A66 Northern Trans-Pennine Project
TR010062

3.2 Environmental Statement
Chapter 5 Air Quality

APFP Regulations 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 3

June 2022

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A66 Northern Trans-Pennine Project Development Consent Order 202x

3.2 ENVIRONMENTAL STATEMENT CHAPTER 5 AIR QUALITY

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010062
Application Document Reference	3.2
Author:	A66 Northern Trans-Pennine Project Team, National Highways

Version	Date	Status of Version
Rev 1	13 June 2022	DCO Application

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TECHNICAL APPENDICES (VOLUME 3)

5 Air Quality

5.1 Introduction

5.1.1 This chapter assesses the likely significant air quality effects of the construction and operation of the Project, following the standards set out in the *Design Manual for Roads and Bridges (DMRB) LA 105 Air quality* (Highways England, 2019)[1] and other relevant guidance as listed below. It details the methodology followed, summarises the legislation and policy framework relevant to the air quality assessment and describes the existing environment in the area surrounding the Project and then assesses the impacts of the Project on identified receptors during both the construction and operational phases of the Project. It then considers the design, mitigation and residual effects of the Project, including taking account of relevant characteristics of the future baseline environment. Any key assumptions and limitations applicable to the assessment are also identified.

5.1.2 Any air quality effects predicted to be significant are identified in section 5.10 of this chapter. Effects identified in the course of the assessment but not predicted to be significant are presented in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

5.1.3 The air quality assessment is supported by a number of figures (Environmental Statement Volume 2) and Technical Appendices (Environmental Statement Volume 3) as listed on the contents page.

5.1.4 This EIA has been undertaken by competent experts with the relevant and appropriate experience in their respective topics. The lead author of this chapter has:

- A PhD from the University of Leeds
- Full Membership of the Institution of Air Quality Management, is a Member of the Institution of Environmental Science and is a Chartered Scientist
- Over 13 years' air quality assessment experience and is a principal air quality consultant.

[1] Highways England (2019) Design Manual for Roads and Bridges LA 105 Air quality

5.2 Key assessment parameters

5.2.1 The following key assessment parameters have been used in order to enable flexibility in the assessment and to provide a reasonable worst case assessment.

Table 5-1: Key Assessment Parameters

Key Assessment Parameters
• The air quality assessment is based on a scheme design relevant to the time of writing the ES, particularly in relation to the alignment of the Project and the associated construction and operational effects. This is considered to be a reasonable worst case approach, prior to detailed design stage. • The construction assessment assumes a starting year of 2024 • The operational assessment assumes an opening year of 2029 • Two meteorological stations have been used in the modelling, to account for differences in wind conditions east and west of the Project. Sensitivity analysis has also been undertaken into the effect of these two datasets • The assessment of nitrogen deposition during the operational phase includes emissions of ammonia using National Highway's ammonia tool kit

5.3 Legislation and policy framework

Legislation

5.3.1 The following key legislation is applicable to the assessment:

- *Part IV of the Environment Act 1995*
- *Environmental Protection Act 1990* s79(1)(d)
- *The Air Quality (England) Regulations 2000*
- *The Air Quality Standard Regulations 2010* (amended in 2016) (Department for Environment, Food and Rural Affairs, as amended - this is the primary regulation for the air quality standards, which transposed the limit values from the 2008/50/EC.
- *The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019.*
- *The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020* - this updates the air quality regulations for $PM_{2.5}$.

5.3.2 The Environment Act 2021 was enacted in November 2021 with key measures around air quality, including bringing forward at least two new air quality targets by 31 October 2022. At the time of assessment, these new targets have not been enacted so therefore have not been considered in this assessment.

National level policy

National Policy Statement for National Networks

5.3.3 The primary basis for the Secretary of State deciding whether or not to grant a Development

Consent Order (DCO) for the Project is the *National Policy Statement for National Networks (NPSNN)* (Department for Transport, 2014)[2].

5.3.4 Table 5-2: Relevant *NPSNN* policies identifies the *NPSNN* policies relevant to the air quality assessment and a reference to where in this Environmental Statement (ES) information is provided to address each policy.

Table 5-2: Relevant NPSNN policies

***NPSNN* paragraph reference**	**Requirement**	**Applicant response**	**Where addressed?**
5.6	Where the impacts of the Project (both on and off-scheme) are likely to have significant air quality effects in relation to meeting EIA requirements and/or affect the UK's ability to comply with the Air Quality Directive, the applicant should undertake an assessment of the impacts of the proposed project as part of the environmental statement.	An assessment has been carried out to determine if there is a risk of affecting the UK's ability to achieve compliance. There are no likely significant effects associated with the Project.	Section 5.10: Assessment of likely significant effects
5.7	The environmental statement should describe: • existing air quality levels; • forecasts of air quality at the time of opening, assuming that the Project is not built (the future baseline) and taking account of the impact of the Project; and • any significant air quality effects, their mitigation and any residual effects, distinguishing between the construction and operation stages and taking account of the impact of road traffic generated by the Project.	Existing air quality levels across the Project have been described, reviewed and summarised. Forecasts of air quality at the time of opening have been	Section 5.7: Baseline conditions and ES Appendix 5.3: Air Quality Baseline (Application Document 3.4). ES Appendix 5.4: Air Quality Assessment Results

[2] Department for Transport (2014) National Policy Statement for National Networks.

NPSNN paragraph reference	Requirement	Applicant response	Where addressed?
		provided for the future baseline and taking account of the impact of the Project. The likely significant effects associated with the Project, including taking account of road traffic generated by the Project, during the construction and operation stages have been determined. There are no significant effects associated with the Project and no additional mitigation or residual effects - the justification of this conclusion is presented in Section 5.10 Assessment of Likely	(Application Document 3.4). Section 5.9: Essential mitigation and enhancement measures. Section 5.10: Assessment of likely significant effects

NPSNN paragraph reference	Requirement	Applicant response	Where addressed?
		Significant Effects	
5.8	Department for Environment, Food and Rural Affairs (Defra) publishes future national projections of air quality based on evidence of future emissions, traffic and vehicle fleet. Projections are updated as the evidence base changes. The Applicant's assessment should be consistent with this but may include more detailed modelling to demonstrate local impacts.	The assessment has used the most recent information from Defra for future background projections and National Highways for vehicle emissions (version 11) and the ammonia tool. The impact of emissions has been assessed using detailed modelling.	Section 5.4 Assessment methodology and ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).
5.9	In addition to information on the likely significant effects of a project in relation to Environmental Impact Assessment (EIA), the Secretary of State must be provided with a judgement on the risk as to whether the Project would affect the UK's ability to comply with the Air Quality Directive.	An assessment has been carried out to determine if there is a risk of affecting the UK's ability to comply with the Air Quality Directive *(as this has been given*	Results are provided in section 5.10: Assessment of likely significant effects

NPSNN paragraph reference	Requirement	Applicant response	Where addressed?
		effect in UK domestic law). There are no likely significant effects associated with the Project.	
5.10	The Secretary of State should consider air quality impacts over the wider area likely to be affected, as well as in the near vicinity of the Project. In all cases the Secretary of State must take account of relevant statutory air quality thresholds set out in domestic and European legislation. Where a project is likely to lead to a breach of the air quality thresholds, the applicant should work with the relevant authorities to secure appropriate mitigation measures with a view to ensuring so far as possible that those thresholds are not breached.	An assessment has been carried out to determine if there is a risk of affecting the UK's ability to comply with the Air Quality Directive and the Air Quality Standards objectives. There are no likely significant effects associated with the Project.	Results are provided in section 5.10: Assessment of likely significant effects
5.11			

NPSNN paragraph reference	Requirement	Applicant response	Where addressed?
	• Air quality considerations are likely to be particularly relevant where schemes are proposed: • within or adjacent to Air Quality Management Areas (AQMA); roads identified as being above Limit Values or nature conservation sites (including Natura 2000 sites and Sites of Special Scientific Interest (SSSI), including those outside England); and • where changes are sufficient to bring about the need for a new AQMAs or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites.	The AQMAs and nature conservation sites present within and adjacent to the Affected Road Network (ARN) study area have been identified. Forecasts of air quality at the time of opening have been provided for the future baseline and taking account of the impact of the Project. Where changes have been identified that meet the relevant criteria, these have been described. There are no likely significant effects associated with the Project.	Section 5.7 Baseline conditions and ES Appendix 5.3: Air Quality Baseline (Application Document 3.4). ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

NPSNN paragraph reference	Requirement	Applicant response	Where addressed?
5.12	The Secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and/or where they lead to a deterioration in air quality in a zone/agglomeration.	An assessment has been carried out to determine if there is a risk of significant air quality impacts. There are no likely significant effects associated with the Project.	Results are provided in section 5.10: Assessment of likely significant effects
5.13	The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the Project will: • result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant; or • affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to the European Commission at the time of the decision.	An assessment has been carried out to determine if there is a risk of non-compliance with the Air Quality Directive. There are no likely significant effects associated with the Project.	Results are provided in section 5.10: Assessment of likely significant effects

National Planning Policy Framework

5.3.5 The *National Planning Policy Framework (NPPF)* (Ministry of Housing Communities & Local Government, 2021)[3] originally published in March 2012 and most recently updated in July 2021, sets out the government's planning policies for England and provides a framework within which locally prepared plans can be produced.

Regional and local level policy

5.3.6 Other regional and local level policies have been considered as part of the air quality assessment where these have informed the identification of receptors and resources and their sensitivity; the assessment methodology; the potential for likely significant environmental effects; and required mitigation. These policies are expanded on in Table 5-3: Regional and local level policies and include:

- *County Durham Plan 2020* (Durham County Council, 2020)[4] Objective 4:

Infrastructure, Objective 9: Natural Environment, Objective 19: Natural Resources and Policy 21: Delivering Sustainable Transport, Policy 24: Provision
of Transport Infrastructure, Policy 31 – Amenity and Pollution, and Policy 43 –
Protected Species and Nationally and Locally Protected Sites.

- *Eden Local Plan 2014-2032* (Eden District Council, 2018)[5] Policy ENV7
- *Richmondshire Local Plan 2012-28: Core Strategy* (Richmondshire District Council, 2012)[6] Core Policy CP3: Achieving Sustainable Development.

5.3.7 Cumbria County Council Local Transport Plan 2011-2026 (Cumbria County Council, 2017)[8] has also been considered as part of the air quality assessment, as this plan includes Health and well-being throughout as well as Life and World class environmental quality strategy priorities.

