The Environment Act 1995

Local Air Quality Management

First Stage Air Quality Review and Assessment for Tyne & Wear

SUMMARY

Part IV of the Environment Act 1995 requires local authorities to review the air quality in their areas in regard to seven specified pollutants: nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), lead, fine particles (PM_{10}), benzene, and 1,3-butadiene. The Government's Expert Panel on Air Quality Standards has recommended certain air quality standards for these pollutants which are based on their effects upon health. These have been translated into a set of statutory objectives which must be met by the end of 2005. Where a local authority finds that a prescribed objective is likely to be exceeded in 2005, it must declare an Air Quality Management Area and draw up an action plan identifying changes which will be necessary to improve air quality.

During 1998, all UK local authorities commenced reviews of their air quality to identify any local problems arising from these pollutants. The five local authorities in Tyne & Wear; Gateshead, Newcastle, North Tyneside, South Tyneside, and Sunderland, are working together to determine the existing and future air quality in the region. This document details their initial findings.

Controls over domestic smoke and industrial processes have reduced levels of some pollutants substantially over the years. Air pollution in Tyne & Wear today is largely caused by traffic using the region's substantial urban road network, and, to an extent, emissions from industrial processes.

In Tyne & Wear, the first stage of this review and assessment exercise has identified six pollutants and their sources which need further investigation and assessment. It has also eliminated certain sources of pollution which are not significant in terms of emissions or the likelihood of the population being exposed. 1,3-butadiene has been eliminated from any further investigation since there are no significant sources of this pollutant within or near the Tyne & Wear region.

The information for this study has been acquired using methodologies and guidance provided by the Department of the Environment, Transport and the Regions. The information required as part of the process includes details of local industrial pollution sources, potential sources outside the area, roads of high or congested traffic flow, and

results from relevant air pollution monitoring activities undertaken throughout the region.

The second stage of the review and assessment process is continuing, with more detailed assessment methodologies, including pollution monitoring and analysis, the application of computer modelling techniques and other appropriate studies. A full inventory of emission sources within Tyne and Wear is nearing completion and will form part of a comprehensive review and assessment report which is currently expected to be published in early 2000.

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1. FIRST STAGE REVIEW AND ASSESSMENT OF AIR QUALITY FOR TYNE AND WEAR

1.1 Introduction

The quality of the air we breathe is an important factor in our general health. The London smogs of the 1950's prompted action in the form of domestic and industrial smoke control. Since then, other pollutants have gained significance, many directly linked to motor vehicles.

In 1995, Part IV of the Environment Act placed a duty upon the Government and local authorities to take action to improve air quality. The National Air Quality Strategy, published in March 1997 (and currently being reviewed), outlined proposals for tackling this issue. It set out air quality "standards" for the seven specific pollutants which had been identified as being of concern with respect to their effects upon health. These standards, which are not in themselves mandatory, represent an assessment of "no significant risk", but do not allow for the technical feasibility of achievement, nor for any assessment of costs and benefits. A set of statutory air quality objectives were, therefore, established by the Air Quality Regulations 1997 setting targets to be achieved by the year 2005. The current review of the National Strategy proposes to amend these objectives significantly, but this review and assessment cannot as yet take the draft proposals into consideration.

The Tyne & Wear Air Quality Management Group, with representatives from each of the five local authorities in the Tyne and Wear area, were charged with the responsibility of undertaking the formal review and assessment of air quality across the entire urban area of Tyne & Wear.

This document details the findings of the Group's First Stage Review and Assessment of local air quality in line with Part IV of the Environment Act 1995.

1.2 Tyne & Wear Air Quality Management

The Tyne & Wear Air Quality Management Group, representing each of the five local authorities, realised the advantages of joint working in the review and assessment process recognising the transboundary nature of air pollution and the efficiencies of pooling resources. The Group has developed an integrated approach aimed at protecting the health of the population, providing information and supporting co-ordinated strategies which will achieve long term improvements and involve the many varied organisations, individuals and bodies with an inherent stake and interest in local air quality.

1.3 Character of Tyne & Wear

The Tyne & Wear region covers an area of 54,006 hectares, with a population of 1.134 million. The conurbation centres around two major rivers, with a mixture of large urban and rural areas.

A substantial rail and road network covers the region which includes a number of motorways and trunk roads, primary roads, principal roads and other classified and non-classified routes. A comprehensive network of bus services operates in Tyne & Wear, as well as a Metro light rail network. Both regional and national rail systems and freight also operate, and Newcastle Airport provides international services. Passenger ferries and freight shipping services operate from The Port of Tyne and cargo traffic enters and leaves the Port of Sunderland.

Cars form the bulk of traffic on the roads - car ownership in Tyne and Wear increased by about 44% between 1980 and 1996, broadly in line with national trends.(**see figure 1.2**). If existing trends continue, further substantial increases in car ownership can be anticipated. This, together with the expected increase in commercial traffic will lead to greater pressure on the road system.

Traffic flows throughout the region vary considerably with highest traffic flows on the A1(M), A19, A69, and A690. Traffic flows build up in the inner urban areas and around major shopping areas such as the MetroCentre. The bridge crossings over the rivers Tyne and Wear and the Tyne Tunnel also suffer high traffic flows and congestion.

Air quality within Tyne and Wear may also be influenced by sources external to the region, notably power generation and metal refining activities.

The region is bounded to the east by the North Sea which is considered to be a source of natural particulates - sea salt - which contribute to the overall particulate level in the region.

