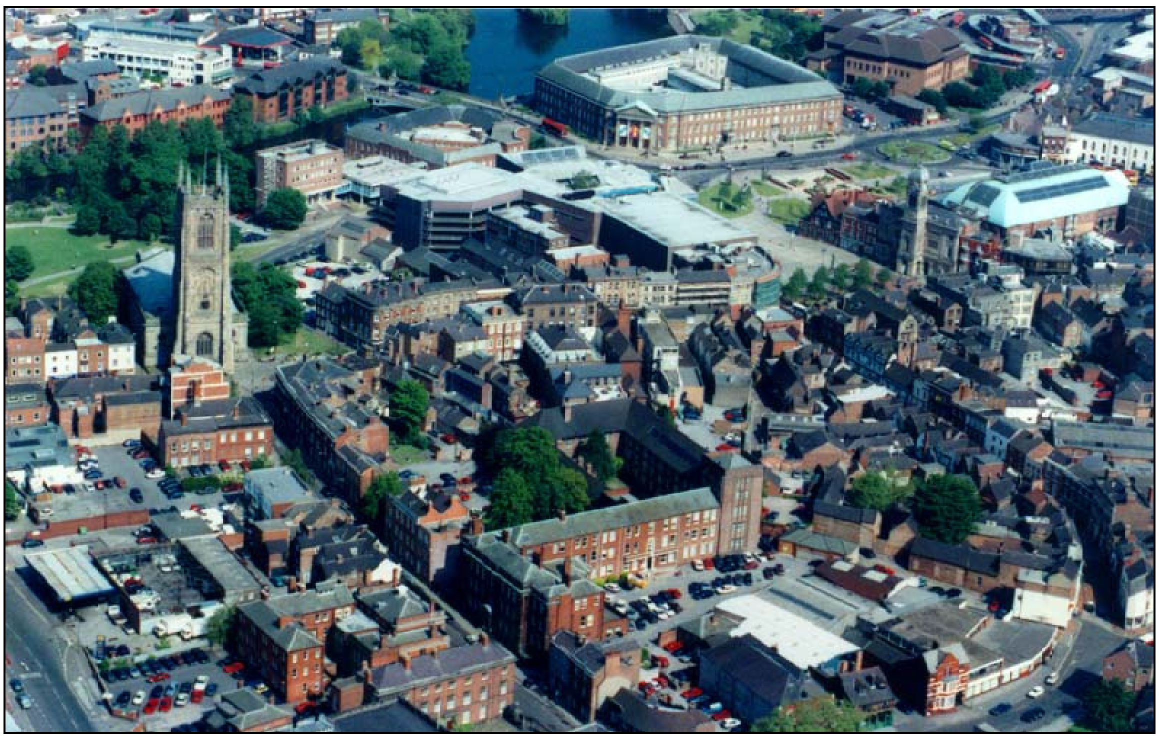
DERBY CITY COUNCIL



(Photograph courtesy of Derby Daily Telegraph Ltd)

DETAILED ASSESSMENT FOR

NITROGEN DIOXIDE

March 2006

SUMMARY

There are two health-based standards for nitrogen dioxide (NO_2), above which relevant public exposure is considered to pose a risk to human health. There is an annual average of 40µg/m^3 and a 1-hour mean of 200µg/m^3, which must not be exceeded any more than 18 times in a calendar year.

It is the NO_2 annual mean standard which is of concern in many roadside locations across the UK. Within Derby, the first Review and Assessment of local air quality resulted in the designation of 2 NO_2 Air Quality Management Areas (AQMAs) in 2002.

The boundaries of these AQMAs follow the routes of Derby's Inner and Outer Ring-Roads. They were designated on the basis of likely exceedences of 40µg/m^3 at dwellings in the vicinity of these busy roads.

A second Review and Assessment of local air quality has now been undertaken, in accordance with the City Council's duties under Local Air Quality Management.   Following on from an initial Updating and Screening Assessment, the need was identified for this Detailed Assessment for road-traffic based NO_2.

The purpose of this Detailed Assessment is to determine whether any revisions to the 2 existing NO_2 AQMAs are required and whether an additional NO_2 AQMA needs to be designated.

The methodology chosen for this Detailed Assessment relies upon the NO_2 monitoring data obtained from the City Council's NO_2 monitoring network, for the 5 year period between 2001 and 2005. In 2005, this extensive monitoring network contained 3 continuous air quality monitoring stations and 86 NO_2 diffusion tubes at roadside locations across the city.

Dispersion modelling was not used in this Detailed Assessment, due to the extensive monitoring data available, including the objective year of 2005.

The Detailed Assessment starts by providing background information on NO_2 and road-traffic pollution. It also details the Review and Assessment process of local air quality within Derby, so as to place this assessment in context.

The second chapter revises the Updating and Screening Assessment (USA), due to the first USA being based upon 2002 monitoring data. Three years of additional NO_2 monitoring data are now available for 2003, 2004 and 2005.

The Detailed Assessment goes on to describe the City Council's NO_2 monitoring network. This includes photographs, location plans and quality control procedures. The monitoring data from these continuous and indicative analysers, underpins the outcomes of this Detailed Assessment.

The 2001 to 2005 monitoring results are then presented and analysed. This includes a discussion of the local bias correction factors obtained from the 3 triplicate co-location studies, which Derby City Council operates at its Council House, Warwick Avenue and Abbey Street air quality monitoring stations.

On the basis of this analysis, it is proposed to:

1. Revise the 2 existing Inner and Outer Ring-Road NO_2 AQMAs. This will involve joining them together along Osmaston Road, as well extending them in some places and reducing them in others.

2. Designate a new road-traffic related NO_2 AQMA in Spondon, which is physically separate to the revised Inner and Outer Ring-Road AQMA. This second smaller AQMA will include dwellings close to both Brian Clough Way (A52), Nottingham Road and Derby Road.

Overall the geographical extent of the existing AQMAs will be increased. A new AQMA will also be created. This is despite year-on-year improvements in annual average NO_2 concentrations across the UK, due to significant improvements in engine technology. This includes exhaust after treatment technologies, on-board diagnostics and fuel efficiency.

The need to increase the size of the AQMAs, arises from an improved understanding of NO_2 pollution concentrations within Derby. This is due to:

1. Extensive NO_2 monitoring data now being available, for a wide range of locations across the city, for the 5 year period between 2001 and 2005.

2. Since the first Review and Assessment, central government has introduced further guidance to assist local authorities with the assessment of road-traffic related NO_2 and local air quality.

It is therefore likely that these exceedences also existed at the last Review and Assessment, but were unable to be identified at this time.

The proposals for the revised and new AQMAs now more accurately represent those locations where members of the public are likely to be exposed to an exceedence of the NO_2 annual average standard of $40\mu g/m^3$.

Despite predictions of significant increases in traffic growth in Derby of 11.9% between 2005 and 2011, further improvements in engine technology are likely to result in fewer exceedences of the NO_2 standard across the city by 2011.

On this basis, the proposals for the revised and new NO_2 AQMAs represent a reasonable worst-case scenario. It is unlikely that they will need to be uniformly extended in future years, although local variations may be required to account for local circumstance.

Following approval of this report by the Department for the Environment, Food and Rural Affairs (Defra), a 2 month consultation exercise will take place with stakeholders. This will include the householders in the new AQMAs, the general public, Councillors and stakeholders.

Comments will be analysed and within 4 months of Defra approving this report, Orders will be made to create the new NO_2 AQMAs. A Further Assessment will then be undertaken of new monitoring data, to consider the effectiveness of the changes made.

Finally, the existing NO_2 Action Plan will be updated. This will be with the aim of enabling the NO_2 AQMAs to be revoked, through the Local Transport Planning process. This is a significant challenge, which is faced by many urban local authorities across the UK.

The final part of this Detailed Assessment, considers some initiatives for further investigation. These initiatives will help inform the forthcoming revision to the NO_2 Action Plan.

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1.0 INTRODUCTION

Derby is a city of almost 250,000 people. It is situated in the heart of the East Midlands and is surrounded by primarily rural districts. The urban conurbation of Derby is the responsibility of the unitary authority of Derby City Council.

Under the Environment Act 1995, Derby City Council is under a duty to continually review and assess whether the concentrations of 7 pollutants will exceed the National Air Quality Objectives. The pollutants in question are benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide (NO_2), particulate matter (PM_{10}) and sulphur dioxide.

This report is a Detailed Assessment for road-traffic related NO_2. It specifically considers the likelihood of exceedences of the annual mean NO_2 standard at points of relevant exposure close to busy roads and junctions in Derby.

Nitrogen dioxide (NO_2) and nitric oxide (NO) are collectively referred to as nitrogen oxides (NO_x). It is the NO_2 component of this NO_x, which is toxic and therefore a cause of ill health. High concentrations of NO_2 result in shortness of breath and chest pains, whilst significant concentrations of NO_2 can result in serious lung damage (Reference 12).

It is people who are sensitive to pollution, such as asthmatics and those with heart conditions or lung diseases, who tend to experience adverse health effects from NO_2. Healthy people will not normally notice any adverse health effects, except when the NO_2 concentrations are very high (Reference 12).

In addition to causing adverse effects upon human health, NO_2 is a strong oxidising agent. It reacts in air to form corrosive nitric acid, which is a component of 'Acid Rain.' It also plays a major role in producing ground-level ozone and photochemical smog (Reference 12).

National Air Quality Objectives have been set for NO_2 for 31 December 2005. Since the date for these NO_2 objectives has now passed, they are called National Air Quality Standards.

As is shown in Table 1, the National Air Quality Standards for NO_2 are an annual average concentration of $40\mu g/m^3$ and a 1-hour mean concentration of $200\mu g/m^3$, which must not be exceeded more than 18 times per year.

Table 1
Summary of the National Air Quality Objectives for NO_2

Pollutant	Concentration	Measurement	Target Date
Nitrogen dioxide	$40\mu g/m^3$	Annual mean	31 Dec 2005
	$200\mu g/m^3$	18 exceedences of hourly mean	31 Dec 2005

These standards are based upon exposure to NO_2 concentrations, above which there is a risk to human health. This is for those locations where members of the public are regularly present for the averaging period of the objective. The health of people in the work place is addressed through health and safety legislation.

In the case of the annual mean standard, this requires assessment at the building facades of dwellings, nurseries, schools and hospitals. For the 1-hour mean, it is locations such as the pavements of busy shopping streets and cafes with outdoor seating that are relevant.

Atmospheric NO_2 is present as a result of combustion processes. These combustion processes initially produce NO_x emissions, largely in the form of nitric oxide (NO). Once this NO is mixed with air, it quickly combines with oxygen, to form nitrogen dioxide (NO_2). The majority of atmospheric NO_2 is formed in his way, although some primary NO_2 is also released directly during combustion.

The principal source of NO_x emissions within the UK is road transport, accounting for 49% of total UK NO_x emissions in 2000. This contribution from road traffic is even higher in urban areas, accounting for more than 75% of NO_x emissions in London (Reference 2).

As is shown in Graph 1, UK total NO_x emissions have steadily decreased since 1970. The increase in NO_x emissions between 1984 and 1989, is due to increased traffic growth. Since then, the year on year decrease in total NO_x emissions is attributable to the introduction of 3-way catalytic converters and reduced NO_x emissions from power stations.

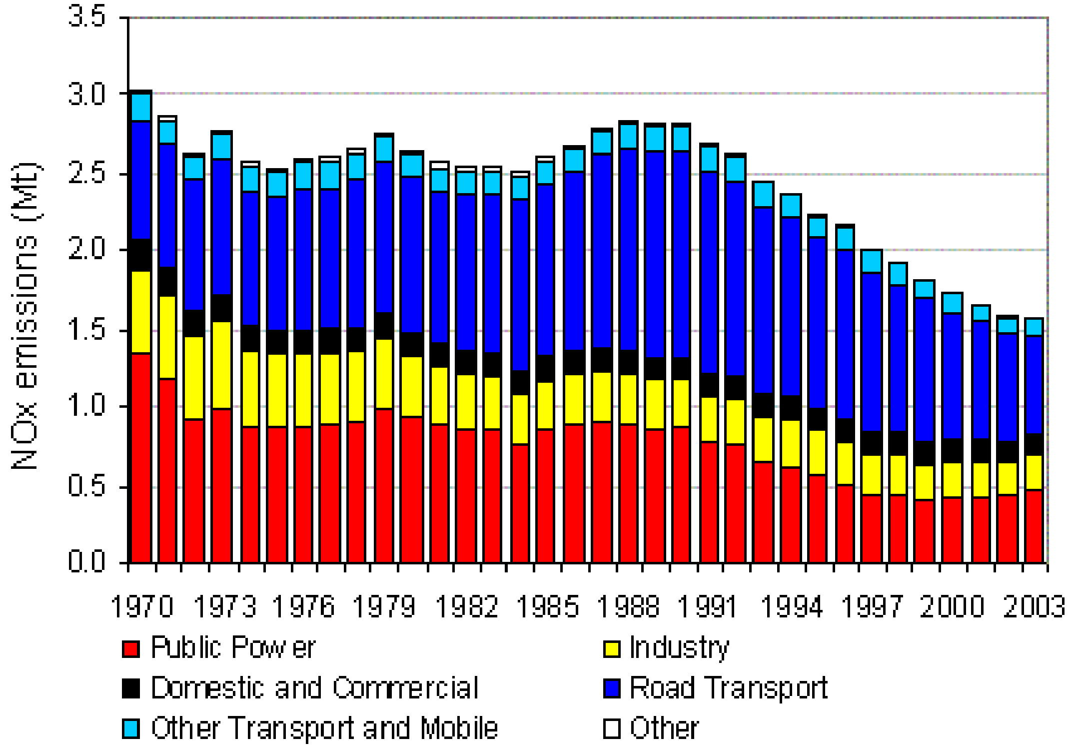
Chapter 7 discusses the projected trend, for this reduction in road-traffic related NO_x and NO_2 emissions to continue until 2011 and beyond.

Even though there is a year on year reduction in NO_x and NO_2 emissions, the annual average NO_2 standard of $40 \mu g/m^3$ is still exceeded at many roadside locations throughout the UK. As a result over 170 Local Authorities in the UK have road-traffic related Air Quality Management Areas (AQMAs). Derby City Council has 2 existing road-traffic related NO_2 AQMAs.

The continual process of Review and Assessment of local air quality requires local authorities to determine the likelihood of an exceedence of National Air Quality Objectives.

Graph 1

UK Total NO_x Emissions 1970-2003



(http://www.naei.org.uk/pollutantdetail.php)

Where an exceedence is considered likely, the local authority is under a duty to designate an AQMA. Following designation, there is also a requirement for the local authority to produce an Action Plan in consultation with stakeholders. This is with the aim of bringing the pollutant concentration back below the Air Quality Objective, so as to enable the AQMA to be revoked.

Derby City Council undertook its first Review and Assessment of local air quality in 2000. This was a four-stage review of the National Air Quality Objectives. It used a combination of real-time monitoring and detailed dispersion modelling, to establish the likelihood of exceedences of the National Air Quality Objectives.

This 2000 Review and Assessment screened out benzene, 1,3-butadiene, carbon monoxide, lead and sulphur dioxide. It determined that none of these pollutants would be likely to cause a breach of the relevant National Air Quality Objectives.

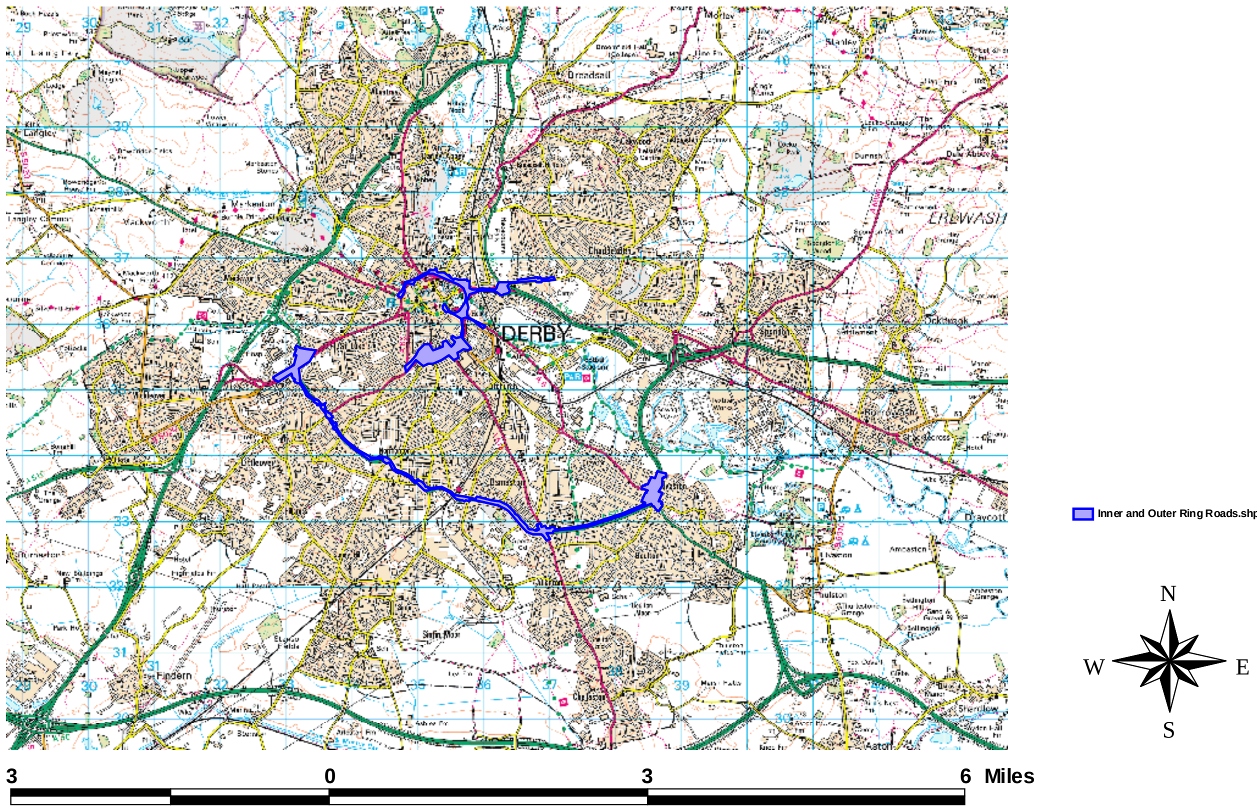
The Stage 3 assessments for both NO_2 and PM_{10} did however identify likely exceedences of the annual mean objectives for both of these pollutants, due to road-traffic based nitrogen dioxide (NO_2) and industrial based particulate matter (PM_{10}).

For NO_2, the primary source of the predicted exceedences of the 2005 annual mean objective of 40$\mu g/m^3$, was road traffic on the inner and outer ring roads. Consequently, an NO_2 Air Quality Management Area was declared in 2001. This AQMA included around 1,500 dwellings close to the inner and outer ring roads.

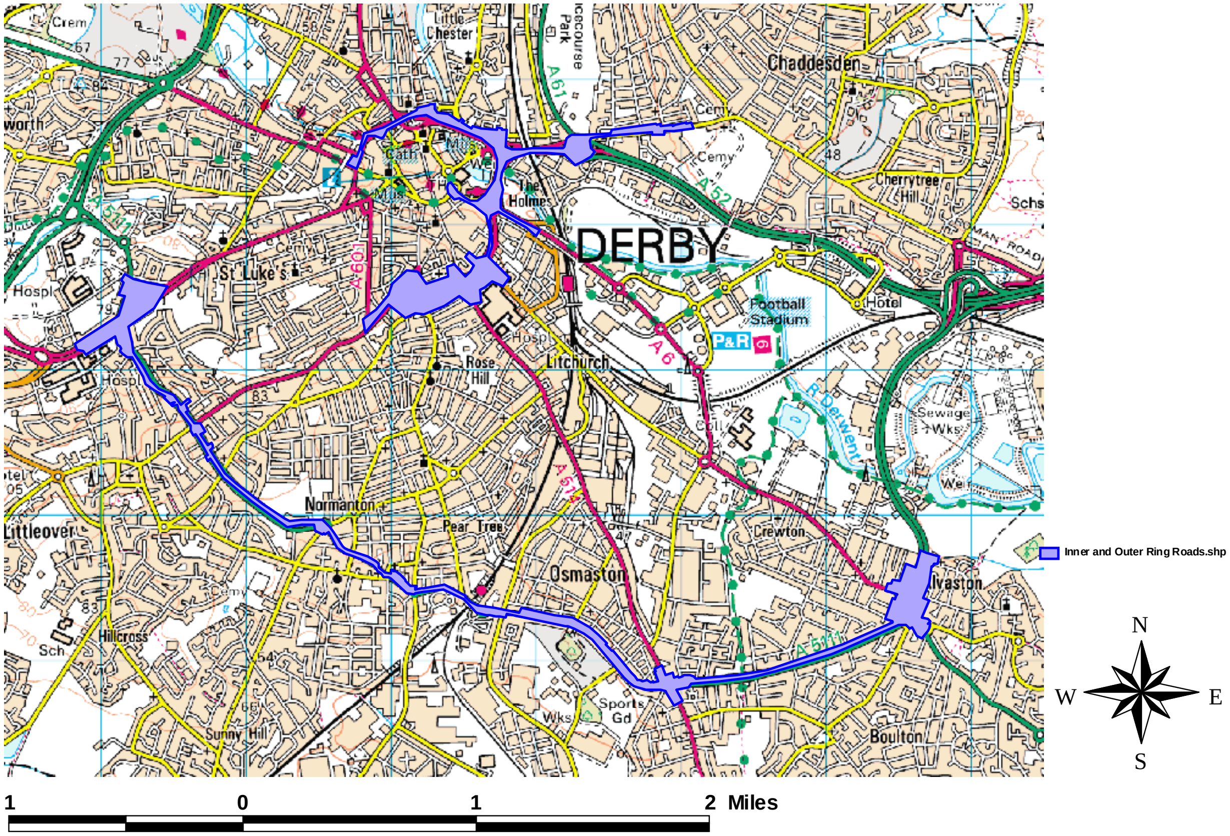
A Stage 4 Report on the NO_2 AQMA considered the boundary of this AQMA, within the context of new developments and the latest results from the network of NO_2 diffusion tubes. On 1 September 2002, this resulted in the NO_2 AQMA being amended to remove the A52 and Raynesway. As a result, 2 separate NO_2 AQMAs for the inner and outer ring roads were created.

The existing Inner and Outer Ring-Road NO_2 AQMAs are shown in Maps 1, 2 and 3.

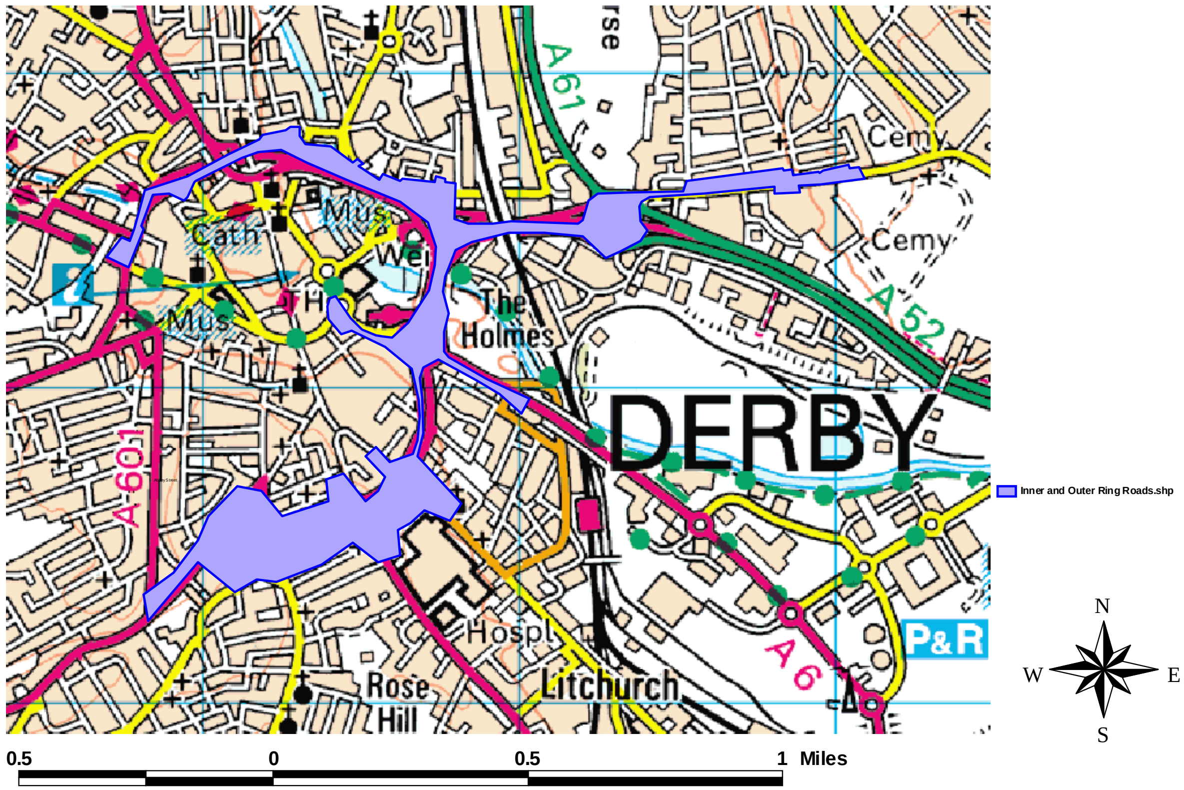
Map 1
Existing Inner & Outer-Ring Road NO_2 AQMAs



Map 2
Existing Inner & Outer Ring-Road NO_2 AQMAs (smaller scale)



Map 3
Existing Inner Ring-Road NO_2 AQMA



The 2 existing NO_2 AQMAs are both road-traffic related and are therefore the subject of a single NO_2 Action Plan.

Following extensive consultation with stakeholders, the NO_2 Action Plan was published in December 2003. As it determined that no single action would be sufficient to provide the entire air quality improvement required, the Action Plan contains a series of measures. Its aim is to redress the issue of predicted exceedences of the 2005 annual mean NO_2 objective.

Derby City Council's Progress Report of April 2005, details the progress made with implementation of the NO_2 Action Plan. In common with many conurbations across the United Kingdom, there were however a large number of dwellings still exceeding the annual average of $40\mu g/m^3$.

In accordance with guidance from central government, the Council's road-traffic based Action Plan has now been integrated with the Local Transport Plan. This 'LTP 2' provides a transport strategy for Derby City and the surrounding rural commuter belt, for the 5 year period of April 2006 to March 2011

In July 2006, continued progress with the NO_2 Action Plan will be reported to Defra. Thereafter, progress with the NO_2 Action Plan will be reported to the Department of Transport, as part of the LTP 2 reporting process.

In 2002, Derby City Council commenced its second Review and Assessment of local air quality. In contrast to the first Review and Assessment, this 2-stage process relies upon an initial Updating and Screening Assessment (USA) to identify those local air quality issues requiring Detailed Assessments. This is to account for any changes in local circumstance since the first Review and Assessment.

Derby City Council's USA was approved by the Department for Environment, Food and Rural Affairs (Defra) in December 2003. It has subsequently been placed on Defra's website as an example of good practice.

The USA concluded that there was a need for Detailed Assessments to be undertaken in relation to both industrial-based benzene, and road-traffic based NO_2 and PM_{10}.

For NO_2, the main issue for the Detailed Assessment concerns busy road junctions currently outside of the 2 existing Air Quality Management Areas (AQMAs). At these junctions, there is the possibility that nearby dwellings may exceed the 2005 NO_2 annual mean standard of $40\mu g/m^3$.

This Detailed Assessment for road-traffic related NO_2 aims to determine if this is the case. If so, it will then need to determine whether the boundaries of the existing AQMAs need to be revised and/or whether any new NO_2 AQMAs are required.

The Detailed Assessment for road-traffic based PM_{10} is the subject of a separate report, which is due to be submitted to Defra by the end of April 2006.

2.0 EVALUATION OF UPDATING & SCREENING ASSESSMENT

The Updating and Screening Assessment (USA), which was completed in March 2004, considered all possible sources of NO_2 and locations of relevant public exposure.

As is shown in Table 2, a Detailed Assessment was found to be necessary for sections A and D of the USA checklist for NO_2. These sections concern analysis of the NO_2 monitoring data and identification of busy road junctions outside of the 2 existing NO_2 AQMAs.

