SYMMETRY PARK – ARDLEY

Environmental Statement – Chapter 6 Appendices

Prepared for: Tritax Symmetry (Ardley) Limited

SLR Ref: 422.12729.00001
Version No: v1.1
December 2021

BASIS OF REPORT

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6.0 AIR QUALITY

APPENDIX 6.1 – Road Traffic Emissions Assessment Methodology

Detailed dispersion modelling has been undertaken using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads v5.0.0.1 dispersion model, focussing on concentrations of NO_2, PM_{10} and $PM_{2.5}$ for the following scenarios:

- 2019 Base Case (2019 B) – Base flows for the year (2019);
- 2025 Do Minimum (2025 DM) – Without development flows for the assumed year of opening (2025), inclusive of relevant committed development flows for cumulative impact assessment; and
- 2025 Do Something (2025 DS) – 'Do Minimum' flows, plus all trips associated with the Proposed Development flows for the proposed year of opening (2025).

For the above future year scenarios (2025), concurrent emission factors and background pollutant concentrations have been used.

Traffic Inputs

The traffic flows used for the future assessment years includes vehicle movements associated with relevant committed developments in the assessment area. As such, the dispersion modelling exercise is inherently cumulative in nature.

The Emissions Factors Toolkit (EFT) version 11.0 developed by Defra[1] has been used to determine vehicle emission factors for input into the ADMS-Roads dispersion model.

Traffic speeds were modelled at the relevant speed limit for each road. However, where appropriate, the speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue in accordance with LAQM.TG(16).

To initially inform the spatial extent of the model, changes in traffic volumes on the local road network were compared to screening thresholds provided within EPUK-IAQM guidance. Details of the traffic flows used in this assessment are provided in Table 6-1, whilst the modelled roads in relation to the Site are presented in Figure 6-4 Appendix 6.5.

Table 6-1
Traffic Data Used Within the Assessment

Road Link	2019 BC		2025 DM		2025 DS		Speed (mph) [a]
	AADT	% HDV	AADT	% HDV	AADT	% HDV	
B430 (Ardley) [b]	8150	5.0	16120	5.0	16466	4.9	40
A43 South of Baynards Green	33800	15.0	43280	15.0	46176	17.1	50
A43 North of Baynards Green	37000	12.0	45940	12.5	47301	13.7	70
B4100 West of Baynards Green	6900	3.0	12170	12.5	12533	12.1	60
B4100 West of M40 J10 application site	n/a	n/a	7920	2.5	8283	2.4	60
B4100 East of Baynards Green	12350	4.0	17880	8.0	21468	7.2	60

[1] Defra, EFT v11.0 (2021).

Road Link	2019 BC		2025 DM		2025 DS		Speed
B4100 East of Site Access	n/a	n/a	17370	4.0	20958	3.8	60
B4100 North of Bicester	12000	4.0	18940	4.0	22528	3.9	40
A4095 East of B4100	17700	4.0	21485	4.0	22386	4.0	50
A4095 West of B4100	13772	2.0	18150	2.0	19051	2.1	50
(a) Traffic speeds have been adjusted to take into account queues and congestion in accordance with LAQM.TG(16). (b) Modelled for verification only, Development traffic increases fall below the EPUK-IAQM screening criteria.							

Meteorological Data

The dispersion modelling has been undertaken using 2019 data from the Benson meteorological station, located approximately 30km to the south of Bicester. LAQM.TG(16) recommends that meteorological data should have a percentage of usable hours greater than 85%. 2019 meteorological data from Benson meteorological station includes 8,666 lines of usable hourly data out of the total 8,760 for the year, i.e. 98.9% usable data. This is therefore suitable for the dispersion modelling exercise. A windrose is presented in Figure 6-1.

