



Land at Halsnead Garden Village, Phase 3

Chapter 10 Air – Appendices 10.1 to 10.4

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Table of Contents

10.0 Air Quality	3
10.1 Construction Phase Dust Emissions.....	3
10.2 Road Traffic Emissions Modelling Assessment Methodology – Human Receptors	10-10
10.3 Construction Dust Mitigation Measures	10-19
10.4 Figures	10-22

Tables in Text

Table A10-1: IAQM Criteria Used to Determine the Dust Emission Magnitude for Each Activity	3
Table A10-2: IAQM Criteria for Defining Sensitivity of Receptors	10-6
Table A10-3: Sensitivity of Area to Dust Soiling Effects on People and Property.....	10-8
Table A10-4: Sensitivity of Area to Human Health Impacts	10-8
Table A10-5: Sensitivity of Area to Ecological Impacts.....	10-9
Table A10-6: Risk of Dust Impacts – Demolition	10-9
Table A10-7: Risk of Dust Impacts – Earthworks	10-9
Table A10-8: Risk of Dust Impacts – Construction	10-9
Table 10-9: Risk of Dust Impacts – Trackout.....	10-10
Table A10-10: Traffic Data Used in the Assessment	10-11
Table A10-11: Receptor Locations Considered	10-14
Table A10-12: Monitoring Data Used for Model Verification	10-15
Table A10-13: NO _x / NO ₂ Model Verification – Initial Stage	10-16
Table A10-14: NO _x / NO ₂ Model Verification – Final Stage.....	10-17
Table A10-15: Construction Dust Mitigation Measures.....	10-19

Figures in Text

Figure A10-1: Windrose NWP Data Centred on the Site (2024)	10-12
Figure A10-2: Comparison of Modelled vs. Monitored Road NO _x Contribution – Initial 4.200	10-16
Figure A10-3: Comparison of Modelled vs. Monitored Road NO _x Contribution – Final 4.156	10-18
Figure A10-4: Modelled Roads - Verification	10-23
Figure A10-5: Modelled Road Links – Study Area.....	10-24
Figure A10-6: Local Monitoring Sites Relative to Site.....	10-25
Figure A10-7: Construction Dust Assessment Buffers.....	10-26



10.0 Air Quality

10.1 Construction Phase Dust Emissions

The construction dust assessment methodology is set out within the *IAQM Guidance on the assessment of dust from demolition and construction* (Version 2.2, January 2024).

Where figures relating to area, volume, approximate number of construction vehicles or distances to receptors are given, these relate to thresholds as defined in the IAQM Dust guidance.

10.1.1 Step 1: Screening the Need for a Detailed Assessment

In accordance with the IAQM Dust guidance, a detailed construction dust assessment is required where a:

- Human receptor (any location where a person or property may experience the adverse effects of airborne dust or dust soiling) is located within 250m of the site, and/or within 50m of routes used by construction vehicles, up to 250m from the site entrance(s); and/or
- Ecological receptor (any sensitive habitat affected by dust soiling) is located within 50m of the site, and/or within 50m of routes used by construction vehicles, up to 250m from the site entrance(s).

Where the need for a more detailed assessment is screened out, effects are not believed to be significant, and no further assessment is required.

10.1.2 Step 2: Assess the Risk of Dust Impacts Arising

10.1.2.1 *Step 2a: Define the Potential Dust Emission Magnitude*

The dust emission magnitude is defined for four potential construction activities using criteria provided within the IAQM Dust guidance (presented in Table A10-1), in combination with professional judgment by a technically competent assessor. The activities considered, if applicable to anticipated works, are as follows:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

Table A10-1: IAQM Criteria Used to Determine the Dust Emission Magnitude for Each Activity

Activity	Dust Emission Magnitude		
	Small	Medium	Large
Demolition	• Total building volume <12,000m³ • Construction material with low potential for dust release (e.g. metal cladding or timber)	• Total building volume 12,000m³ – 75,000m³ • Potentially dusty construction material • Demolition activities 6-12m above ground level	• Total building volume >75,000m³ • Potentially dusty construction material (e.g., concrete) • On-site crushing and screening



Activity	Dust Emission Magnitude		
	Small	Medium	Large
	- Demolition activities <6m above ground - Demolition during wetter months		Demolition activities >12m above ground level
Earthworks	- Total site area <18,000m² - Soil type with large grain size (e.g., sand) <5 heavy earth moving vehicles active at any one time - Formation of bunds <3m in height	- Total site area 18,000m² – 110,000m² - Moderately dusty soil type (e.g., silt) 5-10 heavy earth moving vehicles active at any one time - Formation of bunds 3m-6m in height	- Total site area >110,000m² - Potentially dusty soil type (e.g., clay, which will be prone to suspension when dry due to small particle size) >10 heavy earth moving vehicles active at any one time - Formation of bunds >6m in height
Construction	- Total building volume <12,000m³ - Construction material with low potential for dust release (e.g., metal cladding or timber)	- Total building volume 12,000m³ – 75,000m³ - Potentially dusty construction material (e.g., concrete) - On site concrete batching	- Total building volume >75,000m³ - On site concrete batching - Sandblasting
Trackout	<20 heavy-duty vehicle (HDV) outward movements in any one day - Surface material with low potential for dust release - Unpaved road length <50m	20-50 HDV outward movements in any one day - Moderately dusty surface material (e.g., high clay content) - Unpaved road length 50m – 100m	>50 HDV outward movements in any one day - Potentially dusty surface material (e.g., high clay content) - Unpaved road length >100m

10.1.2.2 Step 2b: Define the Sensitivity of the Area

In accordance with the IAQM Dust guidance, the sensitivity of the area is defined in relation to three separate dust impacts:

- Annoyance due to dust soiling;
- The risk of health effects due to an increase in exposure to PM₁₀; and
- Harm to ecological receptors with account being taken of the sensitivity of the area that may experience these effects.

