GEDLING BOROUGH COUNCIL

Air Quality Detailed Assessment

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

December 2010

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Report Reference No.	DA/2010/01
Date	March 2010

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.

A review and assessment of air quality is the first step in the Local Air Quality Management (LAQM) process. Part IV of the Act requires each local authority to review air quality 'from time to time'. 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 preliminary assessments identify a risk that an air quality objective will be exceeded at a location with relevant public exposure, the Local Authority is required to undertake a "Detailed Assessment". The aim being to identify with reasonable certainty, whether or not a likely exceedence will occur.

Following on from the Updating and Screening Assessment 2009 it has been considered necessary to conduct a Detailed Assessment for the *A60 Mansfield Road.*

The results of this report conclude that data from additional monitoring and modelling carried out to date would tend to indicate that a breech of the Nitrogen Dioxide annual objective of 40µg/m^3 is occurring. Therefore we consider it necessary to declare an Air Quality Management Area along the A60 Mansfield Road.

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1 Introduction

1.1 Review and Assessment

1.1.1 Overview

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007, establishes the framework for air quality improvements. Measures agreed at the national and international level are the foundations on which the strategy is based. It is recognised, however, that despite these measures, areas of poor air quality will remain, and that these will best be dealt with using local measures implemented through the Local Air Quality Management (LAQM) scheme. The role of the Local Authority Review and Assessment process is to identify these areas, where it is considered likely that the Air Quality Objectives will be exceeded.

1.1.2 Phasing of the Assessment

Local Authorities are required to only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded. The first stage of the review and assessment process is an "Updating and Screening Assessment" (USA), carried out on a three year cycle. In the intervening years Progress Reports are produced.

Where the USA/Progress Report has identified a risk that an air quality objective will be exceeded at a location with relevant public exposure, the Local Authority is required to undertake a "Detailed Assessment". The aim being to identify with reasonable certainty, whether or not a likely exceedence will occur.

1.1.3 Public Exposure

The regulations make it clear that likely exceedences of the objectives should be assessed in relation to *'the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present'*.

The review and assessment should therefore, **be focused on those locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective**.

Local Authorities are not to consider exceedences of the objective at any location **where relevant public exposure would not be realistic**.

It is reasonable to consider land designated for some form of public use, including residential development, but not currently in such use, as being a location with relevant exposure.

Table 1.1: Examples of where the Air Quality Objectives should/should not apply
Source LAQM.TG(09) Box 1.4

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties Kerbside sites (as opposed to locations at the building façade) or any other location where public exposure is expected to be short term.
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties*.	Kerbside sites (as opposed to locations at the building façade) or any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24-hour and 8-hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets) Those parts of car parks, bus and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-min mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

* Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

2 Background Information

2.1 Air Quality Objective

The Government and the Devolved Administrations have adopted two Air Quality Objectives for nitrogen dioxide, as an annual mean concentration, not to be exceeded, of 40$\mu g/m^3$ (microgrammes per cubic metre), and a 1-hour mean concentration of 200$\mu g/m^3$, not to be exceeded more than 18 times a year.

2.2 Conclusions from 2009 Updating and Screening Assessment

The Council has reported on 9 months of NO_2 diffusion tube monitoring. When adjusted for bias, using an adjusted national Bias Adjustment Factor, two locations show marginal exceedence of the objective.

Gedling Borough Council therefore propose to progress to a Detailed Assessment for Nitrogen Dioxide along the A60 Mansfield Road through Daybrook Square.

2.3 Location

(See Appendix One)

The A60 Mansfield Road is one of the major arterial roads connecting the northern suburbs and surrounding area into the centre of Nottingham City. At its peak sections the road has an Annual Average Daily Traffic (AADT) flow of approximately forty thousand vehicle movements. There are three primary areas of concern all of which centre around junctions: -

- A60/ Thackerays Lane
- A60/Nottingham Road
- A60/Oxclose Lane

At these points there are sensitive receptors, which have been modelled using the DMRB model and compared against diffusion tube monitoring that has been carried out on or as near as possible to the receptors.

Gedling Borough Council (GBC) monitors NO_2 using diffusion tubes and a chemiluminescent monitor located in the Daybrook Square area. Data from these sources will be used, along with background data and DMRB modelling in the assessment, of areas thought to be at risk of exceeding the objective.

3 Monitoring and Modelling Information

3.1 Diffusion Tube Monitoring

Gedling Borough has 23 diffusion tubes spread along the key areas of concern, which are mainly commuter routes into Nottingham City Centre. The Borough also has three urban background and one rural background tube(s).

In 2004 most of the tubes were moved to new locations that better reflected the "receptor" based risk assessment criteria of guidance. The three tubes, Daybrook Analyser I, II and III, are located at the sampling head of the continuous automatic analyser. (See location maps in Appendix One)

Following the recommendations of the 2009 USA report three additional tubes were placed at relevant locations along the critical section through Daybrook Square, from July 2009.

Table 3.1: NO_2 Diffusion Tube Locations

Site	**OS Grid Ref.**	Description of site
Marion Murdock Court *	SK 61294 42826	Urban background
Hastings Street *	SK 60391 41413	Urban background
Civic Centre, Arnold	SK 58259 44723	Urban background
Ricket Lane	SK 56621 55935	Rural background
Morley Mills Building, Daybrook	SK 57969 44780	Receptor
Mansfield Road, Redhill	SK 57899 45637	Receptor
Daybrook Dental Surgery	SK 57867 45388	Receptor
Daybrook Analyser I,II and III	SK 57974 44632	Reference to Analyser
The Vale PH – Thackerays Lane	SK 57929 44335	Near Receptor
The Grove PH*- Daybrook Square	SK 57943 44685	Receptor
Wickes Store, Daybrook	SK 57904 45259	Near Receptor
T&S Heating, Daybrook	SK 57950 44748	Receptor
Daybrook Chip Shop	SK 57947 44713	Receptor
Frank Keys, Daybrook	SK 57969 44827	Near Receptor

*Sites part of the NETCEN network

3.1.1 Bias Correction

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

3.2 Chemiluminescent Monitoring

The analysis of nitrogen oxides by chemiluminescence is generally acknowledged to be the best direct measurement technique. The chemiluminescence analyser continuously monitors NO, NOx and NO_2 in concentrations measured in parts per million (ppm), and then averaged by the instrument over a 15 minute period. The analyser samples on a 6 second cycle, with a reference zero every seventh cycle. Results are compiled on an Envidas Biscuit data logger, which takes these values and generates a 15-minute average; logger also stores calibration logs. QA/QC procedures can be found in Appendix Five.

During 2001-2007 the analyser was housed in the basement of the Daybrook Baptist Chapel, Daybrook Square (see maps in appendix A). This site provided a safe and secure, dry location with a constant temperature and electrical supply. In January of 2008 however, the analyser was moved to a Casella ROMON enclosure on the opposite side of the A60 Mansfield Road, still in Daybrook Square. The new enclosure is situated approximately 5 metres from the kerb to best represent the receptors located 75 metres further along the road, given the constraints for siting.

Figure 3.1 Location of ROMON enclosure, Daybrook Square

3.3 DMRB Modelling

Estimated annual background concentrations for 2009 have been made available on the Internet via http://laqm1.defra.gov.uk/review/tools/background.php.

The tables below show background concentrations in the areas of concern for junction and receptor modelling. These figures were used in the DMRB model (all figures µg/m^3).

Table 3.2 : Concentrations Used in Junction DMRB Screening Model

Location	NOx	NO_2
20 Mansfield Rd	33.08	21.26
11 Duke St	30.38	19.81
166 Cross St	30.38	19.81
Vale Hotel	33.08	21.26
772 Mansfield Rd	33.08	21.26

Table 3.3 : Concentrations Used in Receptor DMRB Screening Model

Location	NOx	NO_2
53 Mansfield Road	33.08	21.26
1 Church Crescent	30.38	19.81
223 Mansfield Road	30.38	19.81
756 Mansfield Road	33.08	21.26
Analyser	33.08	21.26

Several assumptions have been made during the modelling using the DMRB model: -

- All traffic figures and composition data obtained from Nottinghamshire County Council are 2009. Traffic counts have been carried at various times correction factors, based on the Tempro v5, has been used to give 2009 AADT.
- All traffic speeds are assumed to be 30kph (20mph) for junction calculations and 50kph (30mph) for receptor calculations.
- In each case a “worse case receptor” has been chosen, based on the nearest residential property to the road or junction.

The results of the modelling have been corrected for model bias relative to the chemiluminescent monitor. This was carried out using the sampling head as a receptor in the model and using; traffic, background levels and analyser annual average. The bias adjustment factor was calculated in a similar fashion to the adjustment factor for diffusion tubes, using the procedure laid out below, substituting the model result for the diffusion tube results (Dm).

Appendix Three gives DMRB outputs and the model adjustment calculations.

Extract from Box 6.4: LAQM TG(03)	**Approach to bias correction of nitrogen dioxide diffusion tube data**

Example

A co-location study produces an annual mean diffusion tube concentration, **Dm**, of 35 µg/m^3 and an annual mean chemiluminescence concentration, **Cm**, of 39.5 µg/m^3.

Bias adjustment

A **bias adjustment factor A** is calculated as follows:

A = Cm/Dm

For this example **A** = 39.5/35 = 1.129

The diffusion tube survey annual mean values are then multiplied by this bias adjustment factor.

3.4 ADMS Modelling

(See Appendix Four)

GBC commissioned Air Quality Management Resource Centre (AQMRC) to undertake the detailed dispersion modelling study of the area of concern. The purpose of the modelling was to provide a spatial understanding of the levels of NO_2 when referenced to monitoring data.

ADMS-Roads v2.3, an atmospheric dispersion model developed by Cambridge Environmental Research Consultants Ltd was used to model nitrogen dioxide concentrations in the area of concern.

In undertaking the dispersion modelling the following input data was used:

- Traffic flows –hourly average data derived from 2009 traffic data provided by Nottinghamshire County Council.
- Heavy Duty/Light Duty Vehicle mix – obtained from 2009 traffic data provided by Nottinghamshire County Council.
- Vehicle speeds – established utilising professional judgement.
- Road geometry – the location of roads and buildings (including road width) were obtained using OS MasterMap data provided under license by GBC to AQMRC.
- Background pollution data – background pollution concentrations for nitrogen dioxide for 2009 were obtained from the LAQM Tools section of the Air Quality Archive website (www.airquality.co.uk/archive/laqm/tools.php).
- Meteorological data – Nottingham Watnall was used as the nearest location for which full datasets were available.
- Emission factors – new emission factors have recently been published but at the time of undertaking this study they have not been integrated into the ADMS-Roads software. Therefore, the Emission Factor Toolkit has been utilised to generate emission rates for this study.

To briefly summarise the dispersion modelling process the key steps are as follows:

- Input data is entered into the model (traffic flows/mix/speeds, emissions factors and meteorological data).
- The input data is then exported to the Emission Factor Toolkit to establish the emission rates for each road link using the new updated emission factors. These emission rates are then imported back into the dispersion model.
- The model is run to produce estimates of nitrogen oxides (NOx = NO + NO_2) from the road sources.
- Following the guidance in Annex 3 of LAQM.TG(09), this is verified and if required adjusted using data from local monitoring sites and background concentrations.
- The adjusted NO_2 concentration fields for roads emissions are then added to the 2009 NO_2 background concentrations to produce contours for annual mean NO_2 in 2009.

4 Monitoring and Modelling Results

4.1 Diffusion Tube Data

Table 4.1 below shows adjusted diffusion tube results for the subject area and urban and rural background sites, for reference. The complete set of monitoring results and details of bias adjustments and other data adjustments can be found in Appendix Two.

The results for three tubes in 2009 (Daybrook Chip Shop, T&S Heating and Frank Keys) are calculated from 6 months of data (July-December). The results presented have been annualised following a procedure in guidance. (See Appendix Two)

Table 4.1 Results of Nitrogen Dioxide Diffusion Tubes (adjusted for bias and location)

Location	Annual mean concentrations (μg/m^3)					
	2004	2005	2006	2007	2008†	2009
Marion Murdoch Court (urban bkgd)	21	23	19	20	19	22
Hastings Street (urban bkgd)	23	28	24	24	23	25
Morley Mills Building	36	39	35	39	**40**	**42**
Mansfield Road, Redhill	38	**45**	35	33	27	33
Daybrook Dental Surgery	31	**41**	32	34	37	39
The Vale PH	35	35	29	35	34	36
The Grove PH	36	36	31	37	**40**	**40**
Ricket Lane (rural bkgd)	-	-	-	19	18	20
Wickes Store, Daybrook	-	-	-	33	34	38
Civic Centre, Arnold (urban bkgd)	-	-	-	22	20	22
Daybrook Chip Shop	-	-	-	-	-	**50**††
T&S Heating, Daybrook	-	-	-	-	-	**51**††
Frank Keys, Daybrook	-	-	-	-	-	**45**††

† 9 months of data.
†† 6 month data has been "annualised" using Box 3.2 of TG(09). (See Appendix Two)

4.2 Continuous Monitor Data

Table 4.2 below shows monthly and annual average results from the monitor in Daybrook Square. Details of the monitor QA/QC processes can be found in Appendix Five. The annual average results below have been affected by some periods of low data capture:

- In December 2007 the monitor suffered from low data capture (56%) hence affecting the average for that month.
- The monitor was moved in early 2008; consequently data capture in the early months of the year was reduced.

Table 4.2 : Summary Table of NO_2 Chemiluminescent Monitor Results (Monthly Average µg/m^3)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2001	-	67	63	57	38	48	38	40	36	44	61	63	**50**
2002	52	36	42	36	32	34	36	34	36	44	46	36	**39**
2003	42	50	44	34	36	31	29	31	46	32	48	46	**39**
2004	45	40	41	38	43	28	36	28	36	35	44	50	**39**
2005	38	35	36	30	23	23	25	23	35	34	50	46	**33**
2006	39	51	35	35	29	31	27	24	31	31	43	40	**35**
2007	30	46	37	30	26	26	24	27	32	39	46	26	**32**
2008	-	-	29	37	43	31	25	25	39	33	35	42	**34**
2009	46	42	35	39	30	33	23	29	30	40	37	48	**36**

Reports have been run for the months indicated in the above table for the number of exceedences of the 1-hour objective of 200 µg/m^3 18 times a year. There where no exceedences of this 1-hour objective.

