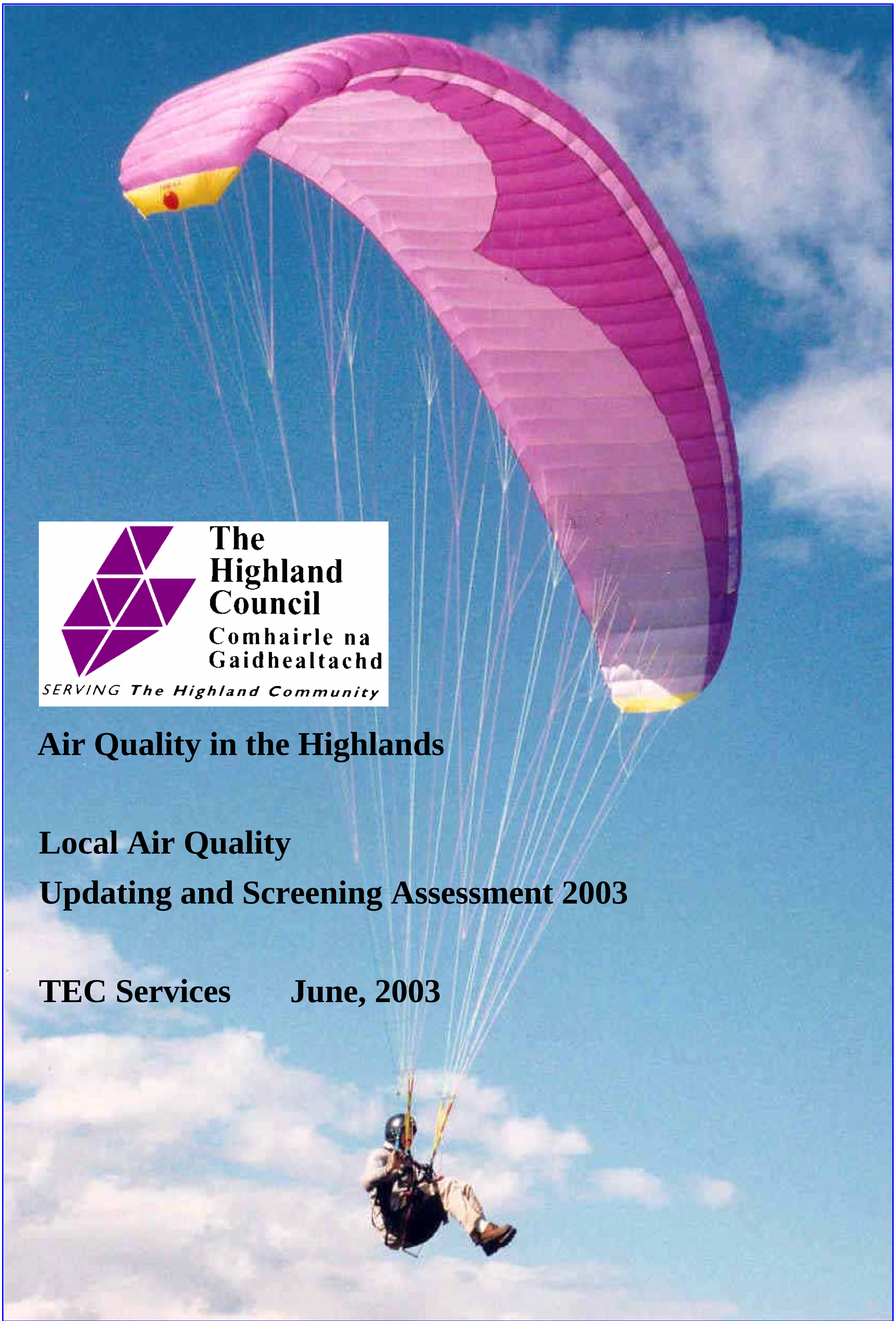


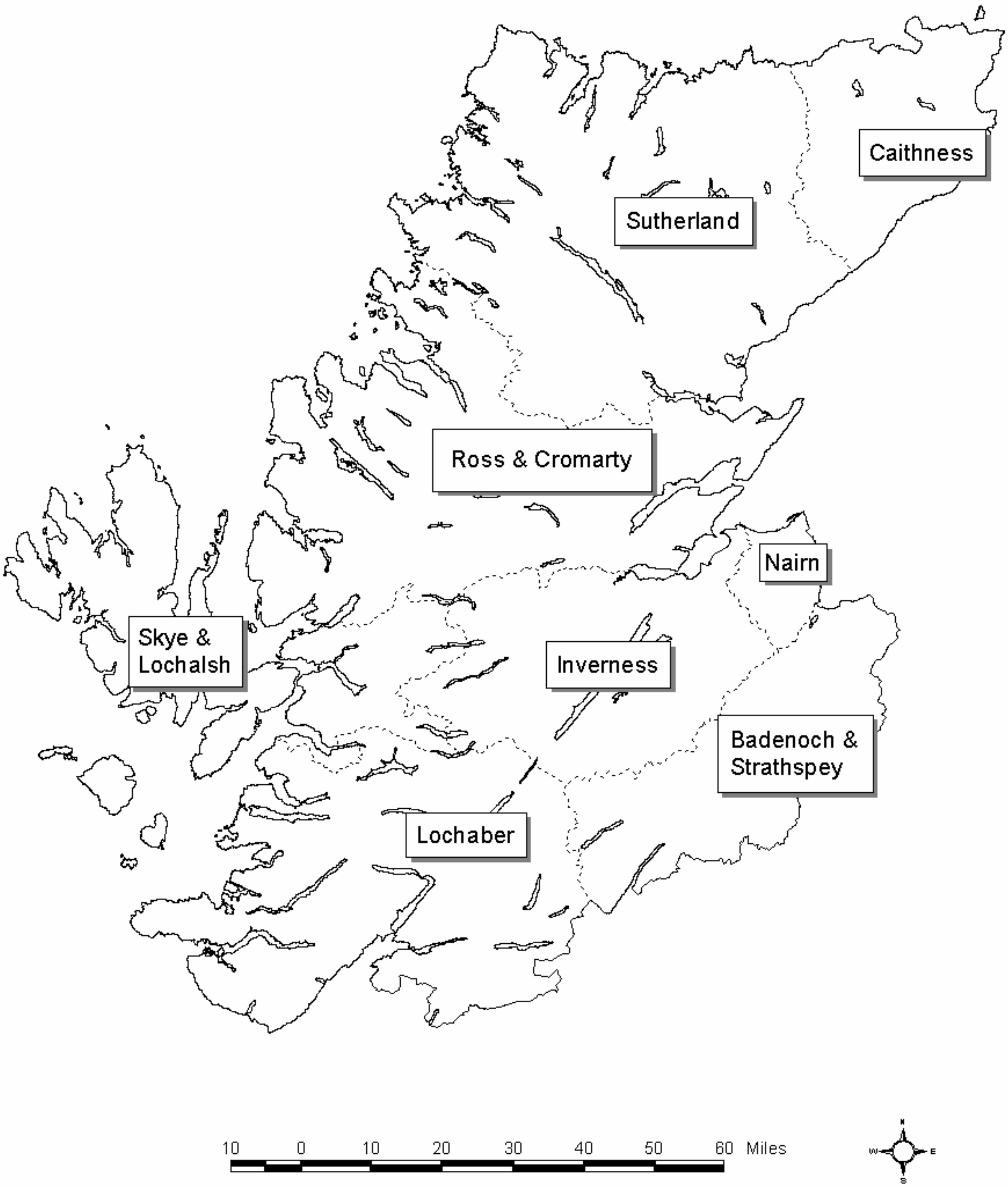
The Highland Council
Comhairle na Gaidhealtachd
SERVING The Highland Community

Air Quality in the Highlands

Local Air Quality
Updating and Screening Assessment 2003

TEC Services June, 2003

The Highland Council Areas



Map produced by the Planning & Development Service

1 CONTENTS

2 Executive Summary and Conclusions

Part IV of the Environment Act 1995 introduced Local Air Quality Management, whereby local authorities have a statutory duty to carry out reviews and assessments of local air quality from time to time. Local Air Quality Management has an important role in helping to deliver the air quality objectives which are set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (January 2000) and the Air quality (Scotland) Regulations 2000 (as amended).

The first review and assessment in Highland was completed in 1998.

The purpose of this report, the Highland Council Updating and Screening Assessment 2003 report, is to update the findings in the previous report and to assess whether any of the air quality objectives are at risk of being exceeded in Highland in the coming years up to 2010.

There are seven air pollutants which each local authority must assess. The assessment is carried out having regard to the directions in The Local Air Quality Management Technical Guidance LAQM. TG (03), which is referred to throughout this report.

Where an Updating and Screening Assessment identifies a risk that an air quality objective will be exceeded at a location with relevant public exposure, the local authority will be required to undertake a Detailed Assessment following the directions in the Technical Guidance LAQM.TG (03) document. The aim of a Detailed Assessment is to identify with reasonable certainty whether or not a likely exceedence will occur.

The main findings of the Updating and Screening Assessment are summarised below:

Pollutant	Conclusions
Carbon Monoxide **1,3-Butadiene** **Lead** **Nitrogen Dioxide** **PM_{10} (small particles)**	The screening assessment indicates that the air quality objectives for these five pollutants are likely to be met. **The Highland Council need not proceed to a Detailed Assessment.**
Benzene	The screening assessment indicates that the running annual mean air quality objective for Benzene may be exceeded in the vicinity of petrol terminals at Inverness harbour and at a petroleum refining process at Nigg. **Highland Council should proceed to a Detailed Assessment.**
Sulphur Dioxide	The screening assessment indicates that the 15 minute mean air quality objective for SO_2 may be exceeded in areas where there are high densities of houses where solid fuel is burned as the main fuel. The Technical Guidance advises that where there are complex sites, with many stacks, the screening nomograms are unlikely to be applicable, and authorities are advised to proceed to the Detailed Assessment. The ALCAN Aluminium Smelter in Fort William is one such site. **Highland Council should proceed to a Detailed Assessment.**

3 Introduction

The Department of the Environment, Transport and the Regions Air Quality Strategy for England, Scotland, Wales and Northern Ireland establishes the framework for air quality improvements.

3.1 Local Air Quality Management

Measures agreed at the national and international level are the foundations on which the strategy is based. It is recognised, however, that despite these measures, areas of poor air quality will remain, and that these will best be dealt with using local measures implemented through the Local Air Quality Management regime.

The role of the local authority review and assessment process is to identify these areas, where it is considered likely that the Air Quality Objectives will be exceeded. The experience gained from such reviews carried out throughout the UK has shown that such areas may range from single residential properties to whole town centres.

The Department for the Environment Food and Rural Affairs, Local Air Quality Management, Technical Guidance LAQM.TG(03), February 2003 builds upon the phased approach to review and assessment established in previous technical guidance, LAQM.TG4(00). The intention is that local authorities should only undertake a level of assessment that is commensurate with the risk of an air quality objective being exceeded. Not every authority will, therefore, need to proceed beyond the first step in the second round of review and assessment.

3.2 Updating and Screening Assessments

The first step of the review and assessment process is an Updating and Screening Assessment, which is to be undertaken by all authorities. This is based on a checklist to identify those matters that have changed since the first round was completed, and which may now require further assessment. This Updating and Screening Assessment should cover:

- new monitoring data;
- the new air quality objectives;
- new sources or significant changes to existing sources, either locally or in neighbouring authorities; and
- any other local changes that might affect air quality.

If there is a risk that these changes may be significant, then a simple screening assessment should be carried out. Nomograms and similar tools are provided to in the Technical Guidance to help with this screening assessment.

3.3 Detailed Assessments

Where the Updating and Screening Assessment has identified a risk that an air quality objective will be exceeded at a location with relevant public exposure, the authority will be required to undertake a Detailed Assessment following the guidance set out in the Technical Guidance. The aim of this Detailed Assessment should be to identify with reasonable certainty whether or not a likely exceedence will occur. The assumptions within the Detailed Assessment will need to be considered in depth, and the data that are collected or used, should be quality-assured to a high standard. This is to ensure that authorities are confident in the decisions they reach.

Where a likely exceedence is identified, then the assessment should be sufficiently detailed to determine both its magnitude and geographical extent.

The Detailed Assessment report, if required, should be completed by the end of April 2004. It is expected that local authorities will then undertake reviews and assessments of air quality every three years.

3.4 Future assessments

A Detailed Assessment report will be required from Highland Council and it should be completed by the end of April 2004.

Updating and Screening Assessments will be required to be submitted during the first four months of 2006 and 2009.

If required, Detailed Assessments will be required to be submitted by the end of April 2007 and 2010.

3.5 Reference publications

Full details of the Air Quality Strategy and the role of Local Air Quality Management can be found in the following publications:

1. Department of the Environment, Transport and the Regions, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Working Together for Cleaner Air, January 2000

http://www.scotland.gov.uk/environment/airquality/publications/2000/strategy/aqs2000.asp

2. Department for the Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum, February2003

http://www.scotland.gov.uk/environment/airquality/addweb.pdf

3. Department for the Environment Food and Rural Affairs, Part IV of the Environment Act 1995, Local Air Quality Management, Technical Guidance LAQM.TG(03), February 2003

http://www.scotland.gov.uk/environment/airquality/laqm.pdf

4. Scottish Executive, Part IV the Environment Act 1995, Local Air Quality Management, Revised Policy Guidance, February 2003

http://www.scotland.gov.uk/library5/environment/laqmg.pdf

3.6 Consultations

The Updating and Screening Assessment has been forwarded to the following organisations:

- The Scottish Executive, Air Quality Team,
  1-H North Victoria Quay, Edinburgh, EH6 6QQ
- The Scottish Environment Protection Agency, Graesser House, Fodderty Way,
  Dingwall Business Park, Dingwall IV15 9XB
- The Moray Council, Council Offices, High Street, Elgin IV30 1BX
- Aberdeenshire Council, Woodhill House, Westburn Road, Aberdeen AB16 5GB
- Perth and Kinross Council, Council Buildings, 2 High Street Perth PH1 5PH
- Argyll & Bute Council Headquarters, Kilmory, Lochgilphead PA31 8RT
- The Cairngorms National Park Authority, 14 The Square,
  Grantown-on-Spey, Moray, PH26 3HG
- Talisman Energy UK Ltd, Nigg Oil Terminal, Tain, Ross-Shire IV19 1QF
- BP Oil (UK) Ltd, Inverness Terminal, Cromwell Road, Inverness IV1 1SX
- Esso Petroleum Co Ltd, Inverness Terminal, Cromwell Road, Inverness IV1 1SX
- Arjo Wiggins Limited, Fort William Mill, Annat Point, Corpach PH33 7NH
- ALCAN Smelting & Power UK, Lochaber Smelter, Fort William PH33 6TH
- D & E Coaches, 8 Deveron Street, Inverness IV1 1NR
- Highland Country Buses Ltd., 1 Seafield Road, Inverness IV1 1TN
- Stagecoach, 6 Burnett Road, Inverness IV1 1TF

3.7 Contacts for further information

Further copies of the Updating and Screening Assessment will be available via the Highland Council's website at http://www.highland.gov.uk/

Or by contacting

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Highland Council TEC Services, Ross House, High St., Dingwall, IV15 9RY
Tel. No. 01349 868447 Fax. No. 01349 868594 E-mail tom.foy@highland.gov.uk

or

Coila A. Watson
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Highland Council TEC Services, Ross House, High St., Dingwall, IV15 9RY
Tel: 01349 868 490 Fax: 01349 868 594 Email: coila.watson@highland.gov.uk

4 Updating report - changes which may have an impact on air quality

4.1 Developments which influence traffic flows

The focus for the assessment of emissions from road traffic continues to be the City of Inverness. The old town centre streets (Union Street, Church Street, Queensgate & Academy Street) are congested at times and are heavily used by buses. Inverness High Street, on the other hand has been pedestrianised since the 1980s. The city has witnessed considerable development in recent years. A superstore with extensive car parking has been built on the north side of Millburn Road next to the Eastgate Centre. Phase II of the Eastgate Shopping Centre opened in March, 2003 doubling the size of the centre. This expansion is on the north side of Millburn Road and to the south of the railway station. The two phases of the Eastgate Centre are linked by a pedestrian bridge which traverse Millburn Road. The expanded centre is complemented by a fine plaza at Falcon Square.

To the east of Inverness and on the south side of the A96, the "golden mile" continues to expand. This retail park hosts a variety of stores, shops, eateries and a multiplex cinema. This stretch of the A96 is the trunk road to Aberdeen and serves the commuter areas of Balloch, Culloden and Ardersier. It is prone to congestion and tail backs at peak times.

4.2 Southern Distributor Road

The Southern Distributor Road (SDR) connects the A9 near Raigmore Hospital to the B862 road to Dores. To date, the Southern Distributor Road has had considerable impact on surrounding roads in the Drakies, Hilton and Culduthel areas, with reductions of traffic flows by at least 50%. Although not yet complete it is envisaged that connection of the SDR to the A82 at Torvean will see an equivalent reduction in freight and private traffic through the centre of Inverness with vehicles preferring to bypass the likes of Kenneth St and Glenurquhart Road in preference to a direct route to the A82 via the SDR. Vehicles from the west side of the canal will also benefit from a more direct route to the North East of Inverness without having to negotiate the city centre.

4.3 Inverness Centre Traffic Reduction and Pedestrian Priority Scheme - Phase 1

The Local Plan (Inverness, Culloden and Ardersier Local Plan) is under review. In relation to circulation and pedestrian priority the new Plan states:

“The Council proposes to extend the pedestrian priority core of the City centre to Church Street, Union Street, Queensgate and Academy Street together with Huntly Street and Ardross Street.”

Phase 1 concentrates on Union Street, Church Street, Queensgate and the associated streets and lanes within the main block of the City Centre served by Academy Street, Friars Lane and Bank Street.. This is a major part of the shopping core of Inverness. It suffers from traffic congestion, a very poor pedestrian environment, traffic noise and fumes, and an unattractive streetscape.”

A map of this area is found at **Annex 6** and photographs of Queensgate and Union Street at Figure 9.16 and Figure 9.17 respectively.

The aims of Phase 1 are:

- To reduce traffic in Union Street, Church Street and Queensgate by 75% by restricting traffic to buses, taxis, disabled vehicles, delivery vehicles and cycles.
- To enhance the pedestrian environment in these streets by re-allocating road space.

- To reduce the three vehicle lanes to two in Union Street, Queensgate and that part of Church Street linking them, and to provide one running lane and one lane for bus stops, loading and disabled parking.

The key elements of Phase 1 will require during the day (08.00 to 18.00 Monday to Saturday and 12.00 to 17.00 on Sundays) the following new traffic restrictions:

- Access only by buses, taxis, pedal cycles and disabled drivers' vehicles, delivery vehicles, and badge holders/specified vehicles.
- No access at all by private cars and motor cycles during this period.
- No access for delivery vehicles during the period 10.00 to 16.00 during weekdays, and 10.00 to 18.00 on Saturdays.
- Loading during the permitted period to be limited to the designated loading bays.
- Disabled drivers' vehicles to be parked only in the designated parking bays and in the loading bays during the no loading period.

None of these restrictions will apply in the evening period from 18.00 to 08.00 when all vehicles will be allowed access to the streets and parking will be permitted in the loading bays.

Bus stops will be reduced from their present number and buses will be discouraged from waiting. As compensation more stops will be provided for local bus services in the northern part of Church Street after the Fraser Street junction, and on Academy Street. In order to re-route buses from these streets a right turning egress will be introduced from Margaret Street.

On street short stay parking spaces, of which there are 30 at present, will be removed from the area.

The aim is to have the contract complete by April 2005.

4.4 Cross Rail Link

The Cross Rail link is programmed for the near future. This new section of road will allow the bypassing of the City centre streets such as Academy St etc, to gain access to the Eastgate shopping development and Safeway Store. The road will connect the A82 at the Inverness College to Millburn Road east of the new Safeway superstore.

4.5 Industrial processes

The Scottish Environment Protection Agency (SEPA) has regulatory responsibility for certain prescribed processes and for landfill sites in Scotland. In order to assist authorities in the compilation of data related to these processes, SEPA have committed to provide information on any changes that may affect emissions from existing processes, and any new processes that have been, or will be, authorised.

On Friday 30th May 2003, the Scottish Environment Protection Agency (SEPA) published emissions data to a new section of its website, at http://www.sepa.org.uk/data/eper/mainpage.htm

This is the first stage in SEPA's contribution to the European Pollutant Emission Register (EPER), which aims to provide an easily accessible, consistent and comprehensive view of what emissions are being made to the environment.

Guidance on the European Pollutant Emission Register can be found at:

http://www.sepa.org.uk/data/eper/pdf/ec_guidance_eper_implementation.pdf

From August this year SEPA will expand the service to provide an easy-to-use search facility for this information using maps and postcodes. The Agency will also be collecting more information from a much wider list of industrial activity next year, including data on water quality,

SEPA's aim is to provide fair and open regulation of industry so Scotland's economy can prosper whilst the ensuring environment is safeguarded and improved. Providing information to the public about this is an essential part of achieving that aim and the development of EPER is a big step in that direction.

EPER is a factual reporting of data, required by European legislation. Inclusion in the Register does not imply that companies have breached their limits for emissions.

SEPA regulates sites under Pollution Prevention Control (PPC) legislation, sets conditions and limits for emissions for individual sites and will take appropriate enforcement action if authorisations are breached.
Notes:

- EPER contains data on the reporting thresholds of 50 chemical totals released in 2002, as part of regulated processes.
- SEPA believes making EPER available to the public will build awareness of the importance of a clean environment, and help to indicate and enhance industries' transparency and comparability.

Figure 4.1 Air Quality Pollutants which are reported in EPER

List of Air Quality Strategy pollutants to be reported in the European Pollutant Emission Register if the threshold value is exceeded	
Pollutants	**Thresholds for emissions to air in kg/yr**
Carbon monoxide	500,000
NOx as Nitrogen dioxide	100,000
SOx as Sulphur dioxide	150,000
Benzene	1,000
PM_{10}	50,000

Of the five companies in Highland which are found on the register, SGL Technic Ltd, Muir Of Ord Industrial Estate, Muir Of Ord, Ross-Shire IV6 7UA and UKAEA, Dounreay, Thurso, Caithness KW14 7TZ do not emit "air quality strategy" pollutants above the threshold value for registration with EPER.

Three companies have registered emissions for "air quality strategy" pollutants. Details from the register are shown in Figure 4.2.

Figure 4.2 European Pollutant Emission Register extracts

Company Name	**ALCAN ALUMINIUM UK LIMITED**
Address: ALCAN Smelting & Power UK, Lochaber Smelter, Fort William, Inverness-shire	
Postcode	PH33 6TH
NGR	NN 124 749
NACE code (economic activity)	Aluminium production
Substances	**To Air (kg)**
SOx (sulphur oxides) as Sulphur dioxide	782,000 (Calculated)
Company Name	**ARJO WIGGINS LIMITED**
Address: Arjo Wiggins Limited, Fort William Mill, Annat Point, Corpach	
Postcode	PH33 7NH
NGR	NN 084 768
NACE code (economic activity)	Manufacture of paper and paperboard
Substances	**To Air (kg)**
NOx (nitrogen oxides) as Nitrogen dioxide	139,000 (Measured)
SOx (sulphur oxides) as Sulphur dioxide	812,000 (Measured)
Company Name	**TALISMAN ENERGY (UK) LIMITED**
Address: Talisman Energy UK Ltd, Nigg Oil Terminal, Tain, Ross-Shire.	
Postcode	IV19 1QF
NGR	NH 792 705
NACE code (economic activity)	Manufacture of refined petroleum products
Substances	**To Air (kg)**
Benzene	6,730 (Estimated)

The screening of the emissions from these companies is described in the sections of this report which deal with the particular pollutants.

