# ANNEX 6:
# Air Quality

## Introduction

Despite an increase in general traffic levels, the Borough area does not experience any serious air quality issues related to traffic sources and does not intend to declare an Air Quality Management Area at the moment.

However, action may be required to tackle the levels of PM10 emissions (related to the use of diesel engines), if the proposed 2010 national target of an annual mean value of 20 micrograms per cubic metre is introduced. We intend to review air quality in 2006/07, working in partnership with our neighbouring Tees Valley local authorities.

## National Context

The UK Government has set air quality objectives and proposals for nine air pollutants, against which the Tees Valley Environmental Protection Group monitor and assess the quality of local air.

The pollutants and objectives are:-

- **nitrogen dioxide**
  Objective 1 Annual mean of 40µg/m$^3$ (21 ppb) maximum with no exceedances
  Objective 2 1 hour mean of 200µg/m$^3$ (105 ppb) maximum with up to 18 exceedances per year
- **particulate PM10**
  Objective 1 Annual mean of 40 µg/m$^3$ (gravimetric) maximum, with no exceedances
  Objective 2 24 hour mean of 50 µg/m$^3$ (gravimetric) maximum, with up to 35 exceedances per year
- **sulphur dioxide**
  Objective 1 24 hour mean of 125 µg/m$^3$ (47 ppb) maximum, with up to 3 exceedances per year
  Objective 2 1 hour mean of 350 µg/m$^3$ (132 ppb) maximum, with up to 24 exceedances per year
  Objective 3 15 minute mean of 266 µg/m$^3$ (100 ppb) maximum, with up to 35 exceedances per year
- **carbon monoxide**
  Objective 8 hour running mean of 10 mg/m$^3$ (8.6 ppm) maximum, with no exceedances
- **benzene**
  Objective 1 Running Annual Mean of 16.25 µg/m$^3$ (5 ppb) maximum, with no exceedances
  Objective 2 Annual Mean of 5.00 µg/m$^3$ (1.54 ppb) maximum, with no exceedances
- **1,3-butadiene**
  Objective Running annual mean of 2.25 µg/m$^3$ (1 ppb) maximum, with no exceedances
- **lead**
  Objective 1 Annual mean of 0.5 µg/m$^3$ (5 ppb) maximum, with no exceedances
  Objective 2 Annual mean of 0.25 µg/m$^3$ (1.54 ppb) maximum, with no exceedances
- **ozone**
  Provisional Objective 8 hour running mean of 100 µg/m$^3$ (50 ppb) maximum, with up to 10 day exceedances per year
- **polycyclic aromatic hydrocarbons**
  Provisional Objective Annual mean of 0.25 ng/m$^3$ (BaP) maximum, with no exceedances

Each objective has to be met by its due date (ranging from 31 December 2003 until 31 December 2010). If this is unlikely to occur, then we are obliged to declare an Air Quality Management Area. Such areas apply if one or more of the relevant target group listed below exists:-

- members of the public are regularly present
- building facades are residential, or public places such as Hospitals
- residential gardens
- public spaces where people may stay for longer than 1 hour

The objectives have associated targets that have been set at levels that are considered not to have harmful effects on most of the population. These threshold levels are regularly reviewed by Government and are based on worldwide research into health effects of pollution.

The Group also measure cadmium, arsenic, nickel and mercury elements in the atmosphere for completeness, since these may become national requirements in the future.

## Local Monitoring

In Darlington, we work in partnership with our neighbouring Tees Valley local authorities to measure relevant pollutants. Currently, we monitor the following sites for nitrogen dioxide and particulate PM10 (**Table 1**). We also intermittently monitor for other elements as detailed in the text.