Table 2
Summary of the Updating and Screening Checklist for NO_2

Section	Source, location or data that need to be assessed	Detailed Assessment Required?	Why?
A	Monitoring data outside AQMA	Yes	The Burton Road 2, Derwent Green and St Albans Road NO_2 diffusion tubes recorded 2002 NO_2 concentrations > 40µg/m^3.
B	Monitoring data within an AQMA	No	-
C	Narrow congested streets with residential properties close to kerb	No	-

Section	Source, location or data that need to be assessed	Detailed Assessment Required?	Why?
D	Junctions	Yes	Outside of the existing AQMAs, predicted annual means > 40µg/m^3 & relevant exposure within 10m of kerb, at the following busy junctions: 1) Osmaston Rd/Ascot Drive 2) Boulton Lne/Chellaston Rd /Merrill Way 3) Stafford St/Friary St 4) Derby Rd/Raynesway/ Acorn Way 5) Friar Gate/Ashbourne Rd /Uttoxeter Old Rd 6) Chain Lne/ Burton Rd/ Pastures Hill
E	Busy streets where people may spend 1-hour or more close to traffic	No	-
F	Roads with high flow of buses and/or HGVs	No	-
G	New roads constructed or proposed since first review and assessment	No	-

Section	Source, location or data that need to be assessed	Detailed Assessment Required?	Why?
H	Roads close to the objective during the first review and assessment	No	-
I	Roads with significantly changed traffic flows	No	-
J	Bus Stations	No	-
K	New industrial sources	No	-
L	Industrial sources with substantially increased emissions	No	-
M	Aircraft	No	-

The conclusions drawn by the first Updating and Screening Assessment are now outdated since:

1. They are based on 2002 monitoring data. NO_2 monitoring data is now available for 2003, 2004 and 2005. The 2005 data is for the target year of the objective and therefore avoids the need to apply future year correction factors, which are predictions and therefore contain inherent errors.

2. The 2005 monitoring data includes data from both a continuous roadside and kerbside NO_x analyser, which again increases its accuracy.

3. The USA used a bias correction factor of 0.981 for the 2002 diffusion tube data. It is apparent that the associated calculation was incorrect, based on the methodology provided in LAQM TG(03). Since a factor of 0.9 should have been used instead, it has been used to correct the 2002 monitoring data provided in this Detailed Assessment.

Consequently, the initial stage of this Detailed Assessment for NO_2 will involve a review of these conclusions. This review is undertaken in the following chapter. In addition to a review of Sections A and D, consideration is also given to Monitoring Data in the AQMAs (Section B). This is on the basis of the additional monitoring data that is now available for 2003 to 2005.

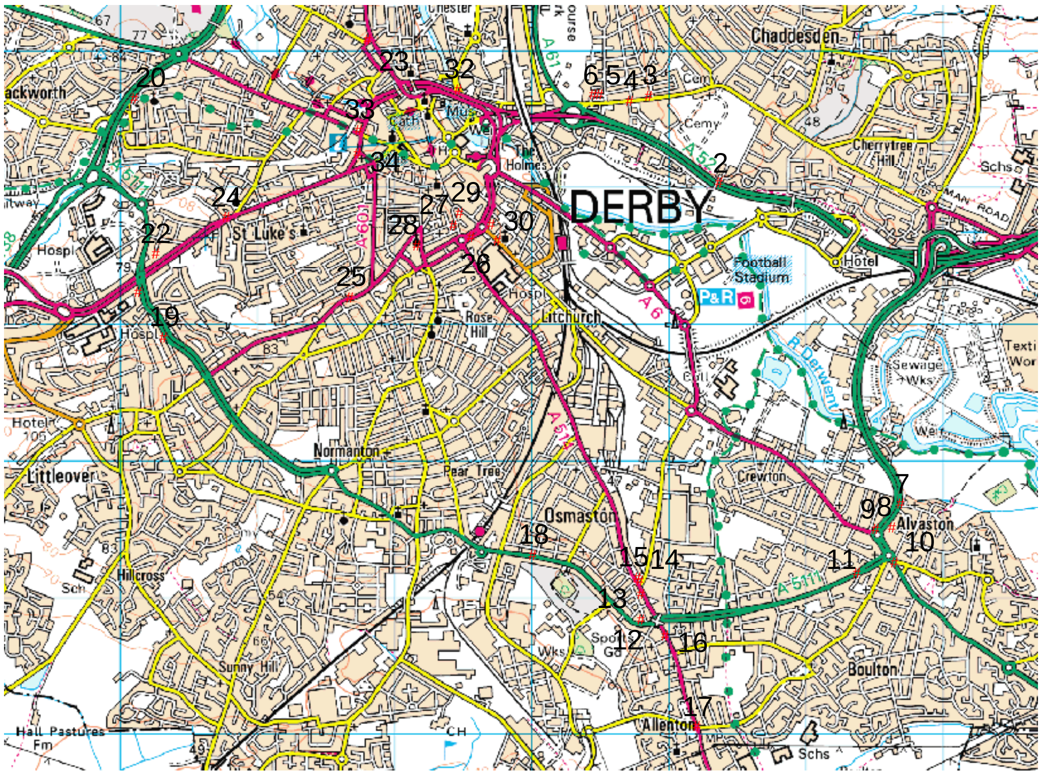
2.1 REVIEW OF UPDATING & SCREENING ASSESSMENT - MONITORING DATA (SECTIONS A & B)

Please note that all NO_2 monitoring data for the 3 continuous NO_x analysers and the network of NO_2 diffusion tubes is provided in Chapter 4.

Map 4 shows the location of these diffusion tubes.

Tables 3 to 12 provide the results from the review of all monitoring data. This data relates to monitoring sites both inside and outside the 2 existing NO_2 AQMAs.

Map 4
NO_2 Monitoring Locations Requiring Detailed Assessment



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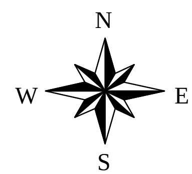


Key

1 Drury Avenue, Spondon (A52)
2 Highfield Lane, alley way
3 Cornwall Road, Chaddesden
4 Nottingham Road – opposite Beaufort Street
5 5 St Marks Road
6 Derwent House
7 Metcalfe Close, Alvaston
8 Beech Gardens, Alvaston
9 Raynesway Dental Practice
10 Elvaston Lane
11 Barrett Street, Alvaston
12 Varley Street
13 758 Osmaston Road
14 Ascot Drive (Spider Island end)
15 Ascot Drive (town end)
16 831 Osmaston Road (south of Spider Island)
17 Merrill Way/Boulton Lane, Allenton
18 Arkwright Street/Osmaston Park Road
19 Eastwood Drive/Manor Road
20 150 Radbourne Street (A38)
21 4 Manor Road/Uttoxeter New Road
22 California Gardens
23 Duffield Road (Five Lamps)
24 Balti International, Uttoxeter New Road
25 Wine Rack, Burton Road
26 Bradshaw Way
27 Opticians, Osmaston Road/Bourne Street
28 Job Centre, Normanton Road
29 Zanzibar, London Road
30 London Road (church railings)
31 Liversage Place
32 31 Nottingham Road (inner ring road)
33 Friar Gate/Uttoxeter Old Road
34 Friary Street - opposite Celtic House

Table 3 - A38 (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Reason for Detailed Assessment
150 Radbourne St	No	Yes	> 40µg/m^3	Possible extension

Table 4 - Brian Clough Way (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Reason for Detailed Assessment
Drury Avenue, Spondon (A52)	No	Yes	> 40µg/m^3	Possible extension
Highfield Lane, alley way	No	Yes	> 40µg/m^3	Possible extension

Table 5 - Five Lamps (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Reason for Detailed Assessment
Duffield Road (Five Lamps)	No	Yes	> 40µg/m^3	Possible extension

Table 6 - Pentagon Island (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of $40\mu g/m^3$?	Reason for Detailed Assessment
Cornwall Road, Chaddesden	Yes	Yes	< $40\mu g/m^3$	Possible revocation
Nottingham Road - opposite Beaufort Street	Yes	No	> $40\mu g/m^3$	Possible revocation
5 St Marks Road	No	Yes	> $40\mu g/m^3$	Possible extension
Derwent House	No	Yes	> $40\mu g/m^3$	Possible Extension

Table 7 - Manor Road/ Uttoxeter New Road (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of $40\mu g/m^3$?	Reason for Detailed Assessment
4 Manor Road/ Uttoxeter New Road	Yes	Yes	< $40\mu g/m^3$ but at side of house	Possible revocation
California Gardens	Yes	Yes	< $40\mu g/m^3$	Possible revocation

Table 8- Spider Island (review of monitoring data)

Diffusion Tube Location	Within Existing NO2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Reason for Detailed Assessment
Merrill Way/Boulton Lane, Allenton	No	Yes	> 40µg/m^3	Possible extension
758 Osmaston Road (north of Spider Island)	No	Yes	> 40µg/m^3	Possible extension
Ascot Drive/ Osmaston Rd (town end)	No	Yes	> 40µg/m^3	Possible extension + busy junction
Ascot Drive/Osmaston Rd (Spider Island end)	No	Yes	> 40µg/m^3	Possible extension + busy junction
831 Osmaston Road (south of Spider Island)	Yes	Yes	< 40µg/m^3	Possible revocation
Varley Street	Yes	Yes	< 40µg/m^3	Possible revocation

Table 9- Uttoxeter New Road (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Reason for Detailed Assessment
Balti International, Uttoxeter New Road/ Lonsdale Place	No	Yes	> 40µg/m^3	Possible extension

Table 10 - Blue Peter Islands & Alvaston (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Reason for Detailed Assessment
Elvaston Lane, Alvaston	Yes	No	> 40µg/m^3	Possible revocation
Barrett Street, Alvaston	Yes	No	< 40µg/m^3	Possible revocation
Metcalfe Close, Alvaston	Yes	No	< 40µg/m^3	Possible revocation
Beech Gardens, Alvaston	Yes	Yes	< 40µg/m^3	Possible revocation
Dental Practice, 1 Raynesway	Yes	Yes	< 40µg/m^3	Possible revocation

Table 11 - Outer Ring Road (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m3?	Reason for Detailed Assessment
Arkwright Street/ Osmaston Park Road	Yes	Yes	< 40µg/m^3	Possible revocation
Eastwood Drive/ Manor Road	Yes	Yes	< 40µg/m^3	Possible revocation

Table 12 - Inner Ring Road (review of monitoring data)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of $40\mu g/m^3$?	Reason for Detailed Assessment
Job Centre, Normanton Road	Yes	No	Much > $40\mu g/m^3$	Possible revocation
Opticians, Osmaston Road/ Bourne Street	Yes	No	> $40\mu g/m^3$	Possible revocation
Bradshaw Way	Yes	No	> $40\mu g/m^3$	Possible revocation
London Road (church railings)	Yes	No	> $40\mu g/m^3$	Possible revocation
Liversage Place	Yes	Yes	< $40\mu g/m^3$	Possible revocation
31 Nottingham Road	Yes	Yes	< $40\mu g/m^3$	Possible revocation
Jacobs/Zanzibar, London Road	No	Yes	> $40\mu g/m^3$	Possible extension
Friar Gate/ Uttoxeter Old Road	No	Yes	> $40\mu g/m^3$	Possible extension + busy junction
Friary Street - opposite Celtic House	No	Yes	> $40\mu g/m^3$	Possible extension
Wine Rack, Burton Road	No	Yes	> $40\mu g/m^3$	Possible extension

2.2 REVIEW OF UPDATING & SCREENING ASSESSMENT - BUSY ROAD JUNCTIONS (SECTION D)

LAQM TG(03) requires identification of those ‘busy’ junctions with a flow greater than 10,000 vehicles per day (vpd) and relevant exposure within 10 metres of the kerb. A screening assessment was therefore undertaken of all the busy junctions throughout the city and outside of the existing AQMAs, using 2003 traffic data from the Derby Area Transport Study (DATS).

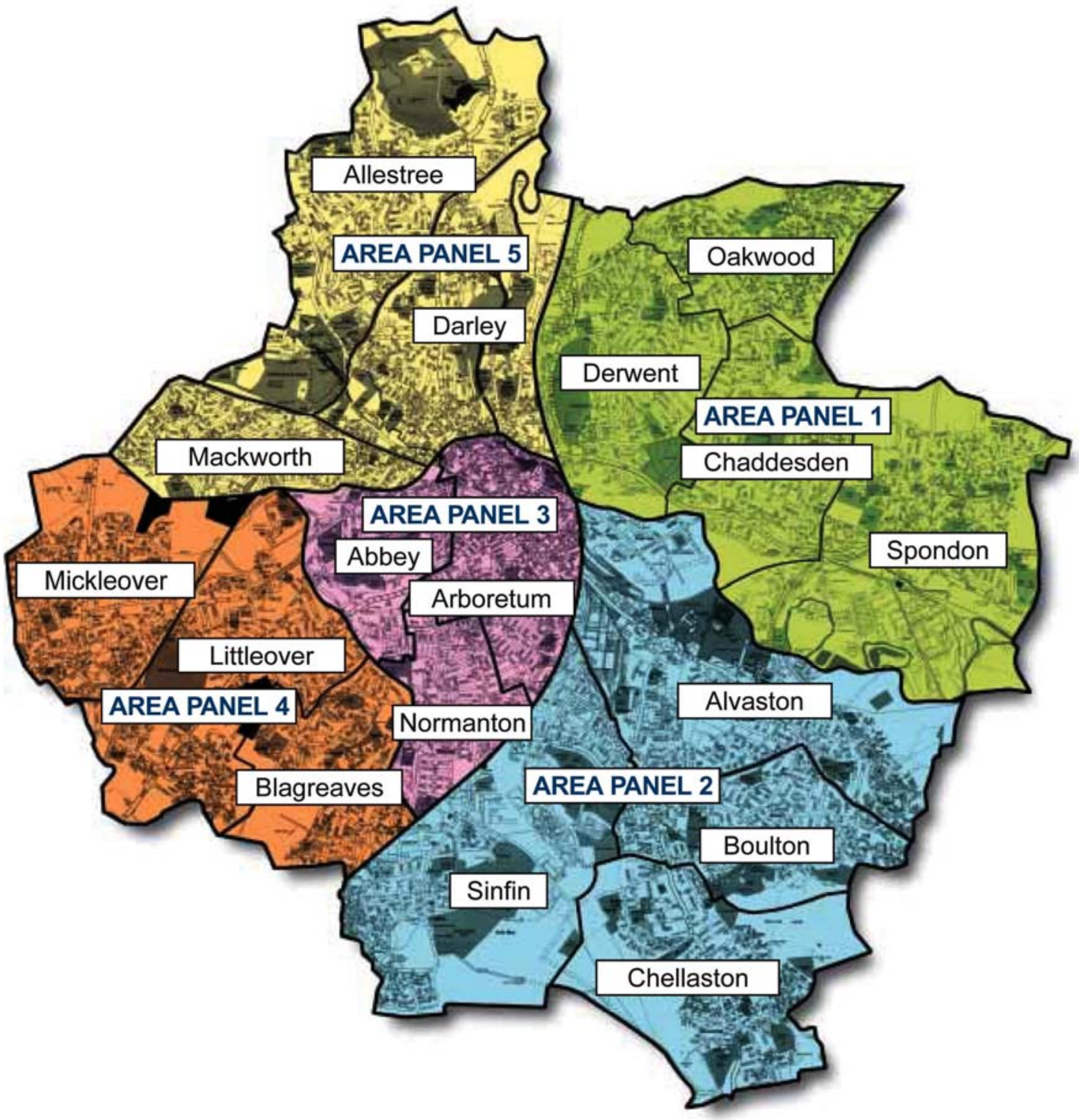
DATS is a comprehensive road-traffic database, commissioned by Derby City Council. It has been used to identify all the busy junctions with more than 2,000 vehicles in the morning peak hour.

The detailed nature of DATS means that it does not provide Annual Average Daily Traffic (AADT) counts. Rather, this road traffic model provides modelled a.m. peak, inter-peak and p.m. peak traffic flows for the main road traffic network. Based on advice from the Highways Department, if a value for the morning peak hour is multiplied by 5, it equates to the AADT. Consequently, a morning peak of 2,000 vehicles per hour approximates to an AADT of 10,000 vehicles per day.

Busy junctions are defined as having an AADT greater than 10,000 and therefore for this assessment, a morning peak greater than 2,000 vehicles per hour.

In order to convert the 2003 AADT into a 2005 AADT, local traffic growth factors have been used. These growth factors have been calculated by the Highways Department, using automatic traffic monitoring data for the 5 Area Panels, which cover the whole of Derby city. These Area Panels are shown in Map 5.

Map 5
Derby City Council's Area Panels



A summary of these local growth factors is provided in Table 13.

Table 13, Local Growth Factors for 2003 - 2005

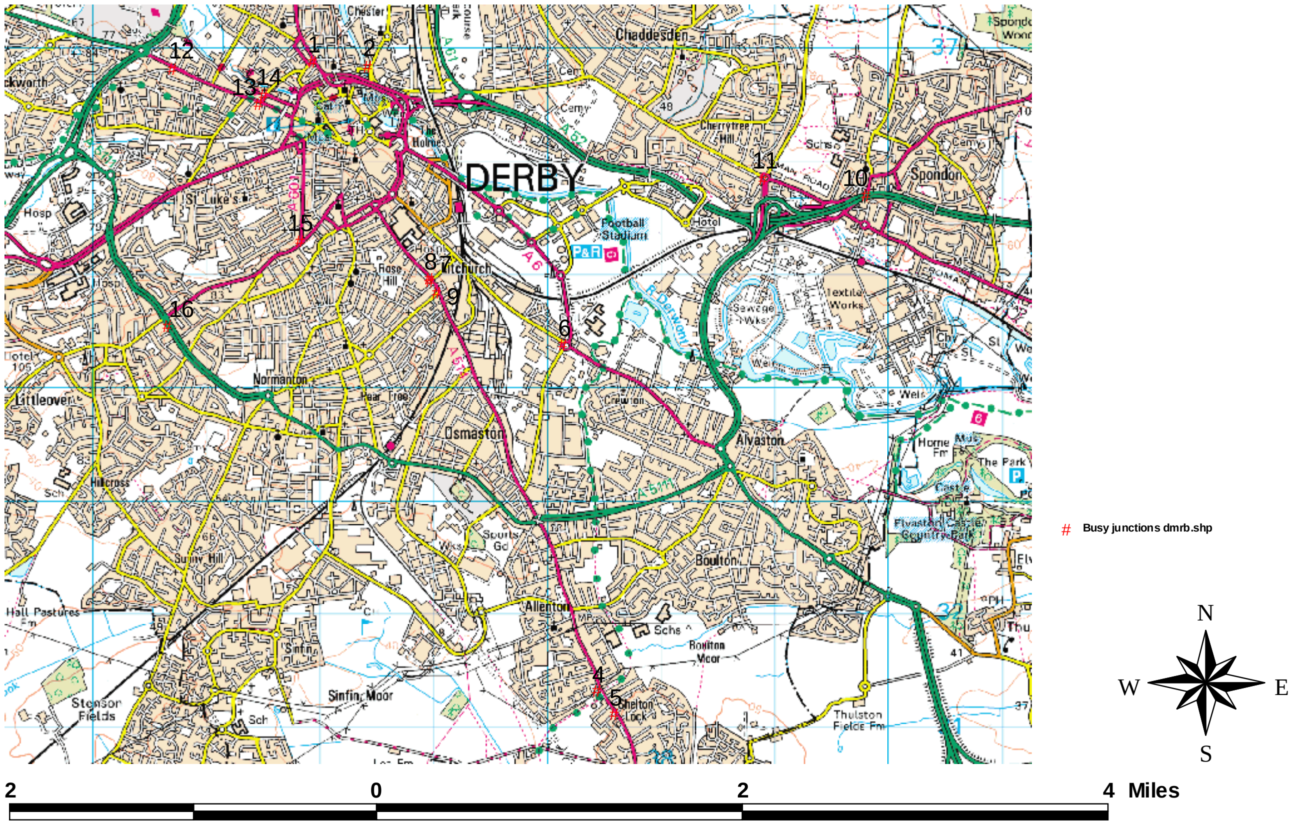
Area Panel Number	Wards	Local Traffic Growth Factor 2003 to 2005 (%)
1	Oakwood, Derwent, Chaddesden & Spondon	6.05
2	Alvaston, Boulton, Sinfin & Chellaston	-4.92
3	Abbey, Arboretum & Normanton	0.46
4	Mickleover, Littleover & Blagreaves	1.63
5	Allestree, Darley & Mackworth	-1.17

The substantial growth and reduction in Area Panels 1 and 2 respectively, are due to the opening of the Alvaston Bypass on 17 December 2003. This bypass was designed to relieve congestion in the Alvaston area.

A list of the busy junctions which are outside of the existing NO_2 AQMAs and for which no NO_2 monitoring data is available, are listed in Table 14 - Parts 1 to 6. This is within the context of determining whether these junctions require a screening assessment using the Design Manual for Roads and Bridges (DMRB).

For those junctions identified as requiring a DMRB assessment, the assessment data and outcomes are provided in Table 15 - Parts 1 to 4. Map 6 shows the locations of these busy junctions.

Map 6
Busy Junctions Requiring DMRB Assessments



Key

1 Mansfield Road/Fox Street
2 Duffield Road/King Street (Five Lamps)
3 A38 slip lanes, Abbey Hill
4 Chellaston Road/Sinfin Avenue
5 Gladstone Close/Derby Road
6 Ascot Drive/London Road/A6 roundabout
7 Grange Street/Osmaston Road
8 Osmaston Road/Bateman Street
9 Douglas Street/Osmaston Road
10 A52/Lodge Lane
11 Raynesway/Derby Road
12 Ashbourne Road/Windmill Hill Lane
13 Friar Gate/Bridge Street
14 Bridge Street/Agard Street
15 Abbey Street NO_x analyser
16 Warwick Avenue NO_x analyser

Table 14 - Part 1
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Mansfield Rd/ Fox St - Panel 5	2002	Yes	14 Mansfield Rd	2,217	11,085	10,955	No	Yes
Mansfield Rd/ Nottingham Road - Panel 5	1098	No	-	-	-	-	No	No
Duffield Rd/ King St (Five Lamps, north and south bound) - Panel 5	2778	Yes	109a King Street	2,308	11,540	11,405	No	Yes
Sir Frank Whittle Rd/ Mansfield Rd/ Hampshire Rd - Panel 1	2076	No	-	-	-	-	No	No
Mansfield Rd/ Alfreton Rd - Panel 5	2024	Yes	2 Old Chester Rd	2,010	10,050	9,932	No	No

Table 14 - Part 2
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Sir Frank Whittle Rd/ Alfreton Rd roundabout - Panel 1	2103	No	-	-	-	-	No	No
Duffield Rd/ Mileash Lane - Panel 5	1865	No	-	-	-	-	No	No
Duffield Rd/ Broadway/ Darley Park Drive roundabout - Panel 5	1871	No	-	-	-	-	No	No
A38 slip lanes, Abbey Hill - Panel 5	2650 2651	Yes	7 Gema Close	1,929 (east) 2,080 (west)	9,645 10,400	9,532 10,278	No	Yes
A38 slip lanes, Queensway - Panel 5	2812 2813	No	-	-	-	-	No	No

Table 14 - Part 3
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Markeaton roundabout - Panel 5	1546 2672 2670 2674 1561 1575	No	-	-	-	-	No	No
A38/ Kingsway roundabout - Panel 5	2682 2683 2678 2681	No	-	-	-	-	No	No
A38 Mickleover Bypass slip roads - Panel 4	1462 1451	No	-	-	-	-	No	No
A38 Mickleover Bypass/ Etwall Rd - Panel 4	1411	No	-	-	-	-	No	No
Littleover Lane/ Village Street/ Stenson Road - Panel 3	1756	No	-	2,036	10,180	10,227	No	No

Table 14 - Part 4
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Chellaston Rd/ Shelton Drive - Panel 2	2237	No	-	-	-	-	No	No
Chellaston Road/ Sinfin Avenue - Panel 2	2239	Yes	267 Chellaston Road	2,218	11,090	10,544	No	Yes
Gladstone Close/ Derby Road - Panel 2	2251	Yes	1 Gladstone Close	2,227	11,135	10,587	No	Yes
Ascot Drive/ London Road/ A6 roundabout - Panel 2	2204	Yes	10 Harrow Street	3,226	16,130	15,336	No	Yes
Harrow Street/ A6 - Panel 2	4100	No	-	-	-	-	No	No
Grange Street/ Osmaston Rd - Panel 3	2059	Yes	2 Ivy Square	2,141	10,705	10,754	No	Yes

Table 14 - Part 5
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Osmaston Road/ Bateman Street - Panel 3	2058	Yes	222A Osmaston Road	2,086	10,430	10,478	No	Yes
Douglas Street/ Osmaston Road - Panel 3	2065	Yes	30 Ivy Square	2,088	10,440	10,488	No	Yes
Alvaston Bypass roundabout/ Raynesway - Panel 2	2753 2754	No	-	-	-	-	No	No
Raynesway/ A52 flyover - Panel 1	2632 2633	No	-	-	-	-	No	No
A52/ Lodge Lane - Panel 1	2465	Yes	17 Gilbert Close (behind concrete wall)	2,107 (easterly)	10,535	11,172	Yes but opposite side of road	Yes
A52/ Stoney Lane/ Borrowash Road - 1	2516 2641 2519	No	-	-	-	-	No	No

Table 14 - Part 6
Busy Road Junctions with > 2,000 vehicles in the morning peak hour

Junction & Area Panel	Link	Relevant exposure within 10m of junction?	Location of nearest receptor	Vehicles per hour	AADT 2003	AADT 2005	Nearby NO_2 monitor?	Require DMRB?
Raynesway/ Derby Road - Panel 1	2418	Yes	208 Derby Road	3,096	15,480	16,417	Yes but not at relevant exposure	Yes
Ashbourne Road/ Windmill Hill Lane - Panel 5	1598	Yes	1 Windmill Hill Lane	2,040	10,200	10,081	No	Yes
Ashbourne Road/ Merchant Street - Panel 5	1678	Yes	56 Ashbourne Road	2,009	10,045	9,927	No	No
Ashbourne Road/ Brick Street - Panel 5	1757	Yes	-	-	-	-	No	No
Friar Gate/ Bridge Street - Panel 5	1001	Yes	2 Bridge St	2,883	14,415	14,246	No	Yes
Bridge Street/ Agard Street - Panel 5	2785	Yes	1-37 Kenneth House	2,140	10,700	10,575	No	Yes

Table 15 - Part 1
DMRB 2005 NO_2 Predictions for Junctions with AADT > 10,000 vpd & Relevant Public Exposure within 10m

Junction	Grid ref	Background 2005 NO_x ($\mu g/m^3$)	Background 2005 NO_2 ($\mu g/m^3$)	Link	2003 AADT	2005 AADT	Speed (km/hr)	Mean % HDV	Distance from link center to receptor point (m)	Road type [(a)]	Predicted 2005 NO_2 Annual Mean ($\mu g/m^3$)
Mansfield Rd/ Fox Street	435656 336803	46.8	26.9	1098/2002 & 2003 2002/2025	21,832 4,936	21,577 4,878	31.3 33.3	7.1 0.07	18.8 10.8	B B	33.4
Duffield Rd/ King St (Five Lamps, north & south)	434956 336874	45.5	26.4	1029 2778	14,098 16,021	13,933 15,834	38 38	2.76 3.18	3.8 9.5	A A	35.7
A38 slip lanes, Abbey Hill	435311 339515	25	17.6	2663/2650 2650/2660 2664/2651 2651/2652	15,634 3,153 15,112 6,661	15,451 3,116 14,935 6,583	91 72.9 91 67.3	15.6 15.5 4.6 3.98	33.9 79.6 49.7 143.2	A A A A	27.2
Chellaston Rd/ Sinfin Ave	437463 331320	28.5	19.2	2237/2239 & 2251 2239/2820	29,520 274	28,068 261	33.6 38	5.3 0.16	9.4 19.5	A B	27.9

Table 15 - Part 2
DMRB 2005 NO_2 Predictions for Junctions with AADT > 10,000 vpd & Relevant Public Exposure within 10m

Junction	Grid ref	Background 2005 NO_x ($\mu g/m^3$)	Background 2005 NO_2 ($\mu g/m^3$)	Link	2003 AADT	2005 AADT	Speed (km/hr)	Mean % HDV	Distance from link center to receptor point (m)	Road type [(a)]	Predicted 2005 NO_2 Annual Mean ($\mu g/m^3$)
Gladstone Close/ Derby Rd	437601 331121	29.4	19.6	2239/2251 & 2256 2244/2251	27,609 2,677	26,251 2,545	35.8 38	5.59 0.42	16.7 21.8	A B	27.1
Ascot Drive/ London Rd/ A6 roundabout	437161 334370	54.4	30	2885/2204 & 7138 2175/2204 & 2152	18,127 17,847	17,235 16,969	36.6 34	6.5 4.7	12.5 65.6	A B	37.8
Grange St/ Osmaston Rd	435968 334954	53	29.4	2059/3134 2058/2059 & 2065	1,789 22,927	1,797 23,032	31.4 29.5	5 5	24 13.8	B A	36.4
Osmaston Rd/ Bateman St	435973 334956	21.3	16	2059/2058 & 2045 2058/2084	24,471 8,794	24,584 8,834	25.6 26.7	1.07 2.3	22.8 33.1	A B	21.3

Table 15 - Part 3
DMRB 2005 NO_2 Predictions for Junctions with AADT > 10,000 vpd & Relevant Public Exposure within 10m

Junction	Grid ref	Background 2005 NO_x (µg/m^3)	Background 2005 NO_2 (µg/m^3)	Link	2003 AADT	2005 AADT	Speed (km/hr)	Mean % HDV	Distance from link center to receptor point (m)	Road type [(a)]	Predicted 2005 NO_2 Annual Mean (µg/m^3)
Douglas St/ Osmaston Rd	436036 334842	39.3	23.8	2059/2065 & 2074 2042/2065	22,927 5,224	23,032 5,248	29.5 24	0.9 1.07	9.35 20.2	A B	29.2
A52/ Lodge Lane	439823 335688	32	20.7	2636/2465 & 2486 2465/2640 2480/2637	33,026 6,368 23,721	35,024 6,753 25,156	100 38 91	3.72 0.63 5.3	17.9 25.3 32.5	A A A	32.5
Raynesway /Derby Rd	438915 335848	32.9	21	2774 + 2413 /2418 & 2806 2387/2418 /2431	14,103 21,116	14,956 22,393	46.6 32.4	1.8 1.83	28.2 16.8	A A	28.6
Ashbourne Rd/ Windmill Hill Lane	433715 336816	34.8	21.9	1575/1598 & 1635 1595/1598	21,780 383	21,525 379	37.9 26	9.6 7.2	8.4 5.6	A B	32.5

Table 15 - Part 4
DMRB 2005 NO_2 Predictions for Junctions with AADT > 10,000 vpd & Relevant Public Exposure within 10m

Junction or Monitor	Grid ref	Background 2005 NO_x ($\mu g/m^3$)	Background 2005 NO_2 ($\mu g/m^3$)	Link	2003 AADT	2005 AADT	Speed (km/hr)	Mean % HDV	Distance from link center to receptor point (m)	Road type [(a)]	Predicted 2005 NO_2 Annual Mean ($\mu g/m^3$)
Friar Gate/ Bridge St	434481 336499	34.8	21.9	820/1001 & 1002 1001/1770	21,809 32,695	21,554 32,312	38 28	7.4 10.9	7.6 13	A A	40.9
Bridge St/ Agard St	434528 336586	45.5	26.4	1002/2785 & 1003 2785/2869	23,305 7,010	23,032 6,928	38 26.4	7 19.4	8.5 8.5	A A	41.4
Abbey Street NO_x analyser	434839 335294	45.9	26.5	1824/1008 /905 & 1053/1008	24,725 9,025	24,839 9,067	20.1 22.1	1.4 1.8	10.3 17.9	A A	33.8
Warwick Avenue NO_x analyser	433678 334533	31.7	20.5	1548/1592 /1624 & 3162/1592 /1605	25,827 18,749	26,248 19,055	32.2 22.4	4 2	12.2 79.4	A A	28.3

The 2 busy junctions that have been identified by a review of Section D of the USA, as requiring a Detailed Assessment, are shown in Table 16.

