**BMT Cordah Limited**
ENVIRONMENTAL CONSULTANCY
AND INFORMATION SYSTEMS

# Local Air Quality Management Detailed Assessment

## A Report for East Dunbartonshire Council

**BMT Cordah Limited,**
Pentlands Science Park,
Penicuik, Midlothian,
UK, EH26 0PZ.
Tel: +44(0)131 445 6120
Fax: +44(0)131 445 6110
Email: main@bmtcordah.com
Website: www.bmtcordah.com

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**Approved and authorised for issue:**

| | | |
|---|---|---|
| Rebecca Chrystie, Consultant | Derek Schoehuys, Senior Consultant | Bill Sheridan, Principal Consultant |

## Glossary

| | |
|---|---|
| AADT | Annual Average Daily Traffic (Vehicles per Day) |
| AQMA | Air Quality Management Area |
| AUN | Automatic Urban (air quality monitoring) Network |
| AURN | Automatic Urban and Rural (air quality monitoring) Network |
| CO | Carbon monoxide |
| Defra | Department for Environment, Food and Rural Affairs |
| DfT | Department for Transport |
| DMRB | Design Manual for Roads and Bridges Screening Model (v1.0g) |
| EAL | Environmental Assessment Level |
| EFD (EFDB) | Emissions Factor Database |
| EIA | Environmental Impact Assessment |
| HDV | Heavy Duty Vehicles (Includes Rigid & Articulated HGVs, Buses and Coaches) |
| HGV | Heavy Goods Vehicles |
| Minor Roads | Non- A roads or motorways |
| NAEI | National Atmospheric Emissions Inventory |
| NAQS | National Air Quality Strategy |
| NETCEN | National Environment Technology Centre (AEA Environmental Technology) |
| $NO_2$ | Nitrogen dioxide |
| NRTF | National Road Traffic Forecasts |
| OS | Ordnance Survey |
| Percentile | The xth percentile is the value at which x percent of the time the measured or modelled pollutant concentration is less than the value. |
| ppb | parts per billion |
| ppm | parts per million |
| $PM_{10}$ | Particulate matter with an (equivalent aerodynamic) diameter of ten microns (10µm) or less |
| $PM_{2.5}$ | Particulate matter with an (equivalent aerodynamic) diameter of two and a half microns (2.5µm) or less |
| SEPA | Scottish Environment Protection Agency |
| $SO_2$ | Sulphur dioxide |
| TEA | Triethanolamine |
| TEMPRO | Trip End Model PROjections of growth in travel demand, and the underlying car ownership and planning data projections |
| U&SA | Local authority Air Quality Management Updating and Screening Assessment |

## CONTENTS

## Table Contents List

## Figure Contents List

## Executive Summary

BMT Cordah Ltd has been commissioned by East Dunbartonshire Council to carry out the Detailed Assessment of $PM_{10}$ from road traffic emissions.

The aim of the study was to determine the risk of exceedence of the National Air Quality Strategy (NAQS) objectives for $PM_{10}$, and to advise whether an Air Quality Management Area (AQMA) is required for $PM_{10}$. East Dunbartonshire did not require a Detailed Assessment for $NO_2$, however $NO_2$ has been included in the modelling assessment and any risk of exceedence of the NAQS objectives for $NO_2$ have been identified.

The three areas assessed are:

- Garscube Switch Roundabout and connecting roads in Bearsden and Milngavie;
- Kirkintilloch Road in Bishopbriggs; and
- the Townhead, Lenzie Road junction in Kirkintilloch.

### $NO_2$ Assessment

Monitoring results for $NO_2$ across East Dunbartonshire projected forward to 2005 indicated that two sites at Bishopbriggs were close to the NAQS annual mean objective of 40µg/m$^3$. An exceedence of the annual mean objective was predicted for 2005 at the automatic monitor in Bishopbriggs.

Modelled traffic emissions for 2005 indicated that there would be two areas of probable exceedence of the 2005 annual mean NAQS objective for $NO_2$, one at Bearsden Cross and the other at Bishopbriggs Cross, a further one area of possible exceedence was identified at Kirkintilloch.

No exceedences of the 2005 1-hour mean NAQS $NO_2$ objective of 200µg/m$^3$ were predicted at any of the assessed locations in East Dunbartonshire

Due to the marginal exceedences predicted by the model, and the fact that automatic monitored $NO_2$ concentrations were available for 6 months only, it is recommended that the decision to declare an AQMA for $NO_2$ be taken upon completion of a full year's monitoring and the triplicate diffusion tube co-location study.

## $PM_{10}$ Assessment

Monitoring results for $PM_{10}$ at the automatic monitor in Bishopbriggs did not indicate an exceedence of either the annual mean or 24-hour mean NAQS objectives of 40µg/m$^3$ and 50µg/m$^3$ for 2004. Results projected forward to 2010 indicated that there would not be an exceedence of the 24-hour mean objective for 2010, but that the annual mean would be close to the 2010 annual mean $PM_{10}$ objective of 18µg/m$^3$.

$PM_{10}$ monitoring data was only available for Bishopbriggs therefore no verification of modelled concentrations was possible for the Bearsden and Kirkintilloch areas.

Modelled traffic emissions for 2004 indicated that it was unlikely that there would exceedences of the 2004 annual mean and 24-hour mean NAQS objective for $PM_{10}$. The modelled traffic emissions for 2010 indicated that there were several small areas, at locations of relevant public exposure, where an exceedence of the 2010 annual mean NAQS objective for $PM_{10}$ was predicted. No exceedences of the 24-hour mean $PM_{10}$ objective for 2010 were predicted by the model at any of the assessed locations in East Dunbartonshire.

Due to the marginal exceedences predicted by the model, and the fact that automatic monitored $PM_{10}$ concentrations were only available for 6 months at one location, it is recommended that reconsideration of an AQMA for $PM_{10}$ at Bishopbriggs be taken upon completion of a full year's monitoring. It is also recommended that automatic monitoring for $PM_{10}$ be considered at Bearsden Cross to verify model results in this area.

# 1 INTRODUCTION

BMT Cordah Ltd has been commissioned by East Dunbartonshire Council to carry out the Detailed Assessment of $PM_{10}$ from Road Traffic Emissions. The study includes detailed modelling of fine particulate material ($PM_{10}$) and nitrogen dioxide ($NO_2$) emissions from road traffic along two roads and one road junction and reports on monitored concentrations of $NO_2$ and $PM_{10}$.

The aim of the study is to determine the risk of exceedence of the National Air Quality Strategy (NAQS) objectives for $PM_{10}$. This report constitutes the Local Air Quality Management (LAQM) Detailed Assessment for East Dunbartonshire Council and will be used to conclude whether an Air Quality Management Area (AQMA) is required for $PM_{10}$.

East Dunbartonshire did not require a Detailed Assessment for $NO_2$, however it has been requested that $NO_2$ be included in the modelling assessment and any risk of exceedence of the NAQS objectives for $NO_2$ be identified in the report.

## 1.1 Review and Assessment Framework

The Environment Act 1995 and subsequent regulations require local authorities to conduct a Review and Assessment of air quality in their area to assess compliance with the standards and objectives set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 (Reference 1), the Air Quality (Scotland) Regulations 2000 (Reference 2) and Air Quality (Scotland) Amendment Regulations 2002 (Reference 3).

The framework of local air quality management (LAQM) requires a Review and Assessment of air quality by local authorities on a regular basis.

The second round of the Review and Assessment commenced in 2003 and has two phases. The first stage of the second round of Review and Assessment was an Updating and Screening Assessment (U&SA). The U&SA considered any changes that had occurred since the first round of Review and Assessment that may have affected air quality.

Where a risk of exceedence of an air quality objective at a location with relevant public exposure was identified by the U&SA then a Detailed Assessment is required. A Detailed Assessment will consider any risk of exceedence of an objective to greater depth in order to determine whether it is necessary to declare an AQMA.

This report represents a detailed modelling study of road traffic emissions, which will make up part of the Detailed Assessment of air quality within East Dunbartonshire Council and follows the guidance laid out in the Technical Guidance document LAQM.TG (03) (Reference 4).

## 1.2 Summary of Review and Assessment Process in East Dunbartonshire

The first round of Review and Assessment by East Dunbartonshire Council concluded that further assessment of CO, $NO_2$, benzene, 1,3-butadiene, lead, $SO_2$ and $PM_{10}$ was not required (Reference 5).

The U&SA for the second round of review and assessment was completed by East Dunbartonshire Council in July 2003 (Reference 6). The report concluded that it was not necessary to proceed to a Detailed Assessment for CO, benzene, 1, 3-butadiene, $SO_2$, $NO_2$ and lead. It was recommended that a Detailed Assessment be carried out for $PM_{10}$ with respect to traffic emissions along two roads and at one junction identified as having the potential to exceed NAQS objective levels. It was requested by the council that the Detailed Assessment of traffic emissions include the impact of $NO_2$ emissions on the local air quality.

This report provides the detailed modelling study for the East Dunbartonshire Council Detailed Assessment for the second round of Review and Assessment.

## 1.3 Description of East Dunbartonshire Council Area

East Dunbartonshire is located to the north west of Glasgow and is one of Scotland's smaller local authorities. A map locating the council area is shown in Figure 1 in Appendix 1.

East Dunbartonshire Council area is neighboured to the west by West Dunbartonshire Council, to the east and north by Stirling council, to the south east by North Lanarkshire Council and to the south by Glasgow City Council where a Detailed Assessment of air quality has been required for $NO_2$, $SO_2$, and $PM_{10}$.

East Dunbartonshire has a population of 108,243 covering an area of 77 square miles. The council area is a mixture of urban and rural areas with the majority of the population resident in the eastern and southern areas. The main towns within East Dunbartonshire are Bearsden, Bishopbriggs, Kirkintilloch, Milngavie and Lenzie.

The Campsie Hills are located to the north of the council area and constitute the catchment area for the Glazert Water, River Kelvin and Craigmaddie and Mugdock Reservoirs.

There are two rail links, the main Edinburgh to Glasgow line used for freight and passenger trains, which passes east to west through East Dunbartonshire and a passenger route passing north to Milngavie from Glasgow. The Forth & Clyde canal passes east to west through the local authority linking the Forth and Clyde rivers. There are no motorway routes within East Dunbartonshire Council and the main roads in the area are the A891, A8006, A807, A81, A809, A803 and the A810.

## 1.4 Proposed New Roads

Two roads, which will have an impact on air quality within East Dunbartonshire within the next few years are the Kirkintilloch Link Road and the Bishopbriggs Relief Road. Outline planning permission has been granted to construct a 4km road linking the Townhead Roundabout in Kirkintilloch with the M80.

The Bishopbriggs Relief Road is planned to be constructed in 5 phases from the M80 at Robroyston Road north to Torrance.

- Phases 1& 2 have already been completed forming a link from the Glasgow City Council boundary to a roundabout on Auchinairn Road.

- Outline planning permission for phase 3 from Auchinairn Road to a roundabout on Wester Cleddens Road has lapsed and a new application is required.

- A planning application for phase 4 is currently under consideration for the section from Wester Cleddens Road north over a new railway bridge to a roundabout acting as the gateway to Westerhill Business Park. Construction of phase 4 is expected to begin in 2005.

- Phase 5 would link Westerhill Business Park to the roundabout on the A803 Kirkintilloch Road. Planning permission for this section has not yet being considered.

The construction of these two new roads will have an impact on traffic flows within the centres of Kirkintilloch and Bishopbriggs. Full planning consent has not yet been granted for the sections currently at application stage and predicted traffic flow data is not available therefore the impact on local air quality due to alterations in traffic flow will be considered at a later date when predicted traffic flow data is available.

# 2 NITROGEN DIOXIDE

Primary sources of Nitrogen Dioxide ($NO_2$) are from vehicle engines and combustion processes. $NO_2$ is also generated by the reaction of oxides of nitrogen ($NO_X$) and atmospheric ozone ($O_3$).

There are two air quality objectives for $NO_2$, an annual mean objective and an hourly objective, set out in the Air Quality (Scotland) Regulations 2000. The objectives are presented in Table 1.

**Table 1 Air Quality Objectives for Nitrogen Dioxide**

| Concentration | Measured As | Date to be Achieved By |
|---|---|---|
| 40 µg/m$^3$ | Annual Mean | 31.12.2005 |
| 200 µg/m$^3$ | 1-hour Mean, not to be exceeded more than 18 times per year[1] | 31.12.2005 |

[1] corresponds to the 99.8$^{th}$ percentile concentration of hourly means

East Dunbartonshire Council monitors ambient $NO_2$ concentrations throughout the area. The monitored concentrations are presented and evaluated against the NAQS objectives in Section 2.2. The Detailed Assessment of road traffic emissions at each of the locations identified in the U&SA is discussed in Section 2.3. A full methodology of the dispersion modelling is provided in Appendix 2.

