South Derbyshire District Council

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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.

Following the submission of the USA, air quality monitoring has been carried out along High Street Repton. A Detailed Assessment of air quality was published in October 2013 which used this monitoring data to undertake an air quality modelling assessment using the DMRB screening model assessment tool.

The results from the assessment indicated that concentrations of NO_2 may be above air quality objectives values at a small number of relevant receptor locations on High Street. However, the air quality monitoring data which underpinned the assessment methodology was the subject of some uncertainty.

The Detailed Assessment was submitted to DEFRA and it was agreed to complete a further full calendar year of air quality monitoring during 2014 in order to investigate this uncertainty further before the Council reaches a decision on the need to declare an Air Quality Management Area (AQMA).

Air quality monitoring has been undertaken at five roadside locations on High Street, Repton throughout 2014. The results of the monitoring confirm that all locations met the relevant Air Quality Objective and therefore we are confident that there is no requirement to declare an Air Quality Management Area.

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1. Introduction

South Derbyshire is one of eight district authorities within Derbyshire. As the name suggests, 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 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 μg/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 μg/m^3	Running annual mean	31.12.2003
	5.00 μg/m^3	Running annual mean	31.12.2010
1,3-Butadiene	2.25 μg/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 μg/m^3	Annual mean	31.12.2004
	0.25 μg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 μg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 μg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 μg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 μg/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 μg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 μg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 μg/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
2013	Repton Detailed Assessment	Potential breach of the annual average NO_2 AQO. Residual uncertainties about the monitoring data.
	Progress Report	None required
2014	Progress Report	None required
2015	Repton Detailed Assessment	This report

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."

The Detailed Assessment approved by the Councils' Environment and Development Services Committee in November 2013 recommended that;

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.

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 based on the two recommendations in the 2013 Detailed Assessment report.

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;
- Where there is a significant risk of the AQO being exceeded then the monitoring data is used to develop 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.

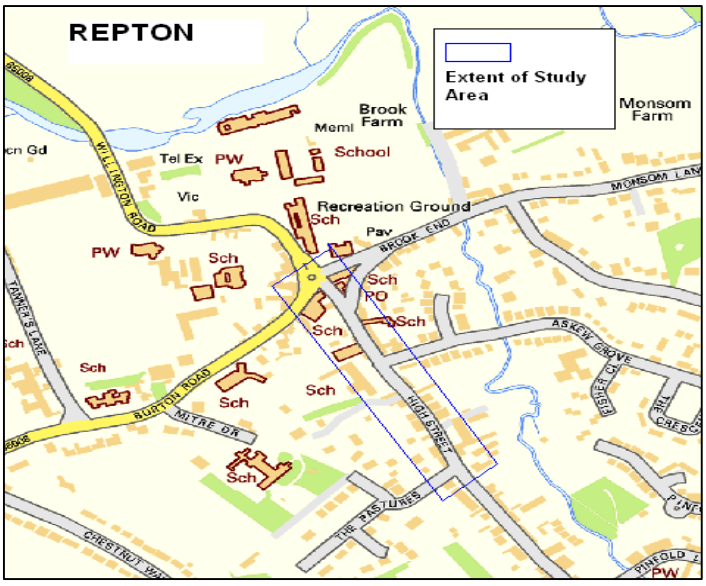
High Street (the C29) is the main arterial route through the village and according to most recent traffic data carries approximately an estimated 6,200 traffic movements a day.

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.

AIR PT Scheme (formerly the WASP & STACKS schemes) is an international scheme for laboratories involved in air quality analysis. The scheme combines HSL's WASP and LGC's STACKS schemes, providing proficiency testing that is specifically designed for laboratories performing chemical analysis of air monitoring samples.

The Scheme 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 five diffusion tube sampling locations in Repton.

Location reference SDDC 12 is located on a lamppost immediately outside 32 High Street. 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 opposite the junction with Askew Grove. It is on the western side of the carriageway 0.3m from the kerb.

SDDC 20 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.

SDDC 21 is located on a lamppost outside 46 High Street. It is on the western side of the carriageway 2.2m from the kerb.

SDDC12, SDDC13 and SDDC 21 are all 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 and SDDC 20 are both right on the kerb of the road and do not therefore give results that absolutely represent the actual exposure of residents on High Street to traffic emissions.

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

Figure 2: Diffusion Tube Monitoring Locations in Repton

Diffusion tube results for the full 2013 and 2014 calendar years were available for the purposes of this Assessment. The raw results from the five 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 (µg/m^3) 2013	Raw Average NO_2 (µg/m^3) 2014
32 High Street, Repton	SDDC12	430416 326948	Roadside. Representative of receptor exposure	36.1	23.9
35-37 High Street, Repton	SDDC13	430507 326785	Roadside. Representative of receptor exposure	32.6	23.0
6 High Street, Repton	SDDC14	430444 326889	Kerbside. NOT representative of receptor exposure	51.5	34.5
Opposite 9 High Street, Repton	SDDC20	430416 326948	Kerbside. NOT representative of receptor exposure	No data	34.8
46 High Street Repton	SDDC21	430537 326720	Roadside. Representative of receptor exposure	No data	26.5

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 2013 and 2014 for Lambeth Scientifics 50% TEA is summarised in Table 4 below.

Table 4: Lambeth Scientifics 50% TEA Bias Correction Factor 2013 – 2014

Year	Number of Co-location Studies	Adjustment Factor
2013	7	0.87
2014	7	0.87

The relevant bias correction factors for each calendar year have been applied to each of the raw annual average datasets for each monitoring location. Following the application of the bias correction factors, the Repton diffusion tube data is summarised in Table 5. Exceedences of the AQO are highlighted in shaded cells

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

Monitoring Location	2013			2014		
	Raw Annual Average (µg/m^3)	Bias Correction	Corrected Annual Average (µg/m^3)	Raw Annual Average (µg/m^3)	Bias Correction	Corrected Annual Average (µg/m^3)
SDDC12	36.1	0.87	31.4	23.9	0.87	20.8
SDDC13	32.6	0.87	28.4	23.0	0.87	20.0
SDDC14	51.5	0.87	44.8	34.5	0.87	30.0
SDDC20	-	0.87	-	34.8	0.87	30.3
SDDC21	-	0.87	-	26.5	0.87	23.1

5.3. Commentary on Results

The corrected annual average diffusion tube monitoring results in 2013 indicate that the AQO was exceeded at SDDC14, but that at SDDC13 and SDDC12 the exposure was less than 80% of the AQO.

The corrected annual average from all five of the monitoring locations in 2014 were all well below the AQO. Moreover they were also all below 36 µg/m^3 which, given the 20% uncertainty associated with diffusion tube studies provides a high degree of certainty that the AQO is being met.

As discussed in the November 2013 Detailed Assessment, the results during 2013 at all of the monitoring locations in operation at the time showed 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.

Based on local knowledge, the atypical trends in the monitoring results could have been accounted for by 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 2013 had the effect of significantly increasing the annual average results over the monitoring period.

6. Conclusions

Air quality monitoring at five locations on High Street in Repton have identified that annual average NO_2 levels within the village are below the Air Quality Objective of 40µg/m^3 at both kerbside and roadside monitoring locations.

The results of the air quality monitoring provide a high degree of certainty that air quality at receptors along High Street, Repton meet Air Quality Objectives.

The results demonstrate that there is no requirement to declare an Air Quality Management Order in Repton.

7. Recommendations

South Derbyshire District Council are recommended to continue monitoring air quality at three locations (SDDC12, SDDC 13 and SDDC 14) on High Street, Repton in order to establish continued compliance with the Air Quality Objectives.

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 – 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