There are a total 387 industrial processes (31 Part A and 356 Part B) in Tyne and Wear registered under Part I of the Environmental Protection Act 1990. There are no planned developments of such processes known at this time, but there are other significant proposals which may require assessment; namely an extension to the Metro Centre, the construction of a second Tyne Tunnel, the extension of the Metro rail network to Sunderland, and future expansion of Newcastle Airport.

2. THE NATIONAL AIR QUALITY STRATEGY

During the early 1990's, the Department of the Environment, Transport and the Regions (DETR) investigated the need for a framework for air quality management. This has been fuelled by recent episodes of poor air quality in many of the UK's major urban areas and increasing concerns expressed by the public and scientific community. The need to reconcile rising demands in living standards with better environmental quality has already been recognised in Local Agenda 21 (a local plan on how to make development socially, economically and environmentally sustainable), and is now taken further with the National Air Quality Strategy.

2.1 The Need for a National Air Quality Strategy

We must find a way of meeting the demand for higher standards of living whilst maintaining a clean and healthy environment. This was highlighted in both Agenda 21 (the touchstone document which came out of the Rio Earth Summit in 1992), and in the UK's own Sustainable Development Strategy.

UK air quality has improved dramatically since the 1950's and 1960's. Levels of pollutants are expected to continue to decrease as a consequence of national and EU policies. However, some areas remain at risk of experiencing high pollution levels, in particular those adjacent to heavily trafficked roads and certain industrial sources. Air pollution does not normally have a serious effect on healthy people, but there is some evidence that premature death, chronic illness and discomfort may be experienced in sensitive groups. The National Strategy is, therefore, needed to improve areas of poor air quality, to reduce any remaining significant risks to health.

2.2 Overview of the Principles and Main Elements of the Strategy

Through this Strategy the Government intends to provide a clear, workable framework for improving air quality based on the following:

- A statement of the Government's aims;
- Clear measurable targets, based as far as possible on an understanding of the health effects and the costs of pollutant abatement methods;
- A balance between national and local action, to ensure a flexible and cost-effective approach to air quality management

- A transport framework to allow businesses, local authorities and the wider community to identify the contribution they can make to improve air quality;
- The need to ensure consistency with international commitments and regular reviews of the strategy elements.

The main elements of the Strategy are:

- Health-based air quality standards and objectives, to act as reference points by which policies are directed
- A target of 2005 for achievement of the objectives;
- Policies for meeting those objectives, including an assessment of the improvements already expected under current policies, and how those policies need to be supplemented;
- The contribution key sectors, in particular industry, transport and local authorities, can make towards the cost-effective achievement of those objectives;
- A commitment to review the strategy every three years.

2.3 National Air Quality Standards

The air quality standards set acceptable concentrations of the pollutants in the atmosphere, based on an assessment of the effects of each pollutant on public health. In setting these standards the Government has accepted the judgment of the Expert Panel on Air Quality Standards regarding the levels of pollutants at which there would be an extremely small or no risk to human health. Where no recommendation has been made by the Panel, the standards have been derived from work undertaken by the World Health Organisation.

2.4 Policies for Achievement of the Objectives

A considerable number of policies have already been put into place in order to improve air quality since the 1950's. The Clean Air Act 1956 allowed local authorities to initiate smoke control programmes. More recently, other policies have been developed, for example :

* *Authorisations for Specified Industrial Processes* :

Nationally some 2000 of these processes (with the potential for polluting air, water and land) are regulated under the system of Integrated Pollution Control (IPC). Operators are required to adopt the "best practicable environmental option" for controlling emissions. Some further 13,000 processes are regulated under Local Air Pollution Control (LAPC). Both control regimes are based on applying the principle of "best available techniques not entailing excessive cost" (BATNEEC).

* *Emission Standards for Fuels and New Road Vehicles.*

These have been agreed by the European Community since the early 1990's and have reduced emissions from new vehicles substantially. Cars must now be fitted with catalytic converters which can reduce some exhaust emissions by 80%. Other substantial improvements have come from the reduced use of lead additives in petrol and the introduction of unleaded fuel, resulting in a fall in lead emissions of some 50%.

To meet the air quality objectives new policies are being put into place. Potential measures include :

- European Commission proposals for further, more stringent vehicle and fuel standards for the years 2000 and 2005;
- Tighter controls on the existing vehicle fleet, its management and operation;
- Development of environmental responsibilities by fleet operators (particularly public service fleets) and the public;
- New regulations which give local authorities powers to conduct roadside emission testing, and prevent drivers in parked vehicles from leaving engines running;
- Fiscal incentives, for example increases in fuel duty;
- Reduction in emissions from IPC and LAPC authorised processes as a result of statutory 4-year reviews of processes by the enforcement agencies.

3. REVIEW AND ASSESSMENT METHODOLOGY

The Tyne & Wear Air Quality Management Group has worked in conjunction with transport engineers, land use planners and other relevant personnel from all of the constituent local authorities to collate road traffic data and geographical information for the purpose of the air quality review and assessment.

In producing this report the Group collated details of the following required data for each of the objective pollutants:

- existing and proposed roads with levels of traffic flow which, by the end of 2005, could generate significant quantities of a pollutant of concern;
- existing and proposed roads, with existing or projected levels of congestion which, by the end of 2005, could generate significant quantities of a pollutant of concern;
- industrial processes regulated under Part I of the Environmental Protection Act 1990;
- other existing and proposed significant sources of a pollutant of concern;
- significant sources of a pollutant of concern outside the Tyne & Wear region, which could lead to a risk of a failure to achieve the air quality objectives within Tyne & Wear by the end of 2005;
- a description of the sources of information used to compile the report;
- surveys and investigations undertaken to obtain the information used to compile this report.

The Group has presented the geographically based information, collated as indicated above, in map form.