Table 16
Busy Road Junctions Outside Existing AQMAs
Requiring Detailed Assessments

Junction	Predicted 2005 Annual Average NO_2 Concentration ($\mu g/m^3$)	Reason for Detailed Assessment
Friar Gate/ Bridge St	40.9	Possible extension
Bridge St/ Agard St	41.4	Possible extension

These DMRB assessment results do however need to be treated with caution because:

1. They only identify 2 busy junctions for this Detailed Assessment. This is within the context of the large number of exceedences recorded across the NO_2 monitoring network.

2. DMRB has significantly under-predicted annual average NO_2 concentrations at both the Warwick and Abbey Street monitoring stations. This verification, predicted a 2005 annual average NO_2 concentration at Abbey Street to be 33.8$\mu g/m^3$, compared with a measured concentration of 40.1$\mu g/m^3$. Again at Warwick Avenue, the predicted 2005 annual mean was 28.3$\mu g/m^3$ compared with a measured concentration of 38$\mu g/m^3$.

This is of concern, given that DMRB assessments are a screening tool and by their very nature, should therefore provide conservative estimates of pollution concentrations. Reasons for this under-estimate may be:

1. Calculation of AADT values from morning peak traffic flows
2. Use of detailed 24-hour traffic speeds, as opposed to lower congested traffic speeds of around 5 km/hr
3. Vehicle split data only being available for HDVs and LDVs

In order to account for the busy junctions within the Detailed Assessment, where there may be exceedences of the NO_2 annual mean, all busy junctions with a DMRB predicted annual mean > 33µg/m^3 have been included. This was on the basis of a predicted annual average NO_2 concentration at Abbey Street of 33.8µg/m^3, compared with a measured an annual mean of 40.1µg/m^3 and an objective of 40µg/m^3.

Using this methodology, the busy junctions contained within Table 17 have been identified for further consideration in this Detailed Assessment.

Table 17
Additional Busy Junctions requiring Detailed Assessment

Junction	Predicted/ Measured 2005 Annual Average NO_2 Concentration (µg/m^3)	Reason for Detailed Assessment
Mansfield Road/ Fox Street	33.4	Possible extension
Duffield Road/ King Street	35.8	Possible extension
Ascot Drive/ London Rd/ A6 roundabout	37.8	Possible Extension
Grange Street/ Osmaston Road	36.4	Possible Extension

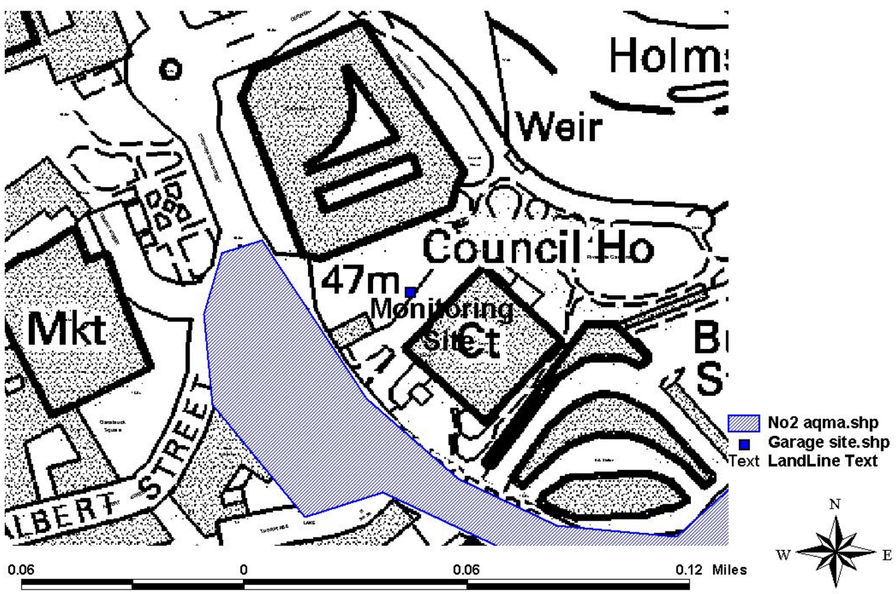
3.0 MONITORING LOCATIONS

3.1 COUNCIL HOUSE

The ‘Council House’ monitoring station is an urban background site. It is located in a converted garage, to the east of the Council House. It is 22 metres to the north of both the Inner-Ring Road NO_2 AQMA and the ‘busy’ Morledge road.

This monitoring station has been used for a number of years, to continuously measure urban background concentrations of both NO_2 and $PM_{10,}$. It uses a combination of a chemiluminescent NO_x analyser and a TEOM particulate analyser.

Map 7
The Council House Monitoring Site



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A co-location study of NO_2 diffusion tubes is located adjacent to the NO_x analyser inlet, which in previous years has been used to produce a bias correction factor for application to the NO_2 diffusion tube network.

Photograph 1
The Council House Monitoring Site

In 2004, several improvements were made to the Council House monitoring station. A high-speed manifold was installed to control the intake of air. The Odessa data logger was also replaced with an Envidas data logger, to reduce the likelihood of monitoring data being lost.

There are however limitations with this monitoring site. The sample inlet for the NO_x analyser is sheltered by nearby buildings and is located next to the Council House car park.

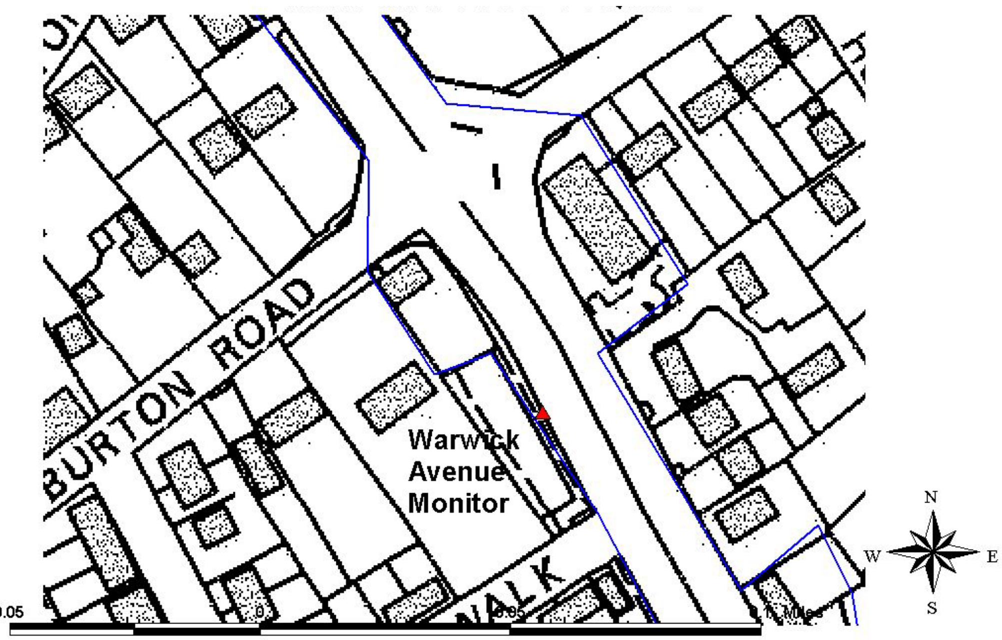
From September 2005, the surrounding area has also been undergoing major redevelopment as part of the ‘Riverlights’ project. This means that for a period of at least the next 2 years, the Council House monitoring station cannot be regarded as a true urban background site and is therefore discounted from the Review and Assessment process.

3.2 WARWICK AVENUE

The 'Warwick Avenue' site is a kerbside monitoring station, which was commissioned on 1 October 2004. It uses a chemiluminescent NO_x analyser to provide continuous NO_2 monitoring data for this Detailed Assessment. It also uses a TEOM analyser to provide data for the Detailed Assessment for road-traffic based PM_{10}.

This monitoring station is located on a grass verge adjacent to the northern carriageway of Derby's outer ring-road, within the Outer Ring-Road NO_2 AQMA. It is also only 4 metres away from a new 4-storey block of flats.

Map 8
Warwick Avenue Monitoring Site & the Outer Ring Road NO_2 AQMA



___ =boundary of NO_2 AQMA

Photograph 2
Warwick Avenue Monitoring Station

Photograph 3
Inside Warwick Avenue Monitoring Station

Warwick Avenue was chosen as a suitable monitoring location for a number of reasons. Most importantly, it represents a site on the outer ring-road, which is exposed to high levels of road-traffic pollution. There was relevant public exposure, due to the new apartment blocks being built immediately to the west. Finally, there was also sufficient space, an acceptable risk of vandalism and an electricity supply.

A co-location study of triplicate NO_2 diffusion tubes has been provided at Warwick Avenue. Together with the Abbey Street co-location study, this provides bias correction factors for application to the NO_2 diffusion tube network.

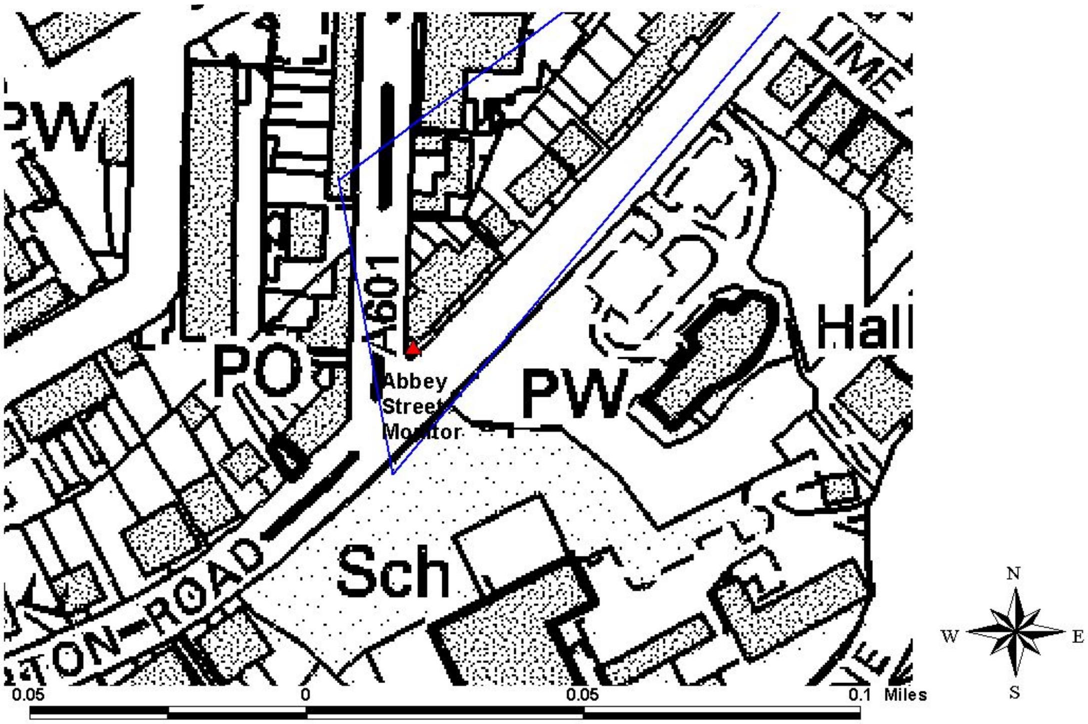
Photograph 4 and 5
Co-location Study of NO_2 Diffusion Tubes at Warwick Avenue

3.3 ABBEY STREET

The 'Abbey Street' monitoring station is situated in a roadside location within the Inner Ring-Road AQMA, at the junction of Abbey Street and Burton Road. It is immediately adjacent to the facade of 202 Burton Road, which is a large house that has been subdivided in to a number of apartments.

This monitoring station was commissioned on 8 October 2004. It uses a chemiluminescent NO_x analyser to provide continuous NO_2 monitoring data for this Detailed Assessment.

Map 9
Abbey Street Monitor and the Inner Ring-Road NO_2 AQMA



=boundary of NO_2 AQMA

Photograph 6
Abbey Street Monitoring Station - looking along Burton Road

Photograph 7
Abbey Street Monitoring Station - top of Abbey Street

Photograph 8
Abbey Street Monitoring Station - corner of Abbey Street/Burton Road

With the support of local residents and the landlord of 202 Burton Road, Abbey Street was deemed to be an ideal monitoring location. It provides facade NO_2 concentrations at a busy junction in the Inner Ring-Road AQMA, at a location where there are 3 lanes of road-traffic on Burton Road and 2 lanes on Abbey Street. There was sufficient space, an acceptable risk of vandalism and an electricity connection available at a reasonable cost.

In common with Warwick Avenue, a co-location study of triplicate NO_2 diffusion tubes is also located there. This is for the purpose of producing a bias correction factor for application to the NO_2 diffusion tube network.

3.4 NITROGEN DIOXIDE DIFFUSION TUBES

Nitrogen dioxide diffusion tubes provide a cost-effective indicative measure of roadside NO_2 concentrations. Every month the network of tubes is collected and sent off to a UKAS accredited laboratory for analysis. At the end of each calendar year, the resultant monthly average NO_2 concentrations are then used to calculate annual average NO_2 concentrations for each monitoring location.

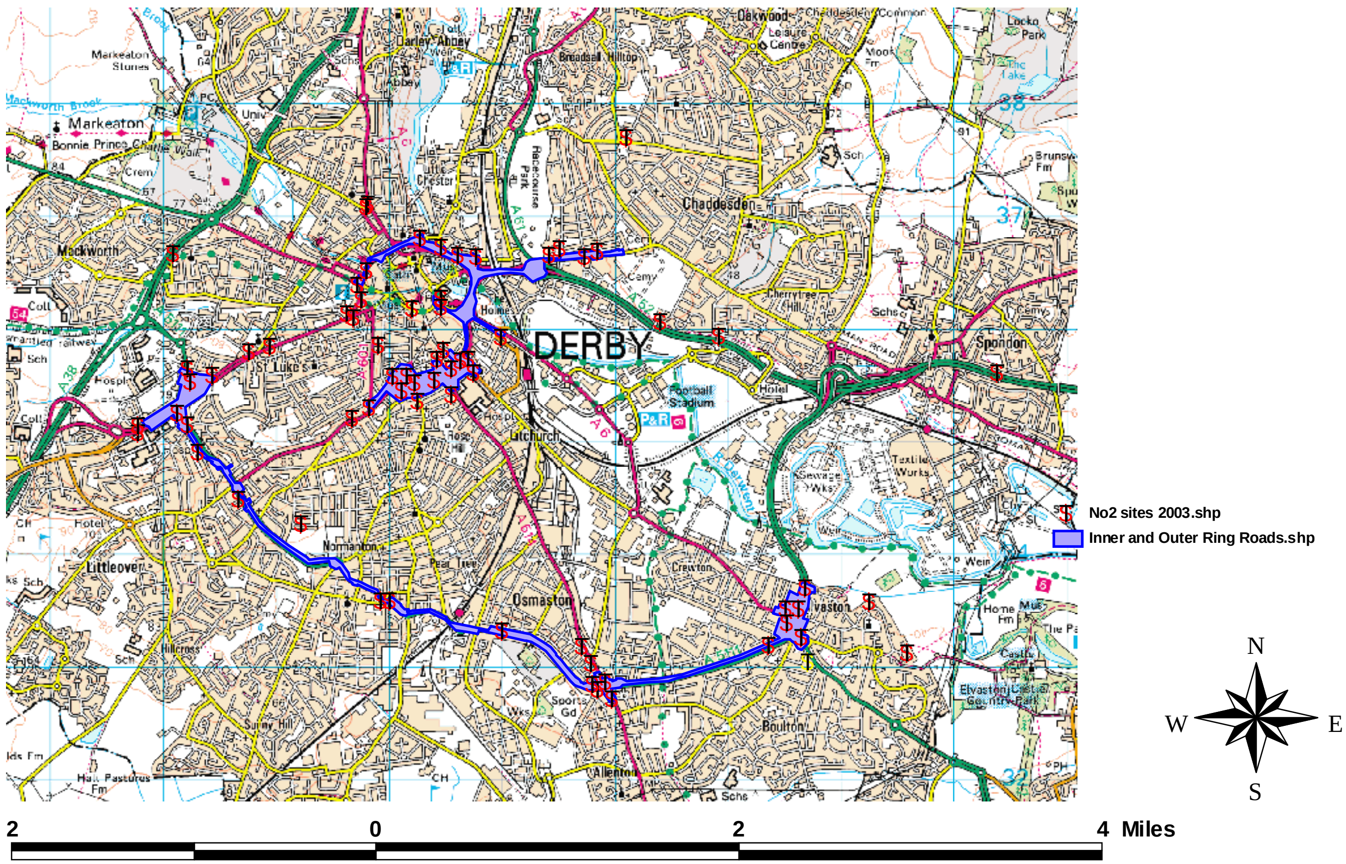
Photograph 9
NO_2 Diffusion Tube (above the parking sign)

In order to increase the accuracy of these indicative monitors, a bias correction factor is applied to the annual average NO_2 concentration. Prior to 2005, this process relied upon data from the Council House co-location study. The accuracy of the network has now been further improved, through the addition of the Warwick Avenue and Abbey Street co-location studies.

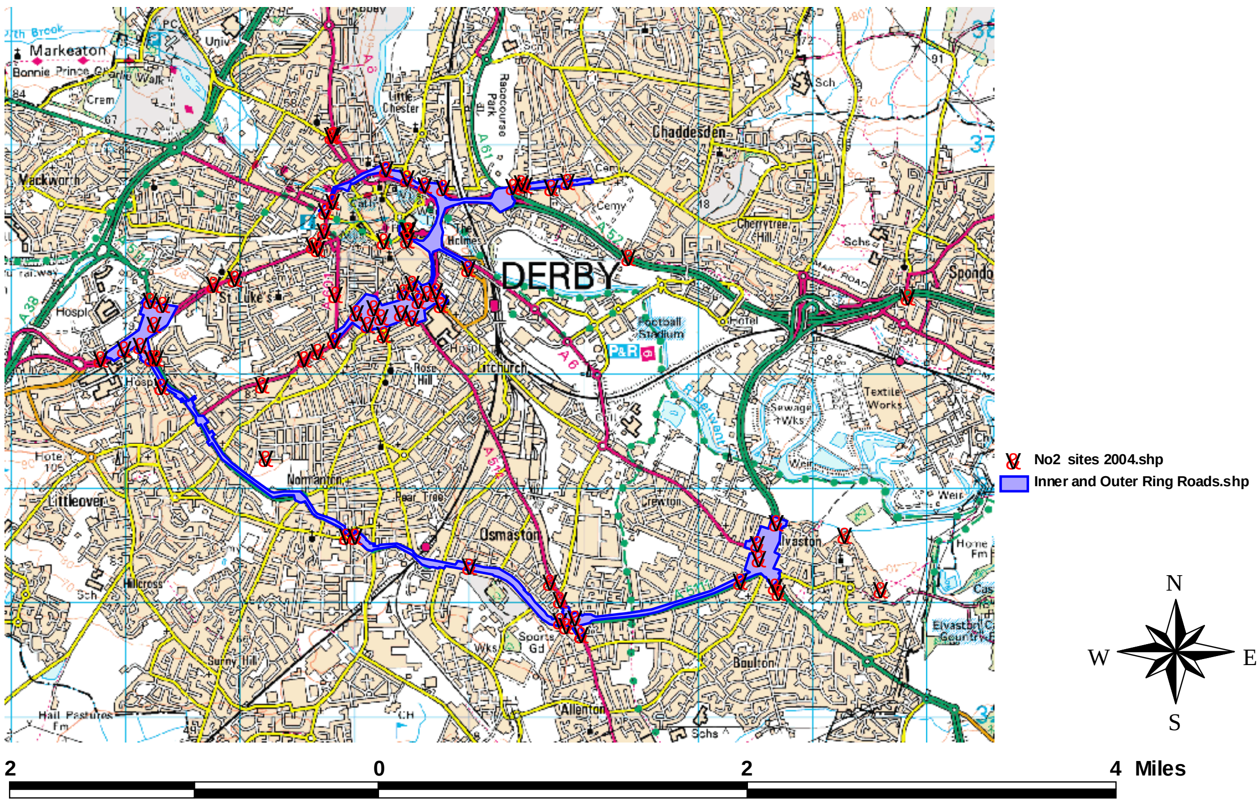
The combination of triplicate co-location studies and an extensive network of NO_2 diffusion tubes provides a comprehensive picture of roadside, kerbside and facade annual average NO_2 concentrations across the city.

In 2001, the City Council's diffusion network comprised 58 NO_2 diffusion tubes. In 2002, this was extended to 72 diffusion tubes. In 2004, it was again extended to 86 diffusion tubes. Several diffusion tube monitoring locations were also altered at the start of each calendar year, following an annual review.

Map 10
Nitrogen Dioxide Diffusion Tubes - 2002 & 2003



Map 11
Nitrogen Dioxide Diffusion Tubes - 2004



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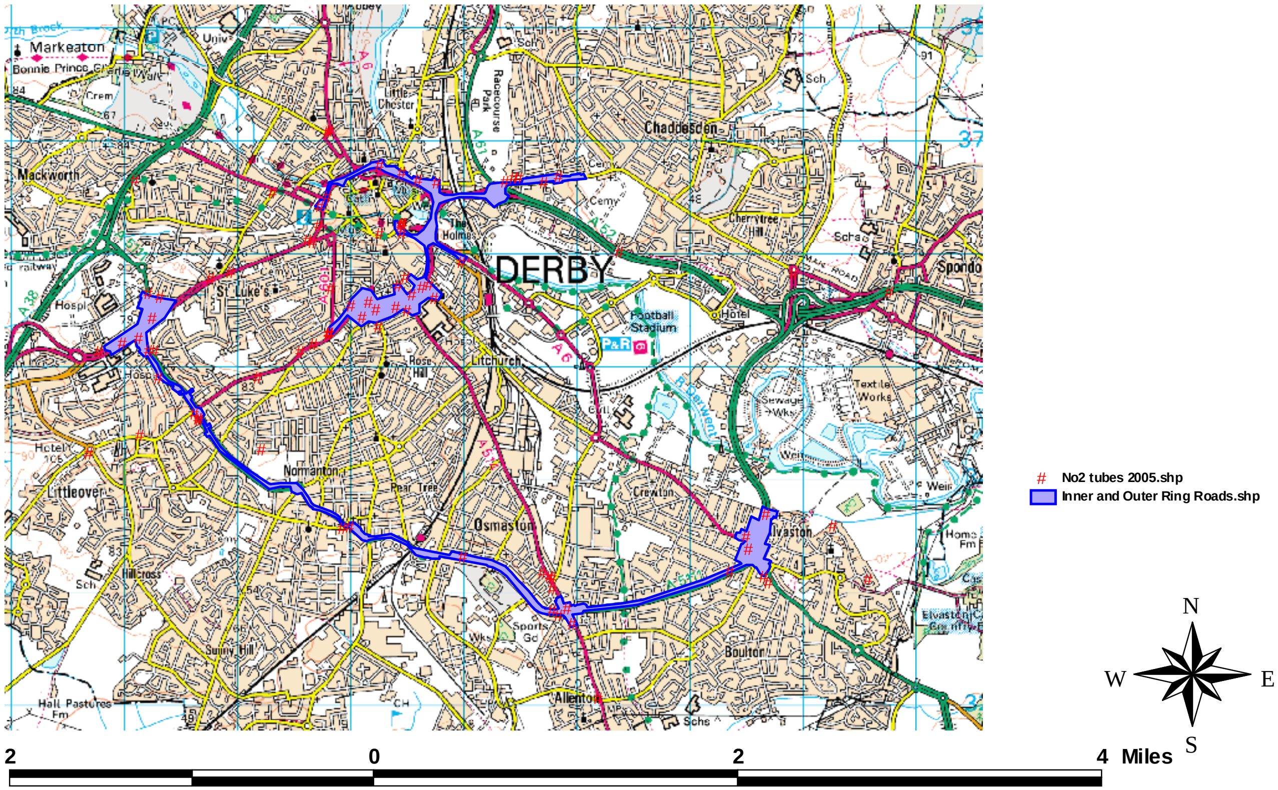
Map 12
Nitrogen Dioxide Diffusion Tubes - 2005



4.0 MONITORING RESULTS

In order to be able to draw accurate and robust conclusions on the need to declare, amend or revoke Air Quality Management Areas, it was decided to obtain at least 12 months of monitoring data from the new roadside NO_x analysers at Warwick Avenue and Abbey Street. This ensures that meteorological and seasonal factors have been accounted for.

The importance of accurate data was increased still further by the fact that many annual average facade NO_2 concentrations in Derby 'hover' around the 40µg/m^3 standard. Without a full year of roadside and kerbside monitoring data, it therefore is not possible to confidently determine whether the standard is in fact being exceeded at these locations.

Monitoring data is provided in this section of the report, for the City Council's entire NO_2 monitoring network between 2001 and 2005. Most notably, for the calendar year of 2005 and the 3 months of October to December 2004, this includes data from the Warwick Avenue and Abbey Street NO_x analysers. The Council House monitoring data is provided for the years 1999 to 2005.

For the sake of completeness, for the 3 continuous NO_x analysers at the Council House, Warwick Avenue and Abbey Street, consideration is given to both the annual average and 1-hour NO_2 objectives.

4.1 CONTINUOUS NO_x ANALYSERS

The City Council operates continuous NO_x analysers at the Council House, Abbey Street and Warwick Avenue.

All of the NO_x analysers are subject to daily checks using modem connections. They are also subject to maintenance agreements. An engineer responds to any problems experienced with the analysers, as well as undertaking regular 6 monthly services. Reports for each of these visits are recorded and referred to during the process of data validation and ratification.

