# Air Quality Review and Assessment

Stage 4


**Manchester City Council**

July 2006

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## SUMMARY

Under Section 84(1) of the Environment Act (1995), Local Authorities that declare an Air Quality Management Area (AQMA) are required to undertake a further review and assessment of air quality within 12 months of the date of the Order. Following the designation of a new AQMA in Manchester in July 2005, this report represents that further review, which has become known as the 'Stage 4 review and assessment'.

The aims of the Stage 4 process were to

- confirm the original assessment;
- calculate how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;
- refine the knowledge of the sources of pollution by source apportionment studies;
- take account of local and national policy developments; and
- respond to any comments made by statuary consultees in respect of authorities earlier reports.

The report presents a description and discussion of each of these steps. The work to compile this report has been timely, but the essential conclusions have not changed. The majority of the Government's various health-based air quality Objectives are being or are predicted to be met. However long term annual average levels of nitrogen dioxide remain above the Objective, and the key source of these measured and predicted exceedences is road traffic exhaust emissions.

Nevertheless the requirements of the LAQM regime combined with the City Council's own actions have resulted in a number of improvements. In respect of technical assessments, emissions inventory methodology and monitoring techniques continue to be improved.

The integration of air quality and transport action planning is a key requirement of the Government's recent approach to the management of traffic emissions, and co-ordinated working across the Greater Manchester authorities has enabled clear measures to be adopted. A series of actions and targets have been established, and in the near future it is likely that the focus will be on a review of the Greater Manchester Air Quality Action Plan.

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# 1 INTRODUCTION

Manchester City Council has recognised and fulfilled its duties under the Government's Local Air Quality Management legislation since the regime was formalised in 1997. There has been an ongoing review and assessment of air quality in the city, with a series of screening, detailed assessment and progress reports submitted to Defra and consultees as required.

Under Section 84(1) of the Environment Act (1995), Local Authorities that declare an Air Quality Management Area (AQMA) are required to undertake a further review and assessment of air quality within 12 months of the date of the Order. Following the designation of a new AQMA in Manchester in July 2005, this report represents that further review, which has become known as the 'Stage 4 review and assessment'.

## 1.1 Legislative Background

Part IV of the Environment Act 1995 introduced new responsibilities for Local Authorities relating to Local Air Quality Management (LAQM). The Act also laid the foundations for a policy that eventually led to the publication of the *National Air Quality Strategy* in March 1997. The new Government later that year endorsed the Strategy, but committed to review it at the earliest opportunity. The second edition, *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, was published in January 2000, which accounted for the devolved administration in a joint approach with common objectives but allowing for different policies of implementation.

The original Strategy identified eight air pollutants associated with effects on human health, and laid down future Objectives for health protection. The revised Strategy introduced further Objectives for the protection of vegetation and ecosystems. The pollutants covered by the Strategy are as follows:

- benzene
- 1,3-butadiene
- carbon monoxide
- lead
- nitrogen dioxide
- particles (as '$PM_{10}$')
- sulphur dioxide
- ozone (not prescribed in Regulations)

An *Addendum* to the Strategy was published in February 2003 which tightened the Objectives for particles, introduced variations in Objectives for carbon monoxide and benzene, and initiated an Objective for polycyclic aromatic hydrocarbons ('PAH') in line with EU Daughter Directives. The current version of the statutory Objectives is provided in Table 1.1.

## Table 1.1 The Air Quality (England) Regulations 2000 as amended by the Air Quality (England) (Amendment) Regulations 2002

| Pollutant | Objective | | Date to be achieved by |
|---|---|---|---|
| | Concentration | measured as | |
| **Objectives for the protection of human health** | | | |
| Benzene | 16.25μg/m$^3$ | running annual mean | 31 December 2003 |
| | 5μg/m$^3$ | annual mean | 31 December 2010 |
| 1,3-Butadiene | 2.25μg/m$^3$ | running annual mean | 31 December 2003 |
| Carbon Monoxide | 10mg/m$^3$ | maximum daily running 8-hour mean | 31 December 2003 |
| Lead | 0.5μg/m$^3$ | annual mean | 31 December 2004 |
| | 0.25μg/m$^3$ | annual mean | 31 December 2008 |
| Nitrogen dioxide[a] | 200μg/m$^3$ not to be exceeded more than 18 times a year | hourly mean | 31 December 2005 |
| | 40μg/m$^3$ | Annual mean | 31 December 2005 |
| Particles, $PM_{10}$ (gravimetric)[b] | 50μg/m$^3$ not to be exceeded more than 35 times a year | 24 hour mean | 31 December 2004 |
| | 40μg/m$^3$ | annual mean | 31 December 2004 |
| Sulphur Dioxide | 350μg/m$^3$ not to be exceeded more than 24 times a year | hourly mean | 31 December 2004 |
| | 125μg/m$^3$ not to be exceeded more than 3 times a year | 24 hour mean | 31 December 2004 |
| | 266μg/m$^3$ not to be exceeded more than 35 times a year | 15 minute mean | 31 December 2005 |

a) The Objectives for nitrogen dioxide are provisional.

b) A provisional Objective for $PM_{10}$ in England & Wales (outside London) has been set at 50μg/m$^3$ as a 24 hour mean with the exceedences allowed reduced to 7 days, to be achieved by 2010, and an annual mean in the same areas of 20μg/m$^3$ to be achieved by the end of 2010. Within London, the number of daily exceedences of the 24 hour mean has provisionally been reduced to 10, and the annual mean to 23μg/m$^3$ by the end of 2010, and 20μg/m$^3$ by 2015.

*(Table continued overleaf)*

**Table 1.1** (*continued*)

| Pollutant | Objective | | Date to be achieved by |
|---|---|---|---|
| | Concentration | measured as | |
| **Other Objectives NOT in Regulations:** | | | |
| PAH (Polycyclic aromatic hydrocarbons) | 0.25ng/$m^3$ | annual mean | 31 December 2010 |
| Ozone | 100$\mu$g/$m^3$, not to be exceeded more than 10 times a year | 8 hour mean | 31 December 2005 |
| **Objectives for the protection of vegetation and ecosystems (prescribed in Air Quality Limit Values (England) Regulations 2001):** | | | |
| Nitrogen dioxide (as NOx) | 30$\mu$g/$m^3$ | annual mean | July 2001. Apply only at a distance >20km from an agglomeration, and >5km from Part A regulated processes, motorways and built-up areas of more than 5000 people. |
| Sulphur dioxide | 20$\mu$g/$m^3$ | annual mean | |
| | 20$\mu$g/$m^3$ | winter mean (Oct – Mar) | |

## 1.2 Local Air Quality Management

Local Air Quality Management (LAQM) which came into effect in December 1997 in England, Scotland and Wales requires local authorities to periodically review and assess the current and future quality of air in their areas. The aim of the review is to assess whether air quality standards and objectives are being achieved, or are likely to be achieved measured against the National Air Quality Strategy.

Any part of a local authority where standards or objectives are not being met, or are unlikely to be met must be designated an 'air quality management area' (AQMA). Where an AQMA is designated the local authority must draw up an action plan setting out how it aims to meet air quality standards in that area.

Under local air quality management (LAQM), local authorities must work towards achieving the objectives for seven of the pollutants (see Table 1.1). Ozone levels are affected by pollutants produced outside the UK and are therefore not assessed by local authorities as part of the air quality review and assessment process.

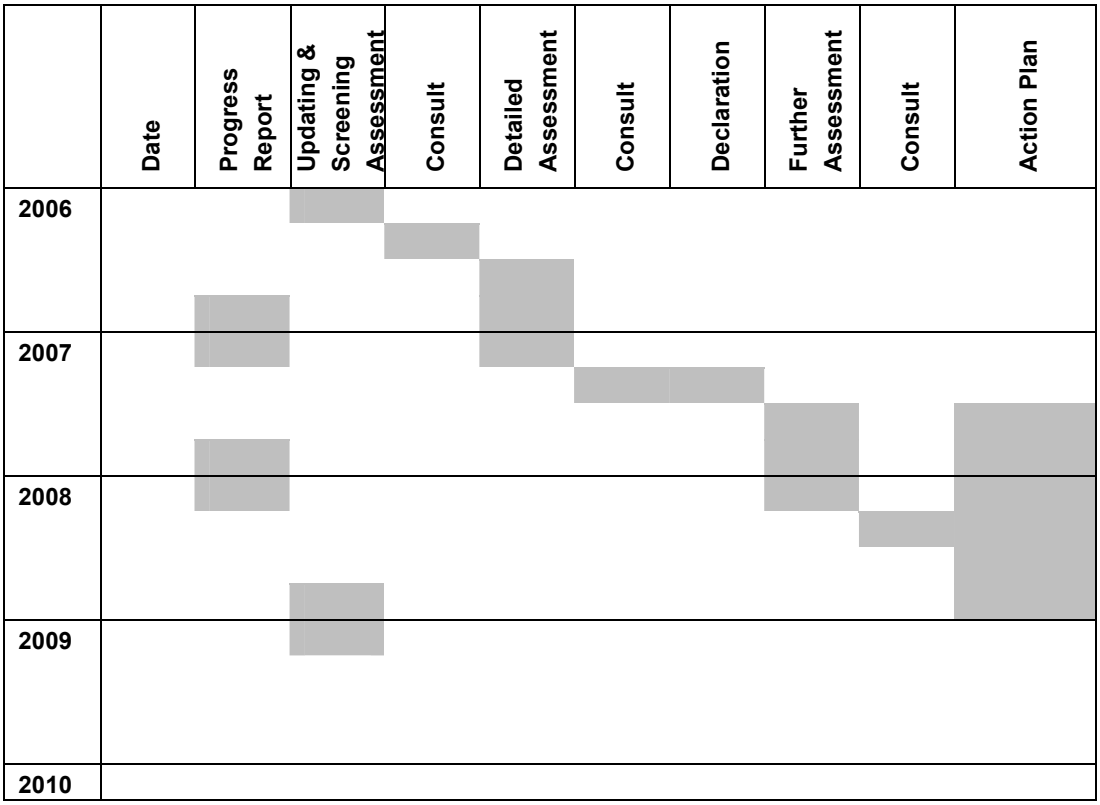
A timetable and phased approach to review and assessment of air quality are outlined in 'Local Air Quality Management Technical Guidance' (LAQM. TG(03)) issued by the Department for Environment Food and Rural Affairs

(DEFRA) in February 2003. The intention is that local authorities should only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded. Not every authority will, therefore, need to proceed beyond the first step in the review and assessment. A description of the 2-step approach is set out in Table 1.2, and the timetable for LAQM is outlined in Figure 1.1.