**Table 1 Local monitoring sites**

| Site | Start Year | Pollutants Measured | Description |
|---|---|---|---|
| Cockerton Bridge | 2004 | $NO_2$, PM10 (from May 2004) | Roadside continuous monitoring |
| St Cuthbert's Way | 2000/01 | $NO_2$, PM10 (until May 2004) | Roadside continuous monitoring |
| Northgate | 2004 site | $NO_2$ | Roadside diffusion tube |
| Salters Lane | 2004 site | $NO_2$ | Roadside diffusion tube |
| Hundens Depot | 2004 site | $NO_2$ | Roadside diffusion tube |
| Arts Centre | 2004 site | $NO_2$ | Roadside diffusion tube |
| Woodland Road | 2004 site | $NO_2$ | Roadside diffusion tube |
| Blackwell Bridge | 2004 site | $NO_2$ | Roadside diffusion tube |
| North Road Station | 2004 site | $NO_2$ | Roadside diffusion tube |
| Haughton Green | 2004 site | $NO_2$ | Roadside diffusion tube |
| Yarm Road | 2004 site | $NO_2$ | Roadside diffusion tube |
| Middleton One Row | 2004 site | $NO_2$ | Roadside diffusion tube |
| Cockerton Bridge | 2004 site | $NO_2$ | Roadside diffusion tube |

The Borough area does not experience any serious air quality issues related to traffic sources and does not intend to declare an Air Quality Management Area at the moment. The Council has also considered the likely effects of future development and is currently of the opinion that an Air Quality Management Area will not be required within the lifetime of the Second Local Transport Plan. However, action may be required to tackle the levels of PM10 emissions (related to the use of diesel engines), if the proposed 2010 national target of an annual mean value of 20 micrograms per cubic metre is introduced.

Further details, justifying this opinion are contained in the results section below. Further detail on all the results quoted in this annex may be found in the 2005 progress report of the Tees Valley Environmental Protection Group (April 2005).

In addition to the work quoted in the 2005 progress report, the Tees Valley Environmental Protection Group have completed a computer model for estimating roadside pollution levels due to traffic in the Tees Valley, based upon Design Manual for Roads and Bridges (DMRB) advice. This model has been successfully validated against the five continuous roadside monitoring sites in the sub-region.

In summary[1] , the work revealed that in Darlington:-

- the model replicates the reality measured by the two continuous monitoring sites,
- Kerbside and roadside NO2 diffusion tubes, within 8 metres of the road centre appear to consistently read 20% high. This has been suspected from other data sources and may be due to high short term concentrations of the pollutant during rush hour.
- The model confirms the analysis of the 2005 report, in that action may be required to tackle the levels of PM10 emissions (related to the use of diesel engines), if the proposed 2010 national target of an annual mean value of 20 micrograms per cubic metre is introduced.

## Results

**Nitrogen Dioxide**
**Objective 1 Annual mean of 40µg/m$^3$ (21 ppb) maximum with no exceedances.**

The target groups are those members of the public that may be exposed to levels of nitrogen dioxide above 40µg/m$^3$, as an annual mean by 31 December 2005.

Nitrogen dioxide is formed as a result of combustion processes of all types, including transport. It is essentially a secondary pollutant, nitric oxide (NO) is emitted into the atmosphere from the combustion processes and combines further with oxygen atoms, usually derived from ozone, to form nitrogen dioxide ($NO_2$).

Long term exposure to nitrogen dioxide may affect lung function and enhance the response to allergens in sensitised individuals.



1 Supplementary Report on Traffic Pollution Study in the Tees Valley 2004, Published by TVEPG in 2005

The results show a good degree of consistency on a year by year basis, but with no clear signs that nitrogen dioxide levels are reducing. **Tables 2 and 3**. While 2003 results showed an increase due to prolonged spells of high pressure weather during February, March and April 2004 results were back to normal levels.

The **St. Cuthbert's Way** site is a town centre kerbside site and demonstrates the significant effect that slow moving, heavy traffic has on ground level concentrations of nitrogen dioxide. Levels are close to the objective, but there are no target groups at this type of location.

The use of a mobile monitor confirms the above. The **Durham Tees Valley Airport** site (measured in 2002), well away from traffic, shows the lowest levels. There is also no evidence of significant industrial impact at any of the sites, so road traffic is the major source of nitrogen dioxide at ground level within Darlington. The generally open aspect of the road system and trunk road corridors means that areas where target groups may be present will have nitrogen dioxide levels well below the objective.

