Appendix 8.3: Methodology for Operational Phase Assessment

Air Dispersion Modelling Inputs

8.4.1 The air dispersion model ADMS-Roads (CERC, Version 5.0) has been used to assess the potential air quality impacts associated with development-generated road traffic emissions. This dispersion model is widely used and accepted for the purpose of undertaking assessments to support both planning and Environmental Permit applications.

Traffic Flow Data

8.4.2 The ADMS-Roads model requires the input of detailed road traffic flow data for those routes which may be affected by the proposed development. Traffic flow data has been obtained for this project by RPS, the appointed transport consultants for the project. The study extent of the model is shown in Figure 8.1.

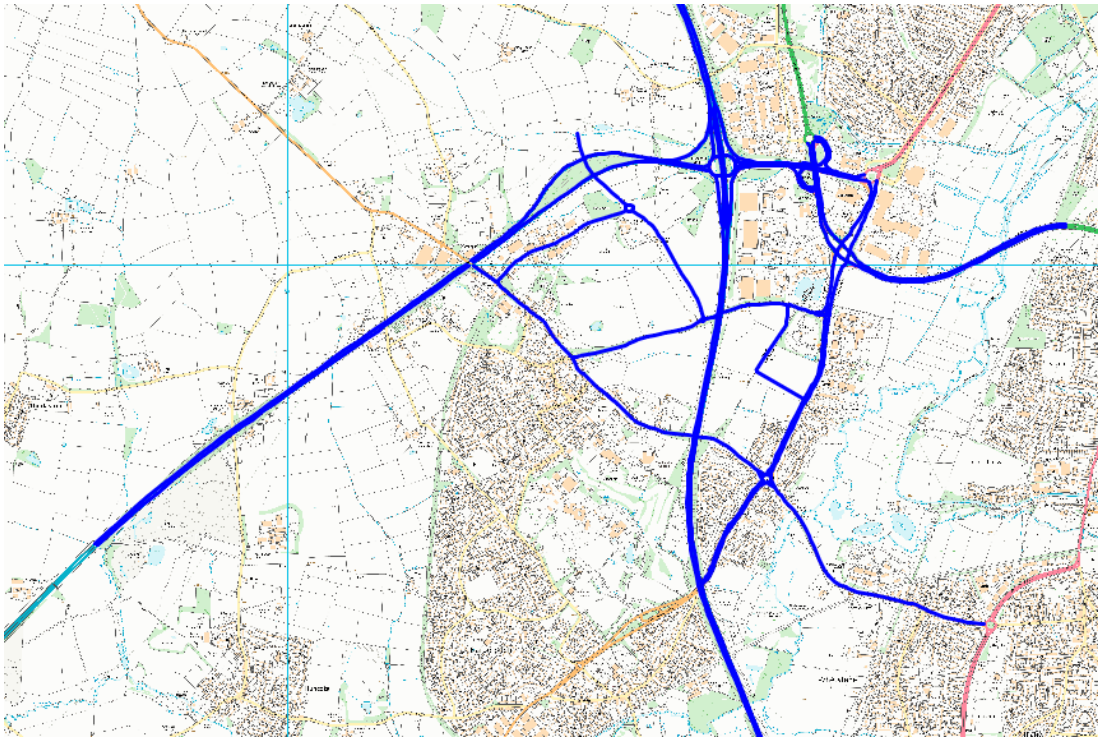


Figure 8.1: Study Extent of Air Dispersion Model. The roads modelled in the assessment can be seen in blue (‘*Reproduced from Ordnance Survey Maps © Crown Copyright All Rights Reserved Licence No. 0100031673’)*

8.4.3 Data has been provided as 24-hour Annual Average Daily Traffic (AADT) flows, with HGV percentages. No average speed information was available and therefore speed limits have been used, with a reduction to 25kph in locations where congestion or the slowing down of vehicles would be expected. Drive-thru vehicles have been modelled at 5kph, the lowest speed available within ADMS.

8.4.4 The traffic flow data used in the assessment is included in Table 8.10.

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
B582 Blaby Road EB, West of B4114 St Johns	5121	354	5328	389	5328	389	5792	467	5792	467	5470	389	5792	467
B582 Blaby Road WB, West of B4114 St Johns	7433	325	7641	373	7641	373	7857	427	7857	427	7798	381	7857	427
B582 Enderby Road EB, East of B4114 St Johns	11988	658	12045	667	12045	667	12045	667	12045	667	12186	667	12186	667
B582 Enderby Road WB, East of B4114 St Johns	10408	484	10483	502	10483	502	10483	502	10483	502	10640	510	10640	510
B4114 Leicester Road SB, South of Roundabout	13888	702	14417	791	14540	811	15711	1008	16066	1067	14681	812	16206	1068
B4114 Leicester Road NB, South of Roundabout	18657	846	19398	969	19398	969	20613	1174	20954	1231	19564	969	21119	1232

