Further Assessment of Air Quality in Gateshead Town Centre

Prepared by

Steve Moorcroft, Prof. Duncan Laxen,

Dr Ben Marner, Dr Clare Beattie and Joe Swift.

on behalf of

Gateshead Council

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Air Quality Consultants Ltd., 23 Coldharbour Road, Bristol BS6 7JT
Tel: 0117 974 1086 Fax: 0117 973 9523 E-Mail: AQC@aqconsultants.co.uk

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1 Introduction

1.1 This is the Further Assessment of air quality in Gateshead Town Centre. It forms part of the air quality Review and Assessment process prescribed by Defra. Gateshead Council has declared the Town Centre an Air Quality Management Area (AQMA) for nitrogen dioxide and this report provides detail of existing and predicted future nitrogen dioxide concentrations. In order to ensure that all relevant traffic emissions have been considered, the Study Area is considerably larger than the AQMA. Both the AQMA and the Study Area are shown in Figure 1.

Introduction to the Second Round of Review and Assessment

1.2 The Government's Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR, 2000) and the addendum to it published in February 2003 (Defra, 2003a), sets out a framework for air quality management, which includes a number of air quality objectives. National and international measures are expected to achieve these objectives in most locations, but where areas of poor air quality remain, air quality management at a local scale has a particularly important role to play. Part IV of the Environment Act 1995 requires local authorities to periodically review and assess the current, and likely future air quality in their areas. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved by the due date. These locations must be designated as AQMAs and a subsequent action plan developed in order to reduce pollutant emissions in pursuit of the objectives.

1.3 Review and Assessment is a long-term, ongoing process, structured as a series of 'rounds'. Local authorities in England, Scotland and Wales have now completed the first round of Review and Assessment and the second round is almost complete.

1.4 Local Air Quality Management Technical Guidance (LAQM.TG(03)) (Defra, 2003b) sets out a phased approach to the second round of Review and Assessment. This prescribes an initial Updating and Screening Assessment (USA), which all authorities must undertake. It is based on a checklist to identify any matters that have changed since the first round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the first round, then the Local Authority should progress to a Detailed Assessment (DA).

1.5 The purpose of the Detailed Assessment (DA) is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the DA is that one or more of the air quality objectives are likely to be exceeded, then an Air Quality Management Area (AQMA) must be declared. Subsequent to the declaration of an AQMA, a Further Assessment should be carried out to confirm that the AQMA declaration is justified; that the appropriate area has been declared; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an Air Quality Action Plan, which will identify measures to improve local air quality.

The Air Quality Objectives

1.6 The Government's Air Quality Strategy (DETR, 2000) defines both standards and objectives for each of a range of air pollutants. The 'standards' are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. The objectives are prescribed within The Air Quality (England) Regulations 2000 (The Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (The Stationery Office, 2002). This latter publication set more stringent objectives for benzene and carbon monoxide which are relevant to the second round, but which were absent in the first. Table 1 summarises the objectives which are relevant to this report. Appendix 1 provides a brief summary of the health effects of the pollutant under consideration.

1.7 The air quality objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective. For annual mean objectives, relevant exposure is limited to residential properties, schools and hospitals. The 1-hour objective applies at these locations as well as at any outdoor location where a member of the public might reasonably be expected to stay for 1 hour or more, such as shopping streets, parks and sports grounds, as well as bus stations and railway stations that are not fully enclosed.

1.8 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60 $\mu g/m^3$ (Laxen and Marner, 2003). Thus, exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration may be used as an indicator of potential exceedences of the 1-hour mean nitrogen dioxide objective.

1.9 The European Union has also set a limit value for nitrogen dioxide. Achievement of this value is a national obligation rather than a local one. The limit value for nitrogen dioxide is the same level as the UK objective, but is to be achieved by 2010.

Table 1: Air Quality Objectives for Nitrogen Dioxide

Pollutant	Status	Time Period	Objective / Value	To be Achieved by[a]
Nitrogen Dioxide	Statutory UK Objective	1-hour mean	200 µg/m³ not to be exceeded more than 18 times a year	2005
		Annual mean	40 µg/m³	2005
	EU Limit Value	1-hour mean	200 µg/m³ not to be exceeded more than 18 times a year	2010
		Annual mean	40 µg/m³	2010

[a] The achievement dates for the UK objectives are the end of the specified year; achievement dates for the EU limit values are the start of the specified year.

Scope

1.10 The revised 'Stage 4' guidance note (available from Defra, 2006b) explains that a Further Assessment report allows authorities:

- to confirm their original assessment of air quality against the prescribed objectives, and thus to ensure that they were right to designate the AQMA;
- to calculate more accurately how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMA;
- to refine their knowledge of the sources of pollution so that air quality action plans can be properly targeted;
- to take account of national policy developments which may come to light after the AQMA declaration;
- to take account as far as possible of any local policy developments which are likely to affect air quality by the relevant date, and which were not fully factored into earlier calculations;
- to carry out real-time monitoring where this has not been done previously;
- to carry out further monitoring in problem areas to check earlier findings;
- to corroborate other assumptions on which the designation of the AQMA has been based, and to check that the original designation is still valid, and does not need amending in any way;
- to respond to any comments made by statutory consultees in respect of authorities' previous reports, particularly where these have highlighted that insufficient attention has been paid to, e.g., the validation of modelled data.

Report Structure and Issues Addressed

1.11 Section 2 of this report assesses the impact of new developments since the Detailed Assessment was produced. Section 3 provides responses to the comments of consultees on the Detailed Assessment. Section 4 comprises a review of monitoring data collected since the

Detailed Assessment was produced and the results of new detailed dispersion modelling that has been carried out. These data are then used to determine the likelihood of exceedences of the objectives within both the AQMA and the wider Study Area. Section 5 estimates the relative contribution of the most significant pollution sources to pollutant concentrations. Section 6 estimates the reduction in local emissions necessary to achieve the Government's objectives. Section 7 appraises a range of nominal emissions reduction targets for their ability to bring about the necessary changes.

Key Findings of the Updating and Screening Assessment and the Detailed Assessment

1.12 The Updating and Screening Assessment for Gateshead Council (Gateshead Council, 2003) concluded that the objectives for carbon monoxide, lead, benzene, 1,3-butadiene, sulphur dioxide and PM_{10} would all be achieved at relevant locations. However, potential exceedences of the annual mean nitrogen dioxide objective were identified at two busy road junctions: Trinity Court (A184/A167) and Regent Street / West Street. Subsequent monitoring indicated potential exceedences of the annual mean nitrogen dioxide objective at two further locations: the A1 at Dunston, and the A184 Askew Road (Melbourne Court).

1.13 The Detailed Assessment for Gateshead Council (Tyne and Wear, 2005) studied each of the areas listed above in more detail. It's conclusions are summarised below:

- A1 Dunston: No AQMA required.
- A184 Askew Road (Melbourne Court): No AQMA required.
- Regent St / West St: No AQMA required.
- Trinity Court (A184/A167): AQMA required in respect of the annual mean objective for nitrogen dioxide, which as a minimum should include Trinity Court and Pereath Court, the residential properties to the south west and north west of the junction.

