South Derbyshire District Council

Detailed Air Quality Assessment Report - Repton NO_2 Assessment

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Executive Summary

South Derbyshire District Council's (SDDC) Updating and Screening Assessment (USA) submitted to DEFRA in August 2012 identified the risk of potentially elevated levels of nitrogen dioxide (NO_2) on High Street, Repton, Derbyshire.

Since the submission of the USA, air quality monitoring has been carried out along High Street Repton at three locations using diffusion tube sampling. The monitoring locations were selected to represent both the likely worst case scenario points of exposure to traffic emissions and to represent the exposure of the facades of residential properties to road emissions. The data from these monitoring locations is presented in this report

This monitoring data is then used to undertake an air quality modelling assessment using the DMRB (Design Manual for Roads and Buildings) screening model assessment tool. The assessment determines the likelihood of the air quality objectives being exceeded at 'relevant' locations in the study area. The report has been prepared in accordance with the Local Air Quality Management Technical Guidance Note LAQM. TG(09).

The results from the assessment indicate that concentrations of NO_2 may be above air quality objective values at a small number of relevant receptor locations on High Street. However, the air quality monitoring data which underlies the assessment methodology used to derive these results are the subject of some uncertainty.

The report therefore proposes a continuation of air quality monitoring in the study area to investigate this uncertainty further before the Council reaches a decision on the need to declare an Air Quality Management Area (AQMA).

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1. Introduction

South Derbyshire is one of eight district authorities within Derbyshire. As the name infers, it is located in the south of the County and abuts the conurbations of Derby to the north and Burton on Trent to the west.

The district covers an area of more than 130 sq. miles, and has a population of around 94,000. Large areas of the river valleys of the Dove and the Trent are dedicated to dairy farming, whilst some arable farming is found on higher ground around Melbourne, and to the south of Swadlincote. In the Trent Valley continuing gravel extraction and historical power generation at Drakelow and Willington power stations provide important landmarks.

The main thoroughfares in South Derbyshire are the A50 and the A38 (both dual carriageway trunk roads). Smaller A roads include the A444, A511 and A514.

South Derbyshire has a number of sources of industrial emissions regulated by both the Environment Agency and the District Council; however previous Review and Assessments of air quality have demonstrated that none of these sources are causing any exceedences of the Air Quality Objectives.

Emissions from traffic sources are considered to be the most significant contributors to the air quality burden in the District.

1.1. Overview of Air Quality Legislation

European air quality legislation is consolidated under Directive 2008/50/EC (commonly known as the Air Quality Framework Directive), which came into force on 11th June 2008. The Directives consolidated into the Framework Directive include:

- Directive 99/30/EC – the First Air Quality "Daughter" Directive – sets ambient air limit values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter;
- Directive 2000/69/EC – the Second Air Quality "Daughter" Directive – sets ambient air limit values for benzene and carbon monoxide; and,
- Directive 2002/3/EC – the Third Air Quality "Daughter" Directive – seeks to establish long term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.
- The fourth “Daughter” Directive was not included within the consolidation and is described as Directive 2004/107/EC which sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

The Air Quality Standards Regulations (2010) provide the most recent transposition into UK law of the Air Quality Framework Directive and also transposes the Fourth Daughter Directive within the UK. The air limit values in the Directives are transposed into the Regulations as Air Quality Standards, with attainment dates in line with the European Directives.

The Air Quality Strategy for England, Scotland, Northern Ireland and Wales (2007) is the main policy tool for implementation of the air quality limit values in England, Scotland, Wales and Northern Ireland and provides a framework for improving air quality and protecting human health from the effects of pollution.

For each nominated pollutant, the Air Quality Strategy sets clear, measurable, outdoor air quality standards and target dates by which these must be achieved; the combined standard and target date is referred to as the Air Quality Objective (AQO) for that pollutant.

Part IV of The Environment Act 1995 (the Act) details the local authority’s role in delivering Directive 2008/50/EC. The Act requires that authorities periodically review air quality to determine compliance with AQOs and that where these Objectives are deemed to be likely to be exceeded they must, by Order, designate an Air Quality Management Area (AQMA). Having declared an Order the relevant authority must publish an Air Quality Action Plan (AQAP) which should demonstrate what the authority is intending to do to work towards achieving the AQO. The Secretary of State has powers within the Act to give directions to Local Authorities (LAs) for the implementation of these Directives.

The AQOs for pollutants included within the Air Quality Strategy are presented in Table 1.

The Table shows the AQOs in units of micrograms per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 1: Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.2. Previous Air Quality Assessments in South Derbyshire

Air quality assessments have been undertaken in South Derbyshire since the requirement was first introduced following the enactment of the Environment Act 1995. The dates and outcomes of all previous assessments are summarised in Table 2 below.

Table 2; Previous Air Quality Assessments in South Derbyshire

Date	Title	Outcome
2003	Updating And Screening Assessment	None required
2004	Progress Report	None required
2005	Progress Report	DRMB Predictions for following year showed compliance with 2005 objective, therefore no action required.
2006	Updating And Screening Assessment	None required
2007	Progress Report	None required
2008	Progress Report	Marginal exceedence in Overseal, site to be monitored closely, if repeated in 2009 USA then detailed assessment to follow.
2009	Updating and Screening Assessment	Marginal exceedence repeated in 2009. Detailed Assessment required.
2010	Detailed Assessment	Detailed Assessment indicated compliance. Commitment to continue with enhanced monitoring in Overseal which demonstrated compliance
2010	Progress Report	None required
2011	Progress Report	None required
2012	Updating and Screening assessment	Screening Assessment identified potential risk of elevated NO_2 concentrations on High Street, Repton

1.3. Requirements for a Detailed Assessment Report

South Derbyshire District Council's Updating and Screening Report of air quality submitted to DEFRA in 2012 concluded that;

"A review of the most recent traffic data has identified a small potential risk that canyon conditions on High Street Repton may restrict the dispersion of traffic emissions to the possible detriment of the air quality in this single street."

Historically, monitoring data obtained by SDDC has always demonstrated that all air quality objectives are being met. However, the screening assessment in 2012 identified that based on guidance in Local Air Quality Management Technical Guidance TG(09) (LAQM TG(09)) there was a possible risk that the annual mean Objective for nitrogen dioxide was being exceeded because;

i. Traffic flows along Main Street Repton are greater than 5,000 as an annual average daily traffic flow (AADT), and;

ii. Main Street is characterised by slow moving traffic which frequently stops and starts, and;

iii. The street has buildings on either side of the road and residential buildings within 2 metres of the kerb.