5 Carbon monoxide (CO)

5.1 Where does it come from?

The main source of carbon monoxide in the United Kingdom is road transport, which accounted for 67% of total releases in 2000 (the most recent year for which estimates are available). Annual emissions of carbon monoxide have been falling steadily since the 1970s, and are expected to continue to do so. Current projections indicate that road transport emissions will decline by a further 42% between 2000 and 2005.

5.2 How can it affect our health?

The main threats to human health from exposure to carbon monoxide are the formation of carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen and deliver it to the tissues, and blockage of important biochemical reactions in cells. People who have an existing disease which affects the delivery of oxygen to the heart or brain (e.g. coronary artery disease (angina)) are likely to be at particular risk if these delivery systems are further impaired by carbon monoxide.

5.3 The Air Quality Objective for Carbon monoxide

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health.

The air quality objective for Carbon monoxide is shown in Figure 5.1.

Figure 5.1 Air Quality Objective for Carbon monoxide

Applies to	**Objective**	**Measured as**	**Date to be achieved by**
Scottish Local Authorities	10 mg/m^3	Running 8-hour mean	31 December 2003

5.4 Estimated Background Concentrations of Carbon monoxide

Estimated annual mean background concentrations for 2001 have been mapped for the UK, and can be accessed from the internet at the following address (**www.airquality.co.uk/archive/laqm/tools.php**).

In the Highland Council area, the estimated annual mean background concentrations for Carbon monoxide are shown in Figure 5.2.

Figure 5.2 Estimated Annual Mean Background Concentrations for Carbon monoxide in Highland

Carbon monoxide	Estimated annual mean background concentration (mg/m^3)		
Year	Minimum	Maximum	Average
2001	0.1	0.2	0.11

5.5 Where should the air quality objectives for Carbon monoxide apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are listed in Figure 5.3

Figure 5.3 Relevant Locations for Carbon monoxide

Carbon monoxide running 8-hour mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc. Gardens of residential properties.
Objective should generally not apply at:	Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.

5.6 The updating and screening checklist

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when carrying out screening assessment.

For Carbon monoxide, the checklist comprises:-

Figure 5.4 Updating and screening checklist for Carbon monoxide

Section reference	Source, location or data that needs to be assessed
A	Monitoring data
B	Very Busy Roads

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

A MONITORING DATA

A.1 National monitoring

Carbon monoxide is monitored automatically at Telford Street, Inverness as part of the UK Automatic Urban and Rural Network. Data collected from national monitoring networks are expected to give a more accurate indication of carbon monoxide concentrations than modelling studies. For the review and assessment of carbon monoxide, only monitoring data collected at roadside sites need be considered This site is classed as a roadside site. See **Annex 1** for details of the monitoring station.

Automatic monitoring commenced in July 2001. In 2002, the data capture of hourly means was 94.3%. This is above the acceptable minimum of 90% data capture specified in Local Air Quality Management Technical Guidance LAQM. TG(03). The data has been fully ratified by NETCEN.

Figure 5.5 Inverness Automatic Urban Network Monitoring Site - Data Summary 2002

Pollutant	**CO mg/m^3**
Maximum 15-minute mean	7.54
Maximum hourly mean	4.06
Maximum running 8-hour mean	**2.32 (10)[1]**
Maximum running 24-hour mean	1.5
Maximum daily mean	1.39
Average of hourly means (equivalent to the annual mean)	0.46

[1]The numbers in brackets is the running 8-hour mean air quality objective. There were no exceedences of the objective in 2002.

An evaluation of monitoring data from national network sites has indicated a poor relationship between the annual mean concentration and the maximum daily running 8-hour mean. It is therefore not practicable to adjust the measured maximum daily running 8-hour concentration forwards to 2003. For this step of the assessment, authorities should assume that the measured concentration in the year of monitoring is applicable to 2003.

Local authorities need only proceed to a Detailed Assessment if the maximum running 8-hour mean is greater than 10 mg/m^3. In 2002, the maximum running 8-hour mean at Telford Street was 2.32 mg/m^3.

A.2 Local monitoring

No Carbon monoxide monitoring is undertaken by Highland Council.

Studies at a national level, based on both measured and modelling data, suggest that there is little likelihood of the new objective for carbon monoxide being exceeded by 2003. There is no need to monitor this pollutant at a local level.

B VERY BUSY ROADS

B.1 Busy roads and junctions

Local authorities are required to consider Carbon monoxide emissions at busy roads and junctions where the 2003 background concentration is likely to exceed 1 mg/m^3.

The maximum 2003 background concentration has been calculated in Highland from data which has been downloaded from (**www.airquality.co.uk/archive/laqm/tools.php**) as a comma separated (csv) file. This includes estimated 2001 annual mean background concentrations for Carbon monoxide. The 2001 background concentrations range from 0.1 to 0.2 mg/m^3 with an average value of 0.11 mg/m^3.

The background concentration has been corrected to 2003 by multiplying the 2001 concentration by 0.826 (as per the Technical Guidance). Thus, the maximum background concentration of Carbon monoxide in Highland in 2003 is estimated to be 0.16 mg/m^3, which is considerably less than the 1 mg/m^3 which is the trigger for an assessment of very busy roads and junctions.

Moreover, in this context , a "very busy" road is defined as:

• Single carriageway roads with daily average traffic flows which exceed 80,000 vehicles per day.

• Dual carriageway (2 or 3-lane) roads with daily average traffic flows which exceed 120,000 vehicles per day.

• Motorways with daily average traffic flows which exceed 140,000 vehicles per day.

When junctions are considered, the flows of each part of the junction are added.

There are no roads or junctions in Highland which meet the above criteria. The busiest road in Highland is the A9 dual carriageway section between Raigmore Interchange and Kessock Bridge. The estimated annual average daily traffic flow in 2003 is 33,660 vehicles. The road junction at the Raigmore Interchange is a key route into Inverness. At that junction, the A96 trunk road (main route east to Aberdeen) joins the A9 trunk road (main route to the North and South). When flows are added the junction is estimated to have an annual average daily average traffic flow in 2003 of 68,130.

5.7 Conclusions for the screening of Carbon monoxide

In the Highland Council area, background concentrations of Carbon monoxide are very low. Traffic flows on roads in the area are such that there is little likelihood of the air quality objective being exceeded. **There is no need to proceed to a Detailed Assessment.**

6 Benzene

6.1 Where does it come from?

The main sources of benzene emissions in the UK are petrol-engined vehicles, petrol refining, and the distribution and uncontrolled emissions from petrol station forecourts without vapour recovery systems. A number of policy measures already in place, or planned for future years, will continue to reduce emissions of benzene. Since January 2000, EU legislation has reduced the maximum benzene content of petrol to 1%, from a previous upper limit of 5%. The European Auto-Oil programme will further reduce emissions for cars and light-duty vehicles, and emissions of benzene from the storage and distribution of petrol are controlled by vapour recovery systems.

6.2 How can it affect our health?

Benzene is a recognised genotoxic human carcinogen. Studies of industrial workers exposed in the past to high levels of benzene have demonstrated an excess risk of leukaemia which increased in relation to their working lifetime exposure. Because it is a genotoxic carcinogen, no absolutely safe level can be specified for ambient air concentrations of benzene. In their 1994 report, the Expert Panel On Air Quality Standards (EPAQS) recommended an air quality standard of 5ppb (16.25µg/m^3) as a running annual mean, a level which they concluded represents an exceedingly small risk to health. In their report, EPAQS considered the advice of the Department of Health's Committee on Carcinogenicity, that exposure to benzene should be kept as low as practicable, and recommended a target of 1ppb (3.25 µg/m^3), also as a running annual mean.

6.3 The Air Quality Objectives for Benzene

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objectives for Benzene are shown below.

Figure 6.1 Air Quality Objectives for Benzene

Applies to	**Objective**	**Measured as**	**Date to be achieved by**
All Local Authorities	16.25µg/m3	running annual mean	31 December 2003
Scottish Local Authorities	3.25 µg/m^3	running annual mean	31 December 2010

6.4 Estimated Background Concentrations

Estimated annual mean background concentrations for 2001, 2003 and 2010 have been mapped for the UK, and can be accessed from the internet at:
www.airquality.co.uk/archive/laqm/tools.php.

In the Highland Council area, the estimated annual mean background concentrations for Benzene are shown in Figure 6.2.

Figure 6.2 Estimated Annual Mean Background Concentration for Benzene in Highland

Benzene	**Estimated annual mean background concentration ($\mu g/m^3$)**		
Year	Minimum	Maximum	Average
2001	0.010	0.300	0.026
2003	0.009	0.300	0.024
2010	0.007	0.250	0.021

6.5 Where should the air quality objectives for Benzene apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are described in Figure 6.3.

Figure 6.3 Relevant locations for Benzene

Benzene running annual mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.
Objective should generally not apply at:	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term

6.6 The updating and screening checklist

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment.

In the case of Benzene, the checklist comprises:-

Figure 6.4 Updating and screening checklist for Benzene

Section reference	Source, location or data that needs to be assessed
A	Monitoring data
B	Very busy roads or junctions in built-up areas
C	Industrial sources
D	Petrol stations
E	Major fuel storage depots (petroleum only)

A MONITORING DATA

A.1 National monitoring

There are no Automatic Urban and Rural Network monitoring stations in the Highland Council area at which Benzene is monitored.

A.2 Local monitoring

No Benzene monitoring is undertaken by Highland Council.

B VERY BUSY ROADS OR JUNCTIONS IN BUILT-UP AREAS

B.1 Very busy roads and junctions in built up areas

Local authorities are required to consider Benzene emissions at busy roads and junctions where the 2003 background concentration is likely to exceed 2 $\mu g/m^3$.

The maximum background concentration of Benzene in Highland in 2003 is estimated to be 0.3 $\mu g/m^3$, which is considerably less than the 2 $\mu g/m^3$ which is the trigger for an assessment of very busy roads and junctions.

Moreover, in this context , "very busy" is defined as:

• Single carriageway roads with daily average traffic flows which exceed 80,000 vehicles per day.

• Dual carriageway (2 or 3-lane) roads with daily average traffic flows which exceed 120,000 vehicles per day.

• Motorways with daily average traffic flows which exceed 140,000 vehicles per day.

(Flows are added at junctions in each case.)

There are no roads or junction in Highland which meet the above criteria. The busiest road in Highland is the A9 dual carriageway section between Raigmore Interchange and Kessock Bridge. The estimated annual average daily traffic flow in 2003 is 33,660 vehicles. The road junction at the Raigmore Interchange is a key route into Inverness. At that junction, the A96 trunk road (main route east to Aberdeen) joins the A9 trunk road (main route to the North and South). When flows are added the junction is estimated to have an annual average daily average traffic flow in 2003 of 68,130.

In Highland, the low background concentrations of Benzene and the relatively low traffic flows indicate that no further screening of Benzene emissions from road traffic is necessary.

C INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area. However, the Technical Guidance advises that local authorities may also wish to consider checking information derived from their first round of review and assessment if there were any doubts regarding their validity.

In view of the information that is available on mass emissions in the European Pollutant Emission Register, (see 4.5 above) screening has been carried out for an industrial process at Nigg Oil Terminal in Ross and Cromarty.

Company Name	**TALISMAN ENERGY (UK) LIMITED**
Address: Talisman Energy UK Ltd, Nigg Oil Terminal, Tain, Ross-Shire.	
Postcode	IV19 1QF
NGR	NH 792 705
NACE code (economic activity)	Manufacture of refined petroleum products
Substances	**To Air (kg)**
Benzene	6,730 (Estimated)

The Technical Guidance advises that screening for Benzene emissions can be carried out by using two nomograms in the guidance.

To use the nomograms (Figures 3.3 and 3.4 in the Technical Guidance) it is necessary to estimate:

- the rate of emission of benzene in tonnes per annum
- the stack height (assumed to be zero for fugitive emissions)

Benzene emissions at this process are assumed to be mainly through displacement losses i.e. fugitive emissions and not through a stack.

The Guidance goes on to say:

"To use the nomograms, identify the line which corresponds to the height of the stack under consideration (assume zero for a fugitive emission), and locate the point on this line whose coordinates equal the closest relevant receptor location. Figure 3.3 should be used for assessment of the 2003 objective, and Figure 3.4 for the 2010 objective. Read off the corresponding emission rate on the vertical axis, and compare this with the actual emission rate for the process. If the actual emission rate is greater than or equal to the emission rate derived from the chart, the authority should proceed to a Detailed Assessment."

In the case of the emissions from Talisman Energy UK Ltd at Nigg Oil Terminal, the European Pollutant Emission Register record these as being 6.73 tonnes. As there is no point source to use to calculate a separation distance, a nominal separation distance of 300 m was used in the nomogram for the 2003 air quality objective. There are dwellings within that vicinity of the site.

On the vertical axis, the corresponding emission rate at 300m was equivalent to the actual emission rate for the process.

However, when the nomogram for the 2010 was used, the corresponding emission rate was less than 1 tonne per annum whereas, the actual emission rate from the site is currently 6.73 tonnes. As this is greater than the emission rate derived from the chart, the Highland Council should proceed to a Detailed Assessment.

D PETROL STATIONS

D.1 Impact of Petrol Stations

The potential impact of emissions arising from petrol stations has been recently investigated by DEFRA and the Devolved Administrations. There are two possible major sources of benzene from evaporative emissions at petrol stations. The first when petrol vapour is displaced when filling underground storage tanks, termed Stage 1 emissions. The second when petrol vapour is displaced from vehicle petrol tanks during refuelling, termed Stage 2 emissions.

All petrol stations with a petrol throughput of greater than 1000m^3 /annum were required to fit Stage 1 vapour recovery before 1 January 1999. Petrol stations with a throughput of less than 1000 m^3 /annum are very unlikely to have any significant effect on the local concentrations of benzene. Stage 1 emissions are therefore, unlikely to have any significant influence on concentrations of benzene in the vicinity of petrol stations. As yet there are no legal requirements to fit Stage 2 vapour recovery systems at petrol stations.

A 12 month study 2 of concentrations of benzene in the vicinity of petrol stations 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:

• the petrol throughput is less than 2000m^3 /annum (2 million litres per annum)

• the petrol distribution pumps are more than 10m from residential properties, either horizontally or vertically. Petrol stations located immediately below residential properties may result in elevated concentrations of benzene in the vicinity of the residential property. (The presence of a canopy seems to have little effect on the concentration of benzene in the immediate vicinity of petrol stations.)

D.2 Screening criteria for Petrol Stations

Local authorities are required to identify all petrol stations with an annual throughput of more than 2,000 m^3 of petrol (2 million litres per annum) and with a busy road nearby. A busy road can be taken to be one with more than 30,000 vehicles per day. Thereafter, the local authority must determine whether there is relevant exposure i.e. residential properties within 10m of the pumps.

D.3 Petrol stations in Highland

Information was collected from Highland Councils' TECS Services Trading Standards section on the throughput of petrol per annum at petrol stations in Highland. 17 petrol stations had annual throughputs in excess of 2 million litres per annum. The petrol station with the highest throughput was around 10 million litres per annum. To err on the side of caution, 4 petrol stations which had annual throughputs of between 1.5 and 2 million litres per annum were also considered, as were 10 petrol stations for which the annual throughput was not known. A total of 31 petrol stations were screened for the presence of adjacent residential properties within 10m of any petrol pump.

Firstly, the location of the petrol stations was considered. Only one of them, is located on a road where the annual average daily average traffic flow is currently around 30,000, namely the Kessock Service Station on Longman Road, Inverness.

However, this part of the inner relief road passes through the Longman Industrial Estate and there are no residential properties in the vicinity.

Secondly, the local knowledge of Environmental Health Officers was drawn upon to identify whether any of the 31 petrol stations were near to residential properties. In the few cases where there was uncertainty, These petrol stations were cross checked by using a GIS mapping system to measure the separation distances. None of the petrol pumps at the 31 petrol stations were found to be within 10m of any residential properties.

In Highland, there are no petrol pumps alongside busy roads and within 10 m of any residential property. There is no need to proceed to a Detailed Assessment for petrol stations.

E MAJOR FUEL STORAGE DEPOTS (PETROLEUM ONLY)

In Scotland, the storage, transport, loading and unloading of petrol at terminals is regulated by the Scottish Environment Protection Agency. Petrol terminals are required to control emissions by technical measures which include vapour recovery systems – “Stage 1” controls.

Stage I petrol vapour recovery concerns the control of volatile organic compounds (VOC) emissions, which include benzene, during the storage, transport, loading and unloading of petrol at terminals and service stations. Stage I controls are implemented in the UK in accordance with EU Directive EC/94/63 as prescribed processes under Part 1 of the Environment Protection Act 1990. The Directive applies to terminals, transport containers (road, rail and inland waterway) and petrol service stations. It requires the establishment of a closed system under which petrol vapour is recovered and regenerated back into petrol. Implementation of the Directive is in four stages spreading a period of nine years to the final deadline of 31 December 2004.

There are four major fuel storage depots in Highland which are listed in Annex 2 of Technical Guidance LAQM.TG(03) These are as shown in Figure 6.5.

Figure 6.5 Petrol terminals (major fuel storage depots)

Process operator	**Location of Depot**	**Post Code**	**Easting**	**Northing**	**Size**
BP Oil (UK) Ltd	Fort William	PH33 6LR	211311	774411	Small
BP Oil (UK) Ltd	Portree, Skye	IV51 9XP	139745	864749	Small
BP Oil (UK) Ltd	Inverness Terminal Cromwell Road, Inverness	IV1 1SX	266489	846341	Large
Esso Petroleum Co Ltd	Inverness Terminal Cromwell Road, Inverness	IV1 1SX	266489	846341	Large

To screen the terminals for the emission of Benzene, Technical Guidance LAQM.TG(03) requires that information of annual emissions from the terminals should be sought from the Emissions Helpdesk.

The Helpdesk advised that the estimated emissions in 2001 from each of the terminals was estimated to be :

- BP Oil (UK) Ltd, Fort William 0.01421 tonnes per annum
- BP Oil (UK) Ltd, Portree, Skye 0.01421 tonnes per annum
- BP Oil (UK) Ltd, Inverness Terminal 0.5415 tonnes per annum
- Esso Petroleum Co Ltd, Inverness Terminal 0.5415 tonnes per annum

With estimated emissions of 0.01421 tonnes per annum, the smaller storage facilities at Fort William and Portree will not lead to exceedences of the air quality objectives at relevant locations. When screened against the nomograms in the Technical Guidance, it is seen that exceedences would only be likely if there were relevant locations within 10m of the storage facilities. There are no relevant locations within 10m.

The two larger petrol terminals are situated next to each other at Cromwell Road, Inverness.

It could be argued that, as fugitive emissions are being considered, the estimated annual emission rates for each terminal should be combined to give an annual emission rate of around 1 tonne per annum. However, the figure of 0.5415 tonnes per annum was used in the screening nomograms As a variation of the procedure described in the Technical Guidance and in the section on industrial processes in section C above, it was assumed that the actual emission rate equaled the estimated emission rate on the vertical axis of the nomogram. Working backwards to the separation distance on the horizontal axis it was possible to estimate how far houses would have to be from the terminals to be outwith the risk of there being an exceedence of the air quality objectives.

A annual emission of 0.5415 tonnes, when set against the nomograms indicate:

- relevant locations which are less than 100 m from either of the terminals could experience benzene levels in excess of the air quality objective for 2003;
- relevant locations which are less than 200 m from either of the terminals could experience benzene levels in excess of the air quality objective for 2010.

As there are dwellings within the above distances from the terminals, a Detailed Assessment of benzene emissions is required at this location.

6.7 Conclusions for the screening of Benzene

In the Highland Council area, background concentrations of Benzene are very low. There is little likelihood of the air quality objective being exceeded in most areas.

The screening assessment indicates that the running annual mean air quality objective for Benzene may be exceeded in the vicinity of petrol terminals at Inverness harbour and at a petroleum refining process at Nigg.

A Detailed Assessment of benzene emissions is required in the vicinity of the petrol terminals at Inverness harbour and the petroleum refining process at Nigg.

7 1,3-butadiene

7.1 Where does it come from?

The main source of 1,3-butadiene in the United Kingdom is emissions from motor vehicle exhausts.

1,3-butadiene is also an important industrial chemical and is handled in bulk at a small number of industrial premises.

The increasing numbers of vehicles equipped with three way catalysts will significantly reduce emissions of 1,3-butadiene in future years. Recently agreed further reductions in vehicle emissions and improvements to fuel quality, including those as part of the Auto-Oil programme, are expected to further reduce emissions of 1,3-butadiene from vehicle exhausts.

7.2 How can it affect our health?

The health effect which is of most concern in relation to 1,3-butadiene exposure is the induction of cancers of the lymphoid system and blood-forming tissues, lymphomas and leukaemias. Like benzene, 1,3-butadiene is a genotoxic carcinogen, and so no absolutely safe level can be defined. The Expert Panel On Air Quality Standards nevertheless believed that a standard could be set at which any risks to the health of the population are exceedingly small.

7.3 Air Quality Objective for 1,3-Butadiene

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objective for 1,3-Butadiene is shown in below.

Figure 7.1 The Air Quality Objective for 1,3-Butadiene

APPLIES TO	Objective	Measured as	Date to be achieved by
All Local Authorities	2.25 µg/m³	Running annual mean	31 December 2003

7.4 Estimated Background Concentrations

Estimated annual mean background concentrations for 2001 and 2003 have been mapped for the UK, and can be accessed from the internet at www.airquality.co.uk/archive/laqm/tools.php.

In the Highland Council area, the estimated annual mean background concentrations for 1,3-butadiene are shown in Figure 7.2.

Figure 7.2 Estimated Annual Mean Background Concentration for 1,3-butadiene in Highland

1,3-butadiene	**Estimated annual mean background concentration (mg/m³)**		
Year	Minimum	Maximum	Average
2001	0.006	0.097	0.011
2003	0.005	0.800	0.010

7.5 Where should the air quality objectives for 1,3-Butadiene apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are listed below.

Figure 7.3 Relevant locations for 1,3-butadiene

1,3-butadiene running annual mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.
Objective should generally not apply at:	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.

7.6 The updating and screening checklist

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment.

In the case of 1,3-Butadiene, the checklist comprises:-

Figure 7.4 Updating and screening checklist for 1,3-butadiene

Section reference	Source, location or data that needs to be assessed
A	Monitoring data
B	New industrial sources
C	Existing industrial sources with significantly increased emissions

A MONITORING DATA

A.1 National monitoring

1,3-butadiene is not monitored at national level within the Highland Council area.

A.2 Local monitoring

No 1,3-butadiene monitoring is undertaken by Highland Council.

B NEW INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area.

C INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS

The Scottish Environment Protection Agency has advised that, in respect of the processes which it regulates, there have been no changes since the last review and assessment that may adversely affect air quality in the Highlands.

7.7 Conclusions for the screening of 1,3-butadiene

In the Highland Council area, background concentrations of 1,3-butadiene are very low. There is little likelihood of the air quality objective being exceeded. **There is no need to proceed to a Detailed Assessment for 1,3-butadiene.**

8 Lead

8.1 Where does it come from?

As the compound tetraethyl lead, it has been used as a petrol additive to enhance the octane rating. The agreement reached between the European Parliament and the Environment Council on the Directive on the Quality of Petrol and Diesel Fuels (part of the Auto-Oil Programme) has led to the ban on sales of leaded petrol in the United Kingdom with effect from 1 January 2000.

