Bishop Auckland Bus Station and Car Park

AIR QUALITY ASSESSMENT

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Durham County Council

Bishop Auckland Bus Station and Car Park

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Contents

1. Introduction

1.1 Overview

This chapter reports the potential air quality effects resulting from the construction and operation of the Scheme on environmental receptors. The assessment has taken the following approach:

- Identification of relevant baseline conditions;
- Assessment of potential air quality effects from the Proposed Scheme;
- Proposals for mitigation measures, if required; and,
- Conclusions on the likely significant residual effects of the Scheme for air quality.
- This air quality assessment describes air pollutants in ambient air and dust, and considers their potential to cause adverse effects to sensitive receptors.

The main pollutants of concern for air quality in the United Kingdom (UK) are associated with combustion emissions typically arising from road traffic and industry, which are primarily oxides of nitrogen (NO_x), nitrogen dioxide (NO_2) and particulate matter as PM_{10} and $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 10 microns or less and 2.5 microns or less, respectively). Air pollutants can affect human health and cause damage to sensitive plants and ecosystems.

Air quality also refers to dust, which could affect health or give rise to annoyance due to the soiling of surfaces through deposition. The term 'dust' refers to all particulate matter including all solid particles suspended in air or settled and deposited on a surface after having been suspended in air, due to activities related to construction. This includes the smaller-sized particles associated with potential health impacts (i.e. PM_{10} and $PM_{2.5}$) and the larger particles associated with causing annoyance or affecting sensitive vegetation through deposition on a surface.

The air quality assessment has included consideration of the following:

- Dust emissions generated by demolition, earthworks and construction-related activities during the construction phase; and
- Exhaust emissions of pollutants to air from road vehicles (e.g. cars, vans, buses and lorries) on the local road network during construction and operation of the Proposed Scheme.

This assessment has considered the potential air quality and dust impacts on the human populations of communities, and habitats and ecosystems which are near to the emission sources. For human exposure, sensitive receptors (termed 'human receptors') include residential properties and schools. In addition, for the construction dust assessment, recreational areas and Public Rights of Way including footpaths have also been included.

For habitats and ecosystems, the sensitive receptors (termed 'ecological receptors') include the following (IAQM, 2020):

- Special Areas of Conservation (SACs) and Special Protection Areas (SPAs);
- Ramsar sites;
- Sites of Special Scientific Interest (SSSIs);
- National Nature Reserves (NNRs) and Local Nature Reserves (LNRs);
- Local Wildlife Sites (LWSs) or their equivalent (in this case these are termed Biological Heritage Sites (BHSs); and

- Ancient woodlands.

1.2 Scope of Assessment

1.2.1 Construction

During the construction of the Proposed Scheme, there is a risk of dust impacts in the absence of mitigation. Therefore a construction dust risk assessment has been undertaken based on the Institute of Air Quality Management (IAQM) construction dust guidance. Mitigation measures appropriate to the demonstrated dust risk potential have been recommended for input to the Construction Environment Management Plan (CEMP) for the Proposed Scheme.

In accordance with the IAQM construction dust guidance (IAQM, 2016), potential air quality impacts associated with construction dust were considered at sensitive human receptor locations extending up to 350m from the Scheme where potentially dust-causing activities would be carried out. Potential impacts at distances greater than 350m would be likely to be less than those at locations closer to the Scheme, and any mitigation measures applied to protect sensitive receptors within 350m would help to reduce any possible impacts beyond 350m. The impacts of trackout (construction-related vehicles moving on and around the construction area interfacing with the public road network emitting exhaust particulate matter and re-suspending loose material on the road) have been determined up to 50m from the edge of the local access roads and within 500m of the respective site exits. Further information is provided in Appendix E.

In the absence of IAQM guidance reference is made to the Design Manual for Roads and Bridges[1] to determine whether exhaust emissions from construction traffic should be assessed. Owing to the temporary nature of construction activities associated with the Proposed Scheme (i.e. its duration likely to be less than 2 years) and following the principles of the Environmental Protection UK (EPUK)/IAQM air quality guidance (EPUK/IAQM, 2017), construction traffic flows are likely to be less 100 vehicles per day. Therefore, a significant air quality effect, as measured against Air Quality Objectives (AQOs), would be unlikely. On this basis the impact of construction traffic exhaust emissions is scoped out of this assessment.

1.2.2 Operation

During the operational phase, the proposed scheme will result in increased vehicle movements to and from the proposed multi-story car park[2], the idling of slow-moving vehicles within the car park, changes in bus movements and the idling of buses within a newly designed bus station. The assessment also accounts, albeit separately, for proposed traffic management measures at key roundabouts to the east of Bishop Auckland. The assessment therefore includes the following scenarios.

- Do Nothing (DN) – Business as usual and includes natural growth in the traffic in year 2024
- Do Minimum (DM) – As per DN but with car park and bus station development in 2024 (termed SC1)
- Do Something (DS) – As per the DM but with additional traffic management measures in 2024 (termed SC2)

An air quality assessment has been undertaken in accordance with the principles of the (EPUK)/IAQM air quality guidance (EPUK/IAQM, 2017). The assessment considered changes in key pollutant concentrations

[1] Design Manual for Roads and Bridges LA105 (Highways England, 2019)

[2] During this assessment the scope included a multi-story car park (MSCP) configuration. The project was then informed that a surface carpark only would be developed. The assessment was not modified on the basis that the MSCP would represent a worst-case scenario. In other words, the preferred scheme would attract fewer vehicle trips in association with fewer parking bays.

(NO_x, NO_2, PM_{10} and $PM_{2.5}$) as a result of the Proposed Scheme, at representative sensitive receptor locations located within 200m of affected roads.

Affected roads, in relation to human and ecological receptors, were identified based on changes in road traffic flows between the Do Nothing (DN) (i.e. without the Scheme) and with development scenarios (SC1 and SC2) in accordance with triggering criteria described in Section 3.1.2.

2. Legislative and Policy Context

2.1.1 Legislation

Key legislation relevant to the protection of air quality is summarised in Table 2-1 whilst further details regarding relevant air quality legislation and how air quality is managed at both a national and local scale are provided below.

Table 2-1 Key Legislation

Legislation	Description
Environment Protection Act 1990; amended by the Pollution Prevention and Control Act 1999.	Part III provides statutory nuisance provisions for dust, which would be generated during construction.
Environment Act 1995, Part IV.	Introduced a system of Local Air Quality Management (LAQM) in the UK. This requires local authorities to review and assess air quality within their boundaries regularly and systematically against Air Quality Objectives (AQOs), appraise development and transport plans against these assessments and make plans to meet the AQOs where these are exceeded.
The Air Quality (England) Regulations 2000 and The Air Quality (England) Amendment Regulations 2002.	Legislate for the AQOs for pollutants set out in the 2000 Air Quality Strategy, which was revised in 2007 (Defra, 2007). AQOs exist for a variety of pollutants including NO_x, NO2, PM_{10} and $PM_{2.5}$. These are established for the protection of human health and of vegetation and ecosystems (refer to Table 5 2 for AQOs relevant to this assessment).
The National Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland, 2007.	Updates the 2000 Air Quality Strategy, and sets out how local air quality is managed, through the application of AQOs based on the above Air Quality (England) Regulations 2000 and 2002 Amendments.
The Air Quality Standards Regulations 2010.	Transposes the formalised Limit Values (LV) set out in the European Union (EU) Ambient Air Quality Directive 2008/50/EC to UK law. The UK Government is responsible for ensuring that it complies with the provisions of EU Directives. On the UK Government's behalf, the Department for Transport (DfT) and Defra have public service agreements relating to LV.
The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020.	Includes an amended LV for particulate matter ($PM_{2.5}$) of 20µg/m^3.
Environment Act 2021.	Establishes a legally-binding duty on government to bring forward at least two new air quality targets in secondary legislation by 31 October 2022. Targets will be developed following an evidence-driven process and the Secretary of State (SoS) will be required to seek independent expert advice before setting targets in secondary legislation.

European Union (EU) Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe was published to consolidate previous EU Directives on ambient air quality. The European Directive includes a number of air quality Limit Values and these were incorporated into UK law through The Air Quality Standards Regulations 2010. Although published in 2007, the Air Quality Strategy and related AQOs are consistent with the Limit Values in The Air Quality Standards Regulations 2010.

Prior to Brexit, the UK Government was responsible to the European Commission (EC) for ensuring that it complied with the provisions of the EU Directive 2008/50/EC. Although this is no longer the case, The Air Quality Standards Regulations 2010 remain in force and compliance with the Limit Values within these regulations is still required. The UK Government's behalf, the Department for Transport (DfT) and Department for Environment Food and Rural Affairs (Defra) had Public Service Agreements relating to the Limit Values. The responsibility for compliance with the Limit Values in The Air Quality Standards Regulations 2010 remains with these bodies. The responsibilities of Local Authorities with respect to meeting air quality standards are not the same as the responsibilities of the UK government with regard to the Limit Values in The Air Quality Standards Regulations 2010. Local Authorities do have statutory duties for LAQM but are not obliged to ensure AQOs are met but are worked towards in the shortest practical time.

It is important to recognise the difference between the Limit Values in The Air Quality Standards Regulations 2010 (for which compliance is determined at a national level by central Government, but is often delegated to local authorities where there are potential exceedances) and the AQOs (for which compliance is determined at a local level by local authorities under the LAQM regime). Whilst the Limit Values and AQOs for the relevant pollutants (NO_2 and PM_{10}) may be set at the same concentration value (e.g. 40 µg/m^3, as an annual mean) the means of determining compliance are fundamentally different, and they must be considered separately.

Compliance is initially determined via the national monitoring network and national model (the Pollution Climate Mapping (PCM) model), followed by more local scale modelling to assess actions to enable compliance, such as in a Clean Air Zone. There are a number of important differences between this and the monitoring/modelling carried out by local authorities to determine compliance with the AQOs. Some of these differences are summarised in Table 2-2.

Table 2-2: Comparison Between National and Local Compliance Approaches

Factor	National Compliance	Local Compliance
Relevant exposure	Limit Values apply everywhere there is public access, within 15 m of the running lane/kerbside. However, paths running perpendicular to the road are excluded.	Annual mean objectives only apply at locations where public exposure is relevant to the averaging period, e.g. at residential building façades.
Treatment of junctions	Monitoring is not carried out within 25 m of a junction and the same constraint is applied to the modelling.	Junctions are specifically considered in both monitoring and modelling.
Microscale	Excludes micro-environments and focuses on locations representative of 100 m lengths of roads.	Focuses on "hot-spot" locations.
Roadside	Modelled concentrations apply to a distance of 4 m from kerbside of the national road network. Local roads are excluded from the model.	Focus is on concentrations at the building façade, whatever distance from the kerb and alongside any road.

Factor	National Compliance	Local Compliance
Monitoring	Restricted to monitoring stations in the national network, operated to meet the Data Quality Objectives of the Directive	Principally based on local authority monitoring, including both automatic and passive diffusion samplers.

Owing to these differences, there are many locations across the UK where the assessment of national compliance with the Limit Values and local compliance with AQOs, are not in agreement. For the purpose of this assessment, they are treated separately. This is consistent with the advice in the relevant Planning Practice Guidance (Ministry of Housing, Communities and Local Government, 2021). Compliance with the Limit Values are normally only considered where there is a potential impact on air quality from road traffic emissions, principally for NO_2, at locations which coincide with links in the PCM model, as other emission sources are more readily mitigated at source during the design.

The UK is currently failing to meet the annual mean NO_2 AQO and Limit Value in some locations. The first Air Quality Plan for NO_2 in the UK (Defra, 2015) outlined how air quality in the UK would be improved by reducing NO_2 emissions in towns and cities. A revised UK Air Quality Plan was published in July 2017 (Defra & DfT, 2017), but the most recent ruling from the High Court in February 2018 (ClientEarth *et al* (No.3) versus SoS EFRA, 2018) concluded that this plan is insufficient to bring compliance with the air quality Limit Values within the soonest timeframe possible.

In May 2018, Defra released a consultation draft of the Clean Air Strategy 2018, outlining actions to tackle emissions from a range of pollutant sources. The consultation on this draft informed the final Clean Air Strategy (Defra, 2019a) and National Air Pollution Control Programme (Defra, 2019b) published in January 2019 and March 2019, respectively. The Environment Act, which became law in 2021, acts as the UK's new framework of environmental protection. The Act allows the UK to enshrine better environmental protection into law. It provides the Government with powers to set new binding targets, including for air quality, water, biodiversity, and waste reduction

The air quality objectives applicable to LAQM in England are set out in the Air Quality (England) Regulations 2000 and subsequent 2002 amendment. The pollutants relevant to this assessment are oxides of nitrogen (NO_x), NO_2, PM_{10}, and $PM_{2.5}$. The relevant AQOs are presented in Table 2-3.

Table 2-3: Relevant National Air Quality Objectives / Limit Values

Pollutant	Threshold Concentration (µg/m^3)	Averaging Period
NO_2 (for human-health)	40	Annual Mean
	200	1-hour mean, not to be exceeded more than 18 times per year (equivalent to the 99.79th percentile of 1-hour means)
Particulate Matter (PM_{10}) (for human health)	40	Annual Mean
	50	24-hour mean, not to be exceeded more than 35 times per year (equivalent to the 90.4th percentile of 24-hour means)
Particulate Matter ($PM_{2.5}$) (for human health)	20	Annual Mean

Pollutant	Threshold Concentration (µg/m^3)	Averaging Period
Nitrogen oxides (NO_x) (for vegetation and ecosystems)	30	Annual Mean

2.1.2 Policy

The Proposed Scheme will be situated in the area administered by Durham County Council. The relevant national and local plans and policies (and how these relate to the air quality assessment) are described in

Table 2-4.

Table 2-4: Summary of Key Relevant Policy

Document	Description	Relevant Policies
National Policy		
The National Planning Policy Framework (NPPF) (Department for Housing, Communities and Local Government, 2021)	Sets out the governments planning policies for England and how these are expected to be applied. The NPPF introduces the presumption in favour of sustainable development in England, where a local plan is "absent, silent or out of date".	Paragraph 181 of NPPF references air quality: "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… 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."
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 (Defra, 2007)	Updates the 2000 Air Quality Strategy and provides an overview and outline of the UK Government and devolved administrations' ambient (outdoor) air quality policy.	The strategy sets out the AQOs and the measures selected to achieve the desired improvements in air quality.
Clean Air Strategy 2019 (Defra, 2019a)	Sets out how different air pollutants are planned to be tackled going forward for both their impact on nature and humans.	

Document	Description	Relevant Policies
The National Air Pollution Control Programme (NAPCP) (Defra, 2019b)	Sets out measures and technical analysis which demonstrate how legally binding 2020 and 2030 emission reduction commitments can be met across the UK.	
Local Policy		
County Durham Local Plan Adopted 2020 (Durham County Council, 2020)	County Durham Local plan establishes objectives to improve wellbeing of its residents, support the development and economy of the district.	**Policy 22 – Durham City Sustainable Transport** "In order to reduce the dominance of car traffic, address air quality and improve the historic environment, the council proposes to deliver the transport interventions in Durham City." **Policy 31 – Amenity and Pollution** "Development will be permitted where it can be demonstrated that there will be no unacceptable impact, either individually or cumulatively, on health, living or working conditions or the natural environment and that can be integrated effectively with any existing business and community facilities."
Durham County Council Air Quality Action Plan for Durham City (2015)	The publication of an Air Quality Action Plan (AQAP) is a statutory requirement of Defra's Local Air Quality Management (LAQM) regime for local authorities that have declared Air Quality Management Areas (AQMAs) for areas that are not expected to achieve the Government's objectives for ambient air quality and so require local action to improve air quality.	

2.1.1 Guidance

Key guidance notes for the air quality assessment are summarised in Table 2-5.

Table 2-5: Summary of Key Guidance

Document	Description
Guidance on the assessment of mineral dust impacts for planning (IAQM 2016 v1.1)	Provides guidance for developers, their consultants and environmental health practitioners on how to undertake a construction impact assessment including demolition and earthworks as appropriate.
Land-Use Planning & Development Control: Planning for Air Quality. Environmental Protection UK (EPUK)/IAQM Air Quality Guidance (EPUK/IAQM, 2017).	Contains advice on the need for an air quality assessment regarding traffic emissions and combustion plant, selection of modelling methodologies, how to describe air quality effects, and advice on determining the significance of air quality effects.
Local Air Quality Management Technical Guidance TG16, Defra and the devolved administrations (Defra, 2021a)	This is designed to guide local authorities through the LAQM process and includes detailed technical guidance on air quality screening, modelling and assessment. It also provides guidance on where the AQOs apply.
IAQM, A guide to the assessment of air quality impacts on designated nature conservation sites (IAQM, 2020)	Document has been produced to advise in terms of assessing air quality impact on designated habitats.
Design Manual for Roads and Bridges LA105 (HE, 2019)	Provides guidance on the assessment, reporting and management of impacts of air quality on human health and biodiversity from the delivery of motorway and all-purpose trunk road projects

3. Methodology

3.1 Assessment Approach

3.1.1 Dust Assessment

Various proposed activities at construction sites could give rise to emissions of dust. There would be potential for dust nuisance at receptors near the construction area and construction access routes associated with the Scheme.

The assessment of dust during construction has been carried out using a risk-based appraisal. This has taken into account the location of nearby sensitive locations in relation to the works associated with constructing the Scheme, and the planned type and scale of the respective construction-related activities. These assessments follow the process set out in the IAQM dust guidance (IAQM, 2016). These guidance documents set out recommendations for dust control and mitigation based on the determined risk level, which have been adopted. The methodology determines that the greater the risk associated with the construction of a particular development, the higher the level of mitigation, controls, management and monitoring required.