The automatic daily calibration factors are used to scale the 15 minute NO_x and NO data. The fortnightly manual calibrations were used instead, where this automatic data was unavailable.

Enview 2000 is a software program used to undertake the scaling, using the following formulae:

$$\textit{Daily Calibration Factor} = \frac{\textit{Span reference}}{\textit{Span measured - Zero factor}}$$

Scaled data = Daily Calibration Factor (Raw data – Zero factor)

NB: Zero and span gases are provided with each NO_x analyser, for manual and automatic calibrations of the monitoring data

The NO_x and NO graphs have been further adjusted, where the fortnightly NO_x concentrations fall below zero at night. This accounts for the small inaccuracies inherent with continuous air quality monitoring. In effect, the fortnightly plots of NO_x and NO are then increased, so that the baseline of the graph does not fall below $0\mu g/m^3$.

The 15-minute NO_2 concentrations are calculated, by subtracting the NO from the NO_x. The resultant ppb NO_2 concentrations are then converted into $\mu g/m^3$, through application of the standard 1.91 conversion factor.

Air quality software is again used to calculate the hourly and annual mean NO_2 concentrations from these 15-minute mean NO_2 concentrations. In order for an hourly mean to be classed as valid, at least three valid 15-minute NO_2 means are required for both NO and NO_x.

Data ratification of the calculated NO_2 concentrations for each of the NO_x analysers involves detailed examination of the validated data. This examination concentrates upon periods of high and low NO_2 concentrations, discrediting any invalid data. This is within the context of adopting a precautionary approach, whereby results are only invalidated where this can be confidently assumed.

Indications of valid high and low NO_x concentrations include:

1) A gradual increase and decrease in hourly NO_2 concentrations.
2) Elevated NO_2 concentrations generally occur during the colder autumn and winter months, due to episodes of poor dispersion. The summer concentrations of NO_2 are not however significantly reduced, due to photochemical smogs and summer oxidant episodes.
3) A large number of pollution episodes occur in the run up to Christmas, when there is an increased volume of road traffic. Outside of this time, the majority of pollution incidents occur on weekdays as diurnal peaks, which correspond with the morning and evening rush hours.
4) Cross-referencing with the NO_x analyser log books and service reports.
5) Cross-referencing with Derby City Council's other 2 NO_x analysers, as well as regional comparisons with Nottingham and Leicester City Council's urban background NO_x analysers.

6) In the case of Warwick Avenue NO_x analyser, cross-referencing is also possible with the roadside PM_{10} concentrations recorded at this monitoring station.

The final element of the validation and ratification process relates to the percentage data capture. In accordance with LAQM.TG(03), a minimum 90% data capture is required for an annual mean to be validated. The data capture rates are provided in Tables 16 to 18.

The 2004 Council House annual average NO_2 concentration has a data capture rate of 65%, due to the NO_2 data for the period 1 March - 15 June 2004 having to be invalidated. This was due to problems with the calibration gas, which prevented the data from being able to be rescaled. Due care must therefore be taken, when considering the 2004 figure as a 'true' annual average.

The figures shown in Tables 18 to 20 for the Council House , Warwick Avenue and Abbey Street vary from the data shown in Derby City Council's May 2005 Progress Report. This is as a result of further validation and ratification of the data having been undertaken, following difficulties with the software at the time.

Table 18
NO_2 Results for the Council House

	1999	2000	2001	2002	2003	2004	2005	National Air Quality Standard
Annual mean (μg/m^3)	47	37	37	38	42.9	32.1	28.4	40
Maximum Hourly Concentration (μg/m^3)	174	129	125	127	165	158	174	-
99.8th Percentile of Hourly Averages (μg/m^3)	124	95	96	102	118	133	106	200
Data Capture (%)	86	93	94	87	96	65	96	-

Table 19
NO_2 Results for Warwick Avenue

	1 Oct 2004 - 31 Dec 2004	1 Jan 2005 - 31 Dec 2005	National Air Quality Standard
Annual Mean ($\mu g/m^3$)	39.7	38.0	40
Maximum Hourly Concentration ($\mu g/m^3$)	155	231	-
99.8^{th} Percentile of Hourly Averages ($\mu g/m^3$)	119	146	200
Data Capture (%)	91	94	-

Table 20
NO_2 Results for Abbey Street

	8 Oct 2004 - 31 Dec 2004	1 Jan 2005 - 31 Dec 2005	National Air Quality Standard
Annual Mean ($\mu g/m^3$)	52.6	40.1	40
Maximum Hourly Concentration ($\mu g/m^3$)	142	200	-
99.8^{th} Percentile of Hourly Averages ($\mu g/m^3$)	115	110	200
Data Capture (%)	91	97	-

4.2 BIAS CORRECTION FACTORS

Between 2000 and 2005 the following bias correction factors have been obtained from the Council House co-location study:

Table 21
Summary of Council House Bias Correction Factors

	2000	2001	2002	2003#	2004	2005
Bias Correction Factor	0.87	1.04	0.9	1.28	0.99	0.8
Diffusion Tube Bias (%)	+14.9	-4.27	+10.75	-21.9	-1.2	-25.4

 # Invalid

With the exception of 2003, these bias correction factors have been applied to the City Council's NO_2 diffusion tube network. In 2003, there were problems with the Council House co-location study, due to the restricted air flow to the collocated diffusion tubes.

In 2003, the National Inter Comparison Study of NO_2 Diffusion Tubes was therefore used to produce a bias correction factor of 1.00. This was used instead of the Council House co-location study to correct the 2003 diffusion tube results.

In 2005, co-location study data was available from the Council House, Warwick Avenue and Abbey Street studies. These results are shown in Table 22.

Table 22
NO_2 Diffusion Tube Co-Location Study Results,
1 January - 31 December 2005

	Council House	**Warwick Avenue**	**Abbey Street**
NO_2 Concentration for Continuous Analyser (C_m)	28.4	38.0	40.1
NO_2 Concentration for Triplicate Diffusion Tubes (D_m)	35.6	50.1	49.7
Bias Correction Factor (C_m/D_m)	0.8	0.76	0.81
Diffusion Tube Bias % ($D_m – C_m/C_m$)	-25.4	-31.8	-23.9

The 2005 local co-location studies have consistent bias correction factors of 0.8, 0.76 and 0.81. The similarity of these results is encouraging and reflects the high data capture rates for all 3 continuous analysers and associated triplicate NO_2 diffusion tubes.

The results from the 2005 National Inter Comparison Study of NO_2 Diffusion Tubes are unavailable at this time. In practice, greater emphasis would however be given to the 3 local co-location studies.

Although the 2005 Council House co-location study bias correction factor correlates with those produced at Warwick Avenue and Abbey Street, it has not been used in this Detailed Assessment. This is because:

1. The Council House is an urban background site, so is less relevant to the network of road-traffic related NO_2 diffusion tubes. This is in contrast to the kerbside and roadside NO_x analysers at Warwick Avenue and Abbey Street.

2. The Council House monitoring station is located immediately adjacent to a 2-storey building and car park. This means that even in previous years, the ‘urban background’ monitoring results need to be treated with caution.

3. In September 2005, redevelopment work associated with the ‘Riverlights’ project commenced. The Council House monitoring station is within 100 metres of this development, so for a period of at least 2 years, LAQM TG(03) states that it can no longer be considered a true urban background site.

4. This situation with the redevelopment work is further complicated by the erection, in September 2005, of 4 two-storey temporary buildings within a few metres of the monitoring station. These office buildings (for the temporary bus station) further inhibit dispersion in this area. They have also replaced a number of car parking spaces, making it more difficult to identify historic trends in NO_x and PM_{10} at this site.

5. Finally, the Council House monitoring station is only 22 metres from Morledge road. From September 2005 and for a period of at least 2 years, the City’s temporary bus station has been relocated along this road. The road-traffic exhaust emissions associated with the buses will therefore be likely to increase the NO_2 concentrations at the Council House.

The 2005 co-location studies at Warwick Avenue and Abbey Street found the NO_2 diffusion tubes to be over-reading by between 23.9 and 31.8%. Taking the precautionary approach, the worst-case a bias correction factor of 0.81 (23.9%) has therefore applied to the 2005 results from the NO_2 diffusion tube network.

Although in 2005, work commenced on both the Riverlights scheme and the Eagle Shopping Centre extension, their construction phases are unlikely to have impacted upon local air quality at either the Warwick Avenue or Abbey Street. The same is true of the Inner Ring-Road Maintenance Scheme (IRRIMS), which only directly affects traffic flows on the northern section of the inner ring-road.

The 2005 monitoring results for both Warwick Avenue and Abbey Street are therefore considered reliable, with data from these analysers representing ‘typical’ pollution levels on these parts of Derby’s road network.

4.3 NITROGEN DIOXIDE DIFFUSION TUBES

Nitrogen dioxide diffusion tubes are indicative monitors, with an inherent accuracy of +/- 30%.

The difficulty of identifying anomalies in diffusion tube data is further complicated, as each tube is deployed for 4 to 5 weeks. Little information is therefore available on any local factors that may have affected the NO_2 concentrations recorded. For example, a substantial increase in NO_2 may result from a localised traffic diversion, which would not be apparent from monitoring data alone.

It is for these reasons that a precautionary approach has been adopted. Unless it can be confidently assumed that diffusion tube results are 'invalid,' they have been validated.

Blank NO_2 tubes are also form part of the quality control procedure for diffusion tubes. These blank tubes remain unexposed for the monitoring period and are then sent to the laboratory, along with the exposed tubes. This highlights any instances of laboratory error, although this is rare.

If laboratory error is apparent, the blank tube results are used to either invalidate or adjust the exposed tube NO_2 concentrations.

Table 23 - Parts 1 to 17, present the NO_2 diffusion tube results for the years 2001 to 2005.

Table 23 - Part 1
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
60 Kirk Leys Ave North	440374 335578	Facade, flat & behind fence	No	Yes	30.8	25.0	36.9	-	-	No
Drury Avenue (A52)	439846 335667	Kerbside & flat	No	Yes	-	-	-	48.1#	36.0*	Yes
Raynesway/ Derby Road junction (busy junction)	438944 335825	Roadside & flat	No	No & all exposure >14m from junction	-	-	-	46.1	38.3	No
85 Meadow Lane	437943 335910	Façade & flat	No	Yes	34.5	26.1	30.8	-	-	No
Highfield Lane, alley way (A52)	437378 336045	Roadside, behind sign & alley way	No	Yes	30.8	26.7	40.0	-	-	Yes
109 Highfield Lane, Chaddesden (A52)	437397 336008	Façade & flat	No	Yes	-	-	-	38.2	29.3	No

Based on just 5 months of monitoring data, due to stolen diffusion tubes
* Change in monitoring location of a few metres, from lamp post at 1 Drury Avenue to lamp post at 37 Lodge Lane

Table 23 - Part 2
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Cornwall Road, Chaddesden	436862 336684	Suburban, roadside & flat	Yes	Yes	35.3	27.8	31.1	31.6	27.5	Yes
Nottingham Road - opposite Beaufort Street	436747 336630	Roadside, flat & former national network site	Yes	No	39.8	43.4	42.4	49.6	40.6	Yes
Derwent Green - near to bus stop	436420 336647	Roadside & flat	No	No	44.2	40.1	39.1	-	-	No
5 St Marks Road	436507 336644	Façade, flat & speed bumps	No	Yes	-	-	-	45.1	26.5	Yes
Derwent House	436467 336670	Roadside & flat	No	Yes	-	-	-	41.1	30.0	Yes
Park View House (Pentagon Island)	436394 336638	Façade & flat	No	Yes	-	-	-	32.7	26.1	No

Table 23 - Part 3
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Metcalfe Close, Alvaston	438692 333675	Suburban, roadside & flat	Yes	No	40.0	29.6	26.5	35.1	26.1	Yes
Halstock Drive, Alvaston	439245 333540	Suburban, kerbside & flat	No	Yes	30.5	20.7	26.0	26.3	21.8	No
Caroline Close, Alvaston	439564 333098	Suburban, roadside & flat	No	Yes	32.6	22.9	19.4	25.3	20.3	No
Beech Gardens, Alvaston	438631 333491	Roadside & flat	Yes	Yes	30.5	27.5	30.6	-	-	Yes
7 Raynesway	438508 333515	Façade, roadside & flat	Yes	Yes	51	37.3	46.5	41.4	-	No
Dental Practice, 1 Raynesway	438493 333473	Façade, roadside & flat	Yes	Yes	-	-	-	-	31.3	Yes
Between Alvaston Islands (Li's Fish Bar)	438532 333380	Façade, roadside & flat	Yes	Yes	41.1	43.6	41.5	39.6	34.8	No

Table 23 - Part 4
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Elvaston Lane, Alvaston	438655 333233	Roadside, behind sign & flat	Yes	No	37.8	44.0	37.7	-	-	Yes
Courtland Gardens, Alvaston	438704 333024	Roadside & flat	No	Yes	-	32.2	30.7	-	-	No
Shardlow Road, Alvaston	438725 333085	Façade & flat	No	Yes	-	-	-	28.1	24.6	No
18 Nunsfield Drive, Alvaston	438685 333137	Roadside & flat	No (close)	Yes	-	-	-	30.6	20.6	No
Barrett Street, Alvaston	438397 333159	Roadside, behind sign & flat	Yes	No	41.5	29.5	32.5	30.8	24.9	Yes
Merrill Way/Boulton Lane, Allenton	437233 332056	Roadside & flat	No	Yes	-	-	-	40.3	33.4	Yes

Table 23 - Part 5
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Osmaston Road (Ascot Hotel)	436690 333172	Façade & flat	No	No	-	39.2	42.8	44.3	27.8	No
758 Osmaston Road (north of Spider Island)	436789 333012	Roadside & flat	No	Yes	53.6	46.4	41.8	54.7	42.9	Yes
Ascot Drive/Osmaston Rd (town end) (busy junction)	436792 333142	Kerbside, behind sign & flat	No	Yes	-	-	-	40.1	34.2	Yes
Ascot Drive/ Osmaston Road (Spider Island end) (busy junction)	436809 333118	Roadside, behind railings & flat	No	Yes	-	-	-	42.7	30.6	Yes
831 Osmaston Road (south of Spider Island)	436997 332705	Façade & flat	Yes	Yes	38.4	32.9	36.3	35.1	29.3	Yes
Varley Street	436801 332791	Roadside, near to hedge & flat	Yes	Yes	36.5	31.9	39.4	34.7	26.4	Yes

Table 23 - Part 6
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Lord Street	436838 332766	Kerbside, behind sign & flat	Yes	Yes	51.7	41.1	53.3	42.2	35.3	No
Mitre Pub, Harvey Road (no. 2)	436948 332840	Roadside & flat	Yes	Yes	46.6	53.0	49.3	41.5	33.4	No
Arkwright Street/ Osmaston Park Road	436027 333270	Kerbside, behind sign & slightly downhill away from ring-road	Yes	Yes	35.4	31.7	37.0	33.6	23.4	Yes
Newdigate Street	435033 333552	Kerbside & flat	Yes	Yes	-	44.4	52.4	50.4	46.0	No
Village St	434910 333540	Kerbside, behind sign & flat	No	Yes	40.3	25.2	29.0	30.0	23.1	No

Table 23 - Part 7
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Junction of Warwick Avenue/ Burton Road	433650 334579	Roadside, uphill and 6m from junction	Yes	Yes	-	-	-	70.5	55.6	No
Derby High School, Burton Road/Hillsway, Littleover (busy junction)	432710 334229	Roadside, near roundabout & flat	No	Yes	-	-	-	34.7	26.9	No
Lawnheads Avenue/ Burton Road	433161 334389	Façade, roadside & flat	No	Yes	-	-	-	32.4	25.8	No
Eastwood Drive/ Manor Road	433326 334866	Kerbside & steep downhill on ring-road	Yes	Yes	38.9	33.2	36.0	36.1	29.1	Yes
4 Manor Road	432874 335100	Side of property & flat	Yes	Yes	-	-	-	-	24.2	No as next to busy junction but on side of property

Table 23 - Part 8
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 ($\mu g/m^3$)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Lamp post outside 2 Manor Road	432894 335100	Roadside & flat	Yes	Yes	51.6	31.1	40.1	44.1	-	No
City Hospital	432798 335014	Roadside (within hospital grounds), behind sign & flat	No	No	36.9	32.6	35.9		-	No
Uttoxeter New Road, near City Hospital	433004 335210	Roadside, next to bus stop, behind sign & flat	Yes	Yes	-	-	-	54.1	42.9	No
Uttoxeter New Road (Travel Lodge)	432798 335100	Roadside & flat	No	No	33.6	30.6	35.1	37.7	28.6	No
Uttoxeter New Road/ Rowditch Avenue	433264 335428	Kerbside, behind sign & flat	Yes	Yes	-	-	-	41.5	34.7	No

Table 23 - Part 9
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
California Gardens	433264 335492	Roadside, flat & suburban	Yes	Yes	-	23.2	28.6	-	-	Yes
Albany Road/ Kingsway	433473 335578	Roadside, flat & approx 15m from dwellings	No - just outside	Yes	31.9	30.9	27.2	35.1	24.6	No
Albany Road (middle)	433252 335100	Suburban, roadside & flat	No - just outside	Yes	31.5	25.8	29.4	29.2	22.1	No
St Albans Rd/ Manor Road	433238 335135	Roadside, behind sign & slightly downhill away from ring-road	No - just outside	Yes	46.4	39.5	38.5	38.0	32.0	No
St Albans Road (middle)	433287 335131	Roadside, flat & slightly further from ring-road	No	Yes	-	-	-	35.5	26.8	No

Table 23 - Part 10
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
150 Radbourne St (A38)	433117 336622	Façade, flat & 23m from A38	No	Yes	42.1	38.9	45.0	59.4#	32.3*	Yes
Balti International, Uttoxeter New Road/ Lonsdale Place	433768 335750	Façade, roadside & downhill	No	Yes	-	38.4	42.1	44.1	32.8	Yes
179 Uttoxeter New Road	433940 335824	Roadside & flat	No	Yes	-	35.6	39.3	36.7	32.9	No
Abbey Street, outside gas cylinder shop and opposite Ye Olde Spa Inn	434847 335688	Roadside, façade & flat	No	Yes	-	-	-	39.4	35.0	No
Burton Road/ Whittaker Gardens	434204 334906	Roadside & flat	No	Yes	-	-	-	34.5	31.4	No

* Change from lamp post to facade in January 2005 # Based on just 3 months of monitoring data

Table 23 - Part 11
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 ($\mu g/m^3$)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
International Hotel, Burton Road	434575 335129	Roadside & downhill	No	Yes	-	-	-	36.2	32.6	No
Burton Road/ Abbey Street junction	434836 335271	Roadside, flat & adjacent to NO_x analyser	Yes	Yes	57.8	44.5	59.3	53.4	44.5	No
Wine Rack, Burton Road	434677 335198	Roadside & downhill	No	Yes	-	40.7	44.1	40.7	34.6	Yes
Water Margin, Burton Road	435033 335532	Roadside & flat	Yes	Yes	44.0	37.9	46.4	45.0	37.2	No
41 Mount Street	435131 335407	Façade, roadside & flat	Yes	Yes	58.5	45.0	60.2	51.2	42.7	No
Brooks shop, Normanton Road	435278 335333	Façade & flat	No	Yes	41.3	35.6	43.2	41.4	33.3	Yes

Table 23 - Part 12
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 ($\mu g/m^3$)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Job Centre, Normanton Road	435192 335554	Roadside, flat & behind sign	Yes	No	63.6	55.4	61.8	73.3	55.1	Yes
Leopold St	435241 335505	Roadside & slightly downhill	Yes	Yes	46.7	34.9	41.3	43.8	36.2	No
Charnwood St	435376 335517	Façade & flat	Yes	Yes	54.8	45.4	57.8	54.5	35.9	No
Community Centre, Osmaston Road	435561 335382	Façade & flat	No	No	41.5	35.6	44.2	-	-	No
Osmaston Road, near Melbourne Street	435521 335485	Roadside & flat	Yes	Yes	-	-	-	60.6	51.8	No
Opticians, Osmaston Road/ Bourne Street	435438 335689	Roadside, behind sign & downhill	Yes	Yes	60.3	34.9	41.1	39.2	31.5	No

Table 23 - Part 13
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Bradshaw Way	435561 335591	Facade & uphill	Yes	No	45.7	38.6	38.7	41.2	32.5	Yes
London Road (church railings)	435782 335578	Roadside & flat	Yes	No	42	38.6	42.5	39.3	35.3	Yes
Strutts Pub, London Road/Traffic Street	435622 335677	Façade, roadside & flat	Yes	Yes	47.5	43.7	47.4	45.7	37.2	No
Liversage Place	435720 335689	Flat & suburban roadside, 20m from Traffic St.	Yes	Yes	36.3	36.6	33.8	35.9	32.3	Yes
Siddals Road, outside residential care home	436015 335873	Façade & flat	Yes - just inside	Yes	44.7	36.9	41.1	42.2	34.4	No

Table 23 - Part 14
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Jacobs/Zanzibar, London Road	435524 335763	Kerbside & flat	No	Yes	-	44.6	53.4	45.9	38.1	Yes
Morledge	435462 336131	Façade & flat	Yes - just inside	Yes	67.8	57.8	60.8	59.9	47.8	No
Tavern Pub, corner of Clarke Street	435782 336610	Façade, roadside & flat	Yes	Yes	43.5	43.3	46.6	43.2	34.1	No
Blind Association, St Alkmunds Way/ Eastgate	435622 336610	Façade, flat, roadside & concrete wall next to A52	Yes	Yes	48.7	38.9	40.7	40.6	32.4	No
31 Nottingham Road	435462 336708	Façade & flat	Yes	Yes	40.3	34.3	35.5	38.1	28.1	Yes
St Mary's Court	435266 336782	Roadside & downhill, next to underpass	Yes	Yes	43.7	37.3	46.3	43.1	36.2	No

Table 23 - Part 15
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (μg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Cavendish Court	434799 336475	Façade, flat & wall blocks off part of Ford St	No - just outside	Yes	35.5	32.1	37.5	32.0	24.2	No
Ford Street	434820 336501	Façade & flat	Yes	Yes	-	-	-	43.1	35.0	No
Friar Gate/ Uttoxeter Old Road (busy junction)	434356 336531	Façade, roadside & flat	No	Yes	-	-	-	46.2	37.5	Yes
Ford Street/ Friar Gate	434750 336340	Kerbside & flat	No	No	45.1	56.4	63.2	-	-	No
Stafford Street/ Uttoxeter New Road	434652 336094	Façade & flat	No	Yes	32.2	31.6	33.4	33.3	27.5	No
41/43 Talbot Street	434689 336057	Suburban roadside & flat	No	Yes	34.9	24.6	28.9	-	-	No

Table 23 - Part 16
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO_2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
Talbot Street - one-way sign	434693 336094	Roadside, flat & behind sign	No	No	-	-	-	37.8	29.7	No
Wilson Street	434922 335824	Former national network site, uphill & kerbside	No	Yes	29.9	31.2	39.4	-	-	No
Victoria Street (in middle of Corn Market)	435229 336156	Roadside & flat	No	No	43.5	39.0	37.5	-	-	No
Victoria Street/ H Samuels	435276 336172	Paved, flat & approx 10m from Victoria St	No	No	-	-	-	35.6	27.4	No
Duffield Road (Five Lamps)	434812 337067	Roadside, façade & flat	No	Yes	-	38.5	43.5	46.9	37.3	Yes
Belper Road (Five Lamps)	434861 337077	Roadside, next to large stone wall & flat	No	Yes	-	30.8	30.3	35.1	27.2	No

Table 23 - Part 17
Annual Average NO_2 Diffusion Tube Results for 2001 to 2005 (µg/m^3)

Diffusion Tube Location	Grid Ref	Monitoring Site	Within Existing NO2 AQMA?	Relevant exposure within 10m?	2001	2002	2003	2004	2005	Detailed Assessment required?
St Marks Road	436531 336696	Former national network site, roadside & flat	No	Yes	39.9	33.2	36.3	-	-	No
St Andrews View	437121 337678	Former national network site, façade & flat	No	Yes	-	30.7	28.7	-	-	No
Gladstone Street	434237 334261	Former n. network, flat, suburban & behind sign	No	Yes	29.6	27.6	21.6	22.1	19.4	No
Friary Street - opposite Celtic House	434771 336243	Former n. network site, roadside, flat, façade & behind sign	No	Yes	34.1	29.0	41.5#	45.4	42.0	Yes

change in monitoring location from lamp post close to Celtic House, to lamp post on the corner of Stafford Street/Friary Street

5.0 ANALYSIS OF RESULTS

5.1 COUNCIL HOUSE

The annual average objective of 40µg/m^3 was exceeded at the Council House monitoring station in 1999 and again in 2003. However, there is no relevant public exposure in the locality.

Since 1999 there has been a downward trend in annual average NO_2 concentrations recorded at the Council House. This is with the exception of 2003, when there was an unusually high annual average of 42.9µg/m^3. This was likely to have been due to meteorological factors, which caused elevated NO_2 and PM_{10} concentrations throughout the UK in 2003.

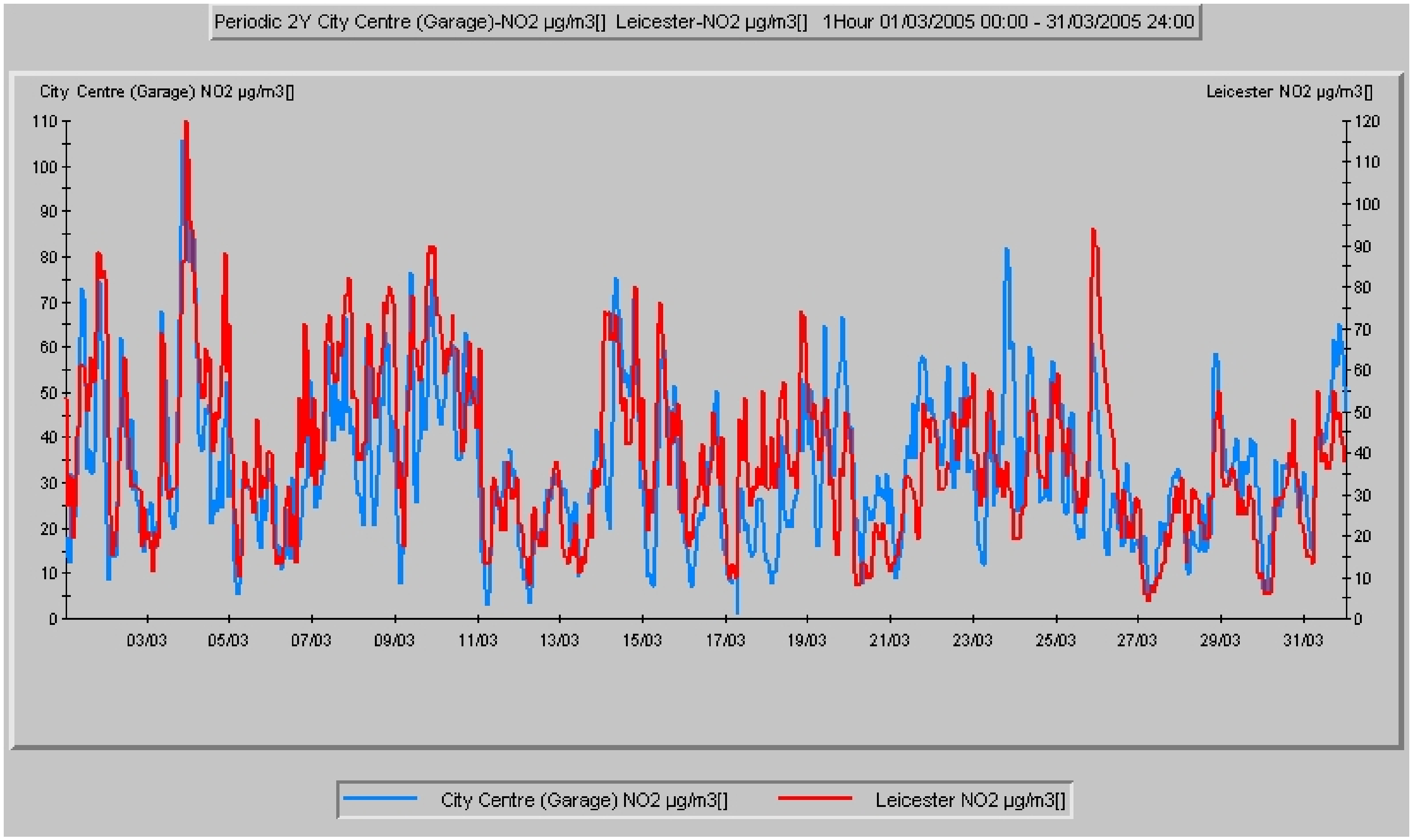
Although pollutant concentrations tended to be higher than normal during 2003, Defra does not consider 2003 pollution levels to be outside of the normal year-to-year variations seen over a long period of time. Although unusual, this situation is therefore likely to be repeated in future years.

