



Air Quality Assessment

Kirkby Valley Golf Club & Course, Knowsley

Green Circle Estates Limited

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Air Quality Assessment

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Non-Technical Summary

- i. This report provides a consideration of potential impacts relating to a proposed redevelopment at Kirkby Valley Golf Club and Course, Knowsley.
- ii. It is understood that full planning permission is sought for the redevelopment of the Golf Club and Course to provide reconfiguration and other improvement works. The proposals also include the provision of a new 9 holes course, adventure golf course, practice putting green and driving range alongside a new clubhouse, offices, golf shop, café/restaurant, function room, changing and toilet facilities.
- iii. The existing clubhouse will be retained and undergo alterations and an extension to deliver the change use to a golf-related grounds maintenance training academy and associated buildings. These facilities will be served by parking spaces with new access created onto Valley Road.
- iv. In order to achieve the proposed reconfiguration and improvements to the golf course significant imports of clean materials will be required. The development therefore has potential to cause impacts at nearby sensitive locations during the construction and operational phases.
- v. Impacts could arise due to fugitive dust emissions generated by construction phase activities and road traffic emissions generated during the importation of materials during construction and vehicle trips generated during the operational phase.
- vi. Construction phase dust impacts were assessed in accordance industry standard guidance to determine risk and identify necessary control measures. The implementation of good practice control measures during construction would ensure that residual impacts relating to fugitive dust emissions were not significant.
- vii. Construction and operational road traffic impacts were modelled with and without the development in place, and results were assessed against industry standard criteria to determine the overall significance of road traffic emission impacts. The results indicated that both construction and operational impacts are not significant at all sensitive locations in the vicinity of the site.
- viii. Based on the predictions there are no constraints to approval from an air quality perspective, and the proposed development is deemed acceptable for planning purposes.

1.0 Introduction

1.1 Background

1.1.1 Enzygo Limited (Ltd) was commissioned by Green Circle Estates Ltd to produce an Air Quality Assessment in support of a planning application for the redevelopment of Kirkby Valley Golf Club & Course, Knowsley, referred to as the 'Proposed Development'.

1.1.2 A full planning application (ref 21/00744/FUL) was submitted in September 2021 and was subsequently revised following feedback from Knowsley Metropolitan Borough Council (KMBC) and other parties. The revised proposal comprises the following elements:

- Reconfiguration and other improvement work across the entire golf course, including the reshaping of tees / greens / bunkers to provide both an improved 18 hole course and the introduction of a new 9 hole course on currently unused land;
- New and improved irrigation / drainage works (including 2 irrigation lakes), extensive tree and shrub planting, and ecological mitigation measures across the course;
- The erection of a footbridge over the River Alt (to provide improved access);
- The erection of a new 2 storey Clubhouse with associated operational/management offices, golf shop, café, restaurant, function room, changing and toilet facilities;
- Retention, alteration and 364 m² extension of the existing clubhouse, and its change of use to form a golf-related / grounds maintenance training academy with associated classroom space, cafeteria and overnight accommodation for golf professionals, teachers, trainers (existing access and car park retained/unchanged);
- A new centrally located greenkeeper's compound with an associated 720 m² portal frame building to contain welfare facilities, office, training space and equipment storage and maintenance and security fencing;
- An adventure golf course and practice putting green;
- A golf driving range with an associated 2 storey building containing 32 driving bays (over two levels), bar / lounge, pro golf shop, training and practice rooms / facilities, and external lighting and safety netting;
- Car, motorcycle, and cycle parking spaces to serve all of the above facilities; and
- One new access created onto Valley Road to serve the development.

1.1.3 In order to deliver the proposed reconfiguration and improvements, including recontouring, and reshaping of tees, greens and bunkers, significant imports of clean materials will be required which is anticipated to be approximately 475,000 m³ in total. Pollutant emissions associated with construction and importation activities, as well as traffic generated during operation have potential to cause impacts at sensitive locations within the vicinity of the site.

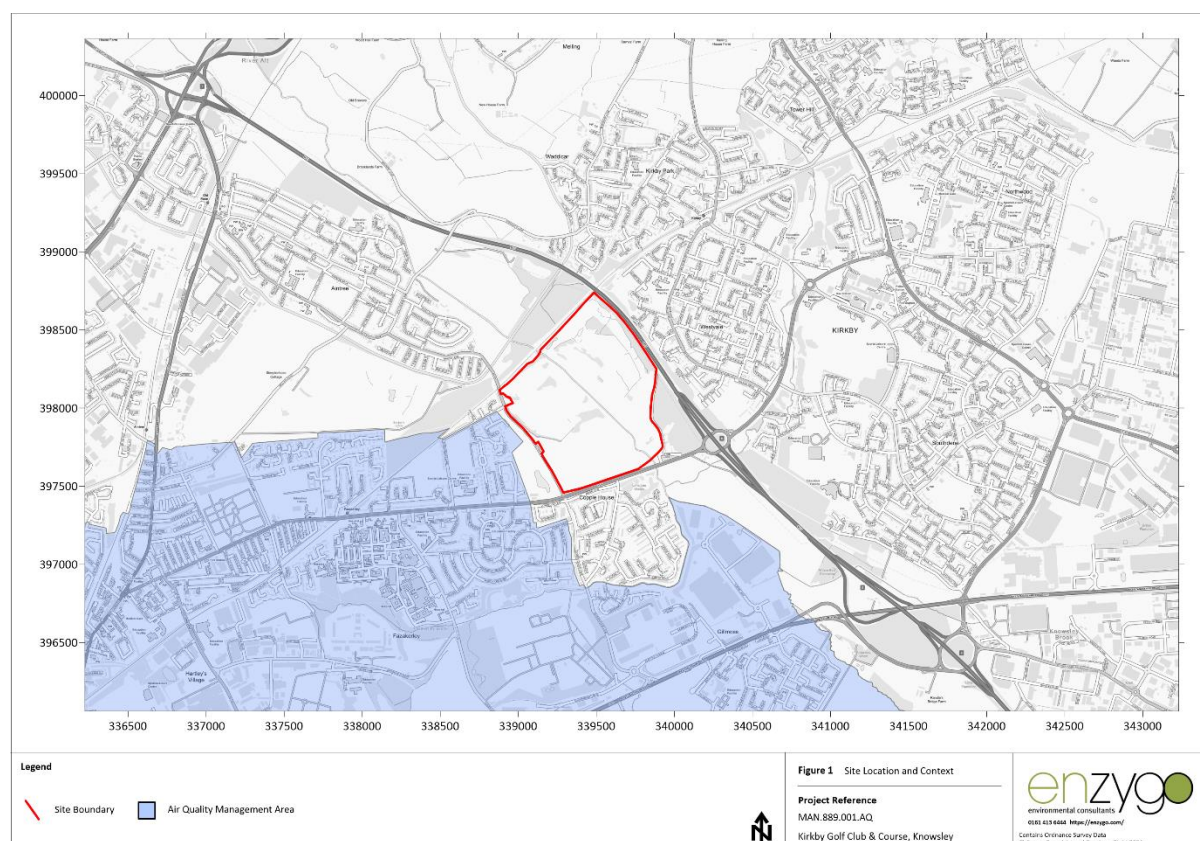
1.1.4 An Air Quality Assessment was therefore required in order to determine baseline conditions at the site, assess site suitability for the proposed end-use and assess the potential impacts as a result of the proposed development in accordance with the requirements of the National Planning Policy Framework (NPPF) and KMBC.

1.1.5 Details of the assessment methodology, assessment inputs, results and conclusions are detailed within this report.

1.2 Site Location and Context

- 1.2.1 The application site is located at the approximate National Grid Reference (NGR): 339460, 398070 and set between Aintree and Kirkby.
- 1.2.2 The application site is approximately 80.3 hectares (ha) and is currently occupied by the existing clubhouse, car park and course. The site includes area of vacant land to the south west which is due for development.
- 1.2.3 The site is within a well-established residential area and bounded by the Merseyrail Northern line to the north, M57 to the east, Valley Road (A506) to the south, and Aintree Lane to the west. Existing residential use adjoins the south and east boundaries, along Valley Road and Aintree Lane, further residential use is located east of the M57 at Whitefield Drive. It is noted that the majority of existing receptor locations are well separated from the road network.
- 1.2.4 Additional sensitive use in the locality includes Dixons Fazakerley Academy, Barlow's Primary School and Aintree University Hospital which are located off the A506.
- 1.2.5 The Liverpool City Wide Air Quality Management Area (AQMA) is located to the west of the site. No ecological designations were identified close to the site.
- 1.2.6 Figure 1 below shows a map of the site boundary and surrounding context.

Figure 1 – Site Location and Surrounding Context



2.0 Legislation Guidance and Policy

2.1 Introduction

2.1.1 The following legislation, guidance and policy were considered relevant during the preparation of the Air Quality Assessment:

- European Union (EU) Directive 2008/50/EC;
- The National Planning Policy Framework (NPPF), updated on 20th July 2021;
- The National Planning Practice Guidance (NPPG), relevant chapters produced on 1st November 2019;
- Section 82 of the Environment Act (1995) (Part IV);
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Department for Environment, Food and Rural Affairs (DEFRA), 2007¹;
- The Air Quality Standards (Amendment) Regulations (2016);
- Local Air Quality Management Technical Guidance 2022²;
- Guidance on the Assessment of Dust from Demolition and Construction, Institute of Air Quality Management (IAQM)³; and
- Land-Use Planning and Development Control: Planning for Air Quality Guidance, Environmental Protection UK and IAQM⁴.

2.2 UK Legislation and National Strategy

2.2.1 Government policy requires the Secretary of State to publish a national Air Quality Strategy (AQS). The national AQS produced by the Department for Environment, Food and Rural Affairs (DEFRA) sets out the framework to reducing adverse impacts of air pollution upon human health, vegetation, and ecosystems. To achieve this the AQS defines air quality objectives (AQOs) for 10 key pollutant species, including nitrogen dioxide (NO₂), fine Particulate Matter (PM₁₀ and PM_{2.5}) which are relevant to this assessment.

2.2.2 In accordance with the Environment Act (1995), Local Authorities (LAs) have an obligation to periodically review and assess air quality within their administration to determine if specified pollutants are exceeding relevant objectives. This review involves the assessment of present and likely future air quality and is termed Local Air Quality Management (LAQM).

2.2.3 Should the LAQM process identify areas which are predicted to or currently exceed relevant AQOs the LA is required to designate an Air Quality Management Area (AQMA). The AQMA is then accompanied by an Air Quality Action Plan (AQAP) which sets various measures and polices to improve air quality with the goal of restoring compliance with the AQOs. The process of LAQM is informed by DEFRA's Technical Guidance LAQM.TG22².

¹ The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA, 2007

² Local Air Quality Management Technical Guidance 2022 LAQM.TG22, DEFRA, August 2022.

³ Guidance on the Assessment of Dust from Demolition and Construction, Institute of Air Quality Management, 2016.

⁴ Land-Use Planning and Development Control: Planning for Air Quality, EPUK and IAQM, January 2017.

2.2.4 European Directive 2008/50/EC also sets out a similar approach to the AQS and defines limit values for the protection of human health and ecosystems. The Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 ensures that the Environmental Permitting (EP) regime can continue following the UK's exit from the European Union (EU).

2.2.5 The regulations state also that exceedances of the objectives should be assessed in relation to air quality at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present".

2.2.6 AQOs applicable to this assessment are summarised in Table 1 with relation to human health receptors. It should be noted that site suitability will be determined using these objectives.

Table 1: National Air Quality Objectives

Pollutant	Air Quality Objectives	
	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Periods
NO ₂	40	Annual mean
	200	1-hour mean; not to be exceeded more than 18 times a year
PM ₁₀	40	Annual mean
	50	24-hour mean; not to be exceeded more than 35 times a year
PM _{2.5}	25	Annual mean

2.2.7 LAQM.TG22² specifies locations where the AQOs should be applied as detailed in Table 2.

Table 2: Where Air Quality Objectives Apply

Averaging Period	Objectives Should Apply At	Objectives Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building facades of offices and places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean	As above together with hotels, and gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	As above, and kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

2.2.8 Based on the proposed F2(c) land use the Proposed Development would be sensitive to short term 1-hour and 24-hour objectives detailed in Table 2.

2.3 Local Planning Policy – Knowsley Local Plan: Core Strategy

- 2.3.1 The Knowsley Local Plan⁵ was adopted in January 2016 and sets out the vision, objectives, and spatial planning strategy for the city for the period up to 2028. Policies contained within this document provide the current basis for planning determination. Following a review those relevant to air quality are detailed below.

Policy CS2 – Development Principles

“1) New development in Knowsley and the preparation of subsequent stages of the Local Plan will be expected to support the following development principles :

Principle 4: Recognise environmental limits, protect, and enhance environmental assets, enhance local character and promote quality of place by:

[...]

e) Mitigating potential negative impacts of traffic growth and road traffic on highway safety, air quality, noise, and health;

j) Minimising negative impact upon flood risk, air quality, water quality, land quality, soil quality, and noise or vibration levels and ensuring any negative impacts are appropriately mitigated.”

Policy CS7 – Transport Networks

“Location, Design and Management of New Development

1) New development will be required to be:

e) Inclusive of measures that will mitigate carbon emissions and improve air quality where appropriate.”

