City of Edinburgh Council

Updating And Screening Assessment
Local Air Quality Management Phase 2

July 2003

Contents

Executive Summary

This report is the Updating and Screening Assessment (U&SA) of air quality in Edinburgh.The U&SA is the first stage of the second phase (Round 2) of the Review and Assessment process relating to Local Air Quality Management (LAQM). The report has been undertaken following government guidance laid out in the document, Technical Guidance (LAQM) TG (03). The key elements contained in this report focus on:

- the assessment of both new and existing monitoring data with respect to the new air quality objectives and EU limit values for nitrogen dioxide

- significant changes which have occurred in the city since the completion of Round 1, including additional sources and locations which were not previously considered

Where the U&SA has identified that there may be a risk of an exceedence of an air quality objective at a location with relevant public exposure, then a Detailed Assessment is required. This will entail further work, by a local authority to determine if an exceedence will definitely occur. The conclusions from a Detailed Assessment will enable a local authority to decide whether or not an Air Quality Management Area (AQMA) is required and if an existing AQMA should be revoked or amended.

The findings of the U&SA are that the pollutants, 1,3-butadiene, benzene, lead, carbon monoxide and sulphur dioxide will meet with the air quality objectives and therefore no further assessment is needed. However, a Detailed Assessment for Particles (PM_{10}) is required and additional traffic related nitrogen dioxide work is considered to be necessary with a view to extending the existing AQMA to St Johns Road Corstorphine.

1.0 Introduction

The foundations for the regime of Local Air Quality Management (LAQM) are embodied in the Environment Act 1995. The Act requires all local authorities to periodically review and assess the current and predict the future quality of air in their areas against air quality objectives which have been prescribed in regulations.Under LAQM a local authority must assess the following pollutants:

1,3-butadiene	Sulphur dioxide
Benzene	Nitrogen dioxide
Carbon monoxide	Particles PM_{10}
Lead	

The air quality objectives are derived from air quality standards, based on medical and scientific knowledge of the effect of the pollutants on health. Standards, as defined by the Expert Panel on Air Quality Standards (EPAQS) are concentrations below which there is not likely to be a significant risk to health. The concentration of a pollutant together with the target date for compliance is known as an objective. Target dates have been set to take account of the costs and the practicability of attaining the air quality standard.

The European EU limit values are derived from World Health Organisation (WHO) guidelines. It is important to note that the objectives for nitrogen dioxide are based on EU limit values and are not health-related standards.

If an air quality objective is not likely to be achieved at a relevant location, the local authority must declare an Air Quality Management Area (AQMA) and produce a written Action Plan. The Action Plan should set out measures, which aim to address the level of air quality improvement that is required.

Although air quality improvements can be accomplished locally, pollutant sources may be difficult to regulate at a local level, due to the transboundary nature of many of the pollutants. Therefore, the Act does not place an absolute obligation on local authorities to meet the prescribed air quality targets, only to ‘act in the pursuit of achieving’ them.

The first phase (Round 1) of LAQM has been completed by the City of Edinburgh Council, and concluded that all pollutants would meet the air quality objectives, apart from the annual average standard for nitrogen dioxide. Round 1 of LAQM resulted in the declaration of an Air Quality Management Area (AQMA) for traffic-related nitrogen dioxide and the subsequent development of an Action Plan. Details of the Council’s air quality reviews and assessments are contained in the following reports:

Review and Assessment of Air Quality in the City of Edinburgh Stage1 and 2	(1999)
City of Edinburgh Council Review and Assessment of Air Quality Stage 3	(2000)
City of Edinburgh Council Review and Assessment of Air Quality Stage 4	(2002)
City of Edinburgh Council Action Plan Draft	(2002)

Edinburgh’s Action Plan is currently a draft document; the final document will be completed by July 2003.

Stage 3 and 4 and the draft Action Plan documents are on the Council's web page:

www.edinburgh.gov.uk/airquality

This report is known as the 'Updating and Screening Assessment' (U&SA), and is the starting block for the second phase (Round 2) of LAQM. It aims to address any significant changes which have occurred within the city since Round 1, which may require further assessment i.e., new industrial processes, new roads, issues which were previously considered not to be a problem, but identified as requiring to be revisited following the outcome of Round 1. Local authorities must also consider any amendments which have been made to the air quality objectives. This is particularly pertinent to Scotland, which has adopted new air quality objectives. Therefore, as well as considering the prescribed air quality objectives in the Air Quality (Scotland) Regulations 2000 Scottish Local Authorities must also carry out the screening assessments with regard to the new air quality objectives for benzene, carbon monoxide and particles contained, in the Air Quality (Scotland) Amendment Regulations 2002.

Should any of the pollutants be identified as not being likely to meet the air quality objectives, then the local authority is required to progress to a 'Detailed Assessment'of that pollutant. The Detailed Assessment involves undertaking a more robust approach. It aims to provide assurance that an exceedence will definitely occur. The conclusions from a detailed assessment will enable a local authority to decide whether or not AQMAs are necessary and if existing AQMAs should be revoked or amended.

2 Methodology and approach to 'Updating and Screening Assessments'

Local authorities are advised to complete the Updating and Screening Assessment, with regard to the new Technical Guidance document LAQM TG (03) issued by the Department for Environment, Food and Rural Affairs (DEFRA), the Scottish Executive and the Welsh Assembly under section 88(1) of the Environment Act 1995. This document replaces the guidance documents LAQM TG4 (98) and TG4 (00) which were used for earlier assessment work and has been revised to take account of new developments, research studies and the knowledge gained from Round 1 of LAQM. It contains a series of checklists for each of the pollutants, their likely sources and conditions which are likely to lead to a detailed assessment being carried out. Various factors and nomograms have been included to project the concentrations of pollutants to future years. Local authorities are also advised to consult with government help desks and use information and basic modelling tools which are available on the government's air quality website (www.airquality.co.uk). Estimated annual mean background concentrations for a number of pollutants have been mapped for all areas in the UK for 2001 and for future years.

The updating and screening assessments are not intended to be onerous! Local authorities are required to build upon their previous knowledge from Round 1; review their data with respect to new objectives and emission factors, take account of areas where there has been significant changes which are likely to result in the breach of the objectives and draw on the general UK wide picture regarding monitoring data collected from the DEFRA UK Automatic Urban and Rural Network sites. Local authorities must also consider any future polices which are likely to bring substantial benefits to air quality.

Local authorities are required to focus their reviews and assessments at locations where there is likely to be relevant public exposure. Thus, if there is no relevant public exposure than there is no requirement to progress any further. The guidance in TG (03) refers to public exposure for both short-term and long-term objectives. Short-term objectives, such as a 15-minute standard require to be assessed at locations where members of the public are likely to be exposed for a single 15-minute period and are regularly present at that location. Long-term objectives such as annual averages and 24-hour objectives would apply at locations where people are likely to be regularly present for longer periods. This does not require the person to be present for a full year, in the case of an annual mean it might be where people are exposed for a cumulative period of 6 months in a year. Or for pollutants with 24-hour objectives, this might be where the public are exposed for 8 hours or more in a day. It is generally accepted that the pollution measured at the building façade will be similar to the concentration inside the building. Thus for exposure along a busy road it is considered to be appropriate to measure at the building façade of residential properties closest to the road to assess exposure for pollutants with 24- hour and annual mean objectives.

Real-time air quality monitoring stations in Edinburgh are in line with the facades of residential tenement property on busy roads. They are classified as roadside locations. The majority of passive diffusion tube locations are at the kerbside adjacent to residential property and values obtained are corrected to provide the equivalent concentration at the building façades. The DEFRA urban network monitoring site, classed as an urban centre has until recently being located in Princes Street Gardens

which is a recreational area used by the general public. The monitoring unit was relocated to the roadside on Princes Street 2002 in order to facilitate refurbishment of the National Art Gallery. All monitoring locations are shown in Appendix Map 2.

For traffic associated pollution local authorities are required to assess certain categories of roads termed ‘very busy’. The definition of ‘very busy’ is a road where the Annual Average Daily Traffic (AADT) flow exceeds:
80,000 vehicles per day (single carriageway)
120,000 vehicles per day (dual carriageway)
140,000 vehicles per day (motorways)

In addition, local authorities require to have regard to street canyons and busy junctions where there are a large percentage of buses and heavy goods vehicles (HGVs).

According to LAQM TG (03) there is evidence to suggest that there will be no breach of the nitrogen dioxide nor particle (PM_{10}) air quality objectives with respect to diesel or coal-fired locomotives and shipping. Therefore, there is no requirement to undertake an assessment of either emission source.

3 Review and assessment of 1,3 – butadiene

Air quality objective:

Maximum running annual mean concentration of 2.25 μg/m^3 to be achieved by the end of 2003

National perspective

All urban background, centre and roadside locations where monitoring is undertaken are well below the objective of 2.25 μg/m^3. It is expected that only those local authorities in the vicinity of major industrial processes which handle, store or emit this pollutant are expected to proceed to a detailed assessment.

No AQMAs have been declared for 1,3 – butadiene from the first round of reviews and assessments.

Edinburgh's perspective

Round 1 of LAQM did not identify this pollutant as being likely to exceed the objective. There are no current industrial processes in Edinburgh which emit 1,3-butadiene.

Monitoring Data

Monitoring data collected from the Hydrocarbon National Network (urban background site) located at Edinburgh Medical School , Middle Meadow Walk is shown below:

Year	1999	2000	2001
Maximum running annual mean concentration μg/m^3	0.21	0.19	0.20

Annual mean estimated background concentrations for Edinburgh obtained from the UK Air Pollution Map for 2003:

Annual mean background for 2003 range = 0.1μg/m^3 – 0.2 μg/m^3

Measured and estimated background data is well below the air quality objective.

Conclusion
There is no requirement to proceed to a detailed assessment for this pollutant.

4 Review and Assessment of Benzene

Air Quality Objectives:

Running annual mean concentration of 16.25 μg/m^3 to be achieved by the end of 2003

Running annual mean concentration of 3.25 μg/m^3 to be achieved by the end of 2010 (SCOTLAND ONLY)

EU Directive limit value:

An annual mean of 5 μg/m^3 to be achieved by 1 January 2010

National perspective

The main sources of benzene emissions in the UK are from petrol-engined vehicles, petrol refining installations and petrol storage depots. Since 1 January 2000, EU legislation has required the amount of benzene in petrol to be below 1%. The current concentration of benzene content is about 0.7% by volume for fuel sold in the UK.

There have been no AQMAs declared from the first round of reviews and assessments based on the 2003 air quality objective. However, data which has been gathered from the first round of reviews and assessments indicates that there are current exceedences of the 2010 objectives at locations in close proximity to petrochemical processes and 'very busy' roads.

Local authorities have been advised to consider roads where the AADT flows exceed the criteria of 'very busy', industrial sources, major fuel storage depots and petrol stations where there is relevant public exposure. All existing data requires to be reviewed with respect to the new objective.

Edinburgh's perspective

The Stage1and 2 Air Quality Review and Assessment report identified that Edinburgh would meet with the 2003 objective for benzene.

Monitoring data

The sites shown in Table 4.1 are all roadside locations (within 5 metres of a busy road). The values for 1997/8 have been projected to years 2003 and 2010 using the estimated correction factors for measured roadside data in Box 3.4 LAQM TG (03). The values have not been corrected to provide long term averages from the short period studies, as the measured concentrations are well below the objective.

