# 2011 Air Quality Further Assessment Report for *Gedling Borough Council*

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

August 2011

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| **Report Reference number** | |
| **Date** | August 2011 |

# Executive Summary

Part IV of the Environment Act 1995 requires local authorities to review and assess the current and future air quality in their areas against objectives set out for eight key air pollutants, under the provisions of the National Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2002.

The National Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2002 prescribe air quality objectives and the dates for meeting them. Local Authorities should only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded. Where an air quality objective is deemed, following Detailed Assessment, to be breached then the Local Authority must declare an Air Quality Management Area (AQMA) and put in place an Action Plan in order to bring pollutant levels below the objective.

Following declaration of an AQMA the Local Authority has 12 months in which to produce a Further Assessment of the air quality in the AQMA. The main purpose of the Further Assessment is to provide authorities with an opportunity to supplement the information they have already gathered from their earlier review and assessment work.

Following completion of a Detailed Assessment in 2010 Gedling Borough declared an AQMA for traffic related Nitrogen Dioxide ($NO_2$), in April 2011.

This Further Assessment report has found that results of ongoing monitoring, since the AQMA declaration, continue to substantiate the findings of previous assessments, particularly the Detailed Assessment (2010).

Additionally, a source apportionment exercise carried out indicates that diesel vehicles contribute the largest portion of emissions of NOx. HGVs (25%), Buses (22%) and diesel cars (21%) share the main proportion of the emissions; with diesel LGVs (15%) and petrol cars (16%) contributing to a lesser extent.

It is recommended that the current extent of the AQMA is maintained, based on continued monitoring with the area.

When assessing the options for the Action Plan consideration should be given to targeting reductions in emissions from the commercial fleet (HGVs, Buses and LGVs) as these make up a large proportion of the emissions. However, actions to tackle the remaining 37% of emissions, from private cars (petrol & diesel), should also be included to ensure the maximum reductions in emissions possible.

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# 1 Introduction

## 1.1 Purpose of the Report

Section 84(1) of the Environment Act, requires authorities to complete a Further Assessment within 12 months of designating an Air Quality Management Area (AQMA). The main purpose of the Further Assessment is to provide authorities with an opportunity to supplement the information they have already gathered from their earlier Review and Assessment work.

The Further Assessment is intended to allow authorities to:

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

## 1.2 What is Nitrogen Dioxide?

[Source: Nitrogen Dioxide in the UK, AQEG, 2004]

Nitrogen dioxide is a brown gas, with the chemical formula $NO_2$. It is chemically related to nitric oxide (nitrogen monoxide), a colourless gas with the chemical formula NO (Figure 1.1). These abbreviations are often used instead of writing the names of the chemicals in full.

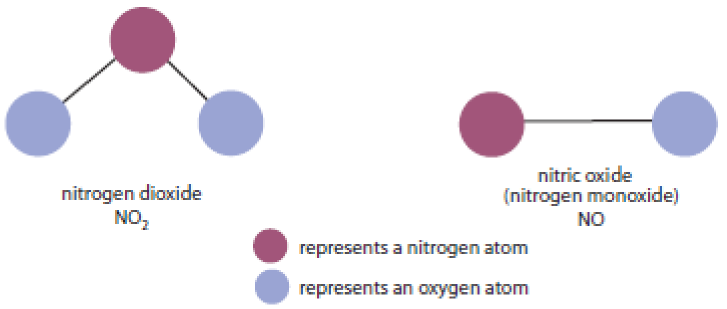


**Figure 1.1 Diagram of the structures of $NO_2$ and NO**

### 1.2.1 What is NOx?

Together, NO and $NO_2$ are known as Nitrogen Oxides or NOx. NOx is released into the atmosphere when fuels are burned (for example, petrol or diesel in a car engine or natural gas in a domestic central heating boiler).

### 1.2.2 How Does NOx affect the level of $NO_2$?

NOx emissions from burning fossil fuels are mainly as NO, but some sources can release a lot of NOx as $NO_2$. These **primary** $NO_2$ emissions are particularly important from diesel vehicles (especially when moving slowly), and can make up as much as 25% of the total NOx emissions from this source.

One reason for this is as a side-effect of measures that have been developed to reduce emissions of particulate matter (PM) from diesel vehicles by treating the exhaust using diesel particulate filters.

These primary $NO_2$ emissions can lead to high concentrations of $NO_2$ at the roadside, especially where there are many diesel vehicles.

$NO_2$ is also formed in the atmosphere in a chemical reaction between NO and ozone ($O_3$):

$$NO + \underset{\text{ozone}}{O_3} \rightarrow NO_2 + \underset{\text{oxygen}}{O_2}$$

Because this $NO_2$ is not released straight into the atmosphere, but is formed there by a chemical reaction, it is known as **secondary** $NO_2$.

Sometimes this reaction cannot take place because there is not enough $O_3$ for the NO to react with. This is most common close to where NO is released, for example, near to busy roads.

### 1.2.3 How is $NO_2$ measured?

The concentration of $NO_2$ is measured in micrograms in each cubic metre of air (µg $m^{-3}$). A microgram (µg) is one millionth of a gram. A concentration of 1 µg $m^{-3}$ means that one cubic metre of air contains one microgram of pollutant.

### 1.2.4 What are the Health Effects?

There is evidence that high levels of it can inflame the airways in our lungs and, over a long period of time, affect how well our lungs work. People with asthma are particularly affected. $NO_2$ can also affect the wider environment, including vegetation.

## 1.3 Air Quality Objectives

The air quality objectives applicable to Local Air Quality Management (LAQM) in England are set out in the Air Quality (England) Regulations 2000 (SI 928), and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043). The pollutant of concern is Nitrogen Dioxide ($NO_2$) the objective being:

**Table 1.1 Air Quality Objectives for the purpose of LAQM in England.**

| Pollutant | Air Quality Objective | | Date to be achieved by |
|---|---|---|---|
| | Concentration | Measured as | |
| Nitrogen dioxide | 200 µg/$m^{-3}$ not to be exceeded more than 18 times a year | 1 hour mean | 31.12.2005 |
| | 40 µg/$m^{-3}$ | annual mean | 31.12.2005 |

## 1.4 Summary of Detailed Assessment 2010

It was considered that, on balance, the objective for Nitrogen Dioxide was likely to be exceeded along the A60 Mansfield Road between its junction with Thackerays Lane and Oxclose Lane. Based on the contour models this equated to approximately 50 residential properties exposed to pollutant concentrations above the objective.

Therefore, it was proposed that GBC declare an Air Quality Management Area (AQMA) for Nitrogen Dioxide

The AQMA order for the A60 Mansfield Road was made on 1st April 2011 following consultation with affected parties. See Appendix A for a plan of the AQMA.

# 2 Monitoring Data since Declaration

## 2.1 Summary of Monitoring Undertaken

### 2.1.1.1 Automatic Monitoring Sites

Gedling Borough has one analyser measuring NOx and NO to calculate a value of $NO_2$. The enclosure is situated within the AQMA approximately 5 metres from the kerb to best represent the receptors located 75 metres further along the road, given the constraints for siting.

**Figure 2.1 Location of ROMON enclosure, Daybrook Square**

**Table 2.1 Details of Automatic Monitoring Site**

| Site Name | Site Type | OS Grid Ref | Pollutants Monitored | In AQMA? | Relevant Exposure? | Distance to kerb of nearest road | Worst-case Location? |
|---|---|---|---|---|---|---|---|
| Daybrook Square | Roadside | X 457944<br>Y 344596 | NOx / $NO_2$ | Y | N (75m) | 5 metres | N |

### 2.1.1.2 Non-Automatic Monitoring

Nitrogen Dioxide Diffusion Tubes

Gedling Borough has 10 diffusion tubes spread along the length of the AQMA, along with three urban background and one rural background tube(s).

Details of the co-location study and subsequent bias adjustment can be found in Appendix B, along with full monitoring results. QA/QC procedures and laboratory details can be found in Appendix C.

**Table 2.2 Details of Non- Automatic Monitoring Sites**

| Site Name | Site Type | OS Grid Ref | In AQMA? | Relevant Exposure? | Distance to kerb of nearest road | Worst-case Location? |
|---|---|---|---|---|---|---|
| Marion Murdoch Court | Urban Background | X 461294 Y 342826 | N | N/A | N/A | N/A |
| Hastings Street | Urban Background | X 460391 Y 341413 | N | N/A | N/A | N/A |
| Morley Mills Building | Receptor | X 457969 Y 344780 | Y | Y | 3m | Y |
| Mansfield Road, Redhill | Near Receptor | X 457899 Y 345637 | Y | N (25m) | 10m | N |
| Daybrook Dental Surgery | Receptor | X 457867 Y 345388 | Y | N (30m) | 2.3m | Y |
| Daybrook Analyser | Reference to Analyser | X 457974 Y 344632 | Y | N/A | 5m | N/A |
| The Vale PH | Roadside | X 457929 Y 344335 | Y | N (14m) | 3.5m | N |
| The Grove PH | Near Receptor | X 457947 Y 344651 | Y | N (16m) | 3.5m | Y |
| Ricket Lane | Rural Background | X 456621 Y 355935 | N | N/A | N/A | N/A |
| Wickes Store, Daybrook | Near Receptor | X 458364 Y 345280 | Y | N (50m) | 3m | N |
| Civic Centre, Arnold | Urban Background | X 458662 Y 345618 | N | N/A | N/A | N/A |
| Daybrook Chip Shop | Near Receptor | X 457947 Y 344713 | Y | Y | 3m | Y |
| T&S Heating, Daybrook | Near Receptor | X 457950 Y 344748 | Y | Y | 3m | Y |
| Frank Keys, Daybrook | Near Receptor | X 457969 Y 344827 | Y | Y | 3m | Y |

## 2.2 Comparison of Monitoring Results with Air Quality Objectives

The results of 2010 monitoring for nitrogen dioxide have been compared against air quality objectives.

### Automatic Monitoring Data

Results for automatic monitoring for 2010 show no exceedences of the air quality objectives for $NO_2$. Figure 2.3 shows a slight increase in $NO_2$ levels over a seven year period (2004-2010).

