

APPENDIX C3 – Model Verification

Model Verification

- C3.1 The ADMS Roads and AERMOD Prime models have been used to predict pollutant concentrations arising from road traffic and Airport sources respectively. This section describes how the model results have been treated, and the process of model verification and adjustment that has been applied. The process of verification is based on a comparison of predicted concentrations with those measured.

Model Verification – Nitrogen Dioxide

- C3.2 The approach to the model verification for nitrogen dioxide has been to firstly verify the road traffic model, and then to verify the combined model performance, after adding together adjusted road-NO₂, Airport-NO₂ and background-NO₂.

Road-Traffic Sources (ADMS Model)

- C3.3 In order to verify the ADMS Roads model, pollutant concentrations have been predicted at a number of roadside monitoring sites operated by the London Borough of Newham (LBN), as well as those within the LCY network. These LBN monitoring sites lie outside of the study area for which the Traffic Impact Assessment was prepared by SBA. The road network included in the dispersion model has thus been extended to include those roads adjacent to the LBN monitoring sites. Traffic data were taken from the Department for Transport's website (www.dft-matrix.net). These traffic count data refer to the year 2005. Flows in 2006 were derived following the approach set out on Defra's Review and Assessment helpdesk website (www.uwe.ac.uk/laqm/review). This involves weighting the DfT National Road Traffic Forecasts (www.dft.gov.uk) with a local factor derived from the Tempro programme (www.tempro.org.uk). The flows and speeds for these roads are set out in Table C2.2.

Table C3.1: Additional Traffic Data used in the Dispersion Model ^a

Road	Light Duty Vehicles (AADT in 2006)	Heavy Duty Vehicles (AADT in 2006)
Barking Rd a	21586	1921
Barking Rd b	24736	1521
Broadway a	30377	2968
Broadway b	22194	2430
Cam Rd	37926	2435
Carpenter's Rd a	9471	801
Carpenter's Rd b	9471	801
Great Eastern Rd a	24895	1925
Great Eastern Rd b	22510	1602
High St N	17293	825
High St S	18392	1539
Rabbit's Rd	8880	253
Romford Rd a	19522	1095
Romford Rd b	25905	1614
Romford Rd c	17505	1151
Station Rd	6915	734
The Grove	28069	1870
West Ham Lane	18438	1952

a: Data taken from DfT counts carried out during 2005 and adjusted to 2006 by multiplying by 1.02

C3.4 The ADMS model has been used to predict concentrations of road NO_x. The nearest roadside NO_x monitor is operated by the LBN at Cam Road. The model has been run to predict annual mean concentrations of NO_x during 2006 at this automatic monitoring site.

C3.5 Since the Cam Road station measures total NO_x, it is necessary to subtract the other sources of NO_x to give an estimated measured road-NO_x concentration. Since Cam Road is some distance from the Airport, it is reasonable to assume that any contribution of Airport-NO_x over and above that already included as background-NO_x will negligible. Thus, road-NO_x is derived by subtracting background-NO_x from total-NO_x (Equation C3.1).

$$\text{Equation C3.1} \quad \text{road-NO}_x = \text{total-NO}_x - \text{background NO}_x$$

C3.6 Calculated in this way, the measured annual mean road-NO_x concentration for 2006 at Cam Road was 44.2 µg/m³. The modelled road-NO_x for the same period is 21.4 µg/m³. This indicates that the model is under-predicting road NO_x by a factor of 2.07. **All raw modelled road-NO_x concentrations have thus been multiplied by 2.07.**

C3.7 Following this adjustment, the predicted road-NO_x concentrations have been used to calculate road-NO₂ concentrations following the approach provided by Defra, and described in Equation C3.2.

$$\text{Equation C3.2} \quad \text{road-NO}_2 = ((-0.0413 \times \text{Ln}(\text{total-NO}_x)) + 0.5225) \times \text{road-NO}_x$$

Where total-NO_x = total non-road-NO_x + road-NO_x, and Ln is log to the base e, and total non-road-NO_x is background-NO_x plus Airport-NO_x as defined below.