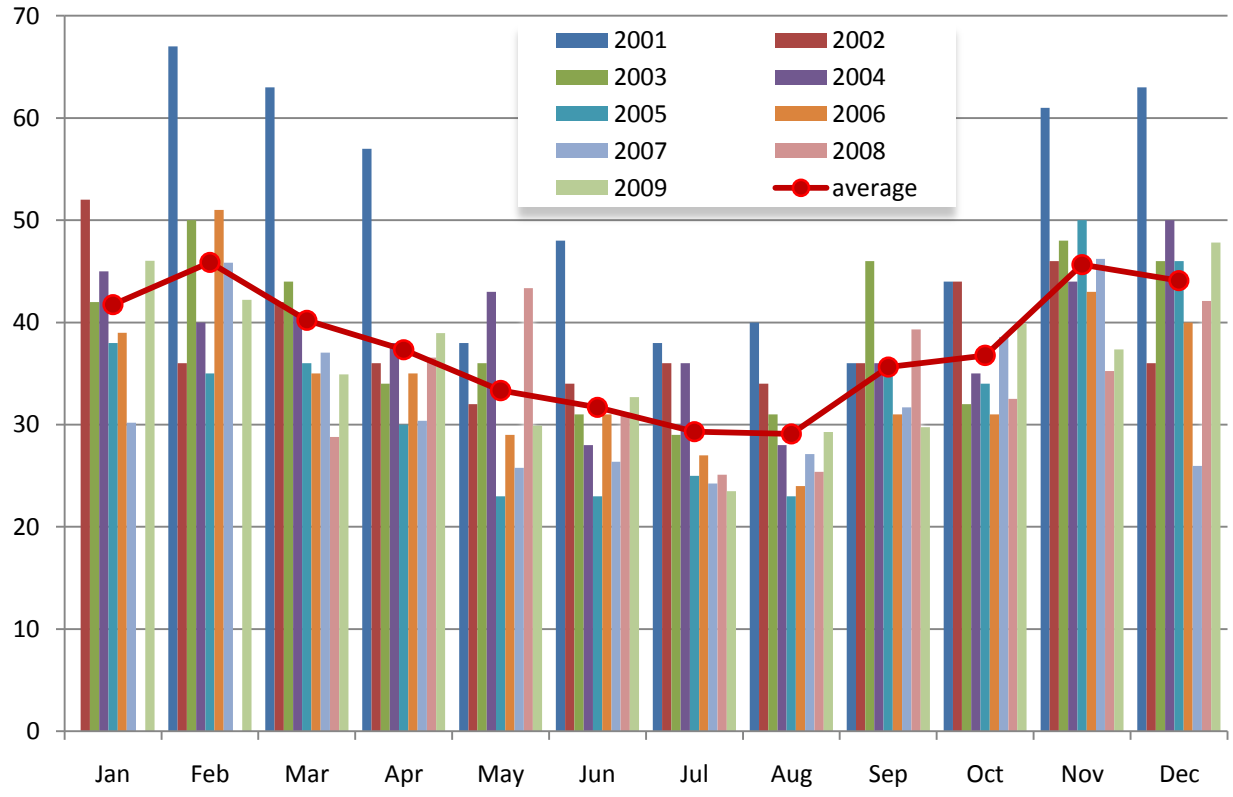

Figure 4.3: Graph showing Daybrook Square Analyser 2001 – 2009 Monthly Average

The above graph shows the seasonal variations in NO_2 monthly averages from the analyser. The graph also illustrates how 2001 levels appear to be particularly high in comparison to the preceding years.

The graph over shows monthly analyser and co-located tubes averages over time (not adjusted for bias). The graph shows a slight downward trend in NO_2 levels over the 6-year period measured by the analyser.

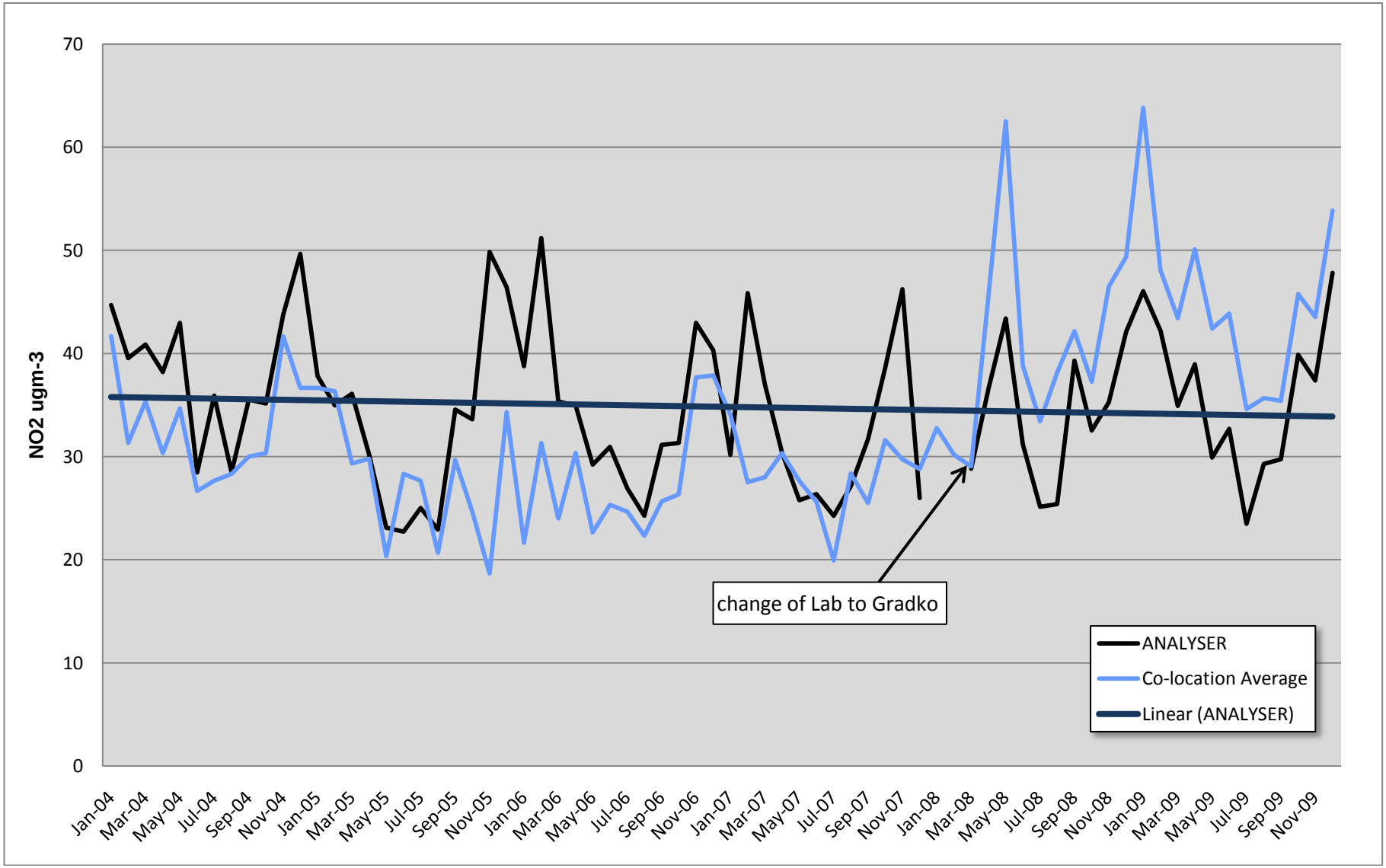

Figure 4.2 - Nitrogen Dioxide Analyser and Co-Located Diffusion Tube Results

4.2.1 Conclusions of Monitoring Data

Diffusion tube monitoring results for 2009 indicate possible exceedences of the 40 µg/m^3 objective level. These are in areas surrounding tubes located:

- Morley Mills Building
- The Grove PH
- Daybrook Chip Shop
- T&S Heating
- Frank Keys, Daybrook

Additionally, the areas around the following diffusion tubes are close to exceeding the 40 µg/m^3 level:

- Daybrook Dental Surgery
- Wickes Store, Daybrook

Results from the continuous monitor indicate no exceedences of the nitrogen dioxide annual mean objective of 40 µg/m^3.

Continuous monitor results from Daybrook Square suggest there is no risk of the 1-hour nitrogen dioxide objective being exceeded.

4.3 DMRB Modelling Results

The following are the junctions considered for further assessment using the DMRB model: -

- Mansfield Road – Nottingham Road (20 Mansfield Rd)
- Mansfield Road – Oxclose Lane (11 Duke St and 166 Cross St)
- Mansfield Road – Thackerays Lane (Vale Hotel and 772 Mansfield Rd)

Four “worse case receptor” have also been chosen for further assessment using the DMRB model: -

- Mansfield Road, Daybrook (53 Mansfield Road)
- Church Crescent, Daybrook (1 Church Crescent)
- Mansfield Road, Redhill (223 Mansfield Road)
- Mansfield Road, Woodthorpe (756 Mansfield Road)

4.3.1 Results of DMRB Modelling 2009

(See Appendix Three)

The table below shows that none of the receptors exceeded the objective when adjusted for model bias relative to the chemiluminescent monitor 2009; however levels at the A60 junction with Nottingham Road and Thackerays Lane are both potentially close to exceedence.

Table 4.3 : Summary of Results - DMRB Modelling 2009 (µg/m^3)

Site	Modelled	Adjusted
223 Mansfield Road	25	33
166 Cross Street	25	34
11 Duke Street	26	35
1 Church Crescent	25	33
53 Mansfield Road	26	35
20 Mansfield Road	28	***38***
Vale Public House	28	***38***
772 Mansfield Road	27	36
756 Mansfield Road	25	31
Analyser	27	36

4.3.2 Conclusions of DMRB Modelling

Results of DMRB modelling show no exceedences of the annual mean objective at all locations when modelled and not adjusted.

Whilst modelling in 2009, when adjusted for bias for that year, indicates no exceedences at all locations, levels at the A60 junctions with Nottingham Road and Thackerays Lane are potentially close to exceedence.

ADMS Modelling Results

(See Appendix Four)

The figures in Appendix Four illustrate the dispersion modelling contours representing the annual mean nitrogen dioxide concentrations ranging from 36 – 44 µg/m^3 for the modelled area.

The contours shown are based on model results adjusted on the basis of appropriate monitoring data from the sites shown. The contours are limited to the extent of the road sources modelled and do not necessarily represent the full extent of any potential exceedences of the annual mean NO_2 objective.

Information and discussion surrounding the verification and adjustment of the dispersion modelling output can also be found in Appendix Four.

The dispersion model indicates exceedences of the nitrogen dioxide annual mean objective of 40 µg/m^3 at locations of relevant exposure particularly:

- in the vicinity of the junction of Mansfield Road and Oxclose Lane;
- in the vicinity of Morley Mills and the junction of Mansfield Road and Nottingham Road; and
- in the vicinity of the junction of Mansfield Road and Thackeray Lane.

Dispersion modelling suggests there is no risk of the 1-hour nitrogen dioxide objective being exceeded at locations of relevant exposure.

5 Conclusions of Detailed Assessment

Monitoring results using passive diffusion tubes would tend to indicate exceedences of the nitrogen dioxide annual mean objective of 40 µg/m^3 at locations of relevant exposure particularly in areas surrounding tubes located:

- Morley Mills Building
- The Grove PH
- Daybrook Chip Shop
- T&S Heating
- Frank Keys, Daybrook

Additionally, the areas around the following diffusion tubes are close to exceeding the 40 µg/m^3 level:

- Daybrook Dental Surgery
- Wickes Store, Daybrook

Results from the continuous monitor indicate no exceedences of the nitrogen dioxide annual mean objective of 40 µg/m^3.

Continuous monitor results from Daybrook Square suggest there is no risk of the 1-hour nitrogen dioxide objective being exceeded.

The DMRB modelling indicated that whilst modelling in 2009, when adjusted for bias for that year, indicates no exceedences at all locations, levels at the A60 junctions with Nottingham Road and Thackerays Lane are potentially close to exceedence.

The ADMS dispersion model indicates exceedences of the nitrogen dioxide annual mean objective of 40 µg/m^3 at locations of relevant exposure particularly:

- in the vicinity of the junction of Mansfield Road and Oxclose Lane;
- in the vicinity of Morley Mills and the junction of Mansfield Road and Nottingham Road; and
- in the vicinity of the junction of Mansfield Road and Thackeray Lane.

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

Therefore, it is proposed that GBC declare an Air Quality Management Area (AQMA) for Nitrogen Dioxide. The proposed extent of the AQMA is shown in the figure in Appendix Six.

5.1 Next Steps

5.1.1 Air Quality Management Areas (AQMA)

Local authorities have a duty under Section 83(1) of the Environment Act 1995 to designate those areas where the air quality objectives are unlikely to be, or are not being, met as air quality management areas. These areas have to be designated officially by means of an ‘order’.

In deciding where to draw the boundaries of an AQMA, local authorities are guided that they may wish to consider some of the following points.

- It may be administratively much simpler to designate a wider area, based on existing boundaries and natural features. This avoids the need to draw artificially precise lines on maps;
- Wherever the boundaries of the air quality management area are drawn, the Action Plan is likely to need to cover a wider area;
- Designating a number of smaller air quality management areas, rather than one single large area, can allow an authority to demonstrate progress by ‘ticking off’ individual areas as air quality improves there;
- Declaring smaller, individual air quality management areas may provide a clear focus on the hot spot locations within a local authority. This may prove particularly important for informing local authority planning processes as to where the more sensitive planning proposals may need to avoid; and
- A more focussed approach to declaring air quality management areas may provide a better indication of where resources need to be allocated in terms of equipment and overall effort.

5.1.2 Further Assessment

Additionally, 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 Further Assessment is intended to supplement the information provided in the Detailed Assessment. It should aim to confirm the exceedence of the objectives; define what improvement in air quality, and corresponding reduction in emissions is required to attain the objectives; and provide information on source contributions.

The latter will provide useful information for the development of the Air Quality Action Plan, and assist in the targeting of appropriate measures. The level of detail required in the Further Assessment is, to some extent, dependant on what information the authority has also accrued and reported in other Review and Assessment reports

5.1.3 Action Plan

Following designation of an AQMA, an air quality Action Plan should be completed between 12 – 18 months following the date of designation. Once a local authority has produced its final action plan, a first Action Plan Progress Report must be submitted by the end of the following April.

Chapter 4 of the Local Air Quality Management Policy Guidance (PG09) lays out the legal framework, principles and processes involved in creating an Air Quality Action Plan to reduce pollutant levels to below the objective level.

An air quality Action Plan must include the following:

- quantification of the source contributions to the predicted exceedences of the relevant objectives; this will allow the Action Plan measures to be effectively targeted;
- evidence that all available options have been considered;
- how the local authority will use its powers and also work in conjunction with other organisations in pursuit of the air quality objectives;
- clear timescales in which the authority and other organisations and agencies propose to implement the measures within its plan;
- where possible, quantification of the expected impacts of the proposed measures and an indication as to whether the measures will be sufficient to meet the air quality objectives. Where feasible, data on emissions could be included as well as data on concentrations where possible; and
- how the local authority intends to monitor and evaluate the effectiveness of the plan.