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

| Location | Within AQMA? | Data Capture for full calendar year 2010 % | Annual mean concentrations (µg/m$^{-3}$) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 2006 | 2007 | 2008 | 2009 | 2010 |
| Daybrook Square | Y | 95 | 35 | 32 | 34 | 36 | 39 |

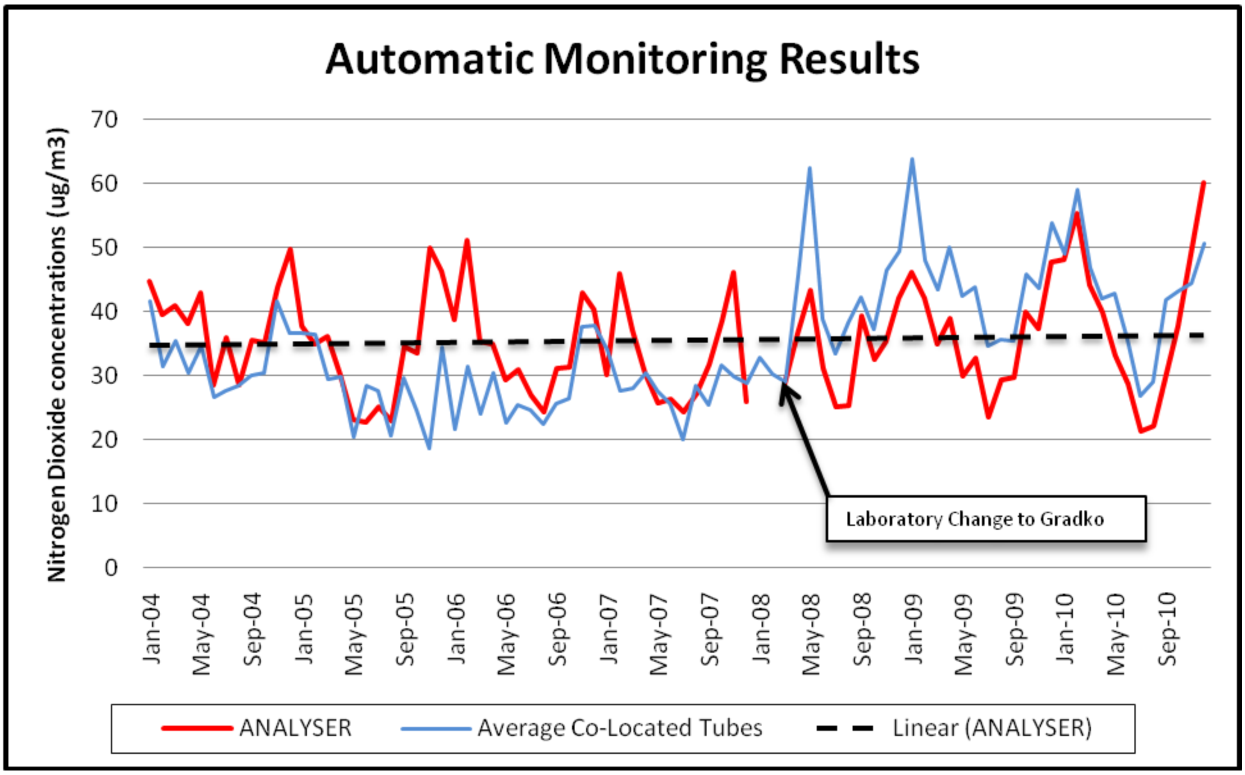


**Figure 2.2 Trends in Monthly Mean Nitrogen Dioxide Concentration Daybrook Square.**

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

| Location | Within AQMA? | Data Capture for full calendar year 2010 % | Number of Exceedences of hourly mean (200 μg/m$^{-3}$) *If the period of valid data is less than 90% of a full year, include the 99.8th percentile of hourly means in brackets.* | | |
|---|---|---|---|---|---|
| | | | **2008*** | **2009** | **2010** |
| Daybrook Square | Y | 95 | 0 (127) | 0 | 1 |

*10 months of data

### Diffusion Tube Monitoring Data

The results of diffusion tube monitoring for 2010 (Table 2.4) show some exceedences of the air quality objectives at receptors along the A60 Mansfield Road: Full diffusion tube monitoring dataset, including details of bias and location adjustments are available in Appendix B.

### Table 2.4 Results of Nitrogen Dioxide Diffusion Tubes (adjusted for bias and location)

| Site ID | Location | Within AQMA? | Data Capture for monitoring period % | Data Capture for full calendar year 2010 % | Annual mean concentrations (μg/m$^{-3}$) | | |
|---|---|---|---|---|---|---|---|
| | | | | | **2008†** | **2009** | **2010** |
| G1 | Marion Murdoch Court | N | n/a | 100 | 19 | 21 | 21 |
| G2 | Hastings Street | N | n/a | 100 | 23 | 24 | 24 |
| G4 | Morley Mills Building | Y | n/a | 100 | **40** | **40** | 38 |
| G5 | Mansfield Road, Redhill | Y | n/a | 100 | 27 | 32 | 29 |
| G6 | Daybrook Dental Surgery | Y | n/a | 100 | 37 | 37 | 37 |
| G14 | The Vale PH | Y | n/a | 100 | 34 | 34 | 33 |
| G15 | The Grove PH | Y | n/a | 100 | **40** | 38 | **42** |
| G16 | Ricket Lane | N | n/a | 100 | 18 | 19 | 16 |
| G17 | Wickes Store, Daybrook | Y | n/a | 92 | 34 | 36 | 35 |
| G18 | Civic Centre, Arnold | N | n/a | 100 | 20 | 21 | 23 |
| G20 | Daybrook Chip Shop | Y | n/a | 92 | - | **48††** | **44** |
| G21 | T&S Heating, Daybrook | Y | n/a | 92 | - | **49††** | **45** |
| G22 | Frank Keys, Daybrook | Y | n/a | 100 | - | **43††** | **41** |

† 9 months of data.
†† 6 month data has been “annualised” using Box 3.2 of TG(09).

# 3 Changes since AQMA Declaration

This section outlines any major changes on a national and local level which may materially affect the declaration of the AQMA.

## 3.1 National Guidance and Policy

Since the Detailed Assessment was carried out in 2010 there have been no changes to guidance issued by Defra and there have been no policy developments.

## 3.2 Changes to Local Area

Since completing the Detailed Assessment there have been no major changes to the area in and around the AQMA. To date no major commercial or residential developments have taken place and there have been no changes to the transport infrastructure.

Additionally, a review of the likely receptors along the A60 Mansfield Road has confirmed that those used in the Detailed Assessment were the worse case.

## 3.3 Detailed Assessment Consultation Process

Following consultation during the Detailed Assessment and subsequent declaration of the AQMA no comments have been received from the statutory consultees.

# 4 Source Apportionment

In order to effectively produce an Action Plan that targets the sources of pollution we must first carry out a Source Apportionment exercise; this process is divided into:

- Calculating the regional and local background contributions; sources that the Authority may have little (local) or no (regional) control over.
- Calculating the local contributions; in this case which part of the traffic contributes most the emissions experienced.

## 4.1 Background $NO_2$ Contributions

Statutory Guidance TG(09) provides in Box 7.1 a method of calculating the regional and background contribution at a particular relevant receptor **[T-$NO_2$]** (45μg/$m^{-3}$); using data from national mapping of background concentrations and the following calulations:

Total Background $NO_2$ [TB-$NO_2$] = 19.74μg/$m^{-3}$
Total Background NOx [TB-NOx] = 30.14μg/$m^{-3}$
Regional Background NOx [RB-NOx] = 7.64μg/$m^{-3}$

1) Local Background NOx is derived from;

   **[LB-NOx]** = [TB-NOx] - [RB-NOx] = 22.5μg/$m^{-3}$

2) Therefore, to apportion the total background $NO_2$ into the regional and local using the regional and local NOx proportions;

   **[RB-$NO_2$]** = [TB-$NO_2$] x ([RB-NOx] / [TB-NOx]) = 5.0μg/$m^{-3}$
   **[LB-$NO_2$]** = [TB-$NO_2$] x ([LB-NOx] / [TB-NOx]) = 14.74μg/$m^{-3}$

3) Thus, to calculate the local $NO_2$ contribution at the worst case receptor **[L-$NO_2$]**;

   **[L-$NO_2$]** = [T-$NO_2$] – [TB-$NO_2$] = 25.26μg/$m^{-3}$

This then provides an estimate of the apportionment of $NO_2$ at the worst case receptor (45μg/$m^{-3}$) as:

| | |
|---|---|
| Regional background | = 5.0μg/$m^{-3}$ |
| Local Background | = 14.74μg/$m^{-3}$ |
| Local Traffic | = 25.26μg/$m^{-3}$ |

Section 4.2 (below) outlines the process by which the local traffic emissions have been apportioned. Using this information the Local Traffic $NO_2$ concentrations can be further split into:

| | |
|---|---|
| Vans and Lorries | = 10.36µg/m$^{-3}$ (41%) |
| Buses | = 5.56µg/m$^{-3}$ (22%) |
| Cars | = 9.35µg/m$^{-3}$ (37%) |

## 4.2 Local Contributions

The Authority has used a spreadsheet Emissions Factor Toolkit (version 4.2.2) (available at http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html ) to carry out the local source apportionment of NOx.

### 4.2.1 Inputs

In order to achieve site specific results the tool has been run using Average Annual Daily Traffic (AADT) flow data and vehicle fleet composition data obtained from traffic studies conducted around the AQMA. Data was provided by Nottinghamshire County Council. Other assumptions used include an average daily speed of 30kph to allow for any congestion during rush hour periods (speed limit is 30mph).

