

In fulfilment of Part IV of the Environment Act 1995  
Local Air Quality Management

**Air quality review and assessment**  
Annual progress report 2013



**NORWICH**  
City Council

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# Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government Guidance when undertaking such work. This Progress Report is a requirement of the Fifth Round of Review and Assessment and is a requirement for all local authorities. The Report has been undertaken in accordance with the Technical Guidance LAQM.TG (09) and associated tools (as updated in 2010).

This Progress Report considers all new monitoring data and assesses the data against the Air Quality Strategy objectives. It also considers any changes that may have an impact on air quality.

Norwich City Council have carried out all past rounds of review and assessment and have consolidated all previous AQMAs into one larger central AQMA.

Proposed actions from this report are as follows:

- Continue with automatic and passive NO<sub>2</sub> monitoring within the city area
- Develop a revised Action Plan to work towards compliance with the air quality objectives within the Norwich Central AQMA. This plan should draw upon the results of the monitoring program, DA's and FA's carried out previously.
- Proceed to 2014 Annual Progress Report.

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# 1 Introduction

## 1.1 Description of Local Authority Area

Norwich covers approximately 39 square kilometres in the heart of Norfolk with a population of circa 132,000 people. The population of the Norwich 'Travel to Work Area' ie the area of Norwich in which most people both live and work is circa 376,500.

Norwich is the fourth most densely populated local authority district in the eastern region with approximately 34 people per hectare.

The workforce of the Norwich Travel to Work Area is approximately 194,000 people. The Norwich City Council area supports around 95,500 jobs. The built-up urban area supports approximately 132,500 jobs. Almost one-third of Norfolk's workforce is based within the City Council area, and 40% are employed in the urban area. Approximately 73% of the City Council's working age resident population is economically active.

Employment in Norwich is predominantly service sector based reflecting the national picture. The Business & Financial Sector accounts for 31% of employment in Norwich. Around 26% of people employed in Norwich work in public services (Government, Health and Education). A further 12% of the workforce is employed in the retail sector and 7% work in tourism. The manufacturing sector accounts for almost 8% of employment in Norwich.

The City permits 44 'Part B' authorised processes, including petrol stations, road stone coating plant, vehicle resprayers and a crematorium. The major pollutant source in the city is road traffic.

## 1.2 Purpose of Progress Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment reports. Their purpose is to maintain continuity in the Local Air Quality Management process.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies the risk of exceedence of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

## 1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in **England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre  $\mu\text{g}/\text{m}^3$  (milligrammes per cubic metre,  $\text{mg}/\text{m}^3$  for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

**Table 1.1 Air Quality Objectives included in Regulations for the purpose of LAQM in England**

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg/m <sup>3</sup>	Running annual mean	31.12.2003
	5.00 µg/m <sup>3</sup>	Annual mean	31.12.2010
1,3-Butadiene	2.25 µg/m <sup>3</sup>	Running annual mean	31.12.2003
Carbon monoxide	10 mg/m <sup>3</sup>	Running 8-hour mean	31.12.2003
Lead	0.50 µg/m <sup>3</sup>	Annual mean	31.12.2004
	0.25 µg/m <sup>3</sup>	Annual mean	31.12.2008
Nitrogen dioxide	200 µg/m <sup>3</sup> not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m <sup>3</sup>	Annual mean	31.12.2005
Particulate Matter (PM <sub>10</sub> ) (gravimetric)	50 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 µg/m <sup>3</sup>	Annual mean	31.12.2004
Sulphur dioxide	350 µg/m <sup>3</sup> , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m <sup>3</sup> , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005



## 1.4 Summary of Previous Review and Assessments

Norwich City Council (NCC) has completed the following review and assessments of air quality to date:

Review and Assessment of Air Quality (1998);  
Further Assessment (1999);  
Further Assessment update (2002);  
Detailed Assessment (2003);  
Updating and Screening Assessment (2004);  
Progress Report (2005);  
Updating and Screening Assessment (2006);  
Progress Report (2007);  
Detailed Assessment (2008);  
Updating and Screening Assessment (2009);  
Progress Report (2010);  
Further Assessment for Riverside Road AQMA (2010);  
Progress Report (2011);  
Updating and Screening Assessment (2012);  
Detailed Assessment (2012)

### First Round of Air Quality Review and Assessment

The first stage of the review and assessment process concluded that within the City the Government's objectives were likely to be met for carbon monoxide, benzene, 1,3-butadiene and lead. However, there were doubts as to whether the Government's objectives would be met with respect to nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>) and particulate matter less than 10µm (PM10). The report recommended that the Norwich City Council progress to a Further Assessment for NO<sub>2</sub>, SO<sub>2</sub> and PM10.

The findings are presented in greater detail in the following report:

Review and Assessment of the Air Quality, Norwich City Council (1998)

The findings of the Further Assessment are presented in greater detail in the following report:

Review and Assessment of Air Quality – Further Assessment, Norwich City Council (2001)

The Further Assessment included estimation, modelling/measurement of pollutants and indicated which national objectives would not be achieved.

The assessment for SO<sub>2</sub> and PM10 concluded that the Air Quality objectives for 2005 would be achieved.

Nitrogen dioxide was taken straight to a Stage 3 review and assessment as Stage 1 indicated Norwich was unlikely to achieve the Air Quality objectives in 2005.

The Further Assessment for NO<sub>2</sub> concluded that the Air Quality Objective was unlikely to be achieved in certain areas of the city by 2005. As a result the council declared three AQMAs for exceedences of the NO<sub>2</sub> annual objective.

An update to the Further Assessment was produced in 2002. The findings of the report are presented in greater detail in the following report:

Air Quality Review and Assessment Further Assessment Update, Norwich City Council (2002)

The Further Assessment concluded that there could be an exceedence of the NO<sub>2</sub> objectives as a result of traffic sources. Declaration of three AQMAs was recommended. Norwich City Council considered the likelihood of receptor exposure to

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exceedences based on the modelling and decided the appropriate locations of AQMAs in the city. Three AQMAs were proposed, Castle, Grapes Hill and St Augustines.

There were no predicted exceedences of the PM10 objective either by traffic or industrial sources. As such, there was no need for further review and assessment of PM10.

There were no sources that would result in predicted exceedences of the SO<sub>2</sub> objective by industrial sources.

There were no sources that would result in predicted exceedences of the lead objective by industrial sources.

Norwich City Council then proceeded to a Detailed Assessment for NO<sub>2</sub>. The findings of the 2003 Detailed Assessment are presented in greater detail in the following report:

Detailed Assessment (stage 4), Norwich City Council (2003)

The monitoring and modelling carried out at this stage of review and assessment showed that NO<sub>2</sub> concentrations were expected to exceed the annual mean objective at certain locations in each of the three declared AQMAs.

The source apportionment work identified emissions of oxides of nitrogen (NO<sub>x</sub>) from traffic on roads close to the AQMAs as the main source from which emissions could be reduced. Emissions of NO<sub>x</sub> from local traffic accounted for approximately 68-79 % of the total modelled oxides of nitrogen concentration at the most affected properties within the AQMAs.

This assessment also considered a number of options in order to assess their potential to reduce the nitrogen dioxide concentration at the most sensitive receptors in the Norwich AQMAs.

### Further Stages of Review and Assessment

A summary of conclusions from the second and third rounds of review and assessment reports is provided below.

### 2004, 2005 and 2007 Progress Reports

Each report concluded that no further action was required in respect of the pollutants:

CO;

Benzene;

1,3-Butadiene;

Lead;

SO<sub>2</sub>;

NO<sub>2</sub>; and

PM10.

### 2004 and 2006 Updating and Screening Assessments

These updating and screening assessment for Norwich City Council concluded that a Detailed Assessment was not required for NO<sub>2</sub>, PM10, benzene, CO, Lead, 1,3 – butadiene or SO<sub>2</sub>.

### 2008 Detailed Assessment

As part of this Detailed Assessment air dispersion modelling was carried out for NCC covering the following locations:

Grapes Hill;

King Street;

Riverside Road;

Magdalen Street; and

Boundary Road.

The assessment concluded that on the basis of the modelled and measured results in the Grapes Hill AQMA, and also due to the fact that the NO<sub>2</sub> concentrations were  
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predicted to fall in 2010, the Council could consider revoking this AQMA. However, as pollution concentrations are variable due to meteorological conditions from year to year, it was recommended that this AQMA be retained at the moment.

On the basis of the modelled and measured NO<sub>2</sub> results in King Street it was recommended that NCC should continue to monitor this site and review each year. Should the 2009 data exceed the objective it was recommended that this area should be declared an AQMA.

Modelling and measured results for Riverside Road suggested that the council consider implementing an improved synchronised fixed time traffic signalling system to reduce queuing effect in Riverside Road. It was recommended that NCC declare an AQMA in this area. This new area was declared in December 2009.

The concentration measured at the location of the diffusion tube in Magdalen Street marginally exceeded the objective in 2007 and was under the objective in 2008. As such, it was recommended that NCC continue to monitor the area. It was not recommended to declare this area as an AQMA.

Finally, it was recommended that the Council continue to monitor the area around Boundary Road. An AQMA was not recommended for this location.

#### 2009 Updating and Screening Assessment

This updating and screening assessment concluded that a Detailed Assessment was not required for NO<sub>2</sub>, PM<sub>10</sub>, benzene, CO, Lead, 1,3 – butadiene or SO<sub>2</sub>.

#### 2010 Annual Progress Report

This report noted that NCC carried out diffusion tube monitoring for NO<sub>2</sub> at 34 locations throughout the city during 2009. The results indicated that concentrations of NO<sub>2</sub> exceeded the annual mean objective at several locations. These locations were:

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King Street;  
St Stephens (Mid);  
St Augustines Street;  
Cattlemarket Street;  
Castle Meadow;  
Castle Meadow 2;  
Bull Close Road; and  
Riverside Road.

Of the areas where the exceedences were found, St Augustines, Cattlemarket Street, both Castle Meadow sites and Riverside Road are within existing AQMA. The site at St Stephens Street is not situated in a location representative of relevant exposure to the general public for the annual mean. The King Street site exceeded the objective level by  $4.2\mu\text{g}/\text{m}^3$ . The Bull Close Road location exceeded the objective level by  $0.5\mu\text{g}/\text{m}^3$ .