This is informed by several parameters which are set out in the IAQM Dust guidance; such as the proximity and number of receptors in relation to construction activities, as well as their individual sensitivity.

Receptors can demonstrate different sensitivities to changes in their environment, dependant on location, use and perceived value. The sensitivities for individual receptors are determined using the approach outlined in Table A10-2 for each assessed impact.



Once the sensitivity of each individual receptor has been established, this is used to determine the sensitivity of the surrounding area in combination with the number of receptors, their distance to dust sources, and the annual mean PM₁₀ background concentration (for human health impacts).

Reproduced from the IAQM Dust guidance, Table A10-3 to Table A10-5 illustrate how the sensitivity of the area may be determined for dust soiling, human health, and ecological impacts, respectively. The highest level of sensitivity from each table should be recorded.

The quoted distances relate to the nearest dust emission source(s). In the context of construction, demolition and earthworks these activities will occur on-site. Where the exact locations of these activities are not known, receptor distances are determined from the site boundary.

By comparison, trackout occurs off-site when HDV transport dust and dirt from construction areas onto the public road network; where it may be deposited and then re-suspended. The quoted distances therefore relate to the proximity of receptors to the public road links likely to be used by construction vehicles. The extent (length) of road links affected by trackout from HDVs leaving the site exit(s) is 250m without site-specific mitigation.



Table A10-2: IAQM Criteria for Defining Sensitivity of Receptors

Sensitivity of Area	Human Receptors		Ecological Receptors ^(A)
	Dust Soiling Effects	Health Effects of Particulate Matter (PM ₁₀)	
High	- Users can reasonably expect enjoyment of a high level of amenity; or - The appearance, aesthetics or value of their property would be diminished by soiling; and - The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. - Indicative examples include dwellings, museums and other culturally important collections, medium- and long-term car parks and car showrooms.	- Locations where members of the public are exposed over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). - Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	- Locations with an international or national designation and the designated features may be affected by dust soiling; or - Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List for Great Britain. - Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
Medium	- Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or - The appearance, aesthetics or value of their property could be diminished by soiling; or - The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. - Indicative examples include parks and places of work.	- Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). - Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM₁₀, as protection is covered by Health and Safety at Work legislation.	- Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or - Locations with a national designation where the features may be affected by dust deposition. - Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.



Sensitivity of Area	Human Receptors		Ecological Receptors ^(A)
	Dust Soiling Effects	Health Effects of Particulate Matter (PM ₁₀)	
Low	- The enjoyment of amenity would not reasonably be expected; or - Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or - There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. - Indicative examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.	- Locations where human exposure is transient. - Indicative examples include public footpaths, playing fields, parks and shopping streets.	- Locations with a local designation where the features may be affected by dust deposition. - Indicative example is a local Nature Reserve with dust sensitive features.
Table Note: ^(A) Only applicable if ecological habitats are present which may be sensitive to dust effects.			



Table A10-3: Sensitivity of Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<250
High	>100	High	High	Medium	Low
	10 – 100	High	Medium	Low	Low
	1 – 10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A10-4: Sensitivity of Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from the Source (m)			
			<20	<50	<100	<250
High	>32µg/m ³	>100	High	High	High	Medium
		10 – 100	High	High	Medium	Low
		1 – 10	High	Medium	Low	Low
	28 – 32µg/m ³	>100	High	High	Medium	Low
		10 – 100	High	Medium	Low	Low
		1 – 10	High	Medium	Low	Low
	24 – 28µg/m ³	>100	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low
		1 – 10	Medium	Low	Low	Low
	<24µg/m ³	>100	Medium	Low	Low	Low
		10 – 100	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
Medium	>32µg/m ³	>10	High	Medium	Low	Low
		1 – 10	Medium	Low	Low	Low
	28 – 32µg/m ³	>10	Medium	Low	Low	Low
		1 – 10	Low	Low	Low	Low
	24 – 28µg/m ³	>10	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
	<24µg/m ³	>10	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low



Table A10-5: Sensitivity of Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

10.1.2.3 Step 2c: Define the Risk of Impacts

The risk of dust impacts arising is based upon the relationship between the dust emission magnitude and the sensitivity of the area.

As reproduced from the IAQM Dust guidance, Table A-6 to Table A-9 illustrates how the dust emission magnitude should be combined with the sensitivity of the area to determine the risk of impacts with no mitigation measures applied.

Table A10-6: Risk of Dust Impacts – Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A10-7: Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A10-8: Risk of Dust Impacts – Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible



Table 10-9: Risk of Dust Impacts – Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

10.1.3 Step 3: Site-specific Mitigation

Mitigation, as provided within the IAQM Dust guidance, is then recommended based upon the calculated dust risks i.e., low, medium or high risk. The measures are classified as either 'highly recommended' or 'desirable'.

The site-specific measures determined from the assessment outcomes are included within Section 10.3 of Appendix 10.3.

10.1.4 Step 4: Determine Significant Effects

As per IAQM Dust guidance, significance is only assigned to the effect after considering the construction activity with mitigation. This is because for almost all construction activities, the aim is to prevent significant effects on receptors through the use of effective mitigation. The IAQM Dust guidance therefore recommends that the significance of the unmitigated effect is not defined, as is not considered appropriate nor relevant in this context.

Following the application of the recommended mitigation measures, residual effects are assessed. In accordance with the IAQM Dust guidance and assuming the effective application of measures, residual effects associated with construction dust are considered to be 'not significant'.

10.2 Road Traffic Emissions Modelling Assessment Methodology – Human Receptors

The following model scenarios have been assessed in relation to operational traffic:

- 2024 Base Case (2024 BC) – Base year flows for 2024 as the set output of the Eddisons Transport Assessment, adopted as 2024;
- 2031 Do Minimum (2031 DM) – base traffic flows projected to the year 2031, inclusive of other relevant committed developments; and
- 2031 Do Something (2031 DS) – 2031 DM traffic flows as above, plus road traffic flows associated with the Proposed Development at completion.