Combined Model Performance

C3.8 The AERMOD Prime model, used to calculate Airport NO_x contributions, has not been verified directly, as there is no straightforward way to do this. Instead, the overall modelling approach has been verified using total NO₂ concentrations, derived by combining the adjusted road-NO₂ with the non-road NO₂, the latter being derived from the combined Airport-NO_x and background-NO_x.

C3.9 Background NO_x concentrations have been derived from the national maps published by Defra (www.airquality.co.uk). Total non-road-NO_x is thus the sum of Airport-NO_x and background-NO_x.

C3.10 The total non-road-NO₂ concentrations have been calculated directly from the total non-road-NO_x following the methodology used in preparing the national maps published by Defra (www.airquality.co.uk) (for inner London) (equation C3.3).

$$\text{Equation C3.3} \quad \text{NO}_2 = (0.128 \times \text{NO}_x + A) \times f(\text{NO}_x)$$

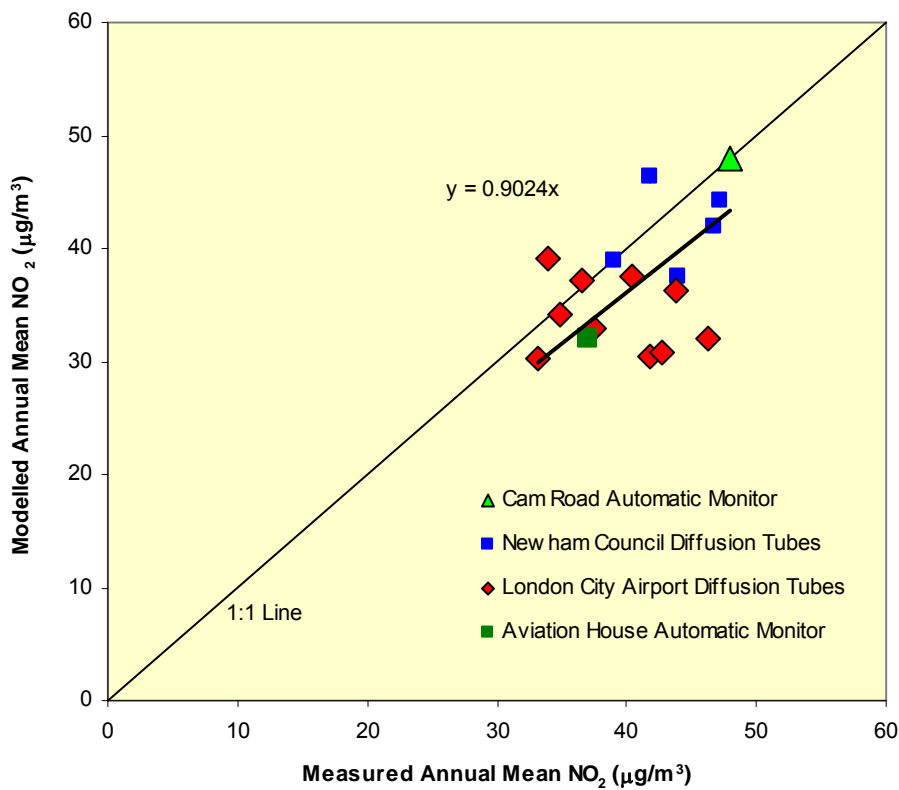
Where NO_x is taken as the sum of background-NO_x and Airport-NO_x; A is 35.4 in 2006 and 35.8 in 2010; and f(NO_x) is given in equation A3.4.

$$\text{Equation C3.4} \quad f(\text{NO}_x) = (1.015 \times 10^{-1}) + (1.367 \times 10^{-2} [\text{NO}_x]) + (6.127 \times 10^{-5} [\text{NO}_x]^2) + (4.464 \times 10^{-8} [\text{NO}_x]^3)$$

