City of Bradford Metropolitan District Council

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# *Updating and Screening Assessment of Air Quality 2006*

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2020 VISION

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City of BRADFORD METROPOLITAN DISTRICT COUNCIL

# Contents

# Introduction

The Environment Act 1995 laid the foundations for a nationwide system of Local Air Quality Management (LAQM) in which local authorities are required to review and assess the air quality in their areas, and to take action where the air quality objectives are at risk of being breached. This system is an integral part of delivering the air quality objectives set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

This report has been prepared by The City of Bradford Metropolitan District Council's (CBMDC) Department of Environmental Services as part of the process of reviewing and assessing the local air quality within the District. This report forms an Updating and Screening Assessment which is the first stage in the third round of air quality reviews and assessments by local authorities. A Detailed Assessment will be made of any pollutants or specific locations that are identified as requiring further work. The Government expect that local authorities should undertake reviews and assessment of air quality every three years.

This updating and screening assessment of air quality not only fulfils The City of Bradford Metropolitan District Council's statutory duty under The Environment Act 1995 it also aims to achieve an integral part of the Councils vision:

> *To work with our partners and communities to make the District one to be proud of, improve the quality of life for all residents, and become a high performing Council within five years.*

This vision is complimented by, and works towards, Bradford Council's local strategic partnership, 2020 Vision, which has the main aim of developing a long term vision for the district which includes achieving a district which is 'clean, healthy, safe and has excellent public services'. In order to realise this vision the Council has produced a corporate plan which highlights six corporate priorities. The relevant corporate priority relating to air quality is *'Improving the Environment'*. The Environmental Health Division works towards this corporate priority within the Department of Environmental Services. However, air quality is not only dealt with by Environmental Health, it is most effectively dealt with as a corporate issue. Air quality is therefore also taken into account in other policy areas such as transport and the Local Transport Plan, land-use planning and Agenda 21.

## Summary of previous reviews and assessments of air quality

The first round of review and assessment of air quality in the Bradford District was carried out as a staged process in accordance with DETR technical guidance. The results of this process were submitted to DETR in December 2000 and were subsequently accepted.

The conclusions of the first round of review and assessment were as follows:

***Stage 1: (1999)***

- That a progression to a second stage of review and assessment was required for lead, nitrogen dioxide, sulphur dioxide, $PM_{10}$ and carbon monoxide.
- That the risk of the air quality objectives being exceeded was negligible for benzene and 1, 3-butadiene and a second or third stage of review and assessment was not required.

***Stage 2 and 3: (2000)***

- That the risk of the air quality objectives being exceeded was unlikely for carbon monoxide and sulphur dioxide.
- It was concluded that although it was unlikely that the objective for lead would be exceeded further work would be required to assess lead emissions from one particular industrial source, however the company in question ceased operation shortly after completion of the stage three review.
- It was considered that although it was unlikely that the $PM_{10}$ objective would be exceeded, further work would be required to develop an accurate and robust model to predict $PM_{10}$ levels in the district.
- It was concluded that it was unlikely that the nitrogen dioxide objective would be exceeded. However, a number of limitations to the assessment were discussed and there were proposals for further work which included more monitoring and improvements in model bias and uncertainty.

The conclusions of the second round of review and assessment were as follows:

***Updating and Screening Assessment: (2003)***

- There is no need to progress to a detailed assessment for carbon monoxide, benzene, 1,3-butadiene or lead.
- It is considered necessary to proceed to a detailed assessment for nitrogen dioxide as there are 12 locations that require further assessment before a decision is to made as to whether it will be necessary to declare one or more air quality management areas.
- Although it is considered there is no need to progress to a detailed assessment for sulphur dioxide, further work is required to assess the contribution from the steam trains that run between Haworth and Keighley. This work will be reported as an appendage to the detailed assessment that will be produced by this authority for nitrogen dioxide next year.

- Although it is considered there is no need to progress to a detailed assessment for $PM_{10}$, further work is required to assess the contribution from Buck Park Quarry which is a possible fugitive source of $PM_{10}$. Also, an investigation into the lower than expected readings for $PM_{10}$ will be completed. This work will be reported as an appendage to the detailed assessment that will be produced by this authority for nitrogen dioxide next year.

***Detailed Assessment: (2005)***

Fine Particles $PM_{10}$

- The investigation into the lower than expected readings for $PM_{10}$ has been completed. The investigation identified an error in the offset factors used for the TEOM data and the data has now all been corrected. Concentrations are now more in line with what would be expected at the sites where $PM_{10}$ is currently being monitored.

- It has been found that it is very unlikely that Buck Park Quarry (which is a fugitive $PM_{10}$ source) is the cause of an exceedance of the objective for $PM_{10}$.

Sulphur Dioxide

- At the present time using all the information available it is unlikely that there are any exceedances of the sulphur dioxide objective within the District. The steam trains at Keighley have been investigated thoroughly using continuous monitoring and it has been found that no exceedance is currently being caused as a result of their operations. However, it will be necessary to inform the operators that any changes in fuel type, journey duration or frequency may require the issue to be reinvestigated.

Nitrogen Dioxide

- The investigation into nitrogen dioxide at 12 sites has discounted the need for an air quality management area declaration at 8 of the sites, as it has been found that it is unlikely that the objective will be exceeded.

- It is the intention of this local authority to declare air quality management areas to include the following four areas of exceedance of the annual objective for nitrogen dioxide:

    - Mayo Avenue/ Manchester Road junction, Bradford
    - Thornton Road, Bradford
    - Shipley Airedale Road/ Church Bank junction, Bradford
    - Manningham Lane/ Queens Road junction, Bradford

## Aims and Objectives

### *The Aims of this Updating and Screening Assessment are:*

- To investigate present and likely future air quality in the City of Bradford Metropolitan District area.
- To assess air quality in relation to the seven pollutants prescribed in the Air Quality Regulations 2000 and the Air Quality (Amendment) Regulations 2002. The pollutants of concern are carbon monoxide, 1,3-butadiene, benzene, sulphur dioxide, nitrogen dioxide, fine particles ($PM_{10}$) and lead.

### *The Objectives of this Updating and Screening Assessment are:*

- To identify those matters that have changed since the last review and assessment, which might lead to a risk of an air quality objective being exceeded.
- To update the new monitoring data collected since the last round of Review and Assessment.
- To assess the likelihood of exceeding the new objectives not included in the last round of Review and Assessment.
- To identify whether or not it will be necessary to progress to a detailed assessment of air quality in relation to any of the seven prescribed pollutants.

## Air Quality and Health

The main reasons for tackling poor air quality are the link between air quality, quality of life and the need to minimise the risk of poor air quality to human health. We now have a better understanding of the short-term and the long-term health effects of air pollution largely due to the work undertaken by the Committee on the Medical Effects of Air Pollutants (COMEAP).

Short-term increases in particles, sulphur dioxide and nitrogen dioxide are associated with increased deaths brought forward, and increases in respiratory and cardiovascular hospital admissions in the elderly and those who are already ill. These pollutants can also worsen symptoms in those with asthma. COMEAP has also recently reported that long-term exposure to particles is associated with reduced life expectancy mainly as a result of earlier deaths from heart disease. Carbon monoxide increases symptoms in those with heart disease, and lead affects brain development in children. Benzene and 1,3-butadiene both cause cancer.

## Links to Climate Change

The Government's and the Devolved Administrations' strategic approach to tackling climate change is set out in the UK Climate Change Programme, published in November 2000. It focuses on practical action to reduce emissions up to 2010 and recognises the contribution that local authorities can make by taking forward the local actions needed to cut emissions.

Policies to improve air quality cannot be considered in isolation from those designed to reduce greenhouse gas emissions, as some policies to improve local air quality can often have the added benefit of producing additional carbon savings, and vice versa. For example, policies designed to reduce the impact that transport has on air quality by tackling congestion and encouraging a shift towards public transport, walking and cycling, should also reduce carbon dioxide emissions. Measures to improve energy efficiency and cut energy demand should also reduce the air pollutants that are produced during electricity generation.

## Air Quality Strategy

Government guidance strongly recommends that all authorities, particularly those that have not yet had to designate AQMAs but who have areas close to the exceedance levels, should consider drawing up a local air quality strategy. Bradford MDC will be designating AQMAs at several sites investigated as part of a detailed assessment, however it has been decided that an Air Quality Strategy would still be of benefit to the Authority in addition to Action Plans as a result of the declaration of AQMAs.

Bradford MDC is still at the preliminary stages of drawing up an air quality strategy. An air quality strategy steering group has been set up which includes representatives within the Council from planning, highways, policy and environmental health. It is anticipated that this group will be widened to include external agencies such as the Primary Care Trust, other Council departments such as Leisure Services and other interested parties in the future.

The first aim of the group has been to ensure that information on air quality is distributed throughout relevant departments so that the information is available to all those that might need to use it. It also allows information on relevant air quality matters such as new road developments, EMAS policy or climate change to be distributed within the group. The group are also involved in the designation of AQMAs.

Both the national Air Quality Strategy and planning guidance identify the planning system as one of the key methods for providing improvements in air quality. Policies have been developed between Environmental Services and Development Control to ensure that air quality considerations, which relate to the use and development of land, are capable of being a material consideration. They are as follows:

### Policy P1

Development will not be permitted where it is likely to have an unacceptable effect on air quality. In determining whether or not an unacceptable effect will result, particular consideration will be given to the following issues:

(1) the likely hood of emissions which are likely to have a significantly unacceptable effect on the amenity of the local area;

(2) where there is the significant risk that public health may be adversely affected;

(3) where there is a significant possibility that any proposed development will lead to a breach of national air quality objectives.

An air quality impact assessment may be required before determining applications with a potential to significantly contribute to air pollution.

## Policy P2

Development will not be permitted near to potentially polluting sources, where the proposed development is likely to be subject to unacceptable risk.

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- *16.16 Unacceptable risk will include situations where the development will be subject to emissions in excess of health related Air Quality Standards set by regulatory bodies.*

## Air Quality Objectives

The objectives included in the Air Quality Regulations 2000 and in the Air Quality (Amendment) Regulations 2002 (England and Wales) for the purpose of LAQM are as follows:

| Pollutant | Air Quality Objective | | Date to be Achieved |
|---|---|---|---|
| | Concentration | Measured as | |
| Benzene[1] | 16.25 µg/m$^3$ | running annual mean | 31.12.2003 |
| | 5 µg/m$^3$ | annual mean | 31.12.2010 |
| 1,3 Butadiene | 2.25 µg/m$^3$ | running annual mean | 31.12.2003 |
| Carbon monoxide | 10.0 mg/m$^3$ | Maximum daily running 8-hour mean | 31.12.2003 |
| Lead | 0.5 µg/m$^3$ | Annual mean | 31.12.2004 |
| | 0.25 µg/m$^3$ | Annual mean | 31.12.2008 |
| Nitrogen dioxide[1] | 200 µg/m$^3$ not to be exceeded more than 18 times a year | 1 hour mean | 31.12.2005 |
| | 40 µg/m$^3$ | annual mean | 31.12.2005 |
| Particles ($PM_{10}$) (gravimetric)[2] | 50 µg/m$^3$ not to be exceeded more than 35 times a year | 24 hour mean | 31.12.2004 |
| | 40 µg/m$^3$ | annual mean | 31.12.2004 |
| Sulphur dioxide | 350 µg/m$^3$ not to be exceeded more than 24 times a year | 1 hour mean | 31.12.2004 |
| | 125 µg/m$^3$ not to be exceeded more than 3 times a year | 24 hour mean | 31.12.2004 |
| | 266 µg/m$^3$not to be exceeded more than 35 times a year | 15 minute mean | 31.12.2005 |

1. The objectives for nitrogen dioxide are provisional

2. Measured using the European gravimetric transfer standard or equivalent.

## Public Exposure

The regulations state that likely exceedances of the objectives should be assessed in relation to;