For all existing and proposed activities identified above, the Group then identified those existing and proposed activities which:

- have the potential, singly or together, to emit significant quantities of the pollutant of concern;
- are expected to be in existence and/or operation by the end of 2005;
- are situated in relevant locations where there is a potential for a person to be exposed to a pollutant of concern.

4. REVIEW AND ASSESSMENT OF NITROGEN DIOXIDE

4.1 Introduction

Nitrogen oxides - nitric oxide (NO) and nitrogen dioxide (NO_2), collectively known as NOx - are formed during high temperature combustion processes from the oxidation of nitrogen in the air/fuel mixture. The main source of NOx is road traffic, so concentrations are highest in urban areas where traffic is heaviest.

NO_2 can be a respiratory irritant at certain concentrations, and individuals with chronic bronchitis or asthma may be sensitive to episodes of high NO_2. In the presence of sunlight, NO_2 reacts with hydrocarbons to produce photochemical pollutants such as low-level ozone. This phenomenon is seen as "summertime smog". Ozone is a secondary pollutant as it is only formed when a reaction between NO_2, hydrocarbons and sunlight occurs. High incidence of photochemical smog is found in urban areas due to the levels of hydrocarbons, as well as NOx, emitted from road traffic and some industrial sources. NOx survive in the atmosphere for approximately one day before reacting with moisture to produce nitric acid, hence contributing to acid rain.

4.2 Standards and Objective for Nitrogen Dioxide

The Government has adopted two air quality standards for NO_2: a 1-hour average of 150ppb (parts per billion); and an annual average of 21ppb. The objective for both of these standards is to achieve them by the end of 2005.

The focus of the review and assessment has been any non-occupational, near ground level outdoor locations likely to suffer elevated NO_2 concentrations in areas where a person might reasonably be expected to be exposed over either of the averaging periods (eg in the vicinity of housing, school, or hospitals).

4.3 National Perspective

The main source of NOx in the UK is road transport which, in 1996, accounted for approximately 47% of total emissions measured as NO2. Power generation (22%) and domestic sources (4%) also contribute, though in urban areas, the contribution of road transport tends to be greater than the national average.

The National Air Quality Strategy suggests that for NO_2 a reduction of 5 to 10% over and above that expected to be attained by national policy measures, will be required to ensure that air quality objectives are achieved everywhere by the end of the year 2005. Local authorities with major or highly congested roads in their area, having the potential to result in elevated levels of NO_2 in relevant locations, are expected to identify a need to progress to the second or third stage review and assessment.

Levels of NO_2 are most likely to exceed the 1-hour objective either in winter, during times of poor dispersion of pollution due to weather conditions, or in summer due to complex photochemical and oxidation reactions.

4.4 The Situation in Tyne & Wear

All Tyne & Wear authorities have undertaken NO_2 monitoring at various sites for a number of years, through the use of passive diffusion tubes and automatic analysers. The tubes have provided mean monthly concentrations, at a mixture of kerbside, intermediate and background sites. The sampling locations for 1996 and other salient monitoring information are presented in **figures 4.1 to 4.4.**

Limited continuous (real time) automatic monitoring has also been undertaken. This provides hourly averaged data, which can be directly compared to the 1-hour annual average quoted as a recommended air quality standard. Relevant site information for Newcastle City Centre national network site (AUN) and data are set out in **figure 4.5**.

Existing national policies are expected to result in a continuing reduction of NO_2 levels such that only those areas which currently have an annual mean urban background concentration of greater than 30 ppb are likely to exceed the objective of 21 ppb in 2005. DETR's Pollutant Specific Guidance (LAQM.TG4(98)) recommends adopting the approach of only focusing on those areas where the mean annual urban background concentration exceeds 30 ppb. Monitoring results for Tyne & Wear from January to December 1996 show that the 30ppb threshold was not exceeded at the chosen monitoring locations.

The National Atmospheric Emissions Inventory contains emissions for NO_2 on a 1km by 1km grid basis for the Tyne and Wear region and surrounding areas. **Figure 4.6** shows that Tyne and Wear as a whole falls within the highest annual NOx emission classes - ie greater than 1000 tonnes, and greater than 100,000 tonnes per annum. However, no in-depth, accurate inventory work had been carried out for the region, and for this reason the Tyne & Wear Group commissioned , and is currently awaiting the results of, a detailed Urban Emission Inventory. Comprehensive emission data relating to NOx and other relevant atmospheric pollutants are not, therefore, presently available for consideration.

4.5 Potential Significant Sources

- An assessment has been undertaken of all existing and planned Part A and Part B processes within Tyne and Wear and within neighbouring areas, to assess their potential to emit significant quantities of NO_2, using the DETR's technical guidance "Pollutant Specific Guidance" TG4(98).
- Existing sources which, acting in combination, may result in a current annual mean concentration of greater than 30ppb have been considered.

  Table 4A and figure 4.7 show the sites and locations of the above potential significant sources.
- A number of roads with current and forecast (2005) annual average daily traffic flows greater than 20,000 vehicles (the threshold in the technical guidance) have been identified. **(Figures 4.8 and 4.9)**

The following information has also been utilised:

- Annual mean urban background concentrations for 1996; **Figure 4.10**
- Current urban concentrations due to dispersed road transport sources.