In response to this evidence, SDDC commenced air quality monitoring along the High Street. This consisted of monitoring air quality at three different locations using diffusion tube samplers. These were fully commissioned in October 2012.

The aim of this Detailed Assessment is to determine, with reasonable certainty, whether or not there is a likelihood of the AQOs not being achieved at 'relevant' receptor locations along Main Street, Repton.

Where a likely exceedence of the objectives is identified, SDDC are required to determine the magnitude and geographical extent of the exceedence in accordance with the relevant provisions of the Environment Act and statutory guidance.

2. Assessment Methodology

The statutory guidance for undertaking air quality assessments is contained in Local Air Quality Management Technical Guidance TG(09). This assessment takes into account the guidance contained in TG(09) in seeking to determine with reasonable certainty whether any AQOs are being exceeded in Repton and the potential extents of any exceedences.

The assessment consists of two stages. Firstly, available air quality monitoring data in the defined study area of the High Street corridor through Repton is analysed. This data is then utilised in a verified air quality screening model (DMRB) in order to predict air quality exposures at locations considered to be representative of key human receptors.

The results of the assessment and any uncertainties inherent in the assessment are then used to make conclusions about air quality in Repton.

3. Study Area Description

Repton is a large village (population circa 2,700) located 4.5 miles north of Swadlincote, 4.5 north-east of Burton upon Trent and 1 mile south of the River Trent. The village is of significant historic interest being the capital of the ancient Kingdom of Mercia. It is the location of Repton School and it is a designated conservation area.

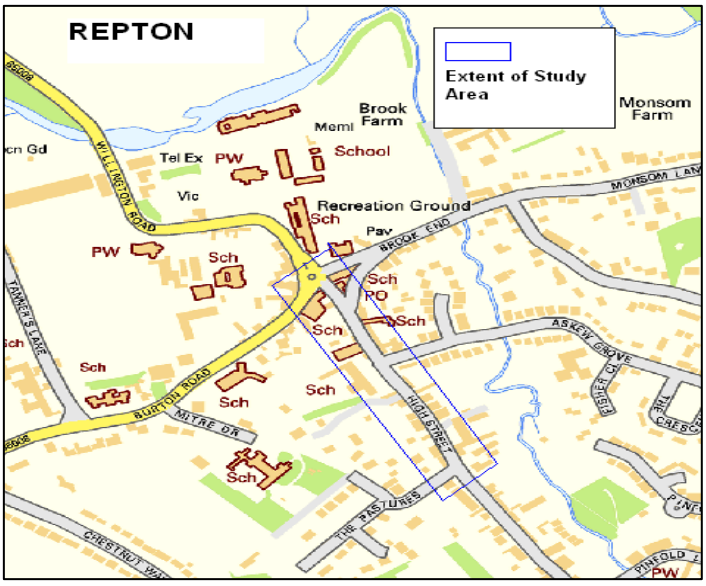
High Street (the C29) is the main arterial route through the village and according to most recent traffic data carries approximately an estimated 6,200 traffic movements a day.

High Street itself is a relatively narrow single carriageway route, with notable historical properties either side of the carriageway and relatively narrow clearance between kerbside and property frontages. There is on street parking along much of the eastern carriageway which results in single direction traffic movement when more than about 50% of the on street parking provision is occupied. At times of high traffic movement this can result in standing traffic particularly in pinch points just south of the roundabout of High Street / Burton Road / Brook End. As a consequence of the road layout, most of the traffic movement is along the western side of the carriageway.

The traffic through the village consists almost entirely of car and small commercial vehicles. The road carries limited numbers of HGVs and most recent traffic data supplied by Derbyshire County Council indicates that the HGV component of the road is only 1.1% - well below the average HGV composition of the national fleet. There are no inclines, traffic lights or traffic calming measures (other than the on road parking) likely to inhibit smooth traffic flow.

The extent of the study area is shown in Figure 1.

Figure 1: Illustration of the Air Quality Assessment Study Area



4. Nature and Sources of Nitrogen Dioxide

Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen. Together they are collectively referred to as NO_X. All combustion processes produce NO_X emissions, largely in the form of nitrogen oxide (NO) which then reacts with other atmospheric gases to form NO_2.

The principal source of NO_X emissions is road transport. Motorways which carry large volumes of high speed traffic are a predominant source, as are roads in congested city centres where there are large volumes of slow moving traffic combined with poor natural dispersion.

The contribution of road transport to NO_X emissions has declined significantly in the last 20 or so years due to the introduction of tighter vehicle emission standards. However predicted reductions in ambient NO_2 levels have not been realised in very recent years. Despite a continued reduction in NO_X emissions there has been growing concern in recent years about levels of primary NO_2 emissions from vehicles. Recent research indicates that these are greater than previously recognised and may have increased in some areas as a result of retrofitting particulate emission control equipment to some vehicles.

Other significant sources of NO_X emissions include the electricity supply industry and the commercial sector. Emissions from both these sectors have also been dramatically reduced in recent years due to the introduction of low NO_X burners and the widespread replacement of solid fuel boiler plant with natural gas.

The majority of the nearly 300 AQMAs which have already been declared in the UK are based on exceedences of the annual average nitrogen dioxide objective due to traffic emissions.

Local Air Quality Management Technical Guidance TG(09) paragraph 2.31 states that:

"Previous research carried out on behalf of DEFRA and the devolved administrations identified a relationship between the annual mean and the 1-hour mean objective, such that exceedences of the latter were considered unlikely where the annual mean was below 60 µg/m^3."

Therefore, for the purposes of this assessment, the 1 hour mean objective for nitrogen dioxide is assumed to be met at receptor locations where the annual mean is determined to be less than 60 µg/m^3.

5. Recent Air Quality Monitoring Data

This section contains a summary of the most recently available air quality monitoring data capable of supporting this assessment.

5.1 Continuous Air Quality Monitoring Data in Repton

There has been no continuous air quality monitoring in Repton. Prior to the USA in 2012 there had been no evidence that there was any significant risk of exceedences of the AQO in Repton. Continuous monitoring is very expensive (both in terms of capital and running costs) and there was no case to support such monitoring.

5.2. Diffusion Tube Air Quality Monitoring Data in Repton

Air quality monitoring has been undertaken by SDDC in Repton since October 2012 using palmes type diffusion tubes. These are small (10cm) long tubes which are exposed at one end to allow in the ambient air and which have an absorbent at the other end which absorbs the target pollutant gas. The tubes are exposed for a period of approximately a month after which the quantity of absorbed pollutant is determined from lab testing. This provides an average concentration of the pollutant gas over the exposure period.

