TECHNICAL APPENDIX 8.2: AIR QUALITY MODELLING INPUTS FOR THE DETAILED ASSESSMENT

The following Appendix details the model inputs for the detailed assessment carried out using the ADMS-Roads model.

8.2.1 Traffic Impacts

8.2.1.1 Potential impacts on air quality due to local traffic emissions have been predicted using the ADMS-Roads (version 4.1.1) dispersion model[1]. This model has been extensively validated against both field and laboratory data sets and against monitoring data in cities throughout the UK.

8.2.1.2 ADMS-Roads incorporates Department for Environment, Food and Rural Affairs' (Defra) emissions rates from the Emission Factor Toolkit (Version 9.0) and is used to predict roadside concentrations of nitrogen oxides (NO_x), particulate matter (PM_{10} and $PM_{2.5}$). The predicted concentrations of NO_x were then converted to total nitrogen dioxide (NO_2) using the Local Air Quality Management (LAQM) calculator (Version 9.0)[2] on the Defra air quality website to allow comparison with the National Air Quality Objective (NAQO). The modelling was split into City of Edinburgh Council (CEC) and Wets Lothian Council (WLC) areas to permit the use of the correct conversion settings.

8.2.1.3 To verify the model, the base year 2017 traffic data was used with the 2017 Edinburgh airport met data and 2017 local monitoring data.

8.2.1.4 In carrying out the assessment of operational traffic impacts the following scenarios have been assessed:

- Existing baseline (2017) to verify the ADMS-Roads model;
- Future baseline (2022) without proposed development (including planned wider Winchburgh Masterplan development) – 'Do Minimum' (DM) scenario;
- Existing baseline (2017) without proposed development and with construction traffic; and
- Future baseline (2022) with proposed development and wider Winchburgh Masterplan development – 'Do Something' (DS) scenario.

8.2.1.5 The traffic data provided by Sweco (the 'traffic consultants') has been taken from the SEStran Regional Model (SRM12). In 2009, the Winchburgh Masterplan development assumed that the complete Winchburgh Masterplan development (3,450 residential units) would in place by 2016. For the current assessment the Future Baseline (2022 – proposed year of opening of motorway junction) includes approximately one third of the development (1,000 residential units), which is an over estimate given the current rate of build out.

8.2.1.6 Road geometry and width was derived from OS Mastermap Highways Network data. Vehicle speeds was estimated by road type and context.

[1] Cambridge Environmental Research Consultants, 2019. ADMS-Roads [online]. Available at: http://www.cerc.co.uk/environmental-software/ADMS-Roads-model.html

[2] Department for Environment, Food & Rural Affairs (Defra), 2019. Background Maps [online]. Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

Sensitive Receptors

8.2.1.7 Annual mean concentrations of NO_2 and PM have been estimated at a number of receptors as shown in Figure 8.2 in Volume 4 and detailed at the end of this appendix in Table TA8.2.1. The modelled receptors represent worst case exposure locations of sensitive receptors within 200 metres (m) of the affected road network as defined by the Design Manual for Roads and Bridges (DMRB) Scoping stage. In addition, a number of representative worst-case exposure locations were modelled along the expected route of the construction traffic.

8.2.1.8 Sensitive receptor locations were identified using OS AddressBase Plus data. Modelled receptor locations were located at worst case façade locations, as indicated by OS Vector Map Local data (1:10,000 scale data).

Meteorological Data

8.2.1.9 The Edinburgh Airport meteorological site is considered to be the most representative meteorological monitoring station for the site. The 2017 hourly sequential meteorological data from this station was used in the ADMS-Roads model.

8.2.1.10 Due to the number of modelled roads, the modelling domain was divided into four parts. To provide an accurate estimate of the effect of surface roughness on dispersion across the model domain, a variable surface roughness file was used. This was derived from Corine Land Cover 2018 and run at a 64 by 64 resolution grid. The surface roughness applied to different types of land cover within the model domain are provided in Table TA8.2.2 at the end of this appendix.

Background Concentrations

8.2.1.11 The ADMS-Roads modelling software estimates concentrations arising from emissions on the local roads based on traffic data inputs. It is necessary to add an estimate of the background concentrations to obtain the total concentration for comparison against the air quality objectives.