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
B114 St Johns SB, South of Police Station	20494	732	21022	822	21022	822	22316	1039	22316	1039	21305	821	22598	1040
B114 St Johns NB, South of Police Station	19305	713	19935	819	19935	819	21261	1041	21261	1041	20068	819	21392	1042
B114 SB, North of Police Station	29277	1093	31116	1401	31116	1401	30790	1346	30790	1346	31398	1400	31065	1352
B114 NB, North of Police Station	28303	1069	29074	1199	29074	1199	28813	1154	28813	1154	29315	1199	29048	1160
A563 Solar Valley Way EB, East of Roundabout	23320	1114	24140	1252	24140	1252	25075	1409	25075	1409	24231	1260	25166	1418
A563 Solar Valley Way WB, East of Roundabout	25266	1135	27178	1455	27178	1455	28105	1612	28105	1612	27287	1461	28340	1492
B114 Narborough Road SB, North of Roundabout	18890	773	19780	923	19780	923	20814	1095	20814	1095	19947	922	20978	1097
B114 Narborough Road NB, North of Roundabout	14239	383	14343	401	14343	401	14357	403	14357	403	14485	400	14499	402

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
A563 Lubbersthorpe Way EB, West of Roundabout	27391	1252	28626	1459	28626	1459	27392	1823	27392	1823	28626	1459	27392	1823
A563 Lubbersthorpe Way WB, West of Roundabout	30107	1498	32152	1842	32152	1842	33516	2071	33516	2071	32152	1842	33516	2071
A563 Lubbersthorpe Way SB, South and North of Slip Roads	3433	175	4736	395	4721	410	5363	500	5363	500	4922	568	5549	673
A563 Lubbersthorpe Way NB, South and North of Slip Roads	31468	1698	33577	2052	33577	2052	35241	2333	35241	2333	33719	2271	35385	2549
A563 Slip Road off A540 onto A563 Lubbersthorpe Way	3433	175	3433	175	3433	175	3433	175	3433	175	3433	175	3433	175

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
A563 Slip Road onto A5460 onto A563 Lubbersthorpe Way	24593	1914	25372	2045	25372	2045	25729	2104	25606	2227	25374	2212	25895	2106
A563 Slip Road on A5460 off roundabout	5050	80	5359	132	5359	132	6370	301	6370	301	5359	132	6370	301
A563 Slip Road off A5460 on roundabout	19303	1594	19608	1647	19608	1647	20053	1720	20053	1720	19608	1782	20186	1722
A5460 EB, West of Narborough Road roudabout	23907	1077	23908	1437	24217	1128	25229	1297	25229	1297	24217	1128	25229	1297
A5460 WB, West of Narborough Road roudabout	16568	766	16568	766	16568	766	16568	766	16568	766	16568	766	16568	766
A5460 EB, East of M1 roundabout	38160	2592	38463	2643	38463	2643	38910	2718	38910	2718	38462	2780	38911	2852
A5460 WB, East of M1 roundabout	39105	2395	39762	2502	39762	2502	40244	2582	40244	2582	39760	2673	40242	2752

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
M1 SB, South of roundabout	34447	8828	34383	8801	34383	8801	34492	8818	34492	8818	34383	8872	34492	8889
M1 NB, South of roundabout	33447	7897	33277	7851	33277	7851	33389	7873	33389	7873	33321	7918	33390	7929
M1 SB, North of roundabout	58008	10885	57845	10855	57845	10855	58081	10891	58081	10891	57845	10912	58081	10948
M1 NB, North of roundabout	57635	13432	57606	13407	57606	13407	57827	13441	57827	13441	57606	13478	57827	13512
M69 EB, West of roundabout	28822	2585	28913	2600	28913	2600	29058	2623	29058	2623	28914	2620	29059	2644
M69 WB, West of roundabout	34036	2712	34279	2751	34279	2751	34431	2780	34431	2780	34278	2779	34433	2804
Leicester Lane EB, West of B4114	5406	282	6063	392	6063	392	7611	599	7611	599	6448	398	7995	606
Leicester Lane WB, West of B4114	4449	267	5124	381	5124	381	6680	588	6680	588	5400	386	6955	593
Leciester Lane EB, West of Smith Way	6772	145	7493	266	7493	266	9025	523	9025	523	7659	266	9403	523
Leciester Lane WB, West of Smith Way	5584	364	6330	489	6330	489	7898	752	7898	752	6472	489	8104	752
Leicester Lane EB, East of B582	7663	164	7988	229	7775	186	8010	234	7961	213	7830	186	8016	213