[3] Ministry of Housing Communities & Local Government (2021) National Planning Policy Framework
[4] Durham County Council (2020) County Durham Plan Adopted 2020
[5] Eden District Council (2018) Eden Local Plan 2014-2032
[6] Richmondshire District Council (2014) Richmondshire Local Plan 2012-28: Core Strategy
[7] Cumbria County Council (2011) Moving Cumbria Forward, Cumbria Transport Plan Strategy 2011-2026
[8] Cumbria County Council (2017) Local Transport Plan 2011-2026.

Table 5-3: Regional and local level policies

Policy document	Policy wording	Applicant response	Where addressed?
County Durham Plan	• Policy 21: Delivering Sustainable Transport: *"The transport implications of development must be addressed as part of any planning application, where relevant this could include through Transport Assessments, Transport Statements and Travel Plans. All development (excluding mineral extraction, waste management and householder extensions) shall deliver sustainable transport by:* • *c) ensuring that any vehicular traffic generated by new development, following the implementation of sustainable transport measures, can be safely accommodated on the local and strategic highway network and does not cause an unacceptable increase in*	An assessment has been carried out to determine if there is a risk of significant air quality effects or unacceptable increase in pollutants concentrations. There are no likely significant effects associated with the Project.	Results are provided in Section 5.10: Assessment of likely significant effects

Policy document	Policy wording	Applicant response	Where addressed?
	congestion or air pollution and that severe congestion can be overcome by appropriate transport improvements; • *d) ensuring the creation of new or improvements to existing routes and facilities do not cause unacceptable harm to the natural, built or historic environment."*		
	• Policy 24 - Provision of Transport Infrastructure: *"New and improved transport infrastructure will be permitted where it meets all of the following criteria:* • *b) minimises and mitigates any harmful impact upon the built, historic and natural environment and the amenity of local communities including by incorporating green infrastructure…".*	An assessment has been carried out to determine if there is a risk of significant air quality effects. There are no likely significant effects associated with the Project.	Results are provided in Section 5.10: Assessment of likely significant effects

Policy document	Policy wording	Applicant response	Where addressed?
	• 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… Development which has the potential to lead to, or be affected by, unacceptable levels of air quality, inappropriate odours, noise and vibration or other sources of pollution, either individually or cumulatively, will not be permitted including where any identified mitigation cannot reduce the impact on the environment, amenity of people or human health to an acceptable level".*	An assessment has been carried out to determine if there is a risk of significant air quality effects. There are no likely significant effects associated with the Project.	Results are provided in Section 5.10: Assessment of likely significant effects

Policy document	Policy wording	Applicant response	Where addressed?
	• Policy 43 - Protected Species and Nationally and Locally Protected Sites: *"All development proposals in, or which are likely to adversely impact upon (either individually or in combination with other developments), any of the following national designations (where not a component of an internationally designated site):* • *Sites of Special Scientific Interest* • *National Nature Reserves* • *will only be permitted where the benefits of development in that location clearly outweigh the impacts on the interest features on the site and any wider impacts on the network of* sites. • All development proposals in, or which	An assessment has been carried out to determine if there is a risk of significant air quality effects. There are no likely significant effects associated with the Project.	Results are provided in section 5.10: Assessment of likely significant effects

Policy document	Policy wording	Applicant response	Where addressed?
	are likely to adversely impact upon, any of the following local designations: • Local Sites (Geology and Wildlife) • Local Nature Reserves (LNRs) • will only be permitted when it can be demonstrated that the benefits of development in that location outweigh the impacts on the local nature conservation interest or scientific interest on the site and any wider impacts on the network of sites."		
Eden Local Plan 2014-2032	• Policy ENV7: *"all major development proposals, defined in Appendix 2, will be required to assess the likely impacts of the proposed development on air quality. Development proposals will be expected to include mitigation measures to offset negative impacts, which may include:* • *Ensuring the development is located within easy reach of established public transport routes*	An assessment has been carried out to determine if there is a risk of significant air quality effects. There are no likely significant effects associated with the Project.	Results are provided in section 5.10: Assessment of likely significant effects

Policy document	Policy wording	Applicant response	Where addressed?
	• *Maximising provision for cycling and pedestrian facilities* • *Encouraging the use of cleaner transport fuels on site, through the inclusion of electric car charging points* • *Contributing towards the improvement of the highway network where the development is predicted to result in increased congestion on the highway network.* • *Development proposed nearby any Air Quality Management Area (AQMA) declared within the district will require an air quality assessment to identify the likely impacts of development upon the designated area. Permission will only be granted if the individual and cumulative impact of the proposed development on air quality is acceptable and appropriate mitigation*		

Policy document	Policy wording	Applicant response	Where addressed?
	measures are applied. Contribution towards measures identified to deliver the Air Quality Action Plan will be required as part of the development."		
Richmondshire Local Plan 2012-28	Core Policy CP3: Achieving Sustainable Development - • *"1. Support will be given for sustainable development which promotes: […] the quality of natural resources including water, air, land and biodiversity and minimises the impacts of airborne pollution.'*	An assessment has been carried out to determine if there is a risk of significant air quality effects. There are no likely significant effects associated with the Project.	Results are provided in Section 5.10: Assessment of likely significant effects

Other relevant policy, standards and guidance

5.3.8 In addition to compliance with the *NPSNN* and *NPPF*, this assessment has been compiled in accordance with professional standards and guidance. The standards and guidance which relate to the assessment are:

- *Clean Air Strategy* (Department for Environment, Food and Rural Affairs, 2019)[9]
- *UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations* (Department for Environment, Food and Rural Affairs and Department for Transport, 2017)[10]
- *DMRB standard: DMRB LA 105 Air quality*
- *Local Air Quality Management Technical Guidance (LAQM TG.16)* (Department for Environment, Food and Rural Affairs, 2018)[11]

Air Quality Objectives

5.3.9 Air Quality Objectives (AQO) detailed in the *Air Quality (England) Regulations 2000* are set out in Table 5-4: AQO Relevant to the assessment of local air quality impacts.

Table 5-4: AQO Relevant to the assessment of local air quality impacts

Pollutant	Concentrations in micrograms per cubic metre (µg/m^3)	Measured as	Number of Exceedances Allowed in a Calendar Year
Set for the protection of human (public health)			
NO_2	40	Annual Mean	None
	200	1-hour (hourly) mean	No more than 18
PM_{10}	40	Annual Mean	None
	50	24-hourly (daily) mean	No more than 35
$PM_{2.5}$	20*	Annual Mean	None
Set for the protection of ecosystems (critical level)			
Oxides of nitrogen (NO_X)	30	Annual Mean	None
*The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 - this updates the air quality regulations for $PM_{2.5}$			

[9] Department for Environment, Food and Rural Affairs (2019) Clean Air Strategy.
[10] Department for Environment, Food and Rural Affairs and Department for Transport (2017) UK plan for tackling roadside nitrogen dioxide concentrations.
[11] Department for Environment Food and Rural Affairs (2021) Part IV of the Environment Act 1995 and Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management Technical Guidance LAQM.TG16.

5.4 Assessment methodology

5.4.1 The methodology for the air quality assessment follows the standards set out within *DMRB LA 105*.

5.4.2 The A66 Environmental Impact Assessment Scoping Report[12] determined that a 'detailed' level of assessment is required for the EIA as there is potential for significant impacts to air quality at sensitive human and ecological receptors. The detailed assessment includes construction traffic and operational phase impacts.

5.4.3 Detailed methodologies applied within this assessment are presented in ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4) following the consideration of key environmental receptors and pollutants.

Construction phase assessment

5.4.4 Chapter 2: The Project contains a summary of the construction programme including information on key construction activities, construction compounds and site access locations.

5.4.5 Dust emissions arising from construction and demolition activities are likely to be variable in nature and would depend on the type and extent of activity, soil type and moisture, road surface conditions and weather conditions.

5.4.6 Construction, demolition and earthwork activities from the Project may all have an impact on local air quality. Trackout of material onto local roads where it can be re-suspended may also affect air quality. Trackout refers to the transport of dust and Fine Particulate Matter (PM_{10} and $PM_{2.5}$) from construction areas onto the road network.

5.4.7 A qualitative assessment of the impact of nuisance dust arising during construction has been undertaken, using standards set out in Section 2.56 *of DMRB LA 105*. Properties and ecological receptors within 200m of dust producing activities have been identified and appropriate mitigation proposed where required.

[12] Highways England, 2021. A66 Northern Trans-Pennine, PCF Stage 3 Environmental Scoping Report2

5.4.8 A detailed assessment has been carried out on the potential impact of construction traffic associated with the Project using an atmospheric dispersion model ADMS-Roads v5.0.0.1 following the methodology in DMRB LA 105 to determine the potential effects on annual mean nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) concentrations at selected sensitive receptors (locations of relevant human exposure and ecological sites).

5.4.9 Section 2.60 of *DMRB LA 105* states that the impact of construction activities on vehicle movements shall be assessed where construction activities are programmed to last for more than 2 years (which is applicable for the Project as construction is expected to commence in 2024, with scheme opening in 2029). Further details are set out in Section 5.6.4.

5.4.10 The emissions from site equipment and non-road mobile machinery have not been taken forward for detailed assessment due to the temporary nature of the works and the minimal impact the site equipment will have on overall pollutant concentrations, once suitable controls and site management are in place as set out in the Environmental Management Plan (EMP) (with reference to *LAQM.TG16* section 7.26).

Operation

Local air quality assessment (routewide)

5.4.11 A detailed assessment has been carried out on the routewide impacts of the Project using ADMS-Roads to determine the potential effects on annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at selected sensitive receptors (locations of relevant human exposure and ecological sites), in accordance with *DMRB LA 105* and the AQOs. Modelled concentrations have also been compared with the Limit Value (LV) for annual mean NO_2 following the method detailed in *DMRB LA 105* to provide a clear indication of the risk of delaying compliance at qualifying features.

5.4.12 The assessment has focused on reviewing updated traffic data received following the PEIR to identify areas of change and has been undertaken for the baseline (2019), Do-Minimum (DM) 'without project' scenario in the opening

year and the Do-Something (DS) 'with project' scenario in the opening year to identify any areas at risk of exceeding the Air Quality Objectives (AQO) detailed in the *Air Quality (England) Regulations 2000*.

5.4.13 To address uncertainty in predicted future roadside NO_2 concentrations and ensure modelled roadside concentrations are not too optimistic, the concentrations have been adjusted in-line with observed monitoring trends using the (then) Highways Agency Interim Alternative Long Term Annual Projection Factors (LTT_{E6}).