- 2.3.2 Consideration has been made to these policies by assessing the significance of impacts related to construction dust and road vehicle exhaust emissions generated by the Proposed Development, and where necessary mitigate potential negative impacts.

⁵ Knowsley Local Plan Core Strategy, Knowsley Metropolitan Borough Council, January 2016

3.0 Methodology

3.1 Introduction

3.1.1 Emissions generated by the Proposed Development during the construction and operational phases have potential to cause impacts at existing sensitive locations.

3.1.2 Consultation with the Air Quality Officer at KMBC was undertaken to discuss the proposed methodology. The agreed methodology comprises of the following assessment stages:

- Baseline Assessment;
- Construction Phase Dust Risk Assessment;
- Construction Phase - Road Vehicle Exhaust Impact Assessment; and
- Operational Phase - Road Vehicle Exhaust Impact Assessment.

3.1.3 Sections 3.2 to 3.4 detail the assessment methodology.

3.2 Baseline Assessment

3.2.1 Baseline conditions within the assessment extents were determined by a review of the latest Air Quality Status Reports (ASR) published by KMBC⁶ and Liverpool City Council (LCC)⁷ as well as predicted background pollutant concentrations produced by DEFRA⁸.

3.2.2 Local emission sources were identified along with AQMAs to identify potential emission sources in the area.

3.3 Construction Phase

Fugitive Dust Impacts

3.3.1 There is potential for fugitive dust impacts to occur at nearby sensitive locations as a result of demolition, earthworks, construction and trackout activities during the construction phase; specifically the importation of materials to deliver the reconfiguration and improvements to the course.

3.3.2 A qualitative assessment was undertaken in accordance with the methodology outlined within the IAQM document³. The assessment identified specific control measures to be implemented on site which aim to reduce residual fugitive dust impacts.

3.3.3 Appendix C details the IAQM methodology.

Road Vehicle Exhaust Impacts

3.3.4 The importation of significant materials to deliver the proposed reconfiguration and improvements to the course will generate Heavy Duty Vehicle (HDV) trips. Exhaust emissions associated with these HDVs have the potential to cause transient impacts at nearby receptor locations.

⁶ 2023 Air Quality Annual Status Report, KMBC, June 2023

⁷ 2023 Air Quality Annual Status Report, LCC, June 2023

⁸ <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018>

- 3.3.5 Vehicle movements within the Site are unlikely to have a significant impact on air quality and any change is considered to be negligible.
- 3.3.6 The construction phase and importation of materials to deliver course reconfiguration and improvements is anticipated to generate an Annual Average Daily Traffic (AADT) flow of 65 (100% HDV), equating to 130 two-way trips. It is anticipated that deliveries will utilise the A506 (Valley Road) to the east of the site, adjacent to the M57 motorway. The proposed site access onto Valley Road will enable HDVs to travel westwards along A506 (Valley Road), turn right into the site, drop off their materials within the course, and then exit left onto A506 (Valley Road) heading east toward the M57. No other road links are expected to be affected during this phase.
- 3.3.7 Based on the anticipated AADT trip generation dispersion modelling was undertaken using ADMS-Roads to quantify potential changes in pollutant concentrations at sensitive locations in the vicinity of the site. The following scenarios were assessed:
- Opening year do-minimum (DM) - Predicted traffic flows for 2024 should the Proposed Development not be completed, plus local committed developments; and
 - Opening year do-something (DS) - Predicted traffic flows for 2024, plus local committed developments in combination with addition of traffic flows generated the construction phase associated with required material imports.
- 3.3.8 Appendix A details the modelling inputs with results presented in Appendix B.

3.4 Operational Phase Impacts

Road Vehicle Exhaust Impacts

- 3.4.1 The operational phase will generate significant traffic flows on the local road network which may cause increases in pollutant concentrations at sensitive receptors close to the Proposed Development. Based on the information provided by the appointed transport consultant, It is expected the operation phase will generate a traffic flow of 1,020 AADT (3.4 HDV%) which includes trips associated with the existing Golf Course and Club.
- 3.4.2 It is anticipated that operational trips access the site using the A506 (Valley Road), to the east and west. Further afield it is expected that trips will affect Copple House Lane, Aintree Lane, the M57, A506 (Longmoor Lane) and A506 (Valley Road) east of the M57.
- 3.4.3 Based on the anticipated AADT generation dispersion modelling was undertaken using ADMS-Roads to quantify potential changes in pollutant concentrations at sensitive locations in the vicinity of the site. The following scenarios were assessed:
- Opening year do-minimum (DM) - Predicted traffic flows for 2026 should the Proposed Development not be completed, plus local committed developments; and
 - Opening year do-something (DS) - Predicted traffic flows for 2026, plus local committed developments in combination with addition of traffic flows generated by the Proposed Development.
- 3.4.4 TEMPRO v8 growth factors were applied to 2022 baseline traffic to take account of forecasted growth in 2024 and 2026.
- 3.4.5 Appendix A details the modelling inputs.

Impact Significance

3.4.6 Receptors potentially sensitive to changes in pollutant concentrations will be identified within the assessment extents and defined using the guidance provide in LAQM.TG22². The significance of impact at each receptor will be defined in accordance with EPUK and IAQM guidance⁴ criteria shown in Table 3.

Table 3: EPUK and IAQM Assessment Impact Criteria

Long Term Average Concentration	% Change in Concentration Relative to AQO			
	1	2-5	6-10	>10
75% or less of AQO	Negligible	Negligible	Slight	Moderate
76 - 94% of AQO	Negligible	Slight	Moderate	Moderate
95 - 102% of AQO	Slight	Moderate	Moderate	Substantial
103 - 109% of AQO	Moderate	Moderate	Substantial	Substantial

3.4.7 The criteria shown in Table 3 is extracted from the EPUK and IAQM guidance⁴ and provides descriptors to allow comparisons of various air quality impacts. It should be noted that changes of 0%, i.e. less than 0.5%, will be described as negligible in accordance with the EPUK and IAQM guidance⁴.

3.4.8 Following the prediction of impacts at discrete receptor locations utilising the criteria in Table 3 the EPUK and IAQM guidance⁴ states that this framework is to be used as a starting point to make a judgement on significance of effect. The guidance suggests that any judgement on the overall significance of effect of a development will need to take into account such factors as:

- the existing and future air quality in the absence of the development
- the extent of current and future population exposure to the impacts; and
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

3.4.9 Section 5.2 provides a summary of the impact significance. Detailed modelling results are presented in Appendix B.

Operational Phase Site Exposure

3.4.10 Based on the proposed Class F2(c) land use development the site does not provide any relevant exposure to long term pollutant concentrations, such as residential units.

3.4.11 On-site exposure to the annual mean NO₂ and PM concentrations therefore does not apply in accordance with LAQM.TG22² and only short-term objective has been considered in further detail with relation to onsite exposure.

4.0 Baseline Conditions

4.1 Introduction

4.1.1 Available air quality data and the surrounding context was reviewed to provide a baseline for assessment. The following sources were used in the assessment of baseline conditions:

- DEFRA's LAQM Background Mapping Data and AQMA Database⁹; and
- Knowsley 2023 ASR⁶; and
- Liverpool 2023 ASR⁷.

4.2 Emission Sources

4.2.1 The main sources pollutant emissions within the vicinity of the Proposed Development site are road vehicle exhaust emissions associated with A506 (Valley Road) and the M57 Motorway which runs parallel the southern and eastern site boundaries, respectively.

4.2.2 No further significant emission sources were identified in the assessment extents.

4.3 Air Quality Management Areas

4.3.1 As required by the Environment Act (1995), KMBC, undertakes an annual review and assessment of air quality across the borough. This process indicated that air quality concentrations across the borough currently meet the AQOs set out in the AQS and as such no AQMAs have been declared.

4.3.2 A wider review of neighbouring LAs indicated the Liverpool City AQMA is located within the assessment extents which has been designated for annual mean NO₂ concentrations and encompasses the whole of the City of Liverpool. The site is located 40 m east of the AQMA and development generated traffic during the operational phase is likely to impact this sensitive area. As such an appropriate assessment has been undertaken.

4.3.3 Construction phase traffic will not access the AQMA.

4.3.4 KMBC and LCC have not declared that any other pollutants considered within the AQS are likely to exceed the relevant AQOs and no further AQMAs have been designated.

4.4 Air Quality Monitoring

4.4.1 The KMBC and LCC ASRs^{6,7} were reviewed to identify representative air quality monitoring stations which could assist in the determination of local baseline conditions. 2020 and 2021 monitoring results are affected by the impact of enforced restrictions during the national and local COVID lockdowns and are considered unrepresentative of normal conditions expected during 2019 and 2022.

4.4.2 The review indicated the closest automatic station as Old Rough Lane (Kirby) operated by KMBC and located 2.1 km from the Proposed Development at the NGR: 341414, 398991. The analyser is not located in a similar urban environment to the Proposed Development or affected road network; however, recent data is presented in Table 4 to inform baseline conditions.

⁹ https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=43

Table 4 Automatic Analyser Monitoring Results

Site ID and Name	Type	Pollutant	Concentration ($\mu\text{g}/\text{m}^3$)			
			2019	2020	2021	2022
Old Rough Lane (Kirby)	Roadside	NO ₂	24.8	25.8	30.8	-
		NO ₂ (>200 $\mu\text{g}/\text{m}^3$)*	0	0	0 (113)	-
Old Rough Lane (Kirby)	Roadside	PM ₁₀	37.6	33.3	32.2	-
		PM ₁₀ (>50 $\mu\text{g}/\text{m}^3$)**	9	35	18 (48)	-

*Number of periods where daily mean concentrations greater than 200 $\mu\text{g}/\text{m}^3$ - AQO is 18 periods or greater.

** Number of periods where daily mean concentrations greater than 50 $\mu\text{g}/\text{m}^3$ - AQO is 35 periods or greater

- KMBC did not undertake any automatic monitoring during 2022.

4.4.3 Data from the Old Rough Lane analyser does not indicate exceedances of the long term or short term AQOs for NO₂ or PM₁₀ in recent years.

4.4.4 A review of KMBC's and LCC's passive diffusion tube network indicated numerous monitoring locations within 2.5 km of the site which are adjacent to the major arterial routes which are likely to be affected by development generated traffic. Data is presented in Table 5 with exceedances of the AQO highlighted in **bold**.

Table 5: Diffusion Tube Monitoring Results

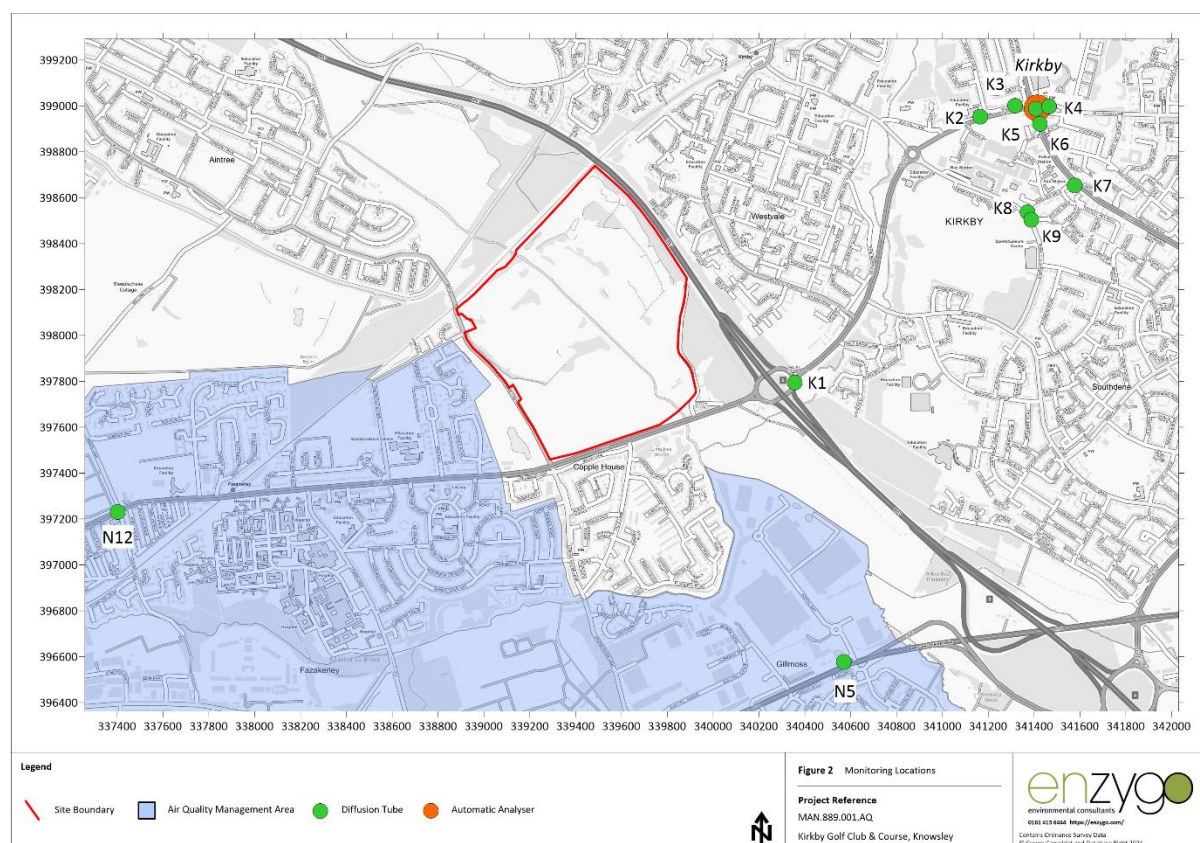
Site ID and Name	Type	Distance to Site (m)	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)			
			2019	2020	2021	2022
K1 - Junction of M57 and Valley Road	Roadside	919	45.4	38.0	33.3	34.0
N5 - East Lancs Road	Roadside	1,833	50.5	32.4	37.2	36.6
K2 - Kirkby C of E School, Hall Lane	Roadside	1,923	26.9	22.1	20.1	19.6
K8 - Webster Drive	Roadside	1,963	32.4	28.7	25.8	24.7
K9 - Cherryfield Drive	Roadside	1,971	35.3	27.7	27.1	28.6
K3 - Hall Drive	Roadside	2,079	25.3	22.5	19.8	20.1
K6 - Kelday Close	Roadside	2,143	35.3	28.1	26.6	28.7
K5 - Old Rough Lane and County Road	Roadside	2,154	35.1	30.9	28.1	28.9
K7 - Corner of County Road and Webster	Roadside	2,192	29.6	24.1	21.7	20.0
K4 - 12 Brakenhurst Grove	Roadside	2,209	32.5	26.9	26.3	23.6
N12 - Longmoor Ln/Seeds Lane*	Roadside	2,222	36.4	24.7	27.4	25.3

*LCC monitoring location

4.4.5 Recent monitoring data indicates two exceedances of the annual mean AQO during 2019. During 2022 NO₂ concentrations at all local monitoring stations complied with the annual mean AQO, this include N12 located within the LCC AQMA.