Table 8.10: 24-hour AADT traffic data used in the assessment														
Link Name	**Scenario 1: 2019 Verification and Base Year**		**Scenario 2: 2024 Opening Year, Without Development**		**Scenario 3: 2024 Opening Year, With Development**		**Scenario 4: 2029 Future Year, Without Development**		**Scenario 5: 2029 Future Year, With Development**		**Scenario 6: 2024 Opening Year, With Development + Logistics Hub**		**Scenario 7: 2029 Future Year, With Development + Logistics Hub**	
	LGV	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**
Leicester Lane WB, East of B582	5191	38	5465	93	5254	51	5520	104	5474	85	5301	51	5521	85
B582 SB, North of Leicester Lane	6962	515	7415	551	4024	320	7250	563	4066	328	4024	320	4066	328
B582 NB, North of Leicester Lane	9195	707	9594	775	5458	234	9456	779	5517	244	5458	234	5517	244
B582 SB, North of Warren Parkway	6516	391	6969	427	3578	196	6804	439	3620	204	3578	196	3620	204
B582 NB, North of Warren Parkway	6632	297	7031	365	2895	156	6893	369	2954	166	2895	156	2954	166
Warren Park Way EB	192	130	192	130	4083	369	192	130	3889	336	4083	369	3889	336
Warren Park Way WB	1595	217	1595	217	4715	612	1595	217	4739	380	4741	586	4739	380
B582 SB, South of Leicester Lane	4244	290	4697	326	1306	95	4532	338	1948	103	1306	95	4532	338
B582 NB, South of Leicester Lane	5102	223	5501	301	1365	156	5363	305	1424	166	1365	156	5363	305
New Link SB, South of Roundabout junction			503	84	3154	529	2541	426	6523	681	3154	529	6744	681

Table 8.10: 24-hour AADT traffic data used in the assessment

Link Name	Scenario 1: 2019 Verification and Base Year		Scenario 2: 2024 Opening Year, Without Development		Scenario 3: 2024 Opening Year, With Development		Scenario 4: 2029 Future Year, Without Development		Scenario 5: 2029 Future Year, With Development		Scenario 6: 2024 Opening Year, With Development + Logistics Hub		Scenario 7: 2029 Future Year, With Development + Logistics Hub	
	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV	LGV	HGV
New Link NB, South of Roundabout junction			550	92	3179	533	2645	444	5958	644	3179	533	6147	644
New Link SB, North of Roundabout junction			92	15	92	15	3151	529	3190	535	92	15	3213	539
New Link NB, North of Roundabout junction			100	17	100	17	3087	518	3087	518	100	17	3087	518
Enderby Bypass EB, West of Roundabout junction					3891	239			3697	206	3891	239	3697	206
Enderby Bypass WB, West of Roundabout junction					3314	201			3136	171	3314	201	3136	171

Table 8.10: 24-hour AADT traffic data used in the assessment														
Link Name	**Scenario 1: 2019 Verification and Base Year**		**Scenario 2: 2024 Opening Year, Without Development**		**Scenario 3: 2024 Opening Year, With Development**		**Scenario 4: 2029 Future Year, Without Development**		**Scenario 5: 2029 Future Year, With Development**		**Scenario 6: 2024 Opening Year, With Development + Logistics Hub**		**Scenario 7: 2029 Future Year, With Development + Logistics Hub**	
	LGV	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**	**LGV**	**HGV**
A5460 Southbound Slip to M1	6662	630	6787	651	6787	651	6895	669	6895	669	6787	722	6895	740
M1 Northbound approach Rd to Rdbt	6644	686	6693	702	6693	702	6769	707	6769	707	6710	752	6769	764
M1 Southbound Slip	19544	1148	19701	1175	19701	1175	19960	1189	19960	1189	19757	1236	19961	1245
M1 Northbound Slip	17364	1173	17652	1221	17665	1208	17871	1257	17871	1257	17652	1292	17870	1329
M69 Northbound Slip	17312	1858	17312	1858	17312	1858	17312	1858	17312	1858	17312	1858	17312	1858
Site Access onto Leicester Lane											1503	400	1503	400
Site Access onto St Johns											444	0	444	0

Vehicle Emission Factors

8.4.5 The air quality assessment has used vehicle emission factors calculated using the Emissions Factor Toolkit (EFT) version 10.1, released in August 2020. This is the most up-to-date version of the EFT currently available.

8.4.6 As discussed in the section 8.5 of the report, there are uncertainties involved with the prediction of future NO_2 concentrations. However, a recent study provides evidence that EFT v9.0 may be relied upon to predict the 'most likely' future emissions reductions as long as model verification has been undertaken using monitored data from 2016 or later[13]. The IAQM has yet to comment on this study.