4.6 Conclusions

- Available monitoring data indicates that the 1-hour average value for NO_2 is currently being met at the current monitoring locations throughout Tyne & Wear. These locations do not provide sufficient information to enable the assessment of all potential sources of NO_2, in many cases having been selected to assess the impact of traffic on background levels.
- The urban background concentrations identified by national statistics do not forecast exceedences in 2005 in Tyne & Wear.
- The region contains a number of industrial sources which may have the potential to emit significant quantities of the pollutant, either singly or in combination, and therefore require further investigation.
- There are a number of planned or existing roads with current or forecast average daily traffic flows above the 20,000 threshold

The review has identified a number of sources within the region which have the potential to emit significant quantities of this pollutant affecting persons in "relevant locations". The Tyne & Wear authorities will therefore proceed to a second stage review for NO_2.

5. REVIEW AND ASSESSMENT OF CARBON MONOXIDE

5.1 Introduction

Carbon monoxide (CO) is an atmospheric pollutant emitted during combustion. It is also formed by the oxidation of hydrocarbons and other organic compounds. In urban areas carbon monoxide is produced almost entirely by road traffic. It survives in the atmosphere for approximately one month eventually being oxidised to carbon dioxide (CO_2). At certain concentrations CO may reduce the oxygen carrying capacity of the blood.

5.2 Standards and Objectives for Carbon Monoxide

The Government has adopted an 8-hour running average of 10 ppm (parts per million) as an air quality standard for CO, with the objective to achieve this target by the end of 2005.

The focus of the review and assessment for CO is non-occupational, near ground level outdoor locations with elevated CO concentrations in areas where a person might reasonably be expected to be exposed over an 8-hour period (e.g. in the vicinity of housing, schools and hospitals.)

5.3 National Perspective

In the UK, road transport accounted for 71% of the total emission of 4.6 million tonnes of CO in 1996. Such sources constitute a large proportion of the total in most cities and higher 8-hour average concentrations are therefore expected near busy and congested roads. There is a large year to year variability in the maximum running 8-hour average and exceedences of the air quality standard for CO were observed in one or more years at Belfast, Birmingham, Glasgow, Manchester and London. Levels have decreased over the period 1990-1997 and, in 1996, there were no exceedences of the CO standard at these sites. Existing national policies are expected to deliver the national air quality objective by the end of 2005 except near heavily used roads, or in the vicinity of certain stationary sources.

5.4 The Situation in Tyne & Wear

There is very little local data on ambient CO concentrations. The Automatic Urban Network site in Newcastle City Centre broadly reflects the national picture, and **figure 5.1** charts equivalent monthly averages which illustrate the year to year variability in CO concentrations. There were no exceedances of the 10 ppm air quality standard at the Newcastle site in either 1995 or 1996 (the most recent years for which ratified data is available from DETR). The maximum running 8 hour average for 1996 was 4.3 ppm (on 6 December 1996) and for 1995 was 3.5 ppm (on 14 November 1995).

5.5 Potential Significant Sources

- Several Part A and B processes have been identified as having the potential to emit significant quantities of CO, as a result of an assessment of all such existing and planned processes within Tyne and Wear and neighbouring areas in accordance with the guidelines in the DETR's "Pollutant Specific Guidance".
- A number of large car parks have been included due to their size and turnover, their proximity to congested highways and likelihood of exposure of the public.

  Table 5A and figure 5.2 highlight the above potential sources.

- A number of roads with current and forecast (2005) annual average daily traffic flows greater than 50,000 vehicle threshold have been identified (**Figures 5.3 and 5.4**)

Information on current urban background concentrations have also been examined, see figure 5.5

5.6 Conclusions

- A number of Part A and B processes and car parks have the potential to emit significant quantities of CO within Tyne & Wear.
- There are a number of roads with existing or forecast traffic flows above the 50,000 threshold.

Due to these factors, and the lack of monitoring data, the Tyne & Wear authorities will proceed to a second stage review and assessment for this pollutant.

6. REVIEW AND ASSESSMENT OF FINE PARTICLES (PM_{10})

6.1 Introduction

Particulate matter in the atmosphere is composed of a wide range of materials from a variety of sources. Man-made sources include carbon particles from incomplete combustion, ash, recondensed metallic vapours and secondary particles or aerosols formed from chemical reactions in the atmosphere. In addition, particles can be emitted from mining, quarrying and construction operations, transport sources such as diesel emissions, brake and tyre wear and road dust. Natural sources of particles include wind-blown dust, sea salt, pollen and fungal spores.

How long a particle stays suspended in the air depends on its size, shape and density. This also governs where the particle remains in the lung tissue after being inhaled. Smaller, spherical particles below 10um in diameter PM_{10} are more likely to penetrate the furthest spaces in the lungs (the alveoli). Studies have shown a connection between PM_{10} levels and health effects such as respiratory and cardio-vascular illnesses.

6.2 Standards and Objectives for PM_{10}

The Government has adopted an air quality standard for PM_{10} of 50 $\mu g/m^3$ (microgrammes per cubic metre of air) measured as a 24-hour average, with the objective for the standard to be achieved as an annual 99th~~th~~ percentile of daily maximum running 24-hour averages by the end of 2005. This means that the standard must not be exceeded on more than 4 days in any year.

The focus of the review and assessment is non-occupational, near ground level outdoor locations with elevated concentrations in areas where a person might reasonably be expected to be exposed over a 24 hour period,(eg in the vicinity of housing, schools and hospitals.)

6.3 National Perspective

National UK emissions of PM_{10} have been estimated as totalling 232,000 tonnes in 1996. **Figure 6.1** represents the various sources and their contribution to the total emission.

PM_{10} levels are generally higher in winter than in summer, with the contribution from transport sources rising to approximately 40-50% of the urban background at this time of year. Where levels rise to above 50$\mu g/m^3$, the contribution from traffic can be in the range of 75-85%.

