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ENVIRONMENTAL CONSULTANCY
AND INFORMATION SYSTEMS

Local Air Quality Management
Detailed Assessment

A Report for
North Lanarkshire Council

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1 INTRODUCTION

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, the Air Quality Regulations 2000 and Air Quality (Scotland) Amendment Regulations 2002 (References 1-2).

The framework of local air quality management (LAQM) requires a Review and Assessment of air quality by local authorities on a regular basis. The first round of the Review and Assessment was completed by North Lanarkshire Council during 2001 following a Stage 2 Review and Assessment. The first round of Review and Assessment concluded that it was unlikely that there would be any breach of air quality objectives but that further consideration of road traffic emissions would be required at a later Review and Assessment.

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 to conduct an Updating and Screening Assessment (U&SA) (Reference 3) of local air quality. The U&SA considered any changes that had occurred since the first stage Review and Assessment that had the potential to affect air quality. The U&SA identified areas of North Lanarkshire where National Air Quality Strategy (NAQS) objectives for nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate material (PM_{10}) may be exceeded. No potential exceedences of NAQS objectives for carbon monoxide (CO), lead, benzene or 1,3-Butadiene were identified.

The second phase of the second round of Review and Assessment requires a more detailed assessment of any potential exceedences of NAQS objectives identified by the U&SA. This report represents the Detailed Assessment of air quality within North Lanarkshire.

The Detailed Assessment is undertaken with reference to the LAQM Technical Guidance document LAQM.TG(03) (Reference 4).

An overview map of the North Lanarkshire Council area is provided for reference in Figure 1.

2 NITROGEN DIOXIDE

The U&SA (Reference 3) identified potential exceedences of NAQS objectives at several locations. These were:

- Whifflett, Coatbridge, as a result of road traffic emissions;
- Chapelhall, as a result of road traffic emissions;
- Motherwell town centre, as a result of road traffic emissions; and
- Motherwell town centre, as a result of industrial processor emissions.

There are two air quality objectives for NO_2, an annual mean objective and an hourly objective, set out in the Air Quality 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 $\mu g/m^3$	Annual Mean	31.12.2005
200 $\mu g/m^3$	1-hour Mean, not to be exceeded more than 18 times per year	31.12.2005

North Lanarkshire Council have continued to monitor ambient NO_2 concentrations throughout the area. The monitored concentrations are presented and evaluated against the NAQS objectives in Section 2.1.

The detailed assessment of road traffic emissions at each of the locations identified in the U&SA is discussed in Section 2.2 whilst the impacts of emissions of NO_2 from industrial sources are discussed in Section 2.3.

2.1 Monitoring Data

North Lanarkshire Council have continued to monitor NO_2 concentrations throughout the area since the U&SA (Reference 3). Monitoring is undertaken using both automatic chemiluminescent analysers and passive diffusion tubes.

Whilst the Detailed Assessment 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 Sections 2.1.1 and 2.1.2. Automatic continuous monitoring by chemiluminescent analysers is discussed in Section 2.1.3.

2.1.1 QA/QC of Diffusion Tube Monitoring Data

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

(NB. not 50% TEA in acetone as reported in the U&SA). The laboratory undertakes the analysis of, amongst others, Glasgow City Council who undertake an annual co-location study of diffusion tubes with automatic monitoring stations in the City.

The U&SA utilised cross-comparison data obtained from Glasgow City Council to obtain a bias correction factor for the diffusion tubes. In 2003 however, the data capture rate at four of the five Glasgow City Council automatic monitoring stations was insufficiently high to allow suitable bias correction factors to be obtained. The fifth automatic monitoring station, at Glasgow Kerbside, whilst having a sufficiently high data capture rate for a bias correction factor to be determined, is situated in a street canyon with particularly high levels of traffic flow. Consequently measured NO_2 concentrations are higher than would be expected within North Lanarkshire. Use of the bias correction factor obtained for this site is therefore thought to be unsuitable for North Lanarkshire.

GSS participate in the AEA Technology laboratory intercomparison scheme. The scheme whilst assessing the analytical performance of laboratories, also allows for the performance of the laboratory against chemiluminesence techniques to be determined. A laboratory bias for GSS was therefore determined using the methodology contained in LAQM Technical Guidance document LAQM.TG(03) (Reference 4) and data obtained from the AEA Technology intercomparison study. Results from the laboratory intercomparison study were obtained from data collated by AQM Consultants on behalf of DEFRA (Reference 5). The methodology and calculated bias are presented in Table 2.

Table 2 Laboratory Bias Correction Factor for Glasgow Scientific Services 2003

Site Name	Annual Mean Diffusion Tube Concentration (μg/m^3) (Dm)	Annual Mean Chemiluminesence Concentration (μg/m^3) Cm	Bias Adjustment Factor (Cm/Dm)	Diffusion Tube Bias (Dm-Cm)/Cm x100%
AEA Technology Laboratory Intercomparison Study	39	32	0.82	21.9%

The AEA Technology intercomparison study therefore provides a laboratory correction factor for GSS of 0.82. No data is available to determine the site location type for which the bias adjustment factor is calculated. In 2002 the bias correction factor for an urban centre site was determined to be 0.82 and for a kerbside site 0.85. The bias factor determined for 2003 is therefore comparable to factors for both urban centre and kerbside sites for previous years. The bias factor for 2003, whilst being used with caution, has therefore been applied to all site types.

2.1.2 Diffusion Tube Monitoring Data

Monitoring was undertaken at a total of thirty-five sites throughout North Lanarkshire in 2003. The sites included receptors adjacent to the busy motorway network through North Lanarkshire, urban background locations within the major towns of the area and roadside/kerbside sites adjacent to busy roads in urban areas. The monitoring results are presented in Table 3. The bias adjustment factor was applied to the diffusion tube monitoring results.

National policy measures and improved emissions from motor vehicles have resulted in a national trend of declining NO_2 concentrations. Whilst there are only three to four years of monitoring data available for each monitoring site, the results show an overall reduction in NO_2 concentration at each site over the period. There is however, no consistent year on year steady reduction in NO_2 concentration. In particular, the monitored concentrations in 2003 show a marked increase on previous 2002 results. Consultation with neighbouring Local Authorities has confirmed that a general increase in NO_2 concentrations was experienced during 2003. The meteorological conditions experienced during 2003 were typical of those which would be expected for high ambient concentrations, namely a warm dry still summer and periods of still cold dry periods during the winter months. The monitoring results therefore indicate that whilst the trend may be an overall decrease in pollutant concentrations, annual variations in meteorological conditions may have a significant influence on ambient pollutant concentrations.

Annual mean NO_2 concentrations measured at four of the monitoring stations in 2004 exceeded the NAQS annual mean objective of 40 µg/m^3. The stations were:

- Auchenkilns roundabout, Cumbernauld;
- Lauchope Street, Chapelhall;
- Civic Centre, Motherwell; and
- New Edinburgh Road, Uddingston.

The monitoring site at Auchenkilns is situated some distance from the nearest receptors (approximately 500m) therefore no further assessment is required. Lauchope Street in Chapelhall and the Civic Centre, Motherwell are two of the scenarios assessed by dispersion modelling. The dispersion modelling of NO_2 emissions from road traffic at both junctions is discussed in Section 2.2 and in Appendix 2. The fourth location at which an annual average concentration in excess of the NAQS objective was measured was on New Edinburgh Road, Uddingston. The New Edinburgh Road site is a kerbside site and is located within 20 metres of the M74 motorway. There is housing within 20m of the monitoring site. The monitoring site was moved in 2002, because of a low data capture rate. The new site is closer to the M74 than the previous site. Further monitoring is required at the site to determine whether the measured exceedence is a result of the meteorological conditions during 2003 or a result of the new monitoring location. The monitoring data for the site will be considered again during the Council's Progress Report in 2005 and further assessment undertaken if required.

In addition to the four sites for which the measured concentration exceeded NAQS objective levels there are other sites for which NO_2 concentration are a concern. These sites include Bank Street in Coatbridge where the NO_2 concentration has remained at 38-39 µg/m^3 for the past three years and at monitoring sites located alongside the M8/A8 motorway. The monitoring sites adjacent to the M8/A8 motorway of concern are at the farmhouses at Bargeddie (either side of the motorway) and at Shawhead, with annual average concentrations measured at each approaching the NAQS objective level. The monitoring sites at Bargeddie and Shawhead are located approximately 20m from the roadside. In addition, the air quality levels measured at these locations will be representative of the air quality at the new housing developments between the Bargeddie and Shawhead junctions of the A8. The concentrations measured at these sites during

2003 may be elevated as a result of the meteorological conditions during 2003 or they may be attributable to the ongoing road works along the M8/A8 between Ballieston and Newhouse. The road works have resulted in reduced speeds for vehicles and increased congestion at peak times. Monitoring data obtained for the sites in 2004 will be reviewed for the Council's Progress Report in 2005. If the monitored results remain close to the objective levels then it will be necessary to undertake further assessment.

Table 3 NO_2 Diffusion Tube Monitoring Results

Location	Site Type	Annual Mean NO_2 Concentration ($\mu g/m^3$)			
		2000	2001	2002	2003
Coatbridge 1, Bank St.	Kerbside	62	38	38	39
Coatbridge 2, Whifflet Court	Roadside	36	30	26	30
Airdrie 1, Hallcraig St.	Background	39	27	22	24
Airdrie 3, Springwells Cresc.	Background	26	19	19	21
Auchenkilns, Cumbernauld	Kerbside	84	70	68	81
Southfield Road, Cumbernauld	Kerbside	32	27	24	28
Lauchope Street, Chapelhall	Kerbside	57	42	41	46
Civic Centre, Motherwell	Kerbside	50	35	36	40
Health Centre, Motherwell	Roadside	30	21	21	21
Emily Drive, Motherwell	Background	21	11	12	15
Kethers lane, Motherwell	Background	20	19	17	19
Coursington Road, Motherwell	Roadside	18	16	14	14
Craigneuk Road, Carfin	Kerbside	20	20	15	18
Coatbridge 3, Hozier Street	Kerbside	-	31	26	25
Camp Street, Motherwell	Background	-	25	19	21
Braehead Farm, Bargeddie, R4	other (motorway)	-	43	37	38
Shawhead, R9	other (motorway)	-	39	34	37
Orchard Farm A8 East, R11	other (motorway)	-	37	29	32
Woodhall Kennels, Calderbank, R12	other (motorway)	-	25	18	20
Sandyford Farm, Newhouse R13	other (motorway)	-	19	16	19
Salsburgh R14	other (motorway)	-	22	19	24
Salsburgh R15	other (motorway)	-	25	19	22
Salsburgh R16	other (motorway)	-	26	21	23
Dewshill Cottages, R17	other (motorway)	-	21	19	20
Blair House, R18	other (motorway)	-	30	25	26
R19	other (motorway)	-	20	16	17
Blairmuchole Road, R20	other (motorway)	-	21	23	25
129 Edinburgh Road, R21	other (motorway)	-	23	21	24
46 Howburn Road, R22	other (motorway)	-	22	13	19
Orchard Fam A8 West, R10	other (motorway)	-	22	19	27
Braehead Farm, Bargeddie W, R5	other (motorway)	-	36	25	39
Johnston Farm, Gartcosh, R23	other (motorway)	-	24	20	22
New Edinburgh Road, Uddingston, R27	other (motorway)	-	39	28	41
Alpine Grove, Udingston, R28	other (motorway)	-	30	23	28
Fallside Road, Uddingston, R29	other (motorway)	-	35	30	31

2.1.3 Automatic Monitoring Data

The Council own and operate three units containing chemiluminescent analysers. One of the three is permanently stationed at Calder Court, Whifflett, Coatbridge whilst another is contained within the mobile unit stationed at Kirk o' Shotts Primary School adjacent to the M8. The third unit is located at Harthill and has been out of service for the latter part of 2003.