Appendix One

Maps

GEDLING BOROUGH COUNCIL

P. Baguley BA(Hons)., M.C.D., M.R.T.P.I.
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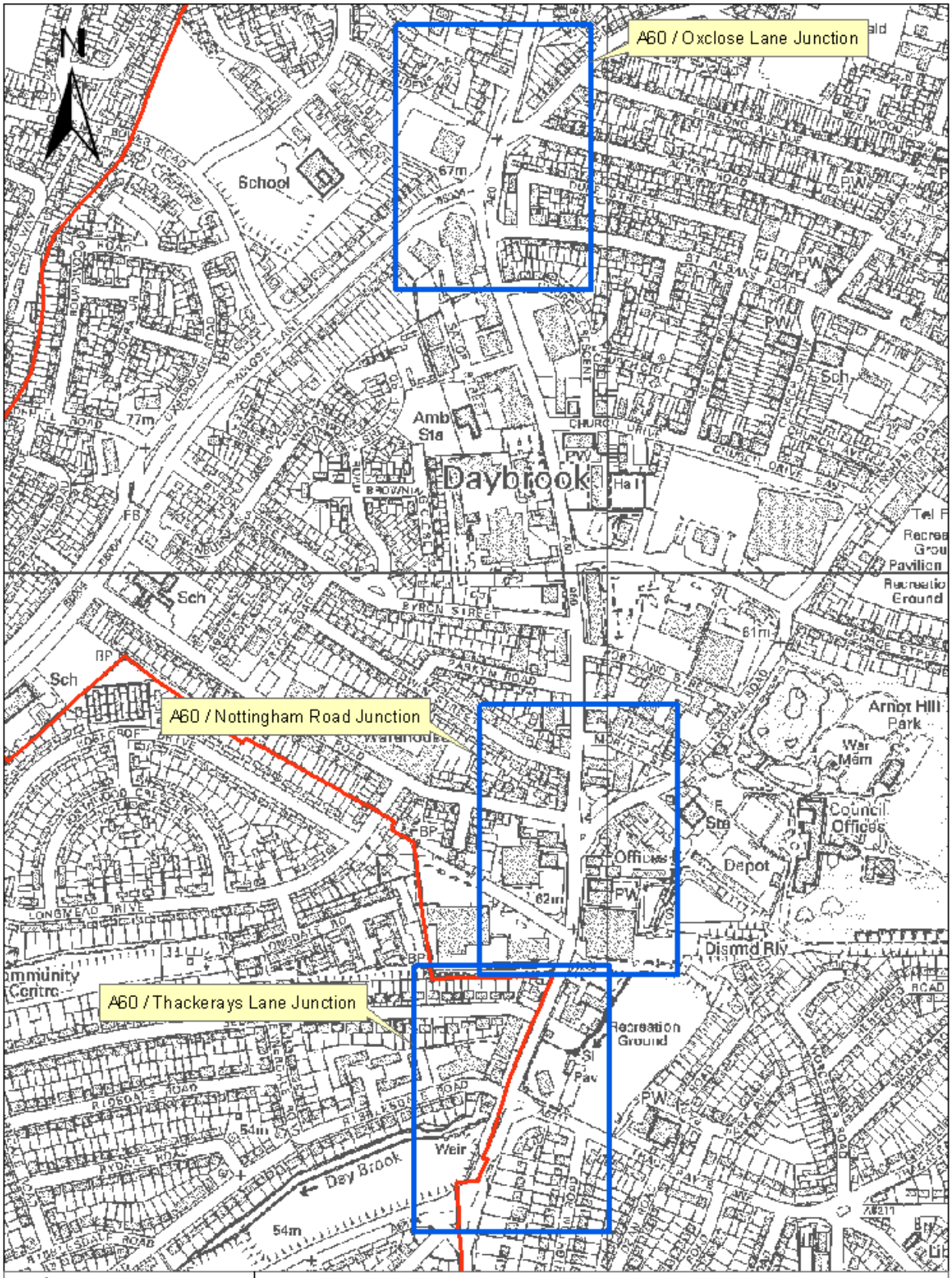
Civic Centre, Arnot Hill Park, Arnold
Nottingham NG5 6LU.

Location

Location Plan

Date Sept 06

Scale 1:50,000



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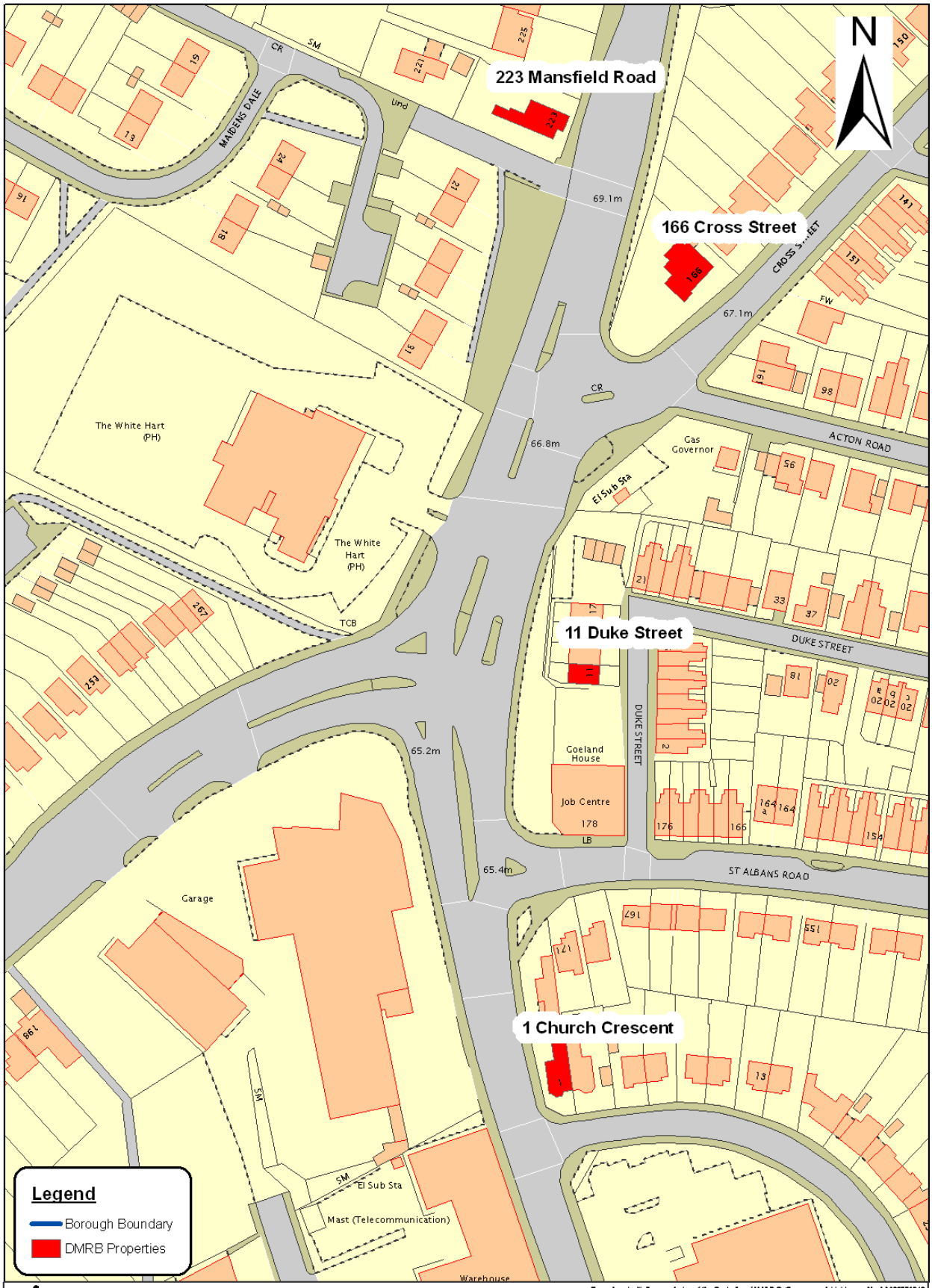
Nottingham NG5 6LU.

Location

A60 Mansfield Road Sheet Layout

Date Sept 06

Scale 1:6,000



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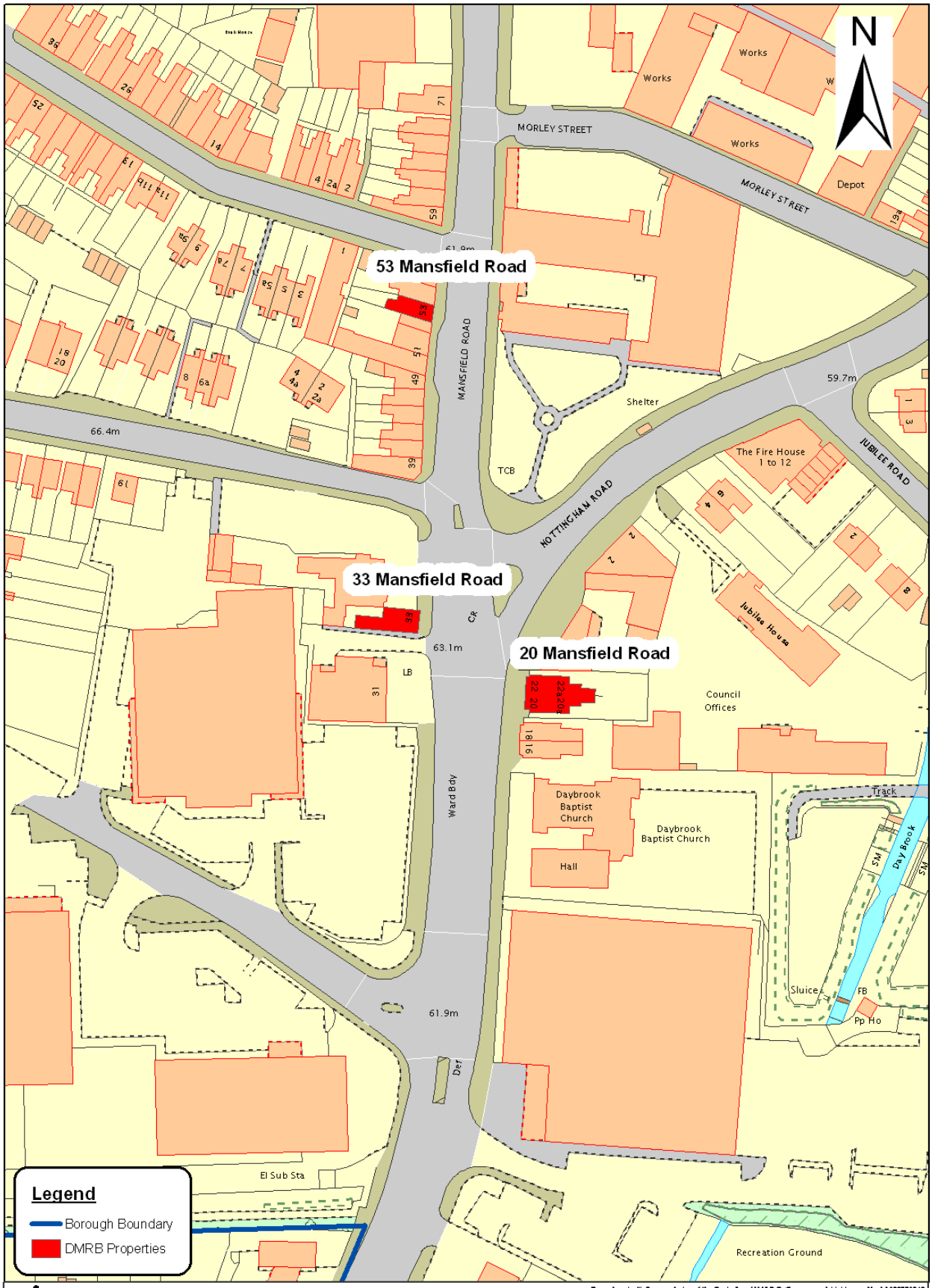
Title

A60 Mansfield Road junction with Oxclose Lane

Scale: 1:1,250



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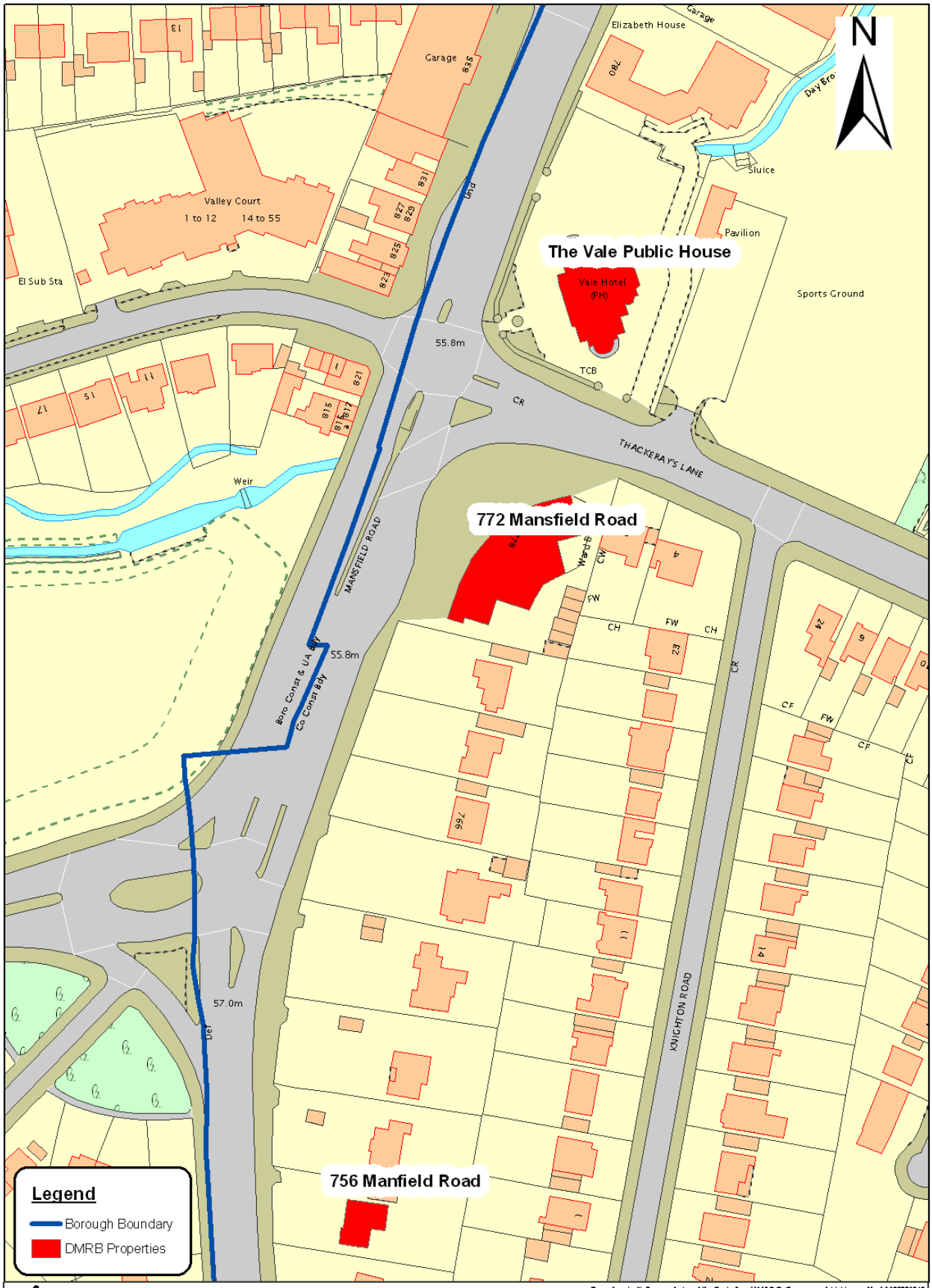
A60 Mansfield Road junction with Nottingham Road

