City of Bradford Metropolitan District Council

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Draft

Updating and Screening Assessment of Air Quality in the City of Bradford Metropolitan District

Department of Environmental Protection and Waste Management
Director: Richard Wixey

2020 VISION

BRADFORD one landscape many views

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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1. 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 Protection and Waste Management 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 second 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 'to improve waste management and the environment'. The Department of Environmental Protection and Waste Management works towards this corporate priority within the Environmental Protection Division. The key objective for Environmental Protection relevant to this report is to 'complete a further review and assessment of air quality in the District by the end of 2003'. However, air quality is not only dealt with by Environmental Protection, 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.

2. Summary of Previous Review and Assessment 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 results of the first round of review and assessment were as follows:

Stage 1:

- That a progression to a second stage of review and assessment was required for lead, nitrogen dioxide, sulphur dioxide, PM10 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:

- 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.

3. 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.

4. 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.

5. 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.

6. 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 $\mu g/m^3$ 5 $\mu g/m^3$	running annual mean annual mean	31.12.2003 31.12.2010
1,3 Butadiene	2.25 $\mu g/m^3$	running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$ 0.25 $\mu g/m^3$	Annual mean Annual mean	31.12.2004 31.12.2008
Nitrogen dioxide[1]	200 $\mu g/m^3$ not to be exceeded more than 18 times a year 40 $\mu g/m^3$	1 hour mean annual mean	31.12.2005 31.12.2005
Particles (PM_{10}) (gravimetric)[2]	50 $\mu g/m^3$ not to be exceeded more than 35 times a year 40 $\mu g/m^3$	24 hour mean annual mean	31.12.2004 31.12.2004
Sulphur dioxide	350 $\mu g/m^3$ not to be exceeded more than 24 times a year 125 $\mu g/m^3$ not to be exceeded more than 3 times a year 266 $\mu g/m^3$ not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005

1. The objectives for nitrogen dioxide are provisional

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

7. 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*'

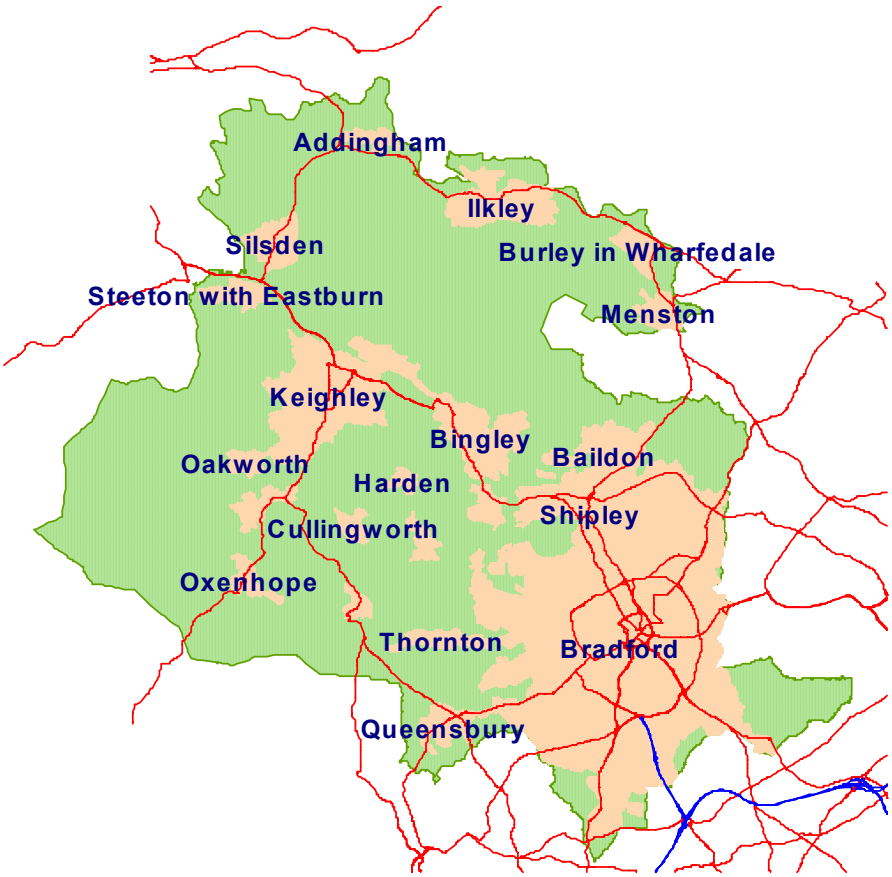
Reviews and Assessments should thus be focused on those locations where members of the public are likely to be **regularly present and are likely to be exposed over the averaging period of the objective:**

- 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, PM10, 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.