The annual mean concentration and 99.79^{th} percentile of hourly mean concentrations (equivalent to the 18^{th} highest value in the year) for each of the stations are summarised in Table 4.

Table 4 Automatic Monitoring Station 2003 NO_2 Monitoring Results

Monitoring Site	Location Type	Annual Mean Concentration ($\mu g/m^3$)	99.79^{th} Percentile of Hourly Mean Concentrations ($\mu g/m^3$)	Data Capture Rate (%)
Calder Court, Coatbridge	Urban Background	20	114.8	64.4
Kirk o' Shotts	Roadside (M8)	34	53.48	56.3
Harthill	Roadside (M8) + Industrial	27	53.64	67.3

The results therefore demonstrate that the annual mean and hourly mean concentrations at Calder Court, Kirk o' Shotts and Harthill are unlikely to exceed the NAQS objectives for NO_2 in 2005. In should be noted, however that the data capture rate at each site is low.

The results indicate that the impact of the M8 motorway on air quality levels in Salsburgh and in particular at the Kirk o' Shotts Primary School, which is just outside the village, are unlikely to result in an exceedence of NAQS objectives. The monitoring site at Harthill is also situated close to the M8, however the station is situated primarily to assess the impact of quarrying activities at Harthill on PM_{10} concentrations at nearby receptors.

Further assessment has been made of traffic emissions at Whifflet Cross by dispersion modelling. The Calder Court monitoring data has been used to assist in verifying the model. Discussion on the dispersion modelling assessment can be found in Section 2.2 and in Appendix 2.

Each of the automatic monitoring stations are scheduled to be relocated during 2004. Automatic monitoring stations are to be located at Motherwell Cross and Lauchope Street in Chapelhall to verify the dispersion modelling of road traffic emissions and at Wishaw Main Street, a road congested at peak times with potential street canyon effects.

2.2 Road Traffic Emissions

Four road junctions in the North Lanarkshire area were identified as emission sources with potential for exceedence of the NAQS objectives for NO_2.

The road junctions were:

- Junction of A723 Hamilton Road and A721 West Hamilton Street/Muir Street, Motherwell Cross;
- Junction of A721 Windmillhill Street and B754 Airbles Road at the Civic Centre, Motherwell;
- Junction of A725 Whifflett Street and B753 Calder Street/School Street, Coatbridge; and
- Junction of A73 and B799 Main Street, Chapelhall.

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 average and hourly mean concentrations of NO_2. The predicted concentrations were verified against monitoring data obtained at each site to determine the accuracy of the modelling study.

The maximum annual average and 99.79th percentile of hourly mean concentrations predicted by the model for each road junction are summarised in Table 5.

NAQS objectives are only applicable to areas of relevant public exposure. Locations of relevant human exposure for the annual mean objective include residential premises, schools, workplace or hospitals. Relevant locations of exposure for the hourly mean objective can be roadside/kerbside locations.

Table 5 Summary of Predicted 2005 NO_2 Concentrations

Road Junction	Predicted NO_2 Concentration (µg/m^3) (including background)	
	Maximum Annual Mean	99.79th Percentile of hourly means
Motherwell Cross	41.98	110.76
Civic Centre, Motherwell	49.97	118.28
Whifflett	32.81	106.70
Chapelhall	59.34	191.88

The modelling results therefore indicate that there is potential for exceedence of the NO_2 annual mean objective in 2005 at three of the four junctions namely Chapelhall, Motherwell Civic Centre and Motherwell Cross. The contour plots however indicate that the maximum concentrations are predicted to occur on the roads themselves. At the Civic Centre, the closest receptors are at the hospital on Airbles Road and at the residential flats on Windmillhill Street. The locations of the receptors are marked on Figure 31. The contour plots indicate that the annual average NO_2 concentrations at these points will be in the range 30-35 µg/m^3. Similarly, at Motherwell Cross the predicted concentrations at locations of relevant public exposure are lower than the maximum predicted concentration and are within the band 30-35 µg/m^3. It is therefore unlikely that there will be an exceedence of the

NAQS annual mean objective for NO_2 at areas of relevant public exposure close to each junction in 2005.

At Chapelhall the maximum concentration is again predicted to occur on the middle of the road. A detailed view of the junction and contour plot is provided in Figure 45. There are relevant residential receptors close to the roadside on each corner of the road junction. The detailed contour plots however indicate that the concentration will have fallen below 40 $\mu g/m^3$ at the nearest receptors. Whilst the modelling study was undertaken using a detailed calculation grid which predicts pollutant concentrations to less than 1m distances the margin of error contained within the model means that it cannot be concluded that the annual average NO_2 concentration at the closest sensitive receptors will be below 40 $\mu g/m^3$. There is therefore potential for an exceedence of the annual mean objective for NO_2 in Chapelhall in 2005.

The maximum predicted annual average NO_2 concentrations at Whifflett is below 40 $\mu g/m^3$. No exceedence of the annual mean standard for NO_2 is therefore predicted at locations of relevant public exposure in 2005.

No exceedences of the hourly mean NO_2 objective were predicted for any of the road junctions.

Maximum PM_{10} concentrations in 2004 and 2010 are predicted to be below NAQS objectives. No exceedences of the NAQS objectives for PM_{10} are therefore predicted at locations of relevant public exposure in either 2004 or 2010.

2.3 Industrial Emissions

The U&SA report identified one industrial processor within North Lanarkshire with significant emissions of oxides of nitrogen (NO_X), namely the Corus Dalzell Works in Motherwell.

Emissions of NO_X from the Dalzell Works are generated by various combustion plant. The combustion plant is powered by an interruptible gas supply. In the event of an interruption to supply the plant is powered on heavy fuel oil. The total NO_X emissions from the Dalzell Works are around 85 tonnes per annum and are emitted from six point sources. The emissions sources and the annual emissions from each source are detailed in Table 6.

Table 6 Emissions of Oxides of Nitrogen from the Dalzell Works

Emissions Source	Annual Emissions (te/annum)
Pusher	31.6
Stein Soaking Pit	5.1
SAS Soaking Pit	10.5
West Roller Hearth	29.5
East Roller Hearth	4.9
No.'s 2-6 Bogie Furnaces	3.0 (combined)
Total	84.6

As the emissions are released from six different points assessing the combined impact of these sources is beyond the scope of the nomograms in LAQM technical guidance TG(03)

(Reference 4). The impact of the emissions has therefore to be assessed by more detailed means.

Corus submitted an application for permission to operate under IPPC regulation for the Dalzell Works in 2003. The application included an assessment of the environmental impact of the emissions to atmosphere from the plant. The application assessed four potential scenarios:

- Long term impact of annual average emissions;
- Short term impact of average emissions; and
- Short term impact of worst case emissions.

The long term impact assessed predicted annual average concentrations based on the plant operating on gas power. The short term impact assessed the maximum predicted hourly concentrations based on average emissions (gas powered) and worst case emissions (plant powered by heavy fuel oil). The impact of the emissions for each scenario was assessed by dispersion modelling techniques. The study used the dispersion modelling tool ADMS 3, a SEPA and DEFRA approved model. The results of the modelling study are summarised in Table 7.

The results are presented for direct comparison with the NAQS objectives, therefore the long term emission scenario is presented as an annual average concentration whilst the results for the short term emission scenarios are presented as the 99.79th percentile of predicted hourly mean concentrations. The 99.79th percentile of hourly mean concentrations corresponds to the eighteenth highest hourly value for direct comparison with the NAQS hourly mean objective.

Table 7 Predicted NO_2 Concentrations from Dalzell Works Emissions

Scenario	Max Predicted Concentration (μg/m^3)	Background Concentration (μg/m^3)	Combined Concentration (μg/m^3)	NAQS Objective Concentration (μg/m^3)	Overall Concentration as Percentage of NAQS Objective
Long-term average emissions	3.0	18	21	40	53%
Short-term average emissions	54	36	90	200	45%
Short-term worst case emissions	145	36	181	200	91%

The maximum long-term concentrations were predicted to occur to the north-east of the Dalzell site just outwith the site boundary. The short-term concentrations were predicted for worst case meteorological conditions and would occur downwind of the site.

The results of the modelling study therefore indicate that it is unlikely that there will be an exceedence of the NAQS objectives for NO_2 as a result of emissions from the Dalzell Works. The predicted maximum hourly concentration occurring as a result of worst case emissions was close (91%) to the hourly mean objective of 200 μg/m^3. The possibility of an exceedence of the objective in conjunction with other emission sources exists, however it is a remote possibility as a combination of the boiler plant at the Dalzell Works operating on heavy fuel oil and worst case meteorological conditions on more than 18 hourly occasions in a year would be required.

The application by Corus for PPC authorisation for the Dalzell site is currently subject to Schedule 4 notice by SEPA. One element of the Schedule 4 notice relates to the justification of stack heights for atmospheric emissions. Whilst there may therefore be some changes to the air quality impact assessment element of the study it is considered unlikely that the assessment conclusions will change. The Corus response to the SEPA Schedule 4 will be assessed and any implications for LAQM or the conclusions of this report will be included in the Council's Progress Report in 2005.

2.4 Conclusions

Monitoring data for 2003 confirmed that the conclusions of the U&SA (Reference 3) remain valid and that annual mean concentrations exceeding NAQS objectives had been measured at Chapelhall and Civic Centre, Motherwell during 2003. In addition an annual average concentration exceeding 40 $\mu g/m^3$ was recorded at New Edinburgh Road, Uddingston and Auchenkilns, Cumbernauld. The Uddingston site was moved during 2003 to be closer to the M74 motorway. Further consideration will be given to the site in the Progress Report in 2005. The Auchenkilns site is situated away from relevant public exposure therefore no further assessment of the site is required. An additional site, Bank Street in Coatbridge experienced high annual average concentration in 2003, the results for the site have been consistently high over the last three years (38-39 $\mu g/m^3$). Further assessment of the site may therefore be required in 2005.

Assessment of emissions from the Corus Dalzell Works in Motherwell was undertaken with reference to an air quality impact assessment carried out by Corus in support for their IPPC application for the site in 2003. It is unlikely that emissions from the Dalzell Works will result in an exceedence of NAQS objectives for NO_2 even assuming worst case emissions.

Dispersion modelling of road traffic emissions predicted annual average NO_2 concentrations exceeding the annual mean objective of 40 $\mu g/m^3$ at three junctions in 2005. The three junctions were Motherwell Civic Centre, Motherwell Cross and Chapelhall. The maximum concentrations for each road junction were predicted to occur at the road centre. Closer inspection of the contour plots for each junction indicated that the annual average NO_2 concentration at the closest sensitive receptors to the Motherwell Civic Centre and Motherwell Cross junctions were below the NAQS objectives. As such no exceedence of the NO_2 annual mean objective is predicted. At Salsburgh the predicted annual mean NO_2 concentration at the closest sensitive receptor in 2005 was also below 40 $\mu g/m^3$, however predicted concentrations close to the nearest receptors (within 1-2 m) were predicted to be higher than 40 $\mu g/m^3$. The accuracy of the model is insufficient to determine exact concentrations to small margins of distance therefore it was concluded that there is potential for an exceedence of the annual mean NO_2 objective in Chapelhall in 2005.

No exceedence of the annual mean or hourly mean objectives for NO_2 in 2005 was predicted for the Whifflett junction.