Scale: 1:1,250



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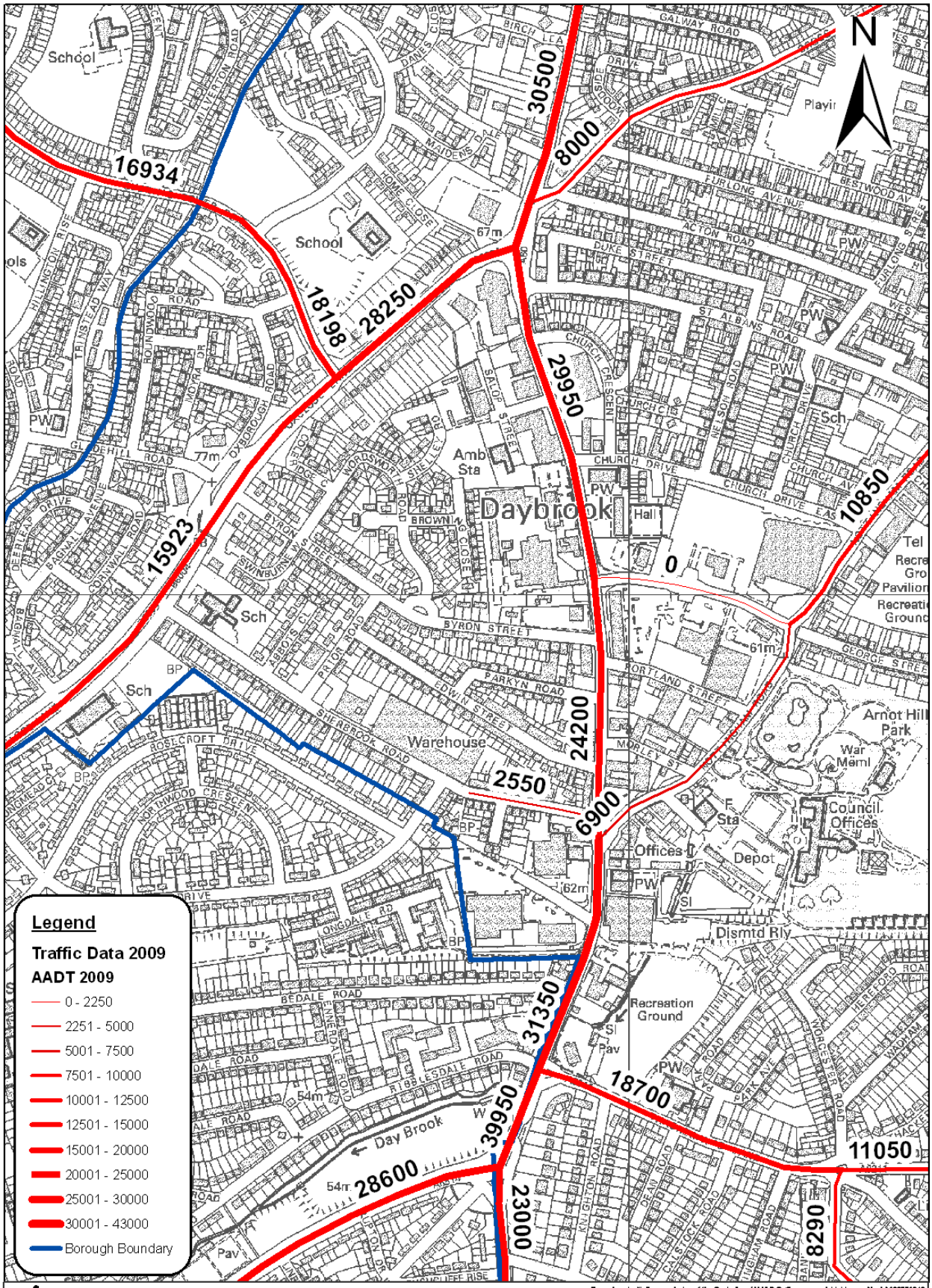
A60 Mansfield Road junction with Thackerays Lane

Scale: 1:1,250



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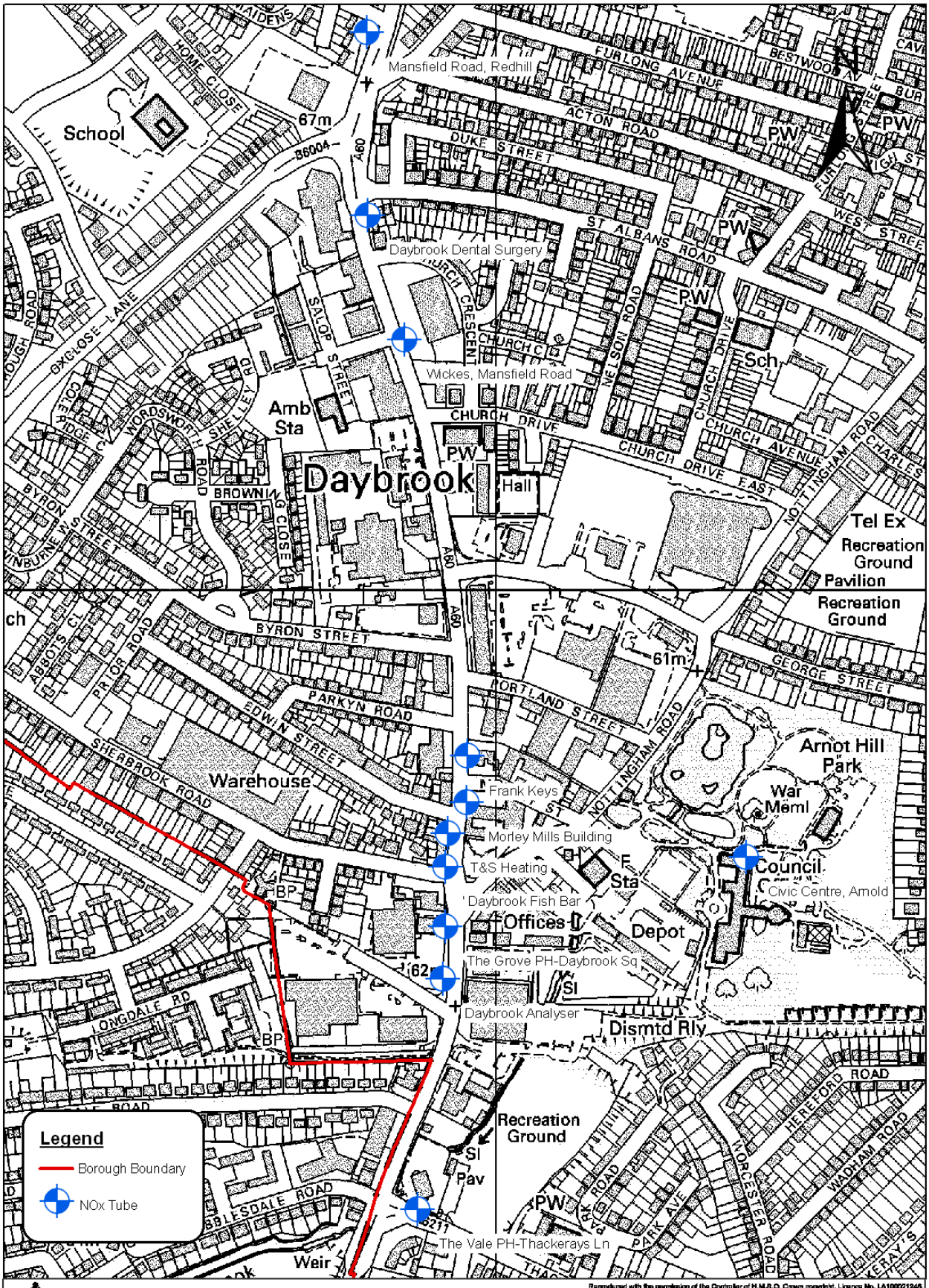
Title

2009 Traffic Data

Scale: 1:6,500



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Nitrogen Dioxide Diffusion Tube Locations

Scale: 1:5,000

Appendix Two

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://laqm1.defra.gov.uk/review/tools/no2/baf.php

The Gradko national BAF 2009 for 20% TEA in water is given as **0.90** from 33 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 **0.80**.

Discussion of Choice of Factor to Use

Based on guidance supplied by the Review and Assessment Helpdesk (http://www.uwe.ac.uk/aqm/review/manswers.html#ROAD3) GBC has used the national bias adjustment factor when adjusting diffusion tube results.

Short-term to long-term data adjustment

In 2009, 3 of the nitrogen dioxide diffusion tubes sites in the study area only achieved 50% data capture , therefore short-term to long-term adjustment has been applied. The approach set out in Box 3.2 of the Technical Guidance (LAQM.TG(09)) was followed.

It was not possible to identify four background sites with 100% data capture in 2009 and within 50 miles of Gedling therefore the following sites were utilised:

- Chesterfield (100% data capture, urban background)
- Market Harborough (100% data capture, rural); and
- Barnsley Gawber (100% data capture, urban background).

A ratio of **1.05** was therefore applied to these tube results to give an annual average.

Adjustment for Receptor Distance

One of the diffusion tube locations (The Vale PH) is not representative of the receptors concerned. Due to site constraints the tubes are located as close as possible to the receptors. The result has therefore been adjusted using the 'NO_2 with distance from roads' spreadsheet; available at http://laqm1.defra.gov.uk/review/tools/monitoring/fall-off.php

Screen shot of the spreadsheet are attached to this appendix.

Nitrogen Dioxide Diffusion Tube Monitoring 2004

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Annual Mean	Adjusted for National Bias	Corrected to 2005
Morley Mills, Daybrook	60	47	54	48	35	24	18	35	25	51	49	47	41	37	36
Mansfield Road, Redhill	58	36	-	46	42	-	30	-	-	-	-	44	43	39	38
Daybrook Dental Surgery	-	-	-	-	-	-	22	27	34	41	41	48	36	32	31
The Vale PH - Thackerays Ln	56	50	-	43	35	24	25	28	45	41	45	-	39	36	35
The Grove PH - Daybrook Sq	47	42	47	37	34	-	-	36	31	49		39	40	37	36
Ricket Lane (RB)													-	-	-
Wickes Store, Daybrook													-	-	-
Civic Centre, Arnold (UB)													-	-	-
Analyser in ppb	23	21	21	20	23	15	19	15	19	18	23	26	20		
ANALYSER IN ug/m-3	45	40	41	38	43	28	36	28	36	35	44	50	**39**		
DATA CAPTURE %	97.7	97.8	97.8	97.9	97.9	97.6	97.9	97.8	97.8	97.8	97.7	97.8	98	%	

Nitrogen Dioxide Diffusion Tube Monitoring 2005

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Annual Mean	Adjusted for National Bias
Morley Mills, Daybrook	44	65	31	36	34	42	-	26	39	35	46	34	39	39
Mansfield Road, Redhill	-	55	56	-	-	49	-	11	48	-	-	50	45	**45**
Daybrook Dental Surgery	-	51	50	35	-	40	-	27	37	31	-	61	41	**41**
The Vale PH - Thackerays Ln	-	53	46	26	25	34	35	30	44	34	25	-	35	35
The Grove PH - Daybrook Sq	39	33	43	23	27	49	34	23	-	35		52	36	36
Ricket Lane (RB)													-	-
Wickes Store, Daybrook													-	-
Civic Centre, Arnold (UB)													-	-
Analyser in ppb	19.8	18	18.9	15.8	12.1	11.9	13.1	12	18.1	17.6	26.1	24.3	17	
ANALYSER IN ug/m-3	38	35	36	30	23	23	25	23	35	34	50	46	**33**	
DATA CAPTURE %	97.9	97.7	97.9	78.3	97.7	97.8	97.8	97.2	97.3	97.8	97.8	97.8	96	%

Nitrogen Dioxide Diffusion Tube Monitoring 2006

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Annual Mean	Adjusted for National Bias
Morley Mills, Daybrook	43	47	34	29	31	25	34	19	26	37	50	46	35	n/a
Mansfield Road, Redhill	-	38	28	39	35	35	-	-	-	-	-	-	35	n/a
Daybrook Dental Surgery	36	30	23	32	-	21	20	25	37	43	54	36	32	n/a
The Vale PH - Thackerays Ln	34	32	26	34	17	24	-	30	-	31	-	-	29	n/a
The Grove PH - Daybrook Sq	35	44	29	29	15	32	32	16	37	30	33	38	31	n/a
Ricket Lane (RB)							-	-	-	-	-	-	-	n/a
Wickes Store, Daybrook							10	9	17	-	16	14	13	n/a
Civic Centre, Arnold (UB)							-	-	-	-	-	-	-	n/a
Analyser in ppb	20	27	19	18	15	16	14	13	16	16	23	21	18	
ANALYSER IN ug/m-3	39	51	35	35	29	31	27	24	31	31	43	40	**35**	
DATA CAPTURE %	97.8	40.4	97.6	97.8	97.8	97	97.6	97.8	97.3	97.5	97.8	97.8	93	%

note: n/a = no local or national co location studies available

Nitrogen Dioxide Diffusion Tube Monitoring 2007

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Annual Mean	Adjusted for National Bias
Morley Mills, Daybrook	-	48	-	45	29	38	-	33	36	-	46	34	39	n/a
Mansfield Road, Redhill	36	54	32	30	33	23	18	20	31	39	37	43	33	n/a
Daybrook Dental Surgery	-	49	33	30	30	25	26	30	37	40	37	44	34	n/a
The Vale PH - Thackerays Ln	-	59	-	34	33	30	20	21	33	39	43	35	35	n/a
The Grove PH - Daybrook Sq	-	56	35	38	37	34	24	27	34	51	31	-	37	n/a
Ricket Lane (RB)	19	25	12	35	18	10	10	16	12	23	18	29	19	n/a
Wickes Store, Daybrook	-	48	35	31	18	31	25	31	29	42	40	34	33	n/a
Civic Centre, Arnold (UB)	31	24	20	21	31	14	14	18	18	24	25	24	22	n/a
Analyser in ppb	15.8	24	19.4	15.9	13.5	13.8	12.7	14.2	16.6	20.2	24.2	13.6	17	
ANALYSER IN ug/m-3	30	46	37	30	26	26	24	27	32	39	46	26	**32**	
DATA CAPTURE %	76.4	97.8	97.8	97.7	83.8	14.9	97.5	97.2	97.8	85.2	97.8	56.5	83	%

note: n/a = no local or national co location studies available

Nitrogen Dioxide Diffusion Tube Monitoring 2008 - Adusted for Bias

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	9 Month Mean	Adjusted for bias	Distance Adjmnt	Data Capture
Morley Mills, Daybrook				49	37	34	36	39	42	47	55	56	44	**40**		75
Mansfield Road, Redhill				38	32	26	26	30	27	29	36	20	29	27		75
Daybrook Dental Surgery				42	34	40	30	37	35	43	55	47	40	37		75
The Vale PH - Thackerays Ln				58	34	43	38	44	32	54	58	56	46	42	34	75
The Grove PH - Daybrook Sq				40	61	41	31	40	36	40	52	56	44	**40**		75
Ricket Lane (RB)				19	16	13	11	7	16	-	-	56	20	18		58
Vickes Store, Daybrook				36	27	35	32	35	24	42	52	53	37	34		75
Civic Centre, Arnold (UB)				24	15	18	17	16	21	28	29	33	22	20		75
Analyser in ppb	-	-	15.1	19.1	22.7	16.3	13.2	13.3	20.6	17.0	18.5	22.0	18			
ANALYSER IN ug/m-3	-	-	29	37	43	31	25	25	39	33	35	42	**34**			
DATA CAPTURE %	0	0	97	97	97	96	97	97	97	97	97	97	81	%		

Bias Adjustment Factors (BAF) use	gradkc	0.91	12 National (various)

