UPDATING AND SCREENING ASSESSMENT OF AIR QUALITY IN NORTH AYRSHIRE

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EXECUTIVE SUMMARY

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality which culminated in the Environment Act, 1995. As a requirement of the Act, the Secretary of State has prepared a National Air Quality Strategy. The National Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. New national air quality standards have been proposed by the Expert Panel on Air Quality Standards (EPAQS) for the UK Government.

These new air quality standards and their objectives have been enacted through the Air Quality Regulations in December 1997. The Environment Act requires local authorities to undertake an air quality review. In areas where air quality objectives may not be met by the year 2005 local authorities are required to establish Air Quality Management Areas.

The first step in this process is to undertake a review of current and potential future air quality. A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives, one to assess air quality at the outset of the National Air Quality Strategy and a second to be carried out towards the end of the policy timescale (2005). The number of reviews necessary depends on the likelihood of achieving the objectives.

This report is equivalent to a Stage One air quality review as outlined in the Government's published guidance. The air quality review investigates current and potential future air quality through an examination of the location and size of principal emission sources and by reference to monitored air quality data.

In North Ayrshire, the Stage One review found that:-

1. The air quality objectives for 6 of the 7 specified parameters namely benzene, 1,3-butadiene, carbon monoxide, lead, PM_{10} and sulphur dioxide are all likely to be achieved by 2005.

2. There is insufficient information at this stage to conclude that the nitrogen dioxide standard will be achieved in the vicinity of several local industrial sources and therefore North Ayrshire will be progressing to a second stage review and assessment for nitrogen dioxide.

INTRODUCTION

The Environment Act 1995 introduces new responsibilities for local authorities in terms of local air quality management. This requires local authorities to assess the air quality in their respective areas and where levels of air pollution exceed or are likely to exceed specified standards the appropriate authority must introduce Local Air Quality Management Areas and Action Plans to ensure compliance with the standards.

The standards have been set by the Expert Panel on Air Quality Standards and encompass 8 parameters comprising Benzene, 1.3-Butadiene, Carbon Monoxide, Lead, Nitrogen Dioxide, PM_{10} (particulates) and Sulphur Dioxide.

Historically North Ayrshire has undertaken extensive air monitoring since 1974 and had much background data on dust, smoke, sulphur dioxide and latterly nitrogen dioxide. This monitoring identified a need for smoke control and in 1981 a Smoke Control Programme was introduced so that now more than 30,000 premises and much of the built-up area in North Ayrshire are subject to smoke control. This led to a dramatic reduction in smoke levels and a significant drop in sulphur dioxide levels. Regular reports have been submitted to the Council on an annual basis detailing the monitoring undertaken and the levels of pollution recorded.

In general the area has been regarded as having relatively good air quality. However the LAQM parameters specified include other air quality indicators which consider the growing impact of road traffic on national and local air pollution trends.

This report complies with the Council's duty to undertake a review and assessment of air quality in North Ayrshire and has been laid out in the manner specified in guidance issued by the Scottish Office.

As part of the process widespread consultation has been carried out involving the public, SEPA, trade, industry and adjoining local authorities. Information was sought from various quarters including other Directorates within the Council and this has been used in the assessment process. The report will be issued to the consultees and any comments will be considered by the Council.

Chapter 1 - Local Air Quality Management

1.1 The National Air Quality Strategy

The Environment Act 1995 required the Secretary of State to produce a National Air Quality Strategy which provides a framework for air quality control through national strategies and policies for air quality and the establishment of air quality standards. This was published in March 1997. The Strategy proposed new national air quality standards and objectives for 8 major pollutants following recommendations from the Expert Panel on Air Quality Standards (EPAQS). **Air Quality Standards** are used as benchmarks for setting air quality objectives. They represent the levels at which there would be an extremely small or no risk to human health. Where EPAQS has not yet made a recommendation the air quality standard has been derived from the World Health Organisation recommendation. Air Quality Objectives represents the Government's best judgement of the progress which can be made towards getting air quality as close to the benchmark standards as is reasonable and justifiable on the grounds of cost and benefits by the year 2005. They will be used as triggers for action by local authorities. These air quality standards and objectives were given statutory force in terms of the Air Quality Regulations 1997.

1.2 Local Air Quality Management

In addition Part IV of the Environment Act 1995 requires local authorities to undertake new duties for local air quality management. These new duties commenced at the end of 1997. Local authorities require to undertake a review and assessment of air quality within their areas. Where air quality objectives will not, or are unlikely to be met by the year 2005, the authority will require to designate an Air Quality Management Area and draw up an Action Plan to remedy the situation. A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives, one to assess air quality at the outset of the National Air Quality Strategy and a second to be carried out towards the end of the timescale of 2005.

The complexity and detail of a review and assessment should be consistent with the risk of air quality objectives not being achieved by the year 2005. In the first instance the local authority should carry out initial screening of industrial, transport, and any other significant sources of pollution within their locality **(first stage review and assessment)**. By using simple screening techniques, it will be possible to determine which areas should be the focus of a local authority's attention. In areas well within the air quality objective it may not be necessary to undertake any further investigation, except for a further assessment of air quality nearer the year 2005 to ensure that there has been no significant decline in air quality.

If exceedances do, or are likely to exist, and there is the potential for human exposure over the specified averaging period for a pollutant, the authority should proceed to a **second stage assessment**. In areas where there is the potential risk of elevated levels of a pollutant, a local authority will require to estimate ground level concentrations at the road side and at industrial and background locations within their area. This will enable the local authority to predict the highest potential pollution concentrations. The approach is intended to be precautionary. If there is no risk that an objective will not be achieved, a local authority can be confident that an Air Quality Management Area will not be necessary. However if by 2005 it is unlikely that the standard will be approached or exceeded, a local authority should proceed to the **third stage**.

Those authorities which need to progress to the third stage are likely to require to undertake more sophisticated modelling and monitoring techniques. Local authorities will have to predict whether the air quality objective is unlikely to be met by the year 2005. This will be the crucial factor which will trigger the designation of an Air Quality Management Area.

Measures have already been put in place in order to tackle the problem of poor air quality at both national and international level. However there is a significant local dimension to air quality, with emissions varying dramatically in different areas, depending on geography, industry and traffic. Local Air Quality Management aims to ensure that solutions are tailored to local needs. The National Air Quality Strategy requires all local authorities to develop an integrated

approach to local air quality management, ensuring that air quality is considered alongside issues such as transport and land use planning. Local authorities will also require to provide the public with information and forecasts on local air quality, and consult on any action which may be required as a result of poor air quality within their area.

1.3 The National Air Quality Objectives

In the review and assessment of air quality local authority's must determine whether air quality objectives for each pollutant will be met.

These objectives are reproduced below.

Table 1.1 - The UK Air Quality Objectives

Substance	Air Quality Objective
Benzene	5ppb or less, when expressed as a running annual mean
1,3-Butadiene	1ppb or less, when expressed as a running annual mean
Carbon Monoxide	10ppm or less, when expressed as a running 8 hour mean
Lead	0.5 micrograms per cubic metre or less, when expressed as an annual mean
Nitrogen Dioxide	150ppb or less, when expressed as an hourly mean, and 21ppb or less, when expressed as an annual mean
PM_{10}	50 micrograms per cubic metre or less, when expressed as the 99th percentile of daily maximum running 24 hour means
Sulphur Dioxide	100ppb or less, when expressed as the 99.9th percentile of 15 minute means

1.4 Information Required For A First Stage Review And Assessment

In compiling information for the first stage review and assessment for each pollutant the government pollutant specific guidance was followed and the information detailed in Table 1.2 was collated by North Ayrshire.

Table 1.2 Information to be collated for a First Stage Review and Assessment

Information required	CO	BENZ	1,3-BUT	LEAD	NO2	PM10	SO2
1. Current and 2005 forecast annual average daily traffic flows for any existing or proposed roads in North Ayrshire with existing or predicted traffic flows which, at the end of 2005, could generate significant quantities of the specified pollutants. These traffic flows are :-							
a. 50000 vehicles	**YES**	N/A	N/A	N/A	N/A	N/A	N/A
b. 25000 vehicles	N/A	N/A	N/A	N/A	N/A	**YES**	N/A
c. 20000 vehicles	N/A	N/A	N/A	N/A	**YES**	N/A	N/A
1a. Approximate emissions densities from road transport / domestic coal burning and other low-level dispersed sources.	N/A	N/A	N/A	N/A	N/A	**YES**	**YES**
2. Current urban background concentrations due to dispersed road transport or other sources derived from locally sites automatic monitoring or from national maps.	**YES**	N/A	N/A	**YES**	**YES**	**YES**	**YES**
2a. Current annual average secondary particulate background concentrations from locally sited sulphate measurements or from the national maps.	N/A	N/A	N/A	N/A	N/A	**YES**	N/A
3. Details of Part A authorised processes in North Ayrshire.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
4. Details of Part B authorised processes in North Ayrshire.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
4a. Combustion systems with thermal power rating greater than 5MW using fuels containing significant quantities of sulphur.	N/A	N/A	N/A	N/A	N/A	N/A	**YES**
5. Any planned development of the above mentioned types in North Ayrshire, including those which will increase traffic flow.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
6. Details of any significant sources of the specified pollutants in neighbouring areas which could impact significantly within North Ayrshire.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
7. Details of any surveys or investigations undertaken obtain information to compile the report.	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

Chapter 2 - North Ayrshire

2.1 Topography

North Ayrshire encompasses a wide variety of landscapes ranging from the rich pastoral lowlands of the Ayr Basin to the dramatic upland summits of northern Arran. North Ayrshire can be divided roughly into four main regional character classifications based on landscape and topography.

Arran represents a distinctive landscape from the mainland, whilst at the same time offering a variety of landscape types which have caused it to be referred to as 'Scotland in Miniature'. This is mainly because the island is cut in half by the Highland Boundary Fault. The northern part comprises a dramatic landscape of heavily glaciated granitic peaks and valleys, whilst the southern part comprises lower and more subdued moorlands. A settled and pastoral fringe runs around the island above raised beaches and clifflines along the coast.

The Inner Firth of Clyde is another distinctive character area which includes the northern coastal fringe and the Cumbrae Islands. It is characterised by medium distance views across semi-sheltered water to steeply rising shorelines, often backed by wooded slopes.

Inland from this, the topography is dominated by the Renfrew heights, which cover the northern part of North Ayrshire. A broad range of hills which extends from a broad area of moorland overlooking the Clyde is the main feature of this area. These hills narrow towards a point near Ardrossan and are largely unsettled.

The final area comprises the northern part of the Ayr Basin which is heavily populated in comparison with the neighbouring areas, with a dense network of roads and settlements. The principal land use is dairy farming resulting in the survival of a framework of hedges and hedgerow trees.

2.2 Meteorology

North Ayrshire Council currently obtain meteorological data from various sources managed by officers in Environmental Health, namely:-

1. A weather station at Hunterston Rail Freight Terminal recording gamma radiation; relative humidity; solar radiation; atmospheric pressure; temperature; rainfall; and wind speed and direction;

2. Sulphur dioxide monitoring station at Cunninghame House, Irvine recording wind speed and direction; and

3. Rain gauges at Fencefoot Farm, Fairlie recording rainfall.

A summary of the data obtained from these sources is shown below.