For the above future year scenarios (2031), concurrent emission factors and background pollutant concentrations have been used.

Further details of the modelling assessment are discussed in turn, below.

10.2.1 Traffic Inputs

Traffic data was provided by Eddisons – the appointed transport consultant for the Proposed Development.

The spatial extent of the ADMS-Roads dispersion model was informed by the scope of the Transport Assessment. Furthermore, where relevant, neighbouring links were also included within the dispersion model to facilitate a robust assessment, rather than rely on their individual contributions being represented within the appropriate background datasets.



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(22). Traffic speeds have been assumed to be consistent across all the modelled scenarios.

The Emissions Factors Toolkit (EFT) version 13.1 developed by Defra¹ has been used to determine vehicle emission factors for input into the ADMS-Roads dispersion model.

Details of the traffic flows used in this assessment are provided in Table A10-10, whilst the modelled roads in relation to the Site are presented in Figure A10-5.

Table A10-10: Traffic Data Used in the Assessment

Link ID	Link Name	2024 BC		2031 DM		2031 DS		Speed (kph)
		AADT	%HDV	AADT	%HDV	AADT	%HDV	
1	Tarbock Interchange to Lickers Lane/Wills Lane	1,290	2.3	5,694	0.5	5,718	0.5	48
2	West of Windy Arbor Road	121	2.5	114	2.5	114	2.5	32
3	East of Windy Arbor Road	1,216	1.6	6,754	0.3	6,778	0.3	48
4	North of Wills Lane/Lickers Lane	1,099	2.5	5,222	0.5	5,222	0.5	48
5	South of Meadway/Stoney Lane	1,366	1.6	5,320	0.4	5,320	0.4	48
6	West of Windy Arbor Road	22	0.0	38	0.0	38	0.0	48
7	East of Windy Arbor Road	1,437	1.5	2,258	0.9	2,459	0.9	48
8	North of Meadway/Stoney Lane	2,363	1.3	6,035	0.5	6,235	0.5	48
9	West of Fox's Bank Lane	1,306	3.4	2,273	1.8	2,593	1.7	64
10	East of Fox's Bank Lane	1,073	2.3	2,098	1.1	2,106	1.1	64
11	South of A5080 Cronton Road	771	2.6	1,071	1.8	1,095	1.7	48
12	North of A5080 Cronton Road	726	1.2	1,740	0.5	2,092	0.6	48
13	South of Site Access	726	1.2	1,740	0.5	2,092	0.6	48
14	Site Access	0	0.0	2,440	0.0	3,241	0.2	32
15	North of Site Access	1,014	0.5	3,232	0.1	3,680	0.2	48/97
16	South of Lickers Lane	1,014	0.5	3,252	0.1	3,700	0.2	48/97
17	West of Fox's Bank Lane	991	1.3	2,174	0.6	2,199	0.6	48
18	North of Lickers Lane	1,011	1.8	2,011	0.8	2,268	0.8	48
19	South of Stoney Lane	933	1.6	1,896	0.7	2,152	0.8	48
20	West of Cumber Lane	1,372	1.4	2,009	0.9	2,257	0.9	48

¹ Defra, EFT v13.1 (March 2025). <https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>. Access February 2026.



Link ID	Link Name	2024 BC		2031 DM		2031 DS		Speed (kph)
		AADT	%HDV	AADT	%HDV	AADT	%HDV	
21	East of Cumber Lane	921	1.0	1,127	0.8	1,127	0.8	48

Table Note:
Speeds presented are based on National Speed Limits. Traffic Speeds have been adjusted to take into account queues, roundabouts and congestion in accordance with LAQM.TG(22).

10.2.2 Meteorological Data

The dispersion modelling has been undertaken using 2024 Numerical Weather Prediction (NWP) data, centred on the Site. In consideration that the closest measured meteorological recording station (Liverpool John Lennon Airport) is located approximately 9km south of the Site in a coastal setting, NWP is considered to be the most representative approach. In respect of using NWP data for dispersion modelling, LAQM.TG(22) states:

“NWP data may be a useful alternative to OBS [standard meteorological observations data] data where there are no suitable meteorological data available, or where OBS data are unlikely to represent local meteorological conditions around the modelled source.”

LAQM.TG(22) recommends that meteorological data should have a percentage of usable hours greater than 85%. The 2024 meteorological NWP dataset 8,760 lines of usable hourly data for the year, i.e. 100% usable data. This is therefore suitable for the dispersion modelling exercise.

A windrose is presented in Figure A10-1.

