





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

Updating and screening assessment 2012



NORWICH
City Council

Document Control Sheet

Issue/Revision	Issue 1	Revision 1
Remarks	Draft for comment	Final
	18/06/2012	02/07/12
Submitted to	Mark Leach	Mark Leach
Prepared by	James Bellinger	James Bellinger
Signature		
Approved by	Ben Warren	Ben Warren
Signature		
Project number	5421948	5421948
File reference	2796	2796

Disclaimer

This Report was completed by Bureau Veritas on the basis of a defined programme of work and terms and conditions agreed with the Client. Bureau Veritas confirms that in preparing this Report it has exercised all reasonable skill and care taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project.

Bureau Veritas accepts no responsibility to any parties whatsoever, following the issue of the Report, for any matters arising outside the agreed scope of the works.

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

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

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

THIS PAGE IS LEFT BLANK INTENTIONALLY

Local Authority Officer	Mark Leach
Department	Environmental Protection
Address	Norwich City Council
Telephone	City Hall, St Peters Street, Norwich, NR2 1NH
e-mail	markleach@norwich.gov.uk
Report Reference number	Norwich/USA/2012
Date	July 2012

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 Updating and Screening Assessment 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 Updating and Screening Assessment 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 are planning to consolidate all current AQMAs into one larger city centre AQMA.

Proposed actions from this report are as follows:

- Due to the exceedance of the hourly mean objectives for NO₂ recorded at the Castle Meadow continuous monitoring site it is recommended that a detailed assessment of monitoring data is carried out to understand the potential for the hourly mean objective for NO₂ to be exceeded in this area.
- The council should proceed with declaring the whole town centre as an AQMA encompassing all areas with current monitoring data above or close to the NO₂ annual mean objectives.
- Ensure the biomass installation at City of Norwich School does not lead to exceedance of any air quality objectives.
- Proceed to 2013 Annual Progress Report.

Table of contents

1	Introduction	5
1.1	Description of Local Authority Area	5
1.2	Purpose of Report.....	5
1.3	Air Quality Objectives	6
1.4	Summary of Previous Review and Assessments	8
2	New Monitoring Data	13
2.1	Summary of Monitoring Undertaken	13
2.1.1	Automatic Monitoring Sites	13
2.1.2	Non-Automatic Monitoring Sites	16
2.2	Comparison of Monitoring Results with AQ Objectives	23
2.2.1	Nitrogen Dioxide	23
2.2.2	PM ₁₀	31
2.2.3	Sulphur Dioxide.....	34
2.2.4	Benzene.....	36
2.2.5	Other pollutants monitored	36
2.2.6	Summary of Compliance with AQS Objectives	37
3	Road Traffic Sources	38
3.1	Narrow Congested Streets with Residential Properties Close to the Kerb	38
3.2	Busy Streets Where People May Spend 1-hour or More Close to Traffic.....	38
3.3	Roads with a High Flow of Buses and/or HGVs.	38
3.4	Junctions.....	38
3.5	New Roads Constructed or Proposed Since the Last Round of Review and Assessment.	39
3.6	Roads with Significantly Changed Traffic Flows.....	39
3.7	Bus and Coach Stations	40
4	Other Transport Sources.....	41
4.1	Airports.....	41
4.2	Railways (Diesel and Steam Trains)	41
4.2.1	Stationary Trains.....	41
4.2.2	Moving Trains	41
4.3	Ports (Shipping)	41
5	Industrial Sources.....	42
5.1	Industrial Installations	42
5.1.1	New or Proposed Installations for which an Air Quality Assessment has been Carried Out	42
5.1.2	Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced	42
5.1.3	New or Significantly Changed Installations with No Previous Air Quality Assessment... ..	42

5.2	Major Fuel (Petrol) Storage Depots	42
5.3	Petrol Stations.....	43
5.4	Poultry Farms.....	43
6	Commercial and Domestic Sources	44
6.1	Biomass Combustion – Individual Installations	44
6.2	Biomass Combustion – Combined Impacts.....	45
6.3	Domestic Solid-Fuel Burning	45
7	Fugitive or Uncontrolled Sources.....	46
8	Conclusions and Proposed Actions.....	47
8.1	Conclusions from New Monitoring Data	47
8.2	Conclusions from Assessment of Sources.....	47
8.3	Proposed Actions.....	47
9	References.....	49

List of Tables

Table 1	Air Quality Objectives included in Regulations for the purpose of LAQM in England	6
Table 2	Details of Automatic Monitoring Sites	15
Table 3	National and locally derived bias adjustment factors	17
Table 4	Details of Non-Automatic Monitoring Sites	19
Table 5	Results of Automatic Monitoring of Nitrogen Dioxide: Comparison with Annual Mean Objective ²⁴	
Table 6	Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour mean Objective ²⁵	
Table 7	Results of Nitrogen Dioxide Diffusion Tubes (2006 to 2011)	29
Table 8	Results of Automatic Monitoring of PM ₁₀ : Comparison with Annual Mean Objective	32
Table 9	Results of Automatic Monitoring for PM ₁₀ : Comparison with 24-hour mean Objective	33
Table 10	Results of Automatic Monitoring of SO ₂ : Comparison with Air Quality Objectives	35
Table 11	DMRB modelled results, roads with >25% increase in flow	40
Table 12	Biomass stack information, City of Norwich School	44

List of Figures

Figure 1	Map of St Augustines AQMA	9
Figure 2	Map of Castle AQMA	10
Figure 3	Map of Riverside AQMA	10
Figure 4	Map of Grapes Hill AQMA	11
Figure 5	Map of proposed town centre AQMA	12
Figure 6	Castle Meadow Automatic Monitoring Station	14
Figure 7	Lakenfields Automatic Monitoring Station	14
Figure 8	Map of Non-Automatic Monitoring Sites	18
Figure 9	Results of Nitrogen Dioxide Diffusion Tubes in 2011	27

Appendices

- Appendix A: QA/QC Data
- Appendix B: Monthly monitoring results
- Appendix C: DMRB Calculations and verification
- Appendix D: Biomass Calculations

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 376,500. Norwich is the fourth most densely populated Local Authority district in the eastern region with 33.9 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 73.5% 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 46 '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 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.

The objective of this Updating and Screening Assessment is to identify any matters that have changed which may lead to risk of an air quality objective being exceeded. A checklist approach and screening tools are used to identify significant new sources or changes and whether there is a need for a Detailed Assessment. The USA report should provide an update of any outstanding information requested previously in Review and Assessment reports.

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. This table shows the objectives in units of microgrammes per cubic metre $\mu\text{g}/\text{m}^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 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 $\mu\text{g}/\text{m}^3$	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	1-hour mean	31.12.2005

Norwich City Council USA 2012

	year		
	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

1.4 Summary of Previous Review and Assessments

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 Figure 1 to Figure 5.

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.

The results of 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 Detailed Assessment (DA) in 2008 to include dispersion modelling at these locations. The DA concluded that a further AQMA was required at Riverside. This area was declared in Dec 2009, and is shown in Figure 3.

A Further Assessment of the Riverside AQMA was completed in 2010. The study confirmed the findings of the previous DA, namely that there are exceedences of the annual mean NO₂ objective to the south of Riverside Road, and that the position and extent of the AQMA was appropriate.

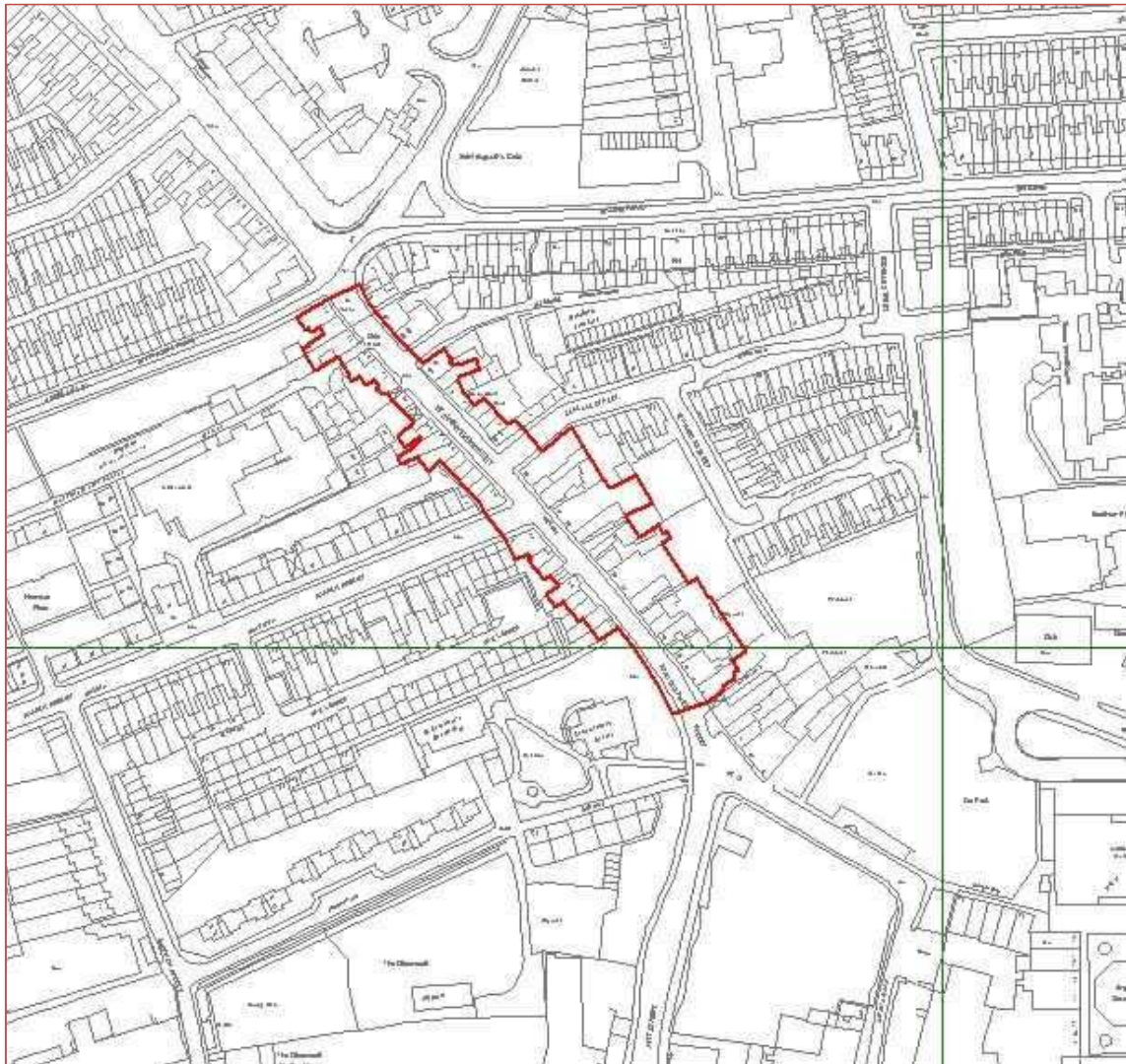
The 2010 APR revealed exceedances of the annual mean NO₂ objective at King Street and Bull Close Road. The Bull Close Road exceedance was very marginal and it was decided to carry out a DA by increasing the monitoring in the area for a further year. It was stated that King Street should be declared as an AQMA.