Emissions of lead are now restricted to a variety of industrial activities, such as battery manufacture, pigments in paints and glazes, alloys, radiation shielding, tank lining and piping.

8.2 How can it affect our health?

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

8.3 The Air Quality Objectives for Lead

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objectives for Lead are shown in Figure 8.1.

Figure 8.1 The Air Quality Objectives for Lead

Applies to	Objective	MEASURED AS	Date to be achieved by
All Local Authorities	0.5 µg/m³	annual mean	31 December 2004
	0.25 µg/m³	annual mean	31 December 2008

8.4 Estimated Background Concentrations

No estimated annual mean background concentrations for Lead (Pb) have been mapped for the UK.

8.5 Where should the air quality objectives for Lead apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are described in Figure 8.2.

Figure 8.2 Relevant locations for Lead

Lead annual mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.
Objective should generally not apply at:	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.

8.6 The updating and screening checklist

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment.

In the case of Lead, the checklist comprises:-

Figure 8.3 Updating and screening checklist for Lead

Section reference	Source, location or data that needs to be assessed
A	Monitoring data outside an Air Quality Management Area
B	New industrial sources
C	Industrial sources with significantly increased emissions

A MONITORING DATA OUTSIDE AN AIR QUALITY MANAGEMENT AREA

A.1 National monitoring

Lead is not monitored at national level within the Highland Council area.

A.2 Local monitoring

No lead (Pb) monitoring is undertaken by Highland Council.

B NEW INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area.

C INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS

The Scottish Environment Protection Agency has advised that, in respect of the processes which it regulates, there have been no changes since the last review and assessment that may adversely affect air quality in the Highlands.

8.7 Conclusions for the screening of Lead

In the UK, background concentrations of Lead are very low. There is little likelihood of the air quality objective being exceeded in Highland.

A Detailed Assessment of lead (Pb) is not required.

9 Nitrogen dioxide (NO_2)

9.1 Where does it come from?

Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as nitrogen oxides (NOx). All combustion processes produce NOx emissions, largely in the form of nitric oxide, which is then converted to nitrogen dioxide, mainly as a result of reaction with ozone. Nitrogen dioxide is produced both directly as a primary and indirectly as a secondary pollutant owing to the spontaneous conversion of NO to NO2 in the presence of ozone or oxygen. It is nitrogen dioxide (NO_2) that is associated with adverse effects upon human health.

The principal source of nitrogen oxides emissions is road transport, which accounted for about 49% of total UK emissions in 2000. Major roads carrying large volumes of high-speed traffic (such as motorways and other primary routes) are a predominant source, as are conurbations and city centres with congested traffic. Within most urban areas, the contribution of road transport to local emissions will be much greater than for the national picture. As an example, road transport is estimated to account for more than 75% of nitrogen oxides emissions in London.

The contribution of road transport to nitrogen oxides emissions has declined significantly in recent years as a result of various policy measures, and further reductions are expected up until 2010 and beyond. For example, urban traffic nitrogen oxides emissions are estimated to fall by about 20% between 2000 and 2005, and by 46% between 2000 and 2010.

Other significant sources of nitrogen oxides emissions include the electricity supply industry and other industrial and commercial sectors, which accounted for about 24% and 23% respectively in 1999. Emissions from both sources have also declined dramatically, due to the fitting of low nitrogen oxides burners, and the increased use of natural gas plant. Industrial sources make only a very small contribution to annual mean nitrogen dioxide levels, although breaches of the hourly nitrogen dioxide objective may occur under rare, extreme meteorological conditions, due to emissions from these sources.

9.2 How can it affect our health?

At relatively high concentrations, nitrogen dioxide causes inflammation of the airways. There is evidence to show that long-term exposure to nitrogen dioxide may effect lung function and that exposure to nitrogen dioxide enhances the response to allergens in sensitised individuals.

9.3 The Air Quality Objectives for Nitrogen dioxide

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objective for Nitrogen dioxide are shown in Figure 9.1.

Figure 9.1 The Air Quality Objectives for Nitrogen dioxide

Applies to	Objective	Measured as	Date to be achieved by
All Local Authorities	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31 December 2005
	40 $\mu g/m^3$ (21ppb)	annual mean	31 December 2005

9.4 Estimated Background Concentrations

Estimated annual mean background concentrations for 2001, 2005 and 2010 have been mapped for the UK, and can be accessed from the internet at **www.airquality.co.uk/archive/laqm/tools.php**.

In the Highland Council area, the estimated annual mean background concentrations for Nitrogen dioxide are shown in Figure 9.2.

Figure 9.2 Estimated Annual Mean Background Concentration for Nitrogen dioxide in Highland

Nitrogen dioxide	Estimated annual mean background concentration (mg/m3)		
Year	**Minimum**	**Maximum**	**Average**
2001	1.07	13.60	2.08
2005	0.92	11.60	1.78
2010	0.78	15.30	1.49

Estimated annual mean background concentrations for 2001, 2005 and 2010 have also been mapped for NOx (as NO_2). There is no air quality objective for the oxides of nitrogen other than NO2. However, Nitrogen dioxide is produced indirectly as a secondary pollutant owing to the spontaneous conversion of NO to NO2 in the presence of ozone or oxygen. For this reason, the estimated background levels of NOx are included in prediction models for levels such as the Design Manual for Roads and Bridges (DMRB).

Figure 9.3 Estimated Annual Mean Background Concentration for Nitrogen oxides in Highland

NOx (as NO2)	Estimated annual mean background concentration (mg/m^3)		
Year	**Minimum**	**Maximum**	**Average**
2001	1.371	17.30	2.65
2005	1.17	14.80	2.27
2010	0.99	20.20	1.90

9.5 Where should the air quality objectives for Nitrogen dioxide apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are described in Figure 9.4.

Figure 9.4 Relevant locations for Nitrogen dioxide

Nitrogen dioxide 1-hour mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc. Kerbside sites (e.g. pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably expected to spend 1-hour or longer. Gardens of residential properties. (Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens.)
Objective should generally not apply at:	Kerbside sites where the public would not be expected to have regular access.
Nitrogen dioxide annual mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.
Objective should generally not apply at:	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.

9.6 The updating and screening checklist

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment.

In the case of Nitrogen dioxide, the checklist comprises:-

Figure 9.5 Updating and screening checklist for Nitrogen dioxide

Section reference	Source, location or data that needs to be assessed
A	Monitoring data outside an Air Quality Management Area
B	Monitoring data inside an Air Quality Management Area
C	Narrowly congested streets with residential properties close to the kerb
D	Junctions
E	Busy streets where people may spend 1-hour or more close to busy traffic
F	Roads with high flows of buses and/or HGVs
G	New roads constructed or proposed since the first review and assessment
H	Roads close to the objective during the first review and assessment
I	Roads with significantly changed traffic flows
J	Bus stations
K	New industrial sources
L	Industrial sources with significantly increased emissions
M	Aircraft

A MONITORING DATA OUTSIDE AN AIR QUALITY MANAGEMENT AREA

A.1 National monitoring - Automatic Urban Network Monitoring Site - Inverness

In order to fulfil the requirements of the EC Directive on ambient air quality assessment and management and the 1st Air Quality Daughter Directive the Scottish Executive is required to have a minimum number of automatic air quality monitoring sites within Scotland. In 2000, work was undertaken to assess the number of sites that will be required by the Directives and where these sites should be situated. The assessment identified that a number of new monitoring sites were required in Scotland including an urban road-side site to monitor NO_2, NOx, Carbon monoxidePM_{10} in the Highlands.

Telford Street, Inverness was the preferred choice for the new monitoring site. The site, which became operational in July, 2001 is part of the UK's Automatic Urban Network. The data is used by Government to check compliance with the European Directives, give the public information on current and forecasted levels of air pollution and help assess the effectiveness of existing and future air quality policies.

The monitoring site is maintained by Casella Stanger and, under contract, routine calibrations are performed by staff of Highland Councils' TECS Services, Environmental Health team based in Inverness.

Data and results have been compiled by NETCEN (an operating division of AEA Technology) and the results for 2002 (converted from ppb to µg/m3) are shown in Figure 9.6.

Figure 9.6 Inverness Automatic Urban Network Monitoring Site - Data Summary 2002

Pollutant	**NO2 mg/m3**	**NOX mg/m3**
Maximum 15-minute mean	**374.4**	721.9
Maximum hourly mean	**116.5 (200)**[1]	649.4
Maximum running 8-hour mean	**85.9**	382
Maximum running 24-hour mean	**66.8**	236.8
Maximum daily mean	**63.1**	223.5
Average of hourly means (equivalent to the annual mean)	**21 (40)**[1]	49.7

[1] The numbers in brackets are the relevant air quality objectives for Nitrogen dioxide. There were no exceedences of the objective in 2002.

A.2 Local monitoring – NO_2 diffusion tubes

Nitrogen dioxide has been monitored using passive diffusion tubes at sites in Highland since 1997. Of the nine sites in use, there are five in Inverness and four in Dingwall. The four in Dingwall are historically, part of the UK Nitrogen Dioxide Survey.

A.3 Laboratory analysis of NO_2 diffusion tubes

From May 2002 the provision and analysis of nitrogen dioxide diffusion tubes has been undertaken by Gradko International Ltd. The Gradko International Ltd Analytical Laboratory has UKAS accreditation to the requirements of ISO/IEC 17025. Its "Statement Of Quality Assurance And Quality Control In Relation To The Supply And Analysis Of Nitrogen Dioxide Passive Diffusion Tubes" is appended at **Annex 2**. The diffusion tubes are prepared with 20%Triethanolamine/Water. The percentage bias for the tubes was as follows:

October 2001 to October 2002 - (2.9%)

November 2002 to March 2003 – (14 to 27%)

The recent report entitled "Compilation of Diffusion Tube Collocation Studies Carried out by Local Authorities" showed good performance by Gradko. The report, prepared by Professor Duncan Laxen and Penny Wilson on behalf of DEFRA and the devolved administrations in November 2002 can be accessed at:
http://www.airquality.co.uk/archive/reports/cat06/NO2DiffusionTubePerformance(Final).pdf

A.4 Handling of Nitrogen dioxide diffusion tubes

The methodology and procedures which have been adopted follow the UK Nitrogen Dioxide Diffusion Tube Network Instruction Manual which can be accessed at :

http://airquality.co.uk/reports/no2man/no2man.html.

All diffusion tubes are stored under refrigeration prior to use and used within expiry dates. The tubes are mounted at their locations in accordance with the guidance in the Instruction Manual. They are exposed for monthly periods as per the UK Nitrogen Dioxide Survey calendar.

Upon collection of the tubes, the site and exposure dates and times are recorded on them and they are stored in sealed bags. They are sent to Gradko for analysis on the day of collection, along with an unexposed tube which has been stored in a desk drawer for the monitoring period. The results of the analysis which Gradko perform are "blank subtracted".

A.5 Location of Nitrogen dioxide tubes

Currently, Nitrogen dioxide is monitored by diffusion tubes in 9 locations of which 5 are located in Inverness and 4 in Dingwall. In 2002 the site locations in Inverness were reassessed and the following changes were made. The Bught park site was dropped as it had consistently shown low concentrations of NO_2 and was in a background location. The two sites in Academy Street (at Margaret Street and at the Eastgate end of Academy Street) were replaced with a single site at the north end of Academy Street below commercial properties with flats above. Two new sites were introduced, namely Queensgate and Union Street. These 2 sites are considered to give a "worst case scenario" of the air quality in the old town centre of Inverness.

The location of the 9 sites are listed in Figure 9.7.

Figure 9.7 Locations of NO_2 diffusion tubes in Inverness and Dingwall

Site Reference	Town	Street	Site Category	Easting	Northing
IV1	Inverness	Union Street	Kerbside*	266663	845346
IV2	Inverness	Academy Street	Roadside	266519	845528
IV3	Inverness	Queensgate	Kerbside	266631	845420
IV4	Inverness	Telford Street	Roadside	265707	845664
IV5	Inverness	Kenneth Street	Kerbside	266009	845549
RC1	Dingwall	Wyvis Terrace	Roadside	254430	858968
RC2	Dingwall	Station Road	Roadside	255200	858185
RC3	Dingwall	Kinnairdie Avenue	Background	255016	859653
RC4	Dingwall	Burns Crescent	Background	254419	859287

*The kerbside sites make use of street furniture such as lamp posts which are stationed at the kerb i.e. within 1 m of the road. The UK Nitrogen Dioxide Diffusion Tube Network Instruction Manual advises that diffusion tubes should be sited between 1-5 m from the kerb edge. However, the alternative is to mount them on the side of a building, ideally, on some projection 0.5 - 1 m horizontal distance from the face of the building. They must not be placed in any form of recess, to avoid the possibility of sampling stagnant air. A compromise had to be reached to avoid the effects of stagnant air and vandalism and kerbside locations presented the best solution at these locations.

A.6 NO_2 diffusion tube bias adjustment

At the automatic monitor station in Telford Street, Inverness, (see **Annex 1**) single NO_2 diffusion tubes were collocated and exposed for monthly periods over the 12 months from May

2002 to April 2003. Each monthly diffusion tube result (**Dm)** was matched to the result from the chemiluminescent analyser (**Cm)** over the corresponding period.

The data from the chemiluminescent analyser was checked for the percentage of data capture each month. This ranged from 84% to 98% and the mean for the 12 months was 95.8%. The results between 6 May and 19 November, 2002 have been ratified by NETCEN. At the time of writing, the data collected after 19 November, 2002 is provisional. As provisional data has been used, it should be noted that the process of ratification will be unlikely to affect the measured annual mean. It may change the number of shorter-term (for example, hourly or 15-minute) means.

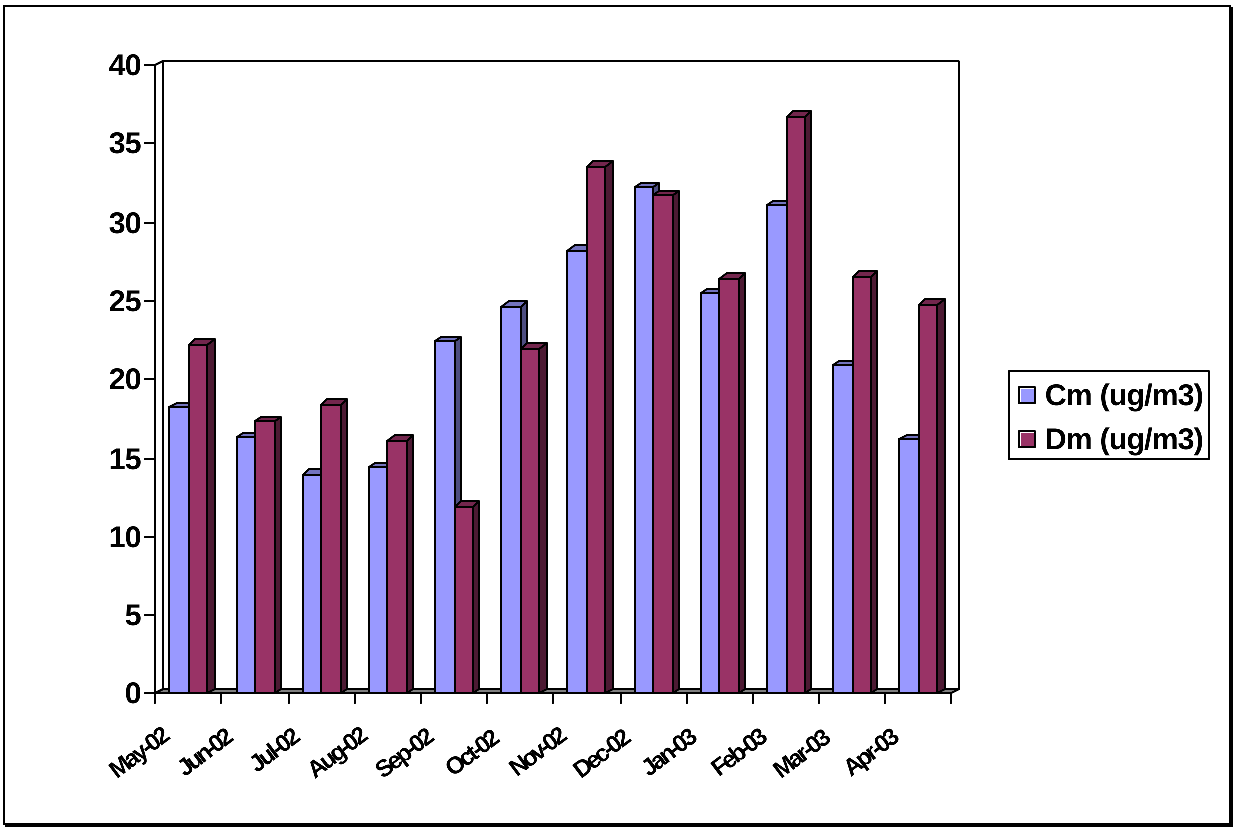
The bias adjustment factor (A) was then calculated as A = Cm/Dm. The NO2 diffusion tube results were then multiplied by this bias adjustment factor to give a bias adjusted NO2 concentration. The results are shown in Figure 9.8.

Figure 9.8 Calculation of bias adjustment factor

Site IV4 Telford Street, Inverness Easting: 265707 Northing: 845664									
Date on	**Time on**	**Date off**	**Time off**	**Time exposed Hours)**	**Dm (ug/m3)**	**Cm (ug/m3)**	**% Data Capture for Cm**	**Bias Adjustment Factor A = (Cm/Dm)**	**Bias Adjusted NO2 (ug/m3)**
06-May-02	2:30 pm	02-Jun-02	3:00 pm	906	22.22	18.25	99.7	0.82	18.25
02-Jun-02	2:45 pm	02-Jul-02	3:05 pm	625	17.34	16.32	99.4	0.94	16.32
03-Jul-02	10:45 am	30-Jul-02	10:20 am	671	18.39	13.96	99.5	0.76	13.96
30-Jul-02	10:20 am	03-Sep-02	11:10 am	840	16.12	14.43	96.1	0.90	14.43
03-Sep-02	11:05 am	30-Sep-02	12:10 pm	649	11.93	22.41	90.4	1.88	22.41
30-Sep-02	10:15 am	30-Oct-02	11:05 am	695	22.00	24.63	99.6	1.12	24.63
30-Oct-02	3:05 pm	03-Dec-02	3:00 pm	820	33.52	28.23	99.5	0.84	28.23
03-Dec-02	2:20 pm	30-Dec-02	3:15 pm	647	31.71	32.24	99.7	1.02	32.24
30-Dec-02	2:20 pm	04-Feb-03	3:20 pm	864	26.43	25.50	96.4	0.96	25.50
04-Feb-03	3:15 pm	07-Mar-03	10:00 am	792	36.70	31.03	83.9	0.85	31.03
07-Mar-03	11:55 am	01-Apr-03	9:50 am	525	26.54	20.88	87.6	0.79	20.88
01-Apr-03	9:20 am	30-Apr-03	9:25 am	692	24.74	16.18	98.3	0.65	16.18
For the 12 month period				**8726**	**23.97**	**22.01**	**95.8**	**0.96**	**22.01**

The relationship between the monthly results from the automatic monitor (Cm) and the diffusion tubes (Dm) can be seen in Figure 9.9.

Figure 9.9 Monthly Nitrogen dioxide collocation results – Telford Street, Inverness



The bias adjustment factor (A) of 0.96 was used to adjust the annual mean NO_2 diffusion tube results for the other 8 sites. As the bias adjustment was based on a single collocated tube, whereas the Technical Guidance LAQM.TG(03) specifies that three diffusion tubes should be collocated at the automatic monitoring site, a bias adjustment factor was also calculated by the alternative method specified in the Technical Guidance. The chemiluminescent analyser data was collected for sites in Aberdeen, Glasgow and Edinburgh and the average ratio (Ra) which can be used as a bias adjustment factor was calculated as shown in the Figure below.

Figure 9.10 Calculation of average ratio Average (Ra)

Long term automatic monitoring site	**Annual mean ug/m3 2001**	**Period mean ug/m3 May 2002 - April 2003**	**Ratio**
	(Am)	**(Pm)**	**R = Am/Pm**
Aberdeen	24.8	27.0	0.92
Edinburgh Centre	43.9	49.2	0.89
Glasgow Centre	34.4	35.7	0.96
Glasgow City Chambers	45.8	49.7	0.92
Glasgow Kerbside	70.7	79.6	0.89
		Average (Ra)	**0.92**

With the exception of Edinburgh Centre which had a data capture of 55.3% in 2001, the data capture for the other sites was greater than 90%. The average ratio **(Ra)** which would be applied as a bias adjustment factor is 0.92. This is less that the bias adjustment factor **(A = 0.96)** which was calculated for the Inverness site. Therefore, the "worst case" bias adjustment factor of **0.96** has been used to adjust the NO_2 diffusion tube concentrations.

A.7 Correction factors to estimate annual average No_2 concentrations in future year from measured roadside and kerbside data

In order to predict what the NO_2 levels are likely to be in 2005 and 2010, a correction factor must be applied. The correction factor is based on the adjacent table. The period over which the NO_2 diffusion tube measurements were collected spanned 2002 and 2003. The corrections were calculated as though the data fell within the 2003 base year as this approach predicts a higher future concentration.

The future years are corrected by:

Fc = M*(Cfuture/ Cbase)

Where

Fc = the predicted concentration in the future year of interest

M = the measured concentrations in the base year

Cfuture = the correction factor for the future year of interest

Cbase = the correction factor for the base year

Assume that the measured concentration of NO2 at a roadside site in 2003 is 24 µg/m3

The corrected concentration for 2005 is then 24 x (0.892/0.941) = 22.75 $\mu g/m^3$

Figure 9.11 Correction factors to estimate annual average No_2 concentrations in future years

Year	Correction Factor to be applied
1999	1.075
2000	1.033
2001	1.000
2002	0.969
2003	0.941
2004	0.915
2005	0.892
2006	0.863
2007	0.832
2008	0.799
2009	0.765
2010	0.734

A.8 Predicted NO_2 concentrations in 2005 and 2010 at sites in Inverness and Dingwall

The concentrations of NO_2 which were measured between May 2002 and April 2003 have been used to predict levels in 2005 and 2010. First the bias adjustment factor was applied as explained in A.6 above, then the adjusted concentrations were corrected for each year as described in A.7 above. The resulting predicted levels are shown below for each site. (The contribution of road transport to nitrogen oxides emissions has declined significantly in recent years as a result of various policy measures, and further reductions are expected up until 2010 and beyond.)

Figure 9.12 Predicted NO_2 concentrations in Inverness and Dingwall in 2003, 2005 and 2010

Site reference	Town	Street	Easting	Northing	2003	2005	2010
IV3	Inverness	Queensgate	266631	845420	**42.8**	**40.3**	33.1
IV2	Inverness	Academy Street	266519	845528	35.1	33.3	27.4
IV1	Inverness	Union Street	266663	845346	34.8	32.9	27.1
IV5	Inverness	Kenneth Street	266009	845549	27.2	25.8	21.2
IV4	Inverness	Telford Street	265707	845664	22.0	20.9	17.2
RC2	Dingwall	Station Road	255200	858185	32.3	30.6	25.2
RC1	Dingwall	Wyvis Terrace	254430	858968	22.6	21.5	17.7
RC4	Dingwall	Burns Crescent	254419	859287	11.4	10.8	8.9
RC3	Dingwall	Kinnairdie Avenue	255016	859653	10.0	9.4	7.8

The results are also shown graphically in

Figure 9.13 and Figure 9.14 below.