Nitrogen Dioxide Diffusion Tube Monitoring 2009 - Adusted for Bias

Site	NO2 /ugm-3 jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	Annual Mean	Adjusted for bias	Distance Adjmnt	Data Capture
Morley Mills, Daybrook	69	47	50	53	36	27	38	43	36	48	52	61	47	**42**		100
Mansfield Road, Redhill	59	39	33	50	-	26	24	30	20	32	46	47	37	33		92
Daybrook Dental Surgery	59	45	49	41	35	29	33	39	39	45	44	60	43	39		100
The Vale PH - Thackerays Ln	70	65	55	40	34	33	41	46	37	48	53	61	49	**44**	36	100
The Grove PH - Daybrook Sq	63	49	45	47	41	37	36	34	37	50	43	53	45	**40**		100
Ricket Lane (RB)	38	29	21	20	-	11	-	13	13	17	25	30	22	20		83
Vickes Store, Daybrook	60	54	48	39	29	24	34	38	33	42	50	56	42	38		100
Civic Centre, Arnold (UB)	39	39	12	23	17	14	19	21	21	27	26	35	24	22		100
Daybrook Chip Shop							43	49	40	56	59	72	55	**50**		50
T&S Heating, Daybrook							54	55	45	62	54	59	57	**51**		50
Frank Kegs, Daybrook							38	46	38	49	58	60	50	**45**		50
Analyser in ppb	24.1	22.1	18.3	20.4	15.7	17.1	12.3	15.3	15.6	20.9	19.6	25.0	19			
ANALYSER IN ug/m-3	46	42	35	39	30	33	23	29	30	40	37	48	**36**			
DATA CAPTURE %	97	97	96	97	97	90	97	97	97	97	97	84	95	%		

Bias Adjustment Factors (BAF) use	gradkc	0.9	33 National (various)

= Adjusted for 6 months using Box 3.2

Site	2009 jul	aug	sep	oct	nov	dec	2010 jan	feb	mar	apr	may	jun	Annual Mean	Adjusted for bias*	Data Capture
Daybrook Chip Shop	43	49	40	56	59	72	-	61	54	45	46	37	51	**46**	92
T&S Heating, Daybrook	54	55	45	62	54	59	58	55	56	42	42	39	52	**47**	100
Frank Keys, Daybrook	38	46	38	49	58	60	59	57	46	37	38	33	46	**42**	100

Nitrogen Dioxide Diffusion Tube Monitoring 2010 - Indicative 12 month Averages

* Bias Adjustment Factors (BAF) used 2009 factor 0.9 for illustration

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)	21.26	$\mu g/m^3$
Step 3	What is your measured annual mean NO_2 concentration (in $\mu g/m^3$)?	(Note 2)	44	$\mu g/m^3$
Result	The predicted annual mean NO_2 concentration (in $\mu g/m^3$) at your receptor	(Note 3)	35.5	$\mu g/m^3$

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

Spreadsheet Version Number: 03/10

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

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 September 2010 on the R&A website

Published by Air Quality Consultants Ltd on behalf of Defra, the Welsh Assembly Government, the Scottish Government and the Department of the Environment Northern Ireland

Step 1:	Step 2:	Step 3:	Step 4:
Select the Laboratory that Analyses Your Tubes from the Drop-Down List	Select a Preparation Method from the Drop-Down List	Select a Year from the Drop-Down List	**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 a laboratory is not shown, we have no data for this laboratory.	If a preparation method is not shown, we have no data for this method at this	If a year is not shown, we have no data[2]	If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Review and Assessment Helpdesk 0117 328 3668 aqm-review@uwe.ac.uk.

Analysed By[1]	Method To make your selection, choose [All] from the pop-up list	Year[5] To make your selection, choose [All]	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m3)	Automatic Monitor Mean Conc. (Cm)	Bias (B)	Tube Precision[6]	Bias Adjustment Factor (A)
Gradko	20% TEA in Water	2009	R	Nottingham CC	12	45	41	11.8%	G	**0.89**
Gradko	20% TEA in Water	2009	R	Nottingham CC	11	45	41	9.4%	G	**0.91**
Gradko	20% TEA in Water	2009	UC	Belfast CC	10	39	34	14.4%	G	**0.87**
Gradko	20% TEA in Water	2009	R	Bromsgrove DC	9	53	52	1.9%	P	**0.98**
Gradko	20% TEA in Water	2009	R	Chelmsford BC	10	39	36	9.5%	G	**0.91**
Gradko	20% TEA in Water	2009	R	Coventry CC	11	45	44	2.8%	P	**0.97**
Gradko	20% TEA in Water	2009	R	Coventry CC	11	38	30	25.6%	P	**0.80**
Gradko	20% TEA in Water	2009	R	Coventry CC	12	37	36	2.1%	G	**0.98**
Gradko	20% TEA in Water	2009	R	Coventry CC	9	51	65	-22.0%	G	**1.28**
Gradko	20% TEA in Water	2009	R	Dudley MBC	11	42	37	13.1%	G	**0.88**
Gradko	20% TEA in Water	2009	B	Dudley MBC	12	30	27	9.4%	G	**0.91**
Gradko	20% TEA in Water	2009	Rural	Dudley MBC	12	19	17	11.2%	G	**0.90**
Gradko	20% TEA in Water	2009	R	Dudley MBC	12	44	40	11.3%	G	**0.90**
Gradko	20% TEA in Water	2009	R	Sandwell MBC	12	47	44	7.1%	S	**0.93**
Gradko	20% TEA in Water	2009	UB	Sandwell MBC	10	19	16	19.5%	S	**0.84**
Gradko	20% TEA in Water	2009	UB	Sandwell MBC	12	29	27	5.9%	S	**0.94**
Gradko	20% TEA in Water	2009	R	Sandwell MBC	11	42	40	5.8%	S	**0.95**
Gradko	20% TEA in Water	2009	R	Rushmoor BC	10	35	33	6.2%	G	**0.94**
Gradko	20% TEA in Water	2009	K	AEA Tech Intercomparison	12	121	107	12.6%	G	**0.89**
Gradko	20% TEA in Water	2009	R	Cheshire West & Chester Council	11	41	37	10.0%	G	**0.91**
Gradko	20% TEA in Water	2009		**Overall Factor[3] (33 studies)**				**Use**		**0.90**

National Bias Adjustment Spreadsheet for Gradko 20% TEA in water - 2009

Appendix Three

DMRB Modelling Results
and Adjustment Calculations

Receptor Name	223 Mansfield Road	Receptor number	1
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	30.4	20.4	50.8	$\mu g/m^3$	Not applicable		
NO_2	19.8	5.3	25.1	$\mu g/m^3$	Annual mean*	25.1	$\mu g/m^3$

Receptor Name	1 Church Crescent	Receptor number	4
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	30.4	20.5	50.9	$\mu g/m^3$	Not applicable		
NO_2	19.8	5.3	25.2	$\mu g/m^3$	Annual mean*	25.2	$\mu g/m^3$

Receptor Name	53 Mansfield Road	Receptor number	5
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	19.6	52.7	$\mu g/m^3$	Not applicable		
NO_2	21.3	5.1	26.3	$\mu g/m^3$	Annual mean*	26.3	$\mu g/m^3$

Receptor Name	756 Mansfield Road	Receptor number	9
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	12.9	46.0	$\mu g/m^3$	Not applicable		
NO_2	21.3	3.5	24.7	$\mu g/m^3$	Annual mean*	24.7	$\mu g/m^3$

Receptor Name	Analyser	Receptor number	10
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	22.6	55.7	$\mu g/m^3$	Not applicable		
NO_2	21.3	5.8	27.0	$\mu g/m^3$	Annual mean*	27.0	$\mu g/m^3$

Receptor Name	166 Cross Street	Receptor number	2
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	30.4	20.9	51.2	$\mu g/m^3$	Not applicable		
NO_2	19.8	5.4	25.2	$\mu g/m^3$	Annual mean*	25.2	$\mu g/m^3$

Receptor Name	11 Duke Street	Receptor number	3
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	30.4	23.7	54.1	$\mu g/m^3$	Not applicable		
NO_2	19.8	6.1	25.9	$\mu g/m^3$	Annual mean*	25.9	$\mu g/m^3$

Receptor Name	20 Mansfield Road	Receptor number	6
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	26.8	59.9	$\mu g/m^3$	Not applicable		
NO_2	21.3	6.7	28.0	$\mu g/m^3$	Annual mean*	28.0	$\mu g/m^3$

Receptor Name	Vale Hotel	Receptor number	7
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	26.0	59.1	µg/m^3	Not applicable		
NO_2	21.3	6.5	27.8	µg/m^3	Annual mean*	27.8	µg/m^3

Receptor Name	772 Mansfield Road	Receptor number	8
Assessment year	2009		

Results

Pollutant	Annual mean				For comparison with Air Quality Standards		
	Background concentration	Road traffic component	Total	Units	Metric	Value	Units
NO_x	33.1	22.8	55.9	µg/m^3	Not applicable		
NO_2	21.3	5.8	27.1	µg/m^3	Annual mean*	27.1	µg/m^3

NOx and NO2 DMRB Modelling Results 2009

(Adjusted for roadside NOx and model bias)

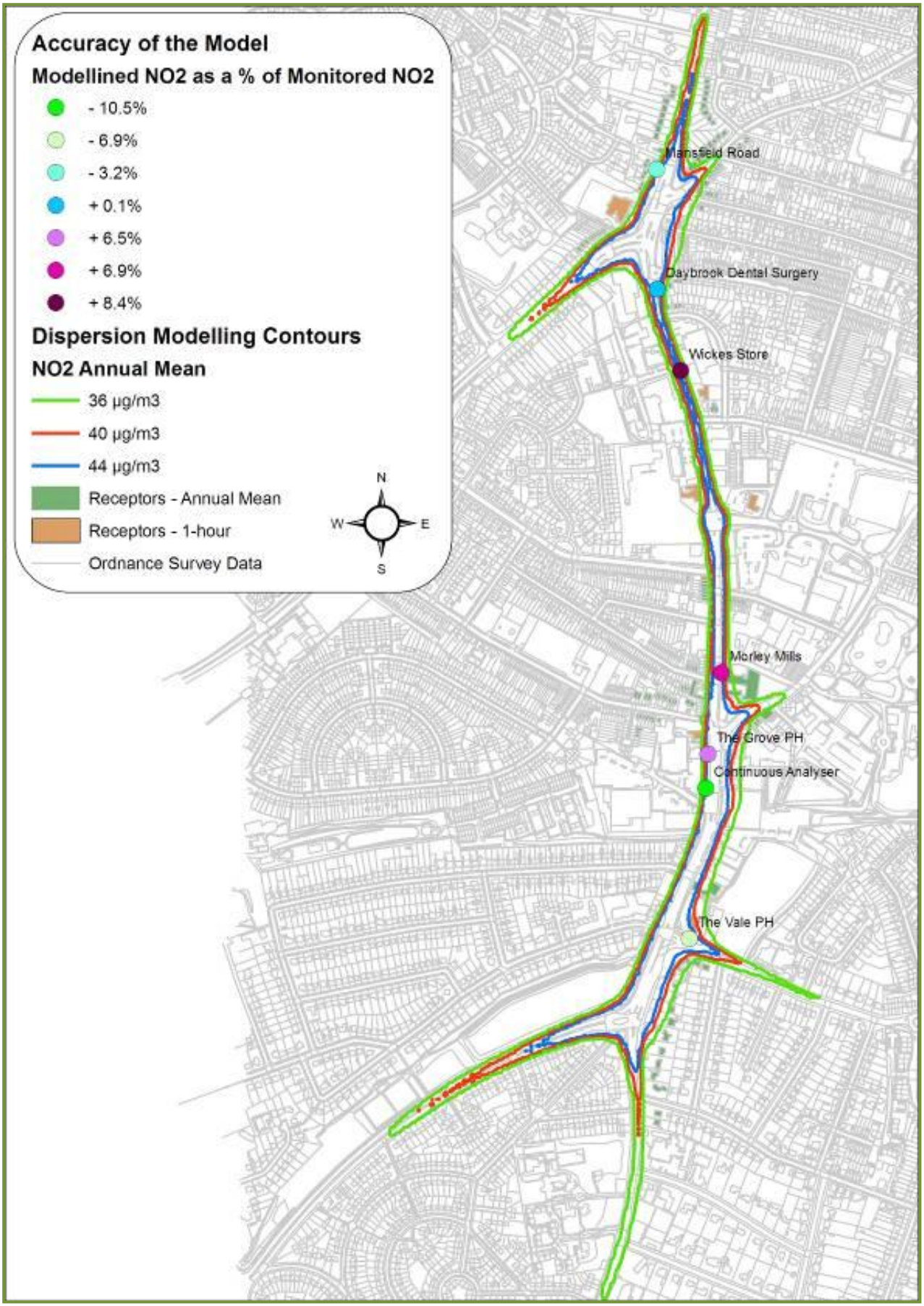
Link	Type	Year	Pollutant	Modelled NOx	Background NOx	Road NOx	DMRB Result NO2 µg/m^3	Adj NOx/NO2 Result NO2 µg/m^3	Adj for bias NO2 µg/m^3
223 Mansfield Road	R	2009	NO2	50.8	30.38	20.42	25.1	28.64	33.44
166 Cross Street	J	2009	NO2	51.2	30.38	20.82	25.2	28.79	33.61
11 Duke Street	J	2009	NO2	54.1	30.38	23.72	25.9	29.94	34.96
1 Church Crescent	R	2009	NO2	50.9	30.38	20.52	25.2	28.68	33.49
53 Mansfield Road	R	2009	NO2	52.7	33.08	19.62	26.3	29.67	34.64
20 Mansfield Road	J	2009	NO2	59.9	33.08	26.82	28	32.45	37.89
Vale Public House	J	2009	NO2	59.1	33.08	26.02	27.8	32.15	37.54
772 Mansfield Road	J	2009	NO2	55.9	33.08	22.82	27.1	30.92	36.10
756 Mansfield Road	R	2009	NO2	46	33.08	12.92	24.7	26.93	31.44
Analyser	R	2009	NO2	55.7	33.08	22.62	27	30.85	36.02

Model Bias Calculations

2009	30.85	Annual Mean DRMB Conc. (Dm)
2009	36.02	Annual Mean Analyser (Cm)
	1.168	bias adjustment factor
	-	
	14.35	% - DRMB bias for 2009
Analyser 2009	**36.02**	**µg/m^3**

