LOCAL AIR QUALITY MANAGEMENT

THIRD STAGE - REVIEW AND ASSESSMENT

OF AIR QUALITY IN WEST WILTSHIRE

UNDER PART IV OF THE ENVIRONMENT ACT 1995

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West Wiltshire
DISTRICT COUNCIL

Contact:-

Kate Bishop
Environmental Protection
West Wiltshire District Council
Bradley Road
TROWBRIDGE
Wilts BA14 ORD

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EXECUTIVE SUMMARY

This is the final stage of West Wiltshire District Council's assessment of air quality. The findings of the report are as follows:-

1 Warminster Road, Westbury - is likely to exceed the Nitrogen Dioxide air quality objective.

2 An area around Masons Lane, Bradford on Avon - is likely to exceed the Nitrogen Dioxide and PM_{10} air quality objectives.

These problems will occur in situations when people are exposed in close proximity to major road networks.

Subject to consultation and further monitoring work it is recommended that West Wiltshire District Council declares air quality management areas.

The exact location of the designated areas is still to be determined and this will be carried out with the aid of computer modelling predictions.

1.0 Introduction

This is the Stage Three Review & Assessment Report for West Wiltshire District Council in compliance with the Environment Act 1995. It consists of technical information in relation to further modelling and monitoring assessments carried out following the conclusions of the Stage Two Review & Assessment Report published March 2000.

The Stage Two Review & Assessment Report was the result of a further screening process to identify which of the relevant specified national air quality strategy pollutants (laid down in the Air Quality (England) Regulations 2000) would be likely to be exceeded by the relevant objective date and at which locations these would occur. These locations and pollutants are the focus of this third stage report.

The main purpose of the review and assessment process is to enable local authorities to assess current and future air quality within their administrative districts in this specific “step by step” three staged approach. The objectives specified in the Air Quality (England) Regulations 2000 are the standards to which comparisons must be made. All local authorities were required to carry out the First Stage Review & Assessment and then proceed to further stages if necessary. If the results of the Third Stage Review & Assessment reveal that the air quality objectives are unlikely to be met by the specified year then the Authority is required to declare an air quality management area(AQMA) and provide an action plan to ultimately control the air quality within that area.

1.1 Recommendations from the Stage Two Review & Assessment Report

The Stage Two Review & Assessment Report indicated the possibility of exceedance of the air quality objective by the relevant objective date for the following pollutants:-

- PM_{10}, SO_2 and NO_2 in Warminster Road, Westbury.
- NO_2 and PM_{10} at Masons Lane, Bradford on Avon
- NO_2 at County Way, Trowbridge
- 1,3-Butadiene in Melksham

This report provides information on the results of the Stage Three Review & Assessment process for the above.

TABLE 1

Air Quality Objectives

Pollutant	Objective Concentration	Measured as	Due to be achieved by
Benzene	16.2µg/m^3 (5ppb)	Running annual mean	31 December 2003
1,3-Butadiene	2.25µg/m^3 (1ppb)	Running annual mean	31 December 2003
Carbon Monoxide	11.6mg/m^3 (10ppm)	Running 8 hour mean	31 December 2003
Lead	0.5µg/m^3 0.25µg/m^3	Annual mean Annual mean	31 December 2004 31 December 2008
Nitrogen Dioxide	200µg/m^3 (105ppb) not to be exceeded more than 18 times a year. 40µg/m^3 (21ppb)	24 hour mean Annual mean	31 December 2005 31 December 2005
PM_{10}	50µg/m^3 not to be exceeded more than 35 times a year. 40µg/m^3	24 hour mean Annual mean	31 December 2004 31 December 2004
Sulphur Dioxide	350 µg/m^3 (132 ppb) not to be exceeded more than 24 times a year. 125 µg/m^3 (47 ppb) not to be exceeded more than 3 times a year. 266 µg/m^3 (100 ppb) not to be exceeded more than 35 times a year.	1 hour mean 24 hour mean 15 minute mean	31 December 2004 31 December 2004 31 December 2005

2.0 Third Stage Review & Assessment Process

The Third Stage Review & Assessment has taken the form prescribed in the DETR Review & Assessment - Pollutant Specific Guidance (LAQM) TG4(00).

If the Third Stage Review & Assessment indicates that there is a risk that an air quality objective may not be met by the relevant future year, then the Authority will need to consider the declaration of an air quality management area.

2.1 Relevant Locations and Exposure

All work in relation to the assessment of air quality must be focussed on those locations where members of the public are likely to exposed over the averaging period for the pollutant objective. This should include locations where likely future developments may affect exposure to existing sources of air pollution or may result in new sources. Table 2 outlines the procedure to be followed.

TABLE 2

Public Exposure

Pollutant	Averaging Period	Focus of Review & Assessment	Example
Sulphur Dioxide Nitrogen Dioxide	15 minute 1 hour (short averaging periods)	Any non-occupational near ground level outdoor location where members of the public might reasonably be expected to be present over the relevant averaging period.	A playing field downwind of a point source (factory). Pavement of a busy shopping street.
Benzene 1,3-Butadiene Carbon Monoxide Lead Nitrogen Dioxide PM_{10}	Annual mean Annual mean 8 hour mean Annual mean Annual mean 24 hour mean (long averaging periods)	Non-occupational, near ground level outdoor locations, ie: background locations roadside locations where members of the public might reasonably be expected to be regularly exposed to outdoor air for a substantial part of the day.	In the vicinity of housing, schools, hospitals, etc.

Note: Exceedances of the objectives at any location where public exposure over the relevant averaging period would not be realistic should not be considered.

2.2 Methods used in this assessment

2.2.1 Models

West Wiltshire District Council commissioned CES to conduct Stage Three Air Quality Review & Assessment modelling based on the findings of the Stage 1 and 2 Review & Assessments. The pollutants to be modelled were nitrogen dioxide, sulphur dioxide and PM_{10}. The AAQuIRE 2000 regional air quality model was used to predict nitrogen dioxide and PM_{10} for road traffic and industrial sources and sulphur dioxide concentrations for industrial sources. In the base year (2000) and the relevant objective year (2004/2005). The AAQuIRE regional dispersion model, which was developed by CES and has been used throughout the world for the past 10 years, uses dispersion algorithms which have been independently and extensively validated.

The AAQuIRE 2000 software is a system to predict ambient air quality and regional environments and comprises a regional air quality model and statistical package. AAQuIRE was developed by consultants in Environmental Sciences Ltd (CES) to meet three requirements in predictive air quality studies.

The way in which AAQuIRE and the models currently available within it operate are discussed below:-

The operation of AAQuIRE can be divided into five main stages. These are:-

(a) Preparation of input data.

(b) Generation of model input files.

(c) Dispersion modelling.

(d) Statistical treatment of dispersion modelling results.

(e) Presentation of results.

The first step in operating AAQuIRE is to prepare the input data. Data are needed on meteorological data expressed as occurrence frequencies for specified combinations of wind speed, direction, stability and boundary layer height; road system layout and associated traffic data within an immediately surrounding study area; industrial stack locations and parameters; grid of model predication locations (receptors). These are needed for the year and pollutant to be modelled. The modelling is always carried out to give annual average results from which appropriate shorter periods of concentrations can be derived. Ten years of meteorological data from Lyneham was used for the West Wiltshire model.

The second stage is the generation of the model input files required for the study. All the data collected from the first stage can be inputted into AAQuIRE using the worksheets, drop down boxes and click boxes in the data manager section of the software. Several diurnal and seasonal profiles can be defined at each separate source. The relevant meteorological data can also be specified at this stage.

The third stage is executing the model. The study area will usually be divided up into manageable grids and run separately during the run manager in AAQuIRE. The results from the separate files can be combined at a later stage. Pollutant concentrations are determined for each receptor point for each meteorological category and are subsequently combined.

The fourth stage is statistical processing of the raw dispersion results to produce results in the relevant averaging periods. Traffic sources and industrial sources can be combined at this stage provided the same receptor grid has been used for both.

Background concentrations should also be incorporated at this stage.

The final stage is the presentation of results.

Currently the AAQuIRE uses the CALINE 4 model for the dispersion of road traffic emissions and AERMOD for all other sources. Both these models are fully validated and have been extensively used world-wide. These are relatively complex models designed for detailed studies of local areas, which are used within AAQuIRE for both local and larger scale studies. This is considered necessary because the frequent importance of local effects, such as traffic junctions, in properly assessing regional effects. The modelling uncertainty for AAQuIRE is approximately plus or minus 20% which is well within the recommendations in technical guidance note LAQM.TG3(00). The model was validated with monitoring data supplied by West Wiltshire District Council.

The model was run to cover the whole district incorporating roads where traffic data was available and industrial sources of significance. The model results have mainly been used to assess the effect of Blue Circle Cement, Trowbridge Road, Westbury, on air quality around Westbury. A problem with the model is that traffic data of an exceptional quality was not available from Wiltshire County Council, thus in assessing emissions in Bradford on Avon, Trowbridge and Westbury from traffic sources the model results are too general and do not take into account specific building heights around these towns. In assessing air quality from traffic in the towns of concern monitoring data has been used as this has provided us with more realistic assessments of air quality within these areas.

2.2.2 Monitoring

Two types of monitoring have been used in the Second Stage Review & Assessment process:-

- Real time analysis.
- Passive diffusion tubes.

2.2.2.1 Real Time Analysers

Four real time analysers have been bought by this Authority to monitor for PM_{10}, Sulphur Dioxide and Nitrogen Dioxide. Real time analysers are regarded as the most accurate of all pollutant monitoring methods but must be accompanied by a suitable Quality Assurance and Quality Control (QA/QC) System to take account of analyser drifts and to ensure that the results obtained can be traced back to a known gas standard. More is discussed on QA/QC later in this report.