With regard to the hourly NO_2 standard of no more than 18 exceedences of the 1-hour mean of 200µg/m^3 per year, no breach of the standard has been recorded in any year. This is to be expected, given that the hourly standard is considered to be easier to meet than the annual average.

Graphs 2 and 3 show significant regional correlation between the hourly NO_2 concentrations recorded at Derby's Council House, and those recorded at Leicester's and Nottingham's AURN sites. This is probably due to both regional weather patterns and diurnal NO_2 concentrations associated with the morning and afternoon 'rush hours.' The graphs also show reduced NO_2 concentrations at weekends (e.g. 12-13 March, 26-27 March, 7-8 May, 14-15 May and 21-22 May), when road traffic flows are reduced.

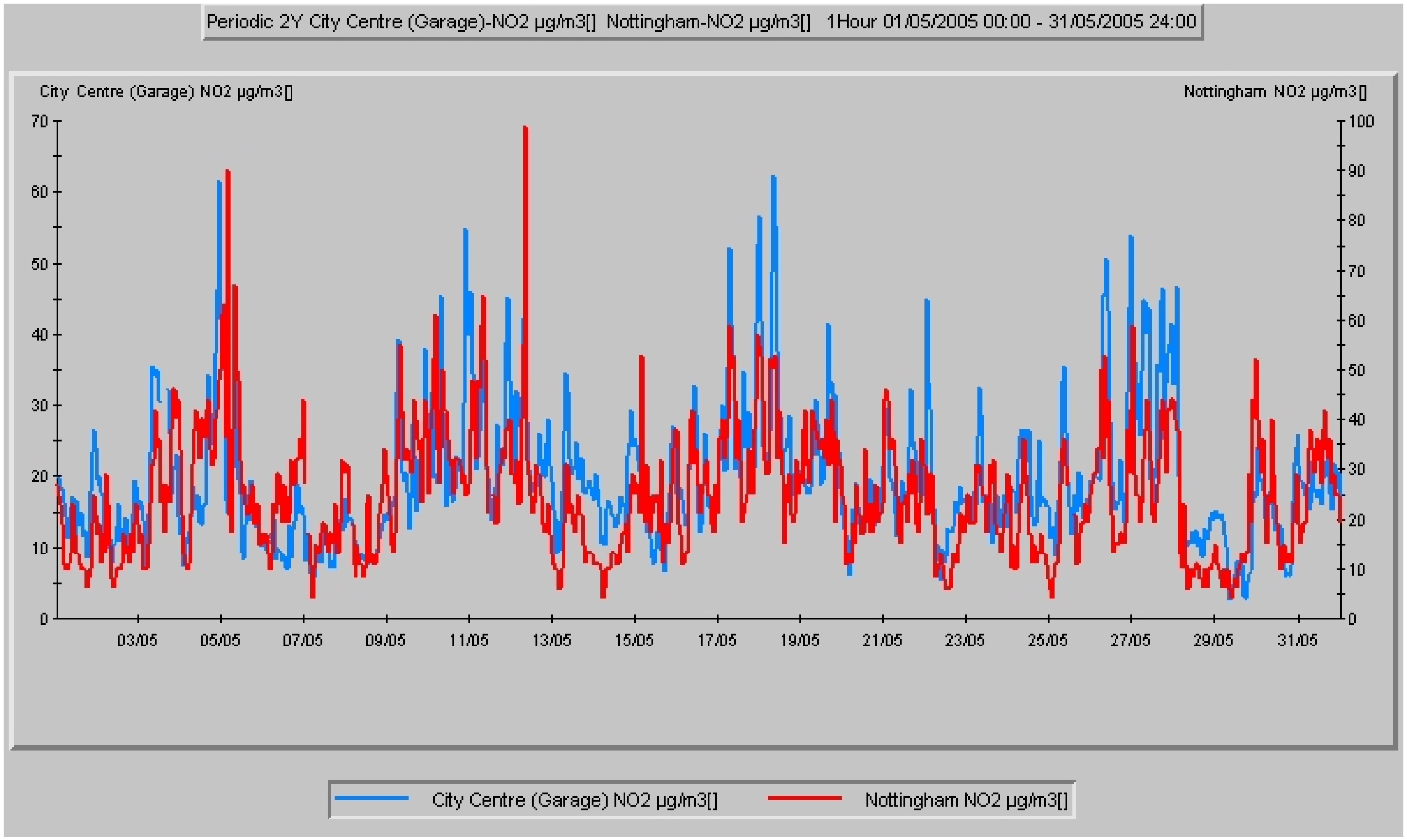
Graph 2

Council House versus Leicester NO_2 Results, 1 - 31 March 2005



Graph 3

Council House versus Nottingham NO_2 Results, 1 - 31 May 2005



5.2 WARWICK AVENUE

The Warwick Avenue NO_x analyser was commissioned on 1 October 2004. For the 3-month period until the end of 2004, an average NO_2 concentration of 39.7µg/m^3 was recorded. This was similar to the 2005 annual average NO_2 concentration of 38µg/m^3 for the same location.

Importantly, neither the 2004 or 2005 values exceed the annual average standard of 40µg/m^3. This is to be expected for this particular monitoring location, because the monitoring station is located 73 metres from the busy Warwick Avenue/Burton Road junction.

Since NO_2 concentrations significantly decrease with distance from busy junctions, the 2005 annual average NO_2 concentration of 38µg/m^3 is far lower than the 55.6µg/m^3 recorded by the Warwick Avenue/Burton Road diffusion tube. This diffusion tube is only 6 metres from the junction.

Unfortunately, physical constraints meant that it was not possible to site the monitoring station any closer to the Warwick Avenue/Burton Road junction, where pollution levels are likely to be higher.

Although the annual average NO_2 concentrations recorded at Warwick Avenue are below those experienced at the busy junction, they are close to the 40µg/m^3 standard. This affects a newly constructed apartment block, which is only 4 metres to the west of the station.

The reasons for the relatively high NO_2 concentrations at Warwick Avenue are:

1) When the traffic lights on Warwick Avenue are on red, there are often 4 lanes of (northbound) stationary road-traffic adjacent to the monitoring station. At the same time, there may also be 2 lanes of free-flowing southbound traffic.

2) When the same traffic lights change to green, the NO_x analyser records a clearly discernable peak in NO_2 exhaust emissions, which are associated with acceleration from a standing start. This problem is exacerbated by the uphill gradient on Warwick Avenue.

3) The uphill gradient also means that for those northbound vehicles queuing at the traffic lights that do not use their handbrake, they have to use their clutch instead. This may also have an adverse effect upon road-traffic exhaust emissions.

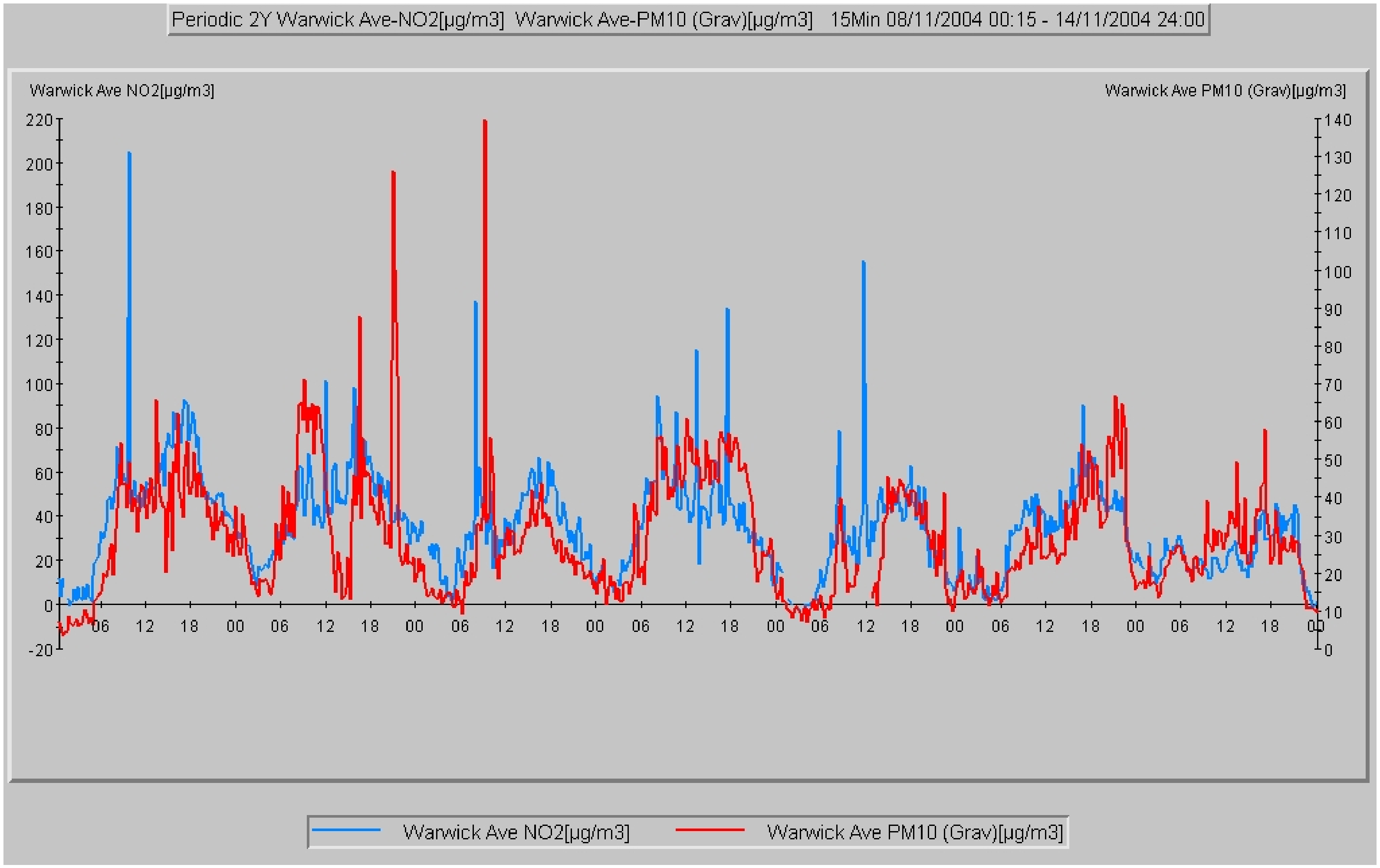
With regard to the hourly NO_2 standard, there was no breach recorded in either 2004 or 2005.

A comparison of the NO_2 and PM_{10} results from the Warwick Avenue NO_x and TEOM analysers is provided shown in Graph 4. As expected, there is a strong correlation between road-traffic generated NO_2 and PM_{10}.

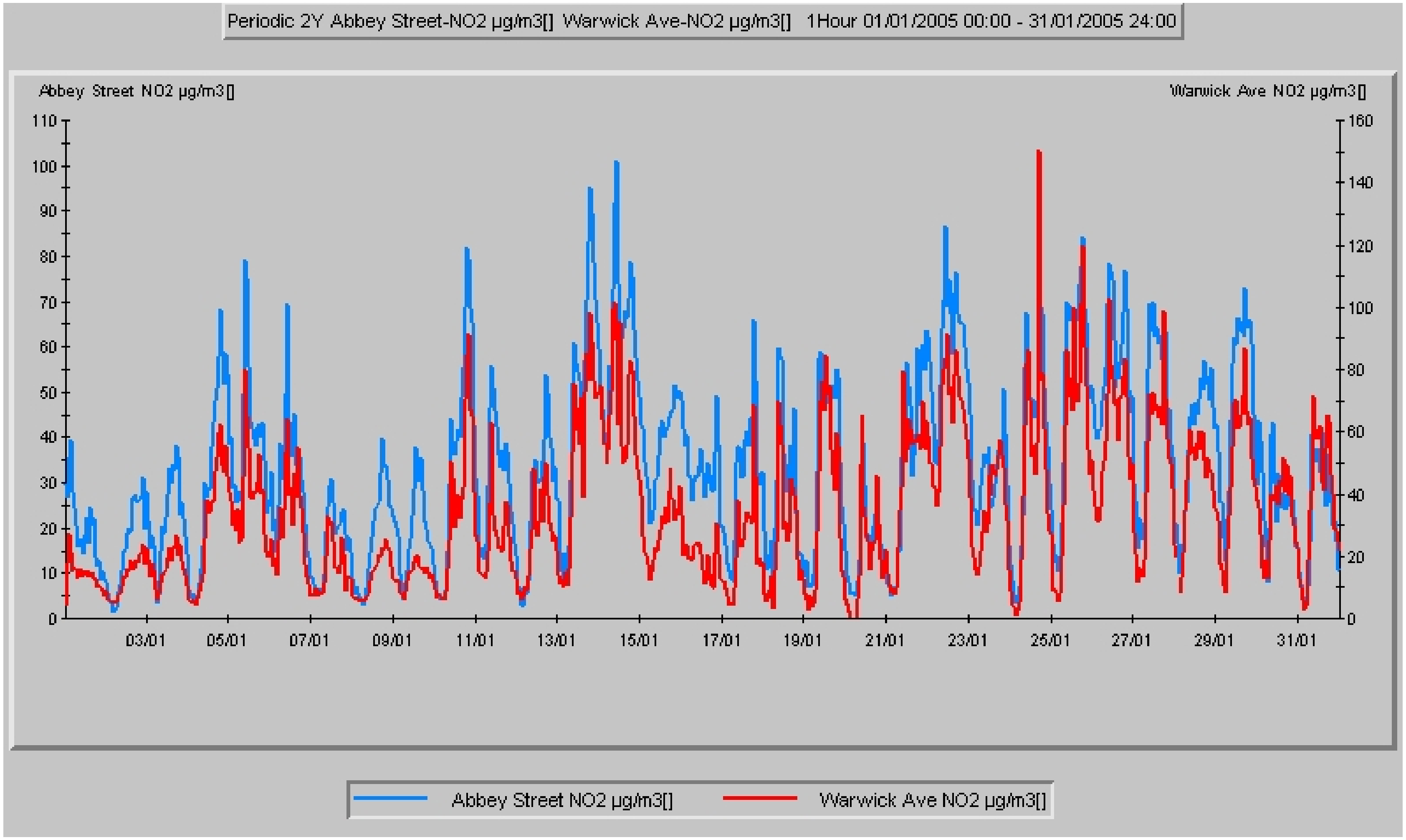
The Warwick Avenue and Abbey Street NO_2 concentrations are compared in Graph 5. A high degree of correlation is evident, presumably due to Warwick Avenue and Abbey Street being linked together by Burton Road.

Significant correlation is also evident between the NO_2 concentrations recorded at Warwick Avenue and at Leicester's and Nottingham's urban background AURN sites. This is shown in Graphs 6 and 7.

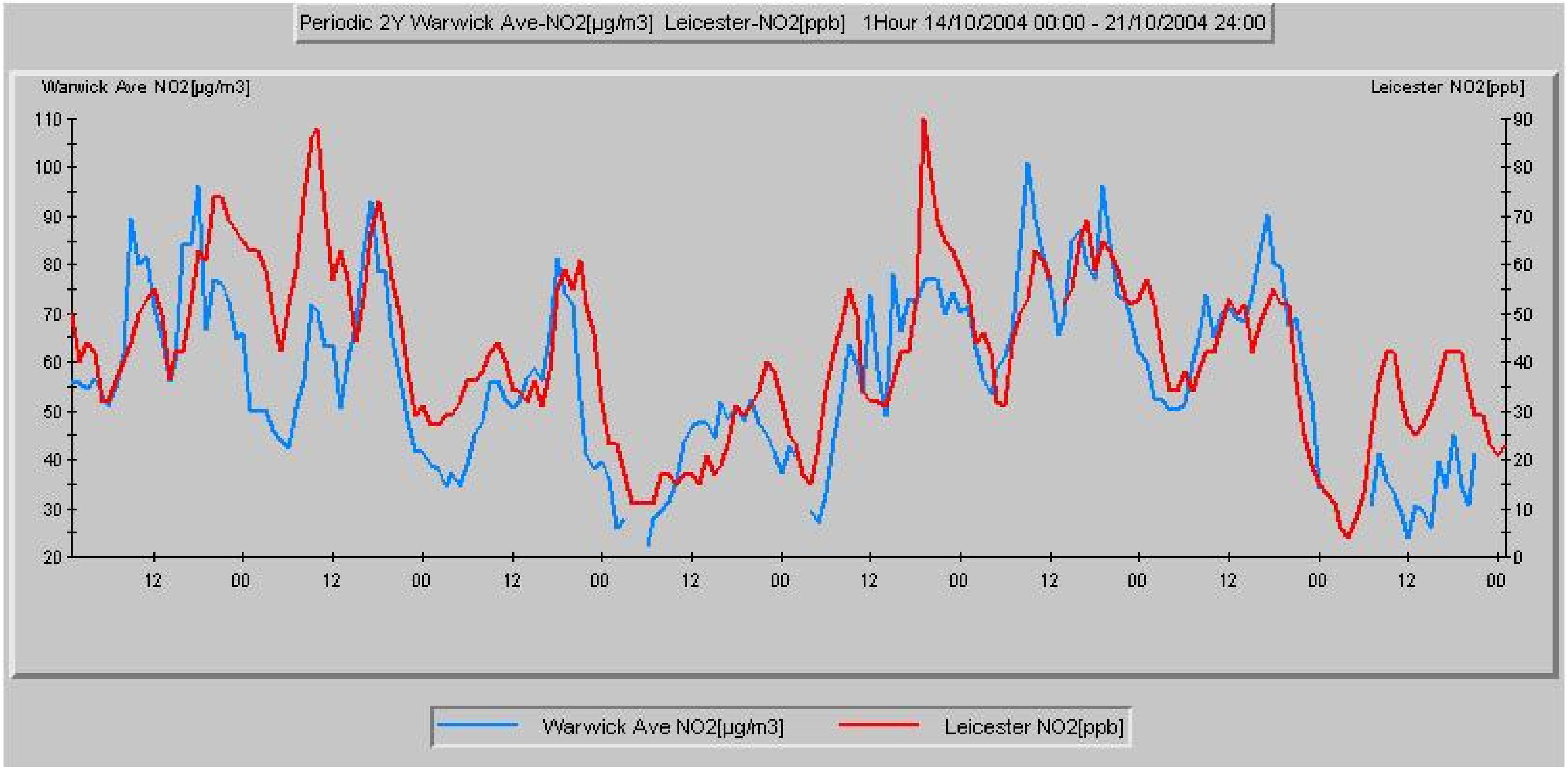
Graph 4
Warwick Avenue NO_2 and PM_{10} (grav) Concentrations, 8 - 14 November 2004



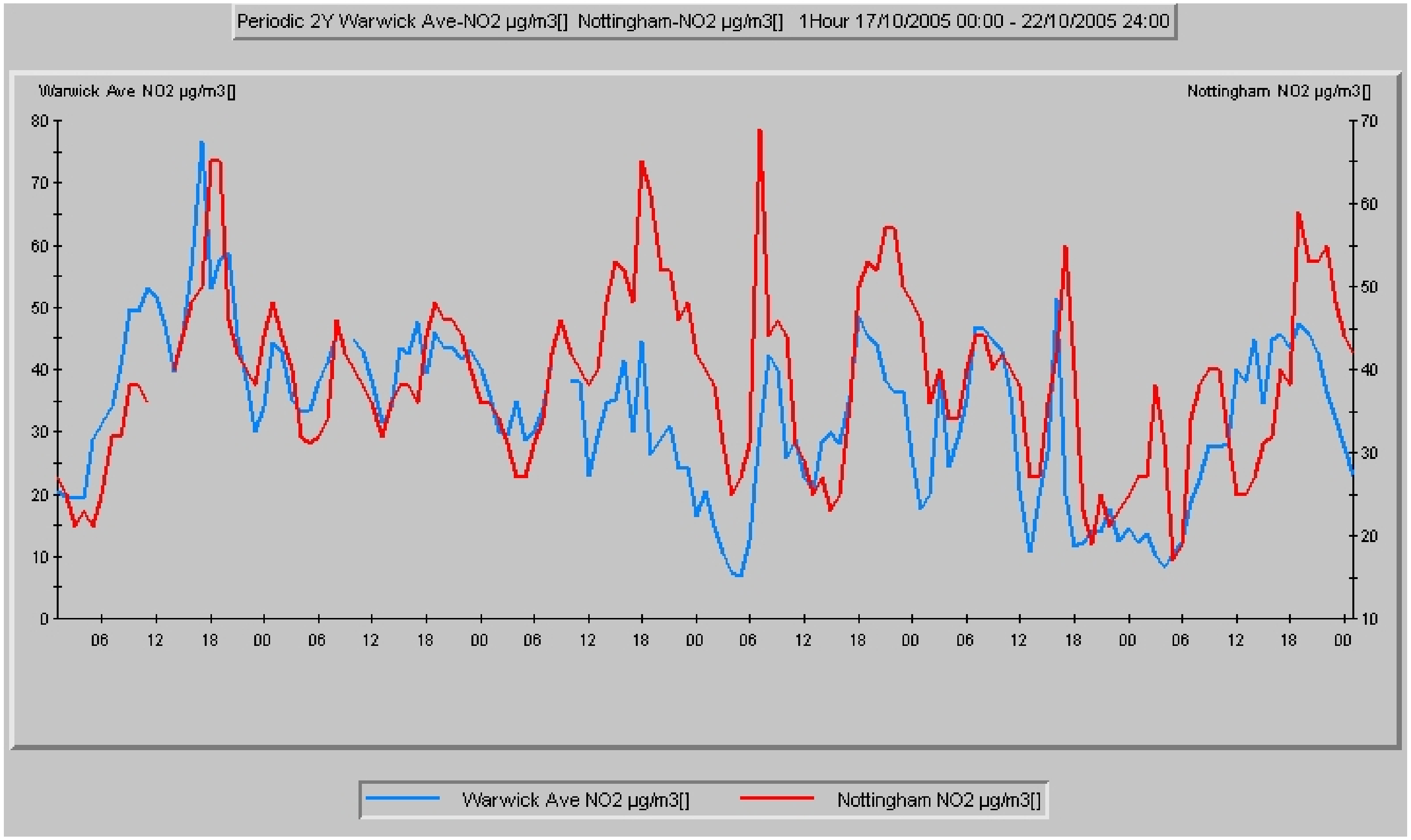
Graph 5
Warwick Avenue versus Abbey Street, 1 - 31 January 2005



Graph 6
Warwick Avenue and Leicester NO_2 Concentrations,
14 - 21 October 2004



Graph 7
Warwick Avenue and Nottingham NO_2 Concentrations, 17 - 22 October 2005



5.3 ABBEY STREET

The Abbey Street continuous NO_x analyser was commissioned on 8 October 2004. For the remainder of 2004, it recorded an average NO_2 concentration of 52.6µg/m^3. In comparison, it recorded a 2005 annual average NO_2 concentration of 40.1µg/m^3, both of which exceed the annual average standard.

The kerbside NO_2 diffusion tube at the Burton Road/Abbey Street junction, also recorded exceedences of the annual average standard each year between 2001 and 2005. These values ranged from 44.5 to 59.3µg/m^3.

This has important implications for the residents of 202 Burton Road. Given the facade location of this analyser, it means that this particular property needs to remain within the Inner Ring-Road NO_2 AQMA.

Although there is a substantial difference between the 2004 and 2005 continuous NO_x analyser results, 2005 data is more likely to be accurate and therefore representative of future annual mean NO_2 concentrations. This is due to its longer sampling period of 12 months, as compared to just under 3 months for the 2004 average.

In comparison to the kerbside NO_x analyser at Warwick Avenue, the roadside site at Abbey Street consistently records slightly higher NO_2 concentrations. This was unexpected given that it is slightly further from the kerb and traffic flows are slightly lower (AADT of 20,547 versus 25,827). This difference may be due to:

1) The roadside Abbey Street analyser being sited adjacent to the busy junction at Abbey Street/Burton Road, whereas Warwick Avenue is 73 metres to the south of the junction.

2) The facade of 202 Burton Road is immediately adjacent to the Abbey Street monitoring station. This means that this monitoring location displays elements of the ‘Street Canyon Effect,’ inhibiting the dispersion of the road-traffic exhaust emissions.

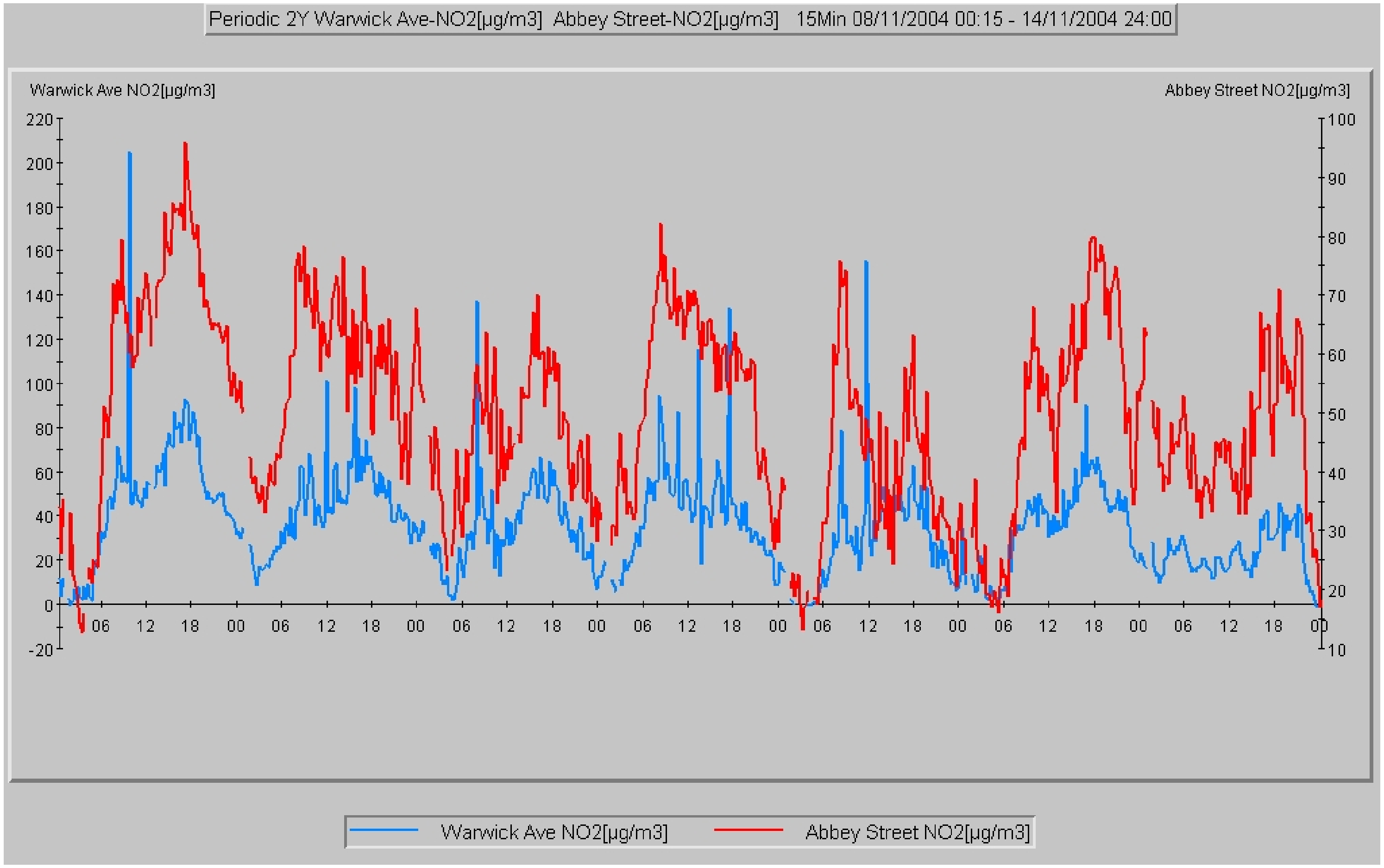
3) The vehicles at Abbey Street are distributed over fewer lanes of traffic. For those traffic lanes further from the kerbside, the increased distance increases dispersion of the associated road-traffic exhaust emissions.

4) Abbey Street is on the inner ring-road and is therefore closer to the centre of Derby, as compared to Warwick Avenue. This is why the National Atmospheric Emissions Inventory determined that the 2005 NO_x and NO_2 urban background concentrations were higher at Abbey Street than Warwick Avenue.

With regard to the hourly NO_2 standard, there was no breach recorded in either 2004 or 2005.

The monitoring results for both Abbey Street and Warwick Avenue follow a clearly defined diurnal pattern, which is associated with the morning and afternoon ‘rush hours.’ This pattern is replicated throughout the year, with a high degree of consistency and is shown in Graph 8.

