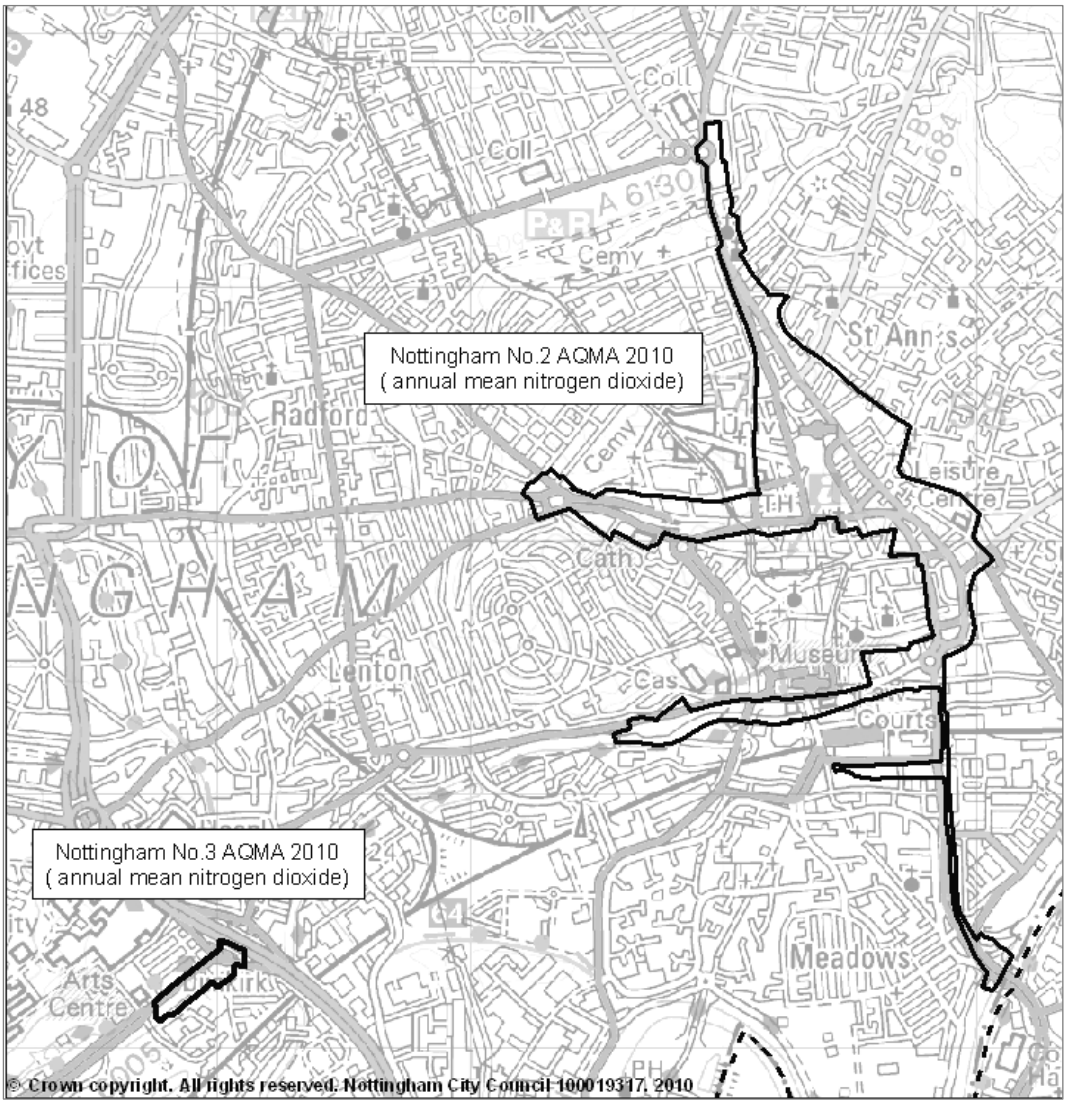
Nottingham City Council

Air Quality Management Areas 2010
Further Assessment Report



January 2012

Local Authority Officer	Richard Taylor Noise & Pollution Control Team Leader

Department	Communities - Community Protection
Address	Environmental Health & Trading Standards Noise & Pollution Control Team Loxley House Station Street Nottingham NG2 3NG
Telephone	0115 9156408
e-mail	richard.taylor@nottinghamcity.gov.uk

Report Reference number	NCC Further Assessment 2012
Date	4 January 2012

NOTTINGHAMSHIRE POLICE
Policing for you

Nottingham City Council

Executive Summary

Nottingham City Council's 'Air Quality Management Areas Further Assessment Report' dated January 2012 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.

Under Section 84 (1) of the Environment Act 1995 where a Local Authority has designated or amended an Air Quality Management Area (AQMA) they are required to undertake a further assessment of existing and likely future air quality in an AQMA. There is also a requirement to consult on the further assessment and make it available to the public.

Nottingham City Council's 2 Air Quality Management Areas originally declared in 2002 were varied and the legal Orders for the amendments sealed in June 2010. The AQMAs are concerned with exceedences of the annual mean nitrogen dioxide Air Quality Objective (AQO).

The Further Assessment (FA) report has considered 2009 and 2010 nitrogen dioxide monitoring data, current/ proposed planning applications and possible new developments associated with the local plan and; has shown that road traffic is the predominant local source that contributes to exceedences of the annual mean Air Quality Objective.

Generally whilst the volume of traffic has an impact at all sites the proportion of particular vehicle types (source apportionment) between cars, buses, light goods (LGV) and heavy goods (HGV) vehicles is also significant. For example, at a site on Queens Road the calculations show that HGVs are responsible for 48.3% of the traffic nitrogen oxides (NOx) emissions; and suggest that up to15µg/m^3 reductions in the levels of nitrogen dioxide (NO_2) along some roads are necessary if the annual mean nitrogen dioxide AQO of 40µg/m^3 is to be met in all parts of the City area.

Estimates of when the AQO will be achieved, based on the methodology given in Local Air Quality Management (LAQM) TG(09) guidance, indicate that nitrogen dioxide (NO_2) levels at some sites should fall below 40µg/m^3 by 2011 and at all sites by 2015. However it should be noted that there are a number of factors such as unknown future meteorology, levels of NO_2/NOx not reducing in line with national forecasts and the impact of air quality action planning measures that mean any predictions of AQO achievement date/s have to be treated with caution.

The information presented confirms that it was necessary to alter the boundaries of the AQMAs declared in 2002.

While there are no new monitoring data, proposed developments or traffic schemes that may adversely affect the vicinity of the Nottingham No.3 AQMA 2010 - Dunkirk the situation is different for Nottingham No.2 AQMA 2010 that covers the City Centre.

In 2010 NO_2 levels of 42 and 48µg/m^3 were measured at 2 diffusion tube sites that are not within the AQMAs. Also under construction/future residential planning proposals and possible Local Plan mixed use developments at various sites in the proximity of the current City Centre AQMA have been identified. These factors suggest that the geographical extent of the AQMA may need to be reconsidered.

Our 2011 Progress Report, which was accepted by Defra, concluded that it was necessary for Nottingham City Council to undertake a Detailed Assessment (DA) in respect of the measured annual mean NO_2 exceedences outside an AQMA where there is relevant exposure of members of the public. It is now proposed to broaden the scope of the DA to include further investigation of the findings outlined in this report and; determine whether the geographical extent of the City Centre AQMA is sufficiently precautionary to avoid having to amend it in the future and whether an AQMA that encompasses a larger area should be considered.

Consultation will take place after the report has been approved by Defra - electronic copies will be sent to statutory consultees and it will be placed on the Council's website.

Table of Contents

1 Introduction 6

1.1 Further Assessment of Air Quality within an AQMA 6

1.2 Purpose of the Further Assessment 7

2 New Monitoring Data 9

2.1 Automatic Monitoring 9

2.2 Non-Automatic – Diffusion Tube Monitoring 12

3 Guidance, Developments, Statutory Consultees' Comments, Discussion 16

3.1 New Guidance/Policy 16

3.2 New Developments 16

3.3 Statutory Consultees' Comments 18

3.4 Discussion 19

4 Source Apportionment, Required Reduction in Pollutant Emissions, By When Will the Air Quality Objective be Achieved? 21

4.1 Source Apportionment 21

4.2 Required Reduction in Pollutant Emissions 22

4.3 By When Will the Air Quality Objective be Achieved? 24

5 Air Quality Action Plan and the Local Transport Plan 27

6 Conclusions 28

7 References 29

Appendices

Appendix A Previous Review and Assessment Reports 31

Appendix B Source Apportionment, Required NO_2 Reduction and Predicted AQO Achievement Calculations 34

Appendix C Trends in Measured Nitrogen Dioxide Levels 37

Appendix D LAQM Helpdesk Response to Query about NO_2/NOx Forecasts 39

List of Tables

Table 2.1 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective 11

Table 2.2 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective 12

Table 2.3 Results of Diffusion Tube Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective 14

Table 4.1 Traffic Source Apportionment for the 'worst case' measured NO_2 levels 22

Table 4.2 Road NO_2 Required Reduction 23

Appendices

Table A-1 Previous Review and Assessment Reports 31

Table B-1 NOx Emissions According to Vehicle Type 35

Table B-2 Calculated Required Reduction in Road NOx Emissions 36

List of Figures

Figure 2.1 Map showing 2010 Automatic Monitoring Sites 10

Figure 2.2 Map showing 2010 Diffusion Tube Monitoring Sites 13

Figure 3.1 Map showing Planning Applications and Local Plan Issues and Options Proposed Sites 17

Figure 4.1 Predicted years by which the Annual Mean NO_2 AQO will be met 24

Figure 4.2 Comparison between predicted and measured NO_2 2008 - 2011 25

Appendices

Figure C-1 AURN Nitrogen Dioxide Annual Mean Concentrations 1998 - 2010 37

Figure C-2 CGNOx Nitrogen Dioxide Annual Mean Concentrations 1998 - 2010 37

1 Introduction

Part IV of the Environment Act 1995 required the Secretary of State to publish a national Air Quality Strategy (currently The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007) and; established the process of Local Air Quality Management (LAQM) for the designation of air quality management areas.

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).

Nottingham City Council has statutory duties under Part IV of the Environment Act 1995:-

Section 82 - to review the air quality within its area, both at the present time and the likely future air quality.

Section 83 – to designate an Air Quality Management Area (AQMA) where air quality objectives as set out in the Air Quality (England) Regulations 2000 Regulations, are not being achieved, or are not likely to be achieved within the relevant period.

Section 84 - where an area has been designated to undertake a further assessment and to develop an Action Plan for the Air Quality Management Area/s.

