Homes England

Lea Castle Village, Kidderminster Outline Planning Application

Air Quality Assessment

Final Report

Wood Group UK Limited – April 2022

Report for

Eiryl McCook
Homes England
1 Friargate
Coventry
CV1 2GN

Main contributors

Muhammad Hashim Malik

Issued by

....
Muhammad Hashim Malik

Approved by

....
Ellenore Calas

Wood Group UK Limited

3rd Floor
11 Westferry Circus
Canary Wharf
London E14 4HD
United Kingdom
Tel +44 (0)20 3215 1610

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Executive summary

This air quality assessment has been prepared by Wood Group UK Ltd. ("Wood") on behalf of Homes England. Homes England is submitting an outline planning application (all matters apart from access reserved) for around 800 new dwellings, village centre with retail and community uses, two form entry primary school, C2 provision (80 bed care home), around 7ha of employment land, new vehicular accesses from Wolverhampton Road, Stourbridge Road and Lea Castle Drive, public open space, orchard, landscaping, drainage and other associated infrastructure, on three parcels of land located adjacent to the Former Lea Castle Hospital Site, Cookley, Kidderminster (approximate central National Grid References (NGR) SO 855 789, SO 847 791 and SO 852 797 respectively), hereafter referred to as 'the Site'.

An assessment of construction-related effects has been undertaken following the IAQM Guidance on the Assessment of Dust from Demolition and Construction. The Proposed Development site is defined as 'high risk' of dust soiling for earthworks and construction activities and as 'medium risk' for trackout. It is defined as 'low risk' of human health effects for earthworks, construction and trackout activities. Appropriate mitigation measures to be implemented during the construction phase have been recommended. These measures will ensure construction dust effects remain negligible.

An assessment of the potential air quality impact of the operational phase of the Proposed Development has been undertaken. ADMS-Roads (version 5.0) modelling has been used to model dispersion from traffic to determine likely NO_2, PM_{10} and $PM_{2.5}$ concentrations at existing and proposed future residential receptors within the Proposed Development.

Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted likely to be <u>comfortably below</u> their respective AQOs at all modelled receptor locations in the first year of operation of the development, 2024. With reference to the EPUK & IAQM impact descriptors, <u>impacts are predicted to be negligible at all existing receptors</u>.

Contents

1. Introduction

This air quality assessment has been prepared by Wood Group UK Ltd. ("Wood") on behalf of Homes England. Homes England is submitting an outline planning application (all matters apart from access reserved) for around 800 new dwellings, village centre with retail and community uses, two form entry primary school, C2 provision (80 bed care home), around 7ha of employment land, new vehicular accesses from Wolverhampton Road, Stourbridge Road and Lea Castle Drive, public open space, orchard, landscaping, drainage and other associated infrastructure, on three parcels of land located adjacent to the Former Lea Castle Hospital Site, Cookley, Kidderminster (approximate central National Grid References (NGR) SO 855 789, SO 847 791 and SO 852 797 respectively), hereafter referred to as 'the Site'. The Proposed Development is not located within an Air Quality Management Area (AQMA), and the nearest AQMA is Kidderminster (Ring Road) AQMA.

The main source of potential pollution in the vicinity is vehicles travelling on the local road network. The Proposed Development is likely to generate traffic on the local road network, therefore the change in concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) at existing sensitive receptors has been assessed. In addition, the pollutant concentrations to which future residents of the Proposed Development will be exposed has been assessed.

2. Policy and legislation

2.1 Relevant policy

Table 2.1 lists policy and guidance relevant to the assessment of the effects on air quality, and the issues included in this policy/guidance that needed to be considered when determining the scope of this assessment.

Table 2.1 Policy issues relating to air quality considered in preparing the report

Policy Reference	Policy Issues
National Policy	
National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2021)	Paragraph 186 states "*Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan*".
National Planning Practice Guidance (NPPG) (Department for Levelling Up, Housing and Communities, 2021)	It is stated in the NPPG that air quality is relevant to planning applications when the development could "*Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality*".
Clean Air Strategy 2019 (Defra, 2019)	This document describes the Government's overarching approach to tackling air pollution in the UK.
Local Policy	
Submitted Wyre Forest District Local Plan 2016 – 2036 (Wyre Forest District Council, 2020)	Policy 9 Health and Wellbeing states that "*Development should help maximise opportunities to ensure that people in Wyre Forest District lead healthy, active lifestyles and experience a high quality of life by: Improving air quality and reducing pollution through the encouragement of more active lifestyles and reducing car dependency*". Policy 16A Pollution and Land Instability states that "*Development proposals must be designed in order to avoid any significant adverse impacts from pollution,*

Policy Reference	Policy Issues
	including cumulative ones, on any of the following: An existing or proposed Air Quality Management Area (AQMA)". Policy 31.2 Lea Castle Village Principles of Development, states that "*Any mitigation required in terms of noise, air quality, drainage and ecology should be determined at an early stage*".
Planning Obligations Supplementary Planning Document (Wyre Forest District Council, 2016)	It is stated in the SPD that, "*Residential developments of 10 or more dwellings, will all be required, usually through planning conditions, to put in place measures to mitigate increased emissions. Such measures could include Travel Plans, design improvements, reduced car parking, sustainable vehicle measures, cycling/pedestrian facilities and improvements to local public transport.* *Where assessments made by the appropriate body indicate a development will have a negative impact on local air quality, schemes will be expected to include further mitigation measures*". Measure to reduce traffic associated with the Proposed Development will be put in place, this includes active travel routes encouraging walking and cycling to the new primary school and local centre. Additionally, electric vehicle charging points will be installed which will encourage uptake of electric vehicles. These measures are presented in the Transport Assessment associated with the Proposed Development (Wood, 2022).

2.2 Relevant legislation

The legislative framework for air quality consists of legally enforceable EU Limit Values that are transposed into UK legislation as Air Quality Standards (AQS) that must be at least as challenging as the EU Limit Values. Action in the UK is then driven by the UK's Air Quality Strategy that sets the AQOs.

The EU Limit Values are set by the European directive on air quality and cleaner air for Europe (2008/50/EC) and the European directive relating to arsenic, cadmium, mercury, nickel, and polycyclic aromatic hydrocarbons in ambient air (2004/107/EC) as the principal instruments governing outdoor ambient air quality policy in the EU. The Limit Values are legally binding levels for concentrations of pollutants for outdoor air quality.

The two European directives, as well as the Council's decision on exchange of information were transposed into UK Law via the Air Quality Standards Regulations 2010, and amended via the Air Quality Standards (Amendment) Regulations 2016. Air Quality Standards are concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment. The Air Quality Strategy sets the AQOs, which give target dates and some interim target dates to help the

UK move towards achievement of the EU Limit Values. The AQOs are a statement of policy intentions or policy targets and as such, there is no legal requirement to meet these objectives except in as far as they mirror any equivalent legally binding Limit Values in EU legislation. The most recent UK Air Quality Strategy for England, Scotland, Wales and Northern Ireland was published in July 2007.

Since Part IV of the Environment Act 1995 came into force, local authorities have been required to periodically review concentrations of the UK Air Quality Strategy pollutants within their areas and to identify areas where the AQOs may not be achieved by their relevant target dates. This process of Local Air Quality Management (LAQM) is an integral part of delivering the Government's AQOs detailed in the Strategy. The Environment Act 2021 establishes a legally binding duty on government to bring forward at least two new $PM_{2.5}$ air quality targets in secondary legislation by 31 October 2022. This duty sits within the environmental targets framework outlined in the Environment Act (Part 1).

When areas are identified where some or all of the AQOs might potentially be exceeded and where there is relevant public exposure, i.e. where members of the public would regularly be exposed over the appropriate averaging period, the local authority has a duty to declare an AQMA and to implement an AQAP to reduce air pollution levels towards the AQOs. The latest guidance on the LAQM process is given in Defra's 2016 Local Air Quality Management Technical Guidance (LAQM.TG(16)).

The UK Government and the Devolved Administrations have set national AQOs for particulate matter smaller than 2.5 µm in diameter ($PM_{2.5}$). These AQOs have not been incorporated into the LAQM Regime, and authorities have no statutory obligation to review and assess air quality against them. However, given that $PM_{2.5}$ is a pollutant of concern at the national and EU levels it has been included in this assessment.

This assessment has focused on emissions of nitrogen oxides (NO_X), PM_{10} and $PM_{2.5}$, in order to assess concentrations of NO_2, PM_{10} and $PM_{2.5}$ as these are the pollutants of greatest health concern associated with road traffic. The NO_X (NO and NO_2) emitted from vehicle exhausts and other combustion sources undergoes photochemical oxidation in the atmosphere, with NO_2 being formed by oxidation of NO to NO_2 and, conversely, NO_2 undergoing photolysis (in the presence of sunlight) to create NO and ozone.

Emissions of other exhaust gases, such as carbon monoxide (CO), small quantities of sulphur dioxide (SO_2) and non-methane volatile organic compounds (NMVOC) including 1,3-butadiene and benzene, will also occur from vehicles. National level measurement and modelling assessments carried out by Defra have shown that policy measures already in place should reduce levels of CO, 1,3-butadiene and benzene to ensure compliance with the respective standards and objectives, even at busy roadside locations.

Table 2.2 sets out the AQOs that are relevant to this assessment, and the dates by which they are to be achieved.