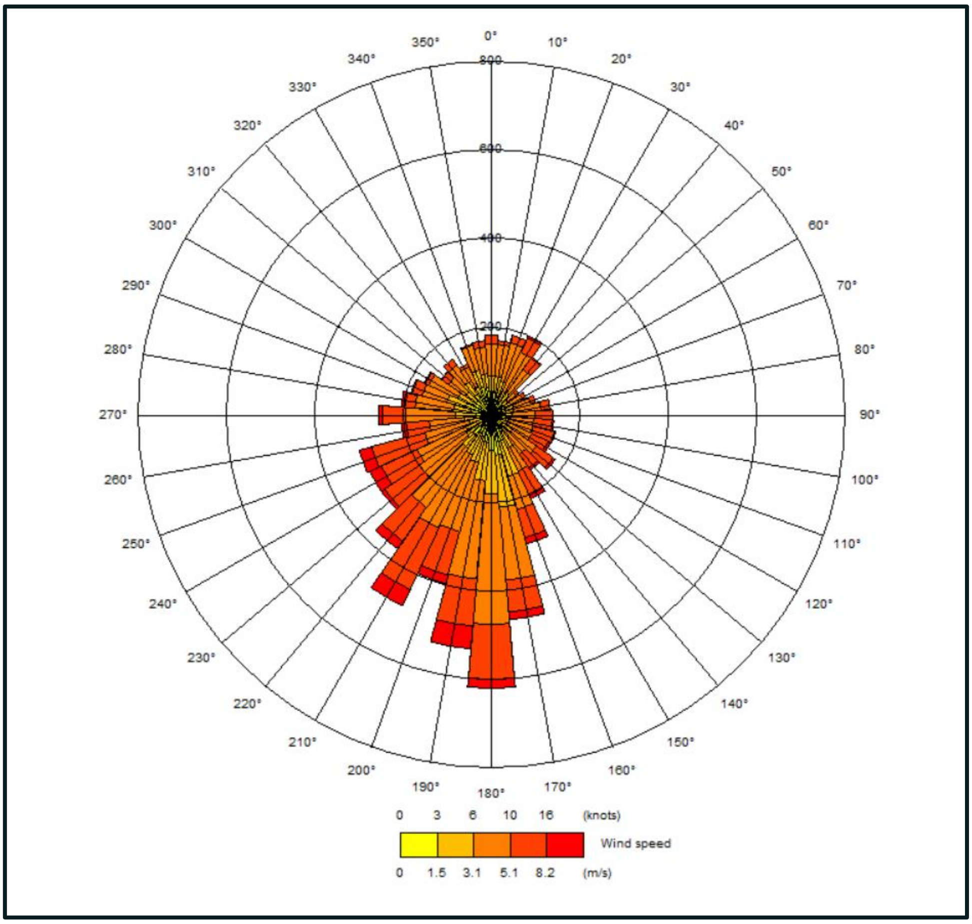

Figure 6-1
Windrose for Benson Meteorological Station (2019)

A surface roughness length of 0.5m was used to represent the surface roughness of the principal study area – i.e. ‘parkland, open suburbia’. Whereas a roughness length of 0.0.2m was used to represent the surface roughness of the meteorological site – i.e. ‘open grassland’.

Background Concentrations

In the absence of locally representative background monitoring sites, annual mean background concentrations used for the purposes of the assessment have been obtained from the Defra supplied background maps (2018 reference year)[2], based on the 1km grid squares which cover the modelled area. Further detail on these datasets can be found in the Chapter 6 to the ES.

To avoid double counting of potential source contributions already contained within the ADMS-Roads dispersion model, 'Primary A Road in' and 'Trunk Road in' were removed from each grid square, as recommended in the Defra Background Maps User Guide[3].

As the relationship between NO_2 and NO_x is not linear, the NO_2 Adjustment for NO_x Sector Removal Tool[4] has been used – in accordance with LAQM.TG(16). No adjustment for background concentration variability with height has been made.

Sensitive Receptors

Human receptors considered in the assessment of emissions from road traffic are shown in Table 6-2, whilst their locations are illustrated in Appendix 6.5. Seventeen receptors were selected across the model domain to represent a range of exposures to air pollution: selected receptors may be representative of air quality conditions at a number of nearby properties, or selected to represent worst-case locations (e.g. façades of residential properties closest to roads), or locations close to junctions or convergence of links. All receptors were considered in relation to exposure at breathing height relative to the adjacent modelled road.

Table 6-2
Modelled Human Receptor Locations

Receptor	X (NGR)	Y (NGR)	Modelled Height (m)
DR1	454716	229237	1.5
DR2	454803	229147	1.5
DR3	454806	229122	1.5
DR4	454749	228958	1.5
DR5	454780	228964	1.5
DR6	454930	229435	1.5
DR7	457252	226298	1.5
DR8	457635	225623	1.5
DR9	457792	225439	1.5
DR10	457901	225325	1.5
DR11	457906	225368	1.5
DR12	458096	224947	1.5

[2] Defra Background Maps (2018 Reference Year): https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018.
[3] Defra Background Concentration Maps User Guide, August 2020.
[4] Defra NO_2 Adjustment for NO_x Sector Removal Tool (v8.0).

