

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

Air quality review and assessment
Annual progress report 2010



NORWICH
City Council

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Executive Summary

The first round of review and assessment of air quality in Norwich was carried out in four stages to determine whether the national air quality objectives would be met by the end of 2005. The results of these assessments indicated that there were areas of Norwich almost certain to exceed the annual mean objective for Nitrogen Dioxide (NO₂). Consequently, Norwich City Council declared three Air Quality Management Areas (AQMA's) on 1st June 2003 for exceedance of the annual NO₂ objective at Grapes Hill St, Augustines Street, and the Castle area of Norwich. The location and extent of these three areas is shown in Figs 1.1 to 1.4.

In conjunction with AEA Technology, Updating and Screening Assessments (USA's) of local air quality for Norwich were produced in January 2004, March 2006 and July 2009. These reviewed the previous assessments undertaken for all pollutants identified in the Air Quality Regulations.

Where a significant risk of exceedance is identified for a pollutant, the local authority has to proceed to a Detailed Assessment (DA). However, the Updating and Screening Assessments concluded that Norwich did not require a Detailed Assessment for NO₂, PM₁₀, Benzene, Carbon Monoxide, Lead, 1-3 Butadiene or Sulphur Dioxide. Where a local authority does not need to undertake a DA, a progress report is required instead. The results from the diffusion tube survey in 2007 confirmed that the annual mean objective for NO₂ was not met at several locations in Norwich. It was therefore decided to undertake a DA in 2008 to include dispersion modelling at these locations. The DA concluded that a further AQMA was required at Riverside. This new area was declared on 1st December 2009, and is shown in Figs 1.1 and 1.5.

Air quality continues to be monitored in areas of Norwich in order to identify trends in pollution levels, and to assess progress towards achieving the annual average NO₂ objective in the four AQMA's.

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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 135,000 people.

The City has a skilled workforce, particularly in the professions, education and research and development. Employment is mainly in the service sector but manufacturing, although small in employment terms, is crucial to the local economy and smaller businesses are increasingly important. Services are sited in the centre of Norwich, whilst industrial and trading estates, and recently established business parks, are sited throughout the city.

The City permits 45 '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

Progress Reports were introduced into the LAQM system following a detailed evaluation of the first round of local authority review and assessments. A need was identified to develop a longer-term vision for both LAQM and the review and assessment process. The process was seen to be too stop-start, possibly resulting in gaps of several years between air quality reviews.

Updating and screening assessments are now required at three yearly intervals, while annual progress reports maintain continuity in the intervening years. This encourages the integration of LAQM into the routine work of local authorities, and is intended to assist local authorities by:-

- helping retain a profile for LAQM within the authority, including the retention of staff with a knowledge of air quality issues
- providing a means for communicating air quality information to members and the public
- maximising the usefulness and interpretation of the monitoring effort being carried out by the local authority
- maximising the value of the investment in monitoring equipment
- making the next round of review and assessment that much easier, as there will be a readily available up-to date source of information
- helping local authorities respond to requests for up-to-date information on air quality
- providing information to assist in other policy areas, such as transport and land use planning
- providing a ready source of information on air quality for developers carrying out environmental assessments for new schemes
- demonstrating progress with implementation of air quality Action Plans and/or air quality strategies
- providing a timely indication of the need for further measures to improve air quality, rather than delaying until the next full round of review and assessment

1.3 Air Quality Standards and Objectives

The air quality standards and objectives set out in the Air Quality Regulations provide the statutory basis for the system of Local Air Quality Management (LAQM).

Air quality *standards* (in the UK Air Quality Strategy) are the concentrations of pollutants in the atmosphere that can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of the effects of each pollutant on human health including the effects on sensitive subgroups. The standards have been set at levels to avoid significant risks to health.

The *objectives* of the UK air quality policy are framed on the basis of the recommended standards. The objectives are based on the standards, but take into account feasibility, practicality, and the costs and benefits of fully complying with the standards. The air quality objectives applicable to Local Air Quality Management (LAQM) **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043). They are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre $\mu\text{g}/\text{m}^3$ (for carbon monoxide the units used are milligrammes per cubic metre, mg/m^3). Table 1.1. includes the number of permitted exceedences in any given year (where applicable).

Table 1.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM₁₀) (gravimetric)	50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 1.2 Air Pollution Bandings and Index and the Impact on the Health of People who are Sensitive to Air Pollution.

Banding	Index	Health Descriptor
Low	1	Effects are unlikely to be noticed even by individuals who know they are sensitive to air pollutants
	2	
	3	
Moderate	4	Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
	5	
	6	
High	7	Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.
	8	
	9	
Very High	10	The effects on sensitive individuals described for 'High' levels of pollution may worsen.

Table 1.3 Boundaries between Index Points for each Pollutant.

Band	Index	Ozone *		Nitrogen Dioxide		Sulphur Dioxide		Carbon Monoxide		PM ₁₀ Particles
		8 hourly running mean or hourly mean		hourly mean		15 minute mean		8 hour running mean		24 hour running mean
		µg/m ³	ppb	µg/m ³	ppb	µg/m ³	ppb	mg/m ³	ppm	µg/m ³
Low										
	1	0-32	0-16	0-95	0-49	0-88	0-32	0-3.8	0.0-3.2	0-16
	2	33-66	17-32	96-190	50-99	89-176	33-66	3.9-7.6	3.3-6.6	17-32
	3	67-99	33-49	191-286	100-149	177-265	67-99	7.7-11.5	6.7-9.9	33-49
Moderate										
	4	100-126	50-62	287-381	150-199	266-354	100-132	11.6-13.4	10.0-11.5	50-57
	5	127-152	63-76	382-476	200-249	355-442	133-166	13.5-15.4	11.6-13.2	58-66
	6	153-179	77-89	478-572	250-299	443-531	167-199	15.5-17.3	13.3-14.9	67-74
High										
	7	180-239	90-119	573-635	300-332	532-708	200-266	17.4-19.2	15.0-16.5	75-82
	8	240-299	120-149	363-700	333-366	709-886	267-332	19.3-21.2	16.6-18.2	83-91
	9	300-359	150-179	701-763	367-399	887-1063	333-399	21.3-23.1	18.3-19.9	92-99
Very High										
	10	360 or more	180 or more	764 or more	400 or more	1064 or more	400 or more	23.2 or more	20 or more	100 or more
* Note that in view of the transboundary nature of this pollutant, and thus the limited effectiveness of action on a local scale, Ozone is not included in the regulations for air quality management										

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 (January 2004);
- Progress Report (2005);
- Updating and Screening Assessment (2006);
- Progress Report (2007);
- Detailed Assessment (2008); and
- Updating and Screening Assessment (July 2009).

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 (NO₂), sulphur dioxide (SO₂) and particulate matter less than 10µm (PM₁₀). The report recommended that the Norwich City Council progress to a Further Assessment for NO₂, SO₂ 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 SO₂ and PM₁₀ concluded that the Air Quality objectives for 2005 would be achieved.

Nitrogen dioxide (NO₂) 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 NO₂ concluded that the Air Quality Objective was unlikely to be achieved in certain areas of the city by 2005.

As a result of the Further Assessment the council concluded that three AQMAs (shown in Figure 1.1) would be declared to tackle the issue of NO₂ Air Quality objective exceedences.

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 NO₂ objectives as a result of traffic sources. Declaration of three AQMAs was recommended. Norwich City Council considered the likelihood of receptor exposure to 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 SO₂ 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 NO₂. The findings of the 2003 Detailed Assessment are presented in greater detail in the following report:

- **Detailed Assessment, Norwich City Council (2003)**

The monitoring and modelling carried out at this stage of review and assessment showed that NO₂ 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_x) from traffic on roads close to the AQMAs as the main source from which emissions could be reduced. Emissions of NO_x 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;
- SO₂;
- NO₂; and
- PM₁₀.

2004 and 2006 Updating and Screening Assessments

These updating and screening assessment for NCC concluded that a Detailed Assessment was **not** required for NO₂, PM₁₀, benzene, CO, lead, 1,3 – butadiene or SO₂.

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 that the NO₂ concentrations are 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 NO₂ 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 recommend 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 signaling 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. A further assessment of the area will be carried out during 2010.

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 NO₂, PM₁₀, benzene, CO, lead, 1,3 – butadiene or SO₂.