8.2.1.12 Background pollutant concentrations have been obtained from the Scottish Air and Defra maps of predicted background pollutant concentrations which have been produced to aid local authorities in carrying out their Review and Assessment of Air Quality work. The concentrations used in the assessment from the latest version (2016 and 2017 reference years) are provided in Table TA 8.2.3 at the end of this appendix. To prevent double counting the contribution of the modelled A roads and motorways to the total background predicted background concentration, the in-cell A road, Trunk road and Motorway contributions to the relevant pollutants was removed. This resulted in the sector removed background concentrations that were then used in the report. The sector removal tool of the Scottish Air website was used for this purpose.

Model Verification

8.2.1.13 The predicted 2017 existing NO_2 concentrations were compared with monitored data at a total of eight air quality monitoring sites to determine whether the model results need adjusting to more accurately reflect local air quality. Five of the sites are located in West Lothian, and three in the CEC. The monitoring locations used to verify the model are shown in Figure 8.5 in Volume 4. In addition, two further locations were considered, but were then disregarded.

8.2.1.14 Dispersion modelling results should be within 25 % of monitored concentrations, ideally within 10 %. Predicted concentrations at all considered locations were within 25 % of the monitored

concentrations. As such, no adjustment factor was applied to these sites, or for modelled receptors in comparable locations. The results are provided in Table TA8.2.4.

8.2.1.15 There is insufficient monitoring of PM_{10} and $PM_{2.5}$ in the vicinity of the development site to verify the model for these pollutants. Following the guidance provided in LAQM TG(16) the predicted roadside contributions have been adjusted, using the same approach as used for NO_2, to predict the annual mean concentrations.

Table TA8.2.4: Model Verification

Monitor	Authority	Modelled Roadside NO_x µg/m³	Modelled Total NO_2 µg/m³	Monitored NO_2 µg/m³	% Difference Modelled to Monitored NO_2
15	CEC	66.1	48.5	41.0	18.4
58	CEC	64.7	48.0	44.0	9.0
16	CEC	46.3	41.7	35.0	19.1
ID10*	CEC	41.9	39.8	26.0	53.0
CM3*	WLC	34.1	28.3	19.0	48.8
DT1	WLC	29.6	26.2	23.0	13.7
DT2	WLC	12.3	21.9	26.0	-15.7
Broxburn CNC	WLC	14.5	23.0	30.0	-23.2
DT3	WLC	12.8	22.2	26.0	-14.7
DT5	WLC	25.4	29.0	27.0	7.3

Notes:

The predicted NO_2 concentrations at ID10 & CM3 do not fall within 25% of the monitored concentrations. Both these monitoring locations are close to other monitoring locations with the same traffic passing that do fall within 25%. ID10 is located on the opposite side of the road from a diffusion tube but, located in an open area that extends away across an airfield, and road traffic pollution is likely to have unusually high dispersion due to this site setting. CM3 appears to have lower monitored concentrations than its setting and nearby monitoring suggests is the norm. As such, both these locations have been removed from the verification, but are reported here for transparency.