Assessment scenarios

5.4.14 The assessment for local air quality has been undertaken for the following scenarios:

- 2019 Baseline scenario
- 2029 Do-Minimum (DM) scenario: the traffic scenario at the year of opening without the Project
- 2029 Do-Something (DS) scenario: the traffic scenario at the year of opening with the Project.

5.4.15 For local air quality, the opening year of the Project is likely to be the worst-case scenario as vehicle emissions and background pollutant concentrations are anticipated to decrease over time due to improvements in fuel technologies.

5.4.16 Evidence from monitoring across the UK has indicated concentrations of pollutants are not reducing as quickly as predicted by Defra despite improvements to engine technology. To account for this, the future baseline projections scenarios were also calculated for 2029 following the stand in section 2.47 of *DMRB LA 105*.

5.4.17 The assessment in this chapter uses data provided from the traffic model for the future years which includes future developments. The developments included in the traffic data are detailed in the Combined Modelling and Appraisal Report (ComMA Report) for the Project which will be published as part of the DCO (Application Document 3.8).

Local air quality modelling

5.4.18 The inputs to the modelling process included:

- traffic data
- receptor locations
- meteorological data

- background concentrations.

5.4.19 Further details of the dispersion modelling inputs are provided in ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4).

Traffic data

5.4.20 Traffic data has been provided for the air quality assessment by the Project team. Traffic data provided represents the annual average daily traffic flows. The following data parameters were provided:

- Annual Average Daily Traffic (AADT) flow, defined as vehicles/hour
- percentage Heavy Duty Vehicles (HDV)
- vehicle speeds, in kilometres per hour (kph)
- speed band information for use in calculation of emission factors in accordance with *DMRB LA 105*.

5.4.21 Emissions from traffic data were calculated using the emission factors provided in the latest version (version 4.3) of the National Highways speed band emissions factors spreadsheet (National England, 2022)[13]. Using this methodology allows the effects of reducing or creating congestion to be more effectively assessed within the air quality study area.

5.4.22 The Geographic Information System (GIS) software, ArcMap has been used to assist inputting the road link information into the air quality models.

Receptors

5.4.23 Human and ecological receptors have been identified and added to the air quality dispersion model.

5.4.24 The building usage was determined using the Ordnance Survey Address Base Plus dataset, and modelled points were at the nearest façade to the busiest road.

5.4.25 A total of 86 human receptors are included in the assessment that were selected using the following criteria and professional judgement:

- proximity to the affected roads;
- representativeness of the maximum effects of the Project in that region; and

[13] National Highways (2022) Speed band emission factors for use with DMRB (version 4.3) provided by email from National Highways.

- whether they are at risk of exceeding the annual mean NO_2 AQO.

5.4.26 The list includes dwellings, hospitals and educational establishments; they are shown as dots on the human receptors drawing, ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3). All locations, referred to as 'receptors' are treated as being equally sensitive.

Designated habitat sites

5.4.27 To assess the impacts on ecosystems the study area was reviewed to identify designated ecological habitats within 200m of the Affected Road Network (ARN) following sections 2.25 to 2.26.1 of *DMRB LA 105*. 124 designated habitats sites were identified along the ARN. Details of the designated sites are provided in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4). Additional information is provided in ES Chapter 6: Biodiversity. All ecological sites are shown in the ecological receptors drawing, ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3).

5.4.28 Effects at ecological receptors have been assessed in accordance with section 2.97 to 2.102 of *DMRB LA 105*.

5.4.29 Receptor transects (receptor points every 10m away from the roadside) for each of the assessed designated sites up to 200m from the source have been included to allow assessment of the drop off in emissions and deposition at increasing distances from the road. All ecological receptor locations were modelled at a height of 0m.

5.4.30 National Highways have developed a tool to account for the additional contribution of ammonia (NH_3) emissions from vehicles to deposited nitrogen[1]. This has been used in the assessment to determine the nitrogen deposition at designated ecological sites within 200m of the ARN.

5.4.31 Following *DMRB LA 105*, in the first instance, the magnitude of change in annual mean nitrogen deposition at the designated habitats has been determined. *DMRB LA 105* notes that where the magnitude of change is less than 0.4kg N/ha/yr it is not considered to result in any loss in species and unlikely to be significant.

Meteorological data

5.4.32 The effect of meteorological conditions on dispersion is accounted for in the dispersion model. The most significant factors that affect dispersion are wind speed, wind direction and atmospheric stability.

5.4.33 Meteorological data used in the detailed assessment have been obtained from the two meteorological stations, Warcop Range and RAF Leaming, for 2019. Data from these sites were obtained in model-ready format. This is consistent with the base/verification traffic year. Warcop Range is located one mile (1.6km) north-east of the Project and RAF Leeming is located over 11 miles (18km) south-east. Data for Warcop Range has been used in the detailed assessment of the impacts of the Project on receptors west of Brough, whilst the assessment of those located to the east is based on observations from RAF Leeming. This approach has been adopted to account for the large geographical extent of the model domain and is consistent with the Planning Inspectorate Scoping Opinion (see below). The wind roses for each station are shown in ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4). The effect of potential transient meteorological conditions, such as the Helm Wind, are also set out in ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4).

5.4.34 The resultant predictions at sensitive receptors have been compared to the AQO and significance has been defined as per *DMRB LA 105*. Professional judgement has been applied alongside the application of GIS tools to identify these sensitive receptors.

Background concentrations

5.4.35 ‘Background’ air quality is a concept used to enable assessment of the effects of particular emission sources without the need for all sources in the area to explicitly considered. For the purpose of this assessment, the background air quality represents the contribution of all other relevant sources of air pollutants except those roads specifically included in the air quality model. The pollution due to the modelled roads

has been added to the background pollution concentrations.

5.4.36 The Defra air quality website (Department for Environment Food and Rural Affairs, 2018)[14] provides NO_x, NO_2, PM_{10} and $PM_{2.5}$ for each 1km by 1km square covering England.

5.4.37 The 'in-grid square' contribution from motorway, trunk 'A' road and primary 'A' road sectors have been removed from the background annual mean NO_x concentration estimates, and background annual mean NO_2 estimates have been corrected, to account for the change in NO_x concentration, using Defra's Background NO_2 Calculator[15]. This process has been undertaken to avoid double counting of road traffic emissions from those road sources included in the dispersion model.

5.4.38 The Defra background concentrations with major road sector contributions removed has been used in the modelling. A comparison with local authority background monitoring data showed a small difference in concentrations between the Defra background concentrations and the local monitored background data. At the location compared, concentrations varied by 1.0 µg/m^3. Details of the comparison and details of sites selected are provided in ES Appendix 5.3: Air Quality Assessment Baseline (Application Document 3.4).

Model verification

5.4.39 A comparison of modelled and measured NO_2 concentrations has been undertaken. This process is known as model verification. Verification has been undertaken for the base year (2019), using the principles laid out in Section A3.223 of LAQM TG.16. Additional receptor points have been included in the baseline modelling to represent the location of diffusion tube sites within 200m of the ARN at roadside locations to provide information for the verification exercise. The locations of selected verification points are listed in Table 1-1: Baseline air quality roadside monitoring sites and annual

[14] Department for Environment, Food and Rural Affairs (2018) Background Mapping data for local authorities.
[15] Department for Environment, Food and Rural Affairs (2020) NO2 Adjustment for NOx Sector Removal Tool.

mean NO_2 concentrations (2016-20), ES Appendix 5.3: Air Quality Baseline (Application Document 3.4) and are shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3).

5.4.40 The objectives of the model verification are to evaluate model performance, determine whether model adjustment is required, and to provide confidence in the assessment.

5.4.41 *LAQM TG.16* suggests that if modelled annual mean NO_2 concentrations are within ±25% and preferably within ±10% of the monitored concentration and there is no systematic under or over prediction, then model adjustment is not considered necessary to further improve modelled results.

5.4.42 Modelled and monitored results may not compare well at some locations for several reasons including:

- uncertainties in estimated traffic flow and speed data
- model setup (including street canyons, road widths, receptor locations)
- model limitations (treatment of roughness and meteorological data)
- uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data)
- uncertainty in emissions/emission factors.

5.4.43 The above factors were investigated as part of the model verification process to reduce the uncertainties as far as practicable.

5.4.44 Some monitoring locations are not suitable for model verification purposes as there may be specific local influences or they are located too close to the road, where *LAQM TG.16* advises they should not be used. Therefore, each site was examined, and it was considered whether it was suitable for use in the verification study. Some locations were then removed from the verification. For those monitoring sites not used, the justification for their removal is provided in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

5.4.45 The locations of these monitoring sites are presented in ES Appendix 5.4 Air Quality Assessment Results Table 5-3: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2015-20) (Application

Document 3.4). and shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3). Further detail on the verification process is provided in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

NO_x to NO_2 conversion

5.4.46 The approach to calculating the conversion of roadside NO_x to NO_2 has followed the guidance in *LAQM TG.16*. This approach allows the calculation of NO_2 from NO_x concentrations, taking into account the difference between ambient NO_x concentration with and without the Project, the concentrations of ozone and the different proportions of primary NO_2 emissions in different years. This approach is available as a spreadsheet calculator (Department for Environment, Food and Rural Affairs, 2020)[16]; the version released in August 2020 (v8.1) has been used.

5.4.47 Emission controls on vehicles have been introduced as a measure to reduce concentrations of NO_2 in the atmosphere. Levels of atmospheric NO_2 have not reduced as quickly as predicted due to ineffective emission controls on some vehicles in real world conditions. *DMRB LA 105* provides a method to address uncertainty in predicted future roadside NO_2 concentrations (section 2.47 to 2.55). This assessment has followed the requirements set out in *DMRB LA 105* to calculate the projected base year and apply gap factors to the modelled results.

Compliance risk assessment

5.4.48 *DMRB LA 105* provides requirements for the assessment of the risk of the Project being non-compliant with the Air Quality Standards *2010 (amended 2016).* The compliance risk assessment is undertaken using the modelling results from the local air quality assessment. To undertake compliance risk assessment, the following information is required:

- local air quality modelled results

[16] Department for Environment, Food and Rural Affairs (2020) NO_X to NO_2 Calculator.

- Defra's Pollution Climate Mapping (PCM) model outputs for the compliance road network (Department for Environment, Food and Rural Affairs, 2017) [17]
- Defra's zones and agglomerations maps (Department for Environment, Food and Rural Affairs, 2019)[18].