Appendix Four

ADMS Modelling
Contour Maps and Parameters


Accuracy of the Model
Modellined NO2 as a % of Monitored NO2
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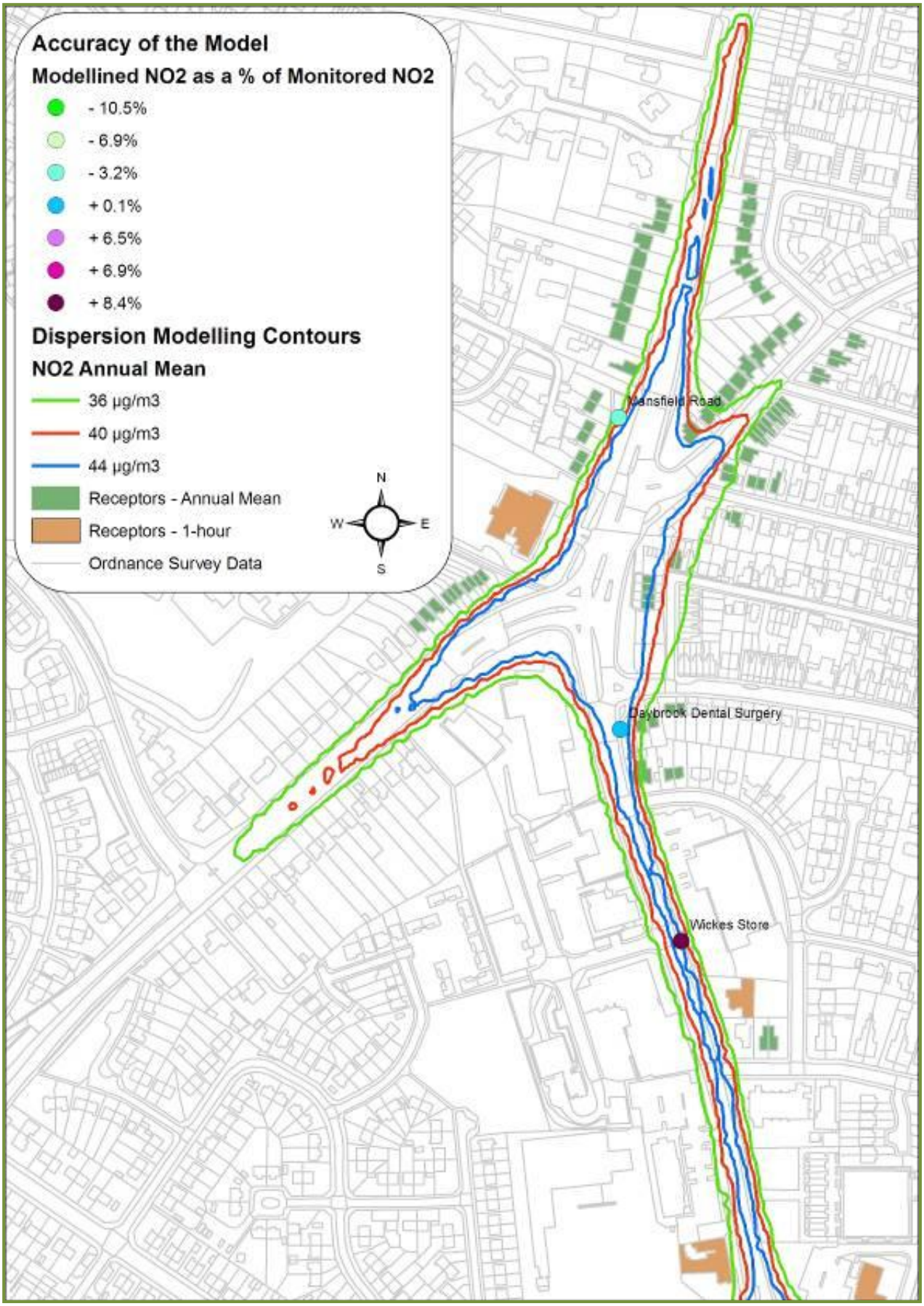
- 6.9%
- 3.2%
+ 0.1%
+ 6.5%
+ 6.9%
+ 8.4%
Dispersion Modelling Contours
NO2 Annual Mean
36 µg/m3
40 µg/m3
44 µg/m3
Receptors - Annual Mean
Receptors - 1-hour
Ordnance Survey Data
N
W
E
S
Mansfield Road
Daybrook Dental Surgery
Wickes Store
Morley Mills
The Grove PH
Continuous Analyser
The Vale PH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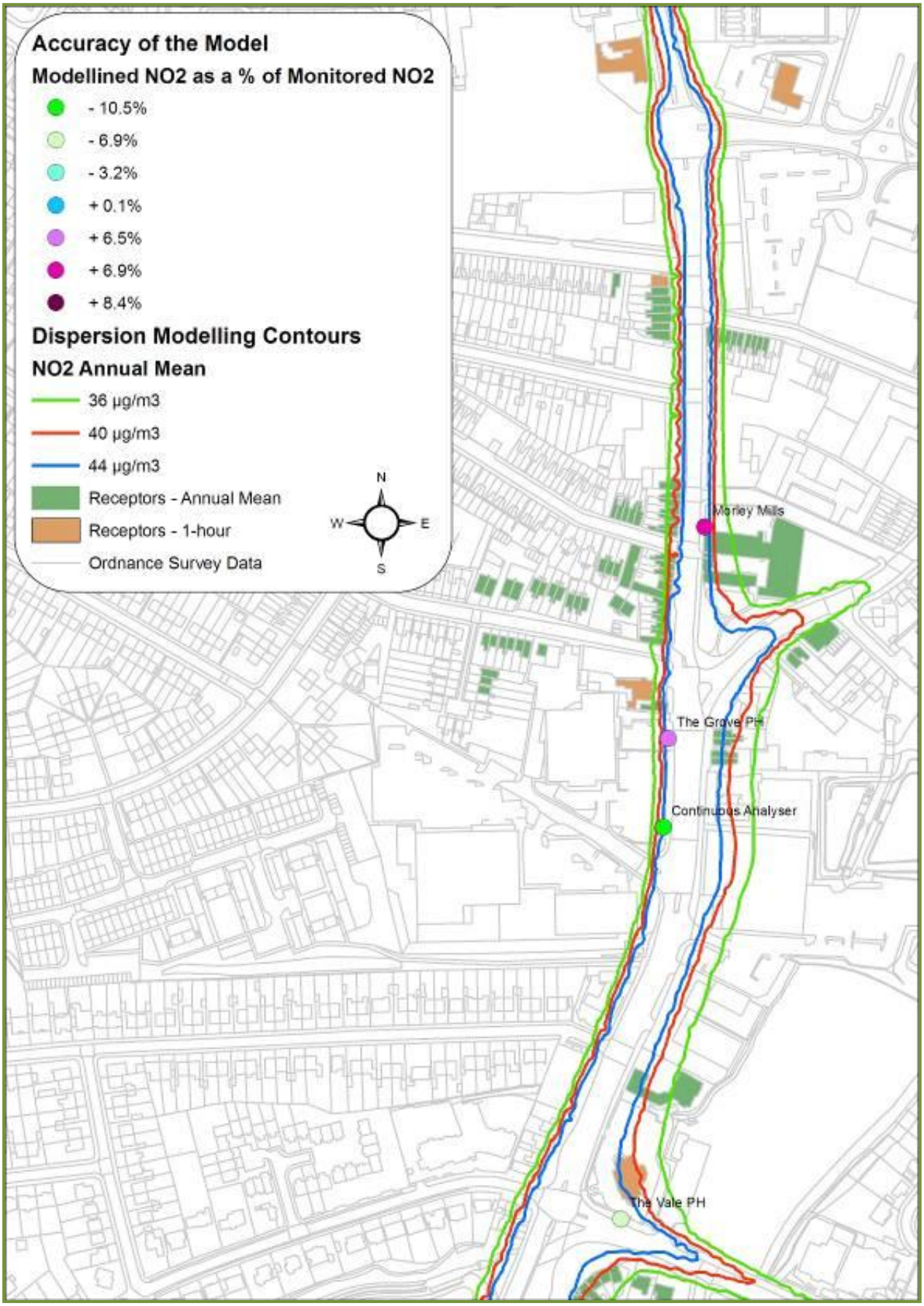
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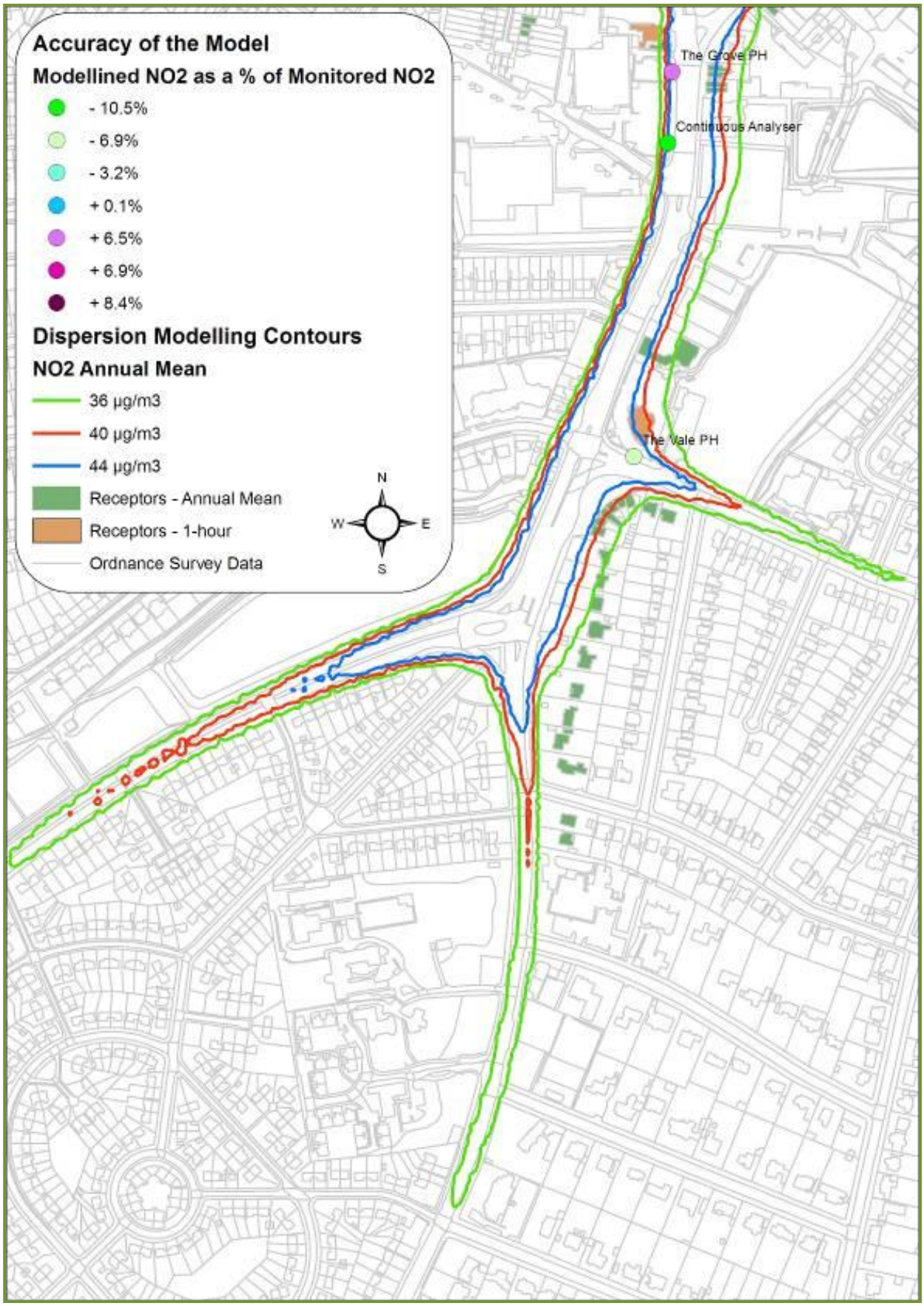
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Model Description, Methodology and Verification

Model Description

ADMS-Roads v2.3, an atmospheric dispersion model developed by Cambridge Environmental Research Consultants Ltd was used to model nitrogen dioxide concentrations in the area of concern.

Model Inputs

Background Concentrations

Background NOx and NO_2 concentrations have been obtained from the LAQM section of the Air Quality Archive Website as discrete 1x1km resolution grid points (http://www.airquality.co.uk/archive/laqm/laqm.php).

Meteorological Data

The meteorological data utilised came from Nottingham Watnall as the nearest location for which full datasets were available. Watnall is located approximately 8km west of Daybrook. Figure 1A illustrates the windrose for this dataset and given its relative proximity, meteorological data from this site is considered representative.

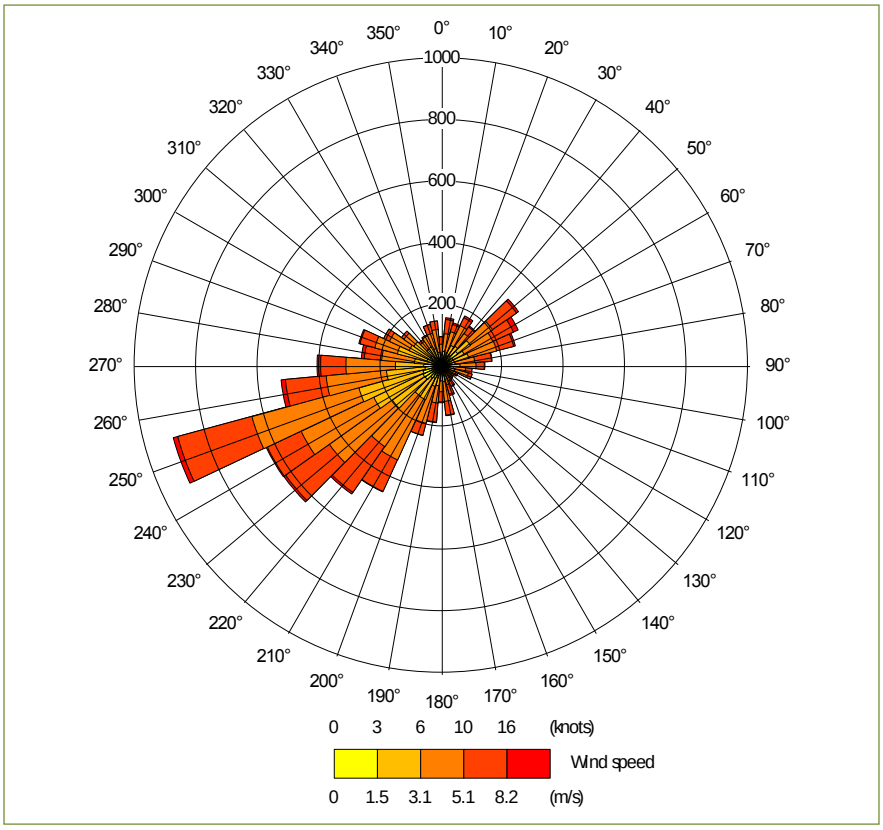


Figure 1A: Windrose for Nottingham Watnall meteorological data

Traffic Data

ATC data from Mansfield Road, Oxclose Road, Arnot Hill and Claverton Road was utilised to generate a generic diurnal traffic profile for the study area. This time varying factors from this profile were utilised within the dispersion model and are illustrated in Figure 2A below.