Table 2.2 Summary of relevant air quality standards and objectives

Pollutant	Objective (UK)	Averaging period	Date to be achieved by and maintained thereafter (UK)
Nitrogen dioxide (NO_2)	200 μgm^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 Dec 2005
	40 μgm^{-3}	Annual mean	31 Dec 2005
Particulate matter – PM_{10}	50 μgm^{-3} not to be exceeded more than 35 times a year	24-hour mean	31 Dec 2004
	40 μgm^{-3}	Annual mean	31 Dec 2004
Particulate matter – $PM_{2.5}$	20 μgm^{-3}	Annual mean	-
	Target of 15% reduction in concentration at urban background locations	3 year mean	-

For NO_2, it is the annual mean objective that is the more stringent AQO; it is generally considered that the 1-hour mean NO_2 AQO will not be exceeded if the annual mean objective is not exceeded. For PM_{10}, the 24-hour mean objective is more stringent than the annual mean.

The likelihood of exceedance of the NO_2 and PM_{10} short-term AQOs can be assessed with reference to the predicted annual means and the relationships recommended by LAQM.TG(16):

The 1-hour mean NO_2 objective is unlikely to be exceeded if the annual mean is less than 60 μgm^{-3};

An estimate of potential exceedances of the 24-hour mean PM_{10} objective[12] is given by:

$$Number\ of\ 24\ hour\ mean\ exceedences = -18.5 + 0.00145\ x\ annual\ mean^3 + \frac{206}{annual\ mean}$$

On the basis of the above relationship, the 24-hour mean objective for PM_{10} is likely to be met if the predicted annual-mean PM_{10} concentration is 31.8 μgm^{-3} or less.

2.3 Relevant guidance

Institute of Air Quality Management (IAQM)

The Institute of Air Quality Management (IAQM, 2014) has developed guidance regarding the assessment of the impacts of construction on air quality and the determination of their significance.

Local communities may be concerned that development activities (particularly construction works) would result in regular and persistent dust emissions, which may affect local amenity and quality of life. The level of concern, and potential for annoyance, is directly related to the existing baseline dust levels, the number and proximity of residential areas to the site, and the exact nature of the activities on-site. The degree of actual annoyance would also depend on factors, such as, the rate of dust deposition, and the application of mitigation measures on site.

Dust complaints are usually associated with periods of peak deposition, occurring during particular weather conditions. There is a 'normal' level of dust deposition in every community and it is only when the rate of deposition is high relative to the norm that complaints tend to occur. The effects of dust on a community will therefore be determined by the following factors:

- the activities being undertaken (demolition, number of vehicles and plant, etc.);
- the duration of these activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall);
- the proximity of receptors to the activities;
- the adequacy of the mitigation measures applied to reduce or eliminate dust; and
- the sensitivity of the receptors to dust.

The amount of dust that might cause annoyance in a circumstance is very difficult to determine and there are no statutory limits such as those applicable to suspended particulates or gaseous pollutants.

A qualitative approach to the assessment of potential dust effects during the construction phase has been undertaken, along with the identification of best-practice dust minimisation techniques, where appropriate.

IAQM and Environmental Protection UK (EPUK)

The IAQM and Environmental Protection UK (EPUK) has also produced guidance (IAQM & EPUK, 2017) regarding the assessment of air quality issues within planning applications, which includes a summary of relevant legislation and the assessment of significance. Using this guidance, the magnitude of change due to an increase/decrease in the annual mean concentration of NO_2 and PM_{10} and other pollutants due to the development is described using specified criteria. The overall significance of the development is then determined using professional judgement.

3. Scope of the assessment

The Proposed Development comprises the construction of around 800 homes, local centre, 7ha of employment and primary school. The Proposed Development will generate additional traffic which may impact air quality at existing sensitive receptors in the vicinity. Also, future residential receptors within the Proposed Development may be affected by emissions from nearby roads. The pollutants of concern requiring assessment are those which are generated by the exhausts of road vehicles, which may lead to exceedance of the AQOs. This assessment will use dispersion modelling to determine concentrations of NO_2, PM_{10} and $PM_{2.5}$ at sensitive receptors using ADMS-Roads.

The potential effects of dust generation and dispersion as a result of construction activities, including earthworks, construction, and trackout, has also been considered.

3.1 Public exposure

Guidance from the UK Government and Devolved Administrations makes clear that exceedance of the health-based objectives should be assessed at outdoor locations where members of the general public are regularly present over the averaging time of the objective. Workplaces are excluded, as explained in Table 3.1 which provides an indication of those locations that may or may not be relevant for each averaging period.

Table 3.1 Examples of where the air quality objectives should apply

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed	Building façade of offices or other places of work where members of the public do not have regular access.
	Building façade of residential properties, schools, hospitals, care homes etc.	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 and 8-hour mean	All locations where the annual mean objectives would apply, together with hotels	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
	Gardens or residential properties*	

Averaging period	Objectives should apply at:	Objectives should generally not apply at:
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives would apply.	Kerbside sites where the public would not be expected to have regular access.
	Kerbside sites (e.g. pavements of busy shopping streets).	
	Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more.	
	Any outdoor locations at which the public may be expected to spend one hour or longer.	
15-minute mean	All locations where members of the public might reasonably be expected to spend a period of 15 minutes or longer.	

Note: * For gardens and playgrounds, such locations should represent parts of the garden where relevant public exposure is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

3.2 Receptor locations

This assessment has predicted pollutant concentrations at both existing and proposed receptor locations that may be impacted by pollution generated by the predicted increase in traffic flow as a result of the Proposed Development.

Existing receptors were selected at the façade of sensitive receptors, predominantly residential properties, closest to the source of pollution (i.e. local roads) in order to present worst case exposure.

Representative future receptors were selected at the Proposed Development site boundary nearest to roads and junction. This represents worst-case exposure as in reality future receptors would likely be located further away from roads.

Receptors were modelled at 'breathing height', which is considered to be 1.5 m.

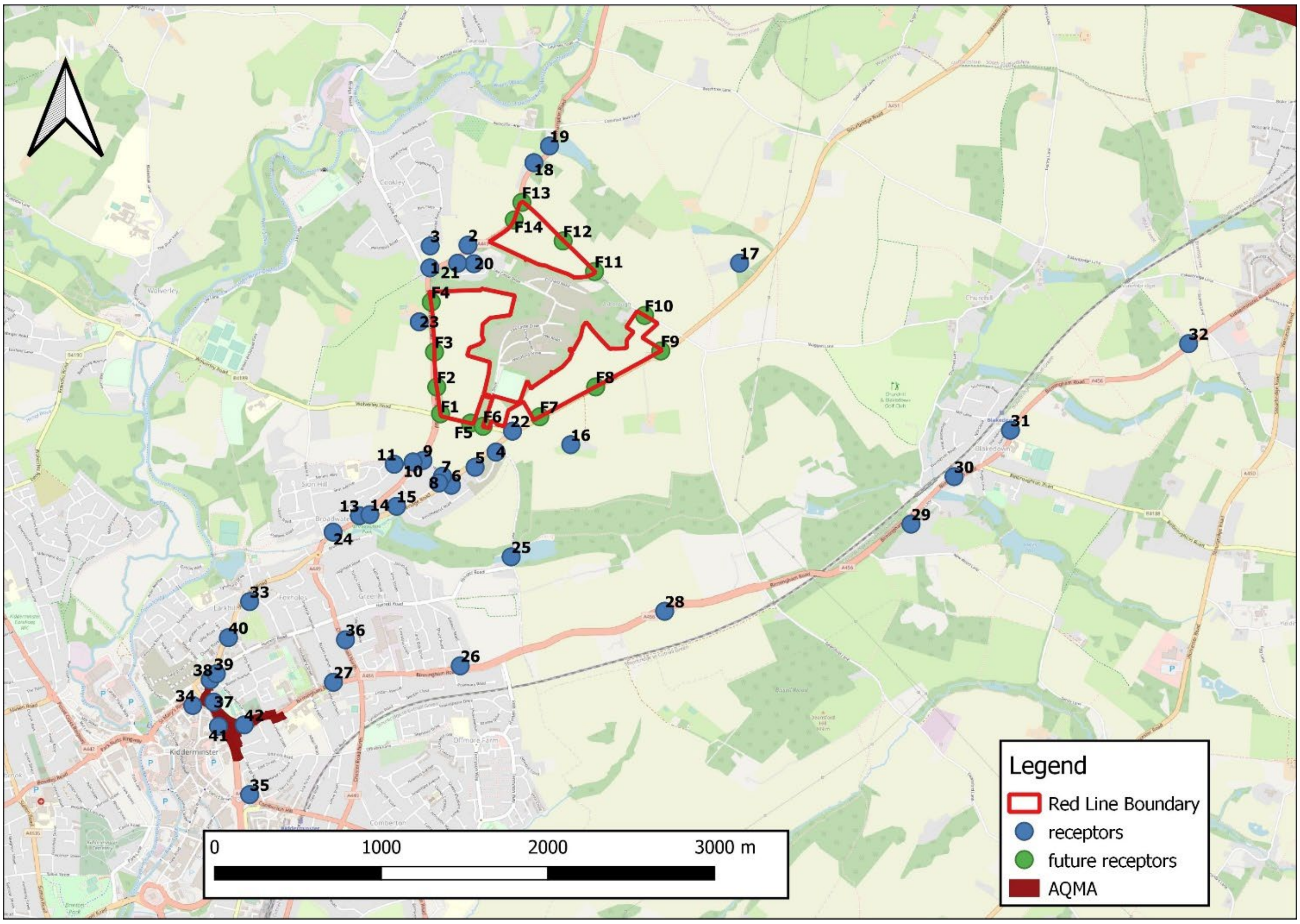
Table 3.2 presents details on the modelled receptors, which are shown in Figure 3.1.