### 4.2.2 Results of Local Apportionment

The outputs from the toolkit can be found in Appendix D; also three maps are presented in Appendix A showing the results associated with individual road links:

1) Total Emissions (g/km) per Road Link
2) Breakdown of Emissions by Vehicle Type
3) Breakdown of Diesel/Petrol Emissions

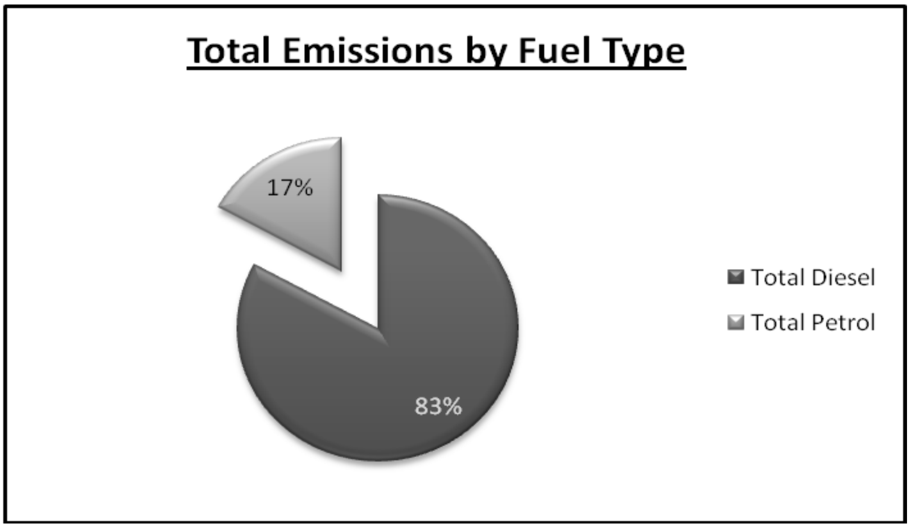


**Figure 4.1 Total NOx Emission Rates by Fuel Type (sum of all road links)**

The results of the apportionment exercise show that overall diesel vehicles contribute to the vast majority (83%) of emissions (Figure 4.1). Of those diesel vehicles the spread is quite even between HGVs, buses and diesel cars; with a smaller percentage coming from diesel LGVs. (Figure 4.2)

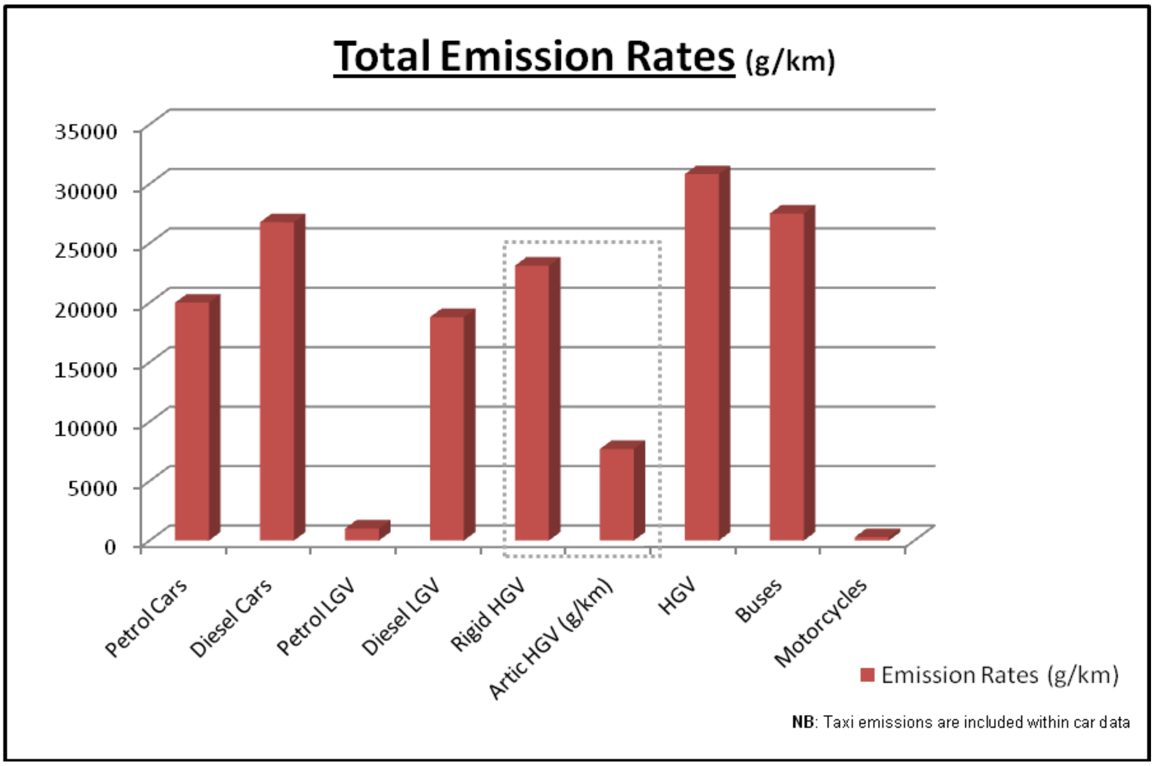


**Figure 4.2 Total NOx Emission Rates by Vehicle Type (sum of all road links)**

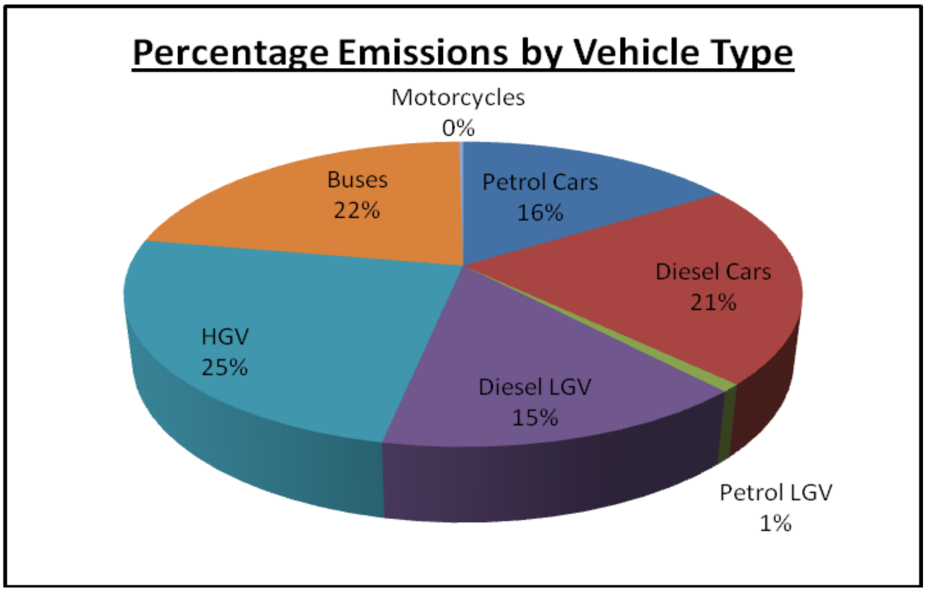


**Figure 4.3 Percentage NOx Emissions by Vehicle Type (sum of all road links)**

# 5 Emissions Reduction

The Statutory Guidance requires Local Authorities to estimate both the required reduction in pollutant emissions and the likely timescale by which it is expected that these will be achieved.

## 5.1 Required Reduction Levels

In the case of $NO_2$ alongside roads, the required reduction should be stated as the $\mu g/m^{-3}$ reduction in the $NO_2$ concentration.

Based on 2010 worse case adjusted diffusion tubes results this would equate to a **5 $\mu g/m^{-3}$ reduction in $NO_2$ from 45 to 40 $\mu g/m^{-3}$.**

However, the required percentage reductions of local emissions should be expressed in terms of NOx due to the local road traffic. This is because the primary emission is of NOx and there is a non-linear relationship between NOx concentrations and $NO_2$ concentrations.

Box 7.2 (as amended) found in TG(09) provides an example of how to calculate the reduction in road NOx emissions required to meet the 40 $\mu g/m^{-3}$ objective; using the $NO_2$ to NOx convertor tool (v2.1).

**Step 1**: Calculate the NOx concentration that equates to **[T-$NO_2$]** (45$\mu g/m^{-3}$).
Therefore, **[Road NOx]** = 65.93$\mu g/m^{-3}$

**Step 2**: Background concentrations for 2010 are:

Total Background $NO_2$ **[TB-$NO_2$]** = 19.74$\mu g/m^{-3}$
Total Background NOx **[TB-NOx]** = 30.14$\mu g/m^{-3}$

[Total NOx] = 30.14 + 65.93 = 96.07$\mu g/m^{-3}$

**Step 3**: Calculate the current 'road NOx' **[Road NOx current]** which is:

[Total NOx] - [TB-NOx] = 65.93$\mu g/m^{-3}$

**Step 4**: Calculate the road NOx concentration required to give a total $NO_2$ concentration of 40 $\mu g/m^3$. **[Road NOx required]** = 50.28$\mu g/m^{-3}$

**Step 5**: Calculate the road NOx reduction to go from [Road NOx current] to the [Road NOx required].

Road NOx reduction = 65.93 – 50.28

Road NOx reduction = **15.65$\mu g/m^{-3}$** which represents a **24% reduction**.

## 5.2 Reduction Timescales

Statutory Guidance TG(09) provides in Box 2.1 (as amended) a method of projecting mesured annual mean roadside $NO_2$ concentrations to future years. Using this box we can estimate the year by which the air quality objective should be met.

Using 2010 as our starting point and based on the worst case receptor for this year (45 $\mu g/m^{-3}$) the objective should be met by **2013** (38.5 $\mu g/m^{-3}$).

It should however be noted that the levels of reductions predicted in these projections do not seem to be occuring in real terms. For example, Box 2.1 predicts from that from 2008 $NO_2$ levels should have reduced 17% by 2010; as we have seen in monitoring carried out (Section 2.2) levels in the Daybrook area have been relatively unchanged over a similar period, no reduction has taken place.

# 6 Conclusions and Proposed Actions

## 6.1 Conclusions

Results of ongoing monitoring since declaration have found levels that agree with the findings of the previous assessments, particularly the Detailed Assessment. Additionally the following has been reviewed, since declaration of the AQMA:

- There have been no major developments in or around the AQMA.
- No changes to statutory guidance.
- All assumptions made during the Detailed Assessment are still valid.
- There were no comments from Consultees during the Detailed Assessment and declaration of the AQMA.

The Source Apportionment exercise generally shows that diesel vehicles contribute the largest portion of NOx emissions. HGVs (25%), Buses (22%) and diesel cars (21%) share the main proportion of the emissions; with diesel LGVs (15%) and petrol cars (16%) contributing to a lesser extent.

The reduction in $NO_2$ emissions required, based on 2010 worse case adjusted diffusion tubes results, expressed as a concentration would be a 5 $\mu g/m^{-3}$ reduction in $NO_2$ from 45 to 40 $\mu g/m^{-3}$.

The reduction in road NOx emissions required to meet the 40 $\mu g/m^{-3}$ objective has been calculated as 16$\mu g/m^{-3}$ which represents a 24% reduction in roadside NOx.

## 6.2 Recommendations

It is recommended that the current extent of the AQMA is maintained, based on continued monitoring with the area.

When assessing the options for the Action Plan consideration should be given to targeting reductions in emissions from the commercial fleet (HGVs, Buses and LGVs) as these make up a large proportion of the emissions. However, actions to tackle the remaining 37% of emissions, from private cars (petrol & diesel), should also be included to ensure the maximum reductions in emissions possible.