The Detailed Assessment carried out in King Street in 2008 stated that if the 2009 data confirmed an exceedence of the annual mean objective for  $\text{NO}_2$ , then this area should be declared as an AQMA. The Bull Close Road site had not been the subject of any previous detailed assessment. Therefore, in line with the recommendations of the 2008 DA, the report stated that NCC would declare an area of King Street as an AQMA and revoke the existing AQMA at Grapes Hill.

The Bull Close Road location exceeded the objective level by  $0.5\mu\text{g}/\text{m}^3$ . Since this was the first, very marginal, exceedence of the annual objective level for  $\text{NO}_2$  based on a single tube at this location, it was proposed to carry out a Detailed Assessment by increasing the monitoring in the area; to include the commencement of triplicate tubes at the existing site, and deployment of additional tubes at new nearby relevant locations. Should the monitoring results for the full 2010 calendar year show a

continuing exceedence, then it was proposed to declare an AQMA in the area during 2011.

The report also concluded that, based upon the findings of previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead, PM10 and SO<sub>2</sub> were unlikely to be in excess of the air quality objectives at any location.

Subsequent to the production of the 2010 APR, discussion took place between the city council, county council and DEFRA. It was agreed in principle that rather than declare King Street as an additional AQMA, it would be preferable to replace the existing four AQMAs with one larger area to encompass all of them plus King Street and Bull Close Road.

#### 2010 Further Assessment for Riverside Road

This report assessed concentrations of NO<sub>2</sub> in and around the Riverside Road AQMA for 2009 using a combination of available monitoring data and a dispersion modelling exercise. The study took account of traffic conditions in the area and the latest meteorological data available.

The study confirmed the findings of the previous detailed assessment, namely that there are exceedences of the annual mean NO<sub>2</sub> objective to the south of Riverside Road.

It was estimated that ambient NO<sub>x</sub> reductions of approximately 48% are required in the AQMA to achieve compliance with the annual mean NO<sub>2</sub> objective.

Source apportionment indicated that the primary source of emissions is derived from local moving traffic, although queuing vehicles are also particularly important near the junction. Light vehicles are thought to be the main source type although important contributions were also noted from buses and other heavy vehicles.

The report concluded that the monitoring and dispersion modelling showed that the AQMA boundary was appropriate and that Norwich City Council should proceed with air quality action planning for the area.

#### 2011 Annual Progress Report

The 2011 annual progress report confirmed the council's intention to declare an area of central Norwich as an AQMA to replace the existing areas and cover the potential areas at King Street and Bull Close Road. This new area came into force on 1st November 2012, and is shown in Figure 1.1.

#### 2012 Updating and Screening Assessment

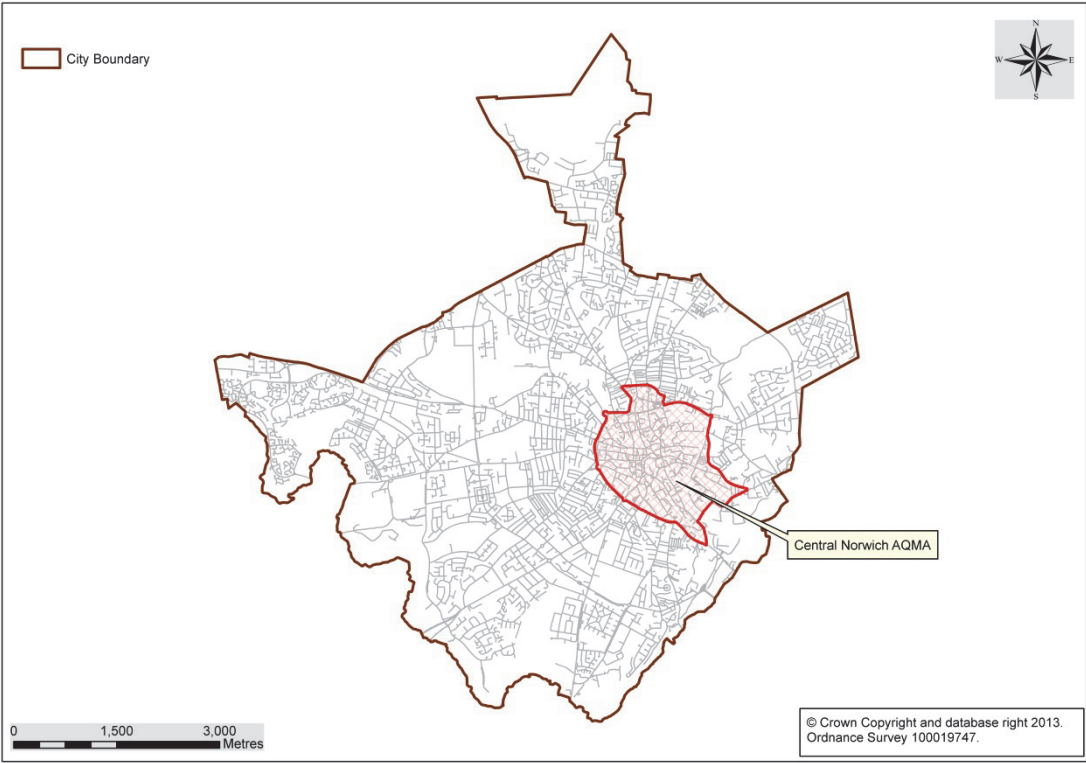
The updating and screening assessment in 2012 identified an exceedence of the short term (hourly) mean objective for NO<sub>2</sub> on Castle Meadow. The report recommended that the council should proceed to a detailed assessment to understand the potential for a continuation of the exceedence in this area.

#### 2012 Detailed Assessment for Castle Meadow

The detailed assessment concluded that there may have been a short-term set of circumstances that caused the exceedence of the hourly objective for NO<sub>2</sub>. It recommended that monitoring was to continue and reported in the 2013 annual progress report.



**Figure 1.1 Map showing Norwich Central AQMA Boundary**



## **2 New Monitoring Data**

### **2.1 Summary of Monitoring Undertaken**

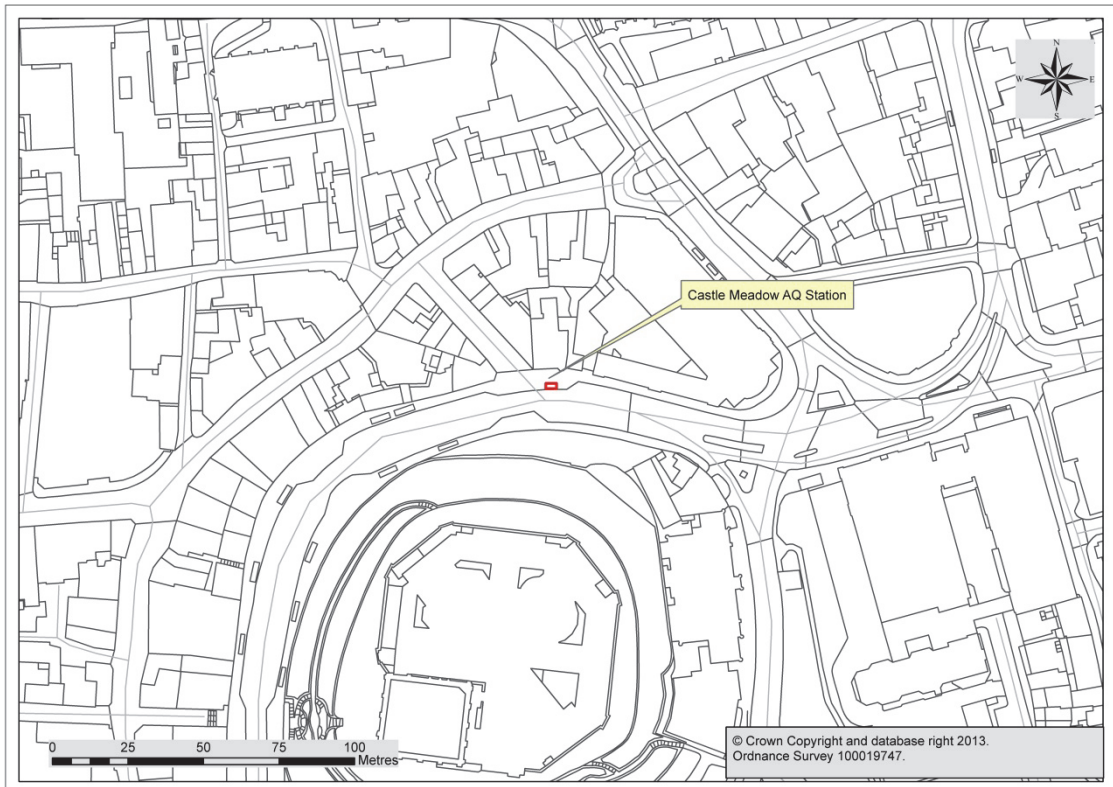
#### **2.1.1 Automatic Monitoring Sites**

Automatic monitoring was carried out at two locations in Norwich during 2012. The locations are shown in Figures 1.2 and 1.3. The Norwich Lakenfields site is an urban background location and is part of Defra's Automatic Urban and Rural Network (AURN). The Norwich Castle Meadow site is a mobile unit that currently monitors roadside concentrations within the City centre.