1.14 Following the Detailed Assessment, Gateshead Council declared an AQMA which includes Trinity Court and Pereath Court and extends across the Town Centre. The Gateshead Town Centre AQMA Order came into force on 1st April 2005. The boundary of the AQMA is shown in Figure 1.

2 Developments since Declaration of the AQMA

New/Proposed Local Developments

2.1 A new residential apartment block has recently been constructed within the AQMA; close to the A167, to the west of the Tyne Bridge approach, and to the Swing Bridge approach road. Nitrogen dioxide concentrations at the roadside façade of this development are discussed within this report.

2.2 Outline planning permission has also been granted for the redevelopment of the shopping centre and supermarket in Gateshead town centre. This, together with other planning proposals for the town centre, will be kept under careful review as the proposed development is situated within the AQMA. Information on proposed developments is obtained from the Council's Planning Service, and procedures have been developed to ensure that planning applications that might impact on air quality are forwarded to the Council's Environmental Health Service.

Local Air Quality Strategy

2.3 Over the last year Gateshead Council has worked closely with the other Tyne & Wear local authorities (Newcastle CC, Sunderland CC, North Tyneside MBC and South Tyneside MBC) and consultants to produce a joint Air Quality Strategy for the Tyne and Wear area. This represents a significant step forward and demonstrates the commitment of the Councils involved to securing future air quality improvements across the area. The strategy addresses a number of policy areas which have the potential to impact on air quality, including transport planning and land use planning as being key to air quality improvements. Transport planners and planning officers representing the Tyne & Wear authorities have been actively involved in the process of drafting of the strategy, which provides a framework for these and other organisations and agencies, including the local public transport operators, with respect to integrating air quality considerations into their policy areas, and vice versa. The strategy has now been approved by Gateshead Council and has been incorporated into the Local Transport Plan (LTP).

Local Transport Plan

2.4 Gateshead Council works in partnership with the other four Tyne & Wear authorities and public transport operators to produce a joint Tyne & Wear LTP and the authorities have recently submitted their second LTP (LTP2) for the area to the Department for Transport.

National Developments

2.5 New national maps of background pollutant concentrations have recently been issued by Defra (2006a) and these have been used in this Further Assessment. Similarly, Defra (2006a) has also issued new factors for predicting concentrations in future years. These have also been used here.

3 Responses to Consultees Comments

3.1 Defra's formal appraisal accepted the conclusions of the DA, but noted that:

1) "*It is not clear from the report that Gateshead MBC have accepted the conclusions of their consultant".*

Gateshead Council have accepted ownership of the Detailed Assessment report and thus accepted its conclusions.

2. "*Intentions to continue monitoring in the vicinity of the A1 at Dunston is noted and endorsed. Uncertainties in the measurements and modelling results for this site strongly support the need to keep this location under careful review ".*

This report addresses the Town Centre AQMA alone, Monitoring of nitrogen dioxide concentrations at Dunston is ongoing, and will be kept under close review.

3.2 No responses/objections were received regarding the Detailed Assessment following a full consultation with residents of AQMA, other Council Services and Councillors/relevant stakeholders.

4 Corroboration of Previous Findings

New Monitoring

Automatic Monitoring

4.1 Gateshead Council measures nitrogen dioxide concentrations using real-time chemiluminescent monitors at three roadside sites within the Town Centre AQMA. The monitors are located at Trinity Court, Lychgate and Bottle Bank. Their positions are shown in Figure 1. Each monitor is operated by Council officers who have been suitably trained. Calibrations and filter changes are carried out at two-week intervals. Lychgate also has an automatic daily calibration feature. All of the monitors are serviced twice a year, according to manufacturer's recommendations.

4.2 The Trinity Court monitoring station is close to the roundabout that acts as the main hub for traffic moving from the A184 on to the A167 Tyne Bridge approach. The monitor is approximately 10 m away from the kerbside, 15 m from the centre of the nearest road exiting the roundabout and 25 m from the central carriageway of the roundabout. The unit is also approximately 55 m from the centre of the elevated flyover (A167) that carries traffic from the A1 to the Tyne Bridge. The manifold inlet is approximately 2 m above road level and the surrounding area is generally open, although there are some low-rise council flats adjacent (6m) to the monitor. The Lychgate monitoring station is located 7 m from the kerb of the A184. There are some low-rise council flats and gardens approximately 5 m south of the monitor. The manifold inlet is approximately 2 m above the road. The Bottle Bank monitor is located in the regenerated Quayside area, 5m from the front of new apartments. The unit is 2.5 m from the kerb and 6 m from Bottle Bank Road, which carries traffic to the swing bridge and the wider Quayside area. The monitor is also 22 m from the road centre of the Tyne Bridge A167, which runs parallel to Bottle Bank.

4.3 Measured nitrogen dioxide concentrations during 2004 and 2005 are summarised in Table 2. No exceedences of the annual mean or 1-hour objectives have been recorded at any of the three sites.

Table 2: Measured Nitrogen Dioxide Concentrations at Automatic Monitors.

		Annual Mean (μg/m³)		Number of Exceedences of 200 μg/m³ as a 1-hour mean	
Site	**Type**	**2004**	**2005**	**2004**	**2005**
Trinity Court	Roadside	34	34	0	0
Lychgate Court	Roadside	-	34 [a]		0 [c]
Bottle Bank	Roadside	-	32 [b]		0 [c]
Objective		**-**	**40**	**-**	**18**

[a] Annual mean predicted from the period mean (8 month's data) following the method in LAQM TG(03) (Defra 2003b). Data were measured for the period 01/5/05 – 31/12/05. The annual mean was predicted based on regional trends recorded at the following AURN monitoring sites: Barnsley Gawber (UB), Hull Freetown (UC), Newcastle (UC) and Sunderland (UB). The factor applied was 0.95.
[b] Annual mean predicted from the period mean (4 month's data) following the method in LAQM TG(03) (Defra 2003b). Data were measured for the period 16/9/05 – 31/12/05. The annual mean was predicted based on regional trends recorded at the following AURN monitoring sites: Barnsley Gawber (UB), Hull Freetown (UC), Newcastle (UC) and Sunderland (UB). The factor applied was 0.74.
[c] The number of exceedences measured during the monitoring period, which was less than a full year.

Diffusion Tube Monitoring

4.4 Monthly average nitrogen dioxide concentrations have been measured at a large number of sites during 2003, 2004 and 2005 using passive diffusion tubes. The monitoring sites within the current Study Area are shown in Figure 1. Diffusion tube number 3 (Melbourne Court (a)) is closer to the road than the nearest residential property, but each other diffusion tube represents residential exposure. Table 3 sets out the annual mean concentrations at each site within the Study Area that produced at least 9 months worth of data during 2003, 2004 or 2005. The diffusion tubes (50% TEA in acetone) are supplied and analysed by Jesmond Dene Laboratory who participate in the WASP QA/QC procedure.

4.5 The annual mean diffusion tube results show good year-to-year consistency, which adds confidence to the results. Two (of the thirteen) diffusion tube sites within the AQMA recorded exceedences of the 40 μg/m³ annual mean objective. One of these (Tube number 3) is a kerbside site, and is much closer to the A184 (Askew Road) than the nearest residential properties. The monitoring site does not represent public exposure for the annual mean objective at this location. Other nearby monitors (Askew/Melbourne and Adelaide Court) better represent concentrations at the façades of residential properties, and these show that levels were well below 40 μg/m³ in 2005. The other measured exceedence of 40 μg/m³ within the AQMA was at Trinity Court (Tube 42). This site does represent relevant public exposure to the annual mean objective.