4.4.6 Figure 2 presents the diffusion tube monitoring locations within the assessment extents.

Figure 2 - Diffusion Tube Monitoring Locations



4.5 DEFRA Background Concentrations

4.5.1 To assist LAs in their air quality Review and Assessments, DEFRA have produced background concentration maps for NO₂, PM₁₀ and PM_{2.5}. Predictions are based on a 1 km by 1 km grid basis across the entire UK with the Proposed Development located in NGR: 339500, 398500.

4.5.2 Data for this grid square was downloaded for the most recent baseline year of 2022 and the anticipated construction phase of 2024 and operational year of 2026. Table 6 presents the data.

Table 6: DEFRA Background Pollutant Concentrations

Pollutant	Annual Mean Concentration (µg/m ³)		
	2022	2024	2026
NO ₂	15.09	18.88	12.95
PM ₁₀	12.60	12.38	12.26
PM _{2.5}	8.40	8.23	8.14

4.5.3 DEFRA background predictions concentrations of NO₂ and PM are not predicted to exceed the relevant AQOs.

4.6 Sensitive Receptors

4.6.1 A sensitive receptor is defined as any location which may be affected by changes in air quality as a result of a development. These have been defined for construction dust and road vehicle exhaust emissions impacts in the following sections.

Construction Phase Dust Impacts - Sensitive Receptors

4.6.2 No national or European ecological designations are located within 50 m of the Site boundary, or 50 m from a route used by construction vehicles on the public highway (up to 500 m from the Site entrance). Therefore, the risk of dust effects at a nationally or European designated ecological receptor site from construction impacts is not considered further in this assessment.

4.6.3 Human receptors sensitive to potential dust impacts during earthworks and construction were identified from a desk-top study of the area up to 350 m from the development boundary. These are summarised in Section 5.1.

Road Traffic Impacts - Sensitive Receptors

4.6.4 A desk-top study was undertaken to identify worst case sensitive receptor locations adjacent to the affected road network. Receptor locations were plotted where additional construction and operational traffic flows exceed the relevant EPUK and IAQM assessment thresholds.

4.6.5 The majority of receptor locations represent residential premises where members of the public might reasonably be expected to spend one hour or more. The identified receptor locations are summarised Table 7.

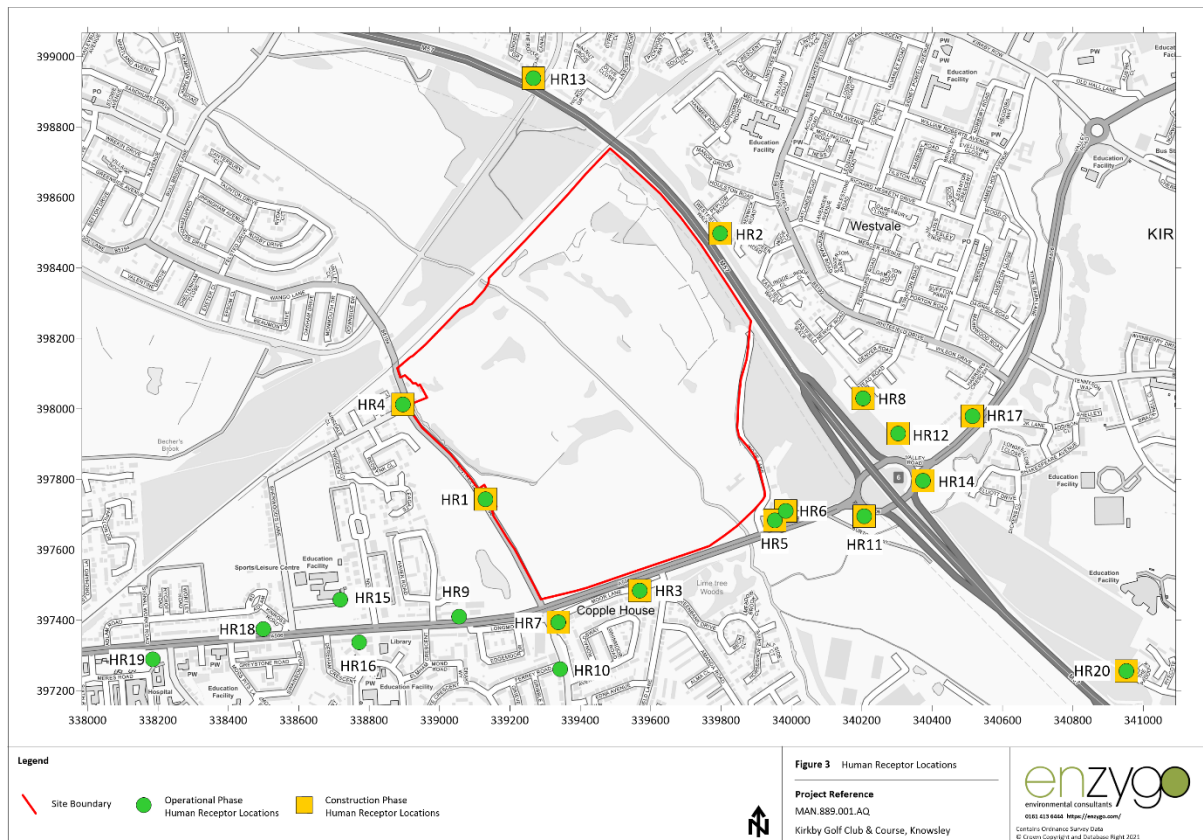
Table 7: Road Traffic Sensitive Human Receptors

Receptor Name		NGR (m)		Height (m)
		X	Y	
HR1	Mather Cottage	339130.2	397742.9	1.5
HR2	22 Westfield Walk	339797.3	398498.4	1.5
HR3	1 Moor Lane	339569.0	397484.4	1.5
HR4	179 Sherwood's Lane	338895.8	398012.8	1.5
HR5	4 Oxton Cottage	339952.5	397683.8	1.5
HR6	8 Oxton Cottage	339984.0	397710.4	1.5
HR7	9 Moor Lane	339337.2	397394.3	1.5
HR8	79 Elstead Road	340203.9	398029.7	1.5
HR9	425 Longmoor Lane	339055.3	397409.8	1.5
HR10	117 Copplehouse Lane	339342.7	397261.3	1.5
HR11	Burtons Farm	340206.9	397694.8	1.5
HR12	Whitefield Brook	340303.1	397929.8	1.5
HR13	16 The Pottery	339267.0	398938.9	1.5
HR14	Tithebarn Cottages	340374.1	397795.7	1.5
HR15	Fazakerley School	338718.2	397457.9	1.5
HR16	710 Longmoor Lane	338771.2	397336.8	1.5
HR17	88 Wilson Drive	340513.9	397979.3	1.5
HR18	377 Longmoor Lane	338498.9	397374.8	1.5
HR19	Buttermere Apartments	338185.3	397288.4	1.5
HR20	180 Ribblers Lane	340952.2	397255.5	1.5

4.6.6 Receptors modelled at 1.5 m to represent the average UK “breathing height” above ground level.

4.6.7 Figure 3 presents the modelled human receptor locations. The receptors represent sensitive locations that reflect the predicted traffic distribution for the construction and operational phases.

Figure 3 – Modelled Receptor Locations



5.0 Assessment

5.1 Construction Phase Impact Assessment

5.1.1 A desk top screening assessment (Step 1) identified sensitive receptors within 350 m of the site boundary, and within 50 m of the anticipated trackout. Receptors likely to be affected by construction phase dust impacts are summarised in Table 8.

Table 8: Construction Phase Sensitive Receptor Counts

Distance from Site or Trackout Routes (m)	Approximate Number of Receptors
Earthworks and Construction	
Less than 20	1 - 10
20 – 50	10 - 100
50 – 100	More than 100
100 – 350	More than 100
Trackout	
Less than 20	1 - 10
20 – 50	10 - 100

5.1.2 A detailed assessment of potential dust impacts was therefore required. This is described in the following sections.

5.1.3 Figure 4 and Figure 5 provide maps of the construction and trackout buffer distances.

Figure 4 – Earthworks and Construction Buffer Distances

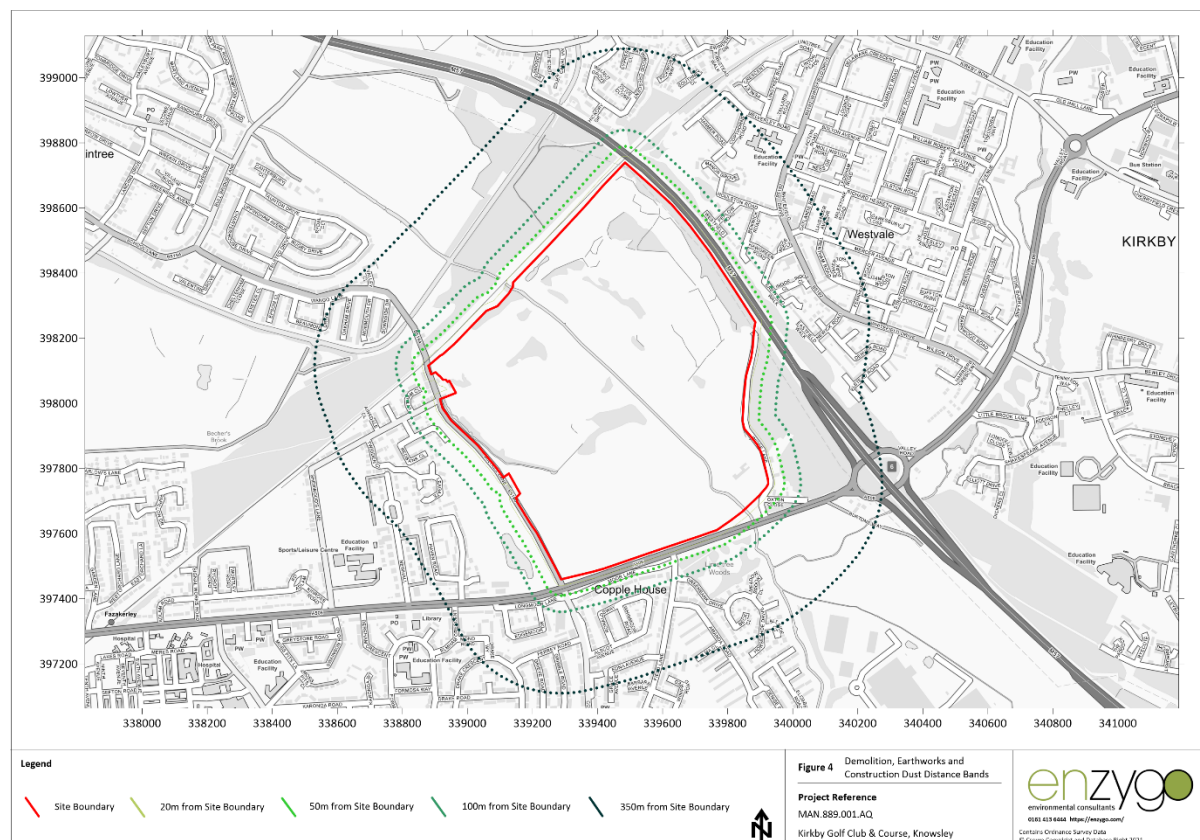
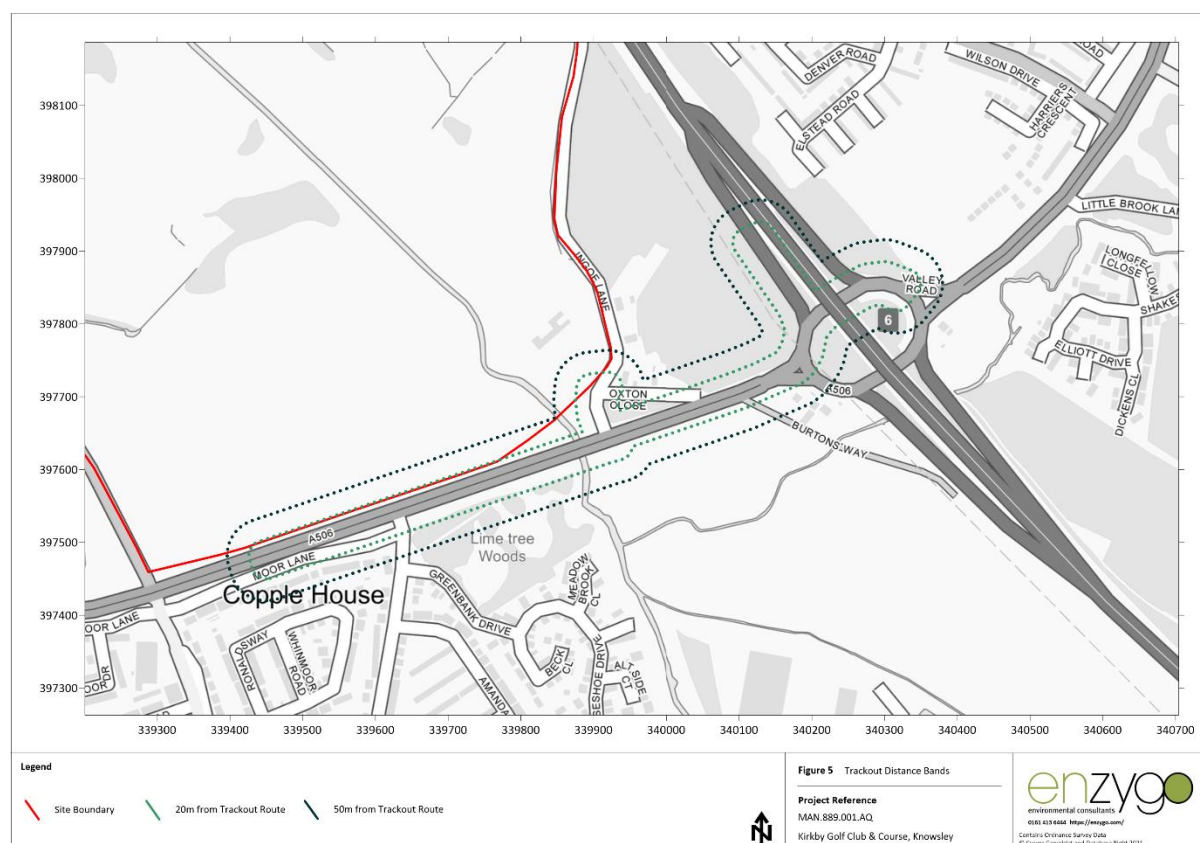


