BMT Cordah Limited
ENVIRONMENTAL CONSULTANCY
AND INFORMATION SYSTEMS

LAQM Detailed Assessment Addendum

A Report for East Dunbartonshire Council

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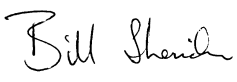

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1 INTRODUCTION

East Dunbartonshire Council conducted a Detailed Assessment for road traffic emissions of PM_{10} and NO_2 in 2004 (Reference 1). The Detailed Assessment included a dispersion modelling assessment of road traffic emissions and reported updated monitoring results for both NO_2 and PM_{10}. It was concluded that the 2004 objectives for PM_{10} would be met; however modelling results indicated that there was a possibility that both the 2010 National Air Quality Strategy (NAQS) objectives for PM_{10} and the 2005 annual mean NAQS objective for NO_2 may be breached. Automatic monitoring data for NO_2 and PM_{10} was only available for six months and NO_2 diffusion tube data did not indicate an exceedence. It was therefore concluded that the decision to declare an air quality management area for PM_{10} would be taken upon completion of one year's automatic monitoring, and that the NO_2 diffusion tube monitoring results would be reconsidered upon completion of one full year's co-location study at Bishopbriggs Cross.

The co-location study and one full year of automatic NO_2 and PM_{10} monitoring were completed in December 2004.

This report is an addendum to the 2004 Detailed Assessment. The report presents an evaluation of updated PM_{10} and NO_2 monitoring results and revised model verifications, to assess the necessity of an AQMA.

2 PM_{10} ASSESSEMENT

The Detailed Assessment used both monitoring data and modelled traffic emissions to assess the requirement for an AQMA for PM_{10}. Revised monitoring data has been used in this assessment to verify the modelled results and determine the necessity for an AQMA.

2.1 PM_{10} Monitoring Results

East Dunbartonshire Council monitors PM_{10} at a roadside site at Bishopbriggs Cross using a beta-attenuation monitor. The monitor is located on Crowhill Road approximately 20m to the south east of the centre of the junction at Bishopbriggs Cross. The analyser has been continually operational since December 2003. A summary of the monitoring data obtained are presented in Table 1. The monitoring data has been factored by 1.3 in line with LAQM.TG(03) (Reference 2) guidance to compare with gravimetric techniques on which the PM_{10} objectives are based.

Table 1: 2004 PM_{10} monitoring results

Annual mean ($\mu g/m^3$)	Maximum 24-hour mean ($\mu g/m^3$)	98th percentile of 24-hour means	No. of exceedences of 50 $\mu g/m^3$	Data capture rate (%)
23.4	74.4	54.9	9	99.2

The overall data capture rate for the year is greater than 90% therefore the results meet criteria for use in Detailed Assessments and declarations of AQMAs.

The measured annual mean and number of 24-hour mean exceedences of 50$\mu g/m^3$ comply with the 2004 NAQS objectives for 2004. However, the annual mean exceeds the 2010 annual mean PM_{10} NAQS objective of 18$\mu g/m^3$ and the number of 24-hour mean exceedences of 50$\mu g/m^3$ exceeds the seven exceedences permitted in the 2010 24-hour mean NAQS objective.

Future PM_{10} concentrations are expected to decline as a result of increased efficiency and emission reduction techniques on motor vehicles. The annual mean concentration has therefore been projected forward to 2010 using the techniques contained within LAQM.TG(03). The method used for the projection is summarised in Equation 1.

Equation 1

Monitored concentration 2004 (gravimetric)	= 23.4 $\mu g/m^3$	
Secondary Concentration 2001 (from maps)	= 3.77 $\mu g/m^3$	
Coarse PM_{10} fraction (from LAQM.TG(03))	= 10.5 $\mu g/m^3$	
Secondary Concentration 2004	= 3.77 $\mu g/m^3$ x 0.932	= 3.51 $\mu g/m^3$
Secondary Concentration 2010	= 3.77 $\mu g/m^3$ x 0.795	= 3.00 $\mu g/m^3$
Primary Concentration 2004	= 23.4 – 3.51 – 10.5	= 9.39 $\mu g/m^3$
Primary Concentration 2010	= 9.39 x (0.815/0.930)	= 8.23 $\mu g/m^3$
Total PM_{10} Concentration 2010	= 8.23 + 3.00 + 10.5	= **21.7 $\mu g/m^3$**

The projected PM_{10} concentration in 2010 therefore exceeds the 2010 annual mean NAQS objective of 18 µg/m^3.

