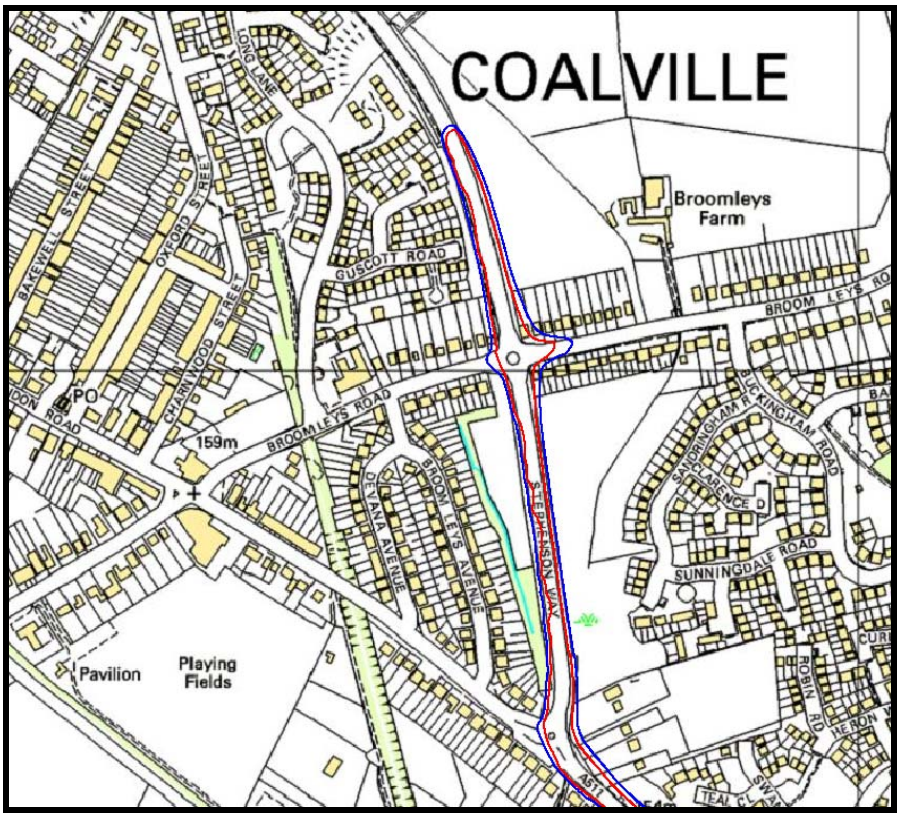

Figure 11 Annual Mean Nitrogen Dioxide Concentration Contours in 2006 at the Broom Leys Road Junction and along Stephenson Way. The Red Contour represents the 40µg/m^3 contour, whilst the Blue Contour represents the 36µg/m^3 contour.