Figure 9.13 Predicted Annual Means from NO2 diffusion Tube results Inverness

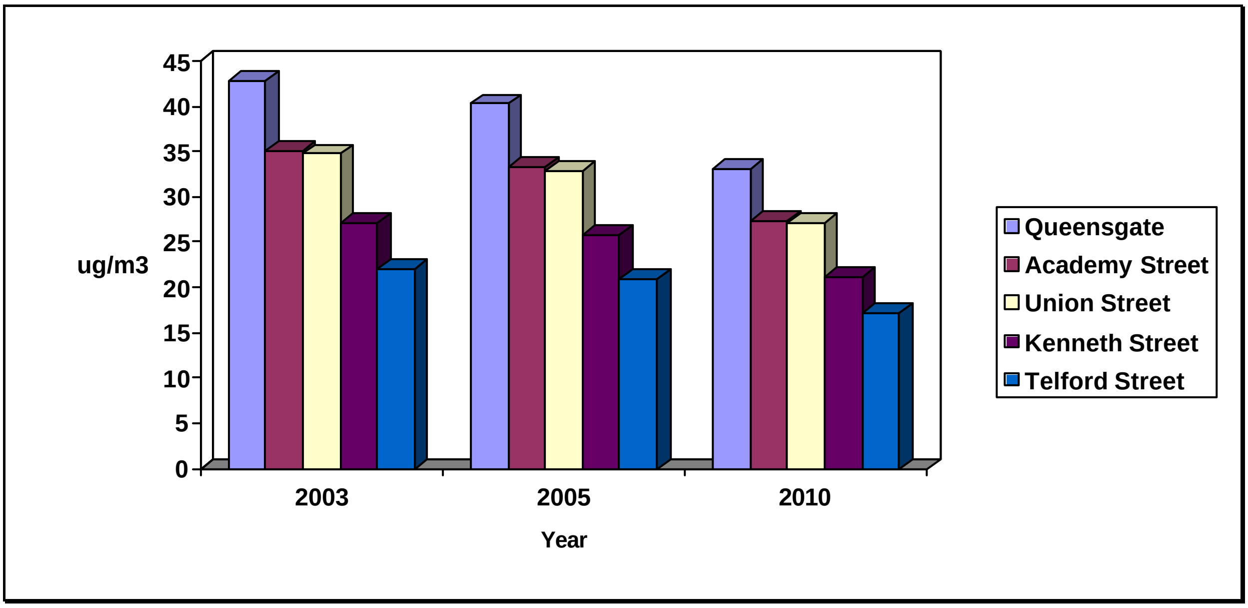
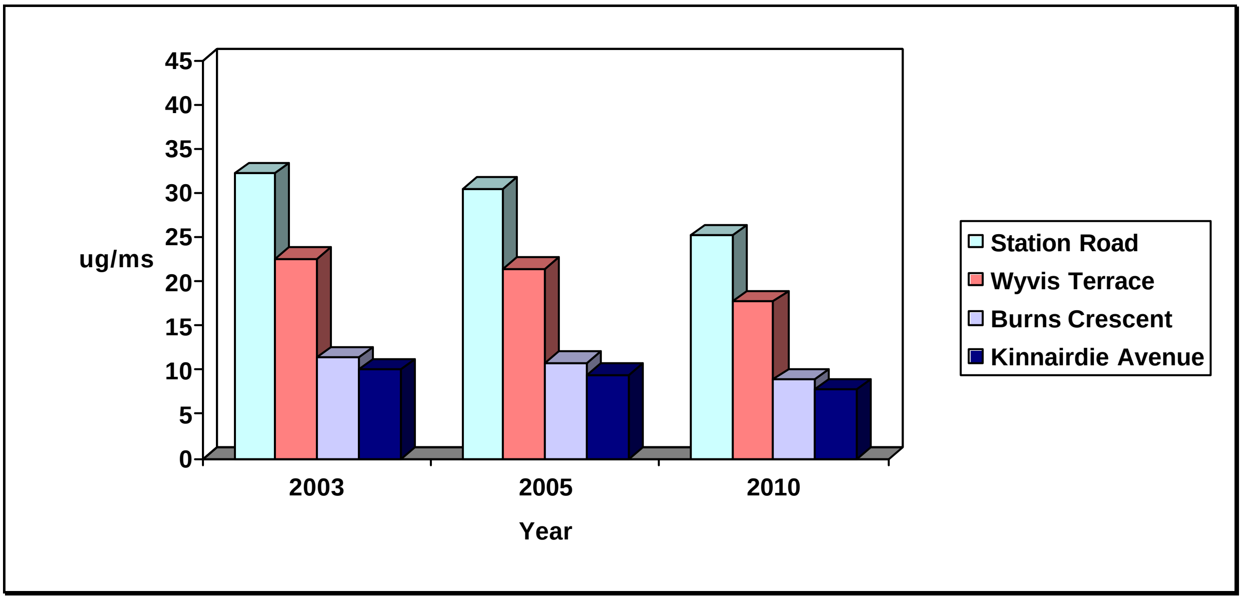


Figure 9.14 Predicted Annual Means from NO2 diffusion Tube results- Dingwall



A.9 Significance of the NO_2 concentrations predicted from the diffusion tube survey

With the exception of the Queensgate site, all sites currently meet the annual mean air quality objective for NO_2 of 40 $\mu g/m^3$ and will do so in 2005 and 2010. The Queensgate site currently exceeds the air quality objective (42.8 $\mu g/m^3$) and is predicted to do so in 2005 (40.3$\mu g/m^3$). By 2010, the concentration at the Queensgate site is predicted to meet the air quality objective and fall to 33.1$\mu g/m^3$.

In considering the reason for the higher concentrations in Queensgate, several factors should be taken into account.

Firstly, the high concentrations in Queensgate are not related to the number of vehicles which use the streets. Queensgate is estimated to have a low traffic flow. At Kenneth Street, with more than double the traffic of Queensgate, the measured kerbside NO_2 concentrations are only 60% of the levels in Queensgate. The figure below shows the traffic flows in each street.

Figure 9.15 Comparison of traffic flows in Inverness streets where NO2 diffusion sites are located

Year	Telford Street	Academy Street	Kenneth Street	Union Street	Queensgate
2001	22,049	15,902	11,193	5,500	5,000
2005	23,578	17,004	11,887	5,881	5,347
2010	25,437	18,346	12,824	6,345	5,768
	The above flows are based on traffic counts			**These figures are estimated.**	

The road with the highest traffic flow in an area may not experience the highest ambient NO_2 concentrations, if it is situated in an fairly open area. Higher concentrations may be experienced at less busy roads with tall buildings on either side such as is often found in the centre of some towns. This is referred to as the "street canyon effect".

Figure 9.16 Queensgate looking west

Union Street, Church Street and Queensgate and comprise a major part of the shopping core of Inverness. The area suffers from traffic congestion, a poor pedestrian environment, traffic noise and fumes. These streets can be regarded as street canyons as the height of the four storey buildings on each side is greater than the street width.

Figure 9.17 Union Street looking west

These streets are heavily trafficked by buses. Queensgate and Union Street act, in effect, as termini for the buses which serve the heart of Inverness.

An analysis of the bus movements by reference to timetables of the three main bus companies which use Queensgate, revealed that on a weekday, 629 buses passed through Queensgate. Of those, 382 stopped at one of the bus stops.

A map of the area showing the NO_2 diffusion tube locations is shown in **Annex 6**.

It is said that if a location can meet the annual mean air quality objective then it will also meet the 1-hour mean air quality objective (200 $\mu g/m^3$ - not to be exceeded more than 18 times a year). As this is not the case in Queensgate, it is worth considering whether people are likely to be present on the pavement for more than 1 hour at a time.

This is thought to be unlikely for the following reasons:

- charity collectors, street entertainers, political canvassers, etc., tend to use the pedestrianised High Street and the revamped Falcon Square plaza, which are nearby, in preference to Queensgate and Union Street;

Figure 9.18 High Street (pedestrianised) looking west

- unlike the High Street and Falcon Square, there is no street furniture in Queensgate;
- external works of maintenance and repair tends to take place in the evening when traffic is much reduced; and
- the bus waiting times are such that passengers do not queue for an hour or more.

Thus, it can be argued that there are likely to be few occasions when people will be present on the pavement for more than an hour when pollution from traffic is at its peak.

However, it is recognised that the centre of Inverness does suffer from traffic fumes and the proposals to pedestrianise this area before 2005 are to be welcomed. See 4.3 above.

In the shorter term, the implementation of new regulations would make a positive contribution to the air quality in this area . The Road Traffic (Vehicle Emissions) (Fixed Penalty) (Scotland) Regulations 2003 enable local authority "Authorised Persons" to request vehicle users to switch off engines when parked and to issue Fixed Penalty Notices to those who refuse to co-operate.

It is a requirement of Regulation 98 of the Road Vehicles (Construction and Use) Regulations 1986, as amended, that drivers switch off engines in parked vehicles. The offence is an existing one but local authorities have only since 1 April 2003 been given the power to carry out enforcement of the offence in an effort to address the growing concerns about pollution and the environment.

Full details of the scheme entitled "Local Authority Powers To Require Drivers To Switch Off Engines When Parked", Guidance Issued Under Section 88 of the Environment Act 1995, April 2003, Paper 2003/16 can be accessed at http://www.scotland.gov.uk/library5/environment/soeg-01.asp#b1

Paragraph 1.2 of Paper 2003/16 explains:

"It is not the intention to target motorists who leave engines running when parked for no more than a few seconds; rather, action will be targeted towards more serious offenders (e.g. coaches which park in busy town centres with their engines running). The scheme is designed to encourage all motorists to have due regard to the local environment when parking. Good public relations and effective publicity will be vitally important to ensure that the scheme is understood, accepted and supported by the majority of motorists."

The purpose of the scheme is to provide local authorities with an additional tool for managing air quality in their areas. At the time of writing, no recommendations on the scheme have been put to Highland Council Certainly, if a voluntary agreement could be reached with targeted vehicle sectors which regularly use the city centre, that could cause a significant reduction of traffic fumes in these street canyons.

It will be interesting to see what effect this scheme will have on the concentrations of NO_2 by diffusion tube in the coming year.

A.10 Conclusion – Local Monitoring of Nitrogen dioxide by diffusion tubes.

In view of the considerations in the previous paragraphs, it can be concluded that air quality objectives for Nitrogen dioxide will be met in all areas by 2005 and will also be met in 2010. There is no need to proceed to a Detailed Assessment.

B MONITORING DATA INSIDE AN AIR QUALITY MANAGEMENT AREA

There are no Air Quality Management Areas designated in the Highland Council area or in the areas of adjacent Councils.

C NARROWLY CONGESTED STREETS WITH RESIDENTIAL PROPERTIES CLOSE TO THE KERB

C.1 Characteristics of the centre of Inverness

The streets in the centre of Inverness have been identified as meeting many of the criteria which will require screening by using the DMRB screening model. These streets such as Queensgate and Union Street have been treated in detail at 4.3 above.

They posses the following features which Technical Guidance suggests should merit screening:

- the traffic is slow moving with a lot of stop/start driving
- the average speed of traffic is less than 50 kph
- there are buildings on either side which reduce the dispersion of exhaust fumes
- there are residential properties within 5 m of the kerb
- the carriageway is less than 10m wide

However, the Highland Councils' TECS Services Transportation section have advised that traffic flows in these street are in the order of 5,500 vehicles, whereas the Technical Guidance suggests that only roads with flows greater than 10,000 need be screened. As the NO_2 diffusion tube survey has indicated high levels of NO_2 in these street canyons, the screening assessment for road traffic sources in 2005 and 2010 was carried out by using the screening model which has been prepared for the Design Manual for Roads and Bridges (DMRB) as published by the Highways Agency .

The DMRB Screening Model (v1.01g) is available in Excel spreadsheet form and was downloaded from the following internet address: http://www.highways.gov.uk/contracts/index.htm#2).

The Local Air Quality Management Technical Guidance LAQM. TG(03) advises:

"The revised DMRB model is expected to provide a slightly conservative assessment of the impact in most cases. This is appropriate for a screening model and should prevent authorities unnecessarily proceeding to a Detailed Assessment. However, the validation work carried out by the Highways Agency has indicated that the model may significantly under predict concentrations of nitrogen dioxide alongside urban city-centre roads classified as 'street canyons'. In this context, a street canyon may be defined as a relatively narrow street with buildings on both sides, where the height of the buildings is generally greater than the width of the road. To avoid missing potential exceedences of the objective in such locations, the authority should multiply the predicted annual mean NO_2 'road traffic component' concentration, in the 'local output' sheet in the DMRB, by a factor of 2, to take account of the model under prediction."

When the DMRB screening model was used , the calculated road traffic component was doubled to allow for the street canyon effect. Full details of the inputs and outputs from the DMRB screening model are recorded in **Annex 7**.

C.2 Results of DMRB screening

There are two factors which have determined the outcome of the screening exercise:

- traffic flows are low, typically less than 6,000 vehicles per day
- the estimated background concentration is low.

The predicted annual mean concentrations for kerbside and façade for 2005 and 2010 are shown in Figure 9.19 and Figure 9.20.

Figure 9.19 DMRB predicted annual mean Nitrogen dioxide outputs for 2005

Receptor	Background $\mu g/m^3$	Road traffic component $\mu g/m^3$	Road traffic component (x 2) $\mu g/m^3$	Total NO_2 $\mu g/m^3$
Union Street kerbside	11.1	8.4	16.8	27.9
Union Street façade	11.1	8.1	16.2	27.3
Church Street façade	11.1	4.2	8.4	19.5
Queensgate kerbside	11.1	7.1	14.2	25.3
Queensgate façade	11.1	6.9	13.8	24.9

Figure 9.20 DMRB predicted annual mean Nitrogen dioxide outputs for 2010

Receptor	Background $\mu g/m^3$	Road traffic component $\mu g/m^3$	Road traffic component (x 2) $\mu g/m^3$	Total NO_2 $\mu g/m^3$
Union Street kerbside	8.9	6.5	13	21.9
Union Street façade	8.9	6.3	12.6	21.5
Church Street façade	8.9	3.2	6.4	15.3
Queensgate kerbside	8.9	5.5	11	19.9
Queensgate façade	8.9	5.4	10.8	19.7

None of the predicted annual means exceed 40 $\mu g/m^3$ in 2005 or 2010. This paints a different picture to the results of the NO_2 diffusion tube monitoring. However, it is understood that the results of DMRB modelling are likely to be conservative and that the measured NO_2 concentrations are more likely to approximate to actual levels.

D JUNCTIONS

D.1 Choice of junctions - NO_2

Two junctions were chosen to represent worst case scenarios:

- **Telford Street roundabout**

This is a 5 arm roundabout at the junction of Telford Street, Friars Bridge, Wells Street, Kenneth Street and Harrowden Road. Of these, only Telford Street, Friars Bridge and Kenneth Street have significant traffic flows. In 2005 traffic flows are predicted to be 23,578 in Telford Street and 11,887 in Kenneth Street. These two streets were chosen because there are houses in Telford Street which are close to the kerbside and roundabout. Thus the junction can be classed as busy, having a joint flow in excess of 10,000.

The DMRB outputs for the chosen receptor are shown in Figure 9.21 below. Details of all the input data are found in **Annex 7**

Figure 9.21 DMRB predicted annual mean Nitrogen dioxide outputs for 2005 and 2010

Telford Street roundabout receptor	**Background** mg/m^3	**Road traffic component Telford Street**	**Road traffic component Kenneth Street**	**Total NO_2** mg/m^3
2005	9.8	8.8	2	18.6
2010	7.8	6.6	1.5	15.9

- **Tore roundabout**

This roundabout is an example of a junction in a rural setting. It is situated 7 mile north of Inverness on the Black Isle. This 5 arm roundabout is in the middle of Tore village and connects the A9, A835 and A832 trunk roads. There are dwellings near to the junction.

A house was chosen which is situated between the A9 south exit and the A832 west exit. The traffic flows for these roads are predicted to be 19,682 and 2,899 respectively in 2005 and so meet the screening criteria for busy junctions of being in excess of 10,000 vehicles.

The background concentrations shown are for the 1 x 1 km square in which the receptor is located. No allowance has been made for "double counting". The Technical Guidance suggests that for roads in rural locations, the estimated background concentration already allows for the road emissions. To avoid double counting, it suggests that the average of the background concentrations in the 1 x 1 km squares, 4 km to either side of the road should be used. In the case of this roundabout, there is no significant difference in the background concentrations, 4 km to either side of the roundabout.

The DMRB outputs for the chosen receptor are shown in Figure 9.22 below. Details of all the input data are found in **Annex 7**

Figure 9.22 DMRB predicted annual mean Nitrogen dioxide outputs for 2005 and 2010

Tore roundabout receptor	**Background** mg/m^3	**Road traffic component A9 south exit**	**Road traffic component A832 west exit**	**Total NO_2** mg/m^3
2005	4.4	2.6	1.2	9.2
2010	3.5	2.6	0.9	7

D.2 Conclusion – Junctions - NO_2

None of the predicted annual means exceed 40 µg/m^3 in 2005 or 2010. It is unlikely that there is the potential for road traffic to cause an exceedence of the air quality objective in 2005 or in 2010 in the Highland Council area.

E BUSY STREETS WHERE PEOPLE MAY SPEND 1-HOUR OR MORE CLOSE TO BUSY TRAFFIC

E.1 Choice of busy streets where people may spend 1-hour or more close to busy traffic.

Three locations were chosen in Inverness. The input data which was used in the DMRB screening tool can be found at **Annex 7**.

- **Johnny Foxes, Bank Street, Inverness**

Johnny Foxes public house in Bank Street provides outside seating in the summer and is close to the junction with the Ness Bridge. The seating is close to the roadside. The junction has traffic lights. The impact of the traffic on Ness Bridge and Bank Street has been considered.

Figure 9.23 DMRB predicted annual mean Nitrogen dioxide outputs for 2005 and 2010

Johnny Foxes	**Background** mg/m^3	**Road traffic component Ness Bridge**	**Road traffic component Bank Street**	**Total NO_2** mg/m^3
2005	11.1	5	6.5	22.6
2010	8.9	3.6	5.1	17.6

- **Falcon Square**

This plaza has recently been formed as part of the Eastgate expansion. It provides a open space and is equipped with street furniture, has a pedestrian link to the railway station and there are outdoor eating facilities. The latter are well away from the roadside. DMRB screening has been carried out at the kerbside and farther back towards the centre of the plaza.

Figure 9.24 DMRB predicted annual mean Nitrogen dioxide outputs for 2005 and 2010

Falcon Square	**Background** mg/m^3	**Road traffic component** mg/m^3	**Total NO_2** mg/m^3
Kerbside 2005	11.1	9	20.1
Plaza 2005	11.1	5.7	16.8
Kerbside 2010	8.9	6.7	15.6
Plaza 2010	8.9	4.2	13.1

- **The Snow Goose**

The beer garden at the Snow Goose is bounded by the A96 to the north. These facilities are relatively far from the roadside.

Figure 9.25 DMRB predicted annual mean Nitrogen dioxide outputs for 2005 and 2010

Snow Goose	Background mg/m^3	Road traffic component mg/m^3	Total NO_2 mg/m^3
2005	8.3	5.3	13.6
2010	6.6	3.9	10.5

E.2 Conclusion - busy streets where people may spend 1-hour or more close to busy traffic

None of the predicted annual means exceed 40 $\mu g/m^3$ in 2005 or 2010. It is unlikely that there is the potential for road traffic to cause an exceedence of the air quality objective in 2005 or in 2010 in the Highland Council area.

F ROADS WITH HIGH FLOWS OF BUSES AND/OR HGVS

This has been addressed under headings A and C of this chapter. In the centre of Inverness, the traffic flow for all vehicles will never approach the screening threshold of 20,000 because of the physical limitations of the streets and the traffic controls which are in place. The proposal to pedestrianise the city centre has also been treated above. The percentage of buses and/or HGVs is not unusually high i.e. greater than 25% as specified in the Technical Guidance. The percentage of buses and heavy goods vehicles is unlikely to exceed 20% .See Figure 9.26.

Figure 9.26 Traffic flows and vehicle splits in old town centre Inverness

Road	Total Traffic Flow AADT (combined, vehicle/day)			Cars (%)	Light (%)	Buses (%)	Rigid HGV (%)	Arctic HGV (%)
Academy Street	15,902	17,004	18,346	83.6	12.0	1.5	2.3	0.6
Union Street	5,500	5,881	6,345	65.1	12.0	20.0	2.3	0.6
Church Street	6,200	6,630	7,135	80.1	12.0	5.0	2.3	0.6
Queensgate	5,000	5,347	5,768	71.1	12.0	14.0	2.3	0.6

G NEW ROADS CONSTRUCTED OR PROPOSED SINCE THE FIRST REVIEW AND ASSESSMENT

G.1 The Southern Distributor Road Inverness

The Southern Distributor Road (SDR) connects the A9 near Raigmore Hospital to the B862 road to Dores and is described in 4.2 above. The line of the road is such that it does not pass close to gardens or other relevant locations. The road has been screened by the using the Design Manual for Roads and Bridges (DMRB) Screening Method V1.01g. Traffic flows expected for that road would not leads to NO_2 concentrations anywhere near the air quality objectives in 2005 or 2010.

H ROADS CLOSE TO THE OBJECTIVE DURING THE FIRST REVIEW AND ASSESSMENT

There are no roads in this category.

I ROADS WITH SIGNIFICANTLY CHANGED TRAFFIC FLOWS

There are no roads which exceed the screening threshold. The screening threshold is roads with AADT traffic flows in excess of 10,000 and which have experienced a 25% increase in traffic since the last review and assessment. Thus, there is no need to proceed to a Detailed Assessment.

J BUS STATIONS

The bus station at Farraline Park in Inverness is the largest in the Highlands. It is situated close to the centre of Inverness – see **Annex 6**. Buses enter the bus station from Strothers Lane and leave by Margaret Street, which is a one way street. On a weekday basis 168 buses pass through the bus station. The screening threshold for bus stations in the Technical Guidance is 1,000 bus movements per day. It also states that a bus coming into a bus station then going out again should be treated as two movements. Thus the number of bus movements at Farraline Park is 336.

As the number of bus movements is much less that 1,000 there is no requirement to consider relevant exposure or to carry out screening by the DMRB method.

K NEW (AND EXISTING) INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area. However, the Technical Guidance advises that local authorities may also wish to consider checking information derived from their first round of review and assessment if there were any doubts regarding their validity.

In view of the information that is available on mass emissions in the European Pollutant Emission Register (see 4.5 above)screening has been carried out for a process in the Fort William area of Lochaber which emits significant quantities of NO_2.

Company Name	**ARJO WIGGINS LIMITED**
Address: Arjo Wiggins Limited, Fort William Mill, Annat Point, Corpach	
Postcode	PH33 7NH
NGR	NN 084 768
NACE code (economic activity)	Manufacture of paper and paperboard
Substances	**To Air (kg)**
NOx (nitrogen oxides) as Nitrogen dioxide	139,000 (Measured)
SOx (sulphur oxides) as Sulphur dioxide	812,000 (Measured)

The screening technique in the Technical Guidance uses a nomogram but a number of factors need to be taken into account before the nomogram can be used. The following paragraphs report how the screening was carried out for the boiler at Arjo Wiggins papermill by quoting from the Technical Guidance and providing the inputs data which pertains at the site.

(**Reference to tables and figures are to tables and figures in the Technical Guidance**.)