Full details of the assessment methodology, including consideration of significance, is provided in Appendix E. A summary of the methodology is provided in Table 3-1.

Table 3-1 Summary of the construction dust assessment methodology.

Step	Methodology summary
Step 1	Screen the need for a detailed assessment
Step 2a	Define the potential dust emission magnitudes for each activity
Step 2b	Define the sensitivity of the area, which includes: - receptor sensitivity based on type and location of receptor; and - sensitivity of the study area to dust soiling, human health and ecological impacts based on the relative proximity and number of receptors and existing PM_{10} concentrations.
Step 2c	Define the risk of impacts, based on the dust emission magnitudes and sensitivity conclusions from Step 2a and Step 2b.
Step 3	Identify site-specific construction management measures (if required).
Step 4	Determine any residual significant effects.

3.1.2 Operational Assessment

This assessment approach has been carried out following guidance detailed within Land-Use Planning & Development Control: Planning for Air Quality (EPUK/IAQM, 2017), where appropriate.

The key elements of the assessment are:

- A review of baseline conditions;
- A local air quality assessment for NO_2, PM_{10} and $PM_{2.5}$ at sensitive human health, compliance risk and designated habitats within 200m of the affected road network, using air dispersion modelling.

Affected roads in relation to human receptors were identified using the qualifying criteria published in the relevant guidance (EPUK/IAQM, 2017), based on changes in road traffic flows between the DN and with development scenarios, as follows:

- The change in heavy duty vehicle (HDV) flows on a road is greater than 25 as the annual average daily traffic flow (AADT) within or adjacent to an AQMA or greater than 100 AADT elsewhere; and
- The change in light duty vehicle (LDV) flows is greater than 100 AADT within or adjacent to an AQMA or greater than 500 AADT elsewhere.

The closest human receptors within 200m of road links that experience a change in traffic flows that exceed the above criteria were assessed. Changes in traffic flows less than the criteria, in accordance with the methodology would not require further assessment, as the change in concentrations of pollutants at receptors close to these roads would be imperceptible. For those receptors within 200m of the road links which exceeded the thresholds, a detailed assessment is undertaken using dispersion modelling. The detailed modelling should include all road links within 200m of the chosen receptors.

Affected roads in relation to ecological receptors were identified using the IAQM guidance on designated nature conservation sites (IAQM, 2020), based on changes in road traffic flows between the DN and with development scenarios, as follows:

- The change in AADT of greater than 1,000; or
- The change in HDV flows of greater than 200 (as an AADT).

The level of impact at any given receptor is incorporated within the specific methods prescribed in the standard good practice guidance documents, which has then been used to define the significance of air quality effects. This is because the guidance is based on compliance with AQOs (which are specified in legislation) or the criteria themselves are different for receptors of different value. Where possible, a magnitude of change of impact has been specified for the air quality impact to help inform the determination of the significance.

3.1.3 Ecological Assessment

Using criteria presented in Section 3.1.2, ecological receptors have been identified within 200m from affected roads. Transects up to 200 m from the road (measured from the edge of the road) are modelled based on professional judgement of where the impact would be highest. Transect points are positioned from the nearest site boundary point to the road with further transect points at 10m increments up to 200 m.

In order to assess the risk of air pollution impacts to ecosystems, critical loads are used as benchmarks. This information has been obtained from the Air Pollution Information System (APIS) website (CEH, 2022). The full scope of assessment is provided in Appendices B and C.

3.2 Study Area

The study area for the air quality assessment was initially considered from the traffic reliability area (TRA) (i.e. the road network selected by the traffic modellers as being statistically reliable). The study area was then refined to the extent of the Affected Road Network (ARN) plus any additional roads, included in the TRA, within 200m of selected receptors. This defines the modelled road network. The modelled road and ARN is shown Figure 1 for SC1 and Figure 2 for SC2.

3.3 Receptors

3.3.1 Human Health

Within the study area, residential properties and other human sensitive receptors (such as schools, hospitals and nursing homes) have been considered. Building usage has been determined using the Ordnance Survey Address Base Plus dataset, and calculations made at the nearest façade to the busiest road. Receptors within 200m of the modelled road links were considered. A total of 38 worst case human health receptors were included in the air quality assessment (the locations of which are shown in Figure 3 for SC1 and Figure 4 for SC2). These locations were selected as those either closest to modelled roads, or representative of the anticipated maximum impacts. All human receptors are considered of equal value and sensitivity.

3.3.2 Designated habitats

Designated habitats, as defined within the relevant guidance (IAQM, 2020), include 'Ramsar' sites, Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs), Local Nature Reserves (LNRs), Local Wildlife Sites (LWS), Nature Improvement Areas (NIAs) and ancient woodland (AW).

Internationally, nationally and locally designated habitats of protected species and of habitats and other species, identified as being of principal importance for the conservation of biodiversity, within 200m of the ARN have been included in the air quality assessment. One designated habitat was defined with the 200m distance from the ARN – Bracks Wood, Ancient Woodland (Natural England, 2022) shown in Figure 3 as receptor EC01.

3.3.3 Compliance Risk

In accordance with the National Highways DMRB LA105 (HE, 2019) a compliance risk assessment was undertaken for the roads identified in the PCM model. There are two PCM links in the study area (shown in Figure 1), but their modelled concentrations are below the AQO. Therefore, it is unlikely that implementing the Scheme would create any potential risk for exceedances for those links. The highest concentration on this link equals less than half of AQO in the Base year, therefore, using professional judgement, compliance risk receptors modelling has been scoped out.

3.4 Air Quality Assessment

3.4.1 Dispersion Model

The assessment of potential air quality effects of the proposed Scheme was undertaken using the ADMS-Roads software version 5.0.1, which has been developed by CERC. It is an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions and is a recognised tool for carrying out air quality impact assessments. The model has been comprehensively validated by both the model developers and independently, and it is used both commercially and by regulatory authorities to assist in decisions related to air quality and traffic management, urban planning and public health in many countries around the world.

It should be noted that dispersion models provide an estimate of concentrations arising from the emissions entered into the model and historical meteorological data. The estimates produced, while appropriately representing the complex factors involved in atmospheric dispersion, are subject to uncertainty.

The ADMS-Roads model was used to predict the road traffic contributions of NO_x, PM_{10} and $PM_{2.5}$ concentrations at the identified receptors. As noted above, the total pollutant concentrations were produced by the addition of the road traffic emissions to the background concentrations of NO_x, PM_{10} and $PM_{2.5}$ for human receptors. The total NO_2 concentrations from road traffic, including the background NO_2 concentrations, were derived from the modelled NO_x concentrations at locations located within 200m of the modelled road links using the Defra NO_x from NO_2 calculator (v8.1) (Defra, 2020a).

A further adjustment step for the modelled road traffic component was undertaken to account for the observed trends in ambient roadside NO_x and NO_2. Highways England (now National Highways) has developed the gap analysis methodology to adjust model predictions, to uplift the opening year (i.e. 2024) predicted concentrations to align them better with the long-term trends of NO_x and NO_2 (Highways England, 2019). Although the emission factors in EFT v11.0 (Defra, 2021b) used to calculate the future year vehicle emissions takes account of some of the previous known discrepancies in the long-term trends for vehicle emissions, the gap analysis methodology was applied as a conservative approach. Further information is provided in Section 3.4.8.

Adjustments were applied to the model predictions based on a comparison between measured and modelled air quality concentrations for the traffic model base year (i.e. 2019) in a process known as model verification (as described in Section 3.4.9).

Whilst the predictions provided by the models should not be regarded as definitive statements of concentrations that will arise in the future, they are the most reasonable, robust and representative estimates available. The estimates are composed of calculations of the impact of all the modelled emission sources at a single point or location referred to as a receptor.

3.4.2 Vehicle Emissions

The ADMS-Roads modelling system takes into account the emissions produced by Light Duty Vehicles (LDV, less than 3.5 tonnes) and HDVs (Heavy Duty Vehicles, more than 3.5 tonnes) travelling at a certain speed along a section of road, averaged over an hour, and predicts the dispersion of these emissions for a given set of meteorological conditions.

Emission rates for LDVs and HDVs were calculated using Defra’s Emission Factors Toolkit v11.0 (Defra, 2021a). The resulting hourly emission rates were input into the ADMS-Roads dispersion model taking into account traffic conditions in each of the traffic model periods (see Section 3.4.5).

3.4.3 Background Concentrations

‘Background’ air quality is a concept used to enable assessment of the impacts of particular emissions sources, without the need for all sources in the area, and beyond, to be considered explicitly within the modelling. The background concentrations are added to the predicted contributions (PCs) from the road traffic emissions modelling for each modelled location to derive the total pollution concentrations.

Defra provide semi-empirical national background pollution concentration maps at a 1 km grid square resolution (Defra, 2020b). The data for NO_x , NO_2, PM_{10} and $PM_{2.5}$ were obtained based on the 2018 base year dataset from which future years are projected.).

The base year for the assessment was 2019 (i.e. traffic model base year). To address the potential variation between mapped and monitored background nitrogen dioxide (NO_2) concentrations in the air quality study area, a comparison of 2019 background monitoring data was made against the 2019 mapped background concentrations for the grid squares corresponding to a number of nearby urban background monitoring sites. The comparison of monitored to mapped background NO_X and NO_2 identified that the Defra maps tend to under predict NOx concentrations on average. An adjustment factor of 1.217 was therefore applied to the mapped background oxides of nitrogen (NOx) concentrations for each grid square used in the assessment. The sites selected for this exercise and the calculations undertaken to determine the adjustment factor are shown in Table 3-2.

Table 3-2: Monitored and mapped concentrations for background adjustment (2019)

Site ID	Site Name	OS grid coordinate (X,Y)	Monitored (µg/m^3)		Mapped (µg/m^3)		NOx monitored/ mapped
			NOx	NO_2	NOx	NO_2	
UKA00213	Newcastle	425026, 564918	49.3	32.1	34.8	23.4	1.416
UKA00645	Hartlepool	451429, 532312	15.6	12.4	17.1	12.7	0.914
UKA00484	Sunderland	438150, 554479	20.1	12.8	15.2	11.5	1.320

Sector removal of primary A-road background concentrations from the Defra 1 km grid maps associated with the air quality study area was undertaken to ensure double counting of road traffic emissions from these roads included in the dispersion modelling did not occur. Key roads included in the modelling included the A688 and A689.

3.4.4 Modelled Scenarios

The following scenarios have been included in the assessment:

- 2019 Baseline (i.e. existing conditions);
- 2024 Do Nothing (DN);
- 2024 Opening Year 'without scheme' referred to as Do-Minimum (DM 2024; SC1); and
- 2024 Opening Year 'with scheme' referred to as Do-Something (DS 2024; SC2).

The local air quality assessment considers the effects of the SC1 and SC2 scenarios with reference to the DN scenario in the opening year 2024. Results of the two options modelling are available in Appendix D.

3.4.5 Traffic Data

Traffic data for the modelling scenarios were taken from the Aimsun traffic model. The results from the traffic model factored in the impact of committed development. This information was provided by Durham County Council in the form of an uncertainty log containing all developments in the study area including those associated with employment and housing. The base year air quality modelling uses traffic data, air pollution measurements and meteorological measurements from 2019.

Traffic data representing average temporal conditions were provided for the periods specified in Table 3-3. For each time period, the following metrics were provided:

- Total traffic flow, defined as vehicles/hour;
- Percentage HDVs;
- Percentage Buses; and
- Vehicle speed, in kilometres per hour (km/h).

AADT data was divided into four time periods for which following time periods were used Table 3-3.

Table 3-3: Traffic Data Parameters

Traffic Period	Time Period
Annual Average Daily Traffic (AADT)	**00:00 – 24:00**
AM Period (AM)	07:00 – 10:00
Inter-Peak Period (IP)	10:00 – 16:00
PM Period (PM)	16:00 – 19:00
Off Period (OP)	19:00 – 07:00

3.4.6 Meteorological Data

The effect of meteorological conditions on dispersion is given complex treatment within the model. The most significant factors in the dispersion of emitted pollutants are wind speed and direction. The nearest and most representative meteorological data site to the study area was Durham Tees Valley Airport. Data from this site for 2019 (the air pollution assessment base year) were used in the modelling work. In addition the dispersion modelling needs also account for surface roughness[3] and Monin-Obukhov[4] length at the meteorological site

3.4.7 Adjustment for Long Term Trends in NO_x and NO_2

In July 2011, Defra published a report (Defra, 2011) examining the long-term air quality trends in NO_x and NO_2 concentrations, which identified a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter NO_2 concentrations have stabilised with little to no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long-term trends is that there is a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air

[3] The level to which air dispersion is subject to turbulence effected by land forms.

[4] Length being the height at which turbulence is generated more by buoyancy than by wind shear.

quality, built into the vehicle emission factors, the projected background maps and the NO_x and NO_2 calculator.

National Highways DMRB LA105 has developed the Gap Analysis methodology to adjust model predictions, which uses the relationship between the base year vehicle emission rates and the opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the long term trends of NO_x and NO_2.

The gap analysis methodology incorporates the Euro 6/VI improvements. These projection factors are referred to as 'Long Term Trend Euro 6/VI (LTTE6)'. The LTTE6 factors take a precautionary approach to account for uncertainty associated with Euro 6/VI performance and fleet mix in the future, rather than assuming full reductions in emissions occur as predicted by Euro 6/VI, which has not been observed by air quality monitoring trends associated with recent Euro standards. This is implemented into LTTE6 by taking the mid-point between the measured trend predictions (which assume no improvement in emissions associated with Euro 6/VI) and predicted Euro 6/VI uptake and emission improvements.

On this basis, the LTTE6 projections are considered to be the most reasonable prediction of likely actual future NO_x and NO_2 concentrations and have been used in the local air quality assessment for locations within 200 m of roads. The gap analysis is not applied to PM_{10} or $PM_{2.5}$ predictions or NO_x / NO_2 predictions at selected receptors adjacent to PCM links.

3.4.8 Calibration and Validation

In order to assess the performance of the air quality model, the results of the base year modelling were compared with available monitoring data. The process of model verification identified that adjustment of the model was required, and this was undertaken following guidance in LAQM.TG(16) (Defra, 2021a). The model adjustment factor derived has been applied to the results presented in Appendix D. Details of the derivation of the model adjustment factor is presented in Appendix B.

3.4.9 Assumptions and Limitations

The key limitations for this assessment relate to the reliance on modelling for the purposes of predicting significant impacts at the location of sensitive receptors as a result of the route options.

It is assumed that buses will switch off their engines whilst stationary to prevent idling emissions.

The air quality assessment is based on a series of computer models containing forecasting of future conditions. The process relies on the modelling of future traffic flows, which is subject to limitations and uncertainties. The traffic data are used within the air quality modelling process to compare future air quality conditions both with and without the scenarios SC1 and SC2. The air quality model draws on a number of other trends and parameters that must be projected into the future (i.e. application of long-term trends)

In addition to the above the air quality impact assess relies heavily on Defra tools such as the NOx to NO_2 calculator[5] to derive NO_2 from NOx wherever NOx is predicted by modelling emissions from roads. The study also applied Defra background maps[6] which estimate pollution levels for future years from a given base. These are adjusted to reduce the uncertainty as described in Section 3.4.3. The dispersion modelling is reliant on representative meteorological data in this case the assumption that weather conditions recorded at Durham Tees Valley Airport is representative of the air quality study area. Modelling predictions are adjusted to reflect pollution concentrations measured in the local area using NO_2 diffusion tubes. Diffusion tubes are adjusted to account for inherent uncertainty either by comparing with local real time monitoring data (which

[5] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/
[6] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/background-maps/

was not available for this assessment) or using the National Bias Adjustment Factors[7]. It is assumed however that the bias informed by the database can accurately account for the laboratory conditions applied to the diffusion tubes deployed across the study area.

As with any computer model that seeks to predict future conditions, there is uncertainty in the predictions made. Whilst being the best predictions available, elements of impact prediction such as the specific concentration of a given pollutant at a given property, or whether an exceedance of the AQOs would or would not occur at a specific location, are not precise and are always subject to a margin of error. These errors have been minimised and where necessary a precautious approach has been used.

3.5 Assessment of Significance

3.5.1 Human Health

Predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations were compared to the relevant AQOs for each of the scenarios modelled in this assessment. The relevant AQOs are detailed in Table 2-3. In order to convey the level of impact of the scenarios SC1 and SC2, it is necessary to determine its significance. The 'significance' of an environmental impact is a function of the 'sensitivity' of the receptor and the 'scale' of the impact.

The model results were used to assess whether there are any significant effects as a result of the scenario options. IAQM's approach to evaluating significant air quality effects is set out in Environmental Protection UK (EPUK)/IAQM Air Quality Guidance (EPUK/IAQM, 2017).

The impact descriptors at receptor locations are detailed in Table 3-4. These impact descriptors consider the predicted magnitude of change in pollutant concentrations and the concentration in relation to the relevant air quality objectives. The changes in predicted concentration are then calculated as the difference between SC1/SC2 and the DN model results at these receptors.

IAQM has developed a framework to provide guidance on the number of receptors for each of the magnitude of change categories that might result in a significant effect. These are guideline values only and are to be used to inform professional judgement on significant effects of the route options.

A receptor with a predicted change in concentration greater than 'negligible' (i.e. greater than a magnitude of 0.4 $\mu g/m^3$ for NO_2 and PM_{10}) is assigned to one of four categories (negligible, slight, moderate and substantial for either worsening or improvement). The percentage of change of receptors in each category are compared to guideline ranges provided in EPUK IAQM Guidance (2017) as shown in Table 3-4.