All of the analysers are sited in a roadside enclosure at a roadside site in Warminster Road, Westbury, the site location as numbers on the plan in Appendix 1. The site was chosen because Warminster Road has historically been regarded as a heavily trafficked road taking a mix of light and heavy duty vehicles (LDV and HDV). Both commercial and residential properties are situated along Warminster Road, Westbury. It was felt that this site would be representative of the relevant locations and averaging periods for the various pollutants monitored and would take into account any influences on air quality in the town from specific industrial sites. The Osiris PM_{10} analyser was located in Masons Lane, Bradford on Avon.

2.2.2.1.1 Measurement for PM_{10}

To monitor for PM_{10} a BAM 1020 analyser was used. This automatically measures and records dust concentrations with built in data logging. The sampling head used on this equipment is specific to only allow particles less than 10 microns in size through to ensure that PM_{10} is accurately measured.

The analyser uses the principle of beta absorption to provide sample determination of mass concentration.

An energy source of beta particles produces repeatable measurement characteristics.

A glass fibre filter tape is used (30mm wide by 20 metres long) and allows for long periods of monitoring. A known amount of electron scattering and attenuation through a clean filter is compared with that of a dust sampled filter. The mass concentration is then calculated by the ratio of the number of detected beta particles passing through the filter and the sample volume.

2.2.2.1.2 Measurement of Sulphur Dioxide (SO_2)

To monitor for SO_2 an APi M100A SO_2 analyser is used. This instrument uses the process of fluorescence of SO_2 due to the absorption of UV energy to determine SO_2 concentration in the sample.

The SO_2 contained within the sample absorbs in the 190nm - 230nm region. The UV lamp within the analyser emits ultra violet radiation which passes through a 214nm filter. This excites the SO_2 molecules and as a result fluorescence is produced. The amount of fluorescence is measured by a photo multiplier tube (PMT) which has a secondary UV filter. The PMT transfers the light energy into an electrical signal which is directly proportional to the light energy in the sample stream being analysed. The fluorescent radiation that impinges upon the PMT is, therefore, directly proportional to the concentration of SO_2 in the sampled air.

2.2.2.1.3 Measurement of Oxides of Nitrogen (NO_x)

To monitor for NO_x an APi M200 analyser is used. This instrument measures the concentration of Nitric Oxide (NO) and total oxides of Nitrogen (NO_x) and then by calculation the NO_2 concentration is determined.

The instrument works on the principle of Chemiluminescence. Ambient air is pumped into a measurement cell and the amount of NO is measured by adding ozone (O_3) into the measurement cell. The NO is converted to NO_2 in an excited state which looses energy by emitting photo light. This is detected and the amount of light emitted is equivalent to the concentration of NO. Next the instrument measures the amount of NO_x by passing ambient air through a reduction catalyst converter. This has the effect of
reducing the NO_2 to NO. The NO is then reacted to NO_2 again and recorded. The NO_2 concentration in the air sample is calculated by taking the amount of recorded NO away from the amount of recorded NO_x.

2.2.2.1.4 Additional Measurements of PM_{10}

To monitor for PM_{10} in Bradford on Avon, a Turnkey Osiris monitor was used. The analyser was located at point 11 shown in Appendix 1.

This analyser uses a light scattering technique to determine the concentration of airborne particles and dust in the size range 0.4 microns to about 20 microns. The analyser was specifically set to measure particles less than 10 microns in size (PM_{10}).

The air sample is continuously drawn into the instrument by a pump at a flow rate of 600cc/min. The incoming dusty air passes through a laser beam in a photometer and then through a filter to remove the particles before reaching the pump.

The light scattered by the individual particles is converted into an electrical pulse which is proportional to the size of the particle. The sampling head is not heated and therefore, according to the "Review and Assessment: Monitoring Air Quality Guidance" (LAQM.TG1(00)) this will equate to a gravimetric assessment.

2.2.2.2 Passive Diffusion Tubes

Two types of passive diffusion tubes have been used as part of the assessment.

- Nitrogen Dioxide
- 1,3-Butadiene

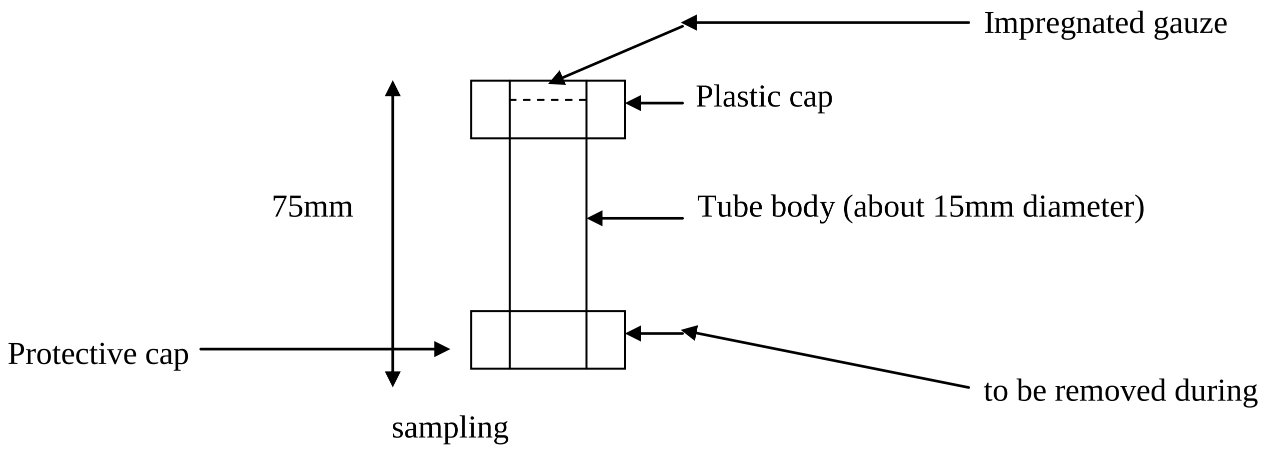
2.2.2.2.1 Nitrogen Dioxide

West Wiltshire District Council has 14 sites within the district to monitor for Nitrogen Dioxide using passive diffusion tubes.

A Nitrogen Dioxide passive diffusion tube is a clear plastic tube open at one end and at the closed end a mesh is impregnated with a pollutant absorbing chemical. The diffusion tube collects the pollutant during the exposure period and then is resealed and returned to a laboratory for analysis. Each tube is exposed for a month period. The laboratory then assesses the quantity of the pollutant absorbed by calculating the average ambient NO_2 concentration over the exposure period.

Each tube is mounted on a lamp-post or similar structure ensuring that the open end is at the bottom to prevent rain water collection.

Figure 1 NO_2 Diffusion Tube



Accuracy +/- 20%

2.2.2.2.2 1,3-Butadiene

A number of assessment locations were set up to measure 1,3-Butadiene by using passive diffusion tubes. The main difference between these tubes and NO_2 diffusion tubes is that they are made of metal. Additionally, the technique uses a molecular sieve 13 x as a method of ensuring 1,3-Butadiene is adsorbed on the tube.

After exposure the used diffusion tube is returned to the laboratory for analysis and the concentration of 1,3-Butadiene is determined, using either GC/FID or GC/MS.

2.3 More about the Real Time Analysers

2.3.1 Data Collection

Data is collected from the analysers via telemetry. The data is stored on a desk top computer at the West Wiltshire District Council Offices.

NO_x, NO and NO_2 data is collected as 1 hour averages
PM_{10} data is collected as 1 hour averages
SO_2 data is collected as 15 minute and 1 hour averages

By collecting data in this manner comparisons can be made with the air quality objectives.

2.3.2 Calibration gas Certification

Two calibration gases are used, SO_2 for the APi M100A and NO for the APi M200A. These gases are obtained from Messer UK in Reigate. All calibration gases are traceable to the national standard, where possible. In cases where no national standard exists, the gas concentration is made up gravimetrically and then analysed by a number of methods to cross check that the calculated concentration is the same as the measured concentration.

2.4 Quality Assurance/Quality Control (QA/QC)

To ensure that the information obtained from the analysers is as accurate as possible and to quantify any instrument drifts a stringent QA/QC protocol is followed.

2.4.1 Daily Automatic Calibrations

Both the APi M100A (SO2) and APi M200A (NO_x) are subjected to daily automatic calibration. This provides a daily check on the performance of each instrument. It should be noted that these results are not used for instrument scaling.

In the APi M100A analyser, zero air is generated by passing ambient air through a charcoal scrubber, before entering the reaction cell.

The span gas is generated by an SO_2 permeation tube which contains a quantity of pure liquid SO_2. The permeation tube is enclosed in an oven which is maintained at a constant temperature. The zero air is passed across the permeation tube at a constant flow rate. Provided the flow rate and temperature are kept constant, the amount of SO_2 permeating from the tube into the air stream will be constant.

The gas produced then passes into the reaction cell and a span calibration response is determined.

In the APi M200A, zero air is generated by passing ambient air through purafil charcoal scrubbers before it is passed into the reaction cell.

The span calibration response is achieved in a similar way to the APi M100A, except that the span gas is generated by an NO_2 permeation tube containing pure liquid NO_2.

2.4.2 Instrument Calibration Checks

These calibration checks are carried out every two weeks on the APi M100A and APi M200A. This allows instrument drifts to be fully qualified and documented using traceable calibration gas standards and the results are used to scale data.

A copy of the equipment calibration checklist can be found in Appendix 2 of this report.