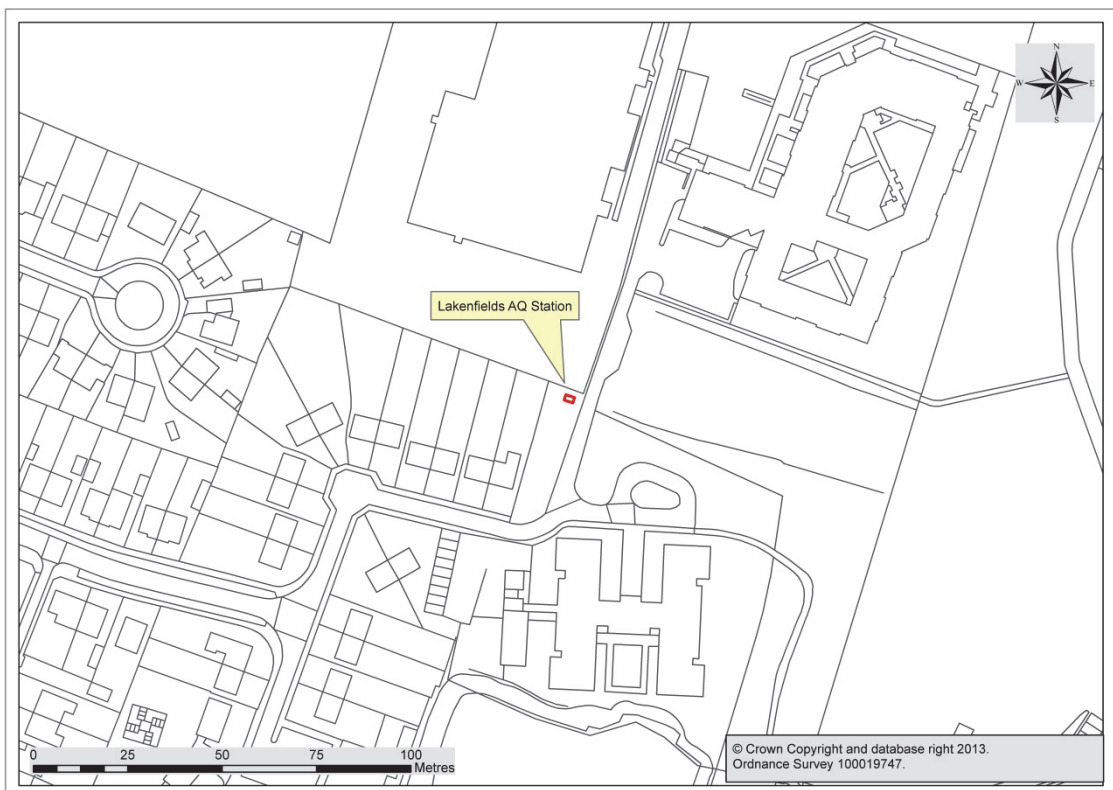
Data for 2012 is available for both the Castle Meadow site (99% NO<sub>2</sub> and 98% PM10 data capture) and the Lakenfields site (98% NO<sub>2</sub> and 87% PM10 data capture).

The Norwich Lakenfields site incorporates an FDMS device on the PM10 and PM2.5 TEOM's to correct for loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by these instruments. The Castle Meadow site does not incorporate an FDMS. Therefore, PM10 data from this site has been corrected using the VCM.

**Figure 1.2 Castle Meadow Automatic Monitoring Station**



**Figure 1.3 Lakenfields Automatic Monitoring Station**



**Table 2.1 Details of Automatic Monitoring Sites**

Site Name & ID	Site Type	OS Grid Ref	Pollutants Monitored	Monitoring Technique	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Worst case exposure?
Norwich Castle Meadow (CM1)	Urban Roadside	X623202 Y308615	O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>10</sub> , NO <sub>x</sub> , NO <sub>2</sub> , PM <sub>2.5</sub>	Ambirak TEOM	Y	N	1m	N/A
Norwich Lakenfields (CM2)	Urban Background	X623637 Y306940	O <sub>3</sub> , SO <sub>2</sub> , PM <sub>10</sub> , NO <sub>x</sub> , NO <sub>2</sub> , PM <sub>2.5</sub>	Thermo FDMS	N	Y (20m)	N/A	N

### 2.1.2 Non-Automatic Monitoring Sites

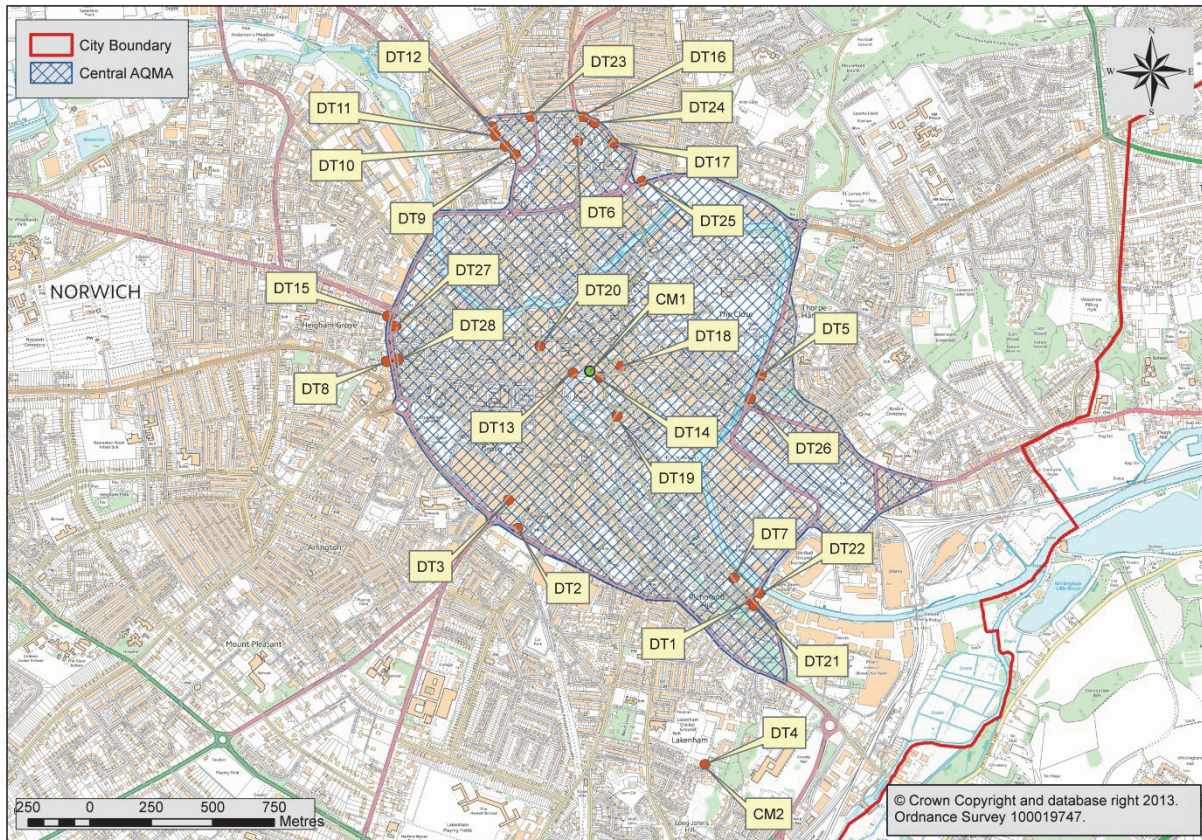
Norwich City Council carried out indicative monitoring of NO<sub>2</sub> by diffusion tubes at 28 sites throughout the city during 2012. Triplicate tubes were located at 130 Magdalen Street, 26 Bull Close Road, 5 Riverside and 256 King Street. A co-location study was also carried out using triplicate tubes at the Lakenfields AURN site.

Details of the diffusion tube monitoring locations are provided in Table 2.2, and shown in figure 1.4. The locations include kerbside, roadside and urban background sites. Non-bias corrected diffusion tube data is presented in Appendix B.

Appendix A contains information on automatic and non-automatic monitoring QA/ QC procedures.



**Figure 1.4 Map showing automatic and non-automatic monitoring locations**



**Table 2.2 Details of Non- Automatic NO<sub>2</sub> Monitoring Sites**

Site ID	Site Name	Site Type	OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road	Worst-case Location?
DT1	256 King Street (x3)	R	X 623863.04 Y 307678.60	Y	Y (1m)	3.5m	Y
DT2	Queens Rd Travelodge	R	X 622917.08 Y 307974.49	Y	N	N/A	N/A
DT3	St Stephens (mid)	K	X 622879.16 Y 308089.96	Y	N	N/A	N/A
DT4	Lakenfields (x3)	UB	X 623681.24 Y 307015.82	N	Y (20m)	N/A	N
DT5	Chalk Hill Road	R	X 623906.97 Y 308596.92	Y	Y (1m)	7m	Y
DT6	130 Magdalen Street (x3)	R	X 623160.89 Y 309550.43	Y	Y (1m)	4m	Y
DT7	Reads Flour Mill	K	X 623796.25 Y 307772.13	Y	Y (1m)	1m	Y
DT8	Grapes Hill (upper)	R	X 622383.05 Y 308653.15	Y	Y (1m)	14m	Y
DT9	13 St Augustines St	K	X 622905.81 Y 309496.11	Y	N	1m	Y
DT10	32 St Augustines St	K	X 622865.96 Y 309529.93	Y	Y (1m)	2m	Y
DT11	50 St Augustines St	K	X 622825.87 Y 309573.17	Y	Y (1m)	1m	Y
DT12	65 St Augustines St	K	X 622813.72 Y 309609.96	Y	N	1m	Y
DT13	Castle Meadow	R	X 623141.06 Y 308606.69	Y	N	N/A	N/A
DT14	Castle Meadow 2	R	X 623250.50 Y 308590.12	Y	N	N/A	N/A
DT15	Grapes Hill (lower)	R	X 622386.31 Y 308838.52	Y	N	N/A	N/A
DT16	Zipfel House	R	X 623185.69 Y 309649.68	Y	Y (1m)	3m	Y
DT17	68 Bull Close Road	R	X 623305.49 Y 309543.95	Y	Y (1m)	4m	Y
DT18	Upper King Street	K	X 623337.40 Y 308632.52	Y	N	N/A	N/A
DT19	Cattlemarket Street	R	X 623320.58 Y 308430.88	Y	Y (1m)	2m	Y
DT20	Exchange St	K	X 623007.27 Y 308716.34	Y	N	N/A	N/A
DT21	Rotary House King Street	R	X 623879.53 Y 307658.91	Y	Y (3m)	2m	Y
DT22	Carrow Bridge House	R	X 623900.96 Y 307709.56	Y	Y (1m)	5m	Y
DT23	62 Magpie Road	R	X 622970.72 Y 309652.02	Y	Y (1m)	2m	Y
DT24	26 Bull Close Road (trip)	R	X 623228.63 Y 309625.14	Y	Y (1m)	5.5m	Y
DT25	24 Bargate Court	R	X 623422.42 Y 309388.23	Y	Y (1m)	4m	Y
DT26	5 Riverside Road (x3)	R	X 623870.26 Y 308515.77	Y	Y (1m)	3m	Y
DT27	Wellington Lane (lower)	K	X 622419.52 Y 308797.22	Y	Y (15m)	1m	Y
DT28	71 Dukes Court	R	X 622431.35 Y 308663.05	Y	Y (1m)	4m	Y

## 2.2 Comparison of Monitoring Results with Air Quality Objectives

### 2.2.1 Nitrogen Dioxide (NO<sub>2</sub>)

#### Automatic Monitoring Data

The annual mean concentration at the Castle Meadow automatic monitoring site was recorded as **53 µg/m<sup>3</sup>** for 2012, which exceeds the annual mean objective by 13µg/m<sup>3</sup>. This monitoring site is within the central AQMA, although it does not represent any nearby relevant exposure. There were 4 exceedences of the 1-hour mean on three days during 2012.