Monitoring of NO_2 concentrations using passive diffusion tubes is widely used throughout the UK. LAQM.TG(09) acknowledges that provided care is taken with the storage, handling and analysis of the tubes and an appropriate 'bias-adjustment' factor is applied, the overall uncertainty of the annual mean results from diffusion tubes is expected to be within +/-20%.

The nitrogen dioxide diffusion tubes used in South Derbyshire are supplied and analysed by Lambeth Scientifics. The preparation method used for the diffusion tubes is 50% TEA (Triethanolamine) in Acetone.

The Workplace Analysis Scheme for Proficiency (WASP) laboratory survey tests the proficiency of laboratories undertaking analysis of chemical pollutants in workplace and ambient air. The most recently published proficiency testing results (rounds 113-120) covering the period April 2011 to March 2013 are summarised in Appendix A.

There are three diffusion tube sampling locations in Repton.

Location reference SDDC 12 is located on a lamppost immediately outside 32 High Street (see plate 1 in Appendix B). The monitoring location is on the western side of the carriageway 3.3metres from the kerb.

Location reference SDDC 13 is located on a lamppost between 35 and 37 High Street on the eastern side of the carriageway and 2.5 metres from the kerb.

Location reference SDDC 14 is located on a road traffic sign at kerbside in front of 6 High Street. It is on the western side of the carriageway 0.3m from the kerb.

SDDC12 and SDDC13 are both approximately the same distance from the source of pollution (i.e. traffic) as the nearby residential houses. These monitoring locations are therefore deemed to be giving results that represent the actual exposure of residents on High Street to traffic emissions. SDDC14 is right on the kerb of the road

and does not therefore give results that represent the actual exposure of residents on High Street to traffic emissions.

The three diffusion tube monitoring locations are illustrated in Figure 2.

Figure 2: Diffusion Tube Monitoring Locations in Repton

Diffusion tube results from October 2012 to September 2013 were available for the purposes of this Assessment. The raw results from the three monitoring locations are summarised in Table 3 below.

Table 3: Diffusion Tube Monitoring Results in Repton

Tube Location	Tube Reference	OS Reference	Site Description	Raw Average NO_2 ($\mu g/m^3$) Oct 2012-Sept 2013
32 High Street, Repton	SDDC12	430416 326948	Roadside. Representative of receptor exposure	35.1
35-37 High Street, Repton	SDDC13	430507 326785	Roadside. Representative of receptor exposure	33.3
6 High Street, Repton	SDDC14	430416 326948	Kerbside. NOT representative of receptor exposure	52.8

Where a full calendar year of air quality monitoring data is not available, Box 3.2 of TG(09) presents a means of deriving annual mean data from shorter term air quality studies. The purpose of making an adjustment for monitoring periods of less than a year is because there are recognised seasonal trends in air quality which need to be accounted for in short term studies. In this case, as we have been able to obtain a full 12 months of monitoring data (all be it not a full single calendar year – i.e. January to January), no seasonal adjustment calculation has been applied.

Bias Correction

Bias correction is a process whereby the results from diffusion tube studies are compared against continuous (usually chemilluminescence) analysers located at an identical monitoring position. Paragraphs 3.24 to 3.30 and Box 3.3 of TG(09) explain how bias correction factors should be derived locally or from a national database.

In order to derive a local bias correction factor it is necessary to operate duplicate, or ideally triplicate, diffusion tubes co-located at a continuous monitor. This enables the coefficient of variation to be calculated to determine if the results from the tubes are deemed to be of 'good' or 'poor' precision.

In this instance there has been no collocation of a diffusion tube with a continuous analyser and therefore based on the TG(09) recommendations a nationally derived bias correction factor has been used.

The national factor is based on a national data base of co-location studies co-ordinated on behalf of DEFRA. The national bias correction factors for 2000 - 2012 for Lambeth Scientifics 50% TEA is summarised in Table 4 below.

Table 4: Lambeth Scientifics 50% TEA Bias Correction Factor 2000 – 2012

Year	Number of Co-location Studies	Adjustment Factor
2000	3	0.97
2001	4	1.09
2002	8	1.15
2003	2	1.05
2004	5	1.19
2005	13	1.24
2006	10	1.28
2007	13	1.07
2008	10	0.98
2009	5	1.02
2010	4	1.06
2011	6	1.06
2012	3	0.87
Average		**1.08**

For the diffusion tube data collected in the monitoring period of October 2012 to September 2013, the average of the Lambeth Scientifics national bias correction factors 2000-12 of 1.08 has been applied.

Following the application of the bias correction factors, the Repton diffusion tube data is summarised in Table 5.

Table 5: Repton Diffusion Tube Results following Seasonal Correction and Bias Adjustment

Monitoring Location	Monitored Average (µg/m3)	Seasonal Adjustment	Bias Correction	Corrected Annual Average (µg/m3)
SDDC12	35.1	1.0	1.08	37.9
SDDC13	33.3	1.0	1.08	35.9
SDDC14	52.8	1.0	1.08	57.0

5.3. Commentary on Results

The annual average diffusion tube monitoring results indicate that the AQO is being exceeded at SDDC14, but that at SDDC13 and SDDC12 the exposure is marginally below the annual average AQO.

The monthly results from each of the monitoring locations are illustrated in Figure 3 below. The graph shows relatively low NO_2 levels at all three monitoring locations in the period December 2012 - February 2013, with relatively high exposure in March and April 2013, followed by fairly consistently low levels from May to September 2013.