PM_{10} levels can also exceed 50μg/m^3 in summer when vehicle emissions will also contribute to the total. Another important component is that arising from secondary particles. Such particles, typically composed of ammonium sulphate and ammonium nitrate, are formed from industrial and transport emissions across Europe and the UK. Secondary particles can travel long distances in the atmosphere being regional scale pollutants, the annual concentrations of which do not vary greatly over distances of ten kilometres.

Clearly, many of the sources of PM_{10} cannot be controlled or reduced by the local authorities as future concentrations will in part depend upon the contribution of the secondary and natural particle components. The Government has established the Airborne Particles Expert Group to advise on sources of PM_{10} in the UK and current and future ambient concentrations. Further advice is expected from DETR in light of any conclusions the Expert Group make. An interim approach to the first stage review and assessment has been taken, as recommended by DETR's "Pollutant Specific Guidance".

6.4 The Situation in Tyne & Wear

National maps hosted on the Internet (http://www.environment.detr.gov.uk /airq/aqinfo) indicate that secondary particles currently contribute between 9 and 10 μg/m^3 to annual average background PM_{10} concentrations for Tyne and Wear (see **figure 6.2**). DETR Pollutant Specific Guidance (LAQM.TG4(98)) recommends that those regions which experience annual average secondary particle concentrations of greater than 8 μg/m^3 may be at risk of exceeding the objective, and therefore should carry out a further review and assessment for this pollutant.

Current monitoring within Tyne and Wear does not identify the contribution of secondary particles to overall concentrations, but is nevertheless very useful in indicating potential problem areas and in giving a "regional" picture. The Tyne and Wear authorities undertook an extensive monitoring exercise of potential point sources of PM_{10} as part of the Phase 1 DETR research project, focusing on : shiprepair, open cast/site reclamation, and limestone quarrying. The results of the exercise, together with some data for additional sites, are graphed as **figures 6.8.1 to 6.8.7.** Site descriptions are summarised below :

* **Bridge Street, Sunderland** - high traffic flows, kerbside site, measurements by TEOM
* **New Herrington - Flinton Hill Farm and Railway Terrace** - adjacent to an open cast coaling site, measurements by partisol gravimetric sampler
* **Mill Dam, South Shields** - within 100 metres to the east of a shiprepair facility involving blastcleaning and coating of ship superstructures and hulls, using a partisol
* **Souter Lighthouse** - 1997/1998 - 200 metres due east of large limestone quarrying and processing facility, using a partisol

* **Garden Lane, East Boldon** - to the east of a cement batching plant, utilising a partisol.

All the data graphed illustrate exceedances of the current objective for PM_{10} .

Analysis of further data obtained by the Newcastle City Centre AUN site for 1996 and 1995 reveals that the air quality standard was exceeded on 27 days and 20 days respectively, well in excess of the curent air quality objective.

6.5 Potential Significant Sources

- An assessment has been undertaken of all existing and planned Part A and B processes within Tyne and Wear and in neighbouring areas, following the guidelines in DETR's "Pollutant Specific Guidance". A number of processes were identified as having the potential to emit significant quantities of PM_{10} .
- Other point sources such as large combustion plant, multi-storey car parks, bus depots, and quarries, have also been identified as having the potential to emit significant quantities of PM_{10} .

  Table 6A and Figure 6.3 show the above sites and locations which been identified.
- Approximate emission densities from road transport and other low-level dispersed sources have been assessed. National Emissions Inventory data for 1996 shows that emissions of PM_{10} in some 1km x 1km grid squares within Tyne & Wear are greater than 10 tonnes. In addition, there are a number of adjacent grid squares where the average emissions of PM_{10} exceed 5 tonnes (**figure 6.4**).
- A number of roads with current and forecast (2005) annual average daily traffic flows greater than the 25,000 vehicle threshold have been identified (**Figures 6.5 and 6.6**)

The following information has also been utilised:

- Current annual average urban background concentrations from national maps (**figure 6.7**);
- Current annual average **secondary** particulate background concentrations from national maps (**fig. 6.2**).

6.6 Conclusions

- Emissions densities of PM_{10} have exceeded the thresholds in some 1km x 1km grid squares within Tyne & Wear.
- There are areas in Tyne & Wear where background particulate levels due to secondary particles are on or above the threshold of $8\mu g/m^3$;
- There are a number of existing or planned roads with current or forecast average daily traffic flows greater than the 25,000 vehicle threshold;

- A number of Part A and B processes and other point sources within Tyne & Wear have been identified as potential significant sources.

For the above reasons, the Tyne & Wear authorities will proceed to a second stage review and assessment for this pollutant.

7. REVIEW AND ASSESSMENT OF LEAD

7.1 Introduction

Lead (Pb) is a non-ferrous metal, which can occur on its own as an element or with other elements to form alloys and compounds. Emissions of lead can be found in the form of fine particles or as fume. Depending upon the sources, the size of particulates can vary from 0.015μm (micrometres), as emitted from petrol engines, to between 0.1 and 5μm found in industrial emissions. A proportion of lead occurs naturally and is released into the environment from the weathering of rocks in the form of mineral ores. Lead is, and has been, used either as an element or in the form of alloys or compounds in a large number of industries. Lead may also be released from the combustion of coal and other fossil fuels as well as from the treatment and disposal of waste. A lead compound, tetraethyl lead, is still used as an additive in petrol to improve combustion efficiency of the engine and makes road transport the most significant contributor to ambient lead levels.

7.2 Standards and Objectives for Lead

The Government has adopted an air quality standard for lead of 0.5μg/m3 (or 500ng/m3 - nanogrammes per cubic metre of air) measured as an annual mean with the objective of achieving this target by the end of 2005. The focus of the review and assessment for lead is non-occupational, near ground level outdoor locations with elevated lead concentrations where a person might reasonably be expected to be exposed over a year (eg in the vicinity of houses, schools and hospitals).

