Air Quality Environmental Impact Assessment

Appendix 12.1 - Assessment Input Data

Bradley Road, Huddersfield

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1.1 Introduction

1.1.1 The proposed development has the potential to cause air quality impacts as a result of vehicles travelling to and from the site. In order to assess nitrogen dioxide (NO_2) and particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}) concentrations at sensitive locations, detailed dispersion modelling was undertaken in accordance with the following methodology.

1.2 Dispersion Model

1.2.1 Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 5.0.0.1). ADMS-Roads is developed by Cambridge Environmental Research Consultants (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 Department for Environment, Food and Rural Affairs (DEFRA).

1.2.2 The model requires 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 (z_0); and,
- Monin-Obukhov length.

1.2.3 Additional options can also be selected within the ADMS-Roads interface to take account of site specific characteristics that may affect model output, such as canyons.

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

1.3 Assessment Area

1.3.1 The assessment area was defined based on the site location and anticipated vehicle trip distribution from the development. Ambient concentrations were predicted over National

Grid Reference (NGR): 414810, 420200 to 416890, 421400. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

1.3.2 Reference should be made to Figure 12.12 in Appendix 12.2 for a map of the assessment area.

1.4 Traffic Flow Data

1.4.1 Baseline 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 Optima Highways & Transportation, the Transport Consultants for the project.

1.4.2 A summary of the traffic flow data is provided in Table A12.1.1.

Table A12.1.1 Traffic Data

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L1	M62, J25, Eastbound (EB), West of A644	61,391	67,258	67,258	70,220	70,220	13.29
L2	M62, J25, EB Slip Road, West of A644	15,348	16,815	16,815	17,555	17,555	13.29
L3	M62, J25, EB	46,043	50,444	50,444	52,665	52,665	13.29
L4	M62, J25, EB Slip Road, East of A644	15,348	16,815	17,033	17,555	18,955	13.29
L5	M62, J25, EB, East of A644	61,391	67,258	67,476	70,220	71,620	13.29
L6	M62, J25, Westbound (WB), East of A644	62,076	67,825	68,043	70,775	72,175	13.15
L7	M62, J25, WB Slip Road, East of A644	15,519	16,956	17,174	17,694	19,093	13.15
L8	M62, J25, WB	46,557	50,869	50,869	53,081	53,081	13.15
L9	M62, J25, WB Slip Road, West of A644	15,519	16,956	16,956	17,694	17,694	13.15

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L10	M62, J25, WB, West of A644	62,076	67,825	67,825	70,775	70,775	13.15
L11	A6107, Clough Lane	12,391	14,296	14,634	14,550	16,785	4.13
L12	A6107, Fixby Road, East of Broomfield Road	12,391	14,296	14,634	14,550	16,785	4.13
L13	A6107, Fixby Road, West of A641, Slow Phase (SP)	12,391	14,296	14,634	14,550	16,785	4.13
L14	A6107, Bradley Road, East of A641, SP	19,092	20,893	21,654	20,807	22,397	3.25
L15	A6107, Bradley Road, West of Shepards Thorn Lane	19,092	20,893	21,654	20,807	22,397	3.25
L16	A6107, Bradley Road, East of Shepards Thorn Lane	19,092	20,893	21,654	20,807	22,397	3.25
L17	A6107, Bradley Road, West of Dyson Wood Way	19,092	20,893	21,654	20,807	22,397	3.25
L18	A6107, Bradley Road, East of Dyson Wood Way	19,092	20,893	21,600	20,807	22,025	3.25
L19	A6107, Bradley Road, West of Lamb Cote Road	19,092	20,893	21,600	20,807	22,025	3.25
L20	A6107, Bradley Road, West of Tithe House Way	19,092	20,893	21,600	20,807	23,161	3.25
L21	A6107, Bradley Road, West of Keldregate	19,092	20,893	21,600	20,807	26,897	3.25
L22	A6107, Bradley Road, West of Oak Road	19,092	20,893	21,600	20,807	26,897	3.25
L23	A6107, Bradley Road, East of Oak Road	19,092	20,893	21,568	20,807	25,250	3.25