8.4.7 A sensitivity analysis has also been undertaken in which base year background pollutant concentrations and vehicle emission factors have been applied to opening/future year scenarios.

8.4.8 It is considered that the results of the sensitivity test provide a conservative upper-bound to the assessment. The results are included later in Appendix 8.4.

Meteorological Data

8.4.9 The meteorological data used in the air quality modelling has been obtained from ADM Limited and is from the East Midlands recording station, covering the period between 1st January and 31st December 2019. This has complete data capture for wind and temperature.

8.4.10 The East Midlands recording station is located approximately 29km from the proposed development and is considered to be the most representative of the conditions at the proposed development, due to its relative location and similar altitude.

8.4.11 The 2019 wind rose for the East Midlands Meteorological Recording Station is shown in Figure 8.2.

[13] Air Quality Consultants, Performance of Defra's Emission Factor Toolkit 2013 – 2019, February 2020

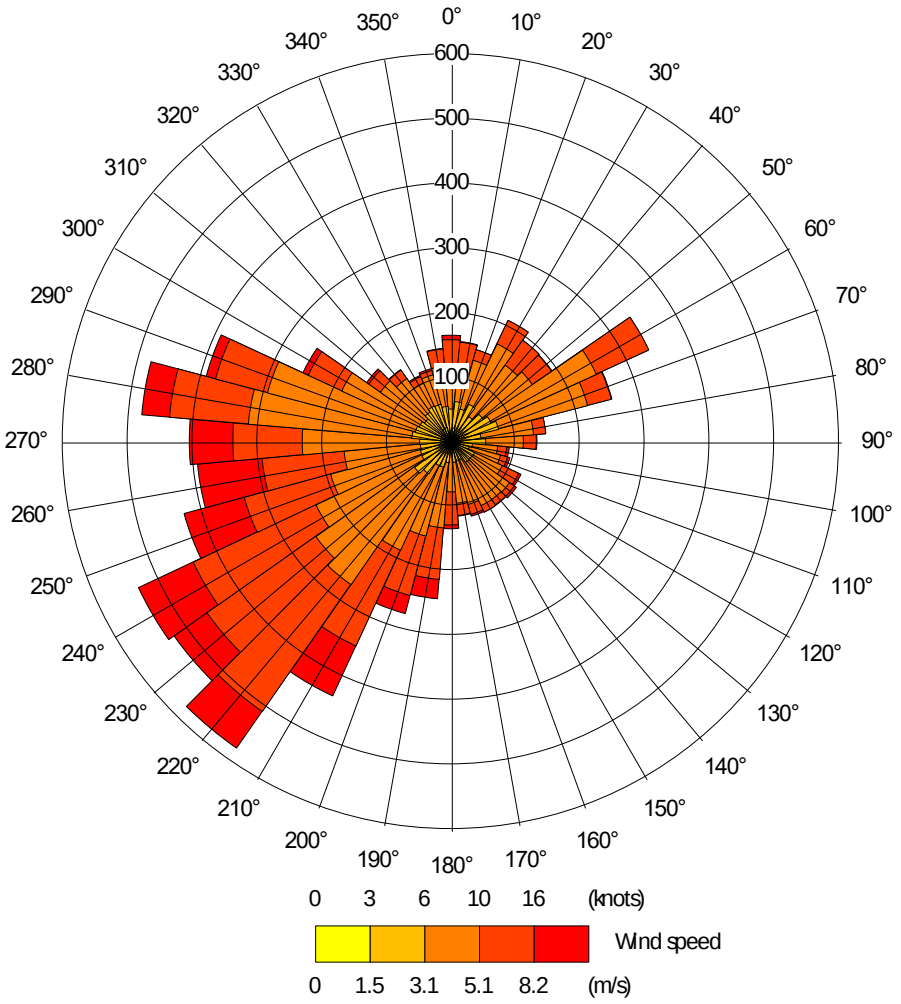


Figure 8.2: 2019 Wind Rose for the East Midlands Meteorological Station

Dispersion and Meteorological Site Characteristics

8.4.12 The characteristics for the dispersion site and meteorological sites, included in the ADMS-Roads model, are detailed in Table 8.11.

Table 8.11: Dispersion and Meteorological Site Characteristics		
Setting	**Dispersion Site**	**Meteorological Site**
Surface Roughness	0.5m	0.1m
Surface Albedo	0.23	0.23
Minimum Monin-Obukhov Length	30m	1m
Priestley-Taylor Parameter	1	1

NO_x to NO_2 Conversion

8.4.13 In accordance with the guidance within LAQM.TG(16), the ADMS-Roads model has been run to predict the road-contribution NO_x concentrations for each receptor

location. These have then been converted to NO_2 concentrations using the Defra NO_x to NO_2 calculator[14].