# 7 References

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# Appendices

Appendix A: Maps

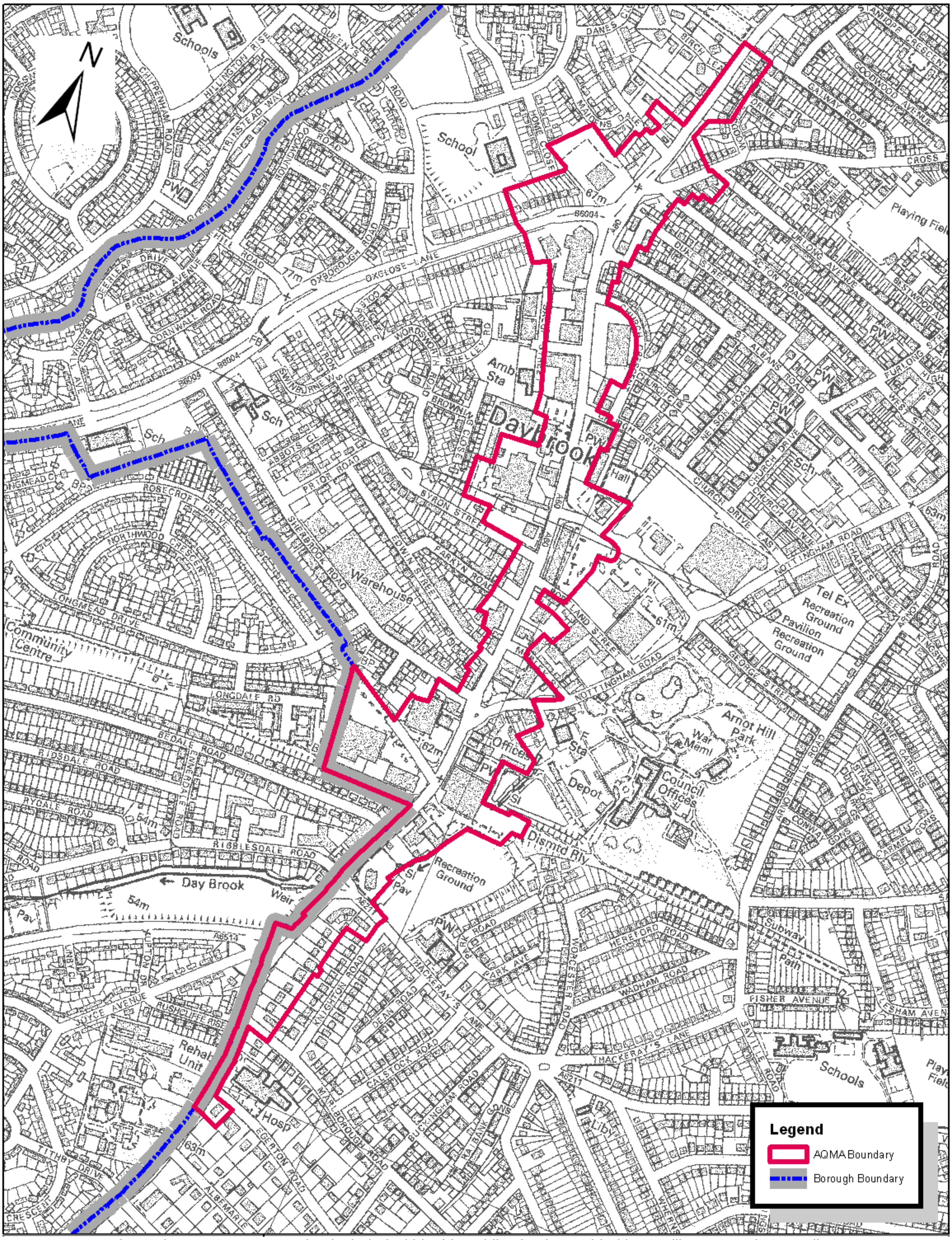
Appendix B: Nitrogen Dioxide Diffusion Tube Results and Bias Adjustment Details

Appendix C: QA/QC Data

Appendix D: Source Apportionment Results

# Appendix A

# Maps






| Title: | August 2011 |
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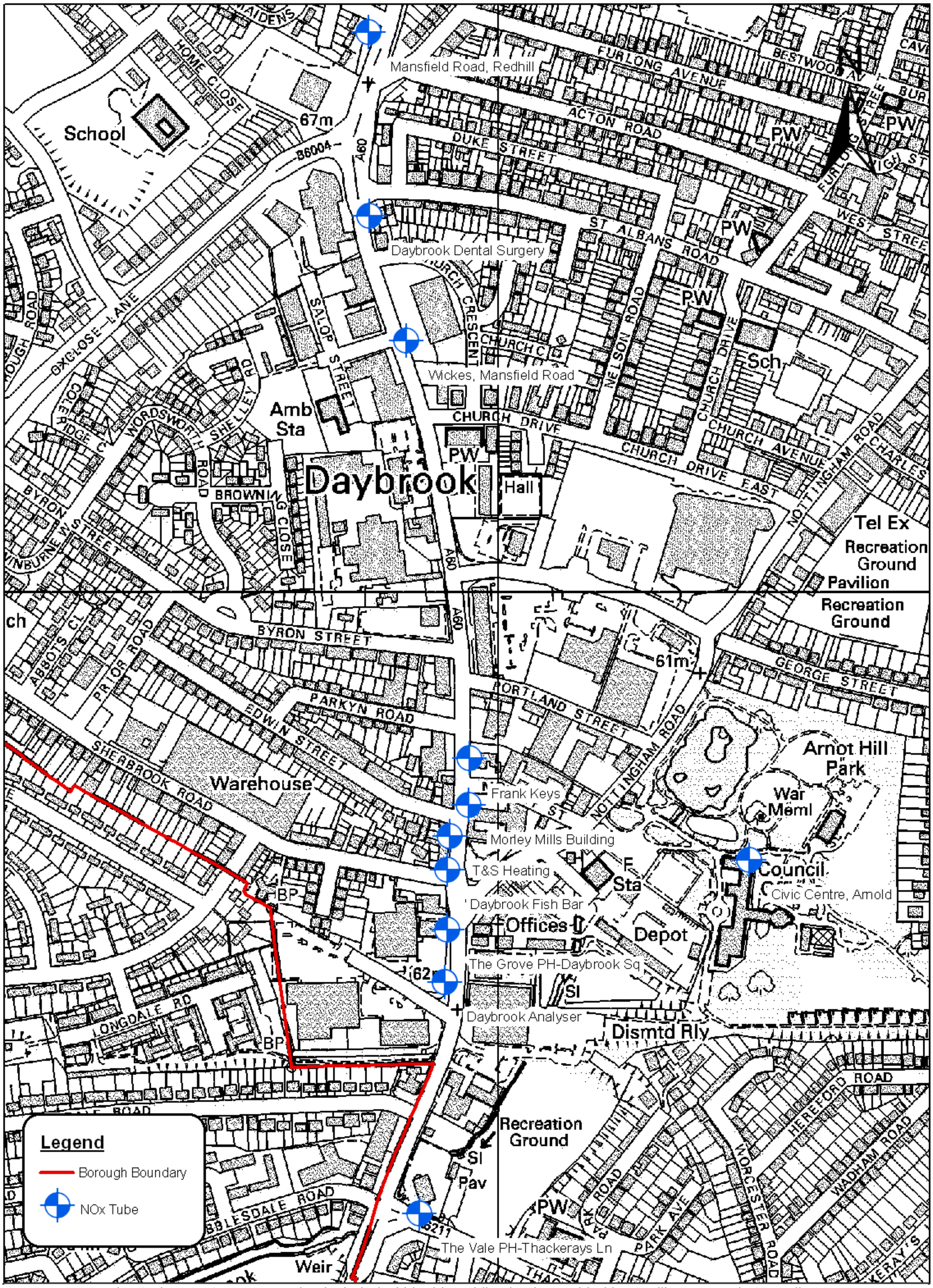
| **Air Quality Management Area** | Scale: nts |

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| Title: **Diffusion Tube Locations** | August 2011 |
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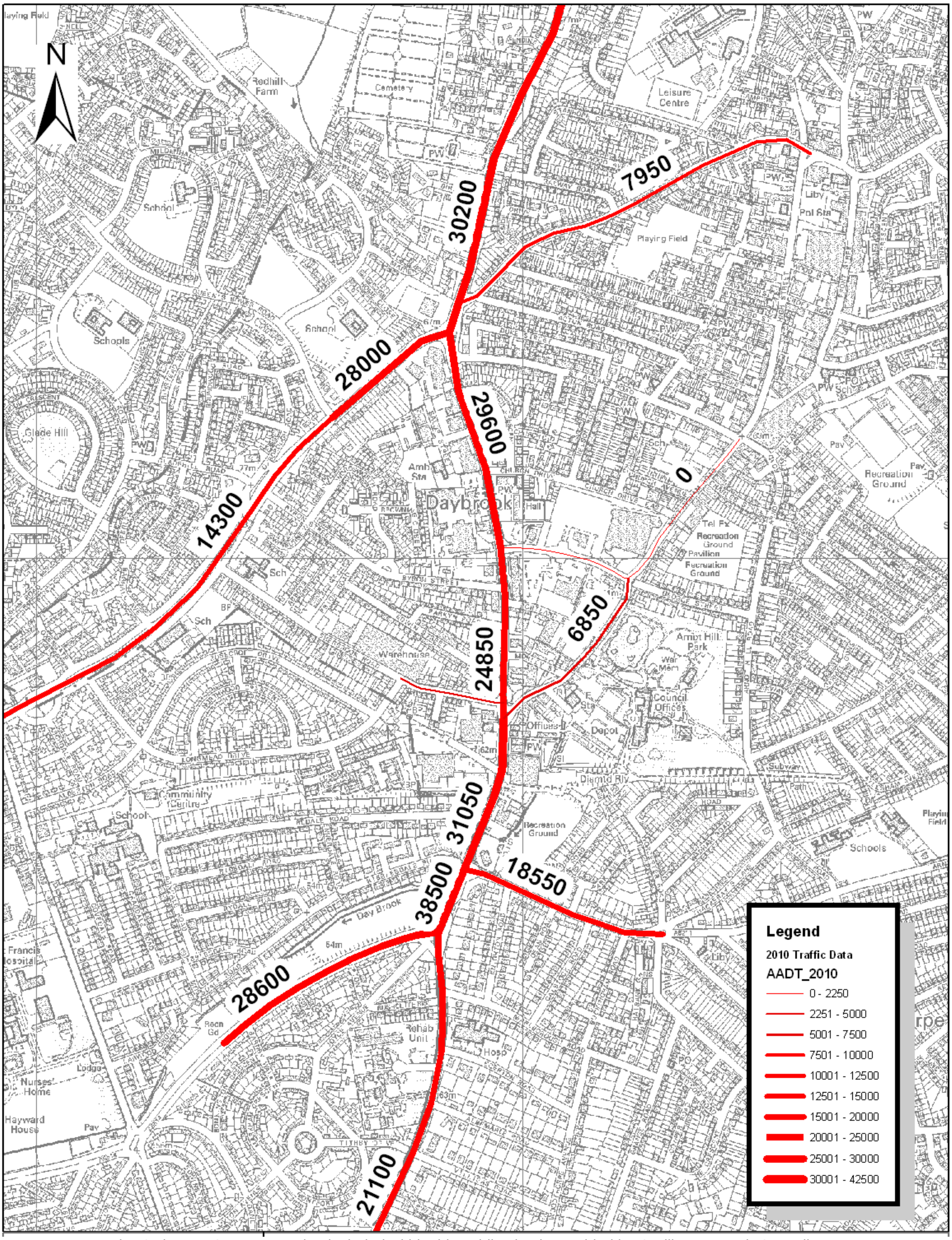