Figure 2.1 - Monthly Rainfall Levels 1997

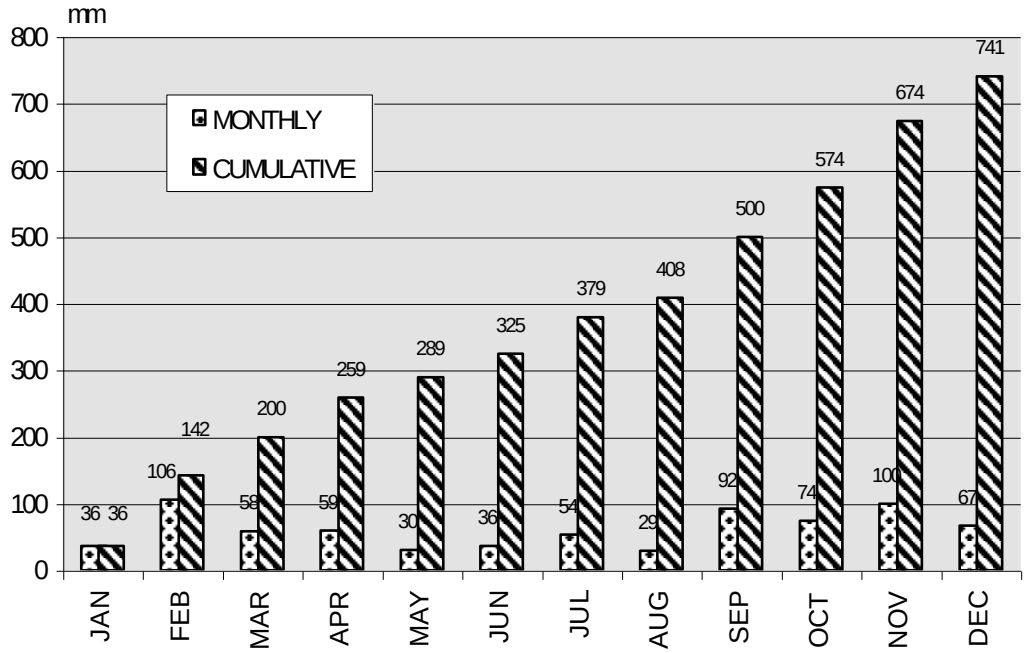


Figure 2.2 - Monthly Average Atmospheric Temperature 1997

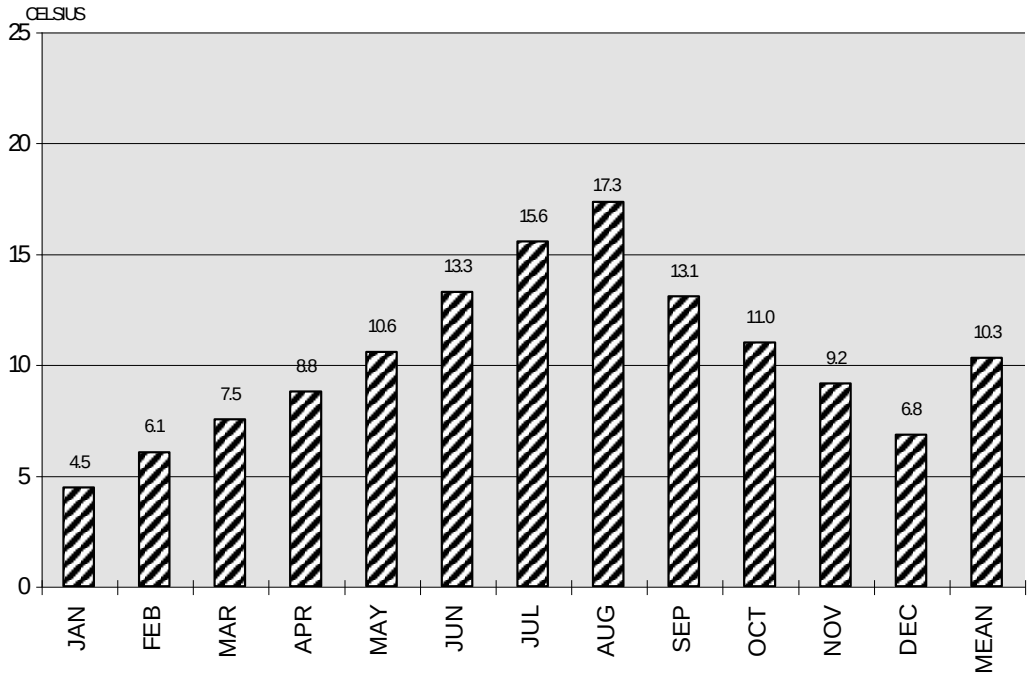


Figure 2.3 - Monthly Average Wind Speed 1997

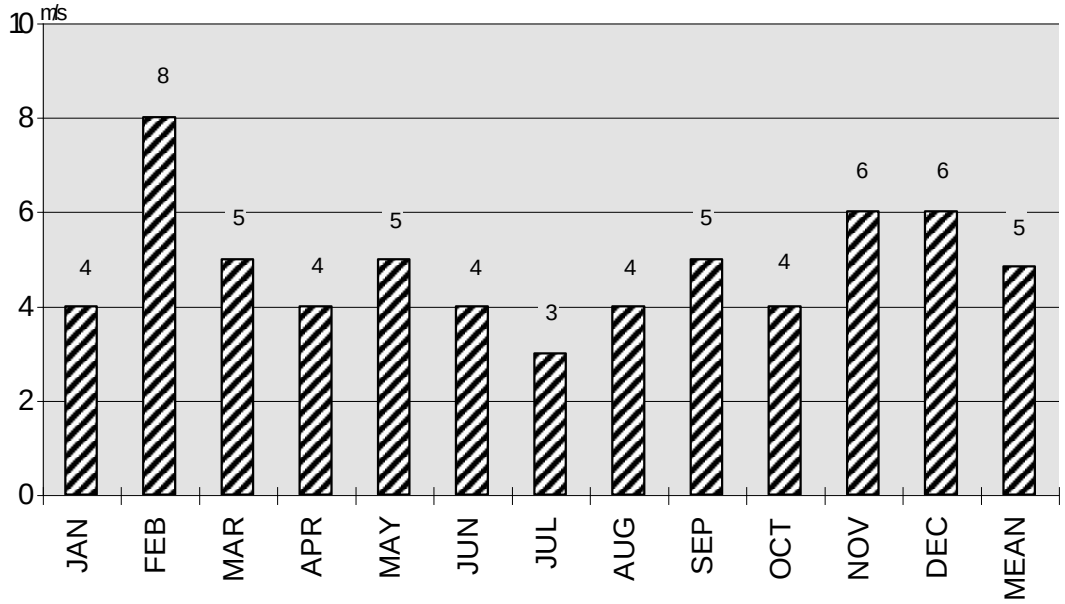
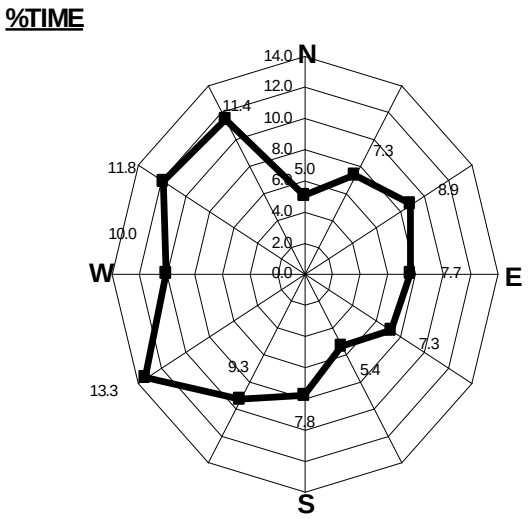


Figure 2.4 - Wind Rose Analysis 1998



In North Ayrshire the wind is from the north-west to south-west sector for approximately 50% of the time. The annual mean wind speed in 1997 was 5m/s with monthly mean wind speeds ranging from 3m/s in July to 8m/s in February.

Wind speed and direction together with turbulence in the atmosphere determine how effectively pollutants in a plume from any emitting source are dispersed and where any polluting effects are likely to occur.

2.3 **Transport**

The major trunk road network within North Ayrshire consists of the A78 coastal route running through Irvine, Kilwinning and the three towns of Ardrossan, Saltcoats and Stevenston to Largs and Greenock and the A737 Garnock Valley link to the M8 and Glasgow conurbation. Other major routes are the A736 connecting Stanecastle Roundabout in Irvine to Barrhead; and the A71 Irvine to Kilmarnock road which provides access to the A77/M77 principal route into Ayrshire from central Scotland. See Figure A2 in the Appendix for map of the main road network and table of traffic flows, both current and projected for the year 2005.

North Ayrshire is also well served by the rail network and there are stations on the main Glasgow Central to Ayr line at Dalry, Glengarnock, Kilwinning and Irvine; served by a frequent passenger service. In addition the Largs line continues on from Kilwinning and serves the towns of Stevenston, Saltcoats, Ardrossan, West Kilbride, Fairlie and Largs with a direct service to Kilwinning and stations to Glasgow, with links to the wider rail network. A further service from Ardrossan Harbour Station provides connections to the Arran ferry.

North Ayrshire has commercial ports at Ardrossan and Hunterston; which has a deep sea terminal, and leisure facilities are also available at Largs, Irvine, Saltcoats and Millport. Ferry services connect Ardrossan to Brodick (Arran) and the Isle of Man, Largs to Millport (Cumbrae), and Lochranza to Claonaig in Argyll.

North Ayrshire has good connections to Prestwick Airport which offers air freight and passenger services.

2.4 **Industry**

North Ayrshire's economy is still heavily reliant on manufacturing, and the main town of Irvine has a solid manufacturing and industrial base; with multi-national companies such as Smithkline Beecham, Volvo, Caledonian Paper and Wilson Sporting Goods. The area also boasts a number of electronic and computer-related manufacturing firms such as Digital, Prestwick Circuits and the recently announced attraction of Taiwanese components firm Universal Scientific Industrial.

Employment in the three towns of Ardrossan, Saltcoats and Stevenston was previously dominated by the Nobel complex of chemical and explosives works, although employment within this sector has declined considerably in recent years.

The Garnock Valley was traditionally associated with iron and steel production; although since this industry's decline new investment has come from companies such as Roche who produce vitamin C and are one of the District's biggest exporters and Johnstone Castings.

The economies of both Arran and Largs are heavily reliant on the tourism and service sectors; although Arran boasts a number of specialist companies such as the Arran Distillery, Arran Provisions and Arran Aromatics.

2.5 **Population**

The population of North Ayrshire in 1996 was 138,323 and is expected to increase to 141,275 over the period to 2001. Table 2.1 indicates the population of North Ayrshire by settlement. It also shows the population change since 1995.

Table 2.1 Voluntary Population Survey: Settlement Population Change 1995-96

Settlement	1995	1996	Change
Irvine/Kilwinning Area			
Irvine	34180	34412	232
Dreghorn	4232	4255	23
Springside	1356	1318	-38
Drybridge	46	44	-2
Kilwinning	16574	16567	-7
Cunninghamehead	214	213	-1
Sub-total	**56602**	**56809**	**207**
Three Towns Area			
Ardrossan	11346	11490	144
Saltcoats	11669	11601	-68
Stevenston	9639	9622	-17
Sub-total	**32654**	**32713**	**59**
Garnock Valley			
Beith	7414	7392	-25
Kilbirnie	8149	8043	-106
Dalry	6299	6224	-75
Sub-total	**21865**	**21659**	**-206**
North Coast Area			
Largs	12133	12065	-68
Fairlie	1654	1662	8
Skelmorlie	2138	2141	3
West Kilbride	4966	5010	44
Cumbrae	1575	1602	27
Sub-total	**22466**	**22480**	**14**
Isle of Arran			
	4557	**4662**	**105**
NORTH AYRSHIRE TOTAL	**138144**	**138323**	**179**

2.6 Possible Sources of Pollution In North Ayrshire

Possible sources of pollution in North Ayrshire are:-

1. Industrial sources particularly Part A and Part B prescribed processes;
2. Traffic on major or congested roads; and
3. Domestic coal burning.

2.6.1 Industrial sources particularly Part A and Part B prescribed processes

In North Ayrshire there are currently twenty authorisations for Part A prescribed processes under the Integrated Pollution Control (I.P.C.) regime. See Figures A2-A6 in the Appendix. The types of processes fall into the following categories:-

1. organic chemicals;
2. halogens;
3. acids;
4. paper;
5. incineration; and
6. boilers and furnaces.

All of these authorised processes are located at six industrial sites. Any emissions from these processes may have an effect on air quality outwith the locality of the premises.

There are currently thirty-three Part B Authorisations for prescribed processes and seven applications under the Local Air Pollution Control (L.A.P.C.) regime. See Figures A2-A6 in the Appendix. The effects of any emissions from these processes are likely to be localised.

2.6.2 **Traffic on Major or Congested Roads**

There are currently two sections of the road network in North Ayrshire namely the A78(T) between the roundabouts at Hawkhill and Ardeer, Stevenston and the A78(T) Kilwinning Bypass which have an annual average daily traffic flow in excess of 20,000 vehicles, but none in excess of 30,000 vehicles.

By the end of year 2005 it has been predicted that the traffic flows for these sections of the road network will be between 30,000 and 40,000 vehicles. It also has been predicted that the traffic flow for the section of the A71 between Irvine and Kilmarnock will be in excess of 20,000 vehicles.

2.6.3 **Domestic Coal Burning**

During the 1980s and early 1990s, following on from air pollution monitoring undertaken in the 1970s, North Ayrshire Council and its predecessor Cunninghame District Council embarked on an extensive scheme of Smoke Control Areas. By 1996, 30,000 premises within North Ayrshire were covered by Smoke Control Orders, including Dalry; Kilbirnie; Glengarnock; Ardrossan; Saltcoats; Stevenston; and Kilwinning. Smoke Control Areas are outlined in Figure A8 in the Appendix.

This has greatly improved the air quality in the urban areas of the Garnock Valley area.

2.7 **Air Quality Monitoring in North Ayrshire**

A summary of the air quality monitoring currently carried out by North Ayrshire is given in Figure A9 in the Appendix.

Chapter 3 - First Stage Review and Assessment for Benzene

3.1 Introduction

Benzene is a chemical consisting of six atoms each of carbon and hydrogen, arranged in a ring structure. At normal ambient temperatures it is a liquid but it readily evaporates and small amounts are detectable in the atmosphere.

There are no well defined natural sources of benzene and all the benzene observed at ground level in the Northern Hemisphere is likely to have resulted from human activities in particular the use of petrol and oil.

In the UK the main atmospheric source of benzene is the combustion and distribution of petrol, of which it is a minor constituent, currently comprising about 2% by volume in the UK, on average. Diesel is a relatively small source. Exhaust fumes contain some unburned benzene, but they also contain benzene formed from the combustion of other aromatic components of petrol. Motor vehicles are the most important single source of benzene on a national basis, accounting in 1996 for 64% of the total UK annual emissions of 41ktonnes.

Benzene is naturally broken down through chemical reactions in the atmosphere but these reactions take several days. Thus, in common with inhabitants of industrial and industrialising nations people living in the United Kingdom are exposed to benzene in the air they breathe.

Benzene is known to be a human carcinogen. The effect of long-term exposure which is of most concern is leukaemia.

It has not been possible to demonstrate a level at which there is zero risk of exposure to benzene and policies to control benzene concentrations in the ambient air therefore adopt a risk management approach, aiming at attaining levels where the risk to health is very small.

3.2 Standard and Objective for Benzene

The Government has adopted a running annual average of 5 ppb as an air quality standard for benzene, with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for benzene should be non-occupational near ground level outdoor locations with elevated benzene concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing schools or hospitals etc).

3.3 The National Perspective

Existing national policies are expected to deliver the prescribed air quality objective for benzene by the end of 2005. Roadside levels of benzene next to even the most busy or congested road are expected to be well below the objective by the year 2005. Only those authorities with major industrial processes which either handle, store or emit benzene, which have the potential, in conjunction with other sources to result in elevated levels of benzene in relevant location are expected to need to undertake a second or third stage review assessment. It is expected for benzene that most local authorities will not need to progress past the first stage.

3.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in paragraph 1.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of benzene and:-

- are expected to be in existence and for operational by the end of 2005 and

- for which there is the potential for exposure of individuals in relevant locations.

For the purposes of a first stage review and assessment for benzene these can be assumed to consist of:-

- one or more Part A or Part B processes of the type indicated by Government guidance to be a potential significant source of benzene and

- planned developments of the above-mentioned types in the locality.

3.5 Background Benzene Concentrations

National maps are available which indicate estimated background benzene concentrations across the UK. The estimated background concentrations of benzene for the North Ayrshire area are <0.5ppb.

3.6 Benzene Monitoring in the UK

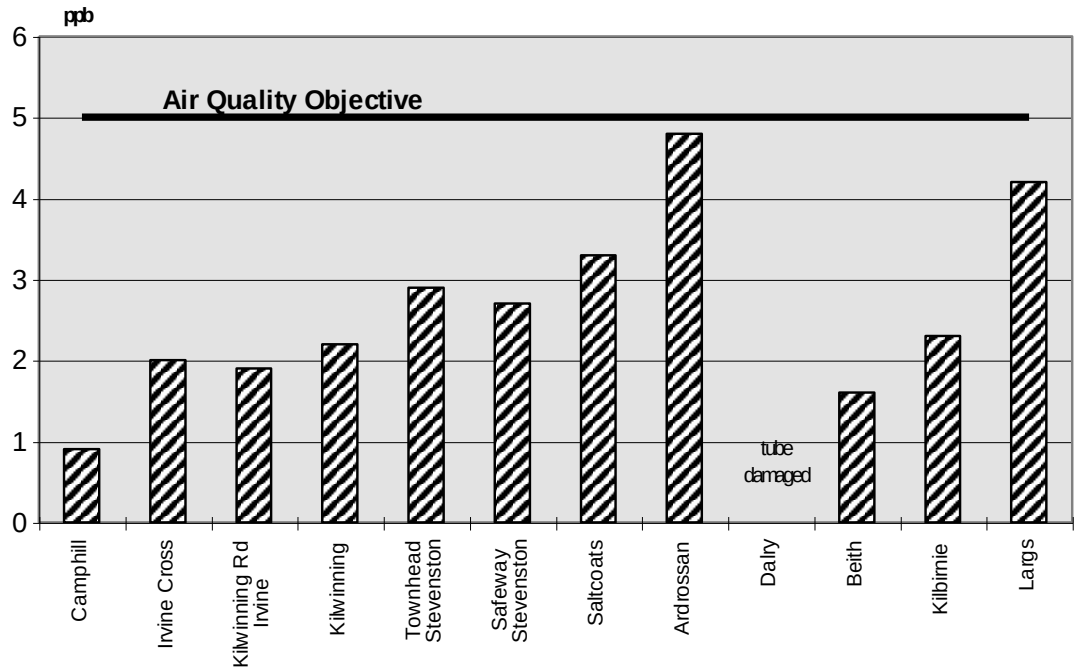
In 1996 the Government operated 12 sites across the UK measuring speciated hydrocarbons every hour. All of these sites, some of which are urban, kerbside and rural, complied with the National Air Quality Standard of 5ppb running annual mean.