> *'the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present'*

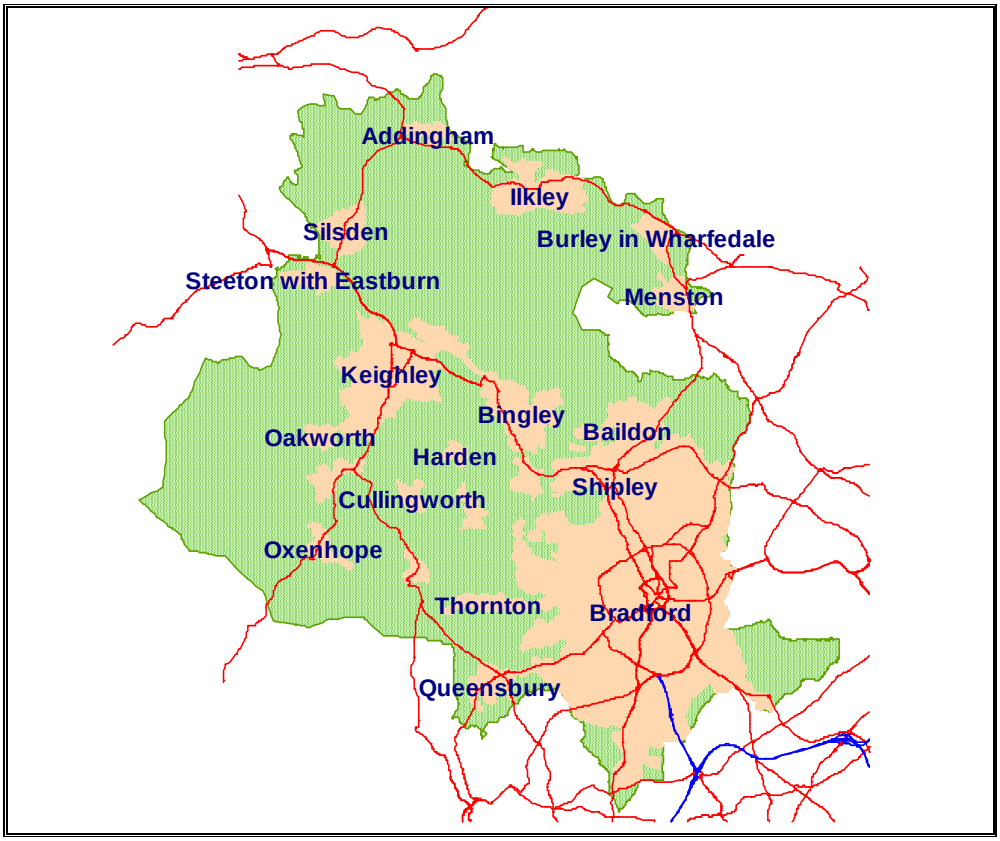
Reviews and Assessments should thus be focused on those locations where members of the public are likely to be **regularly present and are likely to be exposed over the averaging period of the objective:**

- For objectives with short averaging times (sulphur dioxide and the hourly objective for nitrogen dioxide) reviews and assessments should focus on any non-occupational, near ground level outdoor locations where people are likely to be exposed to the pollutant over the short averaging time.

- For objectives with longer averaging times (benzene, 1,3-butadiene, carbon monoxide, $PM_{10}$, lead and the annual objective for nitrogen dioxide) reviews and assessments should be focused on the following; near ground locations; background locations; roadside locations; and other areas of elevated pollutant concentrations where a person might reasonably be expected to be exposed (e.g. in the vicinity of housing, schools or hospitals, etc) over the relevant time of the objective.

## The Bradford Metropolitan District

Map 1




The City of Bradford Metropolitan District Council's area includes five main population areas: the City of Bradford with suburban communities, and the townships of Bingley, Keighley, Ilkley and Shipley. The total population is currently 468,000 (2001 census figures) and is forecast to rise to 511,000 by the year 2011. The District is the most densely populated in West Yorkshire. Approximately 30% of the District is urban. The physiography and topography is varied with moorland and valleys surrounding and penetrating into urban areas. Most population centres are located in the bottom of river valleys or basins.

The District has been declared a Health Action Zone, due to the high incidence of certain causes of mortality and poor health. Deaths from heart disease are more than double the national mean. In some areas the incidence of asthma is significantly raised.

In the early 1950s in the wake of the London smogs, the city was among the first to use local legislation to declare a smoke control area in advance of the Clean Air Act. Since that time some 70% of the district has been subject to smoke control orders using the legislative powers

in the Clean Air Acts of 1957 and 1964. Monitoring records for dark smoke and sulphur dioxide go back to the late 1950s, when a network of volumetric samplers was established to demonstrate the need for the smoke control programme and subsequently its success.

The smoke control programme was suspended in the 1980s as the areas of the district not covered by smoke control orders, being mainly rural in character, were not subject to poor air quality.

The success of the clean air legislation of the 1950s and 1960s has removed the gross pollution of winter smogs, blackened buildings, reduced the incidence of black smoke from industrial chimneys, and ended the palls of hazy smoke which used to cover residential areas due to the burning of coal on open fires.

In the 1990s the focus turned to the invisible pollutants emitted by increasing numbers of vehicles on the road, and from industrial development. The Environmental Protection Act 1990 gave Local Authorities and the Environment Agency powers to control the emissions of air pollution from industry by a system of authorisation to operate. This has now been replaced by the system of Integrated Pollution Prevention and Control (IPPC), and Local Authority Pollution Prevention and Control (LAPPC) introduced by the Pollution Prevention and Control (England and Wales) Regulations 2000, as amended.

# Sources of Air Pollution

## Point sources

These include a diverse group of industrial activities which vary considerably in size and in their release potential. Releases by these sources are usually controlled and occur in the main from fixed stacks or chimneys.

Installations with the greatest release potential (known as A1 installations) are subject to Integrated Pollution Prevention and Control (IPPC). IPPC is administered by the Environment Agency under Part 1 of the Environmental Protection Act 1990, and covers emissions to air, water and land. IPPC installations located in the Bradford Metropolitan District include factories for lead soldering, melting of aluminium, wool scouring and sewage sludge incineration, there are also processes associated with the manufacture of organic chemicals.

Small and medium sized industrial installations are subject to Local Authority Pollution Prevention and Control (LAPPC). LAPPC installations, (known as Part B installations) are regulated by the City of Bradford Metropolitan District Council (CBMDC), under Part 1 of the 1990 Act for emissions to air. Process sectors include power generation, the metal industry and quarries. Local Authority Integrated Pollution Prevention and Control (LA-IPPC), regulates the more complex A2 installations.

Point sources also include coal, oil and gas fired boilers. Larger boilers tend to be associated with authorised IPPC installations. In addition to these there will be a host of smaller boilers associated with schools, colleges, hospitals and commercial buildings.

## Area sources

There are a large number of diffuse, low level sources of pollutants which individually are unlikely to be significant, however when grouped together may contribute significant quantities of emissions to an area. These sources include domestic and commercial combustion of oil and coal. In Bradford and most of the surrounding conurbations, the use of coal is restricted by smoke control orders.

## Uncontrolled and fugitive sources

These include fugitive emissions from industrial processes such as metal foundries. Emissions from the process are uncontrolled and can be released to air via windows, ventilation fans and roof louvres.

Also included will be emissions from outdoor activities such as construction sites, agriculture, quarrying and waste disposal.

## Mobile sources

Combustion of fuel by vehicles on the district's road network will release significant quantities of pollutants. The road network will consist of the main trunk roads and motorways as well as an extensive network of minor roads mostly in residential areas.

Emissions from the network are very variable depending on the number and type of vehicles using the network, and vehicle speeds. This department has benefited from research carried out by our Traffic Studies Unit which has provided data which characterises the volume of traffic, the speed that it is travelling at and information on the proportions of different types of traffic (e.g. percentage HGVs) on most of the districts busier roads.

## Transboundary pollutants

Air quality in the District will be affected by sources located in other administrative areas. Large sources such as regional power stations can have a significant impact many kilometres away from the point of release. Transboundary transport of air pollution for example is a significant source of fine particles ($PM_{10}$). The Airborne Particles Expert Group (APEG) reported that emissions in mainland Europe contribute up to about 20% to annual mean levels of primary particles in the UK.

Ozone is not emitted directly from any manmade source in any significant quantities but arises from chemical reactions in the atmosphere, involving oxides of nitrogen ($NO_X$) and volatile organic compounds (VOCs). These chemical reactions do not take place instantaneously but over several hours or days. Ozone measured at a particular location may therefore arise from VOC and $NO_X$ emissions many hundreds of kilometres away.

# Air Pollution Monitoring

## Monitoring methods and locations

### *Automatic real-time point monitoring*

There are currently three fixed automatic monitoring stations and one mobile station operated in the district. All four sites use Ambirak monitoring systems manufactured by Signal Ambitech. These monitoring stations produce high-resolution measurements for a range of pollutants (see *Table 1*). Oxides of nitrogen, sulphur dioxide and carbon monoxide are measured using chemiluminescent monitors. Particle ($PM_{10}$) measurements are made using Tapered Element Oscillating Membrane (TEOM) samplers.

Table 1 Automatic real-time point monitoring stations sited in the Bradford District

| Site | Pollutants | Monitoring locations |
|---|---|---|
| Bradford Centre | $SO_2$, $NO_X$, CO, $PM_{10}$ | Urban centre |
| Bingley | $NO_X$, $PM_{10}$ | Urban centre |
| Keighley | $NO_X$, $SO_2$, $PM_{10}$ | Urban centre |
| Mobile (Shipley) | $NO_X$, $SO_2$, $PM_{10}$ | Roadside |

The three fixed sites have been located at urban centre sites (i.e. urban locations representative of the typical population exposure in the town or city centre). Maps showing the location of these stations can be found in *Appendix 1*. The mobile station has been sited since February 1999 in Shipley at a roadside location (i.e. less than 5m of a busy road).

The Government station (Bradford Centre) has been operational since November 1997. The two council owned stations at Bingley and Keighley became operational in September 1998.

In addition we also have four StreetNox systems manufactured by Signal Ambitech. This piece of equipment is designed to take real-time measurements of oxides of nitrogen and is of small dimensions so that it can be used at kerbside locations and other sites with limited space. All four units are currently deployed in areas identified as Air Quality Management Areas, those being:

- Mayo Avenue/ Manchester Road junction, Bradford
- Thornton Road, Bradford
- Manningham Lane/ Queens Road junction, Bradford
- Shipley Airedale Road/ Church Bank junction, Bradford

### *Semi-automatic monitoring methods*

Sulphur dioxide and smoke levels were monitored at 4 long-term sites using the 8-port sampler for many years. The 8-port sampler was used to measure the daily average sulphur dioxide levels by pumping air through a chemical solution and subsequent titration. Measuring the reflectance of the exposed filter paper assesses the concentration of smoke. With the exception of smoke stains at the Bradford 6 site all sites have now been discontinued as it is considered that new techniques are more reliable and less labour intensive.

Air lead levels were monitored continuously at five sites between 1993 and 1997 using a non-automatic M-type sampler and a Millipore Aerosol Field Monitor filter of approximately 0.8 micron pore size. The M-type sampler is used to measure a 1-2 week average lead concentration. Monitoring at all of these sites has now been discontinued.

### *Passive sampling methods*

Nitrogen dioxide levels have been measured using passive diffusion tubes at various sites in the district since 1992. In addition to four sites which are part of the UK National Nitrogen Dioxide Network, the authority has undertaken other surveys to obtain a more detailed picture of the spatial variation in nitrogen dioxide levels, including background and roadside sites.

The measurement methodologies used by the Council are comparable to methodologies used in the national survey. Chemical analysis of the tubes is carried out at the West Yorkshire Analytical Services Laboratory in Wakefield.

## Quality Assurance and Quality Control

### *Automatic real-time point monitoring*

The three automatic continuous monitors owned and operated by the City of Bradford Metropolitan District Council are type approved as recommended in LAQM.TG1 (00) *Review and Assessment: Monitoring air quality* and LAQM.TG4 (00) *Review and assessment: Pollutant specific guidance.*

The Council's automatic network is operated by officers trained by the instrument supplier, and the National Environmental Technology Centre (NETCEN), in all aspects of the monitoring process including routine and emergency site operations, field calibration and data ratification. The Bradford Centre Automatic Urban Network (AURN) site is owned and operated by DEFRA. A Central Management and Coordination Unit (CMCU), currently Bureau Veritas on behalf of NETCEN, carry out quality assurance and quality control checks. The Local Site Operator (LSO) is currently the Council's Environmental Health Division.