The Norwich Lakenfields urban background automatic monitoring site measured an annual mean concentration of 14 µg/m<sup>3</sup>. There were no exceedences of the 1-hour mean.

**Table 2.3 Results of Automatic Monitoring for NO<sub>2</sub>: Comparison with Annual Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Annual Mean Concentration (µg/m <sup>3</sup> )			
					2009	2010	2011	2012
CM2	Norwich Lakenfields	N	98	98	16	13	13	14
CM1	Norwich Castle Meadow (mobile)	Y	99	99	<b>41</b>	<b>53</b>	<b>52</b>	<b>53</b>

**Table 2.4 Results of Automatic Monitoring for NO<sub>2</sub>: Comparison with 1-hour Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Number of Exceedences of hourly mean (200 µg/m <sup>3</sup> ) (99.8 <sup>th</sup> percentile of hourly means in brackets)			
					2009	2010	2011	2012
CM2	Norwich Lakenfields	N	98	98	0 (80)	0	0	0
CM1	Norwich Castle Meadow (mobile)	Y	99	99	1	15	<b>34</b>	4

## Diffusion Tube Monitoring Data

Table 2.5 shows the diffusion tube results for 2012, corrected for bias using a national bias adjustment factor of 1.02 using Gradko Labs for analysis and the 50% TEA in Acetone method.

The national bias spreadsheet is shown in Appendix A and is available via the following weblink:

[http://laqm.defra.gov.uk/documents/Database Diffusion Tube Bias Factors-v06 13-Final.xls](http://laqm.defra.gov.uk/documents/Database%20Diffusion%20Tube%20Bias%20Factors-v06%2013-Final.xls) . The precision and accuracy spreadsheet used to calculate the local bias correction is also shown in Appendix A.

**Table 2.5 Results of NO<sub>2</sub> Diffusion Tubes (2012)**

Site ID	Site Name	Site Type	TriPLICATE or Co-located Tube?	Within AQMA?	Data Capture 2012 (%)	2012 Annual Mean Concentration (µg/m <sup>3</sup> ) Bias Adjustment factor = 1.02	
						Uncorrected	Bias-adjusted
DT1	256 King Street	R	Triplicate	Y	100	43.0	<b>43.8</b>
DT2	Queens Rd Travelodge	R	N	Y	92	33.3	33.9
DT3	St Stephens (mid)	K	N	Y	100	60.3	<b>61.6</b>
DT4	Lakenfields	UB	Triplicate & co-located	N	100	13.8	14.1
DT5	Chalk Hill Road	R	N	Y	92	31.9	32.6
DT6	130 Magdalen Street	R	Triplicate	Y	100	32.0	32.7
DT7	Reads Flour Mill	K	N	Y	92	23.6	24.1
DT8	Grapes Hill (upper)	R	N	Y	100	24.0	24.4
DT9	13 St Augustines St	K	N	Y	100	40.9	<b>41.7</b>
DT10	32 St Augustines St	K	N	Y	92	39.3	<b>40.1</b>
DT11	50 St Augustines St	K	N	Y	100	51.1	<b>52.1</b>
DT12	65 St Augustines St	K	N	Y	100	34.4	35.1
DT13	Castle Meadow	R	N	Y	100	56.1	<b>57.2</b>
DT14	Castle Meadow 2	R	N	Y	100	52.7	<b>53.4</b>
DT15	Grapes Hill (lower)	R	N	Y	100	24.1	24.6
DT16	Zipfel House	R	N	Y	100	43.4	<b>44.2</b>
DT17	68 Bull Close Road	R	N	Y	100	30.6	31.2
DT18	Upper King Street	K	N	Y	100	36.4	37.2
DT19	Cattlemarket Street	R	N	Y	100	46.2	<b>47.2</b>
DT20	Exchange St	K	N	Y	100	30.1	30.7
DT21	Rotary House King Street	R	N	Y	75	37.3	38.1
DT22	Carrow Bridge House	R	N	Y	100	25.6	26.1
DT23	62 Magpie Road	R	N	Y	100	33.8	34.4
DT24	26 Bull Close Road	R	Triplicate	Y	100	33.9	34.6
DT25	24 Bargate Court	R	N	Y	100	36.2	36.9
DT26	5 Riverside Road	R	Triplicate	Y	100	50.0	<b>51.0</b>
DT27	Wellington Lane (lower)	K	N	Y	100	29.5	30.0
DT28	71 Dukes Court	R	N	Y	92	27.3	27.8



Using the National bias correction, a total of ten sites exceeded the NO<sub>2</sub> annual mean objective of 40 µg/m<sup>3</sup> during 2012. These sites were:

- 256 King Street;
- St Stephens (Mid);
- 13 St Augustines Street;
- 32 St Augustines Street;
- 50 St Augustines Street;
- Castle Meadow;
- Castle Meadow 2;
- Zipfel House;
- Cattlemarket Street; and
- Riverside Road.

All of these sites are within the existing Norwich Central AQMA. Although the tubes at St Stephens Street and Queens Road are not situated at locations representative of relevant exposure for the annual mean, the St Stephens St tube indicated an annual mean of 61µg/m<sup>3</sup>, which could potentially indicate a risk to the 1-hour objective. This location has been monitored for many years using a single diffusion tube, along with another nearby site using our mobile automatic analyser for a period prior to the changes in kerb layout etc. This is the first occasion that a potential threat to the hourly mean has been indicated, and monitoring will continue to establish whether a continuing threat exists.

Table 2.6 displays the bias adjusted diffusion tube monitoring results across the time series 2008 to 2012. This data is also plotted in Fig 1.5.

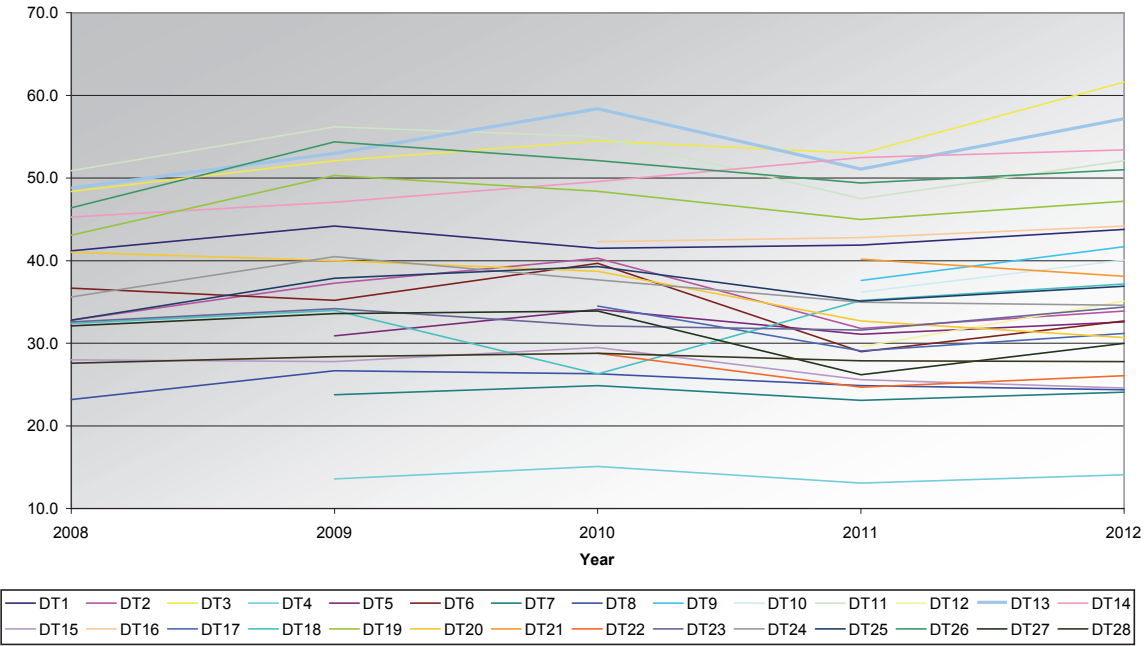
Non bias-corrected monthly diffusion tube results are shown in Appendix B.