**Table 1.2 The phased approach to air quality review and assessment (LAQM.TG(03))**

| Level of assessment | Objective |
|---|---|
| Updating and Screening Assessment | To identify those matters that have changed since the last review and assessment, which might lead to a risk of an air quality objective being exceeded. |
| Detailed Assessment | To provide an accurate assessment of the likelihood of an air quality objective being exceeded at locations with relevant exposure. This should be sufficiently detailed to allow the designation or amendment of any necessary AQMAs. |
| Further Assessment | Section 84(1) of the Environment Act 1995 requires authorities to carry out a further assessment of existing and likely future air quality in any area which has been designated as an AQMA. This further assessment is intended to supplement information the authority has already produced during a Detailed Assessment. The intention is that this further assessment will be used to define the relative contribution of different sources within the areas of exceedence, so as to allow a focused action plan to be prepared. |
| Progress Report | Progress Reports are designed to ensure continuity in the LAQM process. They fill the gaps between the three yearly requirement to carry out a review and assessment of air quality. Progress Reports are only required in years when the authority is not carrying out an Updating and Screening Assessment or a Detailed Assessment. |

**Figure 1.1 Timetable for Local Air Quality Management (Defra, LAQM.TG(03))**




Once an AQMA has been declared local authorities are required under Section 84(1) of the Environment Act 1995 to carry out a further assessment of existing and likely future air quality in any area which has been designated as an AQMA. There are two principal aims of the Further Assessment: 1) To confirm the original decision to declare the AQMA; 2) To quantify the source apportionment of emissions for the development of an action plan.

The initial aim is to assess whether the AQMA is still required and if so, whether it needs increasing or decreasing in size. The assessment should then be used to inform the action planning process through source apportionment of emissions and calculation of improvements required to achieve the objectives.

This report constitutes the Stage 4 Air Quality Review and Assessment for Manchester City Council, as required by Section 84(1) of the Environment Act 1995.

## 1.3 Overview of Guidance

DEFRA issued a short guidance note in 2001 regarding those matters which Local Authorities should consider as part of the Further Assessment report[1]. The guidance is not statutory as defined under Part IV of the Act and was provided solely to provide a focus for the report.

The DEFRA guidance indicates that the main purpose of the further assessment is to supplement the information already gathered (in the Detailed Assessment) and to provide the technical justification for measures to be included in the air quality action plan. The report therefore allows authorities:

- To confirm the original assessment of air quality against the prescribed objectives, and thus to ensure that they were right to designate the AQMA in the first place;

- To calculate more accurately how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;

- To refine the knowledge of the sources of pollution so that the air quality action plans can be properly targeted;

- To take account of national policy developments which may come to light after the AQMA designation

- To take account as far as possible of any local policy developments which are likely to affect air quality by the relevant date, and which were not fully factored into earlier calculations. These might include, for example, the implications of any new transport schemes that are likely to be implemented in the vicinity of the AQMA, or of any new major housing or commercial developments that are likely to be built by the relevant date.

- To carry out real-time monitoring where this has not been done as part of the Stage One to Three Review & Assessments

- To carry out further monitoring in problem areas to check out earlier findings

[1] Department for Environment, Food and Rural Affairs (2001). *Guidance to local authorities on the further ('stage 4') assessments of air quality required under section 84 of the Environment Act 1995. Published 23 August 2001 at* http://www.defra.gov.uk/environment/airquality/laqm.htm

- To corroborate other assumptions on which the designation of the AQMA has been based and to check that the original designation is still valid and does not need amending in any way;

- To respond to any comments made by statuary consultees in respect of authorities earlier reports.

# 2 DETAILED ASSESSMENT 2004 KEY FINDINGS

The Updating & Screening Assessment, completed in 2003 concluded that five pollutants required no further assessment: benzene, 1,3-butadiene, carbon monoxide, lead, and sulphur dioxide. The objectives for these pollutants would be met at all locations in Manchester. However, exceedences were possible for the 2004 24-hour $PM_{10}$ objective, the 2005 1-hour nitrogen dioxide objective, and the 2005 annual average nitrogen dioxide objective. A further detailed assessment was therefore required for nitrogen dioxide and $PM_{10}$.

The key findings of the 2004 detailed assessment for nitrogen dioxide and $PM_{10}$ are outlined below:

*Nitrogen Dioxide*

1. Monitoring of nitrogen dioxide revealed that background concentrations in the city centre were currently at, or just above the annual average objective. Background locations outside the city centre were shown to have annual average concentrations below the objective.

2. Exceedences of the objective were shown at roadside locations throughout the city. Annual roadside concentrations showed a discernable downward trend.

3. Results from the nitrogen dioxide monitoring network were projected to 2005. The projected concentrations showed that the objective would be achieved at background locations across the city, including the city centre. Despite the steady reductions in roadside concentrations, some roadside locations still showed predicted exceedences in 2005.

4. No locations in Manchester were shown to be at risk of suffering an exceedence of the 1 hour objective.

5. Atmospheric dispersion modelling of nitrogen dioxide was carried out. The dispersion modelling showed that exceedences of the 2005 annual average can be expected at roadside locations, and within the site boundary at Manchester Airport. Some of the roadside areas of exceedence included locations where exposure was possible. In respect of the environs of the Airport, there are three isolated properties within the curtlidge of the land owned by airport. However these are due to be replaced by other airport functions as part of the expansion plans and will not be residential buildings by 2010.

*Particulate Matter*

1. $PM_{10}$ monitoring carried out in Manchester city centre indicated that there had been exceedences of the 2004 24-hour average Objective concentration value in 1996 and 2001. These years were considered to be atypical, due to unusual meteorological conditions in 1996, and due to building work occurring close to the monitoring site in 2001, leading to artificially elevated concentrations being recorded in that year.

2. Projections of future $PM_{10}$ concentrations, based on existing monitoring data, indicated that there would not be any exceedences of the 2004 Objectives.

3. Atmospheric dispersion modelling was carried out, for $PM_{10}$ in 2004. The dispersion modelling results indicated that all locations in Manchester would achieve the 2004 $PM_{10}$ Objectives.

# 3 RESPONSE TO CONSULTEES COMMENTS

The Environment Act 1995 requires all Local Authorities to consult on the findings of their Review and Assessment of Air Quality, and on any proposals that they may have for the declaration of an Air Quality Management Area.

The ten local authorities within the Greater Manchester conurbation declared an integrated AQMA following the first round of LAQM procedures, and at that time an extensive public consultation exercise was undertaken.

The Greater Manchester authorities gave careful consideration to the responses received during that consultation exercise. The overwhelming majority of respondents agreed with the location and extent of the proposed AQMA at that time. Manchester City Council does however recognise the concerns of certain respondents over the potential health impacts of adverse air quality, which are likely to reflect a wider view in the community. In response to this, consultation has continued as the LAQM process has progressed, and where respondents provided contact addresses and expressed a wish to be kept informed, further information and updating of the work in Manchester has been provided.

The revocation of the original AQMA and designation of a revised area in 2005 was a result of further detailed air dispersion modelling using amended central guidance and updated emissions data. Nevertheless, the principle of the precautionary approach was retained, and it is the view of the Council that a further extensive public consultation exercise on the AQMA itself and the technical methods involved would not serve any useful purpose nor would further inform the public. The intention is to focus the resources

available for such consultation on the development of the Air Quality Action Plan, the aspect of the LAQM regime where consultees have a greater stake and can influence the process by their own actions.