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L24	A6107, Bradley Road, West of A62	19,092	20,893	21,568	20,807	25,250	3.25
L25	A6107, Bradley Road, West of A62, SP	9,546	10,447	11,122	10,404	14,847	3.25
L26	B6118, Colne Bridge Road, South of A62, SP	7,618	8,216	8,340	8,471	9,294	3.08
L27	B6118, Colne Bridge Road, South of A62	15,236	16,432	16,556	16,941	17,764	3.08
L28	B6118, Colne Bridge Road	15,236	16,432	16,556	16,941	17,764	3.08
L29	B6118, Bog Green Lane	15,236	16,432	16,556	16,941	17,764	3.08
L30	A62, Leeds Road	17,376	18,737	18,769	19,493	21,140	4.33
L31	A62, Leeds Road, South of Station Road	17,376	18,737	18,769	19,493	21,140	4.33
L32	A62, Leeds Road, West of Oak Road	17,376	18,737	18,769	19,493	21,140	4.33
L33	A62, Leeds Road, East of Oak Road	17,376	18,737	18,737	19,493	19,493	4.33
L34	A62, Leeds Road, West of B6118, SP	17,376	18,737	18,737	19,493	19,493	4.33
L35	B6118, Colne Bridge Road, WB, SP	7,618	8,216	8,216	8,471	8,471	3.08
L36	A62, Leeds Road, WB, SP	9,546	10,447	10,447	10,404	10,404	3.25
L37	A62, Leeds Road, West of A6107, SP	17,376	18,737	18,737	19,493	19,493	4.33
L38	A62, Cooper Bridge Road, East of A6107, SP	26,764	28,861	29,412	29,217	32,836	5.93
L39	A62, Cooper Bridge Road, East of A6107	26,764	28,861	29,412	29,217	32,836	5.93

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L40	A62, Cooper Bridge Road, East of Fearnly Mill Drive	26,764	28,861	29,412	29,217	32,836	5.93
L41	A62, Cooper Bridge Road, South of A644	26,764	28,861	29,412	29,217	32,836	5.93
L42	A62, Cooper Bridge Road, South of A644, SP	26,764	28,861	29,412	29,217	32,836	5.93
L43	A6025, Elland Road, West of A644	16,608	19,731	19,785	21,416	21,769	3.79
L44	A6025, Elland Road, West of A644, SP	16,608	19,731	19,785	21,416	21,769	3.79
L45	Lundensheild Link, EB, East of A644, SP	8,882	10,162	10,162	11,304	11,304	4.94
L46	Lundensheild Link, EB, East of A644	8,882	10,162	10,162	11,304	11,304	4.94
L47	Lundensheild Link, EB, West of A641, SP	8,882	10,162	10,162	11,304	11,304	4.94
L48	Lundensheild Link, WB, East of A644, SP	8,882	10,162	10,162	11,304	11,304	4.94
L49	Lundensheild Link, WB, East of A644	8,882	10,162	10,162	11,304	11,304	4.94
L50	Lundensheild Link, WB, West of A641, SP	8,882	10,162	10,162	11,304	11,304	4.94
L51	A641, Bradford Road, North of Lundensheild Link	16,500	17,541	17,559	21,919	22,037	3.13
L52	A641, Bradford Road, North of Lundensheild Link, SP	16,500	17,541	17,559	21,919	22,037	3.13
L53	A644, Huddersfield Road, Southbound (SB)	9,178	11,773	11,782	11,360	11,419	5.19
L54	A644, Huddersfield Road, Northbound (NB)	9,178	11,773	11,782	11,360	11,419	5.19