Since the production of the 2010 APR, discussion has taken place between the city council, county council and DEFRA. It has been agreed in principle that rather than declare King Street as a further AQMA, it would be preferable to revoke the existing

four AQMA's and replace them with one larger area to encompass all of them, as shown in Figure 5.

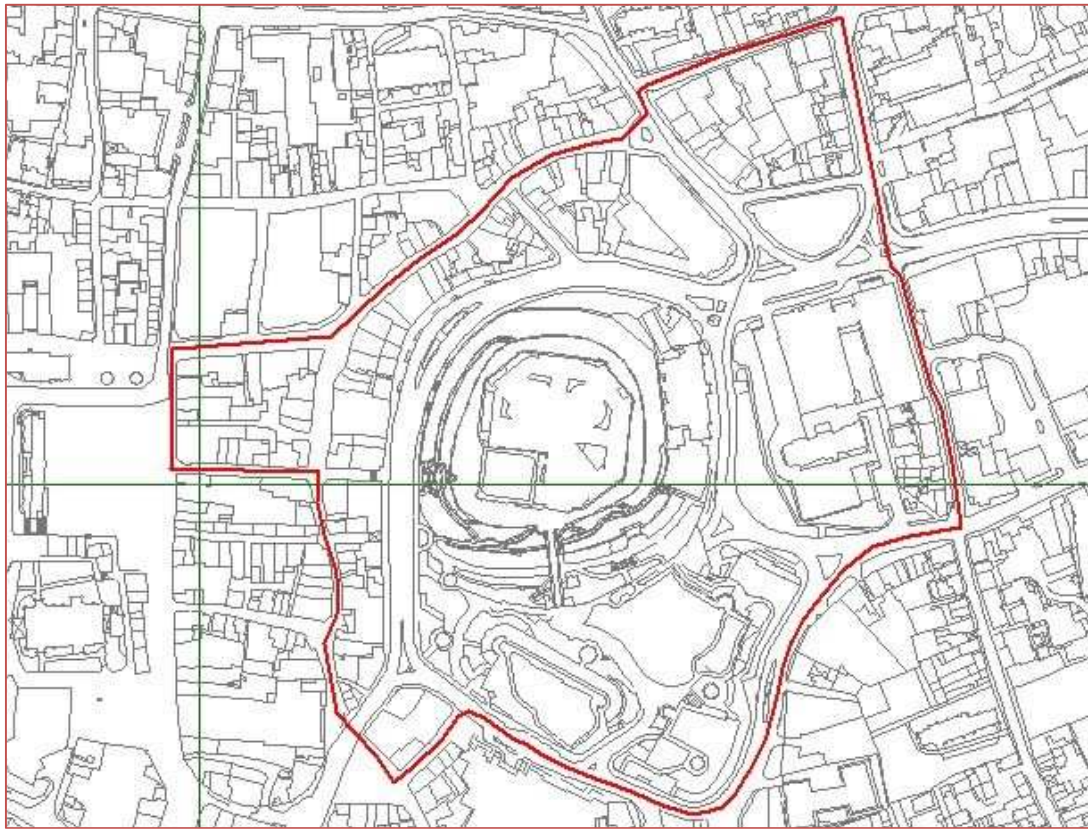
The 2011 APR concluded that the council should move forward in declaring the whole town centre as an AQMA and to continue to monitor at locations across the city.

Figure 1 Map of St Augustines AQMA



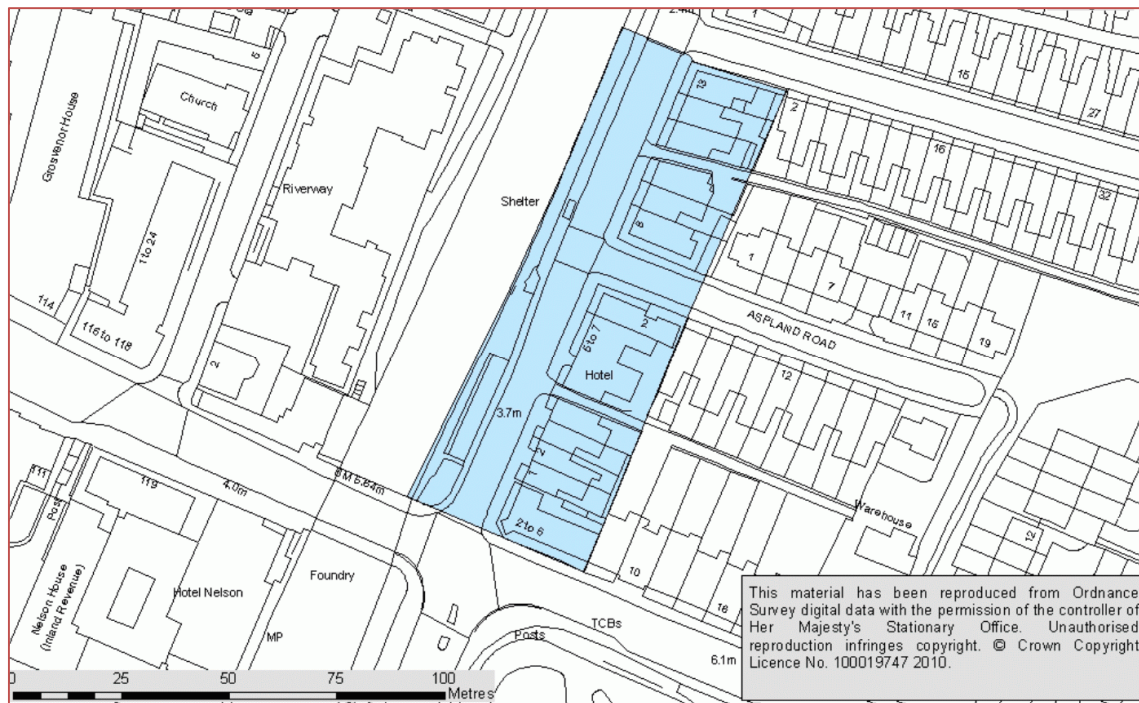
© Crown Copyright Licence No 100019747 2011

Figure 2 Map of Castle AQMA



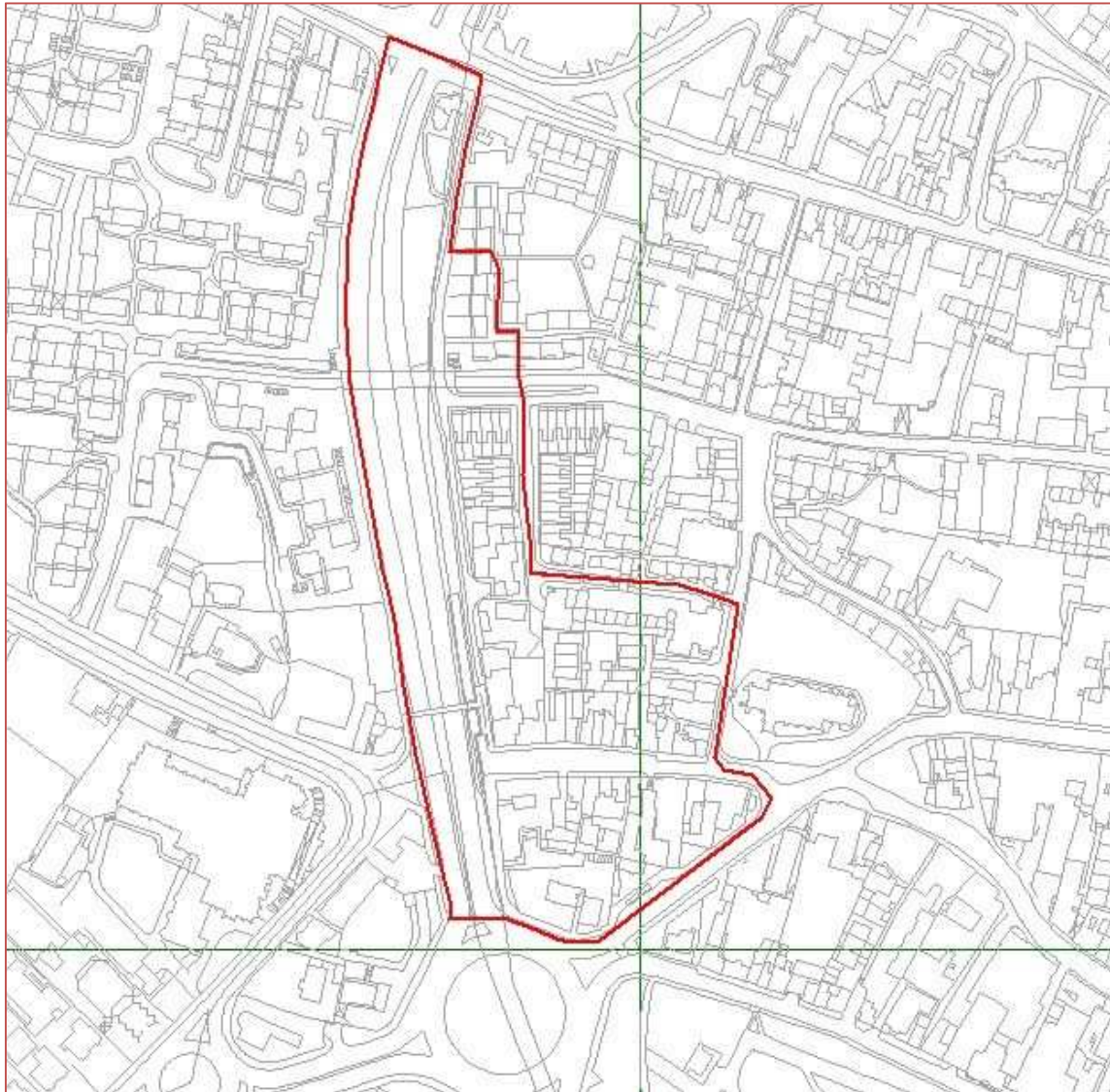
© Crown Copyright Licence No 100019747 2011