The fortnightly calibration procedure requires a zero check on the analyser. This is achieved by a source of zero air being provided by passing ambient air through the charcoal scrubber before it enters the reaction cell. Once stability has been achieved (this is defined as a variation of less than 0.1ppb over a one minute period for the analyser) three readings are recorded from the instrument display after three ten second intervals. Next the calibration gas bottle is opened at a pressure of 30 psi. The analyser is allowed to stabilise for a minimum of ten minutes. Three consecutive readings are taken from the instrument display, allowing ten seconds between readings. The calibration gas is then isolated.

By considering the previous calibration results and the results obtained from the calibration just performed the success of the calibration procedure is determined. The zero value should not differ by more than ± 2ppb from the previous calibration. The span calibration should not differ by more than 5% from that obtained during the previous calibration.

Additionally, the analyser sample inlet filter is changed when necessary.

At the time of the instrument calibration checks, instrument pre-calibration checks are made to ensure that the condition of each analyser, before the calibration check, is assessed and any faults attended to. A copy of the checklist is found in Appendix 3 of this report.

It should be noted that the BAM 1020 does not require fortnightly calibration, but checks are carried out every fortnight to ensure the instrument is working correctly.

2.4.3 Six Monthly Calibration

These checks are carried out by our analyser suppliers, Enviro Technology Ltd, at the same time as servicing of the analysers. They ensure that the measurements from the analyser are representative and inter-comparable. The calibrations act as an independent audit of the system performance. Additionally, any site-specific problems that may have remained undetected will be fully quantified.

2.4.4 BAM 1020

The BAM 1020 PM_{10} analyser does not require fortnightly calibration checks as automatically self-calibration of zero and span are applied at the beginning of every cycle (ie, every 60 minutes). If the instrument fails to perform to its specification, an error is logged in the memory.

The zero testing of the instrument is based on the unit's ability to hold a constant output when measuring the blank filter paper. The span measurements are made by automatically inserting a reference membrane in the measurement path.

The BAM 1020 is serviced once every 6 months and calibrated.

2.4.5 Osiris PM_{10} Analyser

Guidance was sought from the DETR pollutant specific and Monitoring helplines to confirm that the analyser could be used for stage 3 monitoring. We were told that provided we changed the filter every month and that the filter was properly conditioned then it could be used.

The filters were conditioned and weighed before and after exposure by Bristol City Scientific Services. For calibration purposes the following formula was used to establish a calibration factor to be applied to the results obtained:

$$\frac{\text{Weight of the dust on the filter}}{\text{Volume of air}} = \text{Filter Calibration}$$

Filter Calibration x Average Dust Reading = Calibration Factor

2.4.6 Data Scaling

The data obtained from the APi M100A and APi M200A analysers are scaled to take into account instrument drift. The data scaled is that which was collected in the two week period before the calibration check was made.

The corrected data is determined using the following procedure:-

Instrument Zero = Vz
Instrument Span (F) = c/(Vs-Vz)
Pollutant Concentration (ppb) = F(Va-Vz)
Conversion to $\mu g/m^3$ = Pollutant Conc x 1.91

Vz is the response of the analyser when the pollutant being measured is not in the sample airstream.

Vs is the response of the analyser to an accurately known concentration, c.

Va is the recorded signal from the analyser sampling ambient air.

2.4.7 Quality Assurance/Quality Control of NO_2 Passive Diffusion Tubes

The laboratory we use is Bristol City Scientific Services. They follow various QA/QC controls to ensure that the analysis is as accurate as possible.

- Each batch of tubes analysed is accompanied by check standards, reagent blank, tube blank and a QC solution which is supplied by AEA Technology. The results of the QC solution checks are sent to AEA Technology on a monthly basis to tie in with the DETR national NO_2 diffusion tube survey.

- Additionally, the lab also participates in a scheme run by the Health & Safety laboratory called the Workplace Analysis Scheme for Proficiency (WASP). Each month Bristol City Scientific Services Lab is sent a doped diffusion tube which is analysed and returned to WASP.

A copy of the latest WASP result for Bristol City Scientific Services is attached as Appendix 4 to this report.

Additionally, our QA/QC checks are to ensure that when a tube batch is received they are stored air tight in the fridge. On the day of sampling they are removed from the refrigerator.

and installed. Any laboratory blanks sent to us are kept in the fridge and taken out when the exposed tubes are installed and collected.

When the tubes are collected, they are immediately packaged and sent to the laboratory for analysis.

2.4.8 QA/QC Control of 1,3 Butadiene Diffusion Tubes

In November and December 2000 AEA Technology Environment undertook a study on behalf of West Wiltshire District Council. The QA/QC controls are contained in their report Appendix 5.

3.0 The Pollutants of Concern

The pollutants assessed in this review and assessment are **PM_{10}, SO_2, NO_2** and **1,3-Butadiene**. Specific information regarding these pollutant objectives and relevant exposure is detailed below:

3.1 PM_{10}

The Government has adopted two air quality objectives for fine particles (PM_{10}), which are equivalent to the EU Stage 1 Limit Values. The objectives are 40 μg/m^3 as the annual mean, and 50 μg/m^3 as the fixed 24-hour mean to be exceeded no more than 35 days per year. Both objectives are to be achieved by 31 December 2004. The objectives are based on measurements carried out using the European gravimetric transfer reference sampler or equivalent.

The focus of the Authority's Review & Assessment for PM10 should be any non occupational, near ground level outdoor locations also the public might be exposed for a substantial part of the day. Such locations include background locations, roadside locations and other locations where potentially significant groups might be exposed such as schools or hospitals.

3.1.1 Important Sources of PM_{10} on a National Level

Over the last two years a number of studies have been made on a national level into determining the sources of PM_{10} emissions. In the UK there is a wide range of emission sources that contribute to PM_{10} concentrations. The main source categories are as follows:-

- **Primary Combustion Particles**

  Combustion processes such as from road traffic, industrial combustion processes and power generation can emit particles directly into the atmosphere. These particles tend to be less than 2.5 μm and often well below 1μm in diameter.

- **Secondary Particles**

  These consist of particles formed in the atmosphere following their initial release in the gaseous phase. These include sulphates and nitrates formed from emissions of SO_2 and NO_x. These particles tend to be less than 2.5 μm in diameter.

- **Course and Other Particles**

  These components comprise of emissions from a wide range of non-combustion sources. They include resuspended dust from road traffic, construction and mineral extraction processes, wind blown dust and soil and sea salt. These particles tend to be less than 2.5 μm in diameter.

  Table 3 shows the approximate contributions to PM_{10} concentrations in 1998. This information has been obtained from the Review & Assessment: Pollutant Specific Guidance LAQM, TG4(00).

It is important to note the different source categories of PM_{10} emissions because whilst some can be controlled at a local level, others such as SO_2 and NO_x emissions which contribute to PM_{10} concentrations but come from other UK and overseas sources may go largely uncontrolled and their impacts on PM_{10} at a local level will be very meteorological dependent.

The focus of Local Air Quality Management should, therefore, be towards the control of emissions at a local level. It is, therefore, important to ensure that the contribution of local emission sources is correctly identified.

3.1.2 Third Stage Review and Assessment for PM_{10}

Where the first and second reviews and assessments indicate that there is a significant risk of the objectives not being achieved by 2004, then a third stage review and assessment should be undertaken. This requires a detailed and robust assessment of the potential impacts and the assumptions made must be considered in depth. Any data collected must be quality assured to a high standard. The magnitude and geographical extent of the exceedance of the objective must be defined. This is so that confidence can be given on any decision on whether to designate an Air Quality Management Area or not can be soundly based. Monitoring and modelling are the methods of assessment to be used.

TABLE 3

Approximate Contributions to PM_{10} Concentrations 1998

Particle Type	Source Location	Main Source Category	Main Source Types	Typical Contribution to Annual Mean Concentration (µg/m³ Gravimetric)
Course 2.5 - 10 µm/m³	Immediate local (very close)	Traffic	Resuspended dusts and tyre wear	1-6
		Industry	Fugitive dusts Stock piles Quarries Construction	Variable
	Urban background	Traffic	Resuspended dusts and tyre wear	1-4
		Industry	Fugitive dusts Stock piles Quarries Construction	0.5-2
	Regional (including distant sources)	Natural	Resuspended dust/soil Sea Salt Biological	2-3 1-2 1
Fine < 2.5 µm	Immediate local (very close)	Traffic	Vehicle exhaust	1-6
		Industry	Combustion Industrial processes	Variable
		Domestic	Coal combustion	Variable
	Urban background	Traffic	Vehicle exhaust	1-4
		Industry	Combustion Industrial processes	0.5-2
		Domestic	Coal combustion	Variable
	Regional (including distant sources)	Secondary	Power stations	6-16
		Primary (Europe)	Vehicles Combustion processes	1-2
		Natural	Sea Salt	0.5-1

3.2 Nitrogen Dioxide (NO_2)

The Government has adopted an annual mean of 40 μg/m^3 (21ppb) and a 1 hour mean of 286 μg/m^3 as the air quality standards for nitrogen dioxide. The objectives are for the annual standard to be achieved by 31 December 2005 and a 1 hour mean of 200μg/m^3 (105ppb) not to be exceeded more than 18 times a year, to be achieved by 31 December 2005.

The focus of the Authority's Review & Assessment for the annual mean objective for Nitrogen Dioxide should be at non-occupational, near ground level outdoor locations. These include background and roadside locations and other locations where potentially significant groups might be regularly exposed.

For the 1 hour mean objective, the focus should include any non-occupational, near ground level outdoor locations (including kerbside sites) given that short time exposures are potentially likely at these locations.

3.2.1 NO_2 The National Perspective

Nitrogen dioxide and Nitric Oxide (NO) are both oxides of nitrogen and collectively are referred to as NO_x. All combustion processes produce some NO_x emissions, these are mainly in the form of NO which is later converted to NO_2 as a result of NO reacting with Ozone (O_3) which is already present in the atmosphere.