The monitoring sites have a programme of routine operational checks and programmed fortnightly site visits which include:

- Daily checks on data transfer, telephone lines and analyser operation.
- Daily and monthly checks of data quality.
- Prompt fault reporting and carrying out of repairs under a service agreement with the equipment supplier.
- Fortnightly manual calibration checks, site inspections of equipment status, site safety and security.
- Programmed six-monthly servicing and calibration by equipment suppliers under service agreement.

### *Maintenance systems*

The Council's monitoring network of automatic continuous monitors is maintained in accordance with a schedule essentially similar to that employed for the AURN and affiliated sites. All analysers are maintained and serviced according to manufacturers specifications and have a six-monthly service and recalibration by Signal Ambitech, the suppliers of the equipment. The servicing, calibration, and repair documentation is kept in a central record. Routine maintenance is carried out at the two-weekly calibration site visit, and any faults are recorded with the calibration log for the visit. These records are kept on site and centrally at the department's Scientific and Technical Services Team office.

### *Calibration Routines*

The authority's automatic continuous monitors all have calibration routines similar to that applied to the Bradford Centre AURN site. A zero and span calibration check is performed every two weeks during the site inspection visit. The methodology used is essentially that found in the AURN Local Site Operators Manual issued by NETCEN, and the manufacturer's instruction manual.

The basic steps are:

- Pre-calibration check of the general site condition and status of the analyser, before the zero and span checks are performed.
- Zero check to verify the performance of the analyser in the absence of the gas being monitored.
- Span check to verify the response of the analyser to gas of a known concentration.
- Post calibration check of the general site condition and status of the analyser on completion of all calibration routines.

A record of each analyser zero and span check is fully documented and a record kept on site and centrally.

### *Calibration Gas Standards*

The gases used for on site span calibration checks are supplied by Air Liquide Ltd and are traceable via European Accreditation DIN EN 45001 and DIN EN ISO 900. The tolerance of the nitrogen dioxide and nitric oxide in air mixes is typically ±5%, and for sulphur dioxide in air mix it is typically ±5%.

Zero air is generated internally in the Ambirak, and the scrubbers are changed when necessary according to manufacturer's recommendations and the NETCEN LSO Site Manual for the Ambirak.

### *Data scaling, validation and ratification*

Unscaled data is gathered every hour by an Ambidesk system located in the Scientific and Technical Services Team office. Scaling factors are applied automatically by the Ambidesk software using factors derived during the fortnightly calibration check and the daily automatic internal calibration checks at the Ambirak.

A daily report is generated to allow unusual readings to be identified. Monthly reports are produced for further checks on data capture rates, and any other unusual variations in measured scaled data. The original raw unscaled data is retained on disk at the Ambirak in the event of anomalous scaled data events.

### *Diffusion Tubes*

The diffusion tubes are supplied and analysed by West Yorkshire Analytical Services Laboratory (WYAS) in Wakefield. They participate in the Inter-laboratory comparison scheme used by AEA Technology. The results of this scheme are published annually. The WYAS laboratory currently meets the analytical criteria of the UK network.

The $NO_x$ tubes results taken in recent years have correction factors applied to them before they are used as part of a study. The correction factors are calculated on annual basis using co-exposed $NO_x$ tubes which are located next to the sampling inlet of a continuous monitor. The average result of the tubes and the concentration read by the continuous monitor over the same time period are compared to find the relationship between the two readings.

## Reporting of monitoring data

Information about air pollution measured at the Government owned site in central Bradford can be seen on Ceefax, page 413, and on the Internet at http://www.airquality.co.uk/archive. Data from the three automatic monitoring sites owned by the Council can be seen on the Council website at www.bradford.gov.uk and they are also displayed 24 hours a day on computer screens in the following places:

- The Council Shop, Main Street, Bingley.
- Keighley Information Shop, Town Hall, Keighley.
- Hear to Help, City Hall, Bradford.

At present the screens in Keighley and Bradford are temporarily disconnected due to renovations at the premises concerned. We are currently seeking new locations for these two screens in locations where they are most likely to be seen by maximum numbers of the public.

Air pollution measured at the Government owned station and all the others in the UK Automatic Urban Network are reported annually by the National Environmental Technology Centre.

The National Environmental Technology Centre reports summary data for the UK smoke and sulphur dioxide monitoring site and nitrogen dioxide levels measured at the four UK National Survey sites annually.

# Updating and Screening Assessment of Carbon Monoxide

## Introduction

Carbon monoxide (CO) is a gas formed by the incomplete combustion of carbon containing fuels such as coke. Complete combustion in the presence of sufficient oxygen leads to the production of carbon dioxide, whereas if there is a slight deficiency of oxygen some carbon monoxide is formed. Thus most combustion processes produce some carbon monoxide, depending on the efficiency of the process and the availability of oxygen.

Road transport is the major source of carbon monoxide emissions, and road transport emissions fell by 75% between 1990 and 2004. This was mainly due to increased use of catalytic converters, but also to a lesser extent an increase in the proportion of diesel cars. Emissions from residential fossil fuel use fell by 57% between 1990 and 2004 mainly due to the continued decline in the use of solid fuels in favour of gas and electricity (source UK DEFRA e-Digest environment statistics March 2006).

## Health Effects

Carbon Monoxide is a colourless, odourless gas, which at high concentrations can lead to severe poisoning, resulting in loss of consciousness or, at very high concentrations, death. At lower concentrations it causes the reduction in the oxygen-carrying capacity of the blood (due to the formation of carboxyhaemoglobin in preference to oxyhaemoglobin) and may increase the risk of heart problems in predisposed individuals. People who suffer from coronary artery disease and who are subject to bouts of angina are likely to be at risk if their oxygen transport is impaired. Also mental activity could be affected by reductions in oxygen supply resulting from the exposure of carbon monoxide.

## Objective for Carbon Monoxide

The Government had adopted an 8-hour running mean concentration of 11.6 $mg/m^3$ as the air quality standard for carbon monoxide. The new objective has been set at a slightly tighter level of 10 $mg/m^3$ as a maximum daily 8-hour concentration, to be achieved by the end of 2003, bringing it into line with the second Air Quality Daughter Directive limit value.

## The National Perspective

The UK national network measures 8-hour mean carbon monoxide concentrations throughout the country. During the period 2004-2005 there were no measured exceedances of the objective at any site. Carbon monoxide concentrations adjacent to major roads have also been modelled at a national level. The results of this assessment suggested that existing policies will

have been sufficient to reduce maximum daily 8-hour mean concentrations of carbon monoxide below 10 mg/m$^3$ by about 2003.

## Updating and Screening Assessment of Carbon Monoxide in Bradford

### *Current urban background concentrations of CO from national data*

- **Bradford District background CO concentration = 0.3 mg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of carbon monoxide concentrations, 2001)*

### *Monitoring Data*

Carbon monoxide has been monitored at a continuous monitor in central Bradford (which forms part of the Automatic Urban Network) since 1997. The monitoring from that site (which is next to a busy city centre road) shows concentrations which are well below the objective (typically in the region of 0.3-1.0 mg/m$^3$) indicating that it is very unlikely that the objective for carbon monoxide will be exceeded in Bradford.

### *Road Sources*

There are no 'very busy' roads or junctions, or plans for the construction of any 'very busy' roads in Bradford (as defined in Technical Guidance LAQM TG (02) page 2–6). Studies were carried out using Design Manual for Roads and Bridges (DMRB), a screening model as part of the Stage 2 Review and Assessment (December 2000). These studies predicted maximum 8-hour concentrations at 44 locations on the districts busiest roads. There were no predicted exceedances of the standard. There have been no significant changes to the road network or traffic flows since the last round of Review and Assessment.

### *Industrial Sources*

The first round of review and assessment identified six potentially significant industrial sources (including three commercial power stations located outside of the district) that required further investigation. The impact of the source on ground level CO concentrations was modelled using the Environment Agency's document Guidance for Estimating Stationary Sources (GSS) and there were no predicted exceedances of the objective. There are no new significant industrial sources or significant changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Conclusion*

It is therefore considered, that it is very unlikely that the objective for CO will be exceeded and also that there is no need to undertake a detailed review and assessment for Carbon Monoxide

in Bradford. There have been no significant changes to the emissions inventory for Bradford since the last round of review and assessment and furthermore Government Guidance states that it is unlikely that the CO objective will be exceeded anywhere in the UK.

# Updating and Screening Assessment of Benzene

## Introduction

In the United Kingdom the main atmospheric source of benzene is the distribution and combustion of petrol, of which it is a minor constituent. Diesel fuel is a relatively small source. Benzene is a chemical which is a liquid at normal temperature but readily evaporates into the atmosphere. Motor vehicle exhausts gases contain some unburnt benzene but they also contain benzene formed from the combustion of other aromatic components of petrol. Also, benzene is emitted in a number of industrial processes which may contribute to local exposure.

A number of policy measures already in place, or planned for future years, will continue to reduce emissions of benzene. Since January 2000, EU legislation has reduced the maximum benzene content of petrol to 1%, from a previous upper limit of 5%. The European Auto-Oil programme will further reduce emissions for cars and light-duty vehicles, and emissions of benzene from the storage and distribution of petrol are controlled by vapour recovery systems. Benzene emissions fell by 74% between 1990 and 2004, and by 42% between 1999 and 2000 alone. The reduction since 1999 is largely due to a sharp reduction in the benzene content of petrol, as well as the ongoing effect of the penetration of catalytic converters in the vehicle fleet.

## Health Effects

Benzene is acknowledged as a human carcinogen. The effect of long-term exposure which is of most concern is leukaemia and in particular several types of this disease known collectively as non-lymphocytic leukaemia. It has not been possible to demonstrate a level at which there is zero risk of ill effects due to exposure to benzene, so policies to control benzene concentrations in the atmosphere have been based on a risk management approach, aiming at levels where the risks to health are very small.

## Standard and Objective for Benzene

The Government has adopted a running annual mean concentration of 16.25 $\mu g/m^3$ as the air quality standard for benzene, with an objective for the standard to be achieved by the end of 2003. However, in light of the health advice from EPAQS and the Department of Health's Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC) to reduce concentrations of benzene in air to as low a level as possible, additional tighter objectives have also been set. The additional objective is for a fixed annual mean of 5 $\mu g/m^3$ to be achieved by the end of 2010.

## The National Perspective

The UK national network measures benzene concentrations throughout the country. During the period 2004-2005 measured concentrations at all urban background and roadside sites were significantly below the 2003 running annual mean objective of 16.25 µg/m$^3$, furthermore no monitoring sites exceeded the tighter 2010 objective.

The 2010 objectives are expected to be met at all urban background, and most roadside locations, there is the possibility for some remaining exceedances which will require additional measures at a local level.

## Updating and Screening Assessment of Benzene in Bradford

### *Current urban background concentrations of Benzene from national data*

- **Bradford District background benzene concentration = 0.5 µg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of carbon monoxide concentrations, 2001)*

### *Monitoring Data*

There are no monitoring data for Benzene within the Bradford district.

### *Road Sources*

There are no 'very busy' roads or junctions, or plans for the construction of any 'very busy' roads in Bradford (as defined in Technical Guidance LAQM TG (02) page 2–6). Furthermore previous Technical Guidance states that 'benzene emissions from road traffic are unlikely to be significant, and should not generally need to be considered by any authority other than those with relevant locations in the vicinity of major industrial processes which handle, store or emit benzene' (LAQM TG4 (00), page 33). There have been no significant changes to the road network or traffic flows since the last round of Review and Assessment.

### *Industrial Sources*

The first round of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of benzene. There are no new significant industrial sources or significant changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Petrol Stations*

There are petrol stations with an annual throughput of more than 2000 m$^3$ per annum which do not benefit from Stage 2 recovery systems in Bradford, however none of these petrol stations have a busy road nearby (>30,000 vehicles per day) and there is no relevant exposure within 10 metres of the pumps, therefore a detailed assessment in respect of these petrol stations is not considered necessary.

### *Major Petroleum Storage Depots*

There are no major fuel storage depots within the Bradford area, however, there is a large fuel storage depot handling petrol within the district of Leeds. The installation is called Total Oil Ltd and it is positioned near Hunslet, Leeds (grid ref: 431531,432365), this is over 2.5 kilometres from the Bradford boundary and it is therefore considered that this depot will be unlikely to cause an exceedance of the objective for benzene within the Bradford Boundary.