8. 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 is currently being replaced by the system of Integrated Pollution Prevention and Control (IPPC), introduced by the Pollution Prevention and Control (England and Wales) Regulations 2000, as amended.

9. 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.

Processes 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 processes 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 processes are subject to Local Air Pollution Control (LAPC). LAPC processes 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. The Local Authority Integrated Pollution Prevention and Control (LA-IPPC), which covers the more complex A2 installations and Local Authority Pollution Prevention and Control (LAPPC), which covers installations known as Part B installations, are currently, replacing this system of regulation.

Point sources will also include coal, oil and gas fired boilers. Larger boilers tend to be associated with authorised IPPC processes. 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 who have 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.

10. 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.

Semi-automatic monitoring methods

Sulphur dioxide and smoke levels have been monitored at 4 long-term sites using the 8-port sampler for over 5 years, 2 of the sites have now been discontinued. The two sites (Bradford 6 and Keighley 11) where monitoring is ongoing are part of the UK Smoke and Sulphur Dioxide Monitoring Network. The 8-port sampler is 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.

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 (AUN) site is owned and operated by DETR. A Central Management and Coordination Unit (CMCU), currently Stanger Science on behalf of NETCEN, carry out quality assurance and quality control checks. The Local Site Operator (LSO) is currently CBMDC.

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 AUN 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 Specialist Pollution Team office.

Calibration Routines

The authority's automatic continuous monitors all have calibration routines similar to that applied to the Bradford Centre AUN 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 AUN Local Site Operators Manual issued by NETCEN, and the manufacturers 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 Messer UK Ltd and 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 manufacturers 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 Specialist Pollution 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 NOx 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 NOx 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.aeat.co.uk/netcen/airqual. 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.

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 2 UK smoke and sulphur dioxide monitoring sites and nitrogen dioxide levels measured at the four UK National Survey sites annually.

11. 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.

The main source of carbon monoxide in the UK is road transport, which accounted for 67% of total releases in 2000 (the most recent year for which estimates are available). Annual emissions of carbon monoxide have been falling steadily since the 1970s, and are expected to continue to do so. Current projections indicate that road transport emissions will decline by a further 42% between 2000 and 2005 (LAQM. TG (03)).

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 1999-2001 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 suggest that existing policies will be

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, see Appendix 2). 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.

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.

12. Updating and Screening Assessment of Benzene

Introduction

In the United Kingdom the main atmospheric source of benzene is the combustion and distribution 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.

Motor vehicles are the most important single source on a national basis, accounting in 1996 for 64% of the total UK annual emission of 41k tonnes, with most of this total due to emissions from petrol vehicles (Technical Guidance LAQM.TG (03)). Other significant sources are petrol refining, and the distribution of petrol and uncontrolled emissions from petrol station forecourts without vapour recovery systems.

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.

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 1999-2001 measured concentrations at all urban background and roadside sites were significantly below the 2003 running annual mean objective of 16.25 ug/m^3. In 2001 concentrations measured at urban background locations were also below the tighter 2010 objective.

Forecasts based on national mapping suggest that the policy measures currently in place will achieve the 2003 objective at all urban background and roadside locations. Whilst 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 ug/m3**

  (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, see Appendix 2). 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.

13. 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 ug/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 already well below the 2003 objective of 2.25 ug/m3.

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 ug/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.

14. 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.

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/m3**

  (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 process 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.

15. 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 (NOx). All combustion processes produce NOx 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 NOx 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 NOx emissions in London.

The contribution of road transport to NOx emissions has declined significantly in recent years as a result of various policy measures, and further reductions are expected up until 2010 and beyond. For example, urban traffic NOx emissions are estimated to fall by about 20% between

2000 and 2005, and by 46% between 2000 and 2010 (Stedman, Bush, Murrels and King (2001)).

Other significant sources of NOx 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 NOx burners, and the increased use of natural gas plant (LAQM. TG (03)).

The annual mean objective of 40 ug/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 ug/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 ug/m^3				Predicted 2005 Annual Mean ug/m^3
	1999	2000	2001	2002	
Shipley	27.7	41.2	40.3	**	36.0*
Bingley	27.5	21.4	32.0	27.9	25.7
Keighley	33.9	33.1	36.7	33.7	31.0
Bradford	40.1	38.2	43.9	36.3	33.4

*Predicted using the 2001 annual mean rather than the 2002 annual mean.