In undertaking their LAQM work Local Authorities are expected to use policy and technical guidance issued by the Department for Environment and Rural Affairs (Defra). The main documents currently are Local Air Quality Management Policy Guidance (PG09) and Local Air Quality Management Technical Guidance (TG09) respectively.

LAQM is a continuous process and Nottingham Council has prepared a number of reports since the first Review and Assessment in 2000. Details of the Council's previous LAQM reports and a brief outline of their conclusions are given in Appendix A Table A-1.

The conclusion of the Detailed Assessment (DA) undertaken in 2008/9 was:

"Nottingham City Council has identified with reasonable certainty that the nitrogen dioxide annual mean Air Quality Objective has been exceeded and is likely to continue to be exceeded in parts of its area. Therefore it is necessary to modify both of the existing Air Quality Management Areas to reflect the findings of the modelling and monitoring."

Following consultation with statutory consultees and the public and acceptance of the amended DA report by Defra, legal Orders to amend the original Air Quality Management Areas (declared in 2002) were sealed on June 22nd 2010. The abbreviated references for the areas are Nottingham No.2 AQMA 2010 and Nottingham No.3 AQMA 2010.

1.1 Further Assessment of Air Quality within an AQMA

Section 84 (1) of the Environment Act 1995 requires Local Authorities to undertake a further assessment of existing and likely future air quality in an AQMA. Section 84 (2) requires the further assessment to be made within twelve months of designating (or varying) the AQMA. There is also a requirement to consult on the further assessment and make it available to the public.

For the variation of an AQMA, the guidance states that “If there is only to be a minor extension to an existing AQMA order, such as the encompassing of a few further buildings or inclusion of a road junction, as long as the authority has access to substantial information about the area of extension or can reliably extrapolate from information it has about the area originally designated, Defra, ….. would not expect that authority to have to undertake an extensive further assessment.” A more comprehensive assessment is expected if the order is varied by a more substantial change, for example going from a few streets to a whole borough designation.

1.2 Purpose of the Further Assessment

This Further Assessment (FA) is concerned with the levels of nitrogen dioxide and their impact on air quality in the Nottingham City area. It is written in accordance with the LAQM Technical Guidance TG(09) and is intended to supplement the information collected from previous Review and Assessment work.

TG(09) states that ‘The Further Assessment is intended to allow authorities to:

- confirm their original assessment, and thus ensure they were correct to designate an AQMA in the first place;
- calculate more accurately what improvement in air quality, and corresponding reduction in emissions, would be required to attain the air quality objectives within the AQMA;
- refine their knowledge of sources of pollution, so that the Air Quality Action Plan may be appropriately targeted
- take account of any new guidance issued by Defra and the Devolved Administrations, or any new policy developments that may have come to light since declaration of the AQMA;
- take account of any new local developments that were not fully considered within the earlier Review and Assessment work. This might, for example, include the implications of new transport schemes, commercial or major housing developments etc, that were not committed or known of at the time of preparing the Detailed Assessment;
- carry out additional monitoring to support the conclusion to declare the AQMA; corroborate the assumptions on which the AQMA has been based, and to check that the original designation is still valid, and does not need amending in any way; and
- respond to any comments made by statutory consultees in respect of the Detailed Assessment.’

The report is structured as follows:

Section 1 - Introduction and purpose.

Section 2 - 2009 and 2010 nitrogen dioxide monitoring data and maps showing locations of monitoring sites and the Air Quality Management Areas.

Section 3 - Review of any new guidance and new local developments, response to Defra's Detailed Assessment 2008/9 comments and discussion of information given in Sections 2 and 3.

Section 4 - Source apportionment, the required reduction in pollutant emissions and predictions of when the Air Quality Objective level will be achieved.

Section 5 - Brief comments regarding Air Quality Action Plans and the Local Transport Plan.

Section 6 - Conclusion

Appendices - Technical information and calculations in support of the main report.

Throughout this report reference is made to a number of Nottingham City Council's previous air quality reports prepared to fulfill LAQM requirements. They can all be found on the Council's website - Air Pollution and Air Quality page at:

www.nottinghamcity.gov.uk/index.aspx?articleid=1851

Some of the earlier documents are useful as an introduction to the Local Air Quality Management (LAQM) process. Other reports including this one are of a more technical nature because they look in more detail at specific aspects.

Consultation will take place after the report has been approved by Defra - electronic copies will be sent to statutory consultees and it will be placed on the Council's website.

2 New Monitoring Data

The Detailed Assessment conclusions were based on 2008 modelling and monitoring data. This section presents 2009 and 2010 annual data and 9 month averages for 2011 to provide a more up to date assessment of the current nitrogen dioxide levels.

The nitrogen dioxide Air Quality Objectives against which monitoring data are compared are:

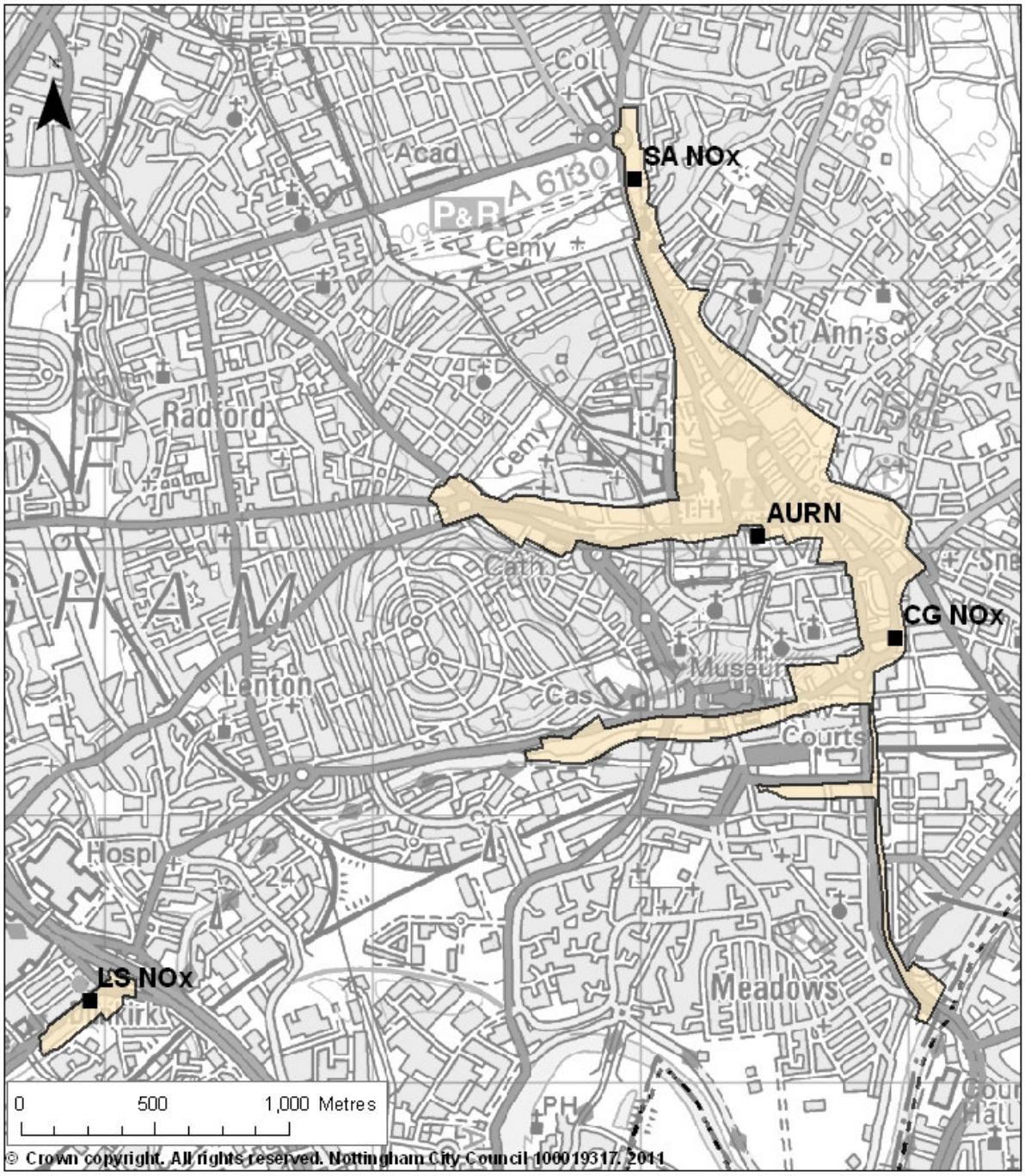
Pollutant	Concentration	Measured as	Date to be achieved by
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005

2.1 Automatic Monitoring

Automatic monitoring instruments measure pollutant concentrations at 10 second intervals which are then averaged to 15 minute concentrations. 1 hour and annual mean nitrogen dioxide (NO_2) concentrations are calculated from the data to allow comparison with the Air Quality Objectives.

Nottingham City Council undertakes continuous automatic nitrogen oxides (NOx) and nitrogen dioxide (NO_2) monitoring at three 'roadside' sites in its area - LS NOx - Lace Street, Dunkirk, CG NOx - Carter Gate, City Centre and SA NOx - St Andrew's Road, Mansfield Road and are the local site operators (LSOs) for Defra's Automatic Urban and Rural Network (AURN) 'urban centre' site on Clinton Street East in the city centre. The locations of the continuous monitoring sites are shown in Figure 2.1.

Figure 2.1 Map Showing 2010 Automatic Monitoring Sites



2.1.1 Annual Mean NO_2 Objective

Annual Mean Nitrogen Dioxide Concentration Measured at Automatic Monitoring Sites

The 2009, 2010 annual mean NO_2 concentrations measured at the automatic sites are shown in Table 2.1 - the 2011 provisional 9 month averages are also given.

Table 2.1 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA 2010?	Data Capture for full calendar year 2010 %	Annual mean concentrations (µg/m^3)		
				2009	2010	*++2011 (9 months averages)*
AURN	Clinton Street East	N	98.6	34.5	40.0	*35.3*
CG NOx	Carter Gate	Y	98.5	40.4	**43.3**	***41.9***
LS NOx	Lace Street	Y	99.7	39.8	**40.9**	*36.3*
*SA NOx	St Andrews Road	Y	41.9	-	**46.8**	*40.4*

1 January 2009 – 31 December 2010 ratified data

* Station established June 2010 – data capture for 5 months monitoring period = 94.9%. Data annualised as per LAQM guidance TG (09) Box 3.2

++ provisional data

2.1.2 I hour mean NO_2 Objective

No exceedences of the 1-hour AQO were recorded in 2009 or 2010 at any of Nottingham City's automatic monitoring sites – see Table 2.2.

