NETWORK MANAGEMENT NOTES

AIR QUALITY

The Pollutants

What are key pollutants?

1) Carbon monoxide
2) Particulates
3) Nitrogen dioxide
4) Benzene
5) 1,3 Butadiene
6) Sulphur dioxide
7) Carbon dioxide
8) Ozone
9) Polycyclic Aromatic Hydrocarbons
10) Lead

What pollutants are directly produced from vehicles?

Particulates	mainly from diesel engines, (30–40% is produced by transport)
Carbon monoxide	formed by the incomplete combustion of fossil fuels, (75% is produced by transport)
Carbon dioxide	formed by the combustion of fossil fuels
Lead	released from the combustion of petrol
Nitrogen oxides	formed during high temperature combustion processes by the oxidation of nitrogen in the air or fuel. Nitrogen oxides is the sum of Nitric oxide and Nitrogen dioxide.
Hydrocarbons	released in vehicle exhaust gases either as unburnt fuels or as combustion products
Benzene	released from the combustion of petrol
1,3 butadiene	formed during the combustion of petrol and diesel

Ozone is a secondary pollutant produced by reaction between nitrogen dioxide, hydrocarbons and sunlight

What are the adverse effects of pollutants in vehicle emissions on Health?

Because of the fuel they burn motor vehicles are a major source of a number of pollutants, including nitrogen oxides (NO_x), hydrocarbons (HC), carbon monoxide (CO), lead, fine particulates (PM10) and carbon dioxide (CO_2). Figures show that with the exception of lead the production of all these pollutants is rising steadily as the use and number of vehicles on our roads increases.

The effect on health of the pollutants which result from vehicle emissions are as follows:

Hydrocarbons
When emitted from vehicle exhausts hydrocarbons react with nitrogen oxides in sunlight to form a number of harmful compounds called photochemical oxidants. This includes ozone and peroyacyl nitrate which are irritating to humans and cause plant damage. Some hydrocarbons are now thought to be carcinogenic, that is they can cause cancers whilst others contribute to the greenhouse effect and the depletion in stratospheric ozone (the ozone hole).

Nitrogen Oxides
As well as reacting with hydrocarbons in the production of photochemical pollution, NO_x emissions react further within the atmosphere contributing to the production of acid rain. This has been linked to the increasing acidity of soil and water and has been implicated in the effects on trees and other natural vegetation.

Carbon Monoxide
When inhaled, CO reduces the oxygen carrying capacity of the blood and can cause headaches, fatigue, stress, respiratory problems and at very high levels, even death.

Lead
Lead emitted from the exhaust is known to be a toxin which builds up in the body causing damage to the nervous system and the kidneys. It may also effect the development of children with neuro-behavioural and learning defects.

Particulates (smoke)
The particulates produced from the combustion process especially in diesels can penetrate into the lungs and cause respiratory problems. Due to the chemicals contained in smoke it can lead to reduced lung function and the possibility of cancer. The fine particulates that reach deep into the lungs are referred to as PM10s.

Carbon Dioxide
This plays an important role in the greenhouse effect which keeps the earth warm. If CO_2 levels continue to rise it is likely that average temperatures will increase.

1,3 Butadiene
This is a potent carcinogen which can cause irritation of the eyes, nose, throat and skin. At high concentrations there is a risk of a variety of health disorders including diseases of the blood and nervous systems.

Benzene
This is a genotoxic carcinogen which in very high concentrations can result in leukaemia. The current average concentrations to which the public are exposed presents an exceedingly small risk to health.

Sulphur Dioxide
High levels of sulphur dioxide especially when combined with smoke can give rise to respiratory problems and premature death. Road transport makes up only two percent of the total UK emissions of SO_2 and therefore has on its own an insignificant effect on human health. It is also one of the main precursors of acid rain.

Why monitor the quality of air?

