STRIDE TREGLOWN

Appendix 9.1 – Air Quality: Assessment Input Data

Environmental Statement

Ellel Holiday Village, Lancaster

Appendix 10.1 - Assessment Input Data

Ellel Gardens, Galgate, Lancaster

6260

21st August 2020

Revision A

1 Appendix 1 - Assessment Input Data

Introduction

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.

Dispersion Model

1.2 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).

1.3 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.

1.4 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.

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

Assessment Area

1.6 The assessment area was defined based on the development location, the anticipated access routes and the positioning of residential properties. Ambient concentrations were predicted over the area National Grid Reference (NGR): 346820, 452660 to 349740, 455580. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

1.7 Reference should be made to Figure 10.8 for a graphical representation of Assessment Area grid extents.

Traffic Flow Data

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

1.9 Baseline traffic data was converted to the site opening year utilising a factor obtained from TEMPro (Version 7.2). This software package has been developed by the Department for Transport (DfT) to calculate future traffic growth throughout the UK.

1.10 A summary of the traffic data used in the assessment is provided in Table A10.1.

Link		24-hour AADT Flow			HDV Proportion (%)		
		2018	2023 DM	2023 DS	2018	2023 DM	2023 DS
L1	A6, Preston Lancaster Road, South of Site Entrance 2	12,472	14,867	15,186	6.22	6.22	6.09
L2	A6, Preston Lancaster Road, North of Site Entrance 2	12,472	14,867	15,909	6.22	6.22	6.09
L3	A6, Preston Lancaster Road, Northbound (NB), South of M6 Junction 33, Slow Phase (SP)	6,236	7,434	7,959	6.22	6.22	6.09

Link		24-hour AADT Flow			HDV Proportion (%)		
		2018	2023 DM	2023 DS	2018	2023 DM	2023 DS
L4	A6, Preston Lancaster Road, Southbound (SB), South of M6 Junction 33, SP	6,236	7,434	7,950	6.22	6.22	6.09
L5	A6, Preston Lancaster Road, NB, North of M6 Junction 33, SP	8,503	10,135	10,268	3.51	3.51	3.47
L6	A6, Preston Lancaster Road, NB, North of M6 Junction 33, SP	8,503	10,135	10,270	3.51	3.51	3.47
L7	A6. Preston Lancaster Road, North of M6 Junction 33	17,005	20,271	20,538	3.51	3.51	3.47
L8	A6. Preston Lancaster Road, South of Skew Bridge Lane	17,005	20,271	20,538	3.51	3.51	3.47
L9	A6, Main Road, North of Skew Bridge Lane	17,005	20,271	20,538	3.51	3.51	3.47
L10	A6, Main Road, South of Stoney Lane, SP	17,005	20,271	20,538	3.51	3.51	3.47
L11	A6, Main Road, North of Stoney Lane, SP	17,005	20,271	20,538	3.51	3.51	3.47
L12	A6, Main Road, South of Chapel Lane	17,005	20,271	20,538	3.51	3.51	3.47
L13	A6, Preston Lancaster Road, North of Chapel Lane	17,005	20,271	20,538	3.51	3.51	3.47
L14	M6, NB, South of Junction 33	36,513	43,525	44,328	12.13	12.13	11.91
L15	M6, NB	26,711	31,840	31,840	13.52	13.52	13.46
L16	M6, NB, North of Junction 33	34,716	41,382	41,570	13.52	13.52	13.46
L17	M6, SB, North of Junction 33	34,716	41,382	41,570	13.52	13.52	13.46
L18	MB, SB	26,711	31,840	31,840	13.52	13.52	13.46
L19	M6, SB, South of Junction 33	36,513	43,525	44,328	12.13	12.13	11.91
L20	M6, Junction 33, Eastbound (EB), East of A6, SP	10,223	12,186	13,177	6.57	6.57	6.08
L21	M6, Junction 33, EB	10,223	12,186	13,177	6.57	6.57	6.08
L22	M6, NB, Junction 33 on-slip	8,679	10,345	10,535	13.52	13.52	13.46
L23	M6, SB, Junction 33 on-slip	9,128	10,881	11,691	12.13	12.13	11.91
L24	M6, SB, Junction 33 off-slip	8,679	10,345	11,142	13.52	13.52	13.46
L25	M6, Junction 33, Westbound (WB)	9,128	10,881	11,067	12.13	12.13	11.91
L26	M6, NB, Junction 33 off-slip	10,223	12,186	13,177	6.57	6.57	6.08
L27	M6, Junction 33, WB, East of A6, SP	10,223	12,186	13,177	6.57	6.57	6.08
R1	A6/M6 Roundabout	8,320	9,918	10,467	6.57	6.57	6.08