**Diffusion tubes** are inherently less accurate than continuous monitors, but are a cost-effective way to measure annual averages of nitrogen dioxide over a wider area. Within the Tees Valley, they are mainly used to identify potential hot-spots of air pollution for further investigation. There is evidence that diffusion tubes at kerbside sites tend to read up to 25% higher than continuous monitors.

Kerbside sites where there tends to be slow moving or frequently stationary traffic, show the highest levels. While some site measurements show an exceedance of the objective level, there are no target groups in the vicinity. These sites are also being further investigated using the DMRB air quality model.

Roadside and intermediate sites, which are set back further from the kerbside and may be located close to target group areas, have lower levels that are comfortably within the objective level. Background sites tend to be consistently well below the objective level.

Overall, the results from each Council are similar at the various category of site. With diffusion tubes tending to read high, and the expectation of reducing nitrogen oxide emissions from vehicles by year 2005, there have been no target group areas identified where the objective will be exceeded.

**Table 2 Continuous monitoring stations - all results µg/m³ as the annual mean**

| Site | Years | | Number of exceedances | |
|---|---|---|---|---|
| | 2004 | 2003 | 2002 | 2001 |
| Cockerton Bridge | 23* | - | - | - |
| St Cuthbert's Way | 38* | 36 | 35 | 36 |
| * - less than 6 months data | | | | |

**Table 3 Diffusion tube sites - all results µg/m³ as the annual mean adjusted by laboratory overall bias factors for the year (Gradko).**

| Site | Location | Years | | Number of exceedances | |
|---|---|---|---|---|---|
| | | 2004 | 2003 | 2002 | 2001 |
| Northgate | kerbside | 44 | 49 | 50 | 46 |
| Salters Lane | kerbside | 33 | 29 | 30 | 33 |
| Hundens Depot | background | 22 | 22 | 25 | 23 |
| Arts Centre | background | 17 | 19 | 19 | 24 |
| Woodland Road | kerbside | 39 | 37 | 39 | 46 |
| Blackwell Bridge | kerbside | 36 | 40 | 37 | 37 |
| North Road Station | kerbside | 37 | 38 | 42 | 49 |
| Haughton Green | kerbside | 43 | 38 | 42 | 46 |
| Yarm Road | kerbside | 33 | 32 | 38 | 35 |
| Middleton One Row | kerbside | 13 | 14 | 18 | 17 |
| Cockerton Bridge | roadside | 26 | - | - | - |

**Nitrogen Dioxide**
**Objective 2 1 hour mean of 200µg/m³ (105 ppb) maximum with up to 18 exceedances per year**

One hour means can only be measured by continuous monitors - Cockerton Bridge and St. Cuthbert's Way.

**Table 4** below shows the 1 hour maximums are the 99.8th percentile of the 1 hour means, which provides a direct comparison with the objective level.

**Table 4 Continuous monitoring stations - all results µg/m³ as the maximum of 1 hour means**

| SiteYears | 2004 | 2003 | 2002 | 2001 |
|---|---|---|---|---|
| Cockerton Bridge | 84 | - | - | - |
| St Cuthbert's Way | 102 | 101 | 95 | 95 |

**Particulate PM10**
**Objective 1 Annual mean of 40 µg/m³ (gravimetric) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of particulate PM10 above 40 µg/m³ (gravimetric) as an annual mean by 31 December 2004.

There are a variety of sources of Particulate PM10, which are very fine particles of less than 10 micron in size. Industrial sources tend to be emitted from high stacks, although these may from time to time fall to ground level. Construction works can cause significant, but mainly temporary emissions, often at ground level. Traffic emissions in particular from diesel engine exhausts, are a major source at ground level. There are a variety of natural sources, such as pollens and coastal sources. Occasionally, under certain meteorological conditions, there can be 'import' of particulate pollution from continental sources.

Exposure to particulate PM10 is associated with a range of effects on health, including effects on the respiratory and cardiovascular systems, asthma and mortality. Those members of the public with pre-existing lung and heart disease are particularly at risk.

The results in **Table 5** from the fixed local monitors show a good degree of consistency on a year by year basis, and are generally well within the objective level, with no exceedances recorded. While 2003 results showed an increase due to prolonged spells of high pressure weather during February, March and April 2004 results were back to normal levels.