## 3.1 Defra Comments on the Manchester Detailed Assessment 2004

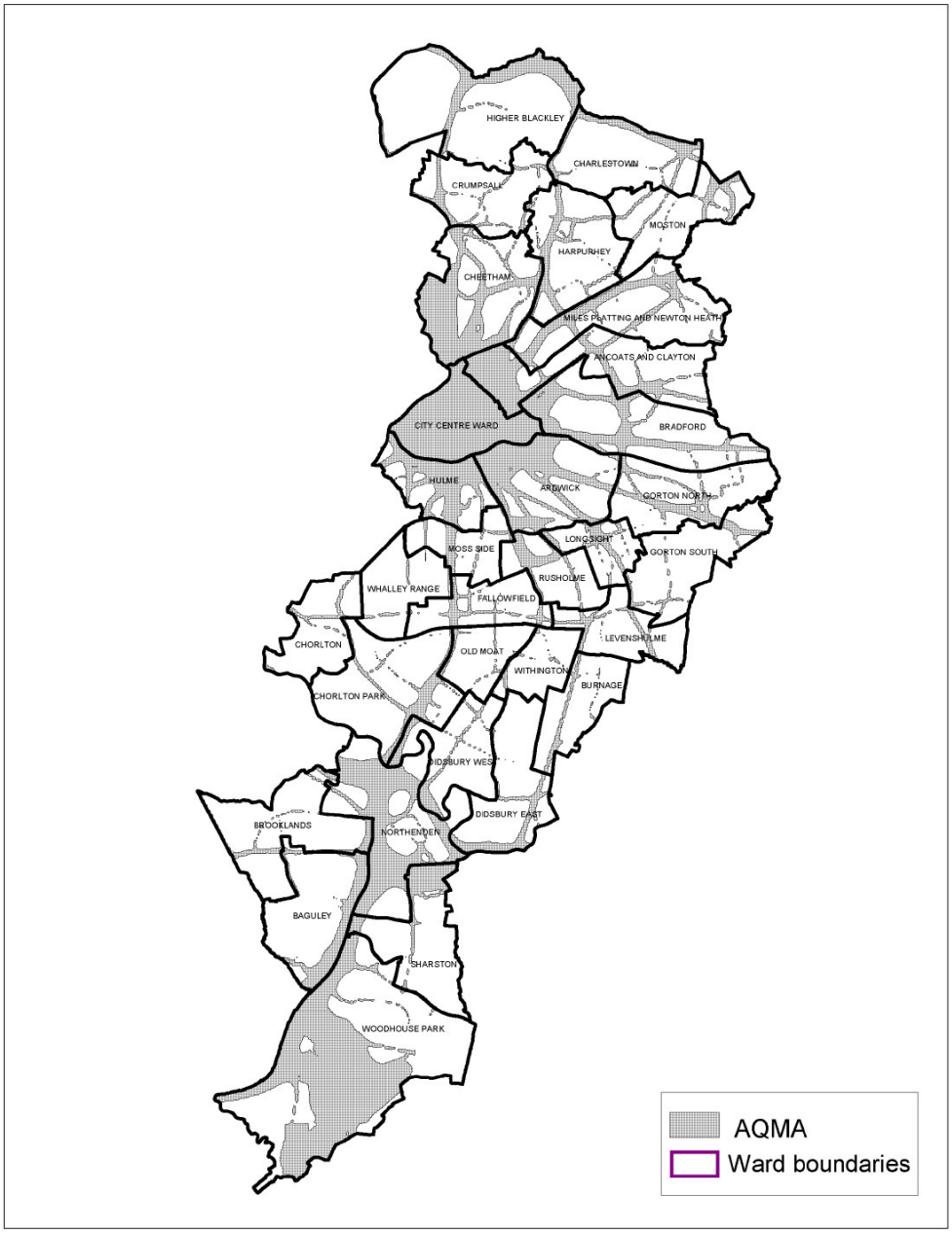
The University of the West of England (UWE) was commissioned by Defra to critically review all formal review and assessment reports submitted by local authorities and to raise technical questions on the procedures as appropriate.

In the most recent Detailed Assessment submitted by Manchester City Council in 2005, the findings of the assessment were accepted and no such technical matters were raised.

# 4 2005 AIR QUALITY MANAGEMENT AREA

In July 2001 Manchester City Council declared an air quality management area for nitrogen dioxide. Following the second round of air quality review and assessment completed in 2004, Manchester City Council revoked this original AQMA and declared a revised boundary. The new AQMA covers all areas where the concentration of nitrogen dioxide was predicted to be 35 micrograms per cubic metre or more, see Figure 4.1.

**Figure 4.1 Manchester City Council Air Quality Management Area 2005 Nitrogen Dioxide**



# 5 CORROBORATION OF PREVIOUS FINDINGS FOR NITROGEN DIOXIDE

**Objectives:**

- **200μg/m$^3$ 1-hr mean (18 exceedences) by December 2005; and**
- **40μg/m$^3$ annual mean by December 2005.**

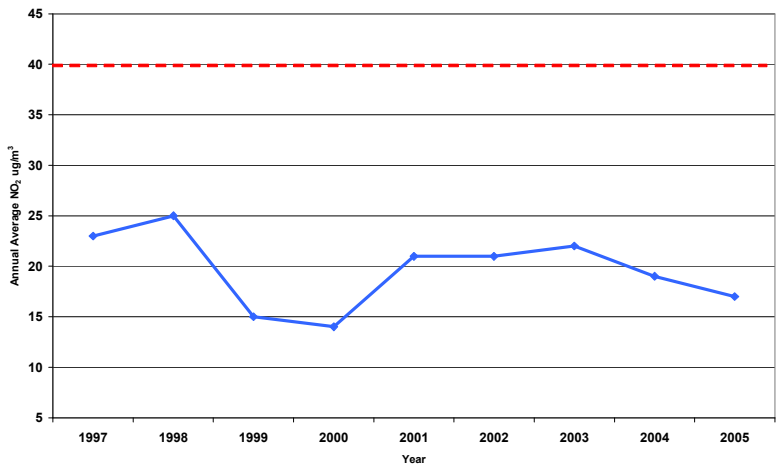
## 5.1 Air Quality Monitoring Update

### 5.1.1 Monitoring data outside the AQMA

*Continuous Automatic Monitoring*

Manchester City Council operate one chemilimuninescent NOx analyser outside the AQMA, located at the Manchester South AURN site. Data obtained at this site are subject to the rigorous QA/QC procedures in the UK national ambient air quality monitoring network. Results obtained from this analyser are shown in Figure 5.1, and the percentage data capture information is presented in Table 5.1.

**Figure 5.1 Measured annual average nitrogen dioxide concentrations (μg/m$^3$) at the Manchester South AURN site, 1997-2006.**



Monitoring results for 2005 cannot be considered representative as the reported data capture was very low due to technical faults with the analyser which were discovered only during the retrospective data ratification process. Summarised monitoring results can be found in Appendix 1.

**Table 5.1 Percentage Nitrogen Dioxide Data Capture at the Manchester South AURN site.**

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|
| % Data Capture | 95% | 98% | 71% | 81% | 96% | 89% | 98% | 87% | 7% |

Figure 5.1 indicates that levels of nitrogen dioxide have been well below the annual objective at this location since 1997. The Manchester South site is situated in a suburban location, to the south of the city centre, near Manchester International Airport. Air pollutant concentrations measured at this location are likely to arise from the combination of general background and distant road traffic sources, together with a contribution from the airport's activities.

*Non continuous diffusion tube monitoring*

In addition to the Manchester South chemiluminescent analyser, Manchester City Council monitors nitrogen dioxide by diffusion tube sampling at five locations outside the AQMA. These diffusion tubes provide an effective means of establishing average nitrogen dioxide concentrations across a wide spatial area.

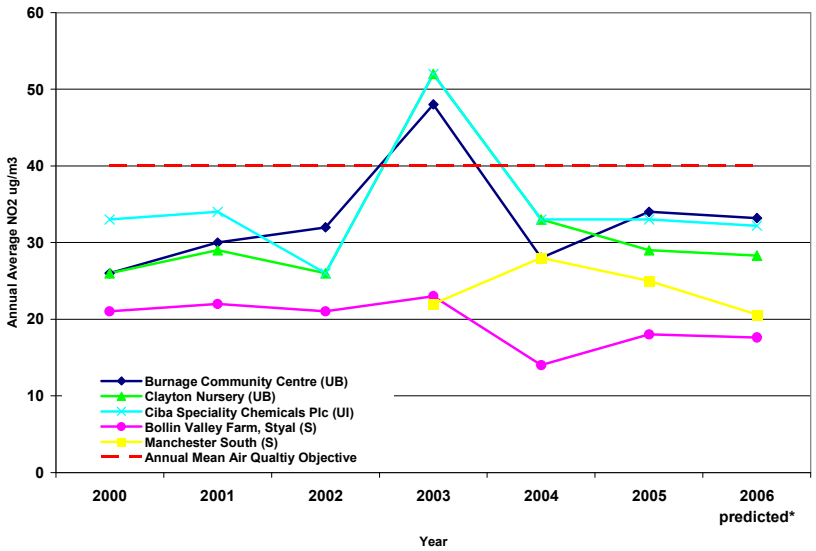
Technical Guidance note LAQM TG(03) Boxes 6.3 and 6.4 provide a method for establishing whether diffusion tubes show a bias, and a means for correcting that bias. The calculation of diffusion tube bias is described in full in Appendix 1.

Of the five diffusion tubes located outside the AQMA, two are located in urban background locations, one at an urban industrial site, and the remaining two at suburban sites (one of these being at the Manchester South AURN station where it is co-located with the continuous analyser). The tubes are exposed over either weekly or monthly periods, and the results from these sites are shown in Figure 5.2

Annual average diffusion tube monitoring results from outside the AQMA show that levels of nitrogen dioxide have generally been below the annual mean air quality Objective since 2000, with the exception of 2003 at three of the sites. This reflects the national picture when ambient air quality measurements were elevated in 2003 across the UK due to adverse meteorological dispersion conditions. Although such conditions do occur

periodically, the measured continuous and diffusion tube data indicate that the nitrogen dioxide annual mean Objective is generally achieved at representative locations outside the AQMA in Manchester.