Figure 3 Map of Riverside AQMA



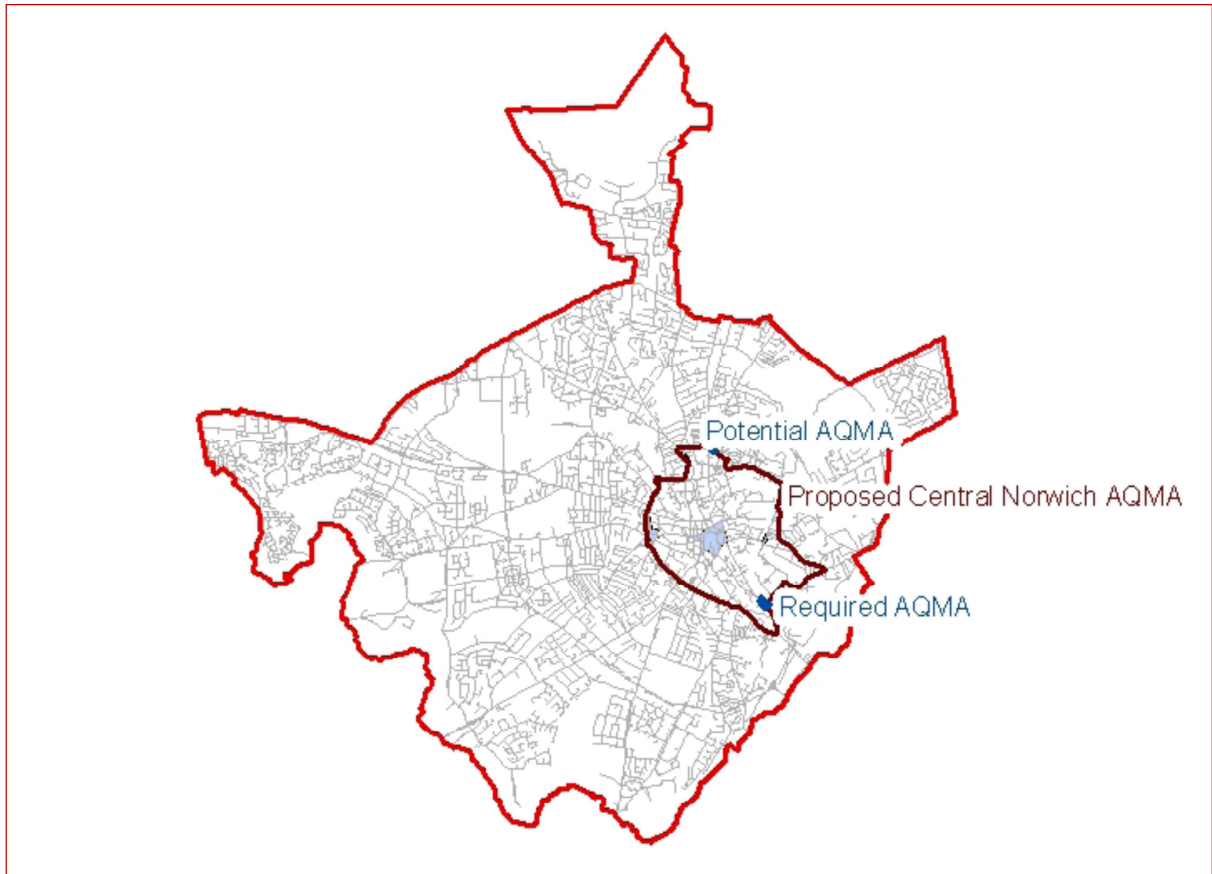
© Crown Copyright Licence No 100019747 2011

Figure 4 Map of Grapes Hill AQMA



© Crown Copyright Licence No 100019747 2011

Figure 5 Map of proposed town centre AQMA



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 2011. The locations are shown in Figure 6 and Figure 7. 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 Norwich Castle AQMA.

Data for 2011 is available for both the Castle Meadow site (93% NO₂ and 94% PM₁₀ data capture) and the Lakenfields site (92% NO₂ and 83% PM₁₀ data capture).

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 Castle Meadow has been VCM corrected.