Table 2.2 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

Site Id	Location	Within AQMA 2010?	Data Capture for full calendar year 2010 %	Number of Exceedences of hourly mean AQO (i.e. 200 µg/m^3 - 18 exceedences allowed) (99.8th percentile of hourly means)		
				2009	**2010**	***++2011***
AURN	Clinton Street East	N	98.7	0	2	*0 (138 µg/m^3)*
CG NOx	Carter Gate	Y	98.5	0	0	*0 (153.1 µg/m^3)*
LS NOx	Lace Street	Y	99.7	0	2	*0 (144.5 µg/m^3)*
SA NOx*	St Andrews Road	Y	41.9	-	0	*0 (162 µg/m^3)*

1 January 2009 – 31 December 2010 ratified data

* Station established June 2010 – data capture for 5 months monitoring period = 94.9%. Data annualised as per LAQM guidance TG (09) Box 3.2

++ provisional data

2.2 Non-Automatic Diffusion Tube Monitoring

Nitrogen Dioxide (NO_2) Diffusion Tubes

Diffusion tubes measure monthly NO_2 concentrations from which an annual mean is calculated to allow comparison with the Air Quality Objectives.

Nottingham City has diffusion tubes sited at a number of locations; the locations are shown on the map - Figure 2.2. During 2010 diffusion tubes were placed within and near Nottingham No.2 AQMA 2010 and Nottingham No.3 AQMA 2010 and in other areas where there may be 'hot spots' due to road and/or traffic changes. The majority of the tubes were placed on building façades of residential properties (termed 'sensitive receptors') at sites classified as 'roadside'.

Figure 2.2 Map Showing Diffusion Tube Monitoring Sites in 2010

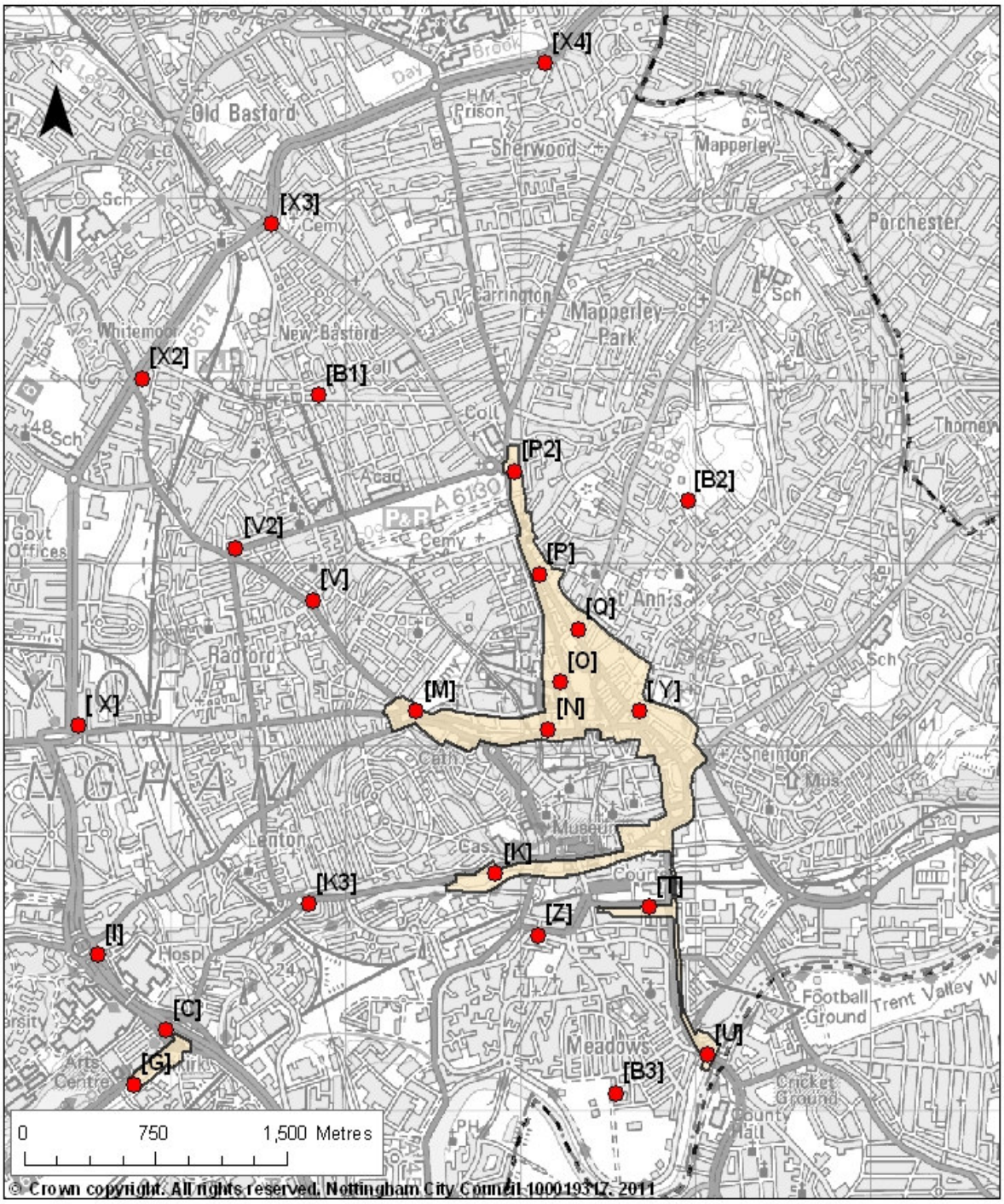


Table 2.3 Results of Diffusion Tube Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

Exceedences of the AQO are highlighted in bold type. The 2 rows that are shaded identify sites i.e. X3 and K3 which are not within the AQMAs and where exceedence of the annual mean AQO was measured.

Site ID	Location	Within AQMA 2010?	Data Capture 2010 %	2010 Annual mean concentrations NO_2 ($\mu g/m^3$) Bias Adjusted
C	Clifton Boulevard	N	83.3	36
G	Beeston Road	Y	100	**42**
I	Derby Road	N	100	34
X	Western Boulevard	N	100	34
X2	Wilkinson Street	N	100	35
X3	Nottingham Road	N	100	**42**
X4	Danethorpe Vale	N	83.3	33
V2	Gregory Boulevard	N	100	33
K	Castle Blvd.	Y	100	**43**
K3	The Grove Castle Blvd.	N	83.3	**48**
V	Bentinck Road	N	100	37
M	Canning Terrace	Y	100	**55**
N	Upper Parliament St.	Y	100	**52**
O	Shakespeare St.	Y	100	**50**
P	Mansfield Road	Y	100	**51**
P2	Mansfield Road (2)	Y	100	39
Q	Woodborough Road	Y	100	**49**
Y	Beck Street	Y	91.7	**50**
T	Queen's Road	Y	100	**53**
Z	Kinglake Place	N	100	34
U	Trent Bridge	Y	100	33
B1	Elson Street	N	91.7	28
B2	Hungerhill Road	N	83.3	24
B3	River View	N	75	29

1 January 2010 – 31 December 2010

Single tubes were located at the above sites. The bias adjustment factor applied = 0.95.

The annual mean NO_2 AQO was exceeded at 11 diffusion tube sites. While all the sites with Site Id 'X' prefixes are located on residential properties adjacent to the outer ring road only X3 – Nottingham Road measured an exceedence of the AQO. This is located at a junction where a busy local traffic route and the outer ring road cross.

The other site K3, where exceedence outside an AQMA was measured, is close to a heavily trafficked roundabout on a residential/commercial building that is currently unoccupied.

2.2.1 I hour-mean NO_2 Objective

In 2010 no diffusion tube annual mean NO_2 concentrations greater than 60µg/m^3 were measured. The advice in TG(09) is that it is reasonable to conclude that the I hour AQO has not been exceeded.

The bias adjustment calculation and monthly raw values for the 2010 DT data and detailed information about Nottingham City Council's automatic and diffusion tube monitoring; site maintenance, data scaling, bias adjustment of diffusion tubes and quality assurance/quality control are given in the 2011 Progress Report (PR2011).

3 New Guidance, New Developments, Statutory Consultees' Comments and Discussion

3.1 New Guidance/Policy

New guidance from Defra and from organisations giving advice and information to assist Local Authorities in their air quality work is regularly published as increased understanding about the various air quality issues come to light.

However when undertaking their LAQM work Local Authorities are required to have regard to current policy and technical guidance i.e. Local Air Quality Management Policy Guidance PG(09) and Local Air Quality Management Technical Guidance TG(09) respectively issued by the Secretary of State and published by Defra.

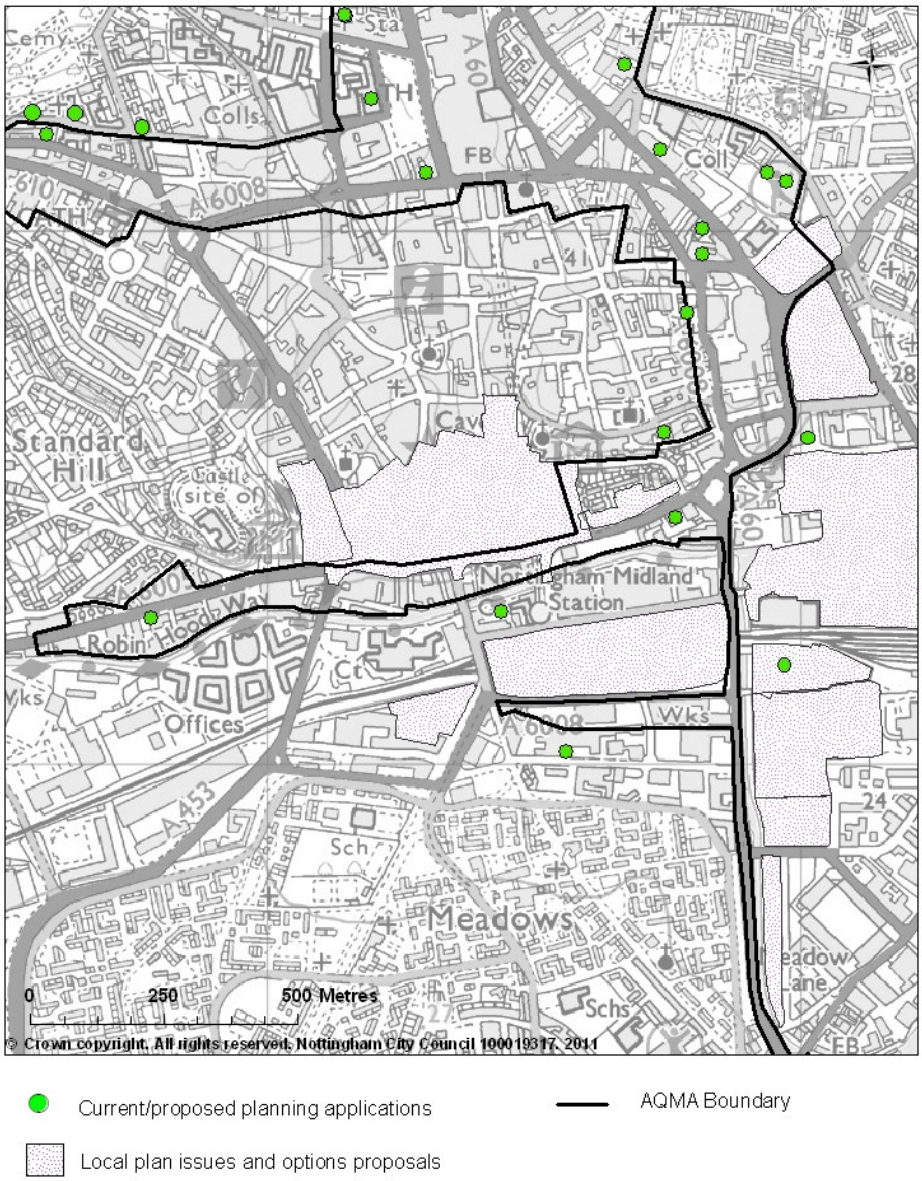
There have not been any recent air quality policy developments or changes in the key guidance other than errata corrections and minor updates.