4.6 The other measured exceedence of 40 μg/m^3 within the Study Area was outside of the AQMA boundary. This site, at the façade of a property on Durham Road (A167) opposite the junction with Dryden Road, represents relevant public exposure. Annual mean nitrogen dioxide concentrations of 43 and 42 μg/m^3 were measured at this site during 2004 and 2005 respectively.

Table 3: Measured 2003, 2004 and 2005 Annual Mean Nitrogen Dioxide Concentrations at Each Diffusion Tube Monitoring Site within the Study Area (μg/m^3). Exceedences of 40 μg/m^3 are shown in bold.

Tube No.	Site	O.S. Ref (x y)	Within AQMA	Site Description	2003 [a]	2004 [b]	2005 [c]
2	Priory Crt	425736 563253	Yes	Roadside	38	36	37
3	Melbourne Crt (a)	425312 563293	Yes	Kerbside	**42**	**-**	**48**
32	Abbotsford	427812 562372	No	Roadside	31	30	-
37-39	Askew/Melbourne (b)	425304 563291[d]	Yes	Roadside	36	34	34
42	Trinity Crt	425781 563055	Yes	Roadside	-	**42**	**42**
43	Regent Crt	425553 562965	Yes	Roadside	-	32	31
44	Adelaide Crt	425292 563233	Yes	Roadside	-	26	25
45	Melbourne Crt (c)	425305 563093	Yes	Roadside	-	32	29
46	Team Vale Villas	425297 562886	Yes	Roadside	-	30	32
47	Dryden Rd	425760 561641	No	Roadside	-	**43**	**42**
48?	Splitcrow Rd	425997 561956	No	Roadside	-	32	-
51	Cuthbert St	424833 562379	No	Roadside	-	35	35
52	Coatsworth Rd	425034 562736	No	Roadside	-	33	31
54	Sage	425469 563760	No	Roadside	-	-	30
58	Park Crt	425756 563193	Yes	Roadside	-	-	34
59	Peareth Crt	425770 563135	Yes	Roadside	-	-	33
60	Lynchgate Crt	425912 563108	Yes	Roadside	-	-	36
61	Monk Crt	425855 562994	Yes	Roadside	-	-	33
62	St Mary's Crt	425798 562968	Yes	Roadside	-	-	30
64	Baltic Flats	425899 563905	No	Roadside	-	-	36

[a] 2003 annual means have been bias adjusted using the factor published on the Review and Assessment helpdesk website (Defra, 2006b) Spreadsheet version 02/06. The factor used rounds to 1.00.
[b] 2004 annual means have been bias adjusted using the factor published on the Review and Assessment helpdesk website (Defra, 2006b) Spreadsheet version 02/06. The factor used is 1.02.
[c] 2005 annual means have been bias adjusted using the factor published on the Review and Assessment helpdesk website (Defra, 2006b) Spreadsheet version 02/06. The factor used is 1.07.
[d] These triplicate-exposed tubes were moved from grid-ref 425280 563254 in October 2003.
Only sites with at least 9-month's data have been included.

New Modelling – Nitrogen Dioxide

4.7 Annual mean concentrations of nitrogen dioxide during 2005 have been predicted at a selection of worst-case receptors both inside and outside of the AQMA using the dispersion modelling methodology set out in Appendix 2. Figure 2 shows the results for the whole Study Area. Figure 3 shows the results for receptors within the AQMA. Eleven of the receptors within the AQMA are individually labelled on Figure 3. These receptors have been chosen to represent the locations with the highest predicted concentrations. Figure 3 also shows all of the relevant residential properties in the area. The results for these eleven receptors are also set out in Table 4.

4.8 These predictions indicate that the objectives were exceeded at two receptors during 2005. The first of these, Receptor 5, represents the residential property on the junction of Charles St and High St. The second represents the worst-case location within the new development near to the Tyne Bridge approach. An annual mean concentration of just below 40 $\mu g/m^3$ was predicted at Receptor 3, which is adjacent to the Gateshead Highway / Charles St junction.

Table 4: Modelled 2005 Annual Mean Nitrogen Dioxide Concentrations at the Worst-Case Representative Receptors.

Receptor Number (as shown in Fig 3)	**Description**	**Modelled Annual Mean Nitrogen Dioxide Concentration ($\mu g/m^3$)**
1	Regent Terrace	33
2	Melbourne Crt (c) Diffusion Tube (no 45)	36
3	Peareth Court	40[a]
4	Lychgate Court	37
5	High Street	**40**
6	Melbourne Court (south east)	36
7	Walker Terrace	36
8	Curzon 1 (Diffusion Tube Site)[b]	**42**
9	Regent Crt Diffusion Tube (no 43)	38
10	Park Crt Diffusion Tube (no 58)	35
11	Trinity Crt Diffusion Tube (no 42)	35
Objective		**40**

[a] The precise modelled concentration is 39.5 $\mu g/m^3$.
[b] This diffusion tube site achieved less than 9 month's data capture and is thus not included in Table 3.

4.9 The modelled concentrations are inherently subject to greater uncertainties than the measurements. Whilst predictions provide the best indication of concentrations across the study area, they are likely to under-predict the true concentrations at some locations, and to over-predict them at others. A full comparison of the modelled data with the measurements is given in Appendix 2. Comparing Table 3 with Table 4, it can be seen that the model over-predicted concentrations at Receptors 2, 9, and 10, and under-predicted the concentration at Receptor 11. The under-prediction of the model at Receptor 11 is important because this is the only relevant monitoring site within the AQMA at which an exceedence of the annual mean objective was recorded. Overall, the model results show a similar pattern to the measurements; whilst the annual mean nitrogen dioxide objective was achieved in most locations across the area, it was breeched in a few isolated locations by a relatively small margin.

4.10 Figure 4 shows a contour map of predicted annual mean nitrogen dioxide concentrations during 2005 across the AQMA. Predicted concentrations are generally well below the level of the objective, with levels above 35 $\mu g/m^3$ confined to areas in the vicinity of busy roads. Most of the residential areas within the AQMA (as highlighted in Figure 3) are likely to have experienced concentrations less than 35 $\mu g/m^3$ during 2005. Figure 5 highlights the areas in which concentrations greater than 40 $\mu g/m^3$ were predicted during 2005. The only residential properties within this area are the property on the junction of Charles St and High St, and the new development near to the Tyne Bridge approach. Both of these locations have been discussed above. There were no predicted exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration at locations where people might reasonably be expected to spend 1-hour or more. Thus, exceedences of the 1-hour nitrogen dioxide objective are highly unlikely.

Summary

4.11 The objectives were not exceeded during 2005 at any of the three automatic monitoring sites. The objectives were met at most of the diffusion tube sites, but one site (Trinity Court) recorded an exceedence of the annual mean objective for nitrogen dioxide. One of the diffusion tube sites outside of the AQMA also recorded an exceedence of the objective. The model results indicate that the objectives were exceeded at a very small number of properties within the AQMA, but were met everywhere else.