Table 4.1

Location	Monitoring period	Value 1997/8	2003	2010	Data capture
Queen Street	07.06.97 - 08.08.97	4.87	1.53	1.13	98.1 %
Queen Street	20.02.98 - 27.05.98	4.22	1.32	0.98	99.8 %
Haymarket Terr	08.02.97 - 25.03.97	2.08	0.65	0.48	75.0 %
Stevenson Rd	10.10.97 - 08.05.98	5.85	1.84	1.36	97.4 %

Factors for years 1997 and 1998 are not documented in Box 3.4 therefore the factor for 1999 was used to project to years 2003 and 2010. Advise from the monitoring help desk considered that this method was appropriate.

Projection of measured roadside data to future years:
Example :
Measured data for 1997/98 = 4.87μg/m^3

Projection to 2003 : 4.87 x 0.871 / 2.767 = 1.53 μg/m^3

Projection to 2010 : 4.87 x 0.647 / 2.767 = 1.13 μg/m^3

Monitoring data obtained from the Hydrocarbon National Network (urban background site) located at Edinburgh Medical School Middle Meadow Walk is shown below:

Year	1999	2000	2001
Maximum running annual mean concentration μg/m^3	1.98	1.72	1.38

The projected background value for 2010 is based on 2001 measured data using the estimated correction factors for background maps or monitoring data in Box 3.3 LAQM TG (03)

Projection of measured background data to 2010
Example :
Measured data 2001 = 1.38 μg/m^3

Projection to 2010 : 1.38 x 0.65 / 1.000 = 0.897 μg/m^3

Annual mean estimated background benzene concentrations for Edinburgh obtained from the UK Air Pollution Map year 2010:

City centre area 0.5 - 0.8 μg/m^3
Outer areas 0.3 - 0.5 μg/m^3
below 0.3 μg/m^3

All projected concentrations calculated from measured data and the estimated background data are well below the new objective.

Road Traffic

Screening for busy roads:

DEFRA assessments for the 2010 objective for benzene suggest that there may be a few locations close to very busy roads in areas with high background concentrations, that may be at risk of exceeding the objective. Local authorities need only undertake a screening assessment where the 2010 annual mean background concentration exceeds 2.0 $\mu g/m^3$ and the 2010 AADT flow exceeds 80,000 vehicles per day (single carriageway) 120,000 (dual carriageway) or 140,000 vehicles per day (motorways)

In Edinburgh, the road that carries the greatest volume of traffic is the A0720 City By Pass, which is a dual carriageway with an AADT flow of 64,605 vehicles. Therefore there are no roads in Edinburgh, which fall within the above 'very busy' criteria. Traffic flows are contained in appendix 3.
The background levels projected for 2010 are less than 2 $\mu g/m^3$ for Edinburgh.

Therefore from the modelled background projections and measured data it is considered that there will not be any exceedence of this air quality objective attributed to road traffic.

Industrial Sources
There are no industrial processes which emit benzene.

Petrol Stations
The impact of benzene emissions from petrol stations has been investigated by DEFRA The study concluded that the presence of a petrol station is unlikely to have a significant influence on the concentrations of benzene close to residential properties where petrol throughput is less than 2,000,000 litres per annum and petrol distribution pumps are more than 10m from residential property, either horizontally or vertically.

For this assessment local authorities have been advised to consider petrol stations which are close to busy roads (in excess of 30,000 vehicles), have a throughput of petrol in excess of 2,000,000 litres per annum and the distance from the pumps to the closest relevant receptor.

There are forty-eight petrol stations within Edinburgh, which have Stage1vapour recovery systems installed and therefore are likely to have a petrol throughput in excess of 1,000,000 litres per annum. Each one was visited and assessed to determine if there was relevant exposure within 10 metres of the pumps. Distances were measured from the pumps to the closest residential building façade using the Geographic Information System (GIS), Arcview. The manager on site provided details of petrol throughput. Where possible road traffic counts were obtained.

The petrol station assessment for Edinburgh is summarised in Table 4.2

Table 4.2 Assessment of petrol stations regarding their impact on atmospheric concentrations of benzene.

Site	Address	Distance to closest relevant receptor metres	Throughput of petrol litres x10^6	Traffic volume 24 AADT
Canonmills (Esso)	23 Canonmills	16	5.8	17076
Parkgrove (Shell)	527 Queensferry Rd	47	2.8	42469
Craigleith (Shell)	135-139 Craigleith Rd	30	1.2	<30000*
Sainsburys	185 Craigleith Rd Retail park	92	8.4	<30000*
Safeway Stores	791 Ferry Rd	57	7.4	19000
Circle (Shell)	143 Crewe Rd South	30	2.7	< 20000*
Windmill (Esso)	102 Queensferry Rd	33	3.5	42469
Ferry Rd (BP)	77 Ferry Rd	16	2.04	19000
Bonnington fuels	14 Ashley Pl	50	Diesel only	
Leith (Shell)	7 Seafield Rd	77	4.6	24039
Leith Wlk	35-40 Haddington Pl	14	1.98	26091
Abbeymount	11-23 Montrose Terr	18	2.03	<20000*
Steven Turner	126 Restalrig Rd	20	0.30	<20000*
Safeway Stores	4 Piersfield Terr	21	4.8	18184
Braefoot (Tesco)	226 Willowbrae Rd	28	3.7	20119
Kennett (Shell)	2- 40 Ratcliffe Terr	20	3.9	<20000*
BP Links	21- 23 Barclay Pl	12.7	2.34	16726
Braidburn	166 Comiston Rd	55	4.7	14554
Star (Texaco)	187 Slateford Rd	38	2.39	23654
Stenhouse (Shell)	1 Stenhouse Rd	23	3.68	27010
Dalry (Shell)	209 Dalry Rd	25	2.21	<30000*
Napier (BP)	382 Calder Rd	27	3.01	36280
Westfield	27 Westfield Rd	70	1.04	<30000*
Drum Brae	30 Drum Brae South	25	2.9	20860
Bowmac (Shell)	21 Glasgow Rd	31	5.7	46968
Safeway Stores	47 Gyle Avenue	259	8.4	>30000*
Maybury (Shell)	166 Glasgow Rd	78	3.6	46968
Roseburn	8 Kew Terr	15	2.4	16928
Tesco Stores	Meadow Pl Rd	43	8.8	<30000*
Dreghorn	50 Dreghorn Link	97	5.0	53860
Firrhill	Colinton Mains Dr	60	5.9	<30000*
Tesco Stores	14- 32 Colinton Mains Dr	20	8.3	<30000*
Rosebank	57 Lanark Rd West	14.6	3.28	16562
Wester Hailes	50 Murrayburn Rd	96	2.0	<30000*
Thimblehall	23 Lanark Rd	27	2.5	17000
Asda	100 Jewel	130	7.8	>30000*
Claymore (Jet)	5-15 Portobello High St	40	2.5	<30000*
Safeway Stores	406 Gilmerton Rd	50	4.96	12982

* No traffic data available therefore flows determined from local knowledge.

Site	Address	Distance to closest relevant receptor metres	Throughput of petrol litres x 10^6	Traffic volume 24 AADT
Savacentre	Cameron Toll Lady Rd	80	5.9	<30000*
Liberton (Shell)	31Liberton Rd	30	2.28	<30000*
Jet Liberton	105 Liberton Gdns	20	2.6	<30000*
Little France	211 Old Dalkeith Rd	20	3.0	15575
Ingliston (BP)	Glasgow Rd	56	4.0	46968
Cliftonhall	1 Clifton Hall Rd	174	2.33	>30000*
Western (Shell)	51Bridge St	56	2.03	<30000*
Forth Rd (Shell)	1 Ferrymuir Gait	41	5.0	>30000*
Leith STS service	Leith Terminal Imperial Dock	>300	>5.0	Site vehicles
National Rental	39 Roseburn St	51	0.18	<!5000

The residential properties, shown in the above table are more than 10m away from the petrol pumps; therefore there is not any relevant exposure. The majority of sites which have the higher throughputs of petrol are located in supermarket forecourts which are situated a greater distance away from residential property. The petrol stations which are located close to residential properties, i.e. between 12.7 and 16 metres are on roads which either have low traffic flows or less than 2.0 x 10^6 petrol throughput.
Therefore, petrol station forecourts are not considered to present a risk with regard to exceeding the air quality objective at relevant locations.

Major fuel storage depots

BP Exploration monitors the impact on the local community of the activities at Dalmeny (Crude Oil Storage Tanks) and Hound Point (Storage and filling facility crude oil). Twelve locations between Edinburgh and West Wemyss on both shores of the forth have been monitored for many years for a number of hydrocarbon species, including benzene. The UKAS accredited National Physical Laboratory undertakes the monitoring and reporting of all results[1]. The locations which are monitored in Edinburgh are:

1 Carlowirie Crescent Dalmeny adjacent to the fuel tanks
2 Whitehouse Park South Queensferry
3 Carmolite Road South Queensferry

All monitoring points are selected to provide the worse case scenario relating to public exposure. Data collected from 1998/99 to 2002 is shown in table 4.3 below:

Table 4.3

Location	Annual average Benzene µg/m^3 Monitoring method Perkin and Elmer difusion tubes			
	1998 / 99	1999 / 00	2000 / 01	2001 / 02
Carlowirie Crescent	1.62	0.98	0.98	0.65
Whitehouse Park	2.28	1.63	1.63	0.98
Carmolite Road	1.95	0.98	1.30	0.98

1 Ambient atmospheric survey for hydrocarbons in the vicinity of Hound Point (Test Report for BP Oil Ltd) Reference 102267. Compiled by the National Physical Laboratory.

The data demonstrates that the crude oil storage facilities do not present a problem in terms of exceeding the 2010 benzene objective.

Conclusion

There is no requirement to proceed to a detailed assessment for benzene.

5 Review and assesssment of carbon monoxide

Air quality objective:

Maximum daily running mean 8- hour mean concentration of 10 mg/m^3 by the end of 2003

National perspective

The main source of carbon monoxide in the UK is road transport. It is considered that existing policies will be sufficient to deliver the air quality objective in the set time scale. Levels which have been recorded at the UK National Network sites show no exceedences.
No AQMAs have been declared for carbon monoxide from the first round of reviews and assessments. Local authorities have been advised to review monitoring data and revisit areas which have roads where the AADT flows exceed the criteria of being 'very busy ' for this assessment.

Edinburgh's perspective

Stage 1 and 2 identified that carbon monoxide would meet with the air quality objective detailed in the initial Air Quality Regulations 1997.
The air quality objective for carbon monoxide has tightened since round 1 of LAQM, from a concentration of 11.6 μg/m^3 to 10 μg/m^3. Therefore existing data has been compared with the new objective.

Monitoring data:

Real-time monitoring data is shown in tables 5.1 and 5.2

Table 5.1

Location	**Discription**	**Maximum daily running 8–hour mean concentration mg/m^3 (monitoring period 1year)**			
		1999	2000	2001	2002
Princes St Gardens National network	Urban Centre	1.7	2.4	5.5	2.2*

* Data capture of hourly means 82.2%
Relocation of site closer to roadside

Table 5.2

Location	**Discription**	**Maximum daily running 8-hour mean concentration mg/m^3**	
		Max value for 1997	Monitoring period
Haymarket Terr	Roadside	1.8	08.02.97 - 25.03.97
Queen St	Roadside	0.8	07.06.97 - 08.08.97

The monitoring data is below the air quality objective.

Busy Roads

A detailed assessment is required to be undertaken on 'very busy' road networks where the background for 2003 is expected to be above 1 mg/m^3.