3.2 New Developments

Since the DA 2008/9 various planning applications for residential and commercial development have been proposed and approved. Some of these have been constructed or are under construction whilst others are dormant. Nottingham City Council is developing a new Local Plan called the 'Land and Planning Policies (LAPP) Development Plan Document'. The 'LAPP Issues & Options Full Document for Consultation' includes a schedule of sites being considered by proposed use and maps of suggested development sites for consultation. Some of the sites are for residential or mixed use (possibly including residential) and are within and adjacent to the City Centre AQMA. These along with some planning proposal sites are shown on the map- Figure 3.1

It is possible that current under construction and/or proposed future developments may introduce residential properties (i.e. relevant exposure) in close proximity to areas where measured levels of NO_2 exceed the AQO. In the future this may lead to having to reconsider the boundaries of the amended AQMAs.

Figure 3.1 Map showing Planning Applications and Local Plan Issues and Options Proposed Sites



Information on some of the Council's key transport schemes and projects currently being delivered across the City is available on the Council's website.

The Turning Point East traffic scheme has brought the east side of the city closer into the centre by making Huntingdon Street and Lower Parliament Street into a logical two way route for traffic heading north and south through the city. Bellar Gate, which serves the National Ice Centre from Hockley and the rest of the city, has formed part of a new direct route for traffic wanting to access the centre. The scheme was completed this year - currently it is difficult to determine whether there will be significant changes in traffic flows and whether the scheme will positively or negatively affect air quality. This will be looked at as part of the Updating and Screening Assessment (USA) 2012.

3.3 Statutory Consultees' Comments

The majority of the statutory consultees' comments that were received in respect of the DA 2008 did not have implications regarding the work that had been carried out for the report.

The following is from Defra's feedback:

"You have presented the 39µg/m^3 contour, to account for uncertainties in the modelling. However the proposed AQMA boundaries do not include the entire area within the 39µg/m^3 contour. It is difficult to see from the figures presented, but it is assumed that many of the locations which lie within this contour, and which are not within the proposed amended AQMA boundary, are not representative of relevant exposure.

You have also chosen to exclude some areas where the modelling predicts exceedence but there is no monitoring data, based on concentrations measured in similar locations. AQMA boundary should include, as a minimum, the area of technical exceedences of the annual mean objective. Where monitoring does not exist, and where modelling has been carried out and correctly adjusted this should include the area of predicted exceedence.

To provide further evidence that the proposed AQMA is correct, the Council should carry out additional monitoring in those areas of modelled exceedence with relevant exposure, and ensure that the AQMA boundary is sufficiently precautionary to avoid having to amend the AQMA boundaries in the future. These can be dealt with in the Further Assessment which will be required 12 months after the amended AQMA boundaries are declared."

Nottingham City Council's Response

With regard to paragraphs 1 and 2 -

With reference to the DA Annex 1 - in the Modelling Analysis section of the report there is comment about monitoring sites where modelled exceedences were not substantiated by the monitored data -'The tubes at these five sites A, C, J, V and I are all located on the facades of residential properties or sensitive receptors. The sites are typical of much of the Nottingham City inner area encompassed by the ring road in that; the main traffic routes are characterised by relatively wide roads with residential properties either side, quite often set back from the roadside.'

The conclusions of the Detailed Assessment 2008 – Annex 1 included the following:

"However there are parts of the City, mostly near and within existing AQMAs, where both modelling and monitoring results demonstrate that the objective has been exceeded at locations with relevant exposure of members of the public. This is consistent with the 2006 modelling exercise undertaken for the DA 2008.

At other locations, the modelling suggested exceedence occurred however some of these were monitoring sites and their results showed that the annual mean AQO was not exceeded.

Nottingham City Council needs to expand its diffusion tube monitoring programme to cover those areas where modelling suggests exceedence but the degree of uncertainty is such that it is not appropriate to include them in Air Quality Management Areas at the moment. Additional monitoring information will assist in informing future rounds of Review and Assessment."

Therefore the rationale for not including the whole area was explained by the uncertainty associated with the modelling data, the conflict between modelled and monitored results at typical roadside monitoring sites and the identified need for monitoring at more sites to help inform the situation.

The LAQM guidance TG(09) paragraph 3.04 states that ' As the "to be achieved by" dates for the objectives (in particular 2004[25] for PM10, and 2005 for NO_2) have now largely passed, there is inevitably an increasing reliance on monitoring data, as opposed to modelling predictions, to determine actual exceedences. Provided that the data are "fit for purpose", then precedence should always be given to measured concentrations over those that have been predicted using a model.'

With regard to paragraph 3 -

Further monitoring has been carried out in areas of modelled exceedence – in 2010 additional diffusion tubes were sited on the inner and outer ring roads, see Figure 2.2 - map of diffusion tube monitoring sites.

As noted in Section 2 of this report, in 2010 2 diffusion tubes measured exceedence of the NO_2 annual mean AQO - the rest of the additional sites did not. This finding supports the Council's decision not to include the whole of the modelled exceedence area in the amended AQMAs. Whilst modelling allows assessment of possible exceedence over a much greater area the methodology followed means the results are inherently more uncertain than monitored data.

Defra's comment about ensuring that the AQMA boundary is sufficiently precautionary to avoid having to amend boundaries in the future is addressed in the next subsection 3.4 - Discussion.

3.4 Discussion

One of the main aims of the Further Assessment is to confirm the decision that it was necessary to amend the AQMAs. This has been done by evaluating additional monitoring data along with the consideration of new or proposed developments and consultees' comments.

Since the DA2008 additional diffusion tube monitoring has been carried out and a new automatic monitoring site established. The 2009 monitoring data show that most of the sites within the amended AQMAs exceeded the NO_2 AQO and all the sites outside the AQMAs did not.

This is also true of the majority of the 2010 results except for the 2 DT sites outside the AQMAs where NO_2 levels greater than 40µg/m^3 were measured; these are located on residential properties at junctions on the outer and inner ring roads. In 2011 additional diffusion tubes were placed around these junctions. The results will be reported in the USA 2012 and will be used to inform the Detailed Assessment that needs to be undertaken (as reported in PR 2011).

Although there have been no proposed major housing developments in or adjacent to the AQMAs there have been smaller ones adjacent to City Centre AQMA No.2 boundary - in the vicinity of DT M site. These will introduce residents (relevant exposure) where there were none previously. The Turning Point East traffic scheme has altered the road layout

and introduced 2-way traffic consequently there could be a positive or negative effect on air quality.

Currently there are no new monitoring data, proposed developments or traffic schemes that may adversely affect the vicinity of the Dunkirk AQMA No.3.

As a dynamic city Nottingham has ongoing regeneration, sustainable development and transport projects. There is always the possibility that new planning developments could bring relevant exposure of people where none existed previously; the same can be said of future traffic schemes that alter roads or traffic flows. Also for any future year, monitoring sites outside the AQMAs could measure exceedence of the AQOs due to a particular year's meteorology or other circumstances and future modelling may identify areas of concern.

Given the potential for these changes to occur it will be difficult to meet Defra's requirement i.e. "ensure that the AQMA boundary is sufficiently precautionary to avoid having to amend the AQMA boundaries in the future".

The information presented in Sections 2 and 3 and discussed here show that the decision to amend the AQMAs was correct however it also suggests that the geographical extent of the City Centre AQMA may need further consideration.

4 Source Apportionment, Required Reduction in Pollutant Emissions, By When Will the Air Quality Objective be Achieved?

4.1 Source Apportionment

In their Further Assessments Local Authorities are expected to 'refine their knowledge of sources of pollution'; according to the TG(09) guidance the intention is that the main sources that lead to air quality exceedences within the AQMA should be identified so that they can be targeted in the Air Quality Action Plan.

Initially this source apportionment should be into regional background, local background and local sources. It is recognised that local sources are those that Local Authorities are more likely to be able to control within the Action Plan so therefore where appropriate they should be separated further - for example vehicle type (and age if significant) split between cars, vans, buses, lorries, taxis etc.

The guidance advises that source apportionment may be undertaken with dispersion modelling or by using a simple spreadsheet approach – for example where road traffic emissions are the principal concern, the percentage contribution to total nitrogen oxides (NOx) emissions may be calculated using the appropriate emissions factors.

Since road traffic is the predominant cause of the exceedences of the AQO the spreadsheet approach has been used. An example of the calculation of source apportionment for nitrogen dioxide is given in TG(09) Box 7.1 This methodology has been used to determine traffic source apportionment for nitrogen dioxide for local sources at a number of locations where the highest 2010 monitoring results, at relevant receptors, were measured. The CG NOx and LS NOx automatic roadside monitoring site results were included, even though they did not have the highest NO_2 levels, because they measure NOx as well as NO_2 and the data is more accurate than DTs (see Appendix B for details of the methodology and calculations).

Table 4.1 shows the final traffic source apportionment for the 'worst case' i.e. highest levels of NO_2 at 4 diffusion tube sites and the 2 automatic roadside sites. The site locations are shown on the map Figure 2.2 in Section 2 and it can be seen that they are a reasonable spatial representation of the AQMAs. It should be noted that DT K3 is not within an AQMA.

The values in the table show NO_2 concentrations in $\mu g/m^3$ with the percentage contribution to total NO_2 in brackets.