Figure 6 Castle Meadow Automatic Monitoring Station

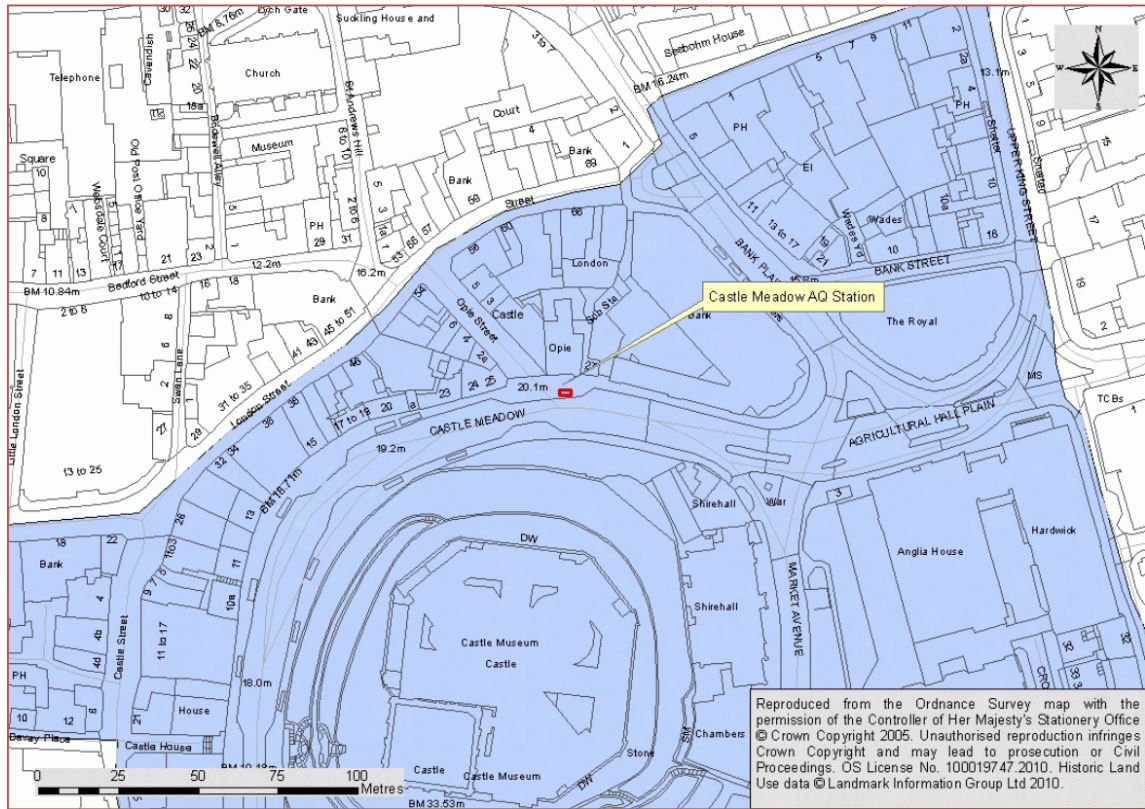


Figure 7 Lakenfields Automatic Monitoring Station

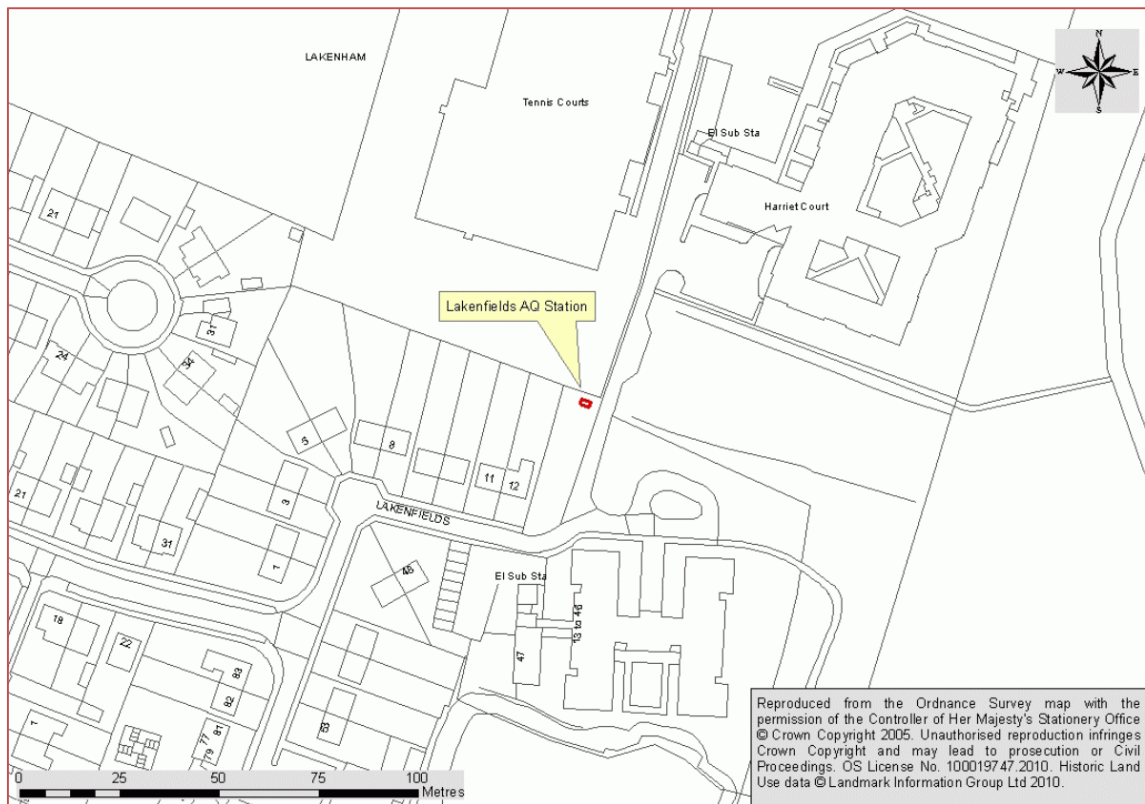


Table 2 Details of Automatic Monitoring Sites

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Relevant Exposure?	Distance to kerb of nearest road	Does this location represent worst-case exposure?
Norwich Castle Meadow	Roadside	X623202	Y308615	PM ₁₀ , PM _{2.5} NO _x , NO ₂ Ozone, CO, SO ₂	Y	TEOM, chemiluminescent	N	1m	N/A
Norwich Lakenfields	Urban Background	X623637	Y306940	PM ₁₀ , PM _{2.5} NO _x , NO ₂ Ozone, SO ₂	N	FDMS, chemiluminescent	Y (20m)	N/A	N

2.1.2 Non-Automatic Monitoring Sites

Norwich City Council carried out passive monitoring for air quality using NO₂ diffusion tubes at 28 locations across the city. Five of these locations were triplicates. A co-location study was carried out at the Lakenfields (AURN) Continuous Monitor.

Four new locations were added during 2011 at:

- 32 St Augustines
- 13 St Augustines
- 65 St Augustines
- Rotary House King Street

Four diffusion tubes were removed during February 2011 from:

- 414 Aylsham Road
- 353 Aylsham Road
- 221 Mile Cross Lane
- 288 King Street

None of the sites removed were exceeding the Air Quality Objectives for NO₂.

The diffusion tubes are supplied and analysed by Gradko utilising 50% Triethanolamine (TEA) in Acetone preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO₂ diffusion tube analysis and the Annual Field Inter-Comparison Exercise. The lab follows the procedures set out by the Harmonisation Practical Guidance.

With regard to the application of a bias adjustment factor for diffusion tube results LAQM TG (09) recommends the use of a local bias adjustment factor where available and relevant to diffusion tube sites. The co-location site at Lakenfields continuous monitor was therefore used to derive a local bias correction factor to be considered and applied if appropriate.

Norwich City Council USA 2012

In order to compare the national factor with the locally derived bias adjustment factor the national bias adjustment spreadsheet (v03/12) was used for the method above. The two factors are compared in Table 3 below.

Both the national and local bias factor produce very similar results with the local being 0.92 and national being 0.93. In the 2010 Annual Progress Report the national bias adjustment factor was used as it provided a more conservative approach to the results. This report will use the national bias factor. Again, this represents a marginally conservative approach.

Table 3 National and locally derived bias adjustment factors

Local Bias Factor	National Bias Factor
0.92	0.93

Figure 8 Map of Non-Automatic Monitoring Sites

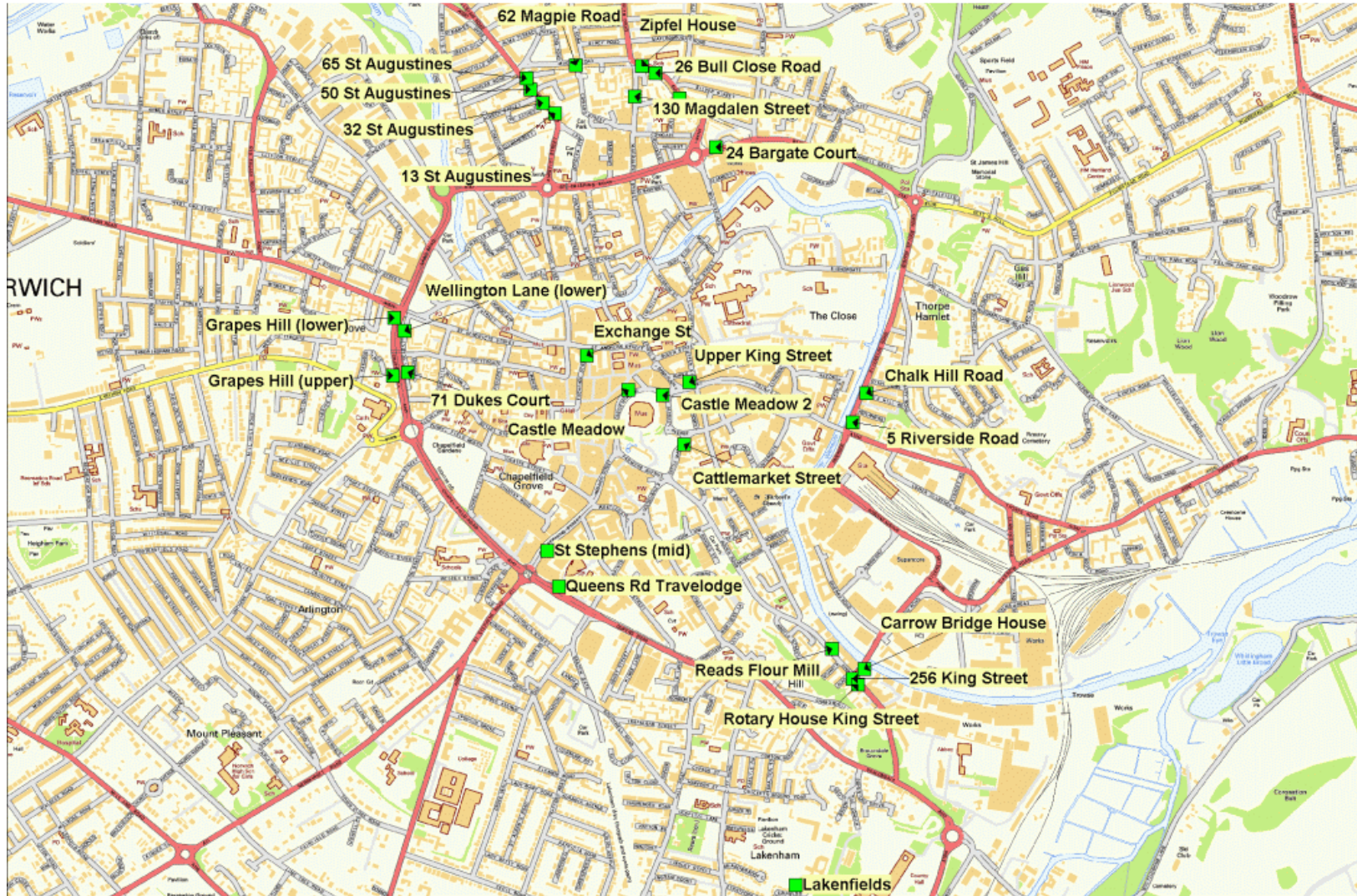


Table 4 Details of Non-Automatic Monitoring Sites

Site Code	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road(N/A if not applicable)	Does this location represent worst-case exposure?
1	256 King Street	R	623863	307678	N	Y (1m)	3.5m	Y
2	Queens Rd Travelodge	R	622917	307974	N	N	N/A	N/A
3	St Stephens (mid)	K	622879	308089	N	N	N/A	N/A
4	130 Magdalen Street	R	623160	309551	N	Y (20m)	N/A	N
5	Grapes Hill (upper)	R	622383	308653	Y	Y (1m)	1m	Y
6	Exchange St	K	623007	308716	N	N	N/A	N/A
7	50 St Augustines	K	622825	309573	Y	Y(1m)	1m	Y

Site Code	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road(N/A if not applicable)	Does this location represent worst-case exposure?
8	32 St Augustines	K	622865	309529	Y	Y(1m)	2m	Y
9	13 St Augustines	K	622905	309496	Y	N	1m	N/A
10	65 St Augustines	K	622813	309609	Y	N	1m	N/A
11	Upper King Street	K	623337	308632	Y	N	N/A	N/A
12	Cattlemarket Street	R	623320	308430	Y	Y(1m)	1m	Y
13	Castle Meadow	R	623141	308606	Y	N	N/A	N/A
14	Castle Meadow 2	R	623250	308590	Y	N	N/A	N/A
15	Lakenfields	UB	623678	307013	N	Y(20m)	N/A	N/A
16	Grapes Hill (lower)	R	622386	308838	Y	N	N/A	N/A

Site Code	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road(N/A if not applicable)	Does this location represent worst-case exposure?
17	62 Magpie Road	R	622970	309651	N	Y (1m)	2m	Y
18	26 Bull Close Road	R	623228	309625	N	Y (1m)	5.5m	Y
19	24 Bargate Court	R	623422	309388	N	Y (1m)	4m	Y
20	5 Riverside Road	R	623863	308501	Y	Y (1m)	3m	Y
21	Wellington Lane (lower)	K	622419	308797	Y	Y (15m)	1m	Y
22	71 Dukes Court	R	622431	308663	Y	Y (1m)	4m	Y
23	Chalk Hill Road	R	623906	308596	Y	Y (1m)	7m	Y
24	Reads Flour Mill	K	623796	307772	N	Y (1m)	1m	Y
25	Carrow Bridge House	R	623900	307709	N	Y (1m)	5m	Y

Site Code	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road(N/A if not applicable)	Does this location represent worst-case exposure?
26	Zipfel House	R	623185	309649	N	Y (1m)	3m	Y
27	68 Bull Close Road	R	623305	309543	N	Y (1m)	4m	Y
28	Rotary House King Street	R	623879	307658	N	Y (3m)	2m	Y

2.2 Comparison of Monitoring Results with AQ Objectives

2.2.1 Nitrogen Dioxide

Automatic Monitoring Data

Automatic monitoring results at the Urban Background Lakenfields (AURN) Site have shown similar NO₂ concentrations over the past three years. The concentrations are well below the AQS objective limits.