## 2.1 Background Concentrations

Background concentrations represent the ambient concentration of a pollutant away from the influence of a specific emission source such as road traffic and industrial sites. In selecting a background concentration care must be taken to ensure that all relevant local pollutant sources are accounted for but that there is no duplication of the specific source being considered.

The background concentrations for East Dunbartonshire Council were taken from the annual mean background concentration database compiled by the National Environmental Technology Centre (Netcen) (Reference 7) and are presented in Table 2.

**Table 2: Predicted Background $NO_2$ Concentrations for East Dunbartonshire**

| Location | 2003 | 2004 | 2005 | 2010 |
|---|---|---|---|---|
| East Dunbartonshire Council | 19.8 | 19.4 | 18.7 | 16.3 |
| Bearsden & Milngavie | 24.3 | 23.9 | 22.9 | 19.7 |
| Kirkintilloch | 23.9 | 22.7 | 22.0 | 19.1 |
| Bishopsbriggs | 26.9 | 26.2 | 25.5 | 22.1 |

The background concentrations averaged for grid squares used in the model include a component of emissions from traffic along the modelled roads. Therefore using a background concentration taken from grid squares through which a modelled road passes will result in the duplication of traffic emissions and thus an overestimation of the predicted $NO_2$ concentration. The background concentrations averaged for the whole of East Dunbartonshire were therefore used in the modelling study.

## 2.2 Monitoring Data

Monitoring for $NO_2$ in East Dunbartonshire is undertaken using both automatic chemiluminescent analysers and passive diffusion tubes.

Whilst the detailed modelling study is focussed on the specific locations identified in the U&SA all monitoring data collected for $NO_2$ is reported for reference. The monitoring by passive diffusion tubes is discussed in Section 2.2.4 and monitoring by chemiluminescent analysers is discussed in Section 2.2.3.

### 2.2.1 QA/QC of Diffusion Tube Monitoring Data

The laboratory analysis of the passive diffusion tubes is undertaken by Glasgow Scientific Services (GSS). GSS prepares the diffusion tubes using the technique of 20% Triethanolamine (TEA) in water.

Glasgow Scientific Services participate in the AEA Technology laboratory intercomparison scheme. The scheme, whilst assessing the analytical performance of laboratories, also allows for the performance of the diffusion tubes against chemiluminesence techniques to be determined. A laboratory bias for GSS was therefore determined using the methodology contained in the technical guidance LAQM.TG(03) and data obtained from the AEA Technology intercomparison study. Results from the laboratory comparison were obtained from the data collated on behalf of DEFRA (Reference 8). The methodology used to calculate the bias is presented in Table 3.

**Table 3: Laboratory Bias Correction Factor for Glasgow Scientific Services 2003**

| Laboratory Study | Annual Mean Diffusion Tube Concentration ($\mu g/m^3$)(Dm) | Annual Mean Chemiluminesence Concentration ($\mu g/m^3$) Cm | Bias Adjustment Factor (Cm/Dm) | Diffusion Tube Bias (Dm-Cm)/Cm |
|---|---|---|---|---|
| AEA Technology Intercomparison Study | 39 | 32 | 0.82 | 21.9% |

The AEA Technology intercomparison study therefore provides a laboratory correction factor for GSS of 0.82. The bias factor determined for 2003 is therefore comparable to factors for both urban centre and kerbside sites for previous years.
East Dunbartonshire is currently operating a triplicate diffusion tube co-location study at Bishopbriggs Cross. Results are available for the months December 2003 to June 2004. As a full year co-location study has not been completed the bias factor calculated for the 6 months from the site in East Dunbartonshire has not been used to correct data. The bias correction factor for the 6 month study is 1.09, indicating that the diffusion tubes are under-recording the $NO_2$ concentration in comparison to the automatic monitor. This also suggests that the bias factor provided by GSS is further producing an under-estimate of reported $NO_2$ diffusion tube results.

### 2.2.2 Diffusion Tube Monitoring Data

East Dunbartonshire Council monitor $NO_2$ using diffusion tubes at sixteen different sites throughout the Council area. The monitoring locations were selected to provide monitoring data from several key areas within East Dunbartonshire:

- at receptors adjacent to busy roads throughout East Dunbartonshire; and
- background concentration levels within East Dunbartonshire as an approximation of the background $NO_2$ concentration throughout urban areas within the area.

The network of 16 passive diffusion tubes distributed throughout East Dunbartonshire provides annual and monthly mean $NO_2$ concentrations for each location. The sites include receptors adjacent to the busy road network through East Dunbartonshire, urban background locations within the major towns of the area and roadside/kerbside sites adjacent to busy roads in urban areas. Annual mean $NO_2$ concentrations for 2005 have been estimated using the factors available in the technical guidance LAQM.TG(03). The monitoring results are presented in Table 4. The $NO_2$ diffusion tube monitoring sites are located in Figures 2, 3, and 4 in Appendix 1.

**Table 4: $NO_2$ Diffusion Tube Monitoring Results for 2003**

| Location | National Grid Reference | Classification | Annual Mean $NO_2$ Concentration ($\mu g/m^3$) | Projected $NO_2$ Annual Mean Concentration 2005 ($\mu g/m^3$) | Data Capture Rate % |
|---|---|---|---|---|---|
| Bishopbriggs 5 | NS 60948 69610 | Urban Background | 19.16 | 18.35 | 91.67 |
| Bishopbriggs 6 | NS 61016 70198 | Kerbside | 37.58 | 35.62 | 100 |
| Bishopbriggs 8 | NS 60842 70278 | Urban Background | 18.04 | 17.28 | 100 |
| Bishopbriggs 12 | NS 60581 69527 | Kerbside | 40.30 | 38.20 | 100 |
| Bishopbriggs 13 | NS 60549 69312 | Kerbside | 41.36 | 39.21 | 75 |
| Bearsden 1 | NS 54218 72193 | Roadside | 28.70 | 27.21 | 100 |
| Bearsden 3 | NS 54655 70158 | Urban Background | 21.54 | 20.63 | 91.67 |
| Bearsden 4 | NS 53075 73382 | Urban Background | 18.57 | 17.79 | 50 |
| Bearsden 7 | NS 54269 72069 | Kerbside | 34.37 | 32.58 | 100 |
| Bearsden 8 | NS 54275 72047 | Kerbside | 35.12 | 33.29 | 100 |
| Bearsden 9 | NS 54751 70621 | Roadside | 28.70 | 27.21 | 100 |
| Bearsden 10 | NS 55394 70683 | Roadside | 30.75 | 29.15 | 100 |
| Bearsden 13# | NS 54809 71057 | Kerbside | #28.39 | #26.91 | #100 |
| Bearsden 14# | NS 54877 71000 | Kerbside | #31.63 | #29.98 | #87.5 |
| Bearsden 15# | NS 54898 71023 | Kerbside | #31.48 | #29.84 | #87.5 |
| Kirkintilloch 15* | NS 65640 73501 | Roadside | *34.73 | *32.92 | *83.33 |

# Based on monitoring data for 8 months (May – December 2003).

* Based on monitoring data for 6 months (December 2003 – May 2004).

Measured annual mean concentrations at 14 of the 16 sites used for diffusion tube monitoring are below the NAQS objective standard of $40\mu g/m^3$. The measured annual mean concentrations at Bishopbriggs 12 and Bishopbriggs 13 are slightly above the NAQS objective standard of $40\mu g/m^3$.

Historical data provided for 3 sites within East Dunbartonshire, and reported in the East Dunbartonshire U&SA, show that the annual mean $NO_2$ concentrations are declining inline

with the national trend. Annual mean $NO_2$ concentrations projected to 2005 demonstrate that $NO_2$ concentrations are likely to fall below the NAQS objective levels at all monitoring sites within East Dunbartonshire.

### 2.2.3 Automatic Monitoring Data

In addition to the diffusion tube monitoring the council operates one stationary automatic monitoring station containing a real-time chemiluminescent analyser suitable for measuring $NO_2$ concentrations at roadside and kerbside locations. The location of the automatic monitor is shown in Figure 3 in Appendix 1.

The stationary monitoring site is located in Crowhill Road, Bishopbriggs at a roadside location. Data from the automatic monitoring site is available from December 2003 until May 2004. Technical guidance LAQMTG(03) provides a methodology for estimating the annual mean concentration for a site based on short term monitoring data. In order to adjust the short term concentration to an annual mean concentration a local site with complete monitoring data is used for comparison. However, it has not been possible to use this methodology as there was a lack of monitoring data for $NO_2$ in the Glasgow area in 2003. Table 5 displays monitoring data from December 2003 to May 2004 for East Dunbartonshire.

**Table 5: Automatic Monitoring Station $NO_2$ Monitoring Results**

| Month | Mean Concentration ($\mu g/m^3$) | 99.79$^{th}$ Percentile of 1-hour means ($\mu g/m^3$) | No of 1-hr exceedences | Predicted Annual Mean for 2005 ($\mu g/m^3$) |
|---|---|---|---|---|
| **Dec 2003** | 49.1 | - | **0** | |
| **Jan 2004** | 45.4 | - | **0** | |
| **Feb 2004** | 50.1 | - | **0** | |
| **Mar 2004** | 40.7 | - | **0** | |
| **Apr 2004** | 33.6 | - | **0** | |
| **May 2004** | 29.1 | - | **0** | |
| **6-Month Mean** | 41.35 | 123.0 | **0** | **40.3** |

The monitoring results therefore indicate that there is likely to be an exceedence of the annual mean NAQS objectives for $NO_2$ within East Dunbartonshire at Bishopbriggs. However, the exceedence is marginal and only 6 months of monitoring data are available, which include 4 winter and 2 summer months as opposed to the recommended 3 months of both winter and summer months monitoring data as a minimum for declaring an AQMA.

## 2.3 Road Traffic Emissions

Three junctions in the East Dunbartonshire area were identified to be included in the Detailed Assessment of $NO_2$. The road junctions were:

- junction of A739 Switchback Road, A809 Drymen Road, A81 Maryhill Road and A81 Milngavie Road, Bearsden/Milngavie;
- junction of A803 Kirkintilloch Road and B812 Colston Road, Bishopbriggs; and

- junction of B757 Townhead, Industry Street and Parliament Street, Kirkintilloch.

The impact of emissions from road traffic at each of the junctions was assessed using dispersion modelling tools. The modelling study utilised traffic flow data commissioned by the Council. The dispersion modelling study is fully reported in Appendix 2.

Using the traffic flow data provided by the Council and local meteorological data obtained from the meteorological office the dispersion modelling study predicted annual mean and hourly mean concentrations of $NO_2$. The predicted concentrations were validated against monitoring data obtained at each site to ensure the accuracy of the modelling study.

The maximum predicted annual average and hourly concentrations and predicted concentrations at locations of relevant human exposure for each road junction are summarised in Tables 6 and 7. Locations of relevant human exposure for the annual mean objective include building facades of residential premises, schools, hospitals or other buildings regularly used by the general public for long periods. Relevant locations of exposure for the hourly mean objective can be roadside/kerbside locations. Maximum predicted future concentrations exceeding NAQS objectives are shaded. The highest annual mean at sensitive receptor refers to the concentrations predicted by the model at specific sensitive receptor locations close to the assessed roads.

**Table 6: Summary of Predicted $NO_2$ Concentrations for 2004**

| Road Junction | Predicted $NO_2$ Concentration ($\mu g/m^3$) | | | |
|---|---|---|---|---|
| | Maximum Annual Mean | Maximum 99.79th Percentile of Hourly Means | Highest Annual Mean at Sensitive Receptor | Highest 98th Percentile of Hourly Means at Sensitive Receptor |
| Bearsden & Milngavie | 48.4 | 123.5 | 43.4 | 119.7 |
| Bishopbriggs | 48.0 | 123.0 | 43.4 | 115.4 |
| Kirkintilloch | 52.5 | 124.6 | 34.4 | 110.6 |

**Table 7: Summary of Predicted $NO_2$ Concentrations for 2005**

| Road Junction | Predicted $NO_2$ Concentration ($\mu g/m^3$) | | | |
|---|---|---|---|---|
| | Maximum Annual Mean | Maximum 99.79th Percentile of Hourly Means | Highest Annual Mean at Sensitive Receptor | Highest 98th Percentile of Hourly Means at Sensitive Receptor |
| Bearsden & Milngavie | 46.6 | 121.1 | 41.8 | 117.3 |
| Bishopbriggs | 46.1 | 120.5 | 41.7 | 112.8 |
| Kirkintilloch | 50.7 | 122.1 | 33.1 | 107.9 |

Isopleth plots show the $NO_2$ concentration contours for 2004 and 2005 providing a pictorial representation of the extent of peak pollutant concentrations with respect to areas of relevant public exposure. Concentration plots are provided for comparison with NAQS objectives in Figures 7 to 15.