In the UK the main source of NO_2 emissions is from road transport. In 1997 this accounted for 50% of the total UK emissions of NO_2. In the same year NO_2 emissions from the industrial and commercial sectors (not including power stations) accounted for about 17% of the total UK emissions. It should be noted that in some urban areas the contribution of road transport to the local emissions will be much greater.

By 2005, significant reductions in NO_2 emissions from road transport are expected. This is due to the implementation of various Governmental policy measures (such as the Auto-Oil programme).

It is likely that to meet the annual mean objective will be more demanding than meeting the 1-hour objective. It is generally considered that if the annual mean objective is achieved, then the 1-hour objective is unlikely to be exceeded.

3.2.2 Third Stage Review and Assessment of NO_2

Where the first and second reviews and assessments indicate that there is a significant risk of the objectives not being achieved by 2005, then a third stage review and assessment should be undertaken. This requires a detailed and robust assessment of the potential impacts and the assumptions made must be considered in depth. Any data collected must be quality assured to a high standard. The magnitude and geographical extent of the exceedance of the objective must be defined. This is so that confidence can be given on any decision on whether to designate an Air Quality Management Area or not can be soundly based. Monitoring and modelling are the methods of assessment to be used.

3.3 Sulphur Dioxide (SO_2)

The Government has adopted a 15-minute mean of 266 μg/m^3 (100ppb) as an air quality standard for sulphur dioxide, with the objective for the standard not to be exceeded more than 35 times a year by 31 December 2005. A new 1-hour mean objective of 350 μg/m^3 (132ppb), not to be exceeded more than 24 times a year, and a new 24 hour mean objective of 125 (47ppb), not to be exceeded more than 3 times a year have also been adopted and are to be achieved by 31 December 2004.

The focus of the Authority's Review and Assessment for the 24 hour objective for sulphur dioxide should be at non-occupational, near ground level, outdoor locations where the public might reasonably be exposed for a substantial part of the day. This would include such locations as schools, housing and hospitals.

For the 1 hour and 15 minute objectives, the focus should include any non-occupational, near ground level, outdoor locations where a member of the public might be exposed over the relevant averaging period. This could include a playing field downwind of a point source (industrial source).

3.3.1 The National Perspective

Coal fired power stations dominate emissions of SO_2 in the UK, they contribute more than 65% of the total. Other industrial processes emit significant emissions and road transport contributes less than 2% of the total UK emissions.

The 15-minute mean is by far the most stringent objective and emissions that create exceedance of this objective tend to come from combustion plants and domestic coal burning.

Nationally, there are a number of controls in place which will significantly reduce emissions from large combustion plant. Road transport is unlikely to create significant emissions of SO_2.

3.3.2 Third Stage Review and Assessment of SO_2

Where the first and second reviews and assessments indicate that there is a significant risk of the objectives not being achieved by 2004 or 2005, then a third stage review and assessment should be undertaken. This requires a detailed and robust assessment of the potential impacts and the assumptions made must be considered in depth. Any data collected must be quality assured to a high standard. The magnitude and geographical extent of the exceedance of the objective must be defined. This is so that confidence can be given on any decision on whether to designate an Air Quality Management Area or not can be soundly based. Monitoring and modelling are the methods of assessment to be used.

3.4 1,3-Butadiene

The Government has adopted a maximum running annual mean of 2.25 μg/m^3 (1ppb) as an air quality standard for 1,3-butadiene, with an objective for the standard to be achieved by 31 December 2003.

The focus of the Authority's Review & Assessment for 1,3-Butadiene should be at non-occupational, near ground level outdoor locations where people might reasonably be expected to be exposed over an annual period. Such locations are background and roadside locations and at other locations where potentially significant groups might be regularly exposed such as schools or hospitals.

3.4.1 The National Perspective

In the UK the main source of 1,3-butadiene is from motor vehicle exhausts, but it is also an important industrial chemical and is handled in bulk as a number of industrial premises.

During the period 1996 to 1998 concentrations of 1,3-butadiene measured by the UK national network sites showed concentrations at all urban background/centre and roadside locations to be well below the 2003 objective of 2.25 $\mu g/m^3$.

Vehicles fitted with 3-way catalysers will significantly reduce emissions of 1,3-butadiene in future years. Emissions from vehicle exhausts should also reduce concentrations as part of the Auto-Oil programme. These measures are expected to deliver the air quality objective by 31 December 2003. Only those authorities with relevant locations in the vicinity of major industrial plant which handles, stores or emits 1,3-butadiene are expected to proceed beyond the first stage review and assessment process.

3.4.2 Third Stage Review and Assessment of 1,3-Butadiene

Where the first and second reviews and assessments indicate that there is a significant risk of the objectives not being achieved by 2003, then a third stage review and assessment should be undertaken. This requires a detailed and robust assessment of the potential impacts and the assumptions made must be considered in depth. Any data collected must be quality assured to a high standard. The magnitude and geographical extent of the exceedance of the objective must be defined. This is so that confidence can be given on any decision on whether to designate an Air Quality Management Area or not can be soundly based. Monitoring and modelling are the methods of assessment to be used.

4.0 Air Quality in Warminster Road, Westbury, Wiltshire

4.1 Introduction

In the Second Stage Review & Assessment Report further assessments of PM_{10}, SO_2 and NO_2 were required in Warminster Road, Westbury. The Third Stage Review & Assessment must contain detailed, robust assessments of the potential impacts of the pollutants concerned and the assumptions made within the review and assessment must be considered in-depth, and the data which is collected and used must be quality assured to a high standard. If this shows that there are still potential breaches of the air quality objectives then the Authority will need to consider whether to designate an AQMA.

Since 1999 West Wiltshire District Council has been monitoring PM_{10}, SO_2 and NO_2 using automatic analysers located in an air conditioned enclosure. The location is shown in Appendix 1. Additionally, since 1994 we have taken part in the DETR nation-wide diffusion tube network survey and all our sites for this are located in Westbury. In 2000, we added two more NO_2 diffusion tube sites at significant locations outside properties (41 Haynes Road and 75 Warminster Road) at the request of a local councillor. The site locations are shown in Appendix 1.

Westbury has a number of potentially significant pollution sources as follows:

- Blue Circle Cement, Trowbridge Road, Westbury
- The A350 road running through the town
- A number of smaller industries, notably Western Solvents and the former Premiere Environmental Ltd (Solvent recovery processes) on the Brook Lane and West Wilts Trading Estates respectively. It should be noted that since the Second stage review and assessment report published in March 2000, Premiere Environmental Ltd have ceased trading.
- Wessex Incineration, Bunns Lane. East Woodlands, Frome. An animal carcass incinerator.

4.2 Conclusion of the Second Stage Review and Assessment

The second stage review and assessment report concluded that a third stage review and assessment was required for the following:

- Blue Circle Cement – To undertake modelling for SO_2 and NO_2 and review PM_{10}
- Warminster Road – To monitor for NO_2 and PM_{10}

4.3 Third Stage Review and Assessment for Blue Circle Cement, Trowbridge Road, Westbury

The third stage review and assessment for Blue Circle Cement took the form of sophisticated modelling using the AAQuIRE 2000 regional air quality model. This work was undertaken on behalf of West Wiltshire District Council by CES consultants who developed the AAQuIRE model. The modelling study looked at the effects of road traffic and industrial sources on the air quality of West Wiltshire as a whole, so that an overall assessment could be made.

4.3.1 Application to Burn Tyres

It should be noted that Blue Circle Cement have recently applied to the Environment Agency (EA) for an application to burn tyres as part of their process. This is at present being determined by the Environment Agency. As part of the application, Blue Circle Cement undertook a tyre burning trial in order to provide emission data and a predictive model to the EA as part of their application. West Wiltshire District Council have made representations to the EA regarding this matter and in particular the air quality considerations.

At the present time it is difficult to predict the effect that the tyre burning will have on the air quality of the surrounding area and we can not pre-empt the EA's decision. It has therefore been concluded that, should tyre burning be allowed at the site, then this will form part of our next review and assessment process to be completed by 2003.

To carry out the modelling study, CES was provided with emission data from the EA for Blue Circle Cement. This was used along with traffic data and data from significant other Part A and B sources. The data was modelled using the AERMOD section of the AAQuIRE 2000 model and the results were incorporated into pollutant plots. The source data used is tabulated in Appendix 6 of this report).

Additionally a large number of small sources of air pollution exist which individually may not be significant, but collectively, over a large area, need to be considered. This consideration was achieved by including background contributions (shown in Table 4). These were based on data from the National Air Quality Archive and local monitoring data. The background concentrations for future years was determined from the relevant base case value by applying a scaling factor as outlined in the "Review and Assessment – Pollutant Specific Guidance" (LAQM.TG4(00)).

TABLE 4 Background Concentrations for Stage 3 Model

Pollutant	Base Case (2000)	Objective Year (2004/2005)
NO_x (µg/m^3)	25.0	19.2
PM_{10} (µg/m^3)	22.4	21.0
SO_2 (µg/m^3)	8.1	4.1

The District Council has some control over emissions of NO_x but little or no control over the atmospheric oxidants that oxidise NO to NO_2, it was appropriate to review NO_2 by first reviewing NO_x. It is for this reason that an NO_x background is applied to the modelled NO_x concentration before variable NO_2/NO_x is applied (see Appendix 7).

Meteorological data was also applied to the model using data from RAF Lyneham (the nearest suitable station). The windrose for this location and more detail of the methodology is shown in Appendix 8.