Figure 5 – Trackout Buffer Distances



Magnitude

5.1.4 The scale and nature of the works has been determined to assess the magnitude (Step 2A) of fugitive dust emissions arising from each construction phase activity. The determination of magnitude was based upon the criteria detailed in Appendix C.

Demolition

5.1.5 Demolition activities are not required to prepare the site for construction. As such the magnitude of fugitive dust emissions arising from demolition activities are not considered further.

Earthworks

5.1.6 The Proposed Development site will require the importation of approximately 1,000,000 tonnes of clean materials to deliver the reconfiguration and improvements to the golf course. Based on this the magnitude of fugitive dust emissions arising from earthwork activities is considered *large*. (i.e. total material moved >100,000 tonnes).

Construction

5.1.7 Based on the anticipated construction volumes the magnitude of fugitive dust emissions arising from construction activities is considered *medium*. (i.e. construction volumes between 25,000 and 100,000 m³).

Trackout

5.1.8 The importation of materials associated is anticipated to generated 65 HDV trips per day (130 two way trips). It is also anticipated that the unpaved road length would be significant. As such,

the magnitude of fugitive dust emissions arising from trackout activities is considered large. (*i.e. unpaved road length <100 m & >50 HDV outward movements in any one day*).

5.1.9 A summary of the construction phase magnitudes is detailed in Table 9.

Table 9: Dust Emission Magnitude

Demolition	Earthworks	Construction	Trackout
-	Large	Medium	Large

Sensitivity of the Area

5.1.10 The next step (Step 2B) determined the sensitivity of the surrounding area, based on the number, proximity, and type of receptors. To ensure a worse case assessment all receptors were assumed to be highly sensitive (e.g. residential).

Dust Soiling

5.1.11 Residential premises are located within 50 m of the site which presents a high receptor sensitivity. When combined with receptor counts provided in Table 8 the sensitivity of the surrounding area is medium for all construction activities.

Human Health

5.1.12 Predicted annual mean background concentrations of PM₁₀ within the vicinity of the proposed site, as predicted by DEFRA, are 12.60 µg/m³ (Table 6). Based on the receptor counts provided in Table 8, the sensitivity of the surrounding area is low for all construction activities.

Table 10: Summary of Area Sensitivity to Dust Impacts

Impact	Demolition	Earthworks	Construction	Trackout
Dust Soiling	-	Medium	Medium	Medium
Human Health	-	Low	Low	Low

Risk

5.1.13 The next stage of the assessment (Step 2C) combined the dust magnitude and receptor sensitivity defined above to determine the overall risk with no mitigation applied. This is summarised in Table 11.

Table 11: Summary of Unmitigated Dust Risk

Impact	Demolition	Earthworks	Construction	Trackout
Dust Soiling	-	Medium	Medium	Medium
Human Health	-	Low	Low	Low

5.1.14 Following the determination of risk for each activity, the final step (Step 3) detailed necessary mitigation measures to reduce impacts during the construction phase. These measures have been adapted for the Proposed Development and summarised in Table 16 within Section 6.1.

5.2 Road Traffic Exhaust Impacts

Construction Phase

5.2.1 Predicted impact significance at individual receptors on annual mean NO₂, PM₁₀ and PM_{2.5} concentrations based on the criteria given in Table 3 are summarised in Table 12.

Table 12: Summary of Construction Phase Road Vehicle Exhaust Emission Impacts

Pollutant and Period	Receptors	Significance of Impact
Annual Mean NO ₂	All Receptors	Negligible
Annual Mean PM ₁₀	All Receptors	Negligible
Annual Mean PM _{2.5}	All Receptors	Negligible

5.2.2 As shown in Table 12 the significance of impacts was predicted to be negligible at all sensitive receptors. The overall significance of potential impacts was determined to be not significant in accordance with the EPUK and IAQM guidance⁴.

5.2.3 Full assessment results and commentary can be found in Appendix B, with justifications summarised in in Table 13.

Table 13: Construction Phase Impact Significance

Guidance	Comment
Number of properties affected by slight, moderate or substantial air quality impacts and a judgement on the overall balance	Impacts on NO ₂ , PM ₁₀ and PM _{2.5} concentrations were predicted to be negligible at all sensitive receptors. These represent worst-case locations and therefore it is unlikely that any other receptors would be significantly affected by the Proposed Development.
Where new exposure is introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant	The Proposed Development will not result in any new sensitive exposure to pollutant concentrations above the AQOs at sensitive locations
The percentage change in concentration relative to the objective and the descriptions of the impacts at the receptors	The maximum changes in annual mean NO₂ and PM₁₀ concentrations relative to their respective AQOs were predicted to range from: • <0.01% to 0.18% for NO₂, • <0.01% to 0.02% for PM₁₀; and • <0.01% to 0.04% for PM_{2.5}. Resultant impacts were therefore negligible at all receptor locations for each pollutant species
Whether or not an exceedance of an objective is predicted to arise or be removed in the study area due to a substantial increase or decrease	There were no predicted exceedances of the annual mean AQOs for NO ₂ , PM ₁₀ or PM _{2.5} at any location within the modelling extents
The extent to which an objective is exceeded e.g. an annual mean NO ₂ concentration of 41 µg/m ³ should attract less significance than an annual mean of 51 µg/m ³	As above, there were no predicted exceedances at any receptor locations within the modelling extents

5.2.4 As such, the overall construction phase road traffic impact associated with the importation of material was determined as not significant.

Operational Phase

5.2.5 It is expected the operational phase of the Proposed Development will generate a net increase of 1,021 (<3.4% HDV) trips when considering flows generated by the existing site. Based on the anticipated AADT trip generation dispersion modelling was undertaken to quantify potential changes in pollutant concentrations at sensitive locations in the vicinity of the site.

5.2.6 Predicted impact significance at individual receptors on annual mean NO₂, PM₁₀ and PM_{2.5} concentrations based on the criteria given in Table 3 are summarised in Table 12.

Table 14: Summary of Operational Phase Road Vehicle Exhaust Emission Impacts

Pollutant and Period	Receptors	Significance of Impact
Annual Mean NO ₂	All Receptors	Negligible
Annual Mean PM ₁₀	All Receptors	Negligible
Annual Mean PM _{2.5}	All Receptors	Negligible

5.2.7 As shown in Table 12 the significance of impacts was predicted to be negligible at all sensitive receptors. The overall significance of potential impacts was determined to be not significant in accordance with the EPUK and IAQM guidance⁴. Full assessment results and commentary can be found in Appendix B, with justifications summarised in in Table 13.

Table 15: Operational Phase Impact Significance

Guidance	Comment
Number of properties affected by slight, moderate or substantial air quality impacts and a judgement on the overall balance	Impacts on NO ₂ , PM ₁₀ and PM _{2.5} concentrations were predicted to be negligible at all sensitive receptors. These represent worst-case locations and therefore it is unlikely that any other receptors would be significantly affected by the Proposed Development.
Where new exposure is introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant	The Proposed Development will not result in any new sensitive exposure to pollutant concentrations above the AQOs at sensitive locations
The percentage change in concentration relative to the objective and the descriptions of the impacts at the receptors	The maximum changes in annual mean NO ₂ and PM ₁₀ concentrations relative to their respective AQOs were predicted to range from: <0.01% to 0.10% for NO₂, <0.01% to 0.02% for PM₁₀; and <0.01% to 0.04% for PM_{2.5}. Resultant impacts were therefore negligible at all receptor locations for each pollutant species
Whether or not an exceedance of an objective is predicted to arise or be removed in the study area due to a substantial increase or decrease	There were no predicted exceedances of the annual mean AQOs for NO ₂ , PM ₁₀ or PM _{2.5} at any location within the modelling extents
The extent to which an objective is exceeded e.g. an annual mean NO ₂ concentration of 41µg/m ³ should attract less significance than an annual mean of 51 µg/m ³	As above, there were no predicted exceedances at any receptor locations within the modelling extents

5.2.8 As such, the overall operational phase road traffic emission impact was determined as not significant.

5.3 On-site Exposure

5.3.1 As stated in Section 3.4 the Proposed Development does not present any relevant exposure to long term pollutant concentrations. 1-hour NO₂ and 24-hour PM₁₀ short term pollutant averaging periods were therefore reviewed to determine site suitability.

- 5.3.2 Section 7.97 of LAQM.TG22² states 1 hour mean exceedance are unlikely to occur where annual mean concentrations are below 60 $\mu\text{g}/\text{m}^3$. Based on worse-case monitoring results provided by the Kirkby Analyser (30.8 $\mu\text{g}/\text{m}^3$) it is unlikely that the 1-hour AQO for NO_2 would be exceeded across the site. Similarly, a maximum modelled annual mean NO_2 concentration of 17.29 $\mu\text{g}/\text{m}^3$ predicted at HR5 close to the site further supports that 1-hour mean concentrations would not exceed the AQO across the site.
- 5.3.3 24-hour PM_{10} monitoring undertaken by the Kirkby Analyser indicates an average concentration of 48 $\mu\text{g}/\text{m}^3$ with 18 days exceeding the 50 $\mu\text{g}/\text{m}^3$ AQO. Based on the worst case location it is not expected the 24-hour AQO for PM_{10} would be exceeded across proposed sensitive use.
- 5.3.4 Additionally, a maximum modelled annual mean concentration of 13.16 $\mu\text{g}/\text{m}^3$ predicted at HR5 further supports that 24-hour mean AQO for PM_{10} would not be exceeded across the Proposed Development. This is in line with guidance provided in LAQM.TG22² which indicates that annual mean PM_{10} concentrations above 32 $\mu\text{g}/\text{m}^3$ equate to likely exceedances of the 24-hour mean AQO.
- 5.3.5 Based on worse case monitoring results, DEFRA background concentrations and modelled concentrations it is not expected that unacceptable short term pollutant exposure would be present across the Proposed Development.

6.0 Mitigation

6.1 Construction Phase

6.1.1 The IAQM guidance³ provides several control measures to reduce fugitive dust impacts during the construction phase. These measures have been adapted based on professional judgment for the Proposed Development site and summarised in Table 16.

