
One Medlock Street
Environmental Statement

Volume 4

November 2022



APPENDIX C: AIR QUALITY

Appendix C1: Road Vehicle Exhaust Emissions Dispersion Modelling Inputs

ES Volume 4, Appendix C1 - Air Quality Dispersion Modelling Inputs



Table of Contents

1.0	INTRODUCTION	1
2.0	METHODOLOGY	2
2.1	Introduction	2
2.2	Dispersion Model	2
	Assessment Area	3
	Traffic Flow Data	3
	Canyons	13
	Emission Factors	18
	Meteorological Data	18
	Roughness Length	18
	Monin-Obukhov Length	18
	Background Concentrations	19
	NO _x to NO ₂ Conversion	19
	Verification	19

1.0 INTRODUCTION

- 1.1.1 This Technical Appendix provides the dispersion modelling inputs utilised in order to predict air quality impacts at sensitive locations in the vicinity of the Proposed Development as a result of construction and operational stage road vehicle exhaust emissions. It should be read in conjunction with the Air Quality Chapter of the Environmental Statement and the other Technical Appendices.

2.0 METHODOLOGY

2.1 Introduction

2.1.1 The Proposed Development has the potential to cause air quality impacts as a result of exhaust emissions associated with vehicles travelling to and from the Site during the construction and operational phases, as well as expose future occupants to any existing air quality issues. In order to assess nitrogen dioxide (NO₂), particulate matter with an aerodynamic diameter of less than 10µm (PM₁₀) and particulate matter with an aerodynamic diameter of less than 2.5µm (PM_{2.5}) concentrations at sensitive locations, detailed dispersion modelling was undertaken in accordance with the following methodology.

2.2 Dispersion Model

2.2.1 Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 5.0.1.3). ADMS-Roads is developed by Cambridge Environmental Research (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and the Department for Environment Food and Rural Affairs (DEFRA).

2.2.2 The model required input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length (z₀); and,
- Monin-Obukhov length.

2.2.3 Additional options can be selected within the ADMS-Roads interface in order to take account of site specific characteristics that may change model outputs, such as canyons.

2.2.4 The following Sections detail the relevant inputs utilised in the assessment.

Assessment Area

2.2.5 Ambient concentrations were predicted over National Grid Reference (NGR): 383530, 397105 to 383710, 397285. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

2.2.6 Reference should be made to ES Volume 4, Appendix C2 Figure 7.7 for a map of the assessment area.

Traffic Flow Data

2.2.7 Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as Heavy Duty Vehicle (HDV) proportion, was provided by Vectos, the Transport Consultants for the project.

2.2.8 Baseline traffic data was not available for Higher Cambridge and Oxford Road as they were outside the extents of the Transport Assessment. As such, flows for these links were obtained from the Department for Transport (DfT)¹. The DfT web tool enables the user to view and download traffic flows on every links of the 'A' road and motorway network, as well as selected minor roads, in Great Britain for the years 1999 to 2020. It should be noted that the DfT is referenced in DEFRA guidance² as being a suitable source of data for air quality assessments and it is therefore considered to provide a reasonable estimate of traffic flows in the vicinity of the Site.

2.2.9 The baseline traffic data for these roads was converted to the Site construction phase and opening year utilising a factor obtained from TEMPro (version 7.2). This software package has been developed by the DfT to calculate future traffic growth throughout the UK.

2.2.10 A summary of the traffic data used for the assessment of construction phase road vehicle exhaust emissions is provided in Table 1.

¹ <https://roadtraffic.dft.gov.uk/#6/55.254/-11.107/basemap-regions-countpoints>.

² Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

Table 1 Traffic Data - Construction Phase Road Vehicle Exhaust Emission Impacts

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2024 DM	2024 DS	2019	2024 DM	2024 DS		
L1	Medlock Street, south of River Street	24,210	24,820	24,882	1.91	1.86	2.08	13.9	30
L2	Medlock Street, Southbound (SB)	12,105	12,410	12,441	1.91	1.91	2.13	7.1	25
L3	Medlock Street SB to A5103	6,052	6,205	6,246	1.91	1.91	2.49	9.0	20
L4	Medlock Street, SB to A5103 Eastbound (EB)	6,052	6,205	6,273	1.91	1.91	2.78	4.4	20
L5	Medlock Street Northbound (NB)	12,105	12,410	12,441	1.91	1.91	2.13	7.8	25
L6	A5103 Roundabout EB	29,480	29,554	29,554	1.63	1.63	1.63	8.3	20
L7	A5103 south of Roundabout, NB to A5103 EB	7,056	7,059	7,059	2.37	2.36	2.36	7.6	20
L8	A5103 NB to Medlock Street	7,056	7,059	7,148	2.37	2.36	3.38	7.1	20
L9	A5103 Roundabout Westbound (WB)	31,278	31,357	31,446	2.08	2.07	2.31	7.9	20
L10	A5103 south of Roundabout, NB	7,056	7,059	7,080	2.37	2.36	2.62	6.9	20
L11	A5103 SB to Princess Road	10,585	10,589	10,610	2.37	2.36	2.54	8.6	20
L12	A5103, WB from Princess Road to Mancunian Way Slip Road On WB	6,050	6,050	6,050	4.12	4.12	4.12	4.0	30
L13	A5103 Roundabout WB to Mancunian Way Slip Road On WB	6,050	6,050	6,071	4.12	4.12	4.41	4.0	30
L14	Mancunian Way Slip Road On WB	12,100	12,100	12,121	4.12	4.12	4.27	4.8	65

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2024 DM	2024 DS	2019	2024 DM	2024 DS		
L15	Mancunian Way Slip Road Off EB	11,519	11,525	11,544	2.35	2.35	2.51	5.7	65
L16	Mancunian Way Slip Road Off EB, adjacent to Garwood Street	11,519	11,525	11,546	2.35	2.35	2.51	6.9	30
L17	Mancunian Way Slip Road Off EB to Medlock Street	11,519	11,525	11,608	2.35	2.35	2.98	7.1	20
L18	A5103, WB to Roundabout	6,353	6,428	6,448	3.27	3.24	3.52	7.7	20
L19	A5103, WB to Princess Road	6,353	6,428	6,428	3.27	3.24	3.24	7.7	20
L20	Upper Mancunian Way, EB	25,535	25,535	25,535	4.82	4.82	4.82	8.5	80
L21	Upper Mancunian Way, WB	25,535	25,535	25,535	4.82	4.82	4.82	8.3	80
L22	Upper Mancunian Way, EB, west of Garwood Street	37,345	37,345	37,366	4.33	4.33	4.38	7.5	80
L23	Upper Mancunian Way, WB, west of Garwood Street	37,345	37,345	37,366	4.33	4.33	4.38	7.5	80
L24	Upper Mancunian Way, Slip Road to A5067	9,336	9,336	9,336	4.33	4.33	4.33	6.8	45
L25	Upper Mancunian Way, Slip Road from A5067	9,336	9,336	9,336	4.33	4.33	4.33	4.5	45
L26	Garwood Street, NB	422	544	575	2.38	2.30	7.04	5.3	25
L27	Garwood Street, SB	422	544	575	2.38	2.30	7.04	5.6	20
L28	Garwood Street SB to A5103	422	544	575	2.38	2.30	7.04	5.6	20
L29	Garwood Street, south of River Street	845	1,089	1,151	2.38	2.30	7.04	8.6	25

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2024 DM	2024 DS	2019	2024 DM	2024 DS		
L30	Garwood Street, north of River Street	3,351	3,707	3,707	2.38	2.35	2.35	7.7	25
L31	Jackson Street, west of Garwood Street	4,477	5,615	5,615	2.44	2.35	2.35	6.8	30
L32	Jackson Street	4,477	5,615	5,615	2.44	2.35	2.35	9.4	30
L33	City Road East, west of Shortcroft Street	4,477	5,615	5,615	2.44	2.35	2.35	9.4	30
L34	City Road East, east of Shortcroft Street	4,477	5,615	5,615	2.44	2.35	2.35	8.9	30
L35	City Road East to Medlock Street	4,477	5,615	5,615	2.44	2.35	2.35	9.4	20
L36	Medlock Street, north of River Street	22,506	23,597	23,597	2.08	2.08	2.08	18.1	30
L37	Medlock Street to River Street	22,506	23,597	23,597	2.08	2.08	2.08	12.8	25
L38	River Street, east of Site Access	1,022	1,133	1,195	2.38	2.35	6.91	8.6	25
L39	River Street, west of Site Access	950	1,061	1,123	2.56	2.51	7.35	8.2	25
L40	River Street to Hulme Street	2,620	2,620	2,620	1.82	1.82	1.82	5.9	25
L41	Wilmott Street	2,620	2,620	2,620	1.82	1.82	1.82	6.5	30
L42	Wilmott Street, south of Hulme Street	2,620	2,620	2,620	1.82	1.82	1.82	3.9	30
L43	Chester Street	654	654	654	2.38	2.38	2.38	7.6	30
L44	Chester Street to Oxford Road	654	654	654	2.38	2.38	2.38	9.9	30
L45	Albion Street	17,007	17,430	17,430	3.55	3.51	3.51	14.5	30
L46	Princess Road, SB	21,169	21,178	21,182	2.37	2.36	2.37	6.7	65
L47	Princess Road, NB	21,169	21,178	21,199	2.37	2.36	2.45	7.4	65