The model predicted higher concentrations of $NO_2$ around East Dunbartonshire during 2004 compared with those for 2005. Traffic flows provided by East Dunbartonshire Council were predicted to remain constant up to 2010. Therefore the decrease in $NO_2$ concentrations between 2004 and 2005 predicted by the model is not due to any variations in traffic flows within the area. The predicted reduction in $NO_2$ concentrations is due to two factors, the

presumed decrease in background concentration and the predicted improvements in vehicle emissions technology.

### 2.3.1 Bearsden and Milngavie

The model predictions for 2005 indicate areas of exceedence of the annual mean NAQS objective for $NO_2$ at one location. The area of predicted exceedence for 2005 occurs at:

- residential and shop properties along both sides of Drymen Road between Kirk Road and Roman Road.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Bearsden or Milngavie in 2005.

### 2.3.2 Bishopbriggs

Predicted $NO_2$ concentrations for the Kirkintilloch Road (A803) / Colston Road (B812) junction in Bishopbriggs indicated that the annual mean NAQS objective for 2005 would be exceeded at one location where there is relevant public exposure during 2005. Sensitive receptors on both sides of Kirkintilloch Road north of the Springfield Road junction and south of the supermarket turning are predicted to exceed the annual mean NAQS objective of 40µg/$m^3$.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Bishopbriggs in 2005.

### 2.3.3 Kirkintilloch

The $NO_2$ concentrations predicted for specific receptors (reported in Table 7) at the Townhead / B757 junction in Kirkintilloch indicated that the annual mean NAQS objective for 2005 would not be exceeded. However, the mapped concentrations (in figure ) revealed that there were other receptors in the area where an exceedence of the annual mean $NO_2$ objective for 2005was probable. The sites of possible exceedence are:

- properties on both sides of Parliament Road up to 20m from the junction;
- properties on the east side of Townhead up to 20m from the junction; and
- properties at the north end of Industry Street up to 20m from the junction.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Kirkintilloch in 2005.

# 3 PARTICULATES ($PM_{10}$)

There are two air quality objectives for $PM_{10}$, an annual mean objective and a daily mean objective, set out in the Air Quality (Scotland) Regulations 2000. In addition the Scottish Executive have set in place stricter objectives to be achieved by 2010. The objectives are presented in Table 8.

**Table 8: Air Quality Objectives for $PM_{10}$**

| Concentration | Measured As | Date to be Achieved by |
|---|---|---|
| 40 ?g/m$^3$ | Annual mean | 31.12.2004 |
| 18 ?g/m$^3$ | Annual mean | 31.12.2010 |
| 50 ?g/m$^3$ not to be exceeded more than 35 times per year | 24-hour mean[1] | 31.12.2004 |
| 50 ?g/m$^3$ not to be exceeded more than 7 times a year | 24-hour mean[2] | 31.12.2010 |

[1] corresponds to the 90.4th percentile concentration of 24-hour means
[2] corresponds to the 98th percentile concentration of 24-hour means

The annual mean concentration therefore should not be predicted to exceed 40 ?g/m$^3$ by the end of 2004 and 18?g/m$^3$ by the end of 2010. In addition it should be predicted that there will be fewer than thirty five 24-hourly exceedences of 50 ?g/m$^3$ in a year by the end of 2004 and less than seven exceedences by the end of 2010.

East Dunbartonshire Council's U&SA concluded that it was unlikely that there would be any exceedence of NAQS objectives for $PM_{10}$ in 2004. Assessment of monitoring data and assumed background concentrations concluded that it was likely that there would be a number of exceedences of the NAQS 2010 annual mean objective of 18µg/m$^3$. Emissions from road traffic were identified as likely to cause exceedence of the 2010 annual mean objective. The assessment of road traffic emissions focuses on the four road junctions identified as potentially exceeding $PM_{10}$ objectives in 2010.

The assessment of the impact of road traffic emissions at each of the junctions under consideration is presented in Section 3.3. A full report of the dispersion modelling study is provided in Appendix 2.

## 3.1 Background Concentrations

The background concentrations for East Dunbartonshire Council were taken from the Netcen annual mean background concentration database and are shown in Table 9.

**Table 9: Predicted Background $PM_{10}$ Concentrations for East Dunbartonshire (µg/m$^3$)**

| Location | 2003 | 2004 | 2010 |
|---|---|---|---|
| East Dunbartonshire Council | 18.9 | 18.9 | 17.4 |
| Bearsden & Milngavie | 19.3 | 19.3 | 17.7 |
| Kirkintilloch | 19.8 | 19.9 | 18.3 |
| Bishopbriggs | 21.0 | 21.1 | 19.4 |

The estimated background concentrations are averaged across grid squares including components of emissions from road traffic. To avoid the duplications of road traffic emissions

the background concentrations averaged for the whole of East Dunbartonshire were used in the modelling study.

## 3.2 Monitoring Data

East Dunbartonshire Council monitor $PM_{10}$ concentrations using a Beta attenuation analyser.

A summary of the monitoring data obtained from the period of December 2003 to May 2004 are presented in Table 10. The location of the automatic monitor is shown in Figure 3 in Appendix 1.

**Table 10: Measured $PM_{10}$ concentrations**

| Month | Monthly Mean Concentration ($\mu g/m^3$) | No. of 24-hour Mean Concentrations >50$\mu g/m^3$ | Data Capture Rate (%) |
|---|---|---|---|
| December | 21.5 | 0 | 100% |
| January | 15.9 | 1 | 100% |
| February | 26.4 | 0 | 100% |
| March | 22.7 | 0 | 100% |
| April | 17.0 | 0 | 100% |
| May | 18.1 | 0 | 100% |
| **6-month average** | **20.2** | **1** | **100%** |

Ideally, monitoring would have been carried over the period of a year, although a shorter period may be sufficient to demonstrate that the risk of an exceedence of the objectives is negligible. It is possible to estimate the annual mean concentration by introducing suitable adjustment to the 6-month average concentration of $PM_{10}$. The adjustment assumes that patterns in pollutant concentrations usually affect a wide region. The annual mean concentration has therefore been estimated using the techniques contained within LAQM.TG(03). The methodology for the projection is summarised in Equation 1.

Table 11 presents data obtained from two long term monitoring sites that are used to obtain an estimate of the average annual concentration in the East Dunbartonshire area. There is a considerable distance between Edinburgh (St Leonards) and the Bishopbriggs monitoring locations (approximately 60km). However, the data at St Leonards can be assumed to be typical of and urban location within Central Scotland where there is an absence of industrial $PM_{10}$ emissions.

**Table 11: Glasgow & Edinburgh measured $PM_{10}$ concentrations ($\mu g/m^3$)**

| Long term site | Annual mean(Am) | Period Mean(Dec-Jun) | Ratio(Am/Pm) |
|---|---|---|---|
| Glasgow city centre | 16.4 | 16.8 | 1.0 |
| Edinburgh St Leonards | 9.8 | 12.4 | 0.8 |
| | | Average (Ra) | 0.9 |

For the best estimate for the annual mean for the site in 2003 is given by the following:

**Equation 1**

Annual mean for 2003 = 6 month average x Average (Ra)
= 0.9 x 20.2
= 18.2µg/$m^3$

The annual average concentration is below the NAQS 2004 objective concentration of 40ug/$m^3$, However the concentration does exceed the 2010 annual mean objective level of 18µg/$m^3$. It is expected that the improvements in emission reduction techniques and the improvement in motor efficiencies will consequently result in a reduction the levels of pollution. The annual mean concentration has therefore been projected forward to 2010 using the techniques contained within LAQM.TG(03). The methodology used for the projection is summarised in Equation 2.

**Equation 2**

Monitored Annual mean concentration in 2003 = 18.2µg/$m^3$

Secondary Concentration 2001 (form maps) = 3µg/$m^3$

Coarse $PM_{10}$ fraction (from LAQM.TG(03)) = 10.5µg/$m^3$

Secondary Concentration 2003 = 3µg/$m^3$ x 0.955 = 2.87µg/$m^3$

Secondary Concentration in 2010 = 3x 0.795 = 2.39µg/$m^3$

Primary concentration in 2003 = 18.2 -2.87 – 10.5 = 4.83µg/$m^3$

Primary Concentration in 2010 = 4.83 x (0.795/0.954)

= 4.02µg/$m^3$

Total $PM_{10}$ concentration in 2010 = 4.02 + 2.39 + 10.5

= 16.9µg/$m^3$

The total projected $PM_{10}$ concentration in 2010 is not predicted to exceed the 2010 annual mean NAQS objective of 18µg/$m^3$.

One exceedence of the 24-hour mean objective of 50µg/$m^3$ was recorded in the 6 month period from December 2003 to May 2004. Thirty-five exceedences of the 24-hour mean objective are permitted by the NAQS objectives in 2004 but only seven exceedences are permitted in 2010. As the number of exceedences cannot be predicted forward it assumed that they will remain constant. It is likely therefore that the 24-hour mean objective will not be exceeded in 2010 at this site.

## 3.3 Road Traffic Emissions

Two roads and one junction in the East Dunbartonshire area were identified as emission sources with potential for exceedence of the NAQS objectives for $PM_{10}$. An assessment of $PM_{10}$ emissions and evaluation of resultant ground level concentrations against NAQS objectives was undertaken. The road junctions under consideration were:

- junction of A739 Switchback Road, A809 Drymen Road, A81 Maryhill Road and A81 Milngavie Road, Bearsden/Milngavie;
- junction of A803 Kirkintilloch Road and B812 Colston Road, Bishopbriggs; and
- junction of B757 Townhead, Industry Street and Parliament Street, Kirkintilloch.

The impact of emissions from road traffic at each of the junctions was assessed using dispersion modelling tools. The modelling study utilised traffic flow data commissioned by the Council. The dispersion modelling study is fully reported in Appendix 2.

Using the traffic flow data provided by the Council and local meteorological data obtained from the meteorological office the dispersion modelling study predicted an annual mean and daily mean concentrations of $PM_{10}$. The predicted concentrations were verified against local monitoring data where available to ensure the accuracy of the modelling study.

The maximum predicted annual average and 24-hourly concentrations at any location and at locations of relevant human exposure for each road junction are summarised in Tables 12 and 13. Locations of relevant human exposure for the $PM_{10}$ objectives include residential premises, schools, hospitals or any other area where the public may be exposed for long durations. Maximum predicted future concentrations exceeding NAQS objectives are shaded. Highest annual mean at sensitive receptor refers to the predicted concentration at specified sensitive receptors in the vicinity of the assessed junctions.

**Table 12: Summary of Predicted $PM_{10}$ Concentrations for 2004**

| Road Junction | Predicted $PM_{10}$ Concentration ($\mu g/m^3$) | | | |
|---|---|---|---|---|
| | Maximum Annual Mean | Maximum 90.4$^{th}$ Percentile of 24-Hour Means | Highest Annual Mean at Sensitive Receptor | Highest 90.4$^{th}$ Percentile of 24-Hour Means at Sensitive Receptor |
| Bearsden & Milngavie | 21.1 | 41.6 | 20.6 | 40.6 |
| Bishopbriggs | 21.2 | 41.8 | 20.8 | 41.0 |
| Kirkintilloch | 21.4 | 42.2 | 19.8 | 39.4 |

**Table 13: Summary of Predicted $PM_{10}$ Concentrations for 2010**

| Road Junction | Predicted $PM_{10}$ Concentration ($\mu g/m^3$) | | | |
|---|---|---|---|---|
| | Maximum Annual Mean | Maximum 98$^{th}$ Percentile of 24-Hour Means | Highest Annual Mean at Sensitive Receptor | Highest 98$^{th}$ Percentile of 24-Hour Means at Sensitive Receptor |
| Bearsden & Milngavie | 18.6 | 37.5 | 18.3 | 37.1 |
| Bishopbriggs | 18.8 | 37.9 | 18.6 | 37.1 |
| Kirkintilloch | 18.7 | 37.8 | 17.9 | 36.0 |

Isopleth concentration contours of $PM_{10}$ for 2004 and 2010 providing a pictorial representation of the extent of peak pollutant concentrations with respect to areas of relevant public exposure. Concentration plots are provided for comparison with NAQS objectives in Figures 19 to 30.

Due to the relatively high background concentration for $PM_{10}$ in comparison with the objective level, all areas surrounding the assessed junctions have predicted concentrations close to or exceeding the annual mean NAQS objective for 2010.

### 3.3.1 Bearsden and Milngavie

Modelling predictions indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in the Bearsden and Milngavie area.