There is therefore potential for exceedence of the NO_2 annual mean objective in Chapelhall in 2005. Verification of the dispersion model at Chapelhall using local monitoring data concluded that the model gave good approximation to monitored concentrations. It is therefore proposed to undertake additional monitoring at the road junction including locating an automatic monitoring station close to the junction and adding additional diffusion tubes. The additional monitoring will be in place early summer 2004 so that at least 9 months of monitoring data will be available by the submission of the Progress Report in 2005. Further monitoring will also be required at receptors close to the Civic Centre and Motherwell Cross junctions to confirm the conclusions of the modelling study.

3 SULPHUR DIOXIDE

North Lanarkshire Council's U&SA (Reference 3) identified three areas of potential exceedence of NAQS objectives for SO_2. These were:

- Muirhead, based on passive sampler monitoring data;
- Greengairs, based on the density of houses burning solid fuel; and
- Salsburgh, also based on the density of houses burning solid fuel.

There are three NAQS objectives for SO_2, namely a 24-hour objective, an hourly objective and a 15-minute mean objective. The objectives are presented in Table 8.

Table 8 NAQS Objectives for SO_2

Concentration	Measured As	Date to be Achieved by
350 µg/m^3 not to be exceeded more than 24 times per year	1-hour mean	31.12.2004
125 µg/m^3 not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
266 µg/m^3 not to be exceeded more than 35 times per year	15-minute mean	31.12.2005

The ground level SO_2 concentration at areas of relevant public exposure should therefore not be predicted to exceed 350 µg/m^3 on more than 24 hourly periods by the end of 2004. In addition it should be predicted that the 24-hour mean will not exceed 125 µg/m^3 on more than three occasions by the end of 2004 and that there will be fewer than 35 15-minute mean exceedences of 266 µg/m^3 a year by the end of 2005.

An update of monitoring data since the U&SA (Reference 3) and in particular recent monitoring data for Muirhead is presented in Section 3.1.

An assessment of the impact of SO_2 from housing burning solid fuel is discussed in Section 3.2.

3.1 Monitoring Data

North Lanarkshire Council monitor SO_2 at a number of sites within the area. Monitoring is undertaken using both automatic ultra-violet fluorescent (UVF) analysers and bubbler samplers.

Monitoring by bubbler samplers is discussed in Section 3.1.1 and monitoring by UVF analysers is discussed in Section 3.1.2.

3.1.1 SO_2 Active Sampler Monitoring

North Lanarkshire Council monitor SO_2 using 8-port active samplers (bubblers) at three locations, Muirhead and Kirkwood and Main Street, both Coatbridge. Analysis of the bubbler is undertaken by Glasgow City Council's public laboratory, Glasgow Scientific Services, using the net acidity titration technique. There are no procedures in place to validate the results.

The SO_2 bubblers monitor over 24-hour periods. The annual mean concentration and the maximum 24-hour mean concentration monitored at the site are presented in Table 9. Technical guidance LAQM.TG(03) (Reference 4) provides a correction factor to adjust 24-hour mean concentrations for comparison with hourly and 15-minute mean objectives. The correction factors are:

99.9^{th} %ile of 15-minute means = 1.8962 x maximum daily mean

99.7^{th} %ile of 1-hour means = 1.3691 x maximum daily mean

The correction factors have been utilised and the results presented in Table 9.

Table 9 SO_2 Concentrations measured within North Lanarkshire

	2000	2001	2002	2003
Muirhead				
Maximum Daily Mean Concentration ($\mu g/m^3$)	46	128	126	55
99.7^{th} %ile of 1-hour Means ($\mu g/m^3$)	63	175	172	75
99.9^{th} %ile of 15-minute Means ($\mu g/m^3$)	87	243	239	104
Coatbridge Kirkwood				
Maximum Daily Mean Concentration ($\mu g/m^3$)	50	60	47	54
99.7^{th} %ile of 1-hour Means ($\mu g/m^3$)	68	82	64	74
99.9^{th} %ile of 15-minute Means ($\mu g/m^3$)	95	114	89	102
Coatbridge Main Street				
Maximum Daily Mean Concentration ($\mu g/m^3$)	105	61	57	57
99.7^{th} %ile of 1-hour Means ($\mu g/m^3$)	144	84	78	78
99.9^{th} %ile of 15-minute Means ($\mu g/m^3$)	199	116	108	108

Historically the monitored results at each of the stations have followed the national downward trend, however in recent years, namely 2001 and 2002, high peak daily mean concentrations have been recorded at the Muirhead monitoring station. These peak concentrations were attributed in the U&SA to heavy fuel boilers in the nearby schools. The heavy fuel boilers were converted to gas during 2002, therefore the reduction in measured concentration in 2003 confirms the suspected source of the high SO_2 concentrations. The measured concentrations at the Kirkwood and Main Street monitors in Coatbridge are comparable with previous years results.

The monitoring results indicate that it is unlikely that there will be an exceedence of NAQS objectives for SO_2 in any of the areas for which monitoring has been undertaken. The areas of monitoring are urbanised areas with no industrial emitters or large boilers and low numbers of housing burning solid fuel. It is therefore unlikely that there will be any exceedence of NAQS objectives for SO_2 in similar areas throughout North Lanarkshire.

3.1.2 UVF Analyser Monitoring

North Lanarkshire Council have operated two mobile automatic monitoring stations since 1999 with an additional stationary analyser added during 2002. These monitoring stations contain real-time UVF analysers. The monitoring stations were provided, maintained and are subject to annual calibrations by Horiba.

The stationary monitoring site is situated within residential accommodation at New Town Hall, Bron Way, Cumbernauld, an urban background monitoring site. The mobile monitoring stations have been rotated around a number of roadside and urban background sites. Details of the historical monitoring locations and maps showing those locations are contained within the U&SA (Reference 3). No exceedences of NAQS objectives for SO_2 were recorded at any of the monitoring locations between 2000 and 2002.

In 2003 the two mobile analysers were situated at Kirk o' Shotts and Harthill with the stationary analyser located at Cumbernauld. The monitoring locations at Kirk o' Shotts and Harthill were selected for assessment of the road traffic emissions from the M8 motorway and particulate emissions from quarrying activities respectively. No SO_2 emission sources were targeted in either case.

The monitors record concentrations on an hourly average basis. The maximum hourly and 24-hourly SO_2 concentrations recorded at each site during 2003 are presented in Table 10.

Table 10 SO_2 Concentrations measured within North Lanarkshire in 2003 by Automatic Analysers

Monitoring Location	Maximum Hourly Concentration (μg/m^3)	Maximum 24-hourly Concentration (μg/m^3)
Bron Way, Cumbernauld	120	29
Harthill	106	21
Kirk o' Shotts	101	19

No exceedences of either the hourly or 24-hourly NAQS objectives for SO_2 were therefore recorded at either of the automatic monitoring sites. None of the sites were targeted to SO_2 emission sources; however the proximity of the Kirk o' Shotts site to Salsburgh will be used to validate the dispersion modelling of emissions from domestic sources.

3.2 Domestic Fuel Burning Emissions

North Lanarkshire Council's U&SA (Reference 3) concluded that there was potential for an exceedence of NAQS objectives for SO_2 in Salsburgh and Greengairs based on the nomograms of domestic burning of solid fuel contained within Technical Guidance LAQM.TG(03) (Reference 4). In order to assess the likelihood of an exceedence of NAQS objectives in either village an impact assessment of the emissions has been undertaken for the worst case of the two villages, namely Salsburgh.

The automatic monitoring station named Kirk o' Shotts has been situated just outwith Salsburgh for two years. No exceedence of NAQS objectives for SO_2 or PM_{10} have been recorded at the monitoring station over the last two years. In order to ascertain pollutant concentration levels within the village however a dispersion modelling study was undertaken.

The modelling study utilised local meteorological and topographical data to simulate the dispersion of pollutants emitted from domestic chimneys within the Salsburgh village.

The rate of pollutant emissions was calculated based on the quantities of fuel combusted in the village which were obtained from survey of local residents undertaken by North Lanarkshire Council officers. The predicted pollutant concentrations from the modelling study were validated against the monitoring data from the Kirk o' Shotts monitoring station.

The results of the housing survey, methodology and background to the modelling study, the predicted pollutant concentrations and the validation of those predictions are discussed in detail in Appendix 1. The conclusions of the assessment are summarised here:

- The predominant source of SO_2 emissions in Salsburgh is from the burning of solid smokeless fuel as the primary heat source in domestic housing.
- The impact of SO_2 emissions from road traffic sources on the M8 motorway is negligible in comparison to emissions from domestic sources.
- The predicted concentrations indicate that it is unlikely that there will be an exceedence of any NAQS objectives for SO_2 in 2004 or 2005.

As no potential exceedences of NAQS objectives for SO_2 were predicted by the model for Salsburgh then it is also considered unlikely that there will be any exceedence of NAQS objectives for SO_2 within Greengairs.

3.3 Conclusions

The U&SA report (Reference 3) identified three potential locations of exceedence of NAQS objectives for SO_2, namely Muirhead based on passive sampler monitoring data and Greengairs and Salsburgh based on the results of the nomogram assessment of the density of housing burning solid fuel.

The two boilers in Muirhead identified as the main SO_2 emissions sources were converted to gas power during 2002. The monitoring results for 2003 indicate that the drop in SO_2 emissions following the boiler conversion has been reflected in a drop in SO_2 concentrations in the area. No potential exceedences of NAQS objectives for SO_2 were recorded at Muirhead in 2003. It is therefore considered that it is unlikely that there will be any exceedence of NAQS objectives for SO_2 at Muirhead in 2004 or 2005.

Monitored SO_2 concentrations at the other passive sampling monitoring locations in Coatbridge and at the automatic monitoring sites indicate that it is unlikely that NAQS SO_2 objectives will be exceeded in urban background locations.

The only emission sources identified by the U&SA (Reference 3) as having potential to result in exceedence of the NAQS objectives for SO_2 were domestic sources burning solid fuel in Greengairs and Salsburgh. Salsburgh was identified as having the highest SO_2 emissions and therefore the worst case of the two villages.

A dispersion modelling study was undertaken of emissions from domestic sources within Salsburgh. The modelling study predicted that ground level concentrations were unlikely to exceed NAQS objectives. As Salsburgh was the worst case of the two villages it is considered unlikely that there will be any exceedence of NAQS objectives for SO_2 in Greengairs.

It is therefore considered unlikely that there will be any exceedence of NAQS objectives for SO_2 within North Lanarkshire in 2004 or 2005.

4 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 Regulations 2000. In addition the Scottish Executive have set in place stricter objectives to be achieved by 2010. The objectives are presented in Table 11.

Table 11 Air Quality Objectives for PM_{10}

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

The annual mean concentration therefore should not be predicted to exceed 40 $\mu g/m^3$ by the end of 2004 and 18 $\mu g/m^3$ by the end of 2010. In addition there should be fewer than 35 24-hourly exceedences of 50 $\mu g/m^3$ in a year by the end of 2004 and less than 7 by the end of 2010.

North Lanarkshire Council's U&SA (Reference 3) 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 2010 annual mean objective of 18 $\mu g/m^3$. Emissions from road traffic, domestic and dust emitting process were identified as likely to cause exceedence of the 2010 annual mean objective. Response to the U&SA (Reference 3) by SEPA, however indicated that they considered it unlikely that any of the dust-generating processes identified will result in an exceedence of the objective.

The Detailed Assessment therefore focuses on road traffic emissions and emissions from domestic combustion sources in Greengairs and Salsburgh. The assessment of road traffic emissions focuses on the four road junctions identified as potentially exceeding NO_2 objectives in 2005. The assessment of domestic combustion sources focussed on the emissions from Salsburgh as the worst case of the two villages.