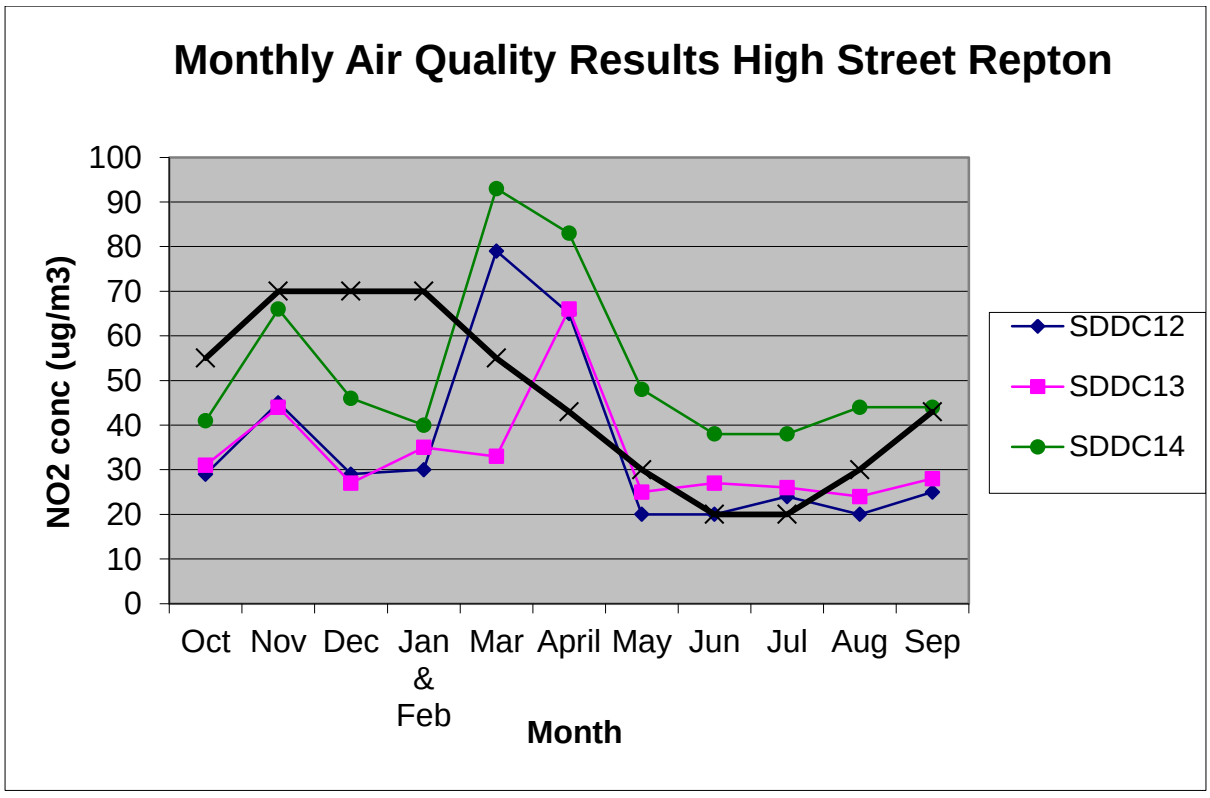
This pattern is not typical of 'normal' trends in air quality over a calendar year. Typically, NO_2 levels are relatively low during the summer months and relatively high during the winter months. A line has been included as the black plot on Figure 3 as an illustration of this typical trend.

Based on local knowledge, the atypical trends in the monitoring results may be accounted for by recent development works in Repton, and in particular at Repton School on Willington Road approximately 250m north of the study area and at Brook End.

Both developments led to traffic restrictions on High Street and abnormal amounts of queuing and static traffic. This may have resulted in abnormally high traffic emissions in the village.

The high NO_2 results in March and April have the effect of significantly increasing the annual average results over the monitoring period. If conditions along High Street in March – April 2013 were not typical, then the dataset used for this assessment may be over estimating air pollution levels in Repton. The implications of this are commented on in the Conclusions and Recommendations sections below.

Figure 3: Comparison of the monthly average results from the three monitoring locations in Repton



6. Assessment of Exposure

An assessment of the predicted exposure of human receptors to nitrogen dioxide has been undertaken using the Design Manual for Roads and Bridges (DMRB) air quality screening model. This model is a Department for Transport approved tool for assessing the environmental impact of new roads. The model has been approved by DEFRA for use as a screening assessment tool for air quality.

The key inputs to the model are summarised in the following sections.

6.1. Receptors

Locations considered as being 'relevant receptors' to exposure to outdoor air quality are defined based on the likely presence of a human at that location for the averaging period of the AQO. For the averaging period see column 3 of Table 1.

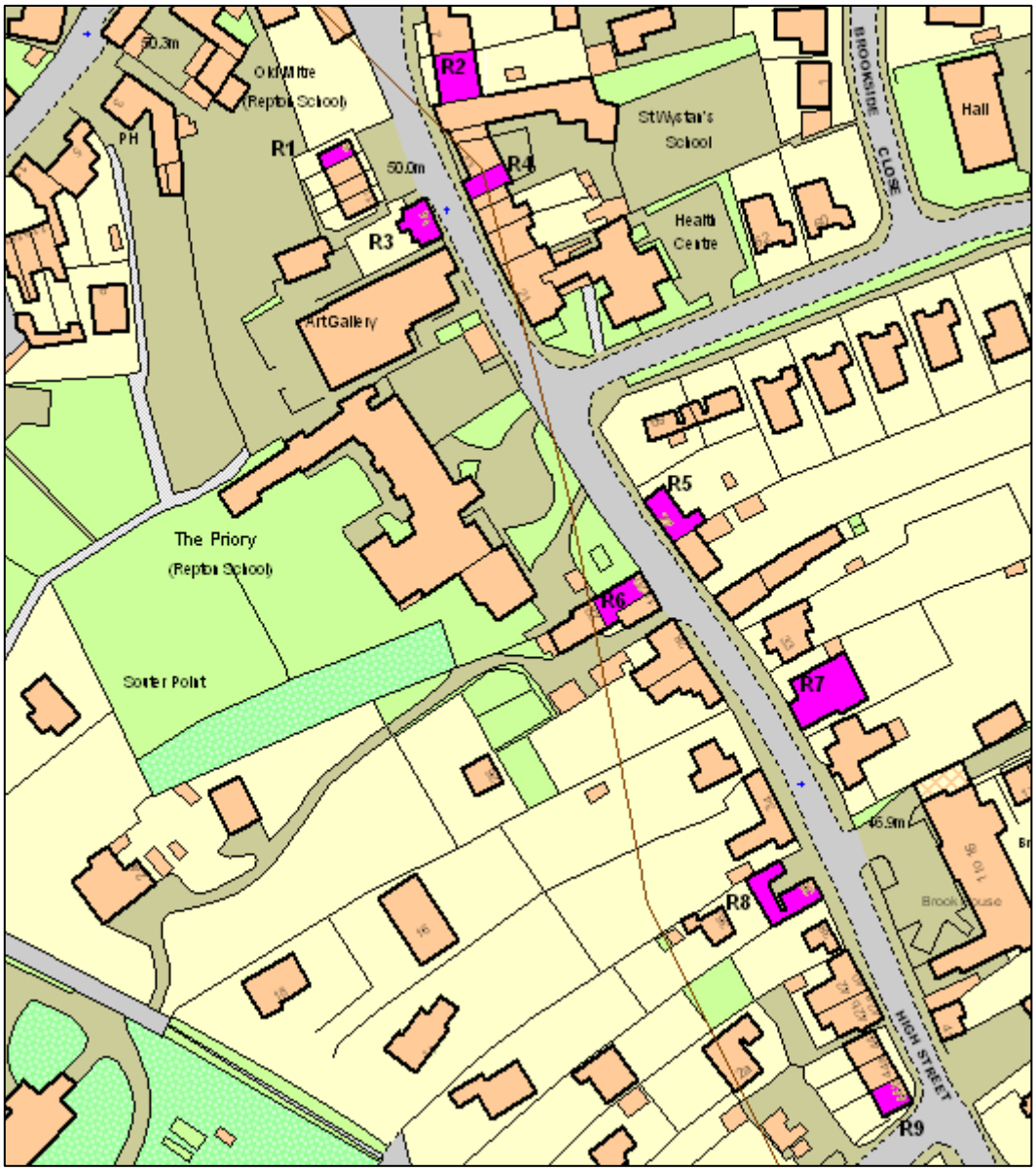
Locations likely to be considered as ‘relevant receptors’ are best defined in Table 1 of the Environmental Protection UK publication ‘Planning for Air Quality' which defines them as “building facades of residential properties, schools, hospitals, care homes”