5.4.49 Defra uses the PCM model to report against compliance with the Air Quality Standards *2010 (amended 2016)*. The current PCM model results have concentrations predicted for each year between 2018 and 2030.

5.4.50 To determine the study area for the compliance risk assessment the local air quality study area is compared to the compliance link locations in the PCM model. Where the two networks intersect these links form the basis of the assessment of compliance risk.

5.4.51 A review was carried out to identify any qualifying features as defined in section 2.64 of *DMRB LA 105* and receptors added if they are within 15m. 16 receptors have been added along the PCM links and corresponding local model 4m validation points were added.

5.4.52 The impacts of the Project (i.e. the change in concentrations predicted by the ADMS-Roads model) are added to the modelled concentrations from the Defra PCM model for the opening year of the Project.

5.4.53 To determine the compliance risk of the Project, the Compliance Risk Flow Chart in figure 2.79 in *DMRB LA 105* has been followed.

Operational assessment criteria

5.4.54 Evaluation of the significance of the local air quality findings has been undertaken in accordance with *DMRB LA 105* (section 2.103). The assessment has assessed the following in order to determine if the Project triggers a significant air quality effect:

- The effects on human health
- The effects on designated habitats
- The outcomes of the compliance risk assessment.

[17] Department for Environment Food & Rural Affairs (2017) Defra PCM Modelled pollutant concentrations.
[18] Department for Environment Food & Rural Affairs (2019) Air Quality Plan for nitrogen dioxide (NO2) in UK (2017): Zone Plans- Defra, UK

5.4.55 A view on the significance for each of the above has been provided along with supporting evidence in section 5.10: Assessment of likely significant effects.

5.4.56 For human health the outcomes of the assessment have been screened following *DMRB LA 105* (section 2.89). If a concentration is greater than the AQO and the Project is predicted to have a greater than 1% change (compared with the relevant objective, e.g. 0.4µg/m^3 for annual mean NO_2), then the results are assigned to the change criteria shown in Table 5-5: Guideline for number of properties constituting a significant effect.

5.4.57 To aid the interpretation of significance of public exposure, as a result of the Project, table 2.92N in *DMRB LA 105* provides the criteria which have been used in this assessment. Where predicted annual mean NO_2 concentrations are below the AQO or the magnitude of change is ≤0.4µg/m^3, effects are likely to be imperceptible.

Table 5-5: Guideline for number of properties constituting a significant effect

Magnitude of change in NO2 (µg/m3)	Number of receptors with:	
	Worsening of AQO already above objective or creation of a new exceedance	Improvement of an AQO already above objective or the removal of an existing exceedance
Large (>4)	1-10	1-10
Medium (>2)	10-30	10-30
Small (>0.4)	30-60	30-60

5.4.58 The evaluation of the significance of nitrogen deposition results requires advice from an ecologist and therefore the significance of changes in pollutant concentrations and deposition rates at ecological designations is also discussed in Chapter 6: Biodiversity. The flow chart (figure 2.98) in *DMRB LA 105* has been used to determine significance at ecological sites.

In-combination climate change impact assessment

5.4.59 An in-combination climate change impact assessment has been conducted to assess likely changes to the significance of effects when considering the combined impact of the Project in a future changed climate on Air Quality receptors in the surrounding environment. The assessment

considers whether climate change could impact the likelihood and magnitude of the effects of the Project on the Air Quality receptors, or affect the susceptibility, vulnerability, value or importance of the receptors themselves. The assessment has been based on the latest UK Climate Change Projections and considers a range of climatic hazards including rising temperatures, higher and lower rainfall, and the increased frequency and magnitude of extreme events such as heat waves and flooding.

Scoping

5.4.60 Table 5-6: Summary of scoping opinion and response sets out the key points from PINS Scoping Opinion relevant to the air quality assessment. The full Scoping Opinion is provided in ES Appendix 4.2: EIA Scoping Opinion (Application Document 3.4).

5.4.61 Where assessment has been undertaken in accordance with the Scoping Opinion, the wording of each point raised with a response and reference to the relevant ES section is provided. Where further discussion and/or an alternative approach has been agreed with the relevant stakeholders and the Planning Inspectorate, an explanation is provided.

Table 5-6: Summary of scoping opinion and response

Consultee/ respondent	Scoping opinion comment	Applicant response	Where addressed?
The Planning Inspectorate	It is unclear whether an assessment of PM_{10} and $PM_{2.5}$ is proposed to be scoped out of the assessment [...] For the avoidance of doubt, the Inspectorate is not in agreement that an assessment of PM_{10} and $PM_{2.5}$ can be scoped out of the assessment across all parts of the scheme at this stage based on the evidence currently presented.	This is noted and has been addressed. PM_{10} and $PM_{2.5}$ have been included in this assessment.	Section 5.7: Baseline conditions and ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4)
The Planning Inspectorate	Due to the extended linear nature of the Proposed Development,	Two meteorological datasets will be considered in the	Section 5.4: Assessment methodology and ES

Consultee/ respondent	Scoping opinion comment	Applicant response	Where addressed?
	the Inspectorate considers that further justification is required for the use of a single meteorological monitoring station, to provide assurance that it is representative of the entire route of the Proposed Development.	assessment representing the east and west of the study area.	Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4)
The Planning Inspectorate	It is noted from Cumbria County Council comments (see Appendix 2) that an area around Castlegate is to be designated as an AQMA. The ES should ensure that this AQMA is considered within the impact assessment where increases in pollutant concentrations could occur as a result of the Proposed Development.	At the time of assessment no AQMA declaration order was in place and the Castlegate area was not identified within the ARN. As such it has not been included in-line with DMRB LA105. Further details are provided in the ES.	Section 5.4: Assessment methodology/ Section 5.7: Baseline conditions. ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4)
The Planning Inspectorate	The Inspectorate notes that the baseline air quality information for the Proposed Development will be collected from the sources listed at paragraph 6.5.1, together with information obtained from the Option Selection stage Environmental Assessment Report (EAR) (Highways England, 2018). No further project-specific monitoring appears to be proposed unless gaps are identified in the local authority monitoring (paragraph 6.5.4). Where no further monitoring is	This is noted and has been addressed. Additional project specific monitoring has been undertaken.	Section 5.4: Assessment methodology. Section 5.7: Baseline conditions. ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4). ES Appendix 5.3: Air Quality Baseline (Application Document 3.4)

Consultee/ respondent	Scoping opinion comment	Applicant response	Where addressed?
	undertaken, the ES should clearly explain why the baseline information is deemed sufficient to determine the baseline conditions for the purposes of the impact assessment.		
The Planning Inspectorate	The Scoping Report confirms that the main traffic related pollutants, namely oxides of nitrogen (NO_x) (together with nitrogen deposition) and PM_{10}, will be considered in the ES. The ES should also consider acid deposition and ammonia emissions from operational road traffic Scoping Opinion for paragraph 6.6.4 on sensitive receptors, such as ecological designated sites, where likely significant effects could occur.	The ES will include assessment of potential ammonia emissions, using the National Highways released toolkit, following *DMRB LA 105*.	Section 5.4: Assessment methodology. Section 5.7: Baseline conditions. ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4).
DCC	Section 2.4 of the PCF Stage 3 Environmental Scoping Report states that the Project has been split into a number of schemes. It should be confirmed whether the air quality assessment will consider the combined impact of all schemes within the Project, or the impact of each scheme individually. The approach would likely alter the extent of traffic impacts significantly. If the latter approach is taken, justification should be provided as to why the Project as a	The assessment has been undertaken on a route wide basis; however, impacts at receptors in each scheme area will be presented for consideration.	Section 5.4: Assessment methodology and ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4). Results are provided in Section 5.10: Assessment of likely significant effects.

Consultee/ respondent	Scoping opinion comment	Applicant response	Where addressed?
	whole is not being evaluated.		
Natural England	To date Natural England has advised that the impacts of ammonia from vehicle emissions should be considered at the appropriate assessment stage, particularly where case specific circumstances would benefit from such an analysis. This is the recommended approach until the importance of this source is better understood and peer reviewed assessment tools are available. The long-term aim will be to require ammonia from vehicles to be assessed at the in-combination stage of screening.	This is noted and has been addressed in the ES. Engagement with Natural England and National Highways is ongoing.	Section 5.4: Assessment methodology. ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4) Results are provided in Section 5.10: Assessment of likely significant effects.

Consultation

5.4.62 A summary of the consultation with key stakeholders is presented in Table 5-7: Summary of key consultation comments received.

Table 5-7: Summary of key consultation comments received

Consultee/ respondent	Comment	Applicant response	Where addressed?
Eden District Council	Consider the impact of traffic in the proposed Castlegate AQMA	At the time of assessment no AQMA declaration order was in place and the Castlegate area was not identified within the ARN. As such it has not been included in-line with *DMRB LA105*. Further details are provided in the ES.	Results are provided in section 5.10: Assessment of likely significant effects.

Consultee/ respondent	Comment	Applicant response	Where addressed?
Durham County Council	Include PM_{10}/$PM_{2.5}$	This has been included in assessment	Results are provided in section 5.10: Assessment of likely significant effects.
Durham County Council	Consider two meteorological stations for assessment	This has been considered and assessed	Results are provided in section 5.10: Assessment of likely significant effects.
Durham County Council	Inclusion of ammonia tool from National Highways	This has been considered and assessed	Results are provided in section 5.10: Assessment of likely significant effects.
Natural England	Consideration of ammonia for nitrogen deposition	This has been considered and assessed	Results are provided in section 5.10: Assessment of likely significant effects.

5.5 Assumptions and limitations

5.5.1 Air quality dispersion modelling has inherent areas of uncertainty, including:

- Traffic data used in the model
- Traffic emissions data
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere
- Background concentrations
- Meteorological data.

5.5.2 The quantitative assessment of road traffic emissions considers the point of full project opening, at which the greatest change in road traffic movements will be experienced.

5.5.3 To reduce uncertainty, sensitivity testing of emissions data has been carried out using the most recent standards from *DMRB LA 105* by including a projected baseline scenario. This reduces uncertainty, ensuring that the modelled roadside NO_2 concentrations are not over optimistic by adjusting the concentrations in-line with observed monitoring trends using the (then) Highways Agency Interim Alternative Long Term Annual Projection. Uncertainties or limitations related to transport data are discussed in the ComMA Report for the Project which will be published as part of the DCO (Application Document 3.8). These limitations have been

minimised as far as possible by verifying the modelled concentrations against monitoring results in appropriate locations.

5.5.4 Road traffic flows and speeds used in the assessment were provided by the project transport modelling specialists for all the operational assessment scenarios. The traffic forecasting is in line with the current guidance.