Table A10.1: Traffic Data

1.11 Reference should be made to Figure 10.8 for a graphical representation of the road link locations.

1.12 Road widths were estimated from aerial photography and UK highway design standards. A summary of the link parameters is provided in Table A10.2.

	Link	Road Width (m)	Average Vehicle Speed (km/h)
L1	A6, Preston Lancaster Road, South of Site Entrance 2	9.8	70
L2	A6, Preston Lancaster Road, North of Site Entrance 2	9.9	70
L3	A6, Preston Lancaster Road, NB, South of M6 Junction 33, SP	10.3	25
L4	A6, Preston Lancaster Road, Southbound (SB), South of M6 Junction 33, SP	7.6	25
L5	A6, Preston Lancaster Road, NB, North of M6 Junction 33, SP	7.8	25
L6	A6, Preston Lancaster Road, NB, North of M6 Junction 33, SP	8.4	25
L7	A6. Preston Lancaster Road, North of M6 Junction 33	8.1	70
L8	A6. Preston Lancaster Road, South of Skew Bridge Lane	7.6	45
L9	A6, Main Road, North of Skew Bridge Lane	6.5	30
L10	A6, Main Road, South of Stoney Lane, SP	7.2	25
L11	A6, Main Road, North of Stoney Lane, SP	7.5	25
L12	A6, Main Road, South of Chapel Lane	6.8	30
L13	A6, Preston Lancaster Road, North of Chapel Lane	8.3	70
L14	M6, NB, South of Junction 33	11.4	100
L15	M6, NB	11.5	100
L16	M6, NB, North of Junction 33	10.9	100
L17	M6, SB, North of Junction 33	10.9	100
L18	MB, SB	10.8	100
L19	M6, SB, South of Junction 33	11.2	100
L20	M6, Junction 33, EB, East of A6, SP	7.8	25
L21	M6, Junction 33, EB	8.3	75
L22	M6, NB, Junction 33 on-slip	8.6	75
L23	M6, SB, Junction 33 on-slip	7.5	75
L24	M6, SB, Junction 33 off-slip	7.4	75
L25	M6, Junction 33, WB	7.1	75
L26	M6, NB, Junction 33 off-slip	7.7	75
L27	M6, Junction 33, WB, East of A6, SP	9.2	25
R1	A6/M6 Roundabout	10.6	45

Table A10.2: Road Parameters

1.13 Reference should be made to Figure 10.8 for a graphical representation of the road link locations.

Canyons

1.14 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.

1.15 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.

1.16 Canyons have five principle 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 canyons; and,
- Pollutants leave the canyon from the canyon top.

1.17 The combined modelling of these effects will result in concentration patterns unique to each canyon. The parameters used in the assessment are outlined in Table A10.3.

Link	Parameter (m)					
	Canyon Width to left	Avg. Height to Left	Building Length left	Canyon Width Right	Avg. Height to Right	Building Length Right
L9	5.3	6.5	46.9	8.1	6.5	51.5
L10	5.7	7.5	23.8	9.4	6.5	18.9
L11	8.1	5.5	22.5	6	7	43.7
L12	9.9	6.5	125.3	11.2	6.5	145.2

Table A10.3: Canyon Parameters

1.18 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 model 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

1.19 Emission factors for each link were calculated using the relevant traffic flows and the Emission Factor Toolkit (version 9.0). This has been produced by DEFRA and incorporates COPERT 5 vehicles emission factors and fleet information.