3.7 Benzene Monitoring in North Ayrshire

As part of Environment Week 1998, North Ayrshire Council carried out a one month benzene survey, using diffusion tubes. Twelve sites were identified, one was at Camphill, near Kilbirnie, and was used as rural background location. The other eleven sites were at a series of locations where benzene levels were expected to be at their highest; for example, in areas where there are one or more of the following - heavy traffic flow, slow moving or queuing vehicles, petrol stations, enclosed street canyons, which restrict natural dispersion. The survey ran March-April 1998.

The results were as follows:-

Figure 3.1 - Benzene Monitoring Results for North Ayrshire March -April 1998



All of the sites were below the 5 ppb objective.

3.8 Benzene Monitoring in Neighbouring Local Authorities

Benzene has also been monitored by neighbouring local authorities using diffusion tubes, including South Ayrshire, Inverclyde and Renfrewshire.

The results for Inverclyde and Renfrewshire indicate that all their monitoring sites comply with the standard of 5 ppb.

The results for South Ayrshire show that benzene levels were below the standard with the exception of one location which showed a marginally elevated level.

Therefore North Ayrshire monitoring results are consistent with neighbouring local authorities.

3.9 Part A and Part B Authorised Processes

The review of authorised processes identified 8 Part A processes at 3 premises which could be a potential significant sources of benzene.

Roche Products, Dalry
Smithkline Beecham, Irvine
Nobel's Explosives, Stevenston

These processes are authorised by the Scottish Environment Protection Agency and the consultation exercise with the agency identified that only two processes would emit benzene and it would only be in small quantities arising from the combustion of coal. Therefore there are no Part A processes within North Ayrshire which are a significant source of benzene.

There are no Part B processes within North Ayrshire which are likely to give rise to significant quantities of benzene.

3.10 Future Developments and Neighbouring Sources

There are no known planned developments within North Ayrshire which will be a significant source of benzene.

There are no sources within neighbouring local authority areas which could impact significantly on air quality within North Ayrshire.

3.11 Conclusions for Benzene

1. There is no significant industrial source of benzene located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality within North Ayrshire.

2. Monitoring has indicated that roadside levels of benzene within North Ayrshire are likely to comply with the standard.

3. There is no need to proceed to a second stage review for benzene.

Chapter 4 - First Stage Review and Assessment 1,3-Butadiene

4.1 Introduction

1,3-Butadiene is a chemical compound which comprises a molecule containing four carbon and six hydrogen atoms. At normal ambient temperatures it is a gas, and trace amounts can be found in the atmosphere that we breathe.

1,3-Butadiene is derived, solely from human activity mainly from the combustion of petrol and other materials. Although neither petrol nor diesel fuel contains 1,3-Butadiene it is formed in the combustion process from olefins in the fuel.

1,3-Butadiene is also an important industrial chemical, and is handled in bulk in a small number of industrial locations in the UK. Other than in the vicinity of such locations, the dominant source of 1,3-Butadiene in the UK atmosphere is the motor vehicle. The UK national inventory for 1,3-Butadiene showed that, in 1995, 67% of national annual emissions arose from petrol vehicles and 13% arose from industrial processes.

1,3-Butadiene is removed from the atmosphere in a few hours by chemical reactions. This prevents it being dispersed far from its source.

1,3-Butadiene is a genotoxic carcinogen and, in theory, it is not possible to determine an absolute safe level for human exposure. It has also been shown that occupational exposure to 1,3-Butadiene results in a slightly higher than expected risk of cancers of the lymphoid system and bone marrow, lymphomas and leukaemias.

As it has not been possible to demonstrate a level at which there is zero risk from exposure to 1,3-Butadiene policies to control its concentration in the ambient air adopt a risk management approach, aiming to attain levels where the risk to health is very small.

4.2 Standard and Objective for 1,3-Butadiene

The Government has adopted a running annual average of 1 ppb as an air quality standard for 1,3-Butadiene with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for 1,3-Butadiene should be non-occupational near ground level outdoor locations with elevated 1,3-Butadiene concentration where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools or hospitals).

4.3 The National Perspective

Existing national policies are expected to deliver the prescribed air quality objective for 1,3-Butadiene by the end of 2005. Roadside levels of 1,3-Butadiene, next to even the most busy or congested roads are expected to be well below the air quality objective. 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 or third stage review and assessment.

4.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in paragraph 1.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of 1,3-Butadiene, and

- are expected to be in existence and/or operation by the end of 2005 and
- for which there is potential for exposure of individuals in relevant locations

For the purposes of first stage review and assessment for 1,3-Butadiene these can be assumed to consist of:-

- one or more Part A or Part B processes of the type indicated by Government guidance to be a potential significant source of 1,3-Butadiene.

- planned developments of the above-mentioned types in the locality.

4.5 1,3-Butadiene Monitoring in the UK

In contrast to better known pollutant gases, there is relatively little information on levels of 1,3-Butadiene in the ambient air of the UK. The Government has now established a network of 12 sites continuously monitoring 1,3-Butadiene. In 1996 there were no recorded exceedances at any site.

4.6 1,3-Butadiene Monitoring in North Ayrshire and Neighbouring Local Authorities

No monitoring of 1,3-Butadiene has been carried out in North Ayrshire. Limited monitoring undertaken at 11 sites in South Ayrshire during 1997 resulted in no exceedance of the standard.

4.7 Part A and Part B Authorised Processes

The review of authorised processes identified 8 Part A processes at three sites which could be a potential significant source of 1,3-Butadiene.

Roche Products, Dalry
Smithkline Beecham, Irvine
Nobel's Explosives, Stevenston

These processes are authorised by the Scottish Environment Protection Agency and the consultation exercise with the agency identified that none of the above processes would emit 1,3-Butadiene to air.

There are therefore no Part A processes within North Ayrshire which are a significant source of 1,3-Butadiene.

There are no Part B processes within North Ayrshire which are likely to give rise to significant quantities of 1,3-Butadiene.

4.8 Future Developments and Neighbouring Sources

There are no known planned developments within North Ayrshire which will be a significant source of 1,3-Butadiene.

There are no sources within neighbouring local authorities which could impact significantly on air quality within North Ayrshire.

4.9 Conclusions for 1,3-Butadiene

1. There is no significant industrial sources of 1,3-Butadiene located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review and assessment for 1,3-Butadiene.

Chapter 5 – Updating and Screening Assessment of Carbon Monoxide

5.1 Introduction

Carbon monoxide (CO) is produced by the incomplete combustion of organic material or materials that are essentially just carbon such as coke.

In the indoor environment, individuals are exposed to carbon monoxide from sources such as domestic fuel burning heaters and gas cooking appliances. Cigarette smoke can be a significant source.

The main source of outdoor exposure to carbon monoxide is general pollution of the atmosphere by vehicle exhaust gases. Proportionately higher levels of carbon monoxide are contained in exhaust gases when the engine is cold or badly tuned, or while the engine is idling or moving slowly. Thus it might be expected that levels of the gas in the ambient air would be highest close to busy roads in towns where traffic flow is reduced as in rush hours.

Carbon monoxide emitted by motor vehicles in urban areas is normally rapidly dispersed away from roads and then is destroyed by photo chemical reaction over a period of months.

Unlike many toxic gases, carbon monoxide is both colourless and odourless and life threatening concentrations can be breathed without giving any warning to the individual. Exposure to high levels results in unconsciousness with further exposure causing death.

Health effects are caused by carbon monoxide interfering with the transport of oxygen by the red blood cells by the formation of carboxyhaemoglobin and also by blocking essential biochemical reactions in cells.

Varying levels of brain damage can result from carbon monoxide poisoning.

5.2 Standard and Objective for Carbon Monoxide

The Government has adopted an 8 hour running average of 10 milligrams per cubic metre (mg/m^3) as the air quality standard for carbon monoxide, with an objective for the standard to be achieved as the maximum 8 hour running average by the end of 2005. The focus of an authority's review and assessment for CO should be the following non-occupational, near ground level outdoor locations: background locations; roadside locations; and other areas of elevated CO concentrations where a person might reasonably be expected to be exposed over an 8 hour period (e.g. in the vicinity of housing, schools or hospitals etc).

5.3 National Perspective

The main source of carbon monoxide in the UK is road transport which accounted for 71% of the total emissions of 4.6 m tonnes in 1996.

Road transport sources will constitute a larger proportion of the total in most cities and maximum concentrations are expected near busy, especially congested roads. Of road transport emissions, the predominant source is petrol vehicles. Emissions of carbon monoxide from diesel vehicles are relatively small.

Emissions of carbon monoxide in the UK have increased significantly from 6.5 million tonnes in 1970 to 7.38 million tonnes in 1990.

However, since 1990 emissions have been decreasing and in 1996 were 4.6 million tonnes. These reductions have been the result of national policies to reduce carbon monoxide emissions from vehicles. These include the introduction of three way catalysts and a reduction of the carbon monoxide limit in exhaust gases.

Table 5.1 - UK Emissions of Carbon Monoxide by source in 1996

Source	*Percentage of Total Emissions*
Power stations	*4*
Domestic	*5*
Other industrial combustion	*1*
Production processes	*1*
Road transport	*71*
Other transport	*16*
Waste treatment and disposal	*1*

These national policies are expected to deliver the national air quality objective by the end of the year 2005 with the possible exception of heavily trafficked roads or in the vicinity of certain stationary sources.

Only those authorities with such sources which have the potential to result in elevated levels of CO in relevant locations are expected to proceed to a second or third stage review and assessment. It is expected that for this pollutant most local authorities will not need to progress past the first stage.

5.4 Information to be considered for an Updating and Screening Assessment

For the purposes of an updating and screening assessment for CO these can be assumed to consist of:

- Single carriageway roads with current or projected daily average traffic flow greater than 80,000 vehicles per day
- Dual carriageway (2 or 3 lane) roads with current or projected daily average traffic flow greater than 120,000 vehicles per day
- Motorways with current or projected daily average traffic flow greater than 140,000 vehicles per day
-
- planned developments of the above-mentioned types in the locality including those which will increase traffic flow.

5.5 Background Carbon Monoxide Concentrations

National maps are available which indicate the estimated background carbon monoxide concentrations across the UK.

Estimated background carbon monoxide concentrations for North Ayrshire are below 0.2 ppm. Areas around the A78, A77 and A736 are estimated to have slightly higher levels of 0.21-0.3 ppm.

5.6 Carbon Monoxide Monitoring in the UK

By 1996 carbon monoxide was being monitored at 39 sites throughout the UK. The results show that carbon monoxide levels are currently showing declining levels, as expected due to the decline in total emissions.

The 1996 annual report on air pollution stated that annual mean concentrations appear to be decreasing at between 0.1 and 0.2 ppm per year at urban background locations and by nearly 0.4 ppm per year at the kerbside monitoring site at Cromwell Road in London.

There are currently four carbon monoxide monitoring sites within Scotland that are part of the UK automatic monitoring network.

These four sites are Edinburgh Centre, Glasgow Centre, Glasgow City Chambers and Glasgow Kerbside. The Glasgow Kerbside was only set up during 1997.

In 1996 the three sites that operated within Scotland all met the air quality standard. The annual statistics for 1996 were as follows:-

Table 5.2 - Carbon Monoxide Results for Scotland 1996 - Automatic Monitoring Network (ppb)

	Ann. Mean	Max Hr	Max. Run 8 hr
Glasgow City Chambers	0.7	5.0	3.8
Edinburgh Centre	0.5	6.0	3.7
Glasgow Centre	0.6	9.0	6.8

In 1997 another site had been added in Scotland and again all four sites which were in operation complied with the air quality standard.

5.7 Carbon Monoxide Monitoring in North Ayrshire and Neighbouring Local Authorities

No carbon monoxide monitoring has been carried out by North Ayrshire Council.

No neighbouring authority has carried out carbon monoxide monitoring.

5.8 Roads in North Ayrshire

North Ayrshire is served by three trunk routes; A78, A737 and A738 with other "A" Class roads including A71, A736 and A760.

There are also five major trunk road projects which are proposed. There are:-

A78 Ardrossan, Saltcoats & Stevenston Bypass
A737 Dalry Bypass
A737 Re-alignment at the Den
A737 Kilwinning Western Bypass
A737 Beith Bypass, upgrading junctions to roundabouts.

All of the above are currently subject to review as part of the Scottish Office trunk road programme review, and it is highly unlikely that any of the above projects would be completed by 2005.

The traffic flows for the existing road network were discussed in Section 2.3 and 2.6.2. There are no roads within North Ayrshire where existing or projected traffic flows are greater than 50,000.

The busiest section of road within North Ayrshire is a short length of the A78 at Hawkhill, Stevenston. At this site the 24 hour - 7 day average flow for both directions is 26,828 currently. The 2005 predicted traffic flow is 30,120.

Although this road passes a modern housing estate, a primary school and a cemetery lodge all are at least 30 metres from the carriageway with the exception of the cemetery lodge which is adjacent to the footpath. The area surrounding the road is open and exposed to the prevailing winds. It is likely therefore that the carbon monoxide generated by the traffic, even when speeds are restricted at peak flows to less than 36 km/hr (20 mph), will be adequately dispersed to minimise if not remove the risk of exceeding the standard at these relevant locations.

5.9 Part A and Part B Authorised Processes

The review of authorised processes in accordance with the government guidance identified one Part A process which could be a significant source of carbon monoxide.

Clinical Waste Incinerator, Irvine

This process was granted authorisation but never became operational and the latest information from the Scottish Environment Protection Agency is that the authorisation is in the process of being revoked.