### *Conclusion*

It is therefore considered, that it is very unlikely that the objective for benzene will be exceeded and also that there is no need to undertake a detailed review and assessment for benzene in Bradford.

# Updating and Screening Assessment of 1,3-Butadiene

## Introduction

1,3-butadiene is a chemical which is a gas at ambient temperatures. Trace amounts can be found in the atmosphere that we breathe and are derived mainly from the combustion of petroleum in motor vehicles and from other sources of combustion such as fossil fuels and open burning. Although neither petrol nor diesel fuel contains 1,3-butadiene, it is formed in the combustion process from olefins in the fuel. 1,3-butadiene is also an important industrial chemical and is handled in bulk at a small number of industrial processes in the United Kingdom.

## Health Effects

The potential effects of long-term exposure to 1,3-butadiene, which are of most concern, are higher than expected risk of cancers of the lymphoid system and bone marrow, lymphomas and leukaemias.

## Objective for 1,3-butadiene

The Government has adopted a maximum running annual mean concentration of 2.25 $\mu g/m^3$ as an air quality standard for 1,3-butadiene. The objective is for the standard to be achieved by the end of 2003.

## The National Perspective

Concentrations of 1,3-butadiene are measured at five UK national network sites. Maximum running annual mean concentrations of 1,3-butadiene measured at all urban background and roadside locations are currently significantly below the 2003 objective of 2.25 $\mu g/m^3$.

## Updating and Screening Assessment of 1,3-butadiene in Bradford

### *Current urban background concentrations of 1,3-butadiene from national data*

- **Bradford District background 1,3-butadiene concentration = 0.18 $\mu g/m^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of 1,3-butadiene concentrations, 2001)*

### *Industrial Sources*

The first round of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of 1,3-butadiene. There are no new significant industrial sources or changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Conclusion*

It is therefore considered, that it is very unlikely that the objective for 1,3-butadiene will be exceeded and also that there is no need to undertake a detailed review and assessment for 1,3-butadiene in Bradford. There have been no significant changes to the emissions inventory for Bradford since the last round of review and assessment and furthermore Government Guidance states that only authorities with relevant receptors in the vicinity of major industrial processes which handle, store or emit 1,3-butadiene, are expected to proceed beyond the updating and screening assessment.

# Updating and Screening Assessment of Lead

## Introduction

Lead is used widely in a large number of industrial applications. The single largest use globally is in the manufacture of batteries. Other uses include pigments in paints and glazes, in alloys, radiation shielding, tank lining and piping. It has been used as a petrol additive in the form of the compound tetraethyl lead to enhance the octave rating; however an agreement reached between the European Parliament and the Environment Council has resulted in the ban of sales of leaded petrol in the United Kingdom with effect from the 1st January 2000.

## Health Effects

Direct human exposure to lead occurs not only through inhalation of particulate lead in ambient air, but also through ingestion of contaminated food and water.

Exposure to high levels of lead can have severe adverse effects on the blood, the nervous system and the kidneys. However, these clinical effects only occur as a consequence of high exposures and are relatively easily prevented. It is the more subtle effects caused by lower exposures, including lead in the ambient air which is of greater concern. The effects of lead on the intellectual development of children have been of particular concern, as children appear to be more susceptible to lead than adults, and may absorb it to a greater extent when exposed.

## Objective for Lead

The Government has adopted an annual mean concentration of 0.5 $\mu g/m^3$ as the air quality standard for lead, with an objective for the standard to be achieved by the end of 2004. In addition, a lower air quality objective of 0.25 $\mu g/m^3$ to be achieved by the end of 2008 has also been set.

## The National Perspective

Measured lead-in-air concentrations at UK national network sites for the period 1997-2001 showed that concentrations at all background and kerbside sites are well below the objectives for 2004 and 2008. Emissions of lead from petrol-engine road vehicles fell virtually to zero in 2000 following reductions in the amount of lead in petrol in the 1980s, the increase in uptake of unleaded petrol in the 1990s, and the ban at the end of 1999 of leaded petrol for general sale (source DEFRA e-digest statistics March 2006).

Detailed assessments of the potential impact of lead emissions from industrial processes have been undertaken by the Government and the devolved administrations based upon both

monitoring and sector analysis studies. This study has included a 12-month monitoring survey in the vicinity of 30 key industrial sites in the UK; this has been used to supplement information already provided from the non-automatic monitoring networks. The monitoring data has generally indicated no exceedances of either the 2004 or 2008 objectives, although locations in proximity to non-ferrous metal productions and foundry processes were deemed to be at risk and further monitoring is underway.

## Updating and Screening Assessment of Lead in Bradford

### *Current urban background concentrations of Lead from national data*

- **West Yorkshire urban background lead concentration = 0.04 µg/m$^3$**

  *(Data source: DEFRA 1999 annual average of lead concentrations, Defra/airquality/arcticle5)*

### *Monitoring Data*

Lead levels in air are not measured at the four continuous monitoring stations. However, air lead levels have been monitored at five sites in the district using a non-automatic M type sampler between the years of 1993 and 1997. The highest results were found at a school near to the busy Manningham Lane in Bradford, however the results at this site were found to be well below both the 2004 and 2008 objectives.

### *Industrial Sources*

The first round of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of lead. The only exception to this was a Part B process, Westcroft Foundry, where it was concluded that emissions could produce a significant fraction of the annual objective, since the stage two air quality report was written this installation has ceased operation. There are no new significant industrial sources or changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Conclusion*

It is therefore considered, that it is very unlikely that the objective for lead will be exceeded and also that there is no need to undertake a detailed review and assessment for lead in Bradford.

# Updating and Screening Assessment of Nitrogen Dioxide

## Introduction

Nitrogen dioxide ($NO_2$) and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as nitrogen oxides ($NO_x$). All combustion processes produce $NO_x$ emissions, largely in the form of nitric oxide, which is then converted to nitrogen dioxide, mainly as a result of reaction with ozone in the atmosphere. It is nitrogen dioxide that is associated with adverse effects on human health.

## Health Effects

Nitrogen dioxide is a respiratory irritant which may exacerbate asthma and increase susceptibility to infections. Children are particularly susceptible to exposure to nitrogen dioxide as it may increase the risk of respiratory infection and poorer lung function later in life. In the presence of sunlight nitrogen dioxide reacts with hydrocarbons to produce photochemical pollutants such as ozone, which also effects lung function.

Nitrogen oxides also contribute to acid deposition. The nitrogen oxides in the atmosphere have a lifetime of approximately one day with respect to conversion to nitric acid. The nitric acid is in turn removed from the atmosphere by direct deposition to the ground or by transfer to aqueous droplets, e.g. cloud or rainwater thereby contributing to acid deposition.

## Objective for Nitrogen Dioxide

A 1-hour mean of 200 $\mu g/m^3$ not to be exceeded more than 18 times a year and an annual mean of 40 $\mu g/m^3$ both of which are to be achieved by the end of 2005.

## The National Perspective

The principal source of $NO_x$ emissions is road transport, which accounted for about 49% of total UK emissions in the year 2000. Major roads carrying large volumes of high-speed traffic (such as motorways and other primary routes) are a predominant source, as are conurbations and city centres with congested traffic. Within most urban areas, the contribution of road transport to local emissions will be much greater than for the national picture. As an example, road transport is estimated to account for more than 75% of $NO_x$ emissions in London.

The contribution of road transport to $NO_x$ emissions has declined significantly in recent years as a result of various policy measures. Total emissions declined by 45% between 1990 and 2004, mainly as a result of catalytic converters on petrol cars and reductions in emissions from large

combustion plants. Fuel switching from some non-catalyst petrol cars to diesel cars also had a small beneficial effect.

Other significant sources of $NO_x$ emissions include the electricity supply industry and other industrial and commercial sectors, which accounted for about 21% and 16% respectively in 1999. Emissions from both sources have also declined dramatically, due to the fitting of low $NO_x$ burners, and the increased use of natural gas plant (LAQM. TG (03)).

The annual mean objective of 40 µg/m$^3$ is currently widely exceeded at roadside sites throughout the UK, with exceedances also reported at urban background in major conurbations.

## Updating and screening assessment of nitrogen dioxide in Bradford

### *Current urban background concentrations of nitrogen dioxide from national data*

- **Bradford district background $NO_2$ concentration 23 µg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of nitrogen dioxide concentrations, 2001)*

### *Monitoring Data*

The monitoring strategy adopted by this Authority has been based on the findings of the first round of review and assessment. A site may be identified as requiring further investigation by either the detailed modelling undertaken in the first round (using ADMS-Urban) or previous monitoring data. Ideally a site will first be investigated using nitrogen dioxide tubes; this method allows identification of the most appropriate place to position the continuous monitor. The continuous mobile monitor can then be deployed for approximately a six-month period (or longer ideally) at locations identified as 'hot spots' for the monitoring of $NO_2$, $PM_{10}$ or $SO_2$. The locations must be representative of areas where people are likely to be exposed over the averaging time of the pollutants.

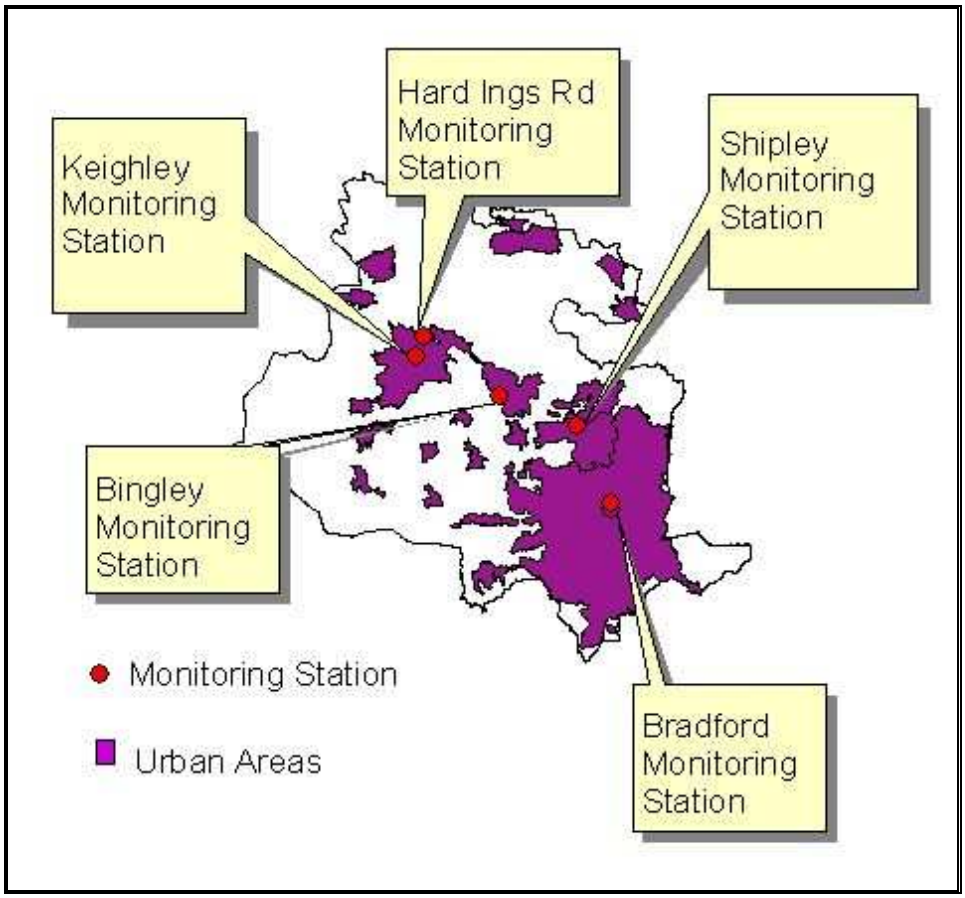
### *Monitoring Results*

Table 2 Nitrogen dioxide monitoring

| SITE | Annual Mean µg/m$^3$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| Shipley | 27.7 | 41.2 | 40.3 | ** | 52.2 | 49.2 | 48.1 |
| Bingley | 27.5 | 21.4 | 32.0 | 27.9 | 30.3 | 28.5 | 19.5 |
| Keighley | 33.9 | 33.1 | 36.7 | 33.7 | 38.3 | 33.0 | 31.3 |
| Bradford | 40.1 | 38.2 | 43.9 | 36.3 | 37.0 | 31.0 | 31.0 |
| Hard Ings Rd, Kly | | | | | | 32.3 | 19.6 |
| Sangster Way, Bradford | | | | | | 32.9 | 29.6 |