Table 3-4: Guideline for a Judgement of Significant Air Quality Effects

Long term average NO_2 or PM_{10} ($\mu g/m^3$) concentration at receptor in assessment year	% Change in concentration relative to Air Quality Objective (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

[7] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/national-bias/

Long term average NO_2 or PM_{10} (µg/m^3) concentration at receptor in assessment year	% Change in concentration relative to Air Quality Objective (AQO)			
	1	2-5	6-10	>10
103-109% of AQO	Moderate	Moderate	Substantial	Substantial
110% or more of AQO	Moderate	Substantial	Substantial	Substantial

The Ordnance Survey Address Base Premium (Ordnance Survey, 2022) dataset was used to define building use within the study area and identify potentially sensitive human receptor locations within 200m of the affected road links.

3.5.2 Designated Habitats

The predicted changes in nitrogen deposition were used to identify the potential for significant effects to occur for designated habitats. With regard to nitrogen deposition, critical loads for designated habitats in the UK have been published by the Centre for Ecology and Hydrology (CEH) and were obtained from the APIS website (CEH, 2022).

IAQM *A guide to the assessment of air quality impacts on designated nature conservation sites* (IAQM, 2020) states that if the change in nitrogen deposition is greater than 1% of the lower critical load and the total deposition is greater than lower critical load, then there is a potential impact. At which point the information should be reviewed by the project ecologists to determine their significance and where practicable, mitigation would be proposed.

3.5.3 Compliance Risk

DMRB LA105 (Highways England, 2019) states that the assessment shall conclude there is no risk to the UK's ability to comply with the Limit Values for reportable locations (as defined in National Highways DMRB LA 105 (Highways England, 2019)) where:

- there are no modelled exceedances of the air quality Limit Values for any PCM link; or
- there are modelled exceedances of the air quality Limit Values for any PCM link, but the change in annual mean NO_2 concentrations between the do minimum and do something is less than or equal to +/-0.4 µg/m^3; or
- the project does not materially impact on measures within local air quality or national plans for the achievement of compliance.

4. Baseline Environment

Baseline conditions have been determined by considering information and data from the following sources:

- Defra background mapping for projected background concentrations in the assessment years (Defra, 2020b);
- Local authority air quality Annual Status Reports and monitoring data (Durham County Council (DCC), 2021)
- Dispersion modelling results for the base year (2019), and
- PCM model outputs (Defra, 2020c).

4.1 Local Air Quality Management (LAQM)

The air quality assessment study area is located across the administrative area of DCC. The most recent air quality Annual Status Report published by DCC (DCC, 2021) has been reviewed and considered as part of the assessment.

The administrative areas described above have declared the following Air Quality Management Areas (AQMA), as described in Table 4-1.

Table 4-1: AQMAs Across the Considered Administrative Areas

Local Authority	AQMA Name	Pollutants Declared	Location
Durham County Council	Durham City AQMA	NO_2 – Annual mean	An area encompassing a number of properties around the streets Moor Cres, Sunderland Road, Gilesgate, Leazes Road, Framwellgate. Approximately 11.8 km north-east of the ARN.

There are no AQMAs in close proximity to the air quality assessment study area, the closest is the Durham City AQMA located over 11 km from the ARN.

4.2 Local Air Quality Monitoring

Whilst DCC undertake air quality monitoring at various locations across the County none has focused more recently on Bishop Auckland. Under these circumstances scheme (both scenarios SC1 and SC2) specific monitoring was required to establish baseline conditions.

4.3 Scheme-specific monitoring survey

A three-month site specific NO_2 monitoring survey using diffusion tubes was undertaken December 2021 to February 2022 inform the assessment process and obtain measurements in close proximity to the scenarios SC1 and SC2 and surrounding local road network. The monitoring locations are shown in Figure 1 and full details of the survey are provided in Appendix A. The measured annualised mean concentrations used in the verification of the pollution dispersion model for the Base 2019 scenario are set out in Table 4-2. Of the ten diffusion tube sites deployed only 6 sites retained sufficient data[8] to be annualised. The other four were discounted.

Table 4-2 Monitoring survey diffusion tubes locations

Site ID	Description	Site Type	Annual Mean NO_2 Concentration (Annualised to 2019) (μg/m^3)
DT1	Durham Road	Roadside	10.6
DT2	N Bondgate	Roadside	17.9
DT3	High Bondgate	Roadside	18.1
DT4	A689	Roadside	Insufficient data
DT5	A689	Roadside	21.7
DT6	Etherley Lane	Roadside	13.9
DT7	Tenters St	Roadside	Insufficient data
DT8	A689	Roadside	Insufficient data
DT9	S Church Road	Roadside	Insufficient data
DT10	A689	Roadside	21.0

4.4 Mapped Background Concentrations

Mapped background annual mean concentrations of NO_x, NO_2, PM_{10} and $PM_{2.5}$ for both the base and assessment years were obtained from Defra's Background Maps, which are based and forecasted from monitoring and meteorological data for year 2018. As the maps provide data for individual pollutant sectors (e.g. motorway, trunk A-roads, primary A-roads, minor roads and industry) the components relating to

[8] Diffusion tubes were damaged and/or removed.

modelled road traffic sources have been removed (motorway, trunk A-roads, primary A-roads) to avoid double counting of road emissions for the prediction of pollutant concentrations. A summary of the minimum and maximum concentrations across the study area is provided in Table 4-3, which indicates that background concentrations for all pollutants within the air quality study area are well within the relevant AQOs, and in some locations are very low reflecting the semi-rural nature of the study area.

Table 4-3: Defra Background Concentrations (2019 and 2024)

Pollutant	AQO	Mapped Annual Mean Background Concentration (µg/m^3)			
		2019		2024	
		Min.	Max.	Min.	Max.
Total Background Concentration					
NO_x	-	4.7	34.8	3.9	17.6
NO_2	40	3.8	32.4	3.2	13.0
PM_{10}	40	6.7	14.2	6.3	13.6
$PM_{2.5}$	20	4.8	8.1	4.4	7.6
Sector-Removed Background Concentration					
NO_x	-	5.7	34.6	4.7	19.7
NO_2	40	4.5	23.1	3.8	14.3
PM_{10}	40	6.7	14.1	6.3	13.4
$PM_{2.5}$	20	4.8	8.1	4.4	7.5

4.5 Modelled Base Year Concentrations

Annual Mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at the identified sensitive human health receptors were modelled for the 2019 year. The results for 10 highest concentrations of NO_2 at selected receptors are summarised in Table 4-4 (with results provided in full in Appendix D). The results of the baseline modelling indicate that annual mean NO_2, PM_{10} and $PM_{2.5}$ are all within the relevant AQOs (i.e. 40 µg/m^3, 40 µg/m^3 and 20 µg/m^3, respectively) at all receptors.

Table 4-4: Air Quality Baseline Results

Receptor ID	Modelled 2019 Annual Mean Concentration (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
AQO	*40*	*40*	*20*
R3	14.3	11.3	7.0

Receptor ID	Modelled 2019 Annual Mean Concentration (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
R5	15.2	13.3	7.5
R11	19.2	14.0	8.0
R14	17.3	13.6	7.7
R16	17.7	13.8	7.8
R17	11.8	10.6	6.6
R24	11.5	10.5	6.6
R25	14.0	10.8	6.6
R26	18.6	10.7	6.7
R38	20.5	12.0	7.5

4.6 Pollution Climate Mapping (PCM) Model Outputs

The Pollution Climate Mapping (PCM) model, provided by Defra, is designed to fulfil part of the UK's Directive (2008/50/EC) requirements to report on the concentrations of major air pollutants that impact human health, such as particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2). Modelled NO_2 roadside concentrations are provided for the 2018 base year, and projected for every year up to 2030, at representative roads throughout the UK. Whilst annual mean NO2 remains non complaint at some PCM reportable receptors compliance risk for of PM_{10} is not an issue nationally.

Two PCM model links form part of the ARN (as shown in Figure 1). Projected roadside annual mean NO_2 concentrations adjacent to these links are within the Limit Value for NO_2 (40 µg/m^3) in both 2019 and 2024, as shown in Table 4-5. The range in 2019 modelled annual mean NO_2 concentrations adjacent to these PCM links area also shown in Table 4-5 .

Given the levels of predicted NO_2 concentrations the risk of noncompliance with the scenarios SC1 and SC2 in place is extremely low. On this basis, further assessment of PCM receptors was not required as part of this assessment.

Table 4-5: Defra Projected Pollution Climate Mapping (PCM) Outputs for NO_2

Census ID	Road Name	Projected Roadside PCM Annual Mean NO_2 Concentration (µg/m^3)	
		2019	2024
802077580	A689	16.9	12.5
802047814	A6072	18.8	14.1

5. Impacts of the Scheme on Air Quality

Within the study area, two types of sensitive receptors were considered:

- Human receptors including residential properties and other sensitive receptors (such as schools, nursing homes, hospitals, permanent canal boat residents and traveller sites etc.);
- Ecological receptors (designated sites at international, European, national or local level);

5.1 Human Health Impacts

5.1.1 Dust Assessment

The dust risks summarised in Appendix E were used to identify the recommended level of risks and mitigation measures as part of the dust assessment measures to be implemented. These are based on the highest risk level identified for each of the construction activities. For general dust control and management, these are based on the highest risk level identified (i.e. Medium Risk).

In the study area, there are located receptors potentially considered as sensitive (i.e. nursery, residential properties) and there are many receptors with medium and high sensitivity.

It is predicted that proposed earthworks, construction and trackout are going to create **low to medium risk** for dust soiling. Full scope of impacts as well as proposed mitigation can be found in Appendix E.

5.1.2 Operational Phase

The predicted annual mean NO_2 concentration changes for the base 2019, DM 2024 and DS 2024 scenarios are presented in Table 5-1. The table shows a selection six of the results for those receptors predicted to experience the highest change in concentrations for both of modelled options – both improvement and worsening of air quality. The Table shows that in all cases annual mean NO_2 concentrations for SC1 and SC2 are less than 50% of the AQO. The results for all modelled receptors are provided in Appendix D. It is noted that the results of the assessment for the receptors shown in Table 5-1 appear to be identical between SC1 and SC2. By example, examining the traffic data shown in Table F-1 Appendix F for receptors R11 and R33 the traffic flows on the nearest roads to these receptors are different. The change in AADT between the DN and S1 was 463 and the corresponding change between DM and DS (S2) was 621. These changes in traffic flow cause only slight differences in emissions rates, which are not detectible through dispersion modelling between the road and receptor. A similar narrative is apparent for each receptor included in the assessment.

Table 5-1 IAQM significance, change in annual concentrations between scenarios and impact of the scenarios

	IAQM Significance			
Receptor	Change (µg/m^3)	% Change	Concentrations as % of AQO[9]	Impact Category
Scenario 1 DN-DM				
R11	0.7	1.8	40.4	Negligible
R12	0.2	0.6	37.4	Negligible
R16	-0.4	-1.0	40.7	Negligible
R24	-0.4	-0.9	42.5	Negligible
R33	0.5	1.4	35.1	Negligible

[9] The total concentration impact categories reflect the degree of potential harm by reference to the AQO value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small.

Receptor	Change (µg/m³)	% Change	IAQM Significance Concentrations as % of AQO[9]	Impact Category
R36	-0.4	-1.0	38.2	Negligible
			Scenario 2 DN-DS	
R11	0.7	1.8	40.4	Negligible
R12	0.2	0.6	37.4	Negligible
R16	-0.4	-1.0	40.7	Negligible
R24	-0.4	-0.9	42.5	Negligible
R33	0.5	1.4	35.1	Negligible
R36	-0.4	-1.0	38.2	Negligible

The key observation is that DS SC2 has no discernible impact over DM SC1.

The annual mean NO_2 concentrations are predicted to be below the AQO of 40µg/m^3 at all receptor locations close to the affected road network in both the modelled scenarios. Reduction in NO_2 emissions were predicted at human receptors close to road links where reductions in traffic flow are forecast owing to the operation of the scenarios SC1 and SC2 (a decrease of up to 0.4µg/m^3 at receptors). Table F-1 shows the traffic data on the nearest link to receptors showing the greatest impact owing to the scheme scenarios.

The largest decreases were predicted at human receptors close to West Road (R16), Adelaide Street (R24) and Kingsway (R36). The largest decrease of annual mean NO_2 (-0.4µg/m^3) concentration was predicted in both the SC1 and SC2 scenarios close to the affected road network at R16 which is located adjacent to the West Road, A689 and High Bondgate Roundabout. The largest increase of 0.7µg/m^3 (1.8%) was predicted at R11 (North Bondgate). The association between changes in concentration and traffic activity data can be observed in Table F-1.

The impact on NO_2 concentrations at all receptors due to the operation of the scenarios SC1 and SC2, whether increases or decreases, is **categorised as negligible**.

The LAQM TG16 guidance (Defra, 2021a) states that exceedance of the 1-hour NO_2 AQO is unlikely where annual mean NO_2 concentrations are below 60µg/m^3. The annual mean NO_2 concentrations predicted at all receptors were below 60µg/m^3 and therefore, exceedance of the 1-hour NO_2 AQO is very unlikely as a result in both scenarios SC1 and SC2.

All predicted total annual mean PM_{10} concentrations at human receptors were below 14µg/m^3 in the DM and DS scenarios and are below the AQO of 40µg/m^3. The maximum predicted increase at any of the receptor points was 0.1 µg/m^3 and the maximum decrease was 0.2µg/m^3 (a change of 0.5% compared to the AQO). The impact is categorised as negligible at all receptors. The PM_{10} results for all modelled receptors are provided in Appendix D. Similarly, $PM_{2.5}$ concentrations did not exceed 8µg/m^3 at all receptors with maximum change of 0.1µg/m^3 in DN-DM scenario and 0.2µg/m^3 in DN-DS scenario. Impact of proposed SC1 or SC2 is then categorised as negligible.

5.1.3 Compliance Risk Assessment

Owing to annual mean NO_2 concentrations equalling less than a half of AQO on existing PCM links in the vicinity of both of SC1 and SC2 , the compliance risk assessment has been scoped out.

5.2 Designated Habitats

5.2.1 Dust Assessment

There was one relevant ecological receptor within 190m of the ARN, the Bracks Wood Ancient Woodland. The sensitivity of the Bracks Wood Ancient Woodland (AW) has been defined as Low. Based on the location of the AW the sensitivities to demolition, earthworks, construction and trackout activities based on the criteria set out in the IAQM dust guidance (IAQM, 2016) are presented in Table 5-2.

Table 5-2 Potential impact and sensitivity of designated habitat in the study area

Potential Impact	Sensitivity of Surrounding Area			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Ecological receptors (Bracks Wood, Ancient Woodland)	N/A	Low	Low	Low

5.2.2 Operational Phase

There is one transect point for one designated habitat. Total nitrogen deposition rate for the Bracks Wood equals 29.3kg N/ha/yr with change in nitrogen deposition between base year and future year of – 0.003kg N/ha/yr, therefore the impact of both scenarios SC1 and SC2 is considered negligible. Full assessment can be found in Appendix D.

The N deposition calculations undertaken showed that Bracks Wood had a predicted total deposition rate above the lower critical load but that the predicted change in N deposition was less than 1% (0.03%) of the lower critical load and less than 0.004kg N/ha/yr. Therefore the impact of the Proposed Scheme is considered negligible.

6. Conclusions

This chapter considered the potential air quality impacts associated with the operation and construction of scenarios SC1 and SC2 on human and ecological receptors.

The assessment included detailed consideration of dust emissions during construction and road traffic emissions during operation. Emissions from road traffic during construction were screened out from the assessment.

Appropriate good practice mitigation measures were identified to manage and control dust emissions during the construction phase based on the identified risk levels. With these measures in place, it was concluded that air quality effects would not be significant and any residual impact manageable.

The assessment of road traffic emissions demonstrated that any changes in air quality at human receptor locations would be negligible, and therefore **not a significant** effect on air quality.

The assessment, conducted following Environmental Protection UK (EPUK)/IAQM air quality criteria (EPUK/IAQM, 2017), found that differences between SC1 and SC2 to be negligible. All results of the assessment are presented in Appendix D.

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Appendix A. Scheme-specific monitoring survey

A.1 Survey Details

A site specific NO_2 monitoring survey using diffusion tubes was commenced in November 2021 to February 2022 to inform the assessment process. The survey duration was three months The following sections describe the survey, the adjustments made to the data to account for bias and details of the survey results.

A.2 Description of diffusion tubes

The use of diffusion tubes is a relatively simple way to measure air quality and gives an indication of average pollution concentrations over a time period ranging from one to five weeks. They are a type of passive sampler, whereby the air flow is controlled by natural diffusion and does not involve the pumping of any air. The tubes are 71 mm long with an internal diameter of 11 mm and contain two stainless steel gauzes at one end. These contain an absorbent (triethanolamine (TEA)) that traps the NO_2 and converts it to nitrite (NO_2-), which is then analysed in an accredited laboratory. The other end of the tube is left open to the atmosphere, facing downward to prevent contamination by rain or dust. To ensure that the tubes do not collect any pollutant after leaving their site location they are sealed before their journey to the laboratory.

NO_2 diffusion tubes are an indicative monitoring technique and may exhibit biases relative to continuous analysers, with positive bias being more common than negative (Defra, 2008). Bias adjustments are therefore applied to the tubes as described in Section A.5 of this report. Factors that can cause under- and over-estimation of diffusion tube NO_2 concentrations include:

- the tube location;
- meteorology, i.e. wind turbulence at the open end of the tube;
- blocking of UV light by the tube material;
- interference from peroxyacetyl nitrate (PAN); and
- handling during laboratory analysis.

The diffusion tubes were supplied by Gradko and prepared using 20% TEA in water. Local Air Quality Management. Technical Guidance (TG16) issued by Defra (2021a) requires diffusion tubes results to be adjusted for bias against a continuous monitoring chemiluminescence analyser.