Nine exceedences of the 24-hour mean objective of 50 µg/m^3 were recorded in 2004. Seven exceedences of the 24-hour mean objective are permitted by NAQS objectives in 2010. The number of exceedences of the 24-hour mean objective cannot be directly projected forward to future years, however LAQM.TG(03) provides an estimation of the number of 24-hour mean exceedences based on the annual mean concentration. The estimation is provided in Equation 2.

Equation 2

Predicted Total PM_{10} Concentration 2010	= 21.7
No of exceedences of the 24-Hour objective in 2010	= -18.5 + 0.00145 * $(21.7)^3$ + (206 / 21.7)
	= 5.8
	= **6**

From the predicted annual mean PM_{10} concentration for 2010 it is estimated that there will be 6 exceedences of the 24 hour mean objective of 50µg/m^3 in 2010. This is below the permitted seven exceedences. However, the number of predicted exceedences is close to the permitted number of exceedences and short term pollutant concentrations are highly dependent upon meteorological conditions. It is therefore concluded that there is the potential for an exceedence of the 24 hour mean PM_{10} objective for 2010 at Bishopbriggs Cross.

2.2 Model Verification

The revised monitoring data has been used to verify the concentrations predicted by the model used in the Detailed Assessment within the Bishopbriggs area.

Table 2: PM_{10} monitoring / modelling comparison for 2004 at Bishopbriggs Cross

NAQS Objective	Modelling Only	Background Concentration	Total	Monitoring Concentration	% Difference
Annual Mean Concentration (µg/m^3)	1.0	18.9	19.9	23.4	-17.6

The verification presented in Table 2 indicates that the model is under-predicting the annual mean concentration recorded at the automatic monitor at Bishopbriggs. The modelled concentration compared well with the monitored value, with an under-prediction of 18%. No correction factor has been applied to model results due to the fact that one comparable datum from which to derive a correction factor or bias is available and it is possible that the bias is site-specific or time-specific. Due to the model under-predicting the annual mean, it is possible that the model has under-predicted the extent of the areas of exceedence.

The revised verification does not alter the conclusions drawn from the modelling assessment in the Detailed Assessment with regards to the areas of predicted exceedence of the 2010 NAQS objectives for PM_{10}. If a bias factor is applied to the modelled results for the Bishopbriggs area then the extent of the predicted exceedence will expand.

The maximum predicted traffic contribution within the Bishopbriggs area is 3µg/m^3, indicating that the background PM_{10} concentration contributes significantly to the predicted exceedences.

2.3 PM_{10} Summary

The 2004 PM_{10} monitoring data at Bishopbriggs Cross indicates that concentrations of PM_{10} will exceed the annual mean NAQS objective for 2010.

The model predicted exceedences of the annual mean PM_{10} NAQS objective for 2010 at all three junctions assessed.

There is no monitoring data to verify model predictions of NAQS exceedences within Kirkintilloch and Bearsden. Therefore based on modelled predictions and monitoring data it is recommended that East Dunbartonshire Council declares an AQMA encompassing the predicted area of exceedence at Bishopbriggs Cross.

It is also recommended that monitoring of PM_{10} be carried out at Bearsden Cross and the Industry St / Lenzie Rd / Townhead junction in Kirkintilloch to verify exceedences predicted by the model.

3 NO_2 ASSESSMENT

The Detailed Assessment used both monitoring data and modelled traffic emissions to assess the requirement for an AQMA for NO_2. Revised monitoring data has been used in this assessment to verify the modelled results and determine the necessity for an AQMA.

3.1 NO_2 Monitoring

East Dunbartonshire Council monitored NO_2 at eighteen locations during 2004 using twenty diffusion tube sites (three as part of the triplicate co-location study) and one automatic NO_2 analyser at Bishopbriggs Cross.