Table 4.1 Traffic Source Apportionment for the 'worst case' measured nitrogen dioxide levels

Final Source Apportionment		Background NO_2		Local Sources -Traffic			
Site	Worst case NO_2 µg/m^3	Regional Back-ground NO_2 µg/m^3 (%)	Local Back-ground NO_2 µg/m^3 (%)	Cars NO_2 µg/m^3 (%)	Buses NO_2 µg/m^3 (%)	LGV NO_2 µg/m^3 (%)	HGV NO_2 µg/m^3 (%)
CGNOx	43.3	4.3 (9.9)	29 (67)	3.4 (7.8)	2.3 (5.3)	1.5 (.3.3)	2.9 (6.7)
LSNOx	40.9	4.8 (11.7)	18.1 (46)	6.3 (15.4)	3.2 (7.7)	2.5 (6.2)	5.3 (12.9)
DT K3	48.0	4.7 (9.9)	20.7 (43.1)	9.8 (20.5)	2.6 (5.5)	3.4 (7.1)	6.8 (14.1)
DT M	55.0	4.7 (8.6)	20.0 (36.4)	5.8 (10.6)	18.5 (33.6)	2.5 (4.5)	3.5 (6.4)
DT P	51.0	4.6 (9)	22.3 (43.8)	2.3 (4.4)	19.7 (38.6)	1.0 (1.9)	1.2 (2.3)
DT T	53.0	4.2 (8)	29.1 (54.8)	6.2 (11.7)	1.5 (2.8)	2.5 (4.8)	9.5 (18)

LGV = light goods vehicles < 3.5 tonnes HGV = heavy goods vehicles > 3.5 tonnes

The results show that at most of the sites cars and taxis are a significant local source of NO_2. This is to be expected due to the volume of these vehicles compared with LGVs, Buses and HGVs however it is clear from the NO_2 percentages that buses make the predominant contribution at sites DT M and DT P. Whilst at site DT T - HGVs are the biggest source of traffic related NO_2. Although, with regard to traffic flow, numbers of buses and HGVs are less they have high emission levels relative to the other vehicle categories.

It is apparent from the source apportionment findings that the contribution of the different vehicle categories to local nitrogen dioxide levels varies at individual sites and this needs to be taken account of in any action planning.

4.2 Reduction in Pollutant Emissions Required to Achieve AQO

Guidance is given in TG(09) 7.21 - 7.24 in respect of assessing the reduction in pollutant level that is required so that AQOs will be met. This advises that in the case of roadside NO_2 the required reduction should be stated as µg/m^3 reduction in NO_2 but that the required percentage reductions of local emissions should be expressed in terms of NOx due to the local traffic.

This is because primary vehicle emissions are as nitrogen oxides (NOx) and there is a non-linear relationship between NOx and NO_2 concentrations. Box 7.2 in TG(09) gives an example of the calculation for the reduction in road NOx required to achieve the NO_2 AQO concentration of 40µg/m^3 - see Appendix B for information regarding the methodology and calculations. The NO_2 required reduction is a subtraction i.e. monitored value minus 40µg/m^3.

Table 4.2 Road NO_2 and NOx Required Reduction

Site	2010 worst case NO_2 µg/m^3	road NO_2 reduction µg/m^3	road NOx reduction %
CG NOx	43.3	3.3	51.0
LS NOx	40.9	0.9	29.0
DT M	55	15	55.5
DT P	51	11	50.4
DT T	53	13	69.4
DT K3	48	8	39.5

The results suggest that 29% to 69% reductions in road NOx and up to 15µg/m^3 reductions in roadside NO_2 are required to achieve nitrogen dioxide levels of 40µg/m^3 in the Nottingham City area.

While monitoring data has been used to quantify the NO_2 reduction needed to meet the AQO the source apportionment data can be used to look at how to achieve the required reduction.

For example at site DT T Queens Road - the required NO_2 reduction is 13µg/m^3 and the local source apportionment, according to vehicle type, is cars and taxis = 12%, LGV= 5%, HGV = 18% and buses = 3%.

In this situation it would be most effective to target emissions associated with HGVs and to a lesser extent cars since buses and LGVs make significantly lower contributions to traffic related nitrogen dioxide levels.

Uncertainty

It should be noted that diffusion tubes do not measure NOx therefore the road NOx required reduction calculation is dependent on a derived relationship between NOx and NO_2 and also on estimated background map data. Both or either of these factors may not be representative of the study sites.

This can be illustrated by comparing 2 of the diffusion tubes results:

DT M - measured NO_2 = 55 ug/m3 requires a 15µg/m^3 reduction in NO_2 and 55.5 % reduction in NOx

DT T - measured NO_2 = 53 ug/m3 requires a 13µg/m^3 reduction in NO_2 and 69.4 % reduction in NOx.

4.3 By When Will the Air Quality Objective be Achieved?

TG(09) guidance provides a methodology by which measured annual mean nitrogen dioxide can be adjusted to estimate future years' values using published factors for roadside NO_2 concentrations. The approach taken is set out in Box 2.1 of TG(09) and this along with the corrected year-adjustment factors were used.

Note: the corrected factors were issued in March 2010.They can be found in the frequently asked questions (FAQs) part of the Review and Assessment helpdesk website:

http://laqm.defra.gov.uk/faqs/faqs.html

The following is an example of the calculation which is based on the adjustment factor ratio between the future year and the measured year.

Example

CG NOx site 2010 measured annual mean NO_2 concentration = 43.3µg/m^3

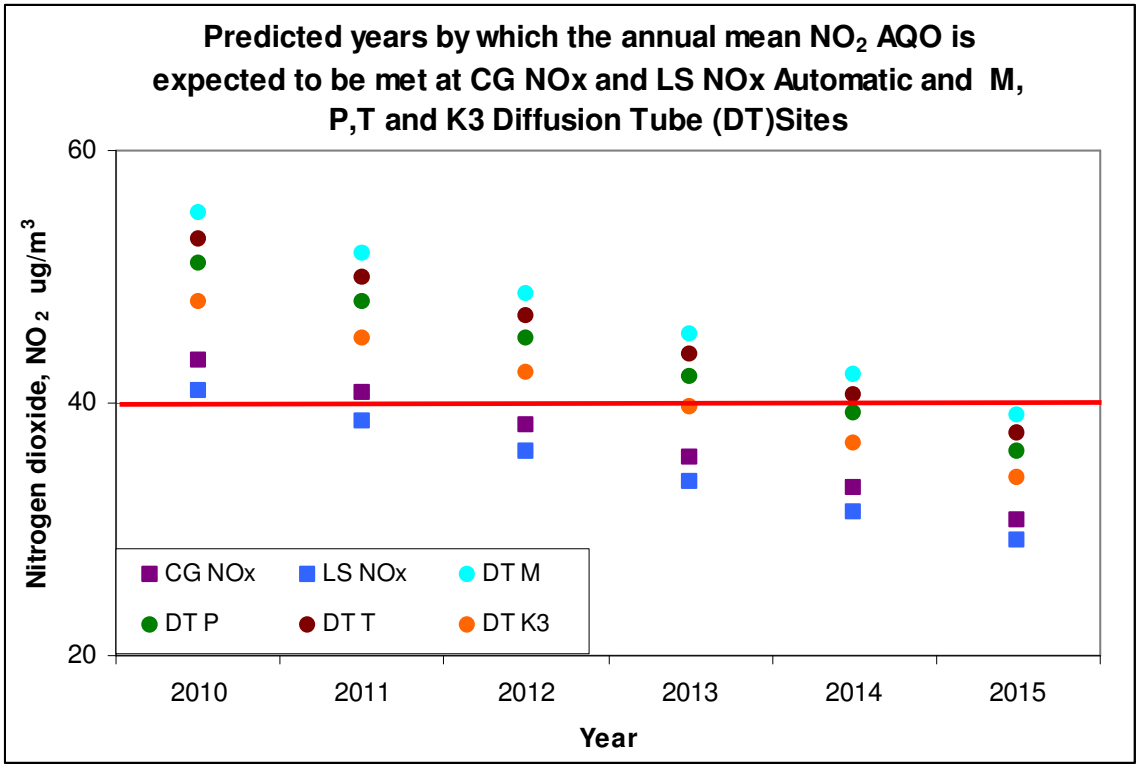
adjustment factor 2010 = 0.832

adjustment factor 2012 = 0.735 predicted 2012 NO_2 = 43.3 x (0.735/0.832) = 38.3µg/m^3

adjustment factor 2014 = 0.639 predicted 2014 NO_2 = 43.3 x (0.639/0.832) = 33.3µg/m^3

Yearly predicted NO_2 concentrations for 2011 to 2015 based on the measured 2010 annual mean levels were determined using the above calculation for each of the selected automatic and diffusion tube sites; these are shown in Figure 4.1 The calculation was not carried out for the AURN because it is not roadside site.

Figure 4.1 Predicted years by which the NO_2 AQO will be met



The information in Figure 4.1 suggests that by 2012 the AQO will be met at the CG NOx and LS NOx automatic monitoring stations and by 2015 should be met at all sites.

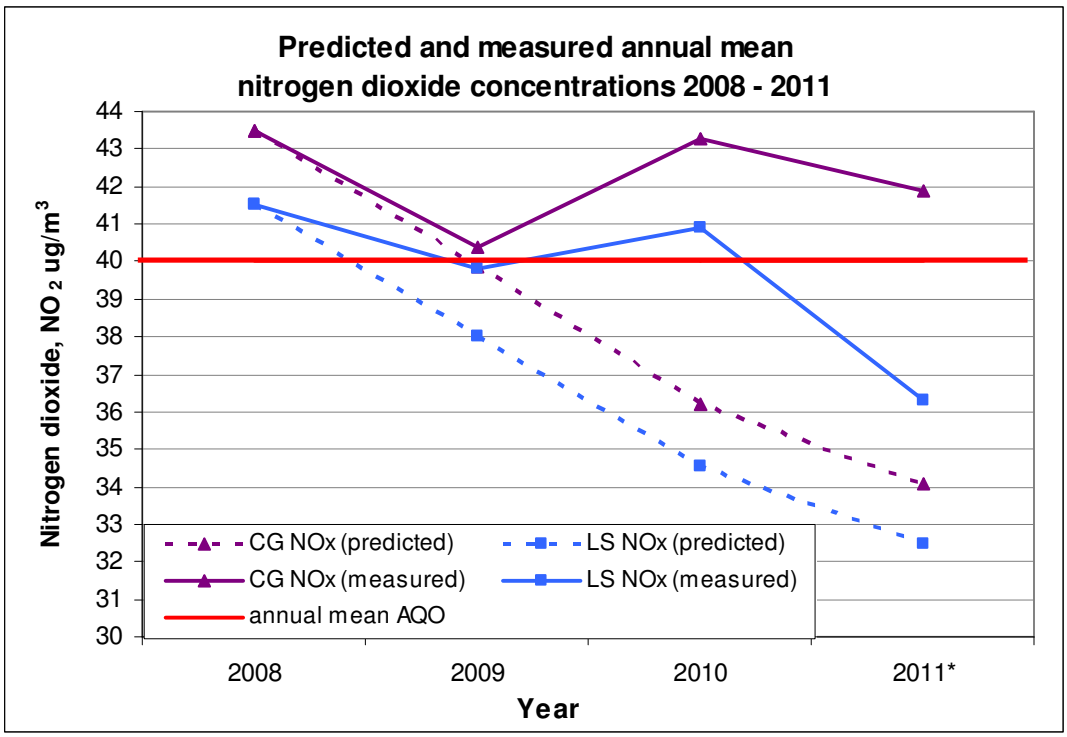
The calculations do not take action plan measures into account so theoretically the AQO should be met earlier than shown. However because the methodology is based on a number of assumptions that may not be borne out in practice the level of uncertainty is relatively high.