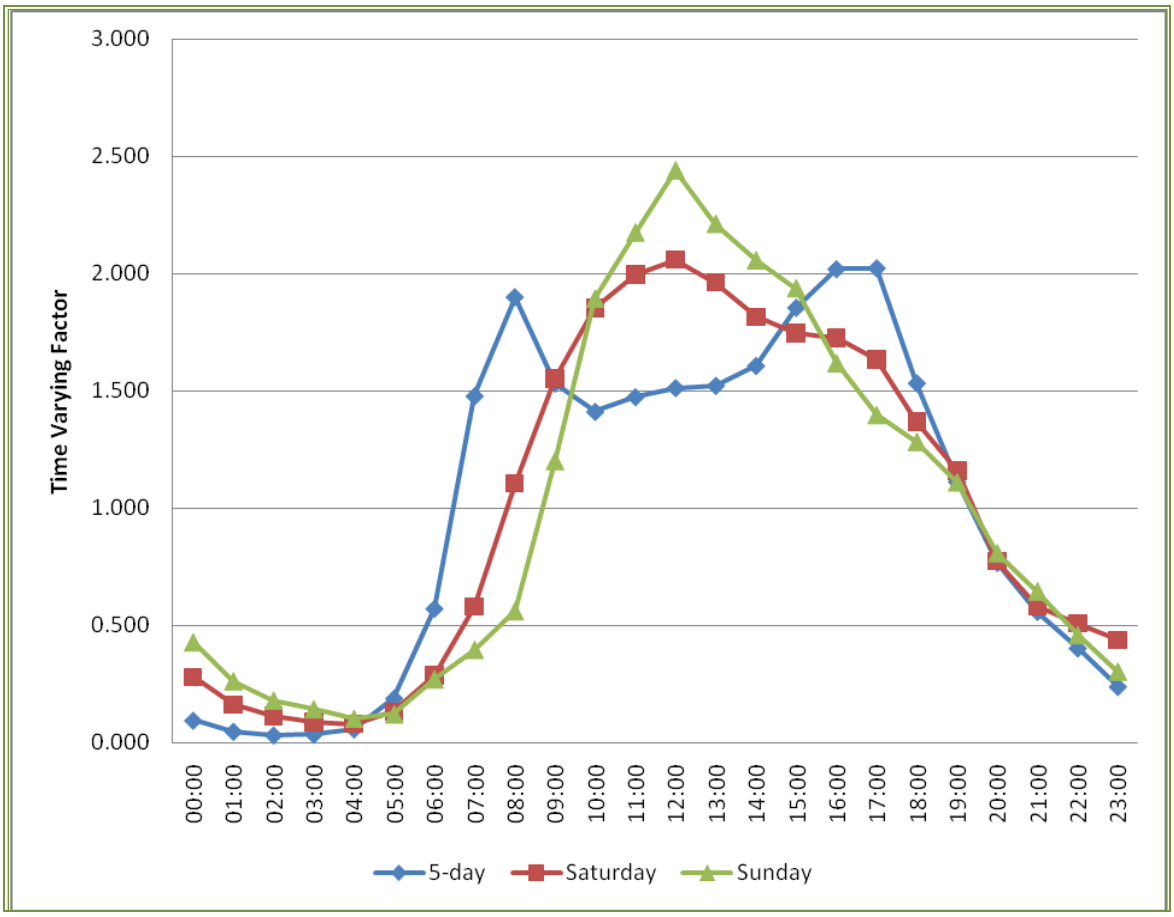


Figure 2A: Generic diurnal traffic profile for the study area

Traffic data utilised in this study has been provided by Gedling Borough Council (Table 1A). The datasets was provided as a GIS Shapefile. A summary of the data utilised can be found in Table 1A below.

Table 1A: Summary of traffic data.

Link ID	Site Name	Traffic Data (AADT)	Percentage Split (%)	
			LGV	HGV
0	Sherbrook Road, Daybrook - A60	2550	97.8	2.2
0	Valley Road, Sherwood: A60 Mansfield Road - Edwards Lane	28600	96.3	3.7
114	Mansfield Road, Arnold: Redhill Road - B 6004 Oxclose Lane	30500	96.4	3.6
115	Mansfield Road, Daybrook: B 6004 Oxclose Lane - Sir John Robinson Way	29950	97.1	2.9
115	Mansfield Road, Daybrook: Sir John Robinson Way - Nottingham Road	24200	96.9	3.1
116	Mansfield Road, Daybrook: Nottingham Road - A 6211 Thackerays Lane	31350	95.9	4.1
117	Mansfield Road, Daybrook: A 6211 Thackerays Lane - A 6514 Valley Road	39950	96.1	3.9
118	Mansfield Road, Woodthorpe: A 6514 Valley Road - Woodthorpe Drive	23000	94.9	5.1
352	Thackerays Lane, Woodthorpe: A60 Mansfield Road - Arno Vale Road	18700	96.7	3.3
353	Arno Vale Road, Woodthorpe: Thackerays Lane - Gedling Road	11050	97.0	3.0
544	Oxclose Lane, Daybrook: Edwards Lane - Queens Bower Road	15923	95.7	4.3
545	Oxclose Lane, Daybrook: Queens Bower Road - A 60 Mansfield Road	28250	96.2	3.8
1111	Nottingham Road, Daybrook: A60 - Sir John Robinson Way	6900	91.9	8.1
1601	Breckhill Road, Woodthorpe: A6211 Thackeray's Lane - Maitland Road	8290	97.9	2.1
1617	Cross Street, Arnold: A 60 Mansfield Road - High Street	8000	95.4	4.6
1634	Nottingham Rd / High Street, Arnold: Sir John Robinson Way - Cross Street	10850	95.4	4.6
1649	Queens Bower Road, Daybrook: B6004 Oxclose Lane - Bestwood Lodge Drive	18198	97.7	2.3
1650	Queens Bower Road, Bestwood: Bestwood Lodge Drive - Ridgeway	16934	97.7	2.3

Model Verification

Model verification is the process by which raw output from the dispersion model is compared with monitoring data in order to assess the overall error in the model. There are a number of assumptions and potential inherent uncertainties in undertaking a dispersion modelling study, these may include:

- Uncertainties in traffic flow data: actual number of vehicles, vehicle mix and speed;
- Simplification in terms of street geography: road width and canyon height;
- Error in the emission factors used, and in their representativeness for local vehicle fleets;
- Estimates of background concentrations;
- Uncertainties and representativeness of meteorological data;
- Model input parameters such as roughness length and Monin-Obukhov length;
- General limitations in the physics of the model itself.

In order to account for these errors the model predictions are verified against available monitoring data and then adjusted to correct for them. This process allows the spatial dispersion of pollution to be based on the model results, whilst the actual predicted concentrations are tied to the available monitoring results. The verification calculations are described in detail in Annex 3 of the Technical Guidance LAQM.TG(09) and the graphical representation of the model adjustment and calculated results at the diffusion tube/receptor sites used are given below (Figure 3A and Figure 4A).

The modelled NOx results from ADMS-Roads have been verified against 6 diffusion tube sites and the Daybrook Square continuous analyser. **Error! Reference source not found.**Table 2A shows the calculation of the adjustment factors and highlights the differences between modelled and monitored concentrations as a percentage difference and actual concentration.

Prior to adjustment monitored road contribution NOx was on average almost twice as high as modelled road contribution NOx. After adjustment, modelled NO_2 was within 10% of monitored NO_2 concentrations at all sites except the continuous analyser at which point the modelled concentrations was 10.5% higher than the monitored concentration.

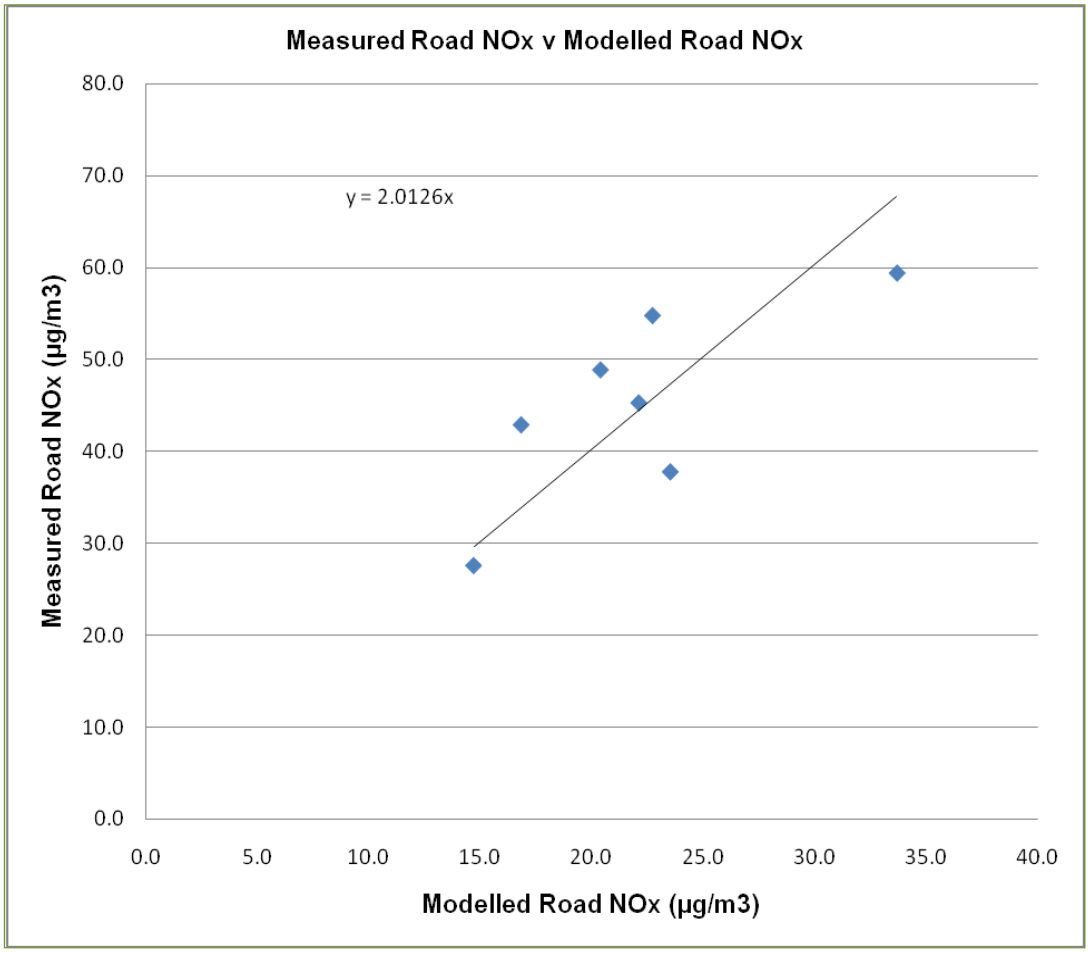


Figure 3A: Unadjusted modelled road NOx v Measured Road NOx

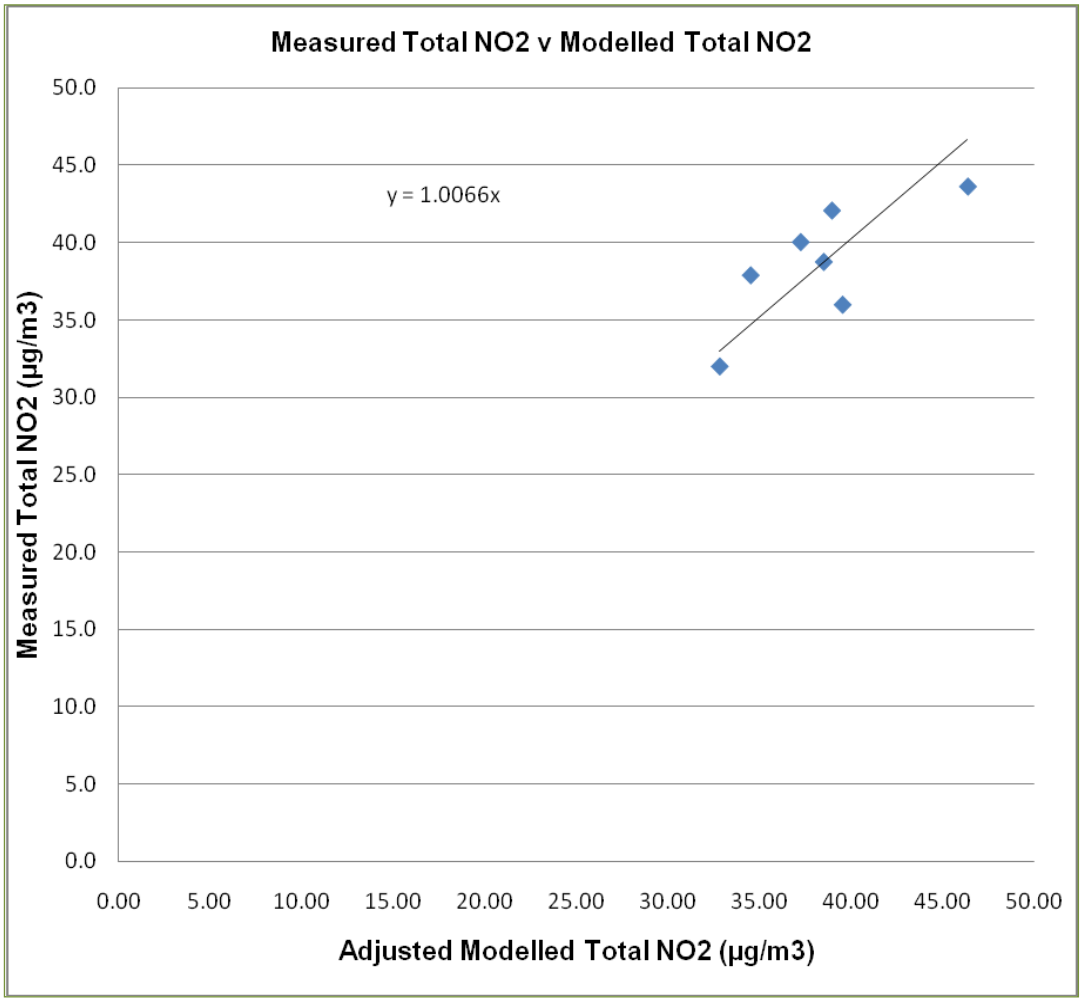


Figure 4A: Adjusted modelled NO_2 v Measured NO_2

Table 2A: Table of calculations for model verification/adjustment based on LAQM.TG(09) methodology

SITE INFORMATION		MONITORING AND MODELLING DATA							VERIFICATION AND ADJUSTMENT							
Name	2009 Data Capture (%)	Total NO_2 Mon. Conc	Total NOx Mon. Conc	Backgrd NO_x	Backgrd NO_2	Mon. Road Cont. NO_2	Mon. Road Cont. NO_X	Mod. Road Cont. NOx	Ratio of Mon. Road NOX v Mod. Road NOx	Adj. Mod. Road Cont. NOx	Adj. Mod. Total NOx	Adj. Mod. Total NO_2	Final Adj. NO_2	Mon. Total NO_2	% Diff NO_2	Conc Diff NO_2
Morley Mills	100%	42.1	85.0	30.2	19.7	22.4	54.8	22.7	2.41	45.72	75.92	38.93	39.2	42.1	6.9	2.9
Mansfield Rd, Redhill	92%	32.0	57.8	30.2	19.7	12.3	27.6	14.7	1.88	29.61	59.81	32.80	33.0	32.0	-3.2	-1.0
Dental Surgery	100%	38.8	75.5	30.2	19.7	19.1	45.3	22.1	2.05	44.48	74.68	38.48	38.7	38.8	0.1	0.0
The Vale	100%	43.7	89.6	30.2	19.7	24.0	59.4	33.7	1.76	67.76	97.96	46.35	46.7	43.7	-6.9	-3.0
The Grove	100%	40.1	79.1	30.2	19.7	20.4	48.9	20.4	2.40	41.04	71.24	37.22	37.5	40.1	6.5	2.6
Wickes Store	100%	37.9	73.1	30.2	19.7	18.2	42.9	16.8	2.55	33.89	64.09	34.49	34.7	37.9	8.4	3.2
Daybrook Continuous	95%	36.0	68.0	30.2	19.7	16.3	37.8	23.5	1.61	47.33	77.53	39.51	39.8	36.0	-10.5	-3.8

Appendix Five

Monitoring QA/QC Procedures

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 (μgm^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 $\pm$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 $\pm$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.

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

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

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 Two.

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 (NO2). The instrument consists of a pneumatic system, an NO2-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	
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.