Figure 1.1 AQMA's within City of Norwich

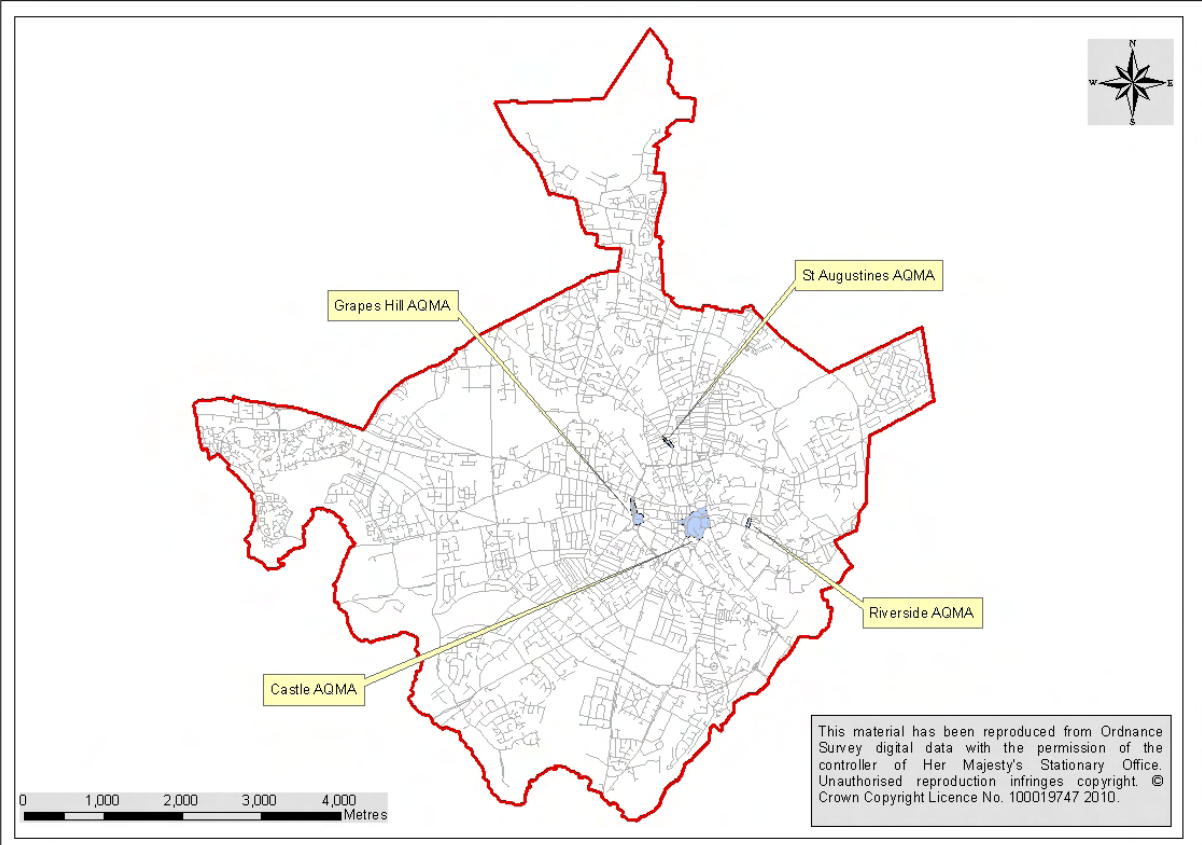


Figure 1.2 Grapes Hill AQMA

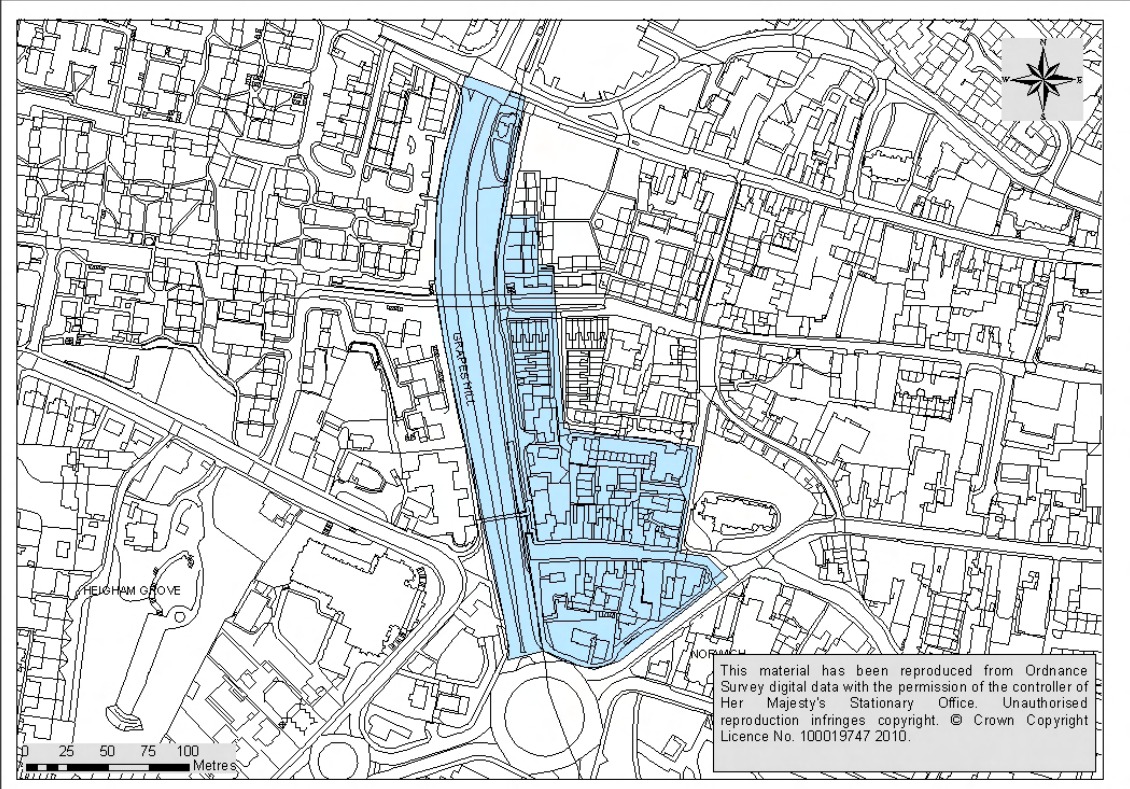


Figure 1.3 St Augustines AQMA

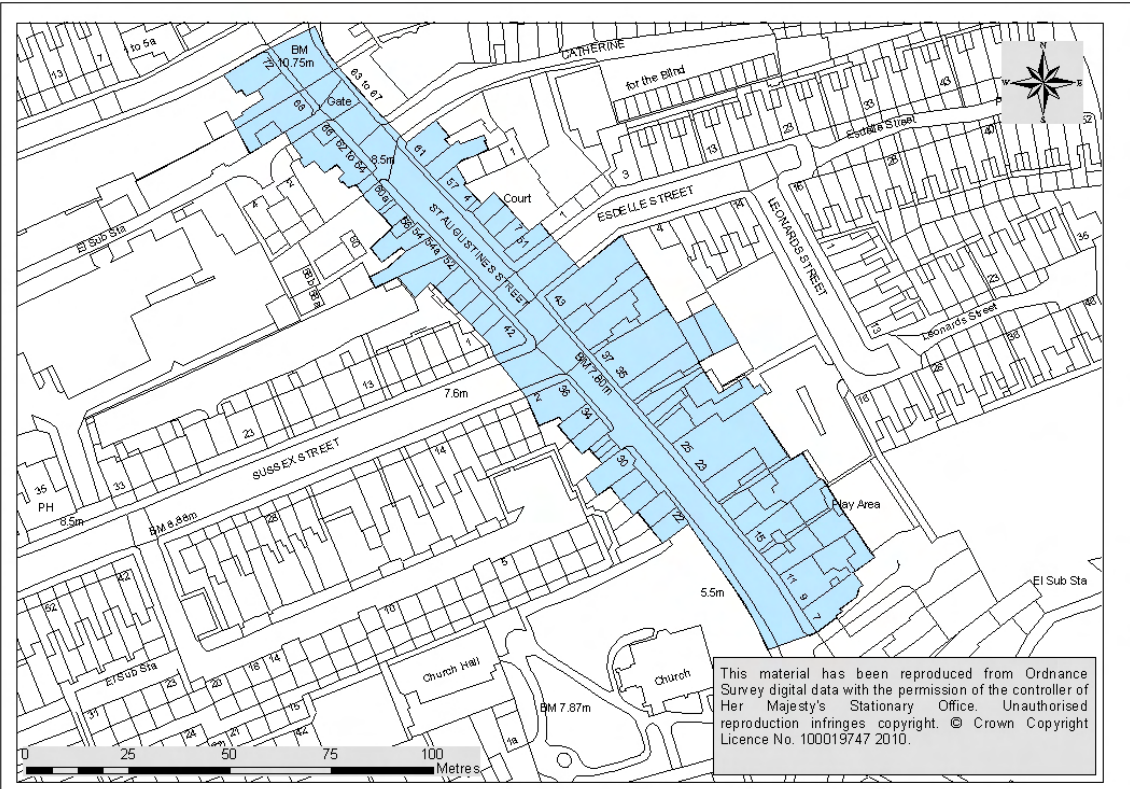


Figure 1.4 Castle AQMA

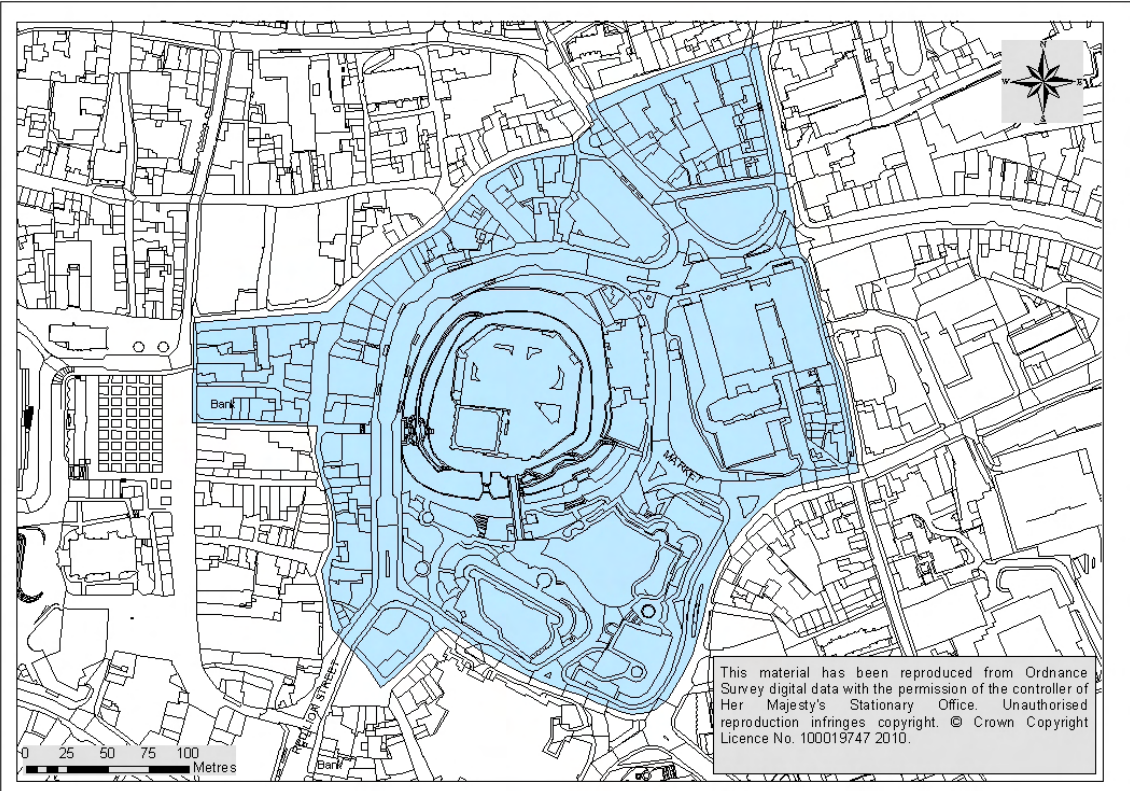
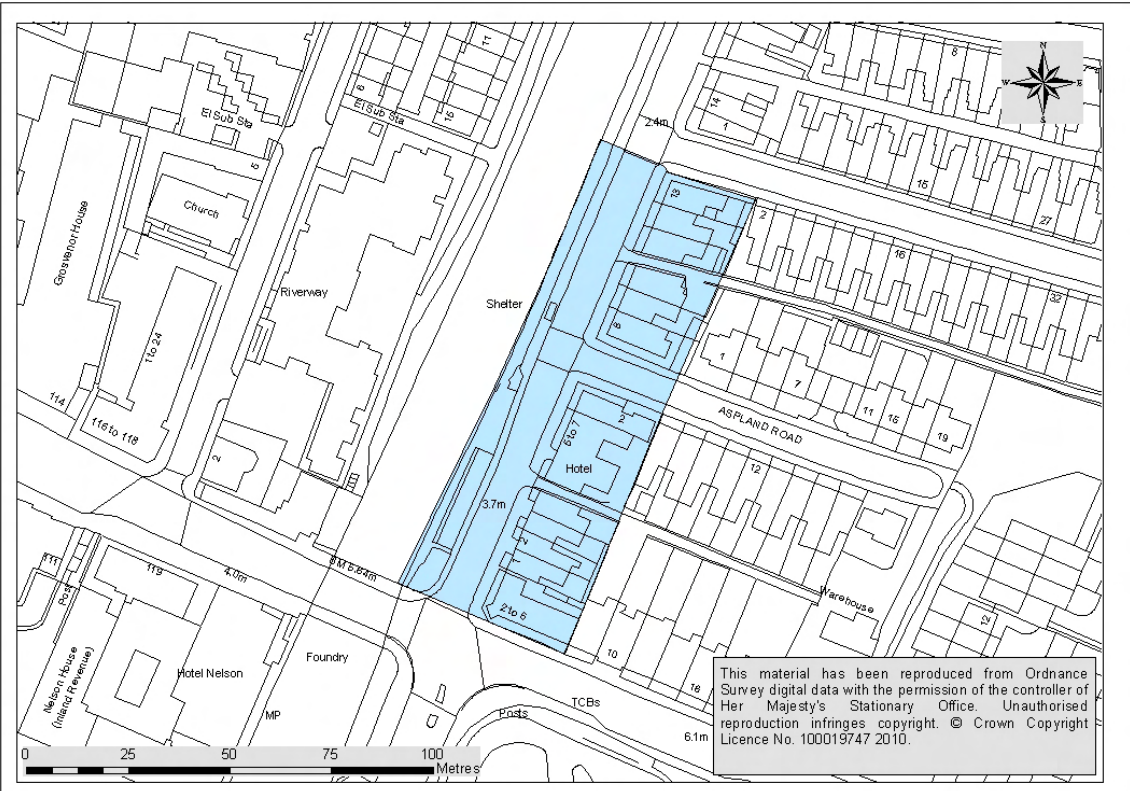


Figure 1.5 Riverside AQMA



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Automatic monitoring was carried out during 2009 at two locations in Norwich. Each location is shown in Tables 2.1 and 2.2. The Norwich Lakenfields site is an urban background location, and the Norwich Castle Meadow site is a mobile unit that currently monitors roadside concentrations within the Norwich Castle AQMA.

Data for the full calendar year of 2009 is only available for the Norwich Castle Meadow site (95% data capture). The Norwich Lakenfields site, which is part of DEFRA's Automatic Urban and Rural Network (AURN), provided data from 1st October 2009 (approx 25% data capture).

As a result of this site having less than one year's data, a period adjustment calculation (detailed in Box 3.2 of LAQM TG (09) guidance) has been carried out for the Norwich Lakenfields site for pollutants NO₂ and PM₁₀. The results of these calculations are presented in Section 2.2.1 and 2.2.2 respectively.

The Norwich Lakenfields site incorporates an FDMS device on the PM₁₀ and PM_{2.5} TEOM's to correct for loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by these instruments. PM₁₀ data from Norwich Castle Meadow has not been corrected using the VCM, as the model indicated low data capture combined with warnings that distant sites were needed to provide the corrections. Therefore, a factor of 1.3 has been applied to give indicative gravimetric equivalent concentrations for the annual mean and 24-hour mean readings.