Uncertainty

i) The Adjustment factors assume year on year proportional reduction in nitrogen dioxide levels but looking at NO_2 trend data for the Nottingham City area shown in Appendix C it is clear that for several years levels have not been reducing and there have been increases particularly in 2010. The 2010 increased NO_2 concentrations are possibly due to the adverse weather that occurred in the winter months since it is known that meteorology has a strong influence on measured pollutant concentrations. Nottingham City's 2010 results are consistent with national data referred to as Figure 5.6 and shown in Appendix C.

ii) The year by which the AQO is predicted to be met is dependent on which base year is used for the measured data. When applying the appropriate adjustment factors using 2008 measured values for the CG NOx and LS NOx automatic sites the prediction suggests that both would be below 40 µg/m^3 by 2009, as shown in Figure 4.2. In the figure the solid lines relate to measured data and indicate that the AQO has not been met at CG NOx site. The LS NOx site is likely to meet it in 2011.

Figure 4.2 Comparison between predicted and measured NO_2 2008 - 2011



*provisional figure - 9 month mean

iii) It is recognised nationally that measured NO_2/NOx concentrations are not reducing as expected by the predictions. Whilst the reasons are not fully understood it is thought in part

to be due to the difference between actual on-road performance of certain vehicle categories compared with the calculated emissions based on Euro vehicle standards.

See Appendix D for Defra's LAQM Review and Assessment help desk response to a question on this matter - it is under investigation and updated guidance to Local Authorities from the Review and Assessment Helpdesk is expected soon.

The source apportionment and required NO_2 reduction information can be used to inform the local action plan measures. These together with the introduction of cleaner vehicles through increasingly stringent European standards and alternatively fuelled vehicles will all contribute to reducing levels of nitrogen dioxide however it is difficult to predict how quickly the AQO will be met in the whole of Nottingham City's area.

5 Air Quality Action Plan and the Local Transport Plan

TG(09) guidance suggests that preparation of the Air Quality Action Plan (AQAP) and the Further Assessment should be taken forward in tandem following declaration of an AQMA.

However the Council's AQAPs have been and will continue to be integrated into the Local Transport Plan (LTP). The LTP process has specific dates to adhere to and in April 2011 Nottingham City Council introduced the third Local Transport Plan (LTP3) - a statutory document that aims to address transport challenges facing the City of Nottingham from 2011 - 2026.

The amended AQMA boundaries and the recognition that management of air quality covers a much wider area than the AQMAs were taken into account throughout the development of and consultation for the LTP3.

Local Transport Plan 3: 2011- 2026

Nottingham Local Transport Plan

Nottingham City has five overarching strategic objectives for transport:

- Deliver a world class sustainable transport system which supports a thriving economy and enables growth
- Create a low carbon transport system and a resilient transport network
- Improve access to key services, employment and training including creation of local employment and training opportunities
- Improve the quality of citizens' lives and transform neighbourhoods
- Support citizens to live safe, independent and active healthy lifestyles

The LTP has been developed to comprise of two component documents:

- **LTP Strategy 2011 - 2026** which sets out the Council's long term transport ambitions and strategy of proposals and details our approach to achieving the objectives

- and

- **LTP Implementation Plan 2011 - 2014** which details the funding allocations and proposed transport measures to be funded over the next three years from April 2011 to March 2014. It seeks to deliver proposals and measures that will help to achieve the five overarching strategic objectives.

The Action Plans for improving air quality part of the LTP3 Strategy document can be downloaded from:

http://www.mynottingham.gov.uk/index.aspx?articleid=12631

The stage reached for each AQAP measure is reviewed and updated annually. The information is included in LAQM Progress Reports (or Updating and Screening Assessments (USA)). The latest update undertaken in June 2010 is presented in the Progress Report 2011.

6 Conclusion

This report has considered 2009 and 2010 monitoring data, current/proposed planning applications and some of the possible new developments associated with the local plan and; has shown that road traffic is the predominant local source that contributes to exceedences of the annual mean nitrogen dioxide Air Quality Objective. Generally whilst the volume of traffic has an impact at all sites the proportions of particular vehicle types (traffic source apportionment) between cars, buses, light goods (LGV) and heavy goods (HGV) vehicles are also of significance. For example, at site DT T on Queens Road the calculations show that HGVs are responsible for 48.3% of the traffic nitrogen oxides (NOx) emissions and; suggest that up to 15µg/m^3 reductions in the levels of nitrogen dioxide alongside roads are necessary if the annual mean nitrogen dioxide AQO is to be met in all parts of the City area.

Estimates of when the AQO will be met, based on the methodology given in TG(09) guidance, indicate that NO_2 levels at some sites should fall below 40µg/m^3 (AQO level) by 2011 and at all sites by 2015. However as noted there are a number of factors such as unknown future meteorology, levels of NO_2/NOx not reducing in line with national predictions and the impact of action plan measures that mean any predicted AQO achievement date should be treated with caution.

The information presented confirms that it was necessary to alter the AQMAs' boundaries and shows that while there are no new monitoring data, proposed developments or traffic schemes that may adversely affect the vicinity of the Dunkirk AQMA No.3, this is not true of the City Centre AQMA No.2.

The 2010 diffusion tube monitoring measured nitrogen dioxide levels of 42 and 48µg/m^3 at 2 residential sites that are not within AQMAs and; there are under construction/future residential planning proposals and possible Local Plan mixed use developments at various sites in the proximity of the current City Centre AQMA that have been identified. These factors suggest that the geographical extent of the AQMA may need to be reconsidered.

Our 2011 Progress Report, which was accepted by Defra, concluded that it was necessary for Nottingham City Council to undertake a Detailed Assessment (DA) in respect of the measured NO_2 exceedences outside an AQMA where there is relevant exposure of members of the public.

Consequently It is now proposed to broaden the scope of the DA to determine whether the extent of the City Centre AQMA is sufficiently precautionary to avoid amending it in the future and; to investigate whether, as a consequence of the monitoring and new development findings outlined in this report, an AQMA that encompasses a much larger area of the inner City should be considered.

7 References

Air Quality (England) Regulations 2000 (SI 928)

City of Nottingham
Air Quality Review & Assessment First & Second Stage April 2000

City of Nottingham
Air Quality Review & Assessment Second & Third Stage Report 2001

City of Nottingham
Local Air Quality Management: Stage Four Review & Assessment of Nottingham's Air Quality Management Areas July 2003

City of Nottingham
Local Air Quality Management: Updating and Screening Assessment October 2003

City of Nottingham
Local Air Quality Management: Detailed Assessment August 2004

City of Nottingham
Local Air Quality Management: Progress Report April 2005

Department for Environment, Food and Rural Affairs (September 2011)
Air Pollution in the UK 2010

Department for the Environment, Food and Rural Affairs (February 2009)
Local Air Quality Management Policy Guidance LAQM.PG (09))

Department for the Environment, Food and Rural Affairs (February 2009)
Local Air Quality Management Technical Guidance LAQM.TG (09))

HMSO (1995)
Environment Act 1995

Nottingham City Council
Local Air Quality Management: Updating and Screening Assessment June 2006

Nottingham City Council
Local Air Quality Management: Detailed Assessment Consultation Document May 2008

Nottingham City Council
Local Air Quality Management: Progress Report July 2008

2009 Air Quality Updating and Screening Assessment for Nottingham City Council April 2009

Nottingham City Council
Local Air Quality Management Detailed Assessment 2008 Annex 1 – Supplementary Information for Nitrogen Dioxide 2008 October 2009

Nottingham City Council
Local Air Quality Management: Detailed Assessment 2009 January 2010

Nottingham City Council
2010 Air Quality Progress Report for Nottingham City Council October 2010

Nottingham City Council
2011 Air Quality Progress Report for Nottingham City Council July 2011

Nottingham City Council (September 2011)
Local Development Framework - Land and Planning Policies (LAPP) Development Plan Document – Issues and Options

Nottingham City Council (March 2011)
Nottingham Local Transport Plan Strategy 2011- 2026

The Air Quality (England) (Amendment) Regulations 2002 (SI 3043)

All Nottingham City Council documents referred to can be found on

www.nottinghamcity.gov.uk/

All Defra documents referred to can be found on

http://www.defra.gov.uk/environment/ or **http://laqm.defra.gov.uk/faqs/faqs.html**

APPENDIX A - Previous Review and Assessment Reports

Table A-1 Previous Review and Assessment Reports

All reports are available on Nottingham City Council's internet site: http://www.nottinghamcity.gov.uk			
Title	**Date**	**Outcome**	**AQMA Declared/ Revoked?** (Date of AQMA Orders)
City of Nottingham Air Quality Review & Assessment First & Second Stage	April 2000	Third stage assessment for sulphur dioxide, nitrogen dioxide and particulates, PM_{10} necessary. No further assessment of 1,3 Butadiene, benzene, carbon monoxide and lead required.	-
City of Nottingham Air Quality Review & Assessment Second & Third Stage Report	Sept 2001	Areas of the city where unlikely to meet air quality objectives for nitrogen dioxide or sulphur dioxide. Proposed 1 AQMA for SO_2 and 2 AQMAs for NO_2	**Declared** AQMA No:1 (Sulphur dioxide) (2002) AQMA No:2 (Nitrogen dioxide) (2002) AQMA No:3 (Nitrogen dioxide) (2002)
City of Nottingham Local Air Quality Management Stage Four Review & Assessment of Nottingham's Air Quality Management Areas	July 2003	Determined that AQOs for sulphur dioxide – hospital chimney and nitrogen dioxide – traffic sources, unlikely to be exceeded by 'due dates' therefore no Air Quality Action Plans needed	-
City of Nottingham Local Air Quality Management Updating and Screening Assessment	October 2003	Necessary to proceed to a Detailed Review and Assessment for nitrogen dioxide with respect to a number of roads and for sulphur dioxide in the vicinity of the Nottingham Main-line Station.	-
		Sulphur dioxide 15-minute mean AQO likely to be met at locations of 'relevant exposure' at Nottingham Mainline Station. Nitrogen	