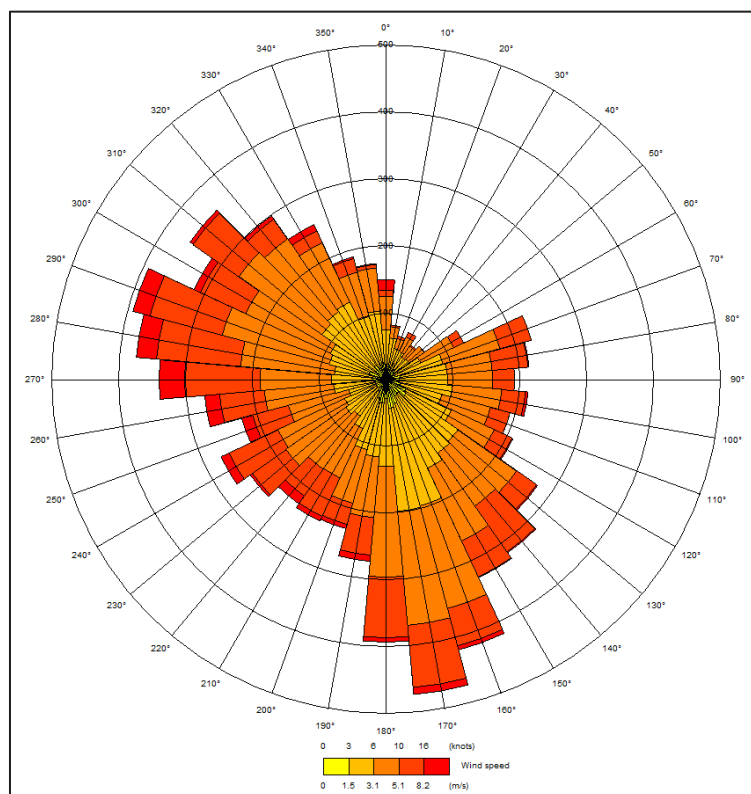


Figure A10-1: Windrose NWP Data Centred on the Site (2024)

10.2.3 Surface Roughness

The following surface roughness values were applied:



- Dispersion site: a value of 0.5m – this represents ‘parkland, open suburbia’.
- Meteorological measurement site: a value of 0.5m – this represents ‘parkland, open suburbia’.

10.2.4 Minimum Monin-Obukhov Length (LMOmin)

The following LMOmin values were applied:

- Dispersion site: a value of 30m – this is applicable for ‘cities and large towns’ and ‘mixed urban/industrial’.
- Meteorological measurement site: a value of 30m – this is applicable for ‘cities and large towns’ and ‘mixed urban/industrial’.

10.2.5 Background Concentrations

Annual mean background concentrations used for the purposes of the assessment have been obtained from the Defra supplied background maps (2021 reference year)², based on the 1km grid squares which cover the modelled area. Further detail on these datasets can be found in Table 10.3.3 and Table 10.3.4 of Chapter 10 (Air Quality).

To avoid double counting of potential background sources already contained within the ADMS-Roads dispersion model, relevant sources were removed from the appropriate background map grid square. This was limited to the removal of ‘Primary A Road in’ and ‘Motorways’ where relevant.

As the relationship between nitrogen dioxide (NO₂) and nitrogen oxides (NO_x) is not linear, the NO₂ Adjustment for NO_x Sector Removal Tool³ has been used – in accordance with LAQM.TG(22). No adjustment for background concentration variability with height has been made.

10.2.6 Sensitive Receptors

Human receptors considered in the road traffic assessment are detailed in Table A10-11, whilst their locations are illustrated in Figure A10-5.

Receptors HR1 – HR15 are representative of existing receptors within the Proposed Development locale, and new receptors PR1 – PR7 are introduced as a result of the Proposed Development.

The receptors have been selected as follows:

- Existing receptors represent worst-case exposure locations relative to the affected road network identified.
- New receptors introduced by the Proposed Development represent worst-case exposure locations relative to the modelled road network within and around the Site.

All receptors have been considered in relation to exposure at breathing height relative to the adjacent modelled road. All receptors have been modelled at a height of 1.5m representing in accordance with LAQM.TG(22).

² Defra Background Maps (2021-Reference) <http://uk-air.defra.gov.uk/data/laqm-background-home>.

³ Defra NO₂ Adjustment for NO_x Sector Removal Tool (v9.0).



Table A10-11: Receptor Locations Considered

Receptor	X	Y	Z (Height (m))
Existing Receptors			
HR1	347419	389815	1.5
HR2	347450	389813	1.5
HR3	347548	389808	1.5
HR4	347416	389915	1.5
HR5	347538	389937	1.5
HR6	347564	389889	1.5
HR7	347672	389943	1.5
HR8	347732	390017	1.5
HR9	347778	389980	1.5
HR10	347829	389966	1.5
HR11	347875	390082	1.5
HR12	347787	390058	1.5
HR13	347799	389820	1.5
HR14	347906	390028	1.5
HR15	347906	390181	1.5
New Receptors			
PR1	347395	389811	1.5
PR2	347369	389749	1.5
PR3	347204	389745	1.5
PR4	347043	389717	1.5
PR5	347072	389757	1.5
PR6	347184	389776	1.5
PR7	347332	389795	1.5

10.2.7 Model Output

The background pollutant values discussed in Section 10.3 of ES Chapter have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO₂ and particulate matter (as PM₁₀ and PM_{2.5}) for each respective scenario.

For the prediction of annual mean NO₂ concentrations at receptor locations for all modelled scenarios, the road NO_x contributions (adjusted as per Section 10.2.8) have been converted to total NO₂ following the methodology in LAQM.TG(22), using the latest version of Defra's NO_x to NO₂ conversion tool (v9.1)⁴. The traffic mix within the calculator was set to "All Other Urban UK traffic" and "Knowsley" was selected as the local authority. The modelled NO₂ road contribution was then added to the appropriate NO₂ background concentration value to obtain an overall total annual mean NO₂ concentration.

For the prediction of short-term NO₂ impacts, LAQM.TG(22) advises that it is valid to assume that exceedences of the 1-hour mean Air Quality Assessment Level (AQAL) for NO₂ are unlikely to occur where the annual mean NO₂ concentration is <60µg/m³. This approach has thus been adopted for the purposes of this assessment at relevant receptor locations with an applicable exposure period.

⁴ Defra NO_x to NO₂ Calculator v9.1 (August 2024), available at <https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/>



For the prediction of short-term PM₁₀, LAQM.TG(22) provides an empirical relationship between the annual mean and the number of exceedences of the 24-hour mean AQAL for PM₁₀ that can be calculated as follows:

$$\text{No. 24-hour mean exceedences} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

This relationship has thus been adopted to determine whether exceedences of the short-term PM₁₀ AQAL are likely in this assessment.