3.1.1 QA/QC Procedures

The laboratory analysis of the passive diffusion tubes was undertaken by Glasgow Scientific Services (GSS). GSS prepares the diffusion tubes using the technique of 20% triethanolamine (TEA) in water. The laboratory undertakes the analysis of diffusion tubes for several local authorities including Glasgow City Council and North Lanarkshire Council, which undertake annual co-location studies of diffusion tubes with automatic monitoring stations for the purposes of validation. The Detailed Assessment utilised cross-comparison data obtained from Glasgow City Council to obtain a bias correction factor for the diffusion tubes. In 2004 however, East Dunbartonshire Council conducted a co-location study at Bishopbriggs Cross. The results from the triplicate co-location study indicate that the diffusion tubes are under-predicting the NO_2 concentration compared with the automatic analyser. Results from other neighbouring local authority co-location studies carried out using the GSS laboratory reported different bias correction factors. All available co-location factors for 2004 from neighbouring local authorities using GSS are provided in Table 3.

Table 3: Laboratory bias correction factors for Glasgow Scientific Services 2004

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 100* (Dm – Cm)/Cm (%)
East Dunbartonshire Council co-location study	33.3	35.5	1.07	-6.1
North Lanarkshire Council co-location study	29	23	0.81	23.3
Glasgow City Council City Centre co-location study	43.4	32.0	0.74	35.6
Glasgow City Council Chambers St co-location study	38.4	49.9	1.30	-22.9
Glasgow City Council Kerbside co-location study	90.8	68.0	0.75	33.5
GSS Mean for 2004			**0.93**	**12.7**

Due to the large variation in bias adjustment factors from neighbouring local authorities, and the fact that historically diffusion tubes from GSS have over-predicted rather than under-predicted the automatic analyser results, the five available factors have been averaged to

derive a mean bias adjustment factor for 2004. The mean bias adjustment factor has been applied to the diffusion tube results for East Dunbartonshire Council.

The annual mean NO_2 concentrations recorded during 2004 are presented in Table 4. Conversion factors provided in the LAQM.TG (03) technical guidance have been applied to the corrected 2004 annual mean concentrations to predict the annual mean NO_2 concentration at each site for 2005 and enable comparison with the 2005 NAQS objective. Sites where there is a predicted exceedence have been heavily shaded; sites with NO_2 concentrations close to the NAQS objective for 2005 (within 10%) have been lightly shaded.

Locations of the monitoring sites are provided in Table 4 and Figures 2 to 4 the Detailed Assessment.

Table 4: Annual mean NO_2 concentrations for East Dunbartonshire Council

Site	2004 Annual Mean (µg/m^3)	2004 Annual Mean corrected for bias (µg/m^3)	2005 predicted annual mean (µg/m^3)
Bishopbriggs 5	19	18	17
Bishopbriggs 6	42	39	38
Bishopbriggs 8	18	17	16
Bishopbriggs 12	38	35	34
Bishopbriggs 13	45	42	41
Bishopbriggs 14A	34	32	31
Bishopbriggs 14B	32	30	29
Bishopbriggs 14C	32	30	29
Bearsden 1	32	30	29
Bearsden 3	21	20	19
Bearsden 4	13	12	12
Bearsden 7	40	37	36
Bearsden 8	40	37	36
Bearsden 9	32	30	29
Bearsden 10	34	32	31
Bearsden 13	36	34	33
Bearsden 14	37	34	34
Bearsden 15	36	34	33
Kirkintilloch 15	34	32	31

Four exceedences of the 2005 annual mean NAQS objective NO_2 were recorded during 2004. However correcting for diffusion tube bias leaves one exceedence at Bishopbriggs 13. The results in Table 4 indicate that it is likely that the NO_2 annual mean NAQS objective for 2005 will be exceeded at one location in 2005, namely Bishopbriggs 13 located at the junction between Kirkintilloch Rd (A803) and Colston Rd (B812). Monitoring results for Bishopbriggs 6, Bearsden 7 and Bearsden 8 indicate that annual mean NO_2 concentrations for 2005 will be close to the NAQS objective for 2005.

3.2 Model Verification

The revised monitoring data has been used to verify the concentrations predicted by the model used in the Detailed Assessment within the East Dunbartonshire Council area. The verification is presented in Table 5.