7.3 National Perspective

The adverse effect on human health has been recognised nationally and efforts to reduce the lead content of petrol have been a clear success. This trend is set to continue as since 1993 all new petrol-engined vehicles have been fitted with catalytic converters which can only run on unleaded fuel.

Typically, urban concentrations have now been reduced so that maximum annual mean values are around 150ng/m3, while rural values are less and range from 5 to 50ng/m3. Localised industrial sources, such as secondary non-ferrous metal smelters, can still have an impact on local air quality. Concentrations around such sites can range from 117 to 882ng/m3. The Government policy of supporting unleaded petrol has meant that the objective for lead at all rural and urban background sites and roadside locations is likely to be complied with in all areas where there are no other significant industrial sources. The requirement to proceed with a second stage review and assessment is therefore dependent upon whether significant industrial sources are present within a particular local authority area.

7.4 The Situation in Tyne & Wear

Data on urban background concentrations of lead has been obtained from two national monitoring network sites within the region, located in North Tyneside and Newcastle. Additional information has been drawn from the national maps of background concentrations (**figure 7.1**). The data obtained from the two network sites reflects the national picture. The annual mean concentrations measured at the North Tyneside site dropped from 90ng/m3 in 1993 to 26ng/m3 in 1994, while the mean concentration in Newcastle dropped from 70ng/m3 to 27ng/m3, over the same period. This reduction corresponds with the implementation of government policy.

In addition, lead monitoring is carried out at selected sites within North Tyneside and Gateshead. Monitoring data from all of the sites throughout the region show that lead levels fall below the air quality standard (**figure 7.2**).

Further monitoring is undertaken in the vicinity of three industrial sources. These sites are assigned National Monitoring Network sites and the concentrations obtained are shown in **figure 7.3**. At two of the sites (Elswick 2 and 6) no exceedences of the air quality standard have occurred. Two exceedences have occurred at site Elswick 1. The trend of the data, at monitoring positions Elswick 2 and 6 illustrates a gradual reduction in ambient lead levels.

Combustion of waste oil has also been considered as a potential lead emission source. Measurements of both lead and particulate concentrations from a waste oil burner (a Part B prescribed process) were carried out as part of an air quality pilot study within Tyne and Wear. Ambient lead concentrations were modelled for a small waste oil burner of less than 0.4 MW (megawatt) thermal rating. The predicted annual mean was considerably below the suggested air quality standard. It is considered that such small waste oil burners will not pose a risk of breaching the objective for lead.

7.5 Potential Significant Sources

Several existing and planned Part A and B processes within Tyne and Wear have been identified as having the potential, singly or together, to emit significant quantities of lead following an assessment carried out in accordance with the DETR's "Pollutant Specific Guidance". Other potential sources were also considered (**figures 7.4 and Table 7A)**

7.6 Conclusions

As several processes have been identified as having the potential to emit significant quantities of lead, it has been concluded that further investigation is required to determine localised concentrations of lead in urban residential areas which are in close proximity to these sites.

The Tyne & Wear authorities will, therefore, proceed to a second stage review and assessment for lead.

8. REVIEW AND ASSESSMENT OF BENZENE

8.1 Introduction

There are two main groups of hydrocarbons of concern: volatile organic compounds (VOCs) and polyaromatic hydrocarbons (PAHs). VOCs are released in vehicle exhaust gases, either as unburned fuels or as combustion products. They are also emitted by the evaporation of solvents and motor fuels. Benzene and 1,3-butadiene are of particular concern as they are known human carcinogens. Other VOCs are important because of the role they play in the photochemical formation of ozone in the atmosphere.

Benzene is a minor constituent of petrol - approximately 2% by volume, although it can be as high as 5%. The main sources of benzene in the atmosphere in the UK are the distribution and combustion of petrol. Diesel is a relatively minor source. Benzene is emitted in vehicle exhausts, not only as unburned fuel but also as a product of the decomposition of other aromatic compounds.

8.2 Standards and Objectives for Benzene

The Government has adopted a running annual average of 5ppb as an air quality standard for benzene, with the objective to achieve this value by the end of 2005. The focus of the review and assessment for benzene is any area where a person might reasonably be expected to be exposed over a year (eg in the vicinity of housing, schools and hospitals).

8.3 National Perspective

Motor vehicles are the most important single source of benzene, accounting for 64% of total UK emissions in 1996, with most of this arising from petrol vehicles. Industrial processes account for 15% of total UK emissions. The Government envisage that existing national policies, such as improving vehicle emission controls and petrol station vapour recovery systems, will deliver the prescribed air quality objective for benzene by the end of 2005. Roadside levels, next to even the most busy or congested roads, are expected to easily meet the objective. The remaining concern centres on larger industrial processes which handle, store or emit benzene, and which may, in conjunction with other sources, result in elevated levels in relevant locations.

8.4 The Situation in Tyne & Wear

National maps of annual mean background concentrations indicate that levels of benzene in Tyne and Wear lie in the range 0.5 to 1.25ppb in 1996 (**figure 8.1**).

A number of authorities in the area have for some time monitored benzene levels using diffusion tubes. In addition, the Tyne & Wear Air Quality Management Group undertook an assessment exercise on behalf of DETR as part of a national pilot study, aimed at establishing the impact of benzene emissions from petrol service stations and distribution depots.