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L55	A643, Clifton Road, EB	9,178	11,773	11,791	11,360	11,478	5.19
L56	A643, Clifton Road, WB	9,178	11,773	11,791	11,360	11,478	5.19
L57	A641, Huddersfield Road, NB	9,075	10,216	10,243	11,134	11,285	2.69
L58	A641, Huddersfield Road, SB	9,075	10,216	10,243	11,134	11,285	2.69
L59	A643, Clifton Common, SP	8,326	13,868	13,868	14,137	14,137	2.28
L60	A643, Clifton Common	8,326	13,868	13,868	14,137	14,137	2.28
L61	A644, Wakefield Road, South of A643, SP	18,863	21,218	21,236	21,248	21,427	7.81
L62	A644, Wakefield Road, South of A643	18,863	21,218	21,236	21,248	21,427	7.81
L63	A644, Wakefield Road, Canyon 1	18,863	21,218	21,236	21,248	21,427	7.81
L64	A644, Wakefield Road, East of Arthur Street	18,863	21,218	21,236	21,248	21,427	7.81
L65	A644, Wakefield Road, EB	9,432	10,609	10,618	10,624	10,714	7.81
L66	A644, Wakefield Road, EB, North of M62, SP	9,432	10,609	10,618	10,624	10,714	7.81
L67	A644, Wakefield Road, WB	9,432	10,609	10,618	10,624	10,714	7.81
L68	A644, Wakefield Road, WB, North of M62, SP	9,432	10,609	10,618	10,624	10,714	7.81
L69	A644, Wakefield Road, EB, South of M62, SP	9,432	10,609	10,818	10,624	11,963	7.81

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L70	A644, Wakefield Road, WB, South of M62, SP	9,432	10,609	10,818	10,624	11,963	7.81
L71	A644, Wakefield Road, West of Cooper Bridge Street	18,863	21,218	21,636	21,248	23,925	7.81
L72	A644, Wakefield Road, West of Cooper Bridge Street, SP	18,863	21,218	21,636	21,248	23,925	7.81
L73	A644, Leeds Road, East of Cooper Bridge Street, SP	20,600	22,581	22,724	22,624	23,565	6.54
L74	A644, Leeds Road	20,600	22,581	22,724	22,624	23,565	6.54
L75	A641, Bradford Road	21,952	23,334	23,814	24,361	26,126	2.96
L76	A641, Bradford Road, NB, South of Long Hill Road	10,976	11,667	11,907	12,181	13,063	2.96
L77	A641, Bradford Road, NB, South of A6107	10,976	11,667	11,934	12,181	13,240	2.96
L78	A641, Bradford Road, NB, South of A6107, SP	10,976	11,667	11,934	12,181	13,240	2.96
L79	A641, Bradford Road, SB, South of Long Hill Road	10,976	11,667	11,907	12,181	13,063	2.96
L80	A641, Bradford Road, SB, South of A6107	10,976	11,667	11,934	12,181	13,240	2.96
L81	A641, Bradford Road, SB, South of A6107, SP	10,976	11,667	11,934	12,181	13,240	2.96
L82	A641, Bradford Road, NB, North of A6107, SP	9,075	10,216	11,101	11,134	12,970	2.69
L83	A641, Bradford Road, NB, South of Site Entrance	9,075	10,216	11,101	11,134	12,970	2.69

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L84	A641, Bradford Road, NB, North of Site Entrance	9,075	10,216	10,283	11,134	12,269	2.69
L85	A641, Bradford Road, NB	9,075	10,216	10,283	11,134	12,269	2.69
L86	A641, Bradford Road, SB, North of A6107, SP	9,075	10,216	11,101	11,134	12,969	2.69
L87	A641, Bradford Road, SB, South of Site Entrance	9,075	10,216	11,101	11,134	12,969	2.69
L88	A641, Bradford Road, SB, North of Site Entrance	9,075	10,216	10,283	11,134	12,269	2.69
L89	A641, Bradford Road, SB	9,075	10,216	10,283	11,134	12,269	2.69
L90	A641, Bradford Road, South of Toothill Lane	18,150	20,432	20,565	22,267	24,538	2.69
L91	A641, Bradford Road, North of Toothill Lane	18,150	20,432	20,556	22,267	23,090	2.69
L92	A641, Huddersfield Road, South of Gooder Lane	18,150	20,432	20,556	22,267	23,090	2.69
L93	A641, Huddersfield Road, South of Cliffe Road	18,150	20,432	20,556	22,267	23,090	2.69
L94	A641, Huddersfield Road, South of Mill Royd Street	18,150	20,432	20,556	22,267	23,090	2.69
L95	A641, Huddersfield Road, North of Mill Royd Street	18,150	20,432	20,486	22,267	22,620	2.69
L96	A641, Huddersfield Road, Canyon 2	18,150	20,432	20,486	22,267	22,620	2.69
L97	A643, Bramston Street, South of George Street	12,250	12,560	12,632	13,553	13,972	2.03