** Data not included due to technical problems

The results of the continuous monitoring undertaken by this authority can be seen in Table 2; so far the continuous monitoring indicates that it is unlikely that there will be an exceedance of the standard at any of the four continuous monitoring sites in the district.

The Nitrogen Dioxide Tubes have highlighted the following areas as potential exceedances (i.e. predicted values in excess of 37 $\mu g/m^3$ in 2005 and in 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) that have not already been investigated further using the continuous monitor:

- Midland Terrace, Canal Road, Bradford
- Shipley Airedale Road and Barkerend Road Junction, Bradford
- Mayo Avenue, Bradford
- Thornton Road, Bradford
- Currer Street, Bradford
- Manningham Lane, Bradford
- Southfield Lane, Bradford
- Great Horton Middle School, Bradford
- Harrogate Road, Bradford
- Hard Ings Road, Keighley
- South Street, Keighley

The actual predicted 2005 values for the nitrogen dioxide tubes in question can be found in Appendix 3.

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.

There is further work to be done to assess the contributions from the M606 motorway and the subsequent concentrations of nitrogen dioxide at Woodlands C of E Primary School the façade of which is located 55 metres from the centre of M606 carriageway.

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 the continuous monitor

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, however, it is considered that further investigation is needed to ascertain pollutant concentrations around the vicinity of Centenary Square, a pedestrianised shopping area in central Bradford, where members of the public may well be regularly exposed for longer than an hour.

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 or traffic flows since the last round of Review and Assessment. Work is now well advanced on the construction of a new road which will by-pass the centre of Bingley, called the A650 Bingley Relief Road, which will be a 5 km length of dual carriageway extending from Crossflatts to Cottingley Bar. The Transport Studies Unit has predicted the traffic flows expected to travel on the new road. These figures have been 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 indicate that it is very unlikely that the objective will be exceeded due to the new road. Furthermore the site is being investigated using nitrogen dioxide tubes 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.

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

The only site identified as having the potential to exceed the objective was the area surrounding the Shipley Airedale Road and Barkerend Road junction. This site will be investigated in detail as part of a detailed assessment for nitrogen dioxide. Continuous monitoring may be deployed if it is considered necessary.

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 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 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 several sites within the Bradford District that have been identified as having the potential to exceed the objective for nitrogen dioxide, these sites are currently under investigation using a variety of methods. It is therefore considered necessary to progress to a detailed assessment for nitrogen dioxide which may involve real-time monitoring and passive monitoring at some of these sites and individual site-by-site complex dispersion modelling to assess pollutant concentrations.

16. 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.

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 $\mu g/m^3$**

(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 using two 8-port bubblers and three real-time continuous chemiluminescent monitors.

The results for the 8-port bubblers and the exceedance statistics for the continuous monitoring 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 4.

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 solids 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. The trains are infrequent and tend to run mainly at weekends and during the school holidays. On the days when the trains run the most frequently (Sundays in June, July, August and September) there are only 7 steam train journeys on the route, it is therefore considered very unlikely that this source will give rise to an exceedance of the objective, however further work will be done to assess any potential receptors and stopping points on the route before the next detailed assessment of air quality.

Conclusion

It is not considered necessary to progress to a detailed assessment for sulphur dioxide, however there is some further work to be done to assess the contribution of sulphur dioxide from the steam trains that run from Keighley to Oxenhope.

17. 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/m3 not to be exceeded more than 7 times per year, and an annual mean of 20 µg/m3, to be achieved by the end of 2010.
- For London, a 24-hour mean of 50 µg/m3 not to be exceeded more than ten times per year, and an annual mean of 23 µg/m3, to be achieved by the end of 2010. An annual mean objective of 20 µg/m3 to be achieved by the end of 2015 has also been set.
- For Scotland a 24-hour mean of 50 µg/m3 not to be exceeded more than 7 times per year, and an annual mean of 18 µg/m3 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

There has been significant progress in recent years in reducing emissions of particles from both the transport and industrial sectors, and total national annual UK emissions declined by nearly 40% in the period between 1990 and 1999.