A.3 Monitoring Locations

The monitoring survey took place at 10 monitoring locations within the vicinity of Bishop Auckland Bus Station and Multi-Storey Car Park adjacent to key road links in the area. The monitoring locations closest to the study area and affected roads are shown in Figure 1 (locations D1-D10) and these were used to inform the verification process described in Appendix B of this report. Further description of the site locations provided in Table A-1 below.

During each changeover period of the survey, one travel blank was used to identify possible contamination of diffusion tubes whilst in transit or storage. The travel blanks were taken to the site when the tubes were installed but returned to the office storage for the duration of the exposure period. The travel blanks were taken to the site again when the tubes were collected, after the exposure period. The travel blank was sent to the Gradko laboratory for analysis along with the exposed tubes. The results of the travel blanks were used to identify any potential contamination issues.

Table A-1 Details of diffusion tube monitoring locations

Site ID	Site Type (LAQM)	OS Grid Reference		Distance to Kerb of Nearest Road (m)	Height Above Ground (m)
		X (m)	Y (m)		
DT1	Roadside	421405	529955	0.9	2.0
DT2	Roadside	421021	530122	0.1	2.0
DT3	Roadside	420808	530035	1.1	2.0
DT4	Roadside	420713	530067	1.2	2.0
DT5	Roadside	420753	529970	1.5	2.0
DT6	Roadside	420684	529869	1.1	2.0
DT7	Roadside	420954	529900	1.1	2.0
DT8	Roadside	420927	529767	0.4	2.0
DT9	Roadside	421075	529626	10.8	2.0
DT10	Roadside	421355	529068	4.9	2.0

A.4 Monitoring Timescales

The diffusion tubes were changed monthly for a period of three months. The start and end dates for each monthly exposure period are shown in Table A-2. Time weighted average concentrations (i.e. period weighted mean concentrations) have been calculated to account for variability in the number of exposure days over each monthly period.

Table A-2 Start and end dates for monthly monitoring periods

Monitoring Period	Month	Start Date	End Date	Number of Days
P1	November	11 November 2021	17 December 2021	36
P2	December	17 December 2021	17 January 2022	31
P3	January	17 January 2022	25 February 2022	39

A.5 Bias Adjustment

In accordance with Local Air Quality Management Technical Guidance TG16 (LAQM TG16) (Defra, 2021a), there is a choice of applying either a national bias adjustment factor or a local bias adjustment, calculated by co-locating tubes with local continuous monitoring sites. The national bias adjustment factor is calculated using the latest LAQM National Diffusion Tube Bias Adjustment Factor Spreadsheet (Defra, 2022a). Bias adjustment factors are collated in a national database from a number of co-location studies, allowing the bias at a range of site locations with consistent analysis methods (laboratory and analysis technique) to be considered.

There were no continuous monitoring sites within a reasonable distance where upon access would be proportionate in terms of adding value to the overall assessment. The national bias adjustment factor recorded for the laboratory and analysis method (i.e. Gradko, 20% TEA in water) for 2020 was used. Consequently, a bias adjustment factor of 0.91 (2019) was applied to the raw monitored diffusion tube concentrations subsequent to annualisation of the data to represent the annual mean.

A.6 Annualisation of diffusion tube survey data

The LAQM TG16 guidance (Defra, 2021a) states that for monitoring sites with less than 9 months' worth of data, it is necessary to perform annualisation to estimate an annual average from a part year average. However, it also states that a minimum of three months of data are required to perform annualisation.

The data from the 3-month study (November 2021 to February 2022) were converted to represent an annual mean concentration using the guidance outlined in the LAQM TG16 guidance (Defra, 2021a) to provide data representative of the calendar year 2019. This used the measurement data from the Hartlepool St Abbs Walk automatic urban background monitoring site which is part of the Defra Automatic Urban and Rural Network (AURN) of air quality monitoring stations (Defra, 2022b). The annualisation also considered the use of data from two other urban background AURN stations (Newcastle Centre and Sunderland Silksworth).

Data for the calendar year of 2019 were used to undertake the annualisation of the diffusion tube measurements in 2021/2022. Although this represents a different year it is assumed that the variation in concentrations experienced throughout the year are similar for both years. The adjustment factors to perform the annualisation of the 2021/2022 diffusion tube survey results are shown below in Table A-3.

Table A-3 Annualisation factors for each diffusion tube

Monitoring Sites Used for the Survey	Annualisation Adjustment Factor (2019 annual mean / period mean)
DT1	0.87
DT2	0.87
DT3	0.87
DT4	0.74
DT5	0.87
DT6	0.87
DT7	0.00
DT8	0.84
DT9	0.92
DT10	0.88

A.7 Study Limitations

As the diffusion tubes are accessible to the public and to outdoor conditions there is always a possibility that they can become misplaced (e.g. stolen, vandalised etc.) between site visits. This has resulted in reduced data capture at several monitoring locations, meaning some sites only had one or two months of data prior to annualisation. Table A-4 shows which monitoring locations experienced reduced data capture represented by blank cells.

As the base year assessment was undertaken based on modelled traffic data for the year 2019, the monitoring survey data recorded primarily in 2020 were annualised to represent the annual mean in 2019 for use in the verification of the road traffic emissions modelling.

A.8 Monitoring Results

All tubes were provided and analysed by the same laboratory (Gradko) and NO_2 concentrations calculated for each tube based on individual exposure times. No data were provided for missing tubes.

The full raw, annualised and bias adjusted results are presented in Table A-4. The annualised and bias adjusted results indicate that the estimated annual mean concentrations at the monitoring locations are within the annual mean NO_2 air quality objective value of 40 µg/m^3. Because only 3 months survey has been conducted, Defra Projection factor for 2019 has been applied to the results of monitoring. The location which recorded the highest estimated annual mean NO_2 concentration (21.7 µg/m^3) was a roadside location (location DT5). However, the concentration is well within the air quality objective value of 40 µg/m^3.

Table A-4 Annualised and bias-adjusted NO_2 monitoring survey results

Site ID	Monitoring Period Data Capture (%)	Measured NO_2 Concentration (µg/m^3)							
		Nov P1	Dec P2	Jan P3	Weighted Average (no Adjust-ment)	NO_2 Projection Factor (2019)	2019 Factored Period Mean	Annualisation Adjustment Factor	Bias Adjusted (0.91) and Annualised to 2019
DT1	100%	16.3	17.7	8.9	14.0	0.95	13.4	0.87	10.6
DT2	100%	24.6	28.5	18.8	23.6		22.5	0.87	17.9
DT3	100%	24.6	26.1	21.6	23.9		22.8	0.87	18.1
DT4	33%	26.9	na	na	0.0		na	0.74	na
DT5	100%	30.8	31.6	24.4	28.7		27.3	0.87	21.7
DT6	100%	19.4	22.5	13.9	18.3		17.4	0.87	13.9
DT7	0%	na	na	na	na		na	na	na
DT8	33%	na	33.7	na	na		na	0.84	na
DT9	67%	na	21.2	16.1	na		na	0.92	na
DT10	100%	30.0	29.4	24.0	27.6		26.3	0.88	21.0

Appendix B. Dispersion Model Verification and Adjustment

B.1 Introduction

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification', which is typically used for road traffic related assessments. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and / or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancies:

- estimates of background pollutant concentrations;
- meteorological data uncertainties;
- traffic data uncertainties;
- model input parameters such as 'roughness length'; and
- overall limitations of the dispersion model

B.2 Model precision

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period.

Monitoring data considered for the purpose of verification, for concentrations of NO_2 at the locations, are shown in the Figure 1.

B.3 Model performance

An evaluation of model performance has been undertaken to establish confidence in the model results. Local Air Quality Management Technical Guidance (hereafter referred to as LAQM.TG(16) (Defra, 2021a)) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess uncertainty. The statistical parameters used in this assessment are:

- root mean square error (RMSE);
- fractional bias (FB); and
- correlation coefficient (CC).

A brief for explanation of each statistic is provided in Table B-1, and further details can be found in LAQM.TG (16) (Defra, 2021a) Box A7.17.

Table B-1: Statistical Parameters

Statistical Parameter	Comments	Ideal Value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25 % of the objective being assessed, it is recommended that the model inputs and verification should be revisited to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40 µg/m³, if an RMSE of 10 µg/m³ or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10 % of the air quality objective would be derived, which equates to 4 µg/m³ for the annual mean NO_2 objective.	< 4.0
FB	FB is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.0
CC	CC is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.0

These parameters estimate how the model results agree or diverge from the observations.

These calculations have been carried out prior to, and after, adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

The verification process involves a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model has performed. Depending on the outcome it may be considered that the model has performed adequately and that there is no need to adjust any of the modelled results (LAQM.TG(16) (Defra 2021a)).

Alternatively, the model may not perform well against the monitoring data, in which case there is a need to check all the input data to ensure that it is reasonable and accurately represented by the air quality modelling process. Where all input data, such as traffic data, emissions rates and background concentrations have been checked and considered reasonable, then the modelled results may require adjustment to improve alignment with the monitoring data. This adjustment may be made either by using a single verification adjustment factor (to be applied to the modelled concentrations across the assessment area) or a range of different adjustment factors to account for different situations in the assessment area.

This assessment uses only one adjustment factor for one zone as opposed to multiple zones and adjustment factors which were used in the previous assessment, due to changes in the base year traffic data.

B.4 Air Quality Monitoring Data

The air quality monitoring data collected as part of this assessment (i.e. the site specific survey) as set out in Appendix A were reviewed to determine the suitability of the monitoring locations for inclusion in the model verification process. The criteria used to determine the suitability of the monitoring data for inclusion into the verification process were:

- the monitoring site was at a roadside or near to a road location within the air quality assessment area;
- the exact location of the monitoring site could be accurately identified;
- data capture was greater than 75 % in the relevant year;
- the monitoring site was not influenced by substantial road or other emission sources for which data were not available in the traffic model, and hence could not be included in the dispersion model;
- the monitoring site was not influenced by any factors considered to have the potential to have a substantial influence on the dispersion of emissions affecting that location, and which could not be accurately accounted for within the modelling process (e.g. elevated road sections or sections of road in a cutting, or walls / barriers / overhanging vegetation or dense vegetation between the monitoring site and the nearest road traffic emission source);
- the monitoring site was not affected by local emission sources (e.g. from a petrol station, bus station, car park or buses accelerating from a bus stop).

The monitoring sites considered for the verification process are shown on Figure B-2. Sites considered to be unsuitable for the purpose of model verification and excluded from the process are presented in Table B-2.

Table B-2: Monitoring Sites Excluded from Verification Consideration

Site ID / Name	Local Authority	Location		Annual Mean NO_2 concentration (µg/m^3)	Included or Reason for Exclusion
		X	Y		
DT4	DCC	420713	530067	0.0	Data Capture <75%
DT7	DCC	420954	529900	0.0	Difussion Tube stolen
DT8	DCC	420927	529767	0.0	Data Capture <75%
DT9	DCC	421075	529626	0.0	Data Capture <75%

B.5 Verification Methodology – NO_x / NO_2

The verification methodology followed the process detailed in LAQM TG(16) (Defra, 2021a). Having reviewed the unadjusted modelled annual mean NO_2 with the monitored NO_2 (i.e. which indicated that modelling adjusted with necessary) a comparison was made between the modelled and monitored contribution from road traffic sources (Road NO_x). Road NO_x contributions at the diffusion tube sites were calculated using the latest Defra NO_x to NO_2 Calculator (Defra, 2020a), because diffusion tubes only measure total NO_2, from which Road NO_x needs to be estimated having first subtracted background NO_2 concentrations.

Once the modelled Road NO_x component had been adjusted within the relevant verification group, this value was used in the Defra NO_x to NO_2 Calculator (Defra, 2020a), and the calculated Road NO_2 component was adjusted following comparison with the monitored Road NO_2.

The non-adjusted modelled versus monitored NO_2 concentrations are presented in Table B-3.

Table B-3: Monitored and Modelled NO_2 Concentrations

Monitor ID	Monitored annual mean NO_2 ($\mu g/m^3$)	Unadjusted modelled annual mean NO_2 ($\mu g/m^3$)	Percentage Difference (%)	Adjusted modelled annual mean NO_2 ($\mu g/m^3$)	Percentage Difference (%)
DT1[10]	10.6	9.8 (-0.9)	-8%	-	-
DT2	17.9	12.0 (5.9)	-33%	17.4	-2.6
DT3	18.1	13.7 (-4.4)	-24%	21.3	17.5
DT5	21.7	12.9 (-8.9)	-41%	17.3	-20.4
DT6	13.9	12.4 (-1.5)	-11%	16.3	17.3
DT10	21.0	13.5 (-7.6)	-36%	19.0	-10.0

The initial comparison between the predicted (unadjusted) concentrations and monitoring data illustrates that the model tends to under-predict NO_2 concentrations over the modelled area.

Model adjustment was, therefore, undertaken in accordance with LAQM.TG(16) (Defra, 2021a). Data was collected from a number of suitable diffusion tube monitoring sites in the vicinity of both scenarios SC1 and SC2.

The results suggested that the model was generally under-predicting road NO_x concentrations but less so for diffusion tube (DT1), where modelled and measured concentrations were well aligned. The ratio between monitored and modelled road NO_x was 2.29, where model was under-predicting, and 1.0 where model was well aligned. Adjusted modelled versus monitored total NO_2 concentrations are also presented in Table B-3.

B.6 Verification Summary – NO_x /NO_2

A review was undertaken of the monitored versus modelled performance across the whole assessment area. The summary results and model performance statistics defined in LAQM.TG(16) (Defra, 2021a) are provided in

[10] Note that DT1 was not included in the adjustment of road NOx at all receptors. No adjustment was made to results in the vicinity of DT1 as agreement was with 10% in accordance with LAQM TG16 guidance (Defra, 2021a) Box 7-17.

Table B-4.

Table B-4: Model Performance Statistics

Summary table	No adjustment	NO_x adjustment
Within +10%	0	0
Within -10%	0	2
Within +-10%	0	2
Within +10 to 25%	0	2
Within -10 to 25%	2	1
Within +-10 to 25%	2	3
Over +25%	0	0
Under -25%	3	0
Greater +-25%	3	0
Within +-25%	2	5
Adjustment factors		
NO_x road adjustment	-	2.295
Uncertainties assessment		
Correlation	0.439	0.296
RMSE (µg/m^3)	6.19	2.83
Fractional bias	0.36	0.02

A comparison of the performance of the modelled concentrations from the air quality model against the monitoring data was undertaken. The results show that two verification results deviate by less than +/-10% between the modelled and monitored concentrations. The model performance statistics show that the uncertainty in the predictions of adjusted total NO_2 was acceptable as the RMSE is within 25% or Ideally 10% of the AQO being assessed (i.e. less than 10 µg/m^3 or 4 µg/m^3 respectively) and reduced post-verification for the study area. In the absence of PM_{10} and or $PM_{2.5}$ continuous monitoring the same adjustment factors derived for road NO_X was also applied to primary particulates. This is in accordance with LAQM TG16 guidance (Defra, 2021a) paragraph 7.570 onwards.

The statistics support the methodology adopted. The statistics show that the RMSE, FB and CC are improved when adjustments of 2.295 and 1.0 are applied.

No verification factors have been derived for PM_{10} and $PM_{2.5}$.

B.7 Prediction of Environmental Concentrations Including Adjustment for Long Term Trends in NO_2

In July 2011, Defra published a report (Defra, 2011) examining the long-term air quality trends in NO_x and NO_2 concentrations. This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter NO_2 concentrations have stabilised with little to no reduction between 2004 and 2012. The consequence of the conclusions of Defra's advice on long-term trends was that there is a gap between the then projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality, which are built into the vehicle emission factors, the projected background maps and the NO_x to NO_2 calculator.

Highways England developed the Gap Analysis methodology to adjust model predictions based on the method in LAQM TG(16) (Defra, 2021a) to account for the long-term NO_x and NO_2 profiles. This uses the relationship between the base year vehicle emission rates and the opening year vehicle emission rates, and the measured trends in roadside air quality concentrations to uplift opening year predicted concentrations to align them better with the Long-Term Trends (LTT) of NO_x and NO_2. These trends are updated periodically and typically reviewed annually against monitoring data.

The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. New vehicles need to comply with the more stringent Euro 6/VI emissions standards from September 2014 onwards. If the Euro 6/VI fleet emissions perform as predicted, then this should lead to substantial reductions in predicted future roadside air quality concentrations.

However, because the likely effects of Euro 6/VI vehicles on air quality are yet to be fully understood, a conservative approach of applying Highways England's LTT has been applied to the modelling results. These LTT assume a projected rate of decrease into the future based on past monitoring trends.

The gap analysis methodology, as set out in National Highways DMRB LA 105 (Highways England, 2019), incorporates the Euro 6/VI improvements. These LTT projection factors are referred to as 'LTTE6'. The LTTE6 factors assume that the measured trends from 2004 to 2012 continue to occur for all pre-Euro 6/VI fleet. They also take a precautionary approach to account for uncertainty associated with Euro 6/VI performance and fleet mix in the future, rather than assuming full reductions in emissions occur as predicted by Euro 6/VI, which has not been observed by air quality monitoring trends associated with recent Euro standards. This is implemented into LTTE6 by taking the mid-point between the measured trend predictions (which assume no improvement in emissions associated with Euro 6/VI) and predicted Euro 6/VI uptake and emission improvements.

On this basis, the LTTE6 projections are considered to be the most reasonable prediction of likely actual future NO_x and NO_2 concentrations, though application of these may lead to slight over prediction (worst-case), and have been used in the calculations for this assessment.

As per DMRB LA 105 (Highways England, 2019), the gap analysis methodology was not applied to modelled compliance risk locations, so the assessment is consistent with Defra's reporting on compliance with the EU limit values.