Estimated background carbon monoxide concentrations from the UK Air Pollution Map 2001:

City centre	0.3 - 0.4 mg/m^3
Outer area	0.2 - 0.3 mg/m^3

Correction of modelled 2001 background data to 2003 using factors in Box 2.3 LAQM TG (03)

$0.4mg/m^3$ x 0.826 / 1.000 = 0.33 mg/m^3

There are no roads which fall under the 'very busy' road category in Edinburgh and the highest background concentration in 2003 is estimated to be less than $1mg/m^3$. Therefore there is not likely to be an exceedence of the carbon monoxide objective attributed to busy roads.

Conclusion
There is no requirement to proceed to a detailed assessment for carbon monoxide.

6 Review and assessment of Lead

Air quality objectives:

Annual mean concentration of 0.5 μg/m^3 to be achieved by the end of 2004

Annual mean concentration of 0.25 μg/m^3 to be achieved by the end of 2008

National perspective

Atmospheric lead concentrations have decreased significantly over the years, due to the reduction of lead in petrol. Emissions of lead are now restricted to a variety of industrial processes such as battery manufacture, paint pigments, glazing, alloys, radiation shielding, tank lining and piping.

Measured lead in air concentrations at UK national network sites 1999 - 2001 are well below both the 2004 and 2008 objectives, apart from one industrial location. DEFRA and the Devolved Administrations have undertaken detailed assessments of lead emissions from industrial sources and have concluded that there are not likely to be any exceedences of the 2004 and 2008 objectives. Only those local authorities with relevant exposure to major industrial processes which emit significant quantities of lead may need to proceed to a detailed assessment.

No AQMAs have been declared from the first round of reviews and assessments in terms of these air quality objectives.

Edinburgh' perspective

The Stage 1 and 2 review and assessment report concluded that lead would meet with the air quality objective.

Monitoring data

Studies undertaken by the former Edinburgh District Council Environmental Health Department (now Environmental and Consumer Services Department) in 1986 and 1992 demonstrated that levels of lead were below 0.1 μg/m^3 and 0.0023 μg/m^3 respectively.[2]

New Industrial sources/ Industrial sources with increased significant emissions

There are no new industrial sources which emit lead.

The emissions database compiled for Stage 1 and 2 did not identify any industrial sources which would give rise to significant lead emissions.

There are only 3 processes in Edinburgh, which produce lead emissions. The processes are listed in Table 6.1

2 Environmental Health Committee report R 947 Titled : An Investigation into Atmospheric Lead levels in the City of Edinburgh 1990 – 1991.

Table 6.1 Processes and associated lead emissions per annum in Edinburgh 2003

Site	Process	Emissions per annum
Henshaws Russel Road	Melting of non ferrous metals	39 kgm
United wire Granton Pk Avenue	Copper and alloy process	70 gm
Edinburgh Art College Lauriston Pl	Lead glass manufacturing	art work (small scale)

The above emissions are considered to be insignificant in terms of exceeding the air quality objectives.

Conclusion
There is no requirement to proceed to a detailed assessment for lead.

Updating and Screening Assessment Summary Checklist for **Lead**

Item	Response
A) Monitoring data	There is no new monitoring data which has been gathered since the previous review and assessment
B) New industrial sources.	There are no new industrial sources in Edinburgh nor authorities that are close to the boundary which emit lead.
C) Industrial sources with substantially increased emissions, or new relevant exposure	

7 Review and Assessment of Sulphur Dioxide.

Air quality objectives:

15 minute mean of 266 μg/m^3 not to be exceeded more than 35 times a year by 2005

1-hr mean of 350 μg/m^3 not to be exceeded more than 24 times a year by 2004

24-hr mean of 125 μg/m^3 not to be exceeded more than 3 times a year by 2004

National perspective

The main source of sulphur dioxide emissions in the UK is attributed to power stations and some industrial combustion sources. Where domestic coal burning is widespread exceedences of the 15- minute objective may occur.

There have been a small number of AQMAs declared from the first round of reviews and assessments with respect to emissions from coal-fired boilers at industrial plants, a hospital, domestic coal burning and shipping at a major port.

Local authorities have been advised to consider new industrial sources, increased emissions from existing industrial sources, areas of domestic coal burning, small boilers > 5 MW which burn oil or coal, shipping and railway locomotives for this assessment.

Edinburgh's perspective

The Stage 1 and 2 report identified that the 15-minute objective would be met and that the highest emissions were derived from mobile sources, 89% from road traffic. There are 2 coal-fired power stations within 30 Km of Edinburgh's boundary, which may influence the background level of sulphur dioxide. However, these sources are outside the city and AQMAs have not been declared in neighbouring local authorities for this pollutant. A combination of a lack of coal fired plant, and Smoke Control Orders imposed in Edinburgh from 1958 to 1996 has resulted in a significant and sustained reduction in sulphur dioxide and black smoke levels for a period of over 40 years.

Monitoring Data

Real- time monitoring data which has been gathered is shown in table 7.1

Table 7.1 Real-time monitoring data within the AQMA

Location	Site description	15 min mean > 266 μg/m^3				1 hr mean > 350 μg/m^3				24 hr mean >125 μg/m^3			
		1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
Princes St Gardens	Urban Centre	0	0	0	0	0	0	0	0	0	0	0	0
Leith Wk	Roadside			0				0				0	
Princes St site relocated closer to roadside 2002		**Maximum values** μg/m^3				**Maximum values** μg/m^3				**Maximum values** μg/m^3			
		1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
Princes St Gardens	Urban Centre	-	260	202	247	-	144	122	197	-	32	27	42
Leith Wlk	Roadside			90				42				49	

All measured data meets with the air quality objectives.

New Industrial Sources / Industrial sources with substantially increased emissions
There are no new industrial sources or increased emissions from existing sources according to information provided by Scottish Environment Protection Agency (SEPA).

Areas of domestic coal burning
There are no areas in Edinburgh where there is significant domestic coal or solid fuel burning.

Small boilers (> 5MW$_{thermal}$) burning oil or coal

The following establishments in Edinburgh have boilers which fall into the category > 5MW$_{thermal}$ .Table 7.2. However, all boilers are gas fired but have a backup system when there is an interruption of the gas supply which enables them to burn gas-oil. Due to the gas supply being more reliable and advances in technology, the need for interruptible gas-oil systems will soon be eliminated. Therefore, it is considered that the boilers are not likely to give rise to an exceedence of the air quality objectives.

Table 7.2

Establishment	Number of days when gas/oil was burnt 2000 - 2002
University of Edinburgh Kingsbuildings Westmains Rd	6 days over 5years New System to be installed 2003 Sept
University of Edinburgh Pollock Halls of Residence	None
Heriot Watt University Riccarton Campus	None
Western General Hospital Craigleith	None in 4 years
Royal Infirmary Edinburgh Little France	None
Scottish Courage Brewery Fountainbridge	None in 2 years
Commonwealth Pool Dalkeith Rd	2 days in 2002

Shipping

Large ships burn oil which has a high sulphur content, this can lead to an exceedence of the short-term (15-minute) objective if there are sufficient shipping movements in a port. Consequently, local authorities have been advised to collect information on shipping movements if there is relevant exposure within 1 Km of the berths and main areas of manoeuvring, The recommendation is to proceed to a detailed assesssment.if there are more than 5,000 movements per year of large ships (e.g. cross channel ferries Ro- Ro, container ships, cruise liners.

Table 7.3 below shows the shipping movements for the Firth of Forth, the majority of ships are destined for Grangemouth and do not berth in the port of Leith Edinburgh

Table 7.3 2002 Shipping movements in the Forth estuary

Berthing Areas	**Shipping movements**
Grangemouth	2466 x 2 = 4932
Leith Docks	708 x 2 = 1416
Rosyth	308 x 2 = 760
Hound point	311 x 2 = 622
Inverkeithing	157 x 2 = 314
Estuary anchoring Kircaldy Bay	106 x 2 = 212
Methol	57 x 2 = 114
Burntisland	48 x 2 = 96
Total shipping movements likely to influence the level of sulphur dioxide in Edinburgh = 2038	

There are less than 5000 shipping movements in the area of Edinburgh's coastline, therefore shipping movements are not likely to cause an exceedence of the sulphur dioxide 15-minute objective.

Railway locomotives

Moving locomotives are not considered to make a significant contribution to short term concentrations of sulphur dioxide, however emissions from stationary diesel locomotives with their engines running for long periods may be of significance. To determine if a detailed assessment is required from this potential source the following criteria requires to be applied:

Distance to closest relevant receptor	Should not be within 15 m of stationary diesel train
Number of occasions a day when diesel train engine is running for more than 15-minutes	Should not be more than 2 per day

Craigentinny Maintenance Depot is situated adjacent to residential property; the closest relevant exposure is 15.8 m from the nearest rail track where safety checks are carried

out. Discussions with the Health and Safety Manager regarding the operations at the Depot revealed that the majority of maintenance work is undertaken in sheds, which are greater than 40m from residential property. To avoid wastage of fuel, during cleaning operations locomotives are shored to an electricity supply and therefore the engines are not idling. The new Virgin Voyager trains are currently being adapted to use this technology. It is anticipated that all trains will have the facility to be shored to an electricity supply by the year 2005.

All trains are required to undergo safety checks. This procedure takes approximately 45 minutes to complete and the engine requires to be running. The train driver prior to leaving the depot carries out a further safety check. Therefore each train in the Depot will have an engine running for two 45-minute periods. Diesel trains have more than one engine. The average number of diesel trains per night in the depot is 9. This equates to approximately 35 diesel engines.

The number of diesel buses idling on Princes Street at any one time is far greater than the number of trains idling at the Cragentinny depot. In 2002, the monitoring station in Princes St Gardens east was relocated within 6 metres of the kerb and close to bus stops. No exceedences of any of the sulphur dioxide objectives have been observed at this new monitoring site. Therefore, it is considered that the air quality objectives for sulphur dioxide would be achieved at the Depot.

Scientifics Ltd has undertaken short term monitoring for nitrogen dioxide and PM_{10} since 1996 at the request of Great Northern Eastern Railway. The monitoring locations are at the southern boundary, close to residential property. There are no current exceedences of either of these pollutants when compared to their respective 2005 and 2004 objectives [3].

Conclusion

There is no requirement to progress to a detailed assessment for sulphur dioxide.

3 Report on environmental survey to determine the ambient concentrations of PM 10 and nitrogen dioxide. July 2002 Ref EKF01774 . Produced by Scientifics Ltd East Kilbride Glasgow

8 Review and assessment of nitrogen dioxide

Air quality objectives:

Annual mean concentration of 40 μg/m^3 to be achieved by the end of 2005

1 hour mean concentration of 200 μg/m^3 not to be exceeded more than 18 times per year to be achieved by the end of 2005

EU Directive limit values:

Annual mean concentration of 40 μg/m^3 to be achieved by the 1 January 2010

1 hour mean concentration of 200 μg/m^3 not to be exceeded more than 18 times per year to be achieved by the 1 January 2010

National perspective

Nitrogen dioxide (NO_2) and nitric oxide (NO) are oxides of nitrogen and are collectively referred to as nitrogen oxides (NOx). All combustion processes produce NOx emissions, mostly in the form of nitric oxide, which reacts with ozone in the atmosphere to produce nitrogen dioxide. The principle source of nitrogen oxide emissions in the UK is road transport. However, due to improvements in vehicle technology, emissions are expected to decline by 46% between 2000 and 2010.

Emissions from industrial sources have also decreased due to fitting of low nitrogen oxide burners and the increased use of natural gas plant. It is considered that industrial sources make a small contribution to the annual mean values.

The majority of AQMAs, which have been declared, are associated with road traffic emissions in terms of the annual average objective of nitrogen dioxide not being achieved. Exceedences of the objective have also been predicted in the vicinity of major airports due to both combined road traffic and aircraft emissions. There have been no exceedences identified from industrial sources.