** Data not included due to technical problems

The following map shows the locations of the continuous monitoring in the Bradford District:



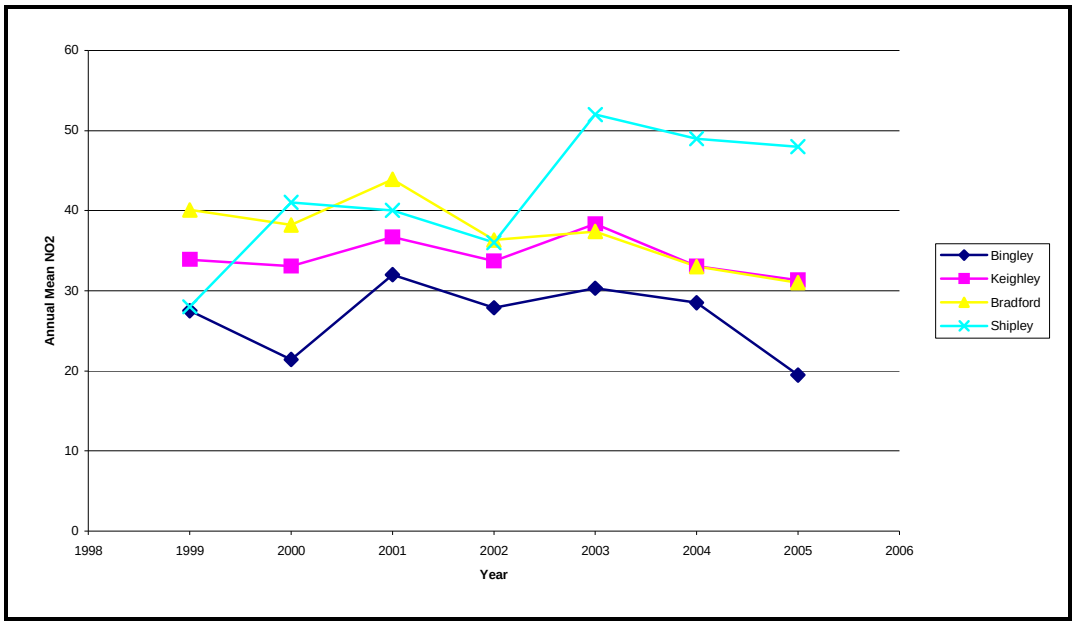

The results of the continuous monitoring undertaken by this authority can be seen in Table 2. The continuous monitoring indicates the following:

- It is unlikely that there is an exceedance at the continuous monitoring sites in Keighley Bingley or Bradford.
- The monitoring site at Fox Corner, Shipley has shown consistently high readings exceeding the objectives since the last USA in 2003. The site itself is a kerbside site and the nearest residential properties are set 30 metres back from the carriageway. Nitrogen Dioxide diffusion tube monitoring has been carried out at the nearest property at Stead Street and has shown that the concentrations at the property average at 38 $\mu g/m^3$ and therefore do not exceed the objective.
- The sites at Hard Ings Road and Sangster Way have been monitored as part of detailed assessment in the last round of review and assessment (Round 2). The concentrations at both sites do not exceed the objectives and monitoring has now been discontinued.

Graph 1 shows the trends in continuous monitoring data for $NO_2$ between the years 1999 and 2005. The graph illustrates the unusually high number of days with poor pollution dispersion conditions in 2001 with higher than average annual means for $NO_2$ for 2001 at all three sites. The graph illustrates

a slight decrease in measured $NO_2$ at the three sites for 2003-2005. The largest reduction is seen at the site at Bingley, this will mainly be attributable to the redirection of traffic from central Bingley on to the new Bingley Relief Road.

Graph 1 Trends in $NO_2$ Annual Mean 1999 - 2005




The detailed assessment in round 2 of review and assessment resulted in the identification of the following areas of exceedance of the objectives:

- Mayo Avenue / Manchester Road junction, Bradford
- Thornton Road, Bradford
- Manningham Lane / Queens Road junction, Bradford
- Shipley Airedale Road / Church Bank junction, Bradford

These four areas are in the process of being designated as air quality management areas. As part of the action planning and monitoring of these areas all four sites will have the benefit of continuous monitoring for nitrogen dioxide using StreetNox equipment supplied by Signal Ambitech.

### *Road Traffic*

In the first round of review and assessment studies were carried out using Design Manual for Roads and Bridges (DMRB), a screening model as part of the Stage 2 Review and Assessment

(December 2000). These studies predicted maximum 8-hour concentrations at 44 locations on the districts busiest roads. Furthermore the entire District was modelled using ADMS-Urban and the West Yorkshire Emissions Inventory. Neither technique indicated any predicted exceedances of the objectives.

The road network has been re-examined using the most up to date traffic data and there are no predicted exceedances of the objectives other than those already identified.

### *Narrow Congested Streets with Residential Properties Close to the Kerb*

Government guidance states that concentrations of pollutants are often higher where traffic is slow moving with stop/start driving, and where buildings on either side reduce the dispersion (also known as 'street canyons').

All roads in the district have been considered in order to identify areas with narrow congested streets which have residential properties within 5 metres of the kerb, an average traffic speed of 50 kilometres per hour or less, traffic flow greater than 10,000 vehicles per day and a carriageway less than 10 metres wide. There were no roads identified in the Bradford District that fit the criteria for a street canyon, the roads in Bradford are generally relatively wide and open thus allowing effective pollutant dispersal.

### *Junctions*

All junctions in the district were considered during the first round of review and assessment as it was considered that the accumulation of slow moving traffic at these locations might lead to potential exceedances. All of the major junctions were modelled using both DMRB and ADMS-Urban. The junctions with higher traffic flows such as the Shipley-Airedale junction were subsequently investigated further using the nitrogen dioxide tubes and continuous monitoring where appropriate. The four areas identified as requiring declaration as an air quality management area are all located at or very near junctions that exhibit congestion problems.

### *Busy Streets where people may spend 1-hour or more close to the traffic*

The approach of this Authorities first round of review and assessment was to look at all locations initially, regardless of whether or not there were relevant receptors. Receptors were identified and assessed after problem areas had been highlighted, this approach made it unlikely that any potential hot spots would be overlooked. Areas such as beer gardens, sports grounds and shops were considered to be relevant receptors in the first round of review and assessment, and as such have already been considered and discounted on the grounds of traffic flow or distance from the road.

### *Roads with a high flow of buses and/or HGVs*

All roads in the district have been considered, and there are no roads with a traffic flow of greater than 2,500 heavy goods vehicles per day (the recommended 'trigger level' prescribed by government guidance LAQM TG (03)). However Market Street in central Bradford is estimated to have an unusually high proportion of buses i.e. in excess of 25% of the traffic flow (LAQM (TG.03)), it is also a street with many shops where members of the public may spend more than one hour close to the traffic. Data from the West Yorkshire Passenger Transport Authority (WYPTE) confirms that Market Street (in Bradford City Centre) has high bus flows, however there are only 650 bus movements per day and as such it is considered unlikely that this factor would cause an exceedance of the objective.

### *New roads*

There has been one significant change to the road network since the start of the last round of Review and Assessment. Work is now complete on the construction of a new road, which by-passes the centre of Bingley, called the A650 Bingley Relief Road, which is a 5 km length of dual carriageway extending from Crossflatts to Cottingley Bar. Traffic began travelling this road in December 2004.

The Transport Studies Unit predicted the traffic flows expected to travel on the new road. These figures were used to model the effect of the road on pollutant concentrations using ADMS-Urban. This study was completed during the first round of Review and Assessment and the results indicated that it was very unlikely that the objective will be exceeded due to the new road. The site was also investigated using nitrogen dioxide tubes at the nearest residential properties to assess the 'before and after' effects of the development in terms of the actual contribution of the new road and any subsequent changes in traffic flows on existing roads. The results of the monitoring were as follows:

| Monitoring Location & Monitoring Method | $NO_2$ Concentration µg/m$^3$ Jan 2004-Dec 2004 (before road) | $NO_2$ Concentration µg/m$^3$ Jan 2005-Dec 2005 (road open) |
|---|---|---|
| Aireworth Grove, Keighley Nitrogen dioxide tube | 30 | 25 |
| Ferrand Street, Bingley Nitrogen dioxide tube | 34 | 35 |
| Ferncliffe Road, Bingley Continuous monitoring | 28.5 | 19.5 |

The results supported the modelling results and confirmed that it was unlikely that the new road would cause exceedances of the objective. The results also illustrate the improvement in nitrogen dioxide concentrations in central Bingley at Ferncliffe Road due to the reduction in traffic travelling through the town centre now that the relief road is open.

### *Roads with significantly changed traffic flows*

There are no roads in Bradford that have experienced any significant changes in traffic flows since the last round of review and assessment.

### *Roads close to the objective during the first round of review and assessment*

Sites identified as having the potential to exceed the objective were investigated in detail during the last round of review and assessment as part of a detailed assessment for nitrogen dioxide. There are no new sites identified since the last round of review and assessment.

### *Bus Stations*

Government guidance states that bus stations with less than 1,000 buses per day are unlikely to cause an exceedance of the objective. Data from the WYPTE indicates that the bus station in central Bradford has 1,500 departures per day however, it is a considerable distance from any relevant residential receptors, furthermore passengers are kept separate in a concourse whilst waiting for buses so are therefore very unlikely to be exposed to any of the pollutants produced by buses left running within the bus station. WYPTE data also gives bus departures for the other bus stations within the District, Shipley and Keighley have 650 and 550 departures per day respectively. Unfortunately there is no current data for the Ilkley bus station however, it is considered to be far smaller than either Shipley or Keighley and as such is very unlikely to cause an exceedance of the objective.

### *New Industrial Sources*

The first and second rounds of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of nitrogen dioxide. There are no new significant industrial sources or changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Other Sources*

Aircraft, trains and shipping have all been considered, government guidance states that there is no evidence to suggest that either trains or shipping could lead to any exceedances of the objectives (LAQM.TG.03 page 6-27).

Leeds/Bradford airport is approximately 2 miles from the border of the Bradford. As the airport is not considered to be a potential problem within the Leeds District (in which it is situated) it is unlikely that the airport will contribute significantly to any of the surrounding authorities, furthermore government guidance (LAQM.TG03 pg 6-27) states that concentrations ‘fall-off’ rapidly on moving away from the source and that relevant exposure is considered to be within 1000 metres of an airport boundary.

### *Conclusion*

There are no new sites identified in Bradford as having the potential to exceed the objective therefore it is not considered necessary to progress to detailed assessment for nitrogen dioxide. It is acknowledged that several areas in Bradford require designation as air quality management areas due to nitrogen dioxide concentrations exceeding the objectives. These areas will be studied in depth and detailed source apportionment work will be undertaken, preliminary indications are that the main source of the problems in these areas are attributable to high traffic flows and congestion.

# Updating and Screening Assessment of Sulphur Dioxide

## Introduction

Sulphur dioxide is a gas at normal temperature and pressure. It dissolves in water to give an acidic solution which is readily oxidised to sulphuric acid. In the past the main emissions of sulphur dioxide were from the combustion of coal in domestic and industrial premises and also from power stations.

## Health Effects

Sulphur Dioxide is an irritant, which can cause breathing difficulties on inhalation. People suffering from asthma may be especially susceptible to the adverse effects of sulphur dioxide particularly within the range of concentrations that occur in pollution episodes as it may provoke attacks of asthma. Recent research has highlighted that even exposures in the order of minutes have been shown to exhibit adverse effects on human health.