Receptor	X (NGR)	Y (NGR)	Modelled Height (m)
DR13	458100	224731	1.5
DR14	458112	224633	1.5
DR15	458424	224437	1.5
DR16	457917	224333	1.5
DR17	457778	224260	1.5

Model Outputs

The Defra background pollutant values discussed above have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ for each respective scenario.

For the prediction of annual mean NO_2 concentrations for all modelled scenarios at receptor locations, the road NO_x contributions (adjusted as per Appendix 6.2) have been converted to total NO_2 following the methodology in LAQM.TG(16) using the latest version of Defra's NO_x to NO_2 conversion tool (v8.1)[5]. The modelled NO_2 road contribution was then added to the appropriate NO_2 background concentration value to obtain an overall total annual mean NO_2 concentration.

For the prediction of short term NO_2 impacts, LAQM.TG(16) advises that it is valid to assume that exceedances of the 1-hour mean Air Quality Assessment Level (AQAL) for NO_2 are unlikely to occur where the annual mean NO_2 concentrations are<60µg/m^3. This approach has thus been adopted for the purposes of this assessment.

For the prediction of short term PM_{10}, LAQM.TG(16) provides an empirical relationship between the annual mean and the number of exceedances of the 24-hour mean AQAL for PM_{10} that can be calculated as follows:

No. 24-hour mean exceedances = -18.5 + 0.00145 × annual mean^3 *+ (206/annual mean)*

This relationship has thus been adopted to determine whether exceedances of the short-term PM_{10} AQAL are likely in this assessment.

Verification of the ADMS-Roads assessment has been undertaken, as per Appendix 6.2. All results presented in the assessment are those calculated following the process of model verification, using an adjustment factor for NO_2.

[5] Defra NO_x to NO_2 Calculator v8.1 (2020).

APPENDIX 6.2 – Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the Defra's LAQM.TG(16) guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the Site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

Prior to undertaking model verification, model setup parameters and input data were reviewed to maximise the performance of the dispersion model in relation to the real-world conditions.

Consistent with advice provided by Defra to local authorities across England, 2019 has been used for the purposes of model verification as relates to the most recent year of monitoring data available which hasn't been impacted by the COVID-19 pandemic. Use of monitoring data recorded in 2020 for the purposes of model verification introduces an element of uncertainty into the final adjusted modelled predictions, as monitoring conditions experienced for the majority of 2020 are not deemed to be representative of long-term baseline conditions, and could lead to a systematic underprediction at modelled receptor locations.

NO_x/NO_2 Verification Calculations

NO_x / NO_2 verification relates to the comparison and adjustment of modelled road-NO_x (as output from the ADMS-Roads dispersion model), relative to monitored road-NO_x.

For NOx / NO_2 model verification, 2019 LAQM CDC monitoring data has been used for those roadside locations situated adjacent to a modelled link i.e. where traffic data exists (Table 6-3). Both DT27 is located on the A4095 in Bicester and representative of receptors in this urban area and DT39 is located on the more rural B430 in Ardley and is considered broadly representative of B roads in the model domain.

Table 6-3
Local Monitoring Data Used for Model Verification

Site ID	X	Y	2019 Monitored NO_2 Concentration (µg/m^3)	2019 Data Capture (%)
DT27	457956	224362	20.7	83
DT39	454301	227498	24.4	100

As NO_2 concentrations are solely reported using diffusion tubes, NO_x was back calculated using the latest version of Defra's NO_x to NO_2 Calculator (v8.1). The NO_x to NO_2 Calculator was also used to facilitate the conversion of modelled road-NO_x (as output from the ADMS-Roads dispersion model) into road-NO_2.

Verification was completed using the 2019 Defra background mapped concentrations (2018 base year) for the relevant 1km x 1km grid squares (i.e. those within which the model verification locations are located).

Comparison of the unadjusted modelled vs. monitored road NO_x is provided in Table 6-4. An adjustment factor has been derived, based on a linear regression forced through zero, as shown in Figure 6-2.