1. *To use the short-term (1-hour) nomogram (Figure 6.1), the following procedure should be used:*

- *•Derive the total oxidant concentration (NO 2 + O 3 , as NO 2) at the nearest national network monitoring station. Table 6.2 describes the 99.8 th percentile values of (NO 2 + O 3 , as NO 2) for all sites in 1999-2001*

At the nearest national network monitoring station (Edinburgh Centre), the annual mean total oxidant concentration was 163 (mg/m^3 as NO_2)

- *Calculate the locally available 'headroom' as the objective value (200 µg/m 3) minus the 99.8 th percentile of (NO 2 + O 3 , as NO 2).*

200 – 163 = 37

- *Divide the headroom by 0.05. This procedure assumes that 5% of the NOx emission is released as NO_2 , and that the remaining NOx released is converted to NO_2 up to the limit of the available ozone.*

37 divided by 0.05 = 740

- *Divide the result by 4 (as a safety margin) to allow for the uncertainty in this screening nomogram. The result is the target concentration for screening.*

740 divided by 4 = 185

- *Divide the NOx emission from the stack (in tonnes/annum) by the target concentration and multiply by 40 to scale the emission to the nomogram.*

The emissions from the stack are 139 tonnes of NO_2 per annum. (139/185) *40 = 30 (the scaled emission rate)

- *Identify the line that corresponds to the diameter of the stack under consideration, and locate the point on this line whose coordinates equal the effective stack height. Read off the corresponding emission rate on the horizontal axis, and compare this with the scaled emission rate for the process. If the scaled emission rate is greater than or equal to the emission rate derived from the chart, the authority should proceed to a Detailed Assessment.*

The chimney stack diameter is taken as 3m and the stack height is 64m. Adjacent buildings within 320m (5 chimney heights) of the stack have been considered and no correction to the stack height is required. The corresponding emission rate read from the horizontal axis of the nomogram is around 500 tonnes per annum. The scaled emission rate is only 30 tonnes per annum and hence, there is no need to proceed to a Detailed Assessment.

2. *To use the annual mean nomogram (Figure 6.2), the following procedure should be used:*

- *Identify any sensitive receptors within 10 stack heights.*

64m x 10 = 640m. There are dwellings within this distance.

- *Derive the background NO_2 concentration at the receptor locations. Include any contribution from local roads if this is likely to be significant.*

The estimated background level in 2001 at the papermill was used – 3.7 $\mu g/m^3$. This is higher than at the dwellings and represents a "worst case scenario". There are no significant contributions from roads.

- *Calculate the locally available 'headroom' as the objective value (40 µg/m 3) minus the maximum background concentration.*

40 – 3.7 = 36.3

- *Divide the headroom by 4 (as a safety margin) to allow for the uncertainty in this screening nomogram. The result is the target concentration for screening. If the calculated target concentration is less than 0.25 µg/m 3 , set the target concentration to 0.25 µg/m 3 . Divide the annual emission (in tonnes) by this target concentration, to scale the emission to the nomogram.*

36.3 / 4 = 9 $\mu g/m^3$ (the target concentration)

Arjo Wiggins emit 139 tonnes NO_2 per annum, so 139 / 9 = 15.4 tonnes per annum.

- *Identify the line that corresponds to the diameter of the stack under consideration, and locate the point on this line whose coordinates equal the effective stack height. Read off the corresponding emission rate on the horizontal axis, and compare this with the scaled emission rate for the process. If the scaled emission rate is greater than or equal to the emission rate derived from the chart, the authority should proceed to a Detailed Assessment.*

The chimney stack diameter is taken as 3m and the stack height is 64m. Adjacent buildings within 320m (5 chimney heights) of the stack have been considered and no correction to the stack height is required. The corresponding emission rate read from the horizontal axis of the nomogram is around 1000 tonnes per annum. The scaled emission rate is only 15.4 tonnes per annum and hence, there is no need to proceed to a Detailed Assessment.

L INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS

The Scottish Environment Protection Agency has advised that, in respect of the processes which it regulates, there have been no changes since the last review and assessment that may adversely affect air quality in the Highlands.

M AIRCRAFT

M.1 Technical Guidance LAQM.TG(03)

The Technical Guidance advises:

"An airport with a throughput of 5 million passengers per annum (mppa) may contribute up to about 25 $\mu g/m^3$ NOx at the nearest receptor location. Some airports have a substantial freight component which also needs to be taken into account; it may be assumed for the purpose of this screening assessment that 100,000 tonnes of freight is equivalent to 1 mppa . (For example, an airport with 3.5 mppa, and an annual freight movement of 300,000 tonnes, is assumed to be 6.5 mppa equivalent).

Authorities need only consider airports that exceed 5 mppa or equivalent (in 2005 or 2010) and/or where the 2005 NOx background concentration exceeds 25 µg/m^3.

Where these criteria are exceeded, the authority will need to proceed to a Detailed Assessment.

M.2 Inverness Airport

The estimated background NOx concentration at the airport in 2005 is 4.44 µg/m^3. The airport manager has provided estimates of the expected future movements at the airport.

Figure 9.27 Inverness Airport – Throughput of passengers and freight

Year	Tonnes of Freight transported by non-passenger aircraft	Passenger equivalents (mppa)	Number of Passengers	Total passenger equivalents (mppa)
2001	1,554 tonnes	0.01554	371,000	0.38654
2004	2,000 tonnes	0.02	500,000	0.52
2010	3,000 tonnes	0.03	700,000	0.73

As can be seen from Figure 9.27 above, the number of "passenger equivalents" per annum is expected to rise to 0.52 mppa in 2004 and 0.73 mppa in 2010. Thus, there is no need to proceed to a Detailed Assessment for aircraft.

9.7 Conclusions for the screening of Nitrogen dioxide

Of all the sources of Nitrogen dioxide in Highland, it is road traffic which has the most significant impact on air quality. However, this impact is limited to a small area of Inverness. With that exception, screening has shown that road traffic in the rest of Highland is unlikely to cause exceedences of the air quality objectives either in 2005 or 2010 the air. Other sources such as shipping and aircraft do not pose a challenge to air quality in Highland.

In the centre of Inverness there are two opportunities to reduce levels of NO_2, namely, to pedestrianise the affected streets and in the shorter term, to manage vehicles which idle for unacceptable periods when stationary.

In view of these measures, **it is proposed that Highland Council does not proceed to a Detailed Assessment** but continues to monitor NO_2 by diffusion tubes and to take steps to address the problem of vehicles idling in the centre of Inverness.

10 Sulphur dioxide (SO_2)

10.1 Where does it come from?

The main source of sulphur dioxide in the United Kingdom is power stations, which accounted for more than 71% of emissions in 2000. There are also significant emissions from other industrial combustion sources. Domestic sources now only account for 4% of emissions, but can be locally much more significant. Road transport currently accounts for less than 1% of emissions.

Local exceedences of the objectives (principally the 15-minute mean objective) may occur in the vicinity of small combustion plant (less than 20 MW) which burn coal or oil, in areas where solid fuels are the predominant form of domestic heating, and in the vicinity of major ports.

10.2 How can it affect our health?

Sulphur dioxide causes constriction of the airways by stimulating nerves in the lining of the nose, throat and airways of the lung. The latter effect is particularly likely to occur in those suffering from asthma and chronic lung disease.

10.3 The Air Quality Objectives for Sulphur dioxide

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objectives for Sulphur dioxide are shown in Figure 10.1 below.

Figure 10.1 The Air Quality Objectives for Sulphur dioxide

Applies to	Objective	Measured as	Date to be achieved by
All Local Authorities	350 µg/m³ not to be exceeded more than 24 times a year	1 hour mean	31 December 2004
	125 µg/m³ not to be exceeded more than 3 times a year	24 hour mean	31 December 2004
	266 µg/m³ not to be exceeded more than 35 times a year	15 minute mean	31 December 2005

10.4 Estimated Background Concentrations

Estimated annual mean background concentrations for 2001 have been mapped for the UK, and can be accessed from the internet at **www.airquality.co.uk/archive/laqm/tools.php**.

In the Highland Council area, the estimated annual mean background concentrations for Sulphur dioxide are shown in Figure 10.2 below.

Figure 10.2 Estimated Annual Mean Background Concentration for Sulphur dioxide in Highland

Sulphur dioxide	**Estimated annual mean background concentration (mg/m^3)**		
Year	Minimum	Maximum	Average
2001	0.27	6.58	0.56

10.5 Where should the air quality objectives for Sulphur dioxide apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered. “Relevant locations” are listed below.

Figure 10.3 Relevant locations for Sulphur dioxide 1-hour mean

Sulphur dioxide 1-hour mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc. Kerbside sites (e.g. pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably expected to spend 1-hour or longer. Gardens of residential properties. (Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens.)
Objective should generally not apply at:	Kerbside sites where the public would not be expected to have regular access.

Figure 10.4 Relevant locations for Sulphur dioxide 24-hour mean

Sulphur dioxide 24-hour mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc. Gardens of residential properties. (Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens.)
Objective should generally not apply at:	Kerbside sites (as opposed to location sat the building facade), or any other location where public exposure is expected to be short term

Figure 10.5 Relevant locations for Sulphur dioxide 15 minute mean

Sulphur dioxide 15 minute mean	
Relevant locations	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer

10.6 The updating and screening checklist

In undertaking the Updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001).

The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment.

In the case of Sulphur dioxide, the checklist comprises:-

Figure 10.6 Updating and screening checklist for Sulphur dioxide

Section reference	Source, location or data that needs to be assessed
A	Monitoring data outside an Air Quality Management Area
B	Monitoring data within an Air Quality Management Area
C	New industrial sources
D	Industrial sources with substantially increased emissions
E	Areas of domestic coal burning
F	Small boilers (>5MW(thermal)) burning coal or oil
G	Shipping
H	Railway Locomotives

A MONITORING DATA OUTSIDE AN AIR QUALITY MANAGEMENT AREA

A.1 National monitoring

SO_2 was monitored at remote rural site at Strath Vaich until March 1997. Currently, only ozone is monitored at Strath Vaich. Details of the monitoring site are shown in **Annex 1**.

SO_2 is not monitored at national level within the Highland Council area.

A.2 Local monitoring

No SO_2 monitoring is undertaken by Highland Council.

B MONITORING DATA WITHIN AN AIR QUALITY MANAGEMENT AREA

There are no Air Quality Management Areas designated in the Highland Council area or in the areas of adjacent Councils.

C NEW (AND EXISTING) INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area. However, the Technical Guidance advises that local authorities may also wish to consider checking information derived from their first round of review and assessment if there were any doubts regarding their validity.

In view of the information that is available on mass emissions in the European Pollutant Emission Register (see 4.5 above)screening has been carried out for two processes in the Fort William area of Lochaber which emit significant quantities of SO_2. These are shown in Figure 10.7.

Figure 10.7 Emissions of SO_2 from an Aluminium Smelter and a Papermill in Lochaber.

Company Name	**ALCAN ALUMINIUM UK LIMITED**
Address: ALCAN Smelting & Power UK, Lochaber Smelter, Fort William, Inverness-shire	
Postcode	PH33 6TH
NGR	NN 124 749
NACE code (economic activity)	Aluminium production
Substances	**To Air (kg)**
SOx (sulphur oxides) as Sulphur dioxide	782,000 (Calculated)
Company Name	**ARJO WIGGINS LIMITED**
Address: Arjo Wiggins Limited, Fort William Mill, Annat Point, Corpach	
Postcode	PH33 7NH
NGR	NN 084 768
NACE code (economic activity)	Manufacture of paper and paperboard
Substances	**To Air (kg)**
NOx (nitrogen oxides) as Nitrogen dioxide	139,000 (Measured)
SOx (sulphur oxides) as Sulphur dioxide	812,000 (Measured)

C.1 Screening of SO_2 emissions from Arjo Wiggins Limited, Papermill

The emissions come from a 47.5 MW Babcock and Wilcock boiler. A map showing the location of the papermill is at **Annex 3** .

The screening nomogram in the Technical Guidance, "Figure 7.1: Emissions of SO_2 which will give rise to a 99.9th percentile 15-minute ground-level mean concentration of 53.2 $\mu g/m^3$ " employs the effective stack height of the chimney stack and the annual emission in tonnes to calculate a threshold emission. If the annual emissions from the combustion process exceeds this threshold emission, the local authority will need to proceed to a Detailed Assessment.

The height of the paper mill stack is 64m and a stack diameter of 3m has been assumed. No correction of the stack height has been made. The threshold emission rate from the nomogram is 1400 tonnes of SO_2 per annum. In the case of the papermill, the European Pollutant Emission Register records a mass emission of 812 tonnes per annum and so a Detailed Assessment need not be undertaken for this source.

It is understood that the Scottish Environment Protection Agency will be carrying out a dispersion modelling in the area. The modelling will also take account of the coal burning in the adjacent settlement of Corpach which from a screening standpoint is quite low, there only being 38 houses burning estimated to burn solid fuel in a 500 x 500 m square.

C.2 Screening of the ALCAN Aluminium Smelter.

From the information available in Authorisation No: IPC/078/1995, SO_2 is emitted from 3 stacks serving the Fume Treatment Plant, 3 stacks serving the Holding Furnaces and a single stack serving the Junkers Furnace - a total of 7 stacks. These stacks are geographically separate. There are dwellings within 500 m of the stacks.

The Technical Guidance advises that where there are complex sites, with many stacks, the nomograms are unlikely to be applicable, and authorities are advised to proceed to the Detailed Assessment.

D INDUSTRIAL SOURCES WITH SUBSTANTIALLY INCREASED EMISSIONS

The Scottish Environment Protection Agency has advised that, in respect of the processes which it regulates, there have been no changes since the last review and assessment that may adversely affect air quality in the Highlands.

E AREAS OF DOMESTIC COAL BURNING

E.1 Previous review of domestic coal burning in Highland based on LAQM.TG4(00)

The previous review was based on Pollutant Specific Guidance LAQM.TG4(00) May 2000. That guidance advised that the risk of exceedence of the air quality objective for SO_2 within an area could be considered significant where the **density of coal burning (or solid smokeless fuel burning) houses exceeds 300 properties per 1 km^2.** As no statistics were available in Highland, surrogate statistics were used. These were taken from the "First Phase Air Quality Review and Assessment" report, produced by NETCEN in March, 2000.

That report contained statistics on household fuel use in Dearne Valley and Belfast. Market research had shown that in areas of high coal burning, particularly where a mains gas supply was not available, domestic coal burning could be as high as 25%. That percentage was applied to a number or settlements in Highland but none were reckoned to have more than 300 properties burning coal per 1 km^2. Of those towns which were screened by that method, the town with the highest number of coal burning houses was Aviemore, with an estimated 245 properties burning coal in a 1 x 1 km square.

On that basis, it was concluded that there would be no significant risk of exceeding the air quality objectives for SO_2 in 2005.

E.2 SO_2 screening assessment of domestic coal burning required by Local Air Quality Management Technical Guidance LAQM. TG(03)

The Technical Guidance LAQM.TG(03) states:

"Coal and smokeless fuel burning for domestic heating has now largely been replaced by alternative fuels throughout most of the UK. However, there are a few areas remaining where it is still predominant, and which may have the potential to cause exceedences of the objectives. Evidence from the first round of review and assessment has indicated that coal burning tends to be concentrated into small areas or estates, which are generally less than 1 km^2 . **The risk of exceedence in an area can be considered significant where the density of coal burning (including coal, anthracite and smokeless fuels) houses exceeds 100 properties per 500m by 500m area.**

In such cases, the authority will need to proceed to a Detailed Assessment."

E.3 Domestic Fuel Survey in Highland

If it is assumed that 25% of domestic properties burn coal, then many settlements in Highland will exceed the criterion which is described above. In the absence of statistics on local coal burning, a domestic fuel survey, as recommended in the Technical Guidance, was carried out in three towns in Highland.

Preliminary screening was carried out for each area of Highland by using the Arc View GIS system. Only settlements which had no mains gas supply were chosen. The GIS system allowed the number of domestic properties to be counted in the most densely populated 500m x 500m area of each settlement. An example of the 500 x 500 m square map for Corpach is found in **Annex 3**. Of the towns thus screened, three were targeted for a domestic fuel survey.

The survey forms (see **Annex 4**) were sent to the occupiers together with a freepost envelope for the return of the completed questionnaire. The results are collated in **Annex 5**. Details of theses towns and their response to the postal survey are shown below.

Figure 10.8 Response to domestic fuel survey

Domestic Fuel Survey	Aviemore	Fort William	Castletown	All
Number of dwellings sampled	390	454	273	1,117
Number of responses	145	166	108	419
Percentage response	37.2%	36.6%	39.6%	37.8%

The results of this exercise are shown in Figure 10.9.

Figure 10.9 Domestic Fuel Survey results – main fuel used for heating the home

Main Fuel for heating the home	Aviemore (%)	Fort William (%)	Castletown (%)	Average (%)
Gas (Bottle or tank)	4.2	2.8	4.6	3.9
Electricity	69.3	71.1	16.7	52.4
Oil	14.5	13.8	24.1	17.5
Coal	7.8	9	8.3	8.4
Anthracite	1.8	0	27.8	9.9
Smokeless	2.4	2.1	16.7	7.1
Wood	0	1.4	1.9	2
Houses using solid fuel	**12**	**12.4**	**54.6**	**26.3**

Figure 10.10 Castletown in Caithness

The percentage of houses burning solid fuel in Aviemore and Fort William were remarkably similar, being around 12%. It would appear that anthracite is not generally available in Fort William.

It was surprising to learn that there was such a significant difference between the solid fuel usage in these towns (12%) and Castletown in Caithness (55%). Caithness is rich in peat resources and it is still cut and burned in that area.

Compared to Aviemore and Fort William, twice as many households use oil to heat their homes in Castletown and four and a half times as many use solid fuel.

E.4 Estimated coal burning dwellings in 500m x 500m squares in selected Towns

The results of the domestic fuel survey were applied to other towns which lack a mains gas supply. The results of the survey cannot be used to estimate solid fuel burning in towns which are provided with a mains gas supply. In towns which are provided with mains gas, the percentages of dwellings which use other fuels for space heating will be considerably less.

The GIS system was used to find the number of domestic properties in the most densely populated 500m x 500m area of each settlement.

The percentage of houses burning solid fuel was around 12%. In order to calculate the number of houses burning solid fuel in other settlements it was decided to use a figure of 15 % for the percentage of solid fuel burning houses. The make up of the solid fuel burned in the settlements was taken to be 9% coal, 2% anthracite, 2% smokeless fuel and 2% wood.

It can be seen from Figure 10.11 below, that with the exception of Castletown, the other settlements which were screened had less than 100 houses which were estimated to burn solid fuel. The highest was Portree with an estimated 61 dwellings burning solid fuel as the main form of heating. Castletown is estimated to have 149 houses in a 500 x 500 m square which use solid fuel as the main domestic fuel.

Figure 10.11 Estimated houses in a 500 x 500 m square using solid fuel as the main fuel for space heating

Location	**Centre of Square**		**No. Houses in 500 x 500 sq m**	**Estimated number of houses burning:**				
	Easting	**Northing**		**Coal**	**Anthracite**	**Smokeless Fuel**	**Wood**	**Total Solid Fuel**
Aviemore	289671	813483	390	30	7	9	0	47
Beauly	252610	846444	373	34	7	7	7	56
Castletown	**319477**	**967951**	**273**	**23**	**76**	**46**	**5**	**149**
Corpach	208901	776975	256	23	5	5	5	38
Fort Augustus	237878	809218	140	13	3	3	3	21
Fort William (1)	209947	772838	365	33	7	7	7	55
Fort William (2)	210587	773750	454	41	0	10	11	61
Golspie (1)	283501	900409	231	21	5	5	5	35
Golspie (2)	282972	899873	288	26	6	6	6	43
Grantown-on-Spey (1)	302722	827499	305	27	6	6	6	46
Grantown-on-Spey (2)	303247	827653	398	36	8	8	8	60
Kingussie	275937	800877	364	33	7	7	7	55
Maryburgh	253944	856225	268	24	5	5	5	40
Portree	148266	843797	406	37	8	8	8	61
Ullapool	212856	894224	290	26	6	6	6	46
Kinlochleven	218627	762097	175	16	4	4	4	31

N.B. Numbers in the above table have been rounded up from 2 decimal places and hence there are slight discrepancies in the additions.

E.5 Consideration of the SO_2 screening threshold for solid fuel burning houses in Technical Guidance LAQM.TG(03)

At the time of going to print, advice is awaited from the Emissions Helpline on the SO_2 screening threshold. Unlike the PM_{10} screening technique, the SO_2 threshold does not appear to take account of estimated SO_2 background concentrations or the relative contribution which each type of solid fuel makes towards the total SO_2 concentration.

Details of the contribution which each solid fuel makes to SO_2 and PM10 concentrations can be downloaded from the National Atmospheric Emissions Inventory at http://www.naei.org.uk/. Taking coal as having a factor of 1, the contribution which each solid fuel to the pollutant concentration is shown below.

Figure 10.12 Effective Coal burning factors (2000) from NAEI database

Pollutant	**Coal**	**Anthracite**	**Smokeless Fuel**	**Wood**
SO_2	1	0.65	0.8	0
PM_{10}	1	0.395	0.56	0.79

If the above factors for SO_2 are applied to the domestic fuel survey figures for Castletown then the number of “ effective coal burning houses” would reduce to 108.

E.6 Conclusion - Areas Of Domestic Coal Burning

From the screening assessment it would appear that there is a risk that the 15 minute mean air quality objective for SO_2 could be exceeded in Castletown in Caithness as a result of the density of dwellings which burn solid fuel in that settlement. Thus, a Detailed Assessment will be required.

There could be other areas in Highland that are at similar risk. Much will depend on the actual percentage of solid fuel burning in each settlement. The domestic fuel survey showed that this could range from 12 to 55%. This should be investigated further while undertaking the Detailed Assessment.

F SMALL BOILERS (>5$MW_{(THERMAL)}$) BURNING COAL OR OIL

Combustion plant which have a greater thermal rating than 20MW are regulated by the Scottish Environment Protection Agency.

In May 2000, Entec UK Ltd reported to the Scottish Executive on “Emissions of Sulphur dioxide from Small Combustion Plants of 5 to 20MW.”

Entec carried out screening of these boilers in each local authority. In Highland, 29 boilers were evaluated. The air quality objective used for comparison in the survey was the 15 minute mean objective. In Highland, the highest concentration which was predicted for a boiler was 166 µg/m3.

There has been no change since the first review and assessment, except that one company has ceased trading.

In the light of the Entec report it can be concluded that, in the case of SO2 emissions from Small Combustion Plants of 5 to 20MW, the risk of exceeding the air quality objectives is insignificant.

G SHIPPING

G.1 Technical Guidance LAQM.TG(03)

The Technical Guidance advises:

“Shipping movements may also give rise to emissions of sulphur dioxide, and where there are significant movements within a major port, there is the potential for the objectives to be exceeded. The authority should determine whether there is relevant public exposure within 1 km of the main berths and maneuvering areas. If there are more than 5000 shipping movements per year (restricted to large ships, such as cross-Channel ferries, container ships etc) the authority will need to proceed to a Detailed Assessment.”

G.2 Ports in the Highland Council area

There are no major ports in the Highlands in terms of the number of shipping movements that are likely to impinge on the air quality objective. (Each visit by a ship to a port will generate two movements.) Three ports have been considered:

Inverness Harbour

The port caters for oil tanker traffic, timber, paper pulp, coal, processed timber, grains and a host of other dry cargoes. There are around 800 shipping movements per annum and of these, 50%

are oil tankers which service the two petrol terminals in Inverness which are listed in Figure 6.5 above.