Graph 8
Warwick Avenue and Abbey Street NO_2 Concentrations,
8 - 14 November 2004



5.4 BIAS CORRECTION FACTORS

The 2005 bias correction factor of 0.81 significantly reduced the annual average NO_2 concentrations recorded by the diffusion tubes. Consequently, just 11 of the 78 monitoring locations (14%) exceeded the 40µg/m^3 standard in 2005. This is as compared to 2004, when 42 of the 80 monitoring locations (53%) exceeded 40µg/m^3 and a bias correction factor of 0.99 was used.

In 2003, 33 of the 69 monitoring locations (48%) exceeded the 40µg/m^3 standard. This figure is not however directly comparable with either the 2004 or 2005 figures. This is due to both a significant change in monitoring locations between 2003 and 2004, and meteorological factors which affected 2003 data.

The 2003 network of NO_2 diffusion tubes was corrected for systematic error, using a bias correction factor of 1.00. Data collection problems with the Council House NO_x analyser meant that this correction factor was based upon 6 other UK co-location studies. Four of these co-location studies were urban background monitoring sites, to ensure comparability.

Table 22 shows that the 2005 bias correction factor of 0.81 is low, in comparison to the factors applied between 2000 and 2004. It is however still within the accepted +/-30% range of NO_2 diffusion tubes, and may have been affected by the change from an urban background location to 2 roadside co-location studies.

Table 24, Bias Correction Factors

2000	2001	2002	2003	2004	2005
0.87	1.04	0.9	1.00	0.99	0.81

Since the City's NO_2 diffusion tubes are primarily in roadside locations, it is likely that the roadside based co-location factor is more accurate.

5.5 NITROGEN DIOXIDE DIFFUSION TUBES

Five years of NO_2 monitoring data have now been collated between 2001 and 2005. With such a comprehensive dataset, it is possible to identify any trends that may exist.

Across Derby's network of bias-corrected NO_2 diffusion tubes, between 2001 and 2005, there is clear evidence of a year-on-year downward trend in annual average NO_2 concentrations. This is shown in Graph 11 later in this report, on page 145. It also fits in with the national reduction in road-traffic related NO_2 emissions during this time.

This reduction in NO_2 emissions is evident at Morledge, where annual average NO_2 concentrations of 67.8 µg/m^3, 57.8µg/m^3, 60.8µg/m^3, 59.9µg/m^3 and 47.8µg/m^3 were recorded between 2001 and 2005. Similarly, at Lord Street the NO_2 concentrations were 51.7µg/m^3, 41.1µg/m^3, 53.3µg/m^3, 42.2µg/m^3 and 35.3µg/m^3 for the same period.

The year-on-year decrease in annual average NO_2 concentrations are probably attributable to significant improvements in exhaust emission technology. These improvements have counteracted the increase in traffic growth during the same period.

At a small number of monitoring locations in Derby, the downward trend in annual average NO_2 concentrations is not as obvious:

For example, between 2001 and 2005, the diffusion tube located adjacent to the Job Centre on Normanton Road, recorded annual average NO_2 concentrations of 63.6µg/m^3, 55.4µg/m^3, 61.8µg/m^3, 73.3µg/m^3 and 55.1µg/m^3. However, this may have been caused by local circumstances on this part of the road network at this time.

Across the NO_2 monitoring network, it is evident that the highest façade level experienced between 2001 and 2005 was the 67.8µg/m^3 concentration recorded at Morledge in 2001. In 2003, Mount Street also recorded a high annual average NO_2 concentration of 60.2µg/m^3.

In order to enable the NO_2 AQMAs to be revoked, there would need to be confidence that the annual average NO_2 concentration would not be likely to exceed of 40µg/m^3 at any locations of relevant public exposure within the city.

The 2001 diffusion tube result for Morledge was the highest NO_2 facade concentration recorded between 2001 and 2005, thereby representing worst-case. On this basis a reduction in annual average NO_2 concentrations of 17.8µg/m^3 is required to enable the existing NO_2 AQMAs to be revoked.

However, to be confident that no further exceedences of 40µg/m^3 will occur in the future, a target of 36µg/m^3 is more appropriate. An overall reduction of 21.8µg/m^3 is therefore required.

In 2005, the co-location studies at Abbey Street and Warwick Avenue resulted in a low bias correction factor of 0.81 being applied to the diffusion tube network. Should this trend continue in future years, then a reduction of 21.8µg/m^3 is indeed likely to be an over-estimate. Whether this happens remains to be seen.

The results from the NO_2 monitoring network demonstrate that within the 2 existing NO_2 AQMAs, there are a number of pollution 'hotspots.' These are primarily associated with busy junctions, although gradient and high AADT values are other contributing factors to local exceedences of the annual average standard.

Busy junctions are often pollution hotspots, due to a combination of congestion and vehicles accelerating from a standing start. There is a significant decrease in annual average NO_2 concentrations with distance from these busy junctions. This is clearly evident at the junction of Warwick Avenue and Burton Road.

The diffusion tube on Warwick Avenue is only 6 metres from the junction and recorded a 2005 annual average NO_2 concentration of 55.6µg/m^3. The Warwick Avenue continuous NO_x analyser is 73 metres from the junction and recorded a lower 2005 annual average NO_2 concentration of 38µg/m^3.

In addition to busy junctions, busy roads also have an important role to play in elevated annual average NO_2 concentrations.

For example, the diffusion tube at Liversage Place is 20 metres from Traffic Street, which is a busy road. Traffic Street suffers congestion for extended periods, forming part of the inner-ring road. Conversely, Liversage Place is a quiet suburban street. However, its proximity to Traffic Street and its relatively open location means that this site still recorded 2001 to 2005 annual average NO_2 concentrations of between 32.3 and 36.6µg/m^3.

Road gradient also appears to be an important factor that affects annual average NO_2 concentrations.

For example, Manor Road is on the outer ring-road and is downhill on the approach to the Manor Road/Uttoxeter New Road junction. The adjacent diffusion tube at Eastwood Drive did not record any exceedences of the standard between 2001 and 2005. This is likely to be due to a combination of a reduced need to accelerate on this downhill section and the traffic generally being free-flowing on this part of the outer ring-road.

6.0 PROPOSED CHANGES TO NO_2 AIR QUALITY MANAGEMENT AREAS

6.1 Monitoring versus Dispersion Modelling

The monitoring results for the Council House, Warwick Avenue and Abbey Street NO_x analysers have confirmed that there is no likelihood of a breach of the hourly NO_2 standard in Derby. However, this is not the case with the 2005 annual average NO_2 standard of 40µg/m^3.

The first Review and Assessment in 2000 identified that road-traffic related NO_2 caused exceedences of the 2005 standard at many dwellings in the vicinity of both the inner and outer ring-roads. As a result, an NO_2 Air Quality Management Area was declared. This in turn was subsequently split into the existing Inner and Outer NO_2 Air Quality Management Areas.

The second Review and Assessment produced the 2003 Updating and Screening Assessment (USA). As a result, the need for this Detailed Assessment for NO_2 was identified.

The initial element of this Detailed Assessment reconsiders the conclusions of this USA, in the light of 2003 to 2005 NO_2 monitoring data now available. Tables 2 to 12, 16 and 17 present these findings. This identifies a number of specific roadside locations, where consideration needs to be given to:

1 Extending parts of the 2 existing NO_2 AQMAs
2 Revoking parts of the 2 existing NO_2 AQMAs
3 Declaring a new NO_2 AQMA

In order to determine the geographical extent of likely exceedences and therefore the boundaries of these AQMAs, a pragmatic approach has been adopted.

Following consultation with the Review and Assessment Helpdesk, a methodology has been adopted, which relies solely upon local NO_2 data from the City Council’s monitoring network (Reference 4).

Dispersion modelling is not considered appropriate for this Detailed Assessment for the following reasons:

1. The recent revision of LAQM TG(03) states that ‘As the attainment year for some of the objectives has now been reached, it is expected that increasing reliance will be placed upon monitoring data, as opposed to modelling predictions (Reference 7).’

2. Comprehensive NO_2 monitoring data is available for 2001 to the objective year of 2005. This network has been improved year on year. In 2005, it consisted of both a roadside, kerbside and urban background NO_x analyser, as well as 86 NO_2 diffusion tubes at 80 monitoring locations.

3. Road-traffic related annual average NO_2 concentrations decrease rapidly with distance from the kerbside. By plotting annual average NO_2 concentrations against distance from kerbside, it is possible to determine the maximum distance at which an exceedence of the annual average NO_2 standard is likely to occur.

4. Dispersion modelling is unable to predict pollutant concentrations beyond roadside facades and therefore cannot predict pollutant concentrations in, for example, rear gardens.

5. The NO_2 monitoring network already provides extensive monitoring data for kerbside, roadside and façade locations. There is therefore little benefit to be gained from using dispersion modelling to predict pollution concentrations at these locations.

6. Although dispersion modelling can be used to predict future year concentrations, this is not necessary in terms of LAQM TG(03). Nevertheless, consideration is given to the 2011 scenario in the next section.

7. Although the accuracy of dispersion modelling can be increased through verification of its outputs against local monitoring data, it is still inherently inaccurate. A difference between the monitored and modelled results as low as +/-25% is extremely difficult to achieve in practice and a factor of up to +/-100% is more commonly achieved.

6.2 Methodology for Drawing AQMA Boundaries

In accordance with both advice from the Review and Assessment Helpdesk and the NSCA's guidance on Air Quality Management Areas, the boundary of an AQMA should be declared using physical features outside of the zone of +/-1 standard deviation of the NO_2 annual average objective of 40µgm^3 (Ref 4 & 5).

In the case of exceedences of the annual average NO_2 standard of 40µg/m^3, the Review and Assessment Helpdesk have therefore advised that 36µg/m^3 is used to set the minimum geographical extent of the AQMA (Reference 4).

The use of the 36µg/m^3 contour as the boundary of the AQMA, provides sufficient margin for error to ensure that all exceedences are included within the AQMA. It also provides sufficient flexibility to enable the boundary of the AQMA to be defined by physical features where appropriate.

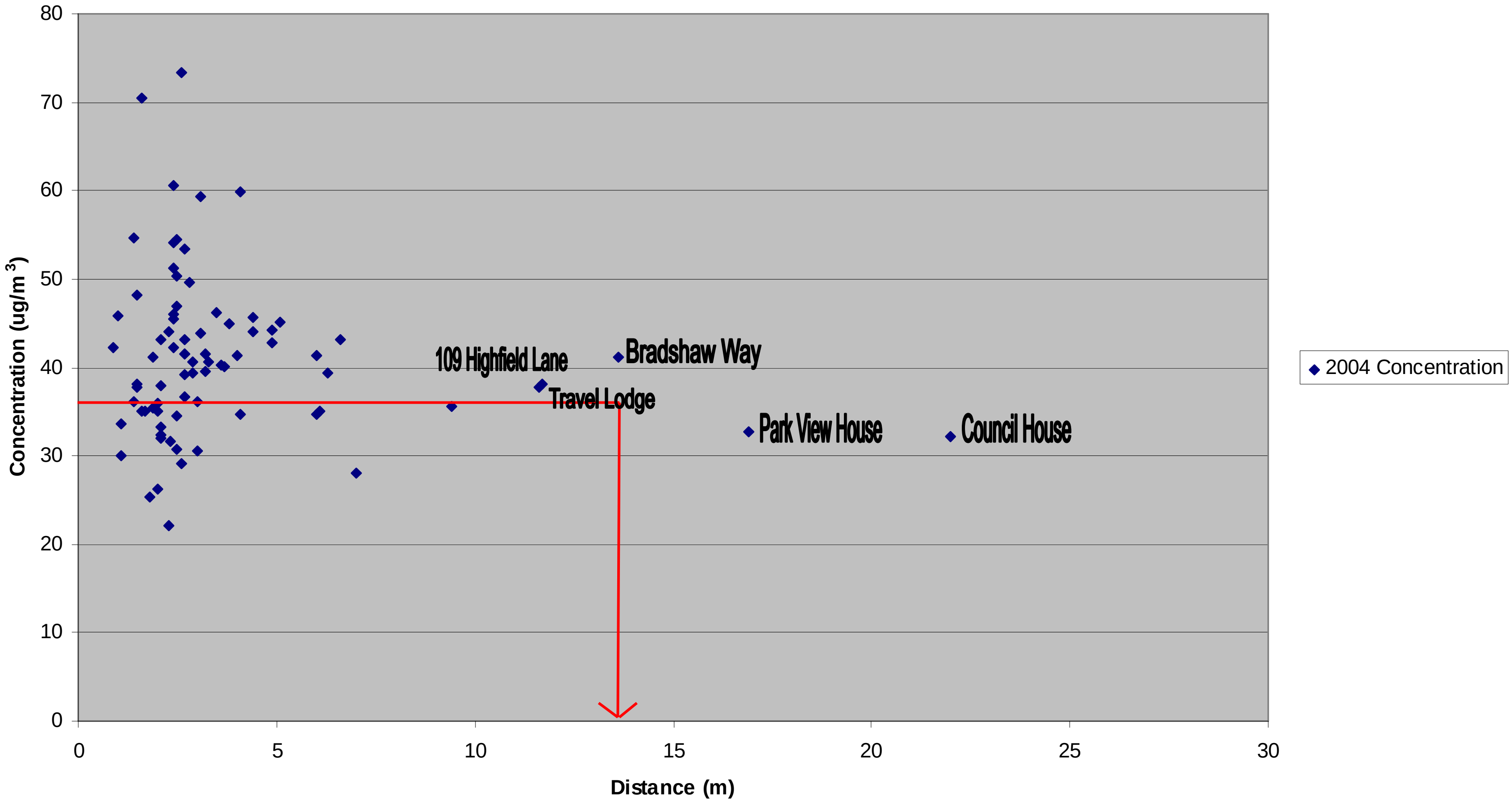
In order to determine the maximum distance from kerbside, where there is a likelihood of an exceedence of the 36µg/m^3 annual average NO_2 contour, Graphs 9 and 10 have been produced. They plot annual average NO_2 concentrations against distance to the nearest kerbside, for all of the 2004 and 2005 sites.

The 2004 plot represents reasonable worst-case, due to a higher bias correction factor of 0.99 having been applied to the 2004 diffusion tube monitoring data. The lower bias correction factor of 0.81 was applied to the 2005 data. Although this 2005 factor is considered more accurate and more likely to be repeated in future years, this cannot be guaranteed.

A bias correction factor of 1.00 was used in 2003. This was also a year of high pollution, due to the impact of meteorological conditions. Although 2003 therefore represents true worst-case, there is sufficient margin of error in the 2004 plot of distance from kerbside, that this additional plot was not required.

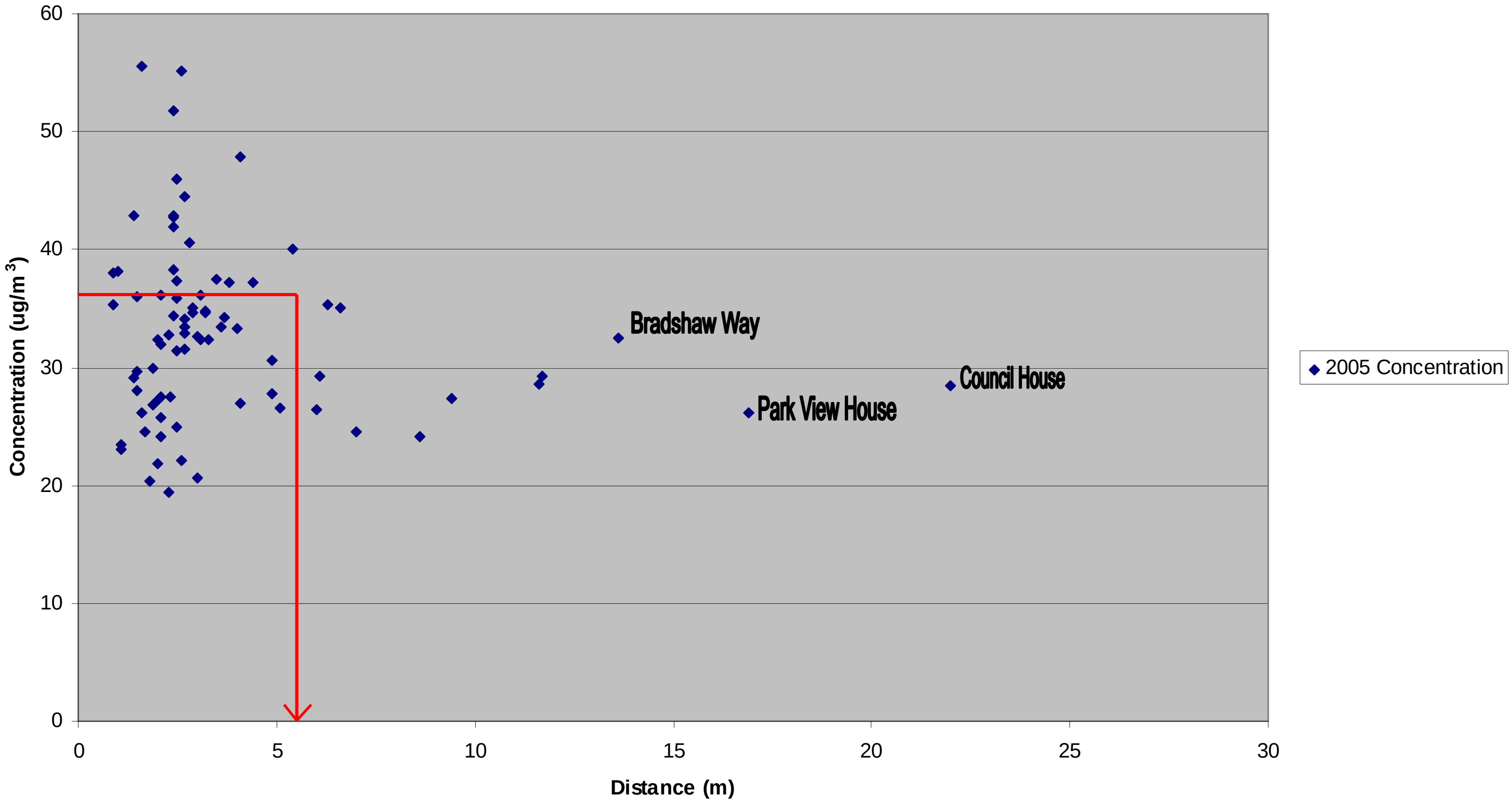
Graph 9

2004 NO_2 Concentrations Against Distance to Kerbside



Graph 10

2005 NO_2 Concentrations Against Distance from Kerbside



The kerbside, roadside and facade monitoring locations used in the 2004 and 2005 NO_2 monitoring network, measure annual average NO_2 concentrations at a range of road-traffic pollution hotspots across the city. These monitoring locations are therefore taken to represent ambient NO_2 concentrations at busy junctions and busy roads in Derby.

In 2004, it is evident that beyond a distance of 14 metres of the kerbside, no monitoring locations recorded an annual average NO_2 concentration greater than 36µg/m^3. This is in contrast to 2005, when beyond a distance of 5.5 metres, no monitoring locations recorded an annual average NO_2 concentration greater than 36µg/m^3.

In 2004, although all exceedences of 36µg/m^3 are within 14 metres of the kerbside, the majority are within 9 metres. The exceptions are Bradshaw Way, 109 Highfield Lane and the Travel Lodge site on Uttoxeter New Road, which all have unusually high NO_2 concentrations for their distance from the kerbside

However, all of these monitoring locations are adjacent to dual-carriageways and therefore generally higher traffic flows. Bradshaw Way is an urban dual carriageway, which is located on an uphill gradient between 2 roundabouts. 109 Highfield Lane is adjacent to the A52 dual carriageway. The Travel Lodge site is adjacent to Uttoxeter New Road, which is an urban dual carriageway.

Although the 2004 annual average for the Council House site was less than 36µg/m^3, it is still unusually high for the distance from kerbside. This anomaly may be explained by this monitoring station being adjacent to a car park, as well Morledge being an urban dual carriageway.

Taking the worst case scenario of 2004 and Bradshaw Way, in future years it is unlikely that there will be an exceedence of 36µg/m^3, at any location beyond 14 metres of the kerbside in Derby. On this basis, it is even more unlikely that there will be an exceedence of the 2005 standard of 40µg/m^3. This is equally true for both busy junctions and busy roads.

Although this '14 metre' rule is based upon Derby's monitoring results, it is anticipated that it is equally applicable to other UK conurbations of a similar size.

The rapid decrease of road-traffic pollution with distance from kerbside, underpins guidance note LAQM TG(03). For example, it states that for conurbations with less than 2 million people, an exceedence of the annual mean NO_2 objective is only likely within 10 metres of the kerbside of busy junctions.

Work undertaken by Air Quality Consultants Limited in 2002, also concluded that outside of major conurbations, exceedences of the NO_2 annual mean objective are unlikely further than 9 metres from the kerbside of single carriageway roads (Reference 1). They also conclude that outside of major conurbations, exceedences of the NO_2 annual mean objective are unlikely beyond 5 metres of dual-carriageways.

Using all of this information, a pragmatic decision has been taken that 14 metres represents realistic worst-case. This is on the basis that:

1. The 1 standard deviation principle has been employed, using an annual mean NO_2 concentration of 36µg/m^3.

2. The 2004 monitoring data used a bias correction factor of 0.99. For the years 2000 to 2005, a higher bias correction factor was only used in 2001.

3. Of all the monitoring locations, in 2004, the Bradshaw Way site represents the greatest distance from kerbside at which 36µg/m^3 was exceeded.

   Although its 2004 annual average is 5.2µg/m^3 greater than the 36µg/m^3 target, Bradshaw Way is an urban dual carriageway located on an uphill gradient between 2 roundabouts. This unique set of circumstances means that 14 metres is still considered to represent the maximum distance from kerbside, at which an exceedence of 36µg/m^3 is likely.

14 metres therefore represents reasonable worst case, so it is this distance which forms the basis for drawing the revised AQMA boundaries. The following rules have been introduced to assist this process:

1 The list of busy roads and junctions requiring consideration, are either within the 2 existing AQMAs, or are identified through the revised 2003 USA in Tables 2 to 12, 16 and 17.

2 Wherever a facade of a dwelling, school or nursery is within 14 metres of the kerbside of any 'busy' junction or busy road, the whole property should be included in the AQMA.

Conversely, any dwelling facade which is further than 14 metres from kerbside should be excluded from the AQMA. These dwellings are unlikely to experience an exceedence of the standard, due to both distance from kerbside and roadside buildings acting as physical barriers to the dispersion of exhaust emissions.

This approach differs to that used when the original AQMAs were declared, which relied upon dispersion modelling. The existing AQMAs include dwellings that are not immediately adjacent to busy junctions, as at Spider Island and the Blue Peter Islands.

3 Although it is only the roadside facades of properties which are likely to exceed the standard, the whole of these premises and their rear gardens should be included in the AQMAs. This is unchanged from when the original AQMAs were declared and simplifies identification of the boundary of each AQMA.

4 Land where there are no dwellings, schools, nurseries or hospitals, should be excluded from the AQMA. At such locations adjacent to busy junctions and roads, the boundary of the AQMA should therefore be pulled back to kerbside. This is unchanged from the original AQMAs.

In those locations where the AQMA includes an area of one or more adjacent roads, the non-sensitive receptors in this area will need to be included within the AQMA. Otherwise, the AQMA will contain a series of gaps in such localities.

5 Include all residential developments at roadside locations within the AQMAs, where planning permission has been granted. This is because these developments may introduce relevant public exposure within 14 metres of kerbside.

6 In accordance with advice from the Modelling Helpdesk, exclude the temporary air quality impacts associated with the building of new developments (Reference 6). Consequently, the AQMA boundary does not consider either the temporary relocation of the City's bus station, or the road-works associated with the Inner Ring Road Maintenance Scheme (IRRIMS).

The final impact of these schemes upon local air quality, will continue to be assessed through the City Council's air quality monitoring network.

7 Exceedences are considered more likely at busy junctions than along the associated busy roads. Nevertheless, roads which link busy junctions should still be included within the AQMAs, where the distances involved are relatively small and there is relevant public exposure along them.

This approach avoids the creation of a substantial number of smaller separate AQMAs. Although these AQMAs would clearly identify pollution hotspots, this would complicate the Review and Assessment process because:

- Problem sections of the road network would not be considered in their entirety, which is a requirement of the subsequent NO_2 Action Plan.

- Affected dwellings would be more likely to be excluded from an AQMA, on the basis that they were not immediately adjacent to an identified pollution hotspot.

- Artificially small AQMA boundaries would be created, which would be more likely to require changes in future years. This would not be cost effective, as such changes would have little impact upon the actions required to revoke the AQMA in the subsequent NO_2 Action Plan.

6.3 Proposed Changes to the NO_2 AQMAs

On the basis of the analysis contained within this Detailed Assessment, it is proposed to:

1. Revise the 2 existing Inner and Outer Ring-Road NO_2 AQMAs. This will involve joining them together along Osmaston Road, as well extending them in some places and reducing them in others.

2. Designate a new road-traffic related NO_2 AQMA in Spondon, which is physically separate to the revised Inner and Outer Ring-Road AQMA. This second smaller AQMA will include dwellings close to both Brian Clough Way (A52), Nottingham Road and Derby Road.

Overall the geographical extent of the existing AQMAs will be increased. A new AQMA will also be created. This is despite year-on-year improvements in annual average NO_2 concentrations across the city and the UK, due to significant improvements in engine technology and more specifically exhaust after treatment technologies, on-board diagnostics and fuel efficiency.

The need to increase the size of the AQMAs, arises from an improved understanding of NO_2 pollution concentrations within Derby. This is due to:

1. Extensive NO_2 monitoring data now being available, for a wide range of locations across the city, for the 5 year period between 2001 and 2005.

2. Since the first Review and Assessment, central government has introduced further guidance to assist local authorities with the assessment of road-traffic related NO_2 and local air quality.

The proposed AQMAs therefore improve the identification of those locations within Derby, where members of the public are likely to be exposed to an exceedence of the NO_2 annual average standard of 40µg/m^3.

Although the Inner and Outer Ring-Road AQMAs have been joined together, this revised AQMA is not then joined to the new NO_2 AQMA in Spondon. This is because there are no dwellings facades within 14 metres of kerbside on the interlinking sections of road, namely:

1. The 5km section of Brian Clough Way between Spondon and the existing Inner Ring-Road AQMA.

2. The 3km stretch of Raynesway between Spondon and the existing Outer Ring-Road AQMA.

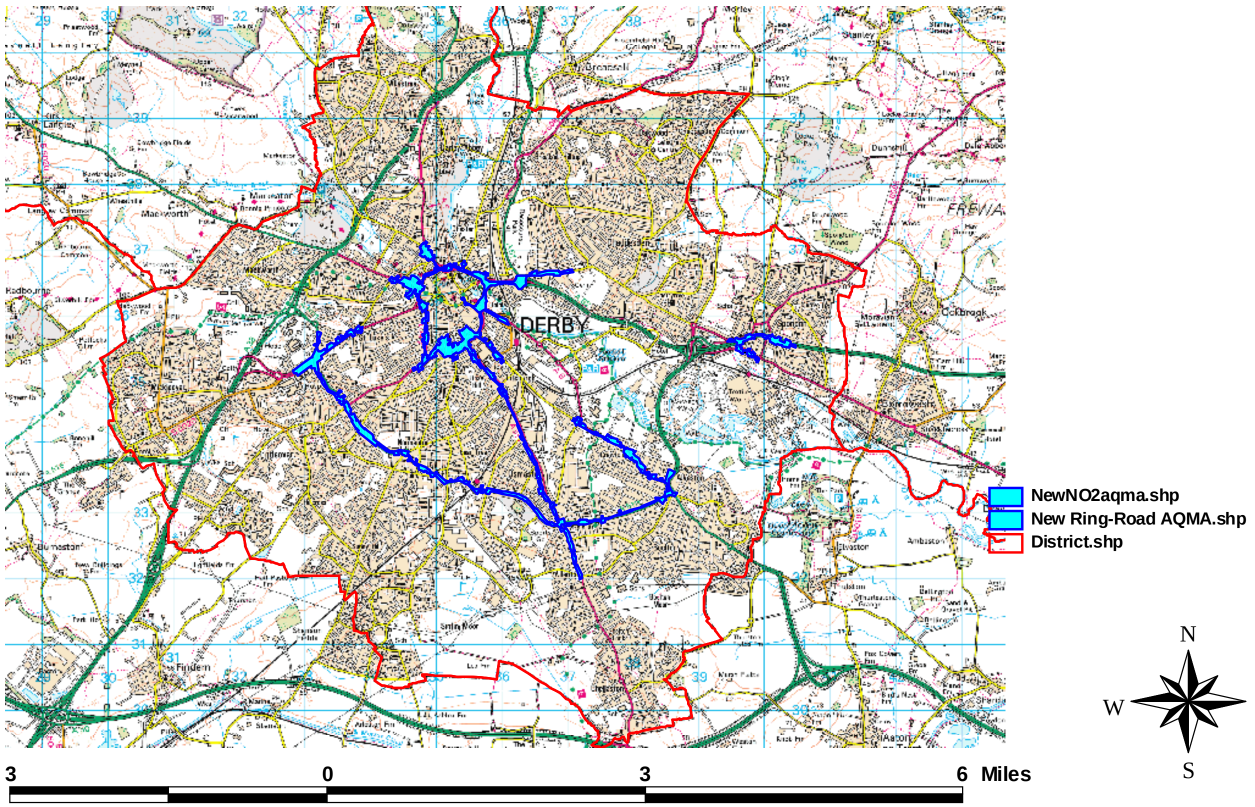
Maps 1 to 3 show the boundaries of the existing Inner and Outer NO_2 AQMAs. Maps 13 to 17 show the proposed boundaries of the revised and new NO_2 AQMAs.