An update of monitoring data since the U&SA (Reference 3) is presented in Section 4.1. A summary of the assessment of the impact of road traffic emissions at each of the junctions under consideration is presented in Section 4.2 whilst an assessment of domestic fuel burning sources is presented in Section 4.3.

4.1 Monitoring Data

North Lanarkshire Council own and operate two stationary and two mobile automatic monitoring stations. The stations monitor PM_{10} continuously using Tapered Element Oscillating Microbalance (TEOM) units providing real-time continuous readings. The monitoring stations were provided and are maintained and are subject to annual calibrations by Horiba.

The stationary monitoring sites are situated within residential accommodation at Calder Court in Whiflett, Coatbridge, an urban background monitoring site and at Holy Cross Primary School in Croy, an industrial monitoring site. The mobile monitoring stations have been rotated around a number of roadside and urban background sites.

In 2003 the two mobile analysers were situated at Kirk o' Shotts and Harthill. The monitoring station at Kirk o' Shotts was selected for it's proximity to the M8 motorway, whilst the monitoring station at Harthill was selected for assessment of quarrying and other dust generating activities.

Details of the historical monitoring locations and maps showing those locations are contained within the U&SA (Reference 3). No exceedences of 2004 NAQS objectives for PM_{10} were recorded at any of the monitoring locations between 2000 and 2002. Exceedences of the 2010 annual mean NAQS objectives have been recorded at Stepps, Greengairs, Croy and Harthill.

The annual average concentration and the number of exceedences of the 24-hour mean objective recorded at each site during 2003 are reported in Table 12. The concentrations have been factored by 1.3 to account for the under-read of TEOM analysers.

Table 12 Automatic Monitoring Station PM_{10} Monitoring Results

Monitoring Site	Annual Mean Concentration ($\mu g/m^3$)	Maximum 24-hour Mean Concentration ($\mu g/m^3$)	No. of 24-hr Mean Exceedences	Data Capture Rate (%)
Calder Court	20	62	6	80.38
Croy	18	93	5	48.07
Kirk o' Shotts	25	60	5	51.56
Harthill	21	100	14	82.02

The PM_{10} concentrations measured in 2003 indicate that it is unlikely that the NAQS 2004 annual mean or daily mean objectives will be exceeded. The results however indicate that there is potential for an exceedence of the NAQS 2010 annual mean objective of 18 $\mu g/m^3$ at each of the sites and that there may also be more than the 7 permitted exceedences of the 2010 daily mean objective at the Harthill monitoring site. It should be again noted that the data capture rate at each of the monitoring sites is low.

Consideration of the monitoring data obtained at each of these sites will be required in the Council's Progress Report in 2005 and beyond in order to assess compliance with the NAQS 2010 objectives. Further assessment will be undertaken at this stage if required.

4.2 Road Traffic Emissions

Four road junctions in the North Lanarkshire area were identified as emission sources with potential for exceedence of the NAQS objectives for NO_2. An assessment of PM_{10} emissions and evaluation of resultant ground level concentrations against NAQS objectives was undertaken in addition to the evaluation of NO_2 concentrations.

The road junctions under consideration were:

- Junction of A723 Hamilton Road and A721 West Hamilton Street/Muir Street, Motherwell Cross;
- Junction of A721 Winmillhill Street and B754 Airbles Road at the Civic Centre, Motherwell;
- Junction of A725 Whifflett St and B753 Calder Street/School Street, Coatbridge; and
- Junction of A73 and B799 Main Street, Chapelhall.

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 90.4^{th} percentile of daily mean concentrations of PM_{10}. The predicted concentrations were validated against local monitoring data where available to determine the accuracy of the modelling study, although predicted concentrations of NO_2 were assessed against monitoring data in each scenario to ensure the validity of the modelling study.

The maximum predicted annual average and hourly concentrations at any location and at locations of relevant human exposure for each road junction are summarised in Table 13. Locations of relevant human exposure for the annual mean objective include residential premises, schools, workplace or hospitals. Relevant locations of exposure for the hourly mean objective can be roadside/kerbside locations.

Table 13 Summary of Predicted PM_{10} Concentrations

Road Junction	Predicted PM_{10} Concentration (µg/m^3)			
	Maximum Annual Mean 2004	90.4^{th} Percentile of 24-hr Means 2004	Maximum Annual Mean 2010	90.4^{th} Percentile of 24-hr Means 2010
Motherwell Cross	20.54	40.59	18.95	37.59
Civic Centre	21.42	42.20	19.50	38.66
Whifflett	19.85	39.60	18.59	36.99
Chapelhall	22.66	44.94	20.21	40.15

The predicted concentrations from the dispersion modelling study therefore indicate that it is unlikely that NAQS objectives for PM_{10} will be exceeded in 2004 however annual average PM_{10} concentrations in 2010 are predicted to exceed the 18 µg/m^3 standard. The exceedence is predicted in the main as a result of the high background concentration (in relation to the objective). The PM_{10} concentration at sensitive receptors or areas of relevant public exposure surrounding the junctions may also exceed the objective.

4.3 Domestic Fuel Burning Emissions

North Lanarkshire Councils U&SA (Reference 3) concluded that there was potential for an exceedence of the NAQS 2010 annual mean objective for PM_{10} in Salsburgh and Greengairs based on the nomograms of domestic burning of solid fuel contained within Technical Guidance LAQM.TG(03) (Reference 4). In order to assess the likelihood of an exceedence of NAQS objectives in either village an impact assessment of the emissions has been undertaken for the worst case of the two villages, namely Salsburgh.

The automatic monitoring station named Kirk o' Shotts has been situated just outwith Salsburgh for two years. No exceedence of NAQS objectives for SO_2 or PM_{10} have been recorded at the monitoring station over the last two years. In order to ascertain pollutant concentration levels within the village however a dispersion modelling study was undertaken. The modelling study utilised local meteorological and topographical data to simulate the dispersion of pollutants emitted from domestic chimneys within the Salsburgh village.

The rate of pollutant emissions was calculated based on the quantities of fuel combusted in the village which were obtained from survey of local residents undertaken by North Lanarkshire Council officers. The predicted pollutant concentrations from the modelling study were validated against the monitoring data from the Kirk o' Shotts monitoring station.

In addition to the emissions from domestic premises the emissions from road traffic on the M8 motorway were also considered in the assessment.

The results of the housing survey, methodology and background to the modelling study, the predicted pollutant concentrations and the validation of those predictions are discussed in detail in Appendix 1. The conclusions of the assessment are summarised here:

- The predominant source of PM_{10} emissions in the areas surrounding Salsburgh is from road traffic sources on the M8 motorway.

- The impact of PM_{10} emissions from road traffic sources on the M8 motorway is restricted to roadside locations with PM_{10} concentrations dissipated to below NAQS objective levels within 10m of the roadside.

- The predicted concentrations indicate that it is unlikely that there will be an exceedence of any NAQS objectives for PM_{10} in 2004 although there is potential for exceedence of the 2010 annual mean objective within the village.

4.4 Conclusions

The U&SA report identified the potential for a number of exceedences of the 2010 NAQS annual mean objective for PM_{10}. The locations of potential exceedence were at busy road junctions and the villages of Greengairs and Salsburgh based on the results of the nomogram assessment of the density of housing burning solid fuel. Of the two villages burning solid fuel Salsburgh has a higher density of housing burning solid fuel and as such is the worst case of the two villages.

A dispersion modelling study was undertaken of emissions from domestic sources within Salsburgh as the worst case of the two villages. The emissions from the village were calculated based on published emission factors and fuel use data obtained in a local housing survey. The modelling study predicted annual average PM_{10} concentrations in excess of the 2010 NAQS annual mean objective limit of 18 µg/m^3 within the Salsburgh village. Whilst the background PM_{10} concentration in 2010 will be less than 2004 concentrations it is considered likely that the 2010 annual mean objective will be exceeded should the current PM_{10} emission levels be maintained. Council housing stock in Salsburgh is however scheduled for a central heating upgrade in coming years therefore PM_{10} emissions may be significantly reduced. Further assessment of PM_{10} levels within Salsburgh will be required in forthcoming years. In addition, the potential for exceedence of the 2010 annual mean objective in Greengairs cannot be discounted; further assessment of PM_{10} levels in Greengairs will therefore be required.

An assessment of road traffic junctions where PM_{10} concentrations will potentially exceed the 2010 annual mean objective focussed on the four road junctions which were identified as locations of potential NO_2 exceedence. The dispersion modelling study, based on calculated emissions from road traffic survey data, predicted that the 2010 annual mean objective may be exceeded at locations of relevant public exposure at each road junction. The future predictions take account of falling background concentration and projected increase in traffic flow. Further assessment of each of the junctions will therefore be required in forthcoming years.

It is therefore considered unlikely that there will be any exceedence of NAQS objectives for PM_{10} within North Lanarkshire in 2004 but there is potential for exceedence of the annual mean objective in 2010.

5 CONCLUSIONS

In response to the conclusions of the Council's U&SA (Reference 3) a Detailed Assessment was undertaken of NO_2, PM_{10} and SO_2 concentrations in North Lanarkshire. The locations considered in the assessment were:

- Whifflett, Coatbridge for NO_2 and PM_{10} a result of road traffic emissions;
- Chapelhall, for NO_2 and PM_{10} as a result of road traffic emissions;
- Motherwell, for NO_2 and PM_{10} as a result of road traffic emissions;
- Motherwell, for NO_2 as a result of industrial processor emissions;
- Salsburgh, for SO_2 and PM_{10} as a result of domestic combustion sources; and
- Muirhead, for SO_2 for local combustion sources.

Dispersion modelling of road traffic emissions at road junctions in Chapelhall, Motherwell and Whifflett identified potential for an exceedence of the NO_2 annual mean objective in Chapelhall and in Motherwell at the Civic Centre and Motherwell Cross junctions. At these road junctions the maximum predicted annual average concentration in 2005 was in excess of the 40 $\mu g/m^3$ objective however the concentration was predicted to fall by the point of the closest receptors. The annual average NO_2 concentration at the closest receptors to the Civic Centre and Motherwell Cross junctions were predicted to be in the band 30-35 $\mu g/m^3$. It can therefore be assumed that it is unlikely that there will be an exceedence of the NAQS objective at areas of public exposure surrounding the junctions. This conclusion will require to be confirmed by further monitoring at the junction. At Chapelhall however, the annual average concentration at the closest receptor in 2005 was predicted to be 39 $\mu g/m^3$. The accuracy of the modelling study is insufficiently high to state with confidence that there will not be any exceedence of the NAQS objectives for NO_2. Further assessment of NO_2 concentrations at the road junction in Chapelhall will therefore be required. This should be achieved by positioning an automatic monitoring station at the junction. The monitoring results will be presented in the Progress Report in 2005.

Verification of the modelling study indicated that the model gave close approximation (within 10%) of NO_2 concentrations in comparison to monitoring data.

Predicted concentrations from the road traffic dispersion modelling studies indicate that it is unlikely that NAQS objectives for PM_{10} will be exceeded in 2004 however annual average PM_{10} concentrations in 2010 are predicted to exceed the 18 $\mu g/m^3$ standard. The exceedence is predicted in the main as a result of the high background concentration (in relation to the objective). The PM_{10} concentration at sensitive receptors or areas of relevant public exposure surrounding the junctions may also therefore exceed the objective. Monitoring of PM_{10} concentrations at each of the road junctions will therefore be required to confirm the conclusions of the modelling study. In addition, further monitoring will be required to determine accurate urban background PM_{10} concentrations.