The model predicted areas of exceedence of the 2010 annual mean NAQS objectives for $PM_{10}$ at several locations within the vicinity of Garscube Switch roundabout and along adjoining roads, Switchback Road (A739) / Maryhill Road (A81) / Milngavie Road (A81) / Drymen Road (A809). The sites of exceedence are:

- properties located on the north east, north and north west sides of the roundabout;
- properties on Mcfarlane Drive between Garscube Switch and Maryhill Road;
- properties on the north side of Maryhill Road, east of Milngavie Road:
- properties along both sides of Drymen Road between Canniesburn Toll and Canniesburn Road;
- properties on the east side of Drymen Road between Roman Road and Kirk Road; and
- properties on both sides of Milngavie Road at the junction of Roman Road and Boclair Road.

Predicted $PM_{10}$ concentrations for Bearsden and Milngavie indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded at any sensitive receptors.

### 3.3.2 Bishopbriggs

The results predicted by the model indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in Bishopbriggs.

Predicted $PM_{10}$ concentrations for the Kirkintilloch Road (A803) / Colston Road (B812) junction in Bishopbriggs indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded. The model predicted areas of exceedence of the 2010 annual mean NAQS objectives for $PM_{10}$ at several sensitive receptors within the vicinity of the junction and along Kirkintilloch Road. The sites of exceedence are:

- properties to the north east of the junction on Colston Road and Kirkintilloch Road: and

- residential and shop properties on the east and west sides of Kirkintilloch Road at the junction with Springfield Road between the Royal Mail office to the south and the supermarket turning to the north.

### 3.3.3 Kirkintilloch

The results predicted by the model indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in Kirkintilloch.

Predicted $PM_{10}$ concentrations for the Townhead / B757 junction in Kirkintilloch indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded. However the model predicted areas where the concentration at several properties around the Townhead / B757 junction was close to the 2010 annual mean NAQS objectives for $PM_{10}$. The sites close to the exceedence level are:

- properties on the north side of Parliament Road up to 100m east of Townhead:

- properties on both sides of the south end of Townhead up to 30m from the junction; and

- properties on both sides of the north end of Industry Street up to 10m from the junction.

# 4 CONCLUSIONS

The atmospheric dispersion model predicted concentrations of $NO_2$ and $PM_{10}$ for areas surrounding three road junctions in Bearsden, Bishopbriggs and Kirkintilloch.

## 4.1 $NO_2$ Concentrations

The model predictions compared well with monitored values at Bishopbriggs and Kirkintilloch.

Model predictions at Bearsden and Milngavie generally overestimated the concentration in comparison to monitored values. The differences calculated between modelled and monitored concentrations were particularly large at the three monitoring sites on the Garscube Switch roundabout. Although data capture rates at these sites was high the monitoring had only been conducted over 8 months, which may have biased the annual mean concentrations recorded at these three sites. Limitations in the model with respect to buildings and terrain effects and any inaccuracies in traffic or street dimension input data could account for these differences. Due to the over prediction of $NO_2$ concentrations by the model in the vicinity of Garscube Switch Roundabout a correction factor of 0.73 was applied to the predicted results for ten specified receptors on or adjacent to the roundabout.

The model predicted exceedences of the annual mean $NO_2$ NAQS objective for 2005 at all three junctions assessed. The exceedences were predicted in areas of relevant public exposure at:

- properties on Drymen Road north of Bearsden Cross between Kirk Road and Roman Road; and
- properties on Kirkintilloch Road north of Bishopbriggs Cross between Springfield Road and the supermarket turning;

Both areas predicted to exceed the annual mean 2005 NAQS objective for $NO_2$ were assessed to be probable or likely exceedences.

Predicted Concentrations at specified receptors within the vicinity of the Kirkintilloch did not indicate an exceednece of the annual mean 2005 NAQS objective for $NO_2$ However predicted concentrations plotted onto map data revealed that there were some areas of exceedence at sensitive receptors. The areas of exceedence, identified using the mapped concentrations, at which there is relevant public exposure are:

- properties within 20m of the Townhead junction with Industry Street and Parliament Street in Kirkintilloch.

The model predicted no exceedences of the 1-hour mean NAQS objective for $NO_2$ within East Dunbartonshire.

The modelling study indicated that there are two areas of probable exceedence and one area of possible exceedence of the 2005 annual mean NAQS objective for $NO_2$ within East Dunbartonshire. These areas were not identified in the U&SA as having the potential to exceed NAQS objectives. Monitoring data for the automatic monitoring station in Bishopbriggs indicates it is probable that there will be an exceedence of the 2005 annual mean NAQS objective. However, monitoring data projected forward to 2005 at other sites around East Dunbartonshire Council area do not indicate exceedences of the annual mean objective for 2005.

Due to the fact that monitoring data was only available for the 6 month period from December 2003 to May 2004 and model predictions indicated marginal or probable exceedences it is recommended that completion of a full year's automatic monitoring data and the triplicate co-location study for 2004 at Bishopbriggs be completed before an AQMA is considered for $NO_2$ at Bishopbriggs Cross. The availability of a local co-location correction factor at the end of 2004 will alter the bias applied to monitored results and thus the recorded concentrations. It is recommended that the automatic monitoring continue at Bishopbriggs Cross and that continuous monitoring be considered at Bearsden Cross where probable exceedences were predicted.

## 4.2 $PM_{10}$ Concentrations

Monitoring data for verification of the $PM_{10}$ concentrations predicted by the model were available for one site in Bishopbriggs, therefore modelled results at Bearsden and Kirkintilloch have not been fully verified. The model results indicated an over prediction of the $PM_{10}$ concentrations in comparison to monitored results.

No exceedences of the 24-hour mean or annual mean $PM_{10}$ NAQS objectives for 2004 were predicted within East Dunbartonshire. No exceedences of the 24-hour mean $PM_{10}$ NAQS objectives for 2010 were predicted within East Dunbartonshire.

The model predicted exceedences of the annual mean $PM_{10}$ NAQS objective for 2010 at all three junctions assessed. The exceedences were more wide spread than those predicted for $NO_2$. The exceedences were predicted in areas of relevant public exposure at:

- properties on the east side of Drymen Road between Kirk Road and Roman Road;
- properties on Drymen Road between Canniesburn Road and Canniesburn Toll;
- properties to the north, north east and north west of Garscube Switch roundabout;
- properties on McFarlane Drive between Garscube Switch and Maryhill Road;
- properties on the north side of Maryhill Road east of Milngavie Road;

- properties on both sides of Milngavie Road at the junction of Roman Road and Boclair Road;
- properties on the north east corner of the junction between Colston Road and Kirkintilloch Road; and
- properties along Kirkintilloch Road at Bishopbriggs Cross between the Royal Mail sorting office and the supermarket turning.

The areas of relevant public exposure at which predicted concentrations were close to the 2010 annual mean objective were:

- properties on the north side of Parliament Road up to 100m east of Townhead:
- properties on both sides of the south end of Townhead up to 30m from the junction; and
- properties on both sides of the north end of Industry Street up to 10m from the junction.

The report indicates that there are small areas of exceedence of the annual mean $PM_{10}$ NAQS objective for 2010 within the vicinity of the three assessed roads and junctions. However, no monitoring data is available to verify the model results at Bearsden or Kirkintilloch.

Monitoring data available for Bishopbriggs indicates that it is unlikely that there will be an exceedence of the 2004 annual mean or 24-hour NAQS objectives for 2004. Monitored results for the 6 month period from December 2003 to May 2004 are currently above the 18µg/m$^3$ annual mean NAQS objective for 2010. However, projecting monitoring results forward to 2010 the concentration at Bishopbriggs indicates an exceedence of the 2010 annual mean NAQS objective for $PM_{10}$ is unlikely. Monitoring data indicates that the 24-hour mean NAQS objective for 2010 is unlikely to be exceeded at the automatic monitor location in Bishopbriggs.

The report indicates that further monitoring data is required before considering an AQMA for $PM_{10}$ at the locations identified within the modelling study. It is therefore recommended that East Dunbartonshire Council carry out monitoring of $PM_{10}$ at a location in Kirkintilloch and Bearsden to verify model predictions before considering the necessity to declare an AQMA for $PM_{10}$ at these locations. Of the two locations the site of greatest predicted concentrations and public exposure is Bearsden Cross. Reconsideration of an AQMA for $PM_{10}$ at Bishopbriggs Cross will be taken upon completion of a full years monitoring.

Updated monitoring results and the local $NO_2$ diffusion tube bias factor will be reported in the Progress Report to be submitted to the Scottish Executive by the end of April 2005. An investigation of the air quality impacts of two roads, the Kirkintilloch and Bishopbriggs relief roads, which are currently being considered for planning permission will also be included the progress report.

# 5 REFERENCES


| | |
|---|---|
| Reference 1 | UK National Air Quality Strategy for England, Wales, Scotland and Northern Ireland, Department of Environment, Food and Rural Affairs, January 2000. |
| Reference 2 | Air Quality Regulations, 2000 |
| Reference 3 | Air Quality (Scotland) Amendment Regulations 2002 |
| Reference 4 | Part IV The Environment Act 1995, Local Air Quality Management, Technical Guidance, Department of Environment, Food and Rural Affairs, January 2003, LAQM.TG(03) |
| Reference 5 | The first round Review and Assessment Report, East Dunbartonshire Council, 2001 |
| Reference 6 | East Dunbartonshire Council Updating and Screening Assessment, April 2003 |
| Reference 7 | The National Environment Technology Centre, NETCEN, 2003 http://www.airquality.co.uk/archive/laqm/laqm.php |
| Reference 8 | Laboratory Inter comparison Study, AQM Consultants, DEFRA, 2001 |
| Reference 9 | CERC, ADMS-Roads An Air Quality Management System, User Guide Version 2.0, July 2003 |
| Reference 10 | Design Manual for Roads and Bridges, Volume 11, Section 3 Part 1, Air Quality Supplement1, Stationery Office, 2000, DMRB Assessment v.1.02 (November 2003) |

# APPENDIX A

# FIGURES

# APPENDIX B

# ROAD TRAFFIC EMISSIONS ASSESSMENT

# 6 AIR QUALITY ASSESSMENT OF ROAD TRAFFIC EMISSIONS

East Dunbartonshire Council's U&SA (Reference 6) identified the potential for exceedence of the 2010 NAQS objectives for $PM_{10}$ at three locations as a result of road traffic emissions. The exceedences were identified through DMRB assessment of road traffic emissions and local monitoring data. In order to ascertain the extent of any potential exceedence and to predict future $PM_{10}$ concentrations a dispersion modelling study was undertaken on road traffic emissions at each road junction. A detailed modelling assessment of $NO_2$ concentrations was also conducted.

A description of the model used is provided in Section 6.1 whilst the data input to the model is discussed through Sections 6.2 to 6.7. The results of the modelling study and the model validation procedures are discussed in Section 6.8.

The closest receptors to the roads considered in the modelling studies are mostly residential accommodation and ground floor commercial premises. Modelling runs were therefore undertaken to predict pollutant concentrations at relevant sensitive receptors at ground level where public exposure could occur.

The modelling study therefore considered two emission scenarios for each group of roads:

- base year emissions based on measured 2004 traffic flows for comparison with local monitoring data using both 2002 and 2003 meteorological data to provide a meteorological sensitivity analysis; and
- traffic emissions for future years (2005 and 2010) based on projected traffic growth and future emissions factors.

## 6.1 Model Description

The dispersion modelling study utilised the dispersion modelling tool ADMS Roads. ADMS Roads is an advanced model and is approved for use in Detailed Assessment dispersion modelling studies in technical guidance LAQM.TG(03). The model has been subject to extensive validation and inter-model comparison studies.

References to the validation studies and other technical details of the dispersion model are reported on the developer's website and user guide (Reference 9).

## 6.2 Area Description

Dispersion modelling was undertaken on road traffic emissions at three junctions. These were:

- junction of A739 Switchback Road, A809 Drymen Road, A81 Maryhill Road and A81 Milngavie Road, Bearsden/Milngavie;

- junction of A803 Kirkintilloch Road and B812 Colston Road, Bishopbriggs; and
- junction of B757 Townhead, Industry St and Parliament Street, Kirkintilloch.

The locations of the modelled AQMA and peripheral roads are presented in Figures 2 - 4.

## 6.3 Review of Local Topographical Data

The ADMS suite of models has an in-built module for the assessment of local terrain on pollutant dispersion. A gradient rise of 1 in 10 metres would normally be necessary to cause significant changes in flow field and hence influence dispersion of emissions.

For each road junction under assessment the modelling domain was minimised to obtain the maximum grid resolution.