**Table 5 Continuous monitoring stations - all results µg/m³ (gravimetric) as the annual mean**

| SiteYears | 2004 | 2003 | 2002 | 2001 |
|---|---|---|---|---|
| Cockerton Bridge | 20* | - | - | - |
| St Cuthbert's Way | 30* | 32 | 29 | 29 |
| * - less than 6 months data | | | | |

The fixed monitors are town centre kerbside locations, and clearly show the influence of slow moving traffic on annual means. There are no target groups present at this type of location.

The Government has also proposed a further annual mean objective of 20 µg/m³ (gravimetric) for year 2010. Current monitoring results suggest that this objective will not be met in many parts of the Tees Valley without a significant reduction in source emissions of particular PM10, including natural sources. If this target was applied, then consideration would have to be given to declaring an Air Quality Management Area in Darlington.

**Particulate PM10**
**Objective 2 24 hour mean of 50 µg/m³ (gravimetric) maximum, with up to 35 exceedances per year**

In Darlington, the fixed monitors are town centre kerbside locations, and clearly show the influence of slow moving traffic on 24 hour levels, with these locations having amongst the highest levels and number of exceedances.

The Government has also proposed a further 24 hour mean objective of 50 µg/m³ (gravimetric), with a maximum of 7 exceedances, for year 2010. Current monitoring results suggest that this objective will not be met in many part of the Tees Valley without a significant reduction in source emissions of particulate PM10, including natural sources. PM10 levels are also weather dependent, as shown by the 2003 data, and can be influenced by sources outside of the Tees Valley. Again, consideration would have to be given to declaring an Air Quality Management Area in Darlington.

Figures shown in **Table 6** provide the 24 hour maximums with the 90th percentile of the 24 hour means, which provides a direct comparison with the objective level.

**Table 6 Continuous monitoring stations - all results µg/m3 (gravimetric) as the maximum of 24 hour means**

Exceedances shown in brackets

| SiteYears | 2004 | 2003 | 2002 | 2001 |
|---|---|---|---|---|
| Cockerton Bridge | 40 (0)*<br>90th % 30 | - | - | - |
| St Cuthbert's Way | 77 (11)*<br>90th % 49 | 103 (49)<br>90th % 56 | 73 (25)<br>90th % 45 | 85 (20)<br>90th % 48 |
| * - less than 6 months data | | | | |

**Sulphur Dioxide**
**Objective 1 24 hour mean of 125 µg/m³ (47 ppb) maximum, with up to 3 exceedances per year**

The target groups are those members of the public that may be exposed to levels of sulphur dioxide above 125 µg/m³ as a 24 hour mean by 31 December 2004.

Exposure to sulphur dioxide is associated with restriction of the airways by stimulating nerves in the lining of the nose, throat and airways of the lung. The latter is particularly to occur in those suffering from asthma and chronic lung disease.

Sulphur dioxide emissions are, in Darlington, almost entirely from industrial sources, and while the emissions are normally from tall stacks, they can fall to ground level under certain conditions. Some of the emitters are continuous over the year, but others are more intermittent when other fuels are not available. These intermittent emissions can be relatively large.

Some industrial emissions are expected to fall by year 2003 when an EU directive limiting the sulphur content of certain fuel oils takes effect.

The 24 hour mean results from all monitors in the Tees Valley show that levels are consistently well within the objective, with no exceedance at any of the sites. For instance, the Darlington 2003 site at Cockerton had a 99th percentile reading of 10 with no exceedances. Therefore, objective will be met in Darlington as long as industrial emissions do not significantly increase.

**Sulphur Dioxide**
**Objective 2 1 hour mean of 350 µg/m³ (132 ppb) maximum, with up to 24 exceedances per year**

The 1 hour mean results from all monitors in the Tees Valley show that levels are consistently well within the objective, with no exceedance at any of the sites. In Darlington, a 99.7th percentile reading of 32 was obtained at the Cockerton site in 2003.

The objective will be met across the whole of the Tees Valley as long as industrial emissions do not significantly increase.