**Figure 5.2 Annual Average Nitrogen Dioxide monitoring results (μg/m$^3$) from diffusion tube sites located outside the AQMA.** UB = Urban background, UI = Urban Industrial, S = Suburban.




**Estimated annual mean concentrations for 2006 have been calculated using the Year Adjustment Calculator spreadsheet available from the air quality archive website (www.airquality.co.uk/archive/laqm/tools.php).*

## 5.1.2 Monitoring data within the AQMA

*Continuous Automatic Monitoring*

Manchester City Council operate two chemiluminescent NOx analysers at locations inside the AQMA. One analyser is located in an urban centre location, at the Manchester Piccadilly AURN site, and the other analyser is located in an urban background location at the Manchester Town Hall AURN site. Results obtained from these analysers are shown in Figure 5.3. These results should be read in conjunction with percentage data capture information in Table 5.2.

Monitoring results from these sites is quality assured to a high standard, by an independent third party, and in accordance with AURN procedures. The results indicate that there has not been an exceedence of the one hour objective since 1994. However, the results do indicate that there have been periodic exceedences of the annual average nitrogen dioxide objective.

Monitoring results for 2005 at the Manchester Piccadilly site can not be considered representative as data capture was well below 90%. Full monitoring results can be found in Appendix 1.

**Figure 5.3 Measured annual average nitrogen dioxide concentrations (μg/m$^3$) at the Manchester Piccadilly and Manchester Town Hall AURN sites.**

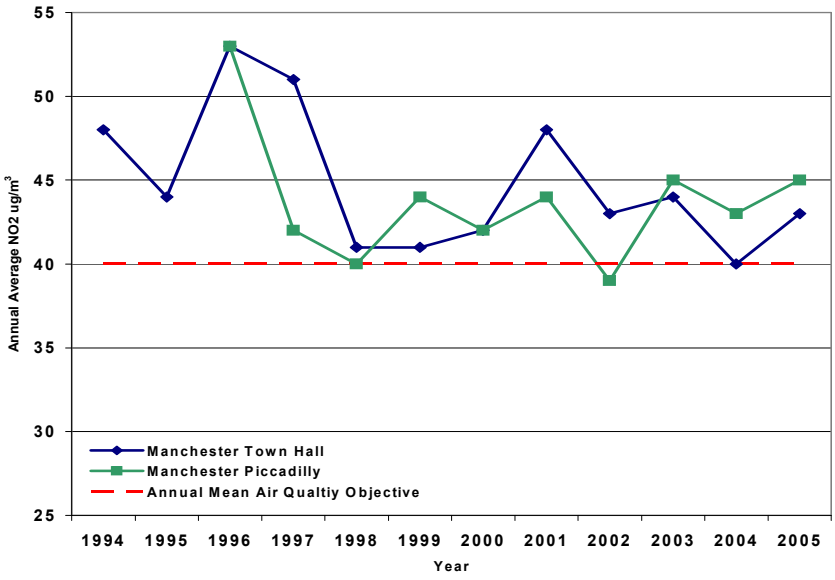



**Table 5.2 Percentage Nitrogen Dioxide Data Capture at the Manchester Piccadilly and Manchester Town Hall AURN sites.**

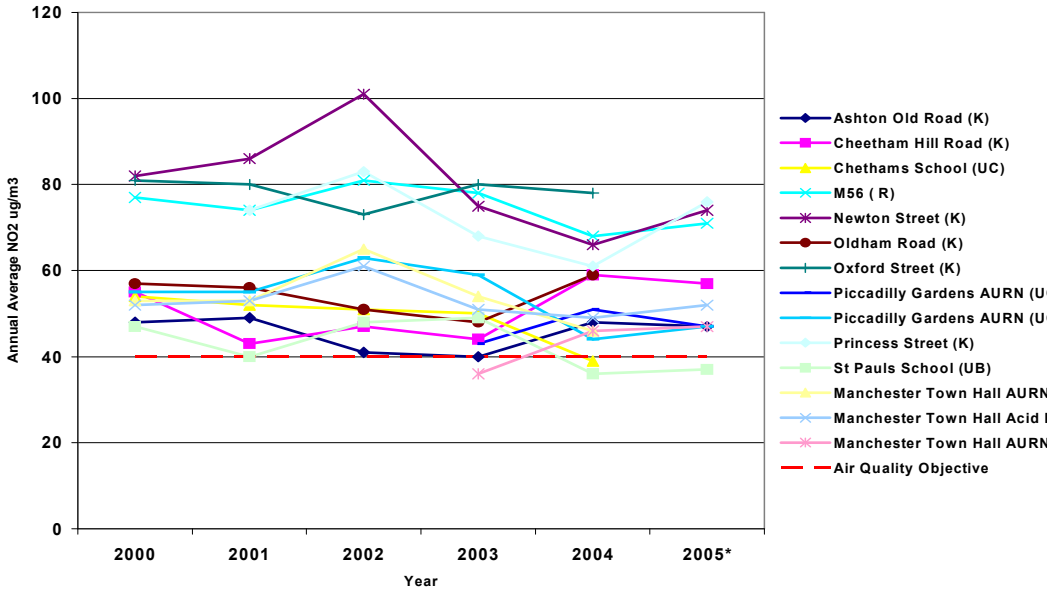
| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mcr Piccadilly | | | 92% | 91% | 95% | 95% | 97% | 72% | 90% | 98% | 94% | 49% |
| Mcr Town Hall | 99% | 94% | 97% | 96% | 97% | 99% | 95% | 99% | 99% | 99% | 95% | 95% |

*Non continuous diffusion tube monitoring*

In addition to these two analysers, Manchester City Council expose diffusion tubes at thirteen locations within the AQMA. The bias exhibited by these diffusion tubes was calculated, using the methodology shown in Boxes 6.3 and 6.4 of LAQM.TG(03). The calculation of the diffusion tube bias is described in Appendix 1. The results from these sites are shown in Figure 5.4

Figure 5.4 indicates that annual average levels of nitrogen dioxide inside the AQMA have generally been above the annual mean air quality Objective since 2000.

**Figure 5.4** Annual Average Nitrogen Dioxide monitoring results (μg/m$^3$) from diffusion tube sites located outside the AQMA. **K = Kerbside, UC = Urban Centre, R = Roadside, UB = Urban background**



## 5.2 Reassessment of Monitoring Data

Assessment of monitoring data against the prescribed air quality objectives is intended to ensure that the AQMA designated in 2005 is still valid, and where necessary highlight where amendments are needed.

### 5.2.1 Monitoring Data Outside the AQMA

Annual Mean monitoring results from the chemiluminescent NOx analyser (Manchester South AURN site), and nitrogen dioxide diffusion tubes at five locations outside the AQMA indicate continued compliance with the annual mean objective.

Automatic hourly measurements from the chemiluminescent NOx analyser outside the AQMA (Manchester South AURN site) continue to show compliance with the hourly objective.

### 5.2.2 Monitoring Data Inside the AQMA

Annual Mean monitoring results from the chemiluminescent NOx analysers (Manchester Piccadilly Manchester Town Hall AURN sites), and nitrogen dioxide diffusion tubes at sixteen locations inside the AQMA indicate continued exceedence of the annual mean objective[2].

Automatic hourly measurements from the chemiluminescent NOx analysers inside the AQMA (Manchester Piccadilly AURN site, Manchester Town Hall AURN site) continue to show compliance with the hourly objective.

### 5.2.3 Summary

Monitoring results inside and outside the AQMA indicate continued compliance with the *hourly* Objective. The main issue with ambient nitrogen dioxide levels in Manchester continues to be, not with the short-term peak values, but with the annual mean concentrations. All exceedences of the annual mean Objective continue to be within the AQMA (although low data capture at the Manchester South AURN site outside the AQMA is noted)

Monitoring data compiled since publication of Manchester City Council's Detailed Assessment in 2004 confirm the findings of that assessment of nitrogen dioxide. The designation of the AQMA is largely endorsed by measurements of nitrogen dioxide in the Manchester air quality monitoring network.

[2] With the exception of one diffusion tube site at St Paul's School

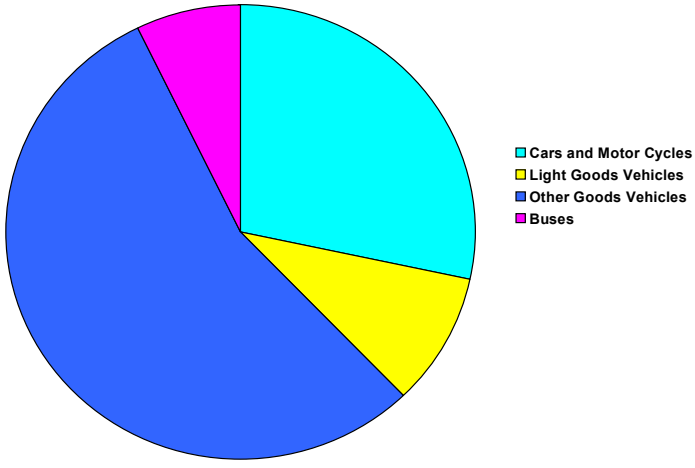
# 6 SOURCE APPORTIONMENT

Source apportionment modelling is the process whereby the relative contributions from the sources of a pollutant are determined by analysis of receptor concentrations. The approach allows the key emission sources to be identified and options to reduce ambient concentrations of pollutants by controls at source can then be considered and assessed.