Table 8.2.1: Modelled Receptor Locations				
ID	X (m)	Y (m)	Z (m)	Name
1	309424	672187	1.5	1 KILPUNT VIEW BROXBURN WEST LOTHIAN
2	309423	672206	1.5	1 KILPUNT VIEW BROXBURN WEST LOTHIAN
3	311355	672639	1.5	HAUGH FARMHOUSE EDINBURGH ROAD NEWBRIDGE CITY OF EDINBURGH
4	311086	672645	1.5	WEST HAUGH COTTAGES EDINBURGH ROAD NEWBRIDGE CITY OF EDINBURGH
5	312340	672669	1.5	68 BRIDGE STREET EDINBURGH CITY OF EDINBURGH
6	312151	672803	1.5	1 OLD LISTON ROAD NEWBRIDGE CITY OF EDINBURGH
7	311680	672821	1.5	EAST HAUGH COTTAGES EDINBURGH ROAD NEWBRIDGE CITY OF EDINBURGH
8	312115	672835	1.5	8 EDINBURGH ROAD NEWBRIDGE CITY OF EDINBURGH
9	312081	672846	1.5	2 EDINBURGH ROAD NEWBRIDGE CITY OF EDINBURGH
10	312266	673713	1.5	BREASTMILL COTTAGE A NEWLISTON ROAD KIRKLISTON CITY OF EDINBURGH
11	311994	674056	1.5	55 KING EDWARD'S WAY KIRKLISTON CITY OF EDINBURGH
12	311907	674105	1.5	95 KING EDWARD'S WAY KIRKLISTON CITY OF EDINBURGH
13	311884	674153	1.5	39 COTLAWS KIRKLISTON CITY OF EDINBURGH
14	311162	674455	1.5	OVERTON BRAE OVERTON FARM ROAD EDINBURGH CITY OF EDINBURGH
15	311749	674575	1.5	42 BUIE BRAE KIRKLISTON CITY OF EDINBURGH
16	311633	674614	1.5	10 BUIE RIGG KIRKLISTON CITY OF EDINBURGH
17	311658	674703	1.5	28 BUIE RIGG KIRKLISTON CITY OF EDINBURGH
18	311821	674731	1.5	6 KIRKLANDS PARK GARDENS KIRKLISTON CITY OF EDINBURGH
19	311792	674941	1.5	8 KIRKLANDS PARK GROVE KIRKLISTON CITY OF EDINBURGH
20	312097	675162	1.5	26 TODSHAUGH GARDENS KIRKLISTON CITY OF EDINBURGH
21	308436	675253	1.5	4 STONEBYRES DRIVE WINCHBURGH WEST LOTHIAN
22	308436	675253	1.5	2 STONEBYRES DRIVE WINCHBURGH WEST LOTHIAN
23	309959	675268	1.5	MURIEHALL B9080 - PENTLAND VIEW TO BOUNDARY WINCHBURGH WEST LOTHIAN
24	309721	675279	1.5	PENTLAND VIEW B9080 - PENTLAND VIEW TO BOUNDARY WINCHBURGH WEST LOTHIAN
25	308079	675348	1.5	1 MILLCRAIG PLACE WINCHBURGH WEST LOTHIAN
26	308226	675396	1.5	35 MILLCRAIG PLACE WINCHBURGH WEST LOTHIAN
27	309276	675401	1.5	NIDDRY MAINS HOUSE BEATLIE ROAD WINCHBURGH WEST LOTHIAN
28	308973	675427	1.5	16 STATION ROAD WINCHBURGH WEST LOTHIAN
29	309034	675451	1.5	15 STATION VIEW WINCHBURGH WEST LOTHIAN
30	309202	675497	1.5	24 STATION VIEW WINCHBURGH WEST LOTHIAN
31	309128	675515	1.5	53 STATION VIEW WINCHBURGH WEST LOTHIAN
32	306883	675551	1.5	TWELVEMILE LODGE C15 - B9080 TO MOUNTHOOLY WINCHBURGH WEST LOTHIAN