The results of this pilot study can be generally interpreted as reflecting the national picture. The data reported related to background and kerbside sites, and to sites located in close proximity to the common benzene sources found in the urban area (ie petrol filling stations and a petrol storage and distribution depot). Additional data is presented in **figures 8.2 and 8.3** for running annual means obtained at several sites in Tyne and Wear. At no location did concentrations approach or exceed the prescribed objective of 5ppb, even when applying a factor of 1.2 to the annual average to reflect the running annual mean, as recommended by DETR Technical Guidance TG1(98) "Monitoring for air quality reviews and assessments".

8.5 Potential Significant Sources

Following the guidelines in the DETR's "Pollutant Specific Guidance", an assessment of all existing and planned Part A and B processes within Tyne and Wear and the neighbouring areas resulted in several being identified as having the potential, singly or together, to emit significant quantities of benzene. These are identified in **Tables 8A and 8.4.**

The two most common categories of source; busy main roads and petrol service stations, may be excluded from the first stage review primarily on the basis of the national estimating exercise supported by local monitoring results in Tyne & Wear. It is present policy to exclude petrol filling stations from the assessment exercise pending the outcome of the research project, even though the larger sites (with a throughput of in excess of 1,000 cubic metres of petrol) are currently being authorised as Part B processes by the local authorities, and hence are included in Appendix B.

8.6 Conclusions

The air quality standard for benzene is not likely to be exceeded as a result of emissions from road transport, nor by vapour losses from petrol filling stations. Several industrial sites have, however, been identified as having the potential to emit significant quantities of this pollutant with a potential to affect persons in relevant locations.

The Tyne and Wear authorities will, therefore, proceed to a second stage review and assessment for benzene.

9.0 REVIEW AND ASSESSMENT OF 1,3-BUTADIENE

9.1 Introduction

1,3-butadiene, like benzene, is a VOC and a recognised human carcinogen. Unlike benzene, however, it is not a constituent of petrol or diesel fuel but is produced during the combustion process, and emitted with other exhaust gases. 1,3-butadiene is also an important chemical in certain industrial processes, particularly the manufacture of synthetic rubber, and may be found in bulk storage installations. Other than in the vicinity of such locations, the dominant source of 1,3-butadiene is the motor vehicle.

9.2 Standards and Objectives for 1,3-Butadiene

The Government has adopted a running annual average of 1ppb as an air quality standard for 1,3-butadiene with the objective for the standard to be achieved by the end of 2005. The focus of the review and assessment is non-occupational, near ground level outdoor locations with elevated 1,3-butadiene concentrations in areas where a person may reasonably be expected to be exposed over a year (eg in the vicinity of houses, schools, and hospitals).

9.3 National Perspective

The UK atmospheric inventory for 1,3-butadiene identified that, in 1995, 67% of national annual emissions arose from petrol vehicles and 13% arose from industrial processes. The Air Quality Standard for 1,3-butadiene is not currently exceeded at any urban background site and road side levels next to even the most busy or congested roads are expected to be well below the objective. It is therefore expected that existing national policies will deliver the prescribed air quality objective for 1,3-butadiene by the end of 2005.

Only those authorities with major industrial processes which either, handle, store or emit 1,3-butadiene and which have the potential, in conjunction with other sources, to result in elevated levels in relevant locations, are expected to need to undertake a second stage review and assessment.

9.4 The Situation in Tyne & Wear

The DETR Urban Hydrocarbon Network provides an indication of pollutant concentrations, and there is a known factor relating benzene and 1,3-butadiene emissions from road transport. The estimation is, that for emissions dominated by road traffic, compliance with the benzene objective will indicate clear compliance with the objective for 1,3-butadiene.

DETR data identifies that the air quality standard is currently not exceeded at any urban background site. Data is available for several urban locations across the UK for 1996, and in all instances the maximum running annual mean concentration falls

below 1ppb. The closest location (Middlesbrough) exhibits a value of 0.3ppb for 1996.

The only diffusion tube survey undertaken in Tyne & Wear highlighted the difficulties inherent in the methodology, with the great majority of samples falling below the limit of detection of the analytical technique.

9.5 Potential Significant Sources

Following the guidelines in the DETR's "Pollutant Specific Guidance", an assessment of all existing and planned Part A and B processes within Tyne & Wear and the neighbouring areas found that there were none which had the potential to emit significant quantities of 1,3- butadiene.

Investigation of the Environment Agency's Chemical Release Inventories for 1996 and 1997 has failed to highlight any significant source either within Tyne and Wear or external to it. This has been confirmed by examination of the Part A public registers. Four Part B rubber processes were discounted (one each in the Sunderland area, Gateshead, North Tyneside and one external Part B process in Derwentside). None of these processes utilised 1,3-butadiene.

9.6 Conclusions

Given the existing national data, together with traffic forecasts and vehicle emission control improvements, and lack of significant industrial sources, it is concluded that there will be no locations within Tyne & Wear which risk exceeding the prescribed objective for 1,3-butadiene of a running annual mean of 1ppb by the end of 2005.

This pollutant will, therefore, not be the subject of further investigation.

10. REVIEW AND ASSESSMENT OF SULPHUR DIOXIDE

10.1 Introduction

Sulphur dioxide (SO_2) is an acid gas produced as a result of the burning of fossil fuels. Together with smoke, it is the most widely measured atmospheric pollutant with records going back to 1914. Ambient concentrations have declined with a reduction in the use of coal due to implementation of Smoke Control Orders. SO_2 combines with water vapour in the atmosphere to produce acid rain, which can damage and destroy vegetation and affect soils, watercourses and building materials. It is also a recognised respiratory irritant and is associated with asthma and chronic bronchitis.