There are no Part B authorised processes within North Ayrshire with the potential to emit significant quantities of carbon monoxide.

5.10 Future Developments and Neighbouring Sources

There are no known planned developments within North Ayrshire which will be a significant source of carbon monoxide.

There are no sources within neighbouring local authorities which could impact significantly on North Ayrshire.

5.11 Conclusions for Carbon Monoxide

1. There is no significant carbon monoxide source, industrial or road transport, located either within North Ayrshire or neighbouring areas which are likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review for carbon monoxide.

Chapter 6 - First Stage Review and Assessment of Lead

6.1 Introduction

Lead occurs in the earth's crust and is released naturally through various processes including weathering of rocks, volcanic activity, and uptake and subsequent release from plants.

Lead in the environment as a result of human activity occurs through the mining and smelting of ores, the production, use, recycling and disposal of lead containing products and the burning of fossil fuels.

Industrial emissions and a large part of the vehicle emissions are in the form of particles of inorganic compounds of lead. Particles of lead emitted from petrol vehicles range from 0.015 μm in diameter and these aggregate to form larger particles with diameters of 0.1-1.0 μm which can remain in the air for 7-24 days. Industrially emitted particles tend to be around 0.1-5.0 μm in diameter depending on the process.

Currently the dominant contribution to airborne lead is from petrol combustion. This results from the use of lead as an additive to increase the octane rating of petrol. There are other sources of lead in the air in addition to lead emitted in motor exhausts. These include coal combustion, the production of non-ferrous metals and waste treatment and disposal.

Lead can be absorbed into the body both through the lungs and the stomach and intestines. Thus people may be at risk of absorbing it when exposed to lead either in the air, dust, soil or as a contaminant in food and drink. Exposure to high levels of lead has severe adverse effects on the blood, the nervous system and the kidneys. Low level exposure to lead can have an effect on the intellectual development of children.

Currently there is no convincing evidence of a threshold exposure to lead below which no effect on intelligence occurs. Therefore in setting a standard the aim has been to identify a level at which any effect on intelligence is likely to be so small at to be negligible.

6.2 Standard and Objective for Lead

The Government has adopted an annual average of 0.5μg/m^3 (500ng/m^3) as an air quality standard for lead. With an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for lead should be non-occupational, near ground level outdoor locations with elevated lead concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. the vicinity of housing, schools and hospitals etc).

6.3 The National Perspective

Lead is the most widely used non-ferrous metal and has a large number of industrial applications, both in its elemental form and in alloys and compounds. The single largest use globally is in the manufacture of batteries, but other uses are as pigment in paints and glazes, in alloys, in radiation shielding, tank linings, piping and gunshot.

Most of the current emissions of lead in the UK arise from petrol-engined motor vehicles. In 1996 this amounted to 894 tonnes. The total UK emissions of lead were 1357 tonnes from all sources.

Existing national policies are expected to deliver the prescribed objective for lead at all, rural, urban background sites and roadside locations by the year 2005. Only local authorities with significant industrial sources, which have the potential to results in elevated levels of lead in relevant locations, are expected to need to undertake a second or third stage review and assessment.

6.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in paragraph 1.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of lead; and

- are expected to be in existence and/or operation by the end of 2005; and
- for which there is a potential for exposure of individuals in relevant locations.

For the purposes of first stage review and assessment for lead these can be assumed to consist of:-

- Part A authorised processes with the potential to emit significant quantities of lead as indicated in the Government guidance
- Part B processes, or a number of such processes in close proximity, which collectively have the potential to emit significant quantities of lead
- Planned developments of the above-mentioned types in the locality.

6.5 Background Lead Concentrations

National maps are available which indicate estimated background lead concentrations across the UK. The estimated background concentrations of lead for North Ayrshire are less than 20ng/m^3 (0.02μg/m^3).

6.6 Lead Monitoring in the UK

Lead has been monitored in the UK by the Government's national networks since 1976. Lead is measured under five different networks throughout the UK.

Urban levels have reduced to the extent that the maximum annual average values are now of the order of 0.15 μg/m^3. Rural values are rather smaller and currently range from 0.005-0.05μg/m^3.

There are two lead monitoring sites in Scotland which are part of the multi-element monitoring network : Glasgow and Motherwell. Since monitoring began lead levels at these sites have reduced dramatically and in 1996 the annual mean concentration of lead was 52ng/m^3 in Glasgow and 30ng/m^3 in Motherwell.

6.7 Lead Monitoring in North Ayrshire and Neighbouring Local Authorities

No monitoring of airborne lead has been carried out in North Ayrshire or the surrounding local authorities.

6.8 Part A and Part B Authorised Processes

The review of authorised processes in accordance with the pollutant specific guidance and in consultation with SEPA identified that there are no Part A processes within North Ayrshire with the potential to emit significant quantities of lead.

There are two Part B processes within North Ayrshire with the potential to emit significant quantities of lead, according to the Government guidance:-

Johnstone Castings, Dalry - Non-ferrous metal process
Rockware Glass, Irvine - Glass Manufacturer

The consultation exercises with SEPA identified that the above two processes were operating satisfactorily and complying with emission standards and that it was highly unlikely that the emissions from these processes would result in exceedances of the air quality standards.

There are therefore no Part B processes within North Ayrshire which will give rise to significant quantities of lead.

6.9 Future Developments and Neighbouring Sources

There are no known planned developments within North Ayrshire which will be a significant source of lead.

There are no sources within neighbouring local authorities which could impact significantly on air quality within North Ayrshire.

6.10 Conclusions for Lead

1. There is no significant industrial source of lead located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review and assessment for lead.

Chapter 7 - First Stage Review and Assessment of Nitrogen Dioxide

7.1 Introduction

Nitrogen dioxide is a gas produced by reaction of nitrogen and oxygen in combustion processes. The reaction usually takes place in two stages, firstly, the formation of nitric oxide which is oxidised to produce nitrogen dioxide. Both oxides exist together and are collectively known as NO_x (nitrogen oxides).

Natural sources of nitrogen oxides include lightning and forest fires as well as bacterial activity in soils and plant metabolism. In the UK, however, the largest amount is formed during the combustion of fossil fuels especially motor transport and non-nuclear power stations.

The main sources of NO_x in the UK are road transport which in 1996 accounted for about 47% of the emissions of 2.1 million tonnes per year as nitrogen dioxide, power stations 22% and domestic sources 4%. In urban areas the proportion due to road transport is larger.

In the atmosphere nitrogen dioxide reacts to form nitric acid and nitrates which are removed by rain. Nitrates, however, can remain in the atmosphere as very small particles, contributing to the airborne concentration of PM_{10}.

Nitrogen dioxide is an irritant gas which has been known for many years to have serious and sometimes fatal effects on health when inhaled in very high concentrations associated with accidental exposure. More subtle effects on health may occur at lower concentrations found in the ambient atmosphere both outdoors and indoors. The major indoor source is cooking with gas although cigarette smoke can also contribute significantly. It has been suggested that nitrogen dioxide may have both acute (short term) and chronic (longer term) effects on health particularly in people with asthma.

People with healthy lungs whether resting or exercising, show little response to inhalation of nitrogen dioxide at concentrations well above those occurring in ambient air even during extreme pollution episodes. However, in people with asthma some studies have shown impairment of lung function and the airways of some may become more sensitive to the inhalation of irritant chemicals after exposure to nitrogen dioxide at concentrations of about 200 ppb.

7.2 Standard and Objective for Nitrogen Dioxide

The Government has adopted a 1 hour average of 150 ppb as an air quality standard for nitrogen dioxide (NO_2), with an objective for the standard to be achieved as an hourly maximum by the end of 2005. The focus of an authority's review and assessment for the hourly objective should be any non-occupational, near ground level, outdoor locations given that exposures over one hour are potentially likely in these locations.

The Government has also adopted an annual average of 21 ppb as an air quality standard with an objective to achieve this by the end of 2005. The focus of an authority's review and assessment for the annual average objective should be non-occupational, near ground level, outdoor locations with elevated NO_2 concentrations where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools or hospitals).

7.3 The National Perspective

The National Air Quality Strategy states that for nitrogen dioxide a reduction in NO_x emissions over and above that achieved by national measures will be required to ensure that air quality objectives are achieved everywhere by the end of 2005. Local authorities with major roads, or highly congested roads, which have the potential to result in elevated levels of nitrogen dioxide in relevant locations are expected to identify the need to progress to the second or third stage review and assessment for this pollutant.

Major roads are defined as busy roads, existing or proposed by 2005 with an actual or projected annual average daily traffic flow of greater than 20,000.

7.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in paragraph 1.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of NO_x and

- are expected to be in existence and/or operational by the end of 2005 and
- for which there is potential for exposure of individuals in relevant locations

For the purposes of a first stage review and assessment these can be assumed to consist of

- an annual mean urban background NO_2 concentration in 1996 of greater than 30ppb
- on or more existing or planned roads with a projected annual average daily traffic flow of greater than 20,000 in 2005
- one or more Part A or Part B process of the type indicated to be a potential significant source of NO_x in accordance with the government guidance.
- an indication of existing sources acting in combination to exceed a current annual mean concentration of 30ppb.

7.5 Nitrogen Dioxide Monitoring in the UK

Nitrogen dioxide is measured nationally as part of the automatic monitoring network. In 1996, NO_2 was measured at five rural and 47 urban sites.

Sites with a data record of five years or more have shown significant trends. Two London sites have surprisingly shown an increase in annual mean NO_x concentrations but all the remaining observed trends in NO_2 and NO_x are down both in terms of the annual mean and the 98th percentile of hourly averages.

In 1996 there were four automatic monitoring network sites in Scotland: Glasgow City Chambers, Glasgow Centre, Edinburgh and Strath Vaich in the Highlands.

The three city locations complied with the hourly standard but were above the annual standard. However the annual standards for 1996 for all three sites were below the 30 ppb level set in the government guidance. The remote site at Strath Vaich complied with both standards.

Nitrogen dioxide is also measured nationally through the NO_2 Diffusion Tube Survey.

7.6 Nitrogen Dioxide Monitoring in North Ayrshire

In North Ayrshire monitoring of nitrogen dioxide by passive diffusion tubes has been undertaken regularly since 1993, after earlier involvement in the two short national surveys.

The aim of the NO_2 monitoring undertaken so far in North Ayrshire has been to measure pollutant concentrations at busy roads and junctions especially near residential areas. Monitoring has also been undertaken at sites where the continuous frontage of buildings provides a canyon effect and allows pollutant levels to accumulate.

Table 7.1 - Nitrogen Dioxide Monitoring Sites in North Ayrshire

Site	Type of Site	Diffusion Tube Monitoring	
		Date started	**Date ended**
Cunninghame House Irvine	Urban Centre	Dec 93	ongoing
Castle Street Irvine	Kerbside	Dec 93	Dec 94
Safeway Stevenston	Kerbside	Dec 93	Dec 94
Dubbs Road Stevenston	Kerbside	Dec 93	Dec 94
Sharphill Road Saltcoats	Kerbside	Dec 93	Dec 94
Parkhouse Road Ardrossan	Kerbside	Dec 93	Dec 94
Eglinton Road Ardrossan	Kerbside	Dec 93	Dec 94
Main Road Largs	Kerbside	Feb 95	ongoing
Eglinton Street Irvine	Kerbside	Jan 95	ongoing
Dalry Road Kilwinning	Kerbside	Feb 95	ongoing
East Road Irvine	Kerbside	Jan 95	ongoing
Irvine Cross North (Kwik Save)	Kerbside	Jan 95	ongoing
Irvine Cross South (Lobster Pot)	Kerbside	Jan 95	ongoing
Irvine Police Station	Urban Background	Nov 97	ongoing
Irvine Townhouse	Urban Centre	Nov 97	ongoing
Irvine Cross, Victoria Cafe	Kerbside	Nov 97	ongoing
Irvine Cross RS McColl	Roadside	Nov 97	ongoing
Irvine Cross OK Joes	Roadside	Nov 97	ongoing
Kirkgate Irvine	Urban Background	Nov 97	ongoing

Four of the monitoring sites in the Irvine Cross area became part of the National NO_2 Diffusion Tube Survey in 1998.

There was also a one year survey of NO_2 undertaken around Rockware Glass Irvine undertaken in 1993/94.

The results of monitoring are summarised in graphs Figure 7.1 and Figure 7.2. They show that for the existing sites nitrogen dioxide levels have reduced over the period 1994 - 1997 at all sites except Cunninghame House where levels have remained relatively constant.

Figure 7.1 - Nitrogen Dioxide Monitoring Results in North Ayrshire 1994-1997 (Annual Mean Values)