Table 3.2 Human receptor locations

Receptor ID	X (m)	Y (m)	Location	Type
1	384640	279604	Wolverhampton Road	Residential
2	384869	279740	Wolverhampton Road	Residential
3	384642	279735	Brampton Close	Residential
4	385037	278499	Stourbridge Road	Residential
5	384911	278408	Stourbridge Road	Residential
6	384769	278299	Stourbridge Road	Residential
7	384716	278354	Stourbridge Road	Residential
8	384694	278314	Stourbridge Road	Residential
9	384599	278449	Stourbridge Road	Residential
10	384539	278440	Stourbridge Road	Residential
11	384427	278426	Stourbridge Road	Residential
13	384217	278117	Stourbridge Road	Residential
14	384280	278124	Stourbridge Road	Residential
15	384440	278174	Stourbridge Road	Residential
16	385485	278543	Stourbridge Road	Residential
17	386498	279632	Stourbridge Road	Residential
18	385264	280235	Wolverhampton Road	Residential
19	385358	280335	Wolverhampton Road	Residential
20	384905	279629	Lea Castle drive	Residential
21	384807	279631	Wolverhampton Road	Residential
22	385136	278624	Park gate road	Residential
23	384576	279280	Wolverhampton Road	Residential
24	384060	278019	Stourbridge Road	Residential
25	385128	277870	Hurcott Lane	Residential
26	384823	277217	Birmingham Road	Residential
27	384062	277118	Birmingham Road	Residential
28	386048	277544	Birmingham Road	Residential

Receptor ID	X (m)	Y (m)	Location	Type
29	387526	278067	Birmingham Road	Residential
30	387785	278352	Birmingham Road	Residential
31	388123	278630	Birmingham Road	Residential
32	389191	279149	Birmingham Road	Residential
33	383559	277602	Stourbridge Road	Residential
34	383218	276979	St Mary’s Ringway	Residential
35	383559	276444	Anchorfields	Residential
36	384134	277373	Chester Road North	Residential
37	383344	276999	St George’s Ringway	Residential
38	383323	277133	Blackwell street	Residential
39	383359	277169	Horsefair	Residential
40	383432	277386	Stourbridge Road	Residential
41	383372	276854	St George’s Ringway	Residential
42	383527	276863	Coventry street	Residential
F1	384704	278729	Proposed Development	Residential
F2	384682	278889	Proposed Development	Residential
F3	384668	279099	Proposed Development	Residential
F4	384649	279399	Proposed Development	Residential
F5	384884	278673	Proposed Development	Residential
F6	384959	278654	Proposed Development	Residential
F7	385299	278711	Proposed Development	Residential
F8	385635	278890	Proposed Development	Residential
F9	386026	279106	Proposed Development	Residential
F10	385928	279318	Proposed Development	Residential
F11	385628	279582	Proposed Development	Residential
F12	385439	279765	Proposed Development	Residential
F13	385192	279997	Proposed Development	Residential
F14	385146	279891	Proposed Development	Residential

Figure 3.1 Human receptor locations



4. Assessment methodology

4.1 Construction dust assessment methodology

The IAQM guidance (IAQM, 2014) provides a method to assess the significance of construction impacts by considering the annoyance due to dust soiling as well as harm to ecological receptors and the risk of health effects due to any significant increases to PM_{10} or $PM_{2.5}$. Site activities are divided into four types to reflect their different potential impacts:

- Demolition – an activity involved with the removal of an existing structure or structures;
- Earthworks – the processes of soil-stripping, ground-levelling, excavation and landscaping;
- Construction – an activity involved in the provision of a new structure; and
- Vehicle movements that can result in trackout – the transport of dust and dirt from the site onto the public road network. This arises when lorries leave site with dusty materials or transfer dust and dirt onto the road having travelled over muddy ground on-site.

A detailed assessment is deemed to be required where there is:

- A 'human receptor' located within: 350 m from the site boundary; and/ or within 50 m of the route(s) used by vehicles on the public highway, up to 500 m from the site entrance(s); and
- An 'ecological receptor' located within: 50 m of the boundary of the site; or 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance.

Detailed assessment involves a three-stage process; construction sites are classified according to the risk of effects (based upon the scale and nature of the works, plus the proximity of sensitive receptors), appropriate site-specific mitigation measures are identified and the significance of effects is then determined.

The significance of the dust effects is generally undertaken after applying the site-specific mitigation. This would take account of the risk of effects, and other factors that might affect the risk of dust effects arising, even after any site-specific mitigation has been implemented. The overall significance of the effects arising from the entire construction phase of the development is based on professional judgement, taking into account the significance of the effects of each of the four activities

4.2 Operational phase methodology

Annual average concentrations of NO_x, PM_{10} and $PM_{2.5}$ have been determined using the ADMS-Roads atmospheric dispersion model (version 5.0). A brief description of the model is included in Appendix A.

Modelling of pollutants was carried out for the following scenarios:

- The 2019 Baseline scenario used for model verification, based on 2019 Department for Transport (DfT) data, 2019 emission factors and predicted background concentrations [2019 model verification];
- The 2024 Without Development scenario, based on 2024 traffic data, emission factors and predicted background concentrations [2024 Without Development]; and
- The 2024 With Development scenario based on 2024 traffic data, emission factors and predicted background concentrations [2024 With Development].

The 2024 scenarios both include traffic flows from Lea Castle Quarry, accounting for cumulative impacts.

Annual mean concentrations of NO_2 were derived from the model-predicted NO_X concentrations, through application of the NO_X to NO_2 conversion tool version 8.1 developed for LAQM purposes, which takes into account the interaction between NO_X and background ozone (AEA Technology, 2013).

The modelling assessment requires source, emissions, meteorological and other site-specific data. For modelling traffic impacts, one year of data is used and model verification is carried out following Defra's guidance.

The results of the assessment have been compared with the AQOs (Table 2.2) to assess whether traffic associated with the Proposed Development will have an impact on sensitive receptors in the vicinity. Additionally, the difference in concentration between the With and Without Development scenarios has been used to determine the increase in pollutant concentrations at sensitive receptors as a result of traffic associated with the Proposed Development.

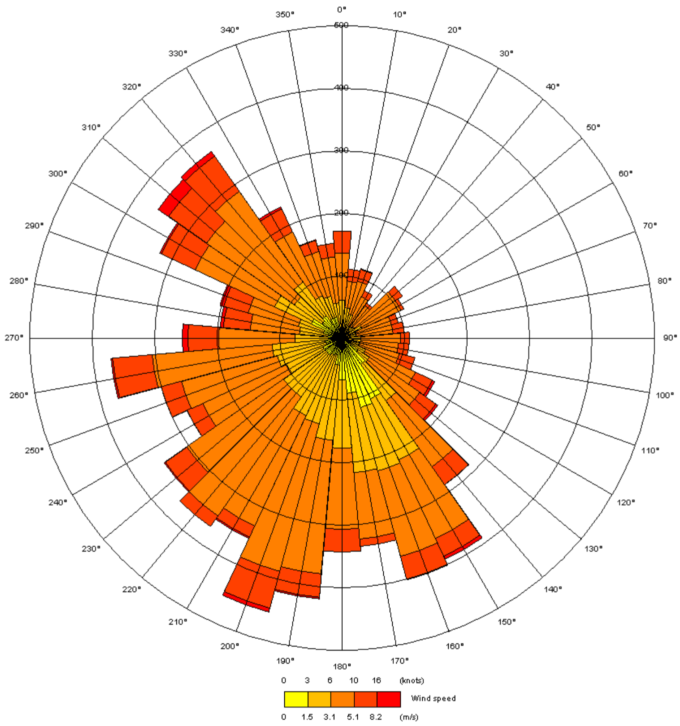
Meteorological data

Detailed dispersion modelling requires hourly sequential meteorological data from a representative synoptic observing station. Hourly sequential meteorological data was obtained for Birmingham meteorological station, which is situated approximately 35 km north-east of the Development Site.

The meteorological data for 2019 has been used with monitoring data and traffic count data for model verification and the traffic assessment.

Figure 4.1 summarises the hourly wind speed and wind direction as a wind rose. In 2019, the predominant wind direction was north-westerly, south-westerly and south-easterly.

Figure 4.1 2019 Birmingham Meteorological Station Wind Rose



Road Traffic Data

Wood Transport consultants provided Annual Average Daily Traffic (AADT) flows based on traffic counts carried out in 2021 for the roads surrounding the Proposed Development.

Emissions were calculated using the latest emissions factors from Defra, the Emission Factor Toolkit v11.0 (Defra, 2019) (EFT), which is used to predict emissions which are subsequently imported into ADMS-Roads. Particulate generated due to brake and tyre wear are also included in the Toolkit. These two factors lead to improved forecasts of particulate concentrations due to traffic.

The EFT provides emissions factors for future years based on the assumed composition of traffic and the likelihood of the replacement of older vehicles with higher emissions. For both the without and with Development scenarios, emission factors were gathered from the EFT by using these assumptions for the year 2024. The roads modelled and traffic data used are given in Appendix B.

Model verification

Model verification enables an estimation of uncertainty and systematic errors associated with the dispersion modelling components of the air quality assessment to be considered. There are many explanations for these errors, which may stem from uncertainty in the modelled number of vehicles, speeds and vehicle fleet composition. Defra has provided guidance in terms of preferred methods for undertaking dispersion model verification (LAQM.TG(16)) Model verification involves the comparison of modelled concentrations and local monitoring data.