Results at the mobile continuous monitor located at the Castle Meadow Site have consistently exceeded the AQS objectives over the past four years. The 2011 results remained at a similar level as those recorded in 2010 with only a 1µg/m³ fall in concentrations. The measured levels of 52µg/m³ in 2011 confirms the poor air quality in the area and demonstrates the continued need for an AQMA in the area.

The hourly objective for NO₂ of (200µg/m³ not to be exceeded more than 18 times per year) has been exceeded for the first time. The results in 2010 came close to this limit with 15 exceedences of 200µg/m³. The 2011 results show 34 exceedences of the 200µg/m³ objective (18 are allowed). This is a substantial increase from the 2010 results. It should be noted the road on which the monitoring takes place is restricted to buses only and the monitor is located in a worst case location between two bus stops. The area is likely to be an area where people may spend an hour; therefore relevant exposure for this objective does exist. It would be recommended Detailed Analysis of monitoring data with reference to the time of day and wind direction is undertaken to assess the cause of this exceedence in more detail.

Table 5 Results of Automatic Monitoring of Nitrogen Dioxide: Comparison with Annual Mean Objective

Location	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture 2011 %	Annual Mean Concentration $\mu\text{g}/\text{m}^3$ (% data capture for the year)			
					2008	2009	2010	2011
Norwich Castle Medow	Roadside	Y	93	93	45	41	53	52
Norwich Lakenfields	Urban Background	N	92	92	N/A	16	13	13

Table 6 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour mean Objective

Location	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture 2011 %	Number of Exceedences of Hourly Mean (200 µg/m ³)			
					2008	2009	2010	2011
Norwich Castle Meadow	Roadside	Y	93	93	0	1	15	34
Norwich Lakenfields	Urban Background	N	92	92	N/A	0 (80)	0	0

Diffusion Tube Monitoring Data

During 2011 diffusion tube monitoring by Norwich City Council identified nine sites exceeding the air quality objective limit of $40\mu\text{g}/\text{m}^3$. The council is currently in the process of declaring a large proportion of the town centre as an AQMA. When this new AQMA is finalised it will cover all areas where an exceedence has been identified in 2011.

The areas where exceedences occurred outside of existing AQMAs were;

- 256 King Street;
- Rotary House King Street;
- St Stephens (mid); and
- Zipfel House.

The continuing exceedences along King Street highlight the need for an AQMA in this area. The monitoring at St Stephens is not at a site of relevant exposure, however this area will be incorporated into the new city centre AQMA. The exceedence at Zipfel House on Bull Close Road indicates the need to declare an AQMA in this area. The new AQMA will include this area.

Figure 9 Results of Nitrogen Dioxide Diffusion Tubes in 2011

Site Code	Location	Site Type	Within AQMA?	Triplicate or Collocated	Data capture 2011 (months)	Annual mean concentration (bias factor = 0.93)
1	256 King Street	R	N	Triplicate	12	41.9
2	Queens Rd Travelodge	R	N	N/A	7	31.8
3	St Stephens (mid)	K	N	N/A	10	53.0
4	130 Magdalen Street	R	N	Triplicate	12	29.0
5	Grapes Hill (upper)	R	Y	N/A	11	24.9
6	Exchange St	K	N	N/A	10	32.7
7	50 St Augustines	K	Y	N/A	12	47.5
8	32 St Augustines	K	Y	N/A	9	36.2
9	13 St Augustines	K	Y	N/A	11	37.6
10	65 St Augustines	K	Y	N/A	11	29.6
11	Upper King Street	K	Y	N/A	12	35.2
12	Cattlemarket Street	R	Y	N/A	12	45.0
13	Castle Meadow	R	Y	N/A	11	51.1

Norwich City Council USA 2012

Site Code	Location	Site Type	Within AQMA?	Triplicate or Collocated	Data capture 2011 (months)	Annual mean concentration (bias factor = 0.93)
14	Castle Meadow 2	R	Y	N/A	11	52.5
15	Lakenfields	UB	N	Co-location Tubes (triplicate)	11	13.1
16	Grapes Hill (lower)	R	Y	N/A	11	25.6
17	62 Magpie Road	R	N	N/A	11	31.6
18	26 Bull Close Road	R	N	Triplicate	12	35.0
19	24 Bargate Court	R	N	N/A	11	35.1
20	5 Riverside Road	R	Y	Triplicate	12	49.4
21	Wellington Lane (lower)	K	Y	N/A	10	26.2
22	71 Dukes Court	R	Y	N/A	10	27.9
23	Chalk Hill Road	R	Y	N/A	12	31.1
24	Reads Flour Mill	K	N	N/A	12	23.1
25	Carrow Bridge House	R	N	N/A	12	24.7
26	Zipfel House	R	N	N/A	11	42.8
27	68 Bull Close Road	R	N	N/A	12	29.1
28	Rotary House King Street	R	N	N/A	11	40.2

Table 7 Results of Nitrogen Dioxide Diffusion Tubes (2006 to 2011)

	Historic Annual Mean Concentrations ($\mu\text{g}/\text{m}^3$)					
	2006	2007	2008	2009	2010	2011
256 King Street	N/A	45.2	41.2	44.2	41.5	41.9
Queens Rd Travelodge	N/A	41.9	32.8	37.3	40.3	31.8
25 Surrey Street	N/A	33.5	27.3	29.9	31.1	#N/A
St Stephens (mid)	46	46.4	48.4	52.1	54.5	53.0
Chapelfield/Wessex St	32	35.6	30.5	36.1	N/A	#N/A
Lakenfields	N/A	N/A	N/A	13.6	15.1	13.1
26 Johnson Place	41	33.7	24.3	31.9	N/A	#N/A
Chalk Hill Road	N/A	N/A	N/A	30.9	34.1	31.1
130 Magdalen Street	N/A	40.1	36.7	35.2	39.7	29.0
Reads Flour Mill	N/A	N/A	N/A	23.8	24.9	23.1
Grapes Hill (upper)	25	28.4	23.2	26.7	26.3	24.9
Exchange St	42	42.3	41	40	38.7	32.7
50 St Augustines	50	52.1	50.9	56.2	55	47.5
Tombland	42	47.7	27.8	30.1	36.3	#N/A
Upper King Street	32	37.8	32.4	34	26.3	35.2
73 Prince of Wales Road	N/A	39.1	31.8	35.4	36.3	#N/A
Cattlemarket Street	42	52.8	43.1	50.3	48.4	45.0
Castle Meadow	46	52.9	48.8	53	58.4	51.1
Castle Meadow 2	46	46.6	45.3	47.1	49.6	52.5
Grapes Hill (lower)	29	30.7	28	27.8	29.5	25.6
32 Key and Castle Yard	N/A	35.6	31.9	33.7	N/A	#N/A

	Historic Annual Mean Concentrations ($\mu\text{g}/\text{m}^3$)					
	2006	2007	2008	2009	2010	2011
29 St Martins Road	N/A	25.3	22.7	26.3	N/A	#N/A
Boundary PH 414 Aylsham Rd	N/A	N/A	25	23.8	29.1	#N/A
Kerrisons 353 Aylsham Rd	N/A	N/A	35.5	37.4	37.2	#N/A
221 Mile Cross Lane	N/A	N/A	33	34.8	36	#N/A
13 Aylsham Rd	N/A	32.7	26.8	30.9	N/A	#N/A
158 Waterloo Rd	N/A	41.1	23.9	25	N/A	#N/A
62 Magpie Road	N/A	34.9	32.6	34.2	32.1	31.6
26 Bull Close Road	N/A	39.9	35.6	40.5	37.7	35.0
24 Bargate Court	N/A	38.4	32.8	37.9	39.3	35.1
124 Barrack St	N/A	32.1	24.9	27.6	N/A	#N/A
5 Riverside Road	47	48.6	46.4	54.4	52.1	49.4
Wellington Lane (lower)	32.4	36.7	32.1	33.6	33.9	26.2
71 Dukes Court	N/A	31.1	27.6	28.4	28.8	27.9
Carrow Bridge House	N/A	N/A	N/A	N/A	28.8	24.7
288 King St	N/A	N/A	N/A	N/A	28.4	#N/A
Zipfel House	N/A	N/A	N/A	N/A	42.3	42.8
68 Bull Close Road	N/A	N/A	N/A	N/A	34.5	29.1
32 St Augustines	N/A	N/A	N/A	N/A	N/A	36.2
13 St Augustines	N/A	N/A	N/A	N/A	N/A	37.6
65 St Augustines	N/A	N/A	N/A	N/A	N/A	29.6
Rotary House King Street	N/A	N/A	N/A	N/A	N/A	40.2

2.2.2 PM₁₀

Monitoring for Particulates has been carried out by the council for a number of years. The AURN Lakenfields site recorded an annual mean of 19µg/m³ in 2011. This site has recorded consistent pollutant concentrations over the past three years from 17 - 19µg/m³ with a 1µg/m³ increase per year. These levels are still well below the AQS objective limit of 40µg/m³. The PM₁₀ objective for daily means has not been exceeded at the Lakenfields site in past years. During 2011 there was a data capture of 83% therefore the 90.4 percentile was calculated. The number of exceedences from the data available was 13 days of a permitted 35. It is recommended the council continue to monitor at this location and improve data capture.