With appropriate analysis and interpretation monitoring data can be transformed into useful information on the environment which can be used for:

- scientific basis for policy development
- determining compliance with air quality standards
- research needs
- assessing air quality trends
- assessing effectiveness of control policies
- public information

By Simon Found, Phil Tidridge, Marie Hancock

Simon Found, Senior Engineer, Implementation, County Surveyors Department, Hampshire CC. Formally responsible for air quality matters and managed the installation of the air quality monitoring stations in Winchester. Phil Tidridge, Scientific Officer, Environmental Health Department, Winchester City Council. Organises maintenance of equipment, validates and analyses air quality information. Marie Hancock, Senior Transport Planner, Transport Policy, County Surveyors, Hampshire CC. Responsible for air quality matters.

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What standards are available to assess air quality?

❖ UK National Air Quality Strategy standards (only for limited number of pollutants at present, for achievement by 2005). See table below.

❖ World Health Organisation standards.

❖ European Community standards.

A bandings system has been set up by the Department of the Environment, Transport and the Regions (DETR) for some time which classifies the level of air quality from very good through to very poor. Following consultation in February 1997 the bandings have been amended to complement the UK Air Quality Strategy. Instead of characterising air quality as very good, good, poor and very poor the new system describes actual pollution levels as low, moderate, high and very high. Grades are based on the health effects of air pollution. In 1999, the Government consulted on revised air quality standards. These revised standards would achieve cleaner air, more quickly.

What Acts/legislation is air quality undertaken by?

Part IV Environment Act 1995

This requires local authorities to carry out a review and assessment of air quality within the Authority's boundary and designated an Air Quality Management Area (AQMA). If the Air Quality standards are not likely to be met, an Air Quality Action Plan is required for the AQMA.

UK National Air Quality Strategy and Air Quality Regulations 1997.

This sets a strategy and targets for common pollutants which should not be exceeded by the year 2005.

What is the purpose of the National Air Quality Strategy ?

It provides a clear and workable framework for improving air quality based upon the following principles:

❖ a statement of the Government's general aims for improving air quality;

❖ clear measurable targets (including timescales);

❖ a balance between national and local action;

❖ a clear framework to allow all parties to identify what contribution they can make;

❖ the need to ensure consistency, and

❖ regular review of the strategy.

What are the key elements?

❖ Health based air quality targets and objectives;

❖ Policies for meeting those objectives;

❖ Key sector contribution – industry, transport and Local Government, and

❖ A commitment to review the strategy every three years.

How are objectives to be met?

❖ Improvements in vehicle technology;

❖ Tighter controls on the existing vehicle fleet, its management and operation;

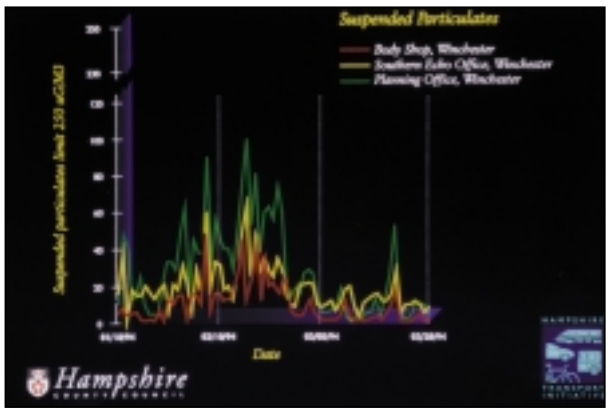
The DETR bandings are characterised as follows:

Low indicates that pollution is within the limits recommended by UK Expert Panel on Air Quality Standards.

Moderate indicates that pollution exceeds the national standards adopted by the Government, asthmatics and other susceptible people are not expected to be seriously affected.

High asthmatics and other susceptible people may be seriously affected.

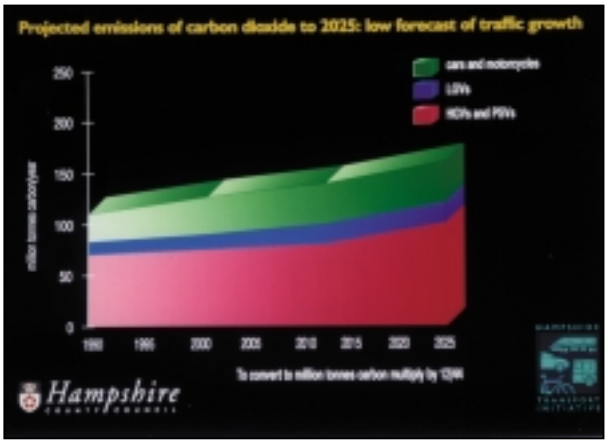
Very high even people not normally affected by pollution could suffer eye irritation, coughing or breathing difficulties.