Comparison with Other Recent Studies

4.12 Gateshead Council's Detailed Assessment (Tyne and Wear, 2005) presented measurements from Trinity Court suggesting that the annual mean nitrogen dioxide objective would be exceeded. Dispersion modelling carried out for the DA, however, indicated that an exceedence was unlikely. Even though this Further Assessment has used a different set of measurements and a revised approach to modelling, a very similar pattern is shown. This is highlighted by comparing Figures 6A and 6B. Figure 6A reproduces the contour plot presented in the DA (Tyne and Wear, 2005). Figure 6B reproduces the data from this Further Assessment using the colour scale from the DA. The dispersion model is clearly unable to take full account of the very complex nature of this split level junction and its surrounding landscape of tower blocks.

4.13 Figures 6C reproduces the contour plot for Melbourne Court from the DA (Tyne and Wear, 2005). Figure 6D shows the results from this current study according to the same scale. Again, even though different datasets have been used for the Further Assessment, the results are very consistent. The differences to the eastern edge of Figures 6C and 6D result from the inclusion of additional roads in the Further Assessment that were not included in the DA. Comparing one set of model results to another does not verify the data, but it is nevertheless encouraging.

4.14 Recent modelling carried out for Newcastle City Council (Newcastle CC, 2005) used a very similar modelling methodology to this current study. The differences between the two approaches are:

- The Gateshead modelling has been verified using local monitoring data from 2005. The Newcastle modelling was verified with area-wide measurements made during previous years.
- The Gateshead modelling used the latest background concentration maps published by Defra (2006b). These were unavailable for the Newcastle study.
- The Gateshead modelling included a network of roads which was specific to Gateshead. The Newcastle study only included roads within Newcastle.

4.15 The modelled results for Newcastle (Newcastle CC, 2005) showed an exceedence area that covered much of the City Centre during 2005. This is a very different situation to the one reported here. This primarily reflects differences between the measured concentrations north and south of The River Tyne, which are affected by, many local factors, including traffic volumes and topography.

4.16 Figure 7 shows the concentrations predicted in the Newcastle AQMA alongside those predicted in this current Study. The boundary between the results from the two separate studies is shown by a bold black line. Very few roads north of the River Tyne were included in the modelling for Gateshead and thus the Gateshead-specific plot would not be expected to reproduce the data for Newcastle Quayside (where it overlaps). It is, however, very easy to see how the two different pictures fit together. Considering the different data that have been used for the two studies, it is concluded that the results compare very well.

5 Source Apportionment

5.1 In order to develop an appropriate action plan it is necessary to identify the sources contributing to the objective exceedences at the worst-case locations. Figure 8 and Table 5 set out the predicted annual mean nitrogen dioxide concentrations in 2005 at each of the eleven receptors described above (labelled in Figure 3). Source contributions have been apportioned to the following categories:

- Cars on commuting journeys
- Cars on business journeys
- Cars on leisure trips
- Light Goods Vehicles
- Heavy Goods Vehicles
- Buses
- Ambient Background

Appendix 2 explains how the data were derived.

5.2 The relative influence of each source category varies by location, but the background concentration, which represents pollution from roads outside of the Study Area and from non-road sources, is the main component at every receptor. Of the locally-generated road component, buses and leisure car trips tend to make the largest contributions, with HGVs also important.

Table 5: Modelled Annual Mean Nitrogen Dioxide Concentrations in 2005 at the Worst-Case Representative Receptors and the Contribution of each Source to the Total

Receptor	Background	Buses	HGV	LGV	Business cars	Commuter cars	Leisure Cars	Total
	Annual Mean Concentration (μg/m³)							
1	20	4	3	1	1	1	3	33
2	23	5	2	1	1	1	3	36
3	23	3	3	1	1	2	5	40
4	23	2	3	1	1	2	5	37
5	23	8	3	1	1	1	3	**40**
6	23	5	2	1	1	1	3	36
7	20	5	3	1	1	1	4	36
8	23	4	4	1	1	2	5	**42**
9	20	8	4	1	1	1	3	38
10	23	2	3	1	1	1	4	35
11	23	3	2	1	1	1	4	35
	Percentage Contribution to the Total							
1	62%	11%	9%	3%	3%	3%	8%	100%
2	65%	15%	6%	2%	2%	3%	7%	100%
3	59%	7%	9%	3%	4%	5%	13%	100%
4	64%	5%	8%	3%	3%	5%	13%	100%
5	58%	19%	8%	3%	2%	2%	8%	100%
6	64%	14%	6%	2%	2%	3%	8%	100%
7	57%	14%	8%	3%	3%	4%	11%	100%
8	56%	10%	11%	3%	3%	5%	12%	100%
9	53%	21%	9%	3%	3%	3%	8%	100%
10	66%	7%	8%	3%	3%	4%	10%	100%
11	67%	8%	7%	2%	2%	3%	10%	100%

Where figures do not appear to add up it is because the numbers as presented in the table have been rounded.

6 Air Quality Improvements Needed

6.1 The highest measured annual mean concentration during 2005 was 42 $\mu g/m^3$. The highest modelled concentration was also 42 $\mu g/m^3$. According to both the measurements and the model, the degree of improvement needed in order for the annual mean objective for nitrogen dioxide to be achieved is 2 $\mu g/m^3$ of nitrogen dioxide.

6.2 In terms of describing the reduction in emissions that is required it is more useful to consider the emissions of nitrogen oxides (NOx) from the local road. It is therefore most appropriate to focus on the highest modelled concentration, which is for Receptor 8. Even though in terms of total nitrogen dioxide, the reduction required is only four or five percent, locally-generated NOx emissions during 2005 at this receptor would need to have been some twelve percent lower in order for the objective to have been achieved[1]. This relatively large percentage reduction reflects the point that local background concentrations make up most of the total and because this contribution is assumed not to change, the influence of changes to the local fraction would be muted[2]. The calculation does not take account of the point that reducing emissions from the wider road network will reduce the background concentrations and thus bring about local improvements.

[1] This reduction was calculated following the modelling methodology, which involves various locally-specific adjustments. The NOx value was NOT calculated directly from NO_2 using national default factors.

[2] Also important is the relative position of the concentrations involved on the NOx to NO_2 relationship curve. Because this relationship is non-linear, a given reduction in locally-generated NOx is unlikely to give rise to exactly the same reduction in locally-generated NO_2. The response in local-NO_2 from a given percentage change in local-NOx depends on the total ambient NOx concentration.

7 Management Planning

7.1 In order to inform potential measures within the action plan, a number of simple and hypothetical measures to deliver the required NOx reductions at the eleven worst-case receptors has been explored. The measures that have been examined involve stepped reductions in local emissions from each of the six vehicle categories defined in Section 5. Table 6 sets out the results. The data are presented only for 2005 and are simply intended to demonstrate the potential benefits that could be achieved from various extreme measures. As is explained below, concentrations in subsequent years are expected to be different to those in 2005 with or without emission-control measures in place.

Table 6: Modelled Annual Mean Nitrogen Dioxide Concentration During 2005 Assuming Hypothetical Emission Reductions from Different Vehicle Classes[a].