**Sulphur Dioxide**
**Objective 3 15 minute mean of 266 µg/m³ (100 ppb) maximum, with up to 35 exceedances per year**

The 15 minute mean results from most monitors in the Tees Valley show occasional high peaks above the objective level, generally due to the prevailing wind from the industrial emitters. In Darlington, a 99.9th percentile reading of 45 was obtained at the Cockerton site in 2003.

It is expected that this difficult objective will be met across the whole of the Tees Valley as long as industrial emissions do not significantly increase.

**Carbon Monoxide**
**Objective 8 hour running mean of 10 mg/m³ (8.6 ppm) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of carbon monoxide about 10 mg/m³ as an 8 hour running mean by 31 December 2003.

Carbon monoxide is formed by the incomplete combustion of carbon-containing fuels. In general, the more efficient the combustion process, the lower the carbon monoxide emission. The main outdoor source in Darlington, particularly at ground level, is road transport, with petrol-engined vehicles being the most significant contributors.

Exposure to carbon monoxide is associated with the formation of carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen and deliver to the tissues, and blockage of important biochemical reactions in cells. People who have an existing disease which affects the delivery of oxygen to the heart or brain (eg coronary heart disease such as angina) are likely to be at particular risk.

The 8 hour running mean results from all monitors in the Tees Valley show that the objective level of 10 mg/m³ continues to be easily met. In Darlington, a value of 0.4 was read at the Cockerton site in 2003 with no exceedances.

**Benzene**
**Objective 1 Running Annual Mean of 16.25 µg/m³ (5 ppb) maximum, with no exceedances**

**Objective 2 Annual Mean of 5.00 µg/m³ (1.54 ppb) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of benzene above 16.25 µg/m³ as a running annual mean by 31 December 2003, and 5.00 µg/m³ as an annual mean by 31 December 2010.

The main sources of benzene in the Tees valley area are from industry, on both sides of the Tees estuary. These are sometimes fugitive emissions that can lead to quite high concentrations, even if only for a short period.

Benzene is a recognised genotoxic human carcinogen, which means that no absolute safe level can be specified for ambient air concentrations of benzene. The first objective level of 16.25 µg/m$^3$ as a running annual mean is considered to represent an exceedingly small risk to health.

In Darlington, benzene is not a cause for concern in Darlington due to the specific types of industrial activity locally and also due to recent reductions in traffic emissions (particuarly from petrol engined vehicles) as a result of improvements to fuels, engines and exhausts.

**1,3 Butadiene**
**Objective Running annual mean of 2.25 µg/m$^3$ (1 ppb) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of 1,3-butadiene above 2.25 µg/m$^3$ as a running annual mean by 31 December 2003.

The main source of 1,3-butadiene emissions in the Tees Valley is from industry. These are sometimes fugitive emissions that can lead to quite high concentrations, even if only for a short period.

Exposure to 1,3-butadiene is associated with the induction of cancers in the lumphoid system and blood-forming tissues, lymphomas and leukaemia.

1,3-butadiene is a genotoxic carcinogen in humans, for which no absolutely safe level can be defined. The objective level of 2.25 µg/m$^3$ as a running annual mean is considered to represent an exceedingly small risk to health.

The nearest continuous monitoring station for 1,3-butadiene to Darlington is that at Breckon Hill in Middlesbrough, which had a reading of 0.06 µg/m$^3$ in 2003. Given this level, near to potential major industrial sources, it is considered that there is a low level of 1, 3-butadiene in Darlington and that these are close to the threshold limit for detection.

**Lead**
**Objective 1 Annual mean of 0.5 µg/m$^3$ (5 ppb) maximum, with no exceedances**
**Objective 2 Annual mean of 0.25 µg/m$^3$ (1.54 ppb) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of lead above 0.5 µg/m$^3$ as an annual mean by 31 December 2004, and an annual mean of 0.25 µg/m$^3$ as an annual mean by 31 December 2008.

A major source of lead at ground level used to be from petrol engine vehicle exhausts, but as a result of the introduction of lead free petrol, this source is no longer significant. There are a number of lead based industries, but none of these are located in the Tees Valley area.