Figure 2.1 Castle Meadow Automatic Monitoring Station

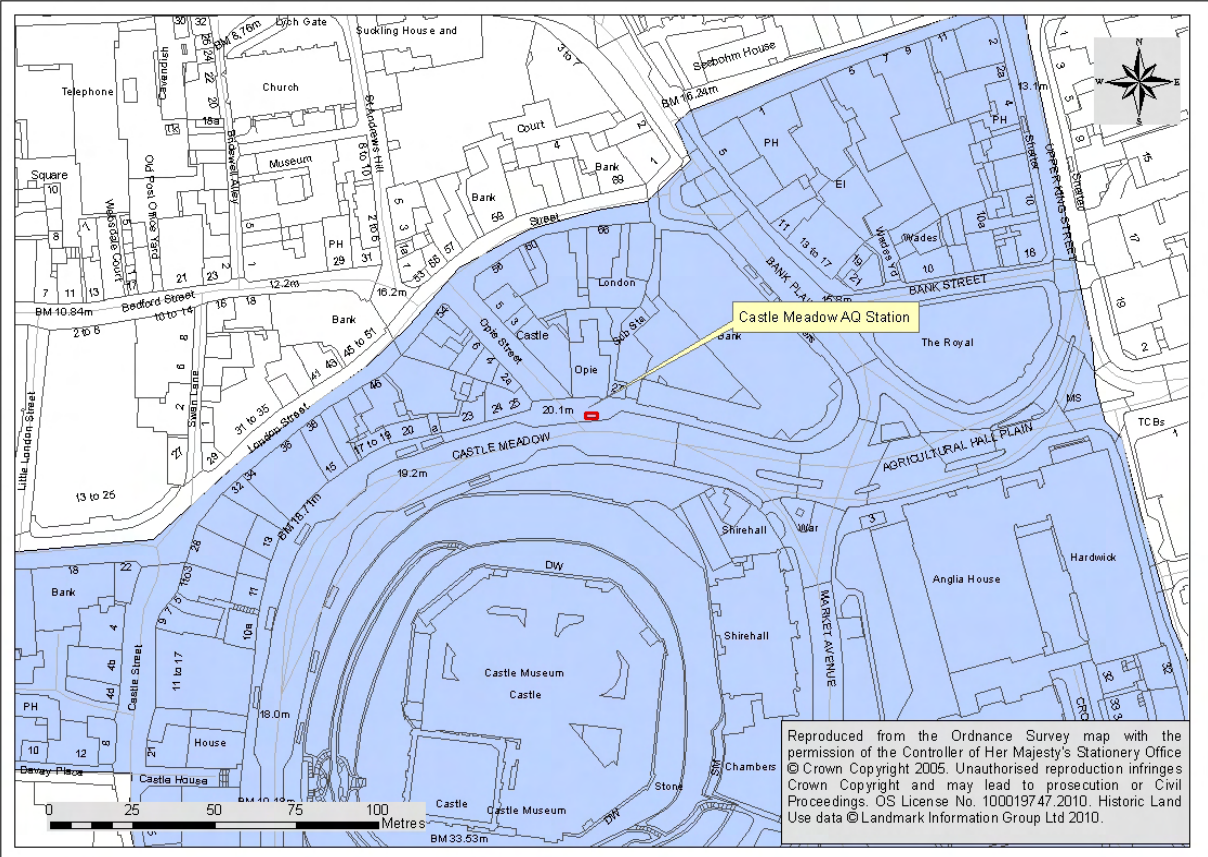


Figure 2.2 Lakenfields Automatic Monitoring Station

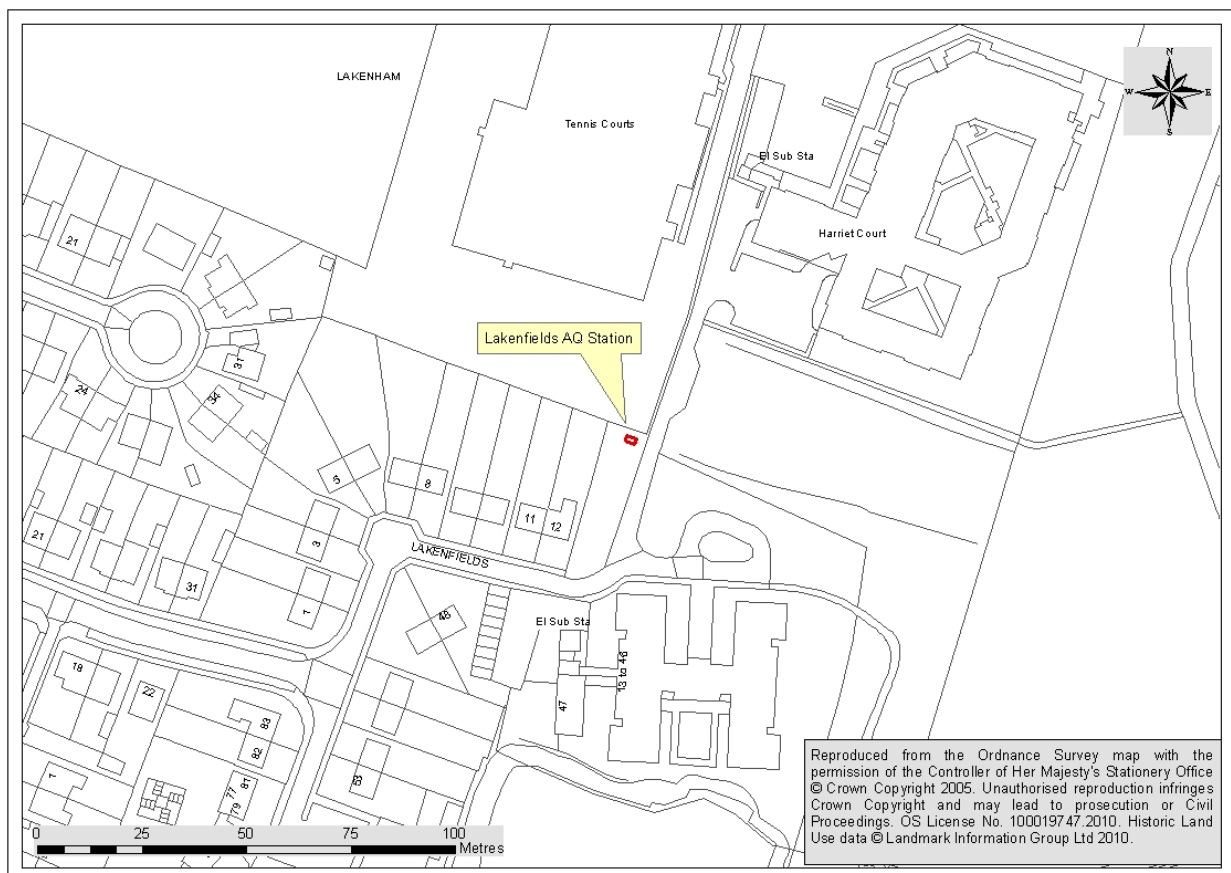


Table 2.1 Details of Automatic Monitoring Sites

Site Name	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	Urban Roadside	X623202 Y308615	O ₃ , CO, SO ₂ , PM ₁₀ , NO _x , NO ₂ , PM _{2.5}	Ambirak TEOM	Y	N	1m	N/A
Norwich Lakenfields	Urban Background	X623637 Y306940	O ₃ , SO ₂ , PM ₁₀ , NO _x , NO ₂ , PM _{2.5}	Thermo FDMS	N	Y (20m)	N/A	N

2.1.2 Non-Automatic Monitoring

Norwich City Council carried out indicative monitoring of NO₂ by diffusion tubes at 34 sites throughout the city during 2009. Sites at Chapelfield/Wessex Street, Johnson Place, Tombland, Key & Castle Yard, St Martins Road, Aylsham Road, Waterloo Road and Barrack Street were discontinued in June and replaced with triplicate diffusion tubes at 256 King Street, Riverside Road, Magdalen Street and a new location at the Norwich Lakenfields AURN site. Further new locations were commenced in June at Chalk Hill Road and Read's Flour Mill. The sites that were removed in June did not threaten the annual mean objective of 40 µg/m³.

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

Co-location diffusion tubes were only available for the last three months of the 2009 calendar year. As such, bias correction was carried out using a national bias correction factor of 0.99 based on using Gradko Labs for analysis, applying the 50% TEA in Acetone method, when carrying out the analysis in 2009. Discussion of the most appropriate bias correction method is presented in the following section and Appendix A.

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

Table 2.2 Details of Non- Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road	Worst-case Location?
256 King Street	R	X 623863.04 Y 307678.60	NO ₂	N	Y (1m)	3.5m	Y
Queens Rd Travelodge	R	X 622917.08 Y 307974.49	NO ₂	N	N	N/A	N/A
25 Surrey Street	R	X 623060.33 Y 308034.28	NO ₂	N	N	N/A	N/A
St Stephens (mid)	K	X 622879.16 Y 308089.96	NO ₂	N	N	N/A	N/A
Chapelfield / Wessex St	R	X 622741.68 Y 308054.79	NO ₂	N	N	N/A	N/A
Lakenfields	UB	X 623681.24 Y 307015.82	NO ₂	N	Y (20m)	N/A	N
26 Johnson Place	R	X 622440.96 Y 308415.09	NO ₂	N	Y (1m)	15m	N
Chalk Hill Road	R	X 623906.97 Y 308596.92	NO ₂	N	Y (1m)	7m	Y
130 Magdalen Street	R	X 623160.89 Y 309550.43	NO ₂	N	Y (1m)	4m	Y
Reads Flour Mill	K	X 623796.25 Y 307772.13	NO ₂	N	Y (1m)	1m	Y
Grapes Hill (upper)	R	X 622383.05 Y 308653.15	NO ₂	Y	Y (1m)	14m	Y
Exchange St	K	X 623007.27 Y 308716.34	NO ₂	N	N	N/A	N/A
St Augustines	K	X 622825.70 Y 309572.99	NO ₂	Y	Y (1m)	1m	Y
Tombland	R	X 623325.49 Y 308857.07	NO ₂	N	Y (1m)	1m	Y
Upper King Street	K	X 623337.40 Y 308632.52	NO ₂	Y	N	N/A	N/A
73 Prince of Wales Road	R	X 623610.05 Y 308577.12	NO ₂	N	Y (1m)	3m	Y
Cattlemarket Street	R	X 623320.58 Y 308430.88	NO ₂	Y	Y (1m)	2m	Y
Castle Meadow	R	X 623141.06 Y 308606.69	NO ₂	Y	N	N/A	N/A
Castle Meadow 2	R	X 623250.50 Y 308590.12	NO ₂	Y	N	N/A	N/A
Grapes Hill (lower)	R	X 622386.31 Y 308838.52	NO ₂	Y	N	N/A	N/A
32 Key & Castle Yard	R	X 622616.95 Y 309385.95	NO ₂	N	Y (1m)	5.5m	Y
29 St Martins Road	R	X 622551.54 Y 309780.86	NO ₂	N	Y (1m)	7m	Y
Boundary PH 414 Aylsham Rd	R	X 621740.97 Y 311534.55	NO ₂	N	Y (1m)	12m	Y
Kerrisons 353 Aylsham Rd	R	X 621803.79 Y 311500.49	NO ₂	N	Y (1m)	6m	Y
221 Mile Cross lane	R	X 621805.30 Y 311594.73	NO ₂	N	Y (1m)	6m	Y
13 Aylsham Road	R	X 622661.32 Y 309805.12	NO ₂	N	Y (1m)	9m	Y
158 Waterloo Road	R	X 622859.37 Y 309725.91	NO ₂	N	Y (1m)	8m	Y
62 Magpie Road	R	X 622970.72 Y 309652.02	NO ₂	N	Y (1m)	2m	Y
26 Bull Close Road	R	X 623228.63 Y 309625.14	NO ₂	N	Y (1m)	5.5m	Y
24 Bargate Court	R	X 623422.42 Y 309388.23	NO ₂	N	Y (1m)	4m	Y
124 Barrack Street	R	X 623694.61 Y 309420.59	NO ₂	N	N	N/A	N/A
5 Riverside Road	R	X 623870.26 Y 308515.77	NO ₂	N	Y (1m)	3m	Y
Wellington Lane (lower)	K	X 622419.52 Y 308797.22	NO ₂	Y	Y (15m)	1m	Y
71 Dukes Court	R	X 622431.35 Y 308663.05	NO ₂	Y	Y (1m)	4m	Y

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide (NO₂)

Automatic Monitoring Data

The annual mean concentration at the Castle Meadow automatic monitoring site was recorded as **41 µg/m³** for 2009, which exceeds the annual mean objective by 1µg/m³. This monitoring site is within the Castle Meadow AQMA, although it does not represent any nearby relevant exposure. There was one exceedence of the 1-hour mean on one day during 2009 at this site. For the Norwich Lakenfields urban background automatic monitoring site, the annual mean concentration for 2009 was 16 µg/m³. For the period of data available from 1st October 2009 to 31st December 2009 there was no exceedence of the 1-hour mean (99.8th percentile is 80 µg/m³).