10.2 Standards and Objectives for Sulphur Dioxide

The Government has adopted a 15-minute average of 100ppb as an air quality standard, with an objective to achieve the 99.9th ~~th~~ percentile by the end of 2005. This means that the level may be exceeded for no more than 35 periods of 15 minutes in any year.

The focus of the review and assessment is non-occupational, near ground level outdoor locations where a person is likely to be exposed for over 15 minutes (eg in the vicinity of houses, schools and hospitals).

10.3 National Perspective

Sulphur dioxide is still associated with the combustion of coal and oil. The total UK emission in 1996 was estimated as two million tonnes, with the main sources being: power generation (65%), other industry (24%), commercial and domestic heating (6%) and road transport (2%). Major problems from SO_2 now tend to be restricted to areas where coal remains widely used for domestic heating, and near industrial processes using significant quantities of oil or coal and where stack heights may not prove sufficient to achieve current air quality requirements.

10.4 The Situation in Tyne & Wear

Local authorities have been monitoring ambient levels of SO_2 for many years. Three distinct methods have been utilised:

* Active sampling - drawing ambient air through a collection medium (typically a liquid bubbler) for a specified time (usually 24 hours). **Figure 10.1** sets out representative SO_2 concentrations for the urban area for the years 1995-1998. All authorities have employed this method in the past, and it can be seen from the results typified by South Tyneside that levels have consistently fallen, in this case to averages of approximately 4 ppb in 1998.

* Automatic (continuous) monitoring - this method provides high quality data, analysed on-line and real time. Two such sites have provided data to the Automatic Urban Network (AUN) - Newcastle City Centre and Sunderland (**figures10.2 and Table 10B**). Data for Newcastle Centre for 1995 shows 96 exceedances of the air quality standard (64 in 1996) which compares unfavourably with the prescribed objective of only 35 exceedances. There is insufficient information from which to determine long term trends. Additionally, there have been a number of occasions when the AUN site in Newcastle has recorded sudden and locally inexplicable 15 minute peaks of the order of 193ppb on 13th ~~th~~ May 1998, 103ppb on 3rd ~~rd~~ June 1998 and 118ppb on 15th ~~th~~ June 1998.

* Passive Diffusion Tubes - These have been used in South Tyneside. The levels of SO_2 have predominantly remained between 4 and 7 ppb (**Fig 10.3**).

Data is not readily available on emission densities for low level sources, but the Tyne and Wear Air Quality Management Group is awaiting the results of a detailed Urban Emission Inventory. There are only a few areas in Tyne and Wear not covered by Smoke Control Orders, but in none of these does the housing density exceed the 300 houses per kilometre square threshold advised by DETR. **Figures 10.4 and 10.5** identify background concentrations and total emissions for Tyne and Wear calculated from national data sets.

10.5 Potential Significant Sources.

An assessment has been undertaken of all existing and planned Part A and B processes within Tyne & Wear and within neighbouring areas, to identify their potential, singly or together, to emit significant quantities of SO_2 , in accordance with the DETR's "Pollutant Specific Guidance".

In addition, an attempt has been made to identify oil and solid fuel-fired combustion installations exceeding 5MW (megawatts) thermal power. **Table 10A and figure 10.6** set out all sites and locations which may have the potential to emit significant quantities of sulphur dioxide.

10.6 Conclusions

It is clear from the results for the Newcastle AUN site for 1995 and 1996 that SO_2 concentrations need to be examined in detail at a number of other locations, particularly bearing in mind the recent anomolies at Newcastle Centre and the potential significant sources identified during the first stage review. The Tyne & Wear authorities will thus proceed to a second stage review and assessment for sulphur dioxide.

11. CONCLUSIONS OF THE FIRST STAGE REVIEW

The first stage review and assessment of local air quality in the Tyne & Wear region has eliminated certain sources of atmospheric pollution, and one pollutant, from the review and assessment process.

Sources of relevant pollutants which may be significant because of their locations and emission characteristics have been identified. They now require a further, more detailed assessment. It has been established that for one of the relevant pollutants, 1,3-butadiene, no further investigation or assessment is necessary. This pollutant will not therefore be subjected to further study during the second stage process.

The remaining six pollutants of local interest and possible significance to be further assessed are: nitrogen dioxide, sulphur dioxide, carbon monoxide, benzene, lead and fine particles (PM_{10}).

The identified pollutants result from emissions to air from road traffic and also originate from fixed industrial and other sources both within and outside the region. Emissions of lead and benzene in significant quantities and concentrations are known to be associated primarily with industrial processes and activities, and are localised as a result. The remaining pollutants, in addition to their possible industrial origins, are also associated with major road systems with high traffic flows or which suffer from severe congestion.

Detailed assessment methodologies (including pollution monitoring and analysis, the application of modelling techniques and other appropriate predictive studies) will now be applied to those sources of pollution (and to their emissions) identified by the first stage review and assessment.

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Local Authority Contacts :

Deputy Director of Housing and Public Health
City of Sunderland Council
PO Box 111
Civic Centre
Sunderland SR2 7DN **Tel. 0191 5531664**

Director of Health and Consumer Services
Gateshead MBC
Civic Centre
Gateshead NE8 1HH **Tel. 0191 4771011**

Director of Enterprise, Environment & Culture
Newcastle City Council
Civic Centre
Newcastle NE1 8PB **Tel. 0191 2328520**

Head of Environmental Services
North Tyneside MBC
PO Box 113
Station Road
Killingworth
Newcastle NE12 0WJ **Tel. 0191 2192474**

Director of Community Services
Central Library
Prince Georg Square
South Shields NE33 2PE **Tel. 0191 4271717**