**Table 2.6 Results of NO<sub>2</sub> Diffusion Tubes (2008 to 2012)**

Site ID	Site Name	Within AQMA?	Annual mean concentrations (µg/m <sup>3</sup> ) Adjusted for bias				
			Bias Adjustment Factors				
			2008	2009	2010	2011	2012
			<b>0.93</b>	<b>0.99</b>	<b>1.03</b>	<b>0.93</b>	<b>1.02</b>
DT1	256 King Street	Y	<b>41.2</b>	<b>44.2</b>	<b>41.5</b>	<b>41.9</b>	<b>43.8</b>
DT2	Queens Rd Travelodge	Y	32.8	37.3	<b>40.3</b>	31.8	33.9
DT3	St Stephens (mid)	Y	<b>48.4</b>	<b>52.1</b>	<b>54.5</b>	<b>53.0</b>	<b>61.6</b>
DT4	Lakenfields	N	N/A	13.6	15.1	13.1	14.1
DT5	Chalk Hill Road	Y	N/A	30.9	34.1	31.1	32.6
DT6	130 Magdalen Street	Y	36.7	35.2	39.7	29.0	32.7
DT7	Reads Flour Mill	Y	N/A	23.8	24.9	23.1	24.1
DT8	Grapes Hill (upper)	Y	23.2	26.7	26.3	24.9	24.4
DT9	13 St Augustines St	Y	N/A	N/A	N/A	37.6	<b>41.7</b>
DT10	32 St Augustines St	Y	N/A	N/A	N/A	36.2	<b>40.1</b>
DT11	50 St Augustines St	Y	<b>50.9</b>	<b>56.2</b>	<b>55.0</b>	<b>47.5</b>	<b>52.1</b>
DT12	65 St Augustines St	Y	N/A	N/A	N/A	29.6	35.1
DT13	Castle Meadow	Y	<b>48.8</b>	<b>53.0</b>	<b>58.4</b>	<b>51.1</b>	<b>57.2</b>
DT14	Castle Meadow 2	Y	<b>45.3</b>	<b>47.1</b>	<b>49.6</b>	<b>52.5</b>	<b>53.4</b>
DT15	Grapes Hill (lower)	Y	28.0	27.8	29.5	25.6	24.6
DT16	Zipfel House	Y	N/A	N/A	<b>42.3</b>	<b>42.8</b>	<b>44.2</b>
DT17	68 Bull Close Road	Y	N/A	N/A	34.5*	29.1	31.2
DT18	Upper King Street	Y	32.4	34.0	26.3	35.2	37.2
DT19	Cattlemarket Street	Y	<b>43.1</b>	<b>50.3</b>	<b>48.4</b>	<b>45.0</b>	<b>47.2</b>
DT20	Exchange St	Y	<b>41.0</b>	40.0	38.7	32.7	30.7
DT21	Rotary House King Street	Y	N/A	N/A	N/A	<b>40.2</b>	38.1
DT22	Carrow Bridge House	Y	N/A	N/A	28.8*	24.7	26.1
DT23	62 Magpie Road	Y	32.6	34.2	32.1	31.6	34.4
DT24	26 Bull Close Road	Y	35.6	<b>40.5</b>	37.7	35.0	34.6
DT25	24 Bargate Court	Y	32.8	37.9	39.3	35.1	36.9
DT26	5 Riverside Road	Y	<b>46.4</b>	<b>54.4</b>	<b>52.1</b>	<b>49.4</b>	<b>51.0</b>
DT27	Wellington Lane (lower)	Y	32.1	33.6	33.9	26.2	30.0
DT28	71 Dukes Court	Y	27.6	28.4	28.8	27.9	27.8

\* Not based on full year's measurements

**Fig 1.5 Chart showing NO<sub>2</sub> trends 2008 to 2012**  
 (Annual mean concentrations (µg/m<sup>3</sup>) adjusted for bias)



**2.2.2 Particulate Matter (PM<sub>10</sub>)**

The annual mean concentration of PM<sub>10</sub> at the Castle Meadow automatic monitoring site was recorded as 21µg/m<sup>3</sup>, which is below the annual mean objective of 40µg/m<sup>3</sup>. There were seven exceedences of the 24-hour mean of 50µg/m<sup>3</sup>, and the maximum daily mean recorded was 66µg/m<sup>3</sup> (98% data capture). Since the station does not incorporate an FDMS device, the data was corrected using the Volatile Correction Method (VCM). This is discussed further in Appendix A.

For the Norwich Lakenfields urban background automatic monitoring site, there was one exceedence of the 24-hour mean, and the maximum daily mean recorded was 53µg/m<sup>3</sup>. The annual mean concentration was 14µg/m<sup>3</sup> (87% data capture).

**Table 2.7 Results of Automatic Monitoring for PM<sub>10</sub>:  
Comparison with Annual Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Confirm Gravimetric Equivalent (Y or N/A)	Annual mean concentrations (µg/m <sup>3</sup> )			
						2009	2010	2011	2012
CM2	Norwich Lakenfields	N	87	87	Y	17	18	19	14
CM1	Norwich Castle Meadow (mobile)	Y	98	98	N/A	21	19	25	17

**Table 2.8 Results of Automatic Monitoring for PM<sub>10</sub>:  
Comparison with 24-hour Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Confirm Gravimetric Equivalent (Y or N/A)	Number of Exceedences of daily mean objective (50 µg/m <sup>3</sup> ) (90 <sup>th</sup> percentile of daily means in brackets)			
						2009	2010	2011	2012
CM2	Norwich Lakenfields	N	87	87	Y	0 (26)	4	13 (37)	1
CM1	Norwich Castle Meadow (mobile)	Y	98	98	N/A	2	3	17	7

### 2.2.3 Sulphur Dioxide (SO<sub>2</sub>)

There are two automatic sites in Norwich that monitor SO<sub>2</sub>.

Norwich Lakenfields had 61% data capture for the calendar year. There were no exceedences of the 15-minute mean during the calendar year, the maximum being 27 µg/m<sup>3</sup>. There were no exceedences of the 1-hour or 24-hour means at this site, with maximums being 16 µg/m<sup>3</sup> and 4 µg/m<sup>3</sup> respectively. The annual mean at Lakenfields is not available due to the low data capture.

The other automatic monitoring site in Norwich, at Castle Meadow, had 98% data capture for SO<sub>2</sub>. There were no exceedences of the 15-minute mean during the

calendar year, the maximum being 168  $\mu\text{g}/\text{m}^3$ . There were no exceedences of the 1-hour or 24-hour means at this site either, with maximums being 56  $\mu\text{g}/\text{m}^3$  and 42  $\mu\text{g}/\text{m}^3$  respectively. The recorded annual mean at Norwich Castle Meadow was 20  $\mu\text{g}/\text{m}^3$ .

**Table 2.9 Results of SO<sub>2</sub> Automatic Monitoring: Comparison with Objectives**

Site ID	Location	Within AQMA?	Data Capture (%)	Number of Exceedences		
				15-minute objective (266 $\mu\text{g}/\text{m}^3$ )	1-hour objective (350 $\mu\text{g}/\text{m}^3$ )	24-hour objective (125 $\mu\text{g}/\text{m}^3$ )
CM2	Norwich AURN Lakenfields	N	61	0	0	0
CM1	Norwich Castle Meadow (mobile site)	Y	98	0	0	0

#### 2.2.4 Benzene

NCC no longer monitors benzene as it has been determined that ambient levels in Norwich are insignificant in terms of the Air Quality Objective.

#### 2.2.5 Other Pollutants Monitored

##### Carbon Monoxide

Monitoring data is available for carbon monoxide from the Norwich mobile monitoring unit at Castle Meadow for the 2012 calendar year. There were no exceedences of the air quality strategy objective of 10  $\text{mg}/\text{m}^3$  (8-hour running mean) for carbon monoxide in Norwich during 2012. The recorded data shows a maximum 8-hour running mean of 1.4  $\text{mg}/\text{m}^3$ .

##### Ozone

Monitoring data is available for ozone from the Norwich mobile monitoring unit at Castle Meadow for the 2012 calendar year. Ozone is not included in the regulations for air quality management for local authorities due to its transboundary nature, and thus the limited effectiveness of action on a local scale. There is however a provisional objective level for this pollutant of 100 $\mu\text{g}/\text{m}^3$  as a running 8-hour mean

that is not to be exceeded more than 10 times per year. The recorded data shows a maximum 8-hour running mean of  $107\mu\text{g}/\text{m}^3$  and two occasions where the 8-hour running mean was above  $100\mu\text{g}/\text{m}^3$ . There was therefore no exceedence of this provisional objective.

## **PM2.5**

Monitoring data is available for PM2.5 from the Norwich mobile monitoring unit at Castle Meadow for the 2012 calendar year. PM2.5 is not included in the regulations for air quality management for local authorities. The recorded data shows an annual mean of  $9\mu\text{g}/\text{m}^3$  and a maximum daily mean of  $34\mu\text{g}/\text{m}^3$ .

PM2.5 data is also available for the Lakenfields site. The recorded data shows an annual mean of  $14\mu\text{g}/\text{m}^3$  and a maximum daily mean of  $53\mu\text{g}/\text{m}^3$ .

### **2.2.6 Summary of Compliance with AQS Objectives**

Norwich City Council has examined the results from monitoring in the district.

Concentrations within the AQMA still exceed the annual mean objective for nitrogen dioxide at ten monitoring sites (eight with relevant exposure), and the AQMA should remain.

Concentrations outside of the AQMA are all below the objectives at relevant locations, therefore there is no need to proceed to a Detailed Assessment.

### 3 New Local Developments

Norwich City Council confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area that have not been adequately considered in previous rounds of Review and Assessment.

Norwich City Council confirms that all of the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources.**

## **4 Planning Applications**

Two major developments are proposed within the city that could potentially impact on air quality. These are the sites at the 'Deal Ground' and at 'Three Score'. These sites are on the fringes of the city and are not within the Central AQMA. Both applications were recently granted outline planning permission subject to conditions.

As part of the application process for both sites an air quality assessment report was submitted. The reports concluded that the developments were unlikely to cause any exceedence of the relevant air quality objectives or any significant change in local pollutant concentrations. As such it is not envisaged that either will give rise to the need for a Detailed Assessment.



## 5 Air Quality Planning Policies

### **The existing Local Plan and the emerging Local Plan**

The *City of Norwich replacement local plan* (RLP) was adopted in November 2004. It contains the policies and proposals for development in the city. The RLP provides policy guidance for developers and the council's own development management service on where and what kind of development may be permitted.

Some adopted RLP policies have since been deleted. There are four reasons for this:

1. Due to national changes in the planning system, in November 2007 some RLP policies were deleted in agreement with the Government Office.
2. The RLP is gradually being superseded by the emerging Local Plan. Two Local Plan development plan documents have been adopted. These are the Joint Core Strategy (JCS) for Broadland, Norwich and South Norfolk (though part of the strategy affecting Broadland district is currently subject to a legal challenge) and the Northern City Centre Area Action Plan (NCCAAP).
3. Some policies have been assessed to be non-compliant with national policy in the National Planning Policy Framework (NPPF) and are no longer being applied after the first anniversary of its publication in March 2013.
4. Some policies are now redundant as the proposal to which they relate has been implemented.