All reports are available on Nottingham City Council's internet site: http://www.nottinghamcity.gov.uk			
Title	**Date**	**Outcome**	**AQMA Declared/ Revoked?** (Date of AQMA Orders)
City of Nottingham Local Air Quality Management Detailed Assessment	August 2004	dioxide annual mean AQO likely to be met. Concluded insufficient monitoring data available to allow revocation of any of the AQMAs.	-
City of Nottingham Local Air Quality Management Progress Report	April 2005	Concluded that SO_2 monitoring data sufficient to propose revocation of AQMA No:1 (Sulphur dioxide). Necessary to maintain AQMAs No 2 & 3 (nitrogen dioxide)	-
Nottingham City Council Local Air Quality Management Updating and Screening Assessment:	June 2006	Necessary to proceed to a Detailed Assessment for PM_{10} for 2 roads in the city centre and for nitrogen dioxide for a number of roads and junctions based on guidance criteria and some diffusion tube data. AQMA No:1 (Sulphur dioxide) to be revoked - agreed by Defra	**Revoked** AQMA No:1 2002 (Sulphur dioxide) (5 April 2007)
Nottingham City Council Local Air Quality Management Detailed Assessment Consultation Document	May 2008	Conclusion that no further action required for PM_{10} - accepted by Defra **Proposed amendments to existing AQMAs No.2 & No.3 for nitrogen dioxide.** **Further work for nitrogen dioxide being undertaken following comment and assessment by Defra** (see DA 2008 – Annex 1 below)	-
Nottingham City Council Local Air Quality Management Progress Report	July 2008	Concluded that there was no need to undertake a further detailed assessment - accepted by Defra	-
2009 Air Quality Updating and Screening Assessment for Nottingham City Council	April 2009	Concluded that there was no need to undertake an additional detailed assessment because all areas of potential	

All reports are available on Nottingham City Council's internet site: http://www.nottinghamcity.gov.uk			
Title	**Date**	**Outcome**	**AQMA Declared/ Revoked?** (Date of AQMA Orders)
		exceedence are being considered in the revised DA May 2008 - accepted by Defra	
Nottingham City Council Local Air Quality Management Detailed Assessment 2008 Annex 1 - Supplementary Information for Nitrogen Dioxide	October 2009	Confirmed the DA May 2008 findings - **need for amended AQMAs for annual mean NO_2.** Accepted by Defra on 31 December 2009. Consultation and declaration of amended AQMAs to be completed by 30 April 2010	-
Nottingham City Council Local Air Quality Management Detailed Assessment 2009	January 2010	For clarification this is a consolidated report of DA May 2008 PM_{10} findings and DA 2008 Annex 1 NO_2 findings. Outcomes are as for the individual reports given above	**Declared** AQMA No:2 2010 (nitrogen dioxide) AQMA No:3 2010 (nitrogen dioxide) By AQMA Variation Orders dated 22 June 2010
2010 Air Quality Progress Report for Nottingham City Council	October 2010	Concluded that there was no need to undertake a detailed assessment for any of the regulated pollutants - accepted by Defra	-
2011 Air Quality Progress Report for Nottingham City Council	July 2011	Concluded that it **was necessary to undertake a Detailed Assessment** for annual mean nitrogen dioxide at two diffusion tube sites outside the existing AQMAs - accepted by Defra	-

AQMA=Air Quality Management Area AQO=Air Quality Objective DA= Detailed Assessment NO_2 = nitrogen dioxide SO_2 = sulphur dioxide PM_{10} = particles

APPENDIX B – Source Apportionment, Required NO_2 Reduction and Predicted AQO Achievement Calculations

The methodology given in TG(09) Box 7.1 was used to calculate source apportionment

Source Apportionment

Box 7.1: Example of source apportionment for nitrogen dioxide

The following is provided as an example of a source apportionment for NO_2 in a hot-spot near to a busy road. The highest annual mean NO_2 concentration **[T-NO_2]** at a relevant receptor, obtained from use of a verified model or from monitoring is **46 µg/m³**.

Step 1: From the national maps of background annual mean concentrations obtain the total background NO_2 for the grid square within which the hot-spot is located **[TB-NO_2] = 28 µg/m³** also the total background NO_X **[TB-NO_X] = 45 µg/m³** and regional background NO_X **[RB-NO_X] = 25 µg/m³.** From the total and regional background NO_X derive a local background NO_X:

[LB-NO_X] = [TB-NO_X] – [RB-NO_X] **= 20 µg/m³**

Step 2: Apportion the total background NO_2 into regional and local using the regional and local NO_X proportions:

[RB-NO_2] = [TB-NO_2] x ([RB-NO_X] / [TB-NO_X]) **= 15.6 µg/m³**

[LB-NO_2] = [TB-NO_2] x ([LB-NO_X] / [TB-NO_X]) **= 12.4 µg/m³**

Step 3: Calculate the local NO_2 contribution at the worst-case location **[L-NO_2]** from the total measured minus background:

[L-NO_2] = [T-NO_2] – [TB-NO_2] **= 18 µg/m³**

Step 4: Apportion the local contributions to total NO_2 concentration using the model concentrations or emission results for NO_X (see text for methodologies for this). In this example, it is shown that 44% of the NO_X at the worst-case relevant is from vans and lorries, 22% from buses and 34% from cars.

NO_2 vans and lorries = 44% x [L-NO_2] **= 7.9 µg/m³**

NO_2 buses = 22% x [L-NO_2] **= 4.0 µg/m³**

NO_2 cars = 34% x [L-NO_2] **= 6.1 µg/m³**

The final source apportionment of the worst-case NO_2 46 µg/m³ is thus

Regional background	**15.6 µg/m³ (34%)**
Local background	**12.4 µg/m³ (27%)**
Local traffic – vans and lorries	**7.9 µg/m³ (17%)**
buses	**4.0 µg/m³ (9%)**
cars	**6.1 µg/m³ (13%)**

Step 4 requires the calculation of the % NOx emissions according to vehicle type. This was carried out using LAQM Tools Emissions Factor Toolkit spreadsheet that is available on Defra's LAQM website. The % NOx emissions according to vehicle type for the selected sites are shown in Table B-1.

Annual average daily traffic (AADT) flows, percentage vehicle split data and average speeds for the relevant road links used in the EFT calculation spreadsheet were supplied by Nottingham City Council's Highways Metric Traffic Services Team.

Table B-1 NOx emissions according to vehicle type

Source Name	NOx % Cars	NOx % LGV	NOx % HGV	NOx % Buses
DT K3 Abbey Bridge	43.5	15.0	30.0	11.6
DT M Canning Circus	19.2	8.2	11.6	61.0
DT P Mansfield Road	9.4	4.1	4.8	81.7
DT T Queens Road	31.4	12.8	48.3	7.6
CGNOx Carter Gate	33.6	14.5	29.1	22.8
LSNOx Lace Street	36.4	14.7	30.6	18.3

Calculated Reduction in Road Nitrogen Oxides (NOx) Emissions

The methodology given in TG(09) was used to estimate the level of NOx reduction required to achieve a level of 40µg/m^3 at the selected monitoring sites.

From the Frequently Asked Questions LAQM Helpdesk, October 2010

Correction for TG(09) Box 7.2

Box 7.2: Example of calculated reduction in road nitrogen oxides emissions.

The following is provided as an example of how to calculate the reduction in road NO_x emissions required to meet the 40 µg/m^3 annual mean objective for NO_2. The measured or modelled NO_2 at the worst-case relevant exposure location is 45 µg/m^3 .

It is based on the required reduction in the road NO_x concentration at the worst-case relevant exposure location.

Step 1: Use the NO_x from NO_2 calculator (see Paras 2.22 – 2.27) to obtain the NO_x concentration that equates to 45 µg/m^3 of NO_2, which in this example is 99.0 µg/m^3.

Step 2: Obtain the background concentrations of NO_x and NO_2 for the year of interest. For this example these are 39.8 and 28.8 µg/m^3 respectively, from the background maps (see Paras 2.02 – 2.09).

Step 3: Calculate the current "road NO_x" concentration (road NO_x -current), this is the difference between total NO_x (calculated or measured) and the local background NO_x. In this example road NO_x -current will be 59.2 µg/m^3 (99.0 minus 39.8 µg/m^3)

Step 4: Calculate the road NOx concentration required to give a total NO_2 concentration of 40 µg/m^3 i.e. the annual mean objective (road NO_x -required). This can be done using the NO_2 from NO_x calculator (see Paras 2.22 – 2.27) by entering a total NO_2 concentration of 40 µg/m^3 along with the local background NO_2 concentrations. The calculator gives the road NO_x -required concentration which in this example is 44.3 µg/m^3.

Step 5: Calculate the road NO_x reduction to go from the road NO_x -current to the road NO_x -required. In this example the road NOX reduction is 14.9 µg/m^3 (59.2 minus 44.3 µg/m^3), which represents a 25.2% reduction in road NO_x (14.9/59.2 as a percentage).

Table B-2 Calculated Required Reduction in Road NOx Emissions

2010 data		STEP 1	STEP 2		STEP 3	STEP 4	STEP 5	
Site	worst case NO_2 $\mu g/m^3$	NOx equiv $\mu g/m^3$	+Local bkgd NOx	+Local bkgd NO_2	*road NOx - current' from NO_2 to NOx spreadsheet	road NOx req'd to give NO_2=40 $\mu g/m^3$	road NOx reduction $\mu g/m^3$	road NOx reduction NOx %
CG NOx	43.3	91.5	59.7	33.3	31.8	15.6	**16.2**	**51.0**
LS NOx	40.9	91.4	37.5	23.6	53.9	38.3	**15.6**	**29.0**
DT M	55		39.9	24.7	80.1	35.7	**44.4**	**55.5**
DT P	51		44.6	26.9	61.5	30.5	**31.0**	**50.4**
DT T	53		59.7	33.3	50.9	15.6	**35.3**	**69.4**
DT K3	48		41.3	25.4	56.27	34.0	**22.2**	**39.5**

+ local NO_2 or NOx refers to entire mapped background (bkgd) concentrations

* calculated using the LAQM NOx from NO_2 spreadsheet tool therefore Step 1not needed for DT calculations.

APPENDIX C - Trends in Measured Nitrogen Dioxide Levels

Local NO_2 Trends

The AURN and CG NOx sites have been established for a number of years, Figures C-1and C-2 respectively show the trends in annual mean NO_2 concentrations at these sites.