Vehicle Type	% reduction in emissions	Predicted Concentration (µg/m^3)										
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
Cars on commuting journeys	10%	32	36	39	37	**40**	36	35	**41**	38	35	35
	25%	32	36	39	36	40	36	35	**41**	38	35	35
	50%	32	35	39	36	40	36	35	**41**	38	35	34
Cars on business journeys	10%	32	36	39	37	**40**	36	36	**41**	38	35	35
	25%	32	36	39	36	40	36	35	**41**	38	35	35
	50%	32	35	39	36	40	36	35	**41**	38	35	34
Cars on leisure trips	10%	32	36	39	36	40	36	35	**41**	38	35	35
	25%	32	35	39	36	40	36	35	**41**	38	35	34
	50%	31	35	38	35	39	35	34	40	37	34	33
Light Goods Vehicles	10%	32	36	39	37	**40**	36	36	**41**	38	35	35
	25%	32	36	39	36	40	36	35	**41**	38	35	35
	50%	32	36	39	36	40	36	35	**41**	38	35	35
Heavy Goods Vehicles	10%	32	36	39	36	40	36	35	**41**	38	35	35
	25%	32	35	39	36	40	36	35	**41**	38	35	34
	50%	31	35	38	35	39	35	34	40	37	34	34
Buses	10%	32	35	39	37	40	36	35	**41**	38	35	35
	25%	32	35	39	36	39	35	35	**41**	37	35	34
	50%	31	34	38	36	37	34	34	40	35	34	34
All Cars	10%	32	35	39	36	40	36	35	**41**	38	35	34
	25%	32	35	38	35	39	35	34	40	37	34	34
	50%	31	34	36	34	38	34	33	38	36	33	32
HGV and LGV	10%	32	36	39	36	40	36	35	**41**	38	35	35
	25%	32	35	39	36	39	36	35	**40**	37	35	34
	50%	31	35	38	35	38	35	34	39	37	34	34
All Vehicles	10%	32	35	38	36	39	35	34	**40**	37	34	34
	25%	30	33	36	34	37	34	32	38	35	33	32
	50%	27	30	33	31	33	31	29	34	31	30	30
Do Nothing	-	33	36	40	37	**40**	36	36	**42**	38	35	35

[a] These data assume that the background concentration would be unchanged by the modelled emission reduction measures.

7.2 The results presented in Table 6 show that targeting some vehicle types in isolation would achieve very little at the worst-case locations. This is because the calculations assume that any changes would apply only to the local area and would not influence the background levels. Only quite appreciable reductions in vehicle emissions adjacent to Receptor 8 would have brought about achievement of the objective during 2005. It is likely, however, that an area-wide transport strategy, which targets local air quality, would influence both the local-generated component and also the background concentration.

Future-Year Predictions

7.3 In terms of management planning, it is clearly more useful to focus on a future year than on 2005. Concentrations in 2010 have been predicted based on two separate scenarios. The first is the 2010 baseline case from the STM traffic model. The joint Tyne and Wear LTP2 sets out measures which are expected to restrict the growth in vehicle numbers within an "Inner Cordon" to 5% between 2005 and 2010 (which is, on average, a lower rate of growth than is assumed in the baseline traffic model). The second 2010 scenario equates to just a 5% growth in vehicle numbers between 2005 and 2010. The results for both scenarios are presented in Table 7. The results for the 2010 STM Traffic Model scenario are also presented for receptors within the entire study area in Figure 9 and for receptors within the AQMA in Figure 10. The results are not plotted for the second scenario, as the results differ only slightly and the first scenario is the worst-case.

7.4 Both scenarios are predicted to deliver large reductions in annual mean nitrogen dioxide concentrations in comparison with 2005 levels. This reduction is due to a range of measures implemented by the UK and the EU Governments to reduce emissions from vehicles and other sources. These measures are expected to more than offset the expected increase in vehicle numbers in the area. It is concluded that the annual mean nitrogen dioxide objective is likely to be achieved at all relevant locations in 2010, based on either scenario. Restricting traffic growth to 5% would offer the largest improvement, but the predicted concentrations are below 35 $\mu g/m^3$ for either assumption.

7.5 The reductions in concentration predicted between 2005 and 2010 have been based upon national estimates of road traffic emission factors, and projections of future year background pollutant concentrations, which are published by Defra (2006b). Figure 11A shows how the concentration at the worst-case (roadside) receptor in 2005 is predicted to decline based on published year-adjustment factors (Defra, 2006b). Based on current estimates, the objective would be achieved by about 2007, without any specific action plan measures.

Table 7: Modelled Annual Mean Nitrogen Dioxide Concentrations (μg/m^3) in 2010 According to Two Different Scenarios and the Contribution of Each Source to the Total[a]

Receptor	Background	Buses	HGV	LGV	Business cars	Commuter cars	Leisure Cars	Total
	Baseline 2010 STM Traffic Model							
1	18	3	3	1	1	1	2	28
2	20	4	2	1	1	1	2	30
3	20	2	3	1	1	2	4	33
4	20	1	3	1	1	2	3	31
5	20	6	3	1	1	1	2	34
6	20	4	2	1	1	1	2	30
7	18	4	3	1	1	1	3	30
8	20	3	4	1	1	2	4	35
9	18	6	3	1	1	1	2	32
10	20	2	2	1	1	1	3	30
11	20	2	2	1	1	1	2	29
	Traffic Growth Limited to (and fixed at) 5% on Each Road Between 2005 and 2010[b]							
1	18	3	2	1	1	1	2	27
2	20	4	2	1	1	1	2	30
3	20	2	3	1	1	2	4	33
4	20	1	2	1	1	1	4	31
5	20	6	3	1	1	1	2	33
6	20	4	2	1	1	1	2	30
7	18	4	2	1	1	1	3	30
8	20	3	4	1	1	2	4	35
9	18	6	3	1	1	1	2	32
10	20	2	2	1	1	1	3	30
11	20	2	2	1	1	1	3	29

[a] Where figures do not appear to add up it is because the numbers as presented in the table have been rounded.
[b] Speeds have been assumed not to change between 2005 and 2010

7.6 However, it is very important to stress that these anticipated improvements do not take specific account of local factors. Furthermore, there is evidence at a national level, that concentrations at some roadside sites have not followed these predicted trends. Reasons for this are currently being explored by the Government's expert advisory panel AQEG; one potential factor may be the increased penetration of diesel vehicles, which emit a higher proportion of primary NO_2.

7.7 Two of the diffusion tube monitoring sites within the Study Area have collected data since 1999. These are at Priory Court (Tube Number 2) and Melbourne Court (a) (Tube Number 3). Figure 11B sets out the measured concentrations for the seven-year period beginning 1999. Also shown in Figure 11B is the concentration that would have been predicted at the Melbourne Court site in each year based on the measured concentration during 1999 (according to Defra's (2006b) future-year projections). Clearly, at these two sites, concentrations have not fallen in line with the national projections. There is thus considerable uncertainty regarding future year projections, and it considered prudent to base any action plan measures on the 2005 concentration data.

8 Summary

8.1 Nitrogen dioxide concentrations within and around the Gateshead Town Centre Air Quality Management Area (AQMA) have been assessed by both monitoring and dispersion modelling. The results indicate that most locations achieved the Government's objective for annual mean nitrogen dioxide concentrations during 2005, but that there were some isolated exceedences, both inside and outside of the AQMA. The exceedences inside the AQMA were at the Gateshead Highway / Park Lane junction; at the new residential development near to the Tyne Bridge; and at the juction of High Street with Charles Street. The exceedence outside of the AQMA was on Durham Road (A167) opposite its junction with Dryden Road. The highest measured or predicted concentration at any location was 42 $\mu g/m^3$, which compares with the objective level of 40 $\mu g/m^3$. The margin of exceedence is thus relatively small. Nevertheless, the emissions from local roads would need to have been some 12% lower for the objective to have been achieved at the worst-case location.