| Title: **2010 Traffic Data (AADT)** | August 2011 |
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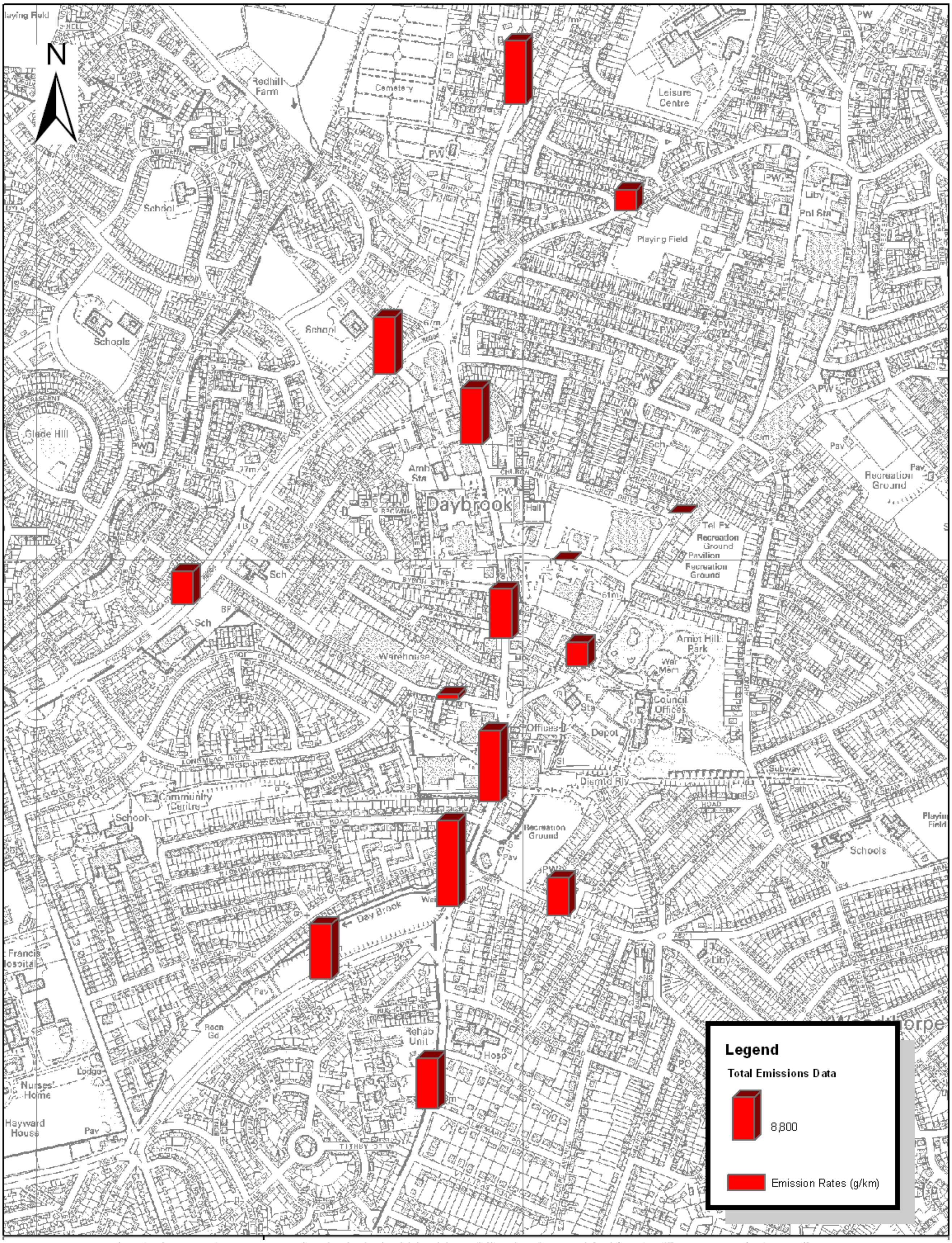
| | Scale: nts |

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| Title: **Total Emissions (g/km) per Road Link** | August 2011 |
| --- | --- |
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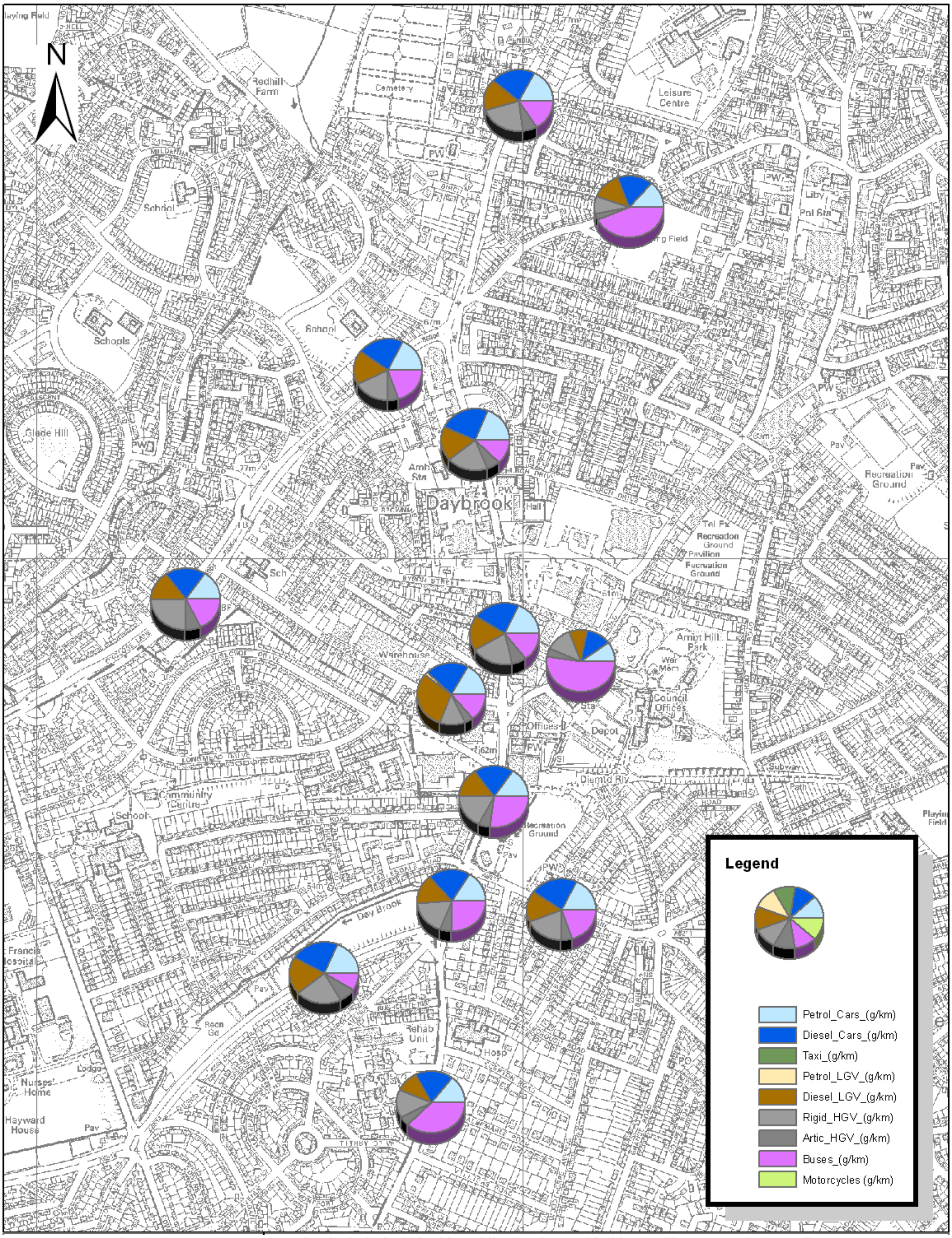




| Title: **Breakdown of Emissions by Vehicle Type** | August 2011 |
|---|---|
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The Ordnance Survey mapping included within this publication is provided by Gedling Borough Council under licence (Licence No. LA 100021246)

| Title: **Breakdown of Diesel/Petrol Emissions** | August 2011 |
|---|---|
| | Scale: nts |

# Appendix B

# Nitrogen Dioxide Diffusion Tube Results And Bias Adjustment Details

### Diffusion Tube Bias Adjustment Factors

National Bias Adjustment Factors (BAF) have been obtaining using the co-location studies spreadsheet available at http://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html

The Gradko national BAF 2010 for 20% TEA in water is given as **0.92** from 39 studies of various types. (see screen shot in this appendix)

### Factor from Local Co-location Studies

A co-location study has been carried out with the GBC NOx analyser.

Attached to this appendix the AEA spreadsheet for calculating bias, precision and accuracy of triplicate tubes. The bias factor calculated is **0.92**.

### Discussion of Choice of Factor to Use

In this instance both factors are **0.92**.

### Adjustment for Receptor Distance

Two of the diffusion tube locations are not representative of the receptors concerned:

1. 36 Victoria Road
2. The Vale PH

Due to site constraints the tubes are located as close as possible to the receptors. The two results have therefore been adjusted using the ‘$NO_2$ with distance from roads’ spreadsheet; available at http://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html

Screen shots of these spreadsheets are attached to this appendix.

# Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

| Period | Start Date dd/mm/yyyy | End Date dd/mm/yyyy | Tube 1 µgm⁻³ | Tube 2 µgm⁻³ | Tube 3 µgm⁻³ | Triplicate Mean | Standard Deviation | Coefficient of Variation (CV) | 95% CI of mean | Automatic Method: Period Mean | Automatic Method: Data Capture (% DC) | Data Quality Check: Tubes Precision Check | Data Quality Check: Automatic Monitor Data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30/12/2009 | 03/02/2010 | 48.0 | 52.1 | 46.8 | 49 | 2.8 | 6 | 6.9 | 48 | 97 | Good | Good |
| 2 | 03/02/2010 | 26/02/2010 | 58.9 | 57.7 | 60.2 | 59 | 1.3 | 2 | 3.1 | 55 | 97 | Good | Good |
| 3 | 26/02/2010 | 31/03/2010 | 48.4 | 46.9 | 44.9 | 47 | 1.8 | 4 | 4.4 | 44 | 97 | Good | Good |
| 4 | 31/03/2010 | 27/04/2010 | 40.3 | 41.4 | 44.4 | 42 | 2.1 | 5 | 5.2 | 40 | 97 | Good | Good |
| 5 | 27/04/2010 | 02/06/2010 | 43.4 | 41.9 | 43.3 | 43 | 0.8 | 2 | 2.0 | 33 | 92 | Good | Good |
| 6 | 02/06/2010 | 30/06/2010 | 30.1 | 38.6 | 38.4 | 36 | 4.8 | 14 | 12.0 | 29 | 75 | Good | Good |
| 7 | 30/06/2010 | 04/08/2010 | 25.9 | 26.4 | 28.5 | 27 | 1.4 | 5 | 3.4 | 21 | 97 | Good | Good |
| 8 | 04/08/2010 | 01/09/2010 | 30.1 | 28.7 | 28.2 | 29 | 1.0 | 3 | 2.5 | 22 | 97 | Good | Good |
| 9 | 01/09/2010 | 29/09/2010 | 42.1 | 40.7 | 42.8 | 42 | 1.1 | 3 | 2.7 | 30 | 95 | Good | Good |
| 10 | 29/09/2010 | 03/11/2010 | 49.0 | 37.4 | 43.3 | 43 | 5.8 | 13 | 14.3 | 38 | 97 | Good | Good |
| 11 | 03/11/2010 | 06/12/2010 | 43.3 | 45.4 | | 44 | 1.5 | 3 | 13.5 | 49 | 96 | Good | Good |
| 12 | 06/12/2010 | 05/01/2011 | 54.6 | 45.2 | 52.3 | 51 | 4.9 | 10 | 12.3 | 60 | 97 | Good | Good |
| 13 | | | | | | | | | | | | | |
| | | | | | | | | | | Overall survey --> | | Good precision | Good Overall DC |

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

Site Name/ ID: Daybrook Square

Precision 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

**Accuracy (with 95% confidence interval)**
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.92 (0.83 - 1.02)
Bias B 9% (-2% - 20%)

Diffusion Tubes Mean: 43 µgm⁻³
Mean CV (Precision): 6

Automatic Mean: 39 µgm⁻³
Data Capture for periods used: 95%

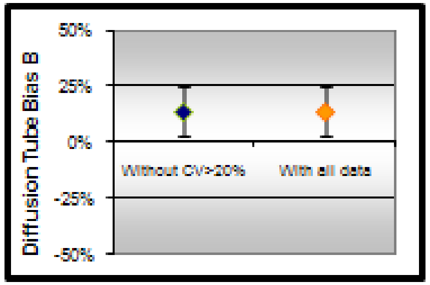
Adjusted Tubes Mean: 39 (35 - 43) µgm⁻³

**Accuracy (with 95% confidence interval)**
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.92 (0.83 - 1.02)
Bias B 9% (-2% - 20%)

Diffusion Tubes Mean: 43 µgm⁻³
Mean CV (Precision): 6

Automatic Mean: 39 µgm⁻³
Data Capture for periods used: 95%

Adjusted Tubes Mean: 39 (35 - 43) µgm⁻³




Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

**Co-Location Spreadsheet 2010**

# Adjustment of SINGLE Tubes

AEA Energy & Environment
From the AEA group

**Adjusted measurement (95% confidence interval) with all the data**
**12 periods used in this calcuations**
**Bias Factor A 0.92 (0.83 - 1.02)**
**Bias B 9% (-2% - 20%)**
Tube Precision: 6 Automatic DC: 95%

**Diffusion Tube Measurements**

| Site Name/ID | Periods 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Raw Mean | Valid periods | Adjusted measurement | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Marion Murdock Court | 33.5 | 31.0 | 23.7 | 20.6 | 14.8 | 13.7 | 13.8 | 14.5 | 19.5 | 24.7 | 27.5 | 34.6 | | 22.7 | 12 | Adjusted with 95% CI | 21 | ( 19 - 23 ) |
| Hastings Street | 38.5 | 36.9 | 31.6 | 26.9 | 19.4 | 15.3 | 16.9 | 17.4 | 21.2 | 25.6 | 29.9 | 37.9 | | 26.5 | 12 | Adjusted with 95% CI | 24 | ( 22 - 27 ) |
| 856 Plains Road | 36.1 | 41.6 | 36.1 | 32.5 | 32.9 | 27.9 | 25.0 | 27.4 | 30.1 | 30.6 | 38.5 | 42.2 | | 33.4 | 12 | Adjusted with 95% CI | 31 | ( 28 - 34 ) |
| Morley Mills, Daybrook | 50.4 | 51.3 | 45.8 | 37.2 | 30.4 | 30.1 | 31.4 | 32.0 | 38.4 | 42.6 | 45.2 | 56.8 | | 41.0 | 12 | Adjusted with 95% CI | 38 | ( 34 - 42 ) |
| Mansfield Road, Redhill | 40.5 | 44.0 | 41.3 | 32.7 | 25.9 | 23.7 | 22.4 | 20.6 | 29.6 | 29.6 | 31.5 | 41.1 | | 31.9 | 12 | Adjusted with 95% CI | 29 | ( 26 - 33 ) |
| Daybrook Dental Surgery | 45.1 | 48.3 | 42.0 | 37.6 | 32.3 | 29.5 | 31.6 | 31.4 | 39.3 | 41.3 | 47.8 | 52.4 | | 39.9 | 12 | Adjusted with 95% CI | 37 | ( 33 - 41 ) |
| Victoria Road, Netherfield 1 | 42.2 | 44.0 | 38.5 | 31.2 | 30.4 | 29.7 | 24.6 | 24.1 | 32.2 | 36.8 | 43.0 | 41.3 | | 34.8 | 12 | Adjusted with 95% CI | 32 | ( 29 - 36 ) |
| Victoria Road, Netherfield 2 | 55.8 | 47.6 | 43.6 | 41.5 | 37.4 | 26.7 | 35.5 | 33.4 | 41.9 | 39.9 | 47.2 | 51.1 | | 41.8 | 12 | Adjusted with 95% CI | 38 | ( 35 - 43 ) |
| 47 Plains Road | 48.7 | 40.0 | 39.1 | 33.9 | 27.0 | 25.6 | 26.3 | 24.7 | 30.8 | 40.1 | 39.2 | 41.8 | | 34.8 | 12 | Adjusted with 95% CI | 32 | ( 29 - 35 ) |
| Burton Rd/Shearing Hill | 35.5 | 36.2 | - | 27.1 | 23.2 | 22.9 | 22.1 | 24.7 | 29.0 | 27.5 | 37.8 | 38.7 | | 29.5 | 11 | Adjusted with 95% CI | 27 | ( 24 - 30 ) |
| Vale PH - Thackerays Ln | 49.0 | 49.2 | 47.0 | 41.9 | 36.4 | 35.0 | 22.6 | 37.6 | 42.6 | 39.5 | 48.4 | 48.9 | | 41.5 | 12 | Adjusted with 95% CI | 38 | ( 34 - 42 ) |
| Grove PH - Daybrook Sq | 55.7 | 63.0 | 46.2 | 46.8 | 41.8 | 35.2 | 29.7 | 33.0 | 46.3 | 39.9 | 51.3 | 55.7 | | 45.4 | 12 | Adjusted with 95% CI | 42 | ( 38 - 46 ) |
| Ricket Lane | 25.6 | 27.1 | 18.3 | 16.0 | 11.2 | 11.1 | 11.8 | 11.7 | 13.8 | 17.4 | 22.6 | 28.6 | | 17.9 | 12 | Adjusted with 95% CI | 16 | ( 15 - 18 ) |
| Wickes Store, Daybrook | 43.2 | 46.0 | 44.8 | 40.2 | 29.8 | 27.0 | 31.1 | 31.5 | 35.4 | 42.3 | - | 51.1 | | 38.4 | 11 | Adjusted with 95% CI | 35 | ( 32 - 39 ) |
| Civic Centre, Arnold | 31.7 | 31.6 | 25.1 | 21.4 | 16.4 | 15.5 | 18.1 | 18.2 | 29.5 | 25.6 | 24.7 | 36.5 | | 24.5 | 12 | Adjusted with 95% CI | 23 | ( 20 - 25 ) |
| Mile End Road | 40.2 | 45.0 | 35.0 | 31.2 | 30.5 | 25.7 | 20.5 | 23.8 | 20.2 | 34.1 | 38.2 | 43.7 | | 32.3 | 12 | Adjusted with 95% CI | 30 | ( 27 - 33 ) |
| Daybrook Chip Shop | - | 60.7 | 53.7 | 44.8 | 45.9 | 37.0 | 41.0 | 38.4 | 49.1 | 42.9 | 56.7 | 57.9 | | 48.0 | 11 | Adjusted with 95% CI | 44 | ( 40 - 49 ) |
| T&S Heating, Daybrook | 57.5 | 55.3 | 56.2 | 42.0 | 41.9 | 39.4 | 42.0 | 40.1 | 45.7 | - | 55.8 | 67.0 | | 49.4 | 11 | Adjusted with 95% CI | 45 | ( 41 - 50 ) |
| Frank Keys, Daybrook | 58.6 | 57.3 | 46.2 | 37.0 | 38.3 | 32.6 | 34.0 | 35.4 | 41.9 | 47.1 | 51.7 | 57.1 | | 44.7 | 12 | Adjusted with 95% CI | 41 | ( 37 - 46 ) |

*The bias adjustment factor used in these calculations include all the data and no screening of data due to poor precision has been applied.*

**2010 Diffusion Tube Results**

# National Diffusion Tube Bias Adjustment Factor Spreadsheet

Spreadsheet Version Number: 04/11

Follow the steps below **in the correct order** to show the results of **relevant** co-location studies

Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods

Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet

This spreadhseet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated in late June 2011 on the LAQM Helpdesk Website

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

**Step 1:** Select the Laboratory that Analyses Your Tubes from the Drop-Down List. If a laboratory is not shown, we have no data for this laboratory.

**Step 2:** Select a Preparation Method from the Drop-Down List. If a preparation method is not shown, we have no data for this method at this laboratory.