Exposure to lead is associated with toxic biochemical effects in humans which can cause problems in the synthesis of haemoglobin, effects on the kidneys, gastrointestinal tract, joints and reproductive system, and acute or chronic damage to the nervous system. The possible effects of lead on the brain development in children, and hence their intellectual development, is the greatest cause for concern.

The only monitoring currently carried out in the Tees Valley is by Stockton-on-Tees Borough Council at three locations as part of a heavy metal monitoring programme. Results going back to 1997, and earlier, clearly show that the objectives are easily met, and all readings are now below the threshold limit for detection. These results are considered to be applicable to Darlington due to the absence of lead based industry and the use of lead free petrol. The national network results also confirm that lead in air concentrations have fallen to very low levels across the UK, even close to lead industry sites.

**Ozone**
**Provisional Objective 8 hour running mean of 100 µg/m$^3$ (50 ppb) maximum, with up to 10 day exceedances per year**

The target groups are those members of the public that may be exposed to levels of ozone above 100 µg/m$^3$ as an 8 hour running mean by 31 December 2005.

Ozone is a secondary air pollutant. It is not emitted by any process, but is formed as a result of complex chemical reactions on other air pollutants, particularly in the presence of strong sunlight. The source pollutants, such as nitrogen dioxide and hydrocarbons, are emitted from traffic and industry, and as the chemical reaction process can take some time, the source pollutants can originate a considerable distance away, such as from the European mainland. Therefore, it is recognised that local or even national action may not be sufficient to reduce ozone levels. The Government has, as a consequence, only set a provisional target for ozone at this time. Ozone is also not included in the national Air Quality Review and Assessment process. The level of ozone tends to peak during sunny summer months, and is often highest in rural areas as a result from pollution elsewhere.

Exposure to high concentrations of ozone is associated with slight irritation to the eyes or nose. Very high levels of exposure (to over 1000 µg/m$^3$, or 10 times the target level) over several hours can cause damage to the airway lining followed by inflammatory reaction. At levels of ozone above 200 µg/m$^3$ as an 8 hour concentration, effects on healthy individuals has been clearly demonstrated.

The provisional objective for ozone has been exceeded or only

just met at the current monitoring sites in Middlesbrough and Billingham. It is thus likely that there will be exceedances in Darlington, particularly when there is a warm and sunny summer period.

Since Ozone is not yet a prescribed air pollutant under the UK air quality strategy, it is not included in Darlington's air quality review and assessment procedures.

**Polycyclic Aromatic Hydrocarbons (PAHs)**
**Provisional Objective Anuual mean of 0.25 ng/m3 (BaP) maximum, with no exceedances**

The target groups are those members of the public that may be exposed to levels of PAH above 0.25 ng/$m^3$ as an annual mean by 31 December 2010.

Polycyclic aromatic hydrocarbons (PAHs) are a large group of organic compounds with two or more benzene rings within their molecular structure. Those compounds with two or three benzene rings are normally present in vapour phase, while heavier compounds with five or more benzene rings are mainly in particulate phase. The EU working group on PAHs has proposed benzo(a)pyrene (BaP) as a marker for PAHs, and it is this compound on which PAH measurement is focused.

The main sources are associated with coal and wood burning, stubble burning, low-temperature incineration, and to a lesser extent, vehicle exhaust emissions. The continuing decline in domestic and industrial coal burning, new controls over agricultural burning, and upgrading of incinerators to high temperature technology, has led to a substantial decline in emissions of BaP over the last decade. Emissions are expected to fall further as a result of reductions in domestic coal burning, improved industrial abatement and lower vehicle emissions.

Exposure to polycyclic aromatic hydrocarbons is associated with an increased incidence of tumours of the lung, skin, and other sites, with lung cancer most obviously linked to exposure through inhaled air. The objective level of

0.25 ng/$m^3$ as an annual average is considered to represent a risk to health so small as to be undetectable.

Monitoring results from the Middlesbrough, Longlands Road site, have shown an erratic, but overall decline from 1995 to 2004, to a value below the provisional objective level. Other national results also show variable year on year results, with the main industrial towns showing the highest concentrations.