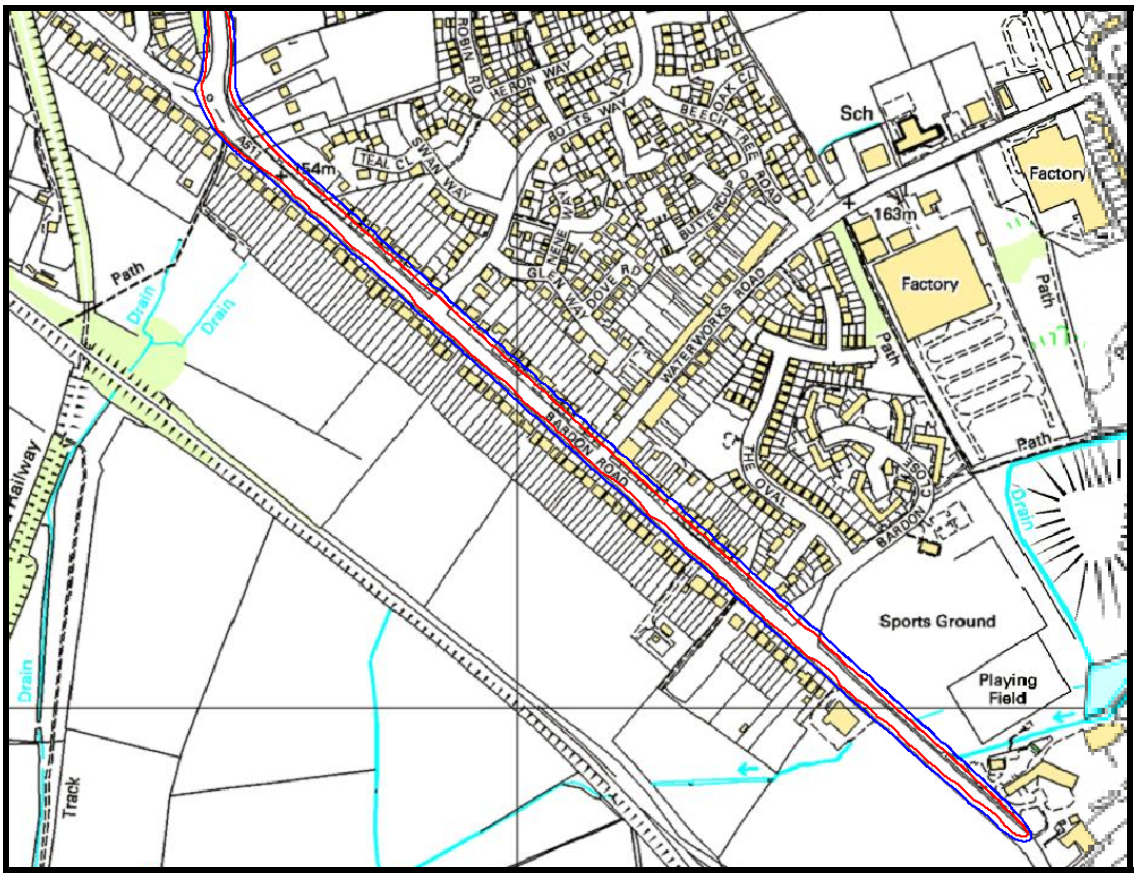

Figure 12 Annual Mean Nitrogen Dioxide Concentration Contours in 2006. The Red Contour represents the 40µg/m^3 contour, whilst the Blue Contour represents the 36µg/m^3 contour.

3.12 With respect to Broom Leys Road Junction, modelling contours indicate exceedences of the annual mean objective at a single property along the east (north) section of Broom Leys Road, as illustrated in Figure 11. From the modelling, the first property on the north side of the west arm of Broom Leys Road appears to experience a concentration of 36µg/m^3. The diffusion tube (diffusion tube site 23), although not representing relevant exposure, was used for model validation purposes and has indicated exceedences of the annual mean over recent years.

3.13 With respect to Bardon Road in Coalville, the modelled contours support the monitoring data results, in that the properties along the north east side of the road are encompassed within the 36µg/m^3 modelling contour. Of the two diffusion tubes located along the south west side of Bardon Road (diffusion tube sites 27 and 32), only one (site 27) experienced exceedences in 2005 and 2006. An annual mean equivalent concentration of 37.8µg/m^3 was derived for site 32 (at 66 Bardon Road). The modelling outcomes suggest that the annual mean nitrogen dioxide objective is not exceeded at properties on the south west side of Bardon Road. This is likely to be as a result of the prevailing wind direction.

Uncertainty

3.14 There is an element of uncertainty in all measured and modelled data. All values presented in this report are the best possible estimates, but uncertainties in the results might cause over or under-predictions. All of the measurements presented have an intrinsic margin of error. Defra (2007c) suggest that this is of the order of plus or minus 20% for diffusion tube data and plus or minus 10% for automatic measurements. The model results rely on traffic count data, which have been factored for the appropriate assessment year, and thus any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that:

- during each year, the vehicle fleet within the study area will conform to the national (UK) average composition;
- the emissions per vehicle conform to the factors published in DMRB 11.3;
- wind conditions measured at Church Lawford during 2006 were representative of wind conditions in Coalville and Castle Donington during 2006, and
- the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain.

3.15 An important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, data have been corrected for any overall under or over-prediction.

3.16 The UK Government's Air Quality Expert Group (AQEG) has published a draft report on trends in primary nitrogen dioxide in the UK (AQEG, 2006). This examines evidence that shows that while NOx emissions have fallen in line with predictions made a decade previously, the composition of NOx has, in some urban environments, changed. This may have caused nitrogen dioxide levels at some locations to fall less rapidly than was expected. The latest guidance from Defra has been followed regarding NOx to NO_2 relationships, but there is still uncertainty as to whether these relationships will continue to apply in 2010 and 2015. Any effect is likely to be greatest close to major roads, where future baseline concentrations may have been underestimated.