**Step 3:** Select a Year from the Drop-Down List. If a year is not shown, we have no data[2]

**Step 4:** Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.

If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953

| Analysed By[1] | Method (To undo your selection, choose (All) from the pop-up list) | Year[5] (To undo your selection, choose (All)) | Site Type | Local Authority | Length of Study (months) | Diffusion Tube Mean Conc. (Dm) (µg/m³) | Automatic Monitor Mean Conc. (Cm) (µg/m³) | Bias (B) | Tube Precision[6] | Bias Adjustment Factor (A) (Cm/Dm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Gradko | 20% TEA in Water | 2010 | R | Rhondda Cynon Taf CBC | 10 | 35 | 35 | 0.4% | G | **1.00** |
| Gradko | 20% TEA in Water | 2010 | O | North Warwickshire BC | 9 | 48 | 42 | 13.6% | P | **0.88** |
| Gradko | 20% TEA in Water | 2010 | UB | LB Ealing | 10 | 39 | 41 | -3.8% | G | **1.04** |
| Gradko | 20% TEA in Water | 2010 | R | South Norfolk Council | 9 | 28 | 17 | 63.7% | G | **0.61** |
| Gradko | 20% TEA in Water | 2010 | B | Chelmsford BC | 11 | 16 | 17 | -5.3% | G | **1.06** |
| Gradko | 20% TEA in Water | 2010 | R | Chelmsford BC | 12 | 33 | 21 | 55.0% | G | **0.65** |
| Gradko | 20% TEA in Water | 2010 | R | Chelmsford BC | 10 | 37 | 32 | 14.6% | G | **0.87** |
| Gradko | 20% TEA in Water | 2010 | R | Wokingham BC | 10 | 37 | 36 | 4.1% | G | **0.96** |
| Gradko | 20% TEA in Water | 2010 | R | West Dunbartonshire Council | 9 | 22 | 22 | 0.1% | G | **1.00** |
| Gradko | 20% TEA in Water | 2010 | R | Scarborough BC | 12 | 35 | 29 | 18.2% | G | **0.85** |
| Gradko | 20% TEA in Water | 2010 | UB | Sandwell MBC | 11 | 31 | 28 | 11.4% | na | **0.90** |
| Gradko | 20% TEA in Water | 2010 | R | Sandwell MBC | 11 | 45 | 45 | -0.9% | na | **1.01** |
| Gradko | 20% TEA in Water | 2010 | R | Sandwell MBC | 11 | 37 | 36 | 2.0% | na | **0.98** |
| Gradko | 20% TEA in Water | 2010 | UB | Sandwell MBC | 10 | 22 | 21 | 8.1% | na | **0.93** |
| Gradko | 20% TEA in Water | 2010 | | **Overall Factor[3] (39 studies)** | | | | | **Use** | **0.92** |

**Gradko 20%TEA in Water Co-location Studies 2010**

This calculator allows you to predict the annual mean $NO_2$ concentration for a location ("receptor") that is close to a monitoring site, but nearer or further the kerb than the monitor. The next sheet shows your results on a graph.

Air Quality Consultants

Enter data into the yellow cells

| | | | | |
|---|---|---|---|---|
| Step 1 | How far from the KERB was your measurement made (in metres)? | (Note 1) | 3.5 | metres |
| Step 2 | How far from the KERB is your receptor (in metres)? | (Note 1) | 14 | metres |
| Step 4 | What is the local annual mean background $NO_2$ concentration (in $\mu g/m^3$)? | (Note 2) | 19.73 | $\mu g/m^3$ |
| Step 3 | What is your measured annual mean $NO_2$ concentration (in $\mu g/m^3$)? | (Note 2) | 38 | $\mu g/m^3$ |
| Result | The predicted annual mean $NO_2$ concentration (in $\mu g/m^3$) at your receptor | (Note 3) | 31.2 | $\mu g/m^3$ |

Note 1: This should be measured horizontally from the kerb and assumes that the monitor and receptor have similar elevations. Each distance should be greater than 0.1m and less than 50m (In practice, using a value of 0.1m when the monitor is closer to the kerb than this is likely to be reasonable). The receptor is the location for which you wish to make your prediction. The monitor can either be closer to the kerb than the receptor, or further from the kerb than the receptor. The closer the monitor and the receptor are to each other, the more reliable the prediction will be. When your receptor is further from the kerb than your monitor, it is recommended that the receptor and monitor should be within 20m of each other. When your receptor is closer to the kerb than your monitor, it is recommended that the receptor and monitor should be within 10m of each other.

Note 2: The measurement and the background must be for the same year. The background concentration could come from the national maps published at www.airquality.co.uk, or alternatively from a nearby monitor in a background location.

Note 3: The calculator follows the procedure set out in Box 2.2 of LAQM TG(08). The results will have a greater uncertainty than the measured data. More confidence can be placed in results where the distance between the monitor and the receptor is small than where it is large.

Issue 1: 30/06/08. Created by Dr Ben Marner; Approved by Prof Duncan Laxen. Contact: benmarner@aqconsultants.co.uk

**Vale PH Calculation for Distance to Receptor**

| Site | NO2 /ugm$^{-3}$ jan | feb | mar | apr | 2010 may | jun | jul | aug | sep | oct | nov | dec | Annual Mean | Adjusted for bias | Distance Adjmnt | Data Capture |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Marion Murdock Court** | 34 | 31 | 24 | 21 | 15 | 14 | 14 | 14 | 19 | 25 | 27 | 35 | 23 | 21 | | 100 |
| **Hastings Street** | 39 | 37 | 32 | 27 | 19 | 15 | 17 | 17 | 21 | 26 | 30 | 38 | 26 | 24 | | 100 |
| **856 Plains Road** | 36 | 42 | 36 | 32 | 33 | 28 | 25 | 27 | 30 | 31 | 38 | 42 | 33 | 31 | | 100 |
| **Morley Mills, Daybrook** | 50 | 51 | 46 | 37 | 30 | 30 | 31 | 32 | 38 | 43 | 45 | 57 | 41 | 38 | | 100 |
| **Mansfield Road, Redhill** | 41 | 44 | 41 | 33 | 26 | 24 | 22 | 21 | 30 | 30 | 31 | 41 | 32 | 29 | | 100 |
| **Daybrook Dental Surgery** | 45 | 48 | 42 | 38 | 32 | 29 | 32 | 31 | 39 | 41 | 48 | 52 | 40 | 37 | | 100 |
| **19 Victoria Road, Netherfield** | 42 | 44 | 38 | 31 | 30 | 30 | 25 | 24 | 32 | 37 | 43 | 41 | 35 | 32 | | 100 |
| **36 Victoria Road, Netherfield** | 56 | 48 | 44 | 42 | 37 | 27 | 35 | 33 | 42 | 40 | 47 | 51 | 42 | 38 | 31 | 100 |
| **47 Plains Road** | 49 | 40 | 39 | 34 | 27 | 26 | 26 | 25 | 31 | 40 | 39 | 42 | 35 | 32 | | 100 |
| **Burton Rd/Shearing Hill** | 35 | 36 | - | 27 | 23 | 23 | 22 | 25 | 29 | 27 | 38 | 39 | 30 | 27 | | 92 |
| **The Vale PH - Thackerays Ln** | 49 | 49 | 47 | 42 | 36 | 35 | 23 | 38 | 43 | 40 | 48 | 49 | 42 | 38 | 33 | 100 |
| **The Grove PH - Daybrook Sq** | 56 | 63 | 46 | 47 | 42 | 35 | 30 | 33 | 46 | 40 | 51 | 56 | 45 | 42 | | 100 |
| **Ricket Lane** | 26 | 27 | 18 | 16 | 11 | 11 | 12 | 12 | 14 | 17 | 23 | 29 | 18 | 16 | | 100 |
| **Wickes Store, Daybrook** | 43 | 46 | 45 | 40 | 30 | 27 | 31 | 32 | 35 | 42 | - | 51 | 38 | 35 | | 92 |
| **Civic Centre, Arnold** | 32 | 32 | 25 | 21 | 16 | 16 | 18 | 18 | 30 | 26 | 25 | 37 | 25 | 23 | | 100 |
| **Mile End Road** | 40 | 45 | 35 | 31 | 30 | 26 | 20 | 24 | 20 | 34 | 38 | 44 | 32 | 30 | | 100 |
| **Daybrook Chip Shop** | - | 61 | 54 | 45 | 46 | 37 | 41 | 38 | 49 | 43 | 57 | 58 | 48 | 44 | | 92 |
| **T&S Heating, Daybrook** | 58 | 55 | 56 | 42 | 42 | 39 | 42 | 40 | 46 | - | 56 | 67 | 49 | 45 | | 92 |
| **Frank Keys, Daybrook** | 59 | 57 | 46 | 37 | 38 | 33 | 34 | 35 | 42 | 47 | 52 | 57 | 45 | 41 | | 100 |
| **Analyser in ppb** | 25 | 29 | 23 | 21 | 17 | 15 | 11 | 12 | 15 | 20 | 26 | 31 | 20 | | | |
| **ANALYSER IN ug/m$^{-3}$** | **48** | **55** | **44** | **40** | **33** | **29** | **21** | **22** | **30** | **38** | **49** | **60** | **39** | | | |
| DATA CAPTURE % | 97 | 97 | 97 | 97 | 92 | 75 | 97 | 97 | 95 | 97 | 96 | 97 | 95 | % | | |

| | | | | |
|---|---|---|---|---|
| Bias Adjustment Factors (BAF) | gradko | 0.92 | 39 | National (various) |

**Nitrogen Dioxide Diffusion Tube Monitoring 2010 - Adjusted for Bias**

# Appendix C

# QA / QC Data

**Quality Assurance and Quality Control – Nitrogen Dioxide Diffusion Tubes**

**Overview**

Diffusion tubes are small clear plastic tubes open at one end with a pollutant-absorbing chemical matrix or gel at the closed end. The tubes are prepared and sealed before being transported to the monitoring site. At site, the tube is exposed, by removal of the end cap, for a period of one month. After the month the tube is resealed and sent to an analytical laboratory.

The laboratory analysis measures the quantity of pollutant absorbed and then calculates an average ambient pollutant concentration over the exposure period. Diffusion tube results are for $NO_2$, concentrations measured in parts per billion (ppb) and micrograms per cubic metre ($\mu gm^{-3}$).

Tubes are exposed on a monthly basis, following the timetable prescribed by the Diffusion Tube Network in which tubes are replaced generally on the first Wednesday of the month.

Historical, Walsall Metropolitan Borough Council Laboratory have supplied and analysed GBC $NO_2$ diffusion tubes, using 50% solution TEA in acetone.