Verification of the ADMS-Roads assessment has been undertaken as per Section 10.2.8. All results presented in the assessment are those calculated following the process of model verification.

10.2.8 Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in Defra's LAQM.TG(22) 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 (insofar as possible).

10.2.8.1 NO_x / NO₂ Verification

NO_x / NO₂ 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 NO_x / NO₂ model verification, 2024 data from KMBC's local monitoring network has been used, as presented in Table A10-12.

Table A10-12: Monitoring Data Used for Model Verification

Site ID	X	Y	Y (Height (m))	2024 Monitored NO ₂ Concentration (µg/m ³)	Data Capture (%)
H8Aa H8Ab	345577	389394	2.5	24.6	100
H5Aa H5Ab	345563	389397	2.4	29.6	100
H1a H1b	345552	389413	2.2	26.0	100
H2a H2b	345537	389407	2.5	24.4	100
H12a H12b	346425	389669	2.4	26.8	100
H7Aa H7Ab	345503	389429	2.4	24.5	100

As NO₂ concentrations are solely reported using diffusion tubes, NO_x was back calculated using the latest version of Defra's NO_x to NO₂ Calculator (v9.1). The NO_x to NO₂ Calculator was also used to facilitate the conversion of modelled road-NO_x (as output from the ADMS-Roads dispersion model) into road-NO₂.

Verification was completed using the 2024 Defra background mapped concentrations (2021 reference year) for the relevant 1km x 1km grid squares (i.e. those within which the model verification locations are located), with those already modelled sources removed to avoid duplication. This was limited to removal of 'Primary A Road in' and 'Motorways', where relevant.



Verification 1 – Initial Verification

Initial comparison of the unadjusted modelled vs. monitored road NO_x is provided in Table A10-13. An adjustment factor of 4.200 has been derived, based on a linear regression forced through zero, as shown in Figure A10-2.

Table A10-13: NO_x / NO₂ Model Verification – Initial Stage

Site ID	Monitored Road NO _x (µg/m ³)	Modelled Road NO _x (µg/m ³)	Ratio (Monitored vs. Modelled Road NO _x)	Adjustment Factor	Adjusted Modelled Total NO ₂ (µg/m ³)	Monitored Total NO ₂ (µg/m ³)	% Difference (Adjusted Modelled NO ₂ vs. Monitored NO ₂)
H8Aa, H8Ab	41.9	6.4	6.5	4.200	24.0	29.6	-19.0
H5Aa, H5Ab	32.1	6.8	4.7		24.6	26.0	-5.5
H1a, H1b	28.0	9.7	2.9		29.1	24.4	+19.4
H2a, H2b	34.2	8.0	4.3		26.6	26.8	-0.7
H12a, H12b	21.6	0.7	31.3		13.0	21.3	-38.9
H7Aa, H7Ab	28.2	7.2	3.9		25.4	24.5	+3.5

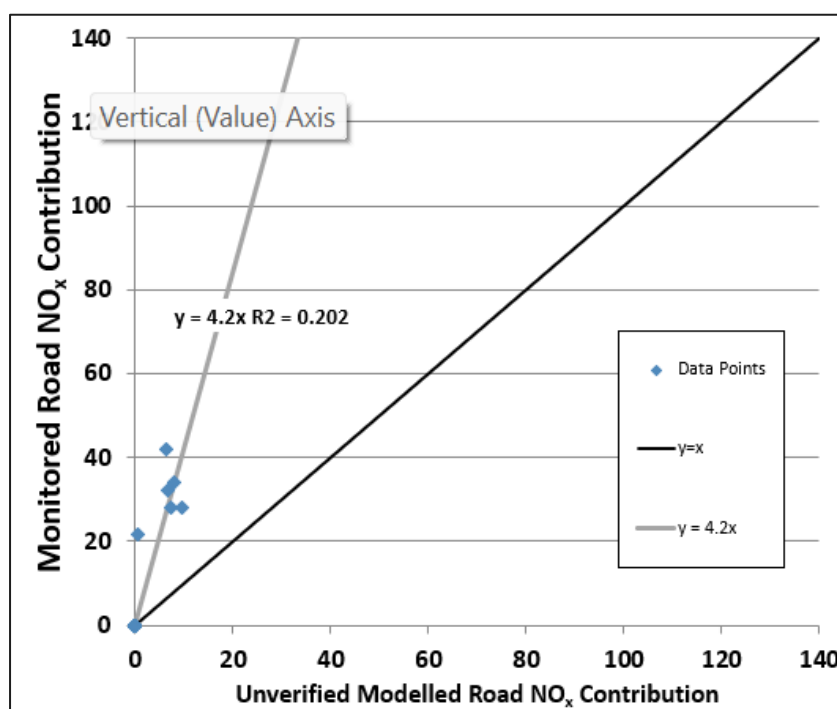


Figure A10-2: Comparison of Modelled vs. Monitored Road NO_x Contribution – Initial 4.200

LAQM.TG(22) 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 displayed in Table A10-13, at most locations the difference between adjusted modelled and monitored NO₂ concentrations is within ±25%. However, results fall outside this range at one location (H12a, H12b). While the model performs well overall, some localised inconsistencies are evident. The verification locations were therefore reviewed further to



identify potential reasons for these discrepancies and to consider any necessary refinements. Following this review, one location was removed from the verification exercise, as discussed below:

- **H12a, H12b:** Reports a -38.9% model underprediction. This monitor is located at the roadside of Windy Arbor Road. Within 200m of the monitoring location is the Tarbock Interchange inclusive of the M57 J1 – M62 J6 bypass. The scope of the Transport Assessment (TA) did not include these areas and, therefore, modelled conditions at this monitoring location were not accurately represented. This likely explains the underprediction observed at this location.