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2024 DM	2024 DS	2019	2024 DM	2024 DS		
L48	Princess Road Slip Road, SB	5,292	5,295	5,295	2.37	2.36	2.36	4.1	50
L49	Princess Road Slip Road, NB	5,292	5,295	5,295	2.37	2.36	2.36	4.3	50
L50	Higher Cambridge Street	6,556	7,349	7,390	1.78	1.78	2.28	9.7	30
L51	Higher Cambridge Street Roundabout	11,475	11,754	11,775	3.10	3.05	3.21	11.1	25
L52	Lower Mancunian Way, EB, west of Roundabout	12,705	12,855	12,876	3.27	3.24	3.38	8.7	30
L53	Lower Mancunian Way, WB, west of Roundabout	12,705	12,855	12,876	3.27	3.24	3.38	9.8	30
L54	Mancunian Way Slip Road On, EB	12,705	12,855	12,876	3.27	3.24	3.38	6.5	25
L55	Mancunian Way Slip Road On, EB	12,705	12,855	12,876	3.27	3.24	3.38	6.5	25
L56	Mancunian Way Slip Road On, EB	12,705	12,855	12,876	3.27	3.24	3.38	6.5	25
L57	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,876	3.27	3.24	3.38	6.1	25
L58	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,876	3.27	3.24	3.38	6.1	25
L59	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,876	3.27	3.24	3.38	6.1	25
L60	Brook Street Slip Road	12,768	6,384	6,384	2.41	4.82	4.82	6.4	25
L61	Oxford Street	5,463	6,123	6,123	43.58	43.58	43.58	9.9	30
L62	Oxford Street Approaching Whitworth Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L63	Oxford Street Exiting Whitworth Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2024 DM	2024 DS	2019	2024 DM	2024 DS		
L64	Oxford Street Between Whitworth Street and Charles Street	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L65	Oxford Street Approaching Charles Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	10
L66	Oxford Road Exiting Charles Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	10
L67	Oxford Road Between Charles Street and Mancunian Way	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L68	Oxford Road	5,463	6,123	6,123	43.58	43.58	43.58	12.5	20
L69	Upper Mancunian Way, WB, east of Cavendish Street	25,535	25,535	25,556	4.82	4.82	4.89	8.3	80
L70	Upper Mancunian Way, EB, east of Cavendish Street	25,535	25,535	25,556	4.82	4.82	4.89	8.5	80
L71	River Street, west of Site Access	950	1,061	1,123	2.56	2.51	7.35	8.2	25

2.2.11 A summary of the traffic data for the assessment of operational phase road vehicle exhaust emissions is provided in Table 2.

Table 2 Traffic Data - Operational Phase Road Vehicle Exhaust Emissions Impacts

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L1	Medlock Street, south of River Street	24,210	24,820	24,916	1.91	1.86	1.88	13.9	30
L2	Medlock Street, SB	12,105	12,410	12,458	1.91	1.91	1.93	7.1	25