Table 8.2.1: Modelled Receptor Locations				
ID	X (m)	Y (m)	Z (m)	Name
33	312564	675668	1.5	SOUTH LODGE DUNDAS ESTATE SOUTH QUEENSFERRY CITY OF EDINBURGH
34	306124	675712	1.5	TRINLAYMIRE COTTAGE B9080 - B8046 TO TRINLAYMIRE THREEMILETOWN WEST LOTHIAN
35	305998	675760	1.5	1 CANAL COURT THREEMILETOWN WEST LOTHIAN
36	305997	675823	1.5	10 CANAL COURT THREEMILETOWN WEST LOTHIAN
37	313732	676168	1.5	CRAIGBRAE COTTAGES MILTON FARM ROAD EDINBURGH CITY OF EDINBURGH
38	312883	677079	1.5	1 NEWBIGGING LODGE DUNDAS HOME FARM SOUTH QUEENSFERRY CITY OF EDINBURGH
39	312625	677131	1.5	12 DUNDAS HOME FARM SOUTH QUEENSFERRY CITY OF EDINBURGH
40	305956	677214	1.5	OLD PHILPSTOUN B8046 - C6 TO A904 PHILPSTOUN WEST LOTHIAN
41	306016	677200	1.5	OLD PHILPSTOUN B8046 - C6 TO A904 PHILPSTOUN WEST LOTHIAN
42	312939	677243	1.5	21 STEIN STREET SOUTH QUEENSFERRY CITY OF EDINBURGH
43	312897	677251	1.5	24 STEIN STREET SOUTH QUEENSFERRY CITY OF EDINBURGH
44	305924	677283	1.5	OLD PHILPSTOUN B8046 - C6 TO A904 PHILPSTOUN WEST LOTHIAN
45	305999	677306	1.5	EAST PHILSTOUN FARM COTTAGES B8046 - C6 TO A904 PHILPSTOUN WEST LOTHIAN
46	308820	677348	1.5	8 HOPELANDS WOODEND NEWTON WEST LOTHIAN
47	308705	677406	1.5	10 WOODEND HOUSE WOODEND NEWTON WEST LOTHIAN
48	308797	677448	1.5	1 WOODEND NEWTON WEST LOTHIAN
49	309113	677606	1.5	1 MAIN STREET NEWTON WEST LOTHIAN
50	309167	677639	1.5	9 MAIN STREET NEWTON WEST LOTHIAN
51	309245	677710	1.5	23 MAIN STREET NEWTON WEST LOTHIAN
52	309215	677707	1.5	2 MAIN STREET NEWTON WEST LOTHIAN
53	309307	677774	1.5	43 MAIN STREET NEWTON WEST LOTHIAN
54	309289	677783	1.5	20 MAIN STREET NEWTON WEST LOTHIAN
55	311542	677877	1.5	1 ECHLINE SOUTH QUEENSFERRY CITY OF EDINBURGH
56	310030	677927	1.5	DUDDINGSTON FARM COTTAGES A904 - U3 TO HEADRIG ROAD NEWTON WEST LOTHIAN
57	308071	675377	1.5	WMI Unbuilt Phase - Worst Case exposure location
58	308237	675431	1.5	WMI Unbuilt Phase - Worst Case exposure location
59	308327	675432	1.5	WMI Unbuilt Phase - Worst Case exposure location
60	308325	675403	1.5	WMI Unbuilt Phase - Worst Case exposure location
61	308491	675474	1.5	WMI Unbuilt Phase - Worst Case exposure location
62	308435	675415	1.5	WMI Unbuilt Phase - Worst Case exposure location
63	308585	675437	1.5	WMI Unbuilt Phase - Worst Case exposure location
64	308647	675466	1.5	WMI Unbuilt Phase - Worst Case exposure location
65	308859	675461	1.5	WMI Unbuilt Phase - Worst Case exposure location
66	309052	675499	1.5	WMI Unbuilt Phase - Worst Case exposure location
67	309111	675510	1.5	WMI Unbuilt Phase - Worst Case exposure location

Table 8.2.1: Modelled Receptor Locations				
ID	X (m)	Y (m)	Z (m)	Name
68	309171	675589	1.5	WMI Unbuilt Phase - Worst Case exposure location
69	309170	675674	1.5	WMI Unbuilt Phase - Worst Case exposure location
70	309205	675675	1.5	WMI Unbuilt Phase - Worst Case exposure location
71	309138	675774	1.5	WMI Unbuilt Phase - Worst Case exposure location
72	309051	676438	1.5	DUNTARVIE CASTLE CHALET U4 - A904 TO B8020 BROXBURN WEST LOTHIAN
R1	309276	675401	1.5	Worst Case Exposure - Construction Traffic
R2	309202	675497	1.5	Worst Case Exposure - Construction Traffic
R3	309170	675674	1.5	Worst Case Exposure - Construction Traffic
R4	309205	675675	1.5	Worst Case Exposure - Construction Traffic
R5	309138	675774	1.5	Worst Case Exposure - Construction Traffic
R6	309277	675080	1.5	Worst Case Exposure - Construction Traffic

Table 8.2.2: Land Cover Types and Modelled Surface Roughness	
Type	Surface Roughness (m)
Discontinuous urban fabric	1
Industrial or commercial units	1
Road and rail networks and associated land	0.5
Port areas	0.5
Airports	0.3
Mineral extraction sites	0.3
Dump sites	0.3
Green urban areas	0.5
Sport and leisure facilities	0.3
Non-irrigated arable land	0.2
Pastures	0.2
Land principally occupied by agriculture, with significant areas of natural vegetation	0.3
Broad-leaved forest	1
Coniferous forest	1
Mixed forest	1
Natural grasslands	0.3
Moors and heathland	0.3
Sparsely vegetated areas	0.2
Intertidal flats	0.001
Water bodies	0.001
Estuaries	0.0001
Sea and ocean	0.0001

Table TA8.2.3: Background concentrations used within the assessment[3] (µg/m)