The gap analysis method is not required to be applied to PM_{10} and $PM_{2.5}$ predictions, as there is less uncertainty in future year concentrations of these pollutants, and the results based on the LAQM TG(16) (Defra, 2021a) method are the final predicted concentrations throughout the assessment.

Appendix C. Additional Dispersion Modelling Parameters

C.1 Modelling Parameters

C.1.1 Road Parameters

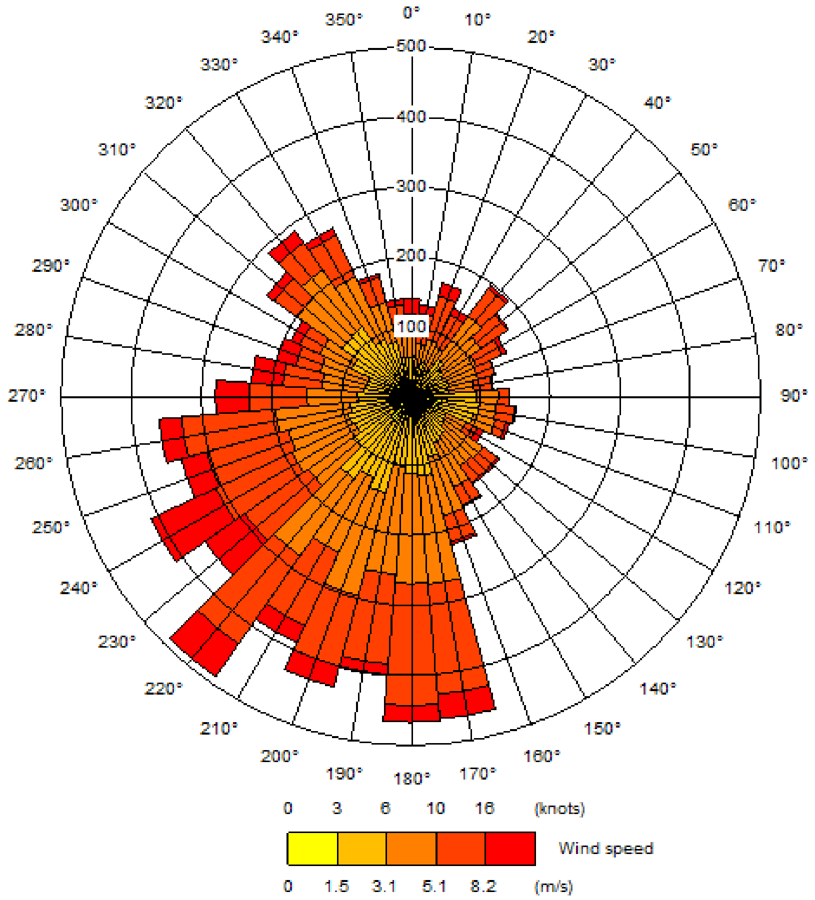
The ADMS-Roads model requires lengths of road of equal width (and height if specified as a canyon) to be input into the model. Road alignment and width were determined using the Ordnance Survey Mastermap (Ordnance Survey, 2022) base mapping within ArcGIS.

C.1.2 Meteorological Data

In order to assess the impact of the both scenarios SC1 and SC2 upon local air quality using a dispersion model, it is important to use representative meteorological data. In simple terms, meteorology is the next most significant factor in determining ambient pollutant levels after emissions.

The nearest and most representative meteorological data site to the study area was Durham Tees Valley Airport. Data from this site for 2019 (the modelled base year) were therefore used in the modelling. The Windrose from Durham Tees Valley Airport for 2019 is shown in Illustration 1.

Illustration 1: Wind rose Durham Tees Valley Airport meteorological station, 2019



C.1.3 Surface Roughness Length

The surface roughness used in this assessment was 0.5m, which is appropriate for an area where the local land-use is categorised as mainly suburban.

C.1.4 Monin-Obukhov Length

ADMS-Roads Models use the Monin-Obukhov length as a parameter to describe the turbulent length scale which is dependent on meteorological conditions. A minimum length can be used to account for the urban heat island effect, whereby retained heat in cities causes convective turbulence, which prevents the formation of a very shallow boundary layer at night. A minimum Monin-Obukhov length of 10m was set as very small area/small town was modelled.

C.1.5 Terrain

Terrain has an effect on the flow field in the air above it. It is recommended that the effect of terrain is incorporated into the ADMS-Roads model where gradients of greater than 1:10 exist within the modelled area, or a short way outside of it. No substantial gradients were identified in the air quality assessment area in the vicinity of the roads (i.e. the roads and locations were close enough not to have a significant change in terrain and therefore terrain has not been accounted for in the air quality modelling).

C.1.6 Street Canyons

‘Street canyons’ in air quality modelling are roads with continuous high buildings on either side. This arrangement tends to impede the dispersion of pollutants from the road, particularly when the wind is at right angles to it, since a vortex is created in the street canyon, entraining the pollution.

No road links in the assessment area were considered as being “street canyons”. Newgate Street might possibly have been included however this street had relatively low traffic flows. The receptor for the modelling assessment was placed at 1.5m as opposed to higher up above the shops where relative exposure may occur. On this basis, the results at this location were conservative. This feature was therefore not included within the modelling assessment.

C.2 Modelled Receptor Locations

C.2.1 Human Health

The ADMS-Roads model is used to predict the road traffic contributions to NO_x concentrations at specified sensitive human locations to determine the potential impact on human health. The modelled concentrations of PM_{10} and $PM_{2.5}$ are then combined with background concentrations, whilst modelled Road-NO_x and background NO_2 are converted to total NO_2, using the Defra NO_x to NO_2 conversion tool (Defra, 2020a).

A total of 38 representative locations were included in the assessment. The locations selected for the modelling of road traffic emissions were positioned to represent the façade of the property or the ecological asset closest to the nearest road in order to provide an estimate of the maximum pollutant concentrations to which that location would potentially experience. The modelled locations are set out in Table C-1 and presented in Figure 3.

Two verification factors were applied as mentioned in Section B5 in Appendix B. There are two receptors when verification factor of 1.0 was applied (R6 and R7). Other receptors had their verification factor of 2.295 set.

Table C-1: Human Health Receptor Locations

Receptor ID	X	Y	Property Use	Verification Zone
R1	421508	528668	Residential	2
R2	422151	529066	Residential	2
R3	422848	529794	Residential	2
R4	422745	529733	Residential	2
R5	422736	529768	Residential	2
R6	421486	529913	Residential	1
R7	421465	529879	Residential	1
R8	421274	530103	Residential	2
R9	421256	530096	Residential	2
R10	421174	530151	Residential	2
R11	421061	530134	Nursery	2
R12	420869	530064	Residential	2
R13	420842	530066	Residential	2
R14	420760	529996	Residential	2
R15	420734	529984	Residential	2
R16	420701	529972	Residential	2
R17	420717	530016	Residential	2
R18	420684	529967	Carehome	2
R19	420568	529729	Residential	2
R20	420576	529709	Residential	2
R21	420935	529655	Residential	2
R22	420757	529938	Residential	2
R23	420894	529791	Residential	2
R24	420993	529639	Residential	2
R25	421084	529645	Residential	2
R26	421145	529842	Residential	2
R27	421162	529978	Residential	2
R28	421043	529915	Residential	2
R29	420982	529895	Residential	2
R30	420932	529901	Residential	2
R31	420966	529906	Residential	2
R32	421161	530160	Residential	2
R33	421037	530114	Residential	2
R34	420687	529679	Residential	2
R35	420940	529642	Residential	2
R36	421108	529684	Residential	2

R37	421076	529872	Residential	2
R38	421046	529659	Residential	2

C.2.2 Designated Habitats

The assessment compares the future baseline situation (DN) and the future situation with the proposed scenarios SC1 and SC2, including hospital traffic for nitrogen deposition.

One designated transect point (within 200 m of affected road links) was considered in the this assessment shown in Table C-2 and in Figure 3.

Modelled NO_2 concentrations were converted to nitrogen deposition concentrations using the methodologies presented in LA105 (Highways England, 2019), which is based on the Air Quality Technical Advisory Group (AQTAG) guidance note: AQTAG 06 “Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air” (AQTAG, 2014).

Information on the existing nitrogen deposition was obtained from the APIS database (Centre for Ecology and Hydrology, 2021). Information on the deposition critical load for the assessed habitate was also obtained from the APIS database using the Site Relevant Critical Load function and the Search by location functions.

The annual dry deposition flux (kg N/ha/yr) can be obtained by multiplying the modelled annual average ground level NO_2 concentration (µg/m^3) with the following:

- grassland and short vegetation: 0.14 kg N/ha/yr; or
- forest, woodland (tall vegetation): 0.29 kg N/ha/yr.

Table C-2: Designated Habitats Receptor Locations

Receptor ID	Designated Habitat	Distance to nearest Affected Road Link (m)	Model ID	Location (m)	
				X	Y
ECO1	Bracks Wood (Ancient Woodland)	190m	ECO1	422089	529243

C.2.3 Compliance Risk Assessment

In accordance with PCM (Pollution Climate Mapping) model projections of NO_2 across the UK the risk of noncompliance at Census IDs in the opening year 2024, within the study assessment area, were considered very low. On this basis the further assessment of PCM receptors were scoped out.

Appendix D. Air Quality Modelling Results

D.1 Human Health

The results of the dispersion modelling at the 37 human health receptors included in the assessment are shown in the tables below. All results have had the verification factor applied. The annual mean NO_2 results have also had the long-terms treads adjustment applied.

As discussed in Section 3.4.5 two options have been modelled:

1. DM Scenario 1
2. DS Scenario 2

Results of NO_2 modelling are shown in Table D-1 (DN-DM) .

Table D-1: Annual Mean Nitrogen Dioxide for Scenario

Receptor ID	Annual Mean NO_2 Concentration (µg/m³)					DM-DN (SC1)	DS-DN (S2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2019	Projected Base	DN 2024	DM (SC1) 2024	DS (S2) 2024					
R1	14.3	10.9	12.8	12.7	10.6	-0.1	-0.1	-0.1	31.7	Negligible
R2	15.2	11.2	13.5	13.5	12.7	0.0	0.0	0.0	33.7	Negligible
R3	19.2	13.8	17.1	16.9	13.4	-0.2	-0.2	-0.6	42.2	Negligible
R4	17.3	12.6	15.4	15.3	13.0	-0.2	-0.2	-0.5	38.2	Negligible
R5	17.7	12.9	15.8	15.6	13.1	-0.2	-0.2	-0.4	39.1	Negligible
R6	11.8	9.3	10.4	10.4	10.0	0.0	0.0	0.0	26.0	Negligible
R7	11.5	9.1	10.1	10.1	9.9	0.0	0.0	0.1	25.3	Negligible
R8	14.0	10.5	12.3	12.2	10.1	-0.2	-0.2	-0.4	30.4	Negligible
R9	14.1	10.5	12.4	12.3	10.1	-0.1	-0.1	-0.4	30.7	Negligible
R10	13.6	10.2	12.0	12.0	10.1	0.1	0.1	0.1	30.0	Negligible
R11	17.5	12.7	15.4	16.1	11.0	0.7	0.7	1.8	40.4	Negligible
R12	16.7	12.1	14.7	15.0	11.1	0.2	0.2	0.6	37.4	Negligible
R13	15.8	11.6	14.0	14.0	10.9	0.0	0.0	0.1	35.0	Negligible
R14	21.2	15.3	18.7	18.6	11.5	-0.1	-0.1	-0.3	46.5	Negligible
R15	18.0	13.3	15.9	15.8	10.7	-0.1	-0.1	-0.4	39.4	Negligible
R16	18.9	13.9	16.7	16.3	10.7	-0.4	-0.4	-1.0	40.7	Negligible
R17	18.5	13.3	16.4	16.1	11.4	-0.3	-0.3	-0.7	40.2	Negligible
R18	15.8	11.9	13.9	13.7	10.2	-0.2	-0.2	-0.6	34.3	Negligible
R19	16.2	12.2	14.3	14.1	10.4	-0.2	-0.2	-0.6	35.3	Negligible

[11] Concentrations are considered as absolute value of the DS (SC2).

Receptor ID	Annual Mean NO_2 Concentration (μg/m³)					DM-DN (SC1)	DS-DN (S2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2019	Projected Base	DN 2024	DM (SC1) 2024	DS (S2) 2024					
R20	17.0	12.6	14.9	14.7	10.7	-0.2	-0.2	-0.6	36.8	Negligible
R21	17.3	12.9	15.2	15.0	10.8	-0.2	-0.2	-0.6	37.5	Negligible
R22	14.6	11.1	12.8	12.8	10.1	-0.1	-0.1	-0.2	31.9	Negligible
R23	16.4	12.2	14.4	14.3	10.4	-0.1	-0.1	-0.2	35.8	Negligible
R24	19.7	14.4	17.4	17.0	11.2	-0.4	-0.4	-0.9	42.5	Negligible
R25	20.6	14.9	18.2	18.0	11.5	-0.3	-0.3	-0.7	44.9	Negligible
R26	18.6	13.6	16.3	16.1	11.5	-0.2	-0.2	-0.5	40.3	Negligible
R27	14.9	11.3	13.2	13.0	10.7	-0.1	-0.1	-0.3	32.6	Negligible
R28	12.0	9.4	10.6	10.6	10.1	0.0	0.0	0.1	26.5	Negligible
R29	13.4	10.4	11.8	11.9	9.8	0.1	0.1	0.2	29.8	Negligible
R30	13.6	10.5	12.0	12.0	9.9	0.0	0.0	0.0	30.0	Negligible
R31	13.2	10.2	11.7	11.7	9.8	0.1	0.1	0.1	29.3	Negligible
R32	16.8	12.3	14.8	14.9	10.8	0.1	0.1	0.2	37.3	Negligible
R33	15.3	11.3	13.5	14.0	10.5	0.5	0.5	1.4	35.1	Negligible
R34	13.3	10.3	11.7	11.6	10.0	-0.1	-0.1	-0.2	29.0	Negligible
R35	15.8	11.9	13.9	13.7	10.5	-0.2	-0.2	-0.5	34.3	Negligible
R36	17.8	13.1	15.7	15.3	11.0	-0.4	-0.4	-1.0	38.2	Negligible
R37	12.8	9.9	11.3	11.3	10.2	0.0	0.0	0.0	28.1	Negligible
R38	20.5	14.8	18.1	17.9	11.6	-0.1	-0.1	-0.3	44.9	Negligible

Concentrations of PM_{10} (Table D-3) and $PM_{2.5}$ (

Table D1) have been modelled. The annual mean PM_{10} and $PM_{2.5}$ results have also had the backgrounds applied.

Table D-3: Annual Mean of PM_{10}

Receptor ID	Annual Mean PM_{10} Concentration (μg/m³)				DM-DN (SC1)	DS-DM (SC2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2018	DN 2024	DM (SC1) 2024	DS (SC2) 2024					
R1	11.3	10.6	10.6	10.6	0.0	0.0	0.0	26.5	Negligible
R2	13.3	12.7	12.6	12.7	-0.1	0.0	0.0	31.8	Negligible
R3	14.0	13.4	13.3	13.4	-0.1	0.0	0.0	33.5	Negligible
R4	13.6	13.0	13.0	13.0	0.0	0.0	0.0	32.5	Negligible

Receptor ID	Annual Mean PM_{10} Concentration (μg/m^3)				DM-DN (SC1)	DS-DM (SC2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2018	DN 2024	DM (SC1) 2024	DS (SC2) 2024					
R5	13.8	13.1	13.1	13.1	0.0	0.0	0.0	32.8	Negligible
R6	10.6	10.0	10.0	10.0	0.0	0.0	0.0	25.0	Negligible
R7	10.5	9.9	9.9	9.9	0.0	0.0	0.0	24.8	Negligible
R8	10.8	10.2	10.1	10.1	-0.1	-0.1	-0.2	25.3	Negligible
R9	10.8	10.2	10.2	10.1	0.0	-0.1	-0.2	25.3	Negligible
R10	10.7	10.1	10.1	10.1	0.0	0.0	0.0	25.3	Negligible
R11	11.5	10.9	11.1	11.0	0.2	0.1	0.2	27.5	Negligible
R12	11.7	11.1	11.2	11.1	0.1	0.0	0.0	27.8	Negligible
R13	11.5	10.9	10.9	10.9	0.0	0.0	0.0	27.3	Negligible
R14	12.0	11.4	11.3	11.5	-0.1	0.1	0.2	28.8	Negligible
R15	11.4	10.7	10.7	10.7	0.0	0.0	0.0	26.8	Negligible
R16	11.6	10.9	10.8	10.7	-0.1	-0.2	-0.5	26.8	Negligible
R17	12.0	11.4	11.3	11.4	-0.1	0.0	0.0	28.5	Negligible
R18	11.0	10.3	10.3	10.2	0.0	-0.1	-0.3	25.5	Negligible
R19	11.1	10.5	10.4	10.4	-0.1	-0.1	-0.2	26.0	Negligible
R20	11.2	10.6	10.5	10.7	-0.1	0.1	0.2	26.8	Negligible
R21	11.3	10.6	10.6	10.8	0.0	0.2	0.5	27.0	Negligible
R22	10.7	10.1	10.1	10.1	0.0	0.0	0.0	25.3	Negligible
R23	11.1	10.5	10.4	10.4	-0.1	-0.1	-0.2	26.0	Negligible
R24	11.7	11.0	10.9	11.2	-0.1	0.2	0.5	28.0	Negligible
R25	12.0	11.4	11.4	11.5	0.0	0.1	0.2	28.8	Negligible
R26	11.9	11.2	11.2	11.5	0.0	0.3	0.8	28.8	Negligible
R27	11.1	10.5	10.5	10.7	0.0	0.2	0.5	26.8	Negligible
R28	10.6	9.9	10.0	10.1	0.1	0.2	0.5	25.3	Negligible
R29	10.5	9.9	9.9	9.8	0.0	-0.1	-0.2	24.5	Negligible
R30	10.5	9.9	9.9	9.9	0.0	0.0	0.0	24.8	Negligible
R31	10.5	9.9	9.9	9.8	0.0	-0.1	-0.2	24.5	Negligible
R32	11.3	10.7	10.8	10.8	0.1	0.1	0.3	27.0	Negligible
R33	11.0	10.4	10.6	10.5	0.2	0.1	0.2	26.3	Negligible
R34	10.5	9.9	9.8	10.0	-0.1	0.1	0.2	25.0	Negligible
R35	11.0	10.3	10.3	10.5	0.0	0.2	0.5	26.3	Negligible
R36	11.5	10.9	10.8	11.0	-0.1	0.1	0.2	27.5	Negligible
R37	10.7	10.1	10.1	10.2	0.0	0.1	0.2	25.5	Negligible
R38	12.0	11.3	11.3	11.6	0.0	0.3	0.7	29.0	Negligible

