Appendix 5-A: ADMS-Roads Model Conditions

Environmental Statement Volume II
Access to Witney

Oxfordshire County Council

March 2022

Delivering a better world

Appendix 5-A: Model Set Up

General inputs

1.1 The parameters were used within ADMS-Roads (Ref 5.1.1) are described in Table 1. The latest version (5.0.0.1) was used in the assessment.

Table 1: General ADMS-Roads model conditions

Variables	ADMS-Roads model inputs
Emissions	NOx, PM_{10}
Emission factors	IAN 185-13 Speed Band Emission Factors v3.1
Surface Roughness at source	0.5m
Minimum Monin-Obukhov length for stable conditions	30m
Meteorological data	Hourly sequential data from Brize Norton for 2018
Receptors	Selected receptors only
Model Output	Road contributions to long term annual mean NO_X and PM_{10} concentrations

1.2 A latitude of 52 degrees was inputted in the site data properties. This determines times of sunrise and sunset for each day throughout the year, which in turn affects stability calculations.

1.3 A surface roughness coefficient of 0.5m (representative of parkland and open suburbia) was applied across the study area. The surface roughness is important in the approximation of turbulent conditions within the atmospheric boundary layer and thus in the estimation of pollutant concentrations at receptors.

1.4 Minimum Monin-Obukhov length (to reasonably limit the occurrence of very stable atmospheric conditions) was defined as 30m the dispersion site (representative of cities and large towns). This parameter limits the occurrence of very stable boundary layer conditions (i.e. when the air is still) to a degree that is appropriate to the general land-use. In general, the potential for very stable conditions is lowest in large urban areas where the 'heat island' effect promoting turbulent motion in the boundary layer is strongest.

Emission rates

1.5 The emission rates used in the local air quality modelling were derived from *DMRB LA 105* guidance (Ref 5.1.2). In accordance with *DMRB LA 105* the competent experts for traffic applied the following procedure:

- Analysis of the performance of modelled traffic speeds on individual road links compared against observed speeds on the same road links;
- Assignment of individual road links into a speed-banding category by road type; and
- Manual adjustment, where required, of assigned speed band where changes in speed did not justify a change in speed band or where a speed band change was considered to not reflect a valid proposed development impact.

1.6 Hourly emission rates were then calculated using the annual average daily traffic (AADT) flow, % heavy duty vehicles (HDV), speed band and road type using the "IAN 185-13 Speed Band Emission Factors v3.1" spreadsheet tool based on the Emissions Factors Toolkit v 8.1.

Meteorological data

1.7 One year (2018) of hourly sequential observation data from Brize Norton meteorological station has been used in the dispersion modelling. The site is located approximately 7.7km east of the proposed development and is considered representative of the meteorological conditions in the area. Plate 1 shows that the dominant direction of wind is from the south and south-

west, as is typical for the UK. The wind speed ranges from 0-16 knots (0 - ~8.2 m/s). There are 8516 lines of usable data (97%) in 2018, which means the site is suitable for use.

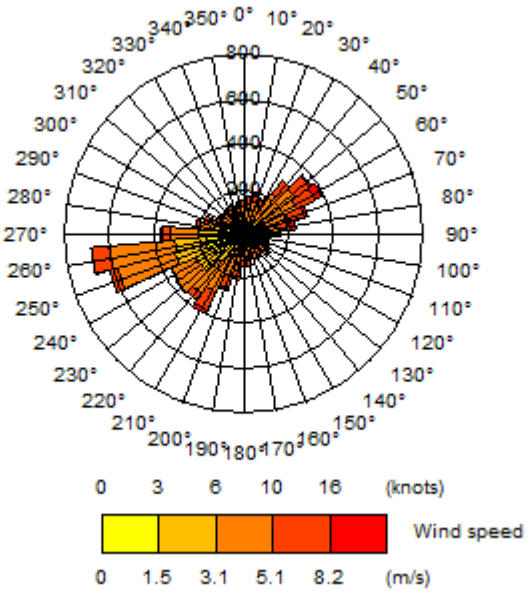

Plate 1: Wind Rose, Brize Norton

Model post processing

General protocol

1.8 The following post-processing procedures have been applied to the modelled road-contributed pollutant concentrations at receptors:

- Conversion of road-contributed NO_X to total NO_2 concentrations (with the addition of background concentrations);
- Application of adjustment factors derived from model verification to bring modelled concentrations into line with monitored concentrations; and
- Application of Highways England LTT_{E6} projection factors in line with *DMRB LA105* to the modelled DM and DS NO_2 concentrations to account for the observed gap between projected vehicle emission reductions and the estimated annual rate of improvement in annual mean NO_2.

1.9 In this study, modelled road contributed NO_X concentrations have been converted to total NO_2 concentrations using Defra's 'NO_X to NO_2' calculator (V8) (Ref 5.1.3). The year and local authority area for which the modelling has been undertaken are specified, along with the appropriate Defra background NO_2 concentrations at each receptor. The calculation then applies an appropriate factor of NO_X emitted as NO_2.

Background concentrations

1.10 To obtain predictions for total pollutant concentrations at receptors, the model outputs of road contributions of NO_X and PM_{10} must be combined with background concentrations. Background concentrations are those from many sources which individually may not be significant, but collectively, over a large area, need to be considered.

1.11 Annual average background concentrations were derived for the baseline year of 2018 and opening year of 2024 from Defra's 2018 referenced 1x1 km background maps (Ref 5.1.4) and adjusted using Defra's Sector Removal tool (Ref 5.1.5), removing emissions from motorways, trunk roads and A roads to avoid double counting, as these roads will be directly modelled.

1.12 In accordance with LAQM.TG(16), as modelled national background maps are used in the assessment, these were first compared to local background monitoring to check they were representative of the area. There were some areas where background monitored concentrations were higher than the concentrations from the background maps, but this was not consistent across the study area. Therefore, no adjustments to the backgrounds were made.

1.13 The 'total concentrations' modelled in the national background maps also include local sources which are not considered to represent background values. Therefore, before adjustment, sector removal of emissions from motorways, trunk roads and A roads was undertaken. This was to ensure the modelled national background maps were being compared with local background monitoring data on a like-for-like basis.

1.14 As the baseline year for this assessment is 2018, the Defra 2018 background concentrations of NO_2 and PM_{10} were compared to monitored background concentration in 2018 at the diffusion tube locations.

1.15 The adjusted 'total concentrations' modelled national background maps were then used as inputs to follow on calculations in the assessment process for all scenarios.

Verification

1.16 Model verification was undertaken using monitoring sites within the air quality study area, from a combination of site specific surveys conducted by AECOM and local authority monitoring data.

1.17 From these sites, only those on the affected road network (ARN) and those representative of modelled sensitive receptor locations with sufficient data capture were considered suitable for the purposes of model verification.

1.18 Following detailed analysis of each monitoring location in the study area, a total of 13 monitoring sites were taken forward in the model verification process.

1.19 Table 2 details the sites removed from the verification process and reasons for exclusion, whilst Table 3 details the sites used in verification.

Table 2: Monitoring sites excluded from Model Verification

Site ID	Local Authority	Grid reference (X, Y)	Reason for exclusion from Verification
NAS4	WODC	435665, 210200	Not located on ARN.
NAS8	WODC	439304, 210260	No data in baseline year of 2018 – tube location reviewed and not identified
NAS9	WODC	440082, 210435	No data in baseline year of 2018 –tube concentrations reviewed and appear low to other tubes in the area
NAS15	WODC	444199, 217343	Background site
NAS40	WODC	442753, 209913	No data in baseline year of 2018 and set back from A40, so anticipate low concentration from the road
NAS41	WODC	443658, 210015	No data in baseline year of 2018 and set back from A40, so anticipate low concentration from the road
DT5	AECOM	445070, 210383	Not on ARN
DT6	AECOM	44925, 210336	Not on ARN
AW2	AECOM	436609, 209927	Not on ARN
AW6	AECOM	437679, 209054	Not on ARN, background site