The Emissions Inventory for the Greater Manchester Area ('EMIGMA') contains information on the emissions of pollutants identified in the UK's Air Quality Strategy from all identifiable sources in the area. The database covers an area of 1552 $km^2$ encompassing the ten administrative districts of Greater Manchester and the district of Warrington in Cheshire.

The EMIGMA database is updated each year, the latest report produced in March 2005 describes estimates of the emissions produced in the conurbation during 2003. The report provides a breakdown of 2003 major road $NO_X$ emissions by vehicle type for the Greater Manchester Authorities, the results are shown in Figure 6.1.

**Figure 6.1 2003 Major Road $NO_X$ Emission Totals by Vehicle Type (Greater Manchester)**




Despite comprising a relatively small proportion of the total number of vehicles on the road, the category of 'other goods vehicles'[3] contribute over half of the emissions of nitrogen oxides on major roads in Greater Manchester. Dispersion modelling shows that the major road network, in particular the motorways, are identified as areas where ground level pollution concentrations are highest. The correlation between the highways network

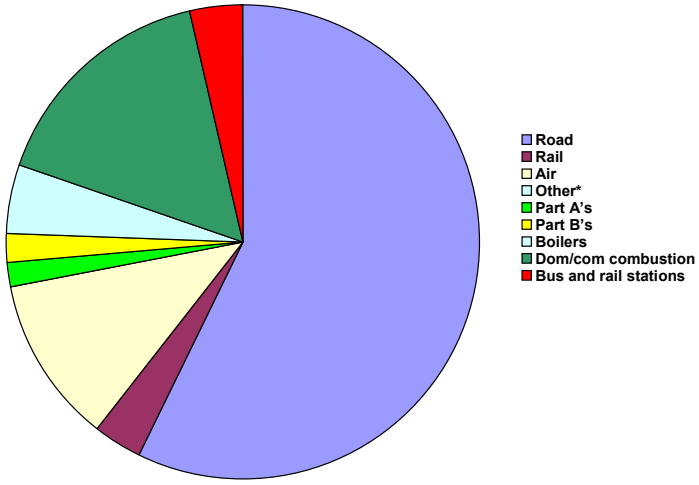
[3] A combination of OGV1 vehicles with 2 or 3 axles and OGV2 vehicles with 4 axles or more.

and high levels of emissions is clearly evident in the Manchester AQMA map (Figure 4.1).

The relative contribution to total NOx in Manchester by all source categories is shown in Figure 6.2. Emissions from sources such as industrial activities and domestic fuel burning contribute a much lower proportion of ground level pollution concentrations than road traffic. Although emissions from these sources may not lead to exceedences of the air quality objectives on their own, they do contribute to the elevated overall background concentrations in urban areas such as Manchester .

**Figure 6.2 Percentage contribution of different source categories to total NOx in Manchester (2003 EMIGMA Update).**

*Other includes other combustion, anthropogenic and biogenic sources




Key emissions sources in the city include;

- The M60 orbital motorway, with traffic flows of over 100,000 vehicles per day in the north of the City, at Junction 20.
- The M56 motorway, with traffic flows of up to 149,887 vehicles per day at Junction 4, in the south of City.
- The major road network, with traffic flows of up to 76,511, at the junction of A5103 Princess Road and the A6010 Barlow Moor Road.
- 7 'Part A' permitted industrial processes and 100 'Part A2' and 'Part B' permitted industrial processes.
- 40 industrial boiler plants, with a rated output of >2MW.
- Manchester Airport, with 189,065 aircraft movements per year, 21,001,950 passengers, and 189,065 tonnes of airfreight per year (2003 figures).

# 7 LEVEL OF IMPROVEMENT REQUIRED TO MEET OBJECTIVE

To determine the degree of reduction in emissions required to theoretically achieve the annual average nitrogen dioxide Objective, it is necessary to take account of the nature of its formation in air. $NO_2$ itself is not released directly from vehicle exhausts or combustion processes, but is formed by atmospheric reactions of a mixture of nitrogen oxides. The primary species released is nitric oxide (NO), which is converted to $NO_2$ according to oxidant availability and other complex atmospheric chemistry and meteorological factors. This conversion also varies with primary NOx concentration.

For predictive purposes therefore, emissions are estimated in terms of NOx, and an empirical function is used to derive the equivalent $NO_2$ concentration. Details of the NOx:$NO_2$ relationship used in modelling studies are provided in Manchester's Detailed Assessment report. The approach recommended in Defra LAQM Guidance Note TG(03)[4] (Box 6.9) gives the following relationship for road traffic sources:

**Equation 1:**

$$NO_{2(road)} = ((-0.068 \text{ x } \text{Ln}(NOx_{(total)})) + 0.53) \text{ x } NOx_{(road)}$$

where

$$NOx_{(total)} = NOx_{(background)} + NOx_{(road)}$$

This equation can therefore be used to determine the percentage reduction in primary emissions of NOx required to achieve an $NO_2$ concentration below the Objective. This has been undertaken for those receptor locations where model outputs in the Detailed Assessment indicated exceedences of the annual mean Objective, and the calculated required reduction in roadside NOx concentrations for the Objective to be met in 2010 are given in **Table 7.1**

[4] Defra (2003). Local Air Quality Management Technical Guidance Note TG(03). January 2003, Ref PB7514.

**Table 7.1 Calculated Required Percentage Traffic NOx Reductions**

| Location | Modelled $NO_2$, µg/m$^3$ | 2010 Background concentrations, µg/m$^3$ | | % Reduction in NOx required |
|---|---|---|---|---|
| | 2005 | NOx | $NO_2$ | |
| M56 / A5103 Princess Rd | 43.04 | 41.9 | 26.2 | 2.7% |
| M56 Jn 4, city bound sliproad | 48.46 | 37.4 | 24.2 | 21.9% |
| M56 / A560 Altrincham Rd | 48.32 | 41.4 | 26.0 | 18.2% |
| M56 Jn 5 Woodhouse Park | 52.31 | 35.8 | 23.5 | 11.8% |
| A34 Oxford Rd City Centre | 43.85 | 60.9 | 34.2 | 64% |

The degree of NOx reduction required for $NO_2$ to be at or below 40µg/m$^3$ in 2010 depends on the predicted NOx concentration and the background concentration at any particular location, as shown by the relationship in Equation 1. **Table 7.1** shows that up to 22% reduction in traffic-related NOx emissions would be required at the various sections of the M56 on the southern boundary of the city. At the city centre receptor a much larger reduction in *traffic related* NOx emissions would be required, but this reflects the significantly higher background concentration at this location. This in turn indicates that the Objective is unlikely to be met by reductions in primary vehicle emissions alone at this roadside location, and that other measures to reduce NOx from overall city centre traffic, commercial and residential sources and industrial activities would be required. This conclusion has been taken forward into air quality action planning for the Greater Manchester conurbation as a whole, and for Manchester City Council with their City Centre campaign (see page 28) being an example of a project to tackle the range of emission sources in the city centre.

## 7.1 The Air Quality Action Plan

Where local authorities have designated an AQMA they have a duty under section 84(2) of the 1995 Act to produce an Air Quality Action Plan (with the exception of authorities rated as ‘excellent’ under the Comprehensive Performance Assessment).

Manchester City Council has used the results of the Review and Assessment of Air Quality to identify the areas of the city, where the health based air pollution targets may not be achieved. These findings inform the air quality actions for the Council and the regeneration of the City. Development proposals include an integrated approach to air quality and sustainable activities. Manchester City Council is fully committed to partnership working with the other 9 Greater Manchester authorities on the Greater Manchester Air Quality Action Plan, which sets out how they will improve air quality.

Annex 3 of the Greater Manchester Air Quality Action Plan sets out the policies and programmes that will be implemented at a local level within the Manchester City Council area. Progress on implementing the Manchester air quality action plan can be found in Manchester City Councils 'Air Quality Progress Report', July 2005.

In 2005 DEFRA issued Policy Guidance: Addendum LAQM.PGA(05) which recommended integration of Air Quality Action Plans with Local Transport Plans for local authorities with AQMAs where 'local transport is identified as a major source of local air pollution concentrations (aside from background concentrations) within the AQMA or where local road traffic is the major source of predicted exceedences of the air quality objectives'.

The emission source apportionment analysis Figure 6.2 clearly indicates that road transport in Manchester is a primary source of air emissions linked to the designation of the AQMA. Analysis of the AQMA map Figure 4.1 also reveals a strong correlation between emissions and the highways network.

In 2005 the Greater Manchester authorities agreed to build on existing joint air quality work and began to actively integrate the Greater Manchester Air Quality Action Plan (GM AQAP) and the Greater Manchester Local Transport Plan2 (GM LTP2), in a bid to reduce emissions associated with local transportation in Greater Manchester (GM) over the next five years, and to strengthen partnership working across the transport and environmental sectors in local authorities.