4.3.2 Modelling Results

The results of the modelling study are shown in the following appendices:

- Appendix 9 - Annual mean NO_2 concentrations 2000
- Appendix 10 - 99.8th percentile of hourly mean NO_2 concentrations 2000
- Appendix 11 - Annual mean NO_2 concentrations 2005
- Appendix 12 - 99.8th percentile of hourly mean NO_2 concentrations 2005
- Appendix 13 - 99.9th percentile of 15 minute means for SO_2 2000
- Appendix 14 - 99.9th percentile of 15 minute means for SO_2 2005

The NO_2 annual mean at 2000 shows that around the Blue Circle Cement plant there is a concentration of 16 $\mu g/m^3$ this is significantly below the objective concentration by 2005 the predicted concentration is well below the objective concentration. For NO_2 1 hour means, in 2000 around the plant it was 73 $\mu g/m^3$ and by 2005 it is predicted to be in the region of 74 $\mu g/m^3$. Thus is well below the 200 $\mu g/m^3$ objective concentration.

For SO_2 the maximum 99.9th percentile of 15 minute means in 2000 is a concentration of 120 $\mu g/m^3$ and the maximum predicted concentration for 2005 is 64 $\mu g/m^3$. Modelling of the 15 minute mean has been chosen because it is the most difficult of the SO_2 objectives to achieve. If no exceedance occurs using this objective, it is unlikely that any exceedance of the other SO_2 objectives will occur.

Note that the Validation of the model gave a +/- 40% accuracy level in comparison with automatic and diffusion tube results.

4.3.3 PM_{10} Results

No modelling could be carried out for this pollutant because no emission data was available. However, as part of the Blue Circle Cement application for authorisation submitted to the EA this year, the EA commissioned a study of dust from the plant. The study used two methods of sampling:-

Rupplecht and Patschinck Partisol 2000 with satellite unit for TSP monitoring.

A frisbee - type dust deposit gauge to collect total undissolved solids.

The survey was carried out by the Advanced Environment on behalf of the Environment Agency to provide particle characterisation of total suspended particulates (TSP) and deposited dust samples collected during tyre burning trials. The sampling periods were split into two phases to compare ambient particles collected during base line conditions with ambient particles collected when tyres were used as a substitute fuel. The resultant samples were qualitatively characterised for their discreet particle type, size and frequency and TSP quantitatively assessed for their aqueous - soluble components.

The mean dust deposition rates were quite high for both base line and tyre burning periods. However, characterisation showed that these dusts were dominated by soil and biological material. The impact from Blue Circle Cement was considered negligible within the context of the total and soluble dust deposited.

The results are shown in Appendix 15.

4.3.4 Conclusion

At the present time Blue Circle Cement is not contributing significant emissions which will cause potential breaches of the Air Quality Objectives. With regard to the application to burn tyres, the predictions are that NO_2 emissions will decrease and SO_2 emissions will increase. There is no information to show that the Air Quality Objectives will be exceeded and no Air Quality Management Area is required. As part of the next round of reviews and assessments the site will be looked at again. Page 75 of the "Review and Assessment: Pollutant Specific Guidance" (LAQM.TG4 (00)) states that…"Where the predicted future year concentrations are well below the objective, the authority may be confident that the objective is unlikely to be exceeded, even if the model accuracy is only within +/- 50%". In view of this and the monitoring work we have carried out in Westbury the conclusion is valid.

4.4 Third Stage Review and Assessment of Warminster Road, Westbury

The third stage review and assessment for Warminster Road , Westbury took the form of monitoring using automatic analysers and passive diffusion tubes. The modelling work mentioned in 4.3 above was also looked at so that comparisons could be made.

4.4.1 Monitoring Results

The results of monitoring are shown in the following appendices:

- Appendix 16 – PM_{10} automatic analyser data
- Appendix 17 – NO_2 automatic analyser data
- Appendix 18 – SO_2 automatic analyser data
- Appendix 19 – NO_2 passive diffusion tube data.

4.4.1.1 PM_{10} data

The PM_{10} analyser used was a BAM 1020 (more detail about this analyser is contained in 2.2.2.1.1 of this report). The results used compare favourably with a gravimetric PM_{10} analyser method. The data capture for 2000 was very poor due to the fact that the analyser developed a fault, the reliability on this years results can not be depended on. Data for 1999 has therefore been used as this gives a better picture of PM_{10} concentrations in this area.

Monitoring over twelve months provided us with a suitable amount of data on which to base our conclusions. We obtained a 91% data capture. The Review & Assessment: Pollutant Specific Guidance (LAQM TG4(00)) states that a minimum of 90% data capture should be achieved.

Graphs showing the 24 hour mean PM_{10} concentrations for February 1999 to January 2000 are contained in Appendix 16 of this report. Table 5 shows a summary of the PM_{10} monitoring data.

The data for 1999 has shown that the annual mean objective of 40 $\mu g/m^3$ is not being exceeded. With regard to the 24 hour mean objective, the site exceeded the 50 $\mu g/m^3$ limit on 34 days. This is just below the 35 day limit.

In accordance with the Review and Assessment: Pollutant Specific Guidance (LAQM TG4 (00)) a prediction of the 2004 PM_{10} concentrations has been determined. When using the methodology the data has to be divided into the separate source categories of primary, secondary and course particulate. Each must be treated separately. As far as local emissions are concerned, it is only the primary component that is of significance.

The complete methodology is shown in Appendix 21 of this report.

In summary, the predicted total PM_{10} for 2004 is 27.28 $\mu g/m^3$(gravimetric). The primary contribution is predicted to be 6 $\mu g/m^3$ (gravimetric).

To predict the 24 hour mean exceedances for 2004 the Design Manual for Roads and Bridges has been used (Volume 11, Section 3). A projected future annual mean for Warminster Road, Westbury is 27 $\mu g/m^3$(gravimetric), this would be expected to be associated with around 20 exceedances a year, or in the worst case, 31 exceedances. These levels are below the objective.

TABLE 5 Summary of PM_{10} Monitoring Data (Westbury)

	Feb 99	March 99	April 99	May 99	June 99	July 99	Aug 99	Sept 99	Oct 99	Nov 99	Dec 99	Jan 00	Total	Standard
Monthly Mean ($\mu g/m^3$) gravimetric	24	34	33	44	27	25	29	34	30	27	19	31	30	40
Number of Exceedances	2	5	3	8	0	0	3	5	4	0	0	4	34	35

4.4.1.2 NO_2 Data

4.4.1.2.1 Automatic Monitoring

The analyser used was an APi M200 (more detail is contained in 2.2.2.1.3 of this report). 11 months data over 1999 and 2000 has been used. The data capture was 94%.

Graphs showing the monthly one hour results are in Appendix 18. The periods chosen are from 1 March 1999 to 30 September 1999 and 1 July 2000 to 30 October 2000. This is 11 months data. The period October - December 1999 has not been used because the data validation could not be guaranteed.

From March - June 2000 the analyser was located in Bradford on Avon.

The 11 month mean was 36 µg/m^3. There were 29 exceedances of the 1 hour mean. This is above the accepted allowance of 18 times a year. This is unusual when the mean is below 40 µg/m^3, but could be attributed to the fact that the analyser is located close to public toilets and a car park. It has been known that people park their vehicle alongside the analyser and leave the engine running.

It should be noted that the analyser location is set back from the road and is approximately 10 metres from the nearest relevant location. The site was chosen in 1998 as being most suitable, particularly as the enclosure could be housed there and services could be easily provided.

Diffusion tubes were also placed at various locations in Westbury, because these are easier to install, they were placed outside relevant locations so that comparisons could be made.

TABLE 6 Summary of the NO_2 Monthly Mean Measured at Each Location µg/m^3

Average	Mar 99	Apr 99	May 99	June 99	Jul 99	Aug 99	Sep 99	Jul 00	Aug 00	Sep 00	Oct 00	11 month mean
Westbury	43	32	27	30	13	12	48	21	21	44	43	36
Bristol	39	35	34	31	32	39	41	29	56	45	33	38
1 hr max	Mar 99	Apr 99	May 99	Jun 99	Jul 99	Aug 99	Sep 99	Jul 00	Aug 00	Sep 00	Oct 00	
Westbury	81	153	91	450	129	51	231	206	84	335	149	
Bristol	121	115	124	101	122	142	134	55	103	69	65	

4.4.1.2.2 Representativeness of the Data

We have tried to put the results into a wider perspective by comparing the concentrations from the Westbury site with concentrations from the National Automatic Urban Network (AUN)) site at Bristol Centre, which is a long term monitoring station. The data has been obtained via the National Air Quality Archive via the Internet (http://www.aeat.co.uk/netcen/airqual/welcome.html).

The Bristol Centre site is an urban background station which is located in the centre of the city, 43 metres from a busy road.

The purpose of comparing the results for both sites is to identify how representative the results are for Westbury compared with longer term concentrations. It should be noted that not all the Bristol data has yet been ratified by the AUN QA/QC network. Therefore, some changes may occur once ratification has taken place.

Table 6 shows the comparative information. In general the Westbury average data compares well with the Bristol data. However, the maximum levels for April 99, June 99 and September 99 show distinct peaks higher than those experienced in Bristol, it is difficult to explain these high peaks specifically. The main trends of both sets of data are similar.

To examine the representativeness of the data further, comparisons have been made with the Bristol Centre site for long term periods using data for the whole of 1997, 1998 and 1999. This information is shown in Table 7.

TABLE 7 Long Term Means at Bristol Centre compared with 11 Month Mean at Westbury

Period	Bristol Avon Mean (µg/m^3)	Westbury Mean (µg/m^3)
1997	44	
1998	40	
1999	37	7 Month Mean 40
2000	10 Month Mean 38	4 Month Mean 29
1999-2000 11 Month Mean		36

The means for these periods are similar for those periods monitored at Westbury. No major pollution episodes occurred during the 11 month period of monitoring in 1999 - 2000. These observations should apply to the Westbury data over the same period.