Local topographical contour data at a 1:50,000 scale provided by East Dunbartonshire Council allowed basic analysis of gradients to be carried out. The areas of assessment were generally of less than a 1 in 10 gradient. It was therefore concluded that the inclusion of terrain modelling would not be required as the effect of local topography would be insignificant in comparison to other influences such as traffic count data, vehicle emissions data and meteorological parameters

## 6.4 Review of Local Meteorological Data

A review of available and suitable meteorological data was undertaken to determine the most suitable data for use in the modelling study. The nearest meteorological station to East Dunbartonshire recording a full suite of meteorological parameters is at Bishopton (Glasgow International Airport), which is located approximately 13 km west of Milngavie, 19km west and 1km north of Bishopbriggs and 24 km west and 3km south of Kirkintilloch. The meteorological station is located at 59m above sea level (a.s.l) to the south west of Glasgow in a suburban area. The meteorological station is located in a slightly more exposed terrain to the areas modelled in Bearsden and Bishopbriggs but is the most representative meteorological dataset available.

The meteorological dataset for Bishopton included all the meteorological parameters required by the model comprising hourly sequential recordings of surface temperature, precipitation, wind speed, wind direction and relative humidity. Cloud cover data was obtained from an observation station in Glasgow. Ratified and validated meteorological data was provided for the two most recent available years, namely 2002 and 2003.

A wind rose of each year's data is provided in Figures 5 and 6. As demonstrated in the wind roses there is little flow variation between the two years of data. Dispersion modelling was undertaken for each year of meteorological data and the worst case year used for modelling future concentrations.

The wind roses for both 2002 and 2003 indicate 3 prominent wind directions, East, South South West and North West. The distribution of wind speeds for both years exhibit a similar pattern with the greatest percentage of wind speeds occurring between 2 and 4 knots. Wind

data measured throughout 2003 showed a greater proportion of easterly winds than 2002, in particular, for mid range to high wind speeds. The meteorological data indicated that 2002 saw a greater proportion of winds originating from the southwest in particularly for mid – high wind speeds compared to wind characteristics for 2003.

Modelling runs were conducted for 2004 base line traffic flows for each year of meteorological data available to identify the year which would produce the highest pollutant concentrations. Modelling runs for future years were undertaken using the meteorological year producing the highest pollutant concentrations to represent the worst case scenario.

## 6.5 Surface Roughness

A surface roughness length is used in the dispersion modelling study to characterise the land use of the surrounding area in terms of the frictional effect that will occur due to the interaction of wind with the surface. This is a key component in the generation of atmospheric turbulence, which influences dispersion.

Each of the locations assessed by dispersion modelling are located within urbanised areas. The areas of consideration within Bearsden, Milngavie and Bishopbriggs are located within conurbations. An appropriate surface roughness length of 1 m was therefore applied in these scenarios. Kirkintilloch, however, is surrounded by agricultural land. A surface roughness of 0.5 m was therefore applied to the Kirkintilloch scenario.

## 6.6 Model Input Data

The sources of road traffic flow data for the roads included in the modelling study were provided by East Dunbartonshire Council. The traffic data provided consisted of:

- AADT flows determined from week long automatic counts commissioned by the Council for assessed roads during February, April and March during 2004;
- vehicle split data determined from a series of week long automatic traffic counts commissioned by the Council during February, March and April 2003 along assessed roads;
- traffic growth predictions provided by the East Dunbartonshire Council Roads Department;
- AADT flows for each section of the Garscube Switch Roundabout derived from 2004 traffic flows and 1999 – 2004 turning counts;
- diurnal variation factors calculated from the automatic week long traffic counts; and
- typical vehicle speeds derived from video footage of vehicle journeys along assessed roads in Milngavie and Bishopbriggs during peak am and pm traffic flows.

The base year for assessment was set at 2004.

The traffic flows on roads within East Dunbartonshire were obtained through a series of automatic traffic counts at each of the junctions under consideration.

The automatic counts were undertaken using sensors known as traffic loops which are laid across the roads. As vehicles pass over the sensors the pressure of the vehicle tyres generates a pulse of air that travels along the tube to the kerbside receiver. The receiver registers the pulse and 'counts' the vehicle. In addition to counting the vehicle the receiver can determine traffic speed by the speed at which the air pulse is received and can determine the vehicle type by the time delay from the pulse received as the front tyres pass over the sensors until the pulse is received from the rear tyres passing over the sensors. The pressure on the sensors required to generate the air pulses means that the counters have to be placed on stretches of road with free-flowing traffic. In areas of congested, and therefore slow moving, traffic the pressure air pulses generated by the sensors will be weak and slow moving. The sensors may not properly register the vehicles in this situation.

The automatic counters are *in situ* for a full week. The data obtained can therefore be used to determine the annual average daily traffic flow (AADT) and the diurnal variation in flow. The automatic counts measure traffic flow continuously for a week. The week over which the traffic flow is measured is assumed to be a 'typical week' and therefore the average hourly traffic flow over the week is assumed to be equivalent of an AADT flow. No seasonal variation in traffic flow can be determined. The vehicle count is split into five categories, these are: cars; light goods vehicles (LGVs); heavy goods vehicles (HGVs); buses and motorcycles.

At each assessed location loops were laid across each road approaching the junction and some larger minor routes adjoining the arterial routes. The loops had to be placed away from the junction due to the slow traffic speed close to the junction. An estimation of traffic speed closer to the junction was therefore made based on local knowledge and video footage of vehicle journeys along assessed roads during peak am and pm traffic flows.

### 6.6.1 Annual Average Daily Traffic (AADT) Flow

The automatic counts measure traffic flow continuously for a week. The week over which the traffic flow is measured is assumed to be a 'typical week' and therefore the average hourly traffic flow over the week is assumed to be equivalent of an AADT flow. The technical guidance LAQM.TG(03) states that consideration of seasonal traffic patterns must be taken in using 1-week or 24-hour traffic survey periods. Traffic counts were therefore conducted during school term time to determine typical traffic flows.

In addition to the AADT flow the model allows the insertion of a diurnal variation factor. The diurnal variation factor allows the model to assess peak hour traffic flows and emissions in order to evaluate the predicted ground level concentrations against hourly air quality objectives. The diurnal variation of traffic flow is calculated as ratios to the AADT flow and is calculated for weekdays, Saturdays and Sundays. Diurnal variation pattern data was not available for all roads considered in the assessment. A diurnal flow variation was calculated for each junction by averaging the diurnal variation available for each contributing road at the junction. A different diurnal variation file was used for each of the three junctions assessed in the model. The diurnal variations are summarised in Table 14.

**Table 14: Diurnal Variation in Traffic Flow**

| | Milngavie & Bearsden | | | Bishopbriggs | | | Kirkintilloch | | |
|---|---|---|---|---|---|---|---|---|---|
| Hour | Weekday | Saturday | Sunday | Weekday | Saturday | Sunday | Weekday | Saturday | Sunday |
| 0 | 0.13 | 0.34 | 0.41 | 0.15 | 0.36 | 0.38 | 0.16 | 0.48 | *0.45* |
| 1 | 0.07 | 0.22 | 0.27 | 0.07 | 0.28 | 0.28 | 0.05 | 0.27 | *0.24* |
| 2 | 0.05 | 0.15 | 0.16 | 0.06 | 0.19 | 0.23 | 0.03 | 0.16 | *0.19* |
| 3 | 0.07 | 0.12 | 0.14 | 0.07 | 0.13 | 0.16 | 0.03 | 0.09 | *0.12* |
| 4 | 0.15 | 0.13 | 0.12 | 0.09 | 0.11 | 0.12 | 0.04 | 0.06 | *0.07* |
| 5 | 0.23 | 0.16 | 0.10 | 0.19 | 0.14 | 0.10 | 0.08 | 0.07 | *0.05* |
| 6 | 0.45 | 0.26 | 0.18 | 0.54 | 0.23 | 0.14 | 0.29 | 0.18 | *0.11* |
| 7 | 1.48 | 0.51 | 0.33 | 1.44 | 0.50 | 0.28 | 1.06 | 0.39 | *0.21* |
| 8 | 2.03 | 0.92 | 0.47 | 1.93 | 0.86 | 0.39 | 1.87 | 0.82 | *0.35* |
| 9 | 1.56 | 1.38 | 0.80 | 1.57 | 1.22 | 0.69 | 1.65 | 1.39 | *0.59* |
| 10 | 1.31 | 1.56 | 1.27 | 1.46 | 1.47 | 1.21 | 1.54 | 1.54 | *1.19* |
| 11 | 1.40 | 1.78 | 1.52 | 1.55 | 1.63 | 1.35 | 1.60 | 1.79 | *1.20* |
| 12 | 1.52 | 1.96 | 1.60 | 1.66 | 1.77 | 1.19 | 1.74 | 2.00 | *1.40* |
| 13 | 1.54 | 1.93 | 1.65 | 1.70 | 1.73 | 1.19 | 1.67 | 1.87 | *1.48* |
| 14 | 1.65 | 1.86 | 1.81 | 1.77 | 1.61 | 1.46 | 1.78 | 1.77 | *1.40* |
| 15 | 1.82 | 1.80 | 1.71 | 1.98 | 1.53 | 1.41 | 1.92 | 1.67 | *1.44* |
| 16 | 2.01 | 1.79 | 1.69 | 2.02 | 1.58 | 1.29 | 2.14 | 1.69 | *1.26* |
| 17 | 2.02 | 1.68 | 1.61 | 1.91 | 1.50 | 1.20 | 2.04 | 1.47 | *1.19* |
| 18 | 1.68 | 1.45 | 1.25 | 1.67 | 1.42 | 1.08 | 1.56 | 1.43 | *1.22* |
| 19 | 1.27 | 1.16 | 0.92 | 1.36 | 1.18 | 0.90 | 1.37 | 1.40 | *0.98* |
| 20 | 0.92 | 0.79 | 0.71 | 1.02 | 0.83 | 0.73 | 1.06 | 1.05 | *0.89* |
| 21 | 0.73 | 0.57 | 0.56 | 0.80 | 0.65 | 0.54 | 0.82 | 0.67 | *0.54* |
| 22 | 0.51 | 0.51 | 0.35 | 0.51 | 0.54 | 0.37 | 0.57 | 0.62 | *0.40* |
| *23* | *0.31* | *0.44* | *0.23* | *0.33* | *0.48* | *0.25* | *0.36* | *0.63* | *0.32* |

### 6.6.2 Vehicle Flow Composition

The measured traffic flow on each road is broken down into five vehicle categories. These are:

- cars;
- light goods vehicles (LGVs);
- heavy goods vehicles (HGVs);
- buses; and
- motorcycles.

The dispersion model ADMS Roads has inbuilt fleet sub-categories of composition based on the Design Manual for Roads and Bridges (DMRB) 2003 (Reference 10) categories. The sub-categories are determined by engine type and emissions. For the initial model runs the traffic flow input to the model was determined as a total flow of cars/LGVs and HGVs/buses. This allowed the emissions to be calculated based on DMRB Urban 2003 vehicle composition emission factors.

### 6.6.3 Traffic Speed

Traffic speed data were available for assessed roads in two forms firstly as the speed limit for each road and as speeds recorded during filmed vehicle journeys along selected routes at times of peak am and pm traffic flow. The video footage was provided by East Dunbartonshire Council Roads Department. The video footage of vehicle journeys along the routes assessed was examined by BMT Cordah Staff to determine peak time traffic speed for each section of each assessed route. The average traffic speeds on each road section were therefore estimated based on the peak time journey speeds and road speed limits. In general the study indicated average speeds of 40 kph (25 mph) for traffic leaving road junctions of speed limit 30mph and reduced speeds of between 15 kph (10 mph) and 30 kph (20 mph) for traffic approaching road junctions of speed limit 30mph. A reduction in speed was assumed for all HGVs and buses.

The assumed average traffic speeds on each section of road included within the modelling study are summarised in Tables 16 and 17.

### 6.6.4 Road Widths and Canyon Heights

The road widths were determined by measurement of digital mapping data. The road widths were determined to the closest metre.

Each road junction was assessed for potential street canyon effects. A street canyon is generally defined as a street where the height of the bwest building is higher than the distance between the buildings on either side of the road. BMT Cordah consultants analysed traffic video footage, provided by East Dunbartonshire Roads Department, of each road and junction to determine potential canyons and confirm street dimensions and traffic speeds. The nature of the suburban residential buildings along assessed routes means that very few of the roads were identified as potential street canyons. The longer roads, such as Kirkintilloch Road, Milngavie Road and Drymen Road were divided into short sections to account for the small sections of street canyons and varying carriage widths along the length of the road.

The road widths and canyon heights included in the study are summarised in Tables 15 and 16.