1.20 There is currently uncertainty over NO_2 concentrations within the UK, with the implementation of new vehicles emission standards not resulting in the previously expected reduction in roadside levels. Therefore, 2018 emission factors were utilised in preference to the development opening year in order to provide robust model outputs. As predictions for 2018 were verified, it is considered the results are a robust indication of worst case concentrations for the future year.

Meteorological Data

1.21 Meteorological data used in the assessment was taken from Blackpool Airport Meteorological Station over the period 1st January 2018 to 31st December 2018 (inclusive). Blackpool Airport Meteorological Station is located at NGR: 332308, 430915, which is approximately 28km south-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.

1.22 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 10.2 for a wind rose of the utilised meteorological data.

Roughness Length

1.23 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 0.3m was used to describe the modelling extents. This value is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (max)'.

1.24 A z_0 of 0.1m was used to describe the meteorological site. This value is considered appropriate for the morphology of the area due to the large expanse of flat land use, such as runways and surrounding grassland, and is suggested within ADMS-Roads as being suitable for 'root crops'.

Monin-Obukhov Length

1.25 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10m 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 'small towns <50,000'.

1.26 A minimum Monin-Obukhov length of 30m 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 'cities and large towns'.

Background Concentrations

1.27 Background concentrations provided by DEFRA were used in the assessment to represent annual mean NO_2 and PM_{10} levels in the vicinity of the site, as shown in Table 10.13, Chapter 10 of the Environmental Statement (ES).

1.28 Similarly to emission factors, background concentrations from 2018 were utilised in preference to the development opening year. This provided a robust assessment and is likely to overestimate pollutant concentrations during the operation of the proposal.

NO_x to NO_2 Conversion

1.29 Predicted annual mean NO_X concentrations were converted to NO_2 concentrations using the spreadsheet (version 7.1) provided by DEFRA, which is the method detailed within DEFRA guidance[1].

Verification

1.30 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.

1.31 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.

1.32 For the purpose of this assessment model verification was undertaken for 2018 using traffic data, meteorological data and monitoring results from this year.

1.33 Lancaster City Council (LCC) undertook monitoring of NO_2 concentrations at four locations within the vicinity of roads included within the model during 2018. The results were obtained and the road contributions to total NO_x concentrations calculated following the methodology contained within DEFRA guidance[1]. The monitored annual mean NO_2 concentrations and calculated road NO_x concentrations are summarised in Table A10.4.

Monitoring Location		Monitored NO_2 Concentration ($\mu g/m^3$)	Modelled Road NO_x Concentration ($\mu g/m^3$)
V	Galgate	33.0	41.2
Z	Galgate	33.0	41.2
ZB	Galgate	24.0	21.9
ZC	Galgate	31.0	36.7