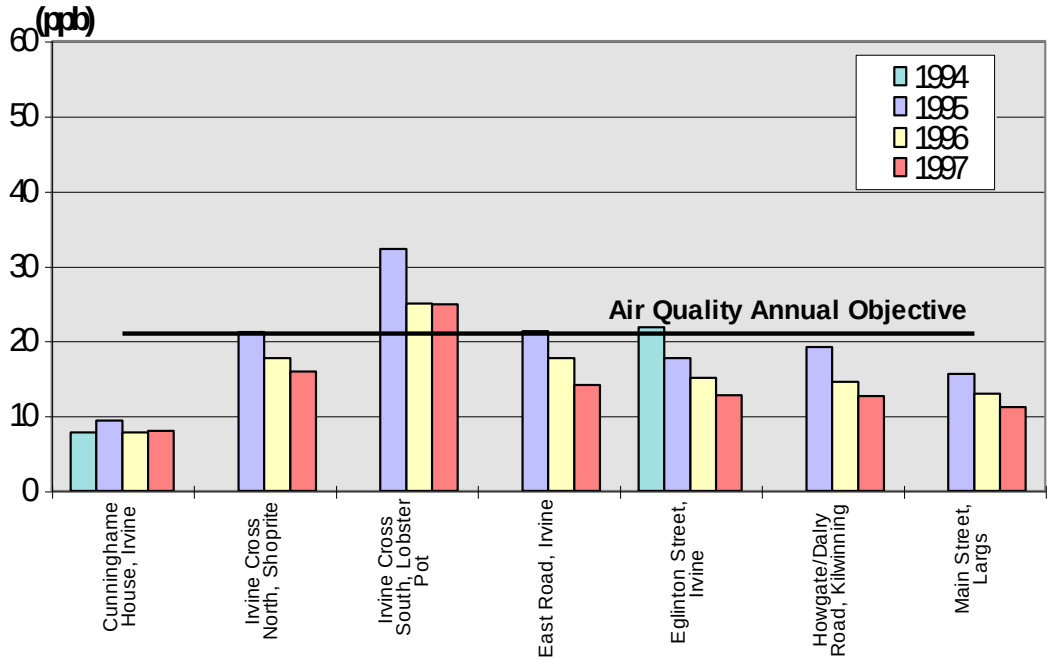
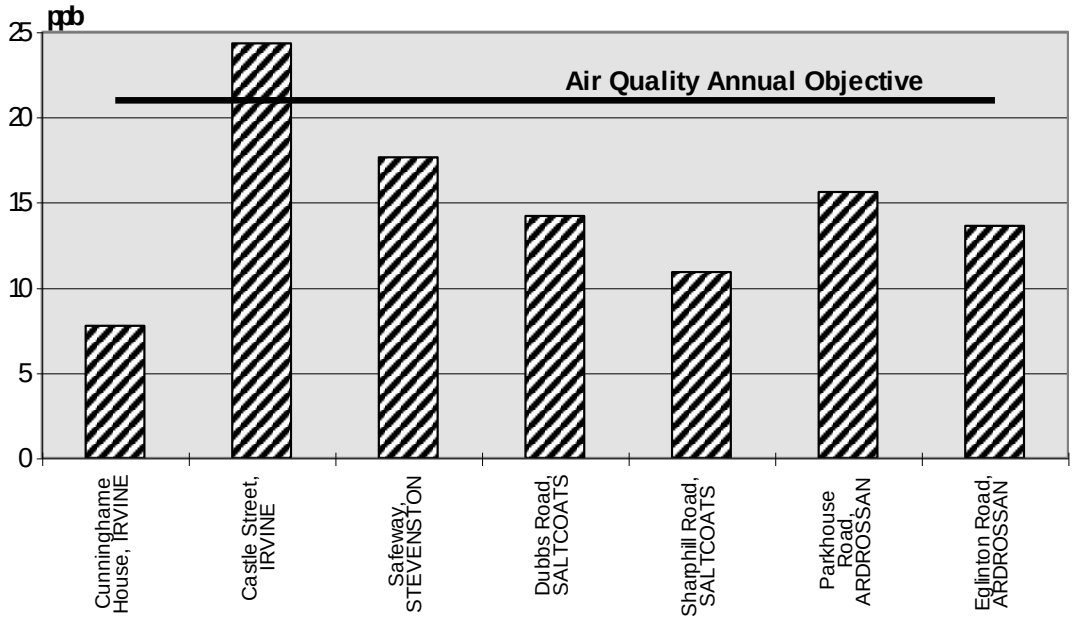


Figure 7.2 - Nitrogen Dioxide Monitoring Results in North Ayrshire 1994 (Annual Mean Values)



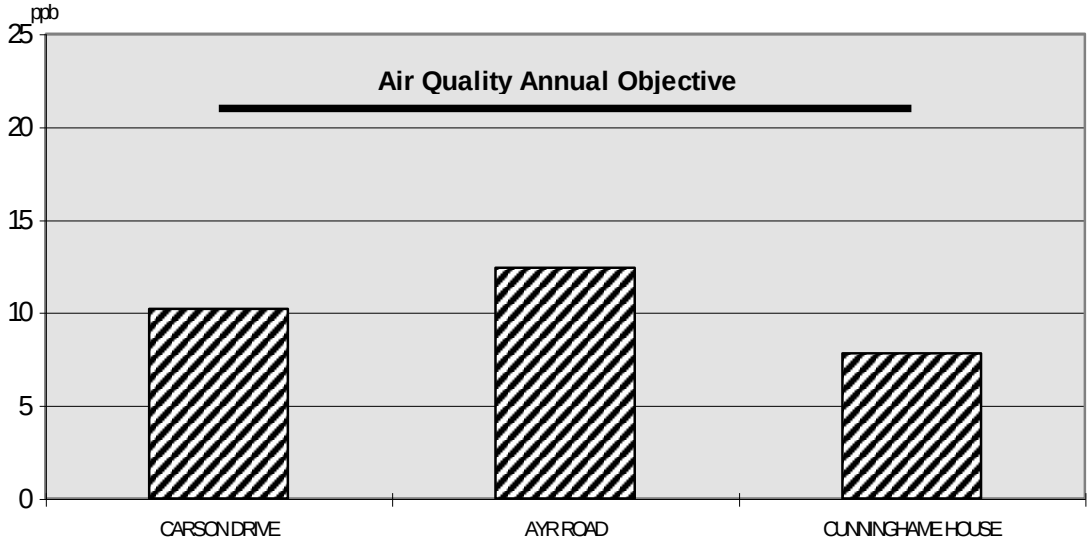
There is only one site within North Ayrshire which currently fails to meet the 21ppb air quality standard and that is the Irvine Cross South site which had an annual average of 25 ppb in both 1996 and 1997. This higher level is likely to be due to poorly dispersed exhaust fumes from public service vehicles which use this area as a main pick-up and deposit point for Irvine town centre. In November 1997 additional diffusion tubes sites were introduced in the area to determine the extent of the elevated levels at Irvine Cross.

Although this one site currently fails the 21ppb air quality annual standard it is still below the 30ppb trigger level for first stage review and assessment.

North Ayrshire Council in conjunction with Inverclyde Council have purchased a mobile automatic monitoring station which will monitor CO, NO_2 and PM_{10} continuously and will be used initially to measure more accurately the pollution levels at Irvine Cross.

The survey undertaken around Rockware in Irvine produced the results shown in Figure 7.3 and concludes that "nitrogen dioxide levels within 1km of the Rockware Factory were well within the statutory air quality limits" (at that time EC limits). The annual mean values for the sites were also well below the 21ppb standard.

Figure 7.3 - Nitrogen Dioxide Monitoring Rockware Glass Survey 1993-1994 (Annual Mean Values)



7.7 Part A and Part B Authorised Processes

The review of authorised processes indicated that there were 20 Part A processes at six sites with the potential to emit significant quantities of nitrogen dioxide

Roche Products, Dalry
Caledonian Paper Plc, Irvine
Clinical Waste Ltd, Irvine
Smithkline Beecham, Irvine
Nobel's Explosives, Stevenston
Scottish Nuclear, Hunterston

Consultation with SEPA was undertaken to determine the significance of these emissions. This consultation exercise produced the following information. The Clinical Waste Incinerator at Irvine has never become operational and SEPA are in the process of revoking the authorisation. The boiler/furnace at Scottish Nuclear is on stand by only and not in regular use.

Thus only four of the Part A processes have the potential to emit significant quantities of NO_2.

Nobel's Explosives is within the large industrial site at Ardeer and as such is at least 1.5km away from the nearest residential areas. The prevailing wind is from the north west to south west sector and therefore takes any plume towards Kilwinning/Irvine where the nearest residential area is over 2km away.

The Roche plant is situated to the north east of Dalry and is approximately 0.5km from the nearest residential area. Again the prevailing wind direction takes any plume away from residential area of Dalry.

The other two potentially significant processes are Smithkline Beecham and Caledonian Paper. Both these premises are situated in an industrial area to the south east of Irvine with the closest residential areas being Drybridge and Dreghorn. The prevailing wind direction will take the plumes towards these settlements. The fact that these two processes are so close together means that there could be an aggregate effect from their emissions. Due to the lack of monitoring in this area it is difficult to conclude that there is no risk of the air quality standard being exceeded.

This requires further investigation which is beyond the scope of a first stage review and assessment.

The review also indicated that there was one Part B process which had the potential to emit significant quantities of NO_2

Rockware Glass, Irvine

As discussed earlier monitoring has already been carried out around this site and the annual average levels are below the 21 ppb standard.

7.8 Roads in North Ayrshire

As discussed in paragraph Section 2.3 and 2.6.2 there are three traffic count sites all on the A78 trunk road in the vicinity of the Hawkhill area where the current and projected annual daily traffic flow exceeds 25,000 vehicles.

Although this road passes a modern housing estate, a primary school and a cemetery lodge they are all at least 30m from the carriageway, with the exception of the cemetery lodge which is adjacent to the footpath. The area surrounding the road is open and exposed to the prevailing winds. It is likely therefore that NO_2 generated by the traffic will be adequately dispersed to minimise if not remove the risk of exceeding the standard at these locations.

Monitoring has been carried out at several points along the A78 including the Safeway Roundabout and Dubbs Road. The results for Jan 94- Dec 94 for these sites are shown in Figure 7.2. It can be seen that these levels are well below the annual mean standard confirming that there is adequate dispersion around this area.

There is also a traffic count site on the A71 at the Springside area where the projected traffic flows indicate that in 2005 the annual daily traffic flow will exceed 20,000 vehicles. This area is away from residential areas and again open and exposed to prevailing winds. It is not anticipated that there would be an air quality problem at the nearest residential areas.

7.9 Future developments and Neighbouring Sources

Future developments which may be a source of nitrogen dioxide is the proposed Ardrossan, Saltcoats and Stevenston Bypass. Figures are unavailable for daily traffic flows but are likely to exceed 20,000 vehicles. However, this trunk road project is currently subject to review as part of the Scottish Office Trunk Road Programme Review and it is highly unlikely that this project would be completed by 2005.

There are no known planned developments within North Ayrshire which will be a significant source of NO_2.

There are no sources within neighbouring local authorities which could impact significantly on air quality within North Ayrshire.

7.10 Conclusions for Nitrogen Dioxide

1. There are two Part A processes Smithkline Beecham and Caledonian Paper Mill in close proximity in the south east of Irvine. It is not known what their collective effect on local air quality is as there is no monitoring data for this area. These two potentially significant sources and their ability to act in conjunction to affect air quality requires further investigation and thus requires a Stage Two review and assessment.

2. Although there are roads which are likely to exceed 20,000 as an annual daily traffic flow by 2005 monitoring data for the area indicates that the annual air quality standard is being complied with.

3. There are no monitoring sites where the annual average level of NO_2 in 1996 was greater than 30ppb.

4. Although the elevated levels of NO_2 at Irvine Cross are of concern they do not breach the 30ppb standard and therefore there is no need to proceed to a stage two review and assessment for their investigation. However the area will continue to be subject to detailed monitoring and the results of the new continuous mobile monitor will give a more accurate understanding of the levels in the area.

5. North Ayrshire Council will be progressing to a second stage review and assessment to investigate further the nitrogen dioxide levels generated by the two Part A processes Smithkline Beecham and Caledonian Paper Plc in Irvine.

Chapter 8 -First Stage Review and Assessment of PM_{10}

8.1 Introduction

Unlike the individual gaseous pollutants discussed elsewhere in this report, which are single, well defined substances, particulate matter in the atmosphere is composed of a wide range of materials arising from a variety of sources.

Natural sources of particles include wind blown dust and sea-salt, and biological particles such as pollens and fungal spores.

Man-made airborne particles result mostly from combustion processes, from the working of soil and rock, from many other industrial processes and from the attrition of road surfaces by motor vehicles.

These types of particles together with those derived from natural combustion sources, may be classified as either primary or secondary; the former such as carbon particles from combustion, mineral particles derived from stone abrasion and salt from the sea, are released directly into the air, while the latter are formed in the atmosphere by the chemical reaction of gases, first combining to form less volatile compounds which in turn condense into particles.

PM_{10} is defined as particles, whatever their source or composition, which fall within the appropriate size range. In general, particles smaller than about 10μm have the greatest likelihood of reaching the lung and thus the mass fraction of such particles are termed PM_{10}.

National UK emission of primary PM_{10} have been estimated as totalling 213,000 tonnes in 1996. The sources of these emissions are shown in table 8.1.

Table 8.1 UK emissions of PM_{10} by source in 1996 (%)

Source	Percentage of Total Emissions
Power Stations	16
Refineries	1
Domestic	14
Commercial, public & agricultural combustion	3
Iron and Steel	1
Other industrial combustion	8
Production processes	27
Road Transport	25
Other Transport	2
Waste Treatment & Disposal	3

Average levels of particles in the air in UK towns and cities derived from domestic coal burning have decreased at some locations by as much as tenfold in the past 25-30 years following the Clean Air Act of 1956 and subsequent restrictions of coal burning in the domestic sector. Over this period, measurements of particles in the air have been made using the "Black Smoke" method whereby air is drawn through a filter paper for 24 hours and the blackness of the stain produced is then measured. This is a relatively crude and simple technique which is now being superseded by direct weighing (gravimetric) techniques which give a more direct measurement of particle concentrations in the atmosphere.

Although many of the obvious effects of air pollution disappeared with the earlier smogs, research over the last few years has suggested that, even at the much lower levels now found in the UK, particulate air pollution appears to be associated with a range of medical conditions including effects on: the respiratory and cardiovascular systems; asthma; and mortality.

The Expert Panel on Air Quality studied the evidence on health effects of particulates and concluded that the present evidence supports a causative link between exposure to particulate air pollution in the urban environment and certain indices of ill health. They indicated that public health benefits could accrue from further reduction in particle concentrations in our towns and cities in

terms of fewer episodes of doctor consultation and hospitalisation for respiratory and cardiovascular diseases.

8.2 Standard and Objective for PM_{10}

The Government has adopted a running 24 hour running average of 50 μgm^{-3} as an air quality standard for PM_{10}, with the objective for the standard to be achieved as the annual 99th percentile of daily maximum running 24 hour averages (that is no more than four days exceeding the standard in a year) by the end of 2005. The focus of an authority's review and assessment for PM_{10} should be non-occupational, near ground level outdoor locations with elevated PM_{10} concentrations in areas where a person might reasonably be expected to be exposed over a 24 hour period (e.g. in the vicinity of housing, schools or hospitals).

8.3 The National Perspective

There are already reduction measures in place for most of the man-made sources of PM_{10}. Over the next ten years they should substantially reduce particle emissions in the UK from these sources. This should in turn lead to much lower concentrations of PM_{10} in the air. Most of the reduction will come from primary transport emissions and secondary aerosol.

However it is recognised that this will be the most difficult of the air quality objective to achieve for most authorities.

It is anticipated that many local authorities will have to proceed to a second or third stage review for this pollutant. Exceptions would be authorities in the north and west of the UK where secondary pollutant concentrations are small, land use is such that dust resuspension is low, local emissions densities are below the national average for urban areas and there are no significant industrial sources.

8.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in paragraph 1.4 above, the authority should then identify those existing or proposed activities which have the potential, singly or together to emit significant quantities of PM_{10} and

- are expected to be in existence and/or operation by the end of 2005
- and for which there is a potential for exposure of individuals in relevant locations

For the purposes of a first stage review and assessment these can be assumed to consist of

- urban areas for which the annual average regional background due to secondary particles is currently greater than $8\mu g/m^3$.
- emissions from low level dispersed sources (including road traffic) greater than 10 tonnes in any single 1km x 1km square or on average of 5 tonnes in several adjacent squares.
- one or more existing or planned roads with a projected annual average daily traffic flow of greater than 25,000.
- one or more Part A or Part B processes of the type indicated to be a potential significant source of PM_{10} according to the Government Guidance
- any industrial process that emits significant quantities of dust in the form of PM_{10} from uncontrolled or fugitive sources within the plant.