Background Pollutant Concentrations

8.4.14 The air quality assessment needs to take into account background concentrations upon which the local, traffic derived pollution is superimposed.

8.4.15 Background concentrations have been obtained from the 2018-based Defra default concentration maps. To ensure that the impacts of the M1 has not been included twice, Defra's sector removal tool has been used to adjust the background concentrations.

8.4.16 The background pollutant concentrations used in this assessment are detailed in Table 8.12.

Table 8.12: Background Pollutant Concentrations Used in the Air Quality Assessment.

Pollutant	Annual Mean Concentrations (µg/m³)			
	NOx	NO_2	PM_{10}	$PM_{2.5}$
2019 Base Year				
ESR 1 – ESR 7 (454500, 298500)	18.25	13.51	15.90	10.03
ESR 8 (455500, 299500)	21.57	15.70	14.86	9.45
ESR 9 – ESR 13 (453500, 299500)	19.25	14.17	14.86	9.43
ESR 14 (452500, 299500)	15.40	11.58	16.03	9.79
ESR 15 & ESR 16 (454500, 300500)	22.53	16.31	17.25	10.43
ESR 17 (453500, 303500)	22.73	16.30	16.83	10.53
ESR 18 (455500, 297500)	17.61	13.07	14.72	9.37
FSR 1 (454500, 301500)	22.79	16.39	16.16	10.18
2024 Opening Year				
ESR 1 – ESR 7 (454500, 298500)	14.44	10.92	15.00	9.32
ESR 8 (455500, 299500)	16.83	12.55	13.96	8.74
ESR 9 – ESR 13	15.22	11.45	13.97	8.73

[14] Defra Local Air Quality Management web pages [http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html]

Table 8.12: Background Pollutant Concentrations Used in the Air Quality Assessment.				
Pollutant	**Annual Mean Concentrations (µg/m^3)**			
	NOx	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
(453500, 299500)				
ESR 14 (452500, 299500)	12.42	9.50	15.16	9.09
ESR 15 & ESR 16 (454500, 300500)	17.59	13.06	16.32	9.68
ESR 17 (453500, 303500)	18.63	13.66	15.92	9.80
ESR 18 (455500, 297500)	14.10	10.67	13.83	8.67
FSR 1 (454500, 301500)	18.28	13.47	15.26	9.44
2029 Future Year				
ESR 1 – ESR 7 (454500, 298500)	12.36	9.44	14.79	9.16
ESR 8 (455500, 299500)	14.15	10.69	13.76	8.58
ESR 9 – ESR 13 (453500, 299500)	12.98	9.88	13.76	8.56
ESR 14 (452500, 299500)	10.80	8.33	14.95	8.92
ESR 15 & ESR 16 (454500, 300500)	14.75	11.10	16.12	9.51
ESR 17 (453500, 303500)	16.44	12.18	15.73	9.64
ESR 18 (455500, 297500)	12.25	9.35	13.62	8.51
FSR 1 (454500, 301500)	15.78	11.77	15.05	9.27
**Obtained from the Defra 2018-based background maps*				

Model Validation and Verification

8.4.17 LAQM.TG(16) refers to model validation as *"the general comparison of modelled results against monitoring data carried out by model developers"*. ADMS-Roads is widely accepted by regulatory authorities for use in this type of assessment.

8.4.18 Model verification is used to check the performance of the model at a local level. The verification of the ADMS-Roads air dispersion model is achieved by modelling concentration(s) at existing monitoring location(s) in the vicinity of the proposed development, and comparing the modelled concentration(s) with the measured

concentration(s).

8.4.19 Following review of the BBC 2019 monitoring data, it is understood there are several roadside air quality monitoring locations in close proximity to the proposed development site. Therefore, these diffusion tubes have been used to verify the results of the model.

8.4.20 Due to the high number of monitoring locations, ESRs 1 – 8 were verified with monitors CM1, DT48 and DT61. ESRs 9 – 16 and FSR 1 with monitors DT4, DT40, DT41, DT43, DT44 and DT49. ESR 17 with monitors DT16, DT18 and DT54. ESR 18 with monitors DT20, DT21, DT26 and DT58.

8.4.21 There was also one PM_{10} monitoring location, however the annual mean concentration recorded was lower than the background concentrations, and therefore it has not been possible to carry out model verification PM_{10} or $PM_{2.5}$ concentrations.