The Castle Meadow continuous monitor recorded an increase in PM₁₀ concentrations over 2010 levels. The annual mean PM₁₀ levels in 2011 were 25µg/m³ and the PM₁₀ daily objective of levels over 50µg/m³ was 17days. Both these results are well below the objective limits.

Both monitors recorded an increase in concentrations for both the annual and daily objectives for PM₁₀ during 2011.

Table 8 Results of Automatic Monitoring of PM₁₀: Comparison with Annual Mean Objective

Location	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture 2011 %	Annual Mean Concentration $\mu\text{g}/\text{m}^3$ (% data capture for the year)			
					2008	2009	2010	2011
Norwich Castle Meadow	Roadside	Y	93.5	93.5	19	21	19	25
Norwich Lakenfields	Urban Background	N	83.5	83.5	N/A	17	18	19

Table 9 Results of Automatic Monitoring for PM₁₀: Comparison with 24-hour mean Objective

Location	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture 2011 %	Number of Exceedences of daily mean objectives (90th percencile of daily mean PM10 concentration if data capture <90%)			
					2008	2009	2010	2011
Norwich Castle Medow	Roadside	Y	93.5	93.5	4	2	3	17
Norwich Lakenfields	Urban Background	N	83.5	83.5	N/A	0 (26)	4	13 (37)

2.2.3 Sulphur Dioxide

Data capture at both continuous monitoring sites was above 90% during 2011 for SO₂ monitoring. The results from both sites in 2011 met all the air quality objectives for SO₂. The objective for SO₂ has not been exceeded in past years.

Table 10 Results of Automatic Monitoring of SO₂: Comparison with Air Quality Objectives

Site ID	Site Type	Within AQMA?	Valid Data Capture for monitoring Period % ^a	Valid Data Capture 2011 % ^b	Number of Exceedences (percentile in bracket µg/m ³) ^c		
					15-minute Objective (266 µg/m ³)	1-hour Objective (350 µg/m ³)	24-hour Objective (125 µg/m ³)
Norwich Castle Meadow	Roadside	Y	98.2	98.2	0	0	0
Norwich Lakenfields	Urban Background	N	97	97	0	0	0

2.2.4 Benzene

Monitoring for Benzene was not carried out by Norwich City Council during 2011. Previous monitoring results for Benzene determined that ambient levels of Benzene 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 Castle Meadow continuous monitor for 2011. There were no exceedences of the air quality objective of $10\text{mg}/\text{m}^3$ (8hr running mean) for carbon monoxide in 2011. Data shows the maximum 8hr running mean of $0.9\text{mg}/\text{m}^3$.

Ozone

Monitoring data is available for ozone from both the continuous monitoring sites in Norwich. Ozone is not included in the LAQM regulations due to its transboundary nature and thus the limited effectiveness of action of a local scale. There is however a provisional objective level 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 Castle Meadow site recorded no exceedences of the $100\mu\text{g}/\text{m}^3$ (8hr running mean). The Lakenfields site also had no exceedences during of the Ozone objective in 2011.

PM_{2.5}

PM_{2.5} monitoring is available for both monitoring stations in 2011. PM_{2.5} is not included in the regulations for air quality management for local authorities. The records for the Castle Meadow site show an annual mean of $12\mu\text{g}/\text{m}^3$. The annual mean recorded at the Lakenfields site was $14\mu\text{g}/\text{m}^3$.

2.2.6 Summary of Compliance with AQS Objectives

Continuous monitoring results for NO₂ at the Castle Meadow site identified an exceedence of the AQS objective for hourly NO₂ concentrations. It is recommended a Detailed Assessment of monitoring results be carried out. If analysis of data highlights a local source, the extent of exceedences will need to be determined.

All diffusion tube exceedences recorded in 2011 are in the area which will be declared as the Norwich City Centre AQMA.

All other pollutants measured meet the LAQM objectives in 2011.

Norwich City Council has measured concentrations of NO₂ above the 1-hour, objective at relevant locations, and **will need to proceed to a Detailed Assessment**, for the area around Castle Meadow continuous monitor.

3 Road Traffic Sources

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

Norwich City Council 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.

3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

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

3.3 Roads with a High Flow of Buses and/or HGVs.

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

3.4 Junctions

Norwich City Council confirms that there are no new/newly identified busy junctions/busy roads.

3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

As part of the new gyratory system developed to improve traffic and air quality in the area around the St Augustines AQMA one new section of road was built to link Edward Street with St Augustines Street. This new road is called New Boltolph Street. There are no receptors located along this new link road. The impacts of the new gyratory system are looked at in more detail in the following section of the report.

Norwich City Council has assessed new roads meeting the criteria in Section A.5 of Box 5.3 in TG(09), and concluded that it will not be necessary to proceed to a Detailed Assessment.

3.6 Roads with Significantly Changed Traffic Flows

The new gyratory system mentioned above was created during 2011 and has increased traffic along some of the roads by >25%. The roads where there has been an increase in traffic by >25% are;

- Magpie Road;
- Edward Street;
- Patteson Road; and
- Buxton Road.

In order to assess the impacts of these new traffic flows, a DMRB calculation has been carried out for the worst case receptors on each of the roads. Model verification was carried out using monitoring on St Augustines Road and Magpie Road. A verification factor of 3.77 was applied to the results. Full details of the DMRB calculation are shown in the appendices. The results of the calculation indicate the air quality objectives will not be exceeded at any of the worst case receptor locations. The highest modelled impact for NO₂ was 29µg/m³ along Edward Street. The PM₁₀ results were all below the objective limits with the highest level for PM₁₀ being 20µg/m³ along Edward Street.

Table 11 DMRB modelled results, roads with >25% increase in flow

Roads	Annual mean NO₂ µg/m³	Annual mean PM₁₀ µg/m³
Magpie Road	28.4	19.95
Edward Steet	29.6	20.05
Starling Road	15.8	19.17
Patteson Road	15.3	19.14
Buxton Road	14.2	19.07

Norwich City Council has assessed new/newly identified roads with significantly changed traffic flows, and concluded that it will not be necessary to proceed to a Detailed Assessment.

3.7 Bus and Coach Stations

Norwich City Council confirms that there are no relevant bus stations in the Local Authority area.

4 Other Transport Sources

4.1 Airports

Norwich City Council confirms that there are no new airports in the Local Authority area.

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

Norwich City Council 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.

4.2.2 Moving Trains

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

4.3 Ports (Shipping)

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

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been Carried Out

Norwich City Council confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced

Norwich City Council confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

Norwich City Council confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

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

5.3 Petrol Stations

Norwich City Council confirms that there are no petrol stations meeting the specified criteria.

5.4 Poultry Farms

Norwich City Council confirms that there are no poultry farms meeting the specified criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

Norwich City Council has identified a new biomass boiler installation which is proposed on school premises (City of Norwich School). In order to screen the proposed stack for air quality impacts, the biomass screening tool¹ on the LAQM website has been used. The stack release information is shown in Table 12.

Table 12 Biomass stack information, City of Norwich School

Stack information	
Diameter (m)	0.23
Stack height (m)	8.2
Output (Kw)	240
Fuel	wood pellets
PM ₁₀ emission rate (g/s)	0.0019
NOx emission rate (g/s)	0.0063
Grid reference (X&Y)	621836.5 306653.5

Building heights have been considered in this assessment; the boiler house which the stack is attached to is lower than the stack height of 8.2 m. However, the height of the tallest building within 5 stack heights is 11.9 m (the school building) at a distance of 15 m from the proposed stack. This building also represents relevant exposure for the air quality objectives.

The biomass screening tools are designed to screen simple situations; since the school building is taller than the nearby stack, eddy and downwash effects could be significant and therefore the screening models are not, strictly speaking, applicable to this situation.

In order to determine whether there are any air quality issues, a minimum stack height of 13 m has been assessed. This is the minimum stack height which the screening tools can be run with, in the light of the nearby tall building.

¹ <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#biomass>

If the release cannot be screened out when assuming a stack height of 13 m, the air quality impacts with the actual, shorter stack of 8.2m also cannot be screened out (since the impact with the short actual stack would be worse).

If the release is screened out when assuming a stack height of 13 m, the air quality impacts with the actual, shorter stack of 8.2m may or may not be acceptable, since the impact with the short actual stack would be worse.

Results from the biomass calculator have shown the stack would be permissible at 13m. At the assessed height of 13m there would be no anticipated exceedences of the air quality objectives. This information will be provided back to the planning department in order to allow them to make an informed decision.

Screen shots from the biomass tool are shown in Appendix D.

Norwich City Council have assessed the biomass plant and determined there will be no exceedences of the air quality objectives with a stack height of 13m. It will not be necessary to carry out a Detailed Assessment.

6.2 Biomass Combustion – Combined Impacts

Norwich City Council confirms that there are no biomass combustion plant in the Local Authority area.

6.3 Domestic Solid-Fuel Burning

Norwich City Council confirms that there are no areas of significant domestic fuel use in the Local Authority area.

7 Fugitive or Uncontrolled Sources

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

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

Continuous monitoring results for NO₂ at the Castle Meadow site identified an exceedence of the AQS objective for hourly NO₂ concentrations. It is recommended that a Detailed Assessment of monitoring results is carried out.

All diffusion tube exceedences recorded in 2011 are in the area which will be declared as the Norwich Town Centre AQMA.

All other pollutants measured meet the LAQM objectives in 2011.