5.5.5 The construction air quality assessment is based on the best information currently available. As with all construction air quality assessments the exact details of activities will not be known before a specific contractor is appointed to complete the works and determines their exact construction methods and programme.

5.5.6 The construction of the Project will be undertaken in phases. The qualitative assessment of construction dust effects described in this chapter considers the construction of the Project as a whole, including all phases of the works. The quantitative assessment of construction phase vehicle movement emissions considers a single phase of construction, where construction vehicle movements associated with the Project are at the most frequent.

5.5.7 It is important to recognise the limitations of models and to use the outputs appropriately. For instance traffic flows of less than a 1,000 AADT are not used in assessment as they are below the confidence that can be attributed to a traffic model. In the same way that changes of less than 1% of the AQO for NO_2 (40 µg/m³ - therefore the criterion is 0.4µg/m³) and NO_X (30 µg/m³ - therefore the criterion is 0.3µg/m³) are considered to imperceptible and not considered further in assessment.

5.5.8 Therefore, for difference in modelled NO_X changes between the 'with' and 'without' Project scenarios will be scoped out where they are less than 1% of the 30µg/m³ NO_X annual mean threshold for vegetation. This is the same principal applied to the assessment of both the impacts on human health and determining compliance with mandatory limit values.

5.5.9 Changes in N deposition from the model are not considered where the difference in NO_X concentrations is imperceptible (as outlined

above), given that this is the basis of the calculation of N deposition.

5.6 Study area

5.6.1 The air quality assessment study area will vary based on the three sub-topics of assessment, as follows:

- Construction dust assessment, which is related to the risk of dust nuisance and dust emissions with potential to affect human health and ecosystems at a local level.
- Construction traffic assessment; which relates to pollutants with the potential to affect human health and designated sites at a local level during the construction phase of the Project.
- Operational traffic assessment, which relates to pollutants with potential to affect human health and designated ecological sites at a local level during the operational phase of the Project.

Construction phase

Construction Dust Assessment

5.6.2 The study area for the construction phase dust assessment includes all sensitive receptors within 200m of the Order Limits, which have the potential to be affected by construction activities (including construction compounds). Table 2.58b of *DMRB LA 105 Air quality* was used to identify the predicted dust risk potential based on the number of receptors within 0-50m, 50-100m and 100-200m.

Construction Traffic Assessment

5.6.3 The study area for the assessment of construction traffic has been determined following the standards outlined in *DMRB LA 105* where construction activities are predicted to exceed a two year duration. The study area comprises:

- Worst case receptors within 200m of the centre line of the affected roads.

5.6.4 A road is in the ARN if there are total flow changes of 1000 AADT or more, and/or HDV flow changes of 200 AADT or more as a result of on-site or off-site vehicle movements.

5.6.5 Figure 5.3: Air Quality Construction Phase Assessment shows the construction traffic study area.

5.6.6 The study area for construction traffic is the affected local ARN and was defined using traffic

data prepared for the Project, which is detailed in the Transport Assessment for the Project which will be published as part of the DCO (Application Document 3.7). It covers the following areas:

- The Project alignment from M6 J40 to west of Brough; and
- The Project alignment from east of Bowes to Scotch Corner.

5.6.7 The change in construction traffic movements between Brough and Bowes has been screened against the criteria given in section 5.6.4 (above). This section is already a dual carriageway and no improvement works will be taking place in this area and therefore has not been included in the assessment.

5.6.8 An assessment has been undertaken of the traffic impact during construction of the Project and is presented in section 11 of the Transport Assessment (Application Document 3.7). This has been undertaken to understand the mitigation measures that would need to be implemented to prevent traffic issues arising during the construction of the Project.

5.6.9 Mitigation would be achieved through the implementation of active traffic management measures, those being considered include limiting the use of speed reductions, i.e., through applying higher safe speeds, or limiting the amount of traffic management that is used in areas where the new route is being built adjacent to the existing A66. As a last resort, reactive traffic management measures would be employed to stop traffic from using the least suitable diversion routes. The proposed mitigation measures form part of EMP Annex B13 Construction Traffic Management Plan (Application Document 2.7).

Operation

Local air quality study area

5.6.10 The Project has been assessed on a route wide basis for the purposes of air quality. This is because the data gathered from traffic modelling undertaken as part of the Transport Assessment considered the Project as a whole.

5.6.11 The study area for the assessment of operational effects has been determined following the standards outlined in *DMRB LA 105* and has

been defined by the changes in traffic flows on the local road network. It comprises:

- Worst case receptors within 200m of the centre line of the existing road, at the Project location
- Worst case receptors within 200m of the centre line of the Project
- Worst case receptors within 200m of the centre line of any other 'affected roads'.

5.6.12 The ARN for the purposes of a local air quality assessment is defined as those roads within the Project 'traffic reliability area' (TRA), (i.e. the area of the traffic model considered to provide reliable estimates of traffic when the base traffic model is compared to observed traffic) that meet any of the following traffic change criteria (based on the two-way flow on all roads). The TRA covers a road network which extends over a wider geographic area than the Project. A road is in the ARN if one or more of the following criteria are met:

- Road alignment changes by 5m or more
- Daily traffic flows change by 1,000 AADT flow or more
- HDV flow changes by 200 AADT or more
- A change in speed band.

5.6.13 The extent of the TRA and its definition can be seen in the Transport Assessment for the Project (Application Document 3.7).

5.6.14 ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3) shows the local air quality study area.

5.6.15 The study area is the affected local ARN and was defined using traffic data provided by the traffic consultants. It covers the following areas:

- The Project alignment
- M6 between junction 35 and junction 45
- A1(M) between junction 48 and junction 61
- Local roads joining those outlined above.

5.7 Baseline conditions

5.7.1 In order to provide an assessment of the significance of any new development proposal (in terms of air quality), it is necessary to identify and understand the baseline air quality conditions in and around the study area. This provides a reference level against which any potential changes in air quality can be assessed. Since the baseline air quality is predicted to change in the

future (mainly because vehicle emissions are changing), the baseline situation has also been predicted for the opening year. The DM scenario is the predicted baseline for the opening year and includes any other schemes with a high level of certainty of being built.

Local air quality management summary

5.7.2 Comparing baseline conditions for relevant pollutants against the AQO detailed in the *Air Quality Standards Regulations 2010*) and the Limit Values (LV), the following has been concluded:

- National assessments have demonstrated that there is no risk of carbon monoxide, sulphur dioxide, 1,3-butadiene or benzene concentrations exceeding relevant AQO and LV thresholds due to emissions from traffic anywhere in the UK. As such, concentrations of these pollutants have not been modelled as it is unlikely that the Project will lead to exceedances for these pollutants.
- No exceedances of the annual mean NO_2 AQO and LV threshold of 40µg/m^3 have been identified in the air quality study area; however, Eden District Council monitoring data for Castlegate, Penrith is borderline with the AQO. The impacts of NO_2 have been considered in this assessment.
- For PM_{10} and $PM_{2.5}$ there are no AQMAs designated or likely to be designated for an exceedance of AQO and LV thresholds in the study area. It is acknowledged however that local authorities have a duty to understand potential impacts to PM_{10} and $PM_{2.5}$ in their administrative areas. Therefore, impacts from PM_{10} have been considered and assessed in the same way as NO_X, and ratios has been used to calculate $PM_{2.5}$ based on PM_{10} concentrations, based on whether the location is rural or urban (according to the TAG data book).

Current baseline

5.7.3 The latest baseline air quality information has been collected, including:

- AQMA interactive map (Department for Environment, Food and Rural Affairs, 2022)[19].
- Local authority air quality monitoring data taken from relevant annual status reports (ASRs).
- Scheme specific baseline air quality monitoring data.
- Defra background maps (Department for Environment, Food and Rural Affairs, 2019)[20] of predicted background NO_X, NO_2, PM_{10} and $PM_{2.5}$ concentrations.

[19] Department for Environment, Food and Rural Affairs (2021) Air Quality Management Areas Interactive Map.
[20] Department for Environment, Food and Rural Affairs (2019) Background Mapping data for Local Authorities.

- Boundaries of relevant designated ecological sites (Department for Environment, Food and Rural Affairs, 2021)[21].
- Background nitrogen (N) deposition for designated habitats included in the assessment have been obtained from Air Pollution Information System website (Air Pollution Information System, 2019)[22].
- Location of sensitive receptors (including ecological and human receptors – e.g. residential properties) that could be impacted on by the Project from OS Address Base Plus mapping, Cumbria Biodiversity Data Centre (Cumbria Biodiversity Data Centre, 2022)[23], Environmental Records Information Centre (Environmental Records Information Centre, 2022)[24], Lancashire Environment Record Network (Lancashire Environment Record Network, 2022)[25], North and East Yorkshire Ecological Data Centre (North & East Yorkshire Ecological Data Centre, 2022)[26] and Natural England (Natural England, 2022)[27].
- Defra information used in its reporting of compliance with the Air Quality Standards *2010 (amended 2016)* (which has included the Pollution Climate Mapping (PCM) Model (Department for Environment, Food and Rural Affairs, 2017)[28] published modelled results).

Air Quality Management Areas

5.7.4 The Project is located in the administrative boundaries of Durham County Council, Eden District Council and Richmond District Council.

5.7.5 Durham County Council has designated two AQMAs (Durham and Chester-le-Street), however these are located over 30km from the A66, outside of the ARN and are unlikely to be affected by the Project.

5.7.6 Eden District Council and Richmond District Council have not designated any AQMAs; however, Eden District Council have been considering the potential for a future AQMA to be declared at Castlegate, Penrith. At the time of writing, no AQMA has been declared at Castlegate.

[21] Department for Environment, Food and Rural Affairs (2021) Magic Interactive Map.
[22] Air Pollution Information System (2016) Background Nitrogen Depositions.
[23] Cumbria Biodiversity Data Centre (2022) Data and Information Services.
[24] Environmental Records Information Centre (2022) Data Request Form.
[25] Lancashire Environment Record Network (2022).
[26] North & East Yorkshire Ecological Data Centre (2022).
[27] Natural England (2022) Open Data]
[28] Department for Environment, Food and Rural Affairs (2021) 2020 and PM NO2 projections data (2018 reference year)

Monitoring data

5.7.7 Local authorities have conducted air quality monitoring along the ARN. The Option Selection Stage Environmental Assessment Report (EAR) identified that annual mean NO_2 concentrations in 2017 were below the annual mean objectives within the extent of the ARN. The latest local air quality management review and assessment reports have been obtained as part of the baseline assessment, which has included all relevant air quality monitoring data derived from local authority sources. The location of the local authority monitoring points within 200m of the ARN are shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3). Information from the monitoring has been used to establish baseline air quality conditions.