Table 6-4
NO_x / NO_2 Model Verification

Site ID	Monitored Road NOx (µg/m³)	Modelled Road NOx (µg/m³)	Ratio (Monitored vs. Modelled Road NOx)	Adjustment Factor	Adjusted Modelled Total NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	% Difference (Adjusted Modelled NO_2 vs Monitored NO_2)
DT27	21.5	12.8	1.7	1.555	19.9	20.7	-4.1
DT39	15.6	11.3	1.4		25.4	24.4	+3.9

LAQM.TG(16) states that:

> *"In order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within 25% of the monitored concentrations as a minimum, preferably within 10%"*.

As noted in Table 6-4, the difference between the adjusted modelled NO_2 and monitored NO_2 is within ±10% at all verification locations and therefore within the ideal LAQM.TG(16) prescribed limit. In addition, a verification factor reduces the Root Mean Square Error (RMSE) from a value of 3.6µg/m³ to 0.9µg/m³ (2.25% of the annual mean AQAL)– within the ideal LAQM.TG(16) prescribed limit (10% of the annual mean AQAL). On this basis, the derived verification factor (1.555) was considered acceptable and was subsequently applied to all road-NOx concentrations predicted (as output of the ADMS Roads dispersion model).

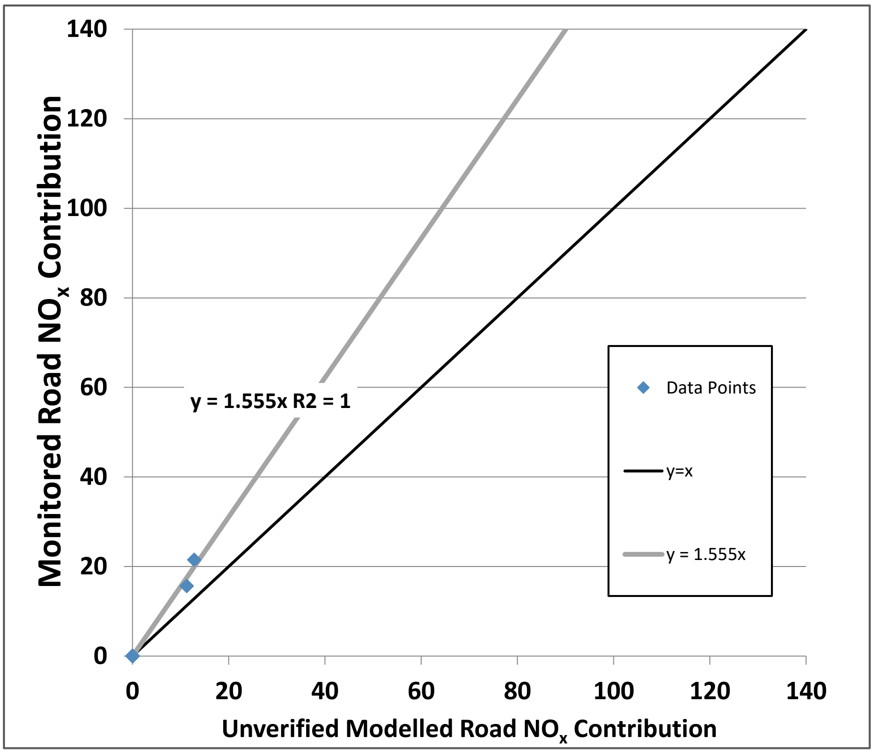

Figure 6-2
Comparison of Modelled vs. Monitored Road NO_x Contribution

PM_{10}/$PM_{2.5}$ Verification Calculations

Whilst there is strong evidence that EFT-based models underpredict road-NOx concentrations in urban areas, there is no equivalent evidence for PM_{10} and $PM_{2.5}$. In the absence of suitable PM_{10} and $PM_{2.5}$ roadside monitoring locations, as a precautionary approach, the NOx verification factor was applied to road-PM_{10} and road-$PM_{2.5}$, as recommended by LAQM.TG(16).

APPENDIX 6.3 - Assessment of Impacts on Ecological Receptors

Initial Screening – Identification of Ecological Receptors

An initial screening was undertaken to identify links above the DMRB traffic screening criteria of a change in AADT flows on a given road of 1000 vehicles or 200 heavy duty vehicles (HDVs). These links were then screened for ecological designations of either European or National conservation status within 200m. These sites were then reviewed for qualifying features sensitive to air pollution. On the basis of this screening, the 'Ardley Cutting and Quarry' Site of Special Scientific Interest (SSSI) that passes underneath the M40 south of Junction 10, was identified for further assessment.

