
# Wycombe District Council

# Second Stage Review and Assessment of Air Quality

## Introduction

During the early 1990's the Department of Environment, Transport and the Regions (DETR) had been investigating the need for a new framework for air quality control. This had been fuelled by recent episodes of poor air quality in many of the UK's major urban areas and by increasing concerns expressed by both public and scientific community. The need to reconcile rising demands in living standards with the maintenance of environmental quality has already been recognised in Agenda 21 and is taken further with the development of the National Air Quality Strategy.

At the centre of the National Air Quality Strategy is the use of air quality standards to enable air quality to be measured and assessed. These also provide the means by which objectives and timescales for the achievement of objectives have been developed. The proposed standards have been based on the health effects represented by different ambient concentrations of selected pollutants and are the consensus view of medical experts on the Expert Panel of Air Quality Standards, These standards and associated specific objectives to be achieved by 2005 (Table 1).

Air quality objectives represent the framework for achievement of improved air quality into the next century. They indicate the expected progress that can be made towards the given air quality standards by 2005. Both general and more specific objectives have been determined against which progress can be assessed All the standards are subject to review in 1999 and two consultation documents have been prepared by the DETR. These documents set out the Government's proposal for amending the strategy and setting new objectives (Table 2).

**Table 1: National air quality standards and objectives as outlined in the National Air Quality Strategy (DOE,1997)**

| Pollutant | Concentration Limit | Averaging Period | Objective by 2005 |
|---|---|---|---|
| Benzene | 5 ppb | running annual mean | 5 ppb |
| 1,3-Butadiene | 1 ppb | running annual mean | 1 ppb |
| Carbon Monoxide | 10 ppm | running 8 hour mean | 10 ppm |
| Lead | 0.5 $\mu g/m^3$ | annual mean | 0.5 $\mu g/m^3$ |
| Nitrogen Dioxide | 150 ppb | 1 hour mean | 150 ppb hourly mean |
| | 21 ppb | annual mean | 21 ppb annual mean |
| Ozone | 50 ppb | running 8 hour mean | 50 ppb as $97^{th}$ percentile |
| $PM_{10}$ | 50 $\mu g/m^3$ | running 24 hour mean | 50 $\mu g/m^3$ as $99^{th}$ percentile |
| Sulphur Dioxide | 100 ppb | 15 minute mean | 100 ppb as $99.9^{th}$ percentile |

**Table 2: Proposed objectives for Regulation as outlined in the review of the National Air Quality Strategy (DETR,1999)**

| Pollutant | Concentration Limit | Averaging Period | Proposed objective |
|---|---|---|---|
| Benzene | 5 ppb | running annual mean | 5 ppb (by 31.12.2003) |
| | | | 1 ppb (indicative) by 31.12.2005 |
| 1,3-Butadiene | 1 ppb | running annual mean | 1 ppb (by 31.12.2003) |
| Carbon Monoxide | 10 ppm | running 8 hour mean | 10 ppm (by 31.12.2003) |
| Lead | 0.5 µg/$m^3$ | annual mean | 0.5 µg/$m^3$ (by 31.12.2004) 0.25 µg/$m^3$ (by 31.12.2008) |
| Nitrogen Dioxide | 150 ppb | 1 hour mean | 104.6 ppb (by 31.12.2005) [maximum of 18 exceedances] |
| | 21 ppb | annual mean | 21 ppb (by 31.12.2004) |
| Ozone | 50 ppb | running 8 hour mean | 50 ppb (by 31.12.2005) |
| $PM_{10}$ | 50 µg/$m^3$ | running 24 hour mean | 50 µg/$m^3$ (maximum of 35 exceedances) |
| | | annual mean | 40 µg/$m^3$ (by 31.12.2004) |
| Sulphur Dioxide | 100 ppb | 15 minute mean | 100 ppb as 99.9$^{th}$ percentile (by 31.12.2005) |
| | | 1 hour mean | 131 ppb |
| | | 24 hour mean | 46.8 ppb (by 31.12.2004) |

An important part of the strategy is the requirement for local authorities to carry out air quality reviews and assessments of their area by which current and future compliance with air quality standards can be measured. Over the longer term these will also enable the effects of policies to be studied and therefore help in the development of future policy.

The timescales for achievement of objectives is an eight year period from the publication of the National Air Quality Strategy in 1997 to the year 2005. In most local authorities in the UK, objectives for most of the pollutants will be met. The Government has recognised the problems associated with achievement of the standard for ozone and thus will not therefore be a statutory requirement.