8.2 Conclusions from Assessment of Sources

The new gyratory system created a short section of new road and caused some roads to have a >25% increase in traffic flow. The new section of road does not have any receptors located along it therefore there is no relevant exposure for the annual objectives for PM₁₀ and NO₂. The roads with increased traffic flow all remain below the air quality objectives for NO₂ and PM₁₀.

The proposed biomass installation at City of Norwich School will be assessed once detailed technical specifications are available and an appropriate stack height will be determined in order to meet the air quality objectives.

8.3 Proposed Actions

Proposed actions from this report are as follows:

- Due to the exceedence of the hourly mean objectives for NO₂ recorded at the Castle Meadow continuous monitoring site it is recommended that a detailed assessment of monitoring data is carried out to understand the potential for the hourly mean objective for NO₂ to be exceeded in this area.

- The council should proceed with declaring the whole town centre as an AQMA encompassing all areas with current monitoring data above or close to the NO₂ annual mean objectives.
- Ensure the biomass installation at City of Norwich School does not lead to an exceedance of any air quality objectives.
- Proceed to 2013 Annual Progress Report.

9 References

DEFRA (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Department of the Environment, Food and Rural Affairs, Cm 7169, NIA 61/06-07

LAQM.TG(09) *Local Air Quality Management Technical Guidance*, Part IV of the Environment Act 1995, February 2009

Local Air Quality Management, Review and assessment of Air Quality – Stages 2 & 3, Consultation Document, City of Norwich, 2001

Air Quality Review and Assessment Stage 3 Update, Norwich City Council, 2003

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2004

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2005

Air Quality Updating and Screening Assessment (2006), Norwich City Council,

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2007

Air Quality Detailed Assessment (2008), Norwich City Council, 2009

Air Quality Updating and Screening Assessment (2009), Norwich City Council,

Air Quality Review and Assessment Annual Progress Report, Norwich City Council, 2010

Air Quality Further Assessment for Riverside Road AQMA, 2010

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2011

St Augustines Gyrotory System Traffic Monitoring Plan - 2011

Appendices

Appendix A: QA/QC Data

Appendix B: Monthly Monitoring Results

Appendix C: DMRB Calculations and Verification

Appendix D: Biomass Calculations

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 v03_12): **0.93**

Factor from local co- location studies

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

Bias Factor A: **0.92** (0.83 – 1.03)

Bias B: 9% (-3% - 21%)

Diffusion Tubes Mean: 14µg/m³

Automatic Mean: 13µg/m³

Data Capture for periods used: 96%

Adjusted Tubes Mean: 13 (12-15) µg/m³

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	End Date	Tube 1	Tube 2	Tube 3	Triplicate Mean	Standard Deviation	Coefficient of Variation	95% CI of mean
	dd/mm/yyyy	dd/mm/yyyy	µg/m ³	µg/m ³	µg/m ³				
1	06/01/2011	02/02/2011	17.4	19.1	17.2	18	1.0	6	2.5
2	02/02/2011	02/03/2011	16.4	17.1	16.3	17	0.4	2	1.0
3	02/03/2011	30/03/2011	15.3	16.4	11.7	15	2.6	18	6.4
4	30/03/2011	06/05/2011	13.8	13.1	13.3	13	0.3	3	0.9
5	06/05/2011	01/06/2011	3.0	7.8	8.3	3	0.7	8	1.6
6	01/06/2011	30/06/2011	3.3	3.8	10.3	10	0.3	3	0.7
7	30/06/2011	03/08/2011							
8	03/08/2011	31/08/2011	10.1	10.0	11.5	11	0.8	8	2.1
9	31/08/2011	28/09/2011	10.5	11.6	10.3	11	0.7	7	1.8
10	28/09/2011	28/10/2011	15.2	15.0	16.7	16	0.3	6	2.4
11	28/10/2011	23/11/2011	21.1	21.3	21.6	22	0.4	2	1.0
12	23/11/2011	04/01/2012	13.5	16.3	14.3	15	1.5	10	3.6
13									

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

From the AEA group

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor
14.41	35	Good	Good
15.18	35	Good	Good
14.53	32	Good	Good
14.73	36	Good	Good
10	33	Good	Good
12	34	Good	Good
14	38	Good	Good
8	50	Good	Good
8	100	Good	Good
13	100	Good	Good
18.33	37	Good	Good
11.5	33	Good	Good

Overall survey --> **Good precision** **Good Overall DC**
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: _____

Accuracy (with 95% confidence interval) without periods with CV larger than 20%

Bias calculated using 10 periods of data

Bias factor A **0.92** (0.83 - 1.03)

Bias B **9%** (-3% - 21%)

Diffusion Tubes Mean: **14** µg/m⁻³

Mean CV (Precision): **6**

Automatic Mean: **13** µg/m⁻³

Data Capture for periods used: **96%**

Adjusted Tubes Mean: **13 (12 - 15)** µg/m⁻³

Precision **11 out of 11 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval) WITH ALL DATA

Bias calculated using 10 periods of data

Bias factor A **0.92** (0.83 - 1.03)

Bias B **9%** (-3% - 21%)

Diffusion Tubes Mean: **14** µg/m⁻³

Mean CV (Precision): **6**

Automatic Mean: **13** µg/m⁻³

Data Capture for periods used: **96%**

Adjusted Tubes Mean: **13 (12 - 15)** µg/m⁻³

Jaume Targa, for AEA
Version 04 - February 2011

Discussion of Choice of Factor to Use

Both the national and local bias factor produce very similar results with the local being 0.92 and national being 0.93. In the 2010 Annual Progress Report the national bias adjustment factor was used as it provided a more conservative approach to the results. This report will use the national bias factor, as the figures are so close, in this case using the national bias will take the marginally more conservative approach.

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.

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

The Castle Meadow Site was corrected using the Kings College VCM correction tool (<http://www.volatile-correction-model.info/>).

Short-term to Long-term Data adjustment

Only one site needed to be annualised due to less than 75% data capture being available in 2011. This was the tubes on Queens Road (Travelodge) which only had 7 months data capture. See below results for the annualisation:

	Average
Mean of site to be annualised / ug m-3	34.2
Data Capture / %	58
Average Annualistaion Factor	1.051
Annualised Mean / ug m-3	35.9

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;
- annual 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 diffusion tubes are supplied and analysed by Gradko utilising 50% Triethanolamine (TEA) in Acetone preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO₂ diffusion tube analysis and the Annual Field Inter-Comparison Exercise. The lab follows the procedures set out by the Harmonisation Practical Guidance.

Appendix B: Monthly Monitoring Results

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
256 King Street	42.6	48.8	49.5	45.6	38.8	40.9	38.8	40.7	42.9	49.6	56.0	46.2
Queens Rd Travelodge	44.2	39.9	40.7		22.1		38.1	32.6				21.8
St Stephens (mid)	54.5	64.0	59.3	67.3	53.5	59.1	46.6	50.2	59.4			55.7
130 Magdalen Street	38.0	33.5	31.2	28.6	27.1	27.5	27.2	32.9	26.9	30.5	37.6	33.7
Grapes Hill (upper)	27.7	30.1	34.4	26.1	21.3	19.5		20.2	22.8	30.6	36.5	24.8
Exchange St	40.2	34.4	35.5	28.7	21.5	27.0	32.6	30.1			54.1	47.8
50 St Augustines	50.6	57.6	51.2	51.8	51.3	48.7	35.9	56.5	42.5	56.5	60.1	50.6
32 St Augustines		38.5	39.8	33.9	33.5		49.6	40.8	26.9		47.8	39.9
13 St Augustines		39.6	40.3	41.4	38.0	40.5	41.3	40.9	39.3	42.4	47.0	34.1
65 St Augustines		32.7	31.3	28.8	33.9	20.7	24.5	32.8	26.7	36.6	42.8	39.7
Upper King Street	38.1	35.1	43.0	35.6	36.5	34.5	27.9	35.1	39.2	37.9	41.3	50.5
Cattlemarket Street	43.1	52.5	56.2	54.0	46.7	45.7	41.7	43.2	42.6	49.8	65.7	39.0
Castle Meadow	58.7	51.6	50.6		50.1	53.9	65.9	51.8	49.1	61.7	61.5	49.7
Castle Meadow 2	56.6	53.2	50.5	56.2		55.9	44.9	52.2	56.5	63.3	60.5	71.5
Lakenfields	17.9	16.8	14.7	13.4	8.6	10.0		10.5	10.8	15.6	21.5	14.7
Grapes Hill (lower)	32.2	33.0	37.6	30.9	19.2	22.8		20.6	21.2	28.2	34.7	22.1
62 Magpie Road	30.4	35.8	38.9	31.0	32.7	33.5	25.2	32.2	32.7		46.3	34.9
26 Bull Close Road	35.0	40.1	38.4	34.1	40.3	37.2	29.2	37.9	38.4	40.0	39.1	41.5
24 Bargate Court	35.2	34.9	35.9	43.1	33.2	37.9	38.7	40.3	36.7	38.3	41.3	
5 Riverside Road	50.8	59.8	58.0	54.2	53.2	48.5	46.0	51.5	49.0	62.3	68.2	35.8
Wellington Lane (lower)	35.0		32.0	27.0	20.9	25.2		30.0	24.0	31.3	36.8	19.8
71 Dukes Court	37.1		36.7	30.0	22.5	23.9		24.5	24.2	31.6	40.4	29.7
Chalk Hill Road	34.3	32.4	34.2	35.4	27.0	28.7	30.9	31.0	30.5	34.3	43.3	39.1
Reads Flour Mill	29.7	28.8	26.0	21.7	17.0	20.0	14.5	19.1	19.8	26.1	36.8	38.8

Norwich City Council USA 2012

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Carrow Bridge House	34.1	31.8	29.0	20.1	21.6	21.7	23.2	25.6	21.8	27.8	34.6	28.0
Zipfel House		52.9	44.1	40.9	48.0	46.3	37.8	43.4	47.6	47.9	52.6	44.2
68 Bull Close Road	30.9	33.6	33.5	29.6	28.8	28.1	27.6	28.5	29.5	34.2	39.2	31.5
Rotary House King Street		47.1	49.7	45.2	40.0	37.9	33.6	39.8	44.9	43.5	49.3	45.0

Appendix C: DMRB Calculations

Input Data

Background Concentrations			
Year	NO _x	NO ₂	PM ₁₀
2011	20	13	19

Roads	X	Y	AADT	Distance to receptor (m)	Speed (kmph)	Road Type	%LDV	%HGV
Magpie Road	623042	309691	9677	7.5	43	B	95	5
Edward Street	622991	309562	10203	6	42	B	95	5
Starling Road	622908	309716	1539	10	32	B	95	5
Patteson Road	622748	309879	1215	11.3	28	B	95	5
Buxton Road	622786	309798	502	6.8	26	B	95	5
Verification sites								
Magpie Road	622970	309651	9677	2	43.2	B	95	5
St Augustines Street	622865	309529	12551	2	36.8	A	95	5

Verification

Verification was carried out based on diffusion tubes located on Magpie Road and St Augustines Street, both of which are impacted by the new gyratory system. An adjustment factor of 3.77 was derived and applied to the modelled NO_x results before putting these into the NO_x to NO₂ converter to derive total NO₂ for the junction.