Verification 2 – Final Verification

With this location removed, final comparison of the unadjusted modelled vs. monitored road NO_x is provided in Table A10-14. An adjustment factor of 4.156 has been derived, based on a linear regression forced through zero, as shown in Figure A10-3.

Table A10-14: NO_x / NO₂ Model Verification – Final Stage

Site ID	Monitored Road NO _x (µg/m ³)	Modelled Road NO _x (µg/m ³)	Ratio (Monitored vs. Modelled Road NO _x)	Adjustment Factor	Adjusted Modelled Total NO ₂ (µg/m ³)	Monitored Total NO ₂ (µg/m ³)	% Difference (Adjusted Modelled NO ₂ vs. Monitored NO ₂)
H8Aa, H8Ab	41.9	6.4	6.5	4.156	23.87	29.60	-19.36
H5Aa, H5Ab	32.1	6.8	4.7		24.46	26.00	-5.92
H1a, H1b	28.0	9.7	2.9		28.98	24.40	+18.77
H2a, H2b	34.2	8.0	4.3		26.49	26.80	-1.16
H7Aa, H7Ab	28.2	7.2	3.9		25.24	24.50	+3.02

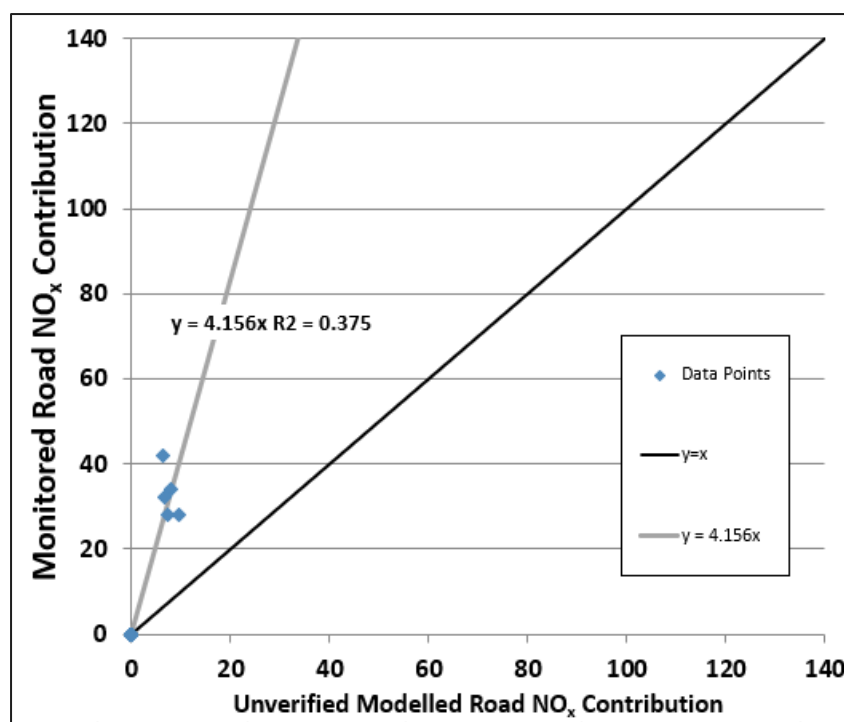


Figure A10-3: Comparison of Modelled vs. Monitored Road NO_x Contribution – Final 4.156

As illustrated in Table A10-14, at all locations, the difference between adjusted modelled NO₂ and monitored NO₂ is within $\pm 25\%$ (i.e. the recommended limit) with three of these being within $\pm 10\%$.

In addition, a verification factor of 4.156 reduces the Root Mean Square Error (RMSE) from a value of $10.7\mu\text{g}/\text{m}^3$ to $3.4\mu\text{g}/\text{m}^3$ (8.4% of the annual mean AQAL) – within the ideal LAQM.TG(22) prescribed limit (10% of the annual mean AQAL).

On this basis the verification factor (4.156) was considered acceptable and was subsequently applied to all road-NO_x concentrations (as output of the ADMS Roads dispersion model).

10.2.8.2 PM₁₀ / PM_{2.5} Verification

The adjustment factor of 4.156 was also applied to road-PM₁₀ and PM_{2.5} concentrations (as output of the ADMS Roads dispersion model), following the recommendations of LAQM.TG(22), in the absence of local particulate monitoring.



10.3 Construction Dust Mitigation Measures

The IAQM guidance outlines a number of site-specific mitigation measures based on the assessed site risk. The measures are grouped into those which are highly recommended and those which are desirable, as detailed in Table A10-15.

Table A10-15: Construction Dust Mitigation Measures

Site Application	Mitigation Measures
Highly Recommended	
Communications	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
	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.
	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. The desirable measures should be included as appropriate for the site.
Construction	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	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.
	Agree dust deposition, dust flux, or real-time PM ₁₀ continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.
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.
	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	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 Application	Mitigation Measures
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
	Avoid site runoff of water or mud.
	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.
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 offsite, and the action taken to resolve the situation in the log book.
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.
	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
	Record all inspections of haul routes and any subsequent action in a site log book.
	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowzers and regularly cleaned.
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
	Access gates to be located at least 10m from receptors where possible.
Waste Management	Avoid bonfires and burning of waste materials.
Desirable	
Construction	Avoid scabbling (roughening of concrete surfaces) if possible.
	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
Earthworks	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
	Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable
	Only remove the cover in small areas during work and not all at once.
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 15mph on surfaced and 10mph 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).



Site Application	Mitigation Measures
	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).