C3.11 NO₂ concentrations have been measured at ten diffusion tube sites near to London City Airport as well as at the automatic monitor on City Aviation House. NO₂ concentrations have also been measured by LBN at five diffusion tube sites near to the roads listed in Table C3.1, as well as at the Cam Road automatic monitor. In order to assess the performance of the model, predictions of annual mean NO₂ concentrations for 2006 have been carried out for each of these sites. Figure C3.1

shows how the predictions compare with the measurements at each site. The bold line and the equation show the results of a least-squares regression on the data, forced through zero. The combined model predicts concentrations within the range of the measurements, but overall, there is a tendency for concentrations to be under-predicted. A small adjustment has therefore been applied. **All total predicted NO₂ concentrations have been multiplied by 1.11 (i.e. 1/0.9024).**

Figure C3.1: Measured vs Modelled Annual Mean (2006) Nitrogen Dioxide Concentrations Prior to Final Adjustment



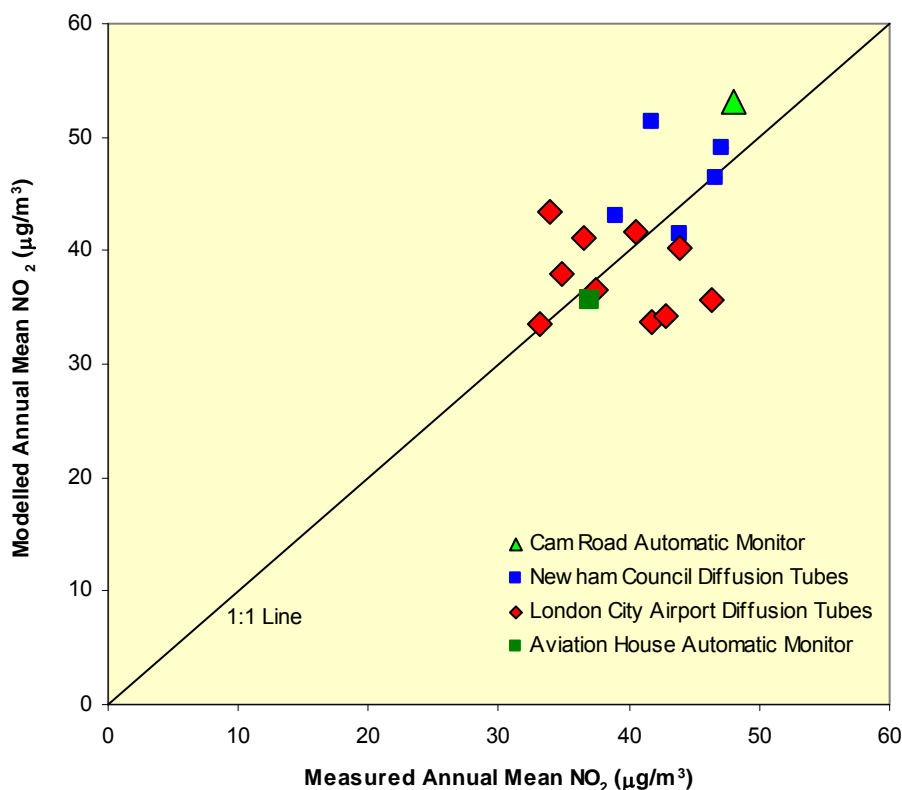
C3.12 Figure C3.2 compares the predicted and measured concentrations following the adjustment described above. The model performs well with no systematic bias, and the predicted concentrations are well within the expected bound of uncertainty. A more detailed description of the results is provided in Table C3.2 below.

Table C3.2 Comparison of Modelled versus Measured Annual Mean (2006) Nitrogen Dioxide Concentrations. The predicted NO_x contributions from Roads, Airport and Background are also shown.