Technical Guidance has been issued in order to enable air quality to be reviewed and assessed in an appropriate and consistent fashion. This includes Technical Guidance note LAQM.TG4(98) on 'Review and Assessment; Pollutant Specific Guidance'.

The primary objective of undertaking a review of air quality is to identify any areas that are unlikely to meet national air quality objectives and ensure that air quality is considered in local authority decision making processes. The complexity and detail required in a review depends on the risk of failing to achieve air quality objectives and it has been proposed that reviews may be carried out in three stages.

Every authority is expected to undertake at least a first stage review and assessment of air quality in their authority area. A stage 1 review is expected to be sufficiently comprehensive as to have considered all sources of pollutants which could have a significant impact in its locality either due to the emission of significant quantities of the pollutant(s) of concern or for which there is potential for exposure of the general public to poor air quality. This

information should include details of any significant existing or planned transportation, industrial or other sources in and around the District. If no sources are identified the local authority can conclude that the risk of failing to meet set air quality objectives by 2005 is negligible and it is therefore not necessary to conduct a second stage review. If on the other hand a local authority can identify a significant source for one or more pollutants, it is necessary to proceed to a second stage air quality review.

The second stage air quality review will provide a further screening of pollutant concentrations in local authority areas. This will involve estimating, through the use of monitored or modelled data, the highest likely concentrations of air pollutants within its area and the localities where this may occur in order to assess whether there is a significant risk of an air quality objective being met. If as a result of estimations of ground level concentrations at roadside, industrial and background sites, a local authority judges that there is no significant risk of not achieving an air quality objective, it can be confident that an air quality objective will be achieved there should be a third stage review conducted.

A third stage review would be an accurate and detailed review and assessment of current and future air quality in a particular district using more sophisticated modelling and monitoring techniques. This will enable a local authority to predict whether or not an objective will be met by 2005 and so determine the location of any necessary Air Quality Management Areas. For each pollutant of concern, it may be necessary to construct a detailed emissions inventory and model the extent, location and frequency of potential air quality exceedances. Should an AQMA become necessary, there are further set of requirements to be considered. Firstly, a further assessment of air quality in the AQMA will be required within 12 months which will enable the degree to which air quality objectives will not be met and the sources of pollution that contribute to this to be determined. A local authority must also prepare a written action plan to achievements of the air quality objective.

A further review will also be expected to be completed for the purposes of the Act before the target date of 2005.

This study will carry out a second stage review and assessment of air quality in Wycombe District in the light of air quality objectives set out in the National Air Quality Strategy and determine what, if any, further action is required.

# Chapter 1

# Carbon Monoxide

### *Introduction*

Carbon monoxide (CO) is produced by the incomplete combustion of fossil fuels or organic material. Approximately 71% of UK emissions of CO are emitted from motor vehicles and hence the highest concentrations are generally close to busy roads and in enclosed spaces such as multi-storey car parks.

### *Standard and Objective for Carbon Monoxide*

The national air quality standard for CO is 10 ppm as a running 8-hour mean, with a specific objective for the standard to be achieved by 2005.

### *Monitoring*

Carbon monoxide monitoring is being carried out within Wycombe District. Automated continuous monitoring has been happening since 1996 at an urban background site in central High Wycombe. This site was set up to the criteria of the Department of the Environment's automated urban monitoring network (AUN) of the time. The results are presented in Table 3.

**Table 3: Carbon monoxide concentrations at Wycombe Abbey.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Wycombe Abbey | Maximum 8 hour mean | 4.0 ppm | 3.1 ppm | 3.3 ppm |

*See Appendix for monitoring specifications

Two automated kerbside monitoring sites were also established in 1996. These employ electrochemical cell systems to measure levels. The two sites were chosen to look at the worst case scenarios for kerbside traffic pollution within the District although not intended to reflect human exposure. The sites are at Handy Cross roundabout (junction 4, M40) and on Abbey Way (A40). The results are presented in Tables 4 & 5.

**Table 4: Carbon monoxide concentrations at Handy Cross.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Handy Cross Roundabout (M40) | Maximum 8 hour mean | 4.6 | 5.0 | 3.2 |

*See Appendix for monitoring specifications

**Table 5: Carbon monoxide concentrations at Abbey Way (A40).**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Abbey Way (A40) | Maximum 8 hour mean | 5.1 | 5.5 | 3.7 |

*See Appendix for monitoring specifications

The results indicate that even at the kerbside locations that the maximum 8 hour means are well within the 10 ppm standard.

### *Modelling*

The concentrations of pollutants at kerbside locations are determined using the Design Manual for Roads and Bridges (DMRB) as a screening model. The version of DMRB used is the current updated version, which provides for comparison with the national air quality standards.