PAHs are not yet prescribed air pollutants under the UK air quality strategy, and are thus not included in Darlington's air quality review and assessment procedures.

**Cadmium, Arsenic, Nickel, Mercury**

No air quality objectives have yet been set for these pollutants, but they are likely to be based on an annual mean, with no exceedances. Target groups will be as defined for PAHs.

**Cadmium** is produced as an inevitable by-product of zinc, and sometimes lead, refining, but once collected is relatively easy to recycle. It is mainly used in high performance nickel/cadmium batteries, but is also a good corrosion resistance coating. Other uses are as pigments, stabilisers for PVC, in alloys, and electronic compounds. UK emissions are associated with lead-zinc smelting and battery recycling plants, iron and steel manufacturing, electricity and waste combustion. Cigarette smoking can be a significant source. However, for the non-smoking population, the major exposure is through food.

Cadmium is bio-persistent and derives its toxicity from its chemical similarity to zinc, which is an essential micronutrient. Long-term exposure can cause renal misfunction. High levels are associated with lung disorders and bone defects.

**Arsenic** is a metalloid with a complex chemistry, which can form a number of inorganic and organic compounds. The principal use of arsenic (as arsenic trioxide) is in wood preserving products, but it is also to be found in agricultural chemicals such as insecticides, herbicides, algaecides and growth promoters. On a global scale, releases to air are from natural sources such as volcanic eruptions and forest fires. On a local scale, emissions are likely to arise from coal burning, industrial waste disposal, and the application of agricultural chemicals containing arsenic, and the burning of wood with arsenic-containing preservatives. Cigarette smoking can be a significant source. However, for the non-smoking population, the major exposure pathway is through food and water.

Arsenic toxicity depends on its chemical form. It may be beneficial in small doses, but is generally considered to be carcinogenic to the lung and skin.

**Nickel** is a metal which has many similarities to the other ferromagnetic metals, iron and cobalt. It is mainly used in the production of stainless steels and other alloys because it

imparts heat and corrosion resistance, as well are hardness and strength. Nickel alloys and plating are commonly found in vehicles, tools, electrical and household goods, jewellery and coinage. The main sources of nickel in air, besides nickel production and plating plants, are from the combustion of coal and oil for heat and power generation, and the incineration of wastes and sewage sludge. Cigarette smoking can be a significant source. However, for the non-smoking population, the major exposure pathway is through food.

Nickel compounds generally exhibit a low acute toxicity. Nickel and its water-soluble salts are potent skin sensitisers, and are restricted for jewellery use where there may be direct contact with the skin.

**Mercury** is a global pollutant with complex chemical and physical properties. It occurs naturally in the atmosphere from degassing of the earth's crust, emissions from volcanoes, and evaporation from natural bodies of water. World-wide mining of the metal leads to indirect discharges to atmosphere. Mercury has widespread use in industrial processes and in products such as batteries, lamps and thermometers. It is widely used in dentistry as an amalgam for fillings, and by the pharmaceutical industry. Mercury is mainly present in the atmosphere in a relatively unreactive gaseous form, but with a long atmospheric lifetime (of the order of 1 year), but methylated forms can form naturally which are highly toxic. UK emissions are associated with chlorine manufacture using mercury cells, non-ferrous metal production, coal combustion, and crematoria. The main pathway for mercury to humans is through the food chain, and not inhalation.

Mercury is a toxic substance with no known function in human biochemistry or physiology. Inorganic poisoning can cause tremors, and spontaneous abortion. Mercury methhyl compounds cause damage to the brain and central nervous system.

Stockton-on-Tees Borough Council has monitored these pollutants for several years, and since 2002 has had a comprehensive heavy metal monitoring programme. The values for their sites at Eaglescliffe, Redmarshall and Seal Sands show that the levels are stable and low, being measured in nanograms (one billionth of a gram). . It is thus likely that the concentrations in Darlington will be similar (if not lower) as a reflection of the distance away from a concentration of heavy industry.

Cadmium, arsenic, nickel and mercury are not yet air pollutants that are included in the UK air quality strategy.