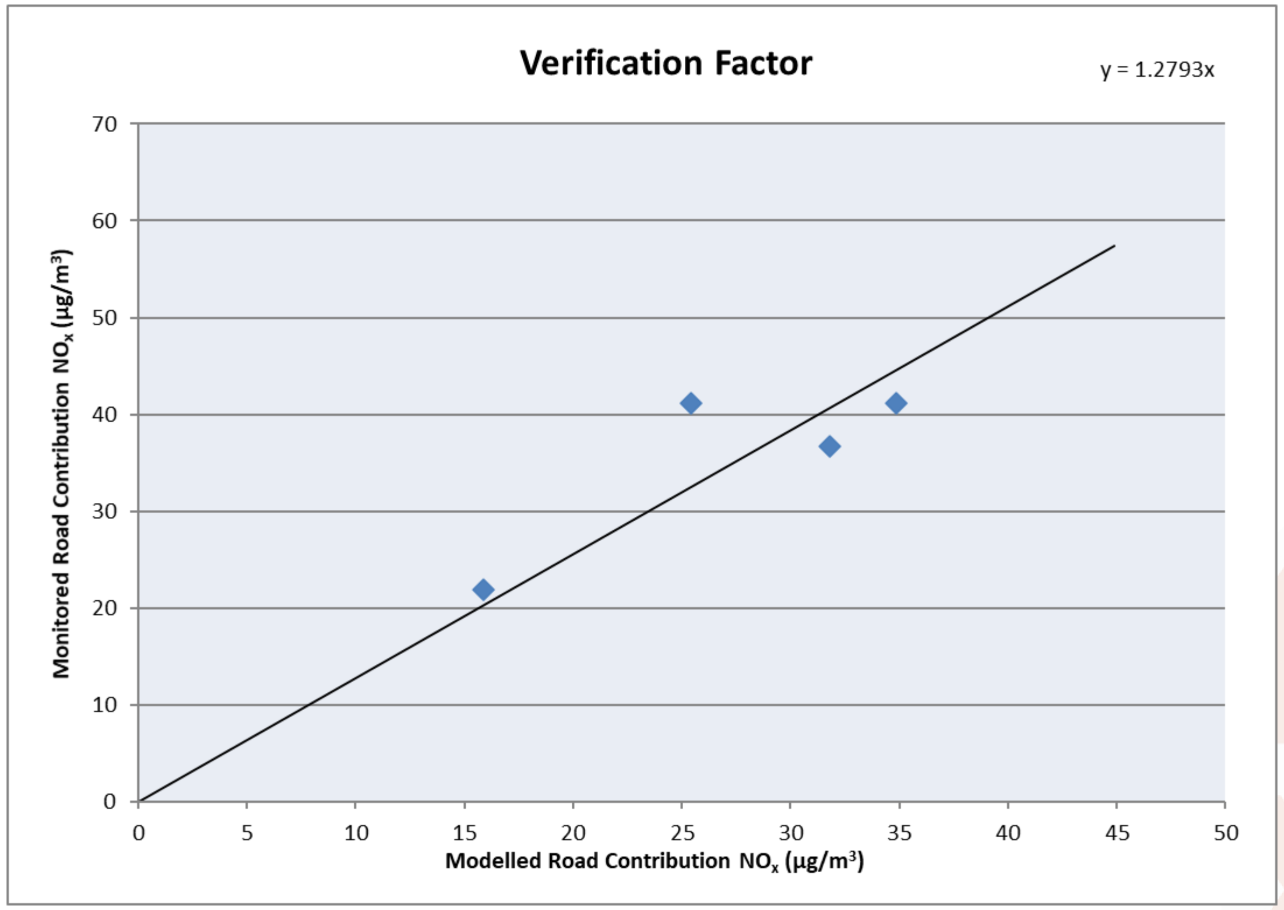
Table A10.4: NO_x Verification - Monitoring Results

1.34 The annual mean road NO_x concentrations predicted from the dispersion model and the road NO_x concentrations calculated from the 2018 monitoring result are summarised in Table A10. 5.

Monitoring Location		Calculated Road NO_x Concentration ($\mu g/m^3$)	Modelled Road NO_x Concentration ($\mu g/m^3$)
V	Galgate	41.2	34.9
Z	Galgate	41.2	25.4
ZB	Galgate	21.9	15.9
ZC	Galgate	36.7	31.8

Table A10. 5: NO_x Verification - Modelling Results

1.35 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 1.2793 was required to be applied to all NO_x modelling results, as shown in Graph A10.1.



Graph A10.1: NO_x Verification Factor

1.36 Monitoring of PM_{10} concentrations are not undertaken within the assessment extents. The NO_x verification factor was therefore used to adjust PM_{10} model predictions in accordance with DEFRA guidance[1].

2 References

1 Local Air Quality Management Technical Guidance (TG16), DEFRA, 2018