Those *City of Norwich replacement local plan* policies which remain in use from March 2013 that relate to air pollution emissions and sensitive uses and air quality management areas are referenced EP5 & EP6 respectively, and are cited below:

## **EP5 - Air Pollution emissions and sensitive uses**

**Development which may give rise to air-borne emissions of harmful substances, including smoke, grit and dust, will be required to assess the level of risk of demonstrable harm to human health or to the environment and to identify appropriate mitigation measures. Particular account will be taken of any sensitive uses, which would adjoin or otherwise be affected by such emissions.**

This policy complies partially with NPPF paragraph 109, 110, and 120 which require plans to ensure that development is appropriate for its location taking account of the need to minimise risk of and prevent unacceptable harm from pollution. However the focus of policy EP5 on mitigating the impact of pollution-causing development does not fully take into account the impacts of locating other forms of development close to *existing* sources of air pollution. The requirement for “**development** (sic) ... **to assess the level of risk of demonstrable harm to human health or to the environment and to identify appropriate mitigation measures**” is poorly worded and does not offer certainty to developers as to detail required, how such an assessment would be used or how it would inform decision-taking. Such an approach may not comply with NPPF paragraph 122 which makes clear that local planning authorities should focus on whether the **development itself** is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions which are the subject of separate legislation (which local planning authorities should assume will operate effectively). In order to comply with the NPPF it will be necessary to apply the more balanced approach set out in emerging DM policies DM2 and DM11. These policies will have a clearer focus on the planning issues, acknowledging the interrelationship of neighbouring uses and recognising that impacts may need to be addressed from existing, as well as proposed, sources of air pollution (complying with NPPF para 109).

## **EP6 - Air Quality Management Areas**

**Where an Air Quality Management Area has been declared (under the Environment Act, 1995), development which may have an impact on air quality will be required to take account of the action plan for that area in respect of its location and density.**

This policy complies with paragraph 124 of the NPPF which requires policies to take into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas, and that planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan. Emerging policy DM11 of the Development Management Policies Plan continues this approach albeit that the planning implications of AQMA designation are more clearly explained.

Two further emerging Local Plan documents, the Site Allocations Plan and the Development Management Policies Plan are in production. When these plans are adopted (scheduled for 2013), RLP policies will no longer apply.

## 6 Local Transport Plans and Strategies

Norfolk's 3<sup>rd</sup> transport plan, Connecting Norfolk has been adopted. This describes the county's strategy and policy framework for delivery up to 2026. It will be used as a guide for transport investment and considered by other agencies when determining planning or delivery decisions.

### **Norfolk's Transport Vision:**

A transport system that allows residents and visitors a range of low carbon options to meet their transport needs and attracts and retains business investment in the county.

Connecting Norfolk reflects the views of local people and stakeholders, identifying six priorities for transport:

- Maintaining and managing the highway network
- Delivering sustainable growth
- Enhancing strategic connections
- Reducing emissions
- Improving road safety
- Improving accessibility

It is important that Connecting Norfolk takes adequate regard of sustainability considerations, such as its impact on biodiversity, social exclusion, carbon emissions and health of the population.

### **With specific regard to transport emissions:**

Measures must be taken to reduce emissions from transport in Norfolk. Connecting Norfolk places importance on:

1. Aiding a shift to a more efficient vehicle fleet through development and facilitation of necessary infrastructure like electric vehicle charging points
2. Promoting active and healthier travel options for short journeys to schools, services and places of employment
3. Enhancing integration between different travel modes, particularly at key bus and rail stations and Norwich Airport
4. Tackling traffic problems where they are resulting in poor air quality.

The full report can be viewed at:

[http://www.norfolk.gov.uk/Travel\\_and\\_transport/Transport\\_future\\_for\\_Norfolk/Local\\_Transport\\_Plan/index.htm](http://www.norfolk.gov.uk/Travel_and_transport/Transport_future_for_Norfolk/Local_Transport_Plan/index.htm)

## 7 Implementation of Action Plans

Table 7.1 Action Plan Progress

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
<b>St Augustines Street</b>					
1	Road Layout Changes	2011	Completed end of 2010	One-way gyratory system to reduce traffic levels in St Augustines Street constructed	Air quality has shown improvement on St Augustine's Street following completion of the scheme. It has not yet achieved the objective, but the NO <sub>2</sub> levels show a marked reduction over the preceding 2 years. Three additional monitoring points were added at the start of the scheme to gain a broader picture of air quality in the area. Two of these locations were below the annual objective level in 2012, and one was just above at 41 µg/m <sup>3</sup> . Caution needs to be taken over simple year on year comparisons, and a truer picture of the ambient pollution levels will be revealed over the coming years. The scheme has also delivered regeneration and road safety benefits.
<b>Castle Area</b>					
2	Low Emission Zone	Design 04/05 phased implementation 06/07 through to 2009/10	Original LEZ measures fully introduced	<u>European match funding was secured through CIVITAS SMILE. Engine switch off TRO implemented April 2007. Retro-fit programme commenced</u>	Continuous automatic monitoring showed a reduction in year on year NO <sub>2</sub> levels from 2007 to 2009. However, 2010 saw an increase in both the annual and hourly mean levels. The increased annual mean level has remained stable. The cause of this increase may be down to environmental or weather related conditions. The detailed assessment carried out in 2012 reported that the overwhelming majority of 1-hour mean exceedences that have occurred over the last six years occurred over the winter of 2010/2011 up to the end of April 2011. This suggests that there may have been a short-term set of circumstances over this period that caused those
3				Castle Meadow Low Emission Zone now fully introduced with application of Traffic Regulation Condition in force	

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
					exceedences. Individual diffusion tubes on Castle Meadow show relatively stable levels. The Castle Meadow 2 tube shows a continuing exceedence that relates to general traffic but which will not be affected by the LEZ.
4	Quality Bus Partnerships & Contracts	Ongoing process	On-going discussions between County/City and First.	Increasingly close working between NCC and operators on quality, but no formal partnerships. Voluntary joint investment partnership established between First, County Council and City Council during 2007 - 2010 period	Joint investment partnership has delivered new Euro IV buses and improved fleet management.
<b>Grapes Hill</b>					
5	Road Layout Changes	Design 04/05 Implemented 05/06	Layout and traffic light sequence changes completed, resulting in reduced queuing on Grapes Hill	2008 DA concluded that AQMA could be revoked, as subsequently reported. This AQMA now forms part of the Central Norwich AQMA. Monitoring locations rationalised, retaining site with closest relevant exposure.	NO <sub>2</sub> levels consistently below objective for previous six years.
<b>Area Wide Measures</b>					
6	Park and Ride (P&R) and Car Parking Policy	Ongoing Process	All programmed Park and Ride works complete	Circa 2.5 million passengers using Park and Ride each year	6 P&R sites in Norwich, with over 5,000 spaces - the most in the country – handling approx 8,000 passengers each day they are open. Along with promotions to use P&R, Norfolk County Council is developing a SMART ticketing system, meaning that those who travel more often pay less. NCC are also currently implementing a coach parking facility at Harford P&R. City centre parking tariffs encourage short/medium stay use which reduces peak hour

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
					movement, and consequently reduces congestion and traffic queues.
Soft Measures:					
7	Car Sharing	Ongoing process	Norfolk Car Share and City Car Club going through continued development.	<u>European match funding was secured through CIVITAS SMILE project</u>  <u>Norfolk Carshare</u>  <u>City Car Club</u>	<p>Norfolk Carshare was set up to provide a free matching service for all those who live, work and travel in and around Norfolk. Users can expect cheaper travel costs as well as promoting less congestion and reduced emissions.</p> <p>Norfolk Car Club was launched four years ago with two cars in the town of Reepham. Three years ago the city car club was set up in Norwich (with four cars). All Norfolk Car Club vehicles are owned by Norfolk County CIC, a not-for-profit social enterprise. There are now 16 car club cars in Norwich, with a further 12 locations designated for use within the next two years. Demand for the car club in Norwich grew by over <b>60%</b> last year and substantial growth is expected again this year.</p>
8	Travel Wise	Ongoing process	Ongoing process	ACT TravelWise is the UK's premier network for all organisations working to promote sustainable transport and mobility.	The Act TravelWise website now up and running. <a href="http://www.acttravelwise.org/home">http://www.acttravelwise.org/home</a> . Norfolk County Council actively promoting.
9	School Travel Plans	Ongoing process	Target Met	Complete	All existing schools now have travel plans. New schools must have a travel plan implemented through their planning application. Norfolk County Council monitor these travel plans

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
10	Workplace Travel Plans	Ongoing process	Ongoing process	All 20 targeted workplaces approved travel plans and implemented a range of initiatives. The four largest employers were monitored and produced positive modal shift results of between 4 & 18 percent. Ten car-sharing schemes were implemented and two shuttle bus initiatives reduced parking by significant amounts at several key sites in Norwich.	<p style="text-align: center;"><u>Integrated into CIVITAS SMILE project</u></p> <p>Two dedicated workplace travel plan officers are in post at Norfolk County Council to monitor and implement workplace travel plans.</p>
11	Cycle Network	Ongoing development process	Comprehensive cycle network launched in June 2012 with map and signed routes. £500k Connect 2 project completed March 2013 to improve the quality of cycling infrastructure on the orange and pink pedal ways in north east Norwich.	No outcome to date	The direct emission reduction effect has not yet been measured.