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L3	Medlock Street SB to A5103	6,052	6,205	6,263	1.91	1.91	1.95	9.0	20
L4	Medlock Street, SB to A5103 EB	6,052	6,205	6,295	1.91	1.91	1.98	4.4	20
L5	Medlock Street NB	12,105	12,410	12,458	1.91	1.91	1.93	7.8	25
L6	A5103 Roundabout EB	29,480	29,554	29,554	1.63	1.63	1.63	8.3	20
L7	A5103 south of Roundabout, NB to A5103 EB	7,056	7,059	7,059	2.37	2.36	2.36	7.6	20
L8	A5103 NB to Medlock Street	7,056	7,059	7,182	2.37	2.36	2.44	7.1	20
L9	A5103 Roundabout WB	31,278	31,357	31,474	2.08	2.07	2.09	7.9	20
L10	A5103 south of Roundabout, NB	7,056	7,059	7,092	2.37	2.36	2.38	6.9	20
L11	A5103 SB to Princess Road	10,585	10,589	10,621	2.37	2.36	2.38	8.6	20
L12	A5103, WB from Princess Road to Mancunian Way Slip Road On WB	6,050	6,050	6,050	4.12	4.12	4.12	4.0	30
L13	A5103 Roundabout WB to Mancunian Way Slip Road On WB	6,050	6,050	6,076	4.12	4.12	4.13	4.0	30
L14	Mancunian Way Slip Road On WB	12,100	12,100	12,126	4.12	4.12	4.13	4.8	65
L15	Mancunian Way Slip Road Off EB	11,519	11,525	11,554	2.35	2.35	2.36	5.7	65
L16	Mancunian Way Slip Road Off EB, adjacent to Garwood Street	11,519	11,525	11,554	2.35	2.35	2.60	6.9	30
L17	Mancunian Way Slip Road Off EB to Medlock Street	11,519	11,525	11,674	2.35	2.35	2.41	7.1	20

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L18	A5103, WB to Roundabout	6,353	6,428	6,518	3.27	3.24	3.28	7.7	20
L19	A5103, WB to Princess Road	6,353	6,428	6,428	3.27	3.24	3.24	7.7	20
L20	Upper Mancunian Way, EB	25,535	25,535	25,535	4.82	4.82	4.82	8.5	80
L21	Upper Mancunian Way, WB	25,535	25,535	25,535	4.82	4.82	4.82	8.3	80
L22	Upper Mancunian Way, EB, west of Garwood Street	37,345	37,345	37,374	4.33	4.33	4.33	7.5	80
L23	Upper Mancunian Way, WB, west of Garwood Street	37,345	37,345	37,374	4.33	4.33	4.33	7.5	80
L24	Upper Mancunian Way, Slip Road to A5067	9,336	9,336	9,336	4.33	4.33	4.33	6.8	45
L25	Upper Mancunian Way, Slip Road from A5067	9,336	9,336	9,336	4.33	4.33	4.33	4.5	45
L26	Garwood Street, NB	422	544	590	2.38	2.30	2.63	5.3	25
L27	Garwood Street, SB	422	544	590	2.38	2.30	2.63	5.6	20
L28	Garwood Street SB to A5103	422	544	590	2.38	2.30	2.63	5.6	20
L29	Garwood Street, south of River Street	845	1,089	1,179	2.38	2.30	2.63	8.6	25
L30	Garwood Street, north of River Street	3,351	3,707	3,746	2.38	2.35	2.39	7.7	25
L31	Jackson Street, west of Garwood Street	4,477	5,615	5,647	2.44	2.35	2.37	6.8	30
L32	Jackson Street	4,477	5,615	5,647	2.44	2.35	2.37	9.4	30

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L33	City Road East, west of Shortcroft Street	4,477	5,615	5,686	2.44	2.35	2.40	9.4	30
L34	City Road East, east of Shortcroft Street	4,477	5,615	5,686	2.44	2.35	2.40	8.9	30
L35	City Road East to Medlock Street	4,477	5,615	5,686	2.44	2.35	2.40	9.4	20
L36	Medlock Street, north of River Street	22,506	23,597	23,629	2.08	2.08	2.09	18.1	30
L37	Medlock Street to River Street	22,506	23,597	23,642	2.08	2.08	2.09	12.8	25
L38	River Street, east of Site Access	1,022	1,133	1,262	2.38	2.35	2.78	8.6	25
L39	River Street, west of Site Access	950	1,061	1,190	2.56	2.51	2.95	8.2	25
L40	River Street to Hulme Street	2,620	2,620	2,633	1.82	1.82	1.84	5.9	25
L41	Wilmott Street	2,620	2,620	2,633	1.82	1.82	1.84	6.5	30
L42	Wilmott Street, south of Hulme Street	2,620	2,620	2,633	1.82	1.82	1.84	3.9	30
L43	Chester Street	654	654	667	2.38	2.38	2.47	7.6	30
L44	Chester Street to Oxford Road	654	654	667	2.38	2.38	2.47	9.9	30
L45	Albion Street	17,007	17,430	17,456	3.55	3.51	3.52	14.5	30
L46	Princess Road, SB	21,169	21,178	21,210	2.37	2.36	2.37	6.7	65
L47	Princess Road, NB	21,169	21,178	21,210	2.37	2.36	2.37	7.4	65
L48	Princess Road Slip Road, SB	5,292	5,295	5,295	2.37	2.36	2.36	4.1	50
L49	Princess Road Slip Road, NB	5,292	5,295	5,295	2.37	2.36	2.36	4.3	50
L50	Higher Cambridge Street	6,556	7,349	7,478	1.78	1.78	1.87	9.7	30