4.4.1.2.3 Passive Diffusion Tubes

Monitoring for NO_2 using passive diffusion tubes has been carried out at four locations in Westbury since 1994. This site forms part of the DETR Nationwide NO_2 diffusion tube survey. The site locations are defined as follows:-

- Kerbside site - Warminster Road, Westbury
- Intermediate site - Station Road, Westbury
- Background site - Oldfield Park, Westbury
- Background site - Danvers Way, Westbury

Two additional sites were set up in May 2000.

A plan showing the approximate locations of these sites is shown in Appendix 1 of this report.

The monthly data for 1999 is shown in Table 8.

TABLE 8 NO_2 Diffusion Tube Results Westbury in µg/m^3

Date	Warminster Road	Station Road	Oldfield Park	Danvers Way	75 Warminster Road	41 Haynes Road
Jan 99	33	30	20	18		
Feb 99	44	32	19	18		
Mar 99	48	32	19	20		
April 99	46	28	15	14		
May 99	43	27	13	13		
June 99	49	31	14	13		
July 99	50	31	17	14		
Aug 99	41	32	18	16		
Sept 99	51	26	16	18		
Oct 99	51	29	20	22		
Nov 99	59	32	21	23		
Dec 99	44	24	17	19		
Jan 00	47	32	27	23		
Feb 00	47	28	17	17		
Mar 00	50	30	19	21		
April 00	42	28	16	16		
May 00	31	26	17	14	54	52
June 00	44	24	12	12	60	43
July 00	34	22	8	9	48	39
Aug 00	43	27	14	18	51	46
Sept 00	50	25	Missing	12	48	31
Oct 00	41	22	14	13	56	29
Average	Nov 99 - Oct 00 - 45	Nov 99 - Oct 00 - 27	Aug 99 - Jul 00 - 17	Nov 99 - Oct 00 - 16	53	40

The two new sites at 75 Warminster Road and 41 Haynes Road are located outside dwellings. These two roads are located along the busy A350 and have houses along both sides of the road. This is possibly why the overall concentrations are higher. Haynes road is wider than Warminster Road and again allows for better dispersion of the pollutant. The diffusion tube results for all sites reflects emissions from road transport.

It should be noted that the "Review and Assessment: Monitoring Air Quality Guidance" (LAQM. TG1 (00)) states that if diffusion tubes are used then ideally triplicate tubes should be used to validate the results. Due to the Council's budget constraints this was not carried out, however, comparisons have been made with North Wiltshire District Council's triplicate NO2 tube trial carried out in Wootton Bassett from July 2000 to October 2000 because they use the same laboratory as West Wiltshire District Council. From this data a factor has been used to compare the results with the automatic analyser as follows:

$$\frac{\text{Automatic Analyser Annual Average Concentration}}{\text{Diffusion Tube Annual Average Concentration}} = \text{Scaling Factor}$$

TABLE 9 Diffusion Tube Results for North Wiltshire District Council at Wootton Bassett

July 2000	August 2000	September 2000	October 2000
34.1	37.8	33.5	39.7
38.2	44.4	43.9	42.6
34.1	36.9	38.4	41.8

3 month average for the triplicate tubes is 38.78 μg/m^3. North Wiltshire DC analyser 4 month mean over the same period was 37.3 μg/m^3. Thus a scaling factor of 0.96 should be applied to the diffusion tube results.
Additionally Bristol City Scientific Services have carried out quality control surveys to assess accuracy of their tubes and analyses and this is detailed in Appendix 4.

With data scaling using the scaling factor of 0.96 obtained from North Wiltshire District Council the results for Westbury are as follows:-

TABLE 10 Corrected Diffusion Tube Data November 1999 - October 2000 in μg/m^3

Date	Warminster Road	Station Road	Oldfield Park	Danver Way	75 Warminster Road	41 Haynes Road
Nov 99	57	31	20	22		
Dec 99	42	23	16	18		
Jan 00	45	31	26	22		
Feb 00	45	27	16	16		
Mar 00	48	29	18	20		
Apr 00	40	27	15	15		
May 00	30	25	16	13	52	50
June 00	42	23	12	12	58	41
Jul 00	33	21	8	9	46	37
Aug 00	41	26	13	17	49	44
Sept 00	48	24	missing	12	46	30
Oct 00	39	21	13	12	54	28
Average	43	26	16	16	51	38

Additionally, before the assessment of significance is completed the DETR pollutant specific guidance (LAQM.TG4 (00)) stats that we have to consider the potential NO_2 concentrations for the relevant objective year, in this case 2005. The calculation to predict 2005 concentrations is as follows:-

$$\text{1999 concentration} \times \left(\frac{\text{correction factor for 2005}}{\text{correction factor for 1999}} \right)$$

This is as follows:-

2000 concentration x (0.79/0.90)

The corrected data is shown in Table 11 and a graph depicting the corrected 1999/2000 concentration and predicted 2005 concentration is shown in Appendix 19.

TABLE 11 Predicted Annual Average 2005 NO_2 Concentrations

Location	Annual Average 2005 in µg/m^3
Warminster Road	38
Station Road	23
Oldfield Park	14
Danver Way	14
75 Warminster Road	45
41 Haynes Road	33

This information indicates that parts of Warminster Road are likely to be in exceedance of the annual average objective concentration of 40 µg/m^3 in 2005.

4.4.1.3 SO_2 Data

The automatic analyser used was an APi M100 (more detail about this analyser is contained in 2.2.2.1.2 of this report). During 1999 the analyser developed a fault and the results could not be used. However, since April 2000 the analyser has been repaired and the results are presented in Appendix 18. The data capture for the period was 95%.

The concentrations of SO_2 at this location are extremely low and no breaches of the air quality objectives have occurred.

To put the information obtained into context of a long term perspective, the Warminster Road results have been compared with concentrations from the AUN site at Bristol Centre which is a long term monitoring site. The data has been obtained from Bristol City Council and the National Air Quality Archive via the Internet (http://www.aeat.co.uk/netcen/airqual/welcome.html).

The Bristol Centre site is an urban background station which is located in the centre of the city, 43 metres from a busy road.

The results are shown in Table 12.

TABLE 12 Summary of SO_2 Monthly Data Measured at each Location µg/m^3

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Bristol 98	9.04	8.8	7.7	8.2	10.1	4.8	6.4	6.11	5.9	4.5	6.7	5.6
Bristol 99	10.6	12.8	13.6	10.6	9.3	10.1	8.5	9.0	9.0	8.8	8.8	7.7
Bristol 00				52.4	33.25	46.3	38.6	70.5	82.9	46.3		
Westbury 00				1.3	1.2	1.6	1.5	32.6	38.7	22.8		
Max	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Bristol 98	66.5	204.8	138.3	117.0	85.1	47.9	85.1	45.2	53.2	63.8	47.9	19.4
Bristol 99	71.8	74.5	79.8	71.8	71.9	50.5	50.5	63.8	130.3	34.6	50.5	45.2
Bristol 00				151.6	159.6	175.6	125.0	258.0	157.9	186.2		
Westbury 00				6.4	7.7	12.2	8.2	67.3	60.1	66.4		

Overall the SO_2 concentrations are far lower in Westbury than at Bristol Centre. It appears that the year 2000 was the worse year at Bristol for SO_2 concentrations. The main trends for both sets of data are similar. In context with Bristol Centre the SO_2 concentrations at Westbury are low.

None of the objective concentrations have been exceeded at the Westbury site, indicating that any further risk of significant exceedance is extremely low.

4.4.2 Conclusions

PM_{10} and SO_2 data obtained for Westbury indicate that there will be on breaches of the air quality objectives. However, there is some concern regarding NO_2 concentrations. The likelihood that the annual average concentration will be exceeded by 2005 in Warminster Road cannot be ruled out.

5.0 Third Stage Review and Assessment of Bradford on Avon

The third stage review and assessment for Bradford on Avon took the form of 6 months automatic NO_2 monitoring, 3 months automatic PM_{10} monitoring and a long term diffusion tube located in Masons Lane (from the Stage 2 review and assessment this location was considered the worst case). Appendix 1 shows a plan of the monitoring location points. Bradford on Avon town centre is made up of a medieval street structure, all the main roads are narrow and houses and shops line both sides of the majority of the streets. Masons Lane has houses on the East Side and On the West is a very high wall, to exacerbate the canyon effect in this road it is on a steep hill, thus cars going up towards the A363 accelerate heavily to get there. Additionally, because of the narrow streets and overall road layout in the town centre, there is a lot of stop start traffic. There are particular AM and PM peak traffic flows. Traffic flow data carried out in Masons Lane from 6 May 2000 to 12 May 2000 by Wiltshire County Council Environmental Services Department is shown in Appendix 20.

5.1 Monitoring Results

The results of monitoring are shown in the following appendices:

- Appendix 22 – NO_2 automatic analyser data
- Appendix 23 – NO_2 Passive diffusion tube data
- Appendix 24 – PM_{10} automatic analyser data

5.1.1 NO_2 Data

As part of the Stage 2 review and assessment from March 1999 to April 2000 NO_2 passive diffusion tubes were installed at four sites in Bradford on Avon the 12 month average was as follows (March 1999 - March 2000):

- Masons Lane – 56 $\mu g/m^3$
- Market Street – 38 $\mu g/m^3$
- Silver Street – 41 $\mu g/m^3$
- St Margaret's Street – 45 $\mu g/m^3$

From March 2000 the diffusion tube sampling was continued in Masons Lane as this location showed the highest concentrations. Additionally 3 months monitoring using the automatic analyser outside 9 Masons Lane was carried out between February 2000 and May 2000. To put the information into a wider regional context, the automatic analyser results have been compared with data from the automatic urban network NO2 background monitoring site in Bristol.