Full details of model verification procedure are provided in Appendix C. Verification was undertaken using locally bias-adjusted diffusion tube concentrations for 2019. In summary, the verification process led to the use of an adjustment factor of 3.04 for both Road-NO_x and Road-PM.

4.3 Significance valuation methodology

Using IAQM guidance, the magnitude of change due to an increase/decrease in the annual mean concentration of NO_2 and PM_{10} and other pollutants due to the development is described using the criteria in Table 4.1. These criteria are based on the change in concentration of a pollutant at an existing receptor location due to a new development, as a percentage of the Air Quality Assessment Level (AQAL) (i.e. the AQO). When describing the effect at a specific receptor, the percentage change in concentration relative to AQAL is considered in combination with the long-term average concentration at a receptor in the assessment year, using the approach detailed in Table 4.1. The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. Changes of less than 0.5% will be described as 'negligible.

Table 4.1 Impact descriptors for individual receptors

Absolute concentration with Proposed Development, relative to assessment level	**% change in Concentration Relative to Assessment Level**				
	0%	**1%**	**2–5%**	**6-10%**	**>10%**
75% or less	Negligible	Negligible	Negligible	Slight	Moderate
76–94%	Negligible	Negligible	Slight	Moderate	Moderate
95–102%	Negligible	Slight	Moderate	Moderate	Substantial
103–109%	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more	Negligible	Moderate	Substantial	Substantial	Substantial

Table notes: When defining the concentration as a percentage of the AQAL, the 'without scheme' concentration is used where there is a decrease in pollutant concentration, and the 'with scheme;' concentration for an increase. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it[14].

The overall significance is then determined using professional judgement. One of the relevant factors to consider is the potential for cumulative impacts e.g. in cases where several 'slight' impacts on receptors individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area. Conversely, a 'moderate' or 'substantial' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health.

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.

Other factors may be relevant in individual cases, such as whether an exceedance of an objective or limit value is predicted to arise in a study area where none existed before or whether an exceedance area is substantially increased.

A judgement of the significance should be made by a competent professional who is suitably qualified. The reasons for reaching the conclusions should be transparent and set out logically. Whilst the starting point for the assessment of significance is the degree of impact, as defined by Table 4.1, this should be seen as one of the factors for consideration, not least because the outcome of this assessment procedure applies to a receptor and not the overall impact.

5. Baseline air quality

5.1 Local Authority review and assessment

As a result of the LAQM process carried out by Wyre Forest District Council (WFDC), two AQMAs have been declared. These are the Kidderminster Ring Road AQMA declared in 2009 and Welch Gate, Bewdley AQMA declared in 2003. Both AQMAs have been declared for exceedance of the NO_2 Annual Mean AQO of 40 μgm^{-3}.

5.2 Air quality modelling

Dust deposition

Dust deposition rates are not monitored extensively in the UK. Monitoring that is undertaken, is usually connected with specific activities such as mining and mineral extraction operations and major infrastructure projects. Dust monitoring may also be undertaken to investigate specific complaints received by local authorities, who are then empowered to investigate dust nuisance under the Environmental Protection Act (1990). No dust measurement data have been obtained for the area surrounding the Development Site.

Passive monitoring

WFDC operates an extensive network of passive diffusion tubes to monitor NO_2. Annual mean concentrations are presented within Air Quality Annual Status Report (ASR) (WFDC, 2021).

In 2020 there were 51 monitoring locations in the council. Table 5.1 shows the location details of passive monitoring sites that are located nearest to the Proposed Development. The nearest passive diffusion tube is SBR 121 located on Stourbridge Road.

Table 5.2 presents annual mean concentrations recorded from 2016 to 2020. Concentrations are comfortably below the annual mean AQO of 40 μgm^{-3} at all diffusion tubes close to the Proposed Development in all years.

Annual mean NO_2 concentrations recorded in 2020 decreased significantly in the UK due to the reduced road traffic during the Covid-19 lockdown period. However, concentrations recorded in this period are not typical and should not be used to determine baseline conditions.

Monitoring locations in the vicinity of the Proposed Development are shown in Figure 5.1.

Model verification was undertaken using NO_2 2019 annual mean concentrations from roadside diffusion tube sites (F) 69COV, HF(K), HF(K) (F) and SBR121, as shown in Figure 5.1. Full details on the verification process is shown in Appendix C.

Table 5.1 Location details of NO_2 diffusion tube sites nearest to the Proposed Development

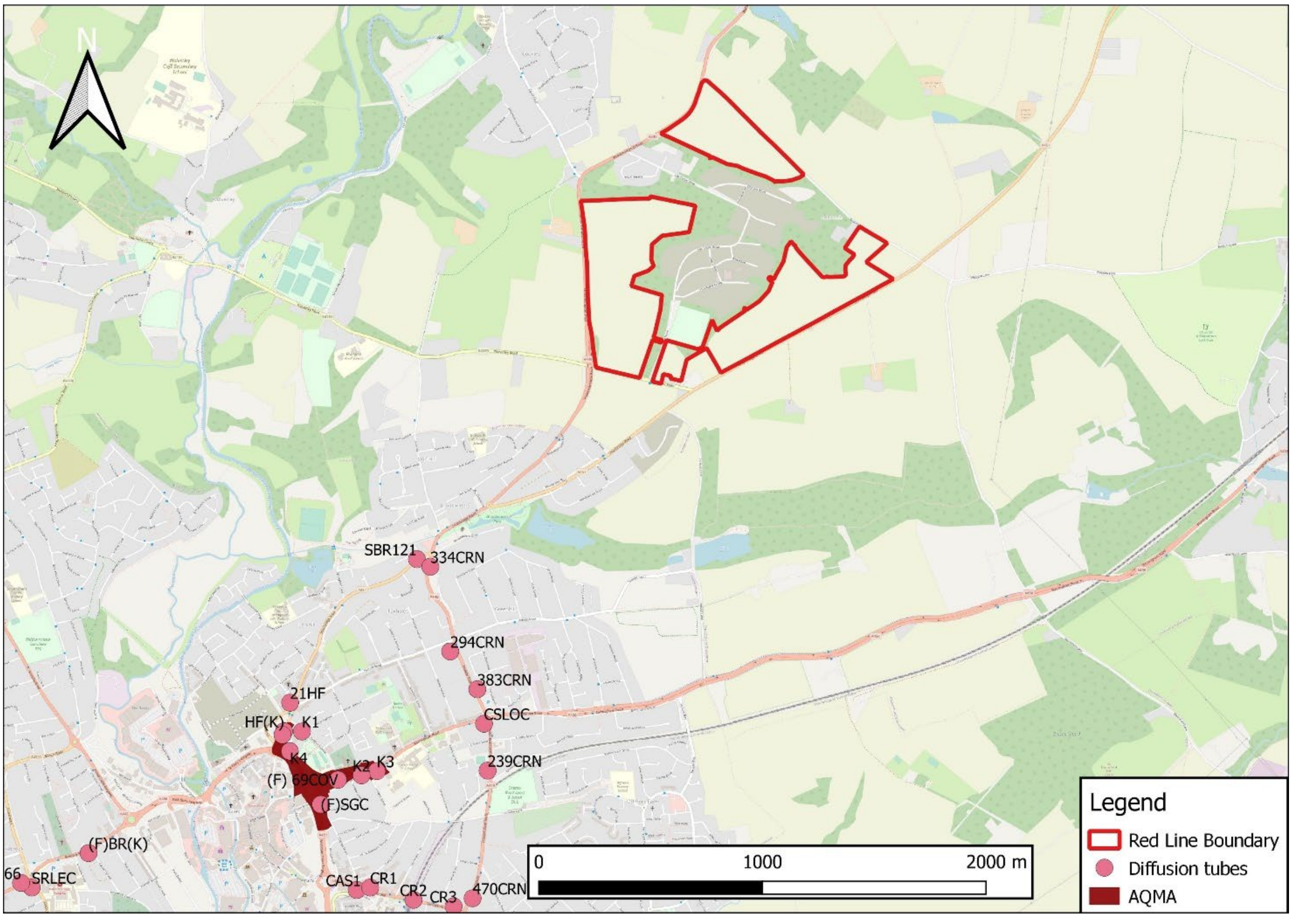
Site ID	Site name	Classification	X (m)	Y (m)	Distance to Road (m)	Distance from the Proposed Development (km)
SBR 121	121 Stourbridge Road, Kidderminster	Roadside	383905	277857	2.4	1.1
334 CRN	334 Chester Road North	Roadside	383965	277823	3.1	1.2
294 CRN	Cambrian House, 294 Chester Road	Roadside	384054	277444	11	1.4
383 CRN	383 Chester Road	Roadside	384175	277275	11	1.5
CSLOC	Flats at top of Coventry Street	Roadside	384205	277121	7.9	1.6

Table 5.2 Passive monitoring data of annual average NO_2 concentration (μgm^{-3})

ID Site	2016	2017	2018	2019	2020	2020 Data capture (%)
SBR 121	36.4	29.0	32.2	27.0	22.6	51.9
334 CRN	-	-	-	29.0	26.4	51.9
294 CRN	-	-	-	20.0	16.3	51.9
383 CRN	-	-	-	18.3	15.7	51.9
CSLOC	36.7	32.1	32.5	27.6	23.4	51.9

Note: Bold denotes exceedance of the AQO. Where concentrations are greater than 60 μgm^{-3}, TG(16) states that the short term AQO (200 μgm^{-3} not to be exceeded more than 18 times per year) is likely to be exceeded; this is indicated by underlining.