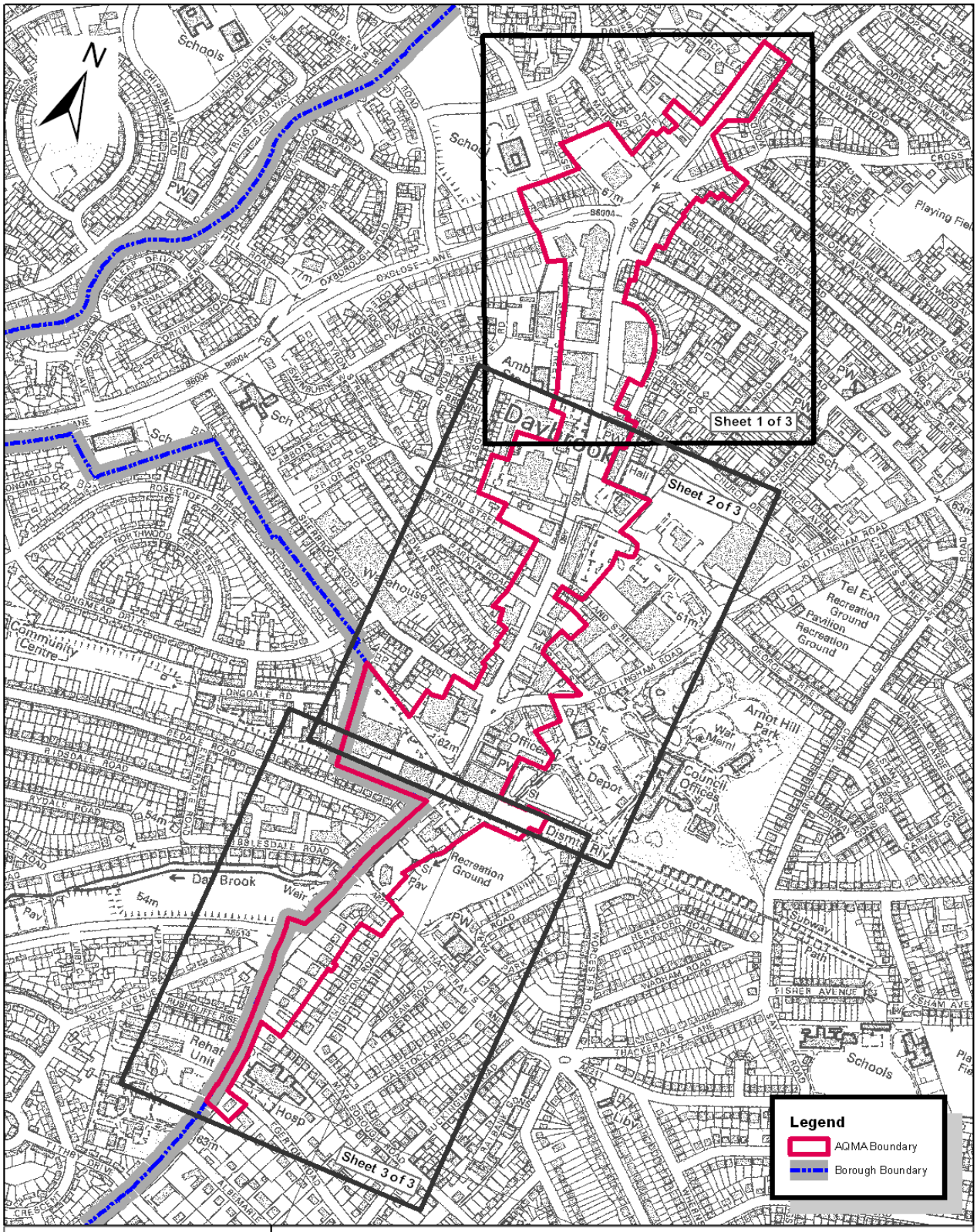
Data Validation and Ratification

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 practise [Annex 1.164 of LAQM TG(09)].

Appendix Six

Proposed Air Quality Management Area



GEDLING BOROUGH COUNCIL

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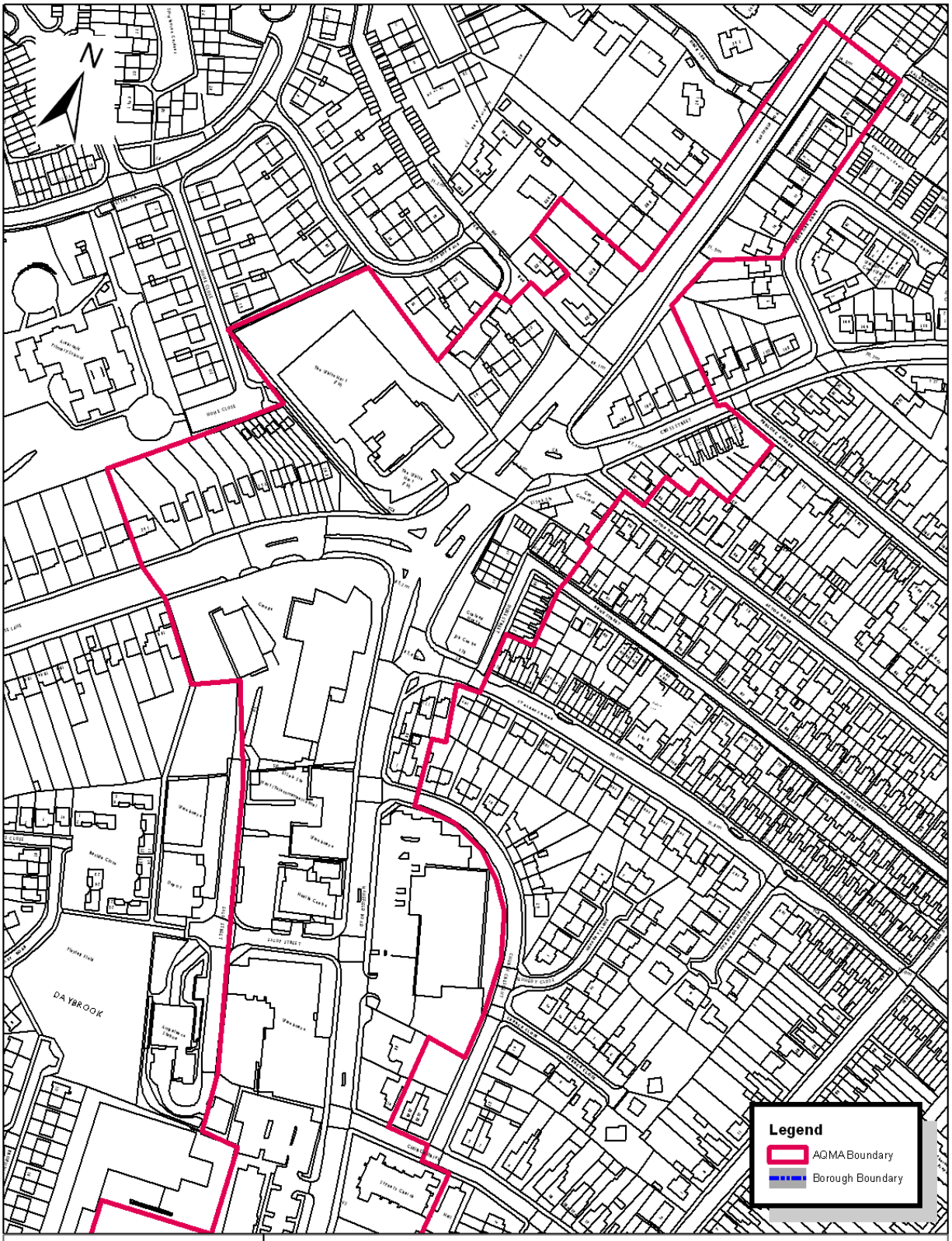
Head of Planning and Environment
Civic Centre, Arnot Hill Park, Arnold
Nottingham NG5 6LU.

Location

Proposed Air Quality Management Area

Date Dec 2010

Scale 1:7,500



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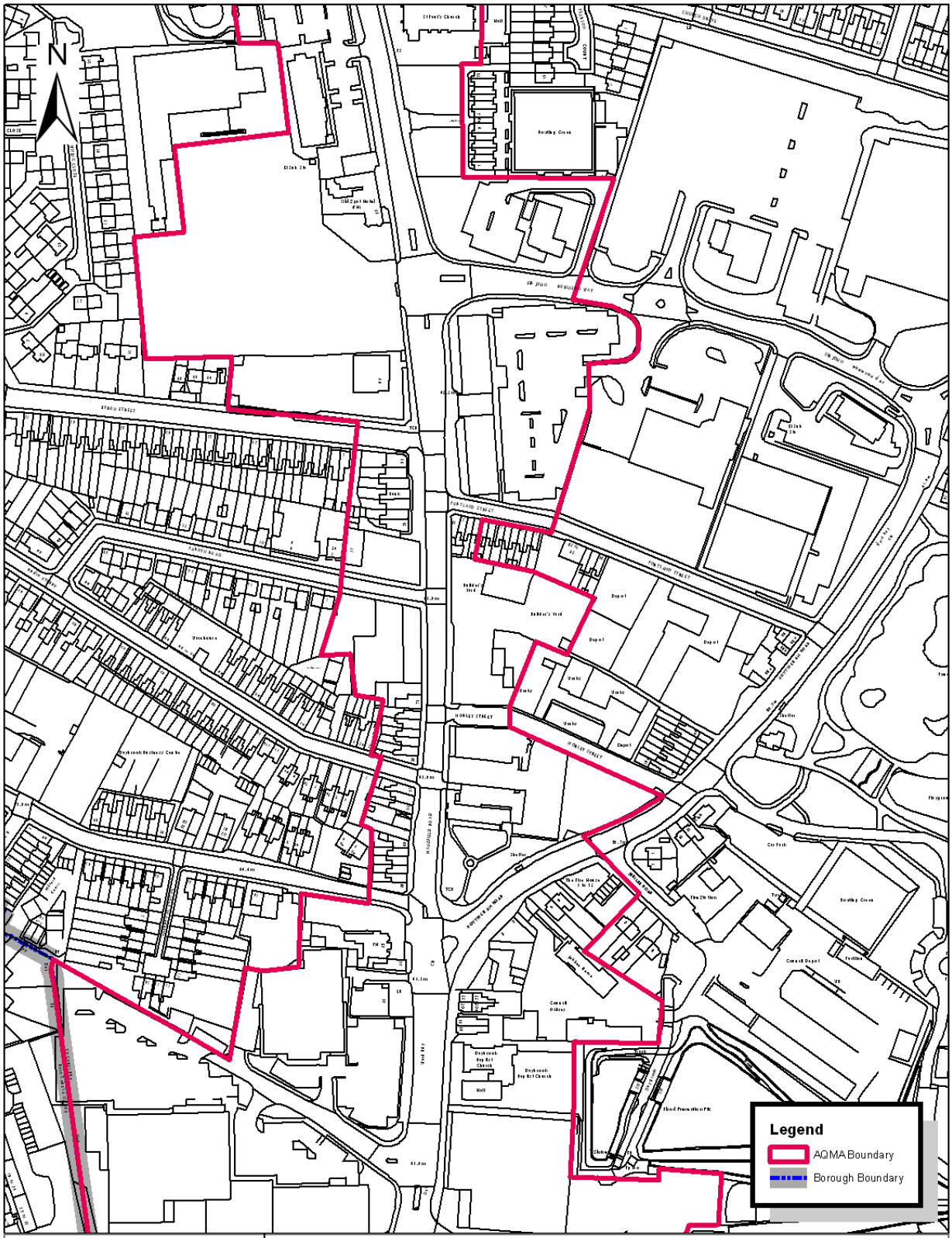
Proposed Air Quality Management Area

Sheet 1 of 3

Date Dec 2010

Scale 1:2,500



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Sheet 2 of 3

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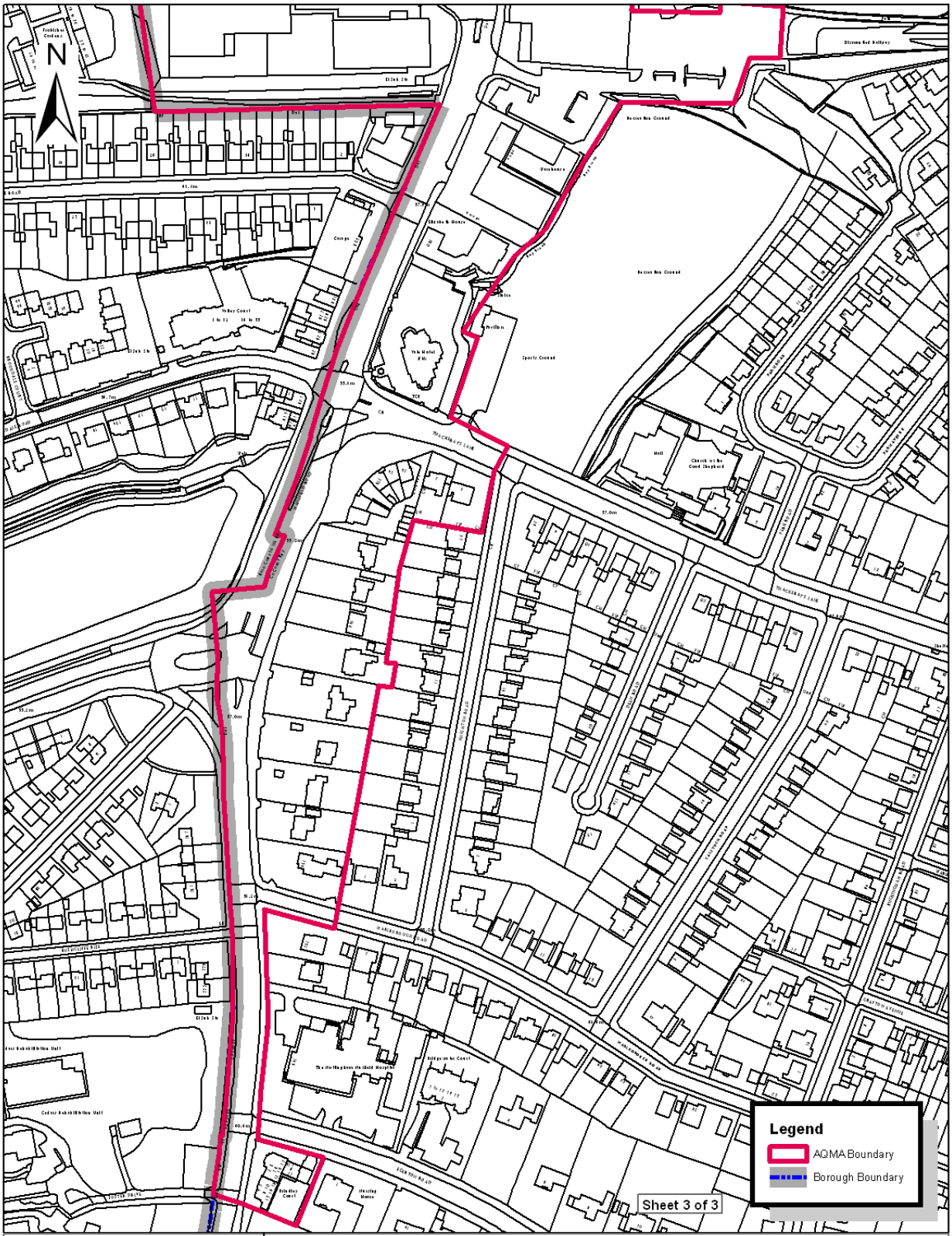

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