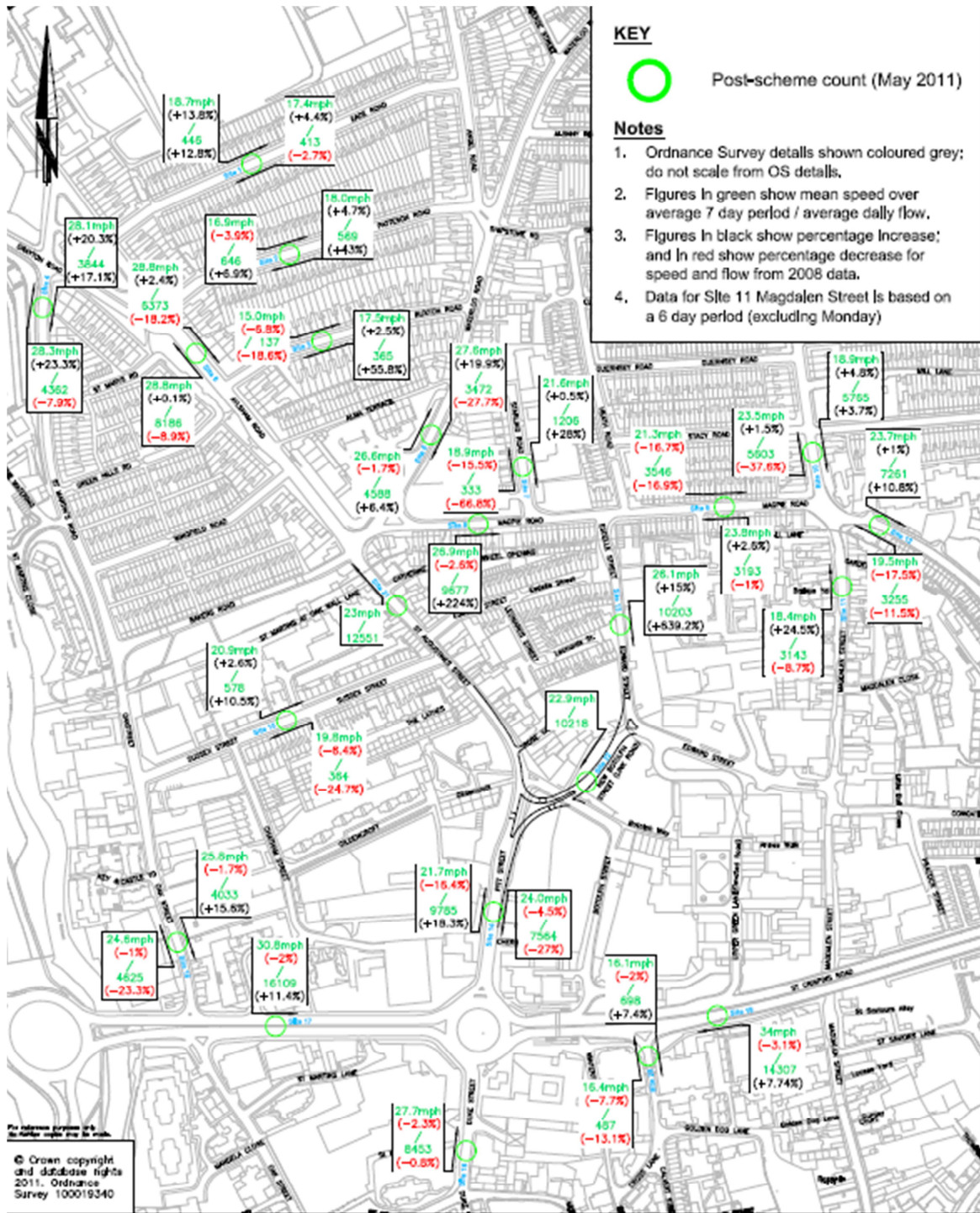
Norwich City Council USA 2012

Site	Background NO ₂ (µg/m ³)	Background NO _x (µg/m ³)	Monitored Total NO ₂ (µg/m ³)	Monitored Road Contribution NO _x (µg/m ³)	Modelled Road Contribution NO _x (µg/m ³)	Ratio of Monitored Road NO _x /Modelled Road NO _x	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NO _x (µg/m ³)	Adjusted Modelled Total NO _x (µg/m ³)	Modelled Total NO ₂ (µg/m ³)	Monitored Total NO ₂ (µg/m ³)	% Difference NO ₂ [(Modelled - Monitored)/ Monitored]
St Augustines Street	13	20.3	36.2	54.6	14.7	3.72	3.775	55.4	75.7	36.6	36.2	1.1%
Magpie Road	13	20.3	31.6	42.1	10.9	3.87		41.0	61.2	31.3	31.6	-0.9%

Results

Roads	Annual mean NO ₂ µg/m ³	Annual mean PM ₁₀ µg/m ³
Magpie Road	28.4	19.95
Edward Street	29.6	20.05
Starling Road	15.8	19.17
Patteson Road	15.3	19.14
Buxton Road	14.2	19.07

Map of St Augustines Gyratory



DRAWING TITLE
 POST SCHEME MONITORING ANALYSIS (MAY 2011)

Mike Jackson
 Director of Environment, Transport
 and Development
 Norfolk County Council
 County Hall
 Marlborough Lane
 Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

SURVEYED BY	OS	INT.	DATE	DRAWING No.
				PJ5004-GP-213
DESIGNED BY				PROJECT TITLE
DRAWN BY	SN	07/11		NORWICH GROWTH POINT
CHECKED BY	BL	07/11		ST. AUGUSTINE'S GYRATORY
				SCALE
				FILE No.
				PJ5004

Appendix D: Biomass Calculations

Review and Assessment Tool for PM ₁₀ from biomass combustion stacks	
<p>The maximum emissions of PM₁₀ in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the 24 hour objective for PM10 in England, Wales and Northern Ireland or the annual mean objective in Scotland.</p>	
<p>Enter required information in Cream Cells Resulting Emission in Red Bold</p>	
Building height	<input type="text" value="12"/> m
Stack diameter	<input type="text" value="0.23"/> m
Stack height	<input type="text" value="13"/> m
Location (Scotland, Rest of UK)	<input type="text" value="Rest of UK"/>
PM ₁₀ Annual mean background concentration (include roadside contribution at relevant receptors)	<input type="text" value="19"/> µg/m ³
Calculated Effective stack height	<input type="text" value="1.7"/> m
Target Emission Rate	<input type="text" value="0.0104"/> g/s
<p>If the maximum stack emission rate is less than the target above then it is not likely that the most stringent objective for PM₁₀ will be exceeded</p>	

Review and Assessment Tool for oxides of nitrogen emissions from biomass combustion stacks	
Annual mean NO ₂ objective	
<p>The target emissions of NO_x in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the annual mean objective for NO₂</p>	
<p>Enter required information in Cream Cells Resulting Emission in Red Bold</p>	
Building height	<input type="text" value="12"/> m
Stack diameter	<input type="text" value="0.23"/> m
Stack height	<input type="text" value="13"/> m
Location (Scotland, Rest of UK)	<input type="text" value="Rest of UK"/>
NO ₂ Annual mean background concentration (include roadside contribution at relevant receptors)	<input type="text" value="19"/> µg/m ³
Calculated Effective stack height	<input type="text" value="1.7"/> m
Target Emission Rate	<input type="text" value="0.0491"/> g/s
<p>If the maximum stack emission rate is less than the target above then it is not likely that the annual mean limit value for NO₂ will be exceeded</p>	

Review and Assessment Tool for oxides of nitrogen emissions from biomass combustion stacks	
Hourly mean NO ₂ objective	
<p>The target emissions of NO_x in g/s from biomass combustion source emissions are calculated for your given stack details. Greater emission rates may result in exceedence of the annual mean objective for NO₂</p>	
<p>Enter required information in Cream Cells Resulting Emission in Red Bold</p>	
Building height	12 m
Stack diameter	0.23 m
Stack height	13 m
Location (Scotland, Rest of UK)	Rest of UK
NO ₂ Annual mean background concentration (include roadside contribution at relevant receptors)	19 µg/m ³
Calculated Effective stack height	1.7 m
Target Emission Rate	0.0306 g/s
<p>If the maximum stack emission rate is less than the target above then it is not likely that the hourly mean objective for NO₂ will be exceeded</p>	

M G Stephenson
Public protection manager

If you require this document in another language or format,
eg large print, audio cassette or Braille, please contact:

Public protection
City Hall
Norwich
NR2 1NH
t: 0344 980 3333
e: info@norwich.gov.uk

Information correct at time of publication.
Published by Norwich City Council, September 2012