5.7.8 Local authority data from 2019 taken from roadside monitoring locations adjacent to the ARN have also been used to verify both the detailed modelling approach and is presented in ES Appendix 5.3: Air Quality Baseline, Table 1: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2016-20) (Application Document 3.4).

Local authority monitoring data

5.7.9 Baseline air quality monitoring data have been taken from local authority NO_2 diffusion tube sites operated by Eden District Council and Richmond District Council over the past five years (2016-2020). Concentrations of annual mean NO_2 have been recorded as exceeding the objective in the study area at roadside monitoring sites Lower Castlegate (42.0µg/m³ in 2019) and New Vic (43.0µg/m³ in 2019) in Eden District Council in 2019 as shown in Table 1: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2016-20), ES Appendix 5.3: Air Quality Baseline (Application Document 3.4). Both of these sites are considered to be representative of relevant exposure. No exceedances were recorded in 2020 at any location, however the national Covid-19 lockdowns are likely to have influenced this.

5.7.10 ES Appendix 5.3: Air Quality Baseline (Application Document 3.4) gives the site

information and annual mean NO_2 concentrations for the local authority monitoring sites that have been used to verify the roads model located within the ARN. Data have been used from locations with a data capture rate of 85% or more in 2019. Where data are above the AQO, these are highlighted in bold.

Scheme specific monitoring data

5.7.11 Scheme specific air quality monitoring was undertaken to support the ES across the Project study area, at both human and ecological receptors, sampling concentrations of NO_2 and NH_3. Further details on the locations of these monitoring sites are set out in ES Appendix 5.3: Air Quality Baseline (Application Document 3.4) and shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3).

5.7.12 As the modelled concentrations used in the assessment have been adjusted in-line with observed monitoring trends using the LTT_{E6} factors, the predicted NO_2 concentrations are likely to be conservative; consequently, monitoring was undertaken to validate the predicted concentrations.

5.7.13 The additional contribution of NH_3 emissions from vehicles to deposited nitrogen was determined using the tool developed by National Highways. The predicted concentrations were also validated using the monitored data.

5.7.14 Monitoring of NO_2 concentrations was undertaken using diffusion tubes at 16 monitoring locations from November 2021 to February 2022. NH_3 concentrations were also monitored using tubes co-located at 13 of the 16 monitoring locations.

5.7.15 The average, raw monitored results are provided in ES Appendix 5.3: Air Quality Baseline (Application Document 3.4). Monitored NO_2 results have been annualised, where more than three months of data exist, to determine a representative annual mean concentration, for comparison with the annual mean NO_2 objective, and bias adjusted.

5.7.16 It is necessary to bias adjust diffusion tube results as this type of monitoring is not a reference method and therefore generally has lower accuracy. Annualisation and bias adjustment was

carried out by consultants on behalf of the Applicant.

5.7.17 The highest NO_2 result was 21.1µg/m^3 at location AQM1 and all the monitoring results were below the objective. The highest NH_3 result was 11.1µg/m^3 at location AQM2. Both locations are adjacent to the A1(M) southbound near Londonderry. Full results are presented in ES Appendix 5.3: Air Quality Baseline (Application Document 3.4) and shown in ES Figure 5.2: Air Quality Baseline (Application Document 3.3).

Defra Pollution Climate Mapping (PCM) modelling

5.7.18 Predicted roadside NO_2 concentrations were obtained from Defra's PCM model for the years 2019 and 2029. The nearest Defra PCM links to the Project, used to determine compliance with the limit values, are in Penrith and are well below the annual mean NO_2 LV of 40µg/m³ (less than 20µg/m^3 in 2019). In 2029 Defra PCM mapping indicates all links would still comply with limit values.

Defra background concentrations

5.7.19 The predicted Defra background concentrations for the base year of 2019 along the route are well below the annual mean objectives for NO_2, PM_{10} and $PM_{2.5}$ with maximum NO_2 concentrations of 11.9µg/m^3, maximum PM_{10} concentrations of 15.6µg/m^3 and maximum $PM_{2.5}$ concentrations of 8.4µg/m^3.

5.7.20 Although the route is predominantly rural, there are pockets of receptors along the A66 which include both residential and ecological receptors.

Future baseline

5.7.21 The 'do-minimum' and 'do-something' scenarios have been set out, with the 'do-minimum' scenario representing the future baseline without the scheme.

5.7.22 Background concentrations are expected to improve in the future through reduced vehicle emissions resulting from efficiencies and technological improvements in the national fleet between 2019 and 2029, for example with the introduction of electric vehicles.

5.7.23 The predicted future Defra background concentrations along the route are well below the annual mean objectives for NO_2, PM_{10} and $PM_{2.5}$, with NO_2 concentrations ranging from 7.4 to 3.3µg/m^3, PM_{10} concentrations ranging 14.8 to 6.8µg/m^3 and $PM_{2.5}$ concentrations ranging 7.8 to 4.6µg/m^3 in the opening year of 2029.

5.7.24 The in-combination climate change assessment has used a future climate baseline that is based on representative concentration pathway 8.5 (RCP 8.5) of the UK climate change 2018 projections (UKCP18). This future climate baseline is presented in Chapter 7: Climate.

5.8 Potential impacts

5.8.1 Based on the Project design and associated construction activities, the Project has the potential to impact upon air quality during both construction and operation.

5.8.2 The design of the Project, including any embedded mitigation measures that have been incorporated, are described in Chapter 2: The Project. Any key aspects of the design and embedded mitigation are also referenced in this section where they are directly applicable to the air quality assessment.

5.8.3 Potential impacts of the Project are described in this section prior to the implementation of the essential mitigation described in section 5.9: Essential mitigation and enhancement measures. The residual effects of the Project, accounting for this essential mitigation, are then described in section 5.10: Assessment of likely significant effects.

Construction

Design and embedded mitigation

5.8.4 To minimise the risk of adverse impacts during construction, industry best practice measures will be employed, including good site management and material storage, monitoring and considerate site planning. Appropriate measures and a schedule of mitigation measures will be specified within the EMP for the Project.

Potential impacts

5.8.5 During construction, potential air quality effects arise from emissions of construction dust and particulate matter (PM). These emissions occur as a result of construction activities such as demolition, earthworks, construction and trackout. The quantities of each depend on the scale and intensity of the construction works.

5.8.6 Dust has the potential to cause nuisance to property, and very high levels of soiling can affect plants and ecosystems. There is the potential for dust nuisance on receptors within 200 metres of construction and haulage routes associated with the Project. This nuisance, which is separate from adverse effects on health, can arise through annoyance caused by the soiling of windows, cars, washing and other property. Potential air quality effects arising from dust emissions due to earthworks and construction activities are assessed in section 5.10: Assessment of likely significant effects.

5.8.7 There are a number of receptors which could be directly affected by dust nuisance associated with the Project works or construction vehicle traffic, and there is therefore potential for adverse impacts. Best practice construction dust control measures and standard mitigation measures are presented in EMP. Any potential impacts will be temporary in nature.

5.8.8 During the construction phase, potential air quality effects arise from emissions from HDVs using the road network. These impacts are discussed in section 5.10: Assessment of likely significant effects.

5.8.9 Following implementation of industry best practice mitigation measures the potential residual impact of construction dust and PM_{10} is expected to be negligible and unlikely to give rise to a significant effect.

Operation

Design and embedded mitigation

5.8.10 Mitigation of operational phase impacts will only be required if significant adverse effects are identified and would follow measures set out in *DMRB LA 105.*

Potential Impacts

5.8.11 During operation, changes to the road network will result in changes to traffic flow, speed and fleet composition. Traffic flows are likely to increase due to the improved desirability of the route, and speeds are likely to increase due to increased capacity and reduced congestion.

5.8.12 These changes will impact on emissions of the main traffic related pollutants, NO_X, PM_{10} and $PM_{2.5}$. As a result, pollutant concentrations at human and sensitive ecological receptors in the vicinity of the Project alignment, and in the wider study area near the ARN will be affected by the Project. These changes may result in permanent improvements and deteriorations in local air quality.

5.9 Essential mitigation and enhancement measures

Construction

Essential mitigation

5.9.1 During construction there is the potential for changes in air quality due to dust emissions from construction activity, emissions from site plant equipment and HDVs and also from changes in traffic flows along the Project and wider road network with traffic management in place.

5.9.2 Best practice mitigation measures to reduce effects from construction dust are included in the EMP. These measures include the following:

- Minimisation of areas to be stripped of vegetation.
- Dampening down of dust generating activities and materials, including site roads, during dry weather, in addition to site monitoring (e.g., periodic visual inspections within and along site boundaries).
- Ensuring vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- As far as possible temporary roads should be hard surfaced to reduce dust generation.
- Road sweeping to be carried out on access roads and local roads to remove any material tracked out of the site.
- Management of stockpiled materials with the potential to generate dust by rolling, covering and//or revegetating as soon as appropriate.

Enhancement

5.9.3 No enhancement measures are proposed for construction phase impacts.

Operation

Essential mitigation

5.9.4 On the basis that the Project does not:

- Lead to exceedances of the AQO for NO_2, PM_{10} and $PM_{2.5}$ at any location in the opening year
- Affect the UK's ability to comply with the Air Quality Directive
- Affect any AQMAs
- Contradict any of the air quality specific measures listed in the *NPSNN*
- Result in likely significant effects at designated ecological habitats as determined by the project biodiversity team (as outlined in ES Chapter 6 Biodiversity).

5.9.5 Consequently, no specific mitigation or Project Air Quality Action Plans (in accordance with *DMRB LA 105*) are required for the operation of the Project.

Enhancement

5.9.6 There are no specific enhancement measures included in the Project for air quality.

5.10 Assessment of likely significant effects

5.10.1 This section identifies the likely air quality effects of the Project that are predicted to be significant. Likely effects not predicted to be significant are presented in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

Construction

Construction dust

5.10.2 The Project involves dualling existing single carriageway sections of an A-road. Junction improvements are proposed, together with changes in route alignment to avoid key constraints, as well as the construction of an underpass at Kemplay Bank.

5.10.3 In line with the standards outlined in Sections 2.58 to 2.73 of *DMRB LA 105* a construction dust assessment has been carried out. The Project has been defined as a major infrastructure project and the construction dust risk potential categorised as large.