The Masons Lane site for both diffusion tube and automatic monitoring was at grid reference ST 827612 outside 9 Masons Lane. This site was chosen because it represented an area where public exposure over the 1 hour and annual exposure periods could be expected.

5.1.1.1 Results

Graphs depicting the automatic monitoring data are shown in Appendix 22 to this report.

In general the automatic monitoring revealed few exceedances of the hourly objective of 200 μg/m^3, but exceedance of the annual objective (an annual average of 40 μg/m^3) is likely. A three month average has been calculated as 69 μg/m^3.

The graphs further reveal the following peak hourly exceedances:-

TABLE 13 Peak NO_2 Concentrations

Date	Time	Concentrations μg/m^3
Tuesday 22 February 2000	1800 hours	204
Tuesday 21 March 2000	1800 hours	212
Wednesday 22 March 2000	1800 hours	213
Tuesday 9 May 200	1800 hours	205

This indicates that particularly on Tuesdays for one day in the month there is heavy traffic through Mason's Lane.

From 6 May to12 May 2000 Wiltshire County Council Environmental Services Department carried out a traffic count in Mason's Lane for West Wiltshire District Council. On 9 May at 1800 hours the peak hour flow was 1,096 vehicles. Although this was the second highest number of hourly vehicle counts on that day (the highest was 1,100 at 9.00am). We can, however, conclude that the peak NO_2 concentration of 202 μg/m^3 was as a result of a high traffic count at 1800 hours on 9 May 2000.

It should also be noted that throughout the monitoring period scaffolding was present at the bottom of Mason's Lane and could have affected traffic flows and speeds and may not provide an accurate picture of nitrogen dioxide concentration in Bradford on Avon during normal conditions. However, it could be argued that the slower speeds of the traffic and large queues, that occurred during that time, then this presents a worst case picture of air quality in Mason's Lane.

5.1.1.2 Accuracy Correction of $N0_2$ Diffusion Tubes

As with the NO_2 monitoring for Westbury we have used the correction factor obtained from North Wiltshire District Council's triplicate NO_2 diffusion tube assessment (see page 35). The scaling factor of 0.96 has been applied to the NO_2 diffusion tube results and these are shown in Table 14.

TABLE 14 Corrected NO_2 Annual Mean Diffusion Tube Data

Location	Annual Mean 99/00
Masons Lane	54
Market Street	36
Silver Street	39
St Margaret's Street	43

Correction for 2005

In guidance issued by the Department of Environment, Transport & the Regions (DETR) to local authorities, a correction factor has been given to correct diffusion tube data for a year to determine what the predicted annual average concentration will be by 2005. In Bradford on Avon during 1999 we carried out nitrogen dioxide diffusion tube surveys at four sites. These were St Margaret's Street, Market Street, Mason's Lane and Silver Street. The annual average nitrogen dioxide concentration has been averaged for the whole year's worth of monitoring from 8 March 1999 to 29 February 2000. The guidance provides us with the following correction formula:-

Concentration 2005 = 1999 concentration x (0.79/0.90).

Table 15 below shows the 1999 annual average at all four sites and the predicted annual average by 2005.

TABLE 15 NO_2 Diffusion Tube Annual Averages

Location	1999	Predicted 2005
St Margaret's Street	43	38
Market Street	36	32
Mason's Lane	54	47
Silver Street	39	34

In interpreting these results where the annual average objective to be achieved by 2005 for nitrogen dioxide is 40, then Mason's Lane is 6 µg/m^3 over this level.

5.1.1.3 Comparison of Automatic Data at Masons Lane, Bradford on Avon with Automatic Monitoring at Bristol Centre on Automatic Urban Network Site (AUN)

Monitoring over three months provides only a 'snapshot' of air quality. It is important to remember that pollutant concentrations vary from hour to hour and week to week. The longer a survey has been going the better the trends can be analysed.

In order to assess the results in a wider perspective, we have compared the Bradford on Avon results with concentrations measured at a national urban network site at Bristol Centre, which is a long term monitoring station. The data has been obtained via the air quality archive on the internet (http//www.aeat.co.uk /netcen/airqual/welcome.html). It should also be noted that the Bristol Centre Site in an urban background station which is located in the centre of the city 43 metres from a busy road. As our monitoring site was 1 metre from the road, you would perhaps expect to record higher NO_2 concentrations due to the close proximity to the road.

The purpose of comparing the results at both sites is to identify how representative the results obtained in Bradford on Avon are when compared to longer term concentrations. It should be noted that the data for Bristol Centre 1999 and 2000 has not yet been ratified by the AUN QA/QC network. Therefore, there may be small changes once ratification takes place.

The following table 16 shows the comparisons of all the data in µg/m^3:

TABLE 16 Comparison of Bradford on Avon Data with Bristol Centre AUN

	Feb/Mar	Mar/April	April/May	3 Month Mean	Standard
Bradford on Avon 2000	65	73	70	69	40 (annual mean) (Bradford on Avon 2000 and Bristol 2000)
Bristol 2000	34	45	33	37	
Bristol 1999	37	34	39	37	
1 Hour maximum	Feb/Mar	Mar/April	April/May		Standard
Bradford on Avon	204	213	205		200 µg/m^3 1 hour
Bristol 2000	97	134	107		
Bristol 1999	120	115	124		

The Bradford on Avon results are consistently above those observed at the Bristol Centre background AUN site. This is because the monitoring site at

Bradford on Avon was very close to the road (but representative of relevant locations), thus very little dispersion of NO_2 has occurred.

It is clear that the annual mean is likely to be exceeded at this location. To project the 3 month mean obtained at Masons Lane, Bradford on Avon to reflect 2005 concentration, the following formula has been used (as stipulated in the LAQM TG4(00) box 6.4).

$$\text{2000 concentration} \times \frac{0.79}{0.90}$$

$$= \quad 69 \times 0.877 = 60.5\ \mu g/m^3$$

Again, the indication is that the annual mean objective for NO_2 is likely to be exceeded.

5.1.1.4 Conclusion

The diffusion tube survey results and automatic monitoring results indicate a high likelihood that the annual average objective of 40 $\mu g/m^3$ for NO_2 is significantly likely to be exceeded at Masons Lane, Bradford on Avon.

5.1.2 PM_{10} Data

The PM_{10} analyser used was a Turnkey Osiris (more detail about this analyser is contained in 2.2.2.1.4 of this report). To ensure it's validity in use with third stage monitoring, the Pollutant Specific Helpline was contacted. They stipulated that it could be used, provided the filter was changed once a month and the filter was weighed and conditioned appropriately. This was carried out by Bristol City Council Scientific Services and the analyser installed on a lamppost outside 9 Masons Lane. The analyser was installed for 3 months from 29 September 2000 until 22 December 2000. 99.4% data capture was obtained. The site was chosen to reflect other monitoring that had been carried out there and it was deemed to be a relative location. 9 Masons Lane is a Buddhist Monastery where the Monks both live and work.

5.1.2.1 Results

A graph depicting the 24 hour average data is shown in Appendix 24.

The 3 month average was 43 $\mu g/m^3$ (gravimetric) and there were 17 days of exceedance above the 24 hour mean objective concentration of 50 $\mu g/m^3$.

This information needs to be put in context of 2004 predictions in accordance with the Review and Assessment: Pollutant Specific Guidance (LAQM.TG4(00)). When using the methodology the data has been divided into the separate source categories of primary, secondary and course particulate. Each must be treated separately. As far as local emissions are concerned, it is only the primary component that is of significance. The complete methodology is shown in Appendix 25 of this report.

In summary the predicted total PM_{10} for 2004 is 39.18 $\mu g/m^3$ (gravimetric).

The primary contribution is predicted to be 20.6 $\mu g/m^3$ (gravimetric).

5.1.2.3 Conclusion

The predicted PM_{10} concentration for 2004 is that based on 3 months data it will be 39.18 $\mu g/m^3$ (gravimetric). Basing this information on just 3 months data is not advisable and LAQM.TE4(00) suggests that a minimum of 6 months data should be collected.

5.2 Overall Conclusion

Significant breaches of the air quality objectives for NO_2 and PM_{10} in Masons Lane, Bradford on Avon by the objective date at relevant locations are likely.

6.0 Third Stage Review and Assessment of County Way, Trowbridge

6.1 Introduction

County Way, Trowbridge is the busiest road in West Wiltshire with an AADT of 18600 in 1998 according to the "Travel Report Wiltshire" 1998. Part of the road is consists of a the Longfield roundabout populated by a number of houses, these are considered to be relevant locations. A diffusion tube has been located outside the Junction public house since March 1999, this is considered to be a relevant location and is the nearest site to the Longfield roundabout.

6.2 Results

The third stage review and assessment for County Way, Trowbridge took the form of monitoring using passive diffusion tubes. The reason for this was that the houses of concern are on the Longfield roundabout, when contacted no one was willing to have the automatic analyser installed. Therefore, the same diffusion tube site used in the stage 2 review and assessment were used for this assessment. Again no triplicate tubes were set up due to budgetary constraints but comparisons have been made with triplicate data from North Wiltshire District Council (see page 35). The results are shown in table 17.

TABLE 17 Diffusion Tube Data

Date	Diffusion Tube Concentration in $\mu g/m^3$
March 99	46
April 99	44
May 99	40
June 99	43
July 99	41
August 99	45
September 99	44
October 99	48
November 99	42
December 99	46
January 00	52
February 00	42
March 00	41
April 00	43
May 00	38
June 00	31
July 00	26
August 00	34
September 00	33
October 00	37
Annual Average Nov 99 – Oct 00	39

The predicted concentration in 2005 is 34 μg/m^3. The prediction has been made using the correction factors in box 6.4 of the "Review and Assessment:Pollutant Specific Guidance" (LAQM.TG4(00)) ie, 39 x (0.79/0.90). This site is predicted to be well below the annual average objective concentration by 2005.