Calculation of Road Traffic Emissions Impacts at Identified Ecological Receptors

The assessment has been undertaken following the 'simple assessment' outlined in IAQM '*A guide to the assessment of air quality impacts on designated nature conservation sites*' to calculate the Process Contribution (PC) (i.e. change in annual mean NOx concentrations to the Critical Level, and contributions to the nutrient nitrogen and acid Critical Loads) associated with Site development trips in the 2025 assessment year.

To derive road traffic emission contributions to the Critical Loads (nutrient nitrogen and acidification), annual mean NO_2 concentrations were initially calculated using the latest DEFRA 'NOx-NO_2 Calculator' (v8.1).

Applied Critical Levels and Critical Loads

The APIS web[6] resource (a support tool for assessment of potential effects of air pollutants on habitats and species, developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology) was consulted to identify habitats of sensitivity to air pollution and used to provide information on pollutant concentrations, current deposition rates and Critical Loads (C_{Lo}).

The applied Critical Level (C_{Le}) and C_{Lo} for nutrient nitrogen and for acidity Table 6-6are presented in Table 6-5 and Table 6-6 respectively below.

Table 6-5
Nitrogen C_{Le}, C_{Lo} and Current Loads

APIS Critical Load Class (most sensitive)	Annual Mean Background NOx (µg/m^3)	Annual Mean NOx Critical Levels (µg/m^3)	Critical Load Range (kg N/ha/yr)	Critical Load Applied in Assessment (kg N/ha/yr)	Current Load (kg N/ha/yr)
Calcareous grassland	24.44	30	15-25	15	23.94

Table 6-6
Acid C_{Lo} Functions and Current Loads

APIS Critical Load Class (most sensitive)	Critical Load Function (k_{eq}/ha/yr)			Current Load (k_{eq}/ha/yr)	
	CLmaxS	CLminN	CLmaxN	N	S
Calcareous grassland	4	0.9	4.9	1.7	0.2

[6] http://www.apis.ac.uk/ (Background pollutant maps 2017-19).

Traffic Inputs

The EFT version 11.0 was used to determine vehicle emission factors for input into the ADMS-Roads dispersion model on the basis of the Developmental-generated trips on the M40 as described in Table 6-7. The M40 was modelled at a height of 5m to represent the bridge over the railway cutting.

Table 6-7
Traffic Data Used Within the Assessment

Road Link	2025 Development Traffic		Speed (mph)
	AADT	% HDV	
M40 South of J10	2,039	69	60

Receptor Locations

Receptor locations were modelled, following IAQM guidance[7], giving consideration to the distribution of habitat features of interest within the site. The receptor locations avoided the railway itself, the motorway embankment, agricultural field, and access road beneath the motorway (see Figure 6-3).