The first stage review and assessment specified looking at roads with or by 2005 traffic flows of over 50000 vehicles per day. The only identified road was the M40 motorway. Traffic data are presented for 1996 – the most recent year for which a complete data set is available.

The models have been used to predict carbon monoxide concentrations for:

- 1996, present case;
- 2005, assuming that the projected volume will be 25% larger than it is today

The concentrations at the kerbside were estimated using the Design Manual for Roads and Bridges (DMRB). The 1996 and 2005 maximum 8 hour concentrations at the kerbside are presented in Table 6. There are no exceedances of the national air quality standard for carbon monoxide.

**Table 6: Annual average and 8 hour running average concentration for carbon monoxide predicted in the Wycombe District Council area.**

| Road Sector | Average traffic flow (veh/h) | Proportion of HDV (%) | Speed (km/h) | Annual average concentration of CO (ppm) | | Maximum running annual 8 hour mean (ppm) | |
|---|---|---|---|---|---|---|---|
| | | | | Present | 2005 | Present | 2005 |
| **Motorway** | | | | | | | |
| M40 (J3-J4) | 2119 | 9 | 110 | 0.6 | 0.3 | 5.8 | 3.2 |
| M40 (J4-J5) | 1869 | 9 | 110 | 0.5 | 0.3 | 5.3 | 3.0 |

### *Summary*

It is concluded that the National strategy objective for carbon monoxide is likely to be achieved by 2005. There is no need to progress to a third stage review and assessment for this pollutant.

# Chapter 2

# Sulphur Dioxide

### *Introduction*

Sulphur dioxide is a corrosive acid gas, which combines with water vapour on the atmosphere to produce acid rain. The principal source of this gas is power stations burning fossil fuels that contain sulphur. Major sulphur dioxide problems now only tend to occur in cities which coal is still widely used for domestic heating, in industry and in power stations.

Both wet and dry depositions have been implicated in the damage and destruction of vegetation and in the degradation of soils, building materials and watercourses. Sulphur dioxide in ambient air is also associated with asthma and chronic bronchitis.

### *Standard and Objective for Sulphur Dioxide*

The Government has adopted a 15 minute average of 100ppb as an air quality standard for sulphur dioxide, with a specific objective for the standard to be achieved as the $99.9^{th}$ percentile (on all but 35 periods of 15 minutes per year), by the end of 2005.

### *Monitoring*

Sulphur dioxide monitoring is being carried out within Wycombe District. Automated continuous monitoring has been happening since 1996 at an urban background site in central High Wycombe. This site was set up to the criteria of the Department of the Environment's automated urban monitoring network (AUN) of the time. The results are presented in Table 7.

**Table 7: Sulphur Dioxide concentrations at Wycombe Abbey.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Wycombe Abbey | Maximum 15 minute mean | 50 ppb | 99 ppb | 111 ppb |

*See Appendix for monitoring specifications

The results indicate that although the maximum 15 minute mean exceeded 100 ppb standard in the last year of monitoring, the number of exceedances was only 2 and was therefore well within the 35 allowed.

### *Modelling*

Modelling of annual mean winter maximum sulphur dioxide concentrations was undertaken for Chiltern District Council by NETCEN for a stage 1 and 2 review and assessment report. This highlighted Prices Risborough and to some extent High Wycombe as hotspots for sulphur dioxide winter maximums. The data to undertake this modelling was taken from the 1996 National Atmospheric Emissions Inventory (NAEI) with results calculated on a 1km x 1km grid using the dispersion model ADMS 2.2.

These hotspots are the areas that were indicated in the Stage 1 review, which looked at the Internet map displaying NAEI data on a regional basis. The data used in forming the inventory has assumed emissions from small industrial plant, emissions from coal combustion in domestic grates and commercial sources.

Local information indicates that the assumptions made are incorrect. High Wycombe is a smoke control area and so domestic coal combustion is not an issue. Commercial sources are covered by the smoke control regime. There are no significant fuel oil or solid fuel combustion sources within High Wycombe. Princes Risborough is not a smoke control area and so domestic combustion occurs. However, coal burning on domestic grates is not significant and wood burning is a common fuel for where domestic burning takes place. There are no major fuel oil or solid fuel combustion sources in Princes Risborough.

***Summary***

There are currently no significant sources of sulphur dioxide within Chiltern District Council nor are there any planned developments of processes emitting significant amounts of sulphur dioxide. The report concludes that it is likely that emissions of sulphur dioxide from point sources within or close to the District are insignificant. There is no need to progress to a third stage review and assessment.