**Table 15: 2004 Road Traffic Flow Data used in Modelling Study for Milngavie & Bearsden**

| Road | AADT | % HGVs & PSVs | Speed (km/hr) | Canyon / Road Width (m) | Canyon Height (m) |
|---|---|---|---|---|---|
| Milngavie & Bearsden | | | | | |
| Canniesburn Road @ Drymen Rd junction | 8141 | 7.0% | 20 / 25 | 12 | 0 |
| Canniesburn Road (Rubislaw Dr – Drymen Rd) | 8141 | 7.0% | 40 | 12 | 0 |
| B8049 Boclair Rd ( Boclair Cr – Rannoch Dr) | 9205 | 7.0% | 37 / 47 | 10 | 0 |
| A809 Drymen Rd (Kirk Rd – Stockiemuir Rd) | 17778 | 10.4% | 40 | 15 | 0 |
| A809 Drymen Rd (Bearsden Cross – Kirk Rd) | 17778 | 10.4% | 30 / 20 | 15 | 15 |
| A809 Drymen Rd (Collylinn Rd – Bearsden Cross) | 17778 | 10.4% | 20 / 30 | 15 | 0 |
| A809 Drymen Rd (Canniesburn Rd – Collylinn Rd) | 15800 | 10.4% | 40 | 15 | 0 |
| A809 Drymen Rd (Canniesburn Rd – Canniesburn Toll) | 22201 | 10.4% | 25 | 20 | 0 |
| A809 Switchback Rd - Canniesburn Toll | 11846 | 10.0% | 30 | 20 | 0 |
| Garscube Switch (Maryhill Rd – Canniesburn Toll) | 12033 | 10.0% | 25 | 20 | 0 |
| A81 Maryhill Rd (Canniesburn Toll – Coronation Way) | 15453 | 10.0% | 30 / 35 | 25 | 0 |
| A81 Maryhill Rd (Coronation Way – Rannoch Dr) | 17758 | 10.0% | 50 | 25 | 0 |
| A81 Milngavie Rd (McFarlane Dr – Garscube Switch) | 7163 | 10.0% | 30 | 15 | 0 |
| A81 Milngavie Rd (Carrickarden – Ferguston Rd) | 22616 | 8.0% | 45 | 20 | 0 |
| A81 Milngavie Rd (West Chapleton Av – Kessington Rd) | 22835 | 8.0% | 35 / 30 | 20 | 0 |
| A81 Milngavie Rd (Boclair Rd - West Chapleton Av) | 22742 | 8.0% | 30 / 35 | 20 | 0 |
| A81 Milngavie Rd (Hillfoot Dr – Boclair Rd) | 19446 | 8.0% | 35 / 30 | 15 | 0 |
| A81 Milngavie Rd (Glasgow Rd - Hillfoot Dr) | 19446 | 8.0% | 45 / 30 | 15 | 0 |
| McFarlane Rd (North of Moore Dr) | 17174 | 5.0% | 25 | 10 | 0 |
| Rannoch Dr | 2542 | 4.5% | 20 / 25 | 8 | 0 |
| Roman Rd @ Railway Bridge | 6370 | 5.0% | 25 | 8 | 0 |
| A739 Switchback Rd @ Canniesburn Toll | 11846 | 10.0% | 30 | 20 | 0 |
| A739 Switchback Rd (North of Braemar Cr) | 23692 | 10.0% | 25 / 30 | 30 | 0 |
| A739 Switchback Rd (Braemar Cr – Henderland Rd) | 22577 | 10.0% | 50 | 30 | 0 |
| Garscube Switch Roundabout - north section | 19385 | 10.0% | 25 | 20 | 0 |
| Garscube Switch Roundabout - east section | 18526 | 10.0% | 25 | 20 | 0 |
| Garscube Switch Roundabout – south east section | 19101 | 10.0% | 25 | 20 | 0 |
| Garscube Switch Roundabout – south west section | 6939 | 10.0% | 25 | 20 | 0 |
| Garscube Switch Roundabout - west section | 18574 | 10.0% | 25 | 20 | 0 |

**Table 16: 2004 Road Traffic Flow Data used in Modelling Study for Bishopbriggs & Kirkintilloch**

| Road | AADT | % HGVs & PSVs | Speed (km/hr) | Canyon / Road Width (m) | Canyon Height (m) |
|---|---|---|---|---|---|
| Bishopbriggs | | | | | |
| Brackenbrae Rd (Kirkintilloch Rd – Brackenbrae Av) | 3287 | 3.0% | 30 / 20 | 10 | 0 |
| B812 Colston Rd West (Junction – Colston Grd) | 10042 | 10.0% | 15 / 25 | 15 | 0 |
| B812 Colston Rd West (@ Colston Grd) | 10042 | 10.0% | 35 / 42 | 15 | 0 |
| B812 Colston Rd East (Junction – Colston Dr) | 9632 | 10.0% | 25 / 15 | 15 | 0 |
| B812 Colston Rd East (@ Colston Dr) | 9632 | 10.0% | 40 / 35 | 15 | 0 |
| Crowhill Rd (@ Railway Bridge) | 3249 | 3.0% | 15 | 6 | 0 |
| Crowhill Rd (Railway Bridge - St Mungos Rd) | 3249 | 3.0% | 25 | 8 | 0 |
| Kenmure Av (Bishopbriggs Cross – Kenmure Dr) | 5949 | 3.0% | 30 / 20 | 10 | 0 |
| A803 Kirkintilloch Rd (S Crosshill Rd – N Bishopbriggs Cross) | 23124 | 6.0% | 40 | 15 | 0 |
| A803 Kirkintilloch Rd (N Bishopbriggs Cross) | 23124 | 6.0% | 25 | 20 | 0 |
| A803 Kirkintilloch Rd (Triangle @ Bishopbriggs Cross) | 23124 | 6.0% | 15 | 20 | 15 |
| A803 Kirkintilloch Rd (Bishopbriggs Cross – Fire Station) | 18315 | 6.0% | 15 / 20 | 20 | 10 |
| A803 Kirkintilloch Rd (Fire Station – Brackenbrae Rd) | 18315 | 6.0% | 40 / 30 | 15 | 0 |
| A803 Kirkintilloch Rd (Brackenbrae Rd – Hillcroft Ter) | 18035 | 6.0% | 45 | 20 | 0 |
| A803 Kirkintilloch Rd (Hillcroft Ter – Colston Rd) | 18035 | 6.0% | 30 / 20 | 25 | 0 |
| A803 Springburn Rd (Colston Rd – Colston Av) | 18019 | 6.0% | 20 / 30 | 25 | 0 |
| A803 Springburn Rd (200m South of junction) | 18019 | 6.0% | 45 / 50 | 20 | 0 |
| Springfield Rd (Bishopbriggs Cross – Railway Bridge) | 3196 | 3.0% | 20 / 25 | 10 | 0 |
| Springfield Rd (Railway Bridge – Arnold Ct) | 3196 | 3.0% | 35 | 10 | 0 |
| Kirkintilloch | | | | | |
| Industry St (Townhead – Ct) | 1502 | 5.0% | 20 / 25 | 15 | 0 |
| Industry St (Ct – Woodielea Av) | 1502 | 5.0% | 25 / 30 | 10 | 0 |
| New Lairdsland Rd (@ junction) | 13043 | 24.0% | 30 / 25 | 20 | 0 |
| New Lairdsland Rd (@ junction) | 13043 | 24.0% | 45 | 20 | 0 |
| Parliament Rd (Industry St – Tenement) | 13625 | 10.0% | 30 / 20 | 15 | 10 |
| Parliament Rd (Tenement – New Lairdsland Rd) | 13625 | 10.0% | 30 / 35 | 20 | 0 |
| B757 Lenzie Rd (S of Donaldson St) | 15911 | 10.0% | 45 | 20 | 0 |
| B757 Townhead (Donaldson St – Industry St) | 15911 | 10.0% | 30 / 40 | 15 | 10 |
| B757 Townhead (Industry St – Willowbank Gar) | 9180 | 10.0% | 25 / 20 | 15 | 10 |
| B757 Townhead (N of Willowbank Gar ) | 9180 | 10.0% | 40 / 35 | 15 | 0 |

### 6.6.5 Traffic Growth

The dispersion modelling studies undertook predictions for future pollutant concentrations based on future emissions factors and projected future traffic flows. East Dunbartonshire Council Roads Department estimate that there will be no traffic growth for East Dunbartonshire prior to 2010. Therefore the traffic flows for 2004 were used for assessments for 2005 and 2010.

### 6.6.6 Emissions Factors

The ADMS Roads model has an in-built database of traffic emissions factors. The modelling study utilised the DMRB emission factor dataset for 2003. The dataset is consistent with the emission factor toolkit dataset discussed in LAQM.TG(03). The emission factors provide an average pollutant emission rate per vehicle type, at a set speed for a distance travelled. The model automatically calculates a linear emission for the stretch of road based on the traffic flow data input.

Emission factor datasets are available for future years including 2004, 2005 and 2010. Predictive modelling was undertaken for future years utilising these datasets and future traffic flow data.

## 6.7 Dispersion Modelling Results

The model predicted ground level $PM_{10}$ concentrations for the base year, namely 2004 and for 2010 for comparison with the NAQS objectives. The model also predicted ground level $NO_2$ concentrations for the base year, namely 2004 and for 2005 for comparison with the NAQS objectives.

The modelling predictions were verified against local monitoring data where possible. The model verification procedures are discussed in Section 6.7.3 whilst the predicted pollutant concentrations are presented in Section 6.7.4.

### 6.7.1 Meteorological Analysis

The sensitivity analysis for meteorological parameters features meteorological data for 2002 and 2003. The base year traffic flows for 2004 were modelled for each year of meteorological data to determine the most appropriate meteorological year for future model runs. Results of the meteorological analysis are shown in Table 17.

**Table 17: Modelled Traffic Emission Comparison for 2002 and 2003 Meteorological Data**

| Location | NAQS Objective | 2002 Concentration ($\mu g/m^3$) | 2003 Concentration ($\mu g/m^3$) |
|---|---|---|---|
| Bearsden & Milngavie | $NO_2$ Annual Mean | 27.80 | 29.02 |
| | $NO_2$ 99.79$^{TH}$ Percentile of 1-Hour Means | 84.90 | 84.73 |
| | $PM_{10}$ Annual Mean | 2.06 | 2.17 |
| | $PM_{10}$ 90.4$^{th}$ Percentile of 24-Hour Means | 3.85 | 3.82 |
| | $PM_{10}$ 98$^{th}$ Percentile of 24-Hour Means | 5.94 | 5.29 |
| Bishopbriggs | $NO_2$ Annual Mean | 27.55 | 28.55 |
| | $NO_2$ 99.79$^{TH}$ Percentile of 1-Hour Means | 84.18 | 84.16 |
| | $PM_{10}$ Annual Mean | 2.34 | 2.44 |
| | $PM_{10}$ 90.4$^{th}$ Percentile of 24-Hour Means | 3.90 | 4.03 |
| | $PM_{10}$ 98$^{th}$ Percentile of 24-Hour Means | 5.90 | 5.53 |
| Kirkintilloch | $NO_2$ Annual Mean | 32.55 | 33.13 |
| | $NO_2$ 99.79$^{TH}$ Percentile of 1-Hour Means | 85.24 | 85.75 |
| | $PM_{10}$ Annual Mean | 2.48 | 2.49 |
| | $PM_{10}$ 90.4$^{th}$ Percentile of 24-Hour Means | 4.66 | 4.43 |
| | $PM_{10}$ 98$^{th}$ Percentile of 24-Hour Means | 6.41 | 5.67 |

The difference between the predicted pollutant concentrations for each year was less than 15% in all cases. The majority of greatest pollutant concentrations were predicted to occur during scenarios using the 2003 meteorological data. The greater pollutant concentrations represent the worst case scenario therefore the 2003 meteorological data was used for future predictions for 2004, 2005 and 2010.

### 6.7.2 Background Concentration

In addition to the emissions from road traffic sources there will be other emission sources impacting on air quality at each junction considered including domestic, industrial and transboundary sources.

To include for these other pollutant sources when assessing the predicted pollutant concentrations against the NAQS objectives a background concentration is added to the model output concentrations. A background concentration for each pollutant was obtained from the NETCEN background concentration maps and from monitoring data from representative background areas. The assumed background concentrations for each pollutant are summarised in Table 18. In line with technical guidance the annual average background concentrations have been doubled to approximate the short-term mean background concentrations.

**Table 18: Assumed Background Concentrations for East Dunbartonshire**

| Pollutant | $PM_{10}$ | | | $NO_2$ | | | |
|---|---|---|---|---|---|---|---|
| Year | 2003 | 2004 | 2010 | 2003 | 2004 | 2005 | 2010 |
| Annual Average Concentration ($\mu g/m^3$) | 18.9 | 18.9 | 17.4 | 19.8 | 19.4 | 18.7 | 16.3 |
| Short-term Concentration ($\mu g/m^3$) | 37.8 | 37.8 | 34.8 | 39.6 | 38.8 | 37.4 | 32.6 |

### 6.7.3 Model Verification

Dispersion modelling studies include a number of uncertainties notwithstanding model input data. The ADMS Roads model has been extensively validated by the developers CERC over a number of scenarios. These validation studies are discussed and referenced in the ADMS Urban manual and CERC website.