In the context of Repton, the receptor locations identified in Table 6 have been chosen as representative of receptors in the village. All of these locations are understood to be residential properties other than where stated. The exact OS reference refers to a point on the facade of each property facing the High Street. Figure 4 illustrates the position of each of these receptor locations.

Table 6: Receptor Locations

Ref	Address	OS Reference (easting:northing)	
R1	6 High Street, Repton	430407	326941
R2	9 High Street, Repton	430426	326958
R3	14 High Street, Repton	430425	326920
R4	15 High Street, Repton (School)	430433	326932
R5	27 High Street, Repton	430474	326859
R6	20 High Street, Repton	430472	326846
R7	36 High Street, Repton	430509	326780
R8	35 High Street, Repton	430504	326818
R9	44b High Street, Repton	430529	326734

Figure 4 – Receptor Locations Used for the Purposes of This Air Quality Assessment



6.2. Traffic Data

Traffic data for inclusion in the screening model has been obtained from Derbyshire County Council. Where no count data is available (for example, for small side streets) this has been estimated from observations made of flows within the study area.

Based on site observations, the speed of traffic along High Street is not uniform. Traffic speed is a major determinant of vehicle emissions and therefore differences in average traffic speed will result in different emissions rates from the same volumes of traffic along different sections of the road. As part of the model verification process (see Section 6.4 below) the traffic speeds have been adjusted to achieve the best correlation between the diffusion tube monitoring results and the

model calculations. The traffic data used in the verified model is summarised in Appendix C.

6.3. Background Air Quality Data

The use of background concentrations within the modelling process ensures that pollutant sources other than traffic are represented appropriately. Background sources of pollutants include industrial and domestic emissions within the vicinity of the study site.

Background concentrations as used within the prediction calculations were referenced from the UK National Air Quality Information Archive database based on the National Grid Co-ordinates of 1 x 1 km grid squares nearest to the development site. The data used as representative background concentrations are summarised in Table 7 below.

The predicted background concentrations in the Archive decrease year on year based on the predicted progressive positive influence of EU and UK air quality legislation. However, guidance published on the DEFRA online Air Quality Review and Assessment Helpdesk in September 2010 states in relation to very recent trends that "there is little evidence of a consistent downward trend in either NO_X or NO_2 concentrations, that would be suggested by emission inventory estimates."

The assessment has therefore assumed that there will be no improvement in background air quality after 2010. As such, 2010 concentrations have been used throughout the assessment to represent background air quality in 2012/13.

Table 7 - Background Air Quality Data

OS Reference		2010 Background Concentrations (µg/m^3)	
Easting	Northing	NO_2	NO_X
430500	326500	16.6	24.5

6.4. Model Verification

Model verification involves the comparison of modelled data to monitored data in order to gain the best possible representation of current pollutant concentrations for the assessment year. The verification process used in this assessment is in general accordance with that contained in Annex 3 of TG (09) and uses the most recently available monitoring data from 2012-13 to best represent this.

The verification process consists of using the monitoring data and the published background air quality data in the UK National Air Quality Information Archive to calculate the road traffic contribution of nitrogen oxides (NO_X) at the monitoring locations.

Outputs from the DMRB model are provided as predicted road traffic contribution NO_X emissions. These are converted into predicted road traffic contribution NO_2 exposure at the relevant receptor locations based on the updated approach to deriving NO_2 from NO_X for road traffic sources published in paragraphs 2.22 to 2.27 of Local Air Quality Management TG(09). The calculation was derived using the most recent (Sept 2012) NO_X to NO_2 worksheet in the online LAQM tools website hosted by DEFRA.

Based on these results an overall adjustment factor is calculated which produces a best fit correlation between the model predictions and monitoring results. This approach ensures that the model provides the best possible representation of local traffic emissions.

Taking the results from all three monitoring locations, a primary model correction of **16.09** was applied to traffic derived NO_X concentrations before converting to NO_2. This figure demonstrates that the DMRB model was significantly under predicting the road traffic emissions at the monitoring locations.

Following primary adjustment of the traffic derived NOx a further comparison was made of the correlation between the modelled traffic derived NO_2 and the predicted road traffic contribution to the monitored NO_2 results. The correlation was found to be acceptable and so there was no secondary model correction required.

The verification factor calculations are summarised in Table 8 below.

Table 8: DMRB Model Verification Calculations

Monitoring Location	Monitored NO_2 ($\mu g/m^3$)	Background NO_X ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Modelled NO_X ($\mu g/m^3$)	Monitored NO_X ($\mu g/m^3$)	Primary Correction
SDDC12	37.9	24.9	16.6	3.70	46.6	16.09
SDDC13	35.9	24.9	16.6	3.70	41.7	16.09
SDDC14	57.0	24.9	16.6	4.80	100.9	16.09