4 Conclusions and Recommendations

4.1 In Castle Donington, monitoring has indicated exceedences of the annual mean objective at relevant receptors along the High Street. Monitoring data from diffusion tube sites 35, 36 and 37 in Castle Donington are not representative of a whole calendar year, with diffusion tubes only recently being located, in mid-2006. However, relevant annual mean equivalent concentrations have been derived, and exceedences are indicated. Future Further Assessment work along the High Street in Castle Donington will consider a 12-month data set, and will clarify whether the Air Quality Management Area to be declared along the High Street is still necessary.

4.2 Modelling work in Castle Donington has indicated that exceedences are experienced only at those properties located next to the carriageway along the High Street and along Bondgate, and in particular the properties located at the junction with Delven Lane.

4.3 With respect to Coalville, monitoring results from both Broom Leys Road Junction (diffusion tube site 23) and Bardon Road (site 5) have indicated exceedences of the annual mean nitrogen dioxide objective for the last three years, with exceedences also indicated over 2005 and 2006 for more recently located diffusion tubes at Broom Leys Road Junction (site 29) and Bardon Road (sites 27 and 30).

4.4 Modelling work in Coalville has identified exceedences of the annual mean objective at properties along the east section of Broom Leys Road. Along Bardon Road in Coalville, the modelled outcomes suggest that the annual mean nitrogen dioxide objective is not exceeded at properties on the south west side of Bardon Road. This is likely to be as a result of the prevailing wind direction.

4.5 As a result of the modelling and monitoring undertaken in Castle Donington and Coalville, the following recommendations are made:

1. That an Air Quality Management Area (AQMA) be declared for the nitrogen dioxide annual mean objective along the High Street and Bondgate area of Castle Donington. The northern extent of the AQMA should not extend beyond the junction of Bondgate with Spital, but should encompass diffusion tube site 34. This will allow a full 12-month monitoring data to be considered from site 34, as part of the Further Assessment. The AQMA should encompass the properties in the vicinity of the Delven Lane Junction, including the Hotel, and the southern extent of the AQMA should extend beyond diffusion

tube site 37 (i.e. 56 High Street), encompassing properties located immediately alongside the High Street.

2. That an AQMA be declared for the nitrogen dioxide annual mean objective at Broom Leys Road Junction, encompassing 4 individual properties; 21, 27, 29 and 44 Broom Leys Road.

3. That an AQMA be declared for the nitrogen dioxide annual mean objective covering properties along the north side of Bardon Road, from the junction of Bardon Road with Stephenson Way to the junction of Bardon Road with Bardon Close.

4.6 The recommended extent of the AQMAs is based on the 36µg/m^3 contour and are thus somewhat precautionary. The local authority may wish to declare a larger area, although this will be even more precautionary.

5 References

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6 Glossary

Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal.
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date, taking into account costs, benefits, feasibility and practicality. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides.
Exceedence	A period of time where the concentration of a pollutant is greater than the appropriate air quality objective.
AQMA	Air Quality Management Area
ADMS Roads	Atmospheric Dispersion Modelling System for Roads.
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometers in aerodynamic diameter.
NO_2	Nitrogen dioxide.
$\mu g/m^3$	Microgrammes per cubic metre.
HDV	Heavy Duty Vehicles >3.5 tonnes
AADT	Annual Average Daily Traffic

7 Appendix 1 – Adjustment of Short-Term Data to Annual Mean

7.1 Additional diffusion tube monitoring sites were established at a number of locations in 2007, and a number of established sites have incomplete data for 2006. As a result, data for these sites do not meet the minimum requirements for reporting an annual mean concentration. Therefore, in accordance with the guidance in LAQM.TG(03), the data have been adjusted to give an estimated annual mean, based on the ratio of concentrations during the relevant short-term monitoring periods to those over a full calendar year at sites where long-term data are available (>90% data capture). The Leicester Centre, Market Harborough and Nottingham Centre AURN sites have been used for this purpose, because they have reliable long-term datasets and are background sites (i.e. not roadside or kerbside), as recommended in LAQM.TG(03) (Defra, 2003b).

7.2 The annual mean nitrogen dioxide concentrations and the period means for each of the monitoring sites from which adjustment factors have been calculated are presented in Table A1.1, along with the overall factor.