8.5 Background PM_{10} Concentrations

National maps are available which indicate the estimated background PM_{10} concentrations across the UK. Estimated background PM10 concentrations for North Ayrshire area are between 12.6 $\mu g/m^3$ - 17.5 $\mu g/m^3$.

8.6 Background Secondary PM_{10} Concentrations

National maps for secondary particulate concentrations in the UK are also available. The secondary particulate maps for the area indicate that the estimated secondary particulate background concentrations for North Ayrshire is 7 $\mu g/m^3$ based on 1996 data. By the end of 2005 reductions in emissions of sulphur dioxides and nitrogen dioxides will lead to a fall in the concentrations of secondary particles. NETCEN have stated that it would be reasonable to assume that the annual mean concentrations of secondary particles in 2005 will be 0.7 times that of 1996.

8.7 Estimated Emissions of PM_{10}

The national atmospheric emissions inventory provides information on approximate emission densities at a national scale. This information is available on the Internet. The information indicates that emissions from domestic and road traffic sources acting in conjunction would be a maximum of 3 tonnes per 1x1km grid square. The maps also give information on low level industrial sources and indicate that there are a few grid squares throughout North Ayrshire area which have emission densities of >10 tonnes per 1x1 km grid square. These squares all correspond to sites of authorised processes.

There are no adjacent squares on average exceeding 5 tonnes.

8.8 PM_{10} Monitoring in the UK

PM_{10} is monitored nationally as part of the automatic monitoring network. In 1996 the sites involved in the network, except Lough Navar (a remote site) exceeded the National Air Quality Standard of 50 μgm^{-3} as a 24 hour running mean.

Most monitoring sites recorded PM_{10} particle concentrations which were described as "High" for a number of days. A significant number of sites also recorded "Very High" air pollution levels.

The network sites include two urban centre sites, one in Glasgow and one in Edinburgh. These sites both failed the standard in 1996.

8.9 PM_{10} Monitoring in North Ayrshire

Over the years smoke monitoring using the "black smoke method" has been carried out in conjunction with SO_2 in the local area.

In the 1970s Cunninghame District Council set up pollution monitoring stations in the form of 8 port smoke and SO_2 bubbler stations at various locations throughout the area.

The results of this monitoring indicated that the Garnock valley had the main burden of smoke pollution. Dalry was found to exceed the EC limits for smoke, closely followed by Kilbirnie. This was due to the topography in the area and the sources of pollution.

As a result of this monitoring the Council embarked on an extensive scheme of Smoke Control Areas during the 1980s and early 1990s. By 1996, 27,000 houses within North Ayrshire were covered by Smoke Control Orders including Dalry, Kilbirnie, Glengarnock, Ardrossan, Saltcoats, Stevenston and Kilwinning. Smoke Control Areas are depicted in figure A8.

This has been a major step forward in the reduction of pollution locally.

Monitoring continued after Smoke Control Areas were set up and significant reductions in black smoke were measured. These reductions are represented graphically in Figures 8.1 and 8.2.

Figure 8.1 Smoke Monitoring in North Ayrshire 1978-1982 (Annual Daily Mean Smoke Values)

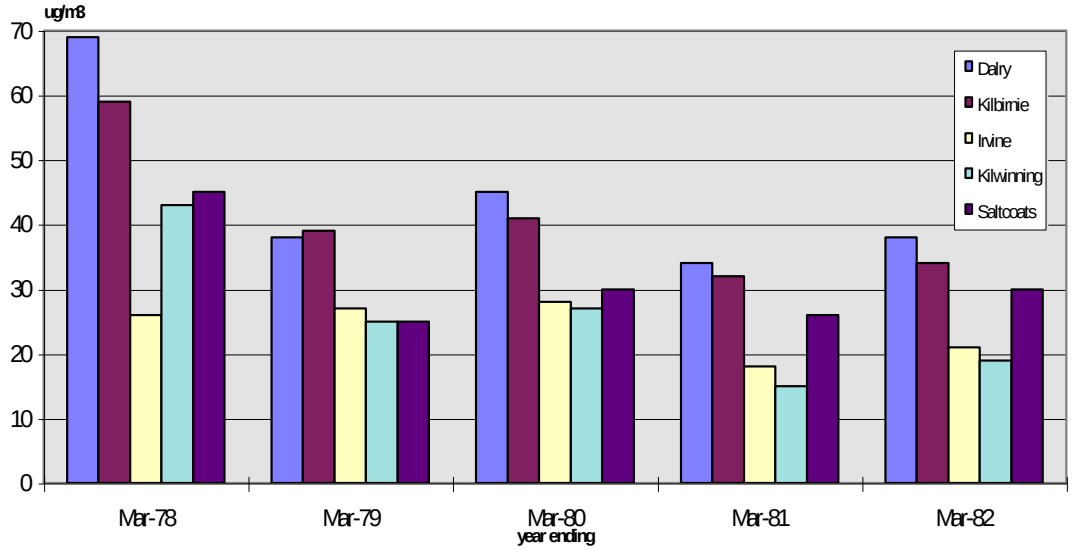
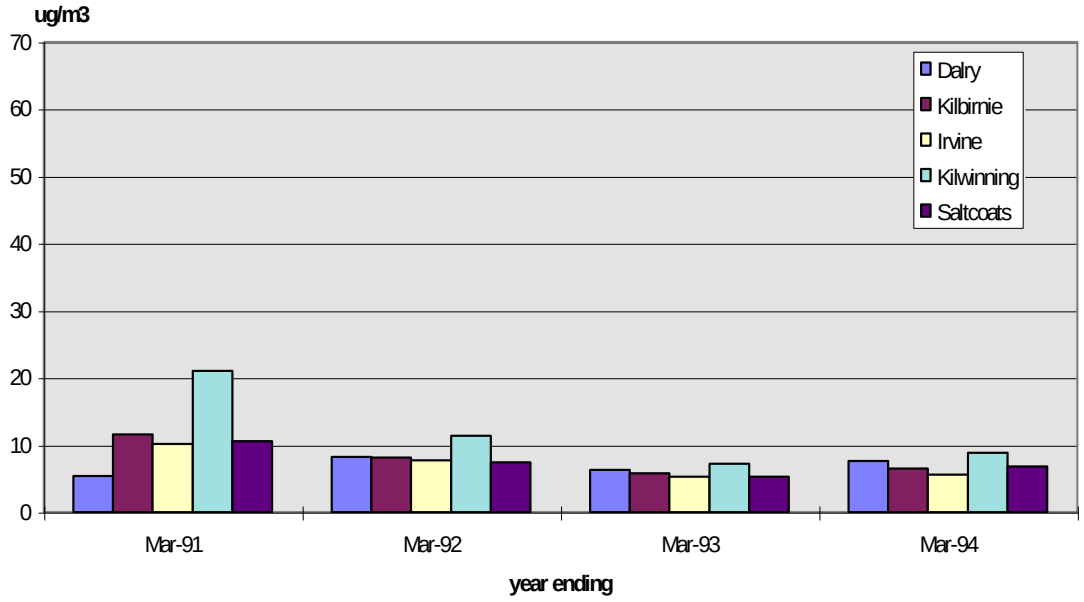


Figure 8.2 Smoke Monitoring in North Ayrshire 1991-1994 (Annual Daily Mean Smoke Values)



During the 1970s and 80s numerous of the Council's monitoring stations were part of the national survey. They were taken out of the national survey in the late eighties, however CDC continued to operate these stations independently.

The Council reviewed the results in 1993 and discovered that the Smoke Control Programme and trends in fuel use over the years meant smoke pollution from area sources was no longer a problem in North Ayrshire. Therefore the smoke stations were discontinued in 1994. Continuous SO_2 UV monitors were introduced because of concerns over short term peak incidents of SO_2 from local industrial sources.

North Ayrshire Council has not carried out any specific PM_{10} monitoring.

8.10 **Part A and Part B Authorised Processes**

The review of authorised processes using the government guidance identified 19 Part A processes at 5 sites which could be a source of PM_{10}. These are:-

Roche Products, Dalry
Caledonian Paper Plc, Irvine
Clinical Waste Ltd, Irvine
Nobel's Explosives, Stevenston
Scottish Nuclear, Hunterston

Consultation with SEPA was undertaken to determine the significance of these emissions. This consultation exercise produced the following information. Roche Products is only likely to emit small quantities of PM_{10} from gas oil during an interruption of the natural gas supply. Caledonian Paper plc emit particulate matter but mostly in the form of grit and the boiler/furnace at Scottish Nuclear, Hunterston is on stand by only and is not in regular use. The Clinical Waste Incinerator has never become operational and SEPA are in the process of revoking the authorisation.

Thus only one Part A process had the potential to emit significant quantities of PM_{10} to air and that is Nobel's Explosives, Ardeer. This process is within the large Ardeer industrial site and as such is at least 1.5 km from the nearest residential areas. The prevailing wind direction is from the north west to south west sector and therefore takes any plume towards Kilwinning/Irvine where the nearest residential area is over 2 km away.

The review also identified two Part B processes which could be a significant source of PM_{10}:

Clydeport Operations, Fairlie
High Smithstone Quarry, Kilwinning (application)

Consultation with SEPA was undertaken to determine the significance of these emissions. This consultation provided information that the Part B processes were operating satisfactorily and meeting their emission standards and thus should not result in any exceedances of the air quality standard.

Monitoring for dust deposition is carried out around the Clydeport site. However this data is not directly comparable to PM_{10} data.

8.11 **Roads in North Ayrshire**

As discussed in section 2.3 and 2.6.2 there are three traffic count sites all on the A78 trunk road in the vicinity of the Hawkhill area where the current and projected annual daily traffic flow exceeds 25,000 vehicles.

Although this road passes a modern housing estate, a primary school and a cemetery lodge they are all at least 30m from the carriageway, with the exception of the cemetery lodge which is adjacent to the footpath. The area surrounding the road is open and exposed to the prevailing winds. It is likely therefore that PM_{10} generated by the traffic will be adequately dispersed to minimise if not remove the risk of exceeding the standard at these locations.

The emissions inventory for roads in North Ayrshire indicates a maximum of 2 tonnes PM_{10} per 1x1km grid square.

The NO_2 monitoring does not indicate elevated traffic pollution levels in the vicinity of this road.

8.12 **Future developments and Neighbouring Sources**

Future developments which may be a source of PM_{10} is the proposed Ardrossan, Saltcoats and Stevenston Bypass. Figures are unavailable for daily traffic flows but are likely to exceed 25,000 vehicles. However, this trunk road project is currently subject to review as part of the Scottish Office Trunk Road Programme Review and it is highly unlikely that this project would be completed by 2005.

There are no other known planned developments within North Ayrshire which will be a significant source of PM_{10}.

There are no sources within neighbouring local authorities which could impact significantly on air quality within North Ayrshire.

8.13 Conclusions for PM_{10}

1. There are no significant industrial sources of PM_{10} either within North Ayrshire or neighbouring areas with the potential for exposure of individuals in the relevant location.

2. The estimated annual average regional background level due to secondary particulates is $<8ug/m^3$.

3. The estimated emissions from low level sources greater than 10 tonnes correspond to industrial sites. These have been shown not to be a significant source or not to be in a relevant location.

4. Part of the A78 has an annual average daily traffic flow of >25,000 vehicles however the topography and weather information means it is unlikely that there will be an exceedance of this standard.

5. There is no need to proceed to a second stage review for PM_{10}.

Chapter 9 - First Stage Review and Assessment of Sulphur Dioxide

9.1 Introduction

Sulphur Dioxide (SO_2) is formed by the combination of one atom of sulphur and two atoms of oxygen. At normal temperature and pressure it is a gas. Sulphur dioxide dissolves in water to give an acidic solution which is readily oxidised to sulphuric acid.

Natural sources of sulphur dioxide include volcanic activity and marine organisms.

In the United Kingdom the predominant source of sulphur dioxide is the combustion of sulphur containing fossil fuels, principally coal and heavy oils.

Sulphur dioxide is an irritant when it is inhaled because of its acidic nature, and high concentrations may cause breathing difficulties in people exposed to it. Recent studies have shown that people suffering from asthma may be especially susceptible to the adverse effects of sulphur dioxide and that, within the range of concentrations that occur in pollution episodes, it may provoke attacks of asthma.

9.2 Standard and Objective for Sulphur Dioxide

The Government has adopted a 15 minutes average of 100 ppb as an air quality standard for sulphur dioxide (SO_2) with an objective for the standard to be achieved as the 99.9th percentile by the end of 2005. The focus of an authority's review and assessment should be any non-occupational, near ground level, outdoor location given that exposures over 15 minutes are potentially likely in these locations.

9.3 The National Perspective

For the first half of the twentieth century, emissions of sulphur dioxide were dominated by the combustion of coal, not only in the domestic sector, but also in commercial and industrial premises, and in power stations which were situated predominantly within towns and cities. This fossil fuel burning gave rise to the smogs of the 1950s and the associated effects on health.

The occurrence of these pollution episodes led to the introduction of the first Clean Air Act in 1956. This and the subsequent moves to the increased use of energy sources such as natural gas and electricity mean that emissions in towns have fallen considerably. Power generation has become concentrated in larger, more efficient stations situated in rural areas.

As a result of the above national emissions of sulphur dioxide have decreased by 63% since 1970, and by 52% since 1980. Urban smogs like those in the 1950s are now a thing of the past and average levels of sulphur dioxide have decreased by around fivefold since the 1960s. Emissions are now dominated by fossil-fuelled power stations which currently account for 65% of the national total. Table 9.1 shows the national inventory of sources for 1996.

Table 9.1 - UK Emissions of SO_2 by Source, 1996 (%)

Source	*Percentage Contribution*
Power Stations	65
Refineries	6
Domestic	3
Commercial, public & agricultural combustion	3
Iron and steel	3
Other industrial combustion	10
Production processes	5
Road transport	2
Other transport	2
Other	1

Sulphur dioxide is currently measured nationally through a variety of monitoring networks nationally including the automatic monitoring networks, the smoke and SO_2 network, the rural SO_2 network.

These monitoring networks have indicated a UK wide decline in SO_2 concentrations over the years.

However, it is recognised that exceedances of the standard do occur in the vicinity of industrial processes for which the stack heights were designed to meet previous air quality standards and in areas where significant quantities of coal are used for space heating. Further measures than those applicable nationally may be required to achieve the air quantity objective.

In view of this local authorities subject to these types of pollution source, which have the potential to result in elevated levels of SO_2 in relevant locations are likely to need to progress to a second or third stage review and assessment for this pollutant.