Table 3: Monitoring sites used in Model Verification

Site ID	Site Location	Grid reference (X, Y)	Local Authority
NAS1	25 Bridge Street, Witney	435857, 210306	WODC
NAS2	10 Bridge Street, Witney	435815, 210235	WODC
NAS3	20 Bridge Street, Witney	435843 ,210274	WODC

Site ID	Site Location	Grid reference (X, Y)	Local Authority
NAS5	4A West End, Witney	435909, 210371	WODC
NAS6	Woodgreen Hill, Witney	435940, 210351	WODC
NAS7	Newland, Witney	435946, 210326	WODC
DT1	A40, East of Barnard Gate	440826, 210392	WODC*
DT2	Cuckoo Lane	442390, 210018	WODC*
DT3	Hanborough Close, Eynsham	443311, 20997	WODC*
AW1	Shores Green	437534, 209534	WODC*
AW3	83 Jubilee Way	436834, 209967	WODC*
AW4	A40 Westbound Layby	436367, 208719	WODC*
AW5	A40 Eastbound Layby	436994, 209043	WODC*

*AECOM tube within local authority

1.20 Following Defra's Technical Guidance LAQM.TG(16), model performance was analysed at these 13 monitoring sites. It was found that five sites had modelled NO_2 concentrations within +/- 25% of the monitored road, and the root mean square error (RMSE), an assessment of the uncertainty in modelled estimates, was higher than the ideal limit (10% of the relevant air quality criterion). Therefore, adjustment factors were calculated to bring modelled concentrations into line with the monitored.

1.21 Due to differing model performance in different areas, the verification and adjustment process was applied to two separate domains. The first deals with the majority of the road network, (zone A) and the second (zone B) deals with Witney Bridge Street only which has been set up as a street canyon due to the narrow street and continuous row of buildings close to the road.

1.22 Model adjustment factors were applied to modelled road NO_X contributions within both model domains as are summarised below in Table 4.

1.23 At three of the sites, modelled NO_2 concentrations were within 10% of the corresponding monitored concentrations post-adjustment; at the remaining sites the concentrations were within 25%. LAQM.TG(16) indicates that an RMSE within 10% of the AQO (4 µg/m^3) is ideal. The model performed better in zone A following adjustment. The performance of the model is considered to be robust.

Table 4: Verification Details

Model domain	No. Sites	Number of Monitoring Sites within ±10% of the Monitored Concentration Pre-Adjustment	RMSE pre-adjust-ment (µg/m^3)	Model Adjust-ment Factor	Number of Sites within ±10% of the Monitored Concen-tration Post Adjustment	RMSE post adjustment (µg/m^3)	Fractional Bias post adjustment)
A	10	0	11.6	2.03	2	4.6	0.00
B	3	1	10.4	1.18	1	5.7	0.00

1.24 Details of modelled NO_2 before and after adjustment at each monitoring site are provided in Table 5 and the relationship between modelled and monitored total NO_2 after adjustment is shown below (Plate 2 and 3).

Table 5: Monitoring Data used in Model Verification

Site	Monitored total NO_2 (µg/m^3)	Monitored Road NO_X (µg/m^3)	Modelled Road NO_X Before Adjustment (µg/m^3)	Modelled Total NO_2 Before Adjustment (µg/m^3)	Modelled Total NO_2 After Adjustment (µg/m^3)
NAS2	**40.5**	65.0	39.4	24.0	32.5