Air quality performance indicators and targets have been set in the GM LTP2 to reduce concentrations of $NO_2$ . The LTP2 air quality targets for Manchester are set out in Table 7.2. The indicators that will be used to assess the performance of local transport measures to improve air quality are summarised in Table 7.3. Specific targets and trajectories associated with each target are detailed within the LTP2 Monitoring Technical Appendix (see Table 7.2). Progress against indicators will be reported in the GM LTP2 Annual Progress Reports (APR).

**Table 7.2 Air Quality Performance Indicators and Targets for Manchester taken from GM LTP2 Monitoring Technical Annex**

| Ref | Type | Indicator | Area | Baseline Value (2003/4 unless otherwise stated) | Target Value (2010/11 unless otherwise stated) | Headline change/notes |
|---|---|---|---|---|---|---|
| LTP8 | Mandatory | **Air quality:** $NO_2$ concentrations *($\mu g/m^3$) at worst case receptor points within the AQMA. *1 hour average $NO_2$ conc. | Manchester GM Avge | 2005 modelled<br>36.71<br>44.86<br>2004 | 2010 modelled<br>29.00<br>38.92<br>2011 | Reduction of 39% in $NO_x$ emissions from traffic on local main roads. |
| | | Intermediate proxy of tonnes NOx emissions from traffic on local main roads | Manchester Total GM | 2001<br>16572 | 1249<br>10177 | |

**Table 7.3 NOx/NO2 Emissions LTP2 Indicator and Target**

| Type | Indicator | Notes |
|---|---|---|
| Mandatory Headline Indicator (LTP9) | Concentration of $NO_2$ at chosen worst case or near worst case receptor points in each GM District AQMA. | An $NO_2$ concentration receptor point has been selected for each District and the GMPTE for monitoring purposes. (See Appendix 7.0 for details and locations of receptor points in GM).<br>A 2005 baseline and 2010 target have been set for each District.<br>Receptor point baseline data will be updated in 2006/7 following new GM air quality and assessment work.<br>Progress against this indicator will be assessed and reported in the final APR in 2011.<br>Intermediate years' progress will be monitored through a proxy indicator (Below) |
| Intermediate Headline Indicator | Number of tonnes NOx emitted annually from road transport in each District. | Proxy intermediate indicator used to assess progress towards the mandatory headline indicator (above).<br>Reported annually in the LTP2 APR |
| Subsidiary Local Indicator | Exposure To Poor Air Quality - Number of properties in areas where National Air Quality Objectives are likely to be exceeded. | |
| Subsidiary Local Indicator | Average number of days at real time monitoring sites where air quality is classed as moderate or worse. | |
| Subsidiary Local Indicator | Number of monitoring sites where the annual mean $NO_2$ objective is Exceeded. | |

# 8 NATIONAL AND LOCAL POLICY DEVELOPMENTS

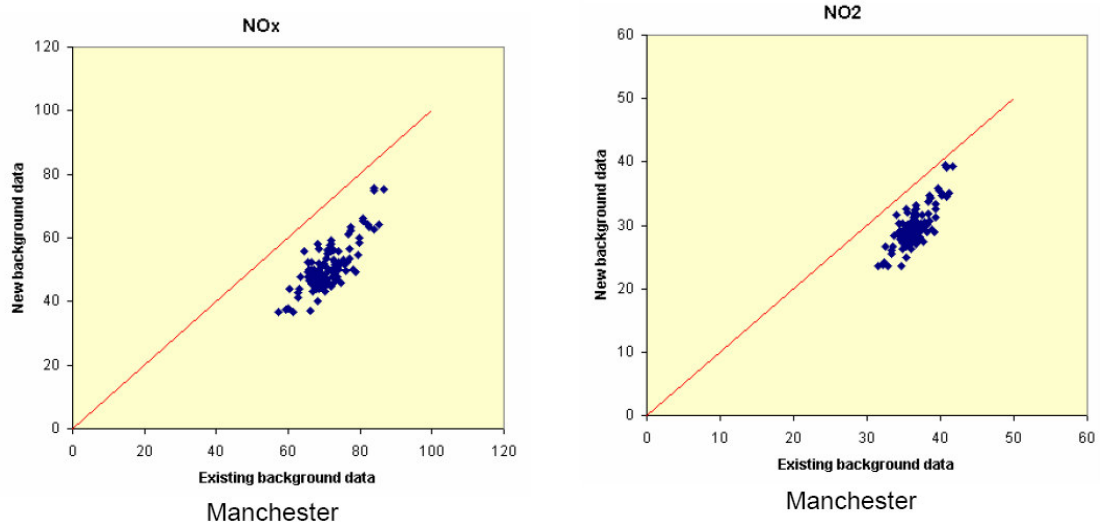
## 8.1 National Policy Developments

National and European policy developments which have been proposed or implemented after the AQMA designation in 2005 are outlined below.

**LAQM.TG(03) – Update: January 2006.** Revised background pollutant maps for NOx, $NO_2$ and $PM_{10}$ have been prepared for the 2004 base year, 2005 and 2010. The maps take account of improved methodologies, and comparisons with 2004 monitoring data.

The guidance provides a comparison of the revised 2004 background 1x1 km concentration with the existing 2001 mapped concentrations (with the data values corrected for 2004), for a number of selected sites throughout the UK. The results are presented as a series of X-Y plots (see Figure 8.1 for Manchester results). In general, the revised NOx and $NO_2$ maps show lower concentrations than the existing maps. The guidance indicates that there should be no direct implications for the next round of Review and Assessment, and authorities will not need to review any earlier conclusions.

**Figure 8.1 Comparison of Revised Background 1x1 km Nitrogen Oxides Concentrations and Nitrogen Dioxide Concentrations in 2004 against Previous Background Values for 2004[5], Manchester (µg/m3 )**

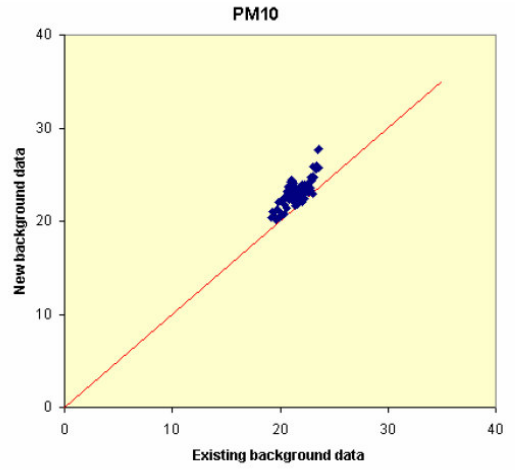



For $PM_{10}$ the situation is slightly different, and some 2004 background values are higher in the revised maps. **Figure 8.2** shoes the comparison for Manchester data. Where roads were considered during the second round of Review and Assessment, and the results were close to, but just below the

[5] Values available for Second Round of Review and Assessment, up until end of 2005.

2004 objective (and the 2010 objective in Scotland), it is recommended that these locations should be re-considered in the 2006 USA. The USA checklist has been updated to reflect this requirement. Manchester City Council's most recent review and assessment conclusion was that predicted $PM_{10}$ concentrations would not breach the 2010 Objectives. However the uncertainties in predicting future $PM_{10}$ levels, as indicated by these revised background concentrations, are recognised, and efforts to reduce primary particulate emissions continue in Manchester.

**Figure 8.2 Comparison of Revised Background 1x1 km $PM_{10}$ Concentrations in 2004 against Previous Background Values for 2004, Manchester (µg/m$^3$)**




Manchester

**Review of the Air Quality Strategy for England, Scotland Wales and Northern Ireland** – The Government perspective on ambient air quality in the UK is that, despite significant reductions in emissions of many pollutants, air pollution still harms public health and causes environmental problems. The Government and devolved administrations therefore recently consulted on a review of the current Air Quality Strategy for England, Scotland, Wales and Northern Ireland. The Consultation period closed in July 2006, and a revised Strategy is expected to be published before the end of the year.

The consultation document presents options for further improvements in air quality proposed new tighter European vehicle emissions standards, incentives for cleaner vehicles, further reductions in emissions from small combustion plants and further reductions in emissions from ships.

As well as direct benefits to public health, these new policies have the potential to provide important benefits to quality of life, reducing health inequalities and helping to protect the environment.

The consultation document also sought views on the Strategy's current objectives for air pollutants, and in particular:

- A new, more cost effective, policy framework and objectives for controlling pollutants for which there is no safe level such as fine particles ($PM_{2.5}$);
- Improved protection for Sites of Special Scientific Interest and other protected habitats; and
- A new objective on ozone for the protection of the environment.

The consultation document also set an agenda for longer term action to improve our understanding of air pollutants and attempts to qualitatively assess the potential for further air quality improvements in the very long term.

### European Commission Proposals

The European Commission in 2005 proposed an ambitious strategy for achieving further significant improvements in air quality across Europe. The Thematic Strategy on air pollution aims by 2020 to cut the annual number of premature deaths from air pollution-related diseases by almost 40% from the 2000 level. It also aims to substantially reduce the area of forests and other ecosystems suffering damage from airborne pollutants.

While covering all major air pollutants, the Strategy pays special attention to fine particulates, and ground-level ozone pollution because these pose the greatest danger to human health. Under the Strategy the Commission is proposing to start regulating fine airborne particulates ($PM_{2.5}$). The Commission also proposes to streamline air quality legislation by merging existing legal instruments into a single Ambient Air Quality Directive, a move that will contribute to Better Regulation.