Photographs 10 and 11 also show the proposed AQMA boundaries, using aerial photographs to place them in context.

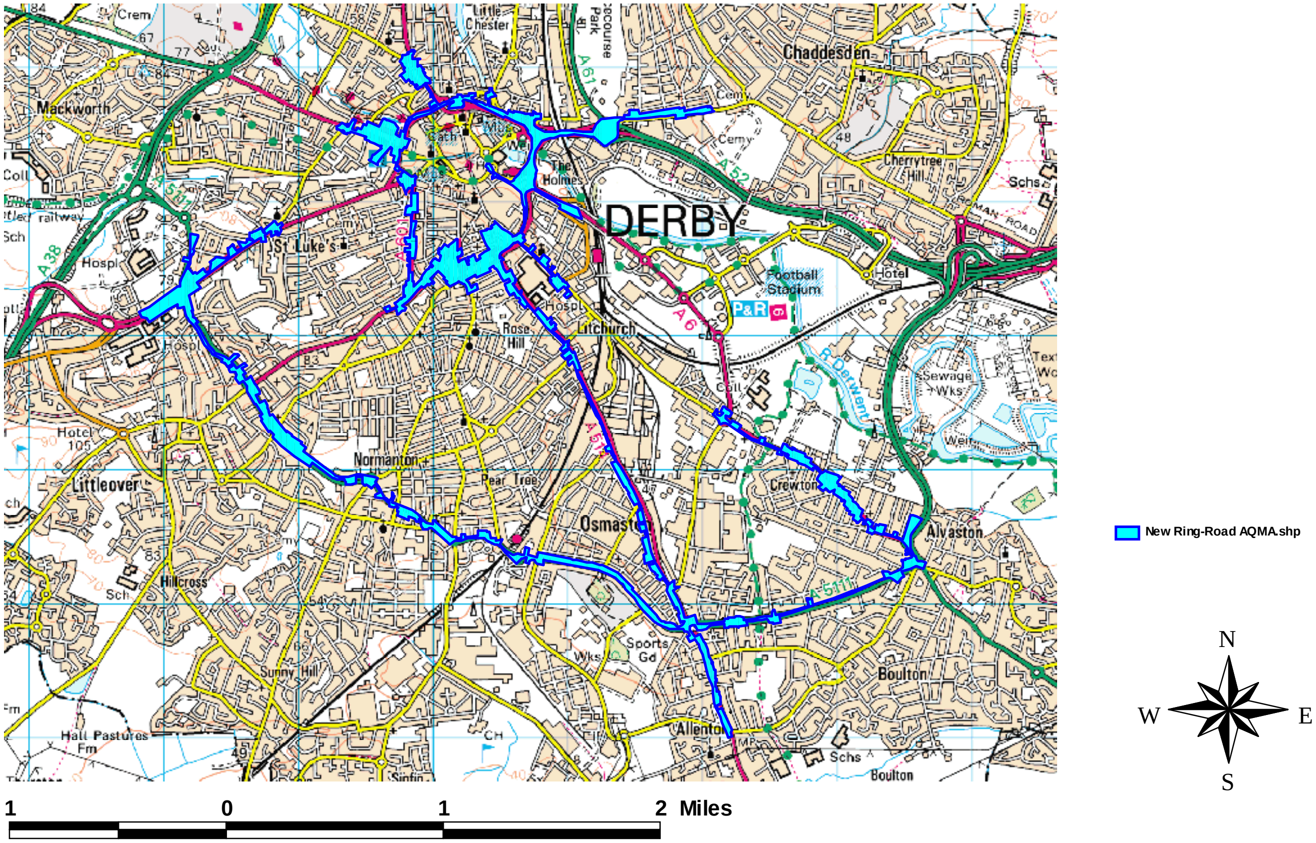
A list of properties included within the existing and new AQMAs is available upon request from Environmental Health and Trading Standards at Derby City Council.

Map 13, Proposed Boundaries of the Revised & New NO_2 AQMAs

(large scale)



Map 14
Proposed Boundary of the Revised Inner & Outer Ring-Road AQMA



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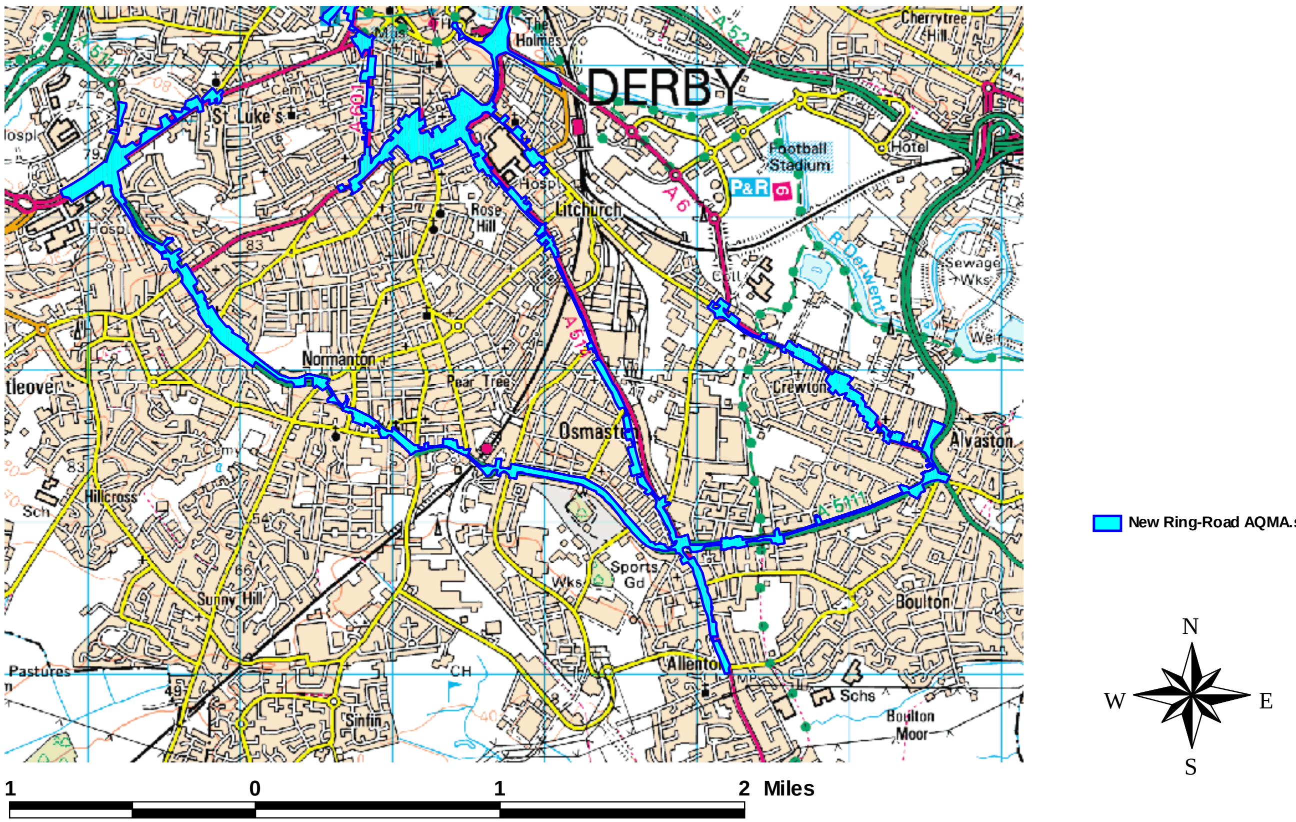
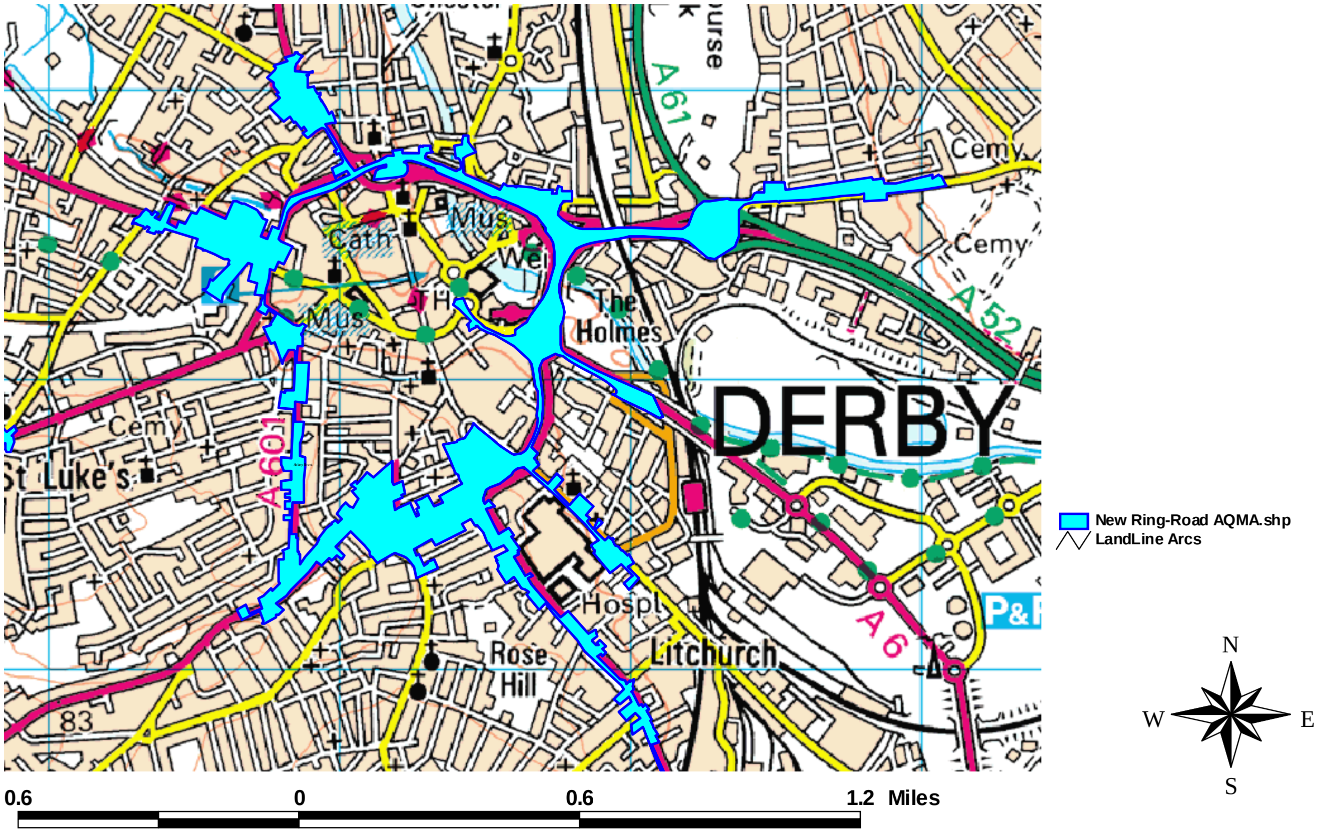
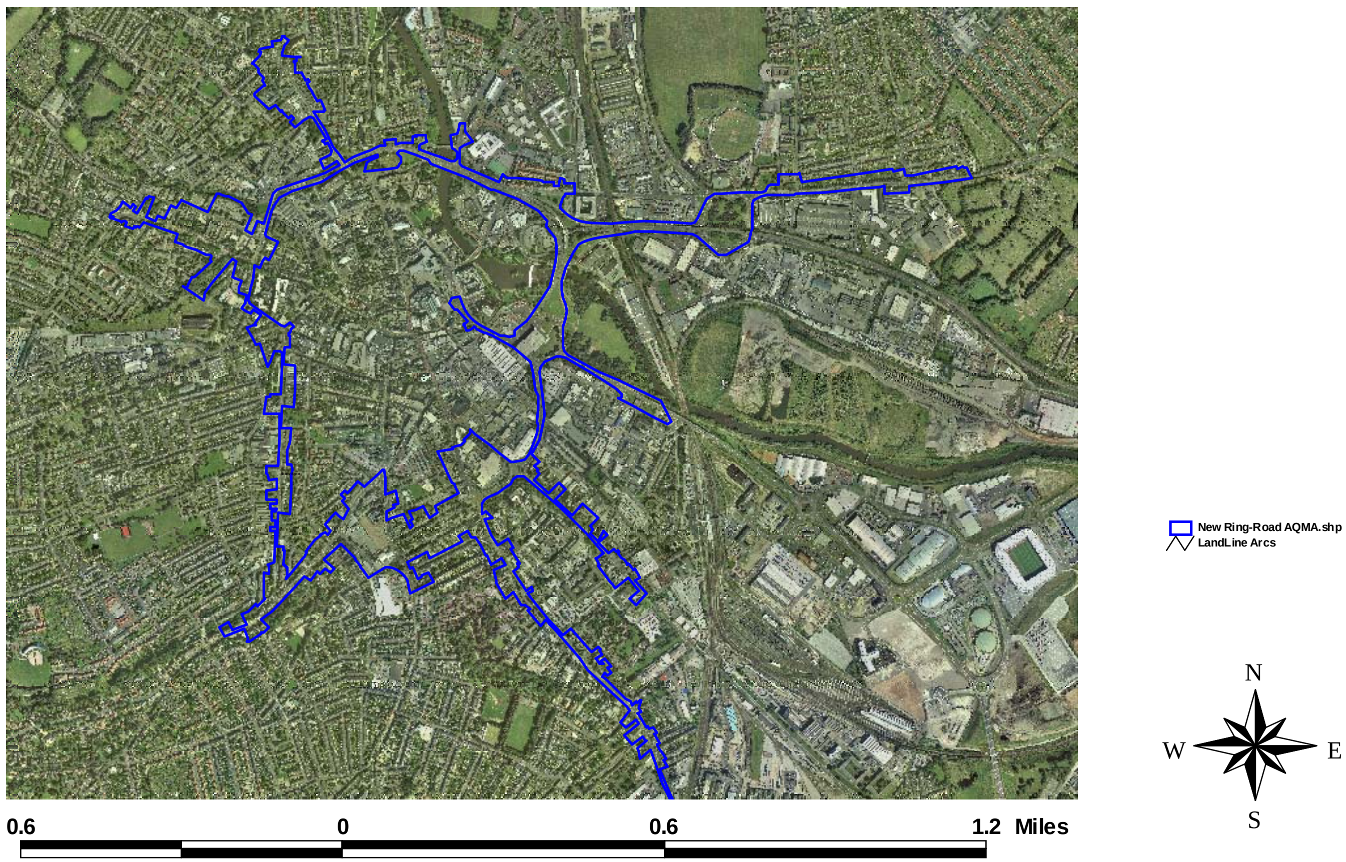
Map 15
Proposed Boundary of the Revised Outer Ring-Road AQMA
(smaller scale and includes part of the inner-ring road)



Map 16
Proposed Boundary of the Revised Inner Ring-Road AQMA

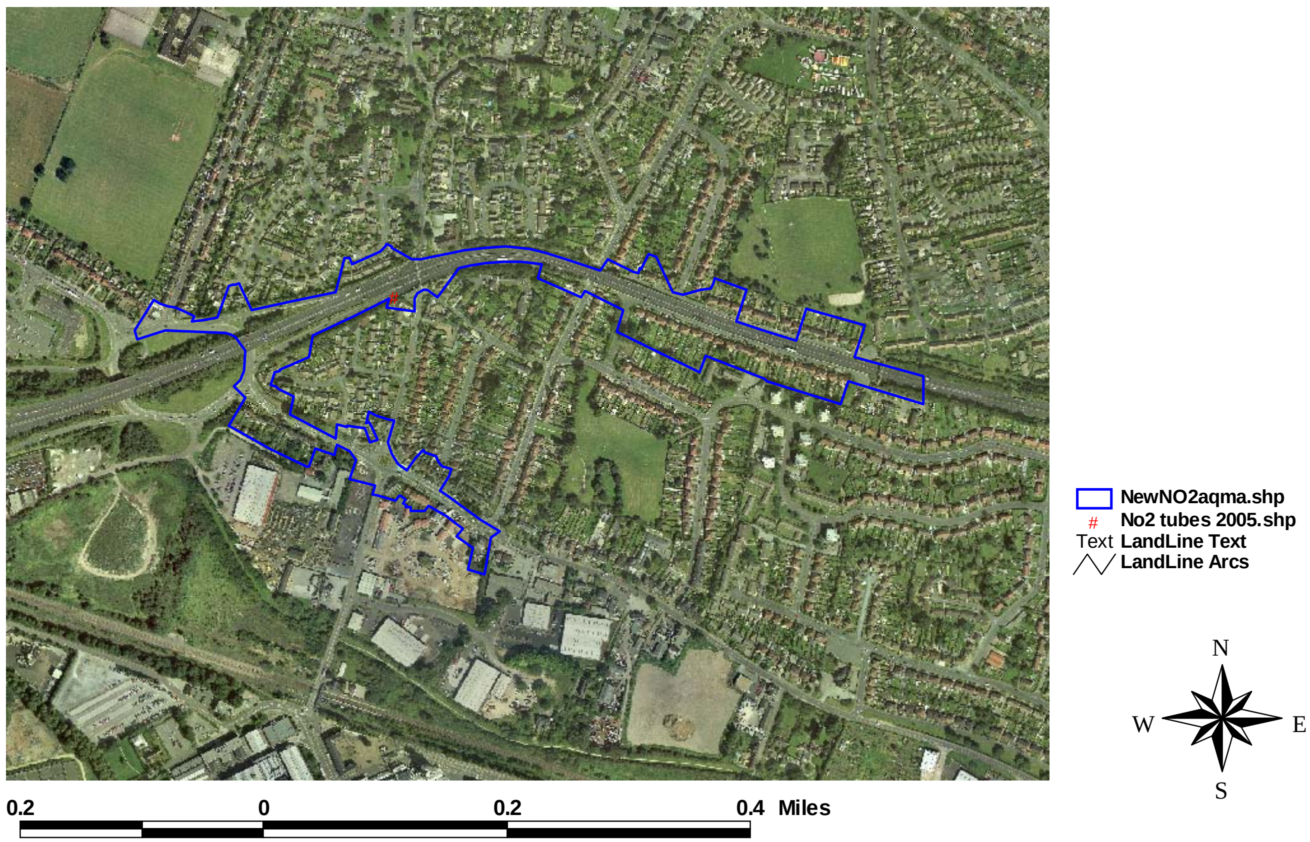


Photograph 10
Proposed Boundary of the Inner Ring-Road AQMA



Map 17
Proposed Boundary of New NO_2 AQMA in Spondon

Photograph 11
Proposed Boundary of New NO_2 AQMA in Spondon



6.4 Details of Proposals for the Outer Ring-Road NO_2 AQMA

The revised Outer Ring-Road NO_2 AQMA follows the same route as the existing AQMA, from the Blue Peter Islands to the junction of Uttoxeter New Road and Manor Road. Along this route there are however a number of important changes:

1. Only dwellings with a facade within 14 metres of the kerbside are included.

2. Extension of the AQMA north from Spider Island, along Osmaston Road, to join together with the revised Inner Ring-Road AQMA.

   This decision is based on the consistently high NO_2 concentrations recorded by the diffusion tubes at the Ascot Hotel, Osmaston Road Community Centre and the junction of Osmaston Road/Melbourne Street.

   All of these diffusion tubes are located at the ends Osmaston Road. Without any major arterial routes along Osmaston Road, those dwellings within 14 metres of this road are therefore likely to exceed the 2005 annual average NO_2 standard of $40\mu g/m^3$. This view is supported by the DMRB assessment for Grange Street/Osmaston Road.

3. The AQMA has also been extended in a southerly direction at Spider Island, out to the junction of Merrill Way and Boulton Lane. This is on the basis of the $40.3\mu g/m^3$ exceedence recorded at this junction in 2004.

4. At the Blue Peter Islands, Spider Island and Uttoxeter New Road/Manor Road junction, dwellings located within the existing AQMA and behind roadside dwellings, have been excluded. This has narrowed the Outer Ring-Road AQMA in these locations.

5. The AQMA has been extended from the junction of Uttoxeter New Road and Manor Road. This extension goes in an easterly direction, along Uttoxeter New Road, towards the city centre.

   This extension is based upon the exceedence recorded at the junction of Uttoxeter New Road and Lonsdale Place. The diffusion tube data for the junction of Stafford Street and Uttoxeter New Road, which showed no exceedences, confirm that the existing AQMAs should not be joined together along Uttoxeter New Road.

6. In 2006 a new NO_2 diffusion tube site was located at the facade of 1178 London Road, outside of the existing AQMAs . In January 2006 it recorded an average NO_2 concentration of 44µg/m^3.

   Furthermore, the DMRB assessment identified the London Road/A6 roundabout as a busy junction that is likely to cause an exceedence.

   It is therefore proposed to extend the Outer Ring-Road AQMA from the Blue Peter Islands, along London Road, to the Ascot Drive/London Road/A6 roundabout. The dwellings on the Wilmorton link approach to this roundabout have also been included, since they are within 14 metres of the kerbside.

7. There is no relevant public exposure within 14 metres of the A38, with the facade of 150 Radbourne Street being 23 metres away. The A38 is therefore excluded from the revised Outer Ring-Road AQMA, although this situation will be subject to review.

   It is noted that the diffusion tube at 150 Radbourne Street exceeded 40µg/m^3 in 2001, 2003 and 2004. This was not he case in 2005, when the monitoring location was moved from the lamp post outside 150 Radbourne Street to its façade, recording an annual average of 32.3µg/m^3.

   This 2005 result is low, even taking into account the low bias correction factor of 0.81. The 2004 exceedence is also invalid, as it is based on just 3 months of monitoring data. The other 9 tubes were stolen.

8. The Kingsway hospital site will include a mixture of new developments, including dwellings. It is anticipated that the design brief will require these dwellings to be built more than 14 metres from the busy Uttoxeter New Road, Kingsway and the A38. In this way, the revised Outer Ring-Road AQMA does not need to be extended any further north.

6.5 Details of Proposals for the Inner Ring-Road NO_2 AQMA

The revised Inner Ring-Road NO_2 AQMA follows broadly the same route as the existing AQMA, from the Blue Peter Islands to the junction of Uttoxeter New Road and Manor Road. Along this route there are however a number of important changes:

1. Only dwellings with a façade within 14 metres of the kerbside are included.

2. Extension of the AQMA south from Bradshaw Way, along Osmaston Road, to join the revised Outer Ring-Road AQMA.

3. Joining together of the AQMA along Abbey Street, Friary Street and Stafford Street. The Inner Ring-Road AQMA now follows the entire length of the inner ring-road.

   This is on the basis that exceedences of the annual mean have been recorded at both Abbey Street/Burton Road and Stafford Street/Friary Street. Abbey Street joins these 2 monitoring locations together and has relevant public exposure. This follows the rules set for drawing the AQMA boundaries.

   Curzon Street and the south part of Stafford Street have been excluded from the revised AQMA, due to the relatively low NO_2 concentrations recorded by the diffusion tube at the junction of Uttoxeter New Road and Stafford Street.

4. Extension of the AQMA to include the Five Lamps junction.

   Although the Belper Road diffusion tube consistently meets the 40µg/m^3 standard, the same is not true for the Duffield Road tube. The 2002 to 2005 annual means for Duffield Road were 38.5µg/m^3, 43.5µg/m^3, 46.9µg/m^3 and 37.3µg/m^3.

   On the basis of both the DMRB assessment for Duffield Road/King Street, and the need to link affected areas together, all relevant receptors adjacent to Five Lamps have been included in the revised AQMA.

   At this time, there is no evidence to suggest that the revised AQMA should be extended along either Kedleston Road or Duffield Road. This situation will however need to be reviewed through additional monitoring.

   The Brookside residential complex on Garden Street has been included in the revised AQMA. This is based on the previously rule of including entire property boundaries within AQMAs, when a facade is within 14 metres of kerbside.

5. Extension of the AQMA to include Mansfield Road/Fox Street, on the basis of the DMRB assessment.

6. Extension of the AQMA near to the Pentagon Island to include additional properties along Nottingham Road, St Marks Road and in Derwent House. This is on the basis of the exceedences recorded at these locations.

7. Reduction in the AQMA, to exclude Liversage Place and other dwellings to the east of Traffic Street, which are more than 14 metres from the kerbside. This is on the basis of diffusion tube data in this locality.

8. Extension of the AQMA along London Road to Osbourne Street. This is due to the exceedences recorded at both the Strutts pub site and on the church railings site on London Road.

9. The revised Inner and Outer Ring-Road AQMAs have not been joined together along the 2km stretch of London Road between Litchurch Lane and the A6 roundabout. This is because the A6 takes much of the traffic away from this part of London Road.

10. Extension of the AQMA to include the junction at Normanton Road and Charnwood Street. This is on the basis of the diffusion tube at Brooks shop consistently recording exceedences.

11. Extension of the AQMA to at the junction of Abbey Street/Burton Road, to include the eastern end of Burton Road. This is on the basis of the diffusion tube data for the Wine Rack on Burton Road, which has consistently recorded exceedences.

    Further along Burton Road, the diffusion tubes at both the International Hotel and the junction of Burton Road with Whittaker Gardens did not record any exceedences. The revised Inner and Outer Ring-Road AQMAs therefore have not been joined together along Burton Road.

12. Extension of the AQMA to include Friar Gate, Bridge Street and Agard Street. This is on the basis of both the diffusion tube data for Friar Gate/Uttoxeter Old Road, and the DMRB assessment identifying both Friar Gate/Bridge Street and Bridge Street/Agard Street, as busy road junctions where exceedences are possible.

13. Continued exclusion of the City Centre from the revised AQMA. The diffusion tube on the corner of Victoria Street and the Corn Market records consistently low annual average NO_2 concentrations. This provides evidence of the benefits of the pedestrianised city centre, with only buses and taxis now allowed to access Victoria Street.

6.6 Details of New NO_2 AQMA in Spondon

The need for a Detailed Assessment and possibly a new road-traffic related NO_2 AQMA in Spondon, was identified by the revised Updating and Screening Assessment. This was on the basis of the exceedences recorded at both the Highfield Lane alley way and Drury Avenue monitoring sites.

Highfield Lane alley way is located towards the city centre end of Brian Clough Way in Chaddesden. This roadside location recorded 2001 to 2003 annual average NO_2 concentrations of 30.8µg/m^3, 26.7µg/m^3 and importantly 40µg/m^3 respectively. This monitoring location has therefore been identified for Detailed Assessment.

In 2004, monitoring was moved from the Highfield Lane alley way to the nearby facade of 109 Highfield Lane. This facade is 21 metres from Brain Clough Way. As is expected, the 2004 and 2005 annual average NO_2 concentrations of 38.2µg/m^3 and 29.3µg/m^3 are both below the 40µg/m^3 standard.

The monitoring location at 85 Meadow Lane is slightly to the west of Highfield Lane, again relatively close to the western carriageway of Brian Clough Way. This facade monitoring location was used between 2001 and 2003, recording annual average NO_2 concentrations of 34.5µg/m^3, 26.0µg/m^3 and 30.8µg/m^3.

On the basis that there are no dwelling facades within 14 metres of the Chaddesden section of Brian Clough Way and the monitoring results already provided, an exceedence of the 40µg/m^3 standard at any dwellings in this locality is unlikely. On this basis, it is not proposed to designate an NO_2 AQMA along this part of Brian Clough Way.

The Drury Avenue site is further to the west than both Highfield Lane and Meadow Lane, directly opposite Lodge Lane. This monitoring location is to the south of Brian Clough Way, immediately adjacent to the start of the slip road to the Derby Road roundabout. This monitoring location therefore under-represents the kerbside NO_2 concentrations expected from this busy dual carriageway.