Assessment of industrial emissions in Motherwell concluded that it was unlikely that there will be any exceedence of NAQS objectives as a result of emissions from the Dalzell Works including for worst case emissions.

Dispersion modelling of SO_2 emissions as a result of domestic combustion sources in Salsburgh indicates that it is unlikely that there will be an exceedence of NAQS objectives. The modelling did however predict an exceedence of the annual mean objective for PM_{10} in 2010 based on the current level of emissions. An upgrade of central heating in the council housing stock in Salsburgh is however scheduled before 2010 therefore there may be an overall reduction in PM_{10} emissions. Assessment of SO_2 and PM_{10} concentrations in Greengairs was based on the conclusions of the assessment of Salsburgh as the worst case of the two villages. Further assessment of PM_{10} concentrations in Greengairs against the 2010 NAQS objective will therefore be required.

Monitoring results for Muirhead demonstrate a decrease in SO_2 concentrations since boiler plant in the area were converted from heavy fuel oil to gas. It is therefore unlikely that there will be an exceedence of NAQS objectives for SO_2 in North Lanarkshire.

It is therefore concluded that the declaration of an Air Quality Management Area (AQMA) is not required in North Lanarkshire at this stage. The potential for exceedence of the annual mean objective for NO_2 in Chapelhall exists and further monitoring data will be required for the junction. The monitoring data will be considered at the Progress Report in 2005 and the potential for exceedence determined. In addition further assessment of PM_{10} concentrations in North Lanarkshire against the 2010 annual mean objective will be required. Initially the further assessment should include monitoring at each of the four road junctions considered in the study to confirm the modelling predictions; however in the longer term consideration should also be given to establishing accurate urban background PM_{10} levels.

6 REFERNCES

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 AND Air Quality (Scotland) Amendment Regulations 2002
Reference 3	North Lanarkshire Council Updating and Screening Assessment, April 2003, BMT Cordah Ltd Report Ref. NLC.003
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	Laboratory Inter-Comparison Study, AQM Consultants, 2003
Reference 6	National Atmospheric Emissions Inventory (NAEI), www.naei.org.uk, 2003
Reference 7	CERC, ADMS-Roads An Air Quality Management System, User Guide Version 2.0, July 2003
Reference 8	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)
Reference 9	Transport STATISTICS Bullettin, Road Traffic Statistics 2002, Department of Transport, HMSO, 2003
Reference 10	CERC, EMIT v2.0 , User Guide, 2003
Reference 11	The National Environment Technology Centre, NETCEN, 2003 http://www.airquality.co.uk/archive/laqm/laqm.php

APPENDIX 1
AIR QUALITY IMPACT ASSESSMENT OF DOMESTIC FUEL BURNING IN SALSBURGH

1 INTRODUCTION

North Lanarkshire Council's U&SA (Reference 3) concluded that there was potential for an exceedence of NAQS objectives for PM_{10} and SO_2 in Salsburgh as a result of domestic burning of solid fuel.

The automatic monitoring station at Kirk o' Shotts has been situated just outwith Salsburgh for two years. No exceedence of NAQS objectives for SO_2 or PM_{10} have been recorded at the monitoring station over the last two years. In order to ascertain pollutant concentration levels within the village a dispersion modelling study was undertaken utilising emissions data calculated from the fuel use housing survey.

The methodology to the modelling study is discussed in Section 1.1, whilst the model input data is presented in Section 1.2. The results of the study are discussed in Section 1.3.

1.1 Modelling Methodology

1.1.1 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) (Reference 4).

1.1.2 Modelled Domain

The modelled domain is presented in Figure 3. The domain encompasses an area of 4 sq. km. A small modelled domain was selected to provide a detailed calculation grid resolution. The calculation grid spacing was 20 m. In addition the model predicted ground level concentrations at the location of the monitoring station at Kirk o' Shotts Primary School to allow verifiation of the modelling predictions.

1.1.3 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.

Salsburgh is situated at a height of approximately 250m above sea level. The modelled domain or output grid of the model is confined to the areas encompassing Salsburgh village and the stretch of the M8 motorway adjacent to the village. There is no significant change in terrain height within the modelled domain.

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 uncertainties such as traffic count data, generalised domestic fuel use data and meteorological parameters.

1.1.4 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. There is a local meteorological station situated just outwith Salsburgh measuring wind speed and direction, however further meteorological parameters are required by the model.

The nearest meteorological stations recording a full suite of meteorological parameters are at Bishopton (Glasgow International Airport), which is approximately 35 km west of Salsburgh and at Gogarbank (Edinburgh International Airport), which is approximately 35 km east of Salsburgh. It was considered that the Bishopton data is more representative of North Lanarkshire therefore the Bishopton data was considered to be the most suitable monitoring station.

The meteorological office therefore supplied data for the model comprising hourly sequential recordings of surface temperature, cloud cover, precipitation and relative humidity from Bishopton and wind speed and direction data from the meteorological station at Salsburgh. 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 4 and 5. 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 with the worst case of the two years used for future prediction modelling.

1.1.5 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.

The highest buildings within Salsburgh are two-storey and the surrounding land uses are predominantly agricultural or woodland. An appropriate surface roughness of 0.5m was therefore used in the study.

1.2 Model Input Data

The emissions data input to the model were calculated based on data obtained in a fuel use survey undertaken for the village. A summary of the fuel use survey is provided in Section 1.2.1 whilst the methodology used to calculate the pollutant emissions is provided in Section 1.2.2.

1.2.1 Fuel Use Survey

A door to door survey of properties within Salsburgh was carried out during February 2004 by Officers from North Lanarkshire Council. Residents were questioned on the type and quantity of each fuel used at the property for heating purposes. The survey period incorporated weekends and weekdays at different times to ensure maximum survey response. In total 520 properties provided responses. The types of fuel used within Salsburgh are shown in Table 14.

Table 14: Fuel types used in residential properties in Salsburgh in 2004

Fuel Type	No. of Properties using Fuel as Primary Fuel source	No. of Properties using Fuel as Secondary Fuel Source
Solid Non-Smokeless Fuel	0	1
Solid Smokeless Fuel (SSF)	230	3
Burning Oil	116	0
Liquid Petroleum Gas (LPG) / Bottled Gas	10	2
Mains Gas	0	0
Electricity	164	1
Total	**520**	**7**

The amount of fuel used by each property varied and responses were provided as annual, monthly or weekly fuel quantity or fuel expenditure.

All responses regarding solid fuel were provided as the number of bags used per week. It is assumed that these are standard 50kg bags used by coal merchants. The figure was factored by 52 to provide the annual solid fuel consumption for each property. This is likely to produce a slightly greater annual consumption than exists because the survey was carried out during the winter months when heating systems are in peak use. This will therefore represent a worst case scenario option in terms of fuel consumption.

Responses regarding oil usage were provided as quantities in litres of fuel or as monthly or annual payments. The typical fuel price, £180 per 1000 litres, provided by residents was used to convert monetary fuel usage to quantity of fuel usage. The fuel usage was factored as required to determine the annual oil consumption of each property.

Any emissions resulting from electrical heating are not emitted from the domestic property but at the point of power generation. Two out of ten properties provided quantities of gas consumed and it is therefore difficult to provide estimates for emissions from all properties using gas or LPG. Burning LPG and bottled gas produce negligible particulate emissions and low sulphur dioxide emissions. Therefore responses regarding electricity, bottled gas and LPG usage are not considered further in this assessment.

34 SSF and 32 oil users responded ‘unknown’ for the quantity of fuel used. A percentage of users was calculated for each category of fuel consumed provided by residents. The unknown responses were therefore allocated to each category according to these percentages to estimate a realistic fuel usage.

A summary of the fuel use data is provided in Table 15.

Table 15: Annual Fuel Consumption by Property in Salsburgh

Fuel Quantity	Non-smokeless Coal	Smokeless Coal	Fuel Quantity (litres)	Fuel Oil
150 kg	1	-	500	2
2600 kg	-	9	1000	3
5200 kg	-	104	1500	16
6500 kg	-	59	2000	37
7800 kg	-	47	2500	30
9100 kg	-	9	3000	8
10400 kg	-	2	3500	10
-	-	-	4000	1
-	-	-	4500	4
-	-	-	5000	3
-	-	-	5500	3
Total Consumption	**150 kg**	**1417000 kg**		**289500 litres**

A total of 1.4 kilo-tonnes of smokeless fuel and 289 m^3 of fuel oil are therefore combusted in Salsburgh on an annual basis.

1.2.2 Emissions Data

Annual emissions of the combustion generated pollutants of concern, namely SO_2 and PM_{10} were calculated based on the data obtained in the fuel use survey. The emissions were calculated using emissions factors obtained from the National Atmospheric Emissions Inventory (NAEI) (Reference 6). The NAEI provides emission factors for pollutants based on a set activity rate, in this case the total mass of fuel combusted. The emissions factors used in the study are presented in Table 16.

Table 16: Pollutant Emission Factors for Domestic Fuel Burning for 2000

Fuel	PM_{10} Emission Factor (Kg PM_{10}/Kg Combusted)	SO_2 Emission Factor (Kg SO_2/Kg Combusted)
Coal	0.0104	0.0154
Solid Smokeless Fuel (SSF)	0.0056	0.016
Burning Oil	0.000014	0.00006

Using the emission factors provided in Table 16, the annual quantity of PM_{10} and SO_2 (in kg) emitted from each surveyed property from both main and backup heating sources was calculated. The emissions from each property were aggregated to provide a total annual emission of each pollutant from the village. The methodology and the total calculated emissions are summarised in Table 17.

The quantity of oil consumed was converted from a volume to a mass quantity using a standard burning oil density of 799 kg/m^3.

Table 17 Total Pollutant Emissions from Salsburgh Village

Fuel Type	Annual Mass Combusted (kg)	Emission Factor (kg/kg fuel)		Total Emissions (kg/annum)	
		PM_{10}	SO_2	PM_{10}	SO_2
Coal	150	0.0104	0.154	2	2
SSF	1,417,450	0.0056	0.016	7938	22679
Burning Oil	231,415	0.000014	0.0006	3	139
		Total Emissions (kg/annum)		**7943**	**22820**
		Total Emissions (g/s)		**0.35**	**0.72**

The total estimated annual emissions of SO_2 and PM_{10} for the Salsburgh arising from domestic fuel burning are therefore nearly 8 tonnes of PM_{10} and nearly 23 tonnes of SO_2.

In order to model the emissions from the domestic housing the emission rate was defined as an annual average emission per second. The emission was modelled as a volume source located at 10m height above ground (the average height of domestic property) with a mixing depth of 3m (allowing for chimney height and plume rise). The volume was calculated for an area encompassing the main part of Salsburgh Village, measured using GIS mapping to be 0.43km^2. This equates to a total volume of 1,290,000 m^3.

The total emissions for the village expressed as a volume emissions are:

- PM_{10} - 2.75 x 10^{-7} g/m^3/s; and
- SO_2 – 2.75 x 10^{-7} g/m^3/s.

1.2.3 Monthly Variation in Emissions

The use of fuel for domestic heating will increase during winter months and decrease during summer months. Modelling an annual average emission will therefore underestimate pollutant concentrations during the winter months and overestimate the pollutant concentrations during the summer months.

To determine more accurately the predicted short term pollutant concentrations for comparison with the objectives, an emission variation file was used to simulate the monthly variations in fuel consumption. The monthly variation figures were provided by the Oil Promotion Federation (Reference. 7). The annual emissions were calculated based on survey data obtained during February. No factoring of the base data is therefore required. The emission rate for each month was therefore multiplied by a factor to reflect the percentage of total annual fuel use in each month. The percentages are shown in Table 18.