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L51	Higher Cambridge Street Roundabout	11,475	11,754	11,844	3.10	3.05	3.08	11.1	25
L52	Lower Mancunian Way, EB, west of Roundabout	12,705	12,855	12,946	3.27	3.24	3.26	8.7	30
L53	Lower Mancunian Way, WB, west of Roundabout	12,705	12,855	12,946	3.27	3.24	3.26	9.8	30
L54	Mancunian Way Slip Road On, EB	12,705	12,855	12,946	3.27	3.24	3.26	6.5	25
L55	Mancunian Way Slip Road On, EB	12,705	12,855	12,946	3.27	3.24	3.26	6.5	25
L56	Mancunian Way Slip Road On, EB	12,705	12,855	12,946	3.27	3.24	3.26	6.5	25
L57	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,946	3.27	3.24	3.26	6.1	25
L58	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,946	3.27	3.24	3.26	6.1	25
L59	Mancunian Way Slip Road, Off, WB	12,705	12,855	12,946	3.27	3.24	3.26	6.1	25
L60	Brook Street Slip Road	12,768	6,384	6,384	2.41	4.82	4.82	6.4	25
L61	Oxford Street	5,463	6,123	6,123	43.58	43.58	43.58	9.9	30
L62	Oxford Street Approaching Whitworth Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L63	Oxford Street Exiting Whitworth Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L64	Oxford Street Between Whitworth Street and Charles Street	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20

Link		24-hour AADT Flow			HDV Prop. of Fleet (%)			Road Width (m)	Avg. Vehicle Speed (km/h)
		2019	2027 DM	2027 DS	2019	2027 DM	2027 DS		
L65	Oxford Street Approaching Charles Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	10
L66	Oxford Road Exiting Charles Street Junction	5,463	6,123	6,123	43.58	43.58	43.58	9.9	10
L67	Oxford Road Between Charles Street and Mancunian Way	5,463	6,123	6,123	43.58	43.58	43.58	9.9	20
L68	Oxford Road	5,463	6,123	6,123	43.58	43.58	43.58	12.5	20
L69	Upper Mancunian Way, WB, east of Cavendish Street	25,535	25,535	25,561	4.82	4.82	4.82	8.3	80
L70	Upper Mancunian Way, EB, east of Cavendish Street	25,535	25,535	25,561	4.82	4.82	4.82	8.5	80
L71	River Street, west of Site Access	950	1,061	1,190	2.56	2.51	2.23	8.2	25

2.2.12 Reference should be made to ES Volume 4, Appendix C2 Figure 7.7 for a graphical representation of the road link locations.

Canyons

2.2.13 Where buildings or walls surround roads, pollutant dispersion patterns are altered which can lead to high pollutant concentrations. These street canyons can significantly influence air quality along a road and therefore it is important to take consideration of their effects when undertaking dispersion modelling.

2.2.14 The release of ADMS-Roads version 4.0.1.0 in December 2015 incorporated a number of new features including an advanced street canyon module, which have been retained in version 5.0.1.3. Advanced street canyon modelling allows a number of parameters to be included in the dispersion model in order to predict pollutant dispersion patterns which better reflect air flow with complex urban geometries.

2.2.15 Canyons have five principal effects on dispersion which can influence pollutant concentrations. These are:

- Pollutants are channelled along street canyons;
- Pollutants are dispersed across street canyons by circulating flow at road height;
- Pollutants are trapped in recirculation regions;
- Pollutants leave the canyon through gaps between buildings - as if there was no canyon; and,
- Pollutants leave the canyon from the canyon top.

2.2.16 The combined modelling of these effects will result in concentration patterns unique to each canyon.

2.2.17 The canyon parameters used in the assessment to represent existing conditions are outlined in Table 3. It should be noted that the "right" and "left" parameters of a number of links were purposefully included at 0 m as buildings are only present on one side of the road.