8.4.22 The monitoring data that has been used in the model verification procedure is detailed in Table 8.13.

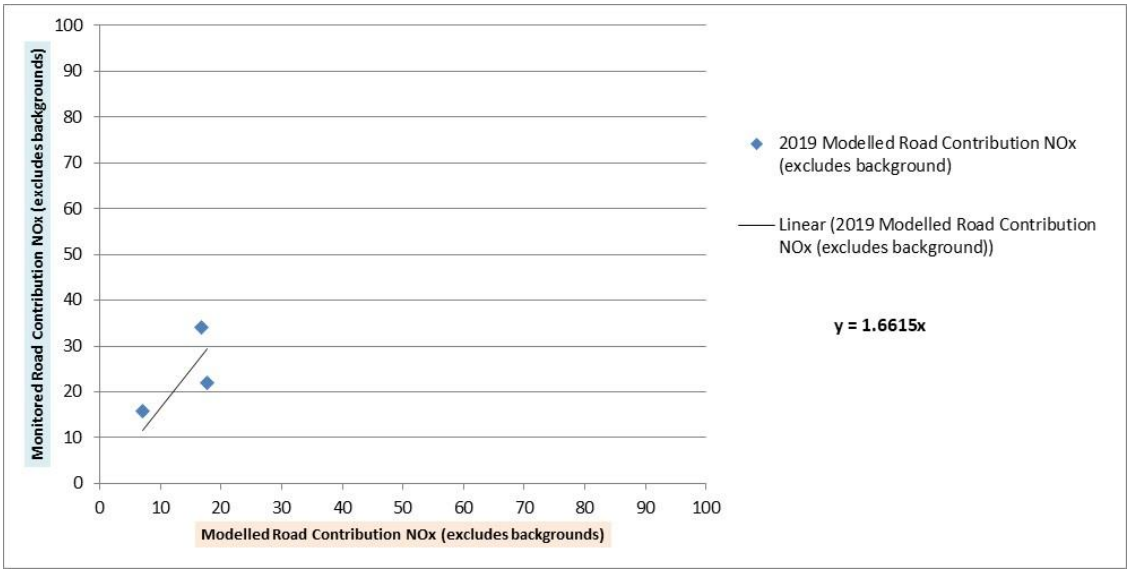
Table 8.13: NO_2 Monitoring Data Used for Verification Purposes

Monitoring Location Reference	Type	Approximate Grid Reference		2019 Bias Adjusted NO_2 Annual Average Concentration (µg/m³)
		Easting	Northing	
CM1	Automatic Monitor	454482	298573	30.90
DT48	Roadside Diffusion Tube	454519	298148	25.00
DT61		454434	297987	20.90
DT16		453220	304273	27.90
DT18		453488	303637	24.90
DT54		453592	303415	26.60
DT20		455819	297954	20.60
DT21		456148	297833	17.20
DT26		455817	297937	27.60
DT58		455995	297859	18.50
DT4		453606	299557	36.90
DT40		453468	299737	21.90
DT41		453439	299740	26.30
DT43		453780	299360	25.20
DT44		453706	299455	24.20
DT49		453565	299609	18.00

8.4.23 The modelled road-contribution NO_x concentration for the diffusion tubes has been compared against the measured road-contribution NO_x concentration for the same location. The measured concentrations have been derived using the Defra NO_x to NO_2

calculator, taking into account the background NO_x concentration for the local area.

8.4.24 The comparison for ESRs 1 - 8 is shown in the below graph. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 1.6615.



8.4.25 This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

8.4.26 A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table 8.14. Following adjustment, modelled concentrations are within 10% of measured concentrations.

Table 8.14: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration ($\mu g/m^3$)	Modelled Total NO_2 Concentration ($\mu g/m^3$)	Difference (%)
CM1	30.90	27.95	-9.55
DT48	25.00	28.65	14.60
DT61	20.90	18.82	-9.95