Table 18: Monthly Variation in Emissions

Month	Percentage of Annual Total	Factor	Month	Percentage of Annual Total	Factor
January	12 %	1	July	4 %	0.33
February	12 %	1	August	6 %	0.5
March	12 %	1	September	8 %	0.67
April	7 %	0.58	October	8 %	0.67
May	5 %	0.42	November	9 %	0.75
June	4 %	0.33	December	12 %	1

A varying emissions file containing the above monthly factors was therefore applied to the model.

1.2.4 Other Emission Sources

The M8 motorway passes within 50 m of Salsburgh. In order to assess the combined impact of emissions from the motorway and domestic sources the motorway was defined in the model. A summary of the vehicle traffic flow data input to the model is summarised in Table 19. The emissions from the road traffic are calculated by the model based on the DMRB dataset for Motorways 2003. Further information on the road traffic flows along the M8/A8 motorway within North Lanarkshire is provided in the U&SA (Reference 3).

Table 19 M8 Motorway Traffic Flow Data Included in Model

Average Speed (km/hr)		Traffic Flow (veh/hr.)	
Cars/LGVs	HGVs/Buses	Cars/LGVs	HGVs/Buses
90	75	48857	5022

1.2.5 Background Concentrations

In addition to the emissions from domestic fuel burning and the M8 motorway there will be other emission sources within Salsburgh including local road traffic and light industrial sources. Salsburgh, like all areas, will also be subject to transboundary PM_{10} emissions.

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. The assumed background concentrations for each pollutant are summarised in Table 20. In line with technical guidance the annual average background concentration for SO_2 has been doubled to approximate the short-term mean background concentrations. The background PM_{10} concentration has been assumed to remain constant.

Table 20 Assumed Background Concentrations

Pollutant	Year	Annual Average Background Concentration (µg/m^3)	Short-term Background Concentration (µg/m^3)
PM_{10}	2004	16	-
	2010	14	-
SO_2	2005	4	8

1.3 Predicted Pollutant Concentrations

1.3.1 Model Verification

The verification of the modelled emissions has been carried out using the data for 2002 and 2003 from the Kirk O' Shotts monitoring site. The site is located at the east end of the village at the closest point to the M8.

The variation between modelled and monitored results is calculated using the methodology contained within Technical Guidance LAQM.TG(03). Namely:

Variation = 100*(Monitored Concentration–Modelled Concentration)/Monitored Concentration

The variation between the modelled and monitored concentrations for the NAQS objective for each pollutant on each year is presented in Table 21. The monitoring results are treated with caution for 2002 due to the low data capture rate obtained in that year.

Table 21 Model Output Validation

Pollutant	Assessment Criterion	Year	Modelled Concentration (incl. background) ($\mu g/m^3$)	Monitored Concentration ($\mu g/m^3$)	Variation (%)
PM_{10}	Annual mean	2002	23.93	16.59	-44.24
		2003	22.41	24.91	10.04
	90.4^{th} Percentile of 24-hour means	2002	29.89	26.70	-8.37
		2003	30.31	30.44	0.43
SO_2	99.17^{th} Percentile of 24-hour means	2002	11.63	21.76	46.55
		2003	12.28	15.63	21.43
	99.73^{rd} Percentile of 1-hour means	2002	18.69	48.19	61.22
		2003	19.53	36.66	46.73
	99.9^{th} Percentile of 15-min means	2002	21.00	61.53	65.87
		2003	21.21	47.71	55.54

The results therefore indicate that the modelling results display good correlation (within 10%) with the monitoring results for the annual mean PM_{10} and 90.4^{th} percentile of 24-hour mean PM_{10} concentrations for 2003. The modelling results show less correlation with the monitoring results however for percentile SO_2 concentrations. The variation of results for the percentile SO_2 concentrations demonstrate that the modelled concentrations under-estimate by between 20-55% in comparison to the monitored concentrations. This indicates that the modelling study is underestimating the peak SO_2 concentrations. As the emissions of SO_2 are based on fuel consumption on a monthly average basis it is likely that this will underestimate peak emissions. The model will therefore under-predict peak ground level SO_2 concentrations.

As a worst case scenario predicted percentile SO_2 concentrations have been doubled when evaluating predicted concentrations against NAQS objectives for SO_2.

1.3.2 Evaluation of Predicted Concentrations

A summary of the maximum predicted concentrations at locations of public exposure are presented in Table 22. The predicted SO_2 concentrations have been doubled to take account of the model verification conclusions. The predicted PM_{10} concentrations are assessed against the 2004 NAQS objectives with an assessment against 2010 objectives given in brackets. The maximum predicted concentration refers to areas of relevant public exposure i.e. excludes the predicted M8 roadside concentrations.

Table 22 Predicted SO_2 and PM_{10} Concentrations in Salsburgh

Pollutant	Criteria	Year	Concentration (µg/m^3)			NAQS Objective Concentration (µg/m^3)
			Predicted	Background	Total (adjusted for validation)	
PM_{10}	Annual mean	2002	3.18	16	19.18	40 (18 in 2010)
		2003	3.17	16	19.17	
	90.4th Percentile of 24-hour means	2002	10.14	16	26.14	50
		2003	10.14	16	26.14	
SO_2	99.17th Percentile of 24-hour means	2002	6.42	8	14.42	125
		2003	6.37	8	14.37	
	99.73rd Percentile of 1-hour means	2002	13.91	8	21.91	350
		2003	13.85	8	21.85	
	99.9th Percentile of 15-min means	2002	16.95	8	24.95	266
		2003	14.88	8	22.88	

The maximum predicted concentrations therefore indicate that it is unlikely that there will be an exceedence of NAQS for SO_2 within or around Salsburgh in 2004 or 2005. The results do however indicate that whilst it is unlikely that there will be an exceedence of 2004 NAQS objectives for PM_{10} that there is potential for exceedence of the 2010 annual mean objective should current conditions remain the same. Council housing stock in Salsburgh is scheduled for upgrade of central heating systems before 2010.

The predicted ground level pollutant concentrations are presented as contour plots on Figures 6 to 12. The contour plots provide good visualisation of the spatial concentration profile.

The concentration contour plots indicate that the M8 motorway is dominant in terms of the source of PM_{10} emissions. Predicted PM_{10} concentrations at locations adjacent to the M8 motorway are in exceedence of NAQS 2004 objective levels; however they do not extend beyond 50m from the kerbside and are not evident within the village of Salsburgh where there is a risk of public exposure. The modelling results indicate that there is potential for exceedence of the 2010 NAQS annual mean objective of 18 µg/m^3. The risk of exceedence is attributable to the high background concentrations.

The concentrations of SO_2 are influenced by the domestic fuel emissions, however the levels of emission are low and no exceedences of the 15-minute, 1-hour or 24-hour objectives are predicted by the model.

There is little variation in the predicted ground level concentrations between 2002 and 2003 with slightly higher concentrations predicted for 2002 than 2003.

1.4 Conclusions

The results of the modelling study therefore indicate that it is unlikely that there will be an exceedence of SO_2 objectives in either 2004 or 2005. In addition, the results indicate that it is unlikely that there will be an exceedence of 2004 objectives for PM_{10} but that based on existing emission levels there is potential of exceedence of the 2010 annual mean objective.

The modelling study demonstrates that whilst road traffic emissions of PM_{10} from the M8 motorway give rise to higher predicted concentrations the spatial distribution of the high PM_{10} concentrations is restricted to within 10m of the roadside. The PM_{10} emissions attributable to road traffic are significantly dispersed such that PM_{10} concentrations based on road traffic emissions alone at the closest receptor are negligible in comparison to the emissions from domestic combustion sources.

Whilst the assumed background concentration (15 µg/m^3 in 2010) comprises the bulk of the predicted PM_{10} concentrations it is the additional loading of the predicted concentrations as a result of emissions from domestic sources that result in predicted exceedence of the 2010 annual mean objective.

Council housing stock in Salsburgh is scheduled for an upgrade of central heating systems in forthcoming years. The result of the upgrade should be a decrease in PM_{10} emissions from domestic combustion sources thereby reducing PM_{10} concentrations. Further assessment of PM_{10} concentrations in Salsburgh will therefore be required post-upgrade of housing stock.

APPENDIX 2
AIR QUALITY IMPACT ASSESSMENT OF ROAD TRAFFIC EMISSIONS IN CHAPELHALL, MOTHERWELL AND WHIFFLETT

2 INTRODUCTION

North Lanarkshire Council's U&SA (Reference 3) identified the potential for exceedence of NAQS objectives for NO2 at four 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 NO2 concentrations a dispersion modelling study was undertaken on road traffic emissions at each road junction.

A description of the model used is provided in Section 2.1 whilst the data input to the modelled is discussed through Sections 2.2 to 2.7. The results of the modelling study and the model validation procedures are discussed in Section 2.8.

2.1 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) (Reference 4).

2.2 Area Description

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

- the junction of A723 Hamilton Road and A721 West Hamilton Street/Muir Street, Motherwell Cross;
- the junction of A721 Windmillhill Street and B754 Airbles Road, Motherwell Civic Centre;
- the junction of A725 Whifflett St and B753 Calder Street/School Street, Coatbridge; and
- the junction of A73 and B799 Main Street, Chapelhall.

The roundabout junction of the A723 and A721 (Motherwell Cross) is situated within Motherwell Town Centre adjacent to the pedestrian shopping precincts. The A723 is the main road between Motherwell and Hamilton Town Centres and is a two-way road to the south-west of the roundabout. To the north-east of the roundabout the road (Muir Street) becomes one-way in a north-easterly direction with a single bus filter lane in the opposite direction. Multi-storey commercial and residential buildings situated on either side of this stretch of Muir Street mean that it is a street canyon. The A721 is the main road connecting Motherwell and Wishaw. The A721 is a two-way road with cottages situated close to the roadside in the northerly direction. The junction is subject to traffic congestion at peak times.

The roundabout junction at Motherwell Civic Centre is the crossroads for the A721 (Windmillhill Street) connecting Motherwell and Wishaw and the B754 (Airbles Road) which is the main thoroughfare of traffic heading between Wishaw and Hamilton/M74. There are no residential receptors surrounding the roundabout, although there is a hospital situated on Airbles Road. The other buildings surrounding the roundabout include the Council Civic Centre offices, car showrooms and a church. The roundabout is subject to traffic congestion at peak times.

The A725 is the main road into Coatbridge from the A8/M8 and South Lanarkshire/M74. The junction of the A725 (Whifflett Street) and the B753 Calder Street/School Street is controlled by traffic lights. The A725 is dual carriageway in each direction whilst the B753 is single-carriageway. Approximately 200m north of the traffic lights along Whifflett Street is a mini-roundabout. At peak times and other periods there is congestion on Whifflett Street approaching the traffic lights in either direction, northbound on Whifflett Street approaching the mini-roundabout and on Calder Street approaching the traffic lights. There are a number of residential premises surrounding the road junction, including housing on either side of Whifflett Street to the south junction. These houses are set back from the road, approximately 30m from the road centre. To the north of the junction there are a series of commercial premises and tenement flats adjacent to the north bound carriageway of Whifflet St. Along the side of the south-bound carriageway and along Calder Street are a series of multi-storey flats. The flats are situated approximately 40m from the road centre. The Calder Court automatic monitoring station is situated behind the flat closest to the road junction.

Maps detailing each road junction are presented in Figures 14 to 17.