9.4 Information to be considered for a First Stage Review and Assessment

For all existing and proposed activities identified by the local authority in accordance with paragraph 1.4 above the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of SO_2 and

- are expected to be in existence and/or operation by 2005 and
- for which there is potential for exposure of individuals in relevant locations.

For the purposes of a first stage review and assessment these can be assumed to consist of

- Part A industrial processes with the potential to emit SO_2.
- Part B industrial processes with the potential to emit SO_2.
- A solid fuel or fuel oil combustion system with thermal power greater than 5MW.
- A 1 km x 1 km grid square in the authority's area for which maximum low-level emissions are greater than 25 kg per hour or 40 tonnes per year.

9.5 Sulphur Dioxide Monitoring in UK

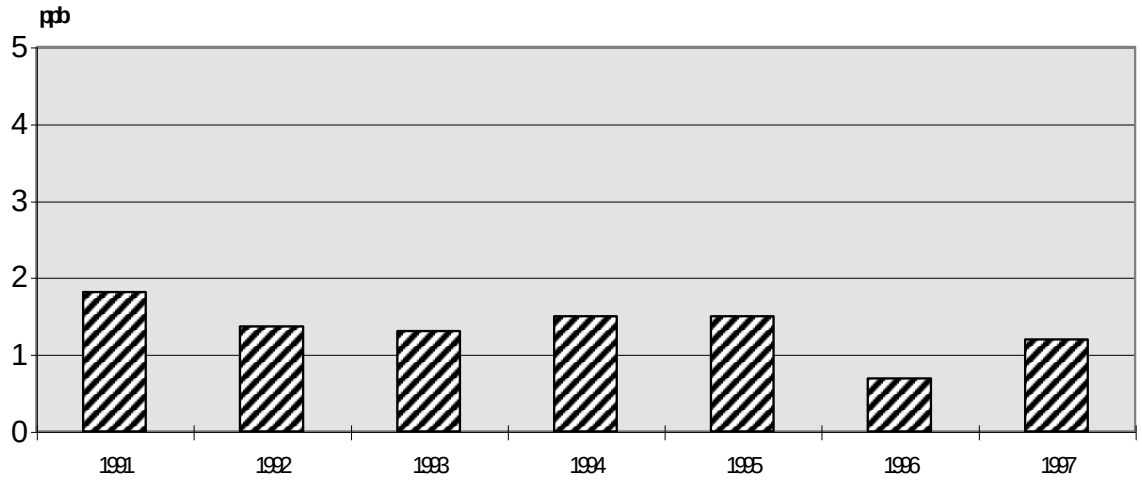
Sulphur dioxide is currently measured nationally through a variety of monitoring networks nationally including the automatic monitoring networks, the smoke and SO_2 network, the rural SO_2 network.

These monitoring networks have indicated a UK wide decline in SO_2 concentrations over the years.

9.6 Rural SO_2 Network

North Ayrshire Council are site operators for Camphill which is part of the rural SO_2 network. This site gives weekly sulphur dioxide concentrations. The results can be used to give an indication of background sulphur dioxide levels for the area. The annual averages are plotted Figure 9.1 and are consistently below 2 ppb.

Figure 9.1 Rural Sulphur Dioxide Monitoring in North Ayrshire at Camphill 1991-1997 (Annual Mean Values)



9.7 Sulphur Dioxide Monitoring in North Ayrshire

Over the years smoke and SO_2 have been monitored extensively throughout the local area. See Table 9.2.

In the 1970s the then District Council of Cunninghame (North Ayrshire's predecessor) set up pollution monitoring stations in the form of the 8 port smoke and SO_2 bubbler stations at various locations throughout the area. The results of this monitoring indicated that the Garnock Valley had the main burden of smoke pollution. Dalry was found to exceed the EEC limits, closely followed by Kilbirnie. This was due to both the topography in the area and the sources of pollution.

As a result of this monitoring the Council embarked on an extensive scheme of Smoke Control Areas during the 1980s and early 1990s. By 1996, 27,000 houses within North Ayrshire were covered by Smoke Control Orders including Dalry, Kilbirnie, Glengarnock, Ardrossan, Saltcoats, Stevenston and Kilwinning. Smoke Control Areas are outlined in Figure A8 in the Appendix.

This has been a major step forward in the reduction of pollution locally.

Table 9.2 - Summary of Monitoring for SO_2 within North Ayrshire

Site	SO2/Smoke	Bubbler Site	Continuous UV	Monitor
	Date started	Date ended	Date Started	Date Ended

Aitken St, Dalry	1977	1994	1994	Ongoing
Cunninghame House, Irvine	1977	1994	1994	Ongoing
Knox Institute, Kilbirnie	1977	1994		
Kilwinning	1977	1994		
Largs	1977	1988		
St Andrews, Saltcoats	1977	1994	1994	Ongoing
Dreghorn Primary, Dreghorn	1998	Ongoing		
Greenwood Academy, Dreghorn	1998	Ongoing		
Springside Primary, Springside	1998	Ongoing		

Monitoring continued after Smoke Control Areas were set up and significant reductions were measured. The reduction in smoke levels was the most significant with sulphur dioxide levels also reduced.

Monitoring results for various sites are represented graphically in figures 9.2 to 9.8.

Figure 9.2 Sulphur Dioxide Monitoring in North Ayrshire 1978-1982 (Annual Maximum Daily SO_2 Values)

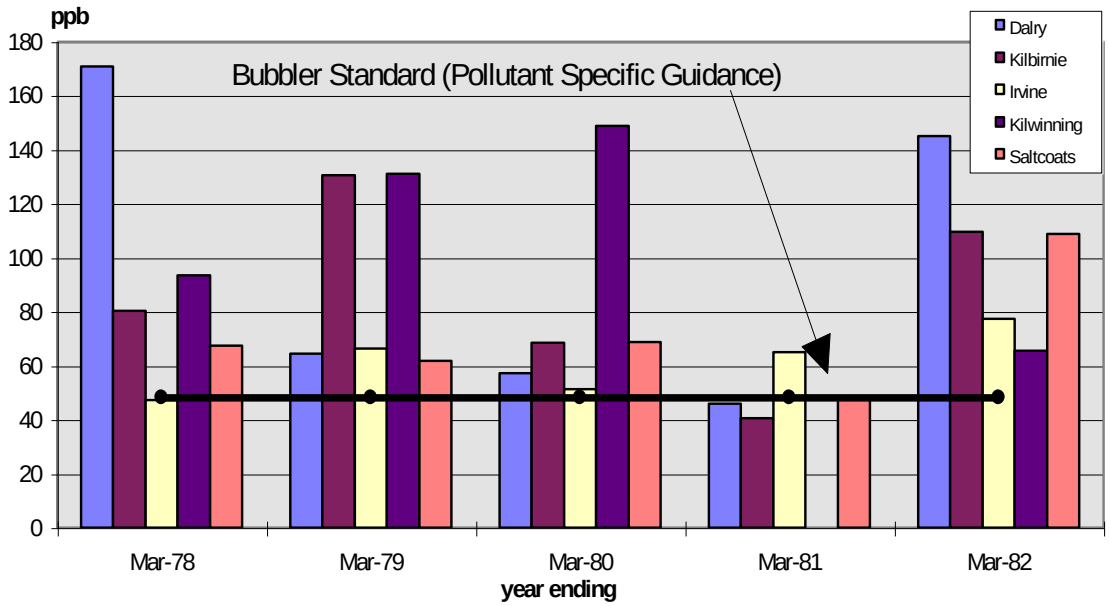
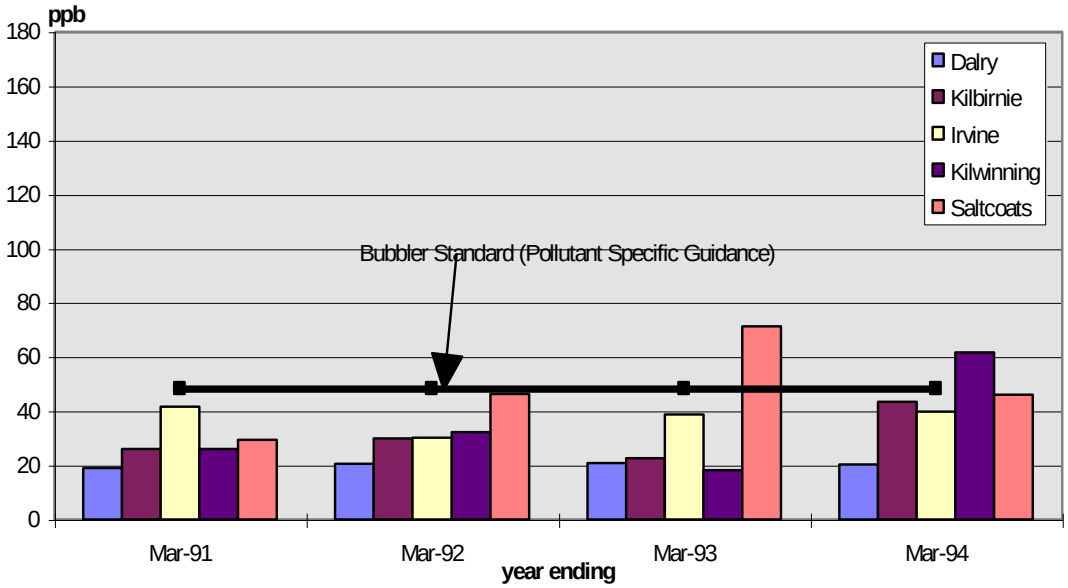


Figure 9.3 Sulphur Dioxide Monitoring in North Ayrshire 1991-1994(Annual Maximum Daily SO_2 Values)



During the 70s and 80s numerous of the Council's monitoring stations were part of the national survey of smoke and sulphur dioxide. These were taken out of the national network in the late eighties however Cunninghame District Council continued to operate these stations independently.

In 1993 a review indicated that due to the smoke control programme and trends in fuel use over the years, smoke pollution from area sources was no longer a problem in North Ayrshire. However the monitors continued to detect some short duration high levels of SO_2. It was thought that these were from industrial sources but the information from the SO_2 smoke station was not sufficiently detailed to confirm the source of these pollutants. The equipment was therefore upgraded and in April 1994 three continuous UV SO_2 analysers were set up within Irvine, Dalry and Saltcoats.

This new monitoring equipment is the same as that used by the Department of the Environment in the UK Automatic Monitoring Network. Compared to the 8 port bubbler it is more sensitive, measures SO_2 over shorter time intervals and along with the wind direction data, measured at the Irvine site, can provide more accurate information on possible sources. The sites were chosen to reflect possible industrial sources of sulphur dioxide.

These monitors provide very useful information on local sulphur dioxide levels and measure at 15 minute intervals which is therefore directly comparable to the UK standard.

The results for 1996 and 1997 have been analysed in detail in the annual reports available from Environmental Health and will therefore be summarised within this report.

Figure 9.4 Sulphur Dioxide Monitoring in North Ayrshire 1996-1997 (Annual Mean Values)

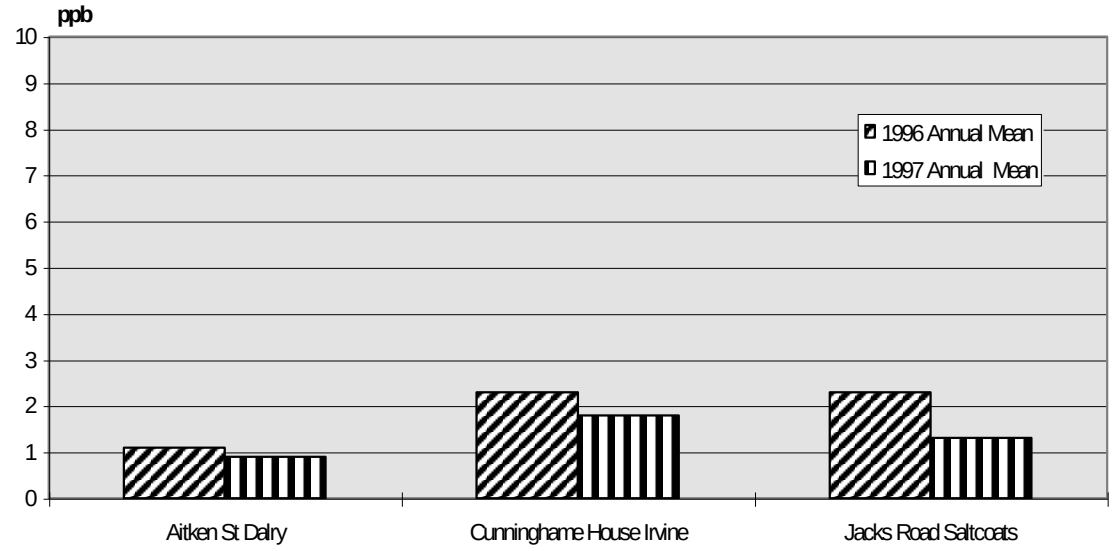
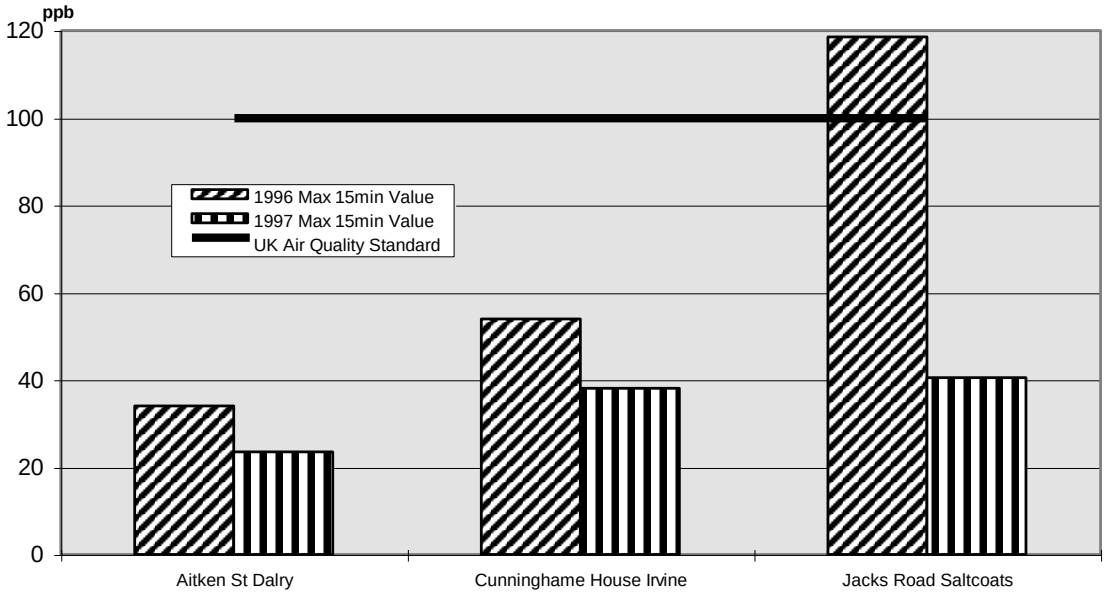


Figure 9.5 Sulphur Dioxide Monitoring in North Ayrshire 1996-1997 (Maximum 15 minute values)



In 1996 and 1997 the three sites complied with the air quality objective (there was only one 15 minute exceedance at one site) and indications are that they will again in 1998.