Link		24-hour AADT Flow					HDV Prop. of Fleet (%)
		Verif.	2029 DM Bradley Villa Farm Phase	2029 DS Bradley Villa Farm Phase	2034 DM Full Allocation	2034 DS Full Allocation	
L98	A643, Bramston Street, Canyon 3	12,250	12,560	12,632	13,553	13,972	2.03
L99	A643, Halifax Road, North of Bridge End	17,667	18,545	18,617	19,461	19,880	2.68
L100	A643, Halifax Road, North of Mill Royd Street	17,667	18,545	18,617	19,461	19,880	2.68
L101	A643, Halifax Road, Canyon 4	17,667	18,545	18,617	19,461	19,880	2.68
L102	A643, Halifax Road, South of Elland Road	17,667	18,545	18,617	19,461	19,880	2.68
L103	A644, Halifax Road, North of Elland Road, Canyon 5	13,977	14,232	14,250	14,288	14,349	3.04
L104	A644, Halifax Road, North of Elland Road	13,977	14,232	14,250	14,288	14,349	3.04
R1	Clifton Interchange	12,432	13,747	13,956	14,124	15,463	13.29
R2	A6107/A641 Roundabout	11,931	13,159	14,044	13,664	15,500	4.13
R3	B6118 Roundabout	15,236	16,432	16,708	16,941	18,750	3.08
R4	A644/A62 Roundabout	22,076	24,220	24,282	24,363	24,775	7.81
R5	A6025/A644 Roundabout	13,203	14,566	14,602	15,555	15,764	4.94
R6	A644/A641 Roundabout	10,524	12,282	12,291	13,449	13,508	5.19
R7	A643/A644 Roundabout	11,386	14,658	14,676	14,526	14,644	7.81
R8	A641 Roundabout	14,635	15,556	15,796	16,241	17,123	2.96

1.4.3 Reference should be made to Figure 12.12 in Appendix 12.2 for a graphical representation of the road link locations.

1.4.4 Road widths were estimated from aerial photography and UK highway design standards. A summary of the link parameters is provided in Table A12.1.2.

Table A12.1.2 Road Parameters

Link		Road Width (m)	Average Vehicle Speed (km/h)
L1	M62, J25, EB West of A644	11.2	100
L2	M62, J25, EB Slip Road, West of A644	6.8	75
L3	M62, J25, EB	11.1	100
L4	M62, J25, EB Slip Road, East of A644	6.9	75
L5	M62, J25, EB, East of A644	11.3	100
L6	M62, J25, WB, East of A644	11.1	100
L7	M62, J25, WB Slip Road, East of A644	6.6	75
L8	M62, J25, WB	11.0	100
L9	M62, J25, WB Slip Road, West of A644	6.7	75
L10	M62, J25, WB, West of A644	11.1	100
L11	A6107, Clough Lane	11.7	40
L12	A6107, Fixby Road, East of Broomfield Road	10.6	60
L13	A6107, Fixby Road, West of A641, SP	14.7	25
L14	A6107, Bradley Road, East of A641, SP	14.5	25
L15	A6107, Bradley Road, West of Shepards Thorn Lane	10.1	45
L16	A6107, Bradley Road, East of Shepards Thorn Lane	10.2	40
L17	A6107, Bradley Road, West of Dyson Wood Way	15.1	30
L18	A6107, Bradley Road, East of Dyson Wood Way	13.6	30
L19	A6107, Bradley Road, West of Lamb Cote Road	10.4	45
L20	A6107, Bradley Road, West of Tithe House Way	10.2	50
L21	A6107, Bradley Road, West of Keldregate	10.1	50
L22	A6107, Bradley Road, West of Oak Road	11.9	40
L23	A6107, Bradley Road, East of Oak Road	12.4	40