2.3 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 assessed the modelling domain was minimised to obtain maximum the grid resolution. There is no significant change in terrain height within the modelled domain of each location of modelling.

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 uncertainties such as traffic count data, vehicle emissions data and meteorological parameters.

2.4 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. There is a local meteorological station situated just outwith Salsburgh measuring wind speed and direction, however further meteorological parameters are required by the model.

The nearest meteorological station to North Lanarkshire recording a full suite of meteorological parameters is at Bishopton (Glasgow International Airport), which is located approximately 25 km west of Whifflett, 30km west-north-west of Motherwell and 32 km west of Chapelhall.

The meteorological station at Salsburgh as situated to the east of the North Lanarkshire boundary in an exposed position. It was considered that the wind conditions experienced at Bishopton were more applicable to the areas considered. The modelling study therefore utilised the full Bishopton meteorological dataset.

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 from Bishopton and cloud cover data 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 18 and 19. 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 future prediction modelling.

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

2.6 Model Input Data

Road traffic flow data for the roads included in the modelling study were obtained following a series of traffic counts commissioned by the Council at each road junction under consideration.

2.6.1 Traffic Flow Data

The traffic flow on roads within North Lanarkshire were obtained by a combination of automatic and manual turning counts at each of the junctions under consideration. Traffic flows at the Motherwell Cross, Motherwell Civic Centre and Chapelhall junctions were measured by automatic counts whilst the traffic flows at the Whifflett junction were measured by manual counts.

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 over a week. The data obtained can therefore be used to determine the annual average daily traffic flow (AADT) and the diurnal variation in 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 Motherwell Cross traffic loops were laid across each road approaching the junction. 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 was therefore made for traffic closer to the junction based on local knowledge.

A total of four traffic loops were laid on the roads approaching the Motherwell Civic Centre junction. Separate loops were laid on the northbound and southbound carriageways of Airbles Road. In addition traffic loops were placed on the stretches of Windmillhill Street (A723) to the north and south of the roundabout. As with the Motherwell Cross junction the loops had to be laid at a distance from the junction.

Estimations of traffic speeds closer to the junction was made based on local knowledge.

At Chapelhall two traffic loops were laid, one on the A73 south of the junction and one on the Main Street. Traffic flows on the A73 north of the junction were calculated based on the flow data for the flow data for the other approaches. As with the other junctions the traffic loops were laid at distance from the junction due to low traffic speed at the junctions itself. The traffic speeds close to the junction were again estimated based on local knowledge.

The turning counts at each road junction are undertaken manually. The turning counts record the number of vehicles performing each possible turn at a junction or roundabout. The turning counts were taken over a 12-hour period (7 am – 7 pm).

The manual turning counts categorise the vehicle flows into the same five categories as the automatic counts, namely cars, LGVs, HGVs, buses and motorcycles. The AADT flow for each road approaching the junction was obtained by summing the net flow into and out of the each road. Manual turning counts do not measure traffic speed.

A manual count of traffic was undertaken at the Whifflett junction. The count included a total traffic flow on each stretch of road and provided the direction that each vehicle approaching the junction turned. The total flow in each direction on each stretch of road could therefore be calculated.

The locations of the automatic and manual turning counts at each road junction are indicated on Figures 14 to 17.

2.6.2 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 manual turning counts were undertaken over a 12 hour period (7am – 7pm) on a day with representative traffic flows. No local diurnal variation data was available. LAQM.TG(03) (Reference 4) provides a national default factor for expanding 12-hour traffic counts to AADT. The default factor, 1.15 for roads outwith London, is recommended for use in screening assessments only. An average variation was therefore calculated based on the traffic flow data for each of the roads considered in the assessment. The variation between the 12-hour and AADT counts for each road considered is presented in Table 23.

Table 23 Variation in Road Traffic Flow between 12-hour and AADT Counts

Road	Average 12-Hour Traffic Flow (Vehicles)	Annual Average Daily Traffic Flow	Variation Factor
West Hamilton Street, Motherwell	11,268	14,636	1.30
Muir Street, Motherwell	6,547	9,823	1.50
Hamilton Road, Motherwell	12,847	17,540	1.37
Windmillhill St (Nth), Motherwell	8,743	12,514	1.43
Airbles Road, Motherwell	22,113	28,891	1.31
Windmillhill St (Sth), Motherwell	25,704	33,029	1.28
A73 (Sth), Chapellhall	13,234	16,561	1.25
Main Street, Chapelhall	17,643	23,404	1.33
		Average	**1.35**

The average variation factor between 12-hour flow and AADT flow was therefore 1.35. This factor was applied to the measured 12-hour flows on the roads converging on the Whifflett junction to obtain an equivalent AADT flow.

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 AQ objectives.

The diurnal variation of traffic flow is calculated as ratios to the AADT flow and is calculated for weekdays, Saturdays and Sundays. The diurnal flow variation used in the model at each location. The diurnal variations are summarised in Table 24. No diurnal variation pattern data was available for the Whifflett junction. The diurnal pattern for Motherwell Civic Centre was applied to Whifflett as both junctions are similar in their proximity to motorways and in relation to Motherwell and Coatbridge town centres respectively.

Table 24 Diurnal Variation in Traffic Flow

	Motherwell Cross			Motherwell Civic Centre			*Chapelhall*		
Hour	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday	Weekday	Saturday	*Sunday*
0	0.269	0.636	0.710	0.175	0.455	0.446	0.150	0.390	0.321
1	0.104	0.425	0.416	0.094	0.277	0.285	0.083	0.191	0.233
2	0.088	0.237	0.331	0.060	0.181	0.198	0.076	0.127	0.125
3	0.096	0.252	0.263	0.073	0.174	0.223	0.086	0.143	0.143
4	0.116	0.146	0.112	0.097	0.110	0.110	0.103	0.169	0.102
5	0.242	0.186	0.104	0.249	0.174	0.113	0.371	0.238	0.142
6	0.672	0.326	0.187	0.725	0.351	0.239	0.937	0.364	0.218
7	1.581	0.542	0.301	1.613	0.663	0.395	2.079	0.720	0.392
8	1.004	0.914	0.398	1.659	0.983	0.448	2.047	0.821	0.500
9	1.331	1.239	0.677	1.561	1.243	0.810	1.578	0.995	0.620
10	1.373	1.486	1.081	1.511	1.393	1.117	1.339	1.105	0.822
11	1.454	1.724	1.157	1.548	1.620	1.289	1.485	1.434	1.099

12	1.560	1.878	1.676	1.614	1.705	1.521	1.390	1.551	1.417
13	1.668	1.595	1.804	1.602	1.601	1.696	1.590	1.639	1.598
14	1.628	1.655	1.683	1.780	1.811	1.690	1.647	1.514	1.432
15	1.551	1.646	1.648	1.737	1.754	1.617	1.863	1.264	1.310
16	1.684	1.710	1.425	1.349	1.637	1.426	2.240	1.342	1.336
17	1.631	1.332	1.438	1.688	1.480	1.266	2.245	1.425	1.173
18	1.766	1.498	1.363	1.695	1.388	1.231	1.607	1.149	1.038
19	1.489	1.409	1.146	1.418	1.194	0.997	1.099	0.938	0.785
20	1.161	0.997	1.005	1.067	0.948	0.797	0.864	0.732	0.682
21	0.971	0.834	0.702	0.862	0.659	0.644	0.714	0.467	0.495
22	0.711	0.815	0.628	0.636	0.544	0.488	0.506	0.392	0.330
23	0.474	0.703	0.399	0.351	0.491	0.306	0.296	0.340	0.252

2.6.3 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 3 has an inbuilt fleet sub-categories of composition based on the Design Manual for Roads and Bridges (DMRB) 2003 (Reference 8) 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.

2.6.4 Traffic Speed

The speed of traffic is recorded by the automatic counters. The automatic counters were however placed in locations of free flowing traffic, avoiding congested junctions. The average traffic speeds on each road junction were therefore estimated based on a site visit by BMT Cordah and local knowledge of congested roads. In general the study assumed average speeds of 45 kph (30 mph) for traffic leaving the road junctions and reduced speeds of between 15 kph (10 mph) and 30 kph (20 mph) for traffic approaching road junctions. An additional reduction in traffic speed was assumed for roads identified as congested, road on an incline and road with high HGV/bus flows.

The assumed average traffic speeds on each section of road included within the modelling study are summarised in Table 25.

2.6.5 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 determined for potential street canyon. A street canyon is generally defined as a street where the height of the lowest building is higher than the distance between the buildings on either side of the road. BMT Cordah consultants undertook a visit to each site to determine potential canyons. The only potential street canyon identified was on Muir Street at the Motherwell Cross junction.

The road widths and canyon heights included in the study are summarised in Table 25.

Table 25 Road Traffic Flow Data used in Modelling Study

Junction	Road	Cars		HGVs		Canyon Width (m)	Canyon Height (m)
		AADT	Speed (km/hr)	AADT	Speed (km/hr)		
Motherwell Cross	Hamilton Road (A723) E/bound 1	320	30	52	30	-	-
	Hamilton Road (A723) E/bound 2	320	45	52	45	-	-
	Hamilton Road (A723) W/bound 1	315	45	43	45	-	-
	Hamilton Road (A723) W/bound 2	315	40	43	40	-	-
	Muir Street (A721) 1	344	30	65	30	18	14
	Muir Street (A721) 2	344	30	65	30	16	14
	West Hamilton Street (A721) N/bound 1	386	35	48	35	-	-
	West Hamilton Street (A721) N/bound 2	386	40	48	40	-	-
	West Hamilton Street (A721) S/bound 1	150	40	26	40	-	-
	West Hamilton Street (A721) S/bound 2	150	45	26	45	-	-
Motherwell Civic Centre	Airbles Road (B754) E/bound 1	557	30	62	30	-	-
	Airbles Road (B754) E/bound 2	557	45	62	45	-	-
	Airbles Road (B754) W/bound	520	35	64	35	-	-
	Windmillhill St East (A721) S/bound 1	240	30	27	30	-	-
	Windmillhill St East (A721) S/bound 2	240	35	27	35	-	-
	Windmillhill St East (A721) N/bound 1	227	30	28	30	-	-
	Windmillhill St East (A721) N/bound 2	227	35	28	35	-	-
	Windmillhill St West (A721) S/bound 1	612	35	76	35	-	-
	Windmillhill St West (A721) S/bound 2	612	45	76	45	-	-
	Windmillhill St West (A721) N/bound 1	613	45	76	45	-	-
	Windmillhill St West (A721) N/bound 2	613	45	76	45	-	-
Whifflett Cross	Whifflett St (A725) Sth N/bound 1	385	35	48	35	-	-
	Whifflett St (A725) Sth N/bound 2	385	30	48	30	-	-
	Whifflett St (A725) Sth S/bound	402	45	50	45	-	-
	Whifflett St (A725) Nth N/bound	385	35	48	35	-	-
	Whifflett St (A725) Nth S/bound	402	45	50	45	-	-
	Calder St (B011) E/bound	182	45	23	45	-	-
	Calder St (B011) W/bound 1	211	30	26	30	-	-
	Calder St (B011) W/bound 2	140	40	17	40	-	-
	School St (B011) E/bound	140	30	17	30	-	-
	School St (B011) W/bound	123	35	15	35	-	-

Junction	Road	Cars		HGVs		Canyon Width (m)	Canyon Height (m)
		AADT	Speed (km/hr)	AADT	Speed (km/hr)		
Chapelhall	A73 Sth (N/bound) 1	292	30	40	25	-	-
	A73 Sth (N/bound) 2	292	50	40	45	-	-
	A73 Sth (S/bound) 1	289	45	43	40	-	-
	A73 Sth (S/bound) 2	289	50	43	45	-	-
	A73 Nth (N/bound) 1	686	45	94	40	-	-
	A73 Nth (N/bound) 2	686	45	94	40	-	-
	A73 Nth (S/bound) 1	673	45	92	40	-	-
	A73 Nth (S/bound) 2	673	45	92	40	-	-
	Main Street (B799) E/bound 1	439	20	54	20	-	-
	Main Street (B799) E/bound 2	439	30	54	25	-	-
	Main Street (B799) W/bound 1	424	30	58	30	-	-
	Main Street (B799) W/bound 2	424	45	58	45	-	-

2.6.6 Traffic Growth

The dispersions modelling studies undertook predictions for future pollutant concentrations based on future emissions factors and projected future traffic flows. No local data was available for projected traffic growth. Future traffic flows were therefore estimated based on national traffic growth data. National traffic growth data were obtained from the Department of Transport (Reference 9). A summary of the traffic growth factors applied to the 2004 traffic flows are presented in Table 26.