# Chapter 3

# Nitrogen Dioxide

### *Introduction*

Nitrogen oxides are formed during high temperature combustion processes from the oxidation of nitrogen in the air or fuel. The principal source of nitrogen oxides – nitric oxide and nitrogen dioxide – is road traffic, which is responsible for approximately half the emissions in Europe. Therefore nitrogen oxide concentrations are greatest in urban areas where traffic is heaviest. Other important sources are power stations, heating plants and industrial processes.

Nitrogen dioxide has a variety of environmental and health impacts. It is a respiratory irritant, may exacerbate asthma with possible increase in susceptibility to infections. In the presence of sunlight, it reacts with hydrocarbons to produce photochemical pollutants such as ozone. Nitrogen oxides can also contribute to acid deposition by the formation of nitric acid in the atmosphere.

### *Standard and Objective for Nitrogen Dioxide*

The Government has adopted a 1-hour average of 150 ppb as an air quality standard for nitrogen dioxide, with a specific objective for the standard to be achieved as the hourly maximum by the year 2005. The Government has also adopted an annual average of 21 ppb as an air quality standard with a specific objective to achieve this by the year 2005.

### *Monitoring*

Nitrogen Dioxide monitoring is being carried out within Wycombe District. Automated continuous monitoring has been happening since 1996 at an urban background site in central High Wycombe. This site was set up to the criteria of the Department of the Environment's automated urban monitoring network (AUN) of the time. The results are presented in Table 8.

**Table 8: Nitrogen Dioxide concentrations at Wycombe Abbey.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Wycombe Abbey | Annual Average | 15 ppb | 18 ppb | 15 ppb |
| | Maximum 1 hour mean | 76 ppb | 62 ppb | 51 ppb |

*See Appendix for monitoring specifications

Two automated kerbside monitoring sites were also established in 1996. These employ electrochemical cell systems to measure levels. The two sites were chosen to look at the worst case scenarios for kerbside traffic pollution within the District although not intended to reflect human exposure. The sites

are at Handy Cross roundabout (junction 4, M40) and on Abbey Way (A40). The results are presented in Tables 9 & 10.

**Table 9: Nitrogen dioxide concentrations at Abbey Way (A40).**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Abbey Way (A40) | Annual Average | 32 ppb | 37 ppb | 35 ppb |
| | Maximum 1 hour mean | 95 ppb | 148 ppb | 78 ppb |

*See Appendix for monitoring specifications

**Table 10: Nitrogen dioxide concentrations at Handy Cross.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Handy Cross Roundabout (M40) | Annual Average | 43 ppb | 49 ppb | 35 ppb |
| | Maximum 1 hour mean | 128 ppb | 165 ppb | 100 ppb |

*See Appendix for monitoring specifications

The continuous monitoring results at Wycombe Abbey indicate that urban background sites are within both the standards for nitrogen dioxide. At the kerbside locations the annual mean of 21 ppb is exceeded yearly. The 150 ppb hourly maximum was exceeded at Handy Cross in 1997/98.

**Table 11: Diffusion Tube Monitoring Results for High Wycombe.**

| High Wycombe | Type of site | 1997* | 1998 | 1999** |
|---|---|---|---|---|
| Bassetsbury Lane | Background | 11 | 15 | 14 |
| Turnpike Road | Kerbside | 19 | 23 | 21 |
| Cressex Road | Kerbside | | | |
| West Wycombe Road | Roadside | | 20 | 20 |
| Plomer Hill | Kerbside | 15 | 20 | 19 |
| Amersham Road | Kerbside | 24 | 23 | 24 |
| Hughenden Road | Kerbside | 23 | 22 | 21 |
| Wycombe Abbey | Background | 14 | 17 | 16 |
| West Wycombe Road (Chapel Lane) | Kerbside | | | 24 |
| West Wycombe Road (Copperfields) | Roadside | | | 14 |
| John Hall Way (Chalfont Way) | Background | | | 18 |
| John Hall Way (Lansdowne Way) | Kerbside | | | 27 |
| Marlow Hill | Kerbside | | | 21 |
| Marlow Hill (Wordsworth Road) | Background | | | 19 |
| Amersham Hill | Kerbside | | | 30 |
| Amersham Hill (Shrubbery Road) | Background | | | 12 |
| Hazlemere (Amersham Road) | Kerbside | | | 26 |
| Hazlemere (Amersham Road) | Background | | | 16 |
| Hazlemere (Roberts Ride) | Background | 10 | 11 | 12 |
| London Road (Laurel Drive) | Kerbside | | | 29 |
| London Road (Laurel Drive) | Background | | | 20 |
| London Road (Micklefield Road) | Kerbside | | | 23 |
| London Road (Queens Road) | Kerbside | | | 25 |
| London Road (Queens Road) | Background | | | 17 |
| Desborough Street | Kerbside | | | 29 |