## 8.2 Local Policy Developments

DEFRA guidance[6] suggests that one of the key objectives of this further assessment is *'to take account as far as possible of any local policy developments which are likely to affect air quality by the relevant date, and which were not fully factored into earlier calculations'*.

Since the first Air Quality Management Area was declared Manchester City Council has taken action to improve air quality through implementation of its Air Quality Action Plan (AQAP). Progress on the implementation of the AQAP can be found in Manchester City Council's 'Air Quality Progress Report' published in 2005.

[6] Department for Environment, Food and Rural Affairs (2001). *Guidance to local authorities on the further ('stage 4') assessments of air quality required under section 84 of the Environment Act 1995. Published 23 August 2001 at* http://www.defra.gov.uk/environment/airquality/laqm.htm

Local campaigns and enforcement undertaken by the Council to improve air quality have included:-

The **Cleaner Vehicles campaign** which concentrates on a regulatory approach with Fixed Penalty Notices (FPNs) for drivers of vehicles that do not comply with the emission standards. The testing results show that while only about 2% of vehicles failed the formal test, a badly tuned diesel vehicle can produce more than 10 times as much smoke as a properly tuned vehicle. In 2003/4 over 430 tests were undertaken with 25 FPNs being issued and in 2004/5 450 tests were undertaken with 9 FPNs.

A **City Centre Campaign** commenced in 2004 and seeks to encourage businesses to think about the impact of their activities on air quality. It has been trialled in partnership with the Council's travel coordinator and energy efficiency advisor. The companies looked at their green travel plans, energy efficiency and fleet management policies with a view to identifying areas where they could improve their environmental performance. 10 companies in the pilot trial have set out what they intend to do as a work programme for 2005. The campaign has now been rolled out to a much larger number of companies across Manchester.

An **Idling Vehicles Campaign** was developed and launched as part of '100 Days to a Clean Manchester' in 2005 and has now been implemented as part of the Street Crime Wardens' duties. Drivers who idle their vehicles unnecessarily when parked at the side of the road emit unnecessary pollution and waste fuel. Observations are that there is a high level of compliance. However idling vehicles continue to be a source of complaint to the Council, and recent action is targeted surveillance and enforcement in problem locations. 44 fixed penalty notices have been served to date in 2006.

A hotline has been set up for the reporting of **Dirty Diesels** for referral to the relevant enforcing authority including the Vehicle and Operator Services Agency (VOSA) and the Council's Licensing Unit for taxis and contact has been made with key fleet operators such as the bus companies to highlight the campaign. Further promotion of the work is programmed for 2006.

A campaign against the **burning of domestic waste**, with links to the ongoing campaigns to recycle more waste, is being implemented and where education and publicity is unsuccessful, the campaign is backed up by regulatory action. Parallel action is being progressed against commercial waste disposal by burning, through regulation of the activity under the Clean Air Act 1993 and the Environmental Protection Act 1990. In 2005, 11 statutory notices were issued against offenders. The Campaign, in partnership with other Greater Manchester authorities, continues to promote the concept that the burning of waste is no longer an environmentally acceptable method of waste disposal.

**Integrated Pollution Prevention and Control (IPPC)** is the permitting regime for the regulation of emissions and controls in industrial processes across the EU. Emission limits are set for prescribed industrial activities by Government and the legislation is enforced locally by the Council with larger processes being controlled by the Environment Agency. In Manchester there are 100 IPPC process controlled by the Council and 6 by the Environment Agency. This year the Government has introduced a best value performance indicator to track local authorities' progress with regard to enforcement of emission standards. The Council has a good performance in enforcing the upgrading of processes where required, and its performance in 2005, the first reporting year for the indicator, was 91%.

There are other areas of environmental action which are not focussed specifically on air quality but nevertheless help to improve air quality.

**Manchester's Energy Strategy** was approved in April 2005 after a period of consultation with the private, public and voluntary sectors and sets out the need to develop frameworks, processes and initiatives which encourage, facilitate, support and enable action by the whole community to improve energy efficiency, increase use of renewable energy sources and reduce Carbon Dioxide (CO2) emissions. The Council's work in improving the housing stock has improved energy efficiency by 14% which translates into an estimated overall 2% reduction in the average nitrogen dioxide concentration.

**Sustainable Design and Construction** seeks to incorporate sustainability into new buildings and settlements. Buildings have a considerable environmental impact, with around 10% of national energy consumption used in the production and transport of construction products and materials and buildings accounting for over 50% of total energy use. Through the Guide to Development in Manchester, the Council is promoting buildings which are highly energy efficiency, integrate renewable energy, conserve water and use sustainable urban drainage, promote recycling and waste minimisation and increase biodiversity. The Council is keen that new and altered buildings achieved a post construction BREEAM rating of "very good" or above.

**Untaxed Vehicles** are typically the older vehicles which can be 10 times as polluting as the more modern vehicles in the fleet. Since having DVLA powers in Jan 2004 to remove untaxed vehicles Manchester City Council has removed 6045 untaxed vehicles and 3059 have been crushed.

# 9 CONCLUSIONS

LAQM.TG(03) states that 'the local authority should aim at the end of the review and assessment process to be confident that it has identified all locations and pollutants for which it is likely that the air quality objective will be exceeded in the relevant future year'. Following the designation of the new AQMA in Manchester in 2005, this further review has aimed to

- confirm the original assessment;
- calculate how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;
- refine the knowledge of the sources of pollution by source apportionment studies;
- take account of local and national policy developments; and
- respond to any comments made by statuary consultees in respect of authorities earlier reports.

The work to compile this report has been timely, and although a useful consolidated document has been produced, the essential conclusions have not changed. The majority of the Government's various health-based air quality Objectives are being or are predicted to be met. For nitrogen dioxide, short term peak episodes of very high concentrations no longer feature in monitoring data, but the long term annual average levels of this pollutant remain above the Objective, and the key source of these measured and predicted exceedences is road traffic exhaust emissions. This feature is reflected in the new AQMA in 2005, which shows a spatial distribution concentrated on the city centre and along the major road network.

Nevertheless the requirements of the LAQM regime combined with the City Council's own actions have resulted in a number of improvements. In respect of technical assessments, there have been significant improvements to the compilation methodology and data contained within the Greater Manchester atmospheric emissions inventory, and development of the database is ongoing. The extensive ambient air quality monitoring network across the city continues to provide quality assured data which are essential for the verification of model outputs and the assessment of long term trends.

The integration of air quality and transport action planning is a key requirement of the Government's recent approach to the management of traffic emissions, and co-ordinated working across the Greater Manchester authorities has enabled clear measures to be adopted. A series of actions and targets have been established, and in the near future it is proposed that the focus will be on a review of the Greater Manchester Air Quality Action Plan.

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**Air Quality Review and Assessment Website:**

http://www.uwe.ac.uk/aqm/review/examples/index.html

**Local Air Quality Management Tools:**

http://www.airquality.co.uk/archive/laqm/tools.php

**National Atmospheric Emissions Inventory:**

http://www.naei.co.uk/

**The Manchester Air Pollution Advisory Council (MAPAC):**

http://www.mapac.org.uk

# 11 APPENDIX 1

## 11.1 Automatic Monitoring

**Table 11.1 Measured annual average nitrogen dioxide concentrations at the Manchester South AURN site (outside AQMA)**

| **Manchester South** | | | | | |
|---|---|---|---|---|---|
| Year | Annual Average | Maximum 1 Hour | No. of Hours Above 200ug/$m^3$ | 99.8$^{th}$ Percentile of hourly means | Data Capture |
| 1997 | 23 | 120 | 0 | - | 95% |
| 1998 | 25 | 120 | 0 | - | 98% |
| 1999 | 15 | 91 | 0 | - | 71% |
| 2000 | 14 | 99 | 0 | - | 81% |
| 2001 | 21 | 158 | 0 | - | 96% |
| 2002 | 21 | 90 | 0 | 75 | 89% |
| 2003 | 22 | 117 | 0 | - | 98% |
| 2004 | 19 | 90 | 0 | 74 | 87% |
| 2005 | 17 | 59 | 0 | 58 | 7% |
| Nitrogen dioxide results in ug/$m^3$ | | | | | |

**Table 11.2 Measured annual average nitrogen dioxide concentrations at the Manchester Piccadilly AURN site (inside AQMA)**

| **Manchester Piccadilly** | | | | | |
|---|---|---|---|---|---|
| Year | Annual Average | Maximum 1 Hour | No. of Hours Above200ug/$m^3$ | 99.8$^{th}$ Percentile of hourly means | Data Capture |
| 1996 | 53 | 259 | 7 | - | 92% |
| 1997 | 42 | 187 | 0 | - | 91% |
| 1998 | 40 | 194 | 0 | - | 95% |
| 1999 | 44 | 185 | 0 | - | 95% |
| 2000 | 42 | 137 | 0 | - | 97% |
| 2001 | 44 | 257 | 11 | - | 72% |
| 2002 | 39 | 143 | 0 | 99 | 90% |
| 2003 | 45 | 262 | 2 | - | 98% |
| 2004 | 43 | 166 | 0 | - | 94% |
| 2005 | 45 | 279 | 6 | 191 | 49% |
| Nitrogen dioxide results in ug/$m^3$ | | | | | |