Link		Road Width (m)	Average Vehicle Speed (km/h)
L24	A6107, Bradley Road, West of A62	13.8	35
L25	A6107, Bradley Road, West of A62, SP	11.3	25
L26	B6118, Colne Bridge Road, South of A62, SP	13.1	25
L27	B6118, Colne Bridge Road, South of A62	11.1	40
L28	B6118, Colne Bridge Road	6.9	40
L29	B6118, Bog Green Lane	7.5	55
L30	A62, Leeds Road	7.8	50
L31	A62, Leeds Road, South of Station Road	12.7	45
L32	A62, Leeds Road, West of Oak Road	9.8	40
L33	A62, Leeds Road, East of Oak Road	10.4	35
L34	A62, Leeds Road, West of B6118, SP	11.2	25
L35	B6118, Colne Bridge Road, WB, SP	6.3	25
L36	A62, Leeds Road, WB, SP	6.6	25
L37	A62, Leeds Road, West of A6107, SP	14.2	25
L38	A62, Cooper Bridge Road, East of A6107, SP	20.1	30
L39	A62, Cooper Bridge Road, East of A6107	12.8	45
L40	A62, Cooper Bridge Road, East of Fearnly Mill Drive	8.7	35
L41	A62, Cooper Bridge Road, South of A644	9.2	30
L42	A62, Cooper Bridge Road, South of A644, SP	16.1	25
L43	A6025, Elland Road, West of A644	7.6	40
L44	A6025, Elland Road, West of A644, SP	14.1	25
L45	Lundensheild Link, EB, East of A644, SP	9.5	25
L46	Lundensheild Link, EB, East of A644	7.1	40
L47	Lundensheild Link, EB, West of A641, SP	8.5	25
L48	Lundensheild Link, WB, East of A644, SP	7.9	25
L49	Lundensheild Link, WB, East of A644	7.1	40

Link		Road Width (m)	Average Vehicle Speed (km/h)
L50	Lundensheild Link, WB, West of A641, SP	8.8	25
L51	A641, Bradford Road, North of Lundensheild Link	10.7	35
L52	A641, Bradford Road, North of Lundensheild Link, SP	15.1	25
L53	A644, Huddersfield Road, Southbound (SB)	10.4	35
L54	A644, Huddersfield Road, Northbound (NB)	9.7	35
L55	A643, Clifton Road, EB	6.2	40
L56	A643, Clifton Road, WB	7.5	40
L57	A641, Huddersfield Road, NB	8.3	40
L58	A641, Huddersfield Road, SB	6.9	40
L59	A643, Clifton Common, SP	6.9	25
L60	A643, Clifton Common	7.4	40
L61	A644, Wakefield Road, South of A643, SP	10.9	25
L62	A644, Wakefield Road, South of A643	9.5	40
L63	A644, Wakefield Road, Canyon 1	6.8	50
L64	A644, Wakefield Road, East of Arthur Street	7.5	60
L65	A644, Wakefield Road, EB	8.9	60
L66	A644, Wakefield Road, EB, North of M62, SP	9.3	25
L67	A644, Wakefield Road, WB	7.9	60
L68	A644, Wakefield Road, WB, North of M62, SP	9.8	25
L69	A644, Wakefield Road, EB, South of M62, SP	7.3	25
L70	A644, Wakefield Road, WB, South of M62, SP	8.5	25
L71	A644, Wakefield Road, West of Cooper Bridge Street	10.6	40
L72	A644, Wakefield Road, West of Cooper Bridge Street, SP	11.2	25
L73	A644, Leeds Road, East of Cooper Bridge Street, SP	23.5	25
L74	A644, Leeds Road	11.3	35
L75	A641, Bradford Road	21.9	60