For the assessment regarding NOx emissions from traffic, local authorities have been advised to focus on areas where the highest concentrations of this pollutant are likely. For example, narrow congested streets with residential properties close to the kerb, busy streets where people are likely to spend more than 1 hour, streets which have high flows of buses / HGVs, and busy junctions. Other areas which require to be assessed are bus stations, roads with significant flow changes, new industrial sources, industrial sources with significantly increased emissions and airports.

Edinburgh perspective

The emissions inventory for Edinburgh (detailed in the Stage1 and 2 report and summarised in Stage 3), identified that road transport is the most significant source of

nitrogen oxides. Mobile sources accounted for up to 96%, 8% of which were attributed to the airport and 88% to road traffic.
The highest emissions of nitrogen oxides occur in the city centre. Exceedences of the annual average nitrogen dioxide air quality objective occurred at various city centre locations.
In order to facilitate an integrated approach with respect to traffic management a single AQMA was declared as detailed in appendix Map1. The majority of the exceedences within the AQMA are at or close to busy junctions. Further work undertaken for Stage 4 identified that the largest contribution of NO_x emissions is attributed to buses.
Historically, Edinburgh has focused its monitoring regime in narrow congested streets flanked by tenement properties and therefore has assessed the worst case scenarios. For the purpose of the second round of LAQM additional sites were established in the following areas where:

traffic flows and congestion has notably increased (i.e. A8)
canyons outside the AQMA, which were previously overlooked.

Monitoring Data

The passive diffusion tube monitoring data, shown in tables 8.2 and 8.3 has been corrected for the bias associated with this method of measurement compared with real-time analyser's for each of the monitoring years. The bias expressed as percentages are summarised below and detailed in appendix 1a

Passive diffusion tube bias	2000	+ 22.2%	weekly	exposures
	2001	+ 9.9%	monthly	exposures
	2002	+ 8.5%	monthly	exposures

The kerb to relevant receptor location correction factors which have been used are detailed in appendix 1b.
The new correction factors to estimate annual average NO_2 in future years from measured data at roadside sites in Box 6.6 LAQM TG (03) have been used for projections to years 2005 and 2010.

The factors which were used together with a calculation example are shown in table 8.1

Table 8.1

Year of measured data	Projection to 2005	Projection to 2010
2000	0.892/1.033 = 0.8635	0.734/1.033 = 0.7105
2001	0.892/1.000 = 0.8920	0.734/1.000 = 0.7340
2002	0.892/0.969 = 0.9205	0.734/0.969 = 0.7574
Example measured data for 2000 = 48 μg/m^3 Projection to 2005 = 48 x 0.892/1.033 = 41μg/m^3		

Monitoring data outside AQMA

Table 8.2 Summary of nitrogen dioxide passive diffusion tube data outwith AQMA corrected for bias, distance from kerb to receptor and projected to years 2005 and 2010

Location	Site description	Annual average concentration µg/m^3								
		2000	2005	2010	2001	2005	2010	2002	2005	2010
St John's Rd	Kerbside/junc Canyon	48	41	34	51	45	37	48	44	36
St John's Rd	Kerbside/junc Canyon	Duplicate start 2001			48	43	35	47	43	36
St John's Rd	Kerbside	Weekly PDT's no bias for monthly PDT's			41	37	30	33	30	25
Glasgow Rd A8 East bound (no 9)	Kerbside	Site started 2002						39	36	30
Glasgow Rd A8 West bound (no 68)	Kerbside	Site started 2002						39	36	30
Deanhaugh St	Kerbside/junc	34	29	24	40	36	29	39	36	30
Queensferry Rd Craigleith	Kerbside Canyon	Site started end 2001/2002						39	36	30
Morningside Rd	Kerbside Canyon	36	31	26	41	37	30	38	35	29
Morningside Rd	Kerbside Canyon	Duplicate start 2001			39	35	29	36	33	27
Hope Park Terr	Kerbside Canyon	38	33	27	45	40	33	38	35	29
Grassmarket	Kerbside	35	30	25	40	36	29	35	32	27
Grassmarket	Kerbside	Duplicate start end 2001						34	31	26
Portobello High St	Kerbside Canyon	34	29	24	Site discontinued end 2000					
Trinity Cres (Newhaven)	Roadside/ junct	Site started 2002						37	34	28
Dundas St	Kerbside/junc	31	27	22	36	32	26	32	29	24
Home St Tollcross	Roadside Canyon	35	30	25	37	33	27	34	31	26
Pier Place Newhaven	Roadside	Site started 2002						31	29	23
Commercial St no 11 Leith	Roadside	Site started 2002						31	29	23
Commercial St No 78 Leith	Roadside	Site started 2002						41	38	31
Calder Rd	Kerbside	34	29	24	28	25	21	29	27	22
Inverleith Row	Kerbside	33	28	23	Site discontinued end 2000					
Slateford Rd	Kerbside Open	30	26	21	Site discontinued end 2000					
Dean Path Queensferry Rd	Kerbside Open	34	29	24	Site discontinued end 2000					
India Street	Kerbside Open	23	20	16	26	23	19	23	21	17
Melville Drive	Roadside Open	23	20	16	29	26	21	24	22	18
Melville Drive	As above Triplicate	26	22	18	28	25	21	24	22	18
Melville Drive	As above Triplicate	23	20	16	27	24	20	24	22	18

Hillview Terr	Urban background	Weekly PDT's no bias for monthly PDT's	19	17	14	21	19	16
Midmar Drive	Urban background	Weekly PDT's no bias for monthly PDT's	18	16	13	15	14	11

Monitoring data within AQMA

Table 8.3 Summary of annual nitrogen dioxide passive diffusion tube (pdt) data within AQMA Values are corrected for pdt bias, distance from monitoring location to relevant receptor and projected to years 2005 and 2010.

Location	Site Description	Annual average concentrations µg/m^3								
		2000	2005	2010	2001	2005	2010	2002	2005	2010
West Maitland St Palmerston Pl	Kerbside/junc Canyon	67	58	48	72	64	53	60	55	45
West Maitland St	Kerbside Canyon	Site started mid 2000			59	53	43	57	52	43
Roseburn Terr/St	Kerbside/junc	60	52	43	57	51	42	55	51	42
Roseburn Terr	Kerbside Canyon	Site started mid 2000			43	38	32	43	40	33
Princes St	Kerbside Open	51	44	36	53	47	39	69	64	52
North Bridge 1*	Kerbside Canyon	55	47	39	55	49	40	58	53	44
North Bridge 2*	Kerbside Canyon	49*	42	35	57	51	42	60	55	45
Gorgie Road/ Ardmillan	Kerbside/junc	42	36	30	58	52	43	55	51	42
Ardmillan Terr	Kerbside	Site started mid 2000			40	36	29	35	32	27
Leith Walk McDonald Rd	Kerbside/ junc	42	36	30	43	38	32	43	40	33
Leith Walk/ Brunswick Rd	Kerbside	Site started mid 2000			36	32	27	40	37	30
Leith Walk Gayfield Pl	Kerbside	39	34	28	Site discontinued end 2000					
Leith Walk	Kerbside	42	36	30	Site discontinued end 2000					
Queen St/ Frederick St	Kerbside/ junc	45	39	32	43	38	32	51	47	39
Queen St/ Frederick St	Duplicate	Site started 2002						49	45	37
Queen St/ York Pl	Kerbside	36	31	26	38	34	28	44	41	33

* North Bridge has had scaffolding erected at the building façade for 18 months, this may have had an effect on the flow of air, leading to poor dispersion

NOTE Data capture at all pdt sites was not less than than 80%.

Table 8.4 Real time (Chemiluminesence analyser) nitrogen dioxide data within AQMA

Location	Site Description	Annual mean				No of hourly exceedences of 200μg/m^3			
		1999	2000	2001	2002	1999	2000	2001	2002
Princes St Gnds National network	Urban Centre	42	45	43	48	0	1	8	0
Haymarket Terr	Roadside	38	37	42	42	0	0	10	0
Queen St/ North Castle St	Roadside	42	38	39	44	0	0	6	0
Gorgie Rd	Roadside	42	38	40	38	0	0	**	0
Leith Walk (Shrubhill)	Roadside	-	-	37	-	-	-	11	-
Cowgate*		31	-	-	-	0	-	-	-

***** Site not within AQMA
** Analyser fault during December.

Note Princes Street Gardens site was relocated closer to the road due to construction works at the National Art Gallery (Mound). Monitoring stopped early November 2000 to accommodate the Hogmany events in the Gardens. Data capture for year was 86.0%

Data capture was greater than 90% at all listed sites.

Table 8.5 Projected values for 2005 and 2010 from real- time monitoring data

Location	Site Description	Annual mean and projected values μg/m^3								
		2000	2005	2010	2001	2005	2010	2002	2005	2010
Princes St Gnds National network	Urban Centre	45	39	32	43	38	32	48	44	36
Haymarket Terr	Roadside	37	32	26	42	37	31	42	39	32
Queen St North castle St	Roadside	38	33	27	39	35	29	44	41	33
Gorgie Rd	Roadside	38	33	27	40	36	29	38	35	29
Leith Walk (Shrubhill)	Roadside				37	33	27			

Details on data capture and QC/QA procedures are contained in appendix 1c and 1b

The monitoring locations outside the AQMA are estimated to meet with the annual average air quality objectives for nitrogen dioxide apart from the canyon/junction site at St Johns Road. Monitoring locations within the AQMA continue to exceed the annual average air quality objective except Leith Walk (although the monitoring location at the junction of McDonald Road just meets with the set target). The majority of the

exceedences within the AQMA are at or close to busy junctions. Levels of nitrogen dioxide have increased at the real-time monitoring and passive diffusion tube sites on Princes Street and Queen Street compared with previous year's data. The monitoring station previously located within Princes Street Gardens was moved closer to the road in 2002, to facilitate the extension of the National Art Gallery. Due to works being undertaken in the area an ice cream van with a diesel generator was moved closer to the passive diffusion tube site. Queen Street was resurfaced during 2002 which resulted in the road being reduced to two lanes and as a consequence gave rise to slower traffic flows. These changes may have caused the noted increases.
The real-time monitoring locations currently meet with the hourly average nitrogen dioxide objective. All the exceedences for 2001 occurred on the same day (12.12.01) due to extreme meteorological conditions which caused poor dispersion of pollutants. Seven out of fourteen of the kerbside monitoring locations at junctions within the AQMA are predicted to exceed the annual average EU directive limit value.

As discussed in Stage 4 there are major traffic proposals for the city centre (Central Edinburgh Traffic Management scheme) which will affect the majority of the AQMA. Whilst these proposals are predicted to improve air quality in George Street they are likely to have a neutral or adverse effect at other locations within the AQMA. The main proposals involve:

> Opening up the junction at Queensferry Street and Princes Street, thus directing more buses along Princes Street and removing buses from Charlotte Square and George Street
>
> Allowing only buses, taxis, emergency vehicles and cycles on the westbound carriageway of Princes Street. The scheme is currently operational on the eastbound carriageway.

Peak traffic flows are expected to increase on Queen Street and more buses will be directed on to Princes Street as a result of these traffic proposals.

There are development proposals of major significance, in terms of housing, schools and commercial properties for the north east of Edinburgh. Such developments are likely to result in additional traffic volumes which may impact on the AQMA in particular Leith Walk.

In view of the city centre traffic proposals and future development plans, it is considered that the AQMA area should continue to include Leith Walk.

Further work is required to determine if an AQMA should be declared for St Johns Road or if the existing AQMA requires to be extended to include this road.