Table D1: Annual Mean of $PM_{2.5}$

Receptor ID	Annual Mean NO_2 Concentration ($\mu g/m^3$)				DM-DN (SC1)	DS-DM (SC2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2018	DN 2024	DM 2024	DS 2024					
R1	7.0	6.5	6.5	6.5	0.0	0.0	0.0	32.5	Negligible
R2	7.5	7.0	7.0	7.0	0.0	0.0	0.0	35.0	Negligible
R3	8.0	7.4	7.4	7.4	0.0	0.0	0.0	37.0	Negligible
R4	7.7	7.2	7.2	7.2	0.0	0.0	0.0	36.0	Negligible
R5	7.8	7.3	7.3	7.3	0.0	0.0	0.0	36.5	Negligible
R6	6.6	6.1	6.1	6.1	0.0	0.0	0.0	30.5	Negligible
R7	6.6	6.1	6.1	6.1	0.0	0.0	0.0	30.5	Negligible
R8	6.6	6.2	6.1	6.1	-0.1	-0.1	-0.5	30.5	Negligible
R9	6.7	6.2	6.2	6.1	0.0	-0.1	-0.5	30.5	Negligible
R10	6.6	6.1	6.1	6.1	0.0	0.0	0.0	30.5	Negligible
R11	7.1	6.6	6.7	6.6	0.1	0.0	0.0	33.0	Negligible
R12	7.1	6.6	6.6	6.6	0.0	0.0	0.0	33.0	Negligible
R13	7.0	6.5	6.5	6.5	0.0	0.0	0.0	32.5	Negligible
R14	7.6	7.1	7.0	7.1	-0.1	0.0	0.0	35.5	Negligible
R15	7.2	6.7	6.7	6.7	0.0	0.0	0.0	33.5	Negligible
R16	7.3	6.8	6.8	6.7	0.0	-0.1	-0.5	33.5	Negligible
R17	7.3	6.8	6.7	6.7	-0.1	-0.1	-0.5	33.5	Negligible
R18	7.0	6.5	6.5	6.4	0.0	-0.1	-0.5	32.0	Negligible
R19	7.1	6.5	6.5	6.5	0.0	0.0	0.0	32.5	Negligible
R20	7.1	6.6	6.6	6.7	0.0	0.1	0.5	33.5	Negligible
R21	7.2	6.6	6.6	6.8	0.0	0.2	1.0	34.0	Negligible
R22	6.8	6.3	6.3	6.4	0.0	0.1	0.5	32.0	Negligible
R23	7.1	6.5	6.5	6.5	0.0	0.0	0.0	32.5	Negligible
R24	7.4	6.9	6.8	6.9	-0.1	0.0	0.0	34.5	Negligible
R25	7.5	6.9	6.9	7.0	0.0	0.1	0.5	35.0	Negligible
R26	7.4	6.8	6.8	7.0	0.0	0.2	1.0	35.0	Negligible
R27	6.9	6.4	6.4	6.6	0.0	0.2	1.0	33.0	Negligible
R28	6.6	6.1	6.1	6.2	0.0	0.1	0.5	31.0	Negligible
R29	6.7	6.2	6.2	6.2	0.0	0.0	0.0	31.0	Negligible
R30	6.7	6.3	6.3	6.2	0.0	-0.1	-0.5	31.0	Negligible
R31	6.7	6.2	6.2	6.2	0.0	0.0	0.0	31.0	Negligible
R32	7.0	6.5	6.5	6.5	0.0	0.0	0.0	32.5	Negligible
R33	6.8	6.3	6.4	6.4	0.1	0.1	0.5	32.0	Negligible

Receptor ID	Annual Mean NO_2 Concentration (µg/m^3)				DM-DN (SC1)	DS-DM (SC2)	Percentage of Change (%)	Concentration as percentage (%) of the AQO[11]	Magnitude of Change
	Base 2018	DN 2024	DM 2024	DS 2024					
R34	6.7	6.2	6.2	6.3	0.0	0.1	0.5	31.5	Negligible
R35	7.0	6.5	6.5	6.6	0.0	0.1	0.5	33.0	Negligible
R36	7.2	6.6	6.6	6.7	0.0	0.1	0.5	33.5	Negligible
R37	6.7	6.2	6.2	6.3	0.0	0.1	0.5	31.5	Negligible
R38	7.5	6.9	6.9	7.1	0.0	0.2	1.0	35.5	Negligible

D.2 Designated Sites

The results of the dispersion modelling at the one designated habitat, included in the assessment, is shown in the table below. All results have had the verification factor and the long-terms treads adjustment applied.

Similarly to Human Health receptors, ecological receptors have been modelled in two options: DN-DM (Table D-2) and DN-DS (Table D-3).

Table D-2: Designated Habitats Results: Annual Mean NOx (DN-DM)

Receptor ID	Designated Habitat	Distance to nearest Affected Road Link (m)	Annual Mean NO_x Concentration (µg/m^3)						Concentration as percentage (%) of the AQO[11]	Magnitude of Change
			Base 2019	Projected Base	DN 2024	DM 2024	DN-DM	% of AQO		
ECO1	Bracks Wood (Ancient Woodland)	190m	13.7	10.7	11.3	11.3	0.0	-0.1	28.3	Negligible

Table D-3: Designated Habitats Results: Annual Mean NOx (DN-DS)

Receptor ID	Designated Habitat	Distance to nearest Affected Road Link (m)	Annual Mean NO_x Concentration (µg/m^3)						Concentration as percentage (%) of the AQO[11]	Magnitude of Change
			Base 2019	Projected Base	DN 2024	DS 2024	DN-DS	% of AQO		
ECO1	Bracks Wood (Ancient Woodland)	190m	13.7	10.7	11.3	11.3	0.0	-0.1	28.3	Negligible

D.3 Deposition Results

The results of the deposition assessment at the one designated habitat included in the assessment are shown in the table below. All results are based on the annual mean NO_2 concentrations, derived from the NO_x concentrations presented in Table D-4.

Table D-4 Designated Habitats Results: Nitrogen Deposition for scenario DN-DM and DN-DS

Receptor ID	Ecological Transect	Distance to nearest ARN road link (m)	APIS data - Average Total N Deposition (kgN/ha/yr)	Total Deposition rate (kgN/ha/yr)		Change in Nitrogen Deposition (Future Year-DN) (kg N/ha/yr)	Critical Load range minimum (kgN/ha/yr)	DS-DM (%) PC/CLmin
				DN	Future Year			
Scenario DN-DM								
ECO1	Bracks Wood AW	190m	28.7	29.3	29.3	-0.003	10	0.0
Scenario DN-DS								
ECO1	Bracks Wood AW	190m	28.7	29.3	29.3	-0.003	10	0.0

Appendix E. Construction Dust Risk Assessment

E.1 Introduction

Emissions of dust to air can occur from works associated with the preparation of land (e.g. demolition, land clearing or grading, earth moving and excavation) and during construction. This report sets out the assessment of dust which could potentially be emitted to air from construction activities associated with the proposed Bishop Auckland bus station and multi-storey car park (hereafter referred to as 'the Proposed Scheme').

This appendix supports the Air Quality Assessment for the Proposed Scheme and outlines a procedure developed by the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction (IAQM, 2016) (hereafter referred to as 'IAQM guidance') for the assessment of dust-related air quality impacts arising from construction activities.

This assessment is based on information available at the time of writing and may be subject to change as the final design details are developed. However, where required a precautionary approach has been taken and at this stage, it is considered that the information provided is sufficient to identify any likely impacts of dust emissions from activities associated with the construction of the Proposed Scheme.

Figure E1.1 shows the extent of the construction dust risk assessment study areas.

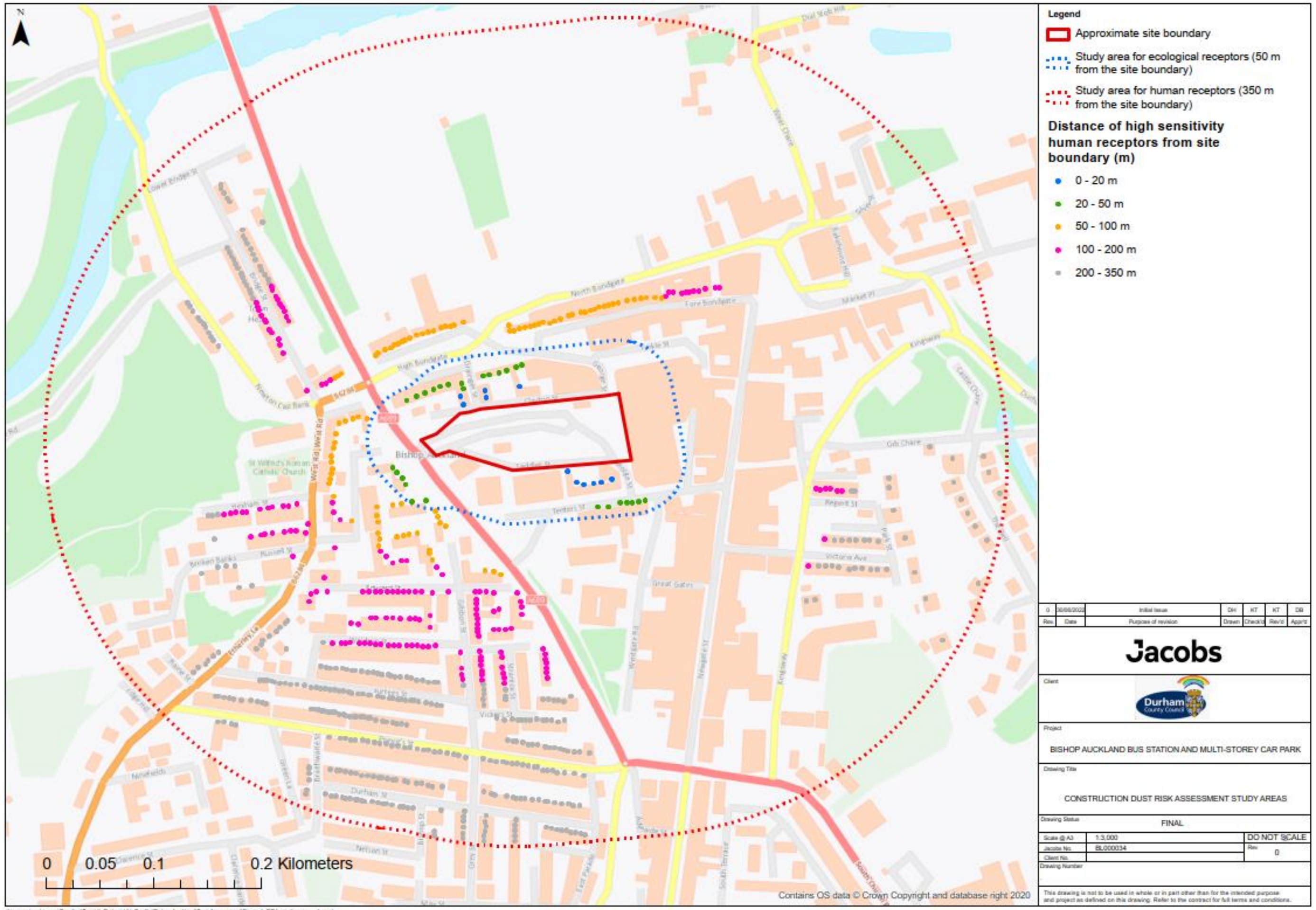


Figure E1.1 Dust Risk Assessment Areas.

E.2 Assessment Methodology

E.2.1 Introduction

Activities carried out on construction sites can give rise to emissions of dust that could cause annoyance or damage to vegetation due to the soiling of surfaces. These activities can also lead to increased short-term and long-term concentrations of fine particulate matter (e.g. PM10 and PM2.5)[12] at off-site locations which may affect human health, unless the appropriate mitigation measures are implemented. The impacts of dust emissions from works associated with the construction of the Proposed Scheme therefore need to be addressed in order to identify the required mitigation measures.

The assessment of dust during construction has been carried out using a qualitative risk-based appraisal with reference to the Proposed Scheme in relation to sensitive receptors, the planned process and site characteristics, as described in the IAQM guidance (IAQM, 2016).

Based on the IAQM guidance (IAQM, 2016), the assessment aims to estimate the impacts of both PM10 and dust together, through a combined risk-based assessment procedure. The IAQM guidance (IAQM, 2016) provides a methodological framework but notes that professional judgement is required throughout the assessment to determine the risk of impacts and mitigation requirements. Based on the calculated risk level, the IAQM guidance (IAQM, 2016) sets out clear requirements for the recommended mitigation measures, which can be used to lessen the impact of dust during the construction phase of the Proposed Scheme. These mitigation measures to control dust emissions would be included in the air quality management strategies set out in the Construction Environmental Management Plan (CEMP) or equivalent management plan that would be agreed with the relevant local planning authority and appointed contractor(s) prior to construction commencing.

It should be noted this assessment does not consider the air quality impacts of exposure to contaminated dust that could arise from the excavation of any contaminated material. Although PM2.5 is not specifically included as a parameter within the assessment, the risk levels associated with PM10 and any subsequent mitigation measures would also apply to PM2.5 as PM2.5 is included within the PM10 fraction.

Larger dust particles (greater than 30 µm) make up the greatest proportion of dust emission from mineral workings or earthworks and will largely deposit within 100 m of sources (Scottish Office, 1998). Intermediate sized particles (10 µm- 30 µm) are likely to travel further. PM10, including the smaller PM2.5 particulates are reported to make up a smaller proportion (approximately 10%) of dust emitted from most workings and the emissions become diluted as they disperse downwind (Ove Arup and Partners, 1995).

E.2.2 Potential sources of dust

The temporary and varied nature of construction or other activities which include similar emission sources differentiates them from other fugitive dust sources when it comes to the estimation and control of emissions. The activity usually consists of a series of different operations, each with its own duration and potential for dust generation. Dust emissions from any single site can be expected to have a definable beginning and end but would also vary between the same types of activities. On large sites, the location and scale of potentially dust-generating activities would also vary throughout the works.

There are potentially sensitive locations close to the site boundary of the Proposed Scheme (see Figure A1-1 Construction Dust Risk Assessment Study Areas), including residential properties and a nursery. Activities associated with construction of the Proposed Scheme have the potential to produce excessive emissions of dust that could be transported towards receptors by the wind. These receptors are close enough to the Proposed Scheme that without mitigation measures, they could perceive increases in the rate of dust deposition to property surfaces.

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12 PM10 refers to particles with an aerodynamic diameter of 10 microns or less and PM2.5 refers to particles with an aerodynamic diameter of 2.5 microns or less.

The key potential construction dust emission sources associated with these activities are summarised below. Where possible, these have been assigned into the four categories used for the IAQM dust assessment method (IAQM, 2016) (i.e. demolition, earthworks, construction and trackout13).

Demolition

Demolition activities include the removal of the existing bus station municipal building, toilet block, bus shelters, café building and associated infrastructure.

Earthworks

Earthworks activities include site preparation prior to the construction of the Proposed Scheme and excavation for the necessary foundations.

Construction

Activities include construction of the new bus station and multi-storey car park and associated infrastructure.

Trackout

Vehicles moving on and around the Proposed Scheme would emit exhaust particulate matter and re-suspend loose material on the compound platform surface. There would be the potential for spillage, from transferring material around the sites and from particulates being lifted from open container vehicles by the wind produced by the vehicle movement. Material tracked out on to the local road network on the wheels of site traffic could be re-suspended by passing traffic.

E.2.3 Baseline conditions

The assessment requires characterisation of the existing conditions regarding PM10 concentrations to determine the sensitivity of the area.

As part of the Local Air Quality Management (LAQM) process, Durham County Council carries out regular assessments and monitoring of air quality within its area. The most recent Air Quality Annual Status Report (Durham County Council, 2019) has been reviewed to determine the concentrations of PM10 in the vicinity of the site. However, Durham County Council do not monitor PM10 within their administrative borough.

Information on background air quality in the vicinity of the site has been obtained from Defra background map datasets (Defra, 2022). The 2018-based background maps by Defra are estimates based upon the principal local and regional sources of emissions and ambient monitoring data. The PM10 concentration obtained from the background map datasets is 9.4 µg/m3 which is the maximum PM10 concentration across the Proposed Scheme for 2022.

13 Trackout refers to the transport of dust and dirt from the sites onto the public road network, where it may be deposited and re-suspended by other vehicles using the road network.

E.3 IAQM Methodology

The methodology for the assessment of the construction impacts is based on a five-step approach as set out in Figure .