Link		Road Width (m)	Average Vehicle Speed (km/h)
L76	A641, Bradford Road, NB, South of Long Hill Road	9.6	30
L77	A641, Bradford Road, NB, South of A6107	6.5	50
L78	A641, Bradford Road, NB, South of A6107, SP	8.2	25
L79	A641, Bradford Road, SB, South of Long Hill Road	9.3	30
L80	A641, Bradford Road, SB, South of A6107	7.3	50
L81	A641, Bradford Road, SB, South of A6107, SP	8.6	25
L82	A641, Bradford Road, NB, North of A6107, SP	8.9	25
L83	A641, Bradford Road, NB, South of Site Entrance	6.8	55
L84	A641, Bradford Road, NB, North of Site Entrance	6.9	55
L85	A641, Bradford Road, NB	7.4	60
L86	A641, Bradford Road, SB, North of A6107, SP	8.6	25
L87	A641, Bradford Road, SB, South of Site Entrance	6.9	55
L88	A641, Bradford Road, SB, North of Site Entrance	7.1	55
L89	A641, Bradford Road, SB	7.5	60
L90	A641, Bradford Road, South of Toothill Lane	9.7	60
L91	A641, Bradford Road, North of Toothill Lane	8.9	60
L92	A641, Huddersfield Road, South of Gooder Lane	6.3	40
L93	A641, Huddersfield Road, South of Cliffe Road	7.5	30
L94	A641, Huddersfield Road, South of Mill Royd Street	8.4	35
L95	A641, Huddersfield Road, North of Mill Royd Street	8.5	35
L96	A641, Huddersfield Road, Canyon 2	9.9	35
L97	A643, Bramston Street, South of George Street	7.6	45
L98	A643, Bramston Street, Canyon 3	10.2	30
L99	A643, Halifax Road, North of Bridge End	6.2	35
L100	A643, Halifax Road, North of Mill Royd Street	8.7	35
L101	A643, Halifax Road, Canyon 4	7.3	35

Link		Road Width (m)	Average Vehicle Speed (km/h)
L102	A643, Halifax Road, South of Elland Road	15.1	40
L103	A644, Halifax Road, North of Elland Road, Canyon 5	9.1	25
L104	A644, Halifax Road, North of Elland Road	7.4	40
R1	Clifton Interchange	11.2	40
R2	A6107/A641 Roundabout	8.9	30
R3	B6118 Roundabout	9.6	30
R4	A644/A62 Roundabout	10.7	30
R5	A6025/A644 Roundabout	7.9	30
R6	A644/A641 Roundabout	10.2	30
R7	A643/A644 Roundabout	8.7	30
R8	A641 Roundabout	10.7	30

1.5 Canyons

1.5.1 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.

1.5.2 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 5.0.0.1. 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 within complex urban geometries.

1.5.3 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.

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

1.5.5 The canyon parameters used in the assessment are outlined in Table A12.1.3.

Table A12.1.3 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
L63	5.7	7.0	145.6	9.1	6.0	145.6
L96	8.1	11.0	74.5	6.8	8.5	43.6
L98	5.8	7.5	42.9	0.0	0.0	0.0
L101	0.0	0.0	0.0	7.2	9.5	55.2
L103	11.9	8.7	32.9	7.0	2.0	65.8

1.5.6 A choice of two modes is provided for use in the advanced canyon module. Standard mode 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.

1.6 Emission Factors

1.6.1 Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 10.1). This has been produced by DEFRA and incorporates COPERT 5.3 vehicle emission factors and fleet information.

1.6.2 There is current uncertainty over NO_2 concentrations within the UK, with the implementation of new vehicle emission standards not resulting in the previously expected reduction in roadside levels. Therefore, 2019 emission factors were utilised in preference to the development opening year in order to provide robust model outputs. As predictions for 2019 were verified, it is considered the results are a robust indication of worst case concentrations for the future year.

1.7 Meteorological Data

1.7.1 Meteorological data used in the assessment was taken from Bingley meteorological station over the period 1st January 2019 to 31st December 2019 (inclusive). Bingley Airport is located at NGR: 408874, 435015, which is approximately 15.7km north-west 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.

1.7.2 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 Figure 12.2 in for a wind rose of the utilised meteorological data.

1.8 Roughness Length

1.8.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.5m 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 'parkland, open suburbia'.