6.3 Conclusion

The predicted annual average NO_2 concentration for this site is well below the annual objective for 2005. The air quality does not give rise for concern at the relevant location. No further work is required at this location.

7.0 Review and Assessment of Cooper Avon, Bath Road Melksham

In the second stage review and assessment of 1,3-butadiene it was concluded that further work was required to assess emissions of 1,3-butadiene. The Third Stage Review & Assessment must contain detailed, robust assessments of the potential impacts of the pollutants concerned and the assumptions made within the review and assessment must be considered in-depth, and the data which is collected and used must be quality assured to a high standard. If this shows that there are still potential breaches of the air quality objectives then the Authority will need to consider whether to designate an AQMA.

In this particular instance the only possible source of 1,3-butadiene in West Wiltshire could be from Cooper Avon Tyres in Melksham. The company operate an authorised rubber process and produce motor vehicle tyres. It is thought that the majority of 1,3-butadiene emissions will be emitted by the rubber manufacturing process, this is not carried out at the Melksham plant. Instead, the Melksham plant buys in particular types of rubber such as Styrene Butadiene rubber (SBR) and butadiene rubber which is then mixed with other ingredients to produce the final product for use in tyre manufacture.

For the second stage review and assessment process, West Wiltshire District Council carried out a survey of 1,3-butadiene at 2 sites either side of the plant using passive diffusion tubes which were analysed using QC/F10. The tubes were located at relevant locations, One site is outside The Unicorn Public House, Bath Road, Melksham, and the other outside a property in Scotland Road, Melksham. These locations were chosen because they were near areas where non-occupational exposure was likely over the annual exposure period, and they represented overall upwind and downwind conditions at the factory taking into account the south westerly prevailing wind. A location plan of the diffusion tube sites for the survey in relation to the factory is enclosed as Appendix 1 of this report. The survey started on 12 July 1999 and ended on 25 January 2000 and the tubes were changed every two weeks.

As part of the second stage review and assessment process the DETR commented on the report stating that in the case of the 1,3-Butadiene monitoring fuller information should be provided on the QA/QC methods and on the analysis of the tubes. This has been taken into account as part of the third stage review and assessment.

7.1 Results

The stage 2 six month average for Scotland Road was 6.19 $\mu g/m^3$ and for Bath Road 4.97 $\mu g/m^3$. These reading appeared to be very high and as a result discussions were made with the company, the British Rubber Manufacturers Association, the supplier of rubber to the factory and the DETR monitoring helpline, to assess a method of validating these results. The emissions can not be modelled because it is thought the most probable emissions are from fugitive sources in the form of roof vents located above the tyre presses.

After taking advice from the above sources West Wiltshire District Council contracted AEA Technology Environment to carry out a validation assessment of 1,3-butadiene at Cooper Avon Tyres. This work was carried out between and 23 November 2000 and 7 December 2000. The report including methodology used is contained in Appendix 5 of this report.

7.2 Conclusion

The survey carried out by AEA Technology Environment used similar diffusion tubes to the ones we had used for the stage 2 assessment, but the analysis was carried out using QC/MS rather than QC/FID. QC/MS is superior to QC/FID in that it is able to speciate specific chemicals better.

1,3-Butadiene was not detected at the boundary of Cooper Avon Tyres indicating that concentrations at these locations were less then 1ppb.

Emissions from the Banbury mixers are unlikely to give rise to significant concentrations of 1,3-Butadiene outside the factory.

Emissions from the tyre presses were less than 10ppb and in assessing the content of 1,3-Butadiene in the diffusion tubes the analyst confirmed that no 1,3-Butadiene was present.

In carrying out the assessment the analyst carried out a lot of work on limits of detection (LOD). The analyst concluded that the presence of 1,3-Butadiene was not evident in any of the samples.

Thus the significance of 1,3-Butadiene being emitted is negligible.

8.0 Conclusions

It is acknowledged that overall air quality in West Wiltshire is good and is set to improve further due to national policies.

However, predicted air quality in some parts of West Wiltshire indicate that PM_{10} and Nitrogen Dioxide emissions from traffic will exceed the air quality objectives. This will occur in situations where people are exposed because of their close proximity to roads.

The air quality objectives will be met for the following pollutants:-

Benzene
1,3-Butadiene
Lead
Sulphur Dioxide
Carbon Monoxide

Areas around Warminster Road, Westbury, are likely to exceed the air quality objective for NO_2 annual mean (See Appendix 26).

Areas around Masons Lane, Bradford on Avon, are likely to exceed the air quality objective for NO_2 annual mean. Although not predicted with certainty, it is likely that the PM_{10} objective will also be exceeded in this area (See Appendix 27).

Subject to consultation it is proposed that West Wiltshire District Council will designate air quality management areas. The exact location of the designated areas is still to be determined and further modelling work is required. This will form part of the consultation process.

Glossary of Terms and Abbreviations

Term	Description
1,3 - Butadiene	A volatile aliphatic compound
AADT	Annual average daily traffic flow
Accuracy	A statistical method for measuring how well a set of data fits the true value
ADMS	Atmospheric Dispersion Modelling System
AEA	Atomic Energy Authority
AEOLIUS	An atmospheric dispersion model developed by the meteorological office
AQMA	Air Quality Management Area
AUN	Automatic Urban Network
Background level	The level of a substance (in this case gases and particulates) which is normally present in an environment and which should be taken into account when monitoring or measuring pollution
Calibration	Determining the accuracy of an instrument and, if necessary, correcting the reading of an instrument with a standard
Carbon Monoxide (CO)	A gaseous pollutant formed during incomplete combustion of carbonaceous fuel
Chemiluminescence	The emission of absorbed energy as light during a chemical reaction. The measurement of the light emitted can give a measure of the concentration of one of the reactants if the other one is known.
Chromatography	A method of separating mixtures. The process is based on the principle of adsorption, different chemicals adsorb at different rates. From this a particular chemical can be isolated.
Concentration	A method of defining an amount of a substance in a volume. In this case air.
DETR	Department of the Environment, Transport and the Regions
Diffusion Tube	An adsorption tube used to measure specific pollutants
Dispersion	Describes the way in which a pollutant spreads from its point of emission and becomes diluted in atmosphere

DMRB	Design Manuel for Roads and Bridges
EPAQS	Expert Panel on Air Quality Standards
Gas Oil	A liquid petroleum distillate having a viscosity and distillation range between paraffin and light lubricating oil. It is in the same boiling point range as diesel oil. It is often used for heating purposes and has a relatively low sulphur content.
Gravimetric Method	An analytical method based on weighing particulate matter collected on a filter. Gravimetric methods are capable of high accuracy, but are more time-consuming and require greater skill than volumetric methods
Mean	The average of a data set
mg/m^3	Milligrammes per cubic metre
Model	An air pollution mathematical model is a numerical simulation of the emission, dispersion and chemical processes controlling ambient pollutant concentrations.
NAMAS	National Auditing Service
Nanogram (ng)	A unit of mass equal to one thousandth of one millionth of a gram (10^{-9}g)
NETCEN	National Environment Technical Centre
Nitric Oxide (NO)	The main oxide of nitrogen. It arises from the combination of atmospheric nitrogen with oxygen which is created during high temperature combustion and from industrial processes.
Nitrogen Dioxide (NO_2)	A pollutant which is created during high temperature combustion and as a result of oxidation of nitric oxide in the presence of ozone
NO_x	Generic name for oxides of nitrogen and in air pollution terms NO_x implies NO and NO_2
PM_{10}	Particulate matter with a mean effective atmospheric diameter of 10 microns or less in size. The concern here is that it is these particles that can penetrate deep into the lungs.
ppb	Parts per billion
PPM	Parts per million (ie the number of parts of the gaseous pollutant in one million parts of air)

Rolling Average	An average set of data over a consecutive time period where the average moves in a continuous step
Sulphur Dioxide (SO_2)	A colourless gas mainly produced from the burning of sulphur contained in fuels (ie coal and oil).
TEOM	Tapered Element Oscillating Microbalance, a method of monitoring for particulate matter
TSP	Total suspended particulate
$\mu g/m^3$	Microgrammes per cubic metre
VOC	Volatile Organic Compounds these are organic compounds that evaporate easily

APPENDIX 26

Calculations used in determining the primary contribution of PM_{10}

A
Select the annual mean concentrations for the latest full year = PM_{10}(1999)

PM_{10} (2000)=43ug/m^3(gravimetric)
based on 3 months data

B
Obtain 1996 secondary PM_{10} concentration for local area from internet map = PM_{10}(secondary)

PM_{10}(secondary) = 13ug/m^3

C
Adjust **B** to 2000
C= B x 0.914

PM_{10} (secondary 2000) = 11.9ug/m^3

E
Calculate local primary PM_{10} for 2000
E=A – C – 10.5* *denotes assumed course PM_{10} contribution

Local Primary PM_{10} for 2000 = 20.6ug/m^3

F
Adjust Primary PM_{10}(2000) to 2004
F=E x 0.871

Primary PM_{10}(2004) = 17.9ug/m^3

G
PM_{10} (secondary, 2004)
G=B x 0829* *denotes 1996 adjustment factor

PM_{10} (secondary,2004) = 10.78ug/m^3

H
Total PM_{10} for 2004
H=F + G + 10.5

Total PM_{10}(2004) = 39.18ug/m^3