Concentrations of PM_{10} are currently measured at more than 60 national monitoring sites in the UK. Data for the period 1999 to 2001 gives concentrations generally well below the 2004 annual mean objective

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 ug/m³*								Predicted Annual Mean ug/m³*	
	1999	exceedances	2000	exceedances	2001	exceedances	2002	exceedances	2004	2010
Shipley	25.7	13	20.5	10	17.0	5	15.6	6	15.4	14.6
Bingley	17.7	6	23.3	0	18.7	1	18.3	1	17.9	16.9
Keighley	16.5	2	14.2	0	16.8	8	15.2	3	15.0	14.3
Bradford	26	13	22.1	5	27.3	16	23.4	8	22.8	21.1

*results given as a gravimetric reading

The results show that it is very unlikely that either the annual mean or the 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 ug/m^3) at the central Bradford site.

It has been noted that the continuous monitoring for PM_{10} has given lower readings than expected at Shipley, Bingley and Keighley. This issue is currently being investigated with the help of the equipment suppliers, the results of which will be documented in the next air quality report which will published in April 2004.

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. The Shipley-Airedale Road and Barkerend Road junction gave the highest results for the modelling and as such is currently being investigated further using nitrogen dioxide tubes, if it is found to be necessary it will be monitored further using continuous monitoring which will include PM_{10} monitoring.

Roads with a high flow of buses and/or HGVs

Government guidance indicates that if the flow of HDVs 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 is currently under construction and its completion is expected by September 2003. This 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 is predicted that it is very unlikely that the new road will cause any exceedances of the 2004 objective for PM_{10}. As a precaution the site is currently being investigated further using nitrogen dioxide tubes which will provide a 'before and after' study of pollutant concentrations next to the site, if it is found to be necessary it will be monitored further using continuous monitoring which will include PM_{10} 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 first 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 solids fuel and as such it is considered that PM_{10} emissions from domestic properties are unlikely to be significant.

Fugitive Sources

Fugitive sources were considered in detail in the last round of review and assessment, the assessment identified six quarries and landfill sites that required further investigation. The assessment of these sites was based on the following three criteria;

- Predicted 2004 background PM10 levels at relevant receptors (provided by NETCEN's mapped data).
- Complaints made to the local authority regarding dust from activities on site including vehicle movements.
- Observations indicating the likelihood of significant dust emissions beyond the site boundary.

The findings were that it was unlikely that there would be any exceedances of the objective due to any of these sites, however, an amount of monitoring was also undertaken using a Microdust 880nm mobile dust monitor at three of the 'worst case' sites (i.e. those with the highest activity rate and residential properties within 60 metres). Unfortunately the data collected during this study was considered to be unreliable and as such was discounted. It is therefore considered that further monitoring is required using Bradford Council's Partisol 2000-H monitor. This work will be most likely to be undertaken at Buck Park Quarry (as this is the quarry with the most activity and a residential property within 50 metres) and it will be completed during the summer months as dry weather is most conducive to dust generation.

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 there is some further work to be done to assess the contribution of fugitive sources which will involve further monitoring, also it will be necessary to continue monitoring for PM_{10} in central Bradford to enable assessment of concentrations with respect to the proposed 2010 objective.