From April 2008 GBC entered into a Countywide contract with Gradko Ltd. for the supply and analysis of $NO_2$ diffusion tubes. At the same time it was agreed to use the same preparation method (20% solution of TEA in water). This harmonisation of laboratory and method for the county will allow easier comparisons of results across LA boundaries.

**QA/QC Procedures**

Gradko

The European Union Daughter Directive for $NO_2$ sets out data quality objectives for overall accuracy. Annual average $NO_2$ concentration results must comply with the objective of ±25% of the reference concentration therefore, average diffusion tube measurements should comply with this objective.

The precision of analytical measurements is also an important consideration, as it is possible to arrive at an average bias of less than ±25% with very imprecise measurements. Following previous intercomparisons of laboratory results an arbitrary guideline figure of 3ppb for acceptable precision has been adopted.

Gradko's $NO_2$ diffusion tube procedures follow the Defra guideline document[1] related to the preparation, extraction, analysis and calculation procedures for $NO_2$ passive diffusion tubes. Their internal analysis procedures are assessed by U.K.A.S. on an annual basis for compliance to ISO17025.

Results from the ongoing Workplace Analysis Scheme for Proficiency (WASP) programme for Gradko generally show a "Satisfactory" performance classification.

[1] Diffusion Tubes for Ambient $NO_2$ Monitoring: Practical Guidance for Laboratories and Users

Gedling Borough Council

Tubes are stored in a refrigerator until the day of exposure. On site, when the tubes are collected the date, site and time are recorded, referenced to the tube numbers assigned by the laboratory. The tubes are then forwarded to Gradko for analysis on the day of collection, along with a ‘blank’ trip diffusion tube.

The Council has conducted a co-location study, details are found in Appendix B.

## Quality Assurance and Quality Control – BTex Diffusion Tubes

The tubes used are Perkin Elmer thermal desorption (ATD) tubes packed, with nominally 100mg of Chromosorb 106. They are analysed using a Perkin Elmer ATD 400 automatic thermal system; Perkin Elmer 8700 gas chromatography with an ion trap detector. The uptake rate for benzene onto Chromosorb 106 is $0.54cm^3$ /min. Tubes were analysed by Walsall Metropolitan Borough Council Laboratory (WMBCL) from 1997 until 2003. However, WMBCL were unable to continue processing Btex tubes and so Harwell Scientifics took over with supply and analysis from April 2003.

Tubes are stored in a refrigerator until the day of exposure. On site, when the tubes are collected the date, site and time are recorded, referenced to the tube numbers assigned by the laboratory. The tubes are then forwarded to Scientific Ltd for analysis on the day of collection.

Tubes are exposed on a monthly basis, following the timetable prescribed by NETCEN in which tubes are replaced generally on the first Wednesday of the month.

## Chemiluminescent Monitor Data

### Overview

The automatic monitoring system used (Monitor Labs ML®9841B) uses gas-phase chemiluminescence detection to perform continuous analysis of nitric oxide (NO), total oxides of nitrogen (NOx), and nitrogen dioxide ($NO_2$). The instrument consists of a pneumatic system, an $NO_2$-to-NO converter (molycon), a reaction cell, photomultiplier tube (PMT) detector, and processing electronics.

During 2001-2007 the analyser was housed in the basement of the Daybrook Baptist Chapel. This site provides a safe and secure, dry location with a constant temperature and electrical supply. In January of 2008 the analyser was moved to a Casella ROMON enclosure on the opposite side of the A60 Mansfield Road.
The analyser has been operational since August 2000; data capture levels are: -

| | | |
|---|---|---|
| 96% 2001 | 96% 2005 | 95% 2009 |
| 95% 2002 | 93% 2006 | 95% 2010 |
| 97% 2003 | 83% 2007 | |
| 98% 2004 | 81% 2008 | |

The ML®9841B analyser has a quoted detection of ± 0.5ppb and a precision of ± 0.5ppb or 1% of reading, which ever is largest. Accuracy of the analyser is dependent on the calibration and the calibration gases used.

**QA/QC Procedures**

The analyser is subject to a fortnightly two point manual calibration, by a suitably trained site operative, which is conducted in accordance with the manufacturers quality control procedures. Filters at the sample head are changed concurrently with calibration. The equipment is serviced twice a year by the manufacturers accredited engineers. In addition the National Physical Laboratory (NPL) audited the site in 2002 and 2005.

Calibration gases (Air and NO) used during the fortnightly calibration are supplied by BOC, who have demonstrated compliance with relevant quality control procedures in the preparation of gas mixtures. Gas cylinders are replaced before use by dates or when the gas levels fall below 50 bar.

**Data Validation and Ratification**

A process of data validation is carried out by GBC on a fortnightly basis after application of the calibration factors. Validation is carried out in accordance with good practise [Annex 1.164 of LAQM TG(09)].

Then every quarter the data undergoes a process of ratification; assessing for drift, removing spurious data etc. Again this process is carried out in accordance with good practice [Annex 1.164 of LAQM TG(09)].

# Appendix D

# Source Apportionment Results

| Road Link | Pollutant | Emission Rates (g/km/s) | Emission Rates (g/km) | Petrol Cars (g/km) | Diesel Cars (g/km) | Taxi (g/km) | Petrol LGV (g/km) | Diesel LGV (g/km) | Rigid HGV (g/km) | Artic HGV (g/km) | Total HGV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mansfield Road, Arnold: Redhill Road - B 6004 Oxclose Lane | NOx | 0.151 | 13009 | 2161 | 2892 | 0 | 106 | 1982 | 2866 | 954 | 3820 |
| Mansfield Road, Daybrook: B 6004 Oxclose Ln - Sir JR Way | NOx | 0.134 | 11605 | 2142 | 2866 | 0 | 102 | 1905 | 2379 | 792 | 3171 |
| Mansfield Road, Daybrook: Nottingham Rd - A 6211 Thackerays Ln | NOx | 0.170 | 14672 | 2192 | 2933 | 0 | 114 | 2133 | 2494 | 830 | 3324 |
| Mansfield Rd, Daybrook: A6211 Thackerays Ln - A6514 Valley Rd | NOx | 0.204 | 17658 | 2743 | 3670 | 0 | 135 | 2513 | 3093 | 1030 | 4123 |
| Mansfield Road, Woodthorpe: A6514 Valley Road - Woodthorpe Dr | NOx | 0.121 | 10486 | 1462 | 1956 | 0 | 62 | 1152 | 1411 | 470 | 1881 |
| Thackerays Lane, Woodthorpe: A60 Mansfield Rd - Breckhill Road | NOx | 0.090 | 7750 | 1341 | 1795 | 0 | 61 | 1145 | 1422 | 474 | 1896 |
| Oxclose Lane, Daybrook: Edwards Lane - Queens Bower Road | NOx | 0.078 | 6710 | 1006 | 1346 | 0 | 53 | 986 | 1619 | 539 | 2157 |
| Oxclose Lane, Daybrook: Queens Bower Road - A 60 Mansfield Rd | NOx | 0.135 | 11694 | 1995 | 2670 | 0 | 103 | 1929 | 2043 | 680 | 2723 |
| Cross Street, Arnold: A 60 Mansfield Road - High Street | NOx | 0.048 | 4169 | 547 | 731 | 0 | 31 | 580 | 348 | 116 | 463 |
| Valley Road, Sherwood: A60 Mansfield Road - Edwards Lane | NOx | 0.131 | 11345 | 2032 | 2719 | 0 | 108 | 2016 | 2611 | 869 | 3480 |
| Mansfield Road, Daybrook: Sir JR Way - Nottingham Rd | NOx | 0.118 | 10179 | 1772 | 2371 | 0 | 92 | 1708 | 2086 | 695 | 2781 |
| Sherbrook Road, Daybrook: A60 Mansfield Rd - Oxclose Ln | NOx | 0.0114 | 984 | 160 | 215 | 0 | 15 | 287 | 128 | 43 | 170 |
| Nottingham Road, Arnold: A60 Mansfield Rd - Sir JR Way | NOx | 0.0573 | 4952 | 460 | 616 | 0 | 24 | 457 | 623 | 207 | 831 |
| **Totals** | | 1.4492 | 125214 | 20015 | 26780 | | 1007 | 18792 | 23123 | 7698 | 30821 |

| Road Link Emissions Contd. | Buses (g/km) | Motorcycles (g/km) | %LDV | %HDV | Total Diesel (g/km) | Total Petrol (g/km) |
|---|---|---|---|---|---|---|
| Mansfield Road, Arnold: Redhill Road - B 6004 Oxclose Lane | 2021 | 26 | 55.1 | 44.9 | 10715 | 2294 |
| Mansfield Road, Daybrook: B 6004 Oxclose Ln - Sir JR Way | 1388 | 31 | 60.7 | 39.3 | 9330 | 2275 |
| Mansfield Road, Daybrook: Nottingham Rd - A 6211 Thackerays Ln | 3948 | 27 | 50.4 | 49.6 | 12338 | 2334 |
| Mansfield Rd, Daybrook: A6211 Thackerays Ln - A6514 Valley Rd | 4433 | 41 | 51.5 | 48.5 | 14740 | 2918 |
| Mansfield Road, Woodthorpe: A6514 Valley Road - Woodthorpe Dr | 3949 | 24 | 44.4 | 55.6 | 8938 | 1548 |
| Thackerays Lane, Woodthorpe: A60 Mansfield Rd - Breckhill Road | 1490 | 22 | 56.3 | 43.7 | 6326 | 1424 |
| Oxclose Lane, Daybrook: Edwards Lane - Queens Bower Road | 1148 | 13 | 50.7 | 49.3 | 5638 | 1072 |
| Oxclose Lane, Daybrook: Queens Bower Road - A 60 Mansfield Rd | 2247 | 26 | 57.5 | 42.5 | 9569 | 2125 |
| Cross Street, Arnold: A 60 Mansfield Road - High Street | 1805 | 12 | 45.6 | 54.4 | 3579 | 590 |
| Valley Road, Sherwood: A60 Mansfield Road - Edwards Lane | 957 | 34 | 60.9 | 39.1 | 9172 | 2174 |
| Mansfield Road, Daybrook: Sir JR Way - Nottingham Rd | 1430 | 26 | 58.6 | 41.4 | 8290 | 1889 |
| Sherbrook Road, Daybrook: A60 Mansfield Rd - Oxclose Ln | 134 | 3 | 69.1 | 30.9 | 806 | 178 |
| Nottingham Road, Arnold: A60 Mansfield Rd - Sir JR Way | 2559 | 6 | 31.6 | 68.4 | 4462 | 490 |
| **Totals contd.** | 27510 | 290 | | | 103903 | 21311 |