In 2004, the same kerbside monitoring location at 1 Drury Lane, recorded an exceedence of 48.1µg/m^3. This kerbside NO_2 concentration was based on just 5 months of monitoring data, due to several of the diffusion tubes being stolen. It is also adjacent to the start of the slip road, which places it 18 metres from Brian Clough Way.

In 2005, the Drury Avenue monitor was moved a short distance to the lamp post outside 37 Lodge Lane, which is again a kerbside monitoring location. This monitoring location recorded a 2005 annual average NO_2 concentration of 36µg/m^3, which is below the standard of 40µg/m^3. In January 2006, the unvalidated monthly average NO_2 concentration was however 57µg/m^3.

In the case of the Spondon section of Brian Clough Way, monitoring data also exists for 60 Kirk Leys Avenue North. This diffusion tube is on the northern side of the dual carriageway and was operated between 2001 and 2003.

The 60 Kirk Leys Avenue North monitoring location is over 14 metres from the dual carriageway, which is beyond the distance at which an exceedence would be expected. It is also behind a fence, which would have further reduced the NO_2 concentrations recorded. As expected, it therefore recorded relatively low 2001 to 2003 NO_2 concentrations of 30.8, 25.0 and 36.9µg/m^3.

It is evident that the NO_2 monitoring data for the Spondon section of Brian Clough Way is limited. Indeed, there are a number of dwellings in this locality which have facades within 14 metres of this busy dual carriageway. However, there is no monitoring data available for these facade locations.

On the basis of the previously established ‘14 metre’ rule for drawing AQMA boundaries, the limited monitoring data that is available and the precautionary principle, it is therefore determined that a new road-traffic related NO_2 AQMA is required along Brian Clough Way in Spondon.

The new NO_2 AQMA:

1. Only includes dwellings with a façade within 14 metres of the kerbside.

2. Focuses upon those dwellings adjacent to Brian Clough Way in Spondon.

   The ground floors of several dwellings to the south Brian Clough Way are well below the level of the dual carriageway road surface. Relevant public exposure at these dwellings may therefore occur at both first and ground floors, if the pollution disperses horizontally and/or sinks below the road surface.

   For those dwellings along Gilbert Close and Kirk Leys Avenue North, diffusion tube monitoring is required in order to establish the effect of their elevation above the dual carriageway. This situation is complicated by noise and safety barriers in some of these locations, which may reduce exposure to exhaust emissions.

3. Extends easterly as far as Park Leys Court, next to the pedestrian footbridge. Beyond these dwellings, there are no sensitive facades within 14 metres of the dual carriageway.

4. Includes dwellings adjacent to the Derby Road roundabout slip roads. This is a precautionary approach, in the absence of specific monitoring data. It will however enable this part of the road network to be considered in its entirety, in the resultant NO_2 Action Plan.

5. Excludes those dwellings adjacent to the Derby Road/Raynesway roundabout, as well as along the section of Derby Road between this roundabout and Brian Clough Way. This is on the basis that although the diffusion tube at this roundabout recorded an exceedence of 46.1µg/m^3 in 2004, there are no dwelling facades within 14 metres of kerbside of these roads.

6. Includes dwellings adjacent to the section of Derby Road between Brian Clough Way and the Nottingham Road mini-roundabout. This is due to the diffusion tube result of 45µg/m^3 for January 2006, for the facade of 1 Station Road. Although this result is unvalidated and only for 1 month, this means that these dwellings are likely to exceed the 2005 standard.

7. Extends beyond the Nottingham Road mini-roundabout, to include the Nottingham Road/Willowcroft Road junction. This is a precautionary measure in the absence of any monitoring data. It is however considered necessary due to both its proximity to the Station Road diffusion tube and the road traffic that is known to queue at this busy junction.

8. Excludes dwellings on Lodge Lane which do not have a façade within 14 metres of Brian Clough Way. This situation will need to be reviewed through additional diffusion tube monitoring.

7.0 2011 SCENARIO

The first Air Quality Daughter Directive sets annual average and 1-hour limit values for NO_2 for 1 January 2010. These same limit values of 40μg/m^3 and a 1-hour mean of 200μg/m^3 not to be exceeded more than 18 times per year, have been transposed into UK legislation. The National Air Quality Standards bring forward the date for compliance for the NO_2 objectives to 31 December 2005.

The 31 December 2005 has now passed. In common with many other UK cities, this Detailed Assessment for road-traffic related NO_2 in Derby, has identified a number of points of relevant public exposure that are likely to exceed 40μg/m^3.

These exceedences of the annual mean standard exist, despite the year on year reductions in UK total NO_x and NO_2 emissions. A significant proportion of these reductions are road-traffic related.

This Chapter considers whether this situation is likely to continue in future years, using a future year scenario of 2011. This is because:

1. It enables comparison against the 2010 limit values.

2. The Local Transport Plan operates on a 5-year cycle. In the case of LTP 2, this is from 2006 to 2011. Consequently, the traffic data collected for LTP 2 and the Derby Area Transport Study (DATS) has already been projected to 2011.

3. By 2011, major city centre schemes such as the Riverlights development, the Eagle Centre extension, Connecting Derby and the Inner Ring-Road Maintenance Scheme are all due to have been completed. The 2011 scenario in DATS accounts for the associated traffic impacts of these schemes.

In order to determine the annual average NO_2 concentrations in 2011 at roadside locations across Derby, a professional judgement has been made. This is necessary, due to the absence of dispersion modelling in this Detailed Assessment. The reliance upon monitoring results, means there is no modelled 2005 base year, from which to make 2011 predictions.

The 2001 to 2005 local NO_2 monitoring data, has shown a general downward trend in kerbside, roadside and facade annual average NO_2 concentrations. As discussed in Chapter 5 on 'Analysis of Results,' there are a few exceptions to this trend, due primarily to local circumstances.

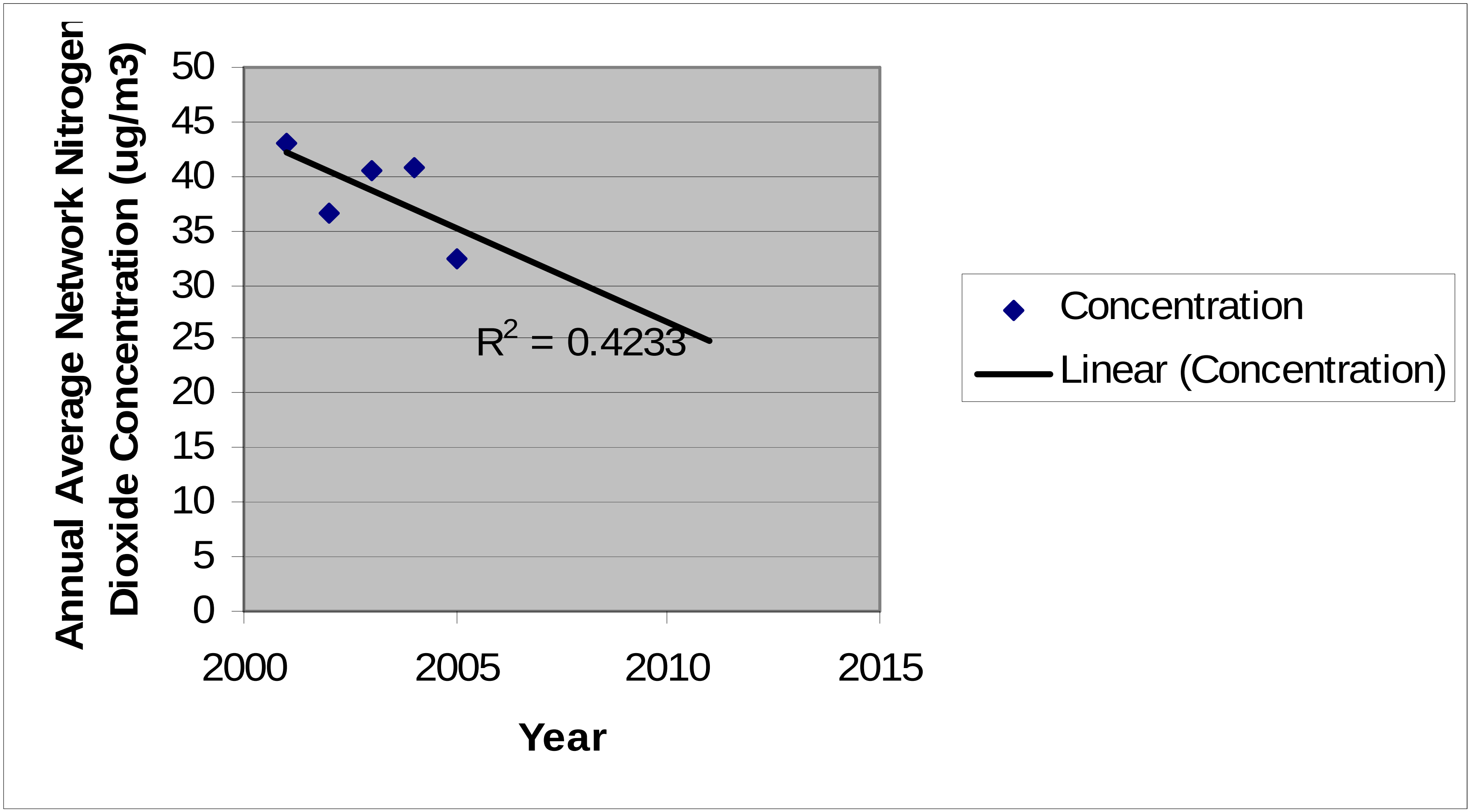
For the 42 diffusion tube monitoring locations which have been used by the City Council for the 5 year period of 2001 to 2005, it has been possible to derive network annual average NO_2 concentrations. A best fit line has also been generated and continued until 2011. This information is presented in Graph 11.

The r^2 value of 0.42 confirms that between 2001 and 2002, there has been a reduction in annual average NO_2 concentrations across the network. A significant correlation is represented by an r^2 value of -1/+1, and no correlation being represented by a value of zero. This means that a local downward trend is evident, although the high network averages for 2003 and 2004 do go against it.

The identified downward trend in annual average NO_2 concentrations between 2001 and 2005, arises from significant improvements in vehicle technology during this time. These technological improvements relate to exhaust after treatment technologies, on-board diagnostics and fuel efficiency.

To a far smaller extent, the increased use of alternative fuels has also benefited local air quality.

Graph 11
Annual Average NO_2 Network Concentrations for 2001 to 2011



The improvements in engine technology have been so significant that they have counteracted the adverse effects of:

1 Increase in car ownership.

2 Increased congestion, which has a disproportionate effect upon the road-traffic pollution at busy junctions and roads.

3 Increase in the physical size of cars, although to some extent this is likely to be counteracted by the use of lighter materials.

4 Increase in power of road vehicles, with turbo-engine technology now fitted as standard in many cases.

5 Air conditioning now fitted as standard to many vehicles, with the associated increase in fuel consumption and exhaust emissions.

6 Change in the composition of the national vehicle fleet, with many more 4 x 4s now on the roads. These are much larger vehicles, which generally have increased fuel consumption.

Central government predict that on a national level, the downward trend in road-traffic generated NO_2 will continue from 2005 to 2011. Indeed, the National Atmospheric Emission Factors predict that during this time, there will be a reduction in road-traffic related NO_2 for each square kilometre in Derby (Reference 8).

The continued downward trend in road-traffic generated NO_2 is predicted, despite likely continuation of the adverse effects listed above. These effects are likely to continue to be outweighed by further improvements in vehicle technology.

The associated natural turnover of the vehicle fleet will remove the older and generally more polluting vehicles. New vehicles are required to use new technology, to meet the latest emissions standards.

These national predictions may be optimistic, as they do not account for the effect of increased concentrations in rural ozone concentrations and primary NO_2. The impact of these increases on the relationship between urban NO_x and NO_2 is not yet fully understood.

To this end, Defra has commissioned further research. Until its findings are published, the traditional empirical relationship between NO_x and NO_2 is however still appropriate. This empirical relationship forms the basis for the National Atmospheric Emission Factors.

On a local level, the national downward trend in annual average NO_2 concentrations is expected to be repeated. This reduction is however likely to be less pronounced, due to extremely high local traffic growth forecasts.

The Derby Area Transport Study has been used to predict an increase in local traffic growth between 2005 and 2011 of 11.9%. This is as compared to Nottingham and Leicester, which have predicted local traffic growth for the same period of 10.9% and 10.0% respectively (Reference 9).

The slight differences in predicted traffic growth between the 3 regional cities, is due to some of Derby's main roads being under capacity. Although these road links are still congested during rush hours, this congestion does not tend to last for the whole of each 3 hour peak period. This is in contrast to congestion in Nottingham and Leicester (Reference 11).

The Strategic Environmental Assessment (SEA) for the latest Local Transport Plan (LTP 2), used the DMRB screening methodology to predict 2011 annual average NO_2 concentrations.

SEA determined that despite significant local traffic growth, technological advances would result in reduced exhaust emissions in even the most congested areas. Having said this, DMRB assessments are only a screening tool and therefore do not specifically account for the effect of increased congestion upon local air quality.

On the basis of Derby's SEA, the annual average NO_2 standard of 40µg/m^3 is likely to be met across the majority of Derby by 2011. Nevertheless, exceedences may however still occur at points of relevant public exposure alongside some busy roads and junctions. If this proves to be the case, the road-traffic related NO_2 AQMAs will be unable to be entirely revoked.

The continued reduction in annual average NO_2 concentrations across Derby's road network, means that it is unlikely that the proposed AQMA boundaries will need to be uniformly increased in size in the future.

The proposals for the revised and new NO_2 AQMAs in Chapter 6, which are based on 2005 monitoring data, therefore remain unchanged. The effect of future years of high pollution, due to unusual meteorological conditions, is already accounted for with the precautionary 14 metre rule.

This situation will of course be subject to ongoing review, through both the Review and Assessment process and LTP 2 Annual Progress Reports. These reviews will also account for changes in local circumstances, such as implementation of the Connecting Derby Inner Ring-Road scheme.

The Air Quality Impact Assessment for Connecting Derby, established that road-traffic related NO_2 will be reduced at some dwellings and increased at others. As a result, the City Council has located NO_2 diffusion tubes along its proposed route.

The monitoring results obtained from these diffusion tubes, will inform any future variation to the Ring-Road NO_2 AQMA. These results will need to include at least a year of monitoring data, following completion of Connecting Derby. This will be necessary, in order to enable the impact of this scheme upon annual average NO_2 concentrations to be measured.

8.0 OUTCOMES OF DETAILED ASSESSMENT

In terms of the locations identified in the Updating and Screening Assessment, this Detailed Assessment has resulted in the following outcomes:

Table 25 - Blue Peter Islands & Alvaston (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Outcome of Detailed Assessment
Elvaston Lane, Alvaston	Yes	No	> 40µg/m^3	Revoked
Barrett Street, Alvaston	Yes	No	< 40µg/m^3	Not revoked
Metcalfe Close, Alvaston	Yes	No	< 40µg/m^3	Revoked
Beech Gardens, Alvaston	Yes	Yes	< 40µg/m^3	Revoked
Dental Practice, 1 Raynesway	Yes	Yes	< 40µg/m^3	Not revoked

Table 26 - Manor Road/ Uttoxeter New Road (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Outcome of Detailed Assessment
4 Manor Road/ Uttoxeter New Road	Yes	Yes	< 40µg/m^3 but at side of house	Not revoked
California Gardens	Yes	Yes	< 40µg/m^3	Not revoked

Table 27 - Spider Island (outcome)

Diffusion Tube Location	Within Existing NO2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Outcome of Detailed Assessment
Merrill Way/Boulton Lane, Allenton	No	Yes	> 40µg/m^3	Extended
758 Osmaston Road (north of Spider Island)	No	Yes	> 40µg/m^3	Extended
Ascot Drive/ Osmaston Rd (town end)	No	Yes	> 40µg/m^3	Extended
Ascot Drive/Osmaston Rd (Spider Island end)	No	Yes	> 40µg/m^3	Extended
831 Osmaston Road (south of Spider Island)	Yes	Yes	< 40µg/m^3	Not revoked
Varley Street	Yes	Yes	< 40µg/m^3	Revoked

Table 28 - Outer Ring Road (outcome)

Diffusion Tube Location	Within Existing NO2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Outcome of Detailed Assessment
Arkwright Street/ Osmaston Park Road	Yes	Yes	< 40µg/m^3	Revoked
Eastwood Drive/ Manor Road	Yes	Yes	< 40µg/m^3	Revoked

Table 29 - Uttoxeter New Road (outcome)

Diffusion Tube Location	Within Existing NO2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Outcome of Detailed Assessment
Balti International, Uttoxeter New Road/ Lonsdale Place	No	Yes	> 40µg/m^3	Extended

Table 30 - A38 (outcome)

Diffusion Tube Location	Within Existing NO2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO2 Objective of 40µg/m3?	Outcome of Detailed Assessment
150 Radbourne St	No	Yes	> 40µg/m^3	No extension

Table 31 - Five Lamps (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Outcome of Detailed Assessment
Duffield Road (Five Lamps)	No	Yes	> 40µg/m^3	Extended

Table 32 - Pentagon Island (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of 40µg/m^3?	Otcome of Detailed Assessment
Cornwall Road, Chaddesden	Yes	Yes	< 40µg/m^3	Not revoked
Nottingham Road - opposite Beaufort Street	Yes	No	> 40µg/m^3	Reduced to kerbside
5 St Marks Road	No	Yes	> 40µg/m^3	Extended
Derwent House	No	Yes	> 40µg/m^3	Extended

Table 33 - Busy Road Junctions Outside Existing AQMAs (outcome)

Junction	Predicted 2005 Annual Average NO_2 Concentration (µg/m^3)	Outcome of Detailed Assessment
Friar Gate/ Bridge St	41	Extended
Bridge St/ Agard St	41.5	Extended

Table 34 - Inner Ring Road (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of $40µg/m^3$?	Outcome of Detailed Assessment
Job Centre, Normanton Road	Yes	No	Much > $40µg/m^3$	Not revoked
Opticians, Osmaston Road/ Bourne Street	Yes	No	> $40µg/m^3$	Not revoked
Bradshaw Way	Yes	No	> $40µg/m^3$	Reduced to kerbside
London Road (church railings)	Yes	No	> $40µg/m^3$	Reduced to kerbside
Liversage Place	Yes	Yes	< $40µg/m^3$	Revoked
Jacobs/Zanzibar, London Road	No	Yes	> $40µg/m^3$	Extended
31 Nottingham Road	Yes	Yes	< $40µg/m^3$	Reduced to kerbside
Friar Gate/ Uttoxeter Old Road	No	Yes	> $40µg/m^3$	Extended
Friary Street - opposite Celtic House	No	Yes	> $40µg/m^3$	Extended
Wine Rack, Burton Road	No	Yes	> $40µg/m^3$	Extended

Table 35 - Additional Busy Junctions Requiring Assessment

Junction	Predicted 2005 Annual Average NO_2 Concentration ($\mu g/m^3$)	Outcome of Detailed Assessment
Mansfield Road/Fox Street	33.4	Extended
Duffield Road/King Street	35.8	Extended
Ascot Drive/ London Rd/ A6 roundabout	37.8	Extended
Grange Street/Osmaston Road	36.4	Extended

Table 36 - Brian Clough Way (outcome)

Diffusion Tube Location	Within Existing NO_2 AQMA?	Relevant exposure within 10 metres?	>/< Annual Average NO_2 Objective of $40\mu g/m^3$?	Outcome of Detailed Assessment
Drury Avenue, Spondon (A52)	No	Yes	> $40\mu g/m^3$	New AQMA
Highfield Lane, alley way	No	Yes	> $40\mu g/m^3$	Not extended

This Detailed Assessment has determined both the magnitude and geographical extent of the revised NO_2 AQMAs. More specifically, it has determined that it is necessary to:

1. Amend the existing Inner and Outer Ring-Road NO_2 AQMAs. This will create a combined NO_2 AQMA, for the main arterial routes into and out of the city. The former Inner and Outer Ring-Road AQMAs will be joined together along Osmaston Road. Details of all the changes are described in Chapter 6.

2. Designate a new road-traffic related NO_2 AQMA, centred upon Brian Clough Way in Spondon. Again the details of this AQMA are provided in Chapter 6.

As a result of these proposals, the following timetable of actions has been produced:

1. Following Defra approval of the Detailed Assessments for road-traffic related NO_2 and PM_{10}, undertake a 2 month consultation with stakeholders. The Detailed Assessment for PM_{10} is due to be submitted to Defra by the end of April 2006.

   The stakeholders involved in the consultation will include all householders within the revised and new NO_2 AQMA, the general public and Councillors. Further consultation will also take place with the City Council's Highways and Planning Departments, and the Highways Agency.

   The Highways Agency has responsibility for maintaining the Brian Clough Way (A52), A6 and A38 trunk roads, which are shown in Map 18.

2. Within 4 months of Defra approving this report, and in accordance with Policy Guidance LAQM PG(03), consider comments made through the consultation process. Then amend the existing AQMAs and designate a new AQMA. This will require use of official Orders, under section 83(1) of the Environment Act 1995.

3. Within 12 months of the Orders being made, and in accordance with Section 84(1) of the Environment Act 1995, a 'Further Assessment' will need to be undertaken.

Map 18
Highways Agency Road Network

The purpose of the Further Assessment will be twofold:

a) To use NO_2 monitoring data, to determine the appropriateness of the boundaries of the 2 new AQMAs. It is suggested that following the annual revision of the NO_2 monitoring locations at the end of 2006, that the 2007 monitoring data forms the basis for this review.

   If appropriate, the Further Assessment can then be used as the basis for making further changes to the AQMAs.

b) Undertake source apportionment of the NO_2 recorded within the AQMAs. This work will inform the revision of the NO_2 Action Plan. For example, it may determine that a particular category of vehicle is having an undue effect on the AQMAs and therefore requires specific control measures.

4. Revise the existing NO_2 Action, to account for both the revised AQMAs, the new AQMA, the Further Assessment and new monitoring data. This will again require consultation with stakeholders.

   The aim of the NO_2 Action Plan is to enable the NO_2 AQMAs to be revoked, by reducing annual average NO_2 concentrations at all relevant receptors within Derby, below an annual average of $40 \mu g/m^3$.

5. Incorporate the revisions to the existing NO_2 Action Plan within LTP 2. These revisions need to be made within 6 months of the Further Assessment being completed.

6. Following the integration of the existing Action Plan with LTP 2, the Highways Department will use the LTP process, to report progress on implementation of the NO_2 Action Plan. The first progress report is due to be submitted to the Department of Transport in 2008.

   In July 2006, Environmental Health will submit its final ‘Action Plan Progress Report’ to Defra, as part of the second Updating and Screening Assessment.

7. Environmental Health will continue with its extensive NO_2 local air quality monitoring network, reporting results to Defra in its ‘Monitoring Progress Reports.’ These reports will be produced in those years where neither an ‘Updating and Screening Assessment’ nor a ‘Detailed Assessment’ is required.

   If the 2006 USA concludes that no further Detailed Assessments are required, the next Monitoring Progress Report will be due in April 2007.

9.0 INITIATIVES FOR FURTHER INVESTIGATION

Distance between vehicle exhausts and dwelling facades, has been shown to be critical to the pollution concentrations experienced by members of the public. Increasing this distance of receptors from the kerbside by just a few metres, could have significant benefits in terms of public health.

The public health benefits of Buffer Zones relate to the reduced likelihood of an exceedence of National Air Quality Standards for road traffic pollution. In addition to the annual mean and 1-hour NO_2 standards, there are also annual mean and 24-hour standards for PM_{10}.

Road-traffic generated PM_{10} is the subject of a separate Detailed Assessment, which will be submitted to Defra by the end of April 2006. In contrast to NO_2, there is no safe exposure limit for PM_{10}. Even if all relevant receptors within Derby are found to meet the National Air Quality Objectives for PM_{10}, a Buffer Zone approach would therefore still provide significant public health benefits.

Although outside the scope of local air quality management, the following public health benefits would also be associated with Buffer Zones:

1) Reduced exposure to road-traffic noise in those dwellings adjacent to busy roads and junctions, due to road-traffic noise and exhaust emissions both decreasing rapidly with distance from kerbside.

2) Reduced exposure of pedestrians to exhaust emissions, where Buffer Zones increase the distance between kerbside and pavements.

On this basis, it is recommended that the revision of the NO_2 Action Plan considers the following additional actions:

1) For new developments close to busy roads and junctions, seek to ensure through the planning process, that the development is designed so that all sensitive facades are at least 14 metres from kerbside.

   The distance of 14 metres results from work undertaken as part of this Detailed Assessment for road-traffic related NO_2. Research undertaken by Air Quality Consultants Limited, indicates that it is equally applicable to road-traffic based PM_{10} (Reference 1).

   The Buffer Zone approach is based upon a distance in any direction of 14 metres between kerbside and sensitive receptor. For new apartment blocks next to an NO_2 AQMA, the introduction of a Buffer Zone therefore creates several options. The apartments could be built:

   - Beyond 14 metres of kerbside, with residential accommodation on the ground floor.

   - Closer to kerbside but with a vertical Buffer Zone of 14 metres. In effect, this may mean no residential accommodation on either ground or first floors.

   - Closer to kerbside and at the top of an embankment, so that residential accommodation is possible at first and maybe even ground floors.

- o Closer to kerbside and at the bottom of an embankment, so that residential accommodation may only be possible on higher floors. This is due to exhaust emissions be able to disperse both horizontally and/or sink below the road surface.

The application of a Buffer Zone approach for dwellings, schools, nurseries and hospitals close to busy roads and junctions, would help to limit any further extensions of the NO_2 AQMAs.

It is recognised that the Buffer Zone approach may conflict with other objectives, including those of urban regeneration and urban design. Further consideration therefore needs to be given to this initiative.

2) Where possible, redesign existing roads in the NO_2 AQMAs, so as to maximise the distance between dwellings and kerbside. This work could be undertaken as part of a road safety improvement scheme, or even as a stand alone project.

   For example, on certain sections of Harvey Road and Osmaston Park Road, the provision of an extensive verge has moved the carriageway away from dwellings. For those dwellings behind this verge, they have therefore been able to be excluded from the Outer Ring-Road AQMA.

3) Consider campaigning for right-hand drive vehicles to have exhaust tailpipes fitted on the right hand side. At present, vehicle exhausts are fitted to both the left and right hand sides of vehicles used in the UK. This measure may prove difficult but if successful, would further increase the distance between vehicle exhausts and sensitive receptors.

4) Where possible, move pedestrians further away from kerbside. This work could be included when redesigning existing roads but could also be a stand-alone project. It could be achieved through the planting trees in kerbside locations, so as to force pedestrians to walk further away from kerbside.

   This is of course dependant upon the availability of resources and the physical constraints of many streets. It would however be feasible in a number of Derby's pollution hotspots. Such tree-lined boulevards are an integral part of many continental European cities.

   If the trees were carefully selected, they would also have benefits in terms of absorbing vehicle exhaust emissions, including carbon dioxide.

As well as the merits of a Buffer Zone, the revised NO_2 Action Plan should consider targeted site-specific actions at each busy junction and road within the AQMAs. To this end, and in addition to area wide Local Transport Plan considerations, further investigation should be undertaken of the following:

1) Road-traffic related noise and exhaust emissions behave in a similar manner. They both significantly decrease with distance from kerbside and can be contained to an extent by physical barriers.

   Noise barriers are already used in the city at some kerbside locations, to reduce noise exposure at sensitive dwellings. It is worth investigating whether these noise barriers also have an air quality benefit.

   If this proves to be the case, noise barriers at certain locations in the AQMAs would have an additional public health benefit. Such measures may therefore be able to secure funding through the NO_2 Action Plan.

2) Specifically in relation to the air quality monitoring station at Warwick Avenue, the uphill gradient at this busy junction appears to be adversely affecting air quality in this particular location. This is in part, due to many of the vehicles queuing at the junction using the bite point on their clutch, as opposed to their handbrake, whilst stationary.

   A simple means of reducing the likelihood of an exceedence of the annual average air quality NO_2 objective at the nearby apartment blocks, would be to use signs requesting drivers to use their handbrake. This would have additional benefits, in terms of driver education and therefore raising public awareness of local air quality issues.

10.0 REFERENCES

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(3) Nitrogen Dioxide in the United Kingdom, Air Quality Expert Group, 2004

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(7) LAQM TG(03) - Update, January 2006

(8) The National Atmospheric Emissions Inventory - www.airquality.co.uk/archive/laqm/tools.php

(9) Locally Adjusted NRTF Traffic Growth Data, Derby City Council Highways Department, 9 March 2006

(10) Rushcliffe Borough Council's 2005 Detailed Assessment for NO_2, CERC

(11) Conversation with Paul Bate, Senior Transportation Engineer,10 March 2006

(12) www.ace.mmu.ac.uk/eae/Air_Quality