Table 16: Fugitive Dust Mitigation Measures

Impact	Recommended Control Measure and Requirement		
Communications	1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
	2	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.	H
	3	Display the head or regional office contact information	H
	4	Develop and implement a Dust Management Plan, which may include measures to control other emissions.	H
Site Management	5	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner	H
	6	Make the complaints log available to the local authority when asked	H
	7	Record any exceptional incidents that cause dust and/or air emissions and the action taken to resolve the situation in the log book.	H
Monitoring	9	Undertake 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 100 m of site boundary, with cleaning to be provided if necessary.	D
	10	Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results, and make an inspection log available to the local authority when asked	H
	11	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.	H
	12	Agree dust monitoring locations with the Local Authority	H
Preparing & Maintaining Site	13	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
	14	Erect solid screens or barriers around dusty activities or the site boundary.	H
	15	Fully enclose site or specific operations where there is a high potential for dust production	H
	16	Avoid site runoff of water or mud	H
	17	Keep site fencing, barriers and scaffolding clean using wet methods	H
	18	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.	H
	19	Cover, seed or fence stockpiles to prevent wind whipping	H

Impact	Recommended Control Measure and Requirement		
Operating Vehicle/Machinery & Sustainable Travel	20	Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NRMM standards	H
	21	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
	22	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	H
	23	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced 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)	D
	24	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials	H
	25	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	D
Operations	26	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction,	H
	27	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	H
	28	Use enclosed chutes and conveyors and covered skips.	H
	29	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	H
	30	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.	H
Waste Management	31	Avoid bonfires and burning of waste materials	H
Demolition	32	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
	33	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
	34	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
	35	Bag and remove any biological debris or damp down such material before demolition	H
Earthworks & Construction	36	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	D
	37	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable	D
	38	Only remove the cover in small areas during work and not all at once	D
	39	Avoid scabbling (roughening of concrete surfaces) if possible	D
	40	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	H

Impact	Recommended Control Measure and Requirement		
		which case ensure that appropriate additional control measures are in place.	
	41	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.	D
	42	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.	D
Trackout	43	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site.	H
	44	Avoid dry sweeping of large areas.	H
	45	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport, as necessary.	H
	46	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
	47	Record all inspections of haul routes and any action in a site log book.	H
	48	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H
	49	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
	50	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.	H
	51	Access gates to be located at least 10 m from receptors where possible	H

*D – desired

*H – highly recommended

6.1.2 Assuming the relevant mitigation measures outlined in Table 16 are implemented, the residual effect from all dust generating activities (Step 4) is predicted to be negligible and therefore not significant in accordance with the IAQM guidance³.

7.0 Conclusions

- 7.1.1 A qualitative dust risk assessment was undertaken in accordance with the IAQM methodology to determine the overall risk of fugitive emission generated during construction and define a suitable mitigation strategy. Assuming good practice and the implementation of suggested dust control measures, detailed in Table 16, residual impacts are predicted to be not significant.
- 7.1.2 Potential road traffic emission impacts during the construction and operational phase of the development may cause NO₂ and fine PM impacts on existing receptor locations as a result of vehicles travelling to and from the site. Dispersion modelling assessment was undertaken to quantify air quality impacts at sensitive receptor locations with results verified using monitoring results obtained from KMBC and LCC.
- 7.1.3 Associated impacts were predicted to be negligible at all sensitive receptor locations within the vicinity of the site during both the construction and operational phase. The overall significance of potential road vehicle exhaust emissions impacts associated with the Proposed Development was determined to be not significant in accordance with the EPUK and IAQM guidance³.
- 7.1.4 Hourly mean concentrations across the Proposed Development site comply with the national AQOs at all proposed sensitive locations. Further mitigation measures to protect future occupiers are not required and onsite exposure impacts were predicted to be not significant.
- 7.1.5 In accordance with principals of best practice a scheme of offsetting measures is recommended to minimise air quality impacts. It is understood that a fixed strategy will be determined at a later stage following discussions with KMBC.
- 7.1.6 In summary, it is predicted that both development impacts and on-site pollutant exposure are deemed not significant and should not form a constraint to planning consent.

8.0 Abbreviations

AADT	Annual Average Daily Traffic
ADM	Atmospheric Dispersion Modelling
ADMS	Atmospheric Dispersion Modelling Software
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
ASR	Annual Status Report
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DM	Do Minimum
DS	Do Something
EA	Environment Agency
EPUK	Environmental Protection UK
EV	Electric Vehicle
EU	European Union
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
KMBC	Knowsley Metropolitan Borough Council
LA	Local Authority
LAQM	Local Air Quality Management
LCC	Liverpool City Council
LDV	Light Duty Vehicle
NGR	National Grid Reference
NO ₂	Nitrogen Dioxide
NO _x	Oxides of nitrogen
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRMM	Non-Road Mobile Machinery
PM ₁₀	Particulate Matter with an aerodynamic diameter less than 10µm
PM _{2.5}	Particulate Matter with an aerodynamic diameter less than 2.5µm
RMSE	Route Mean Square Error
UK	United Kingdom
Z ₀	Roughness Length

Appendix A – Assessment Inputs

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 6.0.0.1) which is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the UK for the prediction of pollutant dispersion from road sources. The Environment Agency and DEFRA also widely accept modelling predictions from this software package.

The model requires input data that details the following parameters:

- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length; and
- Monin-Obukhov length.

Traffic Flow Data

Baseline and future year traffic predictions and anticipated distribution were provided by the appointed transport consultant, Prime Transport Planning. Data was provided for modelled road links L1 - L21 and L47. Traffic flows data for modelled road links L22 – L46 was obtained from the Department for Transport (DfT) Database¹⁰.

Vehicle speeds were estimated based on the free flow potential of each link and local speed limits. Assumptions account for speed reductions at junctions and peak hour congestion in line with Section 7.260 of LAQM.TG22².

Road widths were estimated from aerial photography provided by Google Earth Pro.

A summary of the traffic data used to inform each assessment scenario are presented Table A1.

¹⁰ <https://roadtraffic.dft.gov.uk/#15/53.4211/-2.9354/basemap-countpoints> - Accessed 06/09/2023.

Table A1: 24-hour AADT Traffic Data

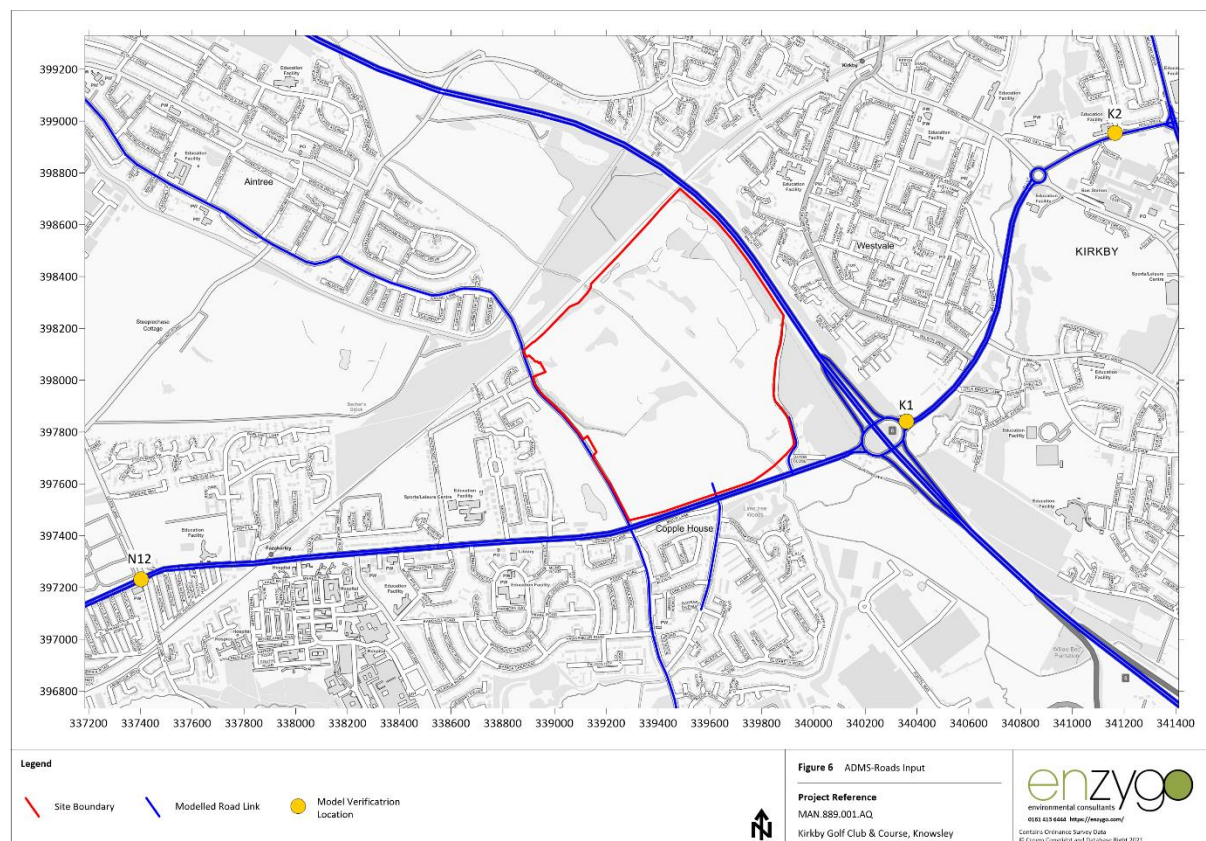
Road Link		Verification Scenario 2022		DM Construction Scenario 2024		DS Construction Scenario 2024		DM Operational Scenario 2026		DS Operational Scenario 2026	
		AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%
L1	Ingoe Lane	525	6.7	533	6.7	533	6.7	545	6.4	277	0.0
L2	A506 (Valley Road EB) - Copple House Lane to Field Lane	16,895	3.0	17,160	3.0	17,160	3.0	17,818	2.8	18,027	2.8
L3	A506 (Valley Road EB) - Field Lane Junction	16,895	3.0	17,160	3.0	17,160	3.0	17,818	2.8	18,027	2.8
L4	A506 (Valley Road EB) - Field Lane to Site Access	18,859	2.8	19,155	2.8	19,220	3.2	19,881	2.7	20,072	2.7
L5	A506 (Valley Road EB) - East of Site Access to M57 Roundabout	18,878	2.9	19,174	2.9	19,239	3.2	19,898	2.7	20,066	2.7
L6	A506 (Valley Road EB) - M57 Roundabout Approach	18,878	2.9	19,174	2.9	19,239	3.2	19,898	2.7	20,066	2.7
L7	A506 (Valley Road WB) - M57 Roundabout Exit	18,878	2.9	19,174	2.9	19,239	3.2	19,898	2.7	20,066	2.7
L8	A506 (Valley Road WB) - M57 Roundabout to Site Access	18,878	2.9	19,174	2.9	19,239	3.2	19,898	2.7	20,066	2.7
L9	A506 (Valley Road WB) - West of Site Access to Field Lane	18,859	2.8	19,155	2.8	19,220	3.2	19,881	2.7	20,072	2.7
L10	A506 (Valley Road WB) - Field Lane Junction	18,859	2.8	19,155	2.8	19,220	3.2	19,881	2.7	20,072	2.7
L11	A506 (Valley Road WB) - West of Field Lane	16,895	3.0	17,160	3.0	17,160	3.0	17,818	2.8	18,027	2.8
L12	A506 (Valley Road WB) - Copple House Lane Junction	16,895	3.0	17,160	3.0	17,160	3.0	17,818	2.8	18,027	2.8
L13	A506 (Longmoor Lane EB) - Copple House Lane Junction	14,355	3.3	14,580	3.3	14,580	3.3	15,113	3.1	15,172	3.1
L14	A506 (Longmoor Lane EB) - East of Lower Lane	14,355	3.3	14,580	3.3	14,580	3.3	15,113	3.1	15,172	3.1
L15	A506 (Longmoor Lane WB) - West of Copple House Lane	14,355	3.3	14,580	3.3	14,580	3.3	15,113	3.1	15,172	3.1
L16	Field Lane - A506 Junction	7,381	2.8	7,497	2.8	7,497	2.8	7,741	2.7	7,741	2.7
L17	Field Lane	7,381	2.8	7,497	2.8	7,497	2.8	7,741	2.7	7,741	2.7
L18	Copple House Lane - A506 Junction	15,761	1.6	16,008	1.6	16,008	1.6	16,549	1.5	16,768	1.6
L19	Copple House Lane	15,761	1.6	16,008	1.6	16,008	1.6	16,549	1.5	16,768	1.6
L20	B5194 (Aintree Lane) - A506 Junction	14,781	1.8	15,013	1.8	15,013	1.8	15,518	1.8	15,605	1.8
L21	B5194 (Aintree Lane)	14,781	1.8	15,013	1.8	15,013	1.8	15,518	1.8	15,605	1.8
L22	A506 - M57 Junction 6 Roundabout	42,010	2.0	42,670	2.0	42,800	2.3	44,504	1.9	44,675	1.9