Table A1.1 Data used for the Adjustment of Short-term Monitoring Data to 2006 Annual Means

Nitrogen Dioxide				
Period Mean Concentration (µg/m^3)	**Leicester Centre**	**Market Harborough**	**Nottingham Centre**	**Overall Factor**
2006	30.5	10.9	33.6	-
April – October 2006	28.2	8.4	29.2	
Adjustment Factor	**1.081**	**1.291**	**1.150**	**1.174**
January – July 2007	29.8	10.7	31.6	-
Adjustment Factor	**1.022**	**1.019**	**1.064**	**1.035**
March – June 07	27.0	9.0	28.7	**-**
Adjustment Factor	**1.129**	**1.216**	**1.169**	**1.171**

8 Appendix 2 – Dispersion Modelling Methodology

8.1 Annual mean concentrations of nitrogen dioxide during 2006 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads if one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003b).

Meteorological Data:

8.2 The model has been run using a full year of meteorological data for 2006 from the meteorological station at Church Lawford, which is approximately 38km south of the study areas.

Horizontal Road Alignment:

8.3 Road alignment was based around Ordnance Survey road centreline data. Each carriageway of each road was entered into the model separately, where data were available. Those roads not explicitly included have been accounted for via the background component of the modelled results.

Traffic Data:

8.4 Traffic data have been determined from count data provided by Leicestershire County Council, for counts carried out in Coalville at the Broom Leys/Stephenson Way junction in 2006, the Broom Leys/Bardon Road junction in 2005 and for Bardon Road in 2004, and for Castle Donington at the junction of Bondgate/High Street with Delven Lane/Park Lane in 2001. These data have been factored forward to the assessment year using growth factors derived from National Road Traffic Forecast (NRTF) factors (DETR, 1997), adjusted to local conditions using the TEMPRO System v5 (DfT, 2007). Traffic speeds have been estimated from local speed restrictions and the proximity to a junction, and the proportion of HDVs has been assumed to remain constant. A summary of the traffic flows entered into the models for each of the study areas are presented in Tables A2.1 and A2.2. They are presented as AADT flows for all traffic and separately for HDV AADT flows.

Table A2.1 Summary of Traffic Flows used in Coalville Assessment[a]

Contribution of:	To the Flow on:	2006	
		AADT	HDV AADT
Stephenson Way (north)	Broom Leys Road (east)	2828	106
	Stephenson Way (south)	5671	1278
	Broom Leys Road (west)	365	21
Broom Leys Road (west)	Stephenson Way (north)	691	15
	Broom Leys Road (east)	3644	167
	Stephenson Way (south)	31	2
Stephenson Way (south)	Broom Leys Road (west)	87	6
	Stephenson Way (north)	5818	1375
	Broom Leys Road (east)	306	16
Broom Leys Road (east)	Stephenson Way (south)	323	15
	Broom Leys Road (west)	3725	158
	Stephenson Way (north)	3227	97
Broom Leys Road	Bardon Road	84	2
	Forest Road	2633	60
	London Road	1918	155
London Road	Broom Leys Road	2222	130
	Bardon Road	2620	207
	Forest Road	1438	40
Forest Road	London Road	941	22
	Broom Leys Road	2431	50
	Bardon Road	643	20
Bardon Road	Forest Road	587	16
	London Road	2166	169
	Broom Leys Road	74	6
Road Link			
Bardon Road northbound		10524	1486
Bardon Road southbound		11149	1591

[a] AADT – Annual Average Daily Traffic flow

Table A2.2 Summary of Traffic Flows used in Castle Donington Assessment[a]

Contribution of:	To the Flow on:	2006	
		AADT	HDV AADT
Park Lane	Bondgate	1517	22
	Delven Lane	456	10
	High Street	838	12
High Street	Park Lane	980	23
	Bondgate	2779	109
	Delven Lane	527	78
Delven Lane	High Street	629	35
	Park Lane	644	10
	Bondgate	696	46
Bondgate	Delven Lane	487	33
	High Street	2812	76
	Park Lane	1152	15

Background Concentrations:

8.5 Background concentrations of nitrogen dioxide have been taken from the national maps of background concentrations available from the Air Quality Archive (Defra, 2007a).

Model Verification:

8.6 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict annual mean road-NOx concentrations during 2006 at the diffusion tube monitoring locations within each of the study areas.