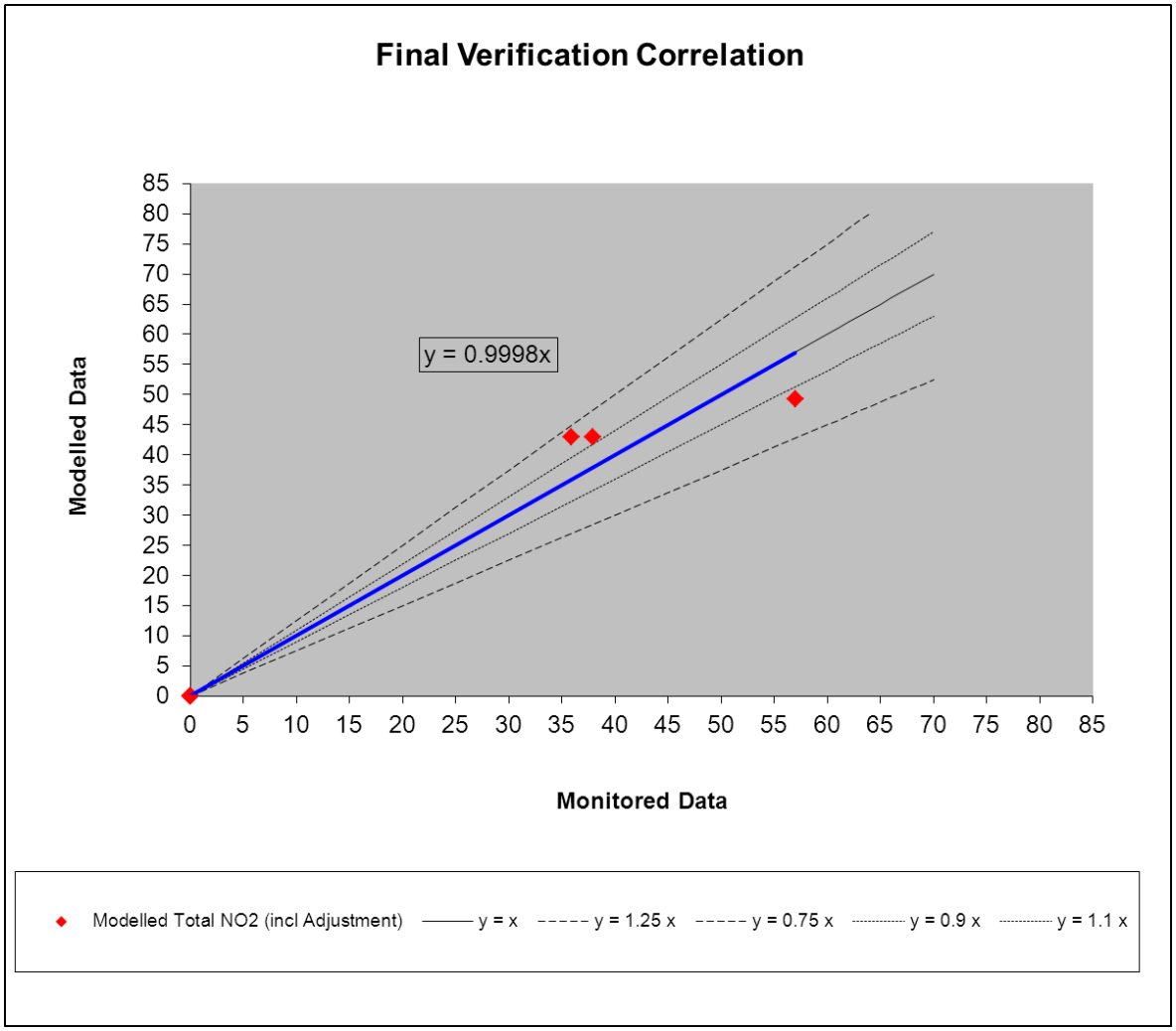
The primary correction was applied to the modelled traffic NO_X emissions which were then used with background NO_X and NO_2 levels in the NO_X to NO_2 worksheet to calculate the modelled total NO_2 exposure at the monitoring locations.

The final model verification correlations are summarised in Table 9 and Figure 5.

Table 9: Model Correlation

Monitoring Location	Monitored NO_2	Modelled Road Contribution NO_2	Modelled Total NO_2	Difference (Modelled - Monitored)	Difference (%)
SDDC12	37.9	26.3	42.9	5.0	-13.2%
SDDC13	35.9	26.3	42.9	7.0	-19.5%
SDDC14	57.0	32.7	49.3	-7.7	13.6%

Figure 5: Model Correlation



The final model was unable to produce data at the monitoring locations to within 10% of all of the monitoring results as recommended in TG(09). The model was therefore not considered to be adequately verified.

A further verification exercise was undertaken by removing the kerbside monitoring location SDDC14 from the data set.

This resulted in substantial reduction in the primary correction factor to **11.93**.

The resulting verification calculations are summarised in Tables 10 and 11 below and the final verification correlation without SDDC14 is illustrated in Figure 6.

Table 10: DMRB Model Verification Calculations without SDDC14

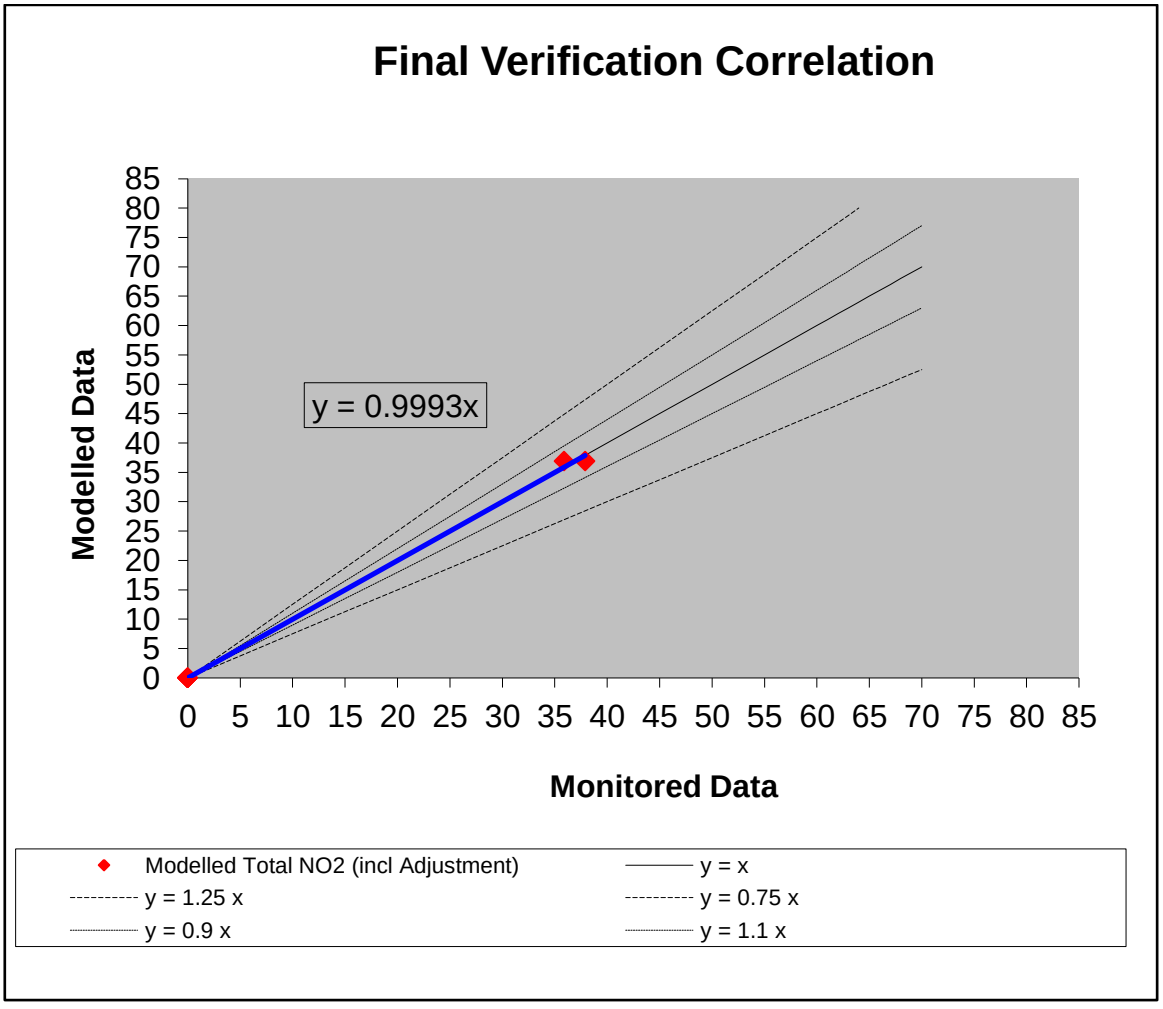
Monitoring Location	Monitored NO_2 ($\mu g/m^3$)	Background NO_X ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Modelled NO_X ($\mu g/m^3$)	Monitored NO_X ($\mu g/m^3$)	Primary Correction