10.4 Figures



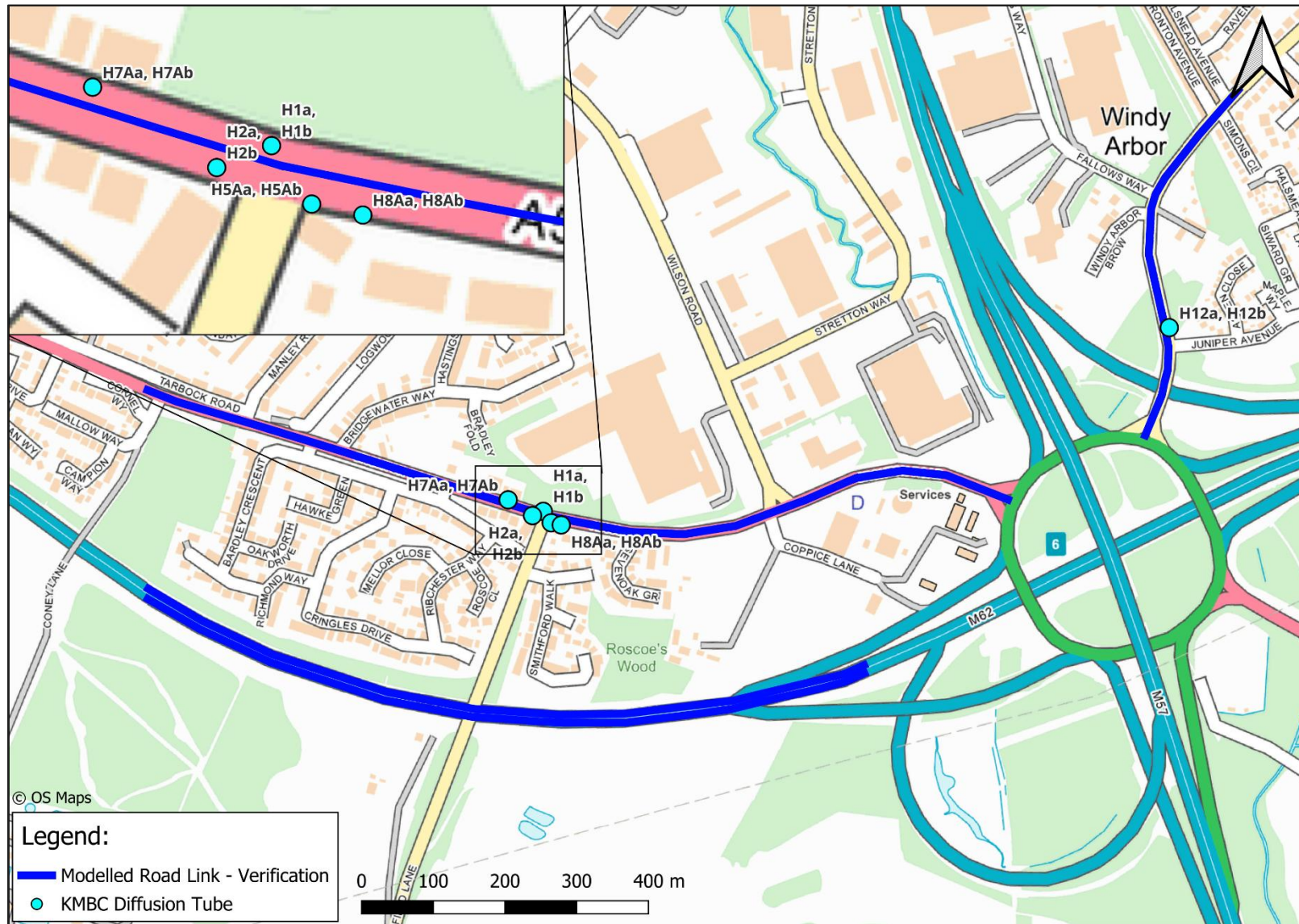


Figure A10-4: Modelled Roads - Verification



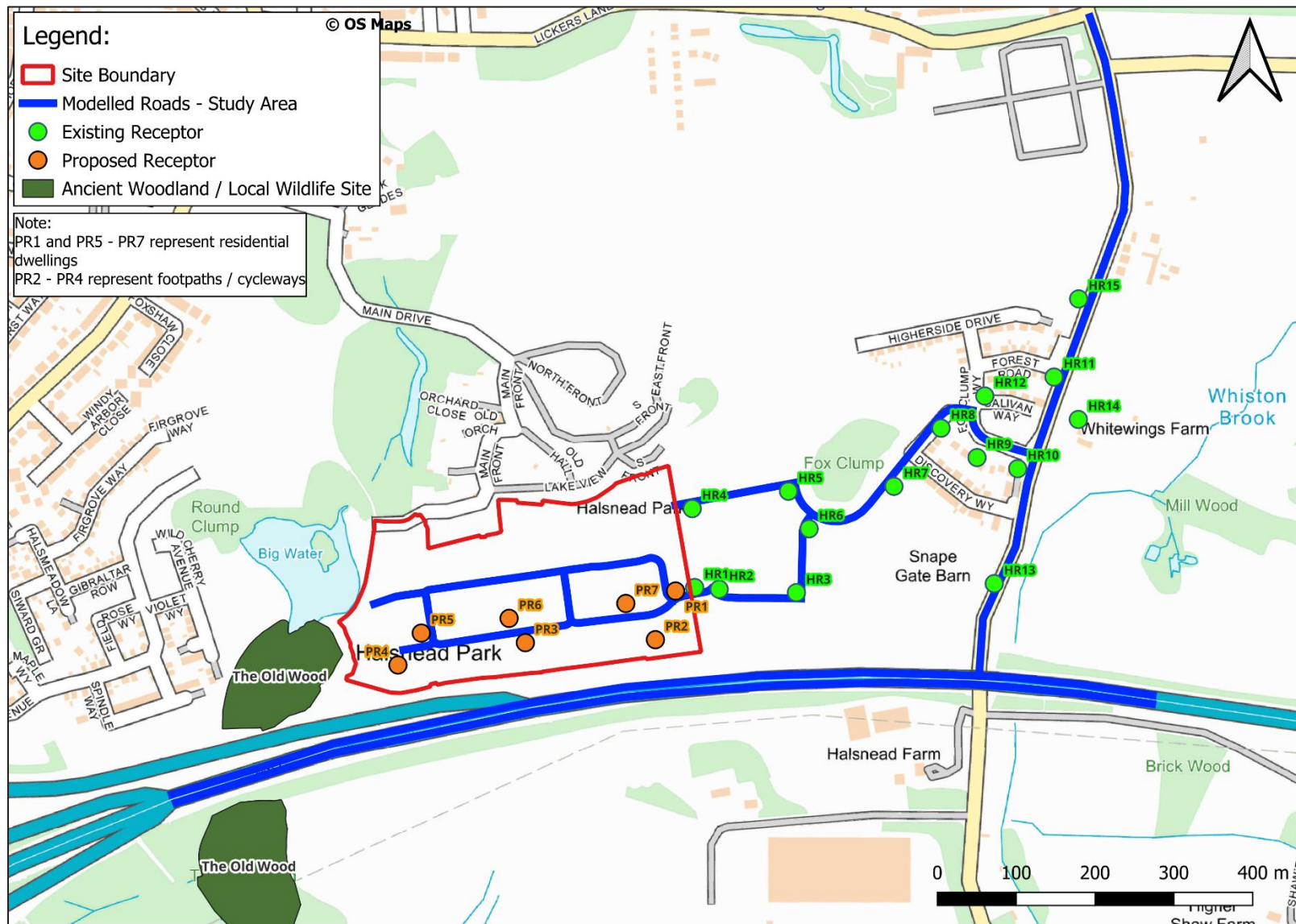


Figure A10-5: Modelled Road Links – Study Area