Table 5: NO_2 monitoring / modelling annual mean results comparison for 2004

Site	Annual Average Concentration (µg/m³)				% Difference
	Modelling Only	Background Concentration	Total	Monitoring	
Monitoring Sites at Bishopbriggs					
Bishopbriggs 6	24.0	19.8	43.8	39.1	+10.7
Bishopbriggs 12	11.5	19.8	31.3	35.3	-12.8
Bishopbriggs 13	13.2	19.8	33.0	41.9	-27.0
Bishopbriggs A	13.1	19.8	32.9	35.5	-7.9
Monitoring Sites at Bearsden & Milngavie					
Bearsden 1	16.1	19.8	35.9	29.8	+17.0
Bearsden 7	11.4	19.8	31.2	37.2	-19.2
Bearsden 8	15.8	19.8	35.6	37.2	+4.5
Bearsden 9	17.3	19.8	37.1	29.8	+19.7
Bearsden 10	15.5	19.8	35.3	31.6	+10.5
Bearsden 13	24.0	19.8	43.0	33.5	+22.1
Bearsden 14	22.0	19.8	41.8	34.4	+17.7
Bearsden 15	13.9	19.8	33.7	33.5	-0.6
Monitoring Sites at Kirkintilloch					
Kirkintilloch 15	14.9	19.8	34.7	31.6	+8.9

The performance of the model against monitoring data varies between monitoring locations with differences varying from a 22% over-prediction by the model to a 27% under-prediction. There is no obvious pattern indicating which locations are over-predicted and which are under predicted. The NO_2 concentrations at four diffusion tubes along Maryhill Road, Canniesburn Toll and the Switchback Road are all over-predicted by the model. However, as other sites included within the same model scenario are under-estimated no correction factor is applied to results. The revised verification does not alter the conclusions drawn from the modelling assessment in the Detailed Assessment with regards to the areas of predicted exceedence of the 2005 NAQS objectives for NO_2.

3.3 NO_2 Summary

Revised monitoring data indicated one site of exceedence at the junction of Colston Road and Kirkintilloch Road in Bishopbriggs.

The model predicted exceedences of the annual mean NO_2 NAQS objective for 2005 at all three junctions assessed. The exceedences predicted by the model at Kirkintilloch and Bearsden Cross have not been confirmed by the diffusion tube monitoring data for 2004.

However, monitored values at Bearsden Cross are close to the NAQS objective value for 2005 and therefore it is recommended that greater attention is placed upon future monitored results at the site. It is also recommended that an automatic NO_2 analyser be considered for Bearsden Cross.

The predicted areas of exceedence of the 2005 annual mean NAQS objective for NO_2 at which there was relevant public exposure are along Kirkintilloch Road at Bishopbriggs Cross, and at the junction of Colston Road and Kirkintilloch Road. The NO_2 diffusion tube results for Bishopbriggs indicate an exceedence at the junction of Kirkintilloch Road and Colston Road and an NO_2 concentration close to exceedence at Bishopbriggs Cross. It is therefore recommended that based on both modelling and monitoring data East

Dunbartonshire Council declares an AQMA(s) for NO_2 encompassing the predicted areas of exceedence at Bishopbriggs Cross and the junction of Kirkintilloch Road and Colston Road.

4 CONCLUSIONS AND RECOMMENDATIONS

Based on monitoring data and the modelling study it is concluded that there is a requirement for an AQMA for NO_2 and PM_{10} at Bishopbriggs Cross and the requirement for an AQMA for NO_2 at the junction of Kirkintilloch Road and Colston Road.

The areas predicted to exceed PM_{10} and NO_2 NAQS objectives are shown in Figure 1.

It is recommended that monitoring of PM_{10} be considered at Bearsden Cross and the Industry St / Townhead / Lenzie Rd junction in Kirkintilloch to verify predictions of NAQS exceedences by the model.

Based on the modelling study and NO_2 diffusion tube results for 2004 it is recommended that greater attention is given to NO_2 concentrations at Bearden Cross and an automatic NO_2 analyser be considered for the junction between Drymen Road, Thorn Road and Roman Road.

5 REFERENCES

Reference 1	LAQM Detailed Assessment 2004 for East Dunbartonshire Council, BMT Cordah report Ref. EDC.001, April 2004
Reference 2	Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance, LAQM.TG(03), DEFRA, January 2003