SDDC12	37.9	24.9	16.6	3.70	46.6	11.93
SDDC13	35.9	24.9	16.6	3.70	41.7	11.93

Table 11: Model Correlation without SDDC14

Monitoring Location	Monitored NO_2	Modelled Road Contribution NO_2	Modelled Total NO_2	Difference (Monitored - Modelled)	Difference (%)
SDDC12	37.9	20.3	36.9	1.0	2.6%
SDDC13	35.9	20.3	36.9	-1.0	-2.8%

Figure 6: Model Correlation without SDDC14



The correlation between the monitoring results and the model results with SDDC14 excluded were within 10% and therefore the model was deemed to be appropriately representative of local air quality during the monitoring period.

6.5. DMRB Assessment Results

In order to obtain predicted air quality levels at the relevant receptor locations the following sequential calculations were undertaken;

1. Relevant parameters were entered into the DMRB screening spread sheet to determine the predicted road contribution NOx at each receptor location. The parameters are summarised in Appendix C.
2. The modelled road contribution NOx was adjusted using the primary correction factor.
3. The modelled road contribution NO_2 was calculated using DEFRAs NOx to NO_2 spread sheet.
4. The secondary adjusted modelled road contribution NO_2 was added to the background NO_2 to provide a final prediction of the annual average air quality at each receptor.

Table 12 presents a summary of the predicted annual average nitrogen dioxide concentrations at relevant receptor locations in the assessment year of 2013. Exceedences of the AQO are highlighted.

Table 12: Predicted Annual Average Nitrogen Dioxide Exposure at Relevant Receptor Locations

Receptor ref	Address	Background NO_2	Road Traffic NO_2	Total NO_2 Exposure
R1	6 High Street, Repton	16.6	21.4	38.0
R2	9 High Street, Repton	16.6	23.6	**40.2**
R3	14 High Street, Repton	16.6	24.7	**41.3**
R4	15 High Street, Repton	16.6	24.5	**41.1**
R5	27 High Street, Repton	16.6	21.8	38.4
R6	20 High Street, Repton	16.6	22.0	38.6
R7	36 High Street, Repton	16.6	20.4	37.0
R8	35 High Street, Repton	16.6	20.1	36.7
R9	44b High Street, Repton	16.6	23.5	**40.1**

Based on the DMRB model calculations, four of the selected nine properties on High Street Repton are predicted to be exposed to NO_2 levels marginally above the AQO.

None of the receptor locations are predicated to be exposed to annual average levels above 60 µg/m^3 and therefore we can be confident that the 1 hour AQO for NO_2 is not being exceeded.

6.6. Assessment Uncertainty

It is important to understand the uncertainties associated with these assessment results. The uncertainties are summarised below along with proposed methods for addressing these uncertainties;

1. The monthly trends in the monitoring data on which the assessment is based are atypical and this may be explained by some local factors which influenced traffic flows and therefore air quality during the monitoring period (see section 5.3). If it is the case that monitoring results were abnormally high during the monitoring period then the outcomes of the assessment will be overly pessimistic. A continuation in the monitoring for a further calendar year will clarify if air quality results in the spring of 2013 were representative or not.

2. The DMRB model is a useful screening tool but it tends to underestimate the reduction in the drop-off in NO_2 concentrations by distance from traffic emissions sources. If the further monitoring demonstrates that the air quality monitoring results obtained to date are representative, then modelling using more sensitive air quality dispersion models would be advisable.

3. LAQM paragraph 3.19 states that the overall uncertainty of the annual mean results from a palmes type diffusion tube is +/- 20% having followed all appropriate quality controls and application of bias adjustment factors.

7. Conclusions

Air quality monitoring at three locations on High Street in Repton have identified that annual average NO_2 levels within the village are above the Air Quality Objective of 40µg/m^3 at a kerbside monitoring location and marginally below the Objective at locations a few metres from the kerb.

The monthly trends in the monitoring results are not typical of the results that would normally be expected in these locations. It is suspected that local development activity resulted in changes in traffic flows, particularly in the spring of 2013, which may have increased the monitoring results well above the norm.

Screening model predictions of the annual average exposure at relevant receptor locations (namely the façade of residential properties closest to the kerb of High Street) conclude that some receptors on High Street are above the AQO. The highest predicted exposure is at 14 High Street, Repton where the annual exposure is predicted to be 41.3µg/m^3.

8. Recommendations

Section 83(1) of the Environment Act 1995 states that;

"Where, as a result of an air quality review, it appears that any air quality standards or objectives are not being achieved…. the local authority shall by order designate as an air quality management area (in this Part referred to as a "designated area") any part of its area in which it appears that those standards or objectives are not being achieved, or are not likely to be achieved within the relevant period"

Section 84 of the Environment Act 1995 states that;

(1) Where an order under section 83 above comes into operation, the local authority which made the order shall, for the purpose of supplementing such information as it has in relation to the designated area in question, cause an assessment to be made of—

(a) the quality for the time being, and the likely future quality within the relevant period, of air within the designated area to which the order relates; and

(b) the respects (if any) in which it appears that air quality standards or objectives are not being achieved, or are not likely within the relevant period to be achieved, within that designated area.