A tram system has been proposed for the North of Edinburgh, the route is scheduled to include Leith Walk.This proposal will be subject to an Environmental Impact Assessment, it is anticipated that air quality issues will be considered as part of this assessment.

Road Traffic

Additional monitoring using passive diffusion tubes was undertaken at canyon locations and other areas which were not addressed in Round 1 of the Review and Assessment process. The data is shown in table 8.6.

Table 8.6 New passive diffusion tube sites established end 2002 uncorrected for bias

Location	Site description	Mean value 5 month 2002/3 $\mu g/m^3$	Predicted to 2005 $\mu g/m^3$
Easter Rd/ London Rd	Kerbside/ junc Canyon	41	38
West Port	Kerbside Canyon	43	40
Bernard St * Leith	Kerbside/junc Canyon	52	48
Gt Junction St* Leith	Kerbside Canyon	51	47
Dalkeith Rd	Kerbside Canyon	42	39
Baileyfield Rd Portobello	Kerbside	29	27
Lanark Rd Juniper Green	Kerbside	23	21
Niddrie Mains Rd	Kerbside	31	29
*Incomplete data sets for the 5 month monitoring period at location Predicted data for 2005 was based on factors for 2002			

The data was gathered over a five-month winter period. Data sets for two locations were incomplete, due to theft and technical problems with the passive diffusion tubes. The data is uncorrected for passive diffusion tube bias, due to limited sampling, but has been corrected for kerb to façade distances where appropriate. The results will be reviewed when a full year of data has been obtained in order to produce more reliable information. However, it is likely that Baileyfield Road, Lanark Road and Niddrie Mains Road will meet with the air quality objectives.

The revised Design Manual for Roads and Bridges (DMRB) screening model was used at a number of locations where traffic data was available. A comparison of the predicted measured data and modelled DMRB data is shown in table 8.7

The Highways Agency carried out a validation study of the DMRB model. Their findings indicated that the model might significantly under predict concentrations of nitrogen dioxide along urban city centre roads classified as Street Canyons. To avoid missing potential exceedences at canyon locations, local authorities are advised to multiply the DMRB predicted road traffic component annual mean by a factor of 2 and then add this value to the background nitrogen dioxide concentration.

Table 8.7 Comparison of predicted nitrogen dioxide measured data and DMRB modelled data .

Location and site descripton		Predicted 2005 annual mean based on measured data μg/m^3	Predicted 2005 annual mean based on the revised DMRB model μg/m^3	
			DMRB value (total)	Road traffic compontent DMRB x 2 + background NO_2
Westport	Canyon	40 * 5months	33	5.3 x 2 = 10.6 + 27.8 = 38.4
Dalkeith Road	Canyon	39 * 5months	32	7.7 x 2 = 15.4 + 23.3 = 38.7
West Maitland Street	Canyon/ junction	55	43	14.8 x 2 = 29.6 + 28.3 = 57.9
Morningside Rd **	Canyon	35	33	7.3 x 2 = 14.6 + 25.9 = 40.5
St Johns Rd	Canyon/ junction	44	40	14.6 x 2 = 29.2 + 25.6 = 54.8
St Johns Rd	Open	36	36	
Haymarket***	Open	39 (2002) 37 (2001)	41	
Queen Street ***	Open	41 (2002) 35 (2001)	34	

Notes
***** passive diffusion tube data not corrected for bias
* * Morningside traffic data was based on a 12 hour manual count x 1.15
** *Queen St and Haymarket measured values predicted to 2005 were calculated from real-time data from 2001 and 2002

The DMRB modelled values (based on the recommended traffic component calculation), are higher than the annual means predicted for measured data at the following canyon locations, West Maitland Street, Morningside Road and St Johns Road. The recommended calculation might overestimate the concentrations of nitrogen dioxide at canyon locations. If this is the case, then both Westport and Dalkeith Road are likely to meet with the air quality objectives for nitrogen dioxide. The comparison study confirms the findings of the Highways Agency, as the total DMRB modelled values (without the traffic component calculation) are lower than the values predicted from the measured data at canyon locations.
Inputs which were used in the DMRB model are tabulated in appendix 4.

Roads with significantly changed traffic flows:

Local authorities have been advised to identify roads that have more than 10,000 vehicles per day and have experienced a 25% increase in traffic to determine if they need to proceed with the screening assessment. The Council's Local Transport Strategy (LTS) aims to stabilise the whole of the city traffic levels at 1996 levels by 2005 and reduce city centre traffic by 10% from 1996 levels by 2005. A progress report by the Council identified that city centre traffic had remained stable since 1997; and that there had been growth of between 3% and 9 % on the whole of the city traffic network.[4] Therefore, in terms of this assessment, the level of increased traffic on the road networks in Edinburgh is considered to be insignificant.

New roads

The only new road to be constructed in Edinburgh since completion of Round 1 is the Granton Access Road. This is an access road, which carries a small volume of traffic in comparison to radial routes into the city. Therefore this road is likely to meet with the air quality objectives and a detailed assessment will not be required.

Bus stations

A local authority only needs to progress to a detailed assessment at bus stations if the number of bus movements exceeds 1000 per day and the nearest relevant receptor is within 10 metres of the bus station. The number of bus movements at Edinburgh bus station, including arrivals and departures are 600 per day and the nearest relevant receptor is at the entrance of the bus station. The bus station in Edinburgh is already within the existing AQMA. Measures in the Action Plan aim to work towards establishing a cleaner bus fleet which will improve the emissions of NO_x at this location.

Therefore the bus station is not considered to be of significance, regarding the risk of an exceedence of the air quality objectives.

Industrial sources

New sources
There are no new industrial sources in Edinburgh, which emit oxides of nitrogen, according to information supplied by SEPA.

Industrial sources with substantially increases emissions
No sources were identified as having significant emissions during the first round of the review and assessment process.
There is no requirement to progress to a detailed assessment for industrial sources.

4 Local Transport Strategy : Progress Report City of Edinburgh Council 14 January 2003 submitted to the Executive of the Council at the request of the Chief Executive.

Aircraft

The Stage 1 and 2 report identified that 8% of NO_x emissions were attributed to aircraft. The airport in Edinburgh is situated adjacent to the A8 Glasgow Road which currently has a traffic flow of 46,988 AADT. The number of airline passengers has increased since Round 1 of LAQM and further growth is expected. Local authorites have been advised to consider the following criteria for this screening exercise:

Relevant exposure within 1000m of the airport boundary Passenger throughput in excess of 5 mppa by 2005 Freight movements 100000 tonnes = 1mppa

Airport activity for the year 2000 is detailed in table 8.8

Table 8.8 Aircraft assessment

Current passenger throughput	5.6 mppa
Air transport movements	89,142
Freight lifted (Thousand tonnes)	18,280
The nearest relevant receptor from the airport boundary	48 metres (Castle Gogar)

The above information suggests that Edinburgh will require to proceed to a detailed assessment. However, if monitoring data is available at a location which depicts the worst case of a relevant exposure, then this can be used in preference to passenger throughput to reach a decision on whether or not to proceed to a detailed assessment.

The air quality modelling study undertaken by AEA technology, for the various airport expansion scenarios for Glasgow and Edinburgh concluded that there would not be any breach of the air quality objectives from the aircraft emissions and associated increased volumes of traffic outwith the boundary of the airport.[5] The assessment year for the study was 2030. The maximum passenger throughput projected for the options proposed for Edinburgh was 23.9 mppa at 2030. The summary document, The Future Development of Air Transport in the United Kingdom: Scotland, concluded that ……No material local air quality exceedences (measured excess in certain pollutants) are expected at any of the major Scottish airports under any of the scenarios. However, major road congestion and traffic flow problems were anticipated at Edinburgh under the Regional Air Services Case Studies (RASCO).

Monitoring using passive diffusion tubes, was undertaken by AEA Technology within and around the airport boundary for NO_2 between 18 August to 18 November 1999. Values ranged from 22μg/m^3 to 59μg/m^3 with an overall mean value of 42 μg/m^3. The value at the south boundary wall adjacent to Castle Gogar was 24.8 μg/m^3. This is the closest relevant receptor to the airport boundary. The higher values were at Apron Stand 10 and the Terminal Road. This data is not corrected for the bias associated with passive diffusion tube measurements and was only carried out for a period of 3 months. However, it does provide an indication that the risk of an exceedence is relatively low.

5 Edinburgh and Glasgow Airport Study Regional Air Services- (Study 3 Part B - Air Quality Modelling for Scotland Contained in Appendix E Air quality Report) Arup Transport Planning
Produced for the Department for Transport, Local Government and the Regions (DTLR)

A robust Environmental Impact Assessment study was also undertaken by RPS Consultants on behalf of the Royal Bank of Scotland for the proposed Headquarters of the Royal Bank at Gogarburn. The air quality monitoring protocol was agreed with the Council and was designed to assess the worst case exposures to nitrogen dioxide at residential properties on the A8 between the Newbridge and Maybury roundabouts.

The monitoring regime comprised of real-time monitoring at a background and roadside location, supported by 9 passive diffusion tubes located at the facades of residential properties and at the kerb adjacent to residential properties. Passive diffusion tubes were co-located with the real-time analysers to correct for bias. Kerb side locations were corrected to account for distance to the closest relevant receptor. Each tube was exposed for a 2-week period. The study was for a period of 3 months from 17 January 16 April 2002. It was assumed that the average values obtained from the real-time analysers for the 3 months was representative for the year. The dispersion model ADMS- roads was also used and validated using the real- time data.

Summarised monitoring data for 2002 is shown below in tables 8.9a and 8.9b. The data has not being projected to years 2005 and 2010

Table 8.9a Real- time chemiluminesence data from Gogarburn Air Quality Impact Assessment Study 2002

Location	**Max NO_2 hourly mean µg/m^3**	**Average of NO_2 hourly means µg/m^3**	**Data capture %**
65 Hillwood Rise (Ratho) Background	80	15	98.4
132 Glasgow Rd (Ratho) Roadside	101	24	98.4
Study period 17 January to 16 April 2002 All the above data was ratified by Netcen			

Table 8.9b Passive diffusion tube data from Gogarburn Air Quality Impact Assessment Study 2002

Location	**Site description**	**Average NO_2 values (Corrected µg/m^3)**	**Data capture %**
1 Gogar East Lodge	Kerbside	33.8	100
2 Middle Norton (on façade)	Kerbside	29.8	100
5 11A Glasgow Rd (Junction Lochend Rd)	Roadside	39.0	100
6 7 Lochend Rd *	Roadside	28.8	100
7 65 Glasgow Rd (on façade)	Roadside	27.8	100
8 117 Glasgow Rd (on façade)	Roadside	26.9	100
9 196 Glasgow Rd	Kerbside	28.9	100
10 Turnhouse Rd	Roadside	32.5	100
11 Glasgow Rd (east of Maybury)	Kerbside	34.7	100
*Site 164m from airport west boundary and 74m from centre point of A8 Glasgow Rd Passive diffusion tubes were corrected for bias and distance to receptor where applicable Analysis was undertaken by Harwell Scientifics Ltd Study period 17 January to 16 April 2002 Council data - Annual average value for 2002 at both locations on the A8 = 39µg/m^3			

The report concluded that the existing and future annual mean concentrations of NO_2 along the A8 are unlikely to exceed the objective for 2005 with or without the

development at a relevant location on the Glasgow Road. The air quality assessment indicated that the dominant source of NO_2 in the study area was due to road traffic and that long term emissions from aircraft were of minor significance. [6]

There is no current or predicted exceedence of this pollutant at this locality based on the Council's monitoring data and the Environmental Impact Assessment report for the development of the Gogarburn site. However, this Council will work jointly with BAE and AEA Technology to develop a long-term programme of monitoring in the area due to the anticipated airport expansion and associated traffic increase. It has been recognised that Edinburgh requires an improved public transport infrastructure to facilitate development in this area. An Environmental Impact Assessment Study for a tramline from the city centre to the airport is currently being undertaken. It is anticipated that air quality will be considered as part of this assessment.