8.2 Because of national and international measures to reduce emissions from road transport and many other sectors, current projections assume that nitrogen dioxide concentrations will fall in the future. Based on this assumption, the objective could be achieved at all locations by around 2007. However, empirical evidence suggests that concentrations in Gateshead Town Centre have not fallen in line with recent predictions. It is thus far from certain that the objectives would be achieved without specific emission reduction measures in place.

8.3 The area of the AQMA area is thought to be conservative, but not innapropriate. It is recommended that additional monitoring should be carried out around the Dryden Road site and that this site should be addressed in the next round of Review and Assessment.

References

CERC, 2006. www.cerc.co.uk

Defra, 2003a. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum. February 2003.

Defra, 2003b. Review & Assessment: Technical Guidance LAQM.TG(03) (available from Defra, 2005a)

Defra, 2006a Review and Assessment Helpdesk Website: www.uwe.ac.uk/aqm/review

Defra 2006b Air Quality Archive Website: www.airquality.co.uk

Defra 2006c Modelling Helpdesk: www.stanger.co.uk

DETR, 2000. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, January 2000.

Laxen and Marner, 2003. Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. Available from Defra, 2004a and 2004b.

Newcastle City Council (2005) Further Assessment of Air Quality in Newcastle City Centre, the Quayside, and Jesmond Road.

Stationery Office, 2002. The Air Quality (England) (Amendment) Regulations 2002. Statutory Instrument 3043

Stationery Office, 2000. Air Quality Regulations, 2000, Statutory Instrument 928.

Tyne and Wear, 2005. Detailed Assessment of Air Quality in Tyne and Wear.

Appendix 1 – Main Health Effects of Nitrogen Dioxide

Short-term exposure to high concentrations may cause inflammation of respiratory airways. Long-term exposure may affect lung function and enhance responses to allergens in sensitised individuals. Asthmatics will be particularly at risk. Nitrogen dioxide is also seen as a useful indicator of general traffic pollution.

Appendix 2 Dispersion Modelling Methodology

A3.1 Pollutant concentrations were assessed by modelling using the ADMS Urban dispersion model, which is described at CERC (2006). Each model input parameter is described below.

Meteorological data:

A3.2 These came from measurements made at the Newcastle meteorological station during 2003.

Road Alignment:

A3.3 Road alignment was based around Ordnance Survey road centreline data, but was adapted, where appropriate, to better represent vehicle trajectories. This adaptation was based on photographic evidence. The roads explicitly entered into the model are shown in Figure A2 1. Those minor roads that were not explicitly included have been accounted for via the background component of the modelled results.

Figure A2.1 Roads Included Explicitly in the Dispersion Model

At the very edges of the modelled area, a few roads have been included that have less precise geographical positioning than is used in the core of the area. This will not affect the results as these roads are considerable distance from any receptors.

Road Geometry:

A3.4 Road characteristics, such as whether a road is elevated or surrounded by tall buildings, can influence the dispersion of pollutants. They were thus incorporated into the modelling based on local knowledge, as well as on photographic evidence.

Link-specific emissions data:

A3.5 The traffic data were not entered directly into the ADMS dispersion model. Instead, data were entered as link-specific emissions, in grammes of oxides of nitrogen (NOx) per second. These emissions were calculated using the 3rd generation emission factor spreadsheet calculator provided by the Review and Assessment modelling helpdesk (Defra 2006c). The emissions for each link were derived from the traffic data described below.

Traffic data:

A3.6 Traffic data were derived from the STM traffic model, which has been developed by Jacobs Babtie on behalf of Gateshead Council. This traffic model was run for both morning peak and inter-peak flows. On advice from Jacobs Babtie, annual average daily traffic (AADT) flows were calculated from the inter-peak data using a factor of 15.41, which came from a compilation of diurnal traffic count data. Speeds were assumed to be equal to the modelled inter-peak speed on open stretches of road, but where traffic was thought likely to move slowly near to junctions, it was artificially reduced to 1/3rd of the inter-peak average modelled speed.

Background Concentrations:

A3.7 These have been taken from new the national maps supplied by Defra (2006a). Because these background maps already include road transport sources, but practically all road transport emissions in the vicinity of the Town Centre have also been included explicitly in the model, this potentially introduces a degree of double counting. The double counting will be largely compensated for through the model verification.

A3.8 The background concentrations represent the concentration away from roads. The contribution from the road can be added to the background concentration in order to predict the total ambient concentration. The background concentration should thus be the lowest concentrations in the area. However, as is shown in Table A2.1, the predicted 2005 annual mean background nitrogen dioxide concentrations from Defra (2006a) are greater than some of the concurrent measured data. This strongly suggests that the local background concentrations are too high. In order to overcome this problem, **all of the predicted background nitrogen dioxide concentrations have been multiplied by 0.8**, which as the data in Table A2.1 show, brings them in line with the smallest measured concentrations. This factor has been applied to the predicted background nitrogen dioxide concentrations in both 2005 and 2010.

Table A2.1 Comparison Between the Predicted Annual Mean Background Nitrogen Dioxide Concentrations and the Smallest Measured Annual Mean Nitrogen Dioxide Concentrations ($\mu g/m^3$).

Diffusion Tube Number	Diffusion Tube Name	Measured Concentration	Predicted Background Concentration Without Adjustment	Predicted Background Concentration After Adjustment
44	Adelaide Crt	25.0	31.2	25.0
45	Melbourne Crt 45	28.8	31.2	25.0
54	Sage	29.9	31.2	25.0

A3.9 If the background nitrogen dioxide concentrations have been over-predicted, then it is likely that the background NOx concentrations have also been over-predicted. Defra (2006a) publish a calculator for predicting the NOx concentration from a measured nitrogen dioxide (NO_2) concentration ("The NOx from NO_2 calculator"). This calculator was used to predict the NOx concentration at each of the diffusion tube sites. For the diffusion tube at Adelaide Court, the "measured" 2005 annual mean NOx concentration (41.4 $\mu g/m^3$) is smaller than the concurrent predicted background concentration (53.2 $\mu g/m^3$). Thus, **all predicted background NOx concentrations have been multiplied by 0.77**, which is the minimum adjustment necessary in order to bring the predicted background values under the measured values.

A3.10 The background nitrogen dioxide concentrations are subsequently multiplied by a secondary adjustment factor which is applied to the total nitrogen dioxide concentration. This is discussed below.

Model Verification:

A3.11 It is important to verify model results by comparing them with local measurements. By adjusting the model to agree closely with the measured data, any uncertainties inherent in the model can be minimised. It is not appropriate to apply the same approach to model verification that was used for the Detailed Assessment (Tyne and Wear, 2005), or for Newcastle City Council's Further Assessment (Newcastle CC, 2005), because these studies did not use the most recent data available.