Table 2.3a Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations (µg/m ³)		
					2007	2008	2009
N/A	Norwich Lakenfields	N	91	25	N/A	N/A	16
N/A	Norwich Castle Meadow (mobile site)	Y	95	95	46	45	41

Table 2.3b Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Number of Exceedences of hourly mean (200 µg/m ³) (99.8 th percentile of hourly means in brackets)		
					2007	2008	2009
N/A	Norwich Lakenfields	N	91	25	N/A	N/A	0 (80)
N/A	Norwich Castle Meadow (mobile site)	Y	95	95	1	0	1

Diffusion Tube Monitoring Data

Table 2.4a displays the diffusion tube monitoring results for 2009, uncorrected and corrected for bias using a national bias adjustment factor of 0.99 based on using Gradko Labs for analysis, applying the 50% TEA in Acetone method for 2009. The national bias spreadsheet is available via the following weblink:

<http://www.uwe.ac.uk/aqm/review/R&Asupport/diffusiantube310310.xls>

Table 2.4a Results of Nitrogen Dioxide Diffusion Tubes

Location	Within AQMA?	Data Capture 2009%	Annual mean concentrations	
			2009 Uncorrected ($\mu\text{g}/\text{m}^3$)	2009 Bias Corrected ($\mu\text{g}/\text{m}^3$)
256 King Street	N	100	44.7*	44.2*
Queens Rd Travelodge	N	100	37.6	37.3
25 Surrey Street	N	100	30.2	29.9
St Stephens (mid)	N	100	52.6	52.1
Chapelfield / Wessex St	N	42	36.4	36.1
Lakenfields	N	58	13.7*	13.6*
26 Johnson Place	N	42	32.3	31.9
Chalk Hill Road	N	58	31.2	30.9
130 Magdalen Street	N	83	35.5*	35.2*
Reads Flour Mill	N	58	24.1	23.8
Grapes Hill (upper)	Y	100	27.0	26.7
Exchange St	N	100	40.4	40.0
St Augustines	Y	100	56.7	56.2
Tombland	N	42	30.4	30.1
Upper King Street	Y	100	34.4	34.0
73 Prince of Wales Road	N	100	35.8	35.4
Cattlemarket Street	Y	100	50.8	50.3
Castle Meadow	Y	100	53.5	53.0
Castle Meadow 2	Y	92	47.6	47.1
Grapes Hill (lower)	Y	75	28.0	27.8
32 Key & Castle Yard	N	42	34.1	33.7
29 St Martins Road	N	42	26.6	26.3
Boundary PH 414 Aylsham Rd	N	100	24.0	23.8
Kerrisons 353 Aylsham Rd	N	100	37.8	37.4
221 Mile Cross lane	N	100	35.2	34.8
13 Aylsham Road	N	42	31.2	30.9
158 Waterloo Road	N	42	25.2	25.0
62 Magpie Road	N	100	34.5	34.2
26 Bull Close Road	N	100	40.9	40.5
24 Bargate Court	N	100	38.3	37.9
124 Barrack Street	N	42	27.9	27.6
5 Riverside Road	Y	100	54.9*	54.4*
Wellington Lane (lower)	Y	100	33.9	33.6
71 Dukes Court	Y	100	28.7	28.4

* Mean of triplicate diffusion tubes

A total of eight sites exceeded the NO₂ annual mean objective of 40 µg/m³. These sites were:

- King Street;
- St Stephens (Mid);
- St Augustines;
- 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 AQMAs. The tube located at St Stephens Street is not situated at a location representative of relevant exposure to the general public. The King Street site exceeded the objective level by 4.2µg/m³. The Bull Close Road location exceeded the objective level by 0.5µg/m³.

The 2008 Detailed Assessment concluded that if the monitoring data for the 2009 calendar year showed the King Street site to exceed the annual mean objective for NO₂, this area should also be designated as an AQMA. The commencement of triplicate tubes at this location in June 2009 has given increased confidence in the results, and indicates that an AQMA is appropriate for this location.

The 2008 Detailed Assessment also noted that the Grapes Hill AQMA may be revoked, as the monitoring carried out at Grapes Hill (Upper & Lower), Wellington Lane (Upper & Lower) and Dukes Court showed that NO₂ levels within this AQMA were below the annual mean objective, and had been so for the previous four years. However, it was recommended that the AQMA remain in place for a further year of monitoring. The monitoring results show that the objective level was comfortably met at all the tube locations in the area during 2009. It is therefore proposed to revoke this AQMA.

Table 2.4b displays the bias adjusted diffusion tube monitoring results across the time series 2006 to 2009. Non-bias corrected monthly diffusion tube results can be found in Appendix B.

Table 2.4b Results of Nitrogen Dioxide Diffusion Tubes

Location	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias			
		2006 ¹	2007 ²	2008 ³	2009
256 King Street	N	N/A	45.2	41.2	44.2
Queens Rd Travelodge	N	N/A	41.9	32.8	37.3
25 Surrey Street	N	N/A	33.5	27.3	29.9
St Stephens (mid)	N	46.0	46.4	48.4	52.1
Chapelfield / Wessex St	N	32.0	35.6	30.5	36.1
Lakenfields	N	N/A	N/A	N/A	13.6
26 Johnson Place	N	41.0	33.7	24.3	31.9
Chalk Hill Road	N	N/A	N/A	N/A	30.9
130 Magdalen Street	N	N/A	40.1	36.7	35.2
Reads Flour Mill	N	N/A	N/A	N/A	23.8
Grapes Hill (upper)	Y	25.0	28.4	23.2	26.7
Exchange St	N	42.0	42.3	41.0	40.0
St Augustines	Y	50.0	52.1	50.9	56.2
Tombland	N	42.0	47.7	27.8	30.1
Upper King Street	Y	32.0	37.8	32.4	34.0
73 Prince of Wales Road	N	N/A	39.1	31.8	35.4
Cattlemarket Street	Y	42.0	52.8	43.1	50.3
Castle Meadow	Y	46.0	52.9	48.8	53.0
Castle Meadow 2	Y	46.0	46.6	45.3	47.1
Grapes Hill (lower)	Y	29.0	30.7	28.0	27.8
32 Key & Castle Yard	N	N/A	35.6	31.9	33.7
29 St Martins Road	N	N/A	25.3	22.7	26.3
Boundary PH 414 Aylsham Rd	N	N/A	N/A	25.0	23.8
Kerrisons 353 Aylsham Rd	N	N/A	N/A	35.5	37.4
221 Mile Cross lane	N	N/A	N/A	33.0	34.8
13 Aylsham Road	N	N/A	32.7	26.8	30.9
158 Waterloo Road	N	N/A	41.1	23.9	25.0
62 Magpie Road	N	N/A	34.9	32.6	34.2
26 Bull Close Road	N	N/A	39.9	35.6	40.5
24 Bargate Court	N	N/A	38.4	32.8	37.9
124 Barrack Street	N	N/A	32.1	24.9	27.6
5 Riverside Road	Y	47.0	48.6	46.4	54.4
Wellington Lane (lower)	Y	32.4	36.7	32.1	33.6
71 Dukes Court	Y	N/A	31.1	27.6	28.4

¹ Bias correction factor applied was 0.98

² Bias correction factor applied was 1.051

³ Bias correction factor applied was 0.93

- 2008 figures are quoted from Updating & Screening Assessment for Norwich City Council, 2009.
- 2007 figures are quoted from Detailed Assessment for Norwich City Council, 2008.
- 2006 figures are quoted from Progress Report for Norwich City Council, 2007.

2.2.2 PM₁₀

The annual mean concentration at the Castle Meadow automatic monitoring site was recorded as 21 µg/m³ for 2009, which is below the annual mean objective. There were two exceedences of the 1-hour mean, and the maximum daily mean recorded was 54 µg/m³. For the Norwich Lakenfields urban background automatic monitoring site, the annual mean concentration for 2009 was 17 µg/m³. Based on the data available from 1 October 2009 to 31 December 2009 the 90th percentile was 26 µg/m³.

Table 2.5a Results of PM₁₀ Automatic Monitoring: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Annual mean concentrations (µg/m ³)		
					2007	2008	2009
N/A	Norwich Lakenfields	N	91	23	N/A	N/A	17
N/A	Norwich Castle Meadow (mobile site)	Y	96	96	23	19	21

Table 2.5b Results of PM₁₀ Automatic Monitoring: Comparison with 24-hour Mean Objective

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture for full calendar year 2009 %	Number of Exceedences of daily mean objective (50 µg/m ³) (90 th percentile of daily means in brackets)		
					2007	2008	2009
N/A	Norwich Lakenfields	N	91	23	N/A	N/A	0 (26)
N/A	Norwich Castle Meadow (mobile site)	Y	96	96	12	4	2

2.2.3 Sulphur Dioxide

Two sites in Norwich monitor for SO₂. Norwich Lakenfields had less than 90% data capture for the calendar year. As such the following information is provided to show that there are no issues with regards to SO₂ in the area of the Norwich Lakenfields monitoring site.

- 99.9th percentile of 15-minute mean was 8 µg/m³.
- 99.7th percentile of 1-hour mean was 5 µg/m³.
- 99th percentile of 24-hour mean was 3 µg/m³.

The other automatic monitoring site in Norwich, Castle Meadow, had 95% data capture for SO₂. There were no exceedences of the 15-minute mean during the calendar year, the maximum being 45 µg/m³. There were no exceedences of the 1-hour or 24-hour means at this site, with maximums being 40 µg/m³ and 28 µg/m³ respectively. The recorded annual mean at Norwich Castle Meadow was 14 µg/m³.