Table 3 Baseline Canyon Parameters

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L1	0.0	0.0	0.0	13.2	15.0	47.8
L27	9.6	30.6	28.9	0.0	0.0	0.0
L30	0.0	0.0	0.0	9.8	15.0	39.8
L33	7.8	20.0	55.5	7.7	16.5	81.9
L34	10.0	22.0	80.5	0.0	0.0	0.0
L36	16.5	25.0	91.8	0.0	0.0	0.0
L39	11.0	22.8	55.0	10.4	15.0	56.5
L40	7.6	25.0	33.2	0.0	0.0	0.0
L43	0.0	0.0	0.0	8.2	25.0	68.0
L44	8.5	25.0	221.0	12.2	20.0	94.0

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L61	12.5	30.0	202.5	7.1	30.0	192.5
L62	12.3	20.0	15.7	7.3	35.0	15.7
L63	12.4	30.0	16.5	8.5	25.0	16.5
L64	12.0	30.0	85.5	9.0	9.0	69.5
L65	13.0	25.0	33.7	9.6	35.0	23.4
L66	15.6	50.0	51.5	9.6	15.0	52.5
L67	15.6	50.0	104.8	10.8	17.0	111.8
L68	11.8	12.0	174.7	0.0	0.0	0.0
L71	0.0	0.0	0.0	10.4	15.0	33.8

2.2.18 A number of committed developments within the vicinity of the Site are anticipated to be completed prior to first occupation of the Proposed Development. These will affect the street topography on a number of links in close proximity to the Site. The parameters used in the assessment to represent the DM scenario are outlined in Table 4.

Table 4 Future Year Canyon Parameters - DM

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L1	9.9	43.0	57.4	13.2	15.0	47.8
L27	9.6	30.6	28.9	0.0	0.0	0.0
L30	0.0	0.0	0.0	9.8	15.0	39.8
L31	7.5	98.3	98.0	0.0	0.0	0.0
L33	7.8	20.0	55.5	7.7	16.5	81.9
L34	10.0	22.0	80.5	0.0	0.0	0.0
L36	16.5	25.0	91.8	12.9	22.5	98.0

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L38	0.0	0.0	0.0	9.6	22.5	38.3
L39	11.0	22.8	55.0	10.4	15.0	56.5
L40	7.6	25.0	33.2	0.0	0.0	0.0
L43	0.0	0.0	0.0	8.2	25.0	68.0
L44	8.5	25.0	221.0	12.2	20.0	94.0
L61	12.5	30.0	202.5	7.1	30.0	192.5
L62	12.3	20.0	15.7	7.3	35.0	15.7
L63	12.4	30.0	16.5	8.5	25.0	16.5
L64	12.0	30.0	85.5	9.0	9.0	69.5
L65	13.0	25.0	33.7	9.6	35.0	23.4
L66	15.6	50.0	51.5	9.6	15.0	52.5
L67	15.6	50.0	104.8	10.8	17.0	111.8
L68	11.8	12.0	174.7	0.0	0.0	0.0
L71	0.0	0.0	0.0	10.4	15.0	33.8

2.2.19 The Proposed Development will affect the street topography at the northern facade fronting River Street and the eastern facade fronting Medlock Street. The parameters used in the assessment to represent the DS scenario are outlined in Table 5.

Table 5 Future Year Canyons - DS

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L1	9.9	43.0	57.4	13.2	15.0	47.8
L27	9.6	30.6	28.9	0.0	0.0	0.0

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L30	0.0	0.0	0.0	9.8	15.0	39.8
L31	7.5	98.3	98.0	0.0	0.0	0.0
L33	7.8	20.0	55.5	7.7	16.5	81.9
L34	10.0	22.0	80.5	0.0	0.0	0.0
L36	16.5	25.0	91.8	12.9	22.5	98.0
L38	0.0	0.0	0.0	9.6	22.5	38.3
L39	11.0	22.8	55.0	10.4	15.0	56.5
L40	7.6	25.0	33.2	0.0	0.0	0.0
L43	0.0	0.0	0.0	8.2	25.0	68.0
L44	8.5	25.0	221.0	12.2	20.0	94.0
L61	12.5	30.0	202.5	7.1	30.0	192.5
L62	12.3	20.0	15.7	7.3	35.0	15.7
L63	12.4	30.0	16.5	8.5	25.0	16.5
L64	12.0	30.0	85.5	9.0	9.0	69.5
L65	13.0	25.0	33.7	9.6	35.0	23.4
L66	15.6	50.0	51.5	9.6	15.0	52.5
L67	15.6	50.0	104.8	10.8	17.0	111.8
L68	11.8	12.0	174.7	0.0	0.0	0.0
L71	0.0	0.0	0.0	10.4	15.0	33.8

2.2.20 A choice of two modes is provided for use in the advanced canyon module. Standard model assumes that each road is part of a continuous network of roads with similar canyon properties. Network mode analyses the road network to determine transport of pollutants between adjoining street canyons, allows for varying concentrations along the canyon and accounts for transport of pollutants out of the end of a canyon. Network mode is considered most accurate for detailed local analysis and as such was selected for use in the model.