8.7 The model outputs of road-NOx (i.e. the component of total NOx coming from road traffic) have been compared with the 'measured' road-NOx. Total measured NOx was calculated from the measured NO_2 concentrations at each of the monitoring location using the recently updated NOx from NO_2 calculator[3] available on the Air Quality Archive website (Defra, 2007b). The measured road-NOx contribution was then calculated as the difference between the total and the background value.

8.8 A weighted primary adjustment factor for each study area was then determined as the inverse of the slope of the best fit line between the calculated (measured) road contribution and the model derived road contribution, forced through zero. (Each diffusion tube measurement was weighted according to its perceived relative accuracy, taking into account the number of months data available and whether the concentration was an annual mean or an annual mean equivalent). The appropriate adjustment factor was applied to the modelled road-NOx concentration for each receptor within the particular study area to provide an adjusted modelled road-NOx concentration. The appropriate background concentration was added to these concentrations to determine the adjusted total modelled NOx concentration. The road contribution to the total annual mean nitrogen dioxide concentration was then determined from these adjusted modelled concentrations, following the method set out by Defra (2003b), taking into account the most recent guidance (Defra, 2007c):

$$NO_2 \text{ (road)} = NOx \text{ (road)} \times (-0.0719 * LN(NOx(total)) + 0.6248$$

8.9 The total nitrogen dioxide concentration was then determined by adding the background NO_2 concentration to this calculated road contribution. A weighted secondary adjustment factor was

[3] http://www.airquality.co.uk/archive/laqm/tools/NOxfromNO2calculator2007.xls

finally calculated as the inverse of the slope of the best fit line applied to the adjusted data and forced through zero.

8.10 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data presented in this report:

Coalville

Primary adjustment factor : 2.01

Secondary adjustment factor: 1.00

Castle Donington

Primary adjustment factor : 7.94

Secondary adjustment factor: 1.00

8.11 The results imply that the model was under-predicting the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustments are insignificant. Figures A2.1 and A2.2 compare the modelled concentrations at each diffusion tube (in each study area), after all adjustments have been made, to the measured concentrations at these locations. The higher adjustment factor in Castle Donington will reflect the more confined setting of the road.

8.12 Monitoring site 34 in Castle Donington was excluded for model verification purposes due to only 2 months of monitoring data, for April and June 2007, being available.

Figure A2.1 Comparison of measured NO_2 to fully adjusted modelled NO_2 concentrations – Coalville

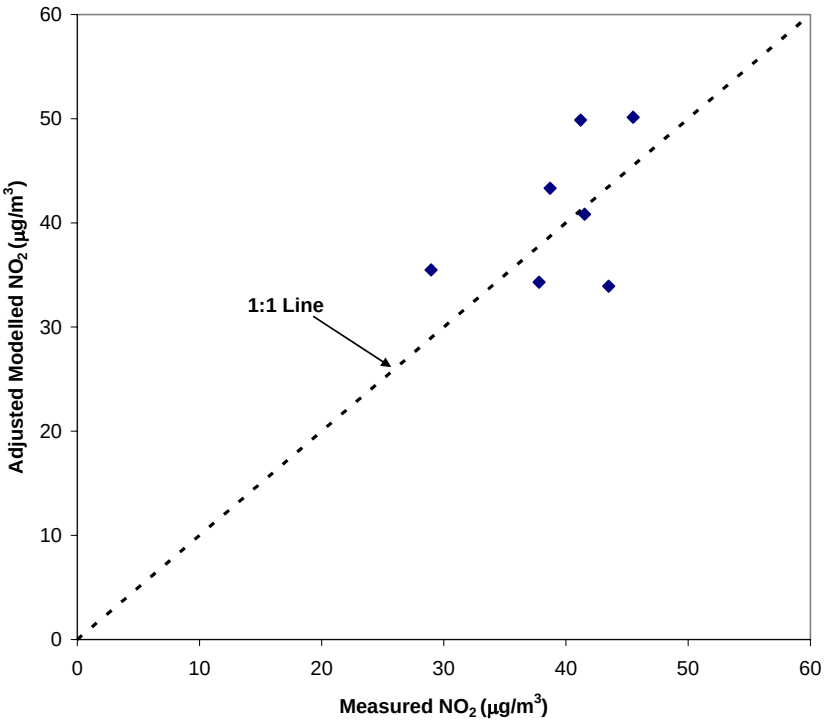

Figure A2.2 Comparison of measured NO_2 to fully adjusted modelled NO_2 concentrations – Castle Donington