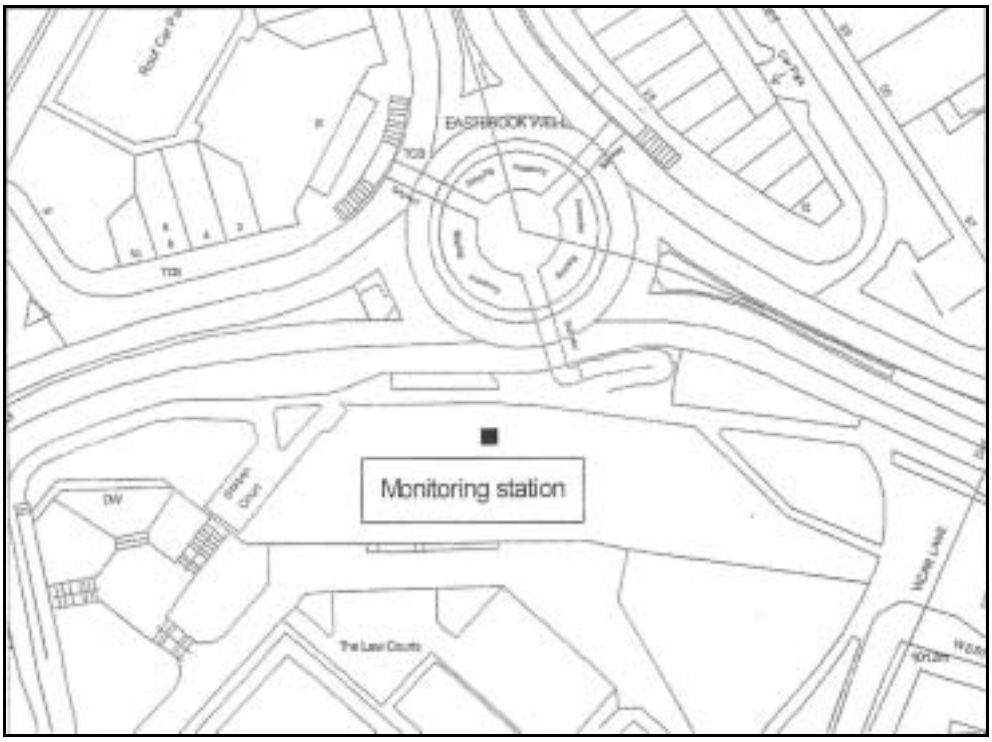
18. Report Conclusions

The overall conclusions reached as a result of the work that has gone into producing this updating and screening assessment are as follows:

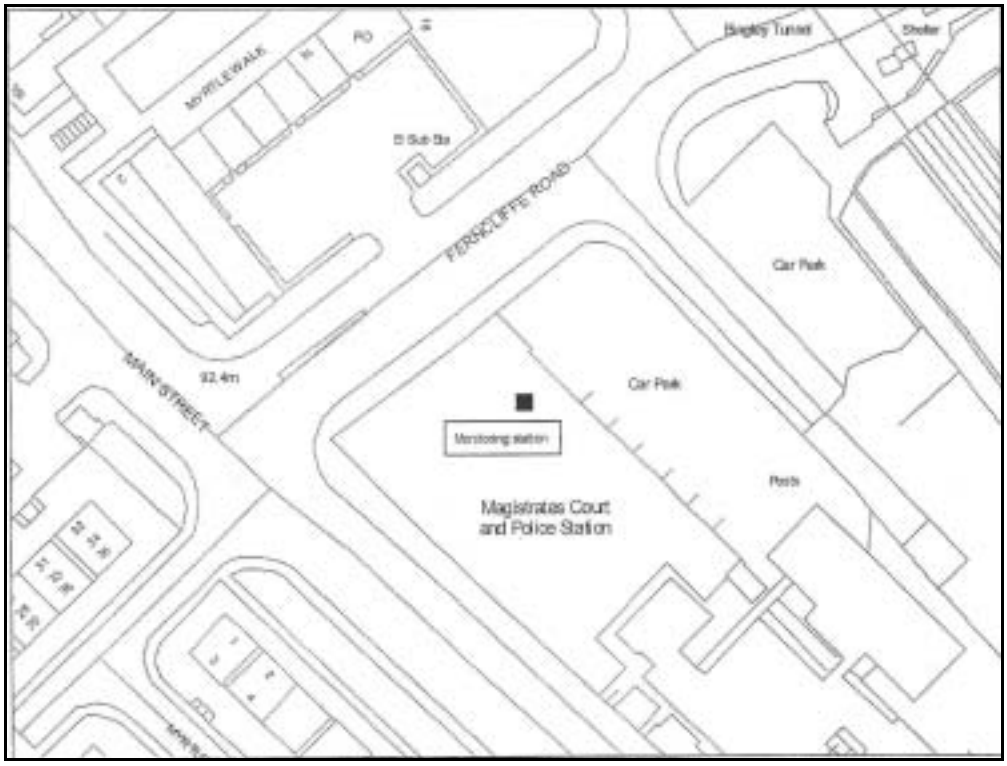
- There is no need to progress to a detailed assessment for carbon monoxide, benzene, 1,3-butadiene or lead.
- It is considered necessary to proceed to a detailed assessment for nitrogen dioxide as there are a number of locations that require further assessment before a decision is to made as to whether 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.