## Objective for Sulphur Dioxide

There are three objectives for sulphur dioxide:

| | | |
|---|---|---|
| 1-hour mean | 350 $\mu g/m^3$ not to be exceeded more than 24 times a year | To be achieved by 31.12.2004 |
| 24-hour mean | 125 $\mu g/m^3$ not to be exceeded more than 3 times a year | To be achieved by 31.12.2004 |
| 15-minute mean | 266 $\mu g/m^3$ not to be exceeded more than 35 times a year | To be achieved by 31.12.2004 |

## The National Perspective

The main source of sulphur dioxide in the United Kingdom is power stations, which accounted for more than 71% of emissions in 2000. There are also significant emissions from other industrial combustion sources. Domestic sources now only account for 4% of emissions, but can be locally much more significant. Road transport currently accounts for less than 1% of emissions. Total sulphur dioxide emissions fell by 77% between 1990 and 2004 (source DEFRA e-Digest Statistics, sulphur dioxide. March 2006)

## Updating and Screening Assessment of Sulphur Dioxide

### *Current urban background concentrations of sulphur dioxide from national data*

- **Bradford District background $SO_2$ Concentration 4.0 µg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of sulphur dioxide concentrations, 2001)*

### *Monitoring Data*

Sulphur Dioxide is monitored in Bradford three real-time continuous chemiluminescent monitors. Until recently it was also monitored using two 8-port samplers.

The exceedance statistics for the continuous monitoring and the historic results for the 8-port samplers show that all monitoring in the District for sulphur dioxide has given readings well below the objectives. These results can be seen in more detail in Appendix 2.

### *Domestic Sources*

In the first round of review and assessment domestic sources in Bradford were assessed using the results of surveys carried out by the council into fuel usage on council owned housing estates (covering almost 27,000 properties). The results showed that only a small fraction of the properties surveyed used solid fuel (0.2%). There has also been a housing condition survey of private sector housing carried out in 2001. This study surveyed almost 3,700 randomly picked households throughout the district. The results indicate that only 1.5% of the district burn any form of solid fuel (including heating oil, house coal, smokeless coal and wood). Both studies indicate that only a small proportion of the households in the Bradford district burn solid fuel and as such it is considered that $SO_2$ emissions from domestic properties are unlikely to be significant.

### *Industrial Sources and Boilers*

The first round of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of sulphur dioxide. In stage 1 of the first round of review and assessment three sources were identified that may be significant in terms of sulphur dioxide emissions. These sources were examined using the Environment Agency's document Guidance for Estimating the Air Quality Impact of Stationery Sources (GSS) and it was found to be unlikely that any of the sources would cause an exceedance of the air quality objective. There are no significant new industrial sources, boilers or any sources with substantially increased emissions (a substantial increase can be taken to be one greater than 30% according to government guidance) since the last round of Review and Assessment.

### *Other Sources*

Both shipping and railway locomotives have been considered. Although Bradford has no sea shipping a small amount of boat traffic can be found on the Leeds-Liverpool canal. Data supplied by British Waterways indicates that there are less than 10 boats per mile along the canal including a waterbus service that operates in holiday periods. The small numbers of boat traffic indicate that it is very unlikely that this source of sulphur dioxide would cause an exceedance of the objective.

The rolling stock on the railway lines passing through the Bradford District are mainly comprised of the new type electric trains so will not be a potential source of sulphur dioxide. However, there is a small section of the rail network (Keighley to Oxenhope) which has coal-fired steam trains running as a tourist attraction. A detailed study of the steam trains was undertaken during the last round of review and assessment which included site visits, detailed dispersion modelling using ADMS Urban and continuous sulphur dioxide monitoring on the station platform. The conclusions of the work were as follows:-

*The objective permits 35 exceedances of the standard of 100ppb for a 15 minute mean per annum. As there are likely to be 23 exceedances throughout the year it is not considered necessary to declare an air quality management area at this site, however, as the results are relatively close to the objective it will be important for this Department to keep a watching brief on the situation at the station. Any changes in the frequency of trains, changes in fuel composition or increases in the number of minutes the train spends idling at the platform may increase the number of exceedances significantly.*

### *Conclusion*

It is not considered necessary to progress to a detailed assessment for sulphur dioxide in Bradford.

# Updating and Screening Assessment of $PM_{10}$

## Introduction

$PM_{10}$ refers to small particulate matter which is less than 10µm in diameter. The size of the particles determines where in the respiratory tract they land when inhaled. Small particles can penetrate further than large ones. In general, small spherical particles below 10µm in diameter have the greatest likelihood of reaching the furthest parts of the lung, the air spaces or alveoli, where the delicate tissues involved in the exchange of oxygen and carbon dioxide are to be found. Particles larger than this up to about 20µm may be lodged in the nose, throat and airways of the lung.

Particulate matter is composed of a wide range of materials arising from a variety of sources. These sources can be usefully divided into 3 main categories. *Primary particle* emissions are derived directly from combustion sources, including road traffic, power generation, industrial processes etc. *Secondary particles* are formed by chemical reactions in the atmosphere, and comprised principally of sulphates and nitrates. *Coarse particles* comprise of emissions from a wide range of sources, including resuspended dusts from road traffic, construction works, mineral extraction processes, wind-blown dusts and soils, sea salt and biological particles.

## Health Effects

Recent research suggests that particulate air pollution appears to be associated with a range of ill health effects including effects on the respiratory and cardiovascular systems, asthma and mortality.

The research also suggests that it is not possible to identify a non-effect threshold, therefore a risk management approach has been adopted to identify a level at which the effects on the population as a whole would be relatively small.

## Objective for $PM_{10}$

The objectives for $PM_{10}$ are 40 µg/m$^3$ as the annual mean, and 50 µg/m$^3$ as the fixed 24-hour mean to be exceeded on no more than 35 days per year, to be achieved by the end of 2004.

There are also provisional objectives to be achieved by the end of 2010 (although it is not intended that these objectives will be brought into Regulation for the purpose of Local Air Quality Management at this time):

- For all parts of England (except London), Wales and Northern Ireland, a 24 hour of 50 µg/m$^3$ not to be exceeded more than 7 times per year, and an annual mean of 20 µg/m$^3$, to be achieved by the end of 2010.

- For London, a 24-hour mean of 50 µg/m$^3$ not to be exceeded more than ten times per year, and an annual mean of 23 µg/m$^3$, to be achieved by the end of 2010. An annual mean objective of 20 µg/m$^3$ to be achieved by the end of 2015 has also been set.

- For Scotland a 24-hour mean of 50 µg/m$^3$ not to be exceeded more than 7 times per year, and an annual mean of 18 µg/m$^3$ to be achieved by the end of 2010.

The objectives are based upon measurements carried out using the European gravimetric transfer reference sampler or equivalent. The $PM_{10}$ readings taken in Bradford use TEOM analysers, which give lower readings than gravimetric samplers. The results from the TEOM analysers have been converted for direct comparison with gravimetric results using the following equation:

$$PM_{10\ (Gravimetric)} = 1.3 \times PM_{10\ (TEOM)}$$

## The National Perspective

Between 1990 and 2004 $PM_{10}$ emissions fell by 48%. About two-fifths of this decrease was attributable to a reduction in emissions from power stations of 85% over the same period. Improvements have been associated with a number of factors: the installation of abatement equipment, increased efficiency and increased use of natural gas for electricity generation. Road transport now contributes 23% of all $PM_{10}$ emissions. The main source of road transport emissions is exhaust from diesel engine vehicles (source DEFRA e-digest environment statistics, 30 March 2006).

## Updating and Screening Assessment for $PM_{10}$

### *Current urban background concentrations of $PM_{10}$ from national data*

- **Bradford district background $PM_{10}$ concentration 18.1 µg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of $PM_{10}$ concentrations, 2001)*

### *Current urban background concentrations of secondary $PM_{10}$ from national data*

- **Bradford district background secondary $PM_{10}$ concentration 6.0 µg/m$^3$**

  *(Data source: NETCEN 2001 estimated background pollutant concentrations in the UK, annual average of $PM_{10}$ concentrations, 2001)*

### *Monitoring Data*

The results of continuous monitoring for $PM_{10}$ are as follows:

| SITE | Annual Mean µg/m³* | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | exceedances | 2000 | exceedances | 2001 | exceedances | 2002 | exceedances | 2003 | exceedances | 2004 | exceedances | 2005 | exceedances |
| Shipley | 25.7 | 13 | 20.5 | 10 | 17.0 | 5 | 15.6 | 6 | 26.6 | 25 | 20.6 | 13 | 19.0 | 23 |
| Bingley | 17.7 | 6 | 23.3 | 0 | 18.7 | 1 | 18.3 | 1 | 20.4 | 29 | 15.6 | 7 | 14.0 | 1 |
| Keighley | 16.5 | 2 | 14.2 | 0 | 16.8 | 8 | 15.2 | 3 | 17.7 | 25 | 12.8 | 1 | 12.6 | 1 |
| Bradford | 26 | 13 | 22.1 | 5 | 27.3 | 16 | 23.4 | 8 | 27 | 30 | 27 | 16 | 32 | 37 |

*results given as a gravimetric reading

The results show that it is very unlikely that either the annual mean or the 24 hourly mean for $PM_{10}$ will be exceeded at any of the locations monitored using continuous monitoring with respect to the 2004 objective. However, the results indicate that there may be problems achieving the provisional 2010 objective (of 20 µg/m$^3$) at the central Bradford site and the Shipley site. Neither of these sites have any nearby relevant exposure at present so would be unlikely to require declaration as air quality management areas.

The central Bradford site has been subject to unusually high dust levels for a substantial portion of 2005 due to building and demolition works. It is expected that the concentrations will reduce to back below the objectives once the work ceases. The work is continuing into 2006. As the ongoing works are a temporary situation and there is no relevant exposure at present it is not considered necessary to declare the site as an air quality management area.

Graph 2 shows the trends in continuous monitoring data for $PM_{10}$ between the years 1999 and 2005. The graph shows the same reduction seen in $NO_2$ for the years 2003-2005 except at the central Bradford site, which can be explained by the demolition works.

Graph 2 Trends in $PM_{10}$ Annual Mean 1999 – 2005


## *Road Traffic*

### *Junctions*

All junctions in the District were considered during the first round of review and assessment as it was considered that the accumulation of slow moving traffic at these locations might lead to potential exceedances. All of the major junctions were modelled using DMRB and ADMS-Urban. It was found that there were no predicted exceedances due to any of the junctions. This work has been undertaken using the most up to date traffic data, which confirms there are no potential exceedances.

### *Roads with a high flow of buses and/or HGVs*

Government guidance indicates that if the flow of HGVs is below 2000 vehicles per day it is unlikely that there will be an exceedance of the objective for $PM_{10}$.

All roads in the District have been considered, and there are no roads with a traffic flow of greater than 2000 heavy goods vehicles per day and/or buses per day (this data has been provided by the Traffic Studies Unit and the WYPTE).

### *New roads constructed since the last round of review and assessment*

The Bingley Relief road was completed in December 2004. The road has been modelled using ADMS-Urban during the first round of review and assessment (using predicted traffic flows produced by the Transport Studies Unit) and it was predicted that it was very unlikely that the new road will cause any exceedances of the 2004 objective for $PM_{10}$.

The site was investigated as a precaution using nitrogen dioxide tubes which provided a 'before and after' study of pollutant concentrations next to the site. The results concluded that increases in traffic pollution due to the new road were minimal and it was not necessary to conduct further continuous monitoring.

### *Roads close to the objective during the first round of review and assessment:*

There were no roads found to be close to the objective for $PM_{10}$ in the last round of review and assessment.

### *Roads with significantly changed traffic flows*

There are no roads in Bradford that have experienced any significant changes in traffic flows since the last round of review and assessment.

### *Industrial Sources*

The first round of review and assessment identified that there were no industrial sources within Bradford or neighbouring authorities with the potential to emit significant quantities of $PM_{10}$. There are no new significant industrial sources or changes to the emissions from the existing industrial sources since the last round of Review and Assessment.

### *Domestic Sources*

In the first round of review and assessment domestic sources in Bradford were assessed using the results of surveys carried out by the council into fuel usage on council owned housing estates (covering almost 27,000 properties). The results showed that only a small fraction of the properties surveyed used solid fuel (0.2%). There has also been a housing condition survey of private sector housing carried out in 2001. This study surveyed almost 3,700 randomly picked households throughout the District. The results indicate that only 1.5% of the district burn any form of solid fuel (including heating oil, house coal, smokeless coal and wood). Both studies indicate that only a small proportion of the households in the Bradford District burn solid fuel and as such it is considered that $PM_{10}$ emissions from domestic properties are unlikely to be significant.