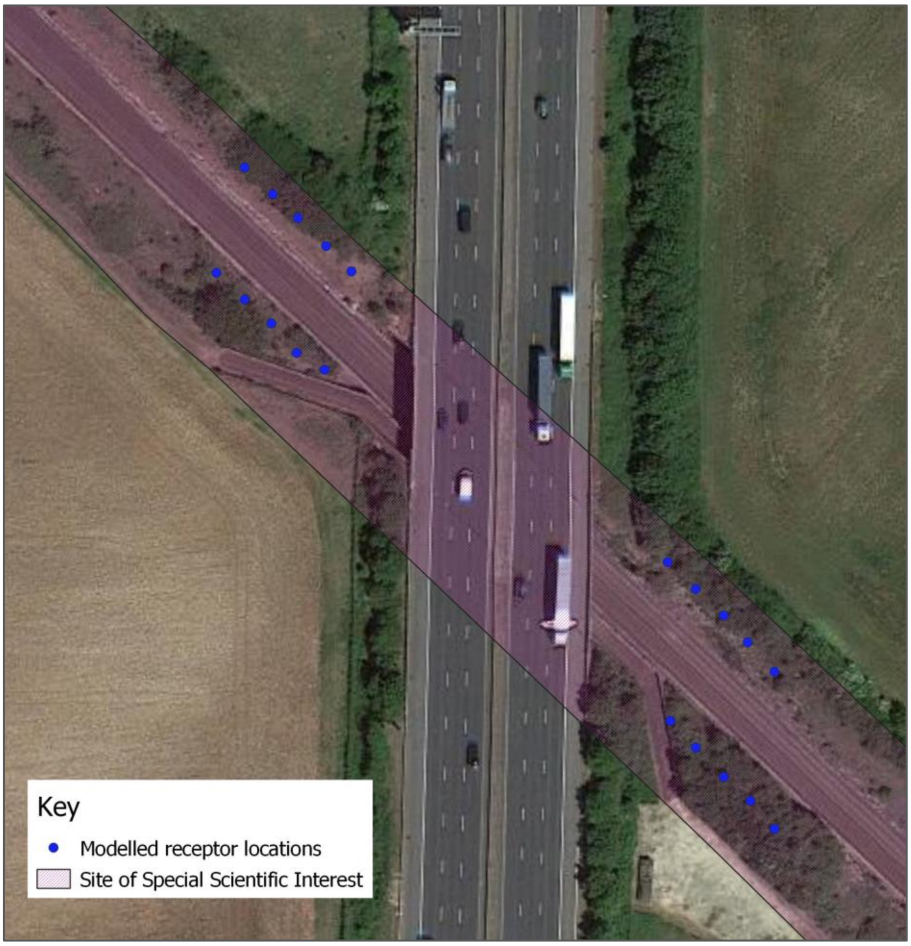

Figure 6-3
Modelled Ecological Receptor Locations

[7] Institute of Air Quality Management, A guide to the assessment of air quality impacts on designated nature conservation sites (Version 1.1 May 2020).

Processing of Model Results

The modelled NOx concentrations at the receptor locations were compared to the Critical Level, and deposition calculation undertaken for comparison to the Critical Loads. There are no suitable NOx monitoring locations adjacent to the motorway to undertake a verification calculation, this is acknowledged as a limitation in the ES.

Deposition rates were calculated using empirical methods recommended by the IAQM guidance[8]. Dry deposition flux was calculated using the following equation:

Dry deposition flux (µg/m^2/s) = ground level concentration (µg/m^3) x deposition velocity (m/s)

The applied deposition velocities for NOx to grassland is 0.0015m/s.

Critical Loads – Eutrophication

The C_{Lo} for nitrogen deposition (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from µg/m^2/s to units of kgN/ha/year by multiplying the dry deposition flux by the standard conversion factor of 95.9.

Critical Loads – Acidification

The deposition PC is converted to units of equivalents (k_{eq}/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the µg/m^2/s by the standard conversion factor of 6.84.

Impacts on Ecological Receptors

Critical Levels

The results of the assessment of impacts on the C_{Le} are presented in Table 6-8 below. The findings are the Development Traffic Contribution does not exceed 1% of the annual mean C_{Le}.

Table 6-8
Annual Mean Impact on Critical Levels

Habitat	NO_X Annual Mean Development Traffic Contribution (µg/m^3)	As % of C_{Le}
Calcareous grassland	0.2	0.7%

Impacts on Critical Loads

The results of the assessment on C_{Lo} are presented in Table 6-9 and Table 6-10 below. The findings are that the Development Traffic Contribution does not exceed 1% of the C_{Lo}.

Table 6-9
Impact on Nitrogen Critical Load

Habitat	Applied C_{Lo} (kg N/ha/yr)	Annual Mean Development Traffic Contribution (kg N/ha/yr)	As % of C_{Lo}
Calcareous grassland	15	0.02	0.1%

[8] Institute of Air Quality Management, A guide to the assessment of air quality impacts on designated nature conservation sites (Version 1.1 May 2020).

Table 6-10
Impact on Acid Critical Load Functions

Habitat	Applied C_{Lo} (kg_{eq}/ha/yr) CLmaxN	Annual Mean PC (kg_{eq}/ha/yr)	PC as % of C_{Lo}
Calcareous grassland	4.900	0.001	<0.1%

Summary

On the basis of the results presented above, the impact of traffic emissions associated with Development trips on the M40 are considered to cause 'no likely significant effect'.

APPENDIX 6.4 – Construction Dust Mitigation Measures

Table 6-11 presents the recommended construction dust mitigation measures, on the basis of the construction dust assessment undertaken.