1.8.2 A z_0 of 0.3m was used to describe the meteorological site. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (max)'.

1.9 Monin-Obukhov Length

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

value is considered appropriate for the nature of the area and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

1.9.2 Monin-Obukhov length of 1m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-Roads as being suitable for 'rural areas'.

1.10 Background Concentrations

1.10.1 Annual mean NO_2 and PM_{10} background concentrations were taken from the DEFRA mapping study for the grid square containing the LV-62E and LV-62W monitoring positions, NGR: 416500, 422500. These are shown in Table A12.1.4.

Table A12.1.4 Background Pollutant Concentration

Pollutant	Predicted 2019 Background Concentration (µg/m^3)
NO_2	21.35
PM_{10}	13.59

1.10.2 The values shown in Table A12.1.4 were chosen to represent concentrations throughout the dispersion modelling extents without the contribution from road vehicles as they were higher than the DEFRA background for the grid square containing the site, as shown in Table 14 in Chapter 12 - Air Quality.

1.10.3 Similarly to emission factors, background concentrations from 2019 were utilised in preference to the opening year. This provided a robust assessment and is likely to overestimate pollutant concentrations during the operation of the proposal.

1.11 NO_x to NO_2 Conversion

1.11.1 Predicted annual mean oxides of nitrogen (NO_x) concentrations were converted to NO_2 concentrations using the spreadsheet (version 8.1) provided by DEFRA, which is the method detailed within DEFRA guidance[1].

[1] Local Air Quality Management (TG16), DEFRA, 2018.

1.12 Verification

1.12.1 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;
- Variations in meteorological conditions;
- Overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

1.12.2 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.

1.12.3 For the purpose of the assessment model verification was undertaken for 2019 using traffic data, meteorological data and monitoring results from this year.

1.12.4 Kirklees and Calderdale Councils undertook monitoring of NO_2 concentrations at 14 locations within the vicinity of roads included within the model during 2019. The results were obtained and the road contribution to total NO_x concentrations calculated following the methodology contained within DEFRA guidance[2]. The monitored annual mean NO_2 concentrations and calculated road NO_x concentrations are summarised in Table A12.1.5.

Table A12.1.5 Verification - Monitoring Results

Monitoring Location		Monitored NO_2 Concentration ($\mu g/m^3$)	Calculated Road NO_x Concentration ($\mu g/m^3$)
K6	Leeds Road - Cooper Bridge	37.9	33.37
K9	Bradley Road	34.4	25.91
K10	Leeds Road Bradley 1	34.5	26.06
K12	Leeds Road Bradley 2	27.4	11.56
K22	Leeds Road Bradley 3	33.4	23.82

[2] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.

Monitoring Location		Monitored NO_2 Concentration (µg/m³)	Calculated Road NO_x Concentration (µg/m³)
LV-62E	Wakefield Road	36.0	29.30
LV-62W	Wakefield Road	37.0	31.44
WR2	Wakefield Road	33.0	22.99
LV-BRD	Bradford Road	27.0	10.87
HXR1	Halifax Road	42.0	42.46
BH3	Huddersfield Road	43.0	44.72
BE4	Briggate	42.0	42.46
BE2	Bramston Street	35.0	27.18
LV-LEE	Cooper Bridge Road	27.0	10.87

1.12.5 The annual mean road NO_x concentrations predicted from the dispersion model and the 2019 road NO_x concentrations calculated from the monitoring results are summarised in Table A12.1.6.