Emission Factors

- 2.2.21 Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 11.0). This has been produced by DEFRA and incorporates COPERT 5.3 vehicle emission factors and fleet information.

Meteorological Data

- 2.2.22 Meteorological data used in the assessment was taken from Manchester Airport meteorological station over the period 1st January 2019 to 31st December 2019 (inclusive). Manchester Airport is located at NGR: 381792, 384116, which is approximately 13.2km southwest of the development. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.
- 2.2.23 All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to ES Volume 4, Appendix C2 Figure 7.2. for a wind rose of the utilised meteorological data.

Roughness Length

- 2.2.24 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 1 m was used to describe the modelling extents. This is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'cities, woodlands'.
- 2.2.25 A z_0 of 0.2 m was used to describe the meteorological site. This is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (min)'.

Monin-Obukhov Length

- 2.2.26 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30 m was used to describe the modelling extents and

meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

Background Concentrations

2.2.27 A review of DEFRA data and local monitoring results was undertaken in order to identify appropriate background values for use in the assessment. This indicated the annual mean NO₂ concentrations recorded at the MA72NO monitor during 2019 was 32.8 µg/m³, which was higher than the DEFRA background of 26.07 µg/m³. As such, the monitoring result was used for model verification in order to provide robust predictions.

2.2.28 The annual mean NO₂ concentration recorded during 2019 was adjusted to the relevant assessment years in accordance with the methodology outlined in DEFRA guidance³. This was undertaken in order to avoid overestimation of pollutant concentrations during construction and operation of the Proposed Development.

2.2.29 Background PM₁₀ and PM_{2.5} concentrations for use in the assessment were obtained from the DEFRA mapping study for the grid square containing the Site. These are outlined in the Air Quality Chapter of the ES.

NO_x to NO₂ Conversion

2.2.30 Predicted annual mean NO_x concentrations were converted to NO₂ concentrations using the spreadsheet (version 8.1) provided by DEFRA, which is the method detailed within DEFRA guidance⁴.

Verification

2.2.31 The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including:

- Estimates of background concentrations;
- Uncertainties in source activity data such as traffic flows and emission factors;

³ Local Air Quality Management Technical Guidance, (TG22), DEFRA, 2022.

⁴ Local Air Quality Management Technical Guidance, (TG22), DEFRA, 2022.

- Variations in meteorological conditions;
- Overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

2.2.32 Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality the differences between modelled and monitored results are likely to be a combination of all of these aspects.

2.2.33 For the purpose of the assessment, model verification was undertaken for 2019 using traffic data, meteorological data and monitoring results from this year. The choice of 2019 as the verification year aligns with the Institute of Air Quality Management (IAQM) position statement 'Use of 2020 and 2021 Monitoring Datasets'⁵ which states:

"If you are carrying out an air quality study that includes validation against monitoring data, use 2019 monitoring data as the last typical year"

Nitrogen Dioxide

2.2.34 Manchester City Council undertook monitoring of NO₂ concentrations at three monitors in the vicinity of roads included within the modelling extents during 2019. The results were obtained and the road contributions to total NO_x concentrations calculated following the methodology contained within DEFRA guidance⁶. The monitored annual mean NO₂ concentrations and calculated road NO_x concentrations are summarised in Table 6.

Table 6 NO_x Verification - Monitoring Results

Monitoring Site		Monitored NO ₂ Concentration (µg/m ³)	Calculated Road NO _x Concentration (µg/m ³)
AURN MAN1	Manchester Oxford Road	59.0	58.90
MA29ANO	Oxford Street	55.4	49.93
MA77NO	Hewitt Street	43.7	22.76

⁵ Use of 2020 and 2021 Monitoring Datasets, IAQM, 2021.