*The average is not calculated from a full years data
**The average is of the year thus far

**Table 12: Diffusion Tube Monitoring Results .**

| Location | Type of site | 1997* | 1998 | 1999** |
|---|---|---|---|---|
| Marlow | | | | |
| High Street | Roadside | 16 | 17 | 17 |
| Globe Park | Kerbside | 22 | 23 | 22 |
| Wycombe Road | Roadside | 16 | 18 | 17 |
| Stokenchurch | | | | |
| Oxford Road | Kerbside | 24 | 21 | 19 |
| Junction 5 M40 | Roadside | 20 | 22 | 23 |
| Slade Road | Background | | | 17 |
| Bourne End | | | | |
| Wakeman Road | Background | 14 | 17 | 17 |
| The Parade | Kerbside | | | 36 |
| West Wycombe Village | | | | |
| High Street | Kerbside | 25 | 25 | 25 |
| Bradenham Road | Kerbside | 25 | 23 | 20 |
| Lane End | Background | 12 | 13 | 13 |
| Wheeler End (M40) | Roadside | | | |
| Wooburn Green | Kerbside | 24 | 22 | 21 |
| Flackwell Heath | Roadside | 17 | 19 | 19 |
| Loudwater | Roadside | 17 | 23 | 23 |
| Princes Risborough | Kerbside | 17 | 22 | 17 |
| Walters Ash | Roadside | 15 | 16 | 13 |
| Great Kingshill | Roadside | 15 | 13 | 14 |
| Hambleden | Kerbside | 8 | 13 | 11 |

*The average is not calculated from a full years data
**The average is of the year thus far

The nitrogen dioxide monitoring programme has been further extended using passive diffusion tubes, which provide average levels of nitrogen dioxide during their exposure. This method of monitoring allows comparison with the annual average standard of 21ppb (Tables 11 & 12).

Government guidance states that due to national emissions reductions up to 2005, concentrations of nitrogen dioxide are likely to decrease significantly up to 2005. Consequently, a1996 nitrogen dioxide concentration of 30ppb at urban background sites is likely to meet the nitrogen dioxide objective of 21ppb in 2005.

The results of the diffusion tube monitoring that none of the sites with complete data sets are close to the 30 ppb level. Some of the sites with a very limited monitoring period show levels above 30 ppb but these are kerbside sites. Further monitoring at these sites will define more precisely the annual average levels.

***Modelling***

The concentrations of pollutants at kerbside locations are determined using the Design Manual for Roads and Bridges (DMRB) as a screening model. The version of DMRB used is the current updated version, which provides for comparison with the national air quality standards.

The first stage review and assessment specified looking at roads with or by 2005 traffic flows of over 20000 vehicles per day. Identified roads were the M40 motorway, A404 and A40. Traffic data are presented for 1996 to 1998 as the most recent year for which a complete data set is available. Details are presented in Table 13.

The models have been used to predict carbon monoxide concentrations for:

- 1996-1998 (depending on data available), present case;
- 2005, assuming that the projected volume will be 25% larger than it is today

The concentrations at the kerbside were estimated using the Design Manual for Roads and Bridges (DMRB). The present case and 2005 maximum hourly concentrations and annual average concentrations at the kerbside are presented in Table 13. All of the sites where DMRB has been applied are predicted to exceed the 21 ppb annual average in 2005. The only exceedances of 150 ppb maximum hourly average predicted to occur in 2005 are kerbside of the M40 motorway. In fact there is a good similarity between the predicted nitrogen dioxide levels kerbside at the M40 for 1996 and the monitored results at Handy Cross (Junction 4).