Road Link		Verification Scenario 2022		DM Construction Scenario 2024		DS Construction Scenario 2024		DM Operational Scenario 2026		DS Operational Scenario 2026	
		AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%
L23	M57 (NB) - North of Junction 6 Slip Road	15,823	1.5	16,071	1.5	16,136	1.9	16,614	1.5	16,614	1.5
L24	M57 (SB) - North of Junction 6 Slip Road	16,202	1.3	16,457	1.3	16,522	1.7	17,013	1.3	17,013	1.3
L25	M57 (NB) - North of Junction 6	36,797	8.0	37,375	8.0	37,440	8.2	38,637	8.0	38,637	8.0
L26	M57 (SB) - North of Junction 6	37,680	7.1	38,272	7.1	38,337	7.2	39,564	7.1	39,564	7.1
L27	M57 (SB) - South of Junction 6 Slip Road	13,678	2.1	13,893	2.1	13,958	2.5	14,362	2.1	14,410	2.1
L28	M57 (NB) - South of Junction 6 Slip Road	13,809	2.1	14,026	2.1	14,091	2.5	15,013	1.9	15,061	1.9
L29	M57 (NB) - Between Junction 6	18,001	18.2	18,283	18.2	18,348	18.5	18,901	18.2	18,901	18.2
L30	M57 (SB) - Between Junction 6	21,478	11.4	21,815	11.4	21,880	11.7	22,551	11.4	22,551	11.4
L31	M57 (NB) - South of Junction 6	31,810	11.2	32,309	11.2	32,374	11.4	33,400	11.2	33,448	11.2
L32	M57 (SB) - South of Junction 6	31,810	11.2	32,309	11.2	32,374	11.4	33,400	11.2	33,448	11.2
L33	A506 (Valley Road NB) - M57 Roundabout Exit	13,165	1.7	13,372	1.7	13,372	1.7	13,823	1.7	13,921	1.7
L34	A506 (Valley Road SB) - M57 Roundabout Approach	14,126	1.6	14,348	1.6	14,348	1.6	14,832	1.6	14,930	1.6
L35	A506 (Valley Road NB) - East of M57 Roundabout	13,165	1.7	13,372	1.7	13,372	1.7	13,823	1.7	13,921	1.7
L36	A506 (Valley Road SB) - East of M57 Roundabout	14,126	1.6	14,348	1.6	14,348	1.6	14,832	1.6	14,930	1.6
L37	A506 Roundabout	13,405	1.7	13,616	1.7	13,616	1.7	14,076	1.7	14,173	1.7
L38	A506 (Hall Lane)	27,291	1.6	27,719	1.6	27,719	1.6	28,656	1.6	28,851	1.7
L39	A506 (Hall Lane) - A5208 Junction	13,646	1.6	13,860	1.6	13,860	1.6	14,328	1.6	14,328	1.6
L40	A506 (Hall Lane) to A5208 (Country Road SB)	6,823	1.6	6,930	1.6	6,930	1.6	7,164	1.6	7,164	1.6
L41	A506 (Hall Lane) to A506 (Country Road NB)	6,823	1.6	6,930	1.6	6,930	1.6	7,164	1.6	7,164	1.6
L42	A506 (Country Road)	15,821	3.5	16,069	3.5	16,069	3.5	16,612	3.5	16,612	3.5
L43	A506 (Country Road SB) - Hall Lane Junction	8,061	4.0	8,188	4.0	8,188	4.0	8,464	4.0	8,464	4.0
L44	A506 (Country Road NB) - Hall Lane Junction	7,760	3.0	7,882	3.0	7,882	3.0	8,148	3.0	8,148	3.0
L45	A5208 (Country Road NB)	4,885	4.6	4,962	4.6	4,962	4.6	5,129	4.6	5,129	4.6

Road Link		Verification Scenario 2022		DM Construction Scenario 2024		DS Construction Scenario 2024		DM Operational Scenario 2026		DS Operational Scenario 2026	
		AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%	AADT	HDV%
L46	A5208 (Country Road SB)	4,443	4.5	4,513	4.5	4,513	4.5	4,665	4.5	4,665	4.5
L47	Proposed Site Access	0	0.0	0	0.0	130	100.0	0	0.0	1,021	6.9

Figure 6 presents the modelled road link locations used within the operational phase assessment.

Figure 6 – ADMS Road Inputs



Emission Factors

Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 11.0) released in November 2021, which incorporates updated COPERT 5.3 vehicle emissions factors for NO_x and PM and EURO 6 vehicle fleet sub-categories.

The 2024 and 2026 future scenarios assume a reduction to future year emission factors guided by increasing EV fleets and future advancements to low emission technologies as provided by the EFT.

Assessment Area

Ambient concentrations were also predicted at discrete sensitive receptor locations, presented in Figure 3, adjacent to the affected road network as presented in Figure 6.

NO_x to NO₂ Conversion

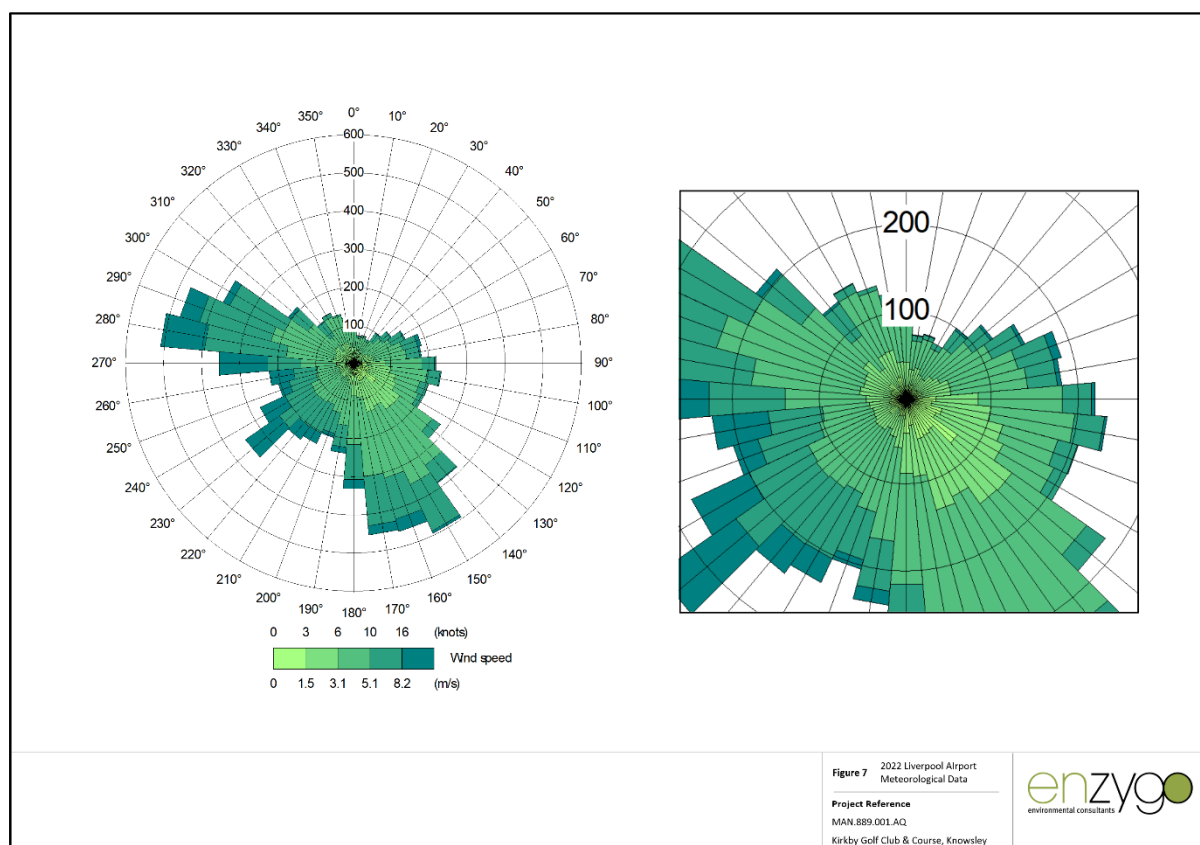
Predicted annual mean NO_x concentrations from the dispersion model were converted to NO₂ concentrations using the NO_x to NO₂ Calculator (v.8.1) provided by DEFRA, which is the method detailed within LAQM.TG22².

Meteorological Data

Hourly sequential data used in this assessment was obtained from Liverpool Airport meteorological station, located 16 km south of the Proposed Development.

Figure 7 presents the meteorological wind rose.

Figure 7 – Meteorological Wind Rose



The choice of data is considered suitable to represent meteorological conditions across the modelled domain. All meteorological data used in the assessment was provided by ADM Ltd.

Meteorological Parameters

The specific roughness length (z_0) values specified with ADMS-5 are summarised in Table A2.

Table A2: Roughness Lengths

Location	Roughness Length (m)	ADMS Description
Assessment Extents	0.5	Parkland, open suburbia
Met Station	0.2	Agricultural areas (min)

The Monin-Obukhov length values are summarised in Table A3.

Table A3: Monin-Obukhov Lengths

Location	Monin-Obukhov Length (m)	ADMS Description
Assessment Extents	30	Cities and Large Towns
Met Station	10	Small Towns <50,000

Background Concentrations

Table A4 displays the specific background concentrations as predicted by DEFRA, utilised to represent the condition at the monitoring locations used within the verification process.

Maximum concentrations were applied to all locations across the assessment extents to ensure a robust approach.

Table A4: Predicted 2022 Background Concentrations for Monitoring Locations

Monitoring Location	DEFRA Grid Square	Pollutant	Background Concentration ($\mu\text{g}/\text{m}^3$)
K1	340500, 397500	NO _x	21.63
		NO ₂	15.76
K2	341500, 398500	NO _x	18.24
		NO ₂	13.50
N12	337500, 397500	NO _x	19.69
		NO ₂	14.36

Table A5 displays the predicted background concentrations by DEFRA used in the operational phase assessment for the sensitive receptor locations.

Table A5: Predicted Background Concentrations at Sensitive Receptors

Receptor Location	DEFRA Grid Square	Pollutant	Background Concentration ($\mu\text{g}/\text{m}^3$)	
			2024	2026
HR1, HR3, HR5 – HR7, HR9 & HR10	339500, 397500	NO _x	17.46	16.39
		NO ₂	12.94	12.21
		PM ₁₀	11.89	11.77
		PM _{2.5}	8.25	8.16
HR2 & HR13	339500, 398500	NO _x	18.88	17.46
		NO ₂	13.92	12.95
		PM ₁₀	12.38	12.26
		PM _{2.5}	8.23	8.14
HR4	338500, 398500	NO _x	12.10	15.38
		NO ₂	16.23	11.51
		PM ₁₀	11.25	11.12
		PM _{2.5}	7.61	7.52
HR8	340500, 398500	NO _x	17.66	16.40
		NO ₂	13.11	12.24
		PM ₁₀	12.28	12.16
		PM _{2.5}	8.46	8.37
HR11 – H14, HR17 & HR20	340500, 397500	NO _x	19.62	17.98
		NO ₂	14.43	13.32
		PM ₁₀	13.25	13.13
		PM _{2.5}	8.75	8.66
HR15 – HR16 & HR18 – HR19	338500, 397500	NO _x	20.75	19.80
		NO ₂	14.98	14.36
		PM ₁₀	11.50	11.38
		PM _{2.5}	8.00	7.91

Similar to emission factors, background concentrations for 2024 and 2026 were used to represent predicted background concentrations during the future year scenarios.

Verification

The predicted results from a dispersion model may differ from measured concentrations for many 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.

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.

For the purpose of this assessment model verification was undertaken for 2022, using traffic data, meteorological data, and monitoring results from this year. The verification process was undertaken using locations K1, K2 and N12 which are directly adjacent to the affected road network. It is noted that several diffusion tubes and the Kirkby analyser are located to the junction of A506 (Hall Lane) and A506 (Country Road), however the signalled junction is not representative of the affected road network and as such monitors situated in this area were not considered further during the verification process.

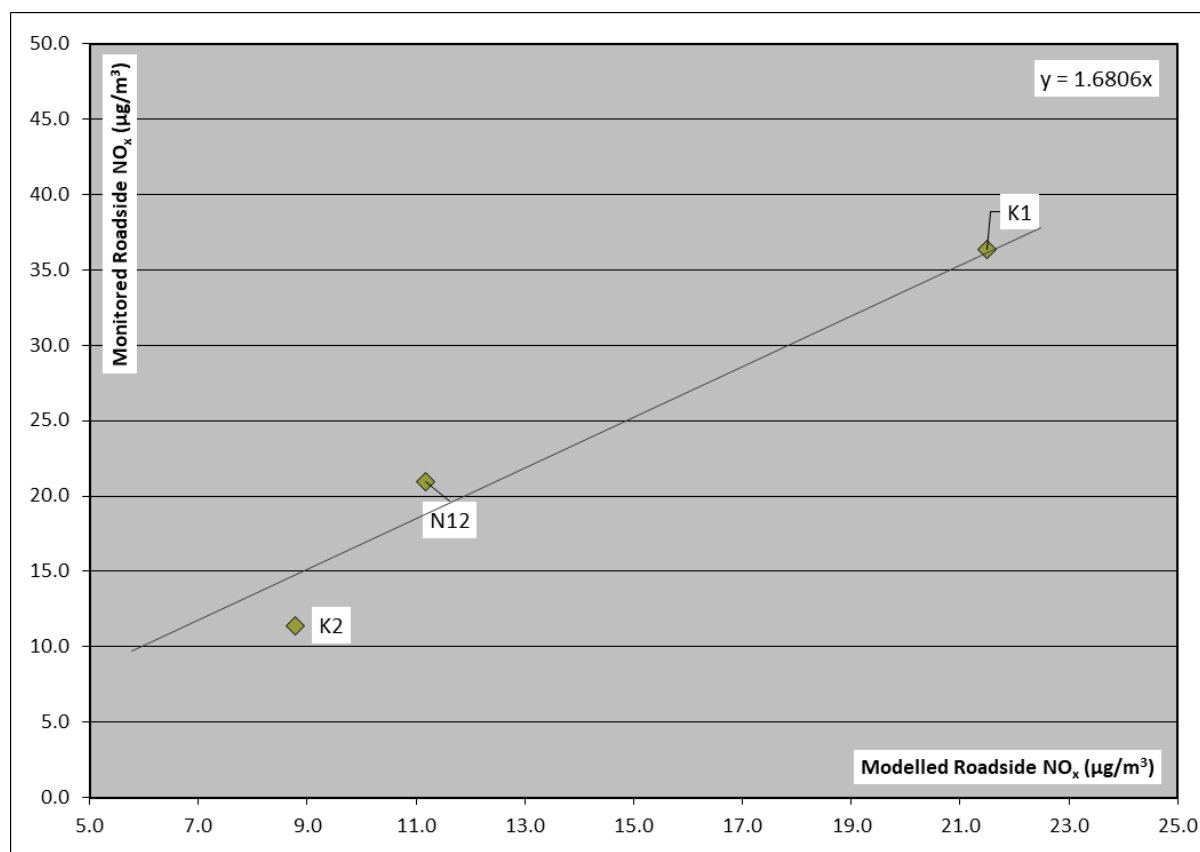
DEFRA guidance LAQM.TG22² advises that the initial verification should consider the performance of the model in predicting road sourced NO_x. Table A6 shows result of the adjusted model and comparison of monitored and predicted annual mean road NO_x concentrations following model adjustment. All reasonable improvements to modelling inputs were made to reduce the overall uncertainties.