The main uncertainty in modelling studies is often the model input data. In this study the road traffic flow and subsequent emissions and the influence of meteorology will have significant effect on the predicted ground level pollutant concentrations.

In order to verify the ground level pollutant concentrations predicted by the model comparison was made between the modelled predictions and available $NO_2$ and $PM_{10}$ monitoring data.

### 6.7.3.1 Verification of $PM_{10}$ Concentrations

$PM_{10}$ monitoring data for the purposes of verification was available for 2003 at one site within East Dunbartonshire Council, Crowhill Road. The automatic monitoring site is continuous and therefore allows comparison between modelled and monitored results for both the annual and 24-hour mean objectives. The technical guidance LAQM.TG(03) specifies that a data capture rate of 90% or greater is required for the purposes of model verification. The automatic monitoring site has a data capture rate greater than 90%. The comparison between monitored and modelled concentrations at the automatic monitoring site is presented in Table 19.

**Table 19: $PM_{10}$ Monitoring / Modelling Comparison for 2003/2004 at Bishopbriggs Automatic Monitor**

| NAQS Objective | Modelling Only | Background Concentration | Total | Monitoring Concentration | % Difference |
|---|---|---|---|---|---|
| Annual Mean Concentration ($\mu g/m^3$) | 1.00 | 18.9 | 19.9 | 18.2 | 9.3 |

An evaluation of the performance of the model against monitoring data was only possible for the annual mean at one site. The modelled concentration compared well with the monitored value, with an over prediction of 9.3%. No correction factor has been applied to model results due to the fact that only one comparable datum from which to derive a correction factor or bias is available and it is possible that the bias is site or time specific.

### 6.7.3.2 Verification of $NO_2$ Concentrations

$NO_2$ monitoring data for the purposes of model verification was available for 2003 at an automatic monitoring site and at 16 diffusion tube sites throughout East Dunbartonshire Council. The verification of results was carried out for the predicted annual mean $NO_2$ concentrations at the automatic monitoring site in Bishopbriggs. The technical guidance LAQM.TG(03) specifies that a data capture rate of 90% or greater is required for the purposes of model verification. Due to the relatively small number monitoring sites within East Dunbartonshire all kerbside and roadside sites with a data capture rate greater than 75% have been included in the verification to provide a better indication of the models performance. For verification purposes sample locations with less than a 90% data capture rate or less than a full year of monitoring data are viewed as less reliable and are discussed further on pages xii to xiii.

Modelled annual mean $NO_2$ concentrations were verified with monitored concentrations recorded at diffusion tube sites located within the vicinity of modelled roads. Background monitoring sites have not been included in the verification of the model. The diffusion tube

monitoring results have been adjusted for field performance and laboratory bias by the methodology set out in technical guidance document LAQM.TG(03).

The diffusion tube and automatic monitoring locations and their respective monitored and modelled concentrations at each site are presented in Table 20. Site with a percentage difference greater than 50% are highlighted in dark grey and those with a percentage difference greater than 25% are highlighted in light grey.

**Table 20: $NO_2$ Monitoring / Modelling Annual Mean Results Comparison for 2003**

| Site | Annual Average Concentration (µg/m$^3$) | | | | % Difference |
|---|---|---|---|---|---|
| | Modelling Only | Background Concentration | Total | Monitoring | |
| Monitoring Sites at Bishopbriggs | | | | | |
| Bishopbriggs 6 | 24.02 | 19.8 | 43.82 | 37.58 | +16.6 |
| Bishopbriggs 12 | 11.49 | 19.8 | 31.29 | 40.32 | -22.2 |
| Bishopbriggs 13 | 13.24 | 19.8 | 33.04 | 41.36 | -20.1 |
| Bishopbriggs A * | 13.09 | 19.8 | 32.89 | 41.35 | -20.5 |
| Monitoring Sites at Bearsden & Milngavie | | | | | |
| Bearsden 1 | 16.14 | 19.8 | 35.94 | 28.7 | +25.2 |
| Bearsden 7 | 11.44 | 19.8 | 31.24 | 34.37 | -9.1 |
| Bearsden 8 | 15.81 | 19.8 | 35.61 | 35.12 | +1.4 |
| Bearsden 9 | 17.29 | 19.8 | 37.09 | 28.7 | +29.2 |
| Bearsden 10 | 15.46 | 19.8 | 35.26 | 30.75 | +14.7 |
| Bearsden 13 | 24.01 | 19.8 | 43.01 | 28.39 | +51.5 |
| Bearsden 14 | 22.00 | 19.8 | 41.80 | 31.63 | +32.2 |
| Bearsden 15 | 13.86 | 19.8 | 33.66 | 31.48 | +6.9 |
| Monitoring Sites at Kirkintilloch * | | | | | |
| Kirkintilloch 15 * | 14.85 | 19.8 | 34.65 | 34.73 | -0.2 |

* Based on monitoring for 6 months December 2003 – May 2004 from the automatic monitor.

The performance of the model against monitoring data varies between monitoring locations with differences varying from a 52% over-prediction by the model to a 22% under-prediction. In general the model is over predicting the $NO_2$ concentrations compared with monitored data. For sites with a full year of monitoring and a data capture rate greater than 90% the model performance was better with differences between modelled and monitored concentrations varying from a 22% under prediction to a 29% over prediction.

The reasoning for variations between modelled and monitored data may be as a result of the data input to the model, model limitations with regards to building and terrain effects or a low data capture for monitored data. The main differences in predicted and monitored concentrations may however be explained by examining each site in isolation:

In general the modelled concentrations for Bishopbriggs and Kirkintilloch compared well with monitored values from the diffusion tube monitoring sites. Modelled concentrations along Kirkintilloch Road tended to under-predict monitored concentrations while the site at Bishopbriggs Cross was over-predicted.

- The comparison of modelled results with the results from the automatic monitor at Bishopbriggs highlighted a difference. However, the automatic monitor results represent a 6-month period from December 2003 to May 2004 and are not therefore wholly representative of an annual mean for 2003. In addition the automatic monitor is located close to three buildings and a low wall which may shelter the monitor from

the vehicle emissions on Kirkintilloch Road and Bishopbriggs Cross to the north west and south west. The model does not include building effects except in the form of street canyons and this may account for some of the differences between the modelled and monitored concentrations. The south side of Bishopbriggs Cross is not a street canyon therefore the model will not have accounted for any building effects at this location therefore predicting a lower $NO_2$ concentration than was recorded. The location of the automatic monitor is shown in Figures 31 and 32.

- Monitoring data at Bishopbriggs 13 had a 75% data capture rate for 2003, this low data capture arte is likely to account for some of the 20% difference between modelled and monitored concentrations.

- The Kirkintilloch 15 monitoring site had an 83.3% data capture rate and data was only available for 6 months. However, the model versus monitored comparison revealed that the model predictions matched the monitored concentration almost exactly.

The model performance appears less reliable for monitoring sites around Bearsden and Milngavie.

- Monitoring data at Bearsden 13 was available for 8 months only and this is likely to have contributed to the 52% difference between monitored and modelled concentrations. Bearsden 13 is located at the kerbside of the Garscube Switch roundabout at the centre of a row of shops. The site is very open and traffic using the roundabout uses the centre two lanes with the inner lane being primarily used for parked vehicles. The proximity of traffic to the kerbside monitoring location is therefore less than may be expected from initial inspections of the road layout and may also account for some of the difference between monitored and modelled concentrations.

- Bearsden 14, located approximately 1m from the kerb on the left-hand side of the A81 exit from the Garscube Switch roundabout, has a data capture rate of 87.5%. However as for Bearsden 13 monitored data is only available for 8 months, which is likely to have contributed to the difference between modelled and monitored concentrations.

- Bearsden 15 also had an 8 month monitoring data set and an 87.5% data capture rate. The site is located in a bus stop lay-by and is therefore set further back from the main carriageway than initial inspections of map data suggested, which is not represented in the model. Both of these factors may account for some of the calculated difference between modelled and monitored results. However, the result comparison presented in Table 20 shows that the difference between modelled and monitored data is not significant.

The locations of the Bearsden 13 and Bearsden 14 $NO_2$ diffusion tubes are shown in Figures 33 and 34.

The traffic flows recorded along the A739, A809 and A81 join at the Garscube Switch Roundabout and represent the highest cumulative traffic flows in East Dunbartonshire. However, the topography at the roundabout is very open with no buildings or other

obstacles restricting air flow therefore the diffusion of any pollutants at the junction would be expected to be rapid in comparison to sections of Drymen Road and Milngavie Road where air flows are restricted by surrounding buildings. The traffic count on McFarlane Drive is north of Moore Drive and therefore does not account for any vehicles using this route. The traffic flows round the Garscube Switch roundabout are generally focussed in the two centre lanes with the inside lane being used for parking in some areas. The model distributes the traffic emissions evenly across the width of the road and this may distort the pattern of $NO_2$ concentrations elevating them on them inside lanes and decreasing them on centre lanes.

For most areas modelled differences were site specific and indicated no systematic differences between modelled and monitored results. However, for kerbside and roadside monitoring locations on and adjacent to the Garscube Switch Roundabout the model over predicted concentrations compared to monitored results. Therefore at specified receptors around the Garscube Switch Roundabout an adjustment has been made to modelled concentrations. The adjustment was calculated as the mean percentage difference for the 5 monitoring sites used in the verification that area located on Garscube Switch Roundabout, namely Bearsden 9, 10, 13, 14 and 15. The adjustment factor used was -26.9% or 0.73.

### 6.7.4 Predicted Modelling Results

The maximum $NO_2$ and $PM_{10}$ concentrations predicted by the model at each road junction assessed are presented in Tables 21 to 23. The results include the respective annual mean concentrations for NAQS objective years and short term concentrations comparable with the NAQS objectives. Maximum predicted future concentrations exceeding NAQS objectives are shaded. No adjustment of predicted concentrations has been made as a result of the model verification.

The isopleth concentration contours plots show the pollutant for each pollutant providing a pictorial representation of the extent of peak pollutant concentrations with respect to areas of relevant public exposure. Concentration plots are provided for comparison with NAQS objectives in Figures 9 to 30.

**Table 21: Maximum Predicted Pollutant Concentrations for Bearsden & Milngavie**

| Pollutant | Criteria | Year | Maximum Predicted Concentration (µg/m$^3$) | Background Concentration (µg/m$^3$) | Total Concentration (µg/m$^3$) |
|---|---|---|---|---|---|
| PM10 | Annual Mean | 2004 | 2.17 | 18.9 | 21.1 |
| | | 2010 | 1.17 | 17.4 | 18.6 |
| | 90.4$^{th}$ Percentile of Hourly Means | 2004 | 3.82 | 37.8 | 41.6 |
| | 98$^{th}$ Percentile of Hourly Means | 2010 | 2.87 | 34.8 | 37.5 |
| NO2 | Annual Mean | 2005 | 27.90 | 18.7 | 46.6 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2005 | 83.72 | 37.4 | 121.1 |
| | Annual Mean | 2010 | 21.50 | 16.3 | 37.8 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2010 | 76.89 | 32.6 | 109.5 |

**Table 22: Maximum Predicted Pollutant Concentrations for Bishopbriggs**

| Pollutant | Criteria | Year | Maximum Predicted Concentration (µg/m$^3$) | Background Concentration (µg/m$^3$) | Total Concentration (µg/m$^3$) |
|---|---|---|---|---|---|
| PM10 | Annual Mean | 2004 | 2.44 | 18.9 | 21.3 |
| | | 2010 | 1.35 | 17.4 | 18.8 |
| | 90.4$^{th}$ Percentile of Hourly Means | 2004 | 4.03 | 37.8 | 41.8 |
| | 98$^{th}$ Percentile of Hourly Means | 2010 | 3.07 | 34.8 | 37.9 |
| NO2 | Annual Mean | 2005 | 27.41 | 18.7 | 46.1 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2005 | 83.07 | 37.4 | 120.5 |
| | Annual Mean | 2010 | 20.87 | 16.3 | 37.2 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2010 | 76.04 | 32.6 | 108.6 |

**Table 23: Maximum Predicted Pollutant Concentrations for Kirkintilloch**

| Pollutant | Criteria | Year | Maximum Predicted Concentration (µg/m$^3$) | Background Concentration (µg/m$^3$) | Total Concentration (µg/m$^3$) |
|---|---|---|---|---|---|
| PM10 | Annual Mean | 2004 | 2.49 | 18.9 | 21.4 |
| | | 2010 | 1.31 | 17.4 | 18.7 |
| | 90.4$^{th}$ Percentile of Hourly Means | 2004 | 4.43 | 37.8 | 42.2 |
| | 98$^{th}$ Percentile of Hourly Means | 2010 | 2.99 | 34.8 | 37.8 |
| NO2 | Annual Mean | 2005 | 32.02 | 18.7 | 50.7 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2005 | 84.72 | 37.4 | 122.1 |
| | Annual Mean | 2010 | 25.10 | 16.3 | 41.4 |
| | 99.79$^{th}$ Percentile of Hourly Means | 2010 | 78.00 | 32.6 | 110.6 |

## 6.8 Results for $NO_2$

In analysing the results of the dispersion modelling assessment the predicted ground level concentrations have been categorised in terms of likelihood of exceedence of the NAQS objectives. The categories are defined by the pollutant bandings and their definitions for predicted $NO_2$ concentrations which are presented in Table 24. The likelihood of exceedence shown in Table 24 has been adapted from the method provided in the technical guidance LAQM.TG(03) to reflect the specific scenarios and model used by BMT Cordah Ltd.