### *Fugitive Sources*

The second round of review and assessment identified the need to make a detailed study of fugitive $PM_{10}$ emissions from Buck Park Quarry at Denholme. This quarry is considered to be a worst case scenario in terms of fugitive $PM_{10}$ emissions in terms of output from the quarry and the distance to the nearest relevant receptor. Monitoring work was undertaken during the summer of 2004 using a Partisol 2000-H monitor. The conclusions of the work were as follows:

*The average concentration measured throughout the monitoring period was 18 µg/m$^3$ (gravimetric). This compares favourably with the background concentration for the Bradford District which is 18.1 µg/m$^3$ (NETCEN 2001). It can therefore be concluded that the quarry contribution to the concentrations of particulates at Buck Park Farm is negligible and very unlikely to cause an exceedance of the $PM_{10}$ objective.*

### *Other Sources*

Aircraft, trains and shipping have all been considered. There are no significant contributions from any of these sources in the Bradford District.

### *Conclusion*

It is not considered necessary to progress to a detailed assessment for $PM_{10}$ in the Bradford District. However, it will be necessary to continue monitoring for $PM_{10}$ in central Bradford and Shipley to enable assessment of concentrations with respect to the proposed 2010 objective.

# Conclusions

The overall conclusions of this updating and screening assessment are as follows:

**Sulphur dioxide**

- There is no need to progress to a detailed assessment for Sulphur Dioxide.
- The steam train running from Keighley to Oxenhope has been investigated in detail and is considered unlikely to be causing an exceedance of the objectives.
- The company operating the railway have been informed that that any changes in fuel type, journey duration or frequency may require the issue to be reinvestigated.

**Nitrogen Dioxide**

- There is no need to progress to a detailed assessment for nitrogen dioxide.
- There are areas in Bradford that currently exceed the objectives with respect to nitrogen dioxide. AQMAs will be declared and action plans formulated with the aim of reducing the concentrations of $NO_2$ at these sites to below the objectives.
- A district wide nitrogen dioxide monitoring programme using nitrogen dioxide tubes will continue with the aim of identifying any new problem areas.

**Fine Particles ($PM_{10}$)**

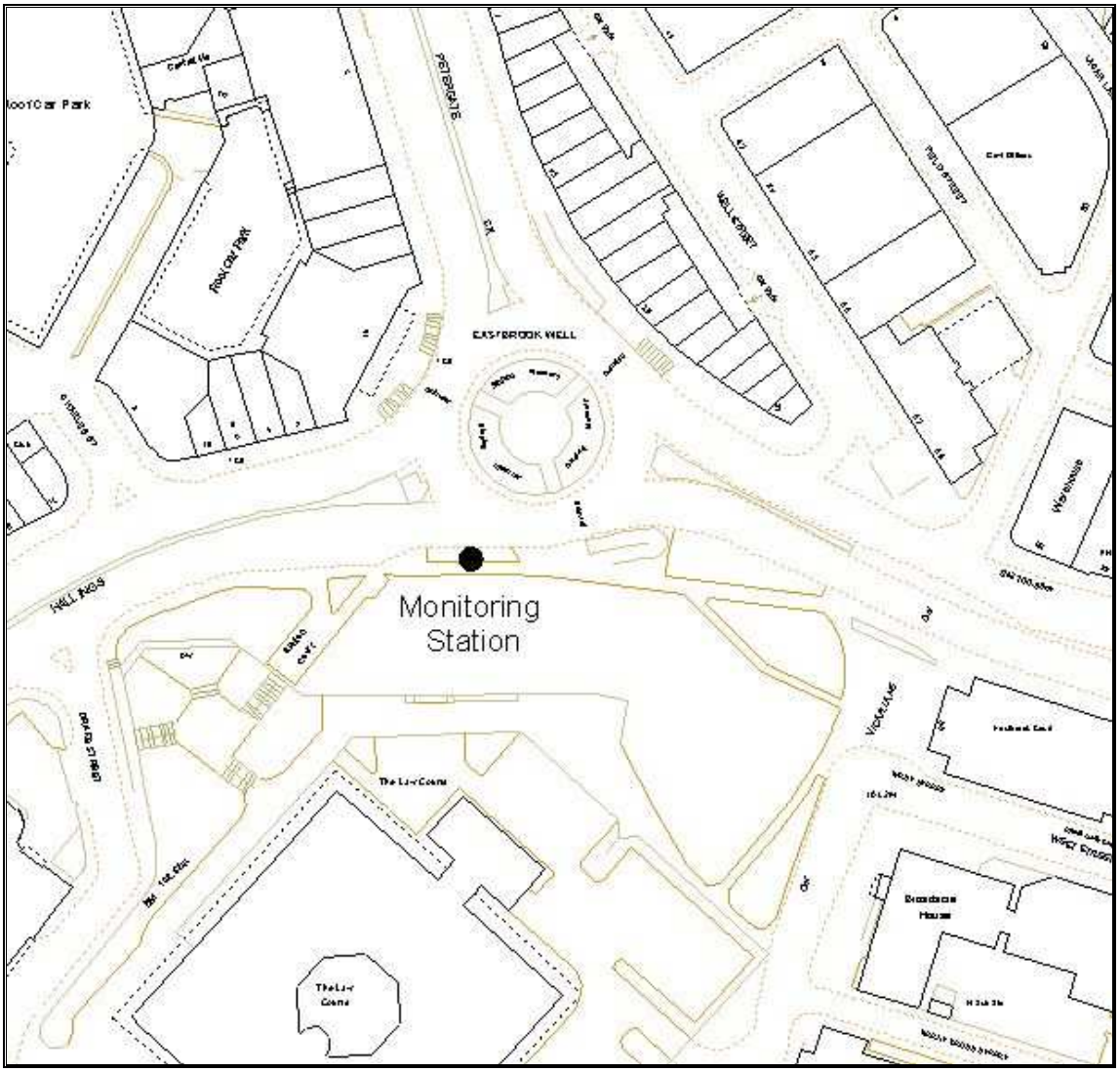
- There is no need to progress to a detailed assessment for $PM_{10}$.
- Potential exceedances of the 2010 objective have been identified at Shipley and the Bradford Centre site, monitoring must continue at these sites to allow assessment with regard to the new objectives.

**Other pollutants**

- There is no need to progress to a detailed assessment for:
  - carbon monoxide
  - benzene
  - 1,3-butadiene
  - lead.

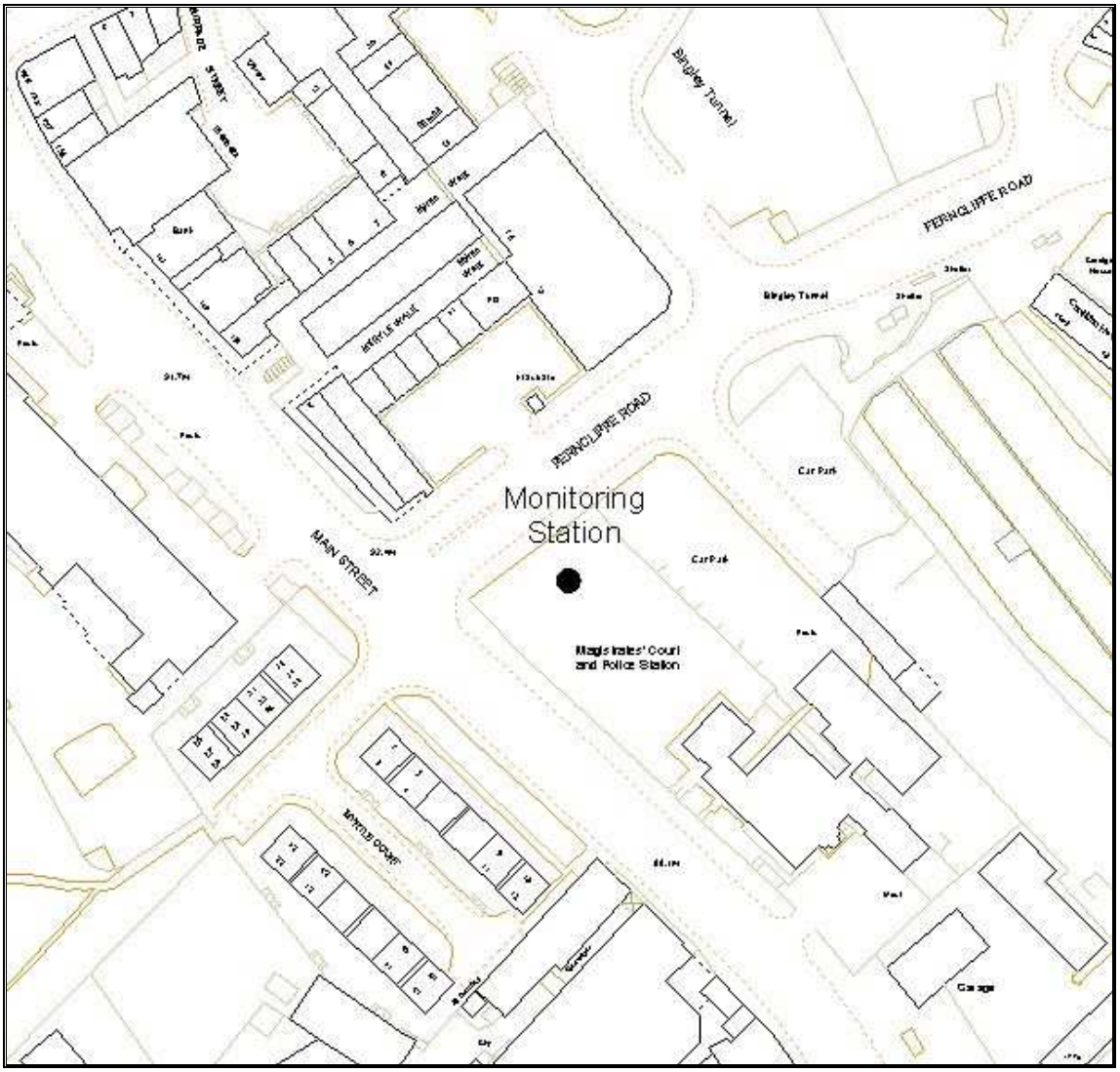
# Appendix 1: Maps of Monitoring Stations