5.10.4 Sensitive human receptors and designated ecological habitats within 200m of the Order Limits have been identified and can be seen on

ES Figure 5.3: Air Quality Construction Phase Assessment (Application Document 3.3). The sensitive human receptors identified include those located in the settlements of Penrith, Kirkby Thore, Warcop, Bowes, West Layton and others along the route of the Project. Chapter 2: The Project contains details of construction activities, construction compounds and site access locations.

5.10.5 The number of human receptors in each distance band of the Order Limits is set out in Table 5-8: Number of human receptors within 200m of construction and demolition activities.

Table 5-8: Number of human receptors within 200m of construction and demolition activities

Distance	Count at Distance	Cumulative Count
0-50m	583	583
50-100m	297	880
100-200m	587	1467

5.10.6 There are twelve designated habitats within 200m of the Order Limits, as detailed in Table 5-9: Designated habitats within 200m of construction and demolition activities, and two veteran trees. The table includes some features that are considered as part of the operational phase assessment, as given in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

Table 5-9: Designated habitats within 200m of construction and demolition activities

Site Name	Designation
Skirsgill Woods	County Wildlife Sites (CWS)
Yanwath Wood	CWS
River Eden	Special Area of Conservation (SAC)
River Eden and Tributaries	SSSI
Salter Wood	Ancient Woodland
Whinfell Forest	CWS
Temple Sowerby Moss	SSSI
Chapel Wood	Ancient Woodland, CWS
Graham's Gill / Jack-Wood	Ancient Woodland
Sandford Mire	CWS
Rokeby Park and Mortham Wood	LWS
Stephen Bank Road Verge	LWS

5.10.7 Construction activities will take place across all schemes, with potential compounds (as detailed

in Chapter 2: The Project) distributed across the Project in addition to the construction of the proposed roads, junctions and underpass. There will be several small satellite compounds, likely to range from 1,000 to 2,000m^2 with some of the larger compounds exceeding 40,000m^2.

5.10.8 Internal material haulage will be expected to be carried out by 30 tonne articulated lorries though site access locations and routes are still to be confirmed. In addition to the compounds, there will be storage areas associated with cut and fill activities; these stockpile heights will be expected to be approximately 2m in height.

5.10.9 As shown in Table 5-8: Number of human receptors within 200m of construction and demolition activities, there are 880 human receptors between 0-100m from the Order Limits. Therefore, the receiving environment's sensitivity to construction dust has been categorised as high for these receptors. For the human receptors between 100-200m from the Order Limits, the sensitivity is low as defined in *DMRB LA 105*.

5.10.10 Overall, the Project is considered to have a large construction dust risk potential. It has the potential to affect receptors during the construction phase and consequently mitigation measures will be required to reduce the frequency and intensity of potential dust impacts.

5.10.11 Mitigation to reduce construction dust impacts to a negligible level will be included in the EMP as described in *DMRB LA 105*. This includes development of a dust management plan with measures to monitor effectiveness of mitigation, on-site and off-site inspections and keeping a record of complaints/exceptional dust events.

5.10.12 With appropriate best practice mitigation measures in place the potential impacts from construction are considered to be not significant.

Construction Traffic

5.10.13 Due to the nature of the Project, large quantities of material will be required during construction and therefore transportation of these materials will be necessary on the local road network and designated haul routes (see Chapter 11 Materials & Waste for further details). As there are few east to west alternative Trans-Pennine routes to the

A66 and the requirement for both online and offline working, an extensive traffic management programme will be implemented for the Project. As noted in Application Document 2.6 (Construction Method and Management Statement), bulk earthworks movements will take place on the new A66 route (prior to being opened) to limit the impacts on local stakeholders and A66 road users. Where there are limitations or where material is required to be stored or stockpiled a distance from where it is being excavated, dedicated haul routes will be considered and established. Parts of the existing A66 will be used to move bulk earthworks material where haul roads can not be established.

5.10.14 There is the potential that the movement of construction-related vehicles may cause a deterioration in air quality along transport routes for human receptors or lead to elevated nitrogen deposition at designated ecological receptors. As noted in Chapter 2: The Project, there are likely to be compounds situated in Penrith and Bowes, amongst other locations. A particular concern would also be if construction-related vehicles affected or diverted local traffic within locations with sensitive receptors close to these routes approaching the AQO. As noted in EMP Annex B13 Construction Traffic Management Plan (Application Document 2.7), the Construction Traffic Management Plan to be developed by the appointed contractor will ensure construction vehicles avoid these areas.

5.10.15 The assessment of impacts to human health has identified seven human receptors where there are predicted annual mean NO_2 changes greater than 0.4µg/m^3 and one exceedance of the AQO at receptor point 22 (Kemplay Bank Roundabout, Penrith) in the first year of construction (2024). There are predicted to be around 218 additional HDV movements per day past this location (total HDV movements include those for the removal of surplus excavated material from the construction site). The annual mean NO_2 concentration at this location is predicted to remain above the air quality objective during the construction phase (receptor 22, 49.4µg/m^3). The change in total concentration is predicted to be 1.5µg/m^3 during the construction phase.

5.10.16 No exceedances are predicted at human receptors for PM_{10} or $PM_{2.5}$.

5.10.17 The assessment of effects at designated habitats identified two locations where the scheme is predicted to result in an increase in nitrogen deposition greater than 0.4 kg N/ha/yr. The maximum increase in nutrient nitrogen deposition as a result of construction-related vehicles is predicted to be 2.4 kg N/ha/year at receptor point Lightwater Alluvial Forest part of the River Eden and Tributaries SSSI. At this location, as a percentage of the lower critical load for the relevant habitat (10 kg N/ha/yr), there is a 24% increase in nitrogen deposition. This receptor point is predicted to experience an increase as a result of construction vehicle movements. There are predicted to be around 365 additional HDV movements per day past this location.

5.10.18 Whilst the construction phase is temporary in nature, due to the likely HDV numbers, duration of works and the presence of sensitive human and ecological receptors near to roads likely to be affected, the potential for likely significant effects from construction-related traffic will be considered further below in section 5.10: Assessment of likely significant effects.

Operation

Route wide

5.10.19 The anticipated concentrations and changes in annual mean NO_2 are discussed in this section, with the potential impact and effect of changes in nitrogen deposition at ecological sites also considered.

Affected Road Network

5.10.20 Following *DMRB LA 105* screening criteria, the ARN was identified for the area around the Project for the 2029 modelled opening year scenario. The 2029 ARN is shown in ES Figure 5.4: Air Quality Operational Phase Assessment (Application Document 3.3).

5.10.21 Roads have been included in the ARN mainly based on changes to the total AADT (total AADT changes by more than plus or minus 1,000 vehicles per day) and on changes to heavy duty vehicle (HDV) volumes. A smaller number of links

have also been screened in based on changes in speed. The areas covered by the ARN are described in paragraph 5.6.14. A summary table of traffic changes along the main roads identified in the ARN is provided in Table 5-10: Summary of ARN traffic changes in opening year (two-way traffic flow changes AADT).

Table 5-10: Summary of ARN traffic changes in opening year (two-way traffic flow changes AADT)

Road section	Do something (DS) - Do minimum (DM) (vehicles/day)
M6 (north of A66)	+1,304
M6 (south of A66)	-2,029
A66 near Penrith	+40,990
Existing A66 near Kirkby Thore	-20,368
New A66 Kirkby Thore bypass	+27,876
Existing A66 near Crackenthorpe	-19,322
A66 near Appleby-in-Westmorland	+14,408
A66 near Warcop	+24,606
A66 near Bowes	+7,727
A1(M) (north of A66)	+2,112
A1(M) (south of A66)	+3,293

Compliance links

5.10.22 Where the ARN overlaps with Defra PCM links, these have been selected and used to determine the risk of delaying compliance with the limit value. In this assessment, the PCM model overlaps with the ARN around Penrith as shown in ES Figure 5.4: Air Quality Operational Phase Assessment (Application Document 3.3).

Model verification

5.10.23 The modelled results at existing monitoring locations were used for model verification based on the method set out in section 5.4.39. Details of the verification process and results are provided in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

Human Receptors

5.10.24 Detailed assessment of the DCO alignment has been undertaken using ADMS-Roads as set out in ES Appendix 5.2: Air Quality Assessment Methodology (Application Document 3.4).

5.10.25 This section describes the predicted concentrations at human receptor locations as a result of the Project in the baseline year (2019) and modelled opening year (2029) when there will be a change in vehicle flows which meet the *DMRB LA 105* screening criteria.

5.10.26 The modelled NO_2, PM_{10} and $PM_{2.5}$ concentrations and magnitude of change for all 86 human receptors modelled are presented in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

5.10.27 There are no predicted exceedances of the NO_2 AQO at human receptor locations.

5.10.28 No exceedances are predicted at human receptors for PM_{10} or $PM_{2.5}$.

5.10.29 Results have been presented in geographic areas known as 'discussion regions'. This approach has been chosen as the air quality assessment study area, shown in ES Figure 5.1: Air Quality Study Area and Constraints (Application Document 3.3), is determined by the geographical extent of the ARN (as defined in section 5.6.12), which extends beyond the A66 and includes the parts of the A1(M) and M6 north and south of the A66 which are included in the TRA. Routewide effects for the A66 are considered within discussion region 1 and discussion region 2. Due to the nature of the traffic data the results have not been presented on a scheme by scheme basis, this reflects the movement of traffic between schemes and the air quality impacts which can extend up to 200m from affected roads.

5.10.30 Selected receptors have been chosen in each discussion region to summarise the changes in air quality as a result of the Project across these different locations. The receptors were selected to show the largest changes in concentrations in the region and the highest total concentrations predicted. Six discussion regions have been used and are as follows:

- Discussion region 1: A66
- Discussion region 2: Penrith
- Discussion region 3: A1(M) - north of A66
- Discussion region 4: A1(M) - south of A66
- Discussion region 5: M6 - north of A66
- Discussion region 6: M6 - south of A66.

5.10.31 The predicted DS 2029 annual mean NO_2 concentrations are illustrated in ES Figure 5.4: Air Quality Operational Phase Assessment (Application Document 3.3).

Discussion region 1 – A66

5.10.32 In discussion region 1 receptors (see Table 5-11: NO_2 concentrations at selected receptors – discussion region 1) have been selected to represent the scale of impacts associated with the Project.