Cromarty Firth Port Authority

The port is centred on Invergordon on the Cromarty firth and extends to Evanton and Nigg. In 2002, there were a little over 1000 shipping movements.

A breakdown of the shipping movements is Cargo vessels - 328; Oil supply and sub sea vessels – 368; Oil tankers – 74; Passenger vessels – 50; RoRo – 28; Heavy lift vessels – 8; Oil Rigs – 52; Buoy tenders and fishery related vessels – 132.

Scrabster Harbour

Scrabster harbour serves the ferry link to the Orkney islands with the Scrabster to Stromness ferry route

In 2002 there were 1092 movements. There were also 80 movements of oil supply ships which service the off-shore oil industry and 64 oil tankers which supply fuel oil to the area. A number of larger fishing vessels also use Scrabster harbour.

In future years, shipping movements are not expected to increase significantly at the ports. Thus, there is no need to proceed to a Detailed Assessment.

H RAILWAY LOCOMOTIVES

The Technical Guidance advises:

"Diesel railway locomotives (and potentially coal fired steam locomotives) may give rise to elevated sulphur dioxide concentrations. This is only likely to occur when locomotives are regularly stationary with their engines running for periods of around 15-minutes or longer close to sensitive locations. It should also be noted that the current maximum allowable sulphur content of rail locomotive diesel (2000 ppm) is expected to reduce to 1000 ppm by 2008 as a result of forthcoming EU legislation (still under discussion). Current emissions of sulphur dioxide from rail locomotives are therefore expected to decline in future years."

Each local authority is required to establish whether there is the potential for regular outdoor exposure of members of the public within 15 m of the stationary locomotives. If this occurs on more than two occasions a day then the local authority needs to proceed to a Detailed Assessment.

In assessing whether these circumstances might occur regard was had to:

- limited observation and local knowledge
- consideration of the locations and durations when locomotives are stationary at stations and loops
- railway timetables
- the proximity of gardens to the railway lines
- passenger activity and control at stations

No relevant locations where exposure might occur for more that 15 minutes were identified.

10.7 Conclusions for the screening of Sulphur dioxide

From the screening assessment it would appear that there is a risk that the 15 minute mean air quality objective for SO_2 could be exceeded in Castletown in Caithness as a result of the density of dwellings which burn solid fuel in that settlement. Highland Council will need to proceed to a Detailed Assessment.

A Detailed Assessment will also need to be carried out in respect of the ALCAN Aluminium Smelter in Fort William as the number of stacks which emit SO_2 at that site, do not lend themselves to simple screening techniques and so, local authorities are advised to proceed to the Detailed Assessment.

Thus, Highland Council will need to proceed to a Detailed Assessment of these sources of SO_2

11 PM_{10} (Particulate matter)

11.1 Where does it come from?

Unlike the individual gaseous pollutants which are single, well-defined substances, particles (PM_{10}) are composed of a wide range of materials arising from a variety of sources.

There is a wide range of emission sources that contribute to PM_{10} concentrations in the UK. Primary particle emissions are derived directly from combustion sources, including road traffic, power generation, industrial processes etc. Secondary particles are formed by chemical reactions, and comprise principally of sulphates and nitrates. Coarse particles comprise of emissions from a wide range of sources, including resuspended dusts from road traffic, construction works, mineral extraction processes, wind-blown dusts and soils, sea salt and biological particles.

11.2 How can it affect our health?

Particulate air pollution is associated with a range of effects on health including effects on the respiratory and cardiovascular systems, asthma and mortality. The Expert Panel on Air Quality Standards concluded that particulate air pollution episodes are responsible for causing excess deaths among those with pre-existing lung and heart disease, and that there is a relationship between concentrations of PM_{10} and health effects, such that the higher the concentration of particles, the greater the effect on health.

11.3 The Air Quality Objectives for PM_{10}

The Scottish Executive is committed to meeting people's right to clean air. Their primary objective is to make sure that everyone can enjoy a level of ambient air quality in public places which poses no significant risk to health or quality of life.

The air quality objectives are generally based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS). The standards are set purely on the basis of medical and scientific evidence of how each pollutant affects human health. The air quality objectives for PM_{10} are shown below.

Figure 11.1 The Air Quality Objective for PM_{10} (gravimetric)

Applies to	Objective	Measured as	Date to be achieved by
All Local Authorities	50 µg/m³ not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
	40 µg/m³	annual mean	31 December 2004
Scottish Local Authorities	50 µg/m³ not to be exceeded more than 7 times a year	24 hour mean	31 December 2010
	18 µg/m³	annual mean	31 December 2010

11.4 Where should the air quality objectives for PM_{10} apply?

Likely exceedences of the objectives should be assessed in relation to the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present. Reviews and assessments should be focussed on those relevant locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Exceedences of the objectives at any location where relevant public exposure would not be realistic should not be considered.

"Relevant locations" are listed below.

Figure 11.2 Relevant locations for PM_{10}

Particles (PM_{10}) annual mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc.
Objective should generally not apply at:	Building facades of offices or other places of work where members of the public do not have regular access. Gardens of residential properties. Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term
Particles (PM_{10}) 24-hour mean	
Relevant locations	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, libraries etc. Gardens of residential properties. (Such locations should represent parts of the garden where relevant public exposure is likely, for example where there are seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens.)
Objective should generally not apply at:	Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.

11.5 Estimated Background Concentrations

Estimated annual mean background concentrations for 2001, 2004 and 2010 have been mapped for the UK, and can be accessed from the internet at www.airquality.co.uk/archive/laqm/tools.php.

In the Highland Council area, the estimated annual mean background concentrations for PM10 are shown Figure 11.3 below.

Figure 11.3 Estimated Annual Mean Background Concentration for PM_{10} in Highland

PM_{10}	Estimated annual mean background concentration (μg/m³ gravimetric)		
Year	Minimum	Maximum	Average
2001	10.90	26.80	11.31
2004	10.80	26.30	11.12
2010	10.50	25.60	10.77

11.6 The updating and screening checklist

In undertaking the updating and screening assessment, the aim has been to maximise and build upon the data collation and assessments completed during the Highland Councils' Air Quality Review and Assessment (December 1998), together with its Addendum (June, 2001). The Local Air Quality Management Technical Guidance LAQM. TG(03) requires local authorities to have regard to the checklists in the guidance when completing the updating and screening assessment. In the case of PM_{10}, the checklist comprises:-

Figure 11.4 Updating and screening checklist for PM_{10}

Section reference	Source, location or data that needs to be assessed
A	Monitoring data outside an Air Quality Management Area
B	Monitoring data inside an Air Quality Management Area
C	Busy roads and junctions in Scotland
D	Junctions
E	Roads with high flows of buses and/or HGVs
F	New roads constructed or proposed since the first review and assessment
G	Roads close to the objective during the first review and assessment
H	Roads with significantly changed traffic flows
I	New industrial sources
J	Industrial sources with significantly increased emissions
K	Areas with domestic fuel burning
L	Quarries, landfill sites, opencast coal handling of dusty cargoes at ports etc
M	Aircraft

A MONITORING DATA OUTSIDE AN AIR QUALITY MANAGEMENT AREA

A.1 National Monitoring

PM_{10} is monitored manually by Partisol gravimetric filter monitoring equipment at the Telford Street automatic air monitoring sit in Inverness. Highland Council Environmental Health staff load and collect the filters and send them to Casella Stanger for weighing. At the time of writing the results have not been provided or posted on the internet but are expected soon.

A.2 Local Authority Monitoring

No PM_{10} monitoring is carried out in Highland.

B MONITORING DATA INSIDE AN AIR QUALITY MANAGEMENT AREA

There are no Air Quality Management Areas designated in the Highland Council area or in the areas of adjacent Councils.

C BUSY ROADS AND JUNCTIONS IN SCOTLAND

The Technical Guidance LAQM.TG(03) requires that the DMRB screening tool be used to predict annual mean PM_{10} concentrations in 2010. The roads and junctions which were considered have estimated annual mean PM_{10} concentrations in 2010 of less than 15 $\mu g/m^3$ and traffic flows in excess of 10,000 (except for certain streets in Inverness where the flow was less than 10,000).

The DMRB predictions for 2010 are listed in **Annex 7**.

The highest predicted concentration in 2010 was 16.01 $\mu g/m^3$ at the kerbside at Falcon Square, Inverness. This fell to 14.75 $\mu g/m^3$ at 27 m from the centre of the carriageway.

C.1 Conclusions – Busy Roads

Annual mean concentrations of PM_{10} are not predicted to exceed 18 $\mu g/m^3$ in 2010 and so there is no need to proceed to a Detailed Assessment.

D JUNCTIONS

D.1 Choice of junctions

Two junctions were chosen to represent worst case scenarios:

- **Telford Street roundabout**

This is a 5 arm roundabout at the junction of Telford Street, Friars Bridge, Wells Street, Kenneth Street and Harrowden Road. Of these, only Telford Street, Friars Bridge and Kenneth Street have significant traffic flows. In 2004 traffic flows are predicted to be 23,186 in Telford Street and 11,193 in Kenneth Street. These two streets were chosen because there are houses in Telford Street which are close to the kerbside and roundabout. Thus the junction can be classed as busy, having a joint flow in excess of 5,000which is the Technical Guidance screening criteria for busy junctions.

The DMRB outputs for the chosen receptor are shown in Figure 11.5 below. Details of all the input data are found in **Annex 7**.

Figure 11.5 DMRB PM_{10} predicted annual mean and 24-hour exceedences outputs for 2004 and 2010

Telford Street roundabout receptor	**Background μg/m^3**	**Road traffic component Telford Street**	**Road traffic component Kenneth Street**	**Total PM_{10} μg/m^3**	**Number of 24-hour exceedences of 50 μg/m^3**
2005	13	3.15	0.89	17.04	0
2010	12	1.8	0.54	14.34	0

- **Tore roundabout**

This roundabout is an example of a junction in a rural setting. It is situated 7 mile north of Inverness on the Black Isle. This 5 arm roundabout is in the middle of Tore village and connects the A9, A835 and A832 trunk roads. There are dwellings near to the junction.

A house was chosen which is situated between the A9 south exit and the A832 west exit. The traffic flows for these roads are predicted to be 19,354 and 2,850 respectively in 2004 and so meet the Technical Guidance screening criteria for busy junctions of being in excess of 5,000 vehicles.

The background concentrations shown are for the 1 x 1 km square in which the receptor is located. No allowance has been made for "double counting". The Technical Guidance suggests that for roads in rural locations, the estimated background concentration already allows for the road emissions. To avoid double counting, it suggests that the average of the background concentrations in the 1 x 1 km squares, 4 km to either side of the road should be used. In the case of this roundabout, the effect of this would be to reduce the estimated background concentration by 0.5 μg/m^3.

The DMRB outputs for the chosen receptor are shown in Figure 11.6 below. Details of all input data are found in **Annex 7**

Figure 11.6 DMRB PM_{10} predicted annual mean and 24-hour exceedences outputs for 2004 and 2010

Tore roundabout receptor	**Background μg/m3**	**Road traffic component A9 south exit**	**Road traffic component A832 west exit**	**Total PM10 μg/m3**	**Number of 24-hour exceedences of 50 μg/m3**
2004	12	1.18	0.35	13.53	0
2010	11	0.67	0.21	11.88	0

D.2 Conclusion – Junctions - PM_{10}

The screening threshold for PM_{10} at junctions is that there should be no more than 35, 24-hour exceedences of 50 $\mu g/m^3$ in 2004. There were no 24-hour exceedences predicted at the selected junctions in 2004. Furthermore there were no predicted exceedence of the Scottish objectives in 2010. (A 24-hour mean of 50 $\mu g/m^3$ not to be exceeded more than 7 times per year, and an annual mean of 18 $\mu g/m^3$ to be achieved by the end of 2010.)

It is unlikely that there is the potential for road traffic at junctions to cause an exceedence of the air quality objectives in 2004 or in 2010 in the Highland Council area.

E ROADS WITH HIGH FLOWS OF BUSES AND/OR HGVS

The centre of Inverness boasts the highest flow of buses in the Highlands.

Figure 11.7 Bus Flows in old town centre, Inverness

Street or route segment	**Queensgate**	**Church Street**	**Union Street**	**Margaret Street to Queensgate**	**Bank Street to Church Street**	**Eastgate**
Traffic Flow	One Way	One Way	One Way	One Way	One Way	Two Way
Number of buses which stop at bus stops	382	83	393	-	-	-
Number of buses which pass through without stopping	247	559	211	70	248	542
Total buses using street	629	642	604	-	-	-

On a weekday basis, more than 600 buses pass through Union Street, Church Street and Queensgate. The overall traffic flows are not high, ranging between 5,000 and 7,000 over the years of interest. Although the percentage of buses does not exceed 20% by this reckoning, the figure of 20% was entered in the vehicle split section of the DMRB screening tool to allow for a worst case scenario.

Technical Guidance LAQM.TG(03) advises:

“The revised DMRB model is expected to provide a slightly conservative assessment of the impact in most cases. This is appropriate for a screening model and should prevent authorities unnecessarily proceeding to a Detailed Assessment.

The validation work carried out by the Highways Agency has indicated that the model may significantly under predict concentrations of nitrogen dioxide and carbon monoxide alongside urban city-centre roads classified as ‘street canyons’. There is no clear evidence, however, that this is the case for PM_{10}, thus no adjustment is required for street canyons in the case of PM_{10}.”

The predicted annual mean concentrations of PM_{10} and exceedences are shown for 2004 in Figure 11.8 and for 2010 in Figure 11.9.

Figure 11.8 DMRB outputs of predicted annual mean PM_{10} concentrations and exceedences in 2004

Receptor	**Background** mg/m³	**Road traffic component** mg/m³	**Total PM_{10}** mg/m³	**Number of 24-hour exceedences of 50 mg/m³**
Union Street kerbside	13	5.07	18.07	1
Union Street façade	13	4.83	17.83	1
Church Street façade	13	4.11	17.11	1
Queensgate kerbside	13	3.95	16.95	1
Queensgate façade	13	2.05	15.05	0

Figure 11.9 DMRB outputs of predicted annual mean PM_{10} concentrations and exceedences in 2010

Receptor	**Background** mg/m³	**Road traffic component** mg/m³	**Total PM_{10}** mg/m³	**Number of 24-hour exceedences of 50 mg/m³**
Union Street kerbside	13	2.9	15.9	0
Union Street façade	13	2.77	15.77	0
Church Street façade	13	2.27	15.27	0
Queensgate kerbside	13	2.18	15.18	0
Queensgate façade	13	1.19	14.19	0

E.1 Conclusions - Roads With High Flows Of Buses And/Or HGVs

The screening threshold for PM_{10} in streets with high flows of buses is:

- there should be no more than 35, 24-hour exceedences of 50 $\mu g/m^3$ in 2004; and
- the predicted annual mean in 2010 should not exceed of 18 $\mu g/m^3$.

As can be seen from Figure 11.8 and Figure 11.9 above, these criteria are predicted to be met.

Although the predicted annual mean concentration at the kerbside in Union Street in 2004 is just above 18 $\mu g/m^3$, it is predicted to fall to 15.9 $\mu g/m^3$ in 2010. At the kerbsides at Union Street, Church Street and Queensgate, the DMRB tool predicts that there will only be one exceedence of the 24-hour mean in 2004. (35 are allowed in the screening threshold). It should be noted that the air quality objectives for PM_{10} 24-hour mean and annual mean should generally not apply at kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.

The predictions suggest that buses operating the centre of Inverness are unlikely to cause an exceedence of the PM_{10} air quality objectives in 2004 or in 2010.

F NEW ROADS CONSTRUCTED OR PROPOSED SINCE THE FIRST REVIEW AND ASSESSMENT

F.1 The Southern Distributor Road Inverness

The Southern Distributor Road (SDR) connects the A9 near Raigmore Hospital to the B862 road to Dores and is described in 4.2 above. The line of the road is such that it does not pass close to gardens or other relevant locations. The road has been screened by the using the Design Manual for Roads and Bridges (DMRB) Screening Method V1.01g. Traffic flows expected for that road would not leads to PM_{10} concentrations anywhere near the air quality objectives in 2004 or 2010.

G ROADS CLOSE TO THE OBJECTIVE DURING THE FIRST REVIEW AND ASSESSMENT

There are no roads in this category.

H ROADS WITH SIGNIFICANTLY CHANGED TRAFFIC FLOWS

There are no roads which exceed the screening threshold. The screening threshold is roads with AADT traffic flows in excess of 10,000 and which have experienced a 25% increase in traffic since the last review and assessment. Thus, there is no need to proceed to a Detailed Assessment.

I NEW INDUSTRIAL SOURCES

There are no new industrial sources which are likely to have a significant effect on air quality in the Highland Council area.

J INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS

The Scottish Environment Protection Agency has advised that, in respect of the processes which it regulates, there have been no changes since the last review and assessment that may adversely affect air quality in the Highlands.

K AREAS OF DOMESTIC COAL BURNING

K.1 PM_{10} screening assessment of domestic coal burning required by Local Air Quality Management Technical Guidance LAQM. TG(03)

The screening method described in the Technical Guidance is similar to that described for SO_2 in the previous section. However, there are refinements which include:

- calculating the density of ‘effective’ coal-burning houses (solid fuels other than coal are weighted to give a ‘coal equivalent’)
- taking account of the annual mean background concentrations

The screening threshold for PM_{10} is that the risk of exceedence in an area can be considered significant where the density of coal burning (including coal, anthracite and smokeless fuels) houses exceeds 50 properties per 500m by 500m area.

In such cases, the authority will need to proceed to a Detailed Assessment.

K.2 Estimated coal burning dwellings in 500m x 500m squares in selected Towns

Figure 11.10 Estimated numbers of houses burning solid fuel by type of solid fuel (S.F.)

Location	Centre of Square		No. Houses in 500 x 500m sq	Estimated number of houses burning:				
	Easting	Northing		Coal	Anth-racite	Smokeless Fuel	Wood	Total S.F.
Aviemore	289671	813483	390	30	7	9	0	47
Beauly	252610	846444	373	34	7	7	7	56
Castletown	**319477**	**967951**	**273**	**23**	**76**	**46**	**5**	**149**
Corpach	208901	776975	256	23	5	5	5	38
Fort Augustus	237878	809218	140	13	3	3	3	21
Fort William (1)	209947	772838	365	33	7	7	7	55
Fort William (2)	210587	773750	454	41	0	10	11	61
Golspie (1)	283501	900409	231	21	5	5	5	35
Golspie (2)	282972	899873	288	26	6	6	6	43
Grantown-on-Spey (1)	302722	827499	305	27	6	6	6	46
Grantown-on-Spey (2)	303247	827653	398	36	8	8	8	60
Kingussie	275937	800877	364	33	7	7	7	55
Maryburgh	253944	856225	268	24	5	5	5	40
Portree	148266	843797	406	37	8	8	8	61
Ullapool	212856	894224	290	26	6	6	6	44
Kinlochleven	218 627	762097	175	16	4	4	4	27

N.B. Numbers in the above table have been rounded up from 2 decimal places and hence there are slight discrepancies in the additions.

For each of the solid fuel categories in Figure 11.10 above, the effective number of coal-burning houses is calculated by applying a weighting to each category, as follows.

Figure 11.11 "Effective coal burning" weightings

Coal [C]	Anthracite [A]	Smokeless fuel [S]	Wood [W]
1	0.36	0.56	0.79

The number of "effective coal burning" houses is calculated by multiplying the number of houses in the solid fuel category by the appropriate weighting. For example, if there were 100 houses burning smokeless fuel then the "effective coal burning" equivalent would be:

100 x 0.56 = 56.

K.3 "Effective coal burning" houses

The "effective coal burning" number of houses has been calculated for the towns listed in Figure 11.12 below.

Figure 11.12 Number of "effective coal burning" houses

Location	**Estimated number of houses in 500 x 500 m square burning:**				**Total Solid Fuel**	**Effective coal burning factors**				**Effective Coal Burning Houses**
						1	0.36	0.56	0.79	
	Coal	**A/cite**	**S/less Fuel**	**Wood**		**Coal**	**A/cite**	**S/less Fuel**	**Wood**	
Aviemore	30	7	9	0	47	30	3	5	0	38
Beauly	34	7	7	7	56	34	3	4	6	46
Castletown	**23**	**76**	**46**	**5**	**149**	**23**	**27**	**26**	**4**	**80**
Corpach	23	5	5	5	38	23	2	3	4	32
Fort Augustus	13	3	3	3	21	13	1	2	2	18
Fort William (1)	33	7	7	7	55	33	3	4	6	45
Fort William (2)	41	0	10	11	61	41	0	6	9	55
Golspie (1)	21	5	5	5	35	21	2	3	4	30
Golspie (2)	26	6	6	6	43	26	2	3	5	36
Grantown-on-Spey (1)	27	6	6	6	46	27	2	3	5	37
Grantown-on-Spey (2)	36	8	8	8	60	36	3	4	6	50
Kingussie	33	7	7	7	55	33	3	4	6	45
Maryburgh	24	5	5	5	40	24	2	3	4	33
Portree	37	8	8	8	61	37	3	4	6	51
Ullapool	26	6	6	6	44	26	2	3	5	36
Kinlochleven	16	4	4	4	27	16	1	2	3	23

N.B. Numbers in the above table have been rounded up from 2 decimal places and hence there are slight discrepancies in the additions.

K.4 Density of effective coal-burning houses

The density of effective coal-burning houses **[Deff]** per 500 x 500 m area is then calculated by the following equation:

[Deff] = [Ceff]/(1-L). Where **L** = proportion of open space.

The proportion of open space for each town was measured on the Arc View GIS system. The density of effective coal burning houses for the settlements is shown in Figure 11.13 below.

Figure 11.13 Density of effective coal burning houses

Location	**Proportion of open space (L)**	**No. Houses in 500 x 500 m square**	**No. of effective coal-burning houses (Ceff)**	**Density of effective coal-burning houses [Deff = Ceff/(1-L)]**
Aviemore	0.27	390	38	51
Beauly	0.22	373	46	59
Castletown	**0.29**	**273**	**80**	**113**
Corpach	0.30	256	32	45
Fort Augustus	0.49	140	18	36
Fort William (1)	0.10	365	45	50
Fort William (2)	0.23	454	55	72
Golspie (1)	0.42	231	30	51
Golspie (2)	0.25	288	36	48
Grantown-on-Spey (1)	0.10	305	37	41
Grantown-on-Spey (2)	0.11	398	50	56
Kingussie	0.16	364	45	54
Maryburgh	0.22	268	33	42
Portree	0.15	406	51	60
Ullapool	0.19	290	36	45
Kinlochleven	0.58	175	23	54

N.B. Numbers in the above table have been rounded up from 2 decimal places and hence there are slight discrepancies in the additions.

K.5 Density of effective coal burning houses compared with the screening thresholds

To complete the screening, the background annual mean concentrations for 2004 and 2010 are determined and used in the nomograms in Figure 8.8 for 2004 and Figure 8.9 for 2010 in the Technical Guidance together with the density of effective coal burning houses and the character of the settlement.