Table A6: Initial Modelled NO_x Results

Site ID	Monitored Road NO _x Concentration (µg/m ³)	Modelled Road NO _x Concentration (µg/m ³)	% Difference ((Modelled – Monitored)/Monitored) * 100
K1	36.35	21.49	-41%
K2	11.42	8.78	-23%
N12	21.00	11.19	-47%

It was necessary to apply a factor to adjust the modelling results. The monitored and modelled NO_x Road contribution concentrations were graphed and the equation of the trend line based on the linear progression through zero was calculated, as shown in Graph 1 below.

Graph 1 – Modelled and Monitored NO_x Road Contributions



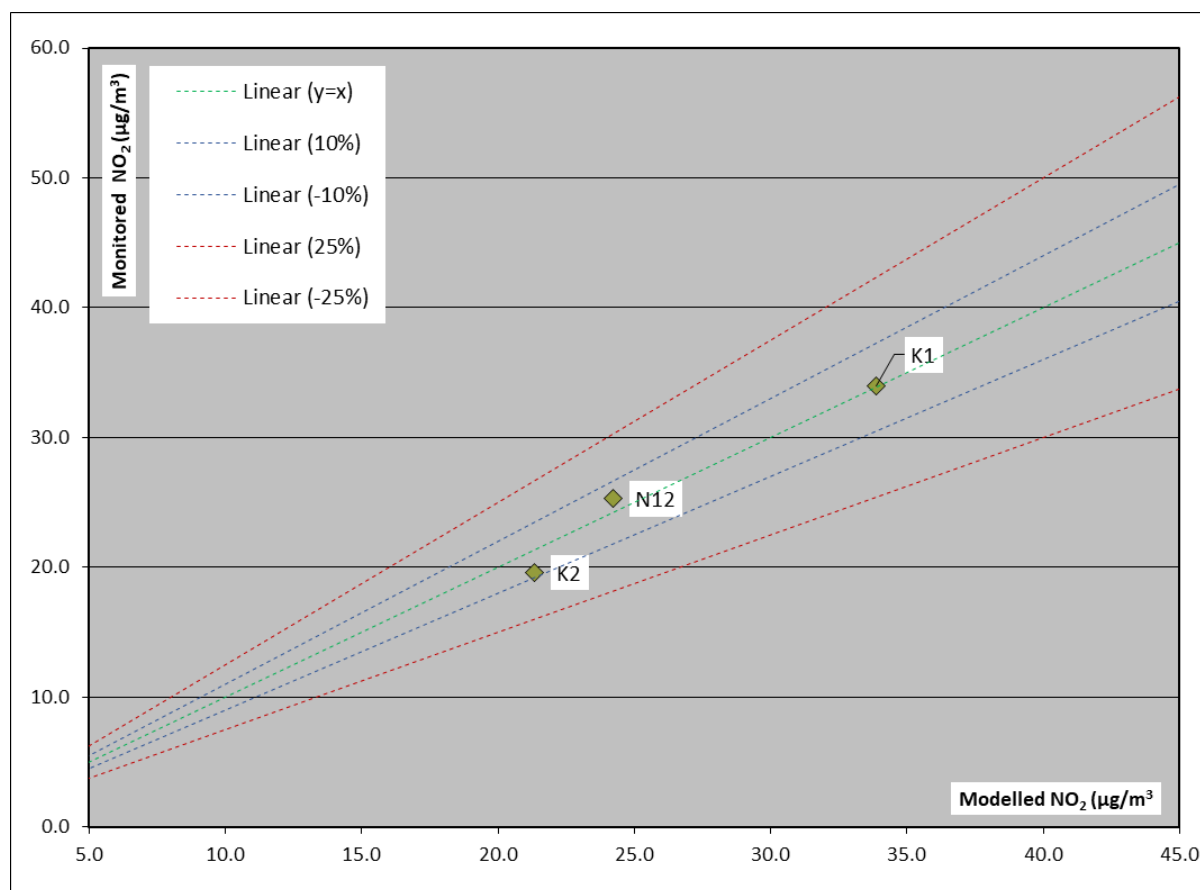
The adjustment factor of **1.6806** was applied to the modelled road NO_x contributions with results presented in Table A7.

Table A7: Adjusted Modelled and Monitored NO₂ Concentrations

Site ID	Monitored NO ₂ Concentration (µg/m³)	Adjusted Modelled NO ₂ Concentration (µg/m³)	% Difference ((Modelled – Monitored)/Monitored) * 100
N22	34.00	33.89	0%
N25	19.60	21.33	9%
N26	25.30	24.22	-4%

A graphical representation of the adjusted NO₂ concentrations is provided within Graph 2.

Graph 2 – Comparison of Monitored and Adjusted Modelled NO₂ Concentrations



As demonstrated in Table A7 and Graph 2, the modelled concentrations are within $\pm 10\%$ of monitored concentrations at all locations. Additional methods for determining model performance are provided below in accordance with Box 7.20 of LAQM.TG22².

Table A8: Model Performance

Method	Calculated Value	Ideal Value
Correlation Coefficient	0.98	1.00
Root Mean Square Error	1.18 (2.95%)	0.0 (<25%)
Fractional Bias	-0.01	0.0

The model performance detailed in Table A8 provides good values which adhere to the guidance provided in LAQM.TG22² and suggest further post adjustment is unnecessary.

KMBC or LCC does not currently monitor PM concentrations in the assessment extents and as such it was appropriate to apply the NO_x adjustment factor to the modelled PM₁₀ and PM_{2.5} concentrations.

Appendix B - Assessment Results

CONSTRUCTION PHASE ROAD TRAFFIC IMPACTS

Predicted Concentrations at Sensitive Receptors - Nitrogen Dioxide

Table B1: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		DM	DS	Change
HR1	Mather Cottage	18.94	18.94	0.00
HR2	22 Westfield Walk	20.75	20.76	0.01
HR3	1 Moor Lane	16.38	16.39	0.01
HR4	179 Sherwood's Lane	19.77	19.77	0.00
HR5	4 Oxton Cottage	19.00	19.06	0.06
HR6	8 Oxton Cottage	17.54	17.58	0.04
HR7	9 Moor Lane	17.79	17.79	0.00
HR8	79 Elstead Road	17.20	17.23	0.03
HR11	Burtens Farm	22.54	22.63	0.09
HR12	Whitefield Brook	19.83	19.87	0.04
HR13	16 The Pottery	24.63	24.64	0.01
HR14	Tithebarn Cottages	25.21	25.31	0.10
HR17	88 Wilson Drive	19.31	19.31	0.00
HR20	180 Ribblers Lane	16.84	16.84	0.00

As indicated in Table B1, annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B2.

Table B2: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.00	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.03	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.03	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.00	75% or Less of AQO	Negligible
HR5	4 Oxton Cottage	0.15	75% or Less of AQO	Negligible
HR6	8 Oxton Cottage	0.10	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.00	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.08	75% or Less of AQO	Negligible
HR11	Burtens Farm	0.23	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.10	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.03	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.25	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.00	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.00	75% or Less of AQO	Negligible

As indicated in Table B2 impacts on annual mean NO₂ concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

Particulate Matter (PM₁₀)

Table B3: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration (µg/m ³)		
		DM	DS	Change
HR1	Mather Cottage	13.64	13.64	0.00
HR2	22 Westfield Walk	13.76	13.77	0.01
HR3	1 Moor Lane	12.85	12.85	0.00
HR4	179 Sherwood's Lane	12.27	12.28	0.01
HR5	4 Oxton Cottage	13.62	13.64	0.02
HR6	8 Oxton Cottage	13.15	13.16	0.01
HR7	9 Moor Lane	13.07	13.07	0.00
HR8	79 Elstead Road	13.14	13.15	0.01
HR11	Burtens Farm	15.14	15.16	0.02
HR12	Whitefield Brook	14.46	14.47	0.01
HR13	16 The Pottery	14.56	14.57	0.01
HR14	Tithebarn Cottages	15.74	15.77	0.03
HR17	88 Wilson Drive	14.59	14.59	0.00
HR20	180 Ribblers Lane	13.77	13.78	0.01

As indicated in Table B3 annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B4.

Table B4: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.00	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.02	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.00	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.02	75% or Less of AQO	Negligible
HR5	4 Oxton Cottage	0.05	75% or Less of AQO	Negligible
HR6	8 Oxton Cottage	0.02	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.00	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.02	75% or Less of AQO	Negligible
HR11	Burtens Farm	0.05	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.02	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.02	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.07	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.00	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.02	75% or Less of AQO	Negligible

As indicated in Table B4 impacts on annual mean PM₁₀ concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

Particulate Matter (PM_{2.5})

Table B5: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration (µg/m³)		
		DM	DS	Change
HR1	Mather Cottage	9.24	9.24	0.00
HR2	22 Westfield Walk	9.09	9.09	0.00
HR3	1 Moor Lane	8.80	8.80	0.00
HR4	179 Sherwood's Lane	8.19	8.19	0.00
HR5	4 Oxtan Cottage	9.23	9.24	0.01
HR6	8 Oxtan Cottage	8.97	8.98	0.01
HR7	9 Moor Lane	8.93	8.93	0.00
HR8	79 Elstead Road	8.98	8.99	0.01
HR11	Burtans Farm	9.85	9.86	0.01
HR12	Whitefield Brook	9.47	9.47	0.00
HR13	16 The Pottery	9.59	9.59	0.00
HR14	Tithebarn Cottages	10.20	10.22	0.02
HR17	88 Wilson Drive	9.52	9.52	0.00
HR20	180 Ribblers Lane	9.07	9.08	0.01

As indicated in Table B5 annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B6.

Table B6: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.00	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.00	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.00	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.00	75% or Less of AQO	Negligible
HR5	4 Oxtan Cottage	0.04	75% or Less of AQO	Negligible
HR6	8 Oxtan Cottage	0.04	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.00	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.04	75% or Less of AQO	Negligible
HR11	Burtans Farm	0.04	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.00	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.00	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.08	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.00	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.04	75% or Less of AQO	Negligible

As indicated in Table B6 impacts on annual mean PM_{2.5} concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

It is therefore considered that the overall impacts as a result of the Proposed Development are not significant. Further justifications are discussed in Section 5.2 and Table 13.

OPERATIONAL PHASE ROAD TRAFFIC IMPACTS

Predicted Concentrations at Sensitive Receptors - Nitrogen Dioxide

Table B1: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		DM	DS	Change
HR1	Mather Cottage	17.21	17.24	0.03
HR2	22 Westfield Walk	18.61	18.61	0.00
HR3	1 Moor Lane	15.07	15.10	0.03
HR4	179 Sherwood's Lane	14.51	14.52	0.01
HR5	4 Oxton Cottage	17.27	17.29	0.02
HR6	8 Oxton Cottage	16.04	16.06	0.02
HR7	9 Moor Lane	16.24	16.28	0.04
HR8	79 Elstead Road	15.64	15.65	0.01
HR9	425 Longmoor Lane	17.43	17.45	0.02
HR10	117 Coplehouse Lane	15.57	15.60	0.03
HR11	Burtens Farm	20.11	20.13	0.02
HR12	Whitefield Brook	17.83	17.84	0.01
HR13	16 The Pottery	21.85	21.85	0.00
HR14	Tithebarn Cottages	22.37	22.40	0.03
HR15	Fazakerley School	15.76	15.76	0.00
HR16	710 Longmoor Lane	16.35	16.36	0.01
HR17	88 Wilson Drive	17.39	17.41	0.02
HR18	377 Longmoor Lane	18.74	18.76	0.02
HR19	Buttermere Apartments	16.15	16.16	0.01
HR20	180 Ribblers Lane	15.31	15.31	0.00

As indicated in Table B1, annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B2.