Levels of SO_2 within the areas are generally very low and the annual mean results reflect this. These are occasional episodes of elevated SO_2 concentrations which the wind direction data allows investigation the identification of possible sources.

Such events include in 1996 an elevated level at Saltcoats when the Air Quality Standard was breached for one 15 minute period. This incident was investigated and it was concluded that the incident of elevated SO_2 was due to raised emissions from the boiler house at St Andrews Academy caused by a malfunction in the modulator unit.

Another event in 1998 occurred at the Irvine site where levels were raised for a prolonged period but the Air Quality Standard was not breached. This was investigated in conjunction with SEPA

and the source was identified as a nearby Part B process which was undergoing work to the stack and was operating temporarily under "unusual combustion conditions".

The results indicate that the air quality standard is currently being complied with and that the objective will be met.

North Ayrshire Council have also recently set up 3 bubbler sites in the villages of Dreghorn and Springside. The results for the first six months are shown in figures 9.6 - 9.8

Figure 9.6 Sulphur Dioxide Monitoring in Springside May-October 1998 (Daily Mean Values)

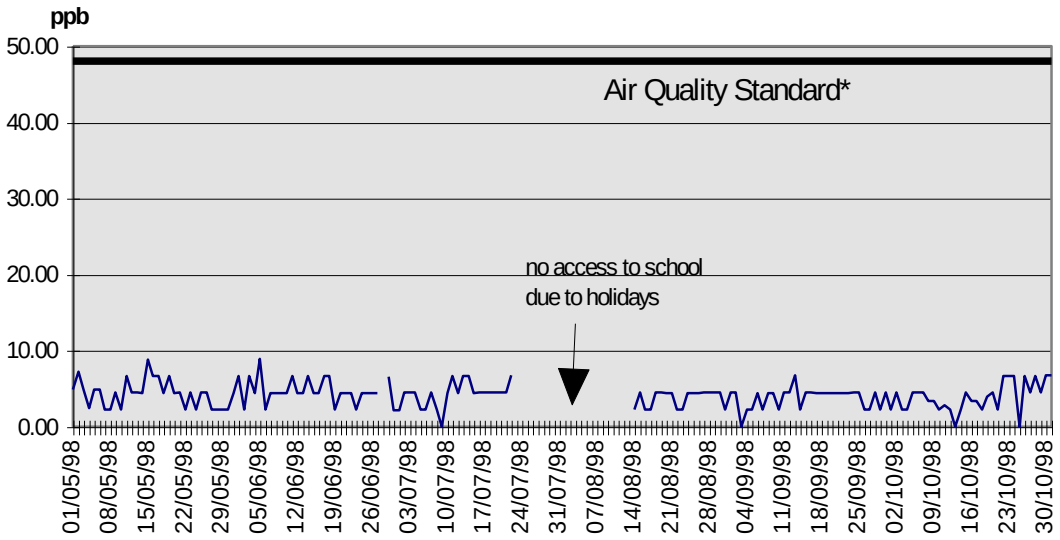


Figure 9.7 Sulphur Dioxide Monitoring at Greenwood Academy May-October 1998 (Daily Mean Values)

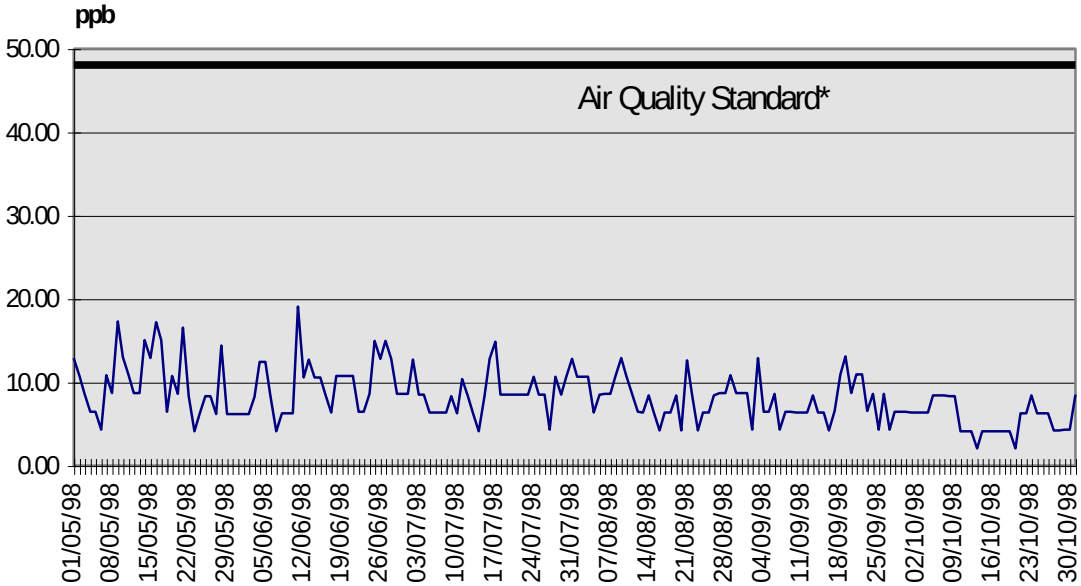
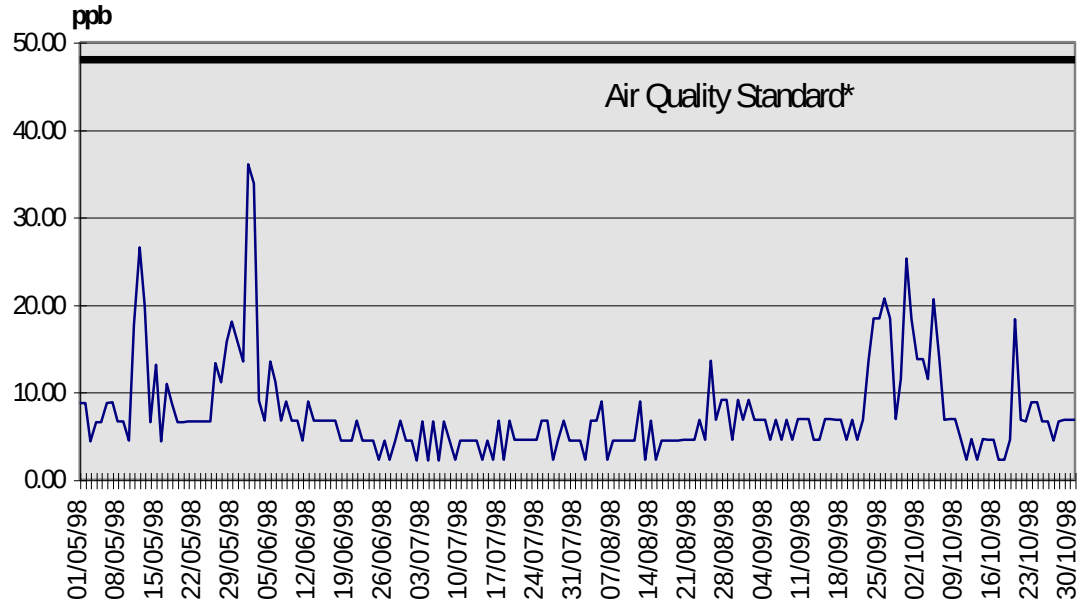


Figure 9.8 Sulphur Dioxide Monitoring at Dreghorn Primary May-October 1998 (Daily Mean Values)



*****Standard for Bubblers as set in Pollutant Specific Guidance

Historical or existing monitoring data is available for nearly every town in the area and there is no indication from these results that the air quality standard is likely to be breached even around local industrial sources.

9.8 Part A and Part B Authorised Processes

The review of authorised processes in accordance with the guidance identified 15 Part A processes at 5 sites which had the potential to emit significant quantities of SO_2.

Roche Products Ltd, Dalry
Caledonian Paper Plc, Irvine
Clinical Waste Ltd, Irvine
SmithKline Beecham, Irvine
Nobel's Explosives, Stevenston

Consultation with SEPA was undertaken to determine the significance of these sources. This consultation exercise produced the following information. Roche would only emit small quantities of SO_2 from gas oil firing during interruption of natural gas supply and at Caledonian Paper the quantity of SO_2 emitted would depend upon the fuel mix.

The Clinical Waste Incinerator has never become operational and SEPA are in the process of revoking the authorisation.

There are therefore three potential Part A sources - Caledonian Paper, Smithkline Beecham and Nobel's Explosives Stevenston. However, the monitoring of SO_2 both historically and currently throughout the area have indicated that industrial sources are unlikely to cause an exceedance of the standard.

The review of authorised processes identified two Part B processes which could be a potential significant source of SO_2:

Rockware Glass, Irvine - Glass Manufacturer
Johnstone Castings, Dalry - Non-ferrous metal process

Consultation with SEPA indicated that Part B processes are complying with their authorisation and emission limits and it is unlikely that they would cause an exceedance of the air quality standard.

The monitoring of SO_2, both historically and currently, throughout the area have indicated that industrial sources are unlikely to cause an exceedance of the standard.

9.9 Combustion Sources greater than 5MW

In order to identify combustion systems >5MW which use solid fuel or fuel oil the following work was undertaken:-

- Consultation with SEPA.
- Consultation with other Council Departments (property owning departments).
- Consultation with Health Board.
- Check of historical chimney height applications.

This information search provided the following information:-

- There are no Council properties which have combustion systems with a thermal power rating >5MW. However there are a significant number of primary and secondary schools which have coal fired plant - 26 in total. There is a planned programme of boiler replacement however a lack of funding has delayed this programme.
- There are no Health Board properties which have combustion systems >5MW.
- SEPA were unaware of any processes.
- Chimney height applications identified at Hunterston A and B and ICI. These applications were for boilers >5MW.

The boilers at Hunterston are auxiliary boilers and are only used as back up if required and are thus not in regular use.

At ICI enquiries identified that the main boilers in use are subject to authorisation and the smaller boilers are stand alone units which have been shut down for over 4 years due to the winding down of the Ardeer site.

9.10 Future Developments and Neighbouring Sources

There are no known planned developments within North Ayrshire which will be a significant source of SO_2.

There are no sources within neighbouring local authorities which could impact significantly on air quality within North Ayrshire.

9.11 Conclusions

1. The extensive smoke control programme undertaken by Cunninghame District Council has improved sulphur dioxide levels in the area.
2. The extensive historical and existing monitoring programme for SO_2 in North Ayrshire has covered every urban area and results indicate the air quality standard is currently being met.
3. There is no need to progress to a second stage review and assessment for sulphur dioxide.

CHAPTER 10 - CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions for Benzene

1. There is no significant industrial source of benzene located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. Monitoring has indicated that roadside levels of benzene within North Ayrshire are likely to comply with the standard.

3. There is no need to proceed to a second stage review for benzene.

10.2 Conclusions for 1,3-Butadiene

1. There is no significant industrial source of 1,3-Butadiene located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review and assessment for 1,3-Butadiene.

10.3 Conclusions for Carbon Monoxide

1. There is no significant carbon monoxide source, industrial or road transport, located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review for carbon monoxide.

10.4 Conclusions for Lead

1. There is no significant industrial source of lead located either within North Ayrshire or neighbouring areas which is likely to adversely affect air quality in North Ayrshire.

2. There is no need to proceed to a second stage review and assessment for lead.

10.5 Conclusions for Nitrogen Dioxide

1. There are two Part A processes Smithkline Beecham and Caledonian Paper Mill in close proximity in the south east of Irvine. It is not known what their collective effect on local air quality is as there is no monitoring data for this area. These two potentially significant sources and their ability to act in conjunction to affect air quality require further investigation and thus requires a Stage Two review and assessment.

2. Although there are roads which are likely to exceed 20,000 as an annual daily traffic flow by 2005 monitoring data for the area indicates that the annual air quality standard is being complied with.

3. There are no monitoring sites where the annual average level of NO_2 in 1996 was greater than the 30ppb trigger value for progressing beyond a first stage review and assessment.

4. Although the elevated levels of NO_2 at Irvine Cross are of concern they do not breach the 30ppb trigger value and therefore there is no need to proceed to a stage two review and assessment for their investigation. However the area will continue to be subject to detailed monitoring and the results of the new continuous mobile monitor will give a more accurate understanding of the levels in the area.

5. North Ayrshire Council will require to progress to a second stage review and assessment to investigate further the nitrogen dioxide levels generated by the two Part A processes Smithkline Beecham and Caledonian Paper Plc in Irvine.

10.6 Conclusions for PM_{10}

1. There is no significant industrial source of PM_{10} either within North Ayrshire or neighbouring areas with the potential for exposure of individuals in the relevant location.

2. The estimated annual average regional background level due to secondary particulates is $<8ug/m^3$.

3. The estimated emissions from low level sources greater than 10 tonnes correspond to industrial sites. These have been shown not to be a significant source or not to be in a relevant location.

4. Part of the A78 has an annual average daily traffic flow of >25,000 vehicles however the topography and weather information means it is unlikely that there will be an exceedance of this standard.

5. There is no need to proceed to a second stage review for PM_{10}.

10.7 Conclusions for SO_2

1. The extensive smoke control programme undertaken by Cunninghame District Council has improved sulphur dioxide levels in the area.

2. The extensive historical and existing monitoring programme for SO_2 in North Ayrshire has covered every urban area and results indicate the air quality standard is currently being met.

3. There is no need to progress to a second stage review and assessment for sulphur dioxide.

10.8 Conclusion for North Ayrshire's First Stage Review and Assessment

In North Ayrshire, the first stage review and assessment has found that the air quality objectives for 6 of the 7 specified parameters namely benzene, 1,3-butadiene, carbon monoxide, lead, PM10 and sulphur dioxide are all likely to be achieved by 2005. However, there is insufficient information at this stage to conclude that the nitrogen dioxide standard will be achieved in the vicinity of local industrial sources and therefore North Ayrshire will require to progress to a second stage review and assessment for nitrogen dioxide.

10.9 Recommendations

1. It is recommended that a second stage review and assessment be undertaken for nitrogen dioxide.

2. It is recommended that the current air quality monitoring work in North Ayrshire be continued. This will provide data to indicate compliance with the objectives and will be useful in the next review and assessment to be undertaken before 2005.