**Table 13: Annual average and maximum hourly average concentration for nitrogen dioxide predicted in the Wycombe District Council area.**

| Road Sector | Average traffic flow (veh/h) | Proportion of HDV (%) | Speed (km/h) | Annual average concentration of NO2 (ppb) | | Maximum hourly concentration of NO2 (ppb) | |
|---|---|---|---|---|---|---|---|
| | | | | Present | 2005 | Present | 2005 |
| Motorway | | | | | | | |
| M40 (J3-J4) | 2119 | 9 | 110 | 43 | 33 | 216 | 166 |
| M40 (J4-J5) | 1869 | 9 | 110 | 42 | 32 | 208 | 158 |
| Dual Carriageway | | | | | | | |
| A404 Marlow Bypass | 909 | 9 | 110 | 36 | 24 | 180 | 118 |
| A404 | | | | | | | |
| Hazlemere | 1102 | 5 | 30 | 34 | 28 | 172 | 139 |
| Terriers/Arnison Avenue | 741 | 5 | 30 | 31 | 24 | 156 | 120 |
| Arnison Avenue/ Hamilton Road | 786 | 5 | 30 | 33 | 25 | 165 | 124 |
| Hamilton Road/ Amersham Hill | 568 | 5 | 40 | 29 | 21 | 145 | 106 |
| Handy X/Marlow Hill | 559 | 5 | 60 | 29 | 19 | 147 | 97 |
| A40 East | | | | | | | |
| Loudwater/Abbey Barn Lane | 757 | 5 | 30 | 30 | 24 | 149 | 122 |
| Abbey Barn Lane/ Micklefield | 1005 | 5 | 30 | 33 | 27 | 167 | 135 |
| Micklefield/ Hatters Lane | 774 | 5 | 30 | 31 | 24 | 154 | 122 |
| Hatters Lane/Rye | 766 | 5 | 30 | 29 | 23 | 147 | 115 |
| Abbey Way | 753 | 5 | 30 | 30 | 23 | 149 | 116 |
| A40 West | | | | | | | |
| Pedestal/Chapel Lane | 982 | 5 | 40 | 32 | 26 | 162 | 128 |
| Chapel Lane/Plomer Hill | 639 | 5 | 30 | 29 | 23 | 144 | 113 |
| Plomer Hill/Pastures | 704 | 5 | 40 | 29 | 22 | 144 | 112 |
| Pastures/Oxford Road | 850 | 5 | 30 | 32 | 25 | 158 | 125 |

***Summary***

Monitoring data shows that current nitrogen dioxide concentrations are currently exceeding the 21 ppb annual average objective for nitrogen dioxide. With the forecast reduction in nitrogen oxide emissions the DMRB calculations indicate that there will still be exceedances of the annual average objective in 2005 at kerbside locations. There are no predicted exceedances of the maximum hourly objective predicted at any location in 2005.

The conclusion is that based on modelling and monitoring data, a third stage review and assessment will be required to be undertaken.

# Chapter 4

# Particulate Matter (PM10)

### *Introduction*

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. PM10 particles are those fraction, which are less than 10µm in size, and are the major current concern because they are small enough to penetrate deep into the lungs and so potentially pose significant health risks.

Major sources of primary particles (those emitted directly into the atmosphere) are combustion processes, in particular diesel combustion. Secondary particles are formed when low volatility products are generated in the atmosphere. The atmospheric lifetime of particulate matter is strongly related to particle size, but may be as long as 10 days for particles of about 1µm in diameter. The principal sources of airborne PM10 particles in European cities is road traffic emissions, particularly from diesel vehicles. As well as creating dirt, odour and visibility problems, PM10 particles are associated with health effects including increased risk of heart and lung disease. In addition they may carry surface-absorbed carcinogenic compounds into the lungs.

### *Standard and Objective for Particulate Matter*

The Government has adopted a running 24-hour average of 50µg/m3 as an air quality standard for PM10, with a specific objective for the standard to be achieved as the annual 99$^{th}$ percentile of daily maximum running 24-hour averages (no more than four days exceeding the standard in a year), by the end of 2005.

### *Monitoring*

Particulate matter monitoring using a TEOM is being carried out within Wycombe District. Automated continuous monitoring has been happening since 1996 at an urban background site in central High Wycombe. This site was set up to the criteria of the Department of the Environment's automated urban monitoring network (AUN) of the time. The results are presented in Table 14.

**Table 14: PM10 concentrations at Wycombe Abbey.**

| Site | Standard | 1996/97 | 1997/98 | 1998/99 |
|---|---|---|---|---|
| Wycombe Abbey | Annual Average | 16 µg/m$^3$ | 17 µg/m$^3$ | 15 µg/m$^3$ |
| | Percentile within 24 hour running mean | 98.9 % | 99.9 % | 99.9 %µg/m$^3$ |

### *Modelling*

The concentrations of pollutants at kerbside locations are determined using the Design Manual for Roads and Bridges (DMRB) as a screening model. The version of DMRB used is the current updated version, which provides for comparison with the national air quality standards.

The first stage review and assessment specified looking at roads with or by 2005 traffic flows of over 25000 vehicles per day. Identified roads were the M40 motorway, A404 and A40. Traffic data are presented for 1996 to 1998 as the most recent year for which a complete data set is available. Details are presented in Table 15.