Conclusion

Further work will be required to determine if there is likely to be a definite risk of exceedence of the annual objective at St Johns Road for traffic related nitrogen dioxide. A monitoring station for NOx and PM_{10} has been installed at Roseburn and additional passive diffusion tubes will be located at the façades of residential property at St Johns Road. The present monitoring location is 0.54 metres from the kerb and is located close to traffic lights. Locations where passive diffusion tubes are situated close to the kerb will also have additional passive diffusion tubes sited at the building facades. This will help to establish a more robust kerbside façade relationship, rather than apply the present conservative factors.
An additional passive diffusion tube was placed at the building façade on Gorgie Road close to the kerbside monitoring site at the junction of Gorgie Road /Ardmillian.The raw data for same time period for the site closer to the kerb was of a greater magnitude than the raw data at the monitoring site at the building façade. The values over 11 months (June 2002 to April 2003) were 67 and 49 μg/m respectively. Correcting the kerbside site to the façade , 67 x 0.9 = 60.3. Therefore the current kerbside to façade correction factors may overestimate concentrations at building facades.

6 Gogarburn air quality validation report 5 July 2002 RPS Consultants Ltd

9 Review and Assessment for PM_{10}

Air quality objectives:

An annual mean of 18 μg/m^3 (gravimetric) to be achieved by the end of 2010 Scotland only

A 24 hour mean of 50 μg/m^3 (gravimetric) not to be exceeed more than 7 times per year by the the end of 2010

The above air quality objectives are based on indicative Stage 2 values set by the EU and have been adopted by the Scottish Executive and incorporated into the Air Quality (Scotland) Amendment Regulations 2002.The annual mean for Scotland is more onerous than the indicative level of 20 μg/m^3 advised by the EU. The Stage 2 values are considered to be more stringent and have yet to be incorporated into regulations in England, Wales and Northern Ireland. Therefore it is only Scottish Local Authorities who are required to consider the new objectives for this updating and screening assessment.

An annual mean of 40 μg/m^3 (gravimetric) to be achieved by the end of 2004

A 24 hour mean of 50 μg/m^3 (gravimetric) not to be exceeded more than 35 times by the end of 2004

The above air quality objectives which have been adopted by the Government and the Devolved Administrations and are equivalent to the EU Stage 1 limit values.

National perspective

It is recognised that the new air quality objectives will be extremely challenging for local authorities to meet. PM_{10} is a complex pollutant. There are various emission sources that contribute towards PM_{10} concentrations, which can be divided in to the following three broad categories:

Primary particles	- Combustion sources including road traffic Power generation
Secondary particles	- Formed by chemical reactions in the atmosphere largely in the form of sulphates and nitrates
Coarse particles	- Wide range covering resuspended dust from road traffic - Construction site works - Mineral extraction processes i.e quarries - Wind blown dusts and soils - Sea salt and biological particles

A significant portion of annual mean PM_{10} is derived from regional background sources, including long distance transport from Europe. According to LAQM TG (03), typical regional annual mean backgrounds are within the range of 14 to 21 μg/m (grav) and are outside the control of local authorities. There are also inconsistencies associated with the various types of measurement to determine PM_{10} concentrations. The EU directive specifies the gravimetric method of measurement, in order to retain volatile components. Most network sites in the UK operate Tapered Element Oscillating Membrane Systems (TEOMS). Correlation studies between the two methodologies have shown an agreement. However, this is site specific. For example at a London roadside location, the correction factor to equate to a gravimetric measurement was 1.15 but can be as high as 1.6 at some localities, personal communication.[7] For the purpose of this review and assessment local authorities have been advised to adopt a correction factor of x 1.3 to equate to a gravimetric reading. The underestimation of TEOM instruments therefore is very variable. Also recent work has shown that gravimetric measurements may overestimate the PM_{10} concentration due to the hydroscopic nature of some particles in wet and humid climates.[8]

Various policy measures have resulted in the decline of particle emissions from transport and industrial processes nationally, and further reductions are forecast due to EU directives on Integrated Pollution Prevention (IPPC) Waste Incineration, Acidification Strategy effecting secondary particle formation and improvement in engine technology.

Nationally more than 50% of AQMAs have been declared in terms of the predicted exceedence of the 24-hour mean 2004 objective. The majority of the exceedences are associated with road traffic sources. Others have been declared due to a quarrying process, coal-fired boilers and a steel plant. An AQMA is under consideration with respect to domestic coal burning. For the purpose of this assessment local authorities have been advised to consider busy roads and junctions, roads which have a high flow of buses /HGVs, roads with significantly changed flows, industrial sources, areas of domestic coal and solid fuel burning, quarrying and aircraft.

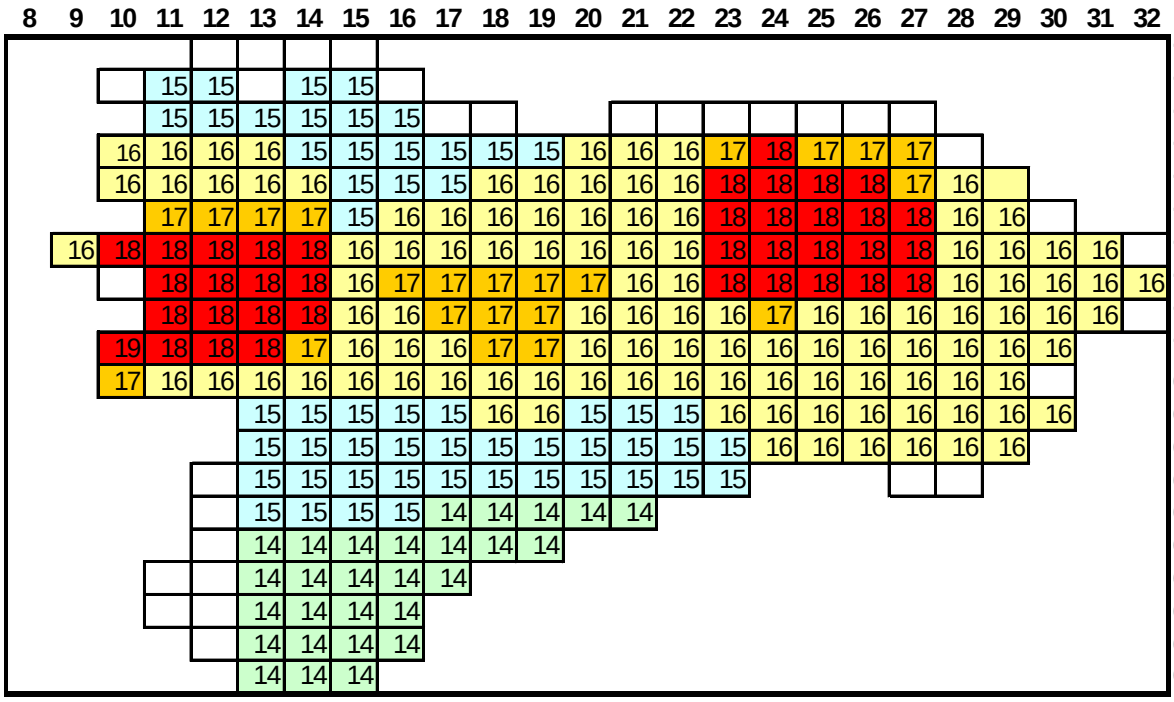
Edinburgh's Perspective

The Stage 3 report identified that the PM_{10} air quality objective 2004 would be met. This was demonstrated by undertaking detailed monitoring and using the DMRB model at a number of roadside locations. Further monitoring data gathered since the first round continues to demonstrate this. However, all monitoring data and previous modelled DMRB data shown in Stage 3 fails to meet with the more recently imposed stringent air quality objectives. The modelled projected background values for 2010 PM_{10} concentrations obtained from the UK Air Quality Maps, indicate that the majority of areas within Edinburgh will either be at or close to the objective. The estimated predicted background values range from 14μg/m^3 to 19 μg/m^3 as detailed in the following 1-Km grid map:

7 Richard Maggs Castella Stanger

8 The role of semi-volatiles in the measurement of PM $_{10}$.Monica Price and Susan Bupitt University of Sunderland. Paper presented at The 4th Annual particulate meeting September 2002 Birmingham University.

1 Km grid map of Edinburgh detailing 2010 PM_{10} background concentrations



Monitoring data

The Cowgate site is the only monitoring location outside the AQMA and for convenience has been included in the table 9.1 below which features 4 other monitoring locations all within the AQMA

Table 9.1 PM_{10} concentrations and number of exceedences measured at various city centre locations

Location	Description	Annual mean µg/m³ (gravimetric)				Number of days > 50µg/m³ (gravimetric)			
		1999	2000	2001	2002	1999	2000	2001	2002
Princes St Gnds National network	Urban centre	19	23	26*	21**	3	5	11	15
Haymarker Terr	Roadside	21	20	22	23	7	0	5	8
Queen St/ North Castle St	Roadside	22	20	23	23	6	0	7	11
Leith Walk (Shrubhill)	Roadside	Site started Aug 2000		25	-	Site started Aug 2000		8	-
Cowgate		25	Site discontinued			10			

PM_{10} concentrations at the above locations currently meet with the 2004 objective and therefore will meet the 2004 objectives. The projected 2010 values for each of the locations are shown in table 9.2

Table 9.2 Projected PM_{10} concentrations for 2010 based on measured data for 2001 and 2002

Location	Site description	**Annual mean μg/m^3 (gravimetric) projected to 2010**			
		2001	2010	2002	2010
Princes St Gardens	Urban centre	26*	23	21**	19
Haymarket Terr	Roadside	22	20	23	21
Queen St/ North Castle St	Roadside	23	21	23	21
Leith Wlk (Shrubhill)	Roadside	25	22		

* Data likely to be elevated due to construction works at Princes Street National Gallery
**Data capture 86% site relocated closer to roadside in Princes Street due to extension of National Gallery

The above data was projected using guidance in Box 8.6 and the relevant factors in Box 8.7 (LAQM TG (03)), to estimate secondary PM_{10} and primary combustion PM_{10} concentrations. An example of the calculation is shown below in table 9.3

Table 9.3

Example of calculation to estimate PM_{10} concentrations to 2010 using measured data from 2001 and 2002		
Correction factors used from Box 8.7 to project to year 2010	2001 measured data	2002 measured data
secondary	0.795 / 1.000 = 0.795	0.795 / 0.977= 0.813
primary	0.815 / 1.000 = 0.815	0.815 / 0.977= 0.834
Correction of secondary 2001 to 2002		x 0.977
TEOM measured data corrected to gravimetric	20μg/m^3 x 1.3 = 26μg/m^3	16.1μg/m^{3}x 1.3 = 21μg/m^3
Secondary PM_{10} 2001 from UK background maps	4 μg/m^3	4 x 0.977 = 3.9
Estimated secondary PM_{10} to 2010	4 x 0.795 = 3.18μg/m^3	3.9 x 0.813 = 3.17
Coarse fraction (remains unchanged)	= 10.5μg/m^3	= 10.5μg/m^3
Primary fraction of PM_{10}	26 - 4 - 10.5 = 11.5μg/m^3	21 - 3.9 - 10.5 = 6.6
Primary fraction of PM_{10} to 2010	11.5 x 0.815 = 9.4μg/m^3	6.6 x 0.834 = 5.5
Total estimated PM_{10} at 2010	9.4 + 3.18 +10.5 = 23μg/m^3	5.5 + 3.17+10.5 = 19 μg/m^3

The data demonstrates that the roadside locations currently within the AQMA and outside the AQMA (Cowgate) will not meet the new objectives by 2010. The data also suggests that the levels of PM_{10} have increased at all sites since 1999.