A3.12 The model was initially run to predict annual mean nitrogen oxides (NOx) concentrations in 2005 at all of the monitoring sites within the study area. These modelled NOx concentrations were then used to predict ambient NO_2 concentrations. This enabled a direct comparison of measured and modelled data, which is shown in Figure A2.2. Almost all of the predictions are lower than the respective measured data (i.e. they lie under the 1:1 line). The model is thus clearly under-predicting.

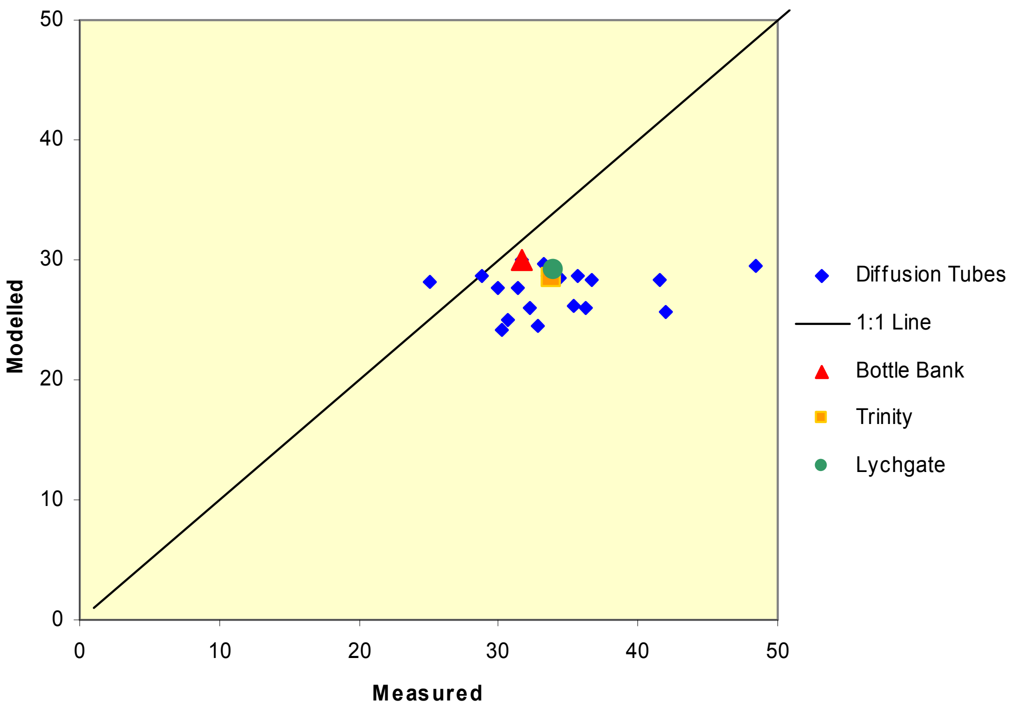

Figure A2.2 Modelled Annual Mean Nitrogen Dioxide Concentration ($\mu g/m^3$) vs Measured Annual Mean Nitrogen Dioxide Concentrations ($\mu g/m^3$) Without any Adjustment of the Model (all data are for 2005). Bottle Bank, Trinity, and Lychgate are automatic monitors.

A3.13 The objective of model verification is to ensure that the modelled values fit well with the measurements, with a particular emphasis on the automatic monitoring sites, at which the measured concentrations are known with greater certainty. The steps in the verification follow the guidance to local authorities in LAQM.TG(03) (Defra, 2003b).

A3.14 NOx is the primary pollutant being modelled, with a secondary step in the calculation being to convert the NOx concentration to an NO_2 concentration. The first step is therefore to verify the ability of the model to predict the NOx concentration.

A3.15 The ambient NOx concentration is the product of that component coming from modelled roads (road-NOx) and that component present in the background (background NOx). For the sites where NOx has been measured (the automatic monitoring sites), road-NOx can thus be calculated by subtracting the predicted background from the total measured concentration. For sites where only the NO_2 concentration has been measured (the diffusion tube sites), the total NOx concentration is first calculated using the NOx from NO_2 calculator published by Defra (2006a). Figure A2.3 shows how the modelled road-NOx compares with the measured road-NOx. The model shows a clear tendency to under-predict.

A3.16 Figure A2.3 also shows an ordinary least squares best fit regression line, passing through zero, and giving double weight to each of the automatic monitoring sites. The equation of this line has been used to adjust the modelled NOx concentrations. **Modelled NOx concentrations have thus been multiplied by 4.193** (i.e. 1/0.2385).

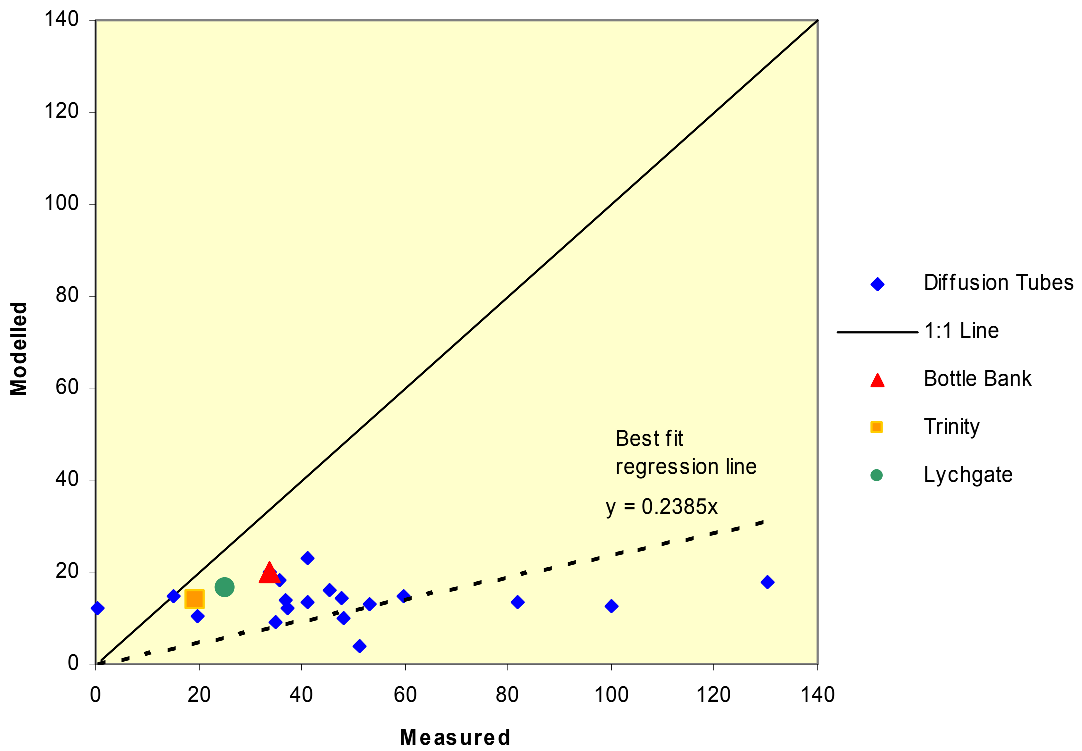

Figure A2.3 Annual Mean Modelled Road-NOx (μg/m^3) vs Annual Mean Measured Road-NOx (μg/m^3) Without any Adjustment of the Model (all data are for 2005). Bottle Bank, Trinity, and Lychgate are automatic monitors.