The models have been used to predict carbon monoxide concentrations for:

- 1996-1998 (depending on data available), present case;
- 2005, assuming that the projected volume will be 25% larger than it is today

The concentrations at the kerbside were estimated using the Design Manual for Roads and Bridges (DMRB). The present case and 2005 maximum hourly concentrations and annual average concentrations at the kerbside are presented in Table 15.

**Table 15: The 24 hour running average concentration for PM10 predicted in the Wycombe District Council area.**

| Road Sector | Average traffic flow (veh/h) | Proportion of HDV (%) | Speed (km/h) | Annual average concentration of PM10 (ug/m3) | | 99th percentile of 24 hour running average (ug/m3) | |
|---|---|---|---|---|---|---|---|
| | | | | Present | 2005 | Present | 2005 |
| **Motorway** | | | | | | | |
| M40 (J3-J4) | 2119 | 9 | 110 | 28 | 19 | 83 | 57 |
| M40 (J4-J5) | 1869 | 9 | 110 | 27 | 19 | 80 | 56 |
| **Dual Carriageway** | | | | | | | |
| A404 Marlow Bypass | 909 | 9 | 110 | 24 | 18 | 73 | 53 |
| **A404** | | | | | | | |
| Hazlemere | 1102 | 5 | 30 | 25 | 19 | 73 | 56 |
| Terriers/Arnison Avenue | 741 | 5 | 30 | 24 | 18 | 71 | 54 |
| Arnison Avenue/ Hamilton Road | 786 | 5 | 30 | 25 | 18 | 75 | 54 |
| Hamilton Road/ Amersham Hill | 568 | 5 | 40 | 23 | 17 | 69 | 52 |
| Handy X/Marlow Hill | 559 | 5 | 60 | 21 | 17 | 63 | 51 |
| **A40 East** | | | | | | | |
| Loudwater/Abbey Barn Lane | 757 | 5 | 30 | 23 | 18 | 68 | 54 |
| Abbey Barn Lane/ Micklefield | 1005 | 5 | 30 | 24 | 18 | 72 | 55 |
| Micklefield/ Hatters Lane | 774 | 5 | 30 | 23 | 18 | 69 | 54 |
| Hatters Lane/Rye | 766 | 5 | 30 | 23 | 18 | 67 | 53 |
| Abbey Way | 753 | 5 | 30 | 23 | 18 | 68 | 53 |
| **A40 West** | | | | | | | |
| Pedestal/Chapel Lane | 982 | 5 | 40 | 23 | 18 | 70 | 55 |
| Chapel Lane/Plomer Hill | 639 | 5 | 30 | 22 | 18 | 67 | 53 |
| Plomer Hill/Pastures | 704 | 5 | 40 | 22 | 18 | 66 | 53 |
| Pastures/Oxford Road | 850 | 5 | 30 | 23 | 18 | 70 | 54 |

The DMRB estimates predict that in 2005 there will be exceedance of the 99$^{th}$ percentile of the 50 µg/m3 standard kerbside for all the locations. The greatest exceedance are obviously seen at the motorway sites.

The revised National Air Quality Strategy is recommending that the EU Air Quality Daughter Directive objectives for PM10 are adopted. These are a 24 hour limit value of50 µg/m3, not to be exceeded more than 35 times per year, and an annual limit value of 40 µg/m3. These limit values are to be achieved by the 1$^{st}$ January 2005. The Daughter Directive specifies that the reference method for determining compliance is to be the gravimetric measuring method in contrast to the TEOM method used to determine compliance with the 1997 objective.

Using the methodology laid out in the DETR guidance on "Assistance with the review and assessment of PM10 concentrations in relation to the proposed EU Stage 1 Limit Values" the worst case scenario identified using DMRB has been recalculated (see Appendix 2). The result is that there would not be an exceedance of the 24 hour mean objective (90$^{th}$ percentile) or the annual mean objective and thus we would expect all kerbside locations within the District to meet the proposed EU objectives.

***Summary***

Monitoring data indicates that the running 24-hour average of 50µg/m3 is currently and will be met in urban background locations.

The DMRB modelling has indicated that at all kerbside locations assessed there will be exceedance of the running 24-hour average of 50µg/m3 99$^{th}$ percentile objective. However, modelling using the proposed EU Air Quality Daughter Directive objectives has indicated that there will not be any exceedances when this is adopted.

The conclusion however, is that due to modelled exceedances of the current objective a third stage assessment is undertaken for PM10.