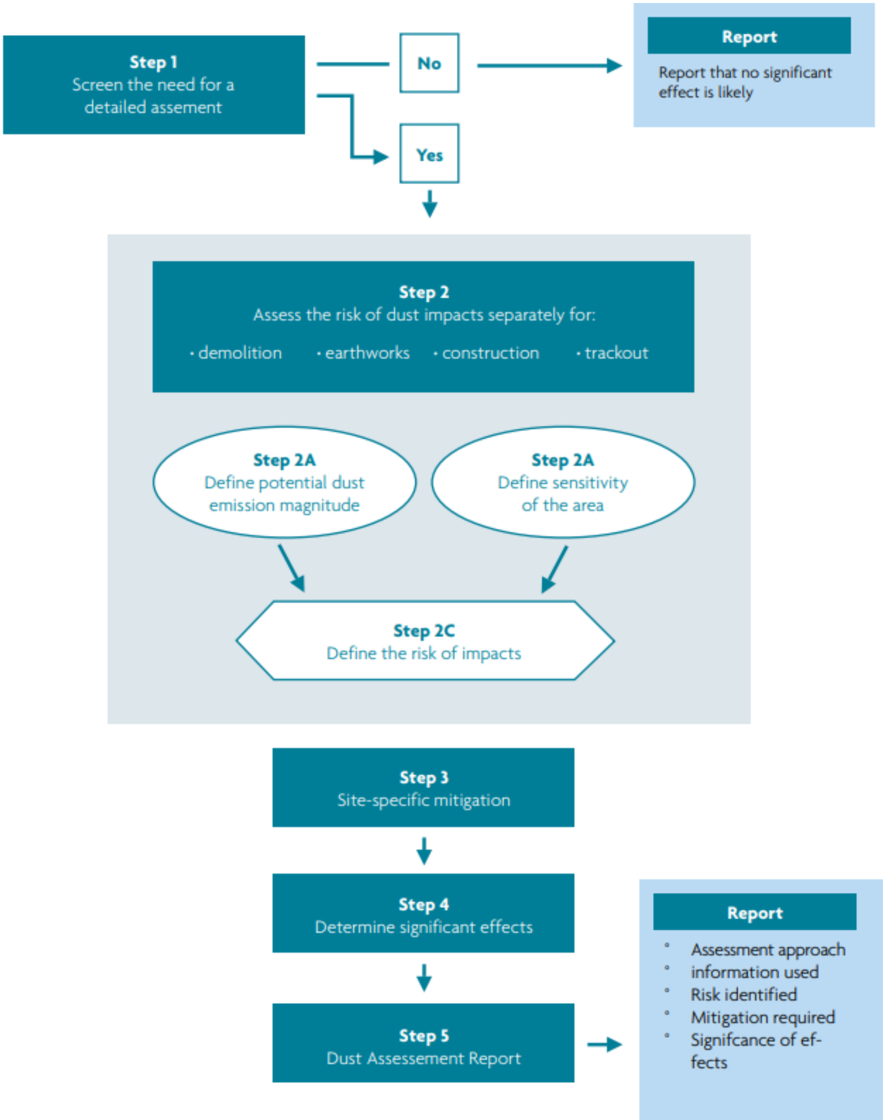

Figure E1.1 Structure of the dust risk assessment (IAQM, 2016)

E.3.1 Step 1 – Identify the need for a detailed assessment

An assessment would normally be required for a detailed assessment

A human receptor within 350 m of the Proposed Scheme boundary and/or within 50 m of the access route(s) used by construction vehicles on the public highway, up to 50 m from the Proposed Scheme site exit(s) for small sites, up to 200 m from the Proposed Scheme site exit(s) for medium sites and up to 500 m from the Proposed Scheme site exit(s) for large sites; and/or

An ecological receptor within 50 m of the Proposed Scheme boundary and/or within 50 m of the access route(s) used by construction vehicles on the public highway, up to 50 m from the Proposed Scheme site exit(s) for small sites, up to 200 m from the Proposed Scheme site exit (s) for medium sites and up to 500 m from the Proposed Scheme site exit(s) for large sites.

The requirement for a dust risk assessment can be screened out where the above criteria are not met, therefore it can be concluded that the level of risk is negligible and any impacts would be 'not significant'. If there are human or ecological receptors within the distance criteria set out in Step 1, then Steps 2 to 4 should be undertaken, as shown in Figure A3-1.

E.3.2 Step 2 - Assess the risk of dust impacts

A site is allocated to a risk category on the basis of the scale and nature of the works (Step 2A – Define potential dust emission magnitude) and the sensitivity of the area to dust impacts (Step 2B – Define sensitivity of the area). These two factors are combined (Step 2C - Define the risk of dust impacts) to determine the risk of dust impacts before the implementation of mitigation measures. Risks are described in terms of there being a low, medium or high risk of dust impacts for each of four separate potentially dust emitting activities (i.e. demolition, construction, earthworks and trackout). Site-specific mitigation would be required, proportionate to the level of risk identified.

E.3.2.1 Step 2A - Define the potential dust emission magnitude

The potential dust emission magnitude is based on the scale of the anticipated works and is classified as small, medium or large. Table E-5 presents the dust emission criteria outlined for each construction activity.

Table E-5. Potential dust emission magnitude

Construction activity	*Large*	*Medium*	*Small*
Demolition	Total building volume >50,000 m3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.	Total building volume 20,000 m3 – 50,000 m3, potentially dusty construction material, demolition activities 10 -20 m above ground level.	Total building volume <20,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months.
Earthworks	Total site area >10,000 m2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.	Total site area 2,500 m2 – 10,000 m2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes.	Total site area <2,500 m2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter month.
Construction	Total building volume >100,000 m3, on site concrete batching, sandblasting.	Total building volume 25,000 m3 – 100,000 m3, potentially dusty construction material (e.g. concrete), on site concrete batching.	Total building volume <25,000 m3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout	>50 Heavy Duty Vehicles (HDV) (>3.5 t) outward movements1 in any one day2, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.	10-50 HDV (>3.5 t) outward movements1 in any one day2, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.	<10 HDV (3.5 t) outward movements1 in any one day2, surface material with low potential for dust release, unpaved road length <50 m.

Note 1: A vehicle movement is a one-way journey. i.e. from A to B and excludes the return journey.

Note 2: HDV movements during a construction project vary over its lifetime, and the number of movements is the maximum not the average.

E.3.2.2 Step 2B – Define the sensitivity of the area

The sensitivity of the area is described as low, medium or high and takes a number of factors into account:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- The local background PM10 concentrations; and

Site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

Table E-6 presents indicative examples of classification groups for the varying sensitivities of people to dust soiling impacts, to the health impacts of PM10 and the sensitivities of receptors to ecological impacts. A judgement is made at the site-specific level where sensitivities may be higher or lower, for example a soft fruit business may be more sensitive to soiling than an alternative industry, such as coal mining, in the same location. Section 7.3 within the IAQM guidance (IAQM, 2016) outlines more detailed parameters for defining sensitivity.

Table E-6. Indicative examples of the sensitivity of different types of receptors

Sensitivity of receptor	*Sensitivities of people and ecological receptors*		
	Dust soiling activities impacts	Heath impacts of PM10	Ecological impacts
High	Dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms.	Residential properties, hospitals, schools and residential care homes.	Locations with an international or national designation and the designated features may be affected by dust soiling (e.g. Special Area of Conservation (SAC)/Special Protection Area (SPA)/Ramsar site). Locations where there is a community of a particular dust sensitive species such as vascular plant species included in the Red Data list for Great Britain (Cheffings et al., 2005)
Medium	Parks, places of work.	Office and shop workers not occupationally exposed to PM10.	Locations where there is a particularly important plant species, where dust sensitivity is uncertain or unknown. Locations with a national designation where the features may be affected by

			dust deposition (e.g. Site of Special Scientific Interest (SSSI)).
Low	Playing fields, farmland, footpaths, short-term car parks and roads.	Public footpaths, playing fields, parks and shopping streets.	Locations with a local designation where the features may be affected by dust deposition (e.g. Local Nature Reserve (LNR).

Note 1: People's expectations would vary depending on the existing dust deposition in the area.

Note 2: This follows the Department for Environment, Food and Rural Affairs (Defra, 2016) guidance as set out in Local Air Quality Management Technical Guidance (LAQM.TG (16)).

Note 3: A Habitat Regulation Assessment of the site may be required as part of the planning process if the site lies close to an internationally designated site (i.e. SACs/SPAs) designated under the Habitats Directive (92/43/EEC) and Ramsar sites.

The IAQM guidance (IAQM, 2016) advises consideration of the risk associated with the nearest receptors to each phase of work. Where there are multiple receptors in a single location, a worst-case representative receptor location is considered and the highest risk applicable is allocated.

The receptor sensitivity and distance are then used to determine the potential dust risk for each dust effect for each construction activity as shown in Table E-7, Table E-8 and Table E-9. It is noted that distances are between the dust source to the nearest receptor so a different area may be affected by trackout than by on-site works.

For trackout, the distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sized sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Based on the likely scale of HDV activities anticipated, the Proposed Scheme is considered a medium site for trackout activities. This means an assessment would be required where there is a human receptor within 50 m of the route used by construction vehicles up to 200 m from the site exit(s) (as per the IAQM guidance (IAQM, 2016)).

Table E-7. Criteria for the 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	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table E-8. Criteria for the sensitivity of the area to human health

Receptor sensitivity	Annual mean PM10 concentrations	Number of receptors	Distance from the source (m)			
			<20	<50	<100	<350
High	>32 µg/m3	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28 – 32 µg/m3	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24 – 28 µg/m3	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m3	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32 µg/m3	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	28 – 32 µg/m3	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	24 – 28 µg/m3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 µg/m3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low

Table E-9. Criteria for the sensitivity of the area to ecological impact

Receptor sensitivity	Distance from the source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low

Low	Low	Low

E.3.2.3 Step 2C – Define the risk of impacts

The dust emission magnitude is then combined with the sensitivity of the area to determine the overall risk of impacts with no mitigation measures applied. The matrices in Table E-10 provide a method of assigning the level of risk for each activity. These can then be used to determine the level of mitigation that is required.

Table E-10. Determination of risk of dust impacts

Sensitivity of the area	Dust emission magnitude		
	Large	Medium	Small
Demolition			
High	High risk	Medium risk	Medium risk
Medium	High risk	Medium risk	Low risk
Low	Medium risk	Low risk	Negligible risk
Earthworks			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible risk
Construction			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible risk
Trackout			
High	High risk	Medium risk	Low risk
Medium	Medium risk	Low risk	Negligible risk
Low	Low risk	Low risk	Negligible risk

E.3.3 Step 3 – Site specific mitigation

During the construction phase, it would be important to control dust levels for high, medium and low risk construction activities. In order to avoid significant impacts from dust during the construction phase, suitable mitigation measures should be adopted. Following the identification of the overall risk category for the demolition, earthworks, construction and trackout activities based on Table E-10, appropriate mitigation measures can be identified for the Proposed Scheme. Activities identified as a high risk would require a greater level of mitigation than those identified as low risk.

A selection of these measures has been specified for low risk to high risk sites in IAQM guidance (IAQM, 2016) as measures suitable to mitigate dust emissions from activities such as those which would be undertaken during the construction of the Proposed Scheme.

E.3.4 Step 4 - Determine significant impacts

Following Step 2 (determining the risk of dust impacts for each activity) and Step 3 (identification of appropriate site-specific mitigation), the significance of the potential dust impacts can be determined. The recommended mitigation measures are considered to be sufficient to reduce emissions of dust based on the successful application of these measures at other large construction sites, such that a significant impact would not occur at off-site receptors.

The approach in Step 4 of IAQM guidance (IAQM, 2016) (Determine significant impacts) has been adopted to determine the significance of impacts with regard to dust emissions. The guidance states the following:

'For almost all construction activity, the aim should be to prevent significant impacts on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'.

IAQM guidance (IAQM, 2016) also states that:

'Even with a rigorous DMP [Dust Management Plan] in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time, and if, for example, dust emissions occur under adverse weather conditions, or there is an interruption to the water supply used for dust suppression, the local community may experience occasional, short-term dust annoyance. The likely scale of this would not normally be considered sufficient to change the conclusion that, with mitigation, the impacts will be 'not significant'.

Step 4 of IAQM guidance (IAQM, 2016) recognises that the key to the above approach is that it assumes that the regulators ensure that the proposed mitigation measures are implemented. The management plan would include the necessary systems and procedures to enable on-going checking by the regulators to ensure that mitigation is being delivered, and that it is effective in reducing any residual effect to 'not significant' in line with the guidance.

E.4 Construction Dust Risk Assessment

This section sets out the construction dust risk assessment following the steps described in the methodology section above. The assessment of potential demolition, earthworks, construction and trackout impacts has been undertaken in accordance with the IAQM methodology described earlier and as set out in the Air Quality Assessment report.

E.4.1 Step 1 - Identify the need for a detailed assessment

An assessment of potential construction impacts (i.e. demolition, earthworks, construction and trackout) has been undertaken in accordance with the IAQM methodology (IAQM, 2016) described earlier. The first step is Step 1, where the need for a detailed assessment is determined based on the location of receptors within the vicinity of the Proposed Scheme.

There are human receptors (i.e. residential properties, commercial premises and a nursery) within 350 m of the Proposed Scheme site boundary and therefore, further assessment is required. There are also human receptors within 50 m of the local road network, up to 200 m from the respective site exit(s), which would be used during the construction works. A count of the relevant human receptors within the specified assessment bands (i.e. up to 20 m, 50 m, 100 m, 200 m and 350 m from the site boundary (see Figure 1-1 - Construction Dust Risk Assessment Study Areas)) has been carried out as recommended in IAQM guidance (IAQM, 2016), the results of which are set out within this section of the report. The receptors have been identified as being of high, medium or low sensitivity as per the criteria set out in Table E-7 and Table E-8 (see Box 6 and Box 7 in the IAQM guidance (IAQM, 2016)). Those receptors within 50 m of the route(s) used by construction vehicles on the public highway, up to 200 m from the site exit(s) are also presented in Table E-11.

The impacts of construction dust on ecological sites have also been considered. Dust can have direct physical impacts including reduced photosynthesis, respiration and transpiration through coating and smothering. The smothering has been found to affect photosynthesis both by shading and also by obstructing diffusion through blocking of the leaf stomata (Environment Agency, 2003). Other direct impacts include altering the pH of the soils or surface water in the ecological site through deposition of dusts with high acidity or alkalinity. This could lead to the loss of certain plants which prefer a specific soil or water chemistry.

Indirect impacts of the dust soiling and smothering can include increased susceptibility of the plant to other stresses, including air pollution or pathogens.

Non-vascular species such as mosses and lichens are considered to be the most sensitive species to dust soiling and smothering as they absorb water and nutrients directly from the air. As these lack a protective cuticle, dust deposited onto their surfaces can act as a desiccant, drying out and damaging their tissues (Meininger & Spatt, 1988). However, there are species of mosses and lichens that are more tolerant to dust deposition (Meininger & Spatt, 1988; Farmer, 1993).

The presence of any ecological receptors within 50 m of the Proposed Scheme site boundary is discussed within this section of the report, together with a description of the ecological site, and its potential sensitivity to dust soiling, in accordance with Step 2B.

E.4.1.1 Human receptors

The human receptors within the designated assessment bands around the Proposed Scheme are set out in Table E-11. A figure of the high sensitivity receptors within the assessment bands is presented in Figure 1-1.

As per IAQM guidance (IAQM, 2016), the high sensitivity receptors identified within 350 m of the Proposed Scheme site boundary presented in Table E-11 include an estimated 40 pupils and staff at the nearby York House Nursey which is approximately 160 m northeast of the Proposed Scheme site boundary at its closest point. At this stage of the Proposed Scheme design, construction routes are yet to be finalised. Furthermore, it is unclear whether construction vehicles will exit the site on to the public highway via George Street or directly on to the A689. For the purposes of this assessment, as a worst-case approach, it is assumed construction vehicles would exit the site via George Street and also directly on to the A689 and then travel north and south along the A689.

Table E-11. Receptor count for the Proposed Scheme

Demolition, earthworks and construction		Receptor count		
Receptor sensitivity		High	Medium	Low
Distance from the Proposed Scheme site boundary	<20 m	10-100	1-10	1-10
	<50 m	10-100	10-100	1-10
	<100 m	>100	10-100	1-10
	<200 m	>100	10-100	1-10
	<350 m	>100	10-100	1-10
Trackout		Receptor count		
Receptor sensitivity		High	Medium	Low
	<20 m	10-100	1-10	1-10

Demolition, earthworks and construction		Receptor count		
Distance from the site exit(s) (up to 200 m)	<50 m	10-100	1-10	1-10

E.4.1.2 Ecological receptors

The effects of construction dust on ecological sites have also been considered. The absence of any relevant ecological sites within 50 m of the Proposed Scheme site boundary, or relevant ecological sites within 50 m of the route(s) used by construction vehicles up to 200 m from the site exit(s), means the potential effects of construction dust on ecological sites is not required to be considered further. The nearest ecological receptor is Bracks Wood Ancient Woodland which is approximately 850 m east-southeast of the Proposed Scheme site boundary at its closest point.

E.4.2 Step 2 - Assess the risk of dust impacts

E.4.2.1 Step 2A Define the potential dust emission magnitude

The works associated with the construction of the Proposed Scheme would be split into several different elements, which could potentially involve different periods of demolition, earthworks, construction and trackout activities, levels of which would not necessarily peak simultaneously.

The dust emission magnitudes of each activity have been specified using the definitions of dust emission magnitudes presented in Table E-5 and professional judgement in line IAQM guidance (see Section 7.2 of the IAQM guidance (IAQM, 2016)).