Table B2: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.07	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.00	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.07	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.02	75% or Less of AQO	Negligible
HR5	4 Oxton Cottage	0.05	75% or Less of AQO	Negligible
HR6	8 Oxton Cottage	0.05	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.10	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.02	75% or Less of AQO	Negligible
HR9	425 Longmoor Lane	0.05	75% or Less of AQO	Negligible

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR10	117 Coplehouse Lane	0.07	75% or Less of AQO	Negligible
HR11	Burtons Farm	0.05	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.03	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.00	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.07	75% or Less of AQO	Negligible
HR15	Fazakerley School	0.00	75% or Less of AQO	Negligible
HR16	710 Longmoor Lane	0.02	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.05	75% or Less of AQO	Negligible
HR18	377 Longmoor Lane	0.05	75% or Less of AQO	Negligible
HR19	Buttermere Apartments	0.03	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.00	75% or Less of AQO	Negligible

As indicated in Table B2 impacts on annual mean NO₂ concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

Particulate Matter (PM₁₀)

Table B3: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration (µg/m ³)		
		DM	DS	Change
HR1	Mather Cottage	14.92	14.93	0.01
HR2	22 Westfield Walk	13.17	13.17	0.00
HR3	1 Moor Lane	12.75	12.76	0.01
HR4	179 Sherwood's Lane	13.32	13.32	0.00
HR5	4 Oxton Cottage	13.15	13.16	0.01
HR6	8 Oxton Cottage	12.67	12.68	0.01
HR7	9 Moor Lane	14.34	14.35	0.01
HR8	79 Elstead Road	13.15	13.15	0.00
HR9	425 Longmoor Lane	13.27	13.28	0.01
HR10	117 Coplehouse Lane	14.31	14.32	0.01
HR11	Burtons Farm	14.10	14.11	0.01
HR12	Whitefield Brook	13.01	13.01	0.00
HR13	16 The Pottery	13.38	13.39	0.01
HR14	Tithebarn Cottages	13.78	13.78	0.00
HR15	Fazakerley School	11.91	11.91	0.00
HR16	710 Longmoor Lane	11.38	11.38	0.00
HR17	88 Wilson Drive	13.13	13.13	0.00
HR18	377 Longmoor Lane	11.38	11.38	0.00
HR19	Buttermere Apartments	11.38	11.38	0.00
HR20	180 Ribblers Lane	13.13	13.13	0.00

As indicated in Table B3 annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B4.

Table B4: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.02	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.00	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.02	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.00	75% or Less of AQO	Negligible
HR5	4 Oxtan Cottage	0.02	75% or Less of AQO	Negligible
HR6	8 Oxtan Cottage	0.02	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.02	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.00	75% or Less of AQO	Negligible
HR9	425 Longmoor Lane	0.02	75% or Less of AQO	Negligible
HR10	117 Coplehouse Lane	0.02	75% or Less of AQO	Negligible
HR11	Burtens Farm	0.02	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.00	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.02	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.00	75% or Less of AQO	Negligible
HR15	Fazakerley School	0.00	75% or Less of AQO	Negligible
HR16	710 Longmoor Lane	0.00	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.00	75% or Less of AQO	Negligible
HR18	377 Longmoor Lane	0.00	75% or Less of AQO	Negligible
HR19	Buttermere Apartments	0.00	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.00	75% or Less of AQO	Negligible

As indicated in Table B4 impacts on annual mean PM₁₀ concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

Particulate Matter (PM_{2.5})

Table B5: Predicted Annual Mean Concentrations

Potential Impact		Predicted Annual Mean Concentration (µg/m ³)		
		DM	DS	Change
HR1	Mather Cottage	9.16	9.17	0.01
HR2	22 Westfield Walk	9.00	9.00	0.00
HR3	1 Moor Lane	8.71	8.72	0.01
HR4	179 Sherwood's Lane	8.11	8.12	0.01
HR5	4 Oxtan Cottage	9.16	9.16	0.00
HR6	8 Oxtan Cottage	8.89	8.89	0.00
HR7	9 Moor Lane	8.84	8.85	0.01
HR8	79 Elstead Road	8.90	8.90	0.00

Potential Impact		Predicted Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
		DM	DS	Change
HR9	425 Longmoor Lane	9.22	9.22	0.00
HR10	117 Coplehouse Lane	8.82	8.83	0.01
HR11	Burtons Farm	9.77	9.78	0.01
HR12	Whitefield Brook	9.39	9.39	0.00
HR13	16 The Pottery	9.51	9.51	0.00
HR14	Tithebarn Cottages	10.14	10.14	0.00
HR15	Fazakerley School	8.19	8.19	0.00
HR16	710 Longmoor Lane	8.31	8.31	0.00
HR17	88 Wilson Drive	9.44	9.44	0.00
HR18	377 Longmoor Lane	8.81	8.81	0.00
HR19	Buttermere Apartments	8.27	8.27	0.00
HR20	180 Ribblers Lane	8.99	8.99	0.00

As indicated in Table B5 annual mean concentrations were below the relevant AQO at all receptor locations considered. Predicted impacts are summarised in Table B6.

Table B6: Predicted Impacts

Potential Impact		% Change in Concentration Relative to AQO	Long Term Average Concentration	IAQM Impact Descriptor
HR1	Mather Cottage	0.04	75% or Less of AQO	Negligible
HR2	22 Westfield Walk	0.00	75% or Less of AQO	Negligible
HR3	1 Moor Lane	0.04	75% or Less of AQO	Negligible
HR4	179 Sherwood's Lane	0.04	75% or Less of AQO	Negligible
HR5	4 Oxton Cottage	0.00	75% or Less of AQO	Negligible
HR6	8 Oxton Cottage	0.00	75% or Less of AQO	Negligible
HR7	9 Moor Lane	0.04	75% or Less of AQO	Negligible
HR8	79 Elstead Road	0.00	75% or Less of AQO	Negligible
HR9	425 Longmoor Lane	0.00	75% or Less of AQO	Negligible
HR10	117 Coplehouse Lane	0.04	75% or Less of AQO	Negligible
HR11	Burtons Farm	0.04	75% or Less of AQO	Negligible
HR12	Whitefield Brook	0.00	75% or Less of AQO	Negligible
HR13	16 The Pottery	0.00	75% or Less of AQO	Negligible
HR14	Tithebarn Cottages	0.00	75% or Less of AQO	Negligible
HR15	Fazakerley School	0.00	75% or Less of AQO	Negligible
HR16	710 Longmoor Lane	0.00	75% or Less of AQO	Negligible
HR17	88 Wilson Drive	0.00	75% or Less of AQO	Negligible
HR18	377 Longmoor Lane	0.00	75% or Less of AQO	Negligible
HR19	Buttermere Apartments	0.00	75% or Less of AQO	Negligible
HR20	180 Ribblers Lane	0.00	75% or Less of AQO	Negligible

As indicated in Table B6 impacts on annual mean PM_{2.5} concentrations as a result of road vehicle exhaust emissions associated with the development were predicted to be negligible at all receptor locations.

It is therefore considered that the overall impacts as a result of the Proposed Development are not significant. Further justifications are discussed in Section 5.2 and Table 13.

Appendix C – IAQM Construction Phase Methodology

There is the potential for fugitive dust emissions to occur as a result of construction phase activities. These have been assessed in accordance with the methodology outlined within the IAQM guidance. Activities are divided into four types to reflect their different potential impacts. These are:

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

The potential for dust emissions was assessed for each activity that is likely to take place and considered three separate dust effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to a significant increase in exposure to PM₁₀ and PM_{2.5}.

The assessment steps are detailed below.

Step 1

Step 1 screens the requirement for a more detailed assessment. Should human receptors be identified within 350m from the site boundary or 50m from the construction vehicle route up to 500m from the site entrance, then the assessment should proceed to Step 2. Additionally, should ecological receptors be identified within 50m of the boundary site or 50m from the construction vehicle route up to 500m from the site entrance, then the assessment should also proceed to Step 2.

Should sensitive receptors not be present within the relevant distances then negligible impacts would be expected and further assessment is not necessary.

Step 2

Step 2 assesses the risk of potential dust impacts. A site is allocated to a risk category based on two factors:

- The scale and nature of the works, which determines the magnitude of dust arising as: small, medium or large (Step 2A); and
- The sensitivity of the area to dust impacts, which can be defined as low, medium or high sensitivity (Step 2B).

The two factors are combined in Step 2C to determine the risk of dust impacts without mitigation applied. Step 2A defines the potential magnitude of dust emission through the construction phase. The relevant criteria are summarised in Table C1.

Table C1: Construction Dust - Magnitude of Emission

Magnitude	Activity	Criteria
Large	Demolition	- Total building volume greater than 50,000m³ - Potentially dusty construction material (e.g. concrete) - On-site crushing and screening - Demolition activities greater than 20m above ground level
	Earthworks	- Total site area greater than 10,000m² - Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) - More than 10 heavy earth moving vehicles active at any one time - Formation of bunds greater than 8m in height - More than 100,000 tonnes of material moved
	Construction	- Total building volume greater than 100,000m³ - On site concrete batching - Sandblasting
	Trackout	- More than 50 Heavy Duty Vehicle (HDV) trips per day - Potentially dusty surface material (e.g. high clay content) - Unpaved road length greater than 100m
Medium	Demolition	- Total building volume 20,000m³ to 50,000m³ - Potentially dusty construction material - Demolition activities 10m to 20m above ground level
	Earthworks	- Total site area 2,500m² to 10,000m² - Moderately dusty soil type (e.g. silt) 5 to 10 heavy earth moving vehicles active at any one time - Formation of bunds 4m to 8m in height - Total material moved 20,000 tonnes to 100,000 tonnes
	Construction	- Total building volume 25,000m³ to 100,000m³ - Potentially dusty construction material (e.g. concrete) - On site concrete batching
	Trackout	10 to 50 HDV trips per day - Moderately dusty surface material (e.g. high clay content) - Unpaved road length 50m to 100m
Small	Demolition	- Total building volume under 20,000m³ - Construction material with low potential for dust release (e.g. metal cladding or timber) - Demolition activities less than 10m above ground level - Demolition during wetter months
	Earthworks	- Total site area less than 2,500m² - Soil type with large grain size (e.g. sand) - Less than 5 heavy earth moving vehicles active at any one time - Formation of bunds less than 4m in height - Total material moved less than 20,000 tonnes - Earthworks during wetter months
	Construction	- Total building volume less than 25,000m³ - Construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	<10 HDV (3.5t) outward movements in any one day - Surface material with low potential for dust release - Unpaved road length <50m

Step 2B defines the sensitivity of the area around the development site for construction, earthworks and trackout. The factors influencing the sensitivity of the area are shown in Table C2.

Table C2: Examples of Factors Defining Sensitivity of an Area

Sensitivity	Receptors	
	Human	Ecological
High	- Users expect of high levels of amenity - High aesthetic or value property - People expected to be present continuously for extended periods of time - Locations where members of the public are exposed over a time period relevant to the AQO for PM₁₀ e.g. residential properties, hospitals, schools and residential care homes	Internationally or nationally designated site e.g. Special Area of Conservation
Medium	- Users would expect to enjoy a reasonable level of amenity - Aesthetics or value of their property could be diminished by soiling - 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 e.g. parks and places of work	Nationally designated site e.g. Sites of Special Scientific Interest
Low	- Enjoyment of amenity would not reasonably be expected - Property would not be expected to be diminished in appearance - Transient exposure, where people would only be expected to be present for limited periods. e.g. public footpaths, playing fields, shopping streets, playing fields, farmland, footpaths, short term car park and roads	Locally designated site e.g. Local Nature Reserve

The sensitivity of the area to dust soiling effects on people and property is shown in Table C3.

Table C3: Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	More than 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	Low
Medium	More than 1	Medium	Low	Low	Low
Low	More than 1	Low	Low	Low	Low

Table C4 outlines the sensitivity of the area to human health impacts.

Table C4: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	Greater than 32µg/m ³	More than 100	High	High	High	Medium	Low
		10 - 100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28 - 32µg/m ³	More than 100	High	High	Medium	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	24 - 28µg/m ³	More than 100	High	Medium	Low	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	Less than 24µg/m ³	More than 100	Medium	Low	Low	Low	Low
		10 - 100	Low	Low	Low	Low	Low
	Less than 24µg/m ³	More than 100	Medium	Low	Low	Low	Low
		10 - 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Medium	Greater than 32µg/m ³	More than 10	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	28 - 32µg/m ³	More than 10	Medium	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	24 - 28µg/m ³	More than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	Less than 24µg/m ³	More than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Low	-	More than 1	Low	Low	Low	Low	Low

Table C5 outlines the sensitivity of the area to ecological impacts.

Table C5: Sensitivity of the Area to Ecological Impacts

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

Step 2C combines the dust emission magnitude with the sensitivity of the area to determine the risk of unmitigated impacts.

Table C6 outlines the risk category from demolition activities.

Table C6: Dust Risk Category from Demolition

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Medium
Medium	High	Medium	Low
Low	Medium	Low	Negligible

Table C7 outlines the risk category from earthworks and construction activities.

Table C7: Dust Risk Category from Earthworks and Construction

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

Table C8 outlines the risk category from trackout.

Table C8: Dust Risk Category from Trackout

	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Low	Negligible
Low	Low	Low	Negligible

Step 3

Step 3 requires the identification of site-specific mitigation measures within the IAQM guidance to reduce potential dust impacts based upon the relevant risk categories identified in Step 2. For sites with negligible risk mitigation measures beyond those required by legislation are not required. However, additional controls may be applied as part of good practice.

Step 4

Once the risk of dust impacts has been determined and the appropriate mitigation measures identified, the final step is to determine the significance of any residual impacts. For almost all construction activity, the aim should be to control effects using effective mitigation.

Experience shows that this is normally possible. Hence the residual effect will normally be not significant.

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