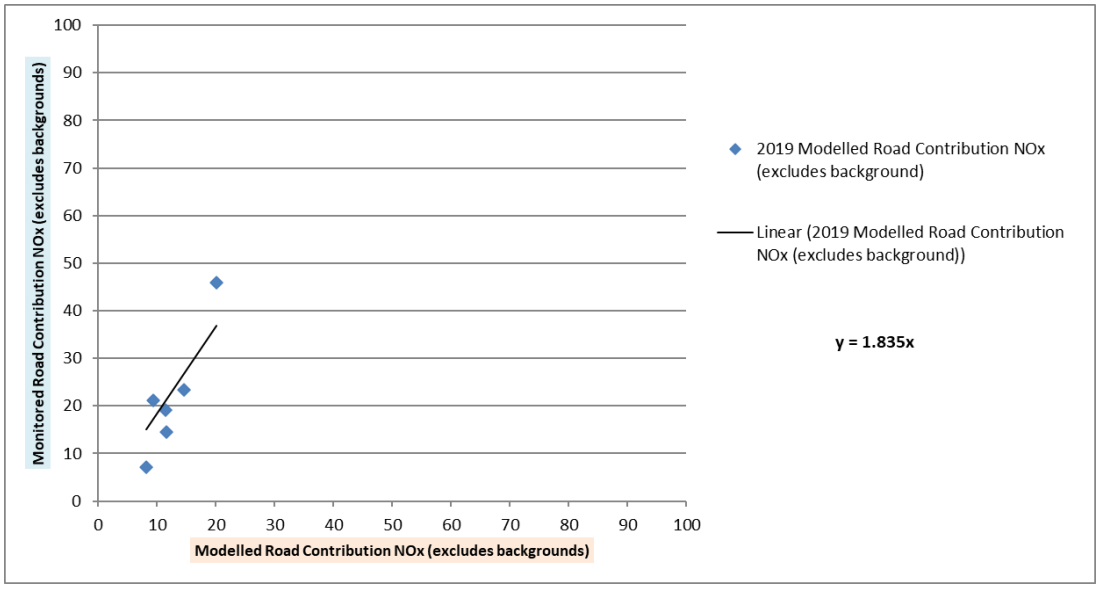
8.4.27 A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the monitoring location included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

8.4.28 The RMSE calculation following adjustment is detailed in Table 8.15.

Table 8.15: RMSE Calculation for Nitrogen Dioxide Concentrations				
Diffusion Tube Location	**After Verification**			
	Observed Value	**Predicted Value**	**Difference**	**RMSE**
CM1	30.90	27.95	-2.95	**2.96**
DT48	25.00	28.65	3.65	
DT61	20.90	18.82	-2.08	

8.4.29 LAQM.TG(16) states that *"ideally an RMSE value within 10% of the objective would be derived"*, a value of within 25% is considered acceptable.The results of the calculation show that following model verification, the RMSE value is within 10% (i.e. 4µg/m^3) of the objective (i.e. 40µg/m^3). Therefore, the model is considered to be performing to an acceptable standard.

8.4.30 The comparison for ESRs 9 – 16 and FSR 1 is shown in the below graph. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 1.835.



8.4.31 This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

8.4.32 A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table 8.16. Following adjustment, modelled concentrations are within 10% of measured concentrations.

Table 8.16: Comparison Between Measured and Monitored NO_2 Concentrations			
Monitoring Location Reference	**Measured Total NO_2 Concentration ($\mu g/m^3$)**	**Modelled Total NO_2 Concentration ($\mu g/m^3$)**	**Difference (%)**
DT4	36.90	32.81	-11.08
DT40	21.90	25.32	15.62
DT41	26.30	27.95	6.27
DT43	25.20	23.23	-7.82
DT44	24.20	25.20	4.13
DT49	18.00	22.19	23.28

8.4.33 A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the monitoring location included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

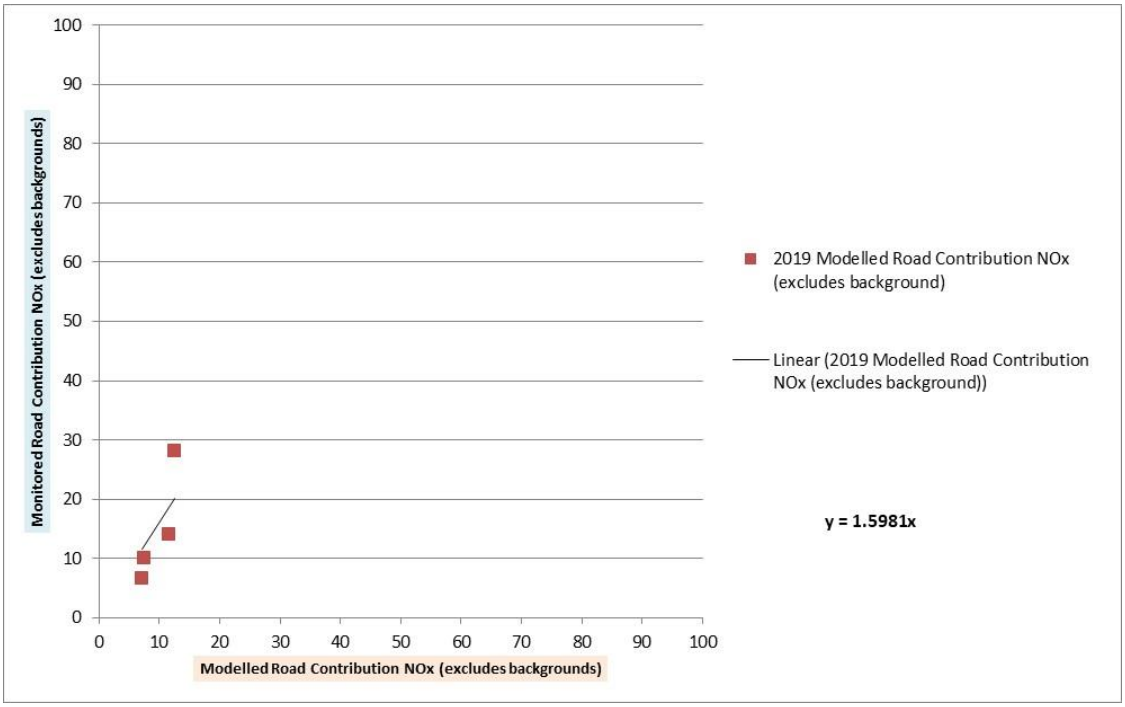
8.4.34 The RMSE calculation following adjustment is detailed in Table 8.17.