Figure 5.1 Location of diffusion tubes in the vicinity of the Proposed Development



5.3 Estimated background concentrations

Defra has made estimates of background pollutant concentrations on a 1km^2 grid for the UK for seven of the main pollutants, including NO_X, NO_2, PM_{10} and $PM_{2.5}$. Table 5.3 shows the estimated values of the pollutants for 2019 (baseline year for model verification), and 2024 (opening year) for the Proposed development grid square, 385500, 279500.

Table 5.3 Defra mapped annual mean background concentrations (μgm^{-3}) for 2019 and 2024

Grid Square: 385500, 279500	2019	2024
Nitrogen dioxide (NO_2)	8.4	7.1
Oxides of nitrogen (NO_X)	10.9	8.4
Particulate matter (PM_{10})	12.6	11.9
Particulate matter ($PM_{2.5}$)	8.1	7.5

6. Construction phase assessment

6.1 Potential dust emission magnitude

This assessment of dust/PM_{10} presents the effects which are likely to be relevant both without and with the implementation of the appropriate mitigation measures on-site, which would be outlined by the site contractor. As per the IAQM guidance, the risk associated with the site to potentially generate dust/PM_{10} in the absence of any mitigation is has been identified and site-specific recommendations made to ensure residual dust/PM_{10} effects associated with the construction phase are not significant.

Demolition

There are currently no permanent buildings on site, therefore no demolition will be taking place.

Earthworks

Potential sources of impacts associated with earthworks/ground preparation activities include fugitive dust/PM_{10} emissions resulting from disturbance of dusty materials by construction plant, the construction materials used, vehicle movements and wind action.

The total area of the site is 24 Ha, which is indicative of a 'large' dust emission magnitude according to the IAQM guidance which defines a '**large'** dust emission from earthworks to include a total site area greater than 10,000 m^2 .

Construction

Potential sources of impacts associated with construction activities include fugitive dust/ PM_{10} emissions resulting from disturbance of dusty materials by construction plant, the construction materials used, vehicle movements and wind action.

The current proposal for the site includes the construction of around 800 dwellings, up to 7ha of employment, primary school and local centre, therefore the dust emission magnitude from construction activities has been considered as '**large'**.

Trackout

Dust emissions during trackout from the site may occur from the transport of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The dust emissions magnitude for trackout activities has been classified as '**large'** as it is estimated that there could be more than 100 Heavy Duty Vehicles (HDV) outward movements in any one day.

Summary

The magnitude of impacts from construction phase activities is summarised in Table 6.1.

Table 6.1 Construction dust emission magnitude

Source	Dust emission magnitude
Demolition	N/A
Earthworks	Large
Construction	Large
Trackout	Large

6.2 Sensitivity of the area

In order to define the sensitivity of the area in which the Site is found, three different impacts are considered:

- Sensitivity to dust soiling;
- Sensitivity to human health; and
- Ecological impacts.

The sensitivity of the area is then assessed in relation to the four dust emitting activities for all three impacts listed above.

Dust soiling

There are seven properties within 20 m of the site boundary located on Axborough Lane and Park Gate Road. There are also more than 10 properties within the former Hospital site that will be occupied when construction of the Proposed Development takes place. Therefore with reference to the IAQM's guidance, sensitivity of the area to dust soiling effects to people and property is considered to be '**large'** for earthworks and construction activities.

According to the IAQM guidance, for Proposed Development classified as 'large', trackout may occur from roads up to 500 m from the site entrance, up to 50 m from the edge of the road. There are six properties within 500 m of the North site access on Wolverhampton Road, 20 m from the edge of the road, and this is indicative of a '**medium'** sensitivity to dust soiling due to trackout activities.

Human health

The estimated annual average background concentration PM_{10} concentration at the Proposed Development is 12.6 μgm^{-3}. Therefore, the sensitivity of the area to human health impacts from dust emission is considered to be '**low'** with reference to the IAQM criteria.

Ecological

The nearest ecological receptor is the Hurrcott Pasture of Special Scientific Interest (SSSI) approximately 650 m to the south of the Proposed Development. Given that the distance from the Proposed Development is greater than 500 m and there are no other ecologically sensitive sites within 50 m, there are unlikely to be any significant impacts due to dust emission, therefore it has not been considered further in this assessment.

Table 6.2 shows a summary of the sensitivity to dust of the surrounding area.

Table 6.2 Sensitivity of the surrounding area to dust impacts

Potential impact	Demolition	Earthworks	Construction	Trackout
Dust soiling	N/A	Large	Large	Medium
Human health	N/A	Low	Low	Low

Risk of impacts

The risk of dust impacts is defined using Tables 6, 7, 8 and 9 in the IAQM guidance for demolition, earthworks, construction and trackout respectively. The dust emission magnitude classes combined with the sensitivity of surrounding area classes, result in the site risk categories shown in Table 6.3.

Table 6.3 Construction dust summary of dust risk

Potential impact			Risk	
	Demolition	**Earthworks**	**Construction**	**Trackout**
Dust soiling	N/A	High risk	High risk	Medium risk
Human health	N/A	Low risk	Low risk	Low risk

Mitigation measures

The Proposed Development is defined as '**high risk**' of dust soiling as a result of earthwork and construction activities, as '**medium risk**' for trackout. Emission control measures suitable to these risk categories should be applied during the construction phase of the development. The measures shown in Table 6.4 are highly recommended by the IAQM. Additional measures in the event of dust complaints have also been included. Implementation of these measures will ensure that construction dust effects are negligible.

Table 6.4 Recommended mitigation measures for the construction phase

Mitigation area	Mitigation measures to be incorporated
Communication	Develop and implement a stakeholder communications plan that includes community engagement before work commences on-site. Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the Project Manager. Display the head or regional office contact information.

Mitigation area	Mitigation measures to be incorporated
Dust management	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority
Site management	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. Make the complaints log available to the local authority when asked. Record any exceptional incidents that cause dust and/or emissions, either on- or off-site and the action taken to resolve the situation in the log book. Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked. Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.
Preparing and maintaining site	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible. Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site. Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period. Avoid site runoff of water or mud. Keep site fencing, barriers and scaffolding clean using wet methods. Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. Cover, seed or fence stockpiles to prevent wind whipping.
Operating vehicle/ machinery	Ensure all vehicles switch off engines when stationary - no idling vehicles. Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.

Mitigation area	Mitigation measures to be incorporated
	Produce a Construction Logistics Plan to manage sustainable delivery of goods and materials. Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced haul roads and work areas. Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking and car-sharing).
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction e.g. suitable local exhaust ventilation systems. Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate. Use enclosed chutes and conveyors, and covered skips. Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate. Ensure equipment 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.
Waste management	Avoid bonfires and burning of waste materials
Earthworks	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable. Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. Only remove the cover in small areas during work and not all at once.
Construction	Avoid scabbing if possible. Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent the escape of material and overfilling during delivery. For smaller supplies of fine powder materials, ensure bags are sealed after use and stored appropriately to prevent dust.
Trackout	Access gates to be located at least 10m from receptors where possible. Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary any material tracked out of the site. This may require the sweeper being continuously in use. Avoid dry sweeping of large areas.

Mitigation area	Mitigation measures to be incorporated
	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. Record all inspections of haul routes and any subsequent action in a site log book. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. 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.

In the event of observed dust impact on nearby properties, of monitored exceedances of dust trigger levels, or of complaints received from residents, a site inspection will be carried to determine if the source of dust emissions can be identified. If the source of dust emissions is confirmed to be from the Proposed Development, the following additional measures will be employed:

- Use of additional water bowsers on haul roads to minimise the generation of dust from haul roads due to on site vehicle movements, particularly in hot, dry and windy conditions;
- Sheeting of temporary stockpiles to ensure dust is not generated by wind moving across these stockpiles;
- Fine water sprays positioned in areas where there are friable surfaces. These sprays would act to create a fine mist in these areas and therefore prevent the re-suspension of dust from the ground and other surfaces; and
- Temporary cessation of activities giving rise to fugitive dust.

7. Operational phase assessment

7.1 Nitrogen dioxide

Table D.1 in Appendix D, shows the predicted annual mean concentrations of NO_2 at the modelled sensitive receptors (existing and future receptors). The NO_2 annual mean AQO of 40 µgm^{-3} is not exceeded at any receptor, both without and with the Proposed Development. With reference to LAQM.TG(16) it is anticipated that the hourly AQO will not be exceeded as the predicted concentration are lower than 60 µgm^{-3}.

With reference to the EPUK & IAQM impact descriptors, as shown in Table 4.1, the impact of the Proposed Development is predicted to be negligible at all existing receptors modelled.

The highest predicted annual mean concentration at an existing receptor with the Proposed Development operational is 29.1 µgm^{-3}. This concentration is found at receptor R42 located at Coventry Street. The greatest increase in concentration is also predicted at receptor R42, where the concentration is expected to increase by 0.3 µgm^{-3}.

Concentrations at all representative future receptors modelled are also predicted to be comfortably below the annual mean AQO.

7.2 Particulate matter

PM_{10}

Table D.2 shows predicted annual mean concentrations of PM_{10} at sensitive receptors (existing and future receptors). Annual mean concentrations, both without and with the Proposed Development operational, are expected to be well below the annual mean AQO of 40 µgm^{-3} at all modelled receptors.

With reference to the EPUK & IAQM impact descriptors, as shown in Table 4.1, the impact of the Proposed Development is predicted to be negligible at all existing receptors modelled.