It is important to note that elevated levels of PM_{10} at all the monitoring sites occur within the same time frame indicating that the source may not be local.

Busy Roads and junctions.

Advise was sought from the help desk regarding the issue of modelling PM_{10} at additional road locations using the DMRB screening model, since the projected background levels for 2010 are 16-18 $\mu g/m^3$ for the majority of the city. Rather than undertake work which will demonstrate a city-wide problem, due to local background concentrations inputs being required in the model it was agreed that we would monitor at a background location for the Detailed Assessment. The purpose of this exercise would be to attain a more accurate picture of background levels pertinent to Edinburgh. However a comparison of the estimated measured data and modelled data using the revised DMRB screening model for Queen Street and Haymarket was undertaken Table 9.4

Table 9.4

Site	Predicted annual average 2010 PM_{10} concentrations based on 2002 measured data $\mu g/m^3$		Predicted 2010 PM_{10} based on DMRB modelled data $\mu g/m^3$		
	Annual mean	Exceedences 2002	Annual mean	Road traffic component	No expected exceedences
Queen Street	21	8	19.9	1.88	3 days
Haymarket Terrace	21	11	20	3.99	3 days

The DMRB model marginally underestimates the annual mean in comparison to the measured predicted data at the above locations. Inputs which were used for the model are tabulated in appendix 4.

Roads with high flows of buses - HGVs

Princes Street has the highest percentage of buses and slow moving traffic at peak times. This location does not meet the air quality objective. Work undertaken for Stage 4 identified that buses were the major problem in the AQMA. Edinburgh has already considered roads where there are a high percentage of buses and HGVs and additional roads where traffic volumes are high and close to dwelling houses using the DMRB model as detailed in Stage 3. Although the levels adequately meet with the 2004 objective they do not meet with the new annual objective of $18\mu g/m^3$. The values for each of the modelled sites range from 20 to 25 $\mu g/m^3$ for 2005. These values are in keeping with current monitoring data obtained from the continuous sites and are therefore not likely to meet with the target date of 2010.

Roads with significant changed traffic flows and new roads

As discussed in section 8.0 Review and Assessment of Nitrogen Dioxide both of these sources are considered to be insignificant in relation to increased emissions of PM_{10}.

Industrial Sources

There are no new industrial sources nor processes with substantially increased emissions which emit this pollutant according to information provided by SEPA.

Domestic Coal / solid fuel burning

Edinburgh is a smoke-controlled area and therefore an assessment is not required. However, coal burning in Belfast may influence levels in Edinburgh since the predominant wind direction is south-westerly.

Fugitive Sources
Quarries /landfill sites/ Concret batching plants

There are two quarries currently in operational use on the periphery of the city, Hillwood and Ravelrig which both have aggregate batching plants. In the absence of any local monitoring data adjacent to quarries it is recommended that local authorities apply the following criteria to determine if there is a need to progress to a detailed assessment at such locations. Table 9.5

Table 9.5 Assessment criteria requirement for quarries

Relevant exposure from Source distance in metres	**2004 PM 10 background level**	**2010 PM10 background level**
1000 or > than	No reqirement to proceed to a detailed assessment (DA)	
400 - 1000	< 27 No requirement for DA	< 17 No requirement for DA
200 - 400	< 26 No requirement for DA	< 16 No requirement for DA

For this assessment modelled background values were obtained from the UK Air Quality Maps and distances from the quarry operations to the nearest relevant receptor were measured using the GIS system. Table 9.6

Table 9.6 Quarry assessment

Quarry Location	**Closest relevant exposure**	**Background levels μgm**	
		2004	**2010**
Hillwood	Hillwood Cottage 232 metres N 313253 E 671963	19	18
Ravelrig	Hoggs Cottages 566 metres N 313457 E 666935	16	15

Based on the above assessment there is no requirement to proceed to a detailed assessment in the vicinity of the Ravelrig quarry as the closest relevant public exposure is of adequate distance away with respect to the modelled background concentrations for 2004 and 2010. Hillwood quarry is approximately 210 metres from the M8 link which

has traffic flows of 59853 AADF and 10% HGVs. This motorway encloses the quarry area to the west and south. To the north of the quarry is the A8 (airport road) which has traffic flows of 46988 AADF. Consequently, the modelled background data is high in this region. Guidance will be the sought from the help desk on how to proceed with this issue, as it will be difficult to determine the contribution of PM_{10} from each source.

Aircraft

Although aircraft are considered not to be a significant source of PM_{10} emissions they may make a contribution close to source. The criteria for the screening assessment are identical to the parameters for the assessment of nitrogen dioxide with respect to relevant exposure and throughput of passengers. As detailed in section 8.0 Review and Assessment of nitrogen dioxide, work which was carried out by AEA Technology did not identify that the proposed airport expansion scenarios would constitute an exceedence of the air quality objectives at any residential properties. The modelled contour values around the periphery of the airport are shown to be $12\mu g/m^{3.}$ However, the assessments have once again being based on the year 2030, the air quality objectives have to be achieved by earlier dates. The modelled 2010 background concentrations for the airport area range from 16 to 18 $\mu gm/^{3}$ and like the majority of locations in Edinburgh will fail to meet the air quality objective, should these background values be used in the DMRB model.

Conclusion

The local authority will require to undertake a Detailed Assessment of PM_{10} based on the Uk Air Quality Map background concentrations for 2010 and monitoring data. The Detailed Assessment will focus on monitoring at a background location to determine a more accurate background concentration. This will also establish how the background real-time values compare with city centre roadside locations. A co-location study to compare TEOM and gravimetric measurements will also be carried out at a roadside location. This will determine if the factor of 1.3 is appropriate to use for roadside sites in Edinburgh. It is likely that Edinburgh may be effected by the long-range transport of PM_{10} and therefore there is very little that can be done to improve the situation at a local level. A three-month comparison study of NOx and PM_{10} concentrations showed no correlation at a roadside site, indicating that traffic may not play an important role in the overall PM_{10} concentrations. This issue will be investigated further in the Detailed Assessment.

10 Conclusion

The U&SA has shown that at relevant exposure locations there is no risk of exceeding the air quality objectives for the pollutants, 1,3- butadiene, benzene, carbon monoxide, sulphur dioxide and lead, under any of the scenario assessments contained in the guidance. Therefore there is no requirement to undertake a Detailed Assessment of these pollutants.

However it will be necessary to progress to a Detailed Assessment for PM_{10}. As previously discussed, the composition of PM_{10} is complex, and the situation is compounded by the problems associated with the method of measurement. For example, the fact that gravimetric measurements may overestimate due to water absorption by particles, and yet currently all TEOM generated data requires to be multiplied by a factor of 1.3 to provide the equivalent EU gravimetric measurement! The relationship between gravimetric measurements and TEOMS is site specific and therefore variable, possibly leading to overestimated concentrations.
Part of the work for the Detailed Assessment will involve monitoring at a background location and undertaking a comparison study of TEOM measurement and gravimetric measurement at a roadside location. Guidance will be sought from the helpdesk regarding this issue. Monitoring at a background location will help to determine the degree of non-locally generated PM_{10}, which due to its transboundary nature may mean that action at a local level will fail to provide the required improvement.

The canyon kerbside junction location at St John's Road has been predicted to fail the annual nitrogen dioxide air quality objective. Therefore a Detailed Assessment is required at St Johns Road to determine if there is a definite risk of exceedence of the annual average nitrogen dioxide objective and if so what actions are required.

Appendix 1a

Passive diffusion tube bias correction expressed as a percentage for 2000 to 2002 data

2000 data (12 months of data)

Site	Analyser	Pdt 1	Pdt 2	Pdt 3	Mean Pdt	% Bias
Queen Street /Castle St	37.8	48.7	50.7	-	49.7	31.6
Gorgie Road	37.8	49.4	45.5	-	47.4	25.5
Haymarket Terrace	37.1	45.0	44.8	-	44.9	21.0
AURN Princes Street	44.6	50.1	47.6	50.3	49.3	10.5
Mean bias = 22.15 % (weekly exposed tubes)						

2001 data 11 months of data only (Comparison dates 03/01/01 to 4/12/01 for both analyser and pdts)

Site	Analyser	Pdt 1	Pdt 2	Pdt 3	Mean Pdt	% Bias
Queen Street/Castle St	38.2	42.0	42.4	-	42.2	10.5
Leith Walk	34.7	38.7	39.4	-	39.1	12.7
Haymarket Terrace	40.5	43.6	42.8	-	43.2	6.7
AURN Princes Street *	42.1	43.9	41.7	47.5	44.3	5.4
Mean bias % all sites = 8.9 % Mean bias% AURN site = 9.9 % (monthly exposed tubes)						
Note 9.9% was the bias factor used due to data still requiring ratification at the AURN						

*** Data sets require to be ratified**

2002 data (12 months data)

Site	Analyser	Pdt 1	Pdt2	Mean Pdt	% Bias
Queen Street/Castle St	43	47.5	47.2	47	8.5
% bias = 8.5 % (monthly exposed tubes)					
Bias data from only one site was considered to be realiable, due to theft of pdts at the Gorgie Rd site, down time and relocation of the AURN site and errors in values caused by other research establishments siting additional ptds and equipment to close to the exposed end of the Council's own pdts					

Calculation of bias correction for the diffusion tubes was as follows:

Example:

Mean annual analyser value = 43μgm/m^3 . Mean annual passive diffusion tubes = 47μg/m^3

47 – 43/47 x 100 = 8. 5 % overread

Data capture for the real time analysers over the monitoring periods was greater than 90%

Passive diffusion tube collection analysis was 95 - 100% .