What are the UK Air Quality Strategy Standards?

The standards that have been established are as follows:

Pollutant	Standard Concentration	Measured as	Specific Objective
Benzene	5ppb (parts per billion)	Running annual mean	5ppb to be achieved by 2005
1,3–Butadiene	1ppb	Running annual mean	1ppb to be achieved by 2005
CO	10ppm (parts per million)	Running eight hour mean	10ppm to be achieved by 2005
Lead	0.5ug/m^3 (microgrammes per cubic metre)	Annual mean	0.5ug/m^3 to be achieved by 2005
NO_2	150ppb	One hour mean	150ppb measured as the 99.9th percentile, to be achieved by 2005
	20ppb	Annual mean	20ppb to be achieved by 2005
OZONE	50ppb	Running 8 hour mean	150ppb measured as the 97th percentile, to be achieved by 2005
PM10	50ug/m^3	Running 24 hour mean	50ug/m^3 measured as the 99th percentile, to be achieved by 2005
SO2	100ppb	15 minute mean	100ppb measured as the 99.9th percentile, to be achieved by 2005



❖ Development of environmental responsibilities by fleet operators, public service fleet operators and by the public at large in transport and vehicle use;

❖ Changes in planning and transport policies which would reduce the need to travel and reliance on the car;

❖ A Local Authority having assessed the level of air quality within its boundaries can designate an area as an Air Quality Management Area(AQMA) if the targets are unlikely to be achieved. The Local Authority will then be required to produce an action plan which states what the course of action will be and to use their statutory powers to achieve the objectives of the action plan. Action plans to improve air quality will need to be developed in cooperation and partnership with other authorities and other organisations.

What powers can Local Authorities use to improve air quality ?

❖ Land use planning;

❖ Traffic management;

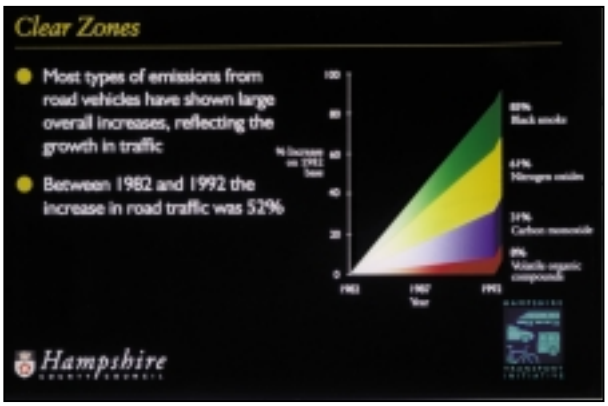
❖ Regulation of Industrial Emissions – Part I of Environmental Protection Act 1990;

❖ Industrial Smoke Control – Clean Air Act 1993;

❖ Domestic Smoke Control – Clean Air Act 1993;

❖ Statutory Nuisance Part III of Environmental Protection Act 1990, and

❖ Vehicle emission testing and control over stationary vehicles



What is the current position on Air Quality Regulations?

Nationally

The Air Quality Regulations were published in December 1997. However they cannot be implemented until additional specific guidance has been issued. The guidelines that have been issued cover the following areas:

General Guidance:

Framework for review and assessment of air quality.
Developing local air quality action plans and strategies: the principle considerations.
Air quality and land use planning.
Air quality and traffic management.

Technical Guidance

Monitoring for air quality reviews and assessments.
Preparation and use of atmospheric emission inventories.
Selection and use of dispersion models.
Review and assessment: pollutant specific guidance.

Locally

Hampshire and the Isle of Wight were nominated as a pilot area to carry out an initial review and assessment of air quality and associated activities using the draft guidelines that were issued previously. This pilot review and assessment was completed in November 1997, and the experiences gained have been further developed in the general and technical guidance published. (All local authorities have now completed their "Stage 1" reviews [by December 1998], and will be completing the Stage 2 and 3 assessments by the end of this year. AQMA will be designated later this year in those areas where the review and assessment process indicates that the Air Quality Standards will not be achieved. Air quality action plans will be drawn up to achieve the standards in the AQMAs.