Demolition

Demolition activities include the removal of the existing bus station municipal building (approximately 170 m2), a toilet block (approximately 70 m2), 10 lightweight bus shelters and a café building (approximately 25 m2). It is anticipated approximately 1,600 m3 of brick rubble, 12 tonnes of steel and 6 tonnes of glass are required to be removed. Furthermore, an area of block paving encompassing approximately 7,700 m2 is to be demolished. The maximum height of demolition is approximately 3 m and the demolition material may be potentially dusty (i.e. concrete). There is no on-site crushing anticipated as all material will be transported to a waste transfer site for processing. As the total demolition volume is likely to be less than 20,000 m3, the assessment of demolition is based on a dust emission class of 'small'.

Earthworks

Earthworks activities include site preparation and profiling of an area encompassing 2,600 m2 prior to the construction of the multi-storey car park. It is anticipated approximately 2,300 m3 of material will need to be excavated prior to the construction of the multi-storey car park. There is likely to be a small amount of heavy earth-moving equipment activity at any one time (i.e. typically less than 5 machines). A desk-based review (Cranfield Soil and Agrifood Institute, 2022) suggests the ground conditions comprise a clay soil which may be prone to suspension when dry and therefore be potentially dusty. The total amount of material to be excavated or moved is approximately 5,500 tonnes. The total site area of the Proposed Scheme is approximately 7,700 m2. As the total amount of material anticipated to be moved is likely to be less than 20,000 tonnes, the assessment of earthworks is based on a dust emission class of 'small'.

Construction

Activities include construction of the multi-storey car park (requiring approximately 710 m3 of concrete slabs), the bus station (requiring approximately 470 m3 of foundation concrete) and associated infrastructure. Furthermore, approximately 900 m3 of bituminous material, 1,300 m3 of sub base and 355 m3 of concrete piles are required. The construction stage would use potentially dusty construction materials such as concrete.

The total construction volume is likely to be less than 25,000 m3 and on-site batching or sandblasting activities are not anticipated. On this basis, the assessment for construction is based on a dust emission class of ‘small’.

Trackout

The maximum number of daily outward movements of HDVs on to the public road network is anticipated to be approximately 40 in any one day. The length of unpaved road is anticipated to be minimal. On this basis, the assessment for trackout is based on a dust emission class of ‘medium’.

Summary of dust emission magnitudes

Table E-12 presents the dust emission magnitude for each activity based on the criteria set out in IAQM guidance (IAQM, 2016).

Table E-12. Dust emission magnitude for the Proposed Scheme

Receptor sensitivity	Dust emission magnitude
Demolition	Small
Earthworks	Small
Construction	Small
Trackout	Medium

E.4.2.2 Step 2B Define the sensitivity of the area

The area surrounding the Proposed Scheme is primarily commercial and residential in nature. York House Nursey is approximately 160 m northeast of the Proposed Scheme site boundary at its closest point.

Table E-9 displays the sensitivities of the surrounding area to demolition, earthworks, construction and trackout based on the criteria set out in Table E-7 and Table E-8, numbers of receptors within certain distance bands of the Proposed Scheme site boundary and existing PM10 concentrations.

The IAQM guidance (IAQM, 2016) recommends that the receptor distance is based on the distance from the source rather than the site boundary. This assessment has been undertaken on the basis that all activities (i.e. earthworks, construction and trackout) take place at the Proposed Scheme site boundary. This represents a conservative assumption as in practice most activities would not take place at the site boundary, thus increasing the distance between the source and the receptor.

Table E-13. Sensitivity of the area for human receptors

Site	Potential impact	Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout
Proposed Scheme	Dust soiling	High	High	High	High
	Human health	Low	Low	Low	Low

Table E-13 shows that, based on the number of receptors within proximity of the Scheme, the sensitivity of the area for dust soiling impacts is high for all stages of the Scheme. Based on the number of receptors in proximity of the Scheme and the background PM10 concentration applied (i.e. 9.4 µg/m3), the sensitivity of the area for human health impacts is categorised as low for all stages of the Scheme.

E.4.2.3 Step 2C Define the risk of impacts

Using the dust emission magnitudes for the various activities in Table E-12 and the sensitivity of the area provided in Table E-13 the risks associated with the Scheme are provided in Table E-14 for dust soiling and human health impacts.

Table E-14. Dust risk at human and receptors

Site	Potential impact	Demolition	Earthworks	Construction	Trackout
Proposed Scheme	Dust soiling	Medium risk	Low risk	Low risk	Medium risk
	Human health	Negligible risk	Negligible risk	Negligible risk	Low risk

The results in Table E-14 indicate that for potential dust soiling impacts, there is predicted to be a medium risk from demolition and trackout activities and a low risk from earthworks and construction activities. For potential human health impacts, there is predicted to be a negligible to low risk from all other stages of the Proposed Scheme.

It would therefore be necessary to adopt an appropriate level of good practice mitigation measures to reduce the risks of causing a significant effect to amenity or human health. This would also prevent or reduce potential dust or PM10 (and PM2.5) emissions which are associated with health impacts such as exacerbating existing health conditions including asthma and other lung conditions.

E.4.2.4 Step 3 Scheme – specific mitigation

Recommended mitigation measures

The results in Table E-14 indicate that there is a medium risk for dust soiling impacts at sensitive human receptors and a low risk for human health impacts.

Good practice mitigation measures would be needed to reduce the potential for dust emissions to lead to significant impacts in the vicinity of the Proposed Scheme. The suggested good practice mitigation measures which should be adopted for the Proposed Scheme are set out below.

The mitigation measures have been derived from those specified in the IAQM guidance (IAQM, 2016) and where possible at this stage, adapted to the activities associated with construction of the Proposed Scheme. Measures such as those specified in the guidance would normally be sufficient to reduce construction dust nuisance and risks to human health to a 'not significant' effect.

These measures are listed in Table E-15 to Table E-1918 with a recommendation as to whether or not they should be applied based on the risk levels identified in the dust assessment. Some specific comments or observations have been added or amendments to the text undertaken, where appropriate.

The general mitigation measures were specified based on the highest risk category (i.e. based on the medium risk to human receptors from dust soiling) as recommended by IAQM guidance (IAQM, 2016).

As specified above, the measures to control dust emissions taken forward from this assessment, derived from the highly recommended or desirable measures (see Table E-15 to Table E-1918) and the monitoring of the effectiveness of the mitigation, would be included in the air quality management strategies set out in the CEMP or equivalent management plan that would be agreed with the relevant local planning authority and appointed contractor(s) prior to construction commencing.

When applying the mitigation measures, IAQM guidance (IAQM, 2016) states the following:

'The most important aspects of the Dust Management Plan are assigning responsibility for dust management to an individual member of staff of the principal contractor, training staff to understand the importance of the issue, and communicating with the local community. Good dust management practices implemented at high risk sites have resulted in no or minimal complaints, which illustrates the value of the recommended approach.'

The mitigation measures set out in Table E-15 to Table E-1918 do not specifically include assigning responsibility for dust management to a staff member or training staff on the importance of dust management and awareness of dust issues. These would be included within the proposed mitigation measures.

Table E-15. Mitigation for the Proposed Scheme, communications

Mitigation measure	Highly recommended/Desirable/Not required
1. Develop and implement a stakeholder communications plan that includes community engagement before work commences on the Scheme.	Highly recommended
2. Display the name and contact details of person(s) accountable for air quality and dust issues on the Scheme. This may be the environment manager/engineer or the site manager.	Highly recommended
3. Display the head or regional office contact information.	Highly recommended
4. Develop dust mitigation and control measures as part of the air quality management strategies as set out in the CEMP or equivalent. This may also include measures to control other pollutant emissions. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this assessment.	Highly recommended
Site management	
5. 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.	Highly recommended
6. Make the complaints log available to the local authority when asked.	Highly recommended
7. Record any exceptional incidents that cause dust and/or air emissions, either on-site or off-site, and the action taken to resolve the situation in the logbook.	Highly recommended
8. Hold regular liaison meetings with other high-risk construction sites within 500 m of the Scheme, 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.	Not required

Mitigation measure	Highly recommended/Desirable/Not required
Monitoring	
9. Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust and 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 the site boundary, with cleaning to be provided if necessary.	Desirable
10. Carry out regular site inspections to monitor compliance with the CEMP or equivalent, record inspection results and make an inspection log available to the local authority when asked.	Highly recommended
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.	Highly recommended
12. Agree dust deposition, dust plant or real-time PM10 continuous monitoring locations with the local authority. Further guidance is provided by IAQM (IAQM, 2018) on monitoring during earthworks and construction (see Section 0).	Highly recommended
Preparing and maintaining the site	
13. Plan site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible.	Highly recommended
14. Erect solid screens or barriers around dusty activities, or the site boundary, which are at least as high as any stockpiles on-site.	Highly recommended
15. Fully enclose site or specific operations where there is a high potential for dust production and the site boundary is active for an extended period.	Highly recommended
16. No discharge of site runoff to ditches, watercourses, drains, sewers or soakaways without consultation of the appropriate authorities.	Highly recommended
17. Keep the site fencing, barriers and scaffolding clean using wet methods.	Highly recommended
18. Remove materials that have a potential to produce dust from the site as soon as possible, unless being re-used on-site. If they are being re-used on-site, cover as described below.	Highly recommended
19. Cover, seed or fence stockpiles to prevent wind-whipping as soon as is reasonably practicable following completion of earthworks.	Highly recommended
Operating vehicles/machinery and sustainable travel	

Mitigation measure	Highly recommended/Desirable/Not required
20. Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London non-road mobile machinery (NRMM) standards, where applicable.	Not applicable
21. Ensure all vehicles switch off engines when stationary- no idling vehicles.	Highly recommended
22. Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable.	Highly recommended
23. Impose and signpost a maximum speed limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).	Desirable
24. Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Highly recommended
25. Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking and car sharing) and stipulates the avoidance of HDV movements through Air Quality Management Areas where practicable.	Desirable
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, e.g. suitable local exhaust ventilation systems.	Highly recommended
27. Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	Highly recommended
28. Use enclosed chutes and conveyors (including transfer points) and covered skips.	Highly recommended
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.	Highly recommended
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.	Highly recommended
44. Avoid dry sweeping of large areas.	Highly recommended

Mitigation measure	Highly recommended/Desirable/Not required
46. Inspect on-site haul routes for integrity and instigate any necessary repairs to the surface as soon as reasonably practicable.	Highly recommended
47. Record all inspections of haul routes and any subsequent action in a site logbook.	Highly recommended
48. Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers, and regularly cleaned.	Highly recommended
Waste management	
31. Avoid bonfires and burning of waste materials	Highly recommended

Table E-1632. Measures specific to demolition

Mitigation measure	Highly recommended/Desirable/Not required
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).	Desirable
33. Ensure effective water suppression is used during demolition operations. Hand-held spays 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.	Highly recommended
34. Avoid explosive blasting, using appropriate manual or mechanical alternatives.	Highly recommended
35. Bag and remove any biological debris or damp down such material before demolition.	Highly recommended

Table E-1733. Measures specific to earthworks

Mitigation measure	Highly recommended/Desirable/Not required
36. Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	Not required
37. Use hessian fabric, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	Not required

Mitigation measure	Highly recommended/Desirable/Not required
38. Only remove the cover in small areas during work and not all at once.	Not required

Table E-18. Measures specific to construction

Mitigation measure	Highly recommended/Desirable/Not required
39. Avoid scabbling (roughening of concrete surfaces) if possible.	Desirable
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 which case ensure that appropriate additional control measures are in place.	Desirable
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.	Not required
42. For smaller supplies of fine powder materials, ensure bags are sealed after use and stored appropriately to prevent dust.	Not required

Table E-1918. Measures specific to trackout

Mitigation measure	Highly recommended/Desirable/Not required
43. 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.	Highly recommended
45. Ensure vehicles entering and leaving the site are covered to prevent escape of materials during transport.	Highly recommended
49. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Highly recommended
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.	Highly recommended
51. Access gates to be located at least 10 m form receptors where possible.	Highly recommended

E.4.2.5 Air quality monitoring

As the works associated with construction of the Scheme have been categorised as a medium risk, an appropriate monitoring survey, as described in Table E-15 (point 12), would be recommended forming part of the overall dust mitigation and management process. The approach and scope of the air quality monitoring survey would be informed by the IAQM Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites (IAQM, 2018) and would likely include dust deposition monitoring using passive dust deposition gauges. Supplementary monitoring of weather conditions including wind speed, wind direction and rainfall would be undertaken.

The IAQM monitoring guidance (IAQM, 2018) states:

'Monitoring may be carried out in order to fulfil a number of objectives:

Ensure that the construction activities do not give rise to any exceedances of the air quality objectives/limit values for PM10 and/or PM2.5, or any exceedances of recognised threshold criteria for dust deposition/soiling;

Ensure that the agreed mitigation measures to control dust emissions are being applied and are effective;

To provide an 'alert' system with regard to increased emissions of dust, and a trigger for cessation of site works or application of additional abatement controls;

To provide a body of evidence to support the likely contribution of the site works in the event of complaints; and

To help to attribute any high levels of dust to specific activities on-site in order that appropriate action may be taken.'

Although the proposed monitoring system will not provide a real-time 'alert' system, the results of the dust deposition monitoring (based on the monthly dust deposition sampling results) would be reviewed to identify if the agreed thresholds have been exceeded, and if investigation and additional mitigation is required to reduce dust emissions from site activities (or even if site activities needs to be altered or temporarily suspended).

The scope of the monitoring discussed in this section and the basis for setting appropriate thresholds for identifying potentially unacceptable dust soiling at human receptors would be included part of the air quality management strategies set out in the CEMP or equivalent management plan that would be agreed with the relevant local planning authority and appointed contractor(s) prior to construction commencing.

E.4.2.6 Step 4 – Determine significant impacts

This assessment has identified that there are potentially sensitive dust receptors located in close proximity to the Proposed Scheme (see Figure 1-1 - Construction Dust Risk Assessment Study Areas), including residential properties and a nursery. There are numerous high and medium sensitivity receptors located within 100 m of the Proposed Scheme site boundary (see Table E-11). The receptor locations are reported from the Proposed Scheme site boundary and not the actual location of activities with the potential to generate dust, and the distances used in the assessment are therefore cautious, as activities with high potential to generate dust (including PM10 and PM2.5) would be offset from the Proposed Scheme site boundary. The sensitivity of the area, which takes into consideration the number and distance of receptors from the site and baseline conditions, are summarised in Table E-13 as being low sensitivity with respect to emissions of PM10 and PM2.5 and high sensitivity with respect to changes in dust deposition rates and associated impacts on amenity.

Based on the matrix of relationships between sensitivity of the area and the dust emission magnitude, it is considered that the proposed earthworks, construction and trackout activities for the Proposed Scheme are predicted to be a low to medium risk for potential dust soiling impacts at human receptors (see Table E-14). There is the potential for infrequent, short-term episodes when baseline dust deposition rates could be increased by an amount that residents could perceive. With regard to human health, there is a negligible to low risk as there is limited potential for emissions of PM10 and PM2.5 to increase baseline concentrations to a value that is above the air quality objective values set for the protection for human health.

The adoption of good practice dust mitigation measures to manage the generation of emissions at source would therefore be required. These mitigation measures to control dust emissions would be included in the air quality management strategies set out in the CEMP or equivalent management plan that would be agreed with the relevant local planning authority and appointed contractor(s) prior to construction commencing (usually required as a condition of the planning permission).

The Proposed Scheme encompasses a large area but is not unusual in scale in comparison with other similar schemes. There are mitigation methods already available that have been successfully applied to other developments to manage emissions of dust so that significant off-site impacts have not occurred. Such measures are considered to be no more than normal good practice that would be adopted by any contractor meeting the requirements of the CEMP. It is considered that there are no dust-generating activities proposed that could not be managed using normal good practices (IAQM, 2016) so as to prevent significant effects at any off-site receptor, including those located within 20 m of the Proposed Scheme site boundary.

IAQM guidance (IAQM, 2016) notes that with the application of good practice mitigation measures of the type available for use on the Proposed Scheme, the environmental impact would not be significant at any off-site receptor. IAQM guidance (IAQM, 2016) also notes that, even with a rigorous package of mitigation measures in place, such as those taken forward from this assessment and included in the air quality management strategies set out in the CEMP or equivalent management plan, occasional impacts may occur. The CEMP or equivalent would provide a framework by which the level of mitigation is adapted to respond proactively to the changing risk of dust emissions, so that significant impacts are prevented.

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Appendix F. Summary Traffic Data

Table F-1. Traffic data on the nearest links to receptors showing the greatest impact owing to the scheme scenarios.

N-DM (S1)						DM-DS (S2)					
Receptor_ID	Change (µg/m³)	Link Ref	DN AADT	DM AADT	AADT change	Receptor_ID	Change (µg/m³)	Link Ref	DN AADT	DS AADT	AADT change
R11 + R33	0.7	347	4508	4971	463	R11 + R33	0.7	347	4508	5128	621
	0.5	367	3803	4210	407		0.5	367	3803	3488	-315
R12	0.2	970	4582	4865	283	R12	0.2	970	4582	5048	466
		973	3747	4031	284			973	3747	3274	-473
R16	-0.4	1069	2862	2797	-65	R16	-0.4	1069	2862	2932	71
		2215	0	0	0			2215	0	0	0
		270	5603	5935	332			270	5603	5941	338
		268	4809	4684	-126			268	4809	4879	70
		250	3344	3139	-205			250	3344	2403	-941
		251	3473	3388	-86			251	3473	3552	78
R24	-0.4	632	44	38	-7	R24	-0.4	632	44	9	-35
		709	4516	4393	-122			709	4516	4579	64
		707	4455	4005	-450			707	4455	4397	-59
R36	-0.4	658	3309	3087	-221	R36	-0.4	658	3309	3196	-113
		662	3705	3655	-50			662	3705	4809	1104