No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
Alternative Fuels:					
12	Cleanup Motorvate Powershift	Ongoing process	None (see comments)	No outcome to date	Grant programmes ended and revised to move to a technology neutral approach, and adjusted to comply with State Aid rules. Continuous research but nothing planned.
13	Retro-fit	2005-2009	Complete	Bus fleet using Castle Area AQMA Euro III or better	<u>Retro-fit evaluated as part of CIVITAS SMILE project as part of wider project to introduce a Low Emission Zone</u>
14	Bio-fuels	2005-2009	Trials commenced with bio-diesel bus and police vehicle fleets. Further work carried out including introduction of first bio-gas powered bus between 2003/04 and 2009/10	Up to 20% bio-diesel blends have no impact and may improve NOx emissions. However uncertainty over supply etc means that Local Authorities now investigating bio-gas with both CO <sub>2</sub> and NOx benefits	<u>Trials evaluated as part of CIVITAS SMILE project</u>
15	Land Use Planning	Ongoing	The emerging Local Plan is a suite of planning policy documents to guide and manage new development in the city of Norwich. It will form part of the overall development plan for Norwich.	Long term effect	Seeks to minimise need for travel and encourage use of non motorised modes and public transport

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
16	Engine Switch-Off	2008	Complete	Vehicles stopping in Castle Meadow required to turn off engine if stationary unless passengers alighting/boarding continuously	To be applied in remainder of city centre on clarification of appropriate approach to enforcement.

Table 7.1 refers to the AQMAs that existed prior to the declaration of the Central Norwich AQMA (though they are all within that area). A revised Action Plan is currently being prepared that will reference measures to be applied to the new area as a whole rather than discreet areas. This is in line with anticipated guidance that is expected to be produced following Defra's current consultation on options to improve air quality management in England. The likely outcome from this consultation is that there will be no reporting requirements on local hotspots outside of the national assessment of EU air quality standards, but a stronger interest and reporting on local measures which help to improve air quality and bring England closer to compliance with EU air quality standards. Local authorities would focus on action planning and public health and report on measures taken to improve air quality and these would be included in reports to the EU on compliance.

## 8 Conclusions and Proposed Actions

### 8.1 Conclusions from New Monitoring Data

NCC undertakes both continuous and diffusion tube nitrogen dioxide monitoring in their area. Continuous monitoring carried out at Castle Meadow in 2012 showed that the NO<sub>2</sub> concentration exceeded the annual mean objective of 40 µg/m<sup>3</sup>. The monitoring also showed that the 1-hour mean objective for NO<sub>2</sub> was exceeded 4 times during the year (18 allowed). Automatic monitoring carried out at Norwich Lakenfields did not indicate any exceedence of the annual mean or the 1-hour mean objectives.

NCC also carried out diffusion tube monitoring for NO<sub>2</sub> at 28 locations throughout the city. The 2012 national bias-adjusted results indicated that concentrations of NO<sub>2</sub> exceeded the annual mean objective at ten locations. These locations were:

- 256 King Street;
- St Stephens (Mid);
- 13 St Augustines Street;
- 32 St Augustines Street;
- 50 St Augustines Street;
- Castle Meadow;
- Castle Meadow 2;
- Zipfel House;
- Cattlemarket Street; and
- Riverside Road.

All of these sites are within the existing Norwich Central AQMA. Although the tubes at St Stephens Street and Queens Road are not situated at locations representative of relevant exposure for the annual mean, the St Stephens St tube indicated an annual mean of 61µg/m<sup>3</sup>, which could potentially indicate a risk to the 1-hour objective. This location has been monitored for many years using a single diffusion tube mounted at the kerbside. Additionally, another site was established on the opposite side of the street to the diffusion tube using our mobile automatic analyser for a period prior to the changes in kerb layout etc. This is the first occasion that a potential threat to the hourly mean has been indicated, and monitoring will continue to establish whether a continuing threat exists.

Based upon the findings of previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead, PM<sub>10</sub> and SO<sub>2</sub> are unlikely to be in excess of the air quality objectives at any location.

## **8.2 Other Conclusions**

The 2012 USA proposed the following actions:

- The council should proceed with declaring the Central Norwich AQMA, encompassing all areas with current monitoring data above or close to the NO<sub>2</sub> annual mean objectives.
- Ensure the biomass installation at City of Norwich School does not lead to an exceedence of any air quality objectives.
- Proceed to 2013 Annual Progress Report.

All of the above proposals have been achieved. The new AQMA came into force on 1<sup>st</sup> November 2012. Further assessment of the biomass installation at the City of Norwich School revealed a negligible overall significance from the proposal at sensitive receptor locations within the assessment extents, and it was given approval in February 2013.

## 8.3 Proposed Actions

This Progress Report concludes that Norwich City Council is not required to carry out a Detailed Assessment for nitrogen dioxide, carbon monoxide, benzene, 1,3-butadiene, lead, PM<sub>10</sub> or sulphur dioxide.

Concentrations within the AQMA still exceed the annual mean objective for nitrogen dioxide at ten monitoring sites (eight with relevant exposure), and the AQMA should remain.

Proposed actions from this report are as follows:

- Continue with automatic and passive NO<sub>2</sub> monitoring within the city area
- Develop a revised Action Plan to work towards compliance with the air quality objectives within the Norwich Central AQMA. This plan should draw upon the results of the monitoring program, DA's and FA's carried out previously.
- Proceed to 2014 Annual Progress Report.

## 9 References

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# Appendices

Appendix A: QA/QC Data

Appendix B: 2012 Monthly Uncorrected NO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)

# Appendix A: QA:QC Data

## National Diffusion Tube Bias Adjustment Factor

Supplier/ Analyst: Gradko

Preparation Method: 50% TEA in Acetone

National Bias Adjustment Factor (from spreadsheet v06/13): **1.02**

## Factor from Local Co-location Studies (Local Bias Adjustment Factor)

Norwich Lakenfields urban background AURN site (based on 12 periods of data)

Bias Factor A: **1.04** (0.88 – 1.26)

Bias B: -4% (-20% - 13%)

Diffusion Tubes Mean: 14 µg/m<sup>3</sup>

Automatic Mean: 14 µg/m<sup>3</sup>

Data Capture for periods used: 98%

Adjusted Tubes Mean: 14 (12-17) µg/m<sup>3</sup>

A copy of the precision and accuracy spreadsheet used to calculate the local bias correction is shown below:

Checking Precision and Accuracy of Triplicate Tubes									
Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µg/m <sup>3</sup>	Tube 2 µg/m <sup>3</sup>	Tube 3 µg/m <sup>3</sup>	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	04/01/2012	07/02/2012	19.4	20.3	21.2	20	0.9	4	2.2
2	07/02/2012	07/03/2012	17.3	15.6	17.0	17	0.9	6	2.3
3	07/03/2012	05/04/2012	16.9	17.9	17.2	17	0.5	3	1.3
4	05/04/2012	04/05/2012	10.9	10.3	11.2	11	0.5	5	1.2
5	04/05/2012	01/06/2012	9.0	10.2	9.3	10	0.6	7	1.6
6	01/06/2012	29/06/2012	7.6	8.0	8.0	8	0.2	3	0.6
7	29/06/2012	04/08/2012	8.0	7.9	8.9	8	0.6	7	1.4
8	04/08/2012	31/08/2012	9.8	10.5	9.8	10	0.4	4	1.0
9	31/08/2012	28/09/2012	11.9	11.6	11.6	12	0.2	1	0.4
10	28/09/2012	02/11/2012	15.3	12.8	14.6	14	1.3	9	3.1
11	02/11/2012	03/12/2012	19.5	19.6	21.4	20	1.1	5	2.6
12	03/12/2012	03/01/2013	19.0	19.1	19.1	19	0.1	0	0.2

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
19	98.66	Good	Good
19	88.65	Good	Good
21	99.87	Good	Good
17	99.86	Good	Good
13	99.6	Good	Good
10	99.86	Good	Good
12	99.19	Good	Good
7	96.24	Good	Good
9	99.72	Good	Good
12	99.87	Good	Good
17	99.86	Good	Good
16	99.6	Good	Good

*It is necessary to have results for at least two tubes in order to calculate the precision of the measurements*

Overall survey --> **Good precision**      **Good Overall DC**

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	
Precision	12 out of 12 periods have a CV smaller than 20%
Accuracy (with 95% confidence interval) without periods with CV larger than 20%	Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data	Bias calculated using 12 periods of data
Bias factor A 1.04 (0.88 - 1.26)	Bias factor A 1.04 (0.88 - 1.26)
Bias B -4% (-20% - 13%)	Bias B -4% (-20% - 13%)
Diffusion Tubes Mean: 14 µg/m <sup>3</sup>	Diffusion Tubes Mean: 14 µg/m <sup>3</sup>
Mean CV (Precision): 5	Mean CV (Precision): 5
Automatic Mean: 14 µg/m <sup>3</sup>	Automatic Mean: 14 µg/m <sup>3</sup>
Data Capture for periods used: 98%	Data Capture for periods used: 98%
Adjusted Tubes Mean: 14 (12 - 17) µg/m <sup>3</sup>	Adjusted Tubes Mean: 14 (12 - 17) µg/m <sup>3</sup>

Without CV>20%	With all data
-1%	-1%
16.9%	16.9%

Jaume Targa, for AEA  
Version 04 - February 2011



## Discussion of Choice of Factor to Use

With regard to the selection of a bias adjustment factor for the diffusion tubes, Technical Guidance LAQM.TG(09) and the LAQM Support website recommend the use of a local bias adjustment factor where available and relevant to diffusion tube sites. The co-location site at Lakenfields was therefore used to derive a local bias correction factor to be considered and applied if appropriate.

However, the technical guidance also states that where the survey consists of tubes exposed over a range of settings, which differ from the co-location site (eg the co-location site is in a very exposed setting and the tubes being assessed are on a building façade in a canyon-like street), then this indicates that the national adjustment factor may be more representative.

There are other arguments for and against using the national bias adjustment factor as opposed to a local figure, and some of these arguments may be applied to the circumstances in Norwich. However, what is clear is that some areas of the city are below but close to the objective level. Therefore, to be as accurate as is reasonably possible using diffusion tubes, it has been decided to use a correction derived from many surveys, and apply the nationally derived bias adjustment factor of 1.02. The Spreadsheet of National Bias Adjustment Factors (v.06/13) is shown below.