Appendix 1: Maps of Monitoring Stations

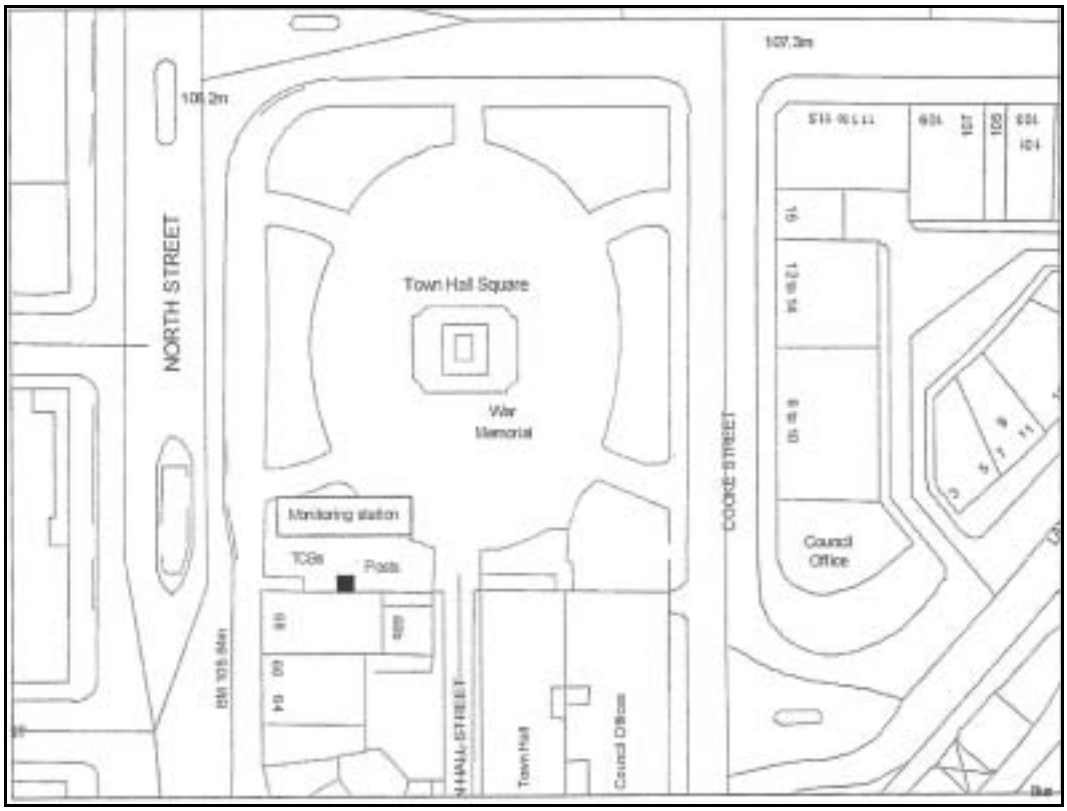
Map 1 Location of fixed monitoring station Bradford.



Map 2 Location of fixed monitoring station Bingley.



Map 3 Location of fixed monitoring station Keighley.



Appendix 2: Very Busy Roads

The Government Guidance - Review and Assessment: Technical Guidance LAQM.TG9 (02) gives the following criteria to allow authorities to identify 'very busy' roads and junctions for the purposes of determining the likelihood of exceeding the objectives for carbon monoxide and benzene:

- Single carriageway roads with daily average traffic flows which exceed 80,000 vehicles per day.
- Dual carriageway (2 or 3-lane) roads with daily average traffic flows which exceed 120,000 vehicles per day.
- Motorways with daily average traffic flows which exceed 140,000 vehicles per day.

Appendix 3: Predicted 2005 Values for Nitrogen Dioxide Tubes Identified as Problem Areas and Requiring Further Investigation.

Site Code	Site Address	Predicted Corrected 2005 Value ug/m^3
A2	Midland Terrace, Canal Road	43.8
A5	Cock & Bottle PH, Bradford	51.5
A7	St Mary's Presbytery, Bradford	47.7
A8	East Parade Apartments, Bradford	44.0
A9	Mayo Avenue, Bradford	54.6
A11	Thornton Road, Bradford	47.2
A13	Currer Street, Bradford	37.9
B6	Hard Ings Road, Keighley	48.6
B9	South Street, Keighley	38.4
DRS2	Manningham Lane, Bradford	42.4
DRS19	Southfield Lane, Bradford	38.0
DRS20	Great Horton Middle School, Bradford	47.9
DRS23	Harrogate Road, Bradford	45.1

Appendix 4: 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	1999	2000	2001	2002	1999	2000	2001	2002
Shipley	0	No Data	1	0	0	No Data	0	0	0	No Data	0	0
Keighley	1	No Data	0	1	1	No Data	0	0	0	No Data	0	0
Bradford	7	0	6	0	1	0	1	0	0	0	0	0

Sulphur Dioxide Monitoring Results
8-port Bubbler 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 bubbler. 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 bubbler. 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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