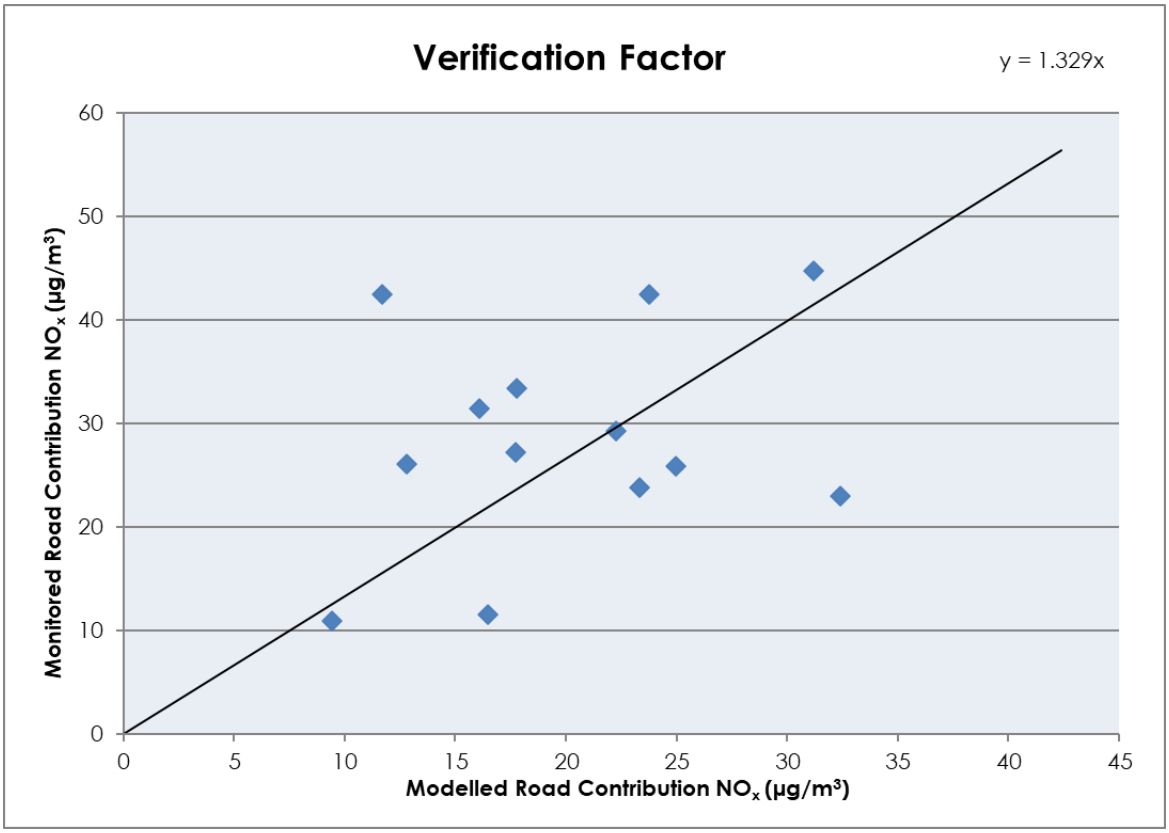
Table A12.1.6 Verification - Modelling Results

Monitoring Location		Monitored NO_2 Concentration (µg/m³)	Modelled Road NO_x Concentration (µg/m³)
K6	Leeds Road - Cooper Bridge	33.37	17.78
K9	Bradley Road	25.91	24.94
K10	Leeds Road Bradley 1	26.06	12.80
K12	Leeds Road Bradley 2	11.56	16.47
K22	Leeds Road Bradley 3	23.82	23.31
LV-62E	Wakefield Road	29.30	22.24
LV-62W	Wakefield Road	31.44	16.11
WR2	Wakefield Road	22.99	32.41
LV-BRD	Bradford Road	10.87	9.44
HXR1	Halifax Road	42.46	11.71
BH3	Huddersfield Road	44.72	31.18
BE4	Briggate	42.46	23.78

Monitoring Location		Monitored NO_2 Concentration (µg/m³)	Modelled Road NO_x Concentration (µg/m³)
BE2	Bramston Street	27.18	17.75
LV-LEE	Cooper Bridge Road	10.87	14.64

1.12.6 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 that a verification factor of 1.329 was required to be applied to all road NO_x modelling results, as shown in Graph 12.1.

Graph 12.1 NO_x Verification Factor



1.12.7 Monitoring of PM_{10} concentrations is not undertaken within the assessment extents. The NO_x verification factor was therefore used to adjust PM_{10} model predictions in lieu of more accurate data in accordance with DEFRA guidance[3].

[3] Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018.