**Table 24: Predicted Ground level $NO_2$ Concentration Categories**

| Category | Predicted Annual Mean $NO_2$ Concentration ($\mu g/m^3$) | Definition |
|---|---|---|
| Unlikely | < 36 | Low ground level concentration predicted. Exceedence of NAQS annual mean objective for $NO_2$ unlikely. |
| Possible | 36 - 40 | Predicted $NO_2$ ground level concentrations below NAQS annual mean objective but within 10%. Some potential for Exceedence therefore exists. |
| Probable | 40 – 44 | Predicted $NO_2$ ground level concentrations above NAQS annual mean objective by up to 10%. It is considered likely that the NAQS objective will be exceeded. |
| Likely | > 44 | Predicted $NO_2$ ground level concentrations above NAQS annual mean objective by greater than 10%. It is considered very likely that the NAQS objective will be exceeded. |

The analysis of the potential for $NO_2$ exceedences has been carried out using the above classification.

### 6.8.1 Bearsden and Milngavie

The model predicted areas of potential exceedence of the annual mean NAQS objectives for $NO_2$ during 2004 at several locations within the vicinity of Garscube Switch roundabout and along adjoining roads, Switchback Road (A739) / Maryhill Road (A81) / Milngavie Road (A81) / Drymen Road (A809). The sites of exceedence are:

- properties located on the north-east, north and south sides of the roundabout;
- properties on Mcfarlane Drive between Garscube Switch and Maryhill Road;
- properties on the north side of Maryhill Road, east of Milngavie Road:
- properties at the west end of Gray Drive adjoining Drymen Road;
- properties along both sides of Drymen Road between Kirk Road and Roman Road;
- properties on the north-west side of Drymen Road between Mains Road and Stockiemuir Road; and

- properties on the west side of Milngavie Road between Kessington Road and Boclair Road including properties at the ends of Kessington Road, Buchanan Drive and Boclair Road that adjoin Milngavie Road.

The adjustment factor was applied to modelled results in the vicinity of Garscube Switch Roundabout and is presented in Table 25.

**Table 25: Adjusted Modelled Annual Mean $NO_2$ Concentrations for Garscube Switch Roundabout for 2005**

| Monitoring Site / Sensitive Receptor | Model Prediction ($\mu g/m^3$) | Model Prediction + Background Concentration ($\mu g/m^3$) | Adjusted Prediction ($\mu g/m^3$) |
|---|---|---|---|
| Bearsden 9 | 16.53 | 35.23 | 25.72 |
| Bearsden 10 | 14.64 | 33.34 | 24.34 |
| Bearsden 13 | 23.05 | 41.75 | 30.48 |
| Bearsden 14 | 21.09 | 39.79 | 29.05 |
| Bearsden 15 | 13.18 | 31.88 | 23.27 |
| Junction of Wardlaw Rd / Switchback Rd | 6.00 | 24.70 | 18.03 |
| Junction of Lomond Rd / Switchback Rd | 6.88 | 25.58 | 18.68 |
| North of Braemar Cr | 12.27 | 30.97 | 22.61 |
| Banchory Cr | 0.27 | 18.97 | 13.85 |
| Junction of Milngavie Rd / McFarlane Rd | 8.01 | 26.71 | 19.49 |
| Junction of Drymen Rd / Canniesburn Rd | 10.30 | 29.00 | 21.17 |

By applying an adjustment factor of 0.73 to the modelled results for 2005 at specified receptors it is shown that there are no predicted exceedences of the annual mean NAQS objective for $NO_2$ within the vicinity of Garscube Switch Roundabout. All receptors in the vicinity are unlikely to experience exceedences of the annual mean NAQS objective for $NO_2$.

The model results for 2005 reveal that one exceedence of the annual mean NAQS objective for $NO_2$ is predicted. The area of predicted exceedence for 2005 occurs at:

- residential properties along both sides of Drymen Road between Kirk Road and Roman Road.

Exceedence of the annual mean 2005 NAQS objective for $NO_2$ at Bearsden Cross is likely.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Bearsden or Milngavie in 2005.

### 6.8.2 Bishopbriggs

The model predicted areas of potential exceedence of the annual mean NAQS objectives for $NO_2$ during 2004 at several locations within the vicinity of the Kirkintilloch Road (A803) / Colston Road (B812) junction and along Kirkintilloch Road. The sites of potential exceedence are:

- the junction on Colston Road and Kirkintilloch Road: and

- residential and shop properties on the east and west sides of Kirkintilloch Road at the junction with Springfield Road between the Royal Mail sorting office to the south and the supermarket turning to the north.

The exceedence located at the Colston Road / Kirkintilloch Road junction is not predicted to extend as far as neighbouring properties and therefore is not considered further.

Predicted $NO_2$ concentrations for Bishopbriggs indicated that the annual mean NAQS objective for 2005 would be exceeded at one location where there is relevant public exposure during 2005. Sensitive receptors on both sides of Kirkintilloch Road north of the Springfield Road junction and south of the supermarket turning are predicted to exceed the annual mean NAQS objective of 40µg/m$^3$. Exceedence of the annual mean 2005 NAQS objective for $NO_2$ north Bishopbriggs Cross is therefore probable.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Kirkintilloch in 2005.

### 6.8.3 Kirkintilloch

The model predicted the potential for exceedence of the annual mean NAQS objective for $NO_2$ during 2004 at five locations:

- along the A8008 New Lairdsland Road;

- properties to the north and south of Lenzie Road between Donaldson Street and Townhead;

- properties to the north and south of Parliament Road between Townhead and the A8008 roundabout;

- properties on both sides of Townhead between Lenzie Road and Willowbank Gardens; and

- properties on both sides of Industry Street up to 30m from Lenzie Road.

The exceedence predicted along the A8008 New Lairdsland Road does not affect any sensitive receptors and is therefore not considered further.

Predicted $NO_2$ concentrations for 2005 at specified sensitive receptors did not provide indication of an exceedence of the 2005 annual mean objective for $NO_2$. However, the predicted $NO_2$ concentrations for the Townhead / B757 junction in Kirkintilloch plotted onto map data revealed that the annual mean NAQS objective for 2005 would be exceeded at a few unspecified sensitive receptors within the vicinity. The sites of predicted exceedence are:

- properties on both sides of Parliament Road up to 20m from the junction;

- properties on the east side of Townhead up to 20m from the junction; and
- properties at the north end of Industry Street up to 20m from the junction.

Exceedence of the annual mean 2005 NAQS objective for $NO_2$ at the junction of Townhead, Parliament Road and Industry Street in Kirkintilloch is therefore possible.

The results predicted by the model indicated that there would be no exceedences of the 1-hour mean NAQS objectives for $NO_2$ in Kirkintilloch in 2005.

## 6.9 Results for $PM_{10}$

In analysing the results of the dispersion modelling assessment the predicted ground level concentrations have been categorised in terms of likelihood of exceedence of the NAQS objectives. The categories are defined by the pollutant bandings and their definitions for predicted $PM_{10}$ concentrations which are presented in Table 26. The likelihood of exceedence defined in Table 26 has been adapted from the method provided in the technical guidance LAQM.TG(03) to reflect the specific scenarios and model used by BMT Cordah Ltd.

**Table 26: Predicted Ground level $PM_{10}$ Concentration Categories**

| Category | Predicted Annual Mean $PM_{10}$ Concentration ($\mu g/m^3$) for 2004 (2010) | Definition |
|---|---|---|
| Unlikely | < 36 (<16) | Low ground level concentration predicted. Exceedence of NAQS annual mean objective for $PM_{10}$ unlikely. |
| Possible | 36 – 40 (16 – 18) | Predicted $PM_{10}$ ground level concentrations below NAQS annual mean objective but within 10%. Some potential for Exceedence therefore exists. |
| Probable | 40 – 44 (18 – 20) | Predicted $PM_{10}$ ground level concentrations above NAQS annual mean objective by up to 10%. It is considered likely that the NAQS objective will be exceeded. |
| Likely | > 44 (>20) | Predicted $PM_{10}$ ground level concentrations above NAQS annual mean objective by greater than 10%. It is considered very likely that the NAQS objective will be exceeded. |

The analysis of the potential for $PM_{10}$ exceedences has been carried out using the above classification.

### 6.9.1 Bearsden and Milngavie

Modelling predictions indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in the Bearsden and Milngavie area. It is therefore concluded that it is unlikely that there will be any exceedence of the NAQS objectives within Bearsden and Milngavie during 2004.

The model predicted areas of exceedence of the 2010 annual mean NAQS objectives for $PM_{10}$ at several locations within the vicinity of Garscube Switch roundabout and along adjoining roads, Switchback Road (A739) / Maryhill Road (A81) / Milngavie Road (A81) / Drymen Road (A809). The sites of exceedence are:

- properties located on the north east, north and north west sides of the roundabout;
- properties on Mcfarlane Drive between Garscube Switch and Maryhill Road;
- properties on the north side of Maryhill Road, east of Milngavie Road:
- properties along both sides of Drymen Road between Canniesburn Toll and Canniesburn Road;

- properties on the east side of Drymen Road between Roman Road and Kirk Road; and

- properties on both sides of Milngavie Road at the junction of Roman Road and Boclair Road.

It is therefore probable that there will be exceedences of the NAQS objectives within Bearsden and Milngavie during 2010 at locations of predicted exceedences.

PM10 concentrations Predicted $PM_{10}$ concentrations for Bearsden and Milngavie indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded at any sensitive receptors.

### 6.9.2 Bishopbriggs

The results predicted by the model indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in Bishopbriggs. It is therefore concluded that it is unlikely that there will be any exceedence of the NAQS objectives within Bishopbriggs during 2004.

Predicted $PM_{10}$ concentrations for the Kirkintilloch Road (A803) / Colston Road (B812) junction in Bishopbriggs indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded. The model predicted areas of exceedence of the 2010 annual mean NAQS objectives for $PM_{10}$ at several sensitive receptors within the vicinity of the junction and along Kirkintilloch Road. The sites of exceedence are:

- properties to the north east of the junction on Colston Road and Kirkintilloch Road: and

- residential and shop properties on the east and west sides of Kirkintilloch Road at the junction with Springfield Road between the Royal Mail sorting office to the south and the supermarket turning to the north.

It is therefore probable that there will be exceedences of the NAQS objectives within Bishopbriggs during 2010 at locations of predicted exceedences.

Predicted $PM_{10}$ concentrations for Bishopbriggs indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded at any sensitive receptors.

### 6.9.3 Kirkintilloch

The results predicted by the model indicated that there would be no exceedences of the 2004 annual mean or 24-hour mean NAQS objectives for $PM_{10}$ in Kirkintilloch. It is therefore concluded that it is unlikely that there will be any exceedence of the NAQS objectives within Kirkintilloch during 2004.

Predicted $PM_{10}$ concentrations for the Townhead / B757 junction in Kirkintilloch indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded. However the

model predicted areas where the concentration at several properties around the Townhead / B757 junction was close to the 2010 annual mean NAQS objectives for $PM_{10}$. The sites close to the exceedence level are:

- properties on the north side of Parliament Road up to 100m east of Townhead:
- properties on both sides of the south end of Townhead up to 30m from the junction; and
- properties on both sides of the north end of Industry Street up to 10m from the junction.

It is therefore possible that there will be exceedences of the NAQS objectives within Kirkintilloch during 2010 at locations of predicted exceedences.

Predicted $PM_{10}$ concentrations for Kirkintilloch indicated that the 24-hour mean NAQS objective for 2010 would not be exceeded at any sensitive receptors.