Table 8.17: RMSE Calculation for Nitrogen Dioxide Concentrations				
Diffusion Tube Location	**After Verification**			
	Observed Value	**Predicted Value**	**Difference**	**RMSE**
DT4	36.90	32.81	-4.09	**2.99**
DT40	21.90	25.32	3.42	
DT41	26.30	27.95	1.65	
DT43	25.20	23.23	-1.97	
DT44	24.20	25.20	1.00	
DT49	18.00	22.19	4.19	

8.4.35 LAQM.TG(16) states that *"ideally an RMSE value within 10% of the objective would be derived"*, a value of within 25% is considered acceptable.The results of the calculation show that following model verification, the RMSE value is within 10% (i.e. 4µg/m^3) of the objective (i.e. 40µg/m^3). Therefore, the model is considered to be performing to an acceptable standard.

8.4.36 The overall adjustment for ESR 17 was lower than 1, and therefore an adjustment factor of 1 was used.

8.4.37 The comparison for ESR 18 is shown in the below graph. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 1.5981.



8.4.38 This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

8.4.39 A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table 8.18. Following adjustment, modelled concentrations are within 10% of measured concentrations.

Table 8.18: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration ($\mu g/m^3$)	Modelled Total NO_2 Concentration ($\mu g/m^3$)	Difference (%)
DT20	20.60	22.87	11.02
DT21	17.20	19.76	14.88
DT26	27.60	23.65	-14.31
DT58	18.50	19.47	5.24

8.4.40 A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the monitoring location included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

8.4.41 The RMSE calculation following adjustment is detailed in Table 8.19.

Table 8.19: RMSE Calculation for Nitrogen Dioxide Concentrations				
Diffusion Tube Location	After Verification			
	Observed Value	Predicted Value	Difference	RMSE
DT20	20.60	22.87	2.27	**2.66**
DT21	17.20	19.76	2.56	
DT26	27.60	23.65	-3.95	
DT58	18.50	19.47	0.97	

8.4.42 LAQM.TG(16) states that *"ideally an RMSE value within 10% of the objective would be derived"*, a value of within 25% is considered acceptable.The results of the calculation show that following model verification, the RMSE value is within 10% (i.e. 4µg/m^3) of the objective (i.e. 40µg/m^3). Therefore, the model is considered to be performing to an acceptable standard.

Assessment Criteria

Assessing the Impact of a Proposed Development on Human Receptors

8.4.43 Guidance has been prepared by Environmental Protection UK (EPUK) and the IAQM[15] with relation to the assessment of the air quality impacts of proposed developments and their significance.

8.4.44 The impact of a development is usually assessed at specific receptors, and takes into account both the long-term background concentrations, in relation to the relevant Air Quality Assessment Level (AQAL) at these receptors, and the change with the development in place.

8.4.45 The impact descriptors for individual receptors are detailed in Table 8.20.

Table 8.20: Impact Descriptors for Individual Receptors				
Long Term Average Concentration at Receptor in Assessment Year*	Percentage Change in Concentration Relative to Air Quality Assessment Level (AQAL)*			
	1%	2-5%	6-10%	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial
**Percentage pollutant concentrations have been rounded to whole numbers, to make it easier to assess the impact. Changes of 0% (i.e. less than 0.5% or 0.2µg/m^3) should be described as Negligible*				

[15] Moorcroft and Barrowcliffe et al, Land-Use Planning and Development Control: Planning for Air Quality (v1.2), January 2017

Determining the Significance of Effects

8.4.46 Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as either 'significant' or 'not significant'.

8.4.47 Once the impact of the proposed development has been assessed for the individual impacts, the overall significance is determined using professional judgement. This takes into account a number of factors such as:

- The existing and future air quality in the absence of the development;
- The extent of the current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.