Table 2.6 Results of SO₂ Automatic Monitoring: Comparison with Objectives

Site ID	Location	Within AQMA?	Data Capture for monitoring period %	Data Capture 2009 %	Number of Exceedences		
					15-minute objective (266µg/m ³)	1-hour objective (350µg/m ³)	24-hour objective (125 µg/m ³)
N/A	Norwich Lakenfields	N	63	17	0	0	0
N/A	Norwich Castle Meadow (mobile site)	Y	95	95	0	0	0

2.2.4 Benzene

NCC no longer monitor benzene as it has been determined that levels affecting Norwich are extremely low and 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 2009 calendar year. There were no exceedences of the air quality strategy objective of 10 mg/m^3 (8-hour running mean) for carbon monoxide in Norwich during 2009. The recorded data shows a maximum 8-hour running mean of 1.6 mg/m^3 .

Further monitoring data for carbon monoxide is available for the Norwich area on the UK National Air Quality Information Archive website at www.airquality.co.uk.

Ozone

Monitoring data is available for ozone from the Norwich mobile monitoring unit at Castle Meadow for the 2009 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 $100 \mu\text{g/m}^3$ 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 $94 \mu\text{g/m}^3$. There were therefore no exceedences of this objective.

PM_{2.5}

Monitoring data is available for PM_{2.5} from the Norwich mobile monitoring unit at Castle Meadow for the 2009 calendar year. PM_{2.5} is also not included in the regulations for air quality management for local authorities. The recorded data shows an annual mean of $9 \mu\text{g/m}^3$ and a maximum daily mean of $24 \mu\text{g/m}^3$.

2.2.6 Summary of Compliance with AQS Objectives

Norwich City Council has measured concentrations of NO₂ above the annual mean objective at relevant locations in King Street and Bull Close Road, which are outside of the existing AQMAs.

The 2008 Detailed Assessment noted that the Grapes Hill AQMA may be revoked, as the monitoring carried out at Grapes Hill (Upper & Lower), Wellington Lane (Upper & Lower) and Dukes Court showed that NO₂ levels within this AQMA were below the annual mean objective, and had been so for the previous four years.

3 New Local Developments

3.1 Road Traffic Sources

NCC confirms that there are no new/ newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

NCC confirms that there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

NCC confirms that there are no new/newly identified roads with high flows of buses/HDVs.

NCC previously assessed new/newly identified junctions meeting the criteria in Section A.4 of Box 5.3 in TG (09) as part of the latest USA.

NCC confirms that there are no new/proposed roads other than that mentioned in Sec 4.

NCC confirms that there are no new/newly identified roads with significantly changed traffic flows other than that mentioned in Sec 4.

NCC confirms that there are no relevant bus stations in the Local Authority area.

3.2 Other Transport Sources

NCC confirms that there are no airports in the Local Authority area that meet the criteria outlined in Box 5.4 of LAQM TG (09).

NCC confirms that there are no locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

NCC confirms that there are no locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

NCC confirms that there are no ports or shipping that meet the specified criteria within the Local Authority area.

3.3 Industrial Sources

NCC previously assessed new/proposed industrial installations as part of the latest USA.

NCC confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area.

NCC confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area.

There are no major fuel (petrol) storage depots within the Local Authority area.

NCC confirms that there are no petrol stations meeting the specified criteria.

NCC confirms that there are no poultry farms meeting the specified criteria.

3.4 Commercial and Domestic Sources

NCC confirms that there are no biomass combustion plants in the Local Authority area.

NCC confirms that there are no biomass combustion plants in the Local Authority area.

NCC confirms that there are no areas of significant domestic fuel use in the Local Authority area

3.5 Fugitive or Uncontrolled Sources

NCC confirms that there are no potential sources of fugitive particulate matter emissions in the Local Authority area.

NCC confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

4 Planning Applications

Progress has been made on improvement and regeneration of the area around the St Augustines Street AQMA as part of the Northern City Centre Area Action Plan. A planning application for the comprehensive regeneration of Anglia Square (which is in close proximity to St Augustines Street) and its environs has been approved for mixed use development, including residential and a food store. The redevelopment will include modified car parking, improved access (including enhanced pedestrian, cycle, public transport accessibility, and a new road layout with the introduction of a new gyratory system. St Augustines Street will become a one-way, going northbound. A new short stretch of link road is in the process of being created to complete the gyratory. The construction of the gyratory is due to be completed by the end of 2010. It is anticipated that the improved, and reduced, flow of traffic through St Augustines Street will improve air quality. More information on the Northern City Centre Area Action Plan can be found on the council's website at:

http://www.norwich.gov.uk/webapps/atoz/service_page.asp?id=1700&pid=1014

5 Air Quality Planning Policies

The *City of Norwich replacement local plan* (adopted in November 2004) provides guidance for developers and the council's own development control service on where and what kind of development may be permitted in the city. It has detailed planning policies for the city and allocates uses for particular sites.

The city council agreed with the Government Office for the East of England that we could continue to use around 70% of the policies in the local plan beyond 30 November 2007. These are called 'saved policies'. Those relating to air pollution and air quality management areas are referenced EP5 & EP6 respectively. Extracts from the plan are quoted below:

Air Pollution

4.19 No specific policy dealing with air pollution was contained in the 1995 adopted Local Plan. This matter was drawn to the City Council's attention by an appeal decision in 1997, which demonstrated that there are circumstances where a Local Plan policy is necessary. PPG23 advises that Local Plans should include policies to separate potentially polluting uses from those uses that are sensitive to such pollution and especially residential development. The abolition of the Special Industrial Classes in the Use Classes Order now also requires that more consideration be given to the potential polluting effects of any general industrial development.

4.20 The policy refers to 'demonstrable harm' being shown to affect human health or the environment. PPG23 accepts that it may be necessary, on occasion, for policies in Local Plans to override the normal criteria of Integrated Pollution Control regimes, particularly where harm to human health can be demonstrated by such emissions. 'Sensitive uses' will include housing, schools, hospitals and certain other activities, such as food processing, where air pollution would have a particularly deleterious impact. The issue of air quality and the Air Quality Management Areas is dealt with in the next policy – although there may in some circumstances be an overlap with policy EP5 on specific emissions from premises.

[Relates to Resource Objectives: Air (i), Quality of Life (i) and (iv)]

EP5

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.

Air Quality Management Areas

4.21 The air quality issues arising in Norwich are nearly all associated with excess traffic volumes in confined areas. Whilst these will not, in general, be resolved by land use measures alone, it is nevertheless important to include such a policy, in order to provide for any control on land uses which may be necessary – including, potentially, the need to exclude uses which may generate heavy car traffic and/or to restrict sensitive uses in the affected locations. Policy EP6 will therefore apply any controls that are necessary when the Air Quality Management Action Plans are published under Part IV of the Environment Act 1995.

[Relates to Resource Objectives: Air (i) and (ii); Quality of Life (iv)]

EP6

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.

In 2004, the government introduced a new system to prepare and deliver planning policy. This is called the *Local Development Framework* (LDF). It is a process that provides a timetable to produce new policies (the *Local development scheme*), a code of practice on how the council will involve people in producing planning policies (the *Statement of community involvement*), a family of policy documents to guide development in the city,) and regular monitoring of the planning services progress (the *Annual monitoring report*).

Local plans will therefore be phased out over the next few years and gradually replaced by a new system of related planning policy documents.

Further information can be found on the link to the Norwich City council website below:

http://www.norwich.gov.uk/webapps/atoz/service_page.asp?id=1501

6 Local Transport Plans and Strategies

The Norfolk Local Transport Plan 2 (LTP) 2006-2011 is currently in place. Three of the thematic strategies prioritise transport and associated environmental impacts resulting from transport sources within the LTP2 and aim to improve air quality and minimising congestion by tackling transport issues across the region.

The LTP2 will spearhead actions aimed at ensuring good air quality is maintained in respect of national air quality objectives and introducing more integrated transport solutions to tackle any identified air quality hotspots. The thematic strategies include plans to improve connections by road and particularly public transport within sub-regions, improve local connections and promote better accessibility to jobs and services, especially by public transport, cycling and walking. Furthermore the LTP2 seeks to prioritise improvements in those deprived areas of the county with low car ownership and poor public transport whilst ensuring sufficient provision is made for cars, freight and other traffic to give it access on the most appropriate routes. Additionally the LTP aims to reduce emissions from transport at source by enabling a shift to alternative fuels and low emission vehicles while also protecting the environment by integrating environmental considerations into plans and programs, and decision making processes.

Further information on the LTP can be found on the Norfolk County Council website at:

<http://www.norfolk.gov.uk/Consumption/groups/public/documents/article/ncc044043.pdf>

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
St Augustines Street					
1	Road layout changes	2011	In progress	One-way system to reduce traffic levels and hence emissions in St Augustines Street being constructed	Scheme will also deliver regeneration and road safety benefits
Castle Area					
2	Low Emission Zone	Design 04/05 Implemented 06/07 and 07/08	Project team established. Main work programme commenced at the end of August 05	European match funding has been secured through CIVITAS SMILE. Engine switch off TRO to be implemented April 2007. Retro-fit programme commencing	Continuous automatic monitoring shows a reduction in year on year NO ₂ levels. Individual tubes on Castle Meadow show relatively stable levels however, revealing localised issues that will be investigated. The Castle Meadow 2 tube shows a continuing exceedance that relates to a separate issue due to general traffic, which will not be affected by the LEZ, but which will receive attention.
3	Low Emission Zone	2010	Complete	Castle Meadow Low Emission Zone now fully introduced with application of Traffic Regulation Condition in full	
4	Quality Bus Partnerships & Contracts	TBA	On-going discussions between County / City and First.	Increasingly close working between NCC and operators on quality, but no formal partnerships.	
Grapes Hill					
5	Road Layout Changes	Design 04/05 Implemented 05/06	Layout and traffic light sequence changes completed, resulting in reduced queuing on Grapes Hill	NO ₂ levels consistently below objective for previous four years. 2008 DA concluded that AQMA could be revoked.	Intention is to revoke this AQMA.