Table 6-11
Construction Dust Mitigation Measures

Site Application	Mitigation Measures
Highly Recommended	
Communications	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
	Display the head or regional office contact information.
Monitoring	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
Operating Vehicle/Machinery and Sustainable Travel	Ensure all vehicles switch off engines when stationary - no idling vehicles.
	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
	Use enclosed chutes and conveyors and covered skips.
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
Preparing and Maintaining the Site	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
Site Management	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
	Make the complaints log available to the local authority when asked.
	Record any exceptional incidents that cause dust and/or air emissions, either on- or

Site Application	Mitigation Measures
	offsite, and the action taken to resolve the situation in the log book.
Waste Management	Avoid bonfires and burning of waste materials.
Desirable	
Communications	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document.
Construction	Avoid scabbling (roughening of concrete surfaces) if possible.
	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
Operating Vehicle/Machinery and Sustainable Travel	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
Operations	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Preparing and Maintaining the Site	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
	Keep site fencing, barriers and scaffolding clean using wet methods.
	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
	Cover, seed or fence stockpiles to prevent wind whipping.
Trackout	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
	Avoid dry sweeping of large areas.
	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
	Record all inspections of haul routes and any subsequent action in a site logbook.
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

APPENDIX 6.5 – Figures

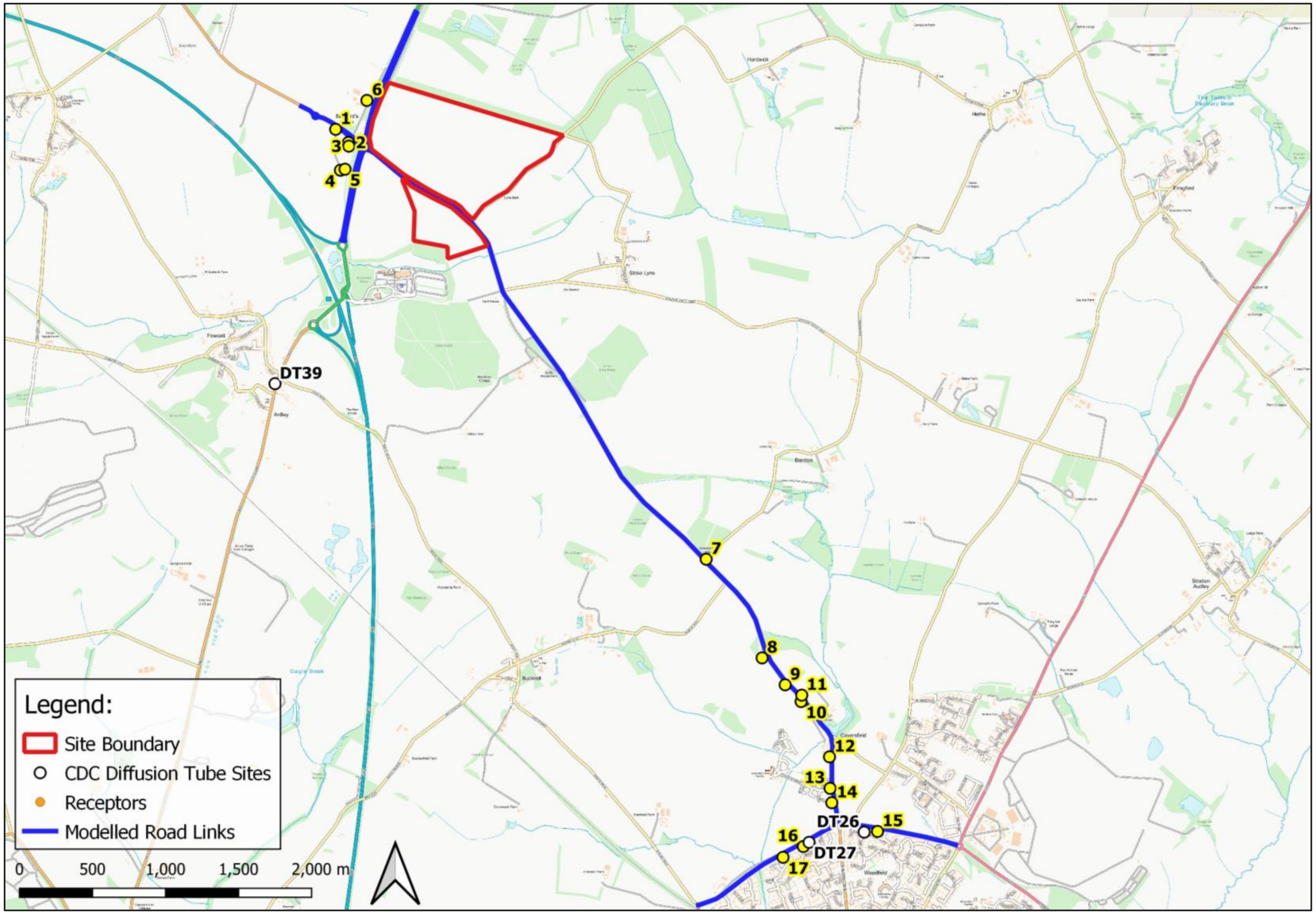

Figure 6-4
Traffic Emissions Assessment: Monitoring Locations and Modelled Human Receptors and Links