Site Name	Site Type	Road NO _x (ug/m ³)	Airport NO _x (ug/m ³)	Background NO _x (ug/m ³)	Modelled Annual Mean NO ₂ (ug/m ³) - 2006	Measured Annual Mean NO ₂ (ug/m ³) -2006	Difference (+/-%)
Cam Road	Continuous	44.2	-	55.3	53.2	48.0	+11% ^a
Fire Station Romford	Diffusion Tube	15.0	-	52.9	41.5	43.9	-6%
Salisbury School Romford	Diffusion Tube	36.0	-	47.4	46.4	46.7	-1%
Town Hall Annex Barking	Diffusion Tube	32.0	-	55.7	49.1	47.1	+4%
Courtyard West Ham T	Diffusion Tube	38.7	-	55.5	51.3	41.8	+23%
Mortuary High St South	Diffusion Tube	15.7	-	55.7	43.1	39.0	+11%
LCA 01	Diffusion Tube	10.5	7.4	48.4	41.1	36.5	+13%
LCA 02	Diffusion Tube	18.8	3.8	50.1	43.3	34.0	+28%
LCA 03	Diffusion Tube	8.0	1.0	50.1	37.9	34.8	+9%
LCA 04	Diffusion Tube	3.4	1.7	48.4	35.6	46.3	-23%
LCA 05	Diffusion Tube	7.2	0.7	48.4	36.6	37.5	-2%
LCA 06	Diffusion Tube	24.0	0.4	46.2	41.7	40.4	+3%
LCA 07	Diffusion Tube	2.5	0.9	46.2	33.7	41.8	-19%
LCA 08	Diffusion Tube	2.1	1.0	46.2	33.6	33.2	1%
LCA 09	Continuous	3.1	1.9	48.4	35.6	36.9	-4%
LCA 10	Diffusion Tube	12.9	2.1	50.1	40.3	43.8	-8%
LCA 11	Diffusion Tube	4.1	0.7	46.2	34.2	42.8	-20%

^a The Cam Road monitoring station was used to derive an adjustment factor for the ADMS-Roads model. It cannot be strictly used to indicate performance of the verified model, but the data are included for completeness.

Figure C3.2: Measured vs Modelled Annual Mean (2006) Nitrogen Dioxide Concentrations After Final Adjustment



Model Verification – PM₁₀

C3.13 The same approach to model verification was adopted for PM₁₀ as for NO₂. However, monitoring data indicated that initial consideration needed to be given to background concentrations, as the mapped background PM₁₀ concentrations published by Defra tend to under-predict levels in this study area, when compared with local monitoring results. This is shown in Table C3.3, which compares measurements at two background PM₁₀ sites with concurrent mapped values. To allow for this, the background PM₁₀ concentrations for the study area in 2006 have been assumed to be the average of the two measured values. Background PM₁₀ concentrations in 2010 were then derived from the 2006 value using the forward projection factors published by Defra.

Table A3.3: Comparison of Measured and Estimated Background PM₁₀ Concentrations

Location	Measurement (µg/m³)	Mapped Estimate (µg/m³)
LBN Canning Town	27.7	24.7
Aviation House a	31.4	23.5
Average	29.6	

a Annualised data following the approach described in Table A2.1

Road Traffic ADMS model

A3.15 The only roadside monitor that measures PM₁₀ concentrations in this area is the LBN site at Cam Road. Using the approach described above, measured road-PM₁₀ concentrations were derived by subtracting the background concentration from the total measured concentration. Measured annual mean road-PM₁₀ at Cam Road was thereby calculated to be 5.1 µg/m³. Modelled road-PM₁₀ for this location was 0.69 µg/m³, indicating that the model was under-predicting by a factor of 7.5. **All predicted road-PM₁₀ concentrations have thus been multiplied by 7.5.**

Combined Model Performance

C3.16 Total PM₁₀ concentrations were derived by summing the adjusted road-PM₁₀ with the Airport PM₁₀ derived from the AERMOD model, and the background-PM₁₀. Figure C3.3 shows how the adjusted model predictions of annual mean PM₁₀ for 2006 compare with the measured concentrations for 2006. This shows that the approach to the modelling is providing results that agree well with the monitoring data.

Figure C3.3: Measured vs Modelled Annual Mean (2006) PM₁₀ Concentrations