National Diffusion Tube Bias Adjustment Factor Spreadsheet							Spreadsheet Version Number: 06/13			
Follow the steps below <b>in the correct order</b> to show the results of <b>relevant</b> co-location studies							This spreadsheet will be updated at the end of September 2013			
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods										
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet										
This spreadsheet will be updated every few months; the factors may therefore be subject to change. This should not discourage their immediate use.							<a href="#">LAQM Helpdesk Website</a>			
The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.							Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.			
Step 1:		Step 2:		Step 3:		Step 4:				
Select the Laboratory that Analyses Your Tubes from the Drop-Down List		SELECT A PREPARATION METHOD from the Drop-Down List		SELECT A YEAR from the Drop-Down List		Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor* shown in blue at the foot of the final column.				
If a laboratory is not chosen, we have no data for this laboratory.		If preparation method is not chosen, we have no data for this method at this laboratory.		If a year is not chosen, we have no data*		If you have your own co-location study then see footnote*. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953				
Analysed By <sup>1</sup>	Method <sup>2</sup>	Year <sup>3</sup>	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) ( $\mu\text{g}/\text{m}^3$ )	Automatic Monitor Mean Conc. (Cm) ( $\mu\text{g}/\text{m}^3$ )	Bias (B)	Tube Precision <sup>4</sup>	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	50% TEA in acetone	2012	UB	Reading Borough Council	12	21	26	-17.3%	G	1.22
Gradko	50% TEA in acetone	2012	R	Reading Borough Council	12	39	47	-16.8%	G	1.20
Gradko	50% TEA in Acetone	2012	R	Stevenage Borough Council	11	33	28	16.6%	G	0.86
Gradko	50% TEA in acetone	2012	R	BC King's Lynn & West Norfolk	10	28	25	13.2%	G	0.88
Gradko	50% TEA in acetone	2012	R	London Borough of Richmond upon Thames	12	36	39	-8.2%	G	1.09
Gradko	50% TEA in acetone	2012	KS	London Borough of Richmond upon Thames	9	46	41	11.8%	G	0.89
Gradko	50% TEA in acetone	2012	B	London Borough of Richmond upon Thames	12	23	24	-3.8%	G	1.04
Gradko	50% TEA in acetone	2012	UB	Norwich City Council	12	14	18	-22.5%	G	1.29
Gradko	50% TEA in acetone	2012	R	London Borough of Croydon	12	44	44	0.4%	P	1.00
Gradko	50% TEA in acetone	2012	KS	London Borough of Croydon	12	60	66	-9.7%	G	1.11
Gradko	50% TEA in acetone	2012	KS	Marylebone Road Intercomparison	12	36	35	1.3%	G	0.99
Gradko	50% TEA in acetone	2012	R	Leeds City Council	9	50	38	23.8%	S	0.77
Gradko	50% TEA in Acetone	2012	UB	London Borough of Bexley	11	24	24	3.2%	G	0.97
Gradko	50% TEA in Acetone	2012	SU	London Borough of Bexley	10	26	28	-6.3%	G	1.07
Gradko	50% TEA in Acetone	2012	SU	London Borough of Bexley	11	27	25	5.3%	P	0.95
Gradko	50% TEA in Acetone	2012	R	London Borough of Bexley	11	49	45	7.4%	G	0.93
Gradko	50% TEA in acetone	2012	R	West Berkshire Council	11	42	46	-7.1%	G	1.08
Gradko	50% TEA in acetone	2012	R	West Berkshire Council	12	25	27	-6.5%	G	1.07
Gradko	50% TEA in acetone	2012	R	Wolverhampton CC	12	40	49	-19.4%	P	1.24
Gradko	50% TEA in acetone	2012	R	Wolverhampton CC	12	37	34	11.1%	G	0.90
Gradko	50% TEA in acetone	2012	R	Sandwell Metropolitan Borough Council	11	46	45	0.6%	G	0.99
Gradko	50% TEA in acetone	2012		<b>Overall Factor* (21 studies)</b>					Use	1.02

## **PM Monitoring Adjustment**

The Volatile Correction Method (VCM) allows corrections to be made to TEOM measurements for the loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by this instrument. The resulting corrected measurements have been demonstrated as equivalent to the gravimetric reference equivalent.

The VCM works by using the volatile particulate matter measurements provided by nearby FDMS instruments (within 130 km) to assess the loss of PM<sub>10</sub> from the TEOM; this value is then added back onto the TEOM measurements.

The VCM model was applied to the Castle Meadow TEOM data to calculate the Indicative Gravimetric Equivalent PM10 for the annual mean and 24-hour mean readings.

The Norwich Lakenfields site incorporates an FDMS device on the PM<sub>10</sub> and PM<sub>2.5</sub> TEOMs.

## **QA/QC of Automatic Monitoring**

In order to satisfy the requirement outlined in the LAQM TG (09), the following QA/QC procedures were implemented:

- 2-weekly calibrations of the analysers;
- Annual audits;
- 6-monthly servicing of the monitoring site; and
- Data ratification.

Calibration of the analysers was carried out using certified compressed gas standards (ISO17025). This ensured that the calibration gas was traceable to national and international standards. In addition to the calibration, sample filters were changed for both gaseous and TEOM analysers and any faults were identified, thus minimising data loss.

Audits of the monitoring site were carried out by AEA Technology and consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinders were also checked against another gas standard in order to confirm the gas concentration. Any identified faults were forwarded on to the service unit for repair.

The final stage of the QA/QC process was to ratify the data. During ratification, all calibration, audit and service data are collated and the data is appropriately scaled. Any suspect data identified are deleted therefore ensuring that the data are of a high quality. The data was ratified by Air Quality Data Management.

## **QA/QC of Diffusion Tube Monitoring**

The diffusion tubes are supplied and analysed by Gradko International utilising a 50% Triethanolamine (TEA) in Acetone preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO<sub>2</sub> diffusion tube analysis and the Annual Field Inter-Comparison Exercise. The lab follows the procedures set out by the Harmonisation Practical Guidance.

## Appendix B: 2012 Monthly Uncorrected NO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)

<u>Location</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Annual Average</u>	<b>2012 Bias Corrected X 1.02</b>
256 King Street (x3)	47.6	45.0	43.8	42.9	33.6	38.6	39.8	45.8	39.7	44.2	51.6	43.4	43.0	43.8
Queens Rd Travelodge	35.6	37.2	42.0	35.2	35.7	24.0	23.0	24.6		33.7	39.7	35.4	33.3	33.9
St Stephens (mid)	65.3	46.6	68.2	55.3	56.4	67.4	62.4	69.8	51.9	62.2	64.5	54.4	60.3	<b>61.6</b>
130 Magdalen Street (x3)	37.4	36.2	33.9	29.3	26.5	21.3	26.5	30.1	33.0	32.0	42.1	36.0	32.0	32.7
Grapes Hill (upper)	31.7	25.0	26.5	24.2	17.2	19.4	18.5	23.0	18.9	26.2	28.1	29.0	24.0	24.4
Exchange St	38.3	39.7	32.8	25.6	24.7	24.4	22.6	22.8	26.6	30.8	39.8	32.6	30.1	30.7
50 St Augustines	53.3	52.4	55.2	48.2	43.7	40.5	46.0	57.3	49.8	54.5	65.0	47.1	51.1	52.1
32 St Augustines	40.7	37.6	41.6	38.1		34.9	39.3	42.9	24.7	40.7	46.6	45.8	39.3	40.1
13 St Augustines	42.7	24.2	48.9	45.5	44.3	39.1	36.1	38.5	39.6	45.6	48.4	38.1	40.9	41.7
65 St Augustines	42.1	33.1	32.4	28.4	26.2	23.0	30.8	32.6	36.6	37.0	49.0	41.9	34.4	35.1
Upper King Street	43.5	42.3	40.5	31.4	29.6	25.1	26.6	34.4	41.6	39.3	42.4	40.8	36.4	37.2
Cattlemarket Street	44.2	55.5	45.5	48.9	42.9	38.4	43.8	49.0	43.8	43.7	55.5	43.7	46.2	47.2
Castle Meadow	64.8	46.2	59.9	53.4	53.8	47.0	54.1	56.6	63.3	59.8	59.4	54.5	56.1	57.2
Castle Meadow 2	56.7	52.1	54.7	46.7	43.6	49.2	52.0	58.0	61.3	48.6	55.7	54.4	52.7	53.8
Lakenfields (x3)	20.3	16.6	17.3	10.8	9.5	7.9	8.3	10.1	11.7	14.2	20.2	19.1	13.8	14.1
Grapes Hill (lower)	30.4	20.1	30.5	24.2	24.1	18.7	20.3	23.6	19.2	26.6	27.5	24.0	24.1	24.6
62 Magpie Road	37.4	32.5	36.6	30.1	22.0	29.5	29.4	35.4	35.2	34.1	45.4	37.7	33.8	34.4
26 Bull Close Road (x3)	38.9	34.4	38.9	28.8	26.1	27.6	31.5	34.9	35.0	33.7	40.5	36.6	33.9	34.6
24 Bargate Court	36.0	39.0	39.7	36.6	20.7	29.2	33.4	32.2	36.8	42.5	46.8	41.6	36.2	36.9
5 Riverside Road (x3)	50.1	36.8	48.5	49.9	41.2	40.5	51.8	59.2	48.0	54.0	63.0	57.5	50.0	51.0
Wellington Lane (lower)	38.8	32.7	34.2	27.5	26.2	21.0	23.0	26.4	26.3	30.7	32.9	33.9	29.5	30.0
71 Dukes Court	32.9	32.8	31.8	26.6	24.0	15.2	23.0	26.9	24.8	29.3		32.8	27.3	27.8
Chalk Hill Road	35.1	29.0	35.5	28.9	25.4	26.4	29.6	33.5	33.4		38.7	36.0	31.9	32.6
Reads Flour Mill	32.7	38.3	25.6	19.7	18.3	14.5	16.0	19.8	20.6	25.1		29.3	23.6	24.1
Carrow Bridge House	30.6	30.5	29.0	22.6	21.8	18.3	20.0	22.7	23.0	27.0	34.4	26.9	25.6	26.1
Zipfel House	58.8	31.0	43.7	39.8	31.0	34.0	39.1	42.0	41.7	49.9	56.1	53.4	43.4	44.2
68 Bull Close Road	34.2	39.3	32.4	24.6	21.7	24.2	27.8	29.4	28.0	36.4	36.8	32.2	30.6	31.2
Rotary House King Street	40.9	39.9	37.6	35.5	28.8	37.5		38.9	37.3	39.5			37.3	38.1

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