Table 26 Traffic Growth Factors used in Modelling Study

Year	Projected Increase in Car/LGV AADT Flow	Projected Increase in HGV/Bus AADT Flow
2005	3%	2%
2010	21%	11%

The factors were applied to the 2004 AADT flow on each road and the resultant flows input to the model for use in the future prediction modelling assessments.

2.6.7 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) (Reference 4). 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 defined 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.

2.7 Dispersion Modelling Results

The model predicted ground level NO_2 concentrations for the base year, namely 2003 and for 2005 for comparison with the NAQS objectives. Dispersion modelling runs were undertaken using both 2002 and 2003 meteorological data. As is demonstrated in the modelling results modelling with 2003 data gave higher predicted pollutant concentrations. The 2003 meteorological data was therefore used for predicting future pollutant concentrations for comparison with NAQS objectives.

The modelling predictions were verified against local monitoring data where possible. The model verification procedures are discussed in Section 2.7.2 whilst the predicted pollutant concentrations are presented in Section 2.7.3.

2.7.1 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 27. In line with technical guidance the annual average background concentrations have been doubled to approximate the short-term mean background concentrations.

Table 27 Assumed Background Concentrations

Pollutant	Year	Annual Average Background Concentration (µg/m^3)	Short-term Background Concentration (µg/m^3)
PM_{10}	2004	16	32
	2010	15	30
NO_2	2004	18	36
	2005	17	34

2.7.2 Model Verification

Dispersion modelling studies include a number of uncertainties not withstanding 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 (Reference 10).

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

In order to validate the ground level pollutant concentrations predicted by the model comparison was made between the modelled predictions and available NO_2 monitoring data at each location assessed.

No monitoring data is available for Motherwell Cross therefore no validation can be undertaken. Model verification for the Civic Centre and Chapelhall junctions have been undertaken based on a single diffusion tube at each site. A single diffusion tube is insufficient to accurately verify the model at each location, however they provide an indication of model performance. The validation of the Whifflet junction has been undertaken utilising the monitoring data obtained from the automatic monitoring station at Calder Court. The Calder Court monitoring station had a low data capture rate during 2003 therefore the verification of the model is not completely accurate but provides an indication of modelling performance.

The monitoring locations and the respective monitored and modelled concentrations at each site are presented in Table 28. 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) (Reference 4).

Table 28 Monitoring / Modelling Results Comparison

Site	Year	Annual Average Concentration (μg/m^3)				% Difference
		Modelling Only	Background Concentration	Total	Monitoring	
Chapelhall	2002	25.91	18	43.91	41	+7.1%
	2003	28.21	18	46.21	46	+0.4%
Civic Centre	2002	17.53	18	35.53	36	-1.3%
	2003	18.39	18	36.39	40	-9%
Whifflett	2002	3.91	18	21.91	27	-18.9%
	2003	6.62	18	24.62	20	+23.1%

The performance of the model against monitoring data therefore varies between monitoring locations with differences varying from a 23% over-prediction by the model to a 9% under-prediction. Low data capture rates and other potential inaccuracies with the monitoring data mean that the verification of the model should be undertaken with caution. On average however, the model over-predicts NO_2 concentrations in comparison to monitoring data, particularly the diffusion tube monitoring data.

The reasoning for variations between modelled and monitored data may be as a result of the data input to the model or low data capture on monitored data. Any differences were site specific therefore no adjustment has been made to modelled concentrations.

2.7.3 Predicted Modelling Results

The maximum NO_2 and PM_{10} concentrations predicted by the model at each road junction assessed are presented in Tables 29 to 32. 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 close to or exceeding NAQS objectives are highlighted in red. No adjustment of predicted concentrations has been made as a result of the model verification.

The isopleth plots show the pollutant concentration contours for each pollutant providing a pictorial representation of the extent of peak pollutant concentrations with respect to areas of relevant public exposure. Plots are provided for comparison with NAQS objectives in Figures 20 to 43.

Table 29 Predicted Pollutant Concentrations at Motherwell Cross

Pollutant	Criteria	Year	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)
PM_{10}	Annual Mean	2002	1.63	19	20.63
		2003	1.68	19	20.68
		2004	1.54	19	20.54
		2010	0.95	18	18.95
	90.4th Percentile of Hourly Means	2002	2.88	38	40.88
		2003	2.82	38	40.82
		2004	2.59	38	40.59
		2010	1.59	36	37.59
NO_2	Annual Mean	2002	26.41	18	44.41
		2003	27.14	18	45.14
		2005	24.98	17	41.98
	99.79th Percentile of Hourly Means	2002	80.35	36	116.35
		2003	79.28	36	115.28
		2005	76.76	34	110.76

Table 30 Predicted Pollutant Concentrations at Civic Centre, Motherwell

Pollutant	Criteria	Year	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)
PM_{10}	Annual Mean	2002		19	
		2003	2.63	19	21.63
		2004	2.42	19	21.42
		2010	1.50	18	19.50
	90.4th Percentile of Hourly Means	2002		38	
		2003	4.78	38	42.78
		2004	4.20	38	42.20
		2010	2.66	36	38.66
NO_2	Annual Mean	2002		18	
		2003	35.20	18	53.20
		2005	32.97	17	49.97
	99.79th Percentile of Hourly Means	2002		36	
		2003	86.41	36	122.41
		2005	84.28	34	118.28

Table 31 Predicted Pollutant Concentrations at Chapelhall

Pollutant	Criteria	Year	Maximum Predicted Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)
PM_{10}	Annual Mean	2002		19	
		2003	3.97	19	22.97
		2004	3.66	19	22.66
		2010	2.21	18	20.21
	90.4th Percentile of Hourly Means	2002		38	
		2003	7.55	38	45.55
		2004	6.94	38	44.94
		2010	4.15	36	40.15
NO_2	Annual Mean	2002		18	
		2003	41.91	18	59.91
		2005	42.34	17	59.34
	99.79th Percentile of Hourly Means	2002		36	
		2003	158.08	36	194.08
		2005	157.88	34	191.88

Table 32 Predicted Pollutant Concentrations at Whifflett

Pollutant	Criteria	Year	Maximum Predicted Concentration (µg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)
PM_{10}	Annual Mean	2002		19	
		2003	1.67	19	20.67
		2004	0.85	19	19.85
		2010	0.59	18	18.59
	90.4th Percentile of Hourly Means	2002		38	
		2003	2.90	38	40.90
		2004	1.60	38	39.60
		2010	0.99	36	36.99
NO_2	Annual Mean	2002		18	
		2003	25.71	18	43.71
		2005	15.81	17	32.81
	99.79th Percentile of Hourly Means	2002		36	
		2003	79.35	36	115.35
		2005	72.70	34	106.70

The modelling results therefore indicate that there is potential for exceedence of the NO_2 annual mean objective in 2005 at two locations namely Chapelhall and Motherwell Civic Centre. The contour plots however indicate that the maximum concentrations are predicted to occur on the roads themselves.

At the Civic Centre, the closest receptors are at the hospital on Airbles Road and at the residential flats on Windmillhill Street. The locations of the receptors are marked on Figure 31. The contour plots indicate that the annual average NO_2 concentrations at these points will be in the range 30-35 µg/m^3. It is therefore unlikely that there will be an exceedence of the NAQS annual mean objective for NO_2 at areas of relevant public exposure in 2005.

Similarly, at Motherwell Cross the closest receptors to the junction are the cottages located on West Hamilton Street. The contour plots indicate that the annual average NO_2 concentration at the cottages will be below 35 µg/m^3. It is therefore unlikely that there will be an exceedence of the NAQS annual mean objective for NO_2 at areas of relevant public exposure in 2005.

At Chapelhall the maximum concentration is again predicted to occur on the middle of the road. A detailed view of the junction and contour plot is provided in Figure 44. There are relevant residential receptors close to the roadside on each corner of the road junction. The detailed contour plots however indicate that the concentration will have fallen below 40 µg/m^3 at the nearest receptors. Whilst the modelling study was undertaken using a detailed calculation grid which predicts pollutant concentrations to less than 1m distances the margin or error contained within the model means that it cannot be concluded that the annual average NO_2 concentration at the closest sensitive receptors will be below 40 µg/m^3. There is therefore potential for an exceedence of the annual mean objective for NO_2 in Chapelhall in 2005. In addition, the predicted 99.79th percentile of hourly mean concentrations in 2005, at over 190 µg/m^3, is close to exceeding the NAQS standard of 200 µg/m^3.

The maximum predicted annual average NO_2 concentrations at Whifflett and Motherwell Cross are below 40 µg/m^3. No exceedence of the annual mean standard for NO_2 is therefore predicted at locations of relevant public exposure in 2005.

No exceedences of the hourly mean NO_2 standard were predicted for any of the other road junctions.

Maximum PM_{10} concentrations in 2004 are predicted to be below both annual mean and 24-hour mean NAQS objectives. It is however predicted that maximum annual average PM_{10} concentrations will exceed the annual mean objective in 2010. This potential exceedence is in the main attributable to the high background PM_{10} concentration (in relation to the objective).

2.8 Conclusions

Dispersion modelling of road traffic emissions predicted annual average NO_2 concentrations exceeding the annual mean objective of 40 µg/m^3 at three junctions in 2005. The three junctions were Civic Centre, Motherwell Cross and Chapelhall. The maximum concentrations for each road junction were predicted to occur at the road centre. Closer inspection of the contour plots for each junction indicated that the annual average NO_2 concentration at the closest sensitive receptors to the Civic Centre and Motherwell Cross junctions were below the NAQS objectives. As such no exceedence of the NO_2 annual mean objective is predicted.

At Chapelhall the predicted annual mean NO_2 concentration at the closest sensitive receptor in 2005 was also below 40 µg/m^3, however predicted concentrations close to the nearest receptors (within 1-2 m) were predicted to be higher than 40 µg/m^3. The accuracy of the model is insufficient to determine exact concentrations to small margins of distance therefore it was concluded that there is potential for an exceedence of the annual mean NO_2 objective in Chapelhall in 2005. In addition, the 99.79th percentile of hourly mean NO_2 concentrations in 2005 was predicted to be close to exceeding the 200µg/m^3 standard.

No exceedence of the annual mean or hourly mean objectives for NO_2 in 2005 were predicted for any of the other road junctions.

Predicted PM_{10} concentrations at each of the road junctions were below NAQS objectives in 2004. The maximum predicted annual mean PM_{10} concentrations in 2010 were predicted to be above the 2010 objective of 18 µg/m^3. Further assessment of PM_{10} concentrations at each of the junctions will be required in forthcoming years.

Figures