How is air quality monitoring funded?

❖ Package bids for transport strategies

❖ Environmental Health Department Budgets

❖ European projects

❖ Supplementary Credit Approval from DETR for monitoring equipment, modelling and emissions inventories

National Air Quality Network

What are the National monitoring sites?

The DETR funds a number of national air quality monitoring stations throughout the UK. These measure a comprehensive range of pollutants including sulphur dioxide, particulates, nitrogen oxides, ozone, carbon monoxide, hydrocarbons, lead, acid deposition and air toxins. Site location, criteria, operational practice and QA/QC structures may differ for each programme.

How many sites are there in national network?

94 automatic monitoring sites.
1200+ sampler measurement sites.

What are objectives of the national monitoring programme?

❖ Understand air quality problems so that cost effective policies and solutions can be developed.

❖ Assess how far standards are being achieved.

❖ Provide public information.

❖ Assist with assessment of personal exposure to air pollutants.

If monitoring stations are up to DETR standards can they be included in the national network and will finance be made available from the Government?

Up until now if a monitoring station met the DETR standards it could be accepted into the national network and funds provided to operate/run the station(s). The current policy is not to increase the number of sites in the national network.

Site location, operational practice and QA/QC (quality assurance/quality control) were important factors in determining whether a site can be accepted into the national network.

Methods of monitoring air quality

There are four main methods

❖ passive sampling (eg, diffusion tube);

❖ active sampling (eg, bubblers, filters etc);

❖ automatic point monitoring, and

❖ long path/remote monitoring.

Passive sampling represents a simple and cost effective method of screening air quality in an area, to give a general indication of average pollution concentrations. The low cost per tube permits sampling at a number of points in the area of interest; this is useful in highlighting hotspots of high concentrations,

such as major roads or emission sources, where more detailed sampling may be needed. This method is becoming increasingly popular in many parts of the UK.

Active sampler methods collect pollutant samples either by physical or chemical means for subsequent analysis in a laboratory. Typically, a known volume of air is pumped through a collector such as a filter or chemical solution for a known period of time, which is then removed for analysis. Samples can be taken each day, thereby providing reasonable time resolution, but at a relatively modest capital cost compared with automatic monitoring methods. There is a long history of sample measurements in the UK, providing valuable baseline data for trend analyses and comparison.

Automatic point monitoring produces high resolution measurements (typically hourly averages or better) at a single point for pollutants. The samples are analysed on line and in real time. This is the most expensive method of air quality monitoring routinely employed.

Long path/remote monitoring uses a long path spectroscopic technique to make real time measurements of the concentration of a pollutant integrated along a path between a light source and a detector.

The more sophisticated methods mean:

- Higher resolution data;
- Increased capital and running costs;
- More difficult operation, calibration and maintenance, and
- Greater complexity and lower reliability.

Within Hampshire a contract has been let to Siemens to produce a system where the information gathered from each air quality station within the County to be networked to all District Councils including the ROMANSE office.

Equipment used

The monitoring equipment has to meet (QA/QC) standards that are approved by Atomic Energy Authority (AEA) (on behalf of DETR).

Data availability

To public via public displays
CEEFAX/TELETEXT
internet
free phone service
newspapers
Internet
CD–Rom (produced by DETR)
free phone service
newspapers

Several companies are able to supply/install monitoring equipment.

Costs

Costs to be considered are as follows:

- capital cost of analysers, etc;
- cost of equipment housing/building rental;
- running costs – electricity, telephone, filters, calibration gases;
- equipment service and maintenance costs;
- person costs – site operation, training, data processing, and
- typically a sum of 10% of capital cost expenditure should be assigned to ongoing support expenditure.

Typical costs are:

- Monitors for each pollutant, £5–20,000;
- Met Station, £3,000;
- Permanent traffic count data for roadside pollution station for comparison of results, £3,000;
- Permanent housing for equipment, £1,300–3,000;
- Maintenance of equipment, £3,000 per site per annum;
- Person costs to analyse results and maintain equipment, say two man days per month, £500, and
- Dedicated telephone line, £150/year.

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