## Recommendations

### *Carbon Monoxide*

It is concluded that the National Air Quality Strategy objectives for carbon monoxide will be achieved in 2005. There is no need to progress to a more detailed third stage review and assessment for this pollutant.

### *Sulphur Dioxide*

Monitoring indicates that National Air Quality Strategy objective will not be exceeded in 2005. There are no significant point or diffuse sources of sulphur dioxide emissions within or close by to Wycombe District. It is concluded that the National Air Quality Strategy objectives for sulphur dioxide will be achieved in 2005.

### *Nitrogen Dioxide*

Monitoring data shows that nitrogen dioxide concentrations in most areas meet the National Air Quality Strategy objectives for nitrogen dioxide. However there are concerns regarding locations near to the motorway and the main roads through High Wycombe. Modelling has concentrated on these kerbside locations and indicates that the annual mean objective will not be met in 2005 despite the forecast reduction in nitrogen oxide emissions.

It is concluded that the nitrogen dioxide objectives particularly the annual mean will not be met in some locations. Thus, a third stage review and assessment will be required to be undertaken for nitrogen dioxide.

### *PM10*

Monitoring does not indicate that there will be exceedance of the National Air Quality Strategy objective at urban background locations. Modelling at kerbside locations does indicate exceedance of the PM10 objective.

However, the Government have proposed changes to the national air quality objective for PM10. It was found that European sources of particulate matter were important and that a local authority was limited to what action it could take to control levels of PM10. The Government has therefore proposed that the current objective is replaced with the proposed EC Air Quality Daughter Directive Stage 1 limit value. This will have the effect of air quality management areas declared for PM10 would be significantly reduced as a result. Modelling using the revised methodology indicates that neither of the EU objectives would be exceeded in Wycombe District.

It is concluded that precautionary principle is followed and that a third stage review and assessment is undertaken based on the current National Air Quality Strategy objective.

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# Appendices

## *Appendix 1: Technical data*

There are three continuous monitoring sites that have provided data for this report. The performance criteria and calibration regime for each one is outlined below.

**Air Monitoring Station**
Type approved analysers. Monitor labs models, TEOM. calibration procedure

**Roadside Pollution Monitor**

***Performance at 20$^{o}$C***

| Reading Range | CO | NO2 |
|---|---|---|
| 100ppb | | +-12.5% |
| 200ppb | | +-7.5% |
| >300ppb | | +-5% |
| 1ppm | +-10% | |
| >5ppm | +-5% | |

***Operating Temperature***

-10$^{o}$C to +40$^{o}$C

***Calibration Procedure***

Auto-zero interval - 1 week
Auto-zero period - 76 mins

## *Appendix 2: PM10 EU Stage 1 limit calculation*

The *Assistance with the review and assessment of PM10 concentrations in relation to the proposed EU Stage 1 Limit Values* report produced for the DETR outlines a methodology to use the DMRB methodology to calculate the 90$^{th}$ percentile of the 24 hour fixed mean using gravimetric analysis. The objective is 50µg/m3 to be achieved by the end of 2004.

This figure is achieved by calculating the annual mean using gravimetric analysis and using a multiplication factor to estimate the 90$^{th}$ percentile of daily means. The equation is:

PM10 (90$^{th}$ percentile of daily means) = PM10 (annual mean) x 1.79.

Thus the proposed 24 hour objective is unlikely to be exceeded if the annual mean concentration is below 28µg/m3, gravimetric.

There is also an annual mean objective of 40µg/m3.

### Calculation

From the DMRB calculations we can see that the highest indicated PM10 levels at a kerbside location are along the M40 motorway between junctions 3 and 4. This data is applied to the revised methodology.

The methodology suggests using an annual mean background value measured with a TEOM in the calculation. However, the original DMRB calculations used the default value of 20µg/m3, which is actually higher than our own TEOM measured background value. Thus, to pursue the worst case scenario the default value was used.

The default background is assumed to be a TEOM based figure for 1996. This is multiplied by 1.3 to give the equivalent gravimetric value of 26µg/m3.

The local primary PM10 is calculated for 1996, which is 6.5µg/m3. The primary PM10 is then calculated for 2004 (4.2µg/m3).

The secondary PM10 for 2004 is calculated from the value on the internet map for the 1996 secondary PM10. This is 7.5µg/m3.

The total background concentration in 2004 is then calculated by adding the primary, secondary and coarse components together. The coarse component is assumed to stay constant at 10.5µg/m3.

The total background concentration for 2004 is predicted to be 22.2µg/m3, gravimetric. This is within the 28µg/m3 value that would indicate exceedance of the 90$^{th}$ percentile objective.