Site	Monitored total NO_2 ($\mu g/m^3$)	Monitored Road NO_X ($\mu g/m^3$)	Modelled Road NO_X Before Adjustment ($\mu g/m^3$)	Modelled Total NO_2 Before Adjustment ($\mu g/m^3$)	Modelled Total NO_2 After Adjustment ($\mu g/m^3$)
NAS3	**41.8**	68.1	68.1	40.3	**47.3**
NAS1	**48.2**	83.9	83.9	41.2	**47.0**
NAS5	35.5	53.4	20.1	19.4	29.8
NAS6	34.4	50.9	33.3	25.9	**41.6**
NAS7	34.5	51.1	18.1	18.4	27.9
DT1	29.3	41.5	24.1	20.8	32.7
DT2	19.4	20.7	13.6	15.7	22.9
DT3	14.4	8.5	7.0	13.6	17.5
AW1	20.6	22.4	12.4	15.1	21.7
AW3	18.6	17.3	4.7	11.9	14.2
AW5	43.9	40.8	25.9	20.2	32.1
AW4	30.3	71.8	23.1	21.5	35.2

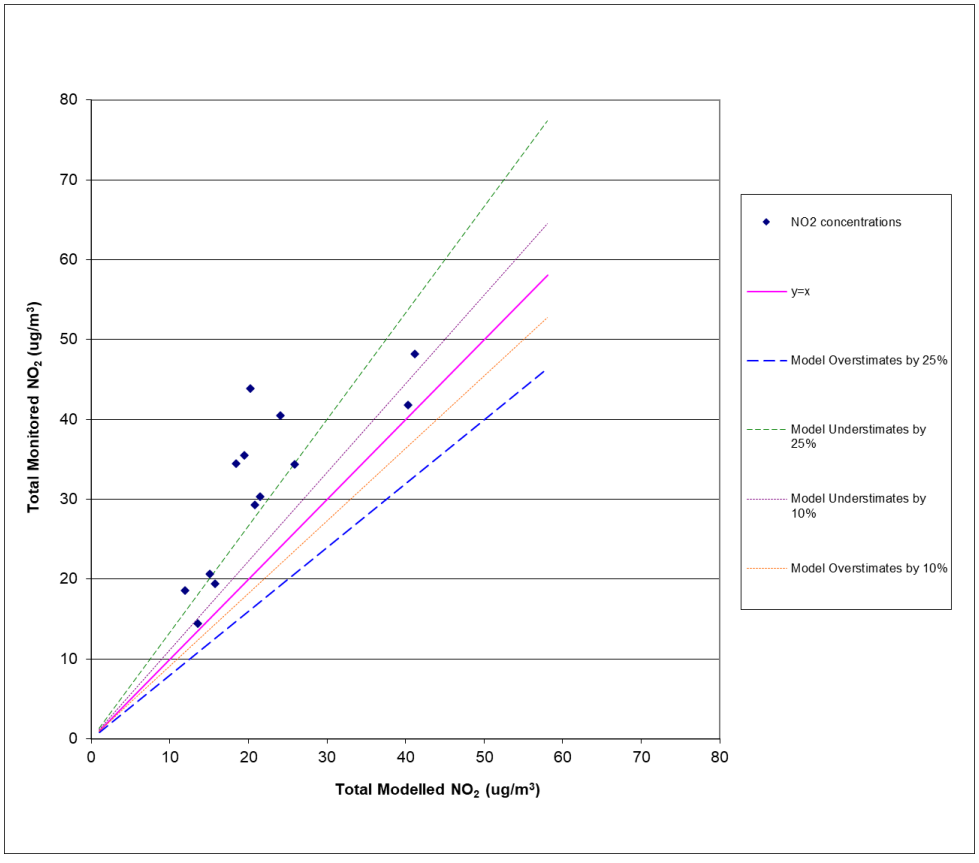

Plate 2: Modelled vs Monitored NO_2 concentration before adjustment

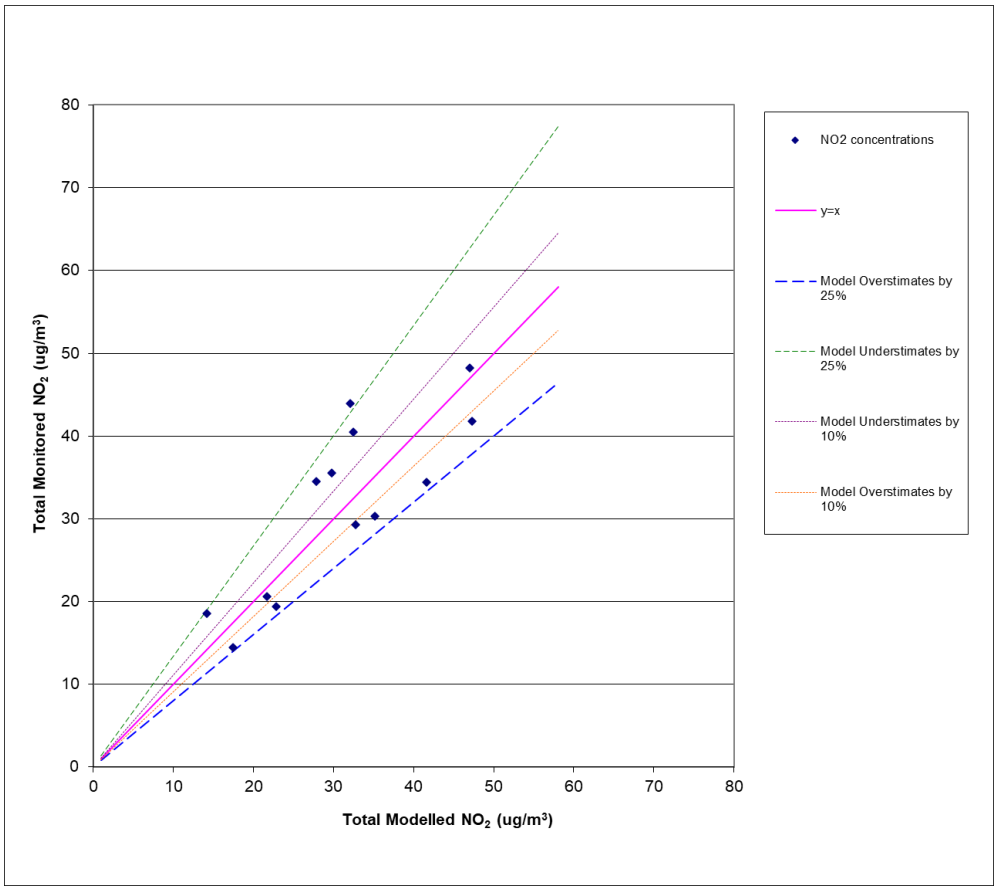

Plate 3: Modelled vs Monitored NO_2 concentration after adjustment

References

Ref 5.1.1 Cambridge Environmental Research Consultants Ltd, ADMS-Roads version 5.0;

Ref 5.1.2 Highways England, DMRB, Sustainability & Environment Appraisal, LA 105: Air quality, 2019;

Ref 5.1.3 Department for Environment, Food and Rural Affairs NO_X to NO_2 Calculator https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc;

Ref 5.1.4 Department for Environment, Food and Rural Affairs. 2018-based background maps for NO_X, NO_2, PM_{10} and $PM_{2.5}$. https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018;

Ref 5.1.5 Department for Environment, Food and Rural Affairs. NO_2 Adjustment for NO_X Sector Removal Tool v8.0 https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector;

Ref 5.1.6 Department for Environment, Food and Rural Affairs. National Bias Adjustment Factors March 2021. National bias adjustment factors. Bias adjustment factors. Local Air Quality Management Support - Defra, UK;

Ref 5.1.7 Department for Environment, Food and Rural Affairs. Local Air Quality Management Technical Guidance (TG16).

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