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
Area Wide Measures					
6	Park and Ride and Car Parking Policy	Ongoing	All programmed Park and Ride works complete	3.727 million passengers using Park and Ride in 2005/06	6 Park and Rides sites in Norwich, with over 5,000 spaces - the most in the country. However, city-centre car parking spaces have been converted to short- and medium-term stay, increasing overall traffic.
Soft Measures:					
7	Car Sharing	Ongoing	Relaunch and rebranding Autumn 2005	European match funding has been secured through CIVITAS SMILE project	Campaign will focus on reducing single-occupancy commuter journeys and harmful emissions
8	Travel Wise	Ongoing	Relaunch and rebranding Autumn 2005	No outcome to date	Campaign will focus on providing better information to the public on sustainable transport options
9	School Travel Plans	Ongoing	Target Met	272 school travel plans agreed to date out of 485 schools in Norfolk	In March 2006 exceeded stretch target of 250 schools travel plans agreed by the end of 2006
10	Workplace Travel Plans	Ongoing	23 workplace travel plans agreed through section 106 agreements in period 2001-2006	No outcome to date	Integrated into CIVITAS SMILE project
Alternative Fuels:					
11	Cleanup Motorvate Powershift	Ongoing	None (see comments)	No outcome to date	Grant programmes ended and are being revised to move to a technology neutral approach, and adjusted to comply with State Aid rules.
12	Retro-Fit	2005-2009	Complete	Bus fleet using Castle Area AQMA Euro III or better	Retro-fit evaluated as part of CIVITAS SMILE project as part of wider project to introduce a Low Emission Zone
13	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	Up to 20% bio-diesel blends have no impact and may improve NOx emissions. However uncertainty over supply etc. means Local Authorities now investigating bio-gas with	Trials evaluated as part of CIVITAS SMILE project

No.	Measure	Original Timescale	Progress with Measure	Outcome to Date	Comments relating to emission reductions
			2009/10	both CO2 and NOx benefits	
14	Land Use Planning	Ongoing	City of Norwich Local Plan takes an integrated approach to land use and transportation planning. Concept retained in emerging LDF	No outcome to date	
15	Engine Switch Off	2008	Complete	Vehicles stopping in Castle Meadow required to turn off engine if stationary unless passengers alighting/boarding continuously	Measure to be extended to rest of the City Centre in 2011
Leading by example:					
16	Alternative Fuel Trials	2003/2004	Trial completed in summer 2004.	County Council will use results to make better use of alternative fuels in its vehicle fleet	Petrol/electric cars have been available as a lease car option, but relative cost and a change of supplier is bringing this to an end.
17	Commuter Plan	Ongoing	New Travel Plan for Norwich City Council agreed 2003 and Norfolk County Council summer 2004	Travel to work survey undertaken annually. Cycling and pedestrian routes reviewed and improvements made including increased cycle storage facilities. Increased promotion of bus services serving County Hall. Further improvements anticipated in autumn 2010.	

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

NCC undertakes both continuous and diffusion tube nitrogen dioxide monitoring throughout their area. Continuous monitoring carried out at Castle Meadow showed that the 2009 NO₂ concentration exceeded the NO₂ annual mean objective of 40 µg/m³. The monitoring also showed that the 1-hourly mean NO₂ objective was exceeded once during 2009. Automatic monitoring carried out at Norwich Lakenfields did not indicate any exceedence of the annual mean objective or the 1-hourly mean objective.

NCC carried out diffusion tube monitoring for NO₂ at 34 locations throughout the city. The 2009 bias adjusted results indicated that concentrations of NO₂ exceeded the NO₂ annual mean objective at several locations. These locations were:

- King Street;
- St Stephens (Mid);
- St Augustines;
- 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 AQMAs. The tube located at St Stephens Street is not situated at a location representative of relevant exposure to the general public. The King Street site exceeded the objective level by 4.2µg/m³. The Bull Close Road location exceeded the objective level by 0.5µg/m³.

A Detailed Assessment was carried out of the King Street area in 2008. It concluded that if the 2009 monitoring data confirmed King Street to exceed the annual mean objective for NO₂, then this area should also be declared as an AQMA.

The Bull Close Road site has not been the subject of any previous detailed assessment.

Based upon the findings of previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead, PM₁₀ and SO₂ are unlikely to be in excess of the air quality objectives at any location.

8.2 Conclusions relating to New Local Developments

Section 4 refers to a new gyratory system to include the current St Augustines AQMA. The construction of the gyratory is due to be completed by the end of 2010. It is anticipated that the improved, and reduced, flow of traffic through St Augustines Street will improve air quality. New monitoring data relating to this area will be available for consideration within the next Updating and Screening Assessment.

8.3 Proposed Actions

King Street was included in the 2008 Detailed Assessment, with a recommendation to monitor for a further year during 2009. The results of this monitoring confirm that an AQMA should be declared. The 2008 DA also noted that the Grapes Hill AQMA may be revoked, as the monitoring carried out at Grapes Hill (Upper & Lower), Wellington Lane (Upper & Lower) and Dukes Court showed that NO₂ levels within this AQMA were below the annual mean objective, and had been so for the previous four years.

Therefore, in line with the recommendations of the 2008 DA, it is Norwich City Council's intention to **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 0.5µg/m³. However, due to the limitations of diffusion tubes, Local Authorities are advised not to rely upon diffusion tube data alone as a basis of a Detailed Assessment or declaration of an AQMA for NO₂. It is recognised that automatic monitoring is not always possible, and therefore if diffusion tube monitoring is the most practicable monitoring method it should be ensured that:

- Monitoring is carried out for a full year as concentrations of some pollutants exhibit seasonal patterns (as a minimum six consecutive months should be monitored (3 in summer and 3 in winter) for example January to June or July to December to ensure they are representative of the full year);
- Tubes are deployed at several sites in the vicinity (for example several points around the roundabout and roads leading to the roundabout at locations of public exposure, as well as a range of urban background sites (3 to 4 sites typically)) to obtain a representative background concentration for the area and roadside or kerbside sites for model validation;
- Diffusion tubes have good precision (triplicate tubes could be positioned at a selected sub-set of the sites in order to gather information on diffusion tube precision); and
- Diffusion tubes are appropriately bias corrected.

Since this is the first, very marginal, exceedence of the annual objective level for NO₂ based on a single tube at this location, it is 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 is proposed to declare an AQMA in the area during 2011.

The Riverside AQMA was declared in December 2009. NCC are currently undertaking a Further Assessment of this area, to be reported later in 2010.

A Progress Report will be submitted in 2011, along with a Further Assessment of the King Street AQMA following it's declaration. Should a Detailed Assessment of the Bull Close Road area be required, this will also be produced during 2011.

This Progress Report also concludes that Norwich City Council is not required to carry out a Detailed Assessment for carbon monoxide, benzene, 1,3-butadiene, lead, PM₁₀ or SO₂.

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Appendices

Appendix A: QA/QC Data

Appendix B: 2009 Uncorrected Monthly NO₂ Concentrations (μg/m³)

Appendix A: QA:QC Data

Diffusion Tube Bias Adjustment Factors

Supplier/ Analyst: Gradko

Preparation Method: 50% TEA in Acetone

National Bias Adjustment Factor: 0.99

Discussion of Choice of Factor to Use

National Bias Adjustment Factor was used as there is no triplicate site in Norwich that could have been used to calculate local Bias Adjustment Factor. National Bias Adjustment Factor of 0.99 applied to all uncorrected diffusion tube annual mean values. National Spreadsheet of Bias Adjustment Factors (v.03/10) is shown below.