Figure C-1

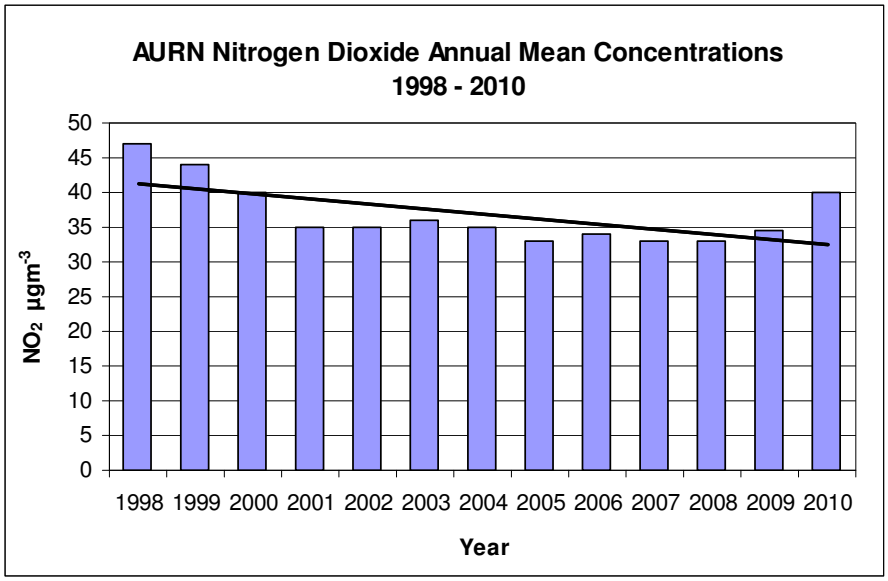


Figure C-1 shows that at the AURN the overall trend has been decreasing annual mean NO_2 concentrations for the 12 years that it has been operational. However the most noticeable decrease was between 1998 and 2000.

Between 2001 and 2009 nitrogen dioxide levels have been relatively steady with minor year on year variations with concentrations no greater than 36µg/m^3. The 2010 value represents a significant increase in the annual mean concentration. It is unlikely to be due to local changes such as increased traffic or congestion but possibly can be attributed to the extreme meteorological conditions that occurred in the last few months of 2010.

Figure C-2

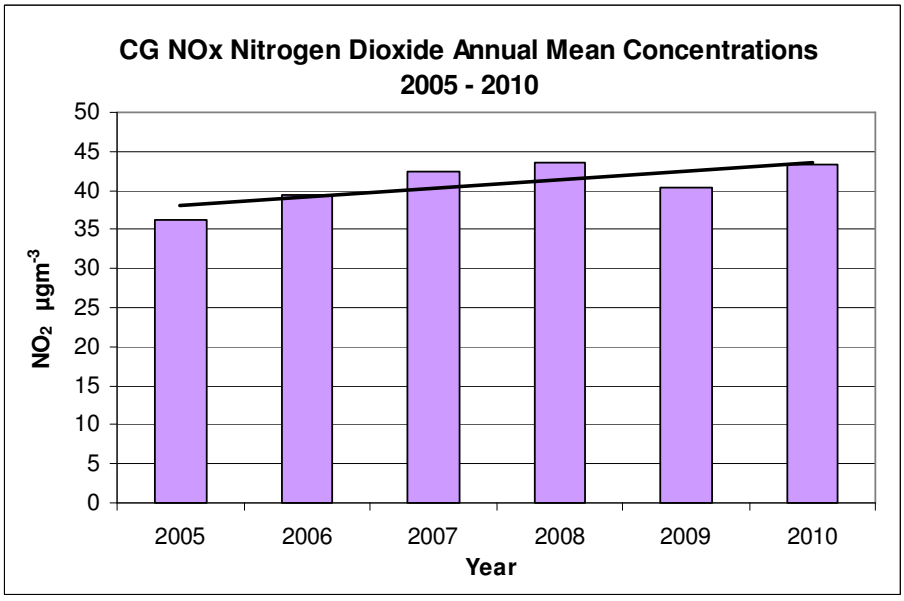
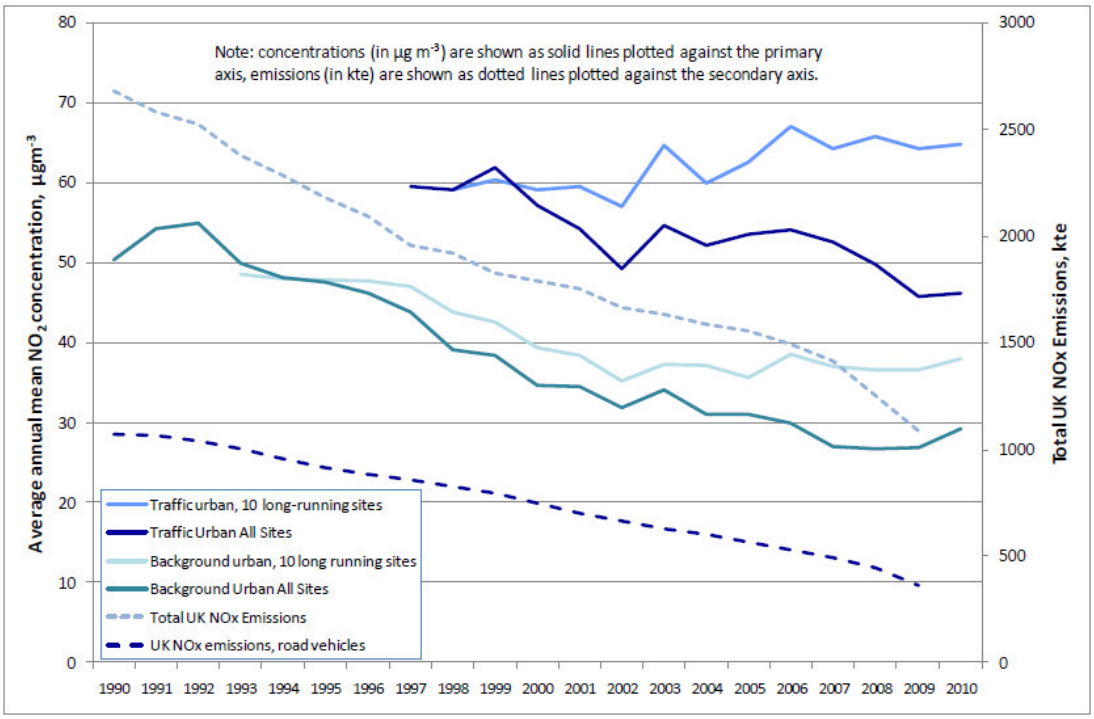


Figure C-2 - the overall trend shows increasing annual mean nitrogen dioxide concentrations that slightly exceed the annual mean NO_2 AQO at the CG NOx roadside site. This is probably indicative of increasing road traffic levels and contrasts with the trend at the AURN which is an urban centre site. Also unlike the AURN the 2010 annual mean was similar to some of the previous years.

National NO_2 Trends

The following graph - Figure 5.6 - is taken from Defra's Air Pollution in the UK 2010 report. It shows how ambient concentrations of nitrogen dioxide (averaged over all sites in the Automated Urban and Rural Network) have decreased since1990.

Figure 5.6 Average annual mean NO_2 concentration: background urban and traffic urban AURN sites



APPENDIX D - LAQM Helpdesk Response to Query about NO_2/NOx Forecasts

Local Air Quality Management Helpdesk, September 2010

'Measured nitrogen oxides (NOx) and/or nitrogen dioxide (NO_2) concentrations in my local authority area do not appear to be declining in line with national forecasts. Should I take this into account in my Review and Assessment work?

Defra and the devolved administrations have published "year –adjustment" factors for roadside NO_2 concentrations, and background (1x1 km) maps for NOx and NO_2 concentrations for all years up until 2020. Technical Guidance (LAQM.TG(09)) advises local authorities to use this information to adjust measured concentrations to future years (e.g. annual mean NO_2 concentrations measured in 2009 can be projected forwards to 2013). Background maps for future years are also used to support modelling studies for Reviews and Assessments.

These projections are based on the Pollution Climate Modelling studies carried out on behalf of Defra and the devolved administrations, and take full account of current understanding of the expected changes in sector-based emissions up until 2020. They also take account of the expected changes to primary NO_2 emissions.

However, recent analyses of historical monitoring data have identified a disparity between the measured concentrations and the projected decline in concentrations associated with the emissions forecasts. Trends in ambient concentrations of NOx and NO_2 in the UK have generally shown two characteristics; a decrease in concentration from about 1996 to 2002-2004, followed by a period of more stable concentrations from 2002-2004 up until 2009.

As a whole, urban roadside sites show evidence that NOx concentrations have declined very weakly over the past 6 – 8 years. NOx concentrations at urban background sites broadly reflect the same trend, and have been close to stable over this same period. For NO_2, levels have largely remained stable at urban roadside and background sites, but show a slight upward trend in inner London. At monitoring sites close to motorways and dual-carriageways, there is evidence that NOx concentrations have fallen at some, but not all locations, while NO_2 concentrations have levelled off.

In all cases there are differences between individual sites (with some showing upward or downward trends) but overall, there is little evidence of a consistent downward trend in either NOx or NO_2 concentrations, that would be suggested by emission inventory estimates.

The precise reason for this disparity is not fully understood, and is currently under investigation, but it is thought to be related to the actual on-road performance of diesel road vehicles when compared with calculations based on the Euro standards. Preliminary studies suggest that:

- NOx emissions from **petrol** vehicles appear to be in line with current projections and have decreased by 96% since the introduction of the 3 way catalysts in 1993;
- NOx emissions from **diesel cars**, under urban driving conditions, do not appear to have declined substantially, up to and including Euro 5. There is limited evidence that the same pattern may occur for motorway driving conditions.
- NOx emissions from **HGV** vehicles equipped with SCR reduction are much higher than expected when driving at low speeds.

On this basis, it might also be expected that the forecast reductions in background NOx and NO_2 concentrations associated with the road traffic component are optimistic. There is no evidence to suggest that background concentrations associated with the other (non-traffic) source contributions should not behave as forecast.

This disparity in the historical data highlights the uncertainty of future year projections of both NOx and NO_2, but at this stage there is no robust evidence upon which to base any revised road traffic emissions projections.

Defra and the devolved administrations are currently investigating these issues, and once the reasons are fully understood updated guidance will be issued. However, the preliminary findings would suggest that the Euro standards will deliver only marginal, if any, reductions in NOx and NO_2 concentrations until the Euro 6 emission standards begin, as is currently forecast, to play a major role (i.e. *circa* post-2015).

Where existing forecasting information is used for decision making or review and assessment and action planning work, local authorities may wish to take account of the emerging findings on the performance of different vehicle types, the performance of Euro standards overall, and the expected effect on forecast background concentrations.'