The highest predicted annual mean concentration with the additional traffic associated with the Proposed Development is 15.9 µgm$^{-3.}$ This concentration is found at receptor R42 which is located on Coventry Street. The greatest increase in predicted concentration with the Proposed Development operational is also at receptor R42, where the concentration is expected to increase by 0.1 µgm^{-3}.

Concentrations at all representative future receptors modelled are also predicted to be comfortably below the annual mean AQO.

$PM_{2.5}$

The predicted annual mean concentrations of $PM_{2.5}$ is shown in Table D.3. Annual mean concentrations, both without and with the Proposed Development operational, are expected to be well below the 20 μgm^{-3} annual mean AQO.

With reference to the EPUK & IAQM impact descriptors, as shown in Table 4.1, the impact of the Proposed Development is predicted to be negligible at all existing receptors modelled.

The highest predicted concentration with the Proposed Development operational is predicted to be 10.3 μgm^{-3} at existing receptor R42. The greatest increase in predicted concentration with the Proposed Development operational is also at receptor R42, where the concentration is expected to increase by <0.1 μgm^{-3}.

Concentrations at all representative future receptors modelled are also predicted to be comfortably below the annual mean AQO.

8. Conclusions

An assessment of construction-related effects has been undertaken following the IAQM Guidance on the Assessment of Dust from Demolition and Construction. The Proposed Development site is defined as ‘high risk’ of dust soiling for earthworks and construction activities and as ‘medium risk’ for trackout. It is defined as ‘low risk’ of human health effects for earthworks, construction and trackout activities. Appropriate mitigation measures to be implemented during the construction phase have been recommended. These measures will ensure construction dust effects remain negligible.

An assessment of the potential air quality impact of traffic associated with the Proposed Development has been undertaken. ADMS-Roads (version 5.0) modelling has been used to model dispersion from traffic to determine likely NO_2, PM_{10} and $PM_{2.5}$ concentrations at existing and proposed residential receptors within the Proposed Development.

Concentrations of NO_2, PM_{10} and $PM_{2.5}$ were predicted likely to be comfortably below their respective AQOs at all modelled receptor locations in the first year of operation of the development, 2024. With reference to the EPUK & IAQM impact descriptors impacts are predicted to be negligible at all existing receptors.

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Appendix A
ADMS- Roads dispersion model

Introduction

The ADMS-Roads dispersion model, developed by CERC[1], is a tool for investigating air pollution problems due to small networks of roads that may be in combination with industrial sites, for instance small towns or rural road networks. It calculates pollutant concentrations over specified domains at high spatial resolution (street scale) and in a format suitable for direct comparison with a wide variety of air quality standards for the UK and other countries. The latest version of the model, version 5.0.1, was used in this study.

ADMS-Roads is referred to as an advanced Gaussian or, new generation, dispersion model as it incorporates the latest understanding of the boundary layer structure. It differs from old generation models such as ISC, R91 and CALINE in two main respects:

- It characterises the boundary layer structure and stability using the boundary layer depth and Monin-Obukhov length to calculate height-dependent wind speed and turbulence, rather than using the simpler Pasquill-Gifford stability category approach; and
- It uses a skewed-Gaussian vertical concentration profile in convective meteorological conditions to represent the effect of thermally generated turbulence.

Model features

A description of the science used in ADMS-Roads and the supporting technical references can be found in the model's User Guide[2]. The main features of ADMS-Roads are:

- It is an advanced Gaussian, "new generation" dispersion model;
- Includes a meteorological pre-processor which calculates boundary layer parameters from a variety of input data e.g. wind speed, day, time, cloud cover and air temperature;
- Models the full range of source types encountered in urban areas including industrial sources (up to 3 point sources, up to 3 lines sources, up to 4 area sources, up to 25 volume sources) and road sources (up to 150 roads, each with 50 vertices);
- Generates output in terms of average concentrations for averaging times from 15minutes to 1 year, percentile values and exceedances of threshold values. Averages can be specified as rolling (running) averages or maximum daily values;
- The option to calculate emissions from traffic count data, speed and fleet split (light duty/ heavy duty vehicles) using UK emission factors. Alternatively, road emissions may be entered directly as user specified values;
- Models plume rise by solving the integral conservation equations for mass, momentum and heat;
- Models the effect of street canyons on concentrations within the canyon and vehicle–induced turbulence using a formulation based on the Danish OSPM model. It is usually

[1] CERC (2015) ADMS-Roads, Air Quality Management System, Version 4.0 User Guide. http://www.cerc.co.uk/environmental-software/assets/data/doc_userguides/CERC_ADMS-Roads3.1_User_Guide.pdf
[2] CERC (2015) ADMS-Roads, Air Quality Management System, Version 4.0 User Guide. http://www.cerc.co.uk/environmental-software/assets/data/doc_userguides/CERC_ADMS-Roads3.1_User_Guide.pdf

only important to model street canyons when the aspect ratio (ratio of the height of buildings along the road to the width of the road) is greater than 0.5;

- Models the effects of noise barriers on concentrations outside the road;
- Models NO_X chemistry using the 8 reaction Generic Reaction Set plus transformation of SO_2 to sulphate particles, which are added to the PM_{10} concentration;
- Models the effect of a small number of buildings on dispersion from point sources;
- Models the effect of complex terrain (hills) and spatially varying surface roughness. Terrain effects only become noticeable for gradients greater than 1:10, but for ground level sources in a built up area, such as urban roads, low gradients will have a negligible effect;
- Models concentrations in units of $ou_E m^{-3}$ for odour studies;
- Link to MapInfo and ArcGIS for input of source geometry, display of sources, aggregation of emissions and plotting of contours; and
- Link to an emissions inventory in Microsoft Access for input and export of source and emissions data.

In this study, noise barriers, buildings and complex terrain were not modelled. The link to ArcMap was used to enter source geometry.

Validation

ADMS-Roads has been validated using UK and US data and has been compared with the DMRB spreadsheet model and the US model, CALINE. Validation of the ADMS and ADMS-Urban models are also applicable to the performance of ADMS-Roads as they test common features: basic dispersion, modelling of roads and street canyons, the effect of buildings and the effect of complex terrain. These validation studies are all reported on the CERC web site[3]. In addition, ADMS-Urban has been validated during its use in modelling many urban areas in the UK for local authorities as part of LAQM, Heathrow Airport for the Department for Transport[4] and all of Greater London for a Defra model inter-comparison exercise[5].

[3] http://www.cerc.co.uk/environmental-software/model-documentation.html#validation
[4] CERC (2007) Air Quality Studies for Heathrow: Base Case, Segregated Mode, Mixed Mode and Third Runway Scenarios Modelled Using ADMS-Airport, prepared for the Department for Transport, *HMSO* Product code 78APD02904CERC
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Appendix B
ADMS Roads Input

Table B1 reports the Annual Average Daily Traffic (AADT) flows on roads in the vicinity of the Proposed Development included in the dispersion modelling assessment.

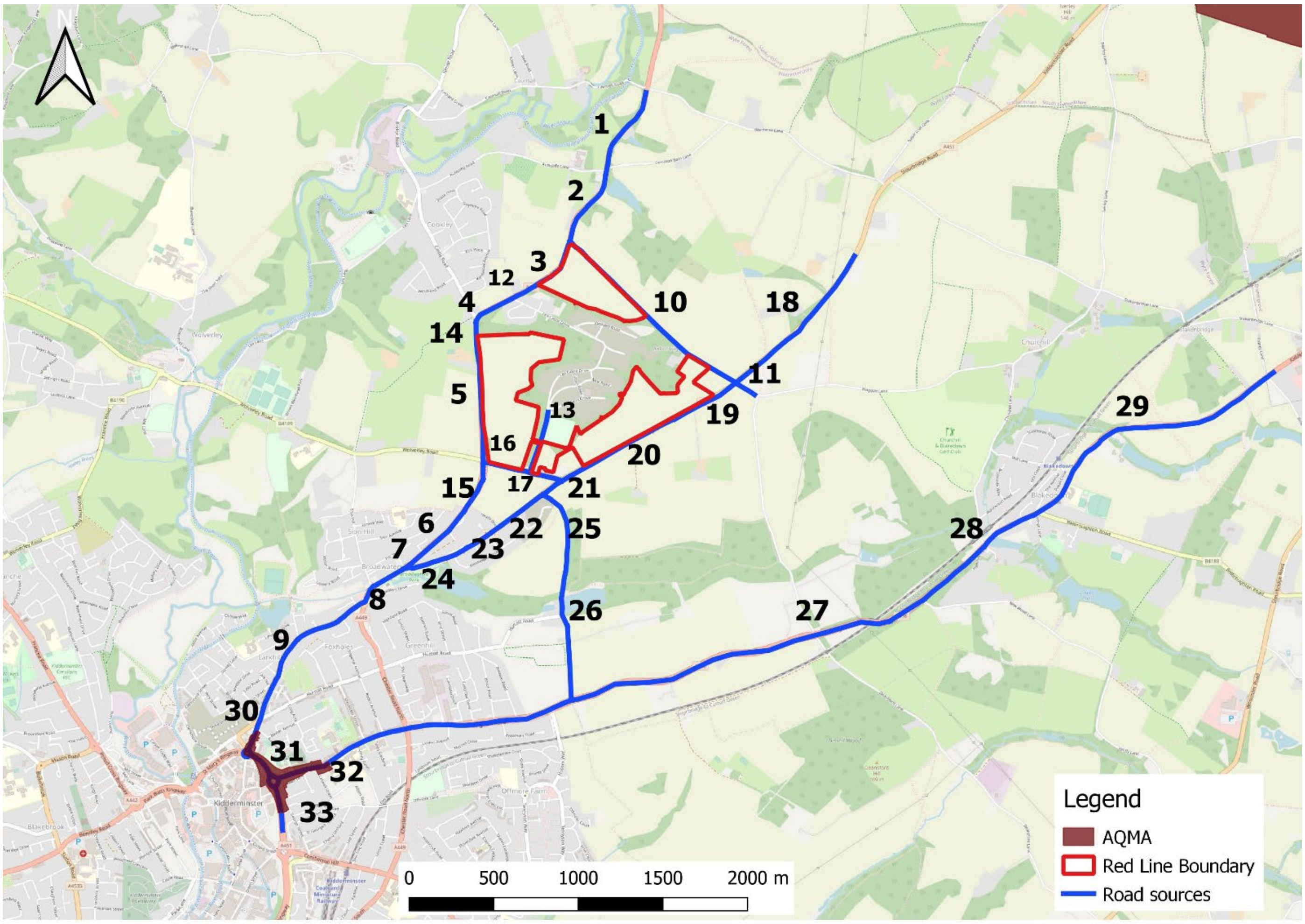
In addition to the roads, 34 junctions were modelled at a speed of 5 kilometre per hour (kph). Figure B1 shows the extent of the road network modelled.