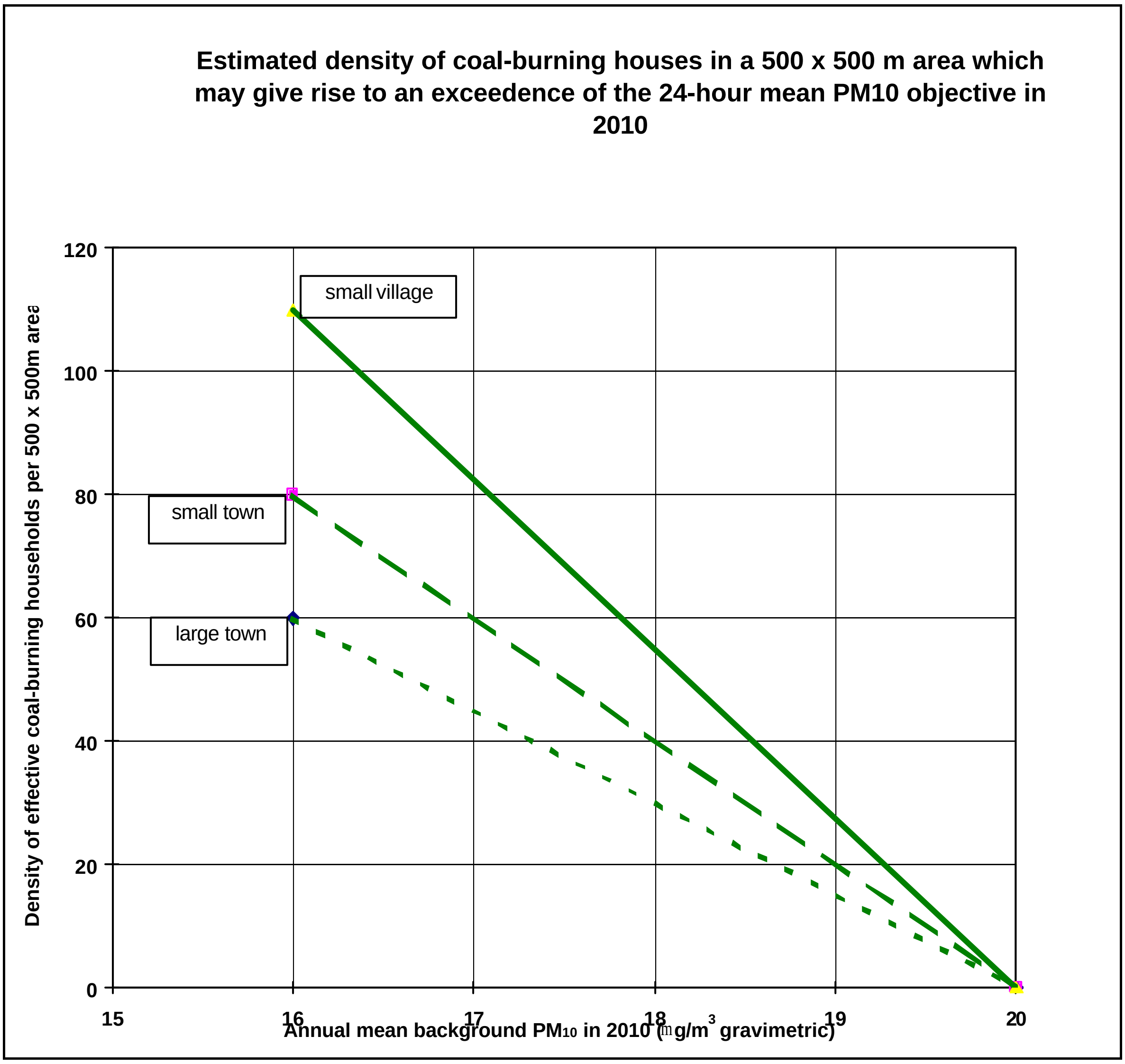
The estimated background PM_{10} concentrations in the settlements in 2004 and 2010 range from 11 to 13 $\mu g/m^3$. The densities of the effective coal burning houses are compared with the screening thresholds in Figure 11.14.

Figure 11.14 Density of effective coal burning houses compared with the screening thresholds

Location	Character	Density of effective coal-burning houses	Screening threshold for estimated PM_{10} of 15 mg/m^3 in:	
			2004	2010
Aviemore	Small town	51	310	100
Beauly	Small village	59	450	130
Castletown	**Small village**	**113**	**450**	**130**
Corpach	Small town	45	310	100
Fort Augustus	Small village	36	450	130
Fort William (1)	Small town	50	310	100
Fort William (2)	Small town	72	310	100
Golspie (1)	Small town	51	310	100
Golspie (2)	Small town	48	310	100
Grantown-on-Spey (1)	Small town	41	310	100
Grantown-on-Spey (2)	Small town	56	310	100
Kingussie	Small town	54	310	100
Maryburgh	Small village	42	450	130
Portree	Small town	60	310	100
Ullapool	Small town	45	310	100
Kinlochleven	Small village	54	450	130

N.B. In Highland, the estimated background concentrations of PM_{10} are less than 15 µg/m^3 and do not appear on the nomograms. In view of this, the Emission Helpdesk was contacted and it advised that it is acceptable to extrapolate to the left of the nomogram to derive the density. A reproduction of the nomogram for 2010 is shown in Figure 11.15 below. From the nomogram, at 15 µg/m^3 on the vertical axis, the screening threshold for a small village and small town are estimated to be 130 and 100 dwellings, respectively.

Figure 11.15 Technical Guidance Nomogram for PM_{10} in 2010



K.6 Conclusion - Areas Of Domestic Coal Burning

The areas of domestic coal burning in Highland are unlikely to exceed the air quality objectives for PM_{10} in 2004 and 2010.

L QUARRIES, LANDFILL SITES, OPENCAST COAL, HANDLING OF DUSTY CARGOES AT PORTS ETC

L.1 Screening by estimated background concentrations

The first step in the assessment is to determine whether there is relevant public exposure near the sources of dust emission. The distances to the actual sources of emission are considered (e.g. the haul roads, crushers, stockpiles etc) and not the distances to the site boundary. Concentrations of PM_{10} fall-off rapidly on moving away from the source.

The Technical Guidance advises:

"In the absence of any local monitoring data, the following approach is recommended:

• If there are no relevant locations for public exposure within 1000 metres of the dust emissions source then there should be no need to proceed further.

• If there are relevant locations for public exposure within 400 to 1000 metres of the dust emissions source, then there should be no need to proceed further if the 2004 PM 10 background is less than 27 $\mu g/m^3$, or the 2010 background is less than 17 $\mu g/m^3$

• If there are relevant locations for public exposure within 200 to 400 metres of the dust emissions source, then there should be no need to proceed further if the 2004 PM_{10} background is less than 26 $\mu g/m^3$, or the 2010 background is less than 16 $\mu g/m^3$."

A number of locations at quarries and landfill sites were considered and it was found that in each case the estimated PM_{10} background concentration in 2004 and 2010 ranged from 11 to 13 $\mu g/m^3$. This is much lower than the screening thresholds which are specified in the Technical Guidance.

L.2 Screening by evidence of complaints

The Technical Guidance also states:

• Where properties lie closer than 200 metres to the source, authorities are advised to investigate whether any dust nuisance complaints have been reported, as this may give a guide to potential problems. The absence of complaints is not alone a basis for saying that the objectives will not be exceeded, and authorities are advised to take account of local background levels and their own professional judgement based on visual inspection of the operations.

The Scottish Environment Protection Agency regulate quarries and landfill sites. They have advised that they have not received any significant complaints regarding dust emissions and that visual inspections of the sites have not suggested that dust emissions present a problem.

M AIRCRAFT

M.1 Technical Guidance LAQM.TG(03)

The Technical Guidance advises that in screening airports, the predicted total passenger equivalents in 2040 and 2010 should be considered. The tonnes of freight handled is converted to passenger equivalents using 100,000 tonnes = 1 mppa (million passengers per annum)

The screening threshold for PM_{10} is that the air quality objectives are unlikely to be exceeded where

- the predicted total equivalent passenger throughput in 2004 does not exceed 10 mppa; and
- the predicted total equivalent passenger throughput in 2010 does not exceed 5 mppa

M.2 Inverness Airport

The airport manager has provided estimates of the expected future movements at the airport.

Figure 11.16 Inverness Airport – Throughput of passengers and freight

Year	Tonnes of Freight transported by non-passenger aircraft	Passenger equivalents (mppa)	Number of Passengers	Total passenger equivalents (mppa)
2001	1,554 tonnes	0.01554	371,000	0.38654
2004	2,000 tonnes	0.02	500,000	0.52
2010	3,000 tonnes	0.03	700,000	0.73

As can be seen from Figure 11.16 above, the number of "passenger equivalents" per annum is expected to rise to 0.52 mppa in 2004 and 0.73 mppa in 2010. Thus, there is no need to proceed to a Detailed Assessment for aircraft.

11.7 Conclusions for the screening of PM_{10}

From the screening assessment it can be concluded that there is a little likelihood that the air quality objectives for PM10 will be exceeded in 2004 or 2010.

A Detailed Assessment is not required for PM_{10} .

12 Annexes

Annex 1 UK Automatic Urban and Rural Network Monitoring Stations in Highland

Photograph 1 Inverness Telford Street

The site is adjacent to a pathway connecting Telford Street (A862) and Cameron Square Inverness. It is 4 meters from the A862. It is a predominantly residential area with a retail business park 250 meters away.

Site Address: Telford Street IV3 5LE

OS Grid Reference: NH 657 456

Site Type: Roadside

StartDate:17/07/01

Pollutants Measured: NO, NO2, NOX, CO and PM_{10}

Photograph 2 Strath Vaich, Ross-Shire

The monitoring station is within a self-contained, air conditioned housing located on remote moorland approximately 500 metres from the nearest inhabited dwellings. The nearest road is approximately 150 metres from the site and used for access only. The manifold inlet is approximately 2.5 metres above ground level. The surrounding area is open and remote.

Site Address:

Strath Vaich, Ross-shire, IV23 2QH

OS Grid Reference: NH 347 750

Site Type: Rural

Start Date:18/03/87

Pollutants currently measured: O_3

Annex 2 Gradko International Quality Assurance and Quality Control

GRADKO INTERNATIONAL,

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STATEMENT OF QUALITY ASSURANCE AND QUALITY CONTROL IN RELATION TO THE SUPPLY AND ANALYSIS OF NITROGEN DIOXIDE PASSIVE DIFFUSION TUBES

ACCREDITATION

Gradko International Ltd Analytical Laboratory has UKAS accreditation to the requirements of ISO/IEC 17025 . Our accreditation number is 2187.

QUALITY ASSURANCE

The Laboratory analysis method for the of NO2 diffusion tubes uses a variation of the Salztman reaction where nitrogen dioxide absorbed by Triethanolamine is determined by ultraviolet / visible spectrophotometry. The analysis protocol forms part of the Gradko International Ltd documented Laboratory Quality Management System assessed by UKAS.

The accuracy of analysis is monitored on a monthly basis by an external laboratory proficiency scheme administered by the Health and Safety Laboratories. This system is called W.A.S.P. (Workplace Analysis Scheme for Efficiency).

The Laboratory is also supplied on a quarterly basis, with a standard solution of Nitrite from AEA Technology Environment Laboratories at Culham (NETCEN) in order to monitor the instrument calibration curve.

In addition to participation in the W.A.S.P. scheme, once per month, NO2 tubes prepared at Gradko International Ltd are sent to HSL Sheffield to be co-located alongside an automatic analyser. This project is the NETCEN NO2 Network Field Intercomparison. The tubes are returned to Gradko for analysis and the results used to publish % bias data for each month.

QUALITY CONTROL

Strict quality control is followed by the Laboratory Analyst in accordance with documented procedures. i.e. The u.v./visible spectrophotometer is calibrated every quarter by the use of traceable Holmium and Didymium filters to check the wavelength accuracy.

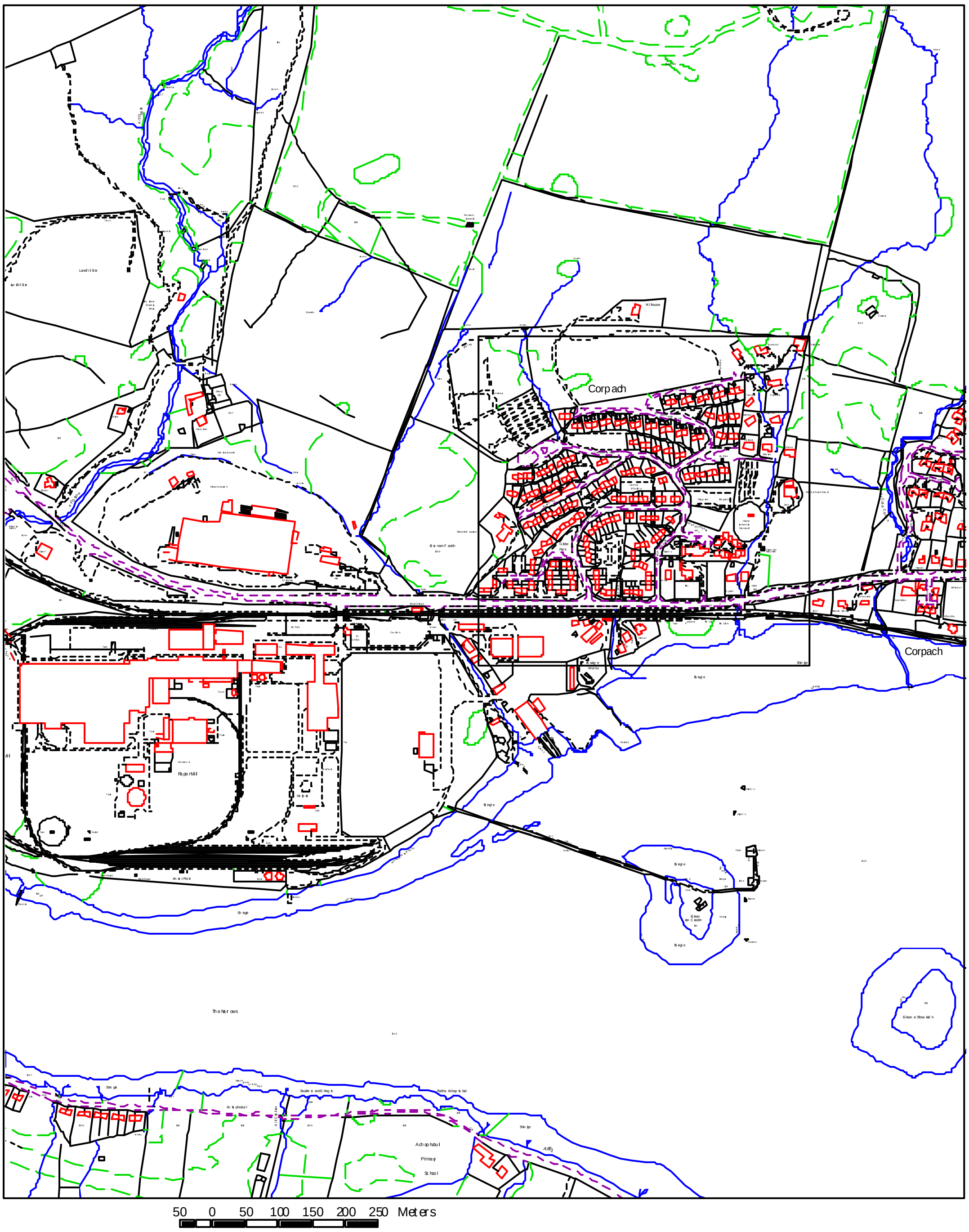
Nitrite Standards ranging 0.5 – 4ppm are used to check the method and accuracy of readings. The full range of these standards is run once per month and a calibration graph generated. The acceptance criteria for a linear graph is R2 = >0.995.

A blank , prepared NO2 tube is doped with the 2ppm nitrite standard and run at the start of every days analysis as a quality control check. New absorbent and analytical solutions are checked after makeup by the use of blank tubes and nitrite standards.

Periodically a number of blank prepared tubes are doped with the standard nitrite solutions and analysed. This serves as a quality control check on the tube preparation procedures.

All of the Gradko International Ltd Laboratory Quality Management Procedures are open to audit.

Annex 3 Map from Arc View GIS showing the 500 x 500m square used for calculating the number of dwellings in Corpach, Fort William and the Arjo Wiggins Papermill to the south east of Corpach



Corpach

(showing paper mill and sawmill)

SUPPLIED BY THE HIGHLAND COUNCIL

N

Scale
1:7500

Annex 4 Domestic Fuel Survey Form

DOMESTIC FUEL SURVEY **CASTLETOWN (Part)**

Please take a few moments to complete this form and return it in the FREEPOST envelope If you have enquiries regarding this survey, please telephone 01349 868440. IF YOU WISH TO ENTER THE **PRIZE DRAW**, PLEASE WRITE YOUR CONTACT DETAILS ON THE BACK OF THIS QUESTIONNAIRE. THE PRIZE IS A **£30 GIFT VOUCHER** OF YOUR CHOICE.

Q1. What is the MAIN FUEL you use for heating your home?

- Gas (Mains, bottle or tank) ☐
- Electricity ☐
- Oil ☐
- Solid fuel:
  - Coal ☐
  - Anthracite ☐
  - Smokeless ☐
  - Wood ☐
- Other ☐

Q1, Please tick ONE box only

Q2. Do you use any OTHER FUELS for heating your home? **YES** ☐ **NO** ☐

Q3 If YES to question 2, which of these OTHER FUELS do you use?

- Gas (Mains, bottle or tank) ☐
- Electricity ☐
- Oil ☐
- Solid fuel:
  - Coal ☐
  - Anthracite ☐
  - Smokeless ☐
  - Wood ☐
- Other ☐

Q3 Example:

If you heat your home mainly with an Oil-Fired Central Heating System but you also have a fireplace and burn solid fuel, you should tick the appropriate box or boxes under solid fuel

Q4 If YES to Q2, on average, how often do you use OTHER FUELS for heating your home?

- Less than 10 days a year ☐
- 11 to 50 days a year ☐
- 51 to 100 days a year ☐
- More than 100 days a year ☐

This will obviously vary from year to year but your best guess will help us.

Q5 What fuels do you use for heating water?

- Gas (inc. Bottled gas) ☐
- Electricity ☐
- Oil ☐
- Solid fuel:
  - Coal ☐
  - Anthracite ☐
  - Smokeless ☐
  - Wood ☐
- Other ☐

You can tick more than one box if necessary.
Example: You may heat your home with a coal fire which has a back boiler for hot water but you may also use an electric immersion heater from time to time. In this example you would tick Coal and Electricity

Thank you for helping us with this survey.

Annex 5 Domestic Fuel Survey results

Domestic Fuel Survey	Aviemore	Fort William	Castletown	Average
Number of dwellings sampled	390	454	273	1117
Number of responses	145	166	108	419
Percentage response	37.2%	36.6%	39.6%	37.8%

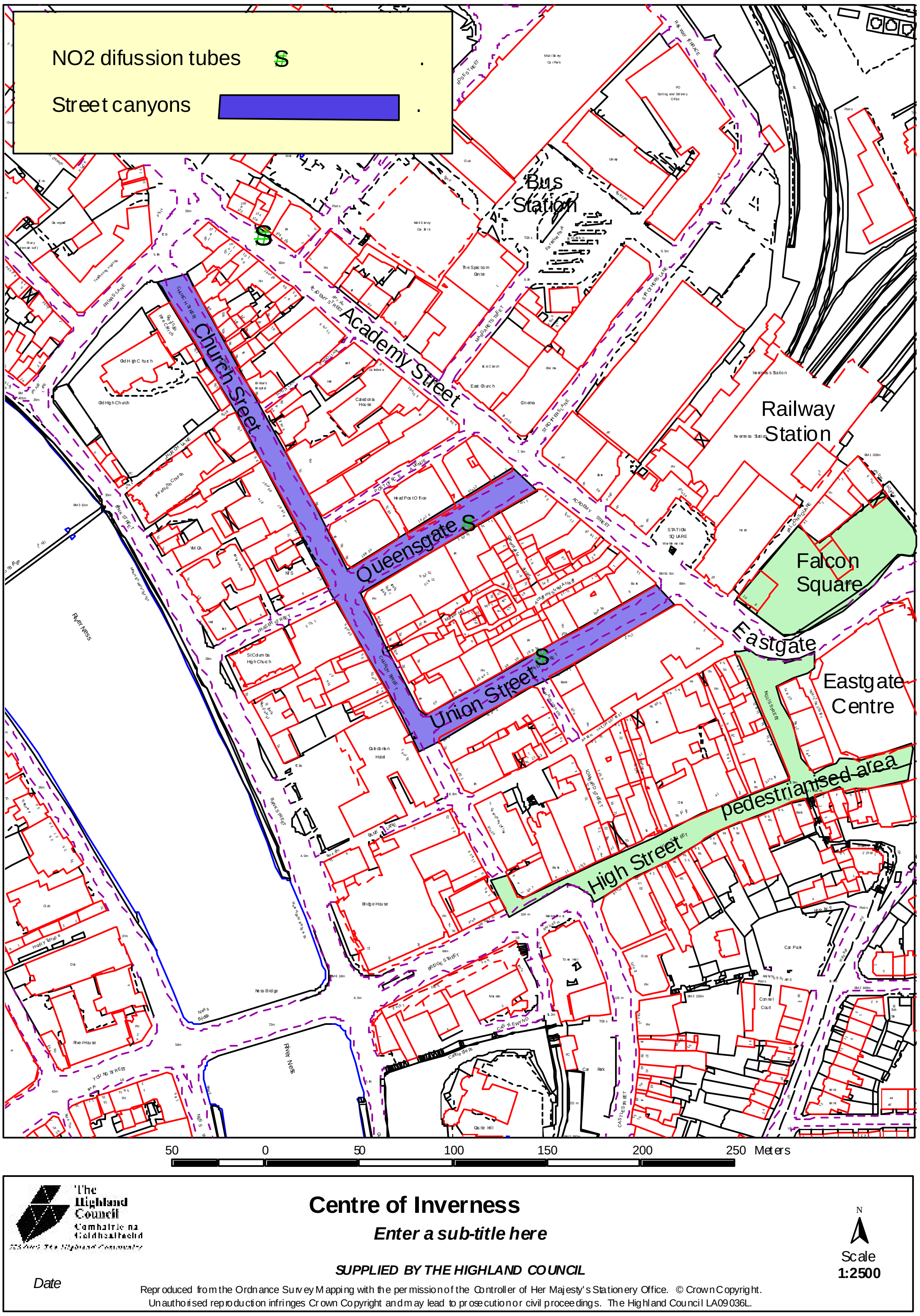
Main Fuel used for Space Heating	Aviemore (%)	Fort William (%)	Castletown (%)	Average (%)
Gas (Mains, bottle or tank)	4.2	2.8	4.6	3.9
Electricity	69.3	71.1	16.7	52.4
Oil	14.5	13.8	24.1	17.5
Coal	7.8	9	8.3	8.4
Anthracite	1.8	0	27.8	9.9
Smokeless	2.4	2.1	16.7	7.1
Wood	0	1.4	1.9	2
Total Solid fuel	**12**	**12.4**	**54.6**	**26.3**

Solid Fuel used as a Secondary Fuel for Space Heating	Aviemore (%)	Fort William (%)	Castletown (%)	Average (%)
Coal	33.9	28.3	17.1	26.4
Anthracite	0	0	0	0
Smokeless	3.6	0	2.4	2
Wood	12.5	13	14.6	13.4
Total Solid fuel	**50**	**41.3**	**34.1**	**41.8**

SOLID FUEL USED AS A SECONDARY FUEL FOR SPACE HEATING	Aviemore (%)	Fort William (%)	Castletown (%)	Average (%)
Less Than 10 Days A Year	10.2	7.3	7.0	8.167
11 To 50 Days A Year	15.9	14.7	10.0	13.53
51 To 100 Days A Year	12.5	6.3	6.0	8.267
More Than 100 Days A Year	14.8	12.6	11.0	12.8

Main Fuel for Domestic Hot Water	Aviemore (%)	Fort William (%)	Castletown (%)	Average (%)
Gas (Mains, bottle or tank)	2.3	3.1	3.6	3
Electricity	69.7	72.8	44.4	62.3
Oil	10.9	11.3	14.8	12.3
Coal	13.7	8.2	6.5	9.467
Anthracite	0	1.5	16.6	6.03
Smokeless	1.7	2.1	11.8	1.7
Wood	1.7	1.0	2.4	1.7
Other	0	0	0	0
Total Solid fuel	**17.1**	**12.8**	**37.3**	**22.4**

Annex 6 Map of Inverness showing location of NO_2 diffusion tubes, street canyons and existing pedestrianised areas



Annex 7 Screening of Roads and Junctions using the Design Manual for Roads and Bridges (DMRB) Screening Method V1.01g

The DMRB Screening Tool in Excel spreadsheet format can be downloaded from the Highways Agency Web site: http://www.highways.gov.uk/contracts/index.htm#2).