A3.17 The next step is to compare the calculated NO_2 concentration with the measured value. The NO_2 concentration is calculated according to the method specified in the LAQM.TG(03) (Defra, 2003b):

A3.18 NO_2(modelled) = NO_2(road) + NO_2(background)

A3.19 where:

NO_2(road) = NOx(road) x (-0.068 x Ln(NOx(total)) + 0.53)

A3.20 The adjusted-modelled NO_2 concentrations are then compared with the measured values, as shown in Figure A2.4. The agreement is better, but the overall tendency of the model (including the predicted background) is to over-predict total nitrogen dioxide concentrations, as is shown by the best-fit regression line. A final adjustment has therefore been applied using the equation of the best-fit line. **Modelled NO_2 concentrations have thus been multiplied by 0.936** (i.e. 1/1.0682). A comparison of the final adjusted modelled concentrations is shown in Figure A2.5.

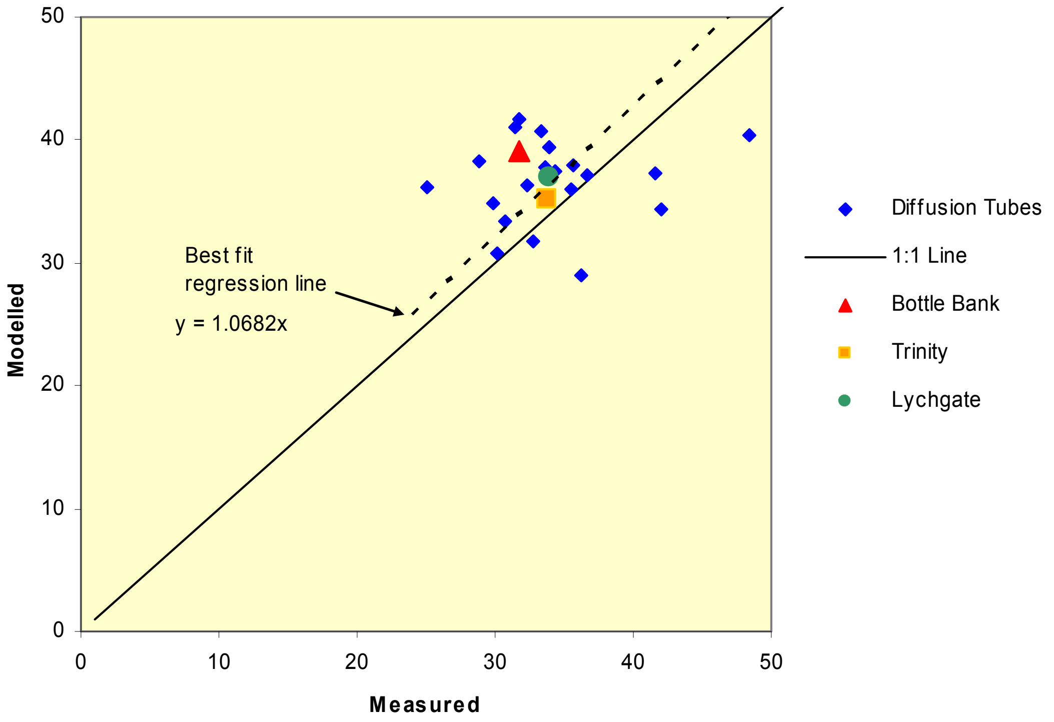

Figure A2.4 Annual Mean Modelled Nitrogen Dioxide (μg/m^3) vs Annual Mean Modelled Nitrogen Dioxide (μg/m^3) After the First Stage of Model Adjustment (all data are for 2005). Bottle Bank, Trinity, and Lychgate are automatic monitors.

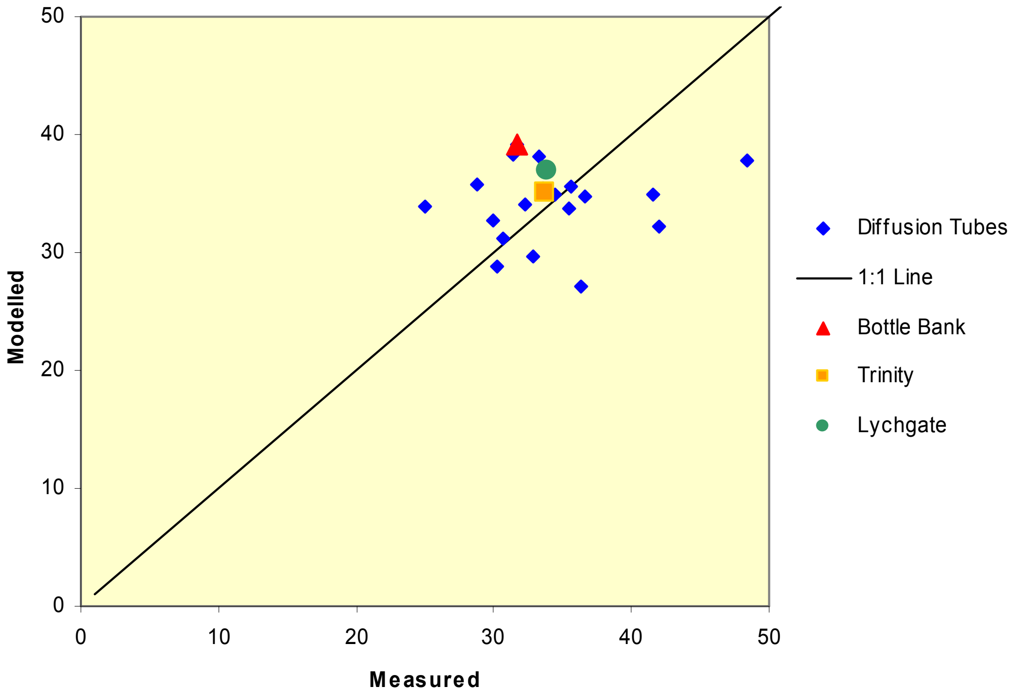

Figure A2.4 Annual Mean Modelled Nitrogen Dioxide (μg/m^3) vs Annual Mean Modelled Nitrogen Dioxide (μg/m^3) After the Final Stage of Model Adjustment (all data are for 2005). Bottle Bank, Trinity, and Lychgate are automatic monitors.

A3.21 The scatter of points around the 1:1 line in Figure A2.5 is less than ideal and highlights uncertainty in both the model results and also in the measurements themselves. The model tends to underpredict at some sites and to overpredict at others. It is worth noting that the model over-predicts in comparison with each of the three automatic monitors. Given that these measured data are known with most certainty, this indicates that overall, the results will tend to be conservative.

Source Apportionment

A3.22 As is discussed above, all of the modelling has used traffic data from the STM traffic model. This model divides vehicles into the following vehicle categories:

Cars on commuting journeys

Cars on business journeys

Cars on leisure trips

Light Goods Vehicles

Heavy Goods Vehicles

Buses

A3.23 Concentrations at each receptor have been modelled for each vehicle category independently. The total NO_2 concentration has first been apportioned to background and road components. The road NO_2 component has then been further apportioned into source categories according to the relative contribution of each source to the total road NOx. This ignores the non-linearity of the NOx to NO_2 relationship, but is the most appropriate way to express the source-apportioned nitrogen dioxide concentration.