Appendix1b

Kerbside to façade corrections

Site number	Code	Location	Distance pdt from kerb (m)	Distance from pdt to façade (m)	Factor used
1	1	St Johns Rd	0.54	1.9	0.95
1	1x	St Johns Rd (Duplicate)	0.54	1.9	0.95
2	2	West Maitland St Palmerston Pl	0.65	4.2	0.90
3	2x	West Maitland St	0.30	2.7	0.95
4	3	Calder Rd	1.75	> 20	0.75
5	4	Gorgie Rd/Ardmillan Terr	0.3	4.9	0.90
6	4x	Ardmillan Terr /Gorgie- Dalry	0.6	3.8	0.95
7	5	Commercial St no 11	2.47	at façade 0.4	
8	6	Morningside Rd	0.45	2.6	0.95
8	6x	Morningside Rd Duplicate	0.45	2.6	0.95
9	7	Commercial St at no 78	2.6	at facade	
10	8	Home St / Toll Cross	2.8	at facade 0.4	
11	9	Lanark Rd at no 610	1.0	3.6	0.95
12	10	Pier Place at Alien Rock	2.15	2.7	0.95
13	11	Deanhaugh St	0.6	3.6	0.95
14	12	Trinity Crescent	4.0	4.3	
15	13	Glasgow Rd at no 9 (East bound)	1.1	4.4	0.90
16	14	Glasgow Rd at no 68	1.8	4.4	0.90
17	15	Hope Park Terrace	0.3	4.5	0.90
18	16	Gorgie Rd close to facade	2.4	1.0	
19	17	Baileyfield Rd (Portobello)	2.0	3.5	0.95
20	19	Mc Donald Rd /Leith Wlk	1.0	4.6	0.90
21	19x	Leith Wlk / Brunswick Rd	1.0	3.3	0.95
22	20	Roseburn Terr/ St	0.57	1.54	0.95
23	20x	Roseburn Terr	0.35	2.14	0.95
24	21	Princes St	0.47	10.5	0.75
25	23	Easter Rd	2.32	at facade	
26	24	North Bridge Pizza Hut	3.5	at facade	
27	24x	North Bridge Clydesdale Bank	3.5	at facade	
28	25	West Port opposite no38	1.7	at facade	
29	26	Bernard St	2.35	at facade	
30	27	Gt Junction St	2.82	at facade	
31	28	Dalkeith Rd 187	1.8	4.9	0.90
32	29	Niddrie Mains Rd / Craigmillar Castle	1.2	4.3	0.90
33	33	Queen St/Frederick St	1.0	4.4	0.90
33	33x	Queen St/Frederick St Duplicate	1.0	4.4	0.90
34	34	India St	0.4	6.55	0.90
35	37	Dundas St	0.4	7.12	0.90
36	39	York Place at no 49	0.75	8.2	0.90
37	45	Grass Market	1.2	18	0.75
38	44	Melville Drive	2.83	> 20	0.75
38	46	Melville Drive	2.83	> 20	0.75
38	47	Melville Drive	2.83	> 20	0.75
39	1A	St Johns Rd /Victor Park Terr	1.7	9.0	0.90
40	2A	Queensferry Rd	2.0	at façade 0.4	
41	3A	Hillview Terrace at no 10	1.0	9.0	0.90
42	4A	Midmar Drive 28-30	1.45	9.4	0.90
43		Portobello High St (discontinued)	1.0	2.5	0.95
44		Inverleith Row (discontinued)	1.0	2.5	0.95

45		Dean Path/ Queensferry Rd (discontinued)	0.5	8.4	0.90
46		Slateford Road (discontinued)	1.0	2.5	0.95
47		Gayfield Place Leith Walk (discontinued)	0.5	2.5	0.95
48		Leith Walk at Asams (discontinued)	0.3	2.6	0.95

The factors used are based on advice provided for the Stage 3 Review and Assessment report from Duncan Laxen (Air Quality Consultants Ltd) personal communication:

0 - 2m x 0.95

2 - 5m x 0.90

> 5m x 0.75

However, more conservative factors have since been advised which are :

2 - 5m x 0.95

5 - 10m x 0.90

10- 20m x 0.75

For the purpose of this U&SA the following factors were used:

0 - 4m x 0.95

4 - 10m x 0.90

10 - 20m x 0.75

Note In all cases the factors err on the side of caution.

Appendix 1c % Data capture at real-time monitoring sites:

Pollutant	**Haymarket Terrace** **% Data capture for years 2000 to 2002**		
	2000	2001	2002
NO_2	92.0	92.4	91.6
PM_{10}	95.3	93.8	96.0

Pollutant	**Queen St /Castle St** **% Data capture for years 2000 to 2002**		
	2000	2001	2002
NO_2	94.4	91.7	92.9
PM_{10}	96.6	92.5	95.1

Pollutant	**Gorgie Rd** **% Data capture for years 2000 to 2002**		
	2000	2001	2002
NO_2	75	94	92

Pollutant	**AURN site Princes St Gardens** **% Data capture for years 2000 to 2002**		
	2000	2001	2002
NO_2	95	98	86.0
PM_{10}	96	97	82.1
CO	98	97	82.2
SO_2	98	96	86.1

Pollutant	**Leith Wlk** **% Data Capture**
	2001
NO_2	94.3
PM_{10}	99.0
CO	99.3
SO_2	96.9

Pollutant	**Hydrocarbon national network Middle Meadow Wlk** **% data capture**		
	1999	2000	2001
Benzene	93.4	93.9	91.5
1, 3- butadiene	93.3	93.9	87.4

Appendix 2 QualityAssurance /Quality Control

Staff competence

Two officers are trained as local site operators in relation to the management of the DEFRA National Network site and undertake the necessary calibrations and basic maintenance at all the automated sites. Both operators have been trained to fulfil the requirements associated with passive diffusion tube samplers.

Calibration procedures

The two ML 9841 B NO_x analysers perform an autocalibration each day with zero air and NO gas. Warning limits are set at +/- 5 % on the software program, the chemiluminesence detector model 42 and ETM200A perform an autocalibration for NO_2 using permeation tubes and a zero air check using an automatic zero air generator.

All sites are visited weekly, apart from the National Network site, which is visited fortnightly and manual calibration checks are carried out using certified NO gas at approximately 500pbb plus a zero check. All cylinders are replaced at 12 - 18 month intervals. All visits to the monitoring stations and actions taken are recorded in the logbook kept at the site.

Servicing

All instruments are serviced and recalibrated every six months by the appropriate supplier

The service contracts include a support package for software and replacement parts, plus any necessary call outs to the sites.

The TEOM heads on the automatic PM 10 units are cleaned fortnightly and filters are changed regularly

Data processing

All data, including calibration data is scrutinised on a daily basis (Monday to Friday), apart from the NO_x Model 42 which is checked weekly. However, to ensure that any drift on the Model 42 is minimised, the site is visited twice per week to check the two point autocalibration data. Should a problem be identified, then a further manual calibration with NO gas is undertaken, as it is recognised that autocalibration using permeation tubes are not as reliable as using a certified gas cylinder. All power failures, instrument breakdowns, actions and activities adjacent to the site are recorded. Any data which is considered to be erroneous is deleted.

Audit

The monitoring station located in Princes Street Gardens is part of the Automated Urban and Rural Network, (AURN). All AURN sites are subject to an independent audit and stringent QA/QC procedures which are undertaken by Casella Stanger and A.E.A Technology on behalf of DEFRA.

Details of manual calibration checks, precision and accuracy of instruments are available on request either in electronic or paper format.

Site details and type of equipment used for the remaining four automated analysers located within the AQMA are shown in table AP 1

Appendix Table 1 Council's automated monitoring equipment used for the review and assessment

Site	**NO_x analyser Model**	**PM 10**	**Supplier**	**Software**
Castle St / Queen St Rollalong	ML 9841B	TEOM Operated at 50 ^{oc}	E.M.C	Enview Data collected daily via modem
Haymarket Terrace Rollalong	ML 9841B	TEOM Operated at 50 ^{oc}	E.M.C	Enview Data collected daily via modem
Leith Walk / Cowgate Mobile trailer	AP1 M200A	BAM Operated at ambient temperatue	E.T	Enview Data collected daily via modem
Gorgie Road (White Park) Housing Police Box	Model 42 Model 142 (auto cal system)	N/A	Thermo Onix	ESC E-Das Ambient Data downloaded weekly via lab top

Additional Analysers contained within mobile trailer

Analyser	**Model**
Carbon monoxide	AP1 M300 Series Gas Filter Correlation CO analyser
Sulphur dioxide	AP1 100A Series Fluorescent SO_2 analyser
BTX hydrocarbons	Syntech spectras GC 855 monitor (hydrocarbons)

Passive Diffusion tubes

Passive diffusion tubes were supplied and analysed by Analytical and Scientific Services, City of Edinburgh Council. The laboratory is UKAS accredited for this task and participates in the Workshop Analysis Scheme for Proficiency (WASP) inter laboratory QC/QA.The laboratories performance was considered to be satisfactory over the monitoring periods 1999, 2000 and 2002.

The laboratory uses 50% v/v Triethanolanine (TEA) in acetone for the adsorbent; the grids are dipped into this solution and allowed to dry before insertion into the tube. The method has remained unchanged during the monitoring periods. Acrylic diffusion tubes were used for the exposure periods.

NO_2 diffusion tube monitoring has been conducted in accordance with the quality requirements contained in the UK NO_2 Survey Instruction Manual for local/unitary authorities and government guidance document LAQM.TG (03). Most of the diffusion tubes are located within 1 metre of the edge of the kerb, attached to sign posts/lampposts, at a height of 2.0m above ground level. All exposure times and dates are recorded and retained as paper documents. Copies of which are sent with the exposed diffusion tubes to the laboratory.
Three unexposed diffusion tubes (blanks) are also submitted with each batch of exposed tubes to check that contamination did not occur during tube preparation.

Co-located passive diffusion tubes.

Passive diffusion tubes are exposed in triplicate on the sampler head cage, on the side closest to the road. The data from the triplicate sets which show the best agreement are used to calculate the bias.

Appendix 3 Traffic Flows Edinburgh AADT Routes which have the greatest flows

Route	Location	Road category	24 AADT 2 way	% Buses HGVs
A0720 City By Pass	N 667800 E 323920	Dual	64605	10
A0720 City By Pass	N 669710 E 319330	Dual	63699	9
A0720 City By Pass	N 670550 E 318400	Dual	53860	8
A0720 City By Pass (Sighthill)	N 672450 E 317500	Dual	34320	
M0008 M8 Link Glasgow	N 671650 E 315000	Motorway	59853	9
M0008 M8 Link Glasgow	N 671400 E 310000	Motorway	57964	10
M0008 M8 Link Glasgow	N 672000 E 312550	Motorway	51247	9
M0009 M9 Link Sterling	N 673800 E 312000	Motorway	37116	11
M0009 M9 Link Sterling	N 674700 E 310900	Motorway	27862	9
M0009 M9 Link Sterling	N 675200 E 311900	Motorway	14670	15
A8 Glasgow Road at Gogar Mount	N 672335 E 315765	Dual	46988	
A90 Queensferry Road (Between Braehead Av and Cramond Bridge)	N 675262 E 317986	Dual	42469	
A90 Queen Street (East of Castle Street junction)	N 674095 E 349220	Dual	37356	2
A1 Musselburgh Bypass	N 674240 E 331280	Dual	36569	
A71 Calder Road at Sitehill Court		Dual	36280	
Lothian Road		Dual	29609 (16hrs)	
A8 Haymarket Terrace		Single	26568	15
A900 Leith Walk		Dual	26091	14
A70 Slateford Road		Dual	23654	
A199 Seafield Road		Dual	24039	
A7 Dalkeith Road		Single	20932	
Gorgie Road		Single	18235	13
A902 Ferry Road	N 676075 E 325000	Single	19000	8
Traffic data was provided by the Scottish Executive and Department of City development Edinburgh City Council. The above data was collected between the years 2000 to 2003				

Appendix 4 DMRB Inputs:

Location	Background values Obtained from UK background maps			Traffic data				
	NO_x	NO_2	PM_{10}	Distance from link centre to receptor	AADT combined	Road type	% HGV	Link
Westport	48.1	27.8		5.5	17273	B	4*	1
Dalkeith Rd	41.0	23.3		8.8	20932	A	6*	1
Westmaitland St/ junction	49.5	28.3		11.6 11.6	22330 11892	A B	14 1	2
Morningside Rd	43.3	25.9		8.6	15887	A	6.5	1
St Johns Rd/ junction	42.8	25.6		8.2 8.2	26768 9840	A B	10* 0.1	2
St Johns Rd	42.0	25.3		10.5	26768	A	10*	1
Queen St	49.6	28.4	18.0	14.0	37356	A	2	1
Haymarket Terr	47.3	27.5	16.0	9.1	26568	A	15	1

Notes:
NO_2 annual averages modelled to 2005 PM_{10} modelled to year 2010
Annual average speeds 40 Km/hour
Traffic data supplied by City Development
*Estimated based on local knowledge