***Map 1 Location of fixed AURN monitoring station at Bradford***

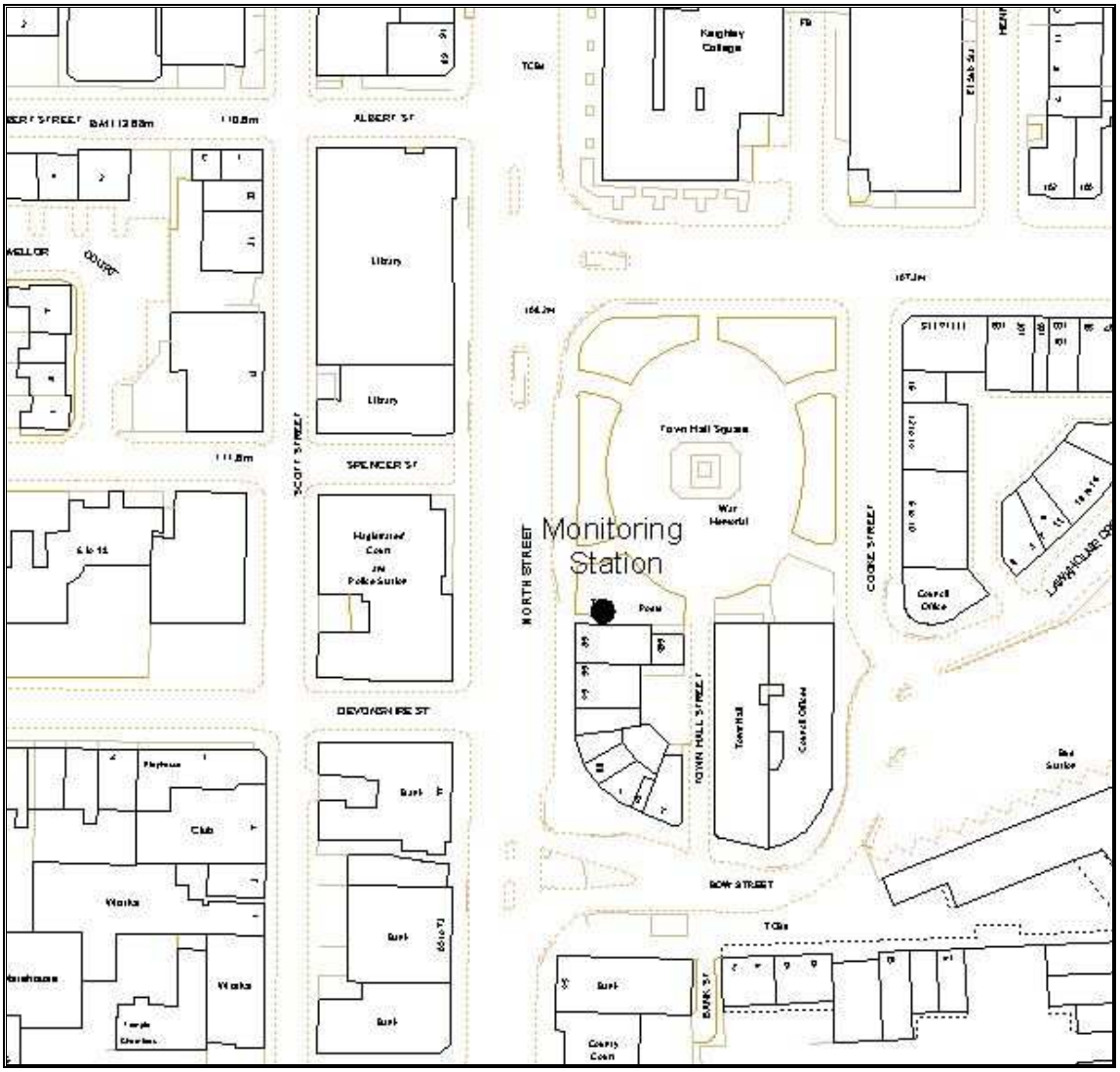



N.B Due to major works occurring in the city centre the location of the road and monitoring will change in 2006, it is expected that the monitoring station will remain approximately 10-25 metres from the road.

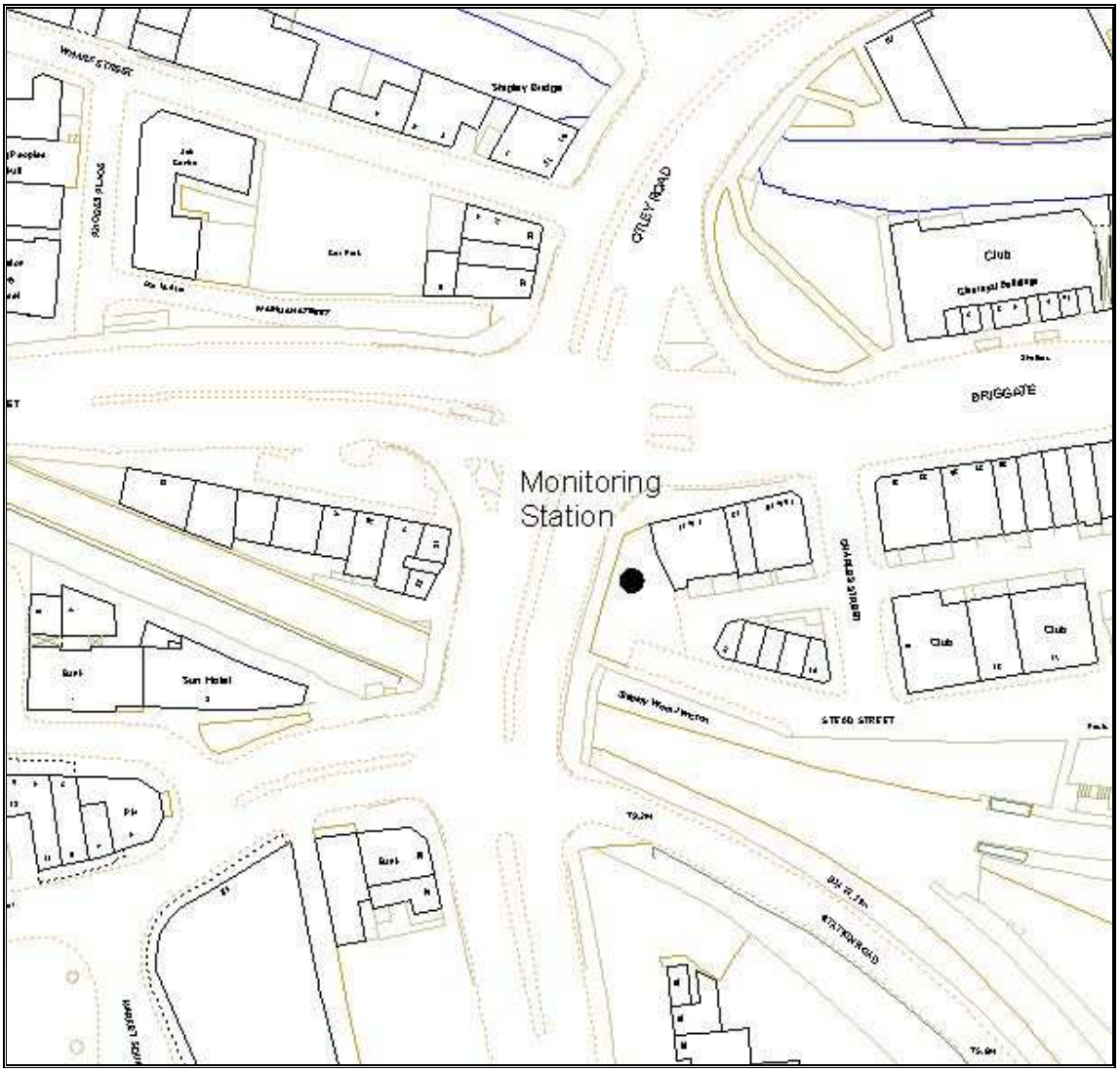
***Map 2 Location of fixed monitoring station at Bingley***



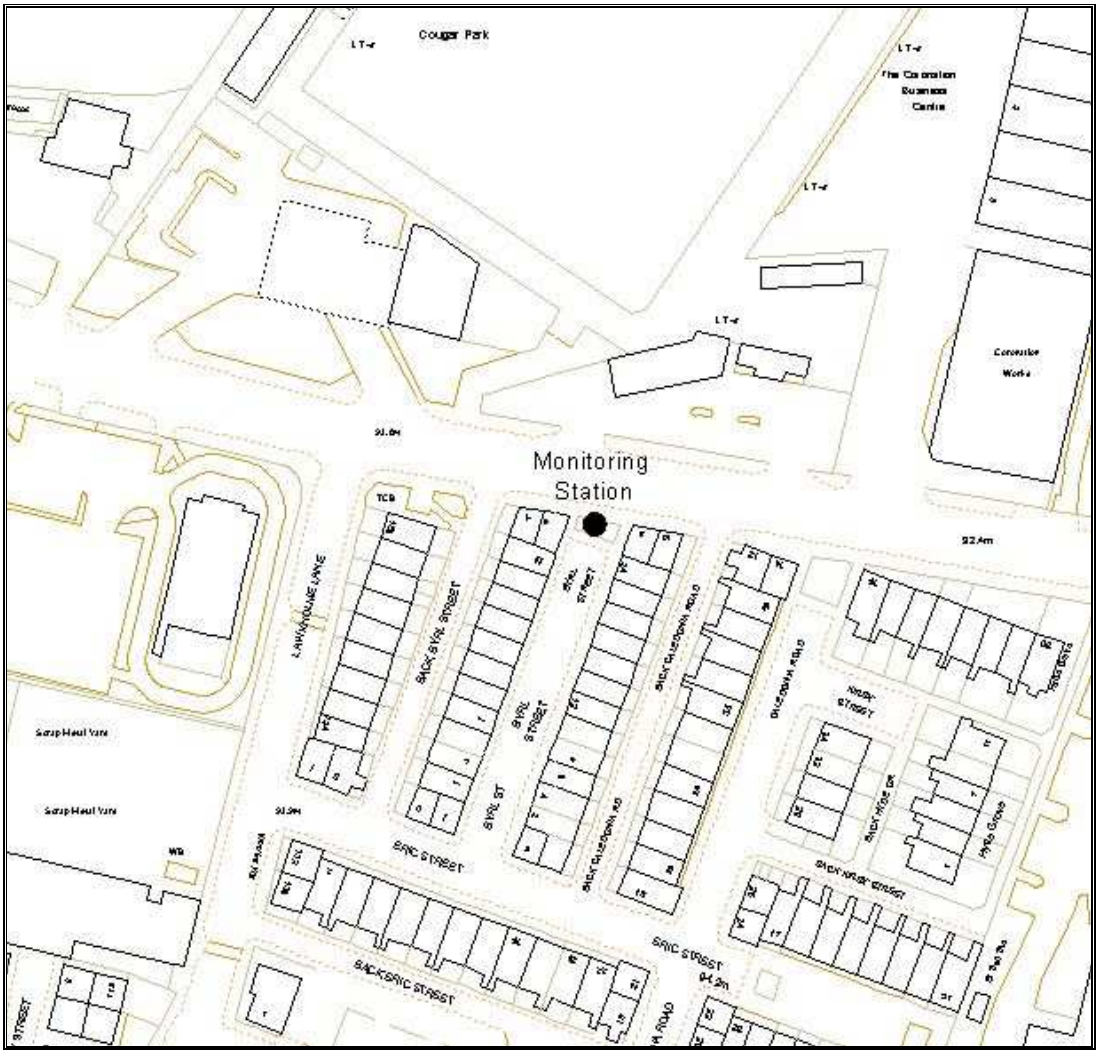
## *Map 3 Location of fixed monitoring station at Keighley*



***Map 4 Location of the mobile monitoring station at Shipley***



## *Map 5 Location of Mobile Monitoring Station at Hard Ings Road Keighley*




The site at Hard Ings Road, Keighley was selected for investigation as part of the Updating and Screening Assessment completed in April 2003. The reason for site selection was that the Nitrogen Dioxide tubes at the location were predicting a 2005 annual mean of 49 µg/m$^3$ which is an exceedance of the annual mean objective for Nitrogen Dioxide. The site represents a relevant exposure location because there are residential properties fronting onto the road on both Byrl Street and Caledonia Road, the monitor was been placed 2.5 metres from the road edge and as such represented the same distance from the traffic as the frontage of the nearby residential properties.

# Appendix 2: Sulphur Dioxide Monitoring

## Continuous Sulphur Dioxide Monitoring

| SITE | 15-min µg/m³ Exceedances >266 µg/m³ | | | | | | | 1-hour µg/m³ Exceedances >350 µg/m³ | | | | | | | 24-hour µg/m³ Exceedances >125 µg/m³ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| Shipley | 0 | * | 1 | 0 | 1 | 4 | 13 | 0 | * | 0 | 0 | 0 | 0 | 3 | 0 | * | 0 | 0 | 2 | 6 | 18 |
| Keighley | 1 | * | 0 | 1 | 0 | 0 | 0 | 1 | * | 0 | 0 | 0 | 0 | 0 | 0 | * | 0 | 0 | 0 | 0 | 1 |
| Bradford | 7 | 0 | 6 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 4 | 1 | 0 |

* No data

## Sulphur Dioxide Monitoring Results
## 8-port Sampler Results

| | 1999 | | 2000 | | 2001 | | 2002 | |
|---|---|---|---|---|---|---|---|---|
| | Keighley | Bradford | Keighley | Bradford | Keighley | Bradford | Keighley | Bradford |
| Max. 24 hour mean | 79 | 44 | 32 | 32 | 25 | 64 | 104 | 37 |
| Max. 15 min mean (x 1.8962) * | 150 | 83 | 61 | 61 | 47 | 121 | 197 | 70 |
| Max. 1 hour mean (x 1.3691) ** | 108 | 60 | 44 | 44 | 34 | 88 | 142 | 51 |

* The 15-minute mean has not actually been measured by the 8-port sampler. Government guidance states that there is a relationship between the 24-hour mean and the likely value for the 15-minute mean of x 1.8962

** The 1-hour mean has not actually been measured by the 8-port sampler. Government guidance states that there is a relationship between the 24-hour mean and the likely value for the 1-hour mean of x 1.3691

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