X (m)	Y (m)	Total NO_2 2017	Sector Removed NO_2 2017	Total NO_x 2017	Sector Removed NO_x 2017	Total PM_{10} 2017	Sector Removed PM_{10} 2017	Total $PM_{2.5}$ 2017	Sector Removed $PM_{2.5}$ 2017	Total NO_2 2022	Sector Removed NO_2 2022	Total NO_x 2022	Sector Removed NO_x 2022	Total PM_{10} 2022	Sector Removed PM_{10} 2022	Total $PM_{2.5}$ 2022	Sector Removed $PM_{2.5}$ 2022
309500	672500	17.2	16.1	27.4	25.6	12.8	12.8	6.7	6.7	14.4	13.6	22.1	20.9	12.5	12.5	6.2	6.2
311500	672500	17.8	16.9	28.4	27.0	13.1	13.1	6.8	6.8	14.5	13.8	22.1	21.1	12.8	12.8	6.4	6.4
312500	672500	24.9	18.3	43.3	31.9	16.2	16.0	7.5	7.4	20.5	15.7	33.7	25.8	15.8	15.8	7.0	7.0
312500	673500	19.7	15.2	32.0	24.6	13.7	13.6	7.2	7.2	16.1	12.8	24.9	19.8	13.4	13.3	6.7	6.7
311500	674500	18.1	12.2	28.5	19.2	12.5	12.4	7.2	7.1	14.4	10.1	21.8	15.3	12.2	12.2	6.7	6.7
312500	675500	16.6	13.7	26.0	21.4	12.6	12.6	7.1	7.1	13.5	11.4	20.3	17.2	12.3	12.3	6.7	6.6
308500	675500	12.7	12.7	19.1	19.1	11.5	11.5	6.5	6.5	10.5	10.5	15.4	15.4	11.2	11.2	6.1	6.1
309500	675500	15.1	12.7	23.3	19.6	12.0	12.0	6.8	6.8	12.3	10.6	18.4	15.8	11.8	11.7	6.3	6.3
306500	675500	9.4	9.4	13.5	13.5	11.0	11.0	6.3	6.3	7.7	7.7	10.9	10.9	10.7	10.7	5.9	5.9
305500	675500	9.0	9.0	12.9	12.9	10.9	10.9	6.3	6.3	7.4	7.4	10.4	10.4	10.7	10.7	5.8	5.8
313500	676500	16.6	13.3	26.0	20.7	12.0	11.9	7.0	7.0	13.5	11.2	20.4	16.8	11.7	11.7	6.5	6.5
312500	677500	17.9	12.5	28.3	19.7	12.4	12.3	7.2	7.1	14.5	10.6	22.1	16.1	12.1	12.1	6.7	6.7
305500	677500	15.6	12.0	24.0	18.5	11.9	11.8	6.7	6.6	12.5	10.0	18.6	14.8	11.6	11.6	6.2	6.2
308500	677500	11.7	11.2	17.2	16.4	10.9	10.9	6.3	6.3	9.6	9.2	13.8	13.3	10.7	10.7	5.9	5.9
309500	677500	11.6	11.0	17.1	16.2	12.3	12.3	6.5	6.5	9.6	9.2	13.9	13.3	12.0	12.0	6.1	6.1
311500	677500	12.4	11.9	18.4	17.7	11.9	11.9	6.7	6.6	10.3	9.9	15.0	14.5	11.7	11.7	6.2	6.2
310500	677500	11.4	11.2	16.9	16.4	11.6	11.6	6.5	6.5	9.6	9.4	13.8	13.5	11.4	11.4	6.1	6.1
309500	676500	13.2	11.9	19.7	17.8	12.0	11.9	6.7	6.7	10.7	9.8	15.7	14.3	11.7	11.7	6.2	6.2
308500	672500	16.0	15.5	25.2	24.3	13.3	13.3	6.7	6.7	13.5	13.1	20.4	19.9	13.1	13.1	6.3	6.3
313500	672500	22.3	19.7	37.6	33.2	13.4	13.4	6.9	6.9	18.2	16.2	29.0	25.9	13.1	13.1	6.4	6.4
306500	676500	12.0	12.0	17.8	17.8	10.1	10.1	6.1	6.1	9.9	9.9	14.4	14.4	9.9	9.9	5.7	5.7
305500	676500	10.3	10.3	15.0	15.0	11.0	11.0	6.3	6.3	8.5	8.5	12.0	12.0	10.8	10.8	5.9	5.9
Max		24.9	19.7	43.3	33.2	16.2	16.0	20.5	16.2	33.7	25.9	15.8	15.8	7.5	7.4	7.0	7.0