Figure A10-6: Local Monitoring Sites Relative to Site



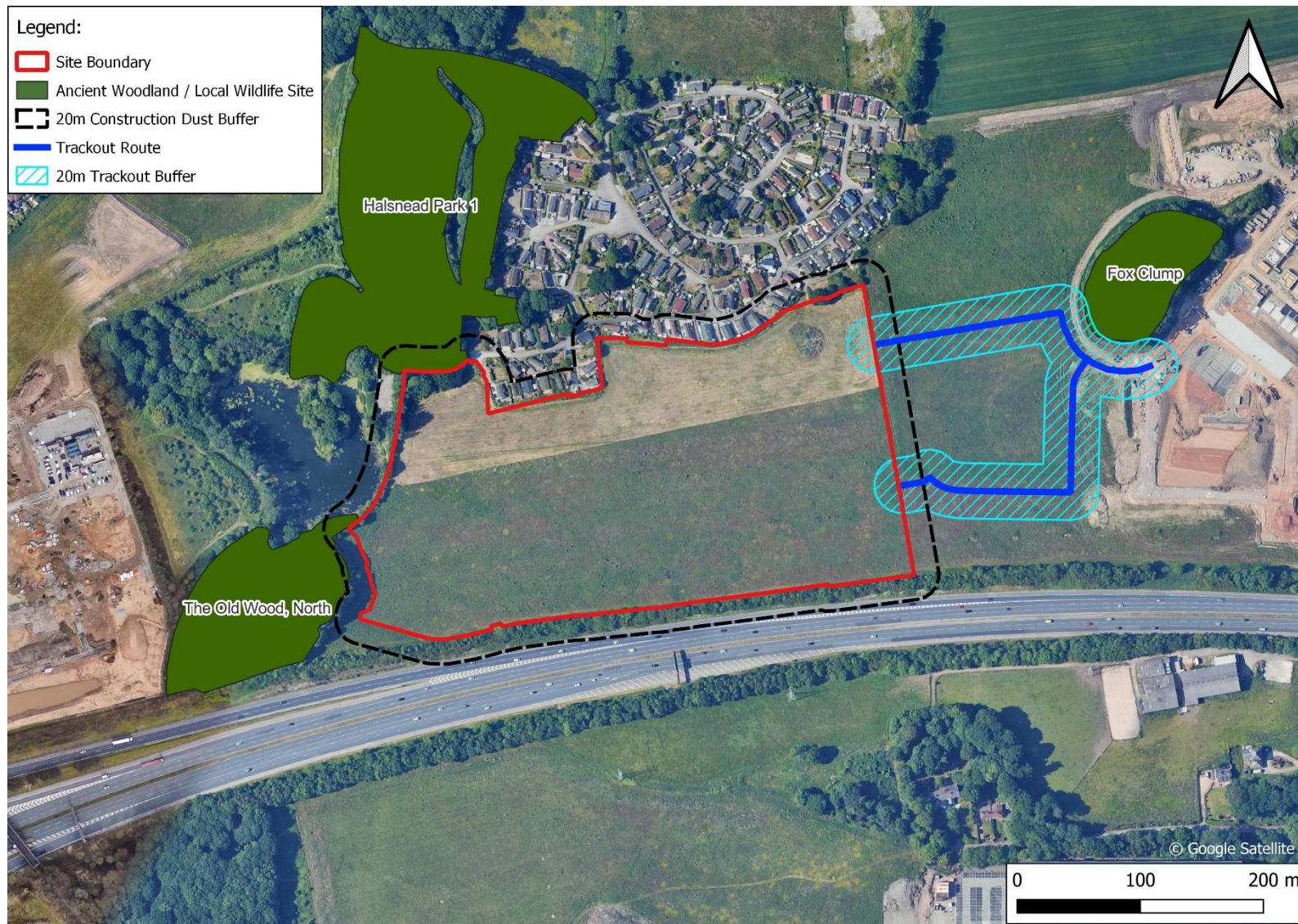


Figure A10-7: Construction Dust Assessment Buffers





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