Spreadsheet Version Number: 03/10										
Follow the steps below in the correct order to show the results of relevant co-location studies								This spreadsheet will be updated in late September 2010 on the E&A website		
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										
This spreadsheet will be updated every few months; the factors may therefore be subject to change. This should not discourage their immediate use.								E&A website		
Published by Air Quality Consultants Ltd on behalf of Defra, the Welsh Assembly Government, the Scottish Government and the Department of the Environment Northern Ireland										
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 ³ shown in blue at the foot of the final column.							
If a laboratory is not shown, we have no data for this laboratory.	If a preparation method is not shown, we have no data for this method at this laboratory.	If a year is not shown, we have no data.	If you have your own co-location study then see footnote ⁴ . If uncertain what to do then contact the Review and Assessment Helpdesk: 0117 328 3668 aqm-review@uwe.ac.uk.							
Analysed By ¹	Method ²	Year ⁵	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m ³)	Automatic Monitor Mean Conc. (Cm) (µg/m ³)	Bias (B)	Tube Precision ⁶	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	50% TEA in Acetone	2009	R	Boston BC	11	45	33	35.2%	G	0.74
Gradko	50% TEA in Acetone	2009	R	East Hampshire DC	12	27	25	8.5%	G	0.92
Gradko	50% TEA in Acetone	2009	B	LB Brent	10	32	31	2.7%	G	0.97
Gradko	50% TEA in Acetone	2009	R	LB Richmond	12	43	43	-0.3%	G	1.00
Gradko	50% TEA in Acetone	2009	S	LB Richmond	12	27	28	-2.4%	G	1.02
Gradko	50% TEA in Acetone	2009	R	Reading BC	11	41	44	-7.8%	G	1.09
Gradko	50% TEA in Acetone	2009	R	Stevenage BC	12	38	29	32.0%	G	0.76
Gradko	50% TEA in Acetone	2009	R	Sandwell MBC	12	45	44	3.0%	G	0.97
Gradko	50% TEA in Acetone	2009	UB	Sandwell MBC	11	17	17	-1.6%	S	1.02
Gradko	50% TEA in Acetone	2009	UB	Sandwell MBC	11	27	28	-6.6%	G	1.07
Gradko	50% TEA in Acetone	2009	R	Sandwell MBC	12	38	40	-3.6%	S	1.04
Gradko	50% TEA in Acetone	2009	UB	Sheffield CC	10	33	38	-12.3%	G	1.15
Gradko	50% TEA in Acetone	2009	UC	Uttlesford DC	9	24	25	-1.7%	G	1.02
Gradko	50% TEA in Acetone	2009	R	West Berkshire Council	12	45	54	-15.3%	P	1.19
Gradko	50% TEA in Acetone	2009	K	AEA Tech Intercomparison	12	106	107	-0.9%	G	1.01
Gradko	50% TEA in Acetone	2009			Overall Factor¹ (15 studies)			Use		0.99

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 PM₁₀ from the TEOM; this value is then added back onto the TEOM measurements.

However, the VCM Model was not applied to results from TEOM measurements recorded at Castle Meadow as the model indicated low data capture combined with warnings that distant sites were needed to provide the corrections. Therefore, a factor of 1.3 has been applied to give indicative gravimetric equivalent concentrations for the annual mean and 24-hour mean readings.

The Norwich Lakenfields site incorporates an FDMS device on the PM₁₀ and PM_{2.5} TEOM's

Short-term to Long-term Data adjustment

For NO₂ the following three sites were used to calculate an average ratio, which was then applied to the period mean for NO₂ from the Norwich Lakenfields site for data captured during the period 1st October 2009 to 31st December 2009. The estimated annual mean for NO₂ using this method was 16 µg/m³. A 99.8th percentile of 80 µg/m³ was also calculated. All three sites used had data capture greater than 80% for the 12 month period 1st Jan to 31st Dec.

Site	Site Type	Annual Mean	Period Mean	Ratio
Northampton		21	25	0.84
Thurrock		31	33	0.94
Wicken Fen		12	14	0.86
			Average	0.88

For PM₁₀ the following two sites were used. The average ratio was calculated from these sites and applied to the period mean for PM₁₀ for the Norwich Lakenfields site for data captured during the period 1st October 2009 to 31st December 2009. The estimated annual mean for PM₁₀ using this method was 17.4 µg/m³. A 90th percentile of 29 µg/m³ was also calculated. Both listed sites had data capture greater than 80% for the 12-month period 1st Jan to 31st Dec 2009.

Site	Site Type	Annual Mean	Period Mean	Ratio
Leicester		16	15	1.07
Leamington Spa		20	18	1.11
			Average	1.09

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 NO_x analyser;
- 6-monthly audits and servicing of the monitoring site; and
- Data ratification.

Calibrations of the NO_x analyser were 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 NO_x and TEOM analysers and any faults were identified thus minimising data loss.

Audits of the monitoring site consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinder was 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.

QA/QC of diffusion tube monitoring

The Workplace Analysis Scheme for Proficiency (WASP) is an independent analytical performance-testing scheme, operated by the Health and Safety Laboratory (HSL). WASP formed a key part of the former UK NO₂ Network's QA/QC, and remains an important QA/QC exercise for laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM). The laboratory participants analyse four spiked tubes, and report the results to HSL. HSL assign a performance score to each laboratory's result, based on their deviation from the known mass of nitrite in the analyte.

The Performance criteria were changed in April 2009, the criteria are now based upon the Rolling Performance Index (RPI) statistic and will be tightened to the following:

- **GOOD:** Results obtained by the participating laboratory are on average within 7.5% of the assigned value. This equates to an RPI of 56.25 or less.
- **ACCEPTABLE:** Results obtained by the participating laboratory are on average within 15% of the assigned value. This equates to an RPI of 225 or less.
- **UNACCEPTABLE:** Results obtained by the participating laboratory differ by more than 15% of the assigned value. This equates to an RPI of greater than 225.

Appendix B: 2009 Monthly NO₂ Concentrations (µg/m³)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average	2009 Bias Corrected 0.99
	256 King Street	54.8	45.6	45.4	45.5	35.1	40.5	42.9	45.4	26.1	47.4	56.3		
Queens Rd Travelodge	37.7	52.9	43.1	42.1	31.7	46.4	23.4	26.0	24.1	44.2	32.4	47.8	37.6	37.3
25 Surrey Street	44.1	46.2	34.9	26.7	19.7	24.4	21.5	21.1	21.9	31.4	33.6	36.5	30.2	29.9
St Stephens (mid)	73.5	49.1	44.3	60.0	47.4	56.2	52.8	50.9	27.7	53.6	58.0	58.4	52.6	52.1
Chapelfield/Wessex St	40.6	37.9	32.5	42.2	29.0								36.4	36.1
26 Johnson Place	40.2	43.8	31.7	26.6	19.0								32.3	31.9
130 Magdalen Street	45.7	51.3	36.7	26.9	24.5	33.8	31.0	33.0	28.8			43.6	35.5	35.2
Grapes Hill (upper)	37.0	32.9	28.0	31.0	19.6	22.8	21.4	21.0	17.3	27.9	30.9	34.2	27.0	26.7
Exchange St	56.8	46.4	37.1	31.9	30.7	35.6	36.2	28.9	22.5	59.1	45.7	54.2	40.4	40.0
St Augustines	64.1	67.1	66.1	62.5	47.8	46.8	53.2	47.2	34.3	64.5	63.4	63.9	56.7	56.2
Tombland	36.8	37.9	30.6	25.4	21.7								30.4	30.1
Upper King Street	38.8	46.0	38.7	29.7	22.8	30.6	30.8	29.6	25.2	39.6	37.2	43.7	34.4	34.0
73 Prince of Wales Road	41.2	47.3	37.7	35.0	29.4	27.8	32.8	30.9	23.5	40.8	37.7	45.1	35.8	35.4
Cattlemarket Street	61.7	49.4	47.8	54.0	46.8	58.7	48.1	47.3	30.3	52.3	54.2	59.1	50.8	50.3
Castle Meadow	60.9	61.4	55.2	54.9	43.5	57.1	56.0	47.0	41.2	58.0	55.9	51.0	53.5	53.0
Castle Meadow 2	53.3	47.6	47.2		39.2	47.9	47.6	48.9	26.1	54.9	54.3	56.2	47.6	47.1
Lakenfields						10.6	9.3	9.4	9.9	18.6	15.2	23.1	13.7	13.6
Grapes Hill (lower)	40.0	30.4	30.3	31.8	23.2	30.3		20.0	15.9			30.6	28.0	27.8
32 Key & Castle Yard	40.8	42.8	33.0	29.8	24.0								34.1	33.7
29 St Martins Road	32.7	31.0	21.4	27.4	20.3								26.6	26.3
Boundary PH 414 Aylsham Rd	29.7	27.9	27.1	26.7	21.6	27.6	16.5	18.5	22.3	21.6	19.4	29.5	24.0	23.8
Kerrisons 353 Aylsham Rd	40.7	45.6	39.2	40.0	34.3	42.5	33.4	31.2	28.2	39.1	35.5	43.8	37.8	37.4
221 Mile Cross lane	37.7	47.5	41.2	30.0	31.1	33.4	32.9	29.3	27.6	41.5	32.4	37.6	35.2	34.8
13 Aylsham Road	36.4	38.4	27.7	29.3	24.3								31.2	30.9
158 Waterloo Road	32.8	28.8	25.2	20.8	18.6								25.2	25.0
62 Magpie Road	37.0	42.8	33.1	30.5	24.4	36.8	34.0	33.4	25.7	37.2	41.0	38.8	34.5	34.2
26 Bull Close Road	46.8	52.1	51.0	39.6	38.5	30.4	42.4	35.6	25.9	41.6	44.2	43.5	40.9	40.5
24 Bargate Court	44.0	45.2	45.6	33.5	32.4	36.3	34.3	33.9	25.5	43.9	40.5	44.2	38.3	37.9
124 Barrack Street	33.6	38.1	27.4	22.1	18.5								27.9	27.6
5 Riverside Road	68.9	52.7	53.6	56.7	51.4	58.1	53.9	55.1	33.9	58.0	57.8	59.1	54.9	54.4
Wellington Lane (lower)	43.6	42.1	36.6	34.9	24.9	28.6	30.6	25.0	22.4	37.2	36.2	44.6	33.9	33.6
71 Dukes Court	37.8	34.2	29.4	27.4	21.9	25.9	22.4	26.2	18.3	31.9	33.5	35.2	28.7	28.4
Chalk Hill Road						30.8	31.4	28.6	20.4	35.8	32.9	38.8	31.2	30.9
Reads Flour Mill						20.0	19.8	17.9	16.6	31.4	25.8	37.1	24.1	23.8

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