The tool enables the predict the impact which road traffic will have on the level of certain pollutants near roads, now and in future years. In the following figures, the derivation of the raw data for NO_2 predictions is explained and the calculated outputs from the screening tool are shown in the Figures below. The predicted NO_2 concentrations for several roads and junctions are shown for the years 2001, 2005, and 2010 in the Figures below. In the case of PM_{10} , the targeted years are 2004 and 2010.

The Technical Guidance LAQM.TG(03) advises:

"The revised DMRB model is expected to provide a slightly conservative assessment of the impact in most cases. This is appropriate for a screening model and should prevent authorities unnecessarily proceeding to a Detailed Assessment. The validation work carried out by the Highways Agency has indicated that the model may significantly under predict concentrations of nitrogen dioxide and carbon monoxide alongside urban city-centre roads classified as 'street canyons'. There is no clear evidence, however, that this is the case for PM_{10}, thus no adjustment is required for street canyons in the case of PM_{10}."

In the same manner, the DMRB Screening Model was used to predict the number of 24-hour exceedences of PM_{10} in 2004 and 2010.

To use the DMRB screening tool, certain data must be collected. These are:

Estimated annual mean background concentrations of the pollutants of interest

Estimated annual mean background concentrations for the years of interest have been mapped for the UK, and can be accessed from the internet at the following address

(www.airquality.co.uk/archive/laqm/tools.php).

The raw data was downloaded and then converted to a pivot table in Excel so that it was possible to read the estimated background concentrations for each 1 x 1 km square. The background concentrations for the point of interest were collected for the relevant pollutants for the relevant years. As required in the DMRB tool for the prediction of NO_2, background concentrations for NO_2 and NOx were inputted in the spreadsheet.

Traffic Flow

AADT24 is required for the measure of traffic flow. (AADT is the annual average daily traffic flow – sometimes referred to as AADT24). This information was obtained from the Highland Councils' TECS Services Transportation section for several survey years and used to calculate traffic growth in future years. The traffic flows for Union Street, Church Street and Queensgate were estimated by TECS Services Transportation section.

Traffic Growth

The TEMPRO programme was downloaded from http://www.tempro.org.uk and traffic flow data was inputted to estimate traffic flows in future years. The results compared favourably with the National Road Traffic Forecasts (NRTF). In the case of the Central Growth Forecast from the NRTF, TEMPRO forecasts were of the order of 100 vehicles less.

The Central Growth Forecast from the National Road Traffic Forecast was used to predict future traffic flows in the years of interest. The percentage annual growth for all vehicles is shown in Figure 12.1.

Figure 12.1 Annual Traffic Growth - Central Growth Forecast - National Road Traffic Forecast

1994 - 2000	2001 - 2005	2006 - 2010
1.7% annual growth	1.69% annual growth	1.53% annual growth

Vehicle Split

TECS Services Transportation section uses the OGV1 and OGV2 traffic classifications in its road surveys. It is not possible to break this down into the vehicle split which is used in the DMRB screening tool. The vehicle splits which were used in the calculations were derived from the UK Fleet Composition Projections 2002 v2.xls spreadsheet available from the National Atmospheric Emissions Inventory, NETCEN, January 2003.

The percentages which were used in the DMRB model were the 2005 projections for Urban and Rural roads.

Figure 12.2 Vehicle split by road type – Source: NETCEN

	Urban Roads					**Rural Roads**				
	2001	2003	2004	2005	2010	2001	2003	2004	2005	2010
Cars	85.1%	85.1%	85.1%	85.1%	85.1%	81.4%	81.3%	81.2%	81.2%	81.8%
Light	10.4%	10.5%	10.5%	10.6%	10.7%	11.5%	11.6%	11.7%	11.8%	11.5%
Buses	1.5%	1.5%	1.5%	1.5%	1.5%	0.7%	0.7%	0.7%	0.7%	0.7%
Rigid HGV	2.3%	2.3%	2.3%	2.3%	2.1%	3.6%	3.5%	3.4%	3.4%	3.0%
Artic HGV	0.6%	0.6%	0.6%	0.6%	0.6%	2.9%	2.9%	3.0%	3.0%	2.9%

In the case of the roads in the old town centre of Inverness, the traffic split was amended on the advice of the Transportation section to that shown in the Figure 12.3.

Figure 12.3 Local traffic split – old town centre, Inverness

	Cars (%)	**Light (%)**	**Buses (%)**	**Rigid HGV (%)**	**Arctic HGV (%)**
Academy Street	83.6	12.0	1.5	2.3	0.6
Union Street	65.1	12.0	20.0	2.3	0.6
Church Street	80.1	12.0	5.0	2.3	0.6
Queensgate	71.1	12.0	14.0	2.3	0.6

Traffic Speed

The Technical Guidance LAQM.TG(03)advises: "For the DMRB Screening Model assessment basic daily average speed for two-way flow is adequate for both road links and junctions. Where possible an emphasis should be placed on collecting or estimating more reliable local data rather than using national averages or speed limits. The likelihood and effect of congestion should be built into the speed estimates for DMRB Screening Model assessments." With these considerations in mind, the speeds which were used in the DMRB screening tool were estimated with the assistance of the TECS Services Transportation section.

Selection of roads and junctions for DMRB screening

Roads and junctions were selected for DMRB screening having regard to the screening requirements in the checklists for the relevant pollutants in the Technical Guidance LAQM.TG(03).

Traffic flows in Highland are highest in and around Inverness City. The traffic flows in and around other towns in the Highlands are insufficient to merit screening . The roads in and around Inverness represent the worst case scenario and if the DMRB outputs do not exceed the air quality objectives, then there is no likelihood of exceedences being found in other areas.

The receptor locations were chosen to show what the predicted concentrations would be at outdoor locations where people may be present for more than 1 hour or where a comparison is made between predicted levels at the kerbside and at building façades in the centre of Inverness.

A brief description of the locations are given:

- The beer garden at the Snow Goose is bounded by the A96 to the north.
- Johnny Foxes public house in Bank Street provides outside seating in the summer and is close to the junction with the Ness Bridge. The junction has traffic lights.
- A private rear garden in Telford Street is close to the Telford Street roundabout.
- The newly formed Falcon square plaza provides outside seating for diners and is likely to be used for street entertainments and the like.
- The area in front of Inverness college next to the inner relief road is populated by students at times of the day.
- The roundabout at Tore is on the A9, the main route to the north.
- Houses in George Street are close to the inner relief road at the Rose Street roundabout.

Details of the input data for the above receptors are shown inFigure 12.4, Figure 12.5 Figure 12.6 and Figure 12.7

The DMRB output results for Nitrogen dioxide are shown in Figure 12.8, Figure 12.9 and Figure 12.10 for the years 2001, 2005 and 2010 respectively.

The results of a desk top survey of bus timetables from the main bus companies which serve Inverness shows the number of buses which travel in the city centre are tabulated in Figure 12.11

The range of background concentrations of PM_{10} in 2004 and 2010 are seen in Figure 12.12.

The DMRB output results for PM_{10} are shown in Figure 12.13 for 2004 and Figure 12.14 for 2010.

Figure 12.4 DMRB Road Links and Receptors

Road	**Receptor**	**Easting**	**Northing**	**Receptor Type**	**Receptor to centre of carriageway (m)**
Telford Street	AUN Monitoring Station	265709	845669	Public Space	9.5
Telford Street	House	265909	845547	Façade	7.2
Telford Street roundabout	Telford Street	265902	845530	Garden	26.2
Kenneth Street	Telford Street	265902	845530	Garden	59.4
Falcon Square	Kerbside	266819	845371	Public Space	7.6
Falcon Square	Plaza	266835	845406	Public Space	27.6
Rose Street roundabout to Harbour Road roundabout	Inverness College	266902	846037	Public Space	26.9
Bank Street	Johnny Foxes	266568	845207	Beer garden	12.1
Ness Bridge	Johnny Foxes	267568	846207	Beer garden	40.2
Academy Street	Kerbside	266649	845474	Kerbside	6.3
Academy Street	Façade	267649	845477	Façade	8.5
Union Street	Kerbside	266684	845347	Kerbside	5.8
Union Street	Façade	267684	845361	Façade	7.8
Church Street	Junction with Queensgate	266562	845374	Façade	16.5
Queensgate	Kerbside	266622	845427	Kerbside	6.3
Queensgate	Façade	267622	845411	Façade	7.8
A96 - Raigmore Interchange to West Seafield	Snow Goose	269156	845739	Beer garden	41.3
Tore roundabout – A9 south exit	House	260259	852384	Façade	51
Tore roundabout – A 832 west exit	House	261259	853384	Façade	30.5
Shore Street roundabout to Rose Street roundabout	House	266547	845751	Façade	21.2

Figure 12.5 DMRB – Traffic speed, road type, vehicle split and traffic flows

Road	**Annual average speed (km/h)**	**Road type (A,B,C,D)**	**Vehicle split***	**Total Traffic Flow AADT (combined, vehicle/day)**		
				2001	**2005**	**2010**
Telford Street	22	D	Urban	22,049	23,578	25,437
Kenneth Street	23	D	Urban	11,193	11,887	12,824
Falcon Square	16	D	Urban	15,902	17,004	18,346
Rose Street roundabout to Harbour Road roundabout	25	D	Urban	31,000	33,149	35,764
Bank Street	24	D	Urban	13,308	14,231	15,353
Ness Bridge	14	D	Urban	20,526	21,949	23,660
Academy Street	20	D	Urban	15,902	17,004	18,346
Union Street	18	D	Local	5,500	5,881	6,345
Church Street	18	D	Local	6,200	6,630	7,135
Queensgate	14	D	Local	5,000	5,347	5,768
A96 - Raigmore Interchange to West Seafield	40	D	Rural	31,162	33,323	35,951
Tore roundabout – A9 south exit	55	D	Rural	18,405	19,682	21,234
Tore roundabout – A 832 west exit	50	D	Rural	2,711	2,899	3,127
Shore Street roundabout to Rose Street roundabout	20	D	Urban	30,507	32,622	35,195

*****See Figure 12.2 and Figure 12.3 above.

Figure 12.6 Traffic flows and vehicle splits in the centre of Inverness

Road	**Total Traffic Flow AADT (combined, vehicle/day)**			**Cars (%)**	**Light (%)**	**Buses (%)**	**Rigid HGV (%)**	**Arctic HGV (%)**
	2001	**2005**	**2010**					
Academy Street	15,902	17,004	18,346	83.6	12.0	1.5	2.3	0.6
Union Street	5,500	5,881	6,345	65.1	12.0	20.0	2.3	0.6
Church Street	6,200	6,630	7,135	80.1	12.0	5.0	2.3	0.6
Queensgate	5,000	5,347	5,768	71.1	12.0	14.0	2.3	0.6

Figure 12.7 DMRB - Background concentrations -NO_2 and NOx

Road	**Receptor**	**BACKGROUND CONCENTRATIONS**					
		2001	**2001**	**2005**	**2005**	**2010**	**2010**
		NOx	**NO_2**	**NOx**	**NO_2**	**NOx**	**NO_2**
Telford Street	AUN Monitoring Station	15.0	12.0	13.0	9.8	10.0	7.8
Telford Street	House	15.0	12.0	13.0	9.8	10.0	7.8
Telford Street roundabout	House	15.0	12.0	13.0	9.8	10.0	7.8
Kenneth Street	House	15.0	12.0	13.0	9.8	10.0	7.8
Falcon Square	Plaza	17.0	13.0	14.0	11.1	11.0	8.9
Falcon Square	Plaza	17.0	13.0	14.0	11.1	11.0	8.9
Rose Street roundabout to Harbour Road roundabout	Inverness College	16.0	13.0	14.0	10.4	11.0	8.6
Bank Street	Johnny Foxes	17.0	13.0	14.0	11.1	11.0	8.9
Ness Bridge	Johnny Foxes	17.0	13.0	14.0	11.1	11.0	8.9
Academy Street	Kerbside	17.0	13.0	14.0	11.1	11.0	8.9
Academy Street	Façade	17.0	13.0	14.0	11.1	11.0	8.9
Union Street	Kerbside	17.0	13.0	14.0	11.1	11.0	8.9
Union Street	Façade	17.0	13.0	14.0	11.1	11.0	8.9
Church Street	Junction with Queensgate	17.0	13.0	14.0	11.1	11.0	8.9
Queensgate	Kerbside	17.0	13.0	14.0	11.1	11.0	8.9
Queensgate	Façade	17.0	13.0	14.0	11.1	11.0	8.9
A96 - Raigmore Interchange to West Seafield	Snow Goose	13.0	10.0	11.0	8.3	8.0	6.6
Tore roundabout – A9 south exit	House	7.0	5.0	6.0	4.4	4.0	3.5
Tore roundabout – A 832 west exit	House	7.0	5.0	6.0	4.4	4.0	3.5
Shore Street roundabout to Rose Street roundabout	House	17.0	13.0	14.0	11.1	11.0	8.9

Figure 12.8 DMRB Nitrogen dioxide outputs - 2001

Road	Receptor	Background concentration	Road traffic component	Total NO2
Telford Street	AUN Monitoring Station	12	11	23
Telford Street	House	12	11.5	23.5
Telford Street roundabout	Telford Street	12	7.6	19.6
Kenneth Street	Telford Street	12	2.5	14.5
Falcon Square	Kerbside	13	11.2	24.2
Falcon Square	Plaza	13	7.1	20.1
Rose Street roundabout to Harbour Road roundabout	Inverness College	13	8.1	21.1
Bank Street	Johnny Foxes	13	8.1	21.1
Ness Bridge	Johnny Foxes	13	6.2	19.2
Academy Street	**Kerbside**	**13**	**10.8**	**34.6**
Academy Street	**Façade**	**13**	**10.4**	**33.8**
Union Street	**Kerbside**	**13**	**9.5**	**32**
Union Street	**Façade**	**13**	**4.5**	**22**
Church Street	**Junction with Queensgate**	**13**	**5**	**23**
Queensgate	**Kerbside**	**13**	**8.1**	**29.2**
Queensgate	**Façade**	**13**	**4.5**	**22**
A96 - Raigmore Interchange to West Seafield	Snow Goose	10	6.8	16.8
Tore roundabout – A9 south exit	House	5	4.8	9.8
Tore roundabout – A 832 west exit	House	5	1.5	6.5
Shore Street roundabout to Rose Street roundabout	House	13	9.6	22.6

The shaded cells show the old town centre streets in Inverness which form "street canyons". As the DMRB can underestimate the concentrations in street canyons, the Technical Guidance LAQM.TG(03) advises that the road traffic component should be multiplied by 2. For these streets, the Total NO_2 concentrations which are shown in the fifth column included a road traffic component which has been doubled.

Figure 12.9 DMRB Nitrogen dioxide outputs - 2005

ROAD	**Receptor**	**Background concentration**	**Road traffic component**	**Total NO2**
Telford Street	AUN Monitoring Station	9.8	8.8	18.6
Telford Street	House	9.8	9.2	19
Telford Street roundabout	Telford Street	9.8	6	15.8
Kenneth Street	Telford Street	9.8	2	11.8
Falcon Square	Kerbside	11.1	9	20.1
Falcon Square	Plaza	11.1	5.7	16.8
Rose Street roundabout to Harbour Road roundabout	Inverness College	10.4	6.3	16.7
Bank Street	Johnny Foxes	11.1	6.6	17.7
Ness Bridge	Johnny Foxes	11.1	5	16.1
Academy Street	**Kerbside**	**11.1**	**8.6**	**28.3**
Academy Street	**Façade**	**11.1**	**8.3**	**27.7**
Union Street	**Kerbside**	**11.1**	**8.4**	**27.9**
Union Street	**Façade**	**11.1**	**8.1**	**27.3**
Church Street	**Junction with Queensgate**	**11.1**	**4.2**	**19.5**
Queensgate	**Kerbside**	**11.1**	**7.1**	**25.3**
Queensgate	**Façade**	**11.1**	**6.9**	**24.9**
A96 - Raigmore Interchange to West Seafield	Snow Goose	8.3	5.3	13.6
Tore roundabout – A9 south exit	House	4.4	3.6	8
Tore roundabout – A 832 west exit	House	4.4	1.2	5.6
Shore Street roundabout to Rose Street roundabout	House	11.1	7.7	18.8

The shaded cells show the old town centre streets in Inverness which form "street canyons". As the DMRB can underestimate the concentrations in street canyons, the Technical Guidance LAQM.TG(03) advises that the road traffic component should be multiplied by 2. For these streets, the Total NO_2 concentrations which are shown in the fifth column included a road traffic component which has been doubled.

Figure 12.10 DMRB Nitrogen dioxide outputs - 2010

Road	**Receptor**	**Background concentration**	**Road traffic component**	**Total NO2**
Telford Street	AUN Monitoring Station	7.8	6.6	14.4
Telford Street	House	7.8	6.9	14.7
Telford Street roundabout	Telford Street	7.8	4.5	12.3
Kenneth Street	Telford Street	7.8	1.5	9.3
Falcon Square	Kerbside	8.9	6.7	15.6
Falcon Square	Plaza	8.9	4.2	13.1
Rose Street roundabout to Harbour Road roundabout	Inverness College	8.8	4.7	13.3
Bank Street	Johnny Foxes	8.9	5.1	14.0
Ness Bridge	Johnny Foxes	8.9	3.6	12.5
Academy Street	**Kerbside**	**8.9**	**6.5**	**21.9**
Academy Street	**Façade**	**8.9**	**6.2**	**21.3**
Union Street	**Kerbside**	**8.9**	**6.5**	**21.9**
Union Street	**Façade**	**8.9**	**6.3**	**21.5**
Church Street	**Junction with Queensgate**	**8.9**	**3.2**	**15.3**
Queensgate	**Kerbside**	**8.9**	**5.5**	**19.9**
Queensgate	**Façade**	**8.9**	**5.4**	**19.7**
A96 - Raigmore Interchange to West Seafield	Snow Goose	6.6	3.9	10.5
Tore roundabout – A9 south exit	House	3.5	2.6	6.1
Tore roundabout – A 832 west exit	House	3.5	0.9	4.4
Shore Street roundabout to Rose Street roundabout	House	8.9	5.7	14.6

The shaded cells show the old town centre streets in Inverness which form "street canyons". As the DMRB can underestimate the concentrations in street canyons, the Technical Guidance LAQM.TG(03) advises that the road traffic component should be multiplied by 2. For these streets, the Total NO_2 concentrations which are shown in the fifth column included a road traffic component which has been doubled.

Figure 12.11 Bus Flows in old town centre, Inverness

Street or route segment	**Queensgate**	**Church Street**	**Union Street**	**Margaret Street to Queensgate**	**Bank Street to Church Street**	**Eastgate**
Traffic Flow	One Way	One Way	One Way	One Way	One Way	Two Way
Number of buses which stop at bus stops	382	83	393	-	-	-
Number of buses which pass through without stopping	247	559	211	70	248	542
Total buses using street	629	642	604	-	-	-

DMRB outputs for PM_{10}

The estimated background concentrations did not vary significantly form site to site and the ranges are summarised in Figure 12.12. The actual estimated background concentrations for each site were used when the data was being entered into the DMRB spreadsheet.

Figure 12.12 DMRB - Background concentrations -PM_{10}

Road	**Receptor**	**BACKGROUND CONCENTRATIONS**	
		2004	**2010**
All roads under consideration	All receptors under consideration	12 -13	11 -13

Figure 12.13 DMRB PM_{10} outputs – 2004

Road	**Receptor**	**Background concentration**	**Road traffic component**	**Total PM_{10}**	**Days >50 mg/m^3**
Telford Street	AUN Monitoring Station	13	4.97	17.97	1
Telford Street	House	13	5.25	18.25	2
Telford Street roundabout	Telford Street	13	3.15	16.15	0
Kenneth Street	Telford Street	13	0.89	13.89	0
Falcon Square	Kerbside	13	5.39	18.39	2
Falcon Square	Plaza	13	3.14	16.14	0
Rose Street roundabout to Harbour Road roundabout	Inverness College	13	3.31	16.31	0
Bank Street	Johnny Foxes	13	3.48	16.48	0
Ness Bridge	Johnny Foxes	13	2.71	15.71	0
Academy Street	Kerbside	13	5.07	18.07	1
Academy Street	Façade	13	4.83	17.83	1
Union Street	Kerbside	13	4.11	17.11	1
Union Street	Façade	13	3.95	16.95	1
Church Street	Junction with Queensgate	13	2.05	15.05	0
Queensgate	Kerbside	13	3.6	16.6	1
Queensgate	Façade	13	3.49	16.49	0
A96 - Raigmore Interchange to West Seafield	Snow Goose	13	2.19	15.19	0
Tore roundabout – A9 south exit	House	12	1.18	13.18	0
Tore roundabout – A 832 west exit	House	12	0.35	12.35	0
Shore Street roundabout to Rose Street roundabout	House	13	4.29	17.29	1

Figure 12.14 DMRB PM_{10} outputs – 2010

Road	**Receptor**	**Background concentration**	**Road traffic component**	**Total PM_{10}**	**Days >50μg/m^3**
Telford Street	AUN Monitoring Station	12	2.85	14.85	0
Telford Street	House	12	3.01	15.01	0
Telford Street roundabout	Telford Street	12	1.8	13.8	0
Kenneth Street	Telford Street	12	0.54	12.54	0
Falcon Square	Kerbside	13	3.01	16.01	0
Falcon Square	Plaza	13	1.75	14.75	0
Rose Street roundabout to Harbour Road roundabout	Inverness College	13	1.91	14.91	0
Bank Street	Johnny Foxes	13	2.09	15.09	0
Ness Bridge	Johnny Foxes	13	1.49	14.49	0
Academy Street	Kerbside	13	2.9	15.9	0
Academy Street	Façade	13	2.77	15.77	0
Union Street	Kerbside	13	2.27	15.27	0
Union Street	Façade	13	2.18	15.18	0
Church Street	Junction with Queensgate	13	1.19	14.19	0
Queensgate	Kerbside	13	1.98	14.98	0
Queensgate	Façade	13	1.92	14.92	0
A96 - Raigmore Interchange to West Seafield	Snow Goose	12	1.24	13.24	0
Tore roundabout – A9 south exit	House	11	0.67	11.67	0
Tore roundabout – A 832 west exit	House	11	0.21	11.21	0
Shore Street roundabout to Rose Street roundabout	House	13	2.45	15.45	0