⁶ Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

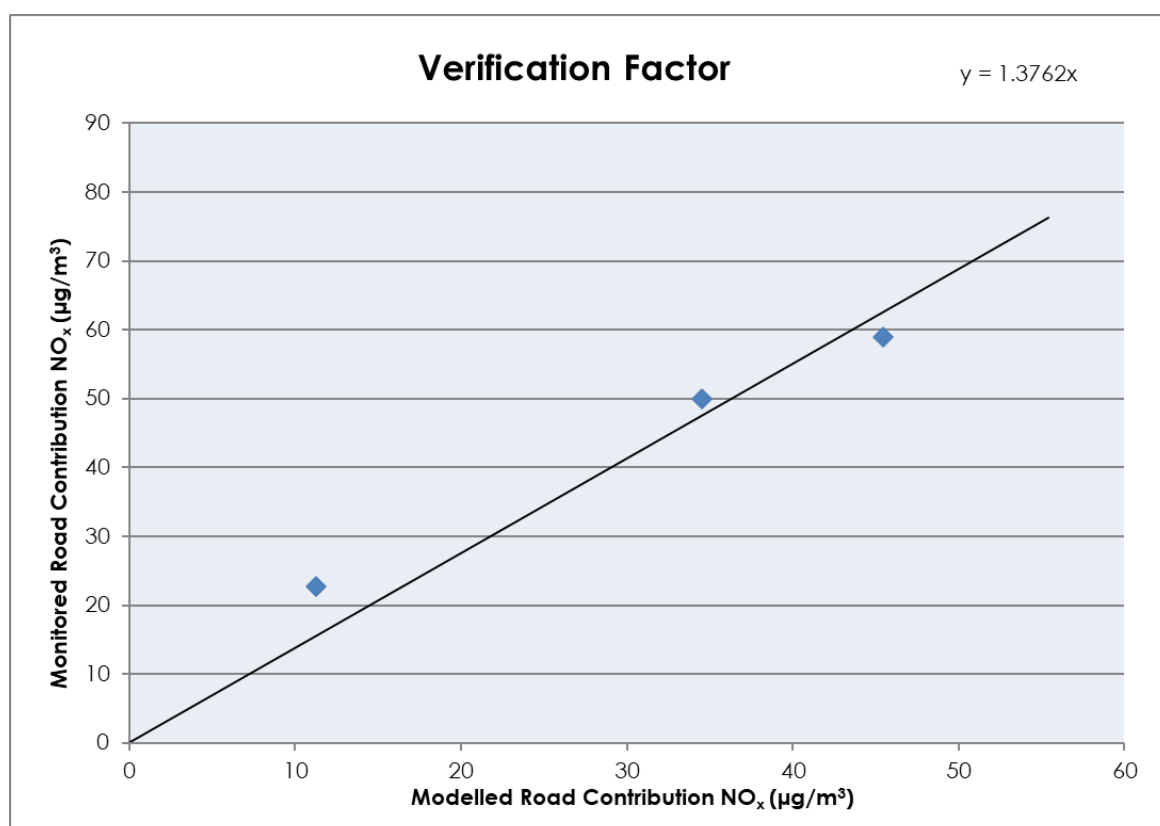
2.2.35 The annual mean road NO_x concentrations predicted from the dispersion model and the calculated 2019 road NO_x monitoring results are summarised in Table 7.

Table 7 NO_x Verification - Modelling Results

Monitoring Site		Calculated Road NO _x Concentration (µg/m ³)	Modelled Road NO _x Concentration (µg/m ³)
AURN MAN1	Manchester Oxford Road	58.90	45.44
MA29ANO	Oxford Street	49.93	34.52
MA77NO	Hewitt Street	22.76	11.28

2.2.36 The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression through zero calculated. This indicated a verification factor of 1.3762 was required to be applied to all road NO_x modelling results, as shown in Graph 1.

Graph 1 Verification Factor



Particulate Matter

2.2.37 Monitoring of PM₁₀ concentrations was undertaken at one location within the modelling extents during 2019. The monitored annual mean PM₁₀ concentration and modelled PM₁₀ concentration is shown in Table 8.

Table 8 PM₁₀ Verification

Monitoring Site		Monitored PM ₁₀ Concentration (µg/m ³)	Modelled PM ₁₀ Concentration (µg/m ³)
AURN MAN1	Manchester Oxford Road	26.0	16.0

2.2.38 The monitored and modelled PM₁₀ concentrations were compared to calculate the associated ratio. This indicated a verification factor of 1.6263 was required to be applied to all modelling results.

2.2.39 Monitoring of PM_{2.5} concentrations is not undertaken within the assessment extents. The PM₁₀ verification factor was therefore used to adjust model predictions of this species in lieu of more accurate data in accordance with DEFRA guidance⁷.

⁷ Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.