Table B1 ADMS-Roads input

Link	Speed (Kph)	2019 current baseline		2024 without development		2024 with development	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
1	80.5	15,126	3.3	15,835	3.6	15,596	3.6
2	80.5	14,866	3.2	15,564	3.6	15,344	3.6
3	80.5	14,951	3.3	15,652	3.6	15,589	3.6
4	80.5	15,265	3.2	15,980	3.6	15,678	3.6
5	64.4	16,947	3.5	17,732	3.8	17,454	3.8
6	48.3	11,806	6.6	12,376	7.0	12,578	7.0
7	48.3	12,840	5.8	13,454	6.2	13,636	6.2
8	48.3	24,048	5.2	25,051	5.2	25,328	5.2
9	48.3	17,067	1.8	17,780	1.8	17,938	1.8
10	96.6	720	0.3	750	0.3	813	0.3
11	96.6	1,439	0.9	1,500	0.9	1,512	0.9
12	48.3	2,377	3.0	2,476	2.9	2,249	2.9
13	32.2	2,008	0.7	2,092	0.7	1,247	0.7
14	48.3	1,730	2.1	1,802	2.1	1,833	2.1
15	96.6	12,574	2.9	13,269	4.0	13,269	4.0
16	96.6	8,547	3.3	8,949	3.6	9,693	3.7
17	80.5	9,902	2.5	10,361	2.8	10,109	2.8
18	80.5	16,458	1.1	17,190	1.3	17,682	1.3
19	80.5	17,008	1.8	17,764	1.9	18,186	2.0
20	80.5	17,008	1.8	17,764	1.9	18,186	2.0
21	80.5	11,293	1.7	11,763	1.7	11,864	1.7
22	48.3	10,307	1.7	10,736	1.7	10,843	1.7

Link	Speed (Kph)	2019 current baseline		2024 without development		2024 with development	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
23	48.3	10,198	1.7	10,623	1.7	10,717	1.7
24	48.3	11,438	1.7	11,914	1.7	12,009	1.7
25	96.6	1,022	0.0	1,065	0.0	1,058	0.0
26	96.6	810	0.0	844	0.0	825	0.0
27	64.4	21,913	4.2	22,827	4.2	22,682	4.2
28	48.3	21,979	4.2	22,896	4.2	22,732	4.2
29	48.3	17,160	3.5	17,875	3.5	17,673	3.5
30	48.3	10,650	1.8	11,095	1.8	11,114	1.8
31	64.4	32,859	2.5	34,231	2.5	33,790	2.5
32	64.4	23,124	1.0	24,087	1.0	24,585	1.0
33	64.4	33,333	3.6	34,722	3.6	34,665	3.6

Figure B1 Road sources



Appendix C
Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment. Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the Proposed Development Site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

Background concentration estimates;

- Meteorological data;
- Source activity data such as traffic flows and emissions factors;
- Model input parameters such as surface roughness length, minimum Monin-Obukhov length;
- Monitoring data, including locations; and
- Overall model limitations.

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.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Road widths;
- Distance between sources and monitoring as represented in the model;
- Speed estimates on roads;
- Source types, such as elevated roads and street canyons;
- Selection of representative meteorological data;
- Background monitoring and background estimates; and
- Monitoring data.

Suitable local monitoring data for the purpose of verification is available for annual mean NO_X/NO_2 concentrations as shown in Table C1 below. Model verification was undertaken using NO_2 2019 annual mean concentrations from roadside diffusion tubes (F) 69COV, HF(K), HF(K) (F) and SBR121.

Their locations is presented in Figure 5.1.

Table C1 Local monitoring data suitable for ADMS-Roads model verification

ID	2019 monitored annual mean NO_2 (μgm^{-3})	X (m)	Y (m)
(F) 69COV	42.2	383552	276870
HF(K)	50.5	383311	277087
HF(K) (F)	54.0	383304	277071
SBR121	27.0	383905	277857

Verification calculations

The verification of the modelling output was performed in accordance with the methodology provided in LAQM.TG (16)[14]. Table C2 shows that there was systematic under prediction of monitored concentrations at the diffusion tubes. It was therefore considered necessary to adjust modelled concentrations.

Table C2 Verification, modelled vs. monitored data

ID	2019 monitored annual mean NO_2 (μgm^{-3})	2019 modelled annual mean NO_2 (μgm^{-3})	Unadjusted % (Modelled-Monitored)/Monitored
(F) 69COV	42.2	24.6	-41.7%
HF(K)	50.5	25.8	-49.0%
HF(K) (F)	54.0	25.8	-52.2%
SBR121	27.0	15.9	-41.11%

Table C3 shows the comparison of modelled road-NO_X, a direct output from the ADMS-Roads modelling, with the monitored road-NO_X, determined from the LAQM NO_X to NO_2 conversion tool. An adjustment factor, determined through regression, of 3.04 was used to adjust modelled results.

Table C3 Comparison of modelled and monitored road-NO_X

ID	2019 Modelled annual mean road-NO_X (μgm^{-3})	2019 Monitored annual mean road-NO_X (μgm^{-3})	Ratio
(F) 69COV	64.0	58.8	2.7
HF(K)	87.0	84.6	2.9
HF(K) (F)	87.3	93.6	3.3
SBR121	28.6	31.1	3.3
Adjustment factor			**3.04**

Table C4 shows the comparison of the modelled NO_2 concentration calculated by multiplying the modelled road NO_X by the adjustment factor of 3.04 and using the LAQM's NO_X to NO_2 conversion tool to calculate the total adjusted modelled NO_2.

Table C4 Comparation of adjusted modelled NO_2 and monitored NO_2

ID	2019 annual mean background NO_2 concentration (μgm^{-3})	2019 Adjusted modelled annual mean NO_2 (μgm^{-3})	2019 Monitored annual mean NO_2 (μgm^{-3})	% (Modelled-Monitored)/ Monitored
(F) 69COV	13.5	44.5	42.2	5.3%
HF(K)	10.8	51.5	50.5	1.9%
HF(K) (F)	10.8	51.6	54.0	-4.5%
SBR121	10.8	25.8	27.0	-4.5%

All adjusted concentrations are within 10% of monitored annual mean concentrations, which is the below the threshold recommended within LAQM.TG(16)[14]. Therefore, modelled Road-NO_X concentrations have been adjusted by a factor of 3.04.

Appendix D
ADMS – Roads results

Table D1 NO_2 annual mean concentrations (μgm^{-3})

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
1	20.7	15.8	15.7	-0.1	0%	Negligible
2	15.2	11.7	11.7	-<0.1	0%	Negligible
3	11.0	8.8	8.8	-<0.1	0%	Negligible
4	16.7	12.6	12.7	<0.1	0%	Negligible
5	14.5	11.1	11.1	<0.1	0%	Negligible
6	14.0	10.8	10.8	<0.1	0%	Negligible
7	13.8	10.7	10.7	<0.1	0%	Negligible
8	15.2	11.6	11.6	<0.1	0%	Negligible
9	18.9	14.1	14.2	0.1	0%	Negligible
10	22.9	17.6	17.7	0.1	0%	Negligible
11	13.3	10.4	10.4	<0.1	0%	Negligible
13	33.3	25.1	25.2	0.1	0%	Negligible
14	24.0	17.5	17.6	0.1	0%	Negligible
15	16.4	12.3	12.3	0.1	0%	Negligible
16	10.5	8.5	8.5	<0.1	0%	Negligible
17	10.6	8.4	8.5	<0.1	0%	Negligible
18	9.2	11.6	11.5	-0.1	0%	Negligible
19	15.2	12.0	11.9	-0.1	0%	Negligible
20	15.7	9.4	9.4	-<0.1	0%	Negligible
21	11.9	11.1	11.0	-0.1	0%	Negligible
22	14.5	27.6	27.6	<0.1	0%	Negligible
23	8.9	9.1	9.1	-<0.1	0%	Negligible
24	37.6	21.1	21.2	0.2	0%	Negligible
25	11.5	9.4	9.4	-<0.1	0%	Negligible
26	29.6	15.7	15.7	-<0.1	0%	Negligible
27	11.8	19.2	19.4	0.2	0%	Negligible