Table 5-11: NO_2 concentrations at selected receptors – discussion region 1

Receptor	Grid reference (m)		Annual mean NO_2 (µg/m^3)			Change (DS - DM) (µg/m^3)	AADT change (vehicles/ day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 60	405041	513817	10.3	9.0	9.9	+0.9	+3,603
HSR 43	368565	521110	8.8	7.5	8.2	+0.7	+2,867
HSR 51	379069	514607	8.7	7.4	8.0	+0.6	+3,245
HSR 44	371378	518571	8.7	7.4	8.2	+0.8	+3,189
HSR 56	385987	513883	10.2	8.9	9.8	+0.9	+5,939
HSR 55	382311	514752	9.6	8.3	9.1	+0.8	+5,939

5.10.33 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project with concentrations well below the AQS.

5.10.34 The overall traffic on the A66 does increase due to the increased desirability of the cross-Pennine strategic route, but the traffic flow is improved and existing baseline concentrations are well below the relevant AQOs.

5.10.35 There are also improvements in concentrations at receptors along the existing A66 alignment where a new alignment is proposed. These are detailed in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4).

Discussion region 2 – Penrith

5.10.36 In this discussion region 2 receptors (see Table 5-12: NO_2 concentrations at selected receptors – discussion region 2) have been selected to represent the scale of impacts associated with the Project. Local authority monitoring showed that roadside concentrations of annual mean NO_2 in the Penrith area has exceeded the AQO between 2017-2019.

Table 5-12: NO_2 concentrations at selected receptors – discussion region 2

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 22	352176	529010	38.5	33.3	30.5	-2.8	+352*
HSR 8	351067	529266	36.3	32.6	35.2	+2.6	+1,770
HSR 6	351060	529281	36.4	32.2	34.6	+2.4	+4,359
HSR 4	350292	530194	39.2	36.4	36.9	+0.5	+1,305
HSR 10	351083	529267	31.5	28.5	30.7	+2.2	+1,770
HSR 7	351063	529297	32.5	28.6	30.4	+1.8	+4,359
Note: *The adjacent links at the roundabout experience a decrease in AADT of 9555 vehicles/day due to the new through roundabout alignment of the A66.							

5.10.37 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project with concentrations well below the AQS.

5.10.38 The maximum increase in NO_2 concentrations as a result of the Project in 2029 is predicted to be at receptor point 8 (Skirsgill Close, Penrith) of 2.6$\mu g/m^3$.

5.10.39 The greatest reduction in NO_2 concentrations as a result of the Project in 2029 is predicted to be at receptor point 22 (Kemplay Bank Roundabout, Penrith) of 2.8$\mu g/m^3$. This reduction is due to the redesign of the roundabout and realignment of adjoining roads next to this isolated property.

Discussion region 3 – A1(M) (north of A66)

5.10.40 In this discussion region 3 receptors (see Table 5-13: NO_2 concentrations at selected receptors – discussion region 3) have been selected to represent the scale of impacts associated with the Project.

Table 5-13: NO_2 concentrations at selected receptors – discussion region 3

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 79	425228	515675	13.8	12.1	12.2	+0.1	+1,294
HSR 81	426939	515378	9.5	8.0	7.9	-0.1	-33*
HSR 82	427161	515341	11.1	9.4	9.3	-0.1	-33*
HSR 83	427704	519905	12.8	11.1	11.2	+0.1	+1,148

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
*These links were included as within 200m of receptors within the ARN							

5.10.41 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project with concentrations well below the AQS.

5.10.42 The overall traffic on the A1(M) does increase slightly, but the traffic flow is improved and existing baseline concentrations are well below the relevant AQOs.

Discussion region 4 – A1(M) (south of A66)

5.10.43 In this discussion region 4 receptors (see Table 5-14: NO_2 concentrations at selected receptors – discussion region 4) have been selected to represent the scale of impacts associated with the Project.

Table 5-14: NO_2 concentrations at selected receptors – discussion region 4

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 86	430978	486370	21.7	19.6	20.1	+0.5	+2,878
HSR 78	422329	499532	17.2	15.2	15.5	+0.3	+3,293
HSR 80	426624	493429	16.4	14.7	15.1	+0.4	+3,202
HSR 85	429976	487724	15.6	13.9	14.1	+0.2	+2,878
HSR 71	421559	504755	14.9	13.3	13.1	-0.2	+1,496*
Note: *The reasoning for the decrease in concentration at HSR71, despite the increase in AADT is due to a change in speed band high speed to free flow between DM and DS scenarios							

5.10.44 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project with concentrations well below the AQS.

5.10.45 The overall traffic on the A1(M) does increase due to the increased desirability of the cross-Pennine strategic route from the M6 north of A66 and A1(M) south of A66, but the traffic flow is improved and existing baseline concentrations are well below the relevant AQOs.

Discussion region 5 – M6 (north of A66)

5.10.46 In this discussion region 5 receptors (see Table 5-15: NO_2 concentrations at selected receptors – discussion region 5) have been selected to represent the scale of impacts associated with the Project.

Table 5-15: NO_2 concentrations at selected receptors – discussion region 5

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 1	341299	559588	14.9	12.9	13.0	+0.1	+1,076
HSR 2	342906	548969	11.5	10.3	10.4	+0.1	+1,181
HSR 3	349154	533838	12.3	10.9	11.0	+0.1	+1,181

5.10.47 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project with concentrations well below the AQS.

5.10.48 The overall traffic on the M6 (north of A66) does increase due to the increased desirability of the cross-Pennine strategic route from the A1(M) up to Scotland, but the traffic flow is improved and existing baseline concentrations are well below the relevant AQOs.

Discussion region 6 – M6 (south of A66)

5.10.49 In this discussion region 6 receptors (see Table 5-16: NO_2 concentrations at selected receptors – discussion region 6) have been selected to represent the scale of impacts associated with the Project.

Table 5-16: NO_2 concentrations at selected receptors – discussion region 6

Receptor	Grid reference (m)		Annual mean NO_2 ($\mu g/m^3$)			Change (DS - DM) ($\mu g/m^3$)	AADT change (vehicles/day)
	X	Y	2019 Base	2029 DM	2029 DS		
HSR 31	359948	495777	14.2	12.6	12.4	-0.2	-1,580
HSR 28	355287	520236	14.0	12.4	12.2	-0.2	-1,920
HSR 21	351836	528378	13.4	11.7	11.6	-0.1	-1,920
HSR 24	352921	479316	11.1	9.5	9.5	<0.1	-1,492

5.10.50 There are no predicted exceedances of the annual mean NO_2 objective in 2029 as a result of the Project.

5.10.51 The overall traffic on the M6 (south of A66) reduces slightly due to the increased desirability of the M6 north of A66 and A1(M) south of A66, with improvements in concentrations and existing baseline concentrations are well below the relevant AQOs.

Compliance Links

5.10.52 *DMRB LA 105* sets the method which has been followed to assess compliance with the air quality directive based on PCM data provided by Defra.

5.10.53 There are eight PCM links in the study area; all of which are located around Penrith. There are no exceedances of the NO_2 air quality objective as a result of the Project at PCM receptors.

5.10.54 Four locations are predicted to have an increase in concentration greater than 0.4µg/m^3, these are: C5, C6, C7 (0.6µg/m^3) and C8 (0.5µg/m^3). The greatest concentrations in these locations are predicted to be 14.5µg/m^3 at C5 and C7 and are not at risk of exceeding or delaying compliance with the LV.

5.10.55 The remaining four locations are predicted to have a reduction in concentration greater than 0.4µg/m^3: C1 and C2 (-2.5µg/m^3), C3 (-1.0µg/m^3) and C4 (-0.8µg/m^3).

5.10.56 All other changes in concentrations at locations 4m from PCM links are in-line with those set out above (increases and reductions >+/- 0.4µg/m^3), with the exception of C8_4m, which is predicted to experience an increase in 0.4µg/m^3.

5.10.57 Based on the results of this assessment, the compliance testing indicates that the Project is low risk as defined in *DMRB LA 105* (Figure 2.79). None of the links are at risk of becoming non-compliant as a result of the Project, the date for achieving compliance will not be affected, and there will be no increase in the length of roads in exceedance in the zones.

Air quality management areas

5.10.58 There are no local AQMAs which are likely to be affected by the Project.

Habitat sites

5.10.59 The change in nutrient nitrogen deposition as a result of the Project has been predicted at 124 ecologically sensitive receptors.

5.10.60 The nutrient nitrogen deposition in the baseline year and modelled opening year, and the magnitude of change between 'Do-Minimum' and 'Do-Something' scenarios for all ecological receptors modelled are presented in ES Appendix 5.4: Air Quality Assessment Results (Application Document 3.4). These results take into account the additional contribution of ammonia emissions from vehicles, using the National Highways emissions toolkit.

5.10.61 The maximum increase in nutrient nitrogen deposition as a result of the Project in 2029 is predicted to be 2.7 kg N/ha/year at receptor point Lightwater Alluvial Forest part of the River Eden and Tributaries SSSI. At this location, as a percentage of the lower critical load for the relevant habitat (10 kg N/ha/yr), there is a 27% increase in nitrogen deposition. This receptor point experiences an increase as a result of Project-related vehicle movements.

5.10.62 In relation to internationally designated ecological sites, the maximum impact in nutrient nitrogen deposition at North Pennine Moors SAC is predicted to be 0.9 kg N/ha/year. At this location, as a percentage of the lower critical load for the relevant habitat (5 kg N/ha/yr), there is an 18% increase in nitrogen deposition. Existing nitrogen deposition levels at this location are however already significantly exceeding the lower critical load.

5.10.63 The maximum reduction in nutrient nitrogen deposition of 3.6 kg N/ha/year has been predicted at Chapel Wood CWS (36% of relevant critical load).

5.10.64 In relation to internationally designated ecological sites, the maximum reduction in nutrient nitrogen deposition at Asby Complex SAC is predicted to be 0.3 kg N/ha/year. At this location, as a percentage of the lower critical load for the relevant habitat (5 kg N/ha/yr), there is a 6% reduction in nitrogen deposition. This is due to reductions in vehicle movements on the M6 south of Penrith as a result of the Project.

5.10.65 Increases in nutrient nitrogen deposition are predicted to be above 1% of the lower critical load at the following receptors:

- North Pennine Moors SPA
- North Pennine Moors SAC
- Argill Woods Pasture SSSI
- Augil Valley Pastures SSSI
- Bowes Moor SSSI
- Lightwater Alluvial Forest part of the River Eden and Tributaries SSSI
- Stainmore Common CWS
- Belah to Stainmore disused line CWS
- Rokeby Park and Mortham Wood LWS
- Low Coniscliffe Tees Bank LWS