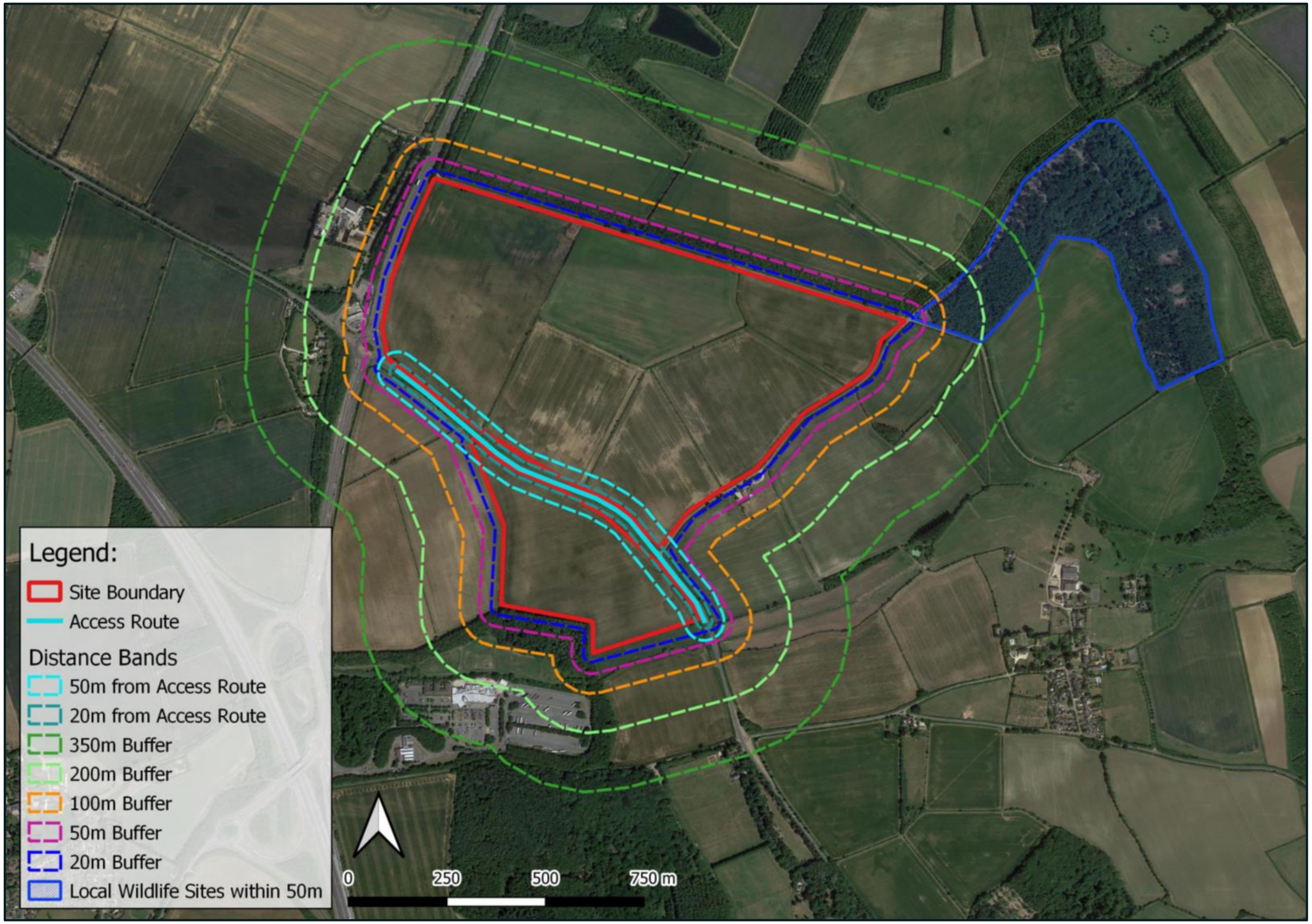

Figure 6-5
Construction Dust Assessment Distance Bands

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