(2) A local authority which is required by subsection (1) above to cause an assessment to be made shall also be under a duty—

(a) to prepare, before the expiration of the period of twelve months beginning with the coming into operation of the order mentioned in that subsection, a report of the results of that assessment; and

(b) to prepare, in accordance with the following provisions of this Part, a written plan (in this Part referred to as an "action plan") for the exercise by the authority, in pursuit of the achievement of air quality standards and objectives in the designated area, of any powers exercisable by the authority.

The test of the need to declare an Air Quality Management Area in the statutory guidance is whether there is 'reasonable certainty' that an AQO is being exceeded.

Given the uncertainty about the monitoring results in spring 2013 it is not considered that it is reasonably certain that the AQO is being exceeded in Repton.

Based on the statutory requirements, the following recommendations are therefore made;

1. That a year of further monitoring of NO_2 be undertaken on High Street, Repton using diffusion tubes to improve the quantity of the air quality data within the study area. The number of monitoring points will be increased to monitor as near as practicable to the façade of receptors R2, R3, R4 and R9.
2. If additional monitoring indicates that the annual average NO_2 levels are more than 36 μgm^3, that a revised Detailed Assessment be undertaken using computational atmospheric dispersion modelling to provide more certainty about the spatial distribution of traffic emissions and to define the spatial extents and magnitude of any AQO exceedences. We have chosen 36 μgm^3

to allow for a possible 20% uncertainty in the assessment predictions given the factors outlined in section 6.6.

Appendix A - WASP Interauthority Lab Performance

Table 1: Laboratory summary performance for WASP NO_2 PT rounds 113 - 120

The following table lists those UK laboratories undertaking LAQM activities that have participated in recent HSL WASP NO_2 PT rounds and the percentage (%) of results submitted which were subsequently determined to be satisfactory based upon a z-score of $\leq \pm 2$ as defined above.

WASP Round	WASP R113	WASP R114	WASP R115	WASP R116	WASP R117	WASP R118	WASP R119	WASP R120
Round conducted in the period	April - June 2011	July - September 2011	October - December 2011	January – March 2012	April – June 2012	July – September 2012	October – December 2012	January – March 2013
Aberdeen Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Bristol City Council [4]	100 %	100 %	100 %	-	-	-	-	-
Cardiff Scientific Services	100 %	100 %	75 %	100 %	100 %	100 %	100 %	100 %
Edinburgh Scientific Services	100 %	100 %	0 %	100 %	100 %	100 %	100 %	100 %
Environmental Services Group, Didcot (formerly Bureau Veritas Laboratories, Glasgow and Harwell Scientifics) [1] [2]	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Exova (formerly Clyde Analytical)	100 %	0 %	75 %	0 %	0 %	100 %	25 %	75 %
Glasgow Scientific Services	100 %	100 %	100 %	100 %	50 %	100 %	100 %	50 %
Gradko International [2]	100 %	100 %	37.5 %	100 %	100 %	100 %	100 %	100 %
Kent Scientific Services	100 %	100 %	75 %	75 %	100 %	75 %	100 %	50 %
Kirklees MBC	0 %	0 %	50 %	100 %	100 %	75 %	100 %	100 %
Lambeth Scientific Services	25 %	100 %	25 %	75 %	100 %	0 %	100 %	100 %
Milton Keynes Council	75 %	100 %	100 %	100 %	100 %	75 %	100 %	50 %
Northampton Borough Council	100 %	100 %	100 %	100 %	100 %	100 %	100 %	0 %
Somerset Scientific Services [3]	-	-	100 %	100 %	100 %	100 %	100 %	100 %
South Yorkshire Air Quality Samplers	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Staffordshire County Council	100 %	100 %	100 %	100 %	100 %	75 %	100 %	50 %
Tayside Scientific Services (formerly Dundee CC)	100 %	100 %	100 %	100 %	100 %	100 %	100 %	75 %
West Yorkshire Analytical Services	75 %	100 %	100 %	75 %	75 %	50 %	100 %	100 %

[1] Bureau Veritas laboratory and Harwell Scientific now part of ESG Group.
[2] Participant subscribes to two sets of test samples (2 x 4 test samples) in each WASP PT round.
[3] New participant from R115.
[4] No longer involved in NO_2 diffusion tube measurements from R116.

Appendix B – Locations of Repton Diffusion Tube Monitoring Locations

Plate 1 – SDDC12,

Plate 2 – SDDC13

Plate 3 – SDDC14

Appendix C

Traffic Data used in DMRB Model

Link Ref	Description	AADT	Speed (kph)	Road type	% cars	% LGV	Total % Light	% Buses	% Rigid HGV	% Artics	total % HGV
1	High Street (north of 21 Main Street)	6142	15	C	88.9%	10%	98.9%	0.1%	0.5%	0.5%	1.1%
2	High Street (south of 21 Main Street)	6142	30	C	88.9%	10%	98.9%	0.1%	0.5%	0.5%	1.1%
3	Boot Hill	500	30	C	89%	10%	0%	0%	1%	0%	1%
4	Brookside Close	500	30	C	89%	10%	0%	0%	1%	0%	1%
5	The Pastures	700	30	C	89%	10%	0%	0%	1%	0%	1%

AADT = Annual average daily traffic flow
LGV = light goods vehicles
HGV = heavy goods vehicles

Additional Inputs into the DMRB Air Quality Assessment

Receptor ref	Address	Link Ref & Distance to Link Centre
R1	6 High Street, Repton	Link 1 – 13m Link 3 – 33m
R2	9 High Street, Repton	Link 1 – 9m Link 3 – 23m
R3	14 High Street, Repton	Link 1 – 3m Link 3 – 45m
R4	15 High Street, Repton (School)	Link 1 – 6m Link 3 – 45m
R5	27 High Street, Repton	Link 2 – 6m Link 4 – 34m
R6	20 High Street, Repton	Link 2 – 3m Link 4 – 45m
R7	36 High Street, Repton	Link 2 – 6m
R8	35 High Street, Repton	Link 2 – 7m
R9	44b High Street, Repton	Link 2 – 6m Link 5 – 6m

Appendix D – Reference Documents

The Air Quality Standards Regulations, 2010

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, 2007

The Environment Act, 1995

Local Air Quality Management Technical Guidance LAQM.TG(09), DEFRA, 2009

Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1, HA 207/07 - Air Quality, Highways Agency, 2007

Development Control: Planning for Air Quality, National Society for Clean Air and Environmental Protection, 2010