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
28	21.2	19.3	19.2	-0.1	0%	Negligible
29	26.1	11.5	11.5	-<0.1	0%	Negligible
30	27.4	15.4	15.3	-0.1	0%	Negligible
31	15.4	13.1	13.1	-0.1	0%	Negligible
32	21.4	14.4	14.4	-0.1	0%	Negligible
33	17.9	13.3	13.4	<0.1	0%	Negligible
34	19.9	15.8	15.8	-<0.1	0%	Negligible
35	17.5	12.1	12.1	<0.1	0%	Negligible
36	20.4	10.8	10.8	<0.1	0%	Negligible
37	14.9	28.6	28.5	-0.2	0%	Negligible
38	13.4	28.0	28.0	<0.1	0%	Negligible
39	13.4	21.3	21.4	0.1	0%	Negligible
40	20.7	22.8	22.9	0.1	0%	Negligible
41	15.2	22.9	23.0	<0.1	0%	Negligible
42	11.0	28.8	29.1	0.3	1%	Negligible
F1	N/a	N/a	25.5	N/a	64%	N/a
F2	N/a	N/a	32.3	N/a	81%	N/a
F3	N/a	N/a	17.9	N/a	45%	N/a
F4	N/a	N/a	15.3	N/a	38%	N/a
F5	N/a	N/a	17.5	N/a	44%	N/a
F6	N/a	N/a	31.9	N/a	80%	N/a
F7	N/a	N/a	15.2	N/a	38%	N/a
F8	N/a	N/a	19.3	N/a	48%	N/a
F9	N/a	N/a	13.5	N/a	34%	N/a
F10	N/a	N/a	8.5	N/a	21%	N/a
F11	N/a	N/a	8.2	N/a	20%	N/a
F12	N/a	N/a	8.1	N/a	20%	N/a

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
F13	N/a	N/a	13.0	N/a	32%	N/a
F14	N/a	N/a	18.9	N/a	47%	N/a

Table D2 PM_{10} annual mean concentrations (μgm^{-3})

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
1	13.1	12.3	12.3	-<0.1	0%	Negligible
2	12.8	12.0	12.0	-<0.1	0%	Negligible
3	12.3	11.5	11.5	-<0.1	0%	Negligible
4	13.9	13.1	13.1	<0.1	0%	Negligible
5	13.3	12.5	12.5	<0.1	0%	Negligible
6	13.3	12.5	12.5	<0.1	0%	Negligible
7	13.2	12.4	12.4	<0.1	0%	Negligible
8	13.4	12.6	12.6	<0.1	0%	Negligible
9	13.7	12.9	12.9	<0.1	0%	Negligible
10	13.6	12.8	12.8	<0.1	0%	Negligible
11	13.0	12.2	12.2	<0.1	0%	Negligible
13	14.6	13.8	13.8	<0.1	0%	Negligible
14	14.5	13.6	13.7	<0.1	0%	Negligible
15	13.6	12.8	12.8	<0.1	0%	Negligible
16	13.4	12.6	12.6	<0.1	0%	Negligible
17	13.2	12.4	12.4	<0.1	0%	Negligible
18	12.6	12.4	12.4	-<0.1	0%	Negligible
19	13.1	12.5	12.4	-<0.1	0%	Negligible
20	13.2	11.6	11.6	-<0.1	0%	Negligible
21	12.4	12.1	12.0	-<0.1	0%	Negligible
22	12.8	14.7	14.7	-<0.1	0%	Negligible

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
23	12.5	11.6	11.6	-<0.1	0%	Negligible
24	15.6	14.3	14.3	<0.1	0%	Negligible
25	12.4	12.6	12.6	-<0.1	0%	Negligible
26	15.1	13.4	13.4	-<0.1	0%	Negligible
27	13.4	14.1	14.1	<0.1	0%	Negligible
28	14.2	15.3	15.2	-<0.1	0%	Negligible
29	14.9	12.3	12.3	-<0.1	0%	Negligible
30	16.1	13.2	13.2	-<0.1	0%	Negligible
31	13.1	13.0	13.0	-<0.1	0%	Negligible
32	14.0	13.2	13.2	-<0.1	0%	Negligible
33	13.8	12.8	12.8	<0.1	0%	Negligible
34	14.0	13.0	13.0	-<0.1	0%	Negligible
35	13.6	12.7	12.7	-<0.1	0%	Negligible
36	13.9	12.1	12.1	<0.1	0%	Negligible
37	13.5	15.0	15.0	-<0.1	0%	Negligible
38	12.9	14.0	14.0	<0.1	0%	Negligible
39	12.9	13.7	13.7	<0.1	0%	Negligible
40	13.1	14.9	14.9	<0.1	0%	Negligible
41	12.8	13.9	13.9	-<0.1	0%	Negligible
42	12.3	15.8	15.9	0.1	0%	Negligible
F1	N/a	N/a	13.6	N/a	34%	N/a
F2	N/a	N/a	15.1	N/a	38%	N/a
F3	N/a	N/a	13.7	N/a	34%	N/a
F4	N/a	N/a	13.1	N/a	33%	N/a
F5	N/a	N/a	13.8	N/a	34%	N/a
F6	N/a	N/a	14.4	N/a	36%	N/a
F7	N/a	N/a	14.1	N/a	35%	N/a

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
F8	N/a	N/a	15.2	N/a	38%	N/a
F9	N/a	N/a	13.6	N/a	34%	N/a
F10	N/a	N/a	12.1	N/a	30%	N/a
F11	N/a	N/a	12.1	N/a	30%	N/a
F12	N/a	N/a	12.1	N/a	30%	N/a
F13	N/a	N/a	13.2	N/a	33%	N/a
F14	N/a	N/a	14.7	N/a	37%	N/a

Table D3 $PM_{2.5}$ annual mean concentrations (μgm^{-3})

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
1	9.1	8.0	8.0	-<0.1	0%	Negligible
2	8.7	7.8	7.8	-<0.1	0%	Negligible
3	8.3	7.6	7.6	-<0.1	0%	Negligible
4	9.0	8.1	8.1	<0.1	0%	Negligible
5	8.9	8.0	8.0	<0.1	0%	Negligible
6	8.9	8.0	8.0	<0.1	0%	Negligible
7	8.8	8.0	8.0	<0.1	0%	Negligible
8	9.0	8.1	8.1	<0.1	0%	Negligible
9	9.3	8.3	8.3	<0.1	0%	Negligible
10	9.2	8.2	8.2	<0.1	0%	Negligible
11	8.6	7.9	7.9	<0.1	0%	Negligible
13	10.3	8.8	8.8	<0.1	0%	Negligible
14	10.1	8.7	8.7	<0.1	0%	Negligible
15	9.2	8.2	8.2	<0.1	0%	Negligible
16	8.4	7.8	7.8	<0.1	0%	Negligible
17	8.4	7.7	7.7	<0.1	0%	Negligible
18	8.0	7.9	7.9	-<0.1	0%	Negligible

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
19	8.9	8.0	8.0	-<0.1	0%	Negligible
20	9.0	7.6	7.6	-<0.1	0%	Negligible
21	8.4	7.9	7.9	-<0.1	0%	Negligible
22	8.8	9.1	9.1	<0.1	0%	Negligible
23	8.0	7.6	7.6	-<0.1	0%	Negligible
24	10.7	9.1	9.1	<0.1	0%	Negligible
25	8.4	7.8	7.8	-<0.1	0%	Negligible
26	10.7	8.9	8.9	-<0.1	0%	Negligible
27	8.6	9.3	9.3	<0.1	0%	Negligible
28	10.2	9.3	9.3	-<0.1	0%	Negligible
29	10.8	7.9	7.9	-<0.1	0%	Negligible
30	11.1	8.4	8.4	-<0.1	0%	Negligible
31	8.9	8.2	8.2	-<0.1	0%	Negligible
32	9.8	8.4	8.4	-<0.1	0%	Negligible
33	9.3	8.5	8.5	<0.1	0%	Negligible
34	9.6	8.6	8.6	-<0.1	0%	Negligible
35	9.5	8.4	8.4	<0.1	0%	Negligible
36	9.5	8.1	8.1	<0.1	0%	Negligible
37	9.1	9.8	9.8	-<0.1	0%	Negligible
38	8.9	9.3	9.3	<0.1	0%	Negligible
39	8.9	9.0	9.1	<0.1	0%	Negligible
40	9.1	9.7	9.7	<0.1	0%	Negligible
41	8.7	9.1	9.1	-<0.1	0%	Negligible
42	8.3	10.3	10.3	<0.1	0%	Negligible
F1	N/a	N/a	8.7	N/a	22%	N/a
F2	N/a	N/a	9.6	N/a	24%	N/a
F3	N/a	N/a	8.9	N/a	22%	N/a

Receptor	2019 Baseline	2024 Without Development	2024 With Development	Change in concentration (With-Without)	As a % of AQO	Impact Descriptor
F4	N/a	N/a	8.5	N/a	21%	N/a
F5	N/a	N/a	8.8	N/a	22%	N/a
F6	N/a	N/a	9.2	N/a	23%	N/a
F7	N/a	N/a	8.6	N/a	22%	N/a
F8	N/a	N/a	9.2	N/a	23%	N/a
F9	N/a	N/a	8.3	N/a	21%	N/a
F10	N/a	N/a	7.6	N/a	19%	N/a
F11	N/a	N/a	7.6	N/a	19%	N/a
F12	N/a	N/a	7.6	N/a	19%	N/a
F13	N/a	N/a	8.2	N/a	21%	N/a
F14	N/a	N/a	9.1	N/a	23%	N/a