**Table 11.3 Measured annual average nitrogen dioxide concentrations at the Manchester Town Hall AURN site (inside AQMA)**

| Manchester Town Hall | | | | | |
|---|---|---|---|---|---|
| Year | Annual Average | Maximum 1 Hour | No. of Hours Above200ug/m$^3$ | 99.8$^{th}$ Percentile of hourly means | Data Capture |
| 1994 | 48 | 671 | 110 | - | 99% |
| 1995 | 44 | 345 | 13 | - | 94% |
| 1996 | 53 | 227 | 4 | - | 97% |
| 1997 | 51 | 227 | 6 | - | 96% |
| 1998 | 41 | 200 | 1 | - | 97% |
| 1999 | 41 | 187 | 0 | - | 99% |
| 2000 | 42 | 137 | 0 | - | 95% |
| 2001 | 48 | 307 | 11 | - | 99% |
| 2002 | 43 | 138 | 0 | - | 99% |
| 2003 | 44 | 159 | 0 | - | 99% |
| 2004 | 40 | 141 | 0 | - | 95% |
| 2005 | 43 | 183 | 0 | - | 95% |
| Nitrogen dioxide results in ug/m$^3$ | | | | | |

## 11.2 Nitrogen Dioxide Diffusion Tubes

**Table 11.4 Annual Average Nitrogen Dioxide monitoring results (ug/m$^3$) from diffusion tube sites located outside the AQMA. UB = Urban background, UI = Urban Industrial, S = Suburban.**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 predicted* |
|---|---|---|---|---|---|---|---|
| Burnage Community Centre (UB) | 26 | 30 | 32 | **48** | 28 | 34 | 33.2 |
| Clayton Nursery (UB) | 26 | 29 | 26 | **52** | 33 | 29 | 28.3 |
| Ciba Speciality Chemicals Plc (UI) | 33 | 34 | 26 | **52** | 33 | 33 | 32.2 |
| Bollin Valley Farm, Styal (S) | 21 | 22 | 21 | 23 | 14 | 18 | 17.6 |
| Manchester South (S) | | | | 22 | 28 | 25 | 20.6 |

**Table 11.5 Percentage Data Capture at diffusion tube sites located outside the AQMA**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| Burnage Community Centre (UB) | 94% | 94% | 98% | 98% | 94% | 94% |
| Clayton Nursery (UB) | 94% | 92% | 96% | 98% | 94% | 98% |
| Ciba Speciality Chemicals Plc (UI) | 94% | 98% | 96% | 98% | 94% | 96% |
| Bollin Valley Farm, Styal (S) | 85% | 87% | 94% | 98% | 87% | 94% |
| Manchester South (S) | | | | 97% | 100% | 92% |

**Table 11.6 Annual Average Nitrogen Dioxide monitoring results (ug/m$^3$) from diffusion tube sites located inside the AQMA. UB = Urban background, UI = Urban Industrial, S = Suburban.**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005* |
|---|---|---|---|---|---|---|
| Ashton Old Road (k) | 48 | 49 | 41 | 40 | 48 | 47 |
| Cheetham Hill Road (K) | 55 | 43 | 47 | 44 | 59 | 57 |
| Chethams School (UC) | 54 | 52 | 51 | 50 | 39 | 46 |
| M56 (R) | 77 | 74 | 81 | 78 | 68 | 71 |
| Newton Street (K) | 82 | 86 | 101 | 75 | 66 | 74 |
| Oldham Road (K) | 57 | 56 | 51 | 48 | 59 | 78 |
| Oxford Street (K) | 81 | 80 | 73 | 80 | 78 | 93 |
| Piccadilly Gardens AURN (UC) | - | - | - | 43 | 51 | 47 |
| Piccadilly Gardens AURN (UC) | 55 | 55 | 63 | 59 | 44 | 47 |
| Princess Road (R) | - | - | - | - | - | 49 |
| Princess Street (K) | - | 74 | 83 | 68 | 61 | 76 |
| Rochdale Road (K) | - | - | - | - | - | 52 |
| St Pauls School (UB) | 47 | 40 | 48 | 49 | 36 | 37 |
| Manchester Town Hall AURN (UB) | 53 | 53 | 65 | 54 | 46 | 50 |
| Manchester Town Hall Acid Rain (UB) | 52 | 53 | 61 | 51 | 49 | 52 |
| Manchester Town Hall AURN (UB) | - | - | - | 36 | 46 | 47 |

**Table 11.7 Percentage Data Capture at diffusion tube sites located inside the AQMA**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005* |
|---|---|---|---|---|---|---|
| Ashton Old Road | 100% | 92% | 92% | 100% | 83% | 100% |
| Cheetham Hill Road | 92% | 92% | 100% | 92% | 83% | 100% |
| Chethams School | 94% | 92% | 100% | 96% | 87% | 96% |
| M56 | 94% | 94% | 100% | 96% | 88% | 96% |
| Newton Street | 92% | 94% | 98% | 94% | 92% | 96% |
| Oldham Road | 92% | 92% | 100% | 92% | 92% | 100% |
| Oxford Street | 83% | 92% | 92% | 83% | 83% | 100% |
| Piccadilly Gardens AURN | - | - | - | 86% | 92% | 100% |
| Piccadilly Gardens AURN | 89% | 85% | 98% | 96% | 94% | 96% |
| Princess Road | - | - | - | - | - | 83% |
| Princess Street | - | 90% | 100% | 94% | 92% | 96% |
| Rochdale Road | - | - | - | - | - | 75% |
| St Pauls School | 92% | 96% | 96% | 92% | 92% | 96% |
| Manchester Town Hall AURN | 94% | 98% | 94% | 98% | 94% | 94% |
| Manchester Town Hall Acid Rain | 92% | 98% | 98% | 96% | 92% | 98% |
| Manchester Town Hall AURN | - | - | - | 100% | 100% | 92% |

## 11.3 Nitrogen dioxide diffusion tube bias correction

Manchester City Council expose a number of nitrogen dioxide diffusion tubes, at locations across the city. These diffusion tubes provide an effective means of establishing nitrogen dioxide concentrations across a wide spatial area. However, DEFRA has expressed concern over the accuracy of diffusion tubes.

Technical Guidance note LAQM TG(03) Boxes 6.3 and 6.4 provide a method for establishing whether diffusion tubes show a bias, and the boxes also provide a means for correcting that bias.

The nitrogen dioxide diffusion tubes used by Manchester City Council are supplied, prepared, and analysed by Eurofins Laboratories at their UKAS accredited facilities in Trafford Park. Diffusion tubes used by Manchester City Council are all prepared using the 10% TEA in water method.

Diffusion tubes have been co-located with the chemiluminescent NOx analysers at Manchester Piccadilly, Manchester Town Hall and Manchester South AURN sites. The following results were obtained.

**Table 11.8 Calculation of nitrogen dioxide diffusion tube bias***

| **Year** | **Manchester Piccadilly** | | | | |
|---|---|---|---|---|---|
| | AURN | | Tube | | Bias |
| | Result | Capture | Result | Capture | A |
| 2003 | 45 | 98% | 43 | 86% | 1.04 |
| 2004 | 43 | 94% | 51 | 92% | 0.84 |
| 2005 | 46 | 49% | 47 | 100% | - |
| | | | | | |
| Year | Manchester Town Hall | | | | |
| | AURN | | Tube | | Bias |
| | Result | Capture | Result | Capture | A |
| 2003 | 44 | 99% | 36 | 100% | 1.24 |
| 2004 | 40 | 95% | 46 | 100% | 0.88 |
| 2005 | 44 | 95% | 47 | 92% | 0.93 |
| | | | | | |
| Year | Manchester South | | | | |
| | AURN | | Tube | | Bias |
| | Result | Capture | Result | Capture | A |
| 2003 | 22 | 98% | 29 | 100% | 0.75 |
| 2004 | 19 | 86% | 37 | 92% | - |
| 2005 | 17 | 7% | 33 | 92% | - |
| Nitrogen dioxide results in ug/$m^3$ | | | | | |

**Bias adjusted averages for 2005 have been calculated using provisional AURN data*

These results show that the diffusion tube bias has varied on a year to year basis, and that the bias is different at the three different sites. This effect could be due to the diffusion tubes performing differently at the different types of site. Manchester Piccadilly is an urban central site, which is subject to rapidly changing levels of NOx, including occasional peak concentration events. Manchester Town Hall is an urban background site, where NOx concentrations remain relatively constant.

Manchester South is a suburban site, where NOx concentrations will also remain relatively constant. To reflect these differences in site characteristic, the Piccadilly derived correction factor will be used to correct tubes in roadside and central locations, whilst the Town Hall derived correction factor will be used for tubes at urban background locations. The Manchester South derived correction factor will be used for suburban sites. Correction factors have only been used where the AURN data capture has been above 90%, in accordance with Technical Guidance Note TG (03), Box 6.4. For years where data capture for the AURN site has been below 90%, the most recent correction factor has been used where AURN data capture has been above 90%.

The results show that the majority of tubes have given readings higher than those recorded using the chemiluminescent analysers.

In order to improve the accuracy of calculated diffusion tube bias, Manchester City Council has begun exposing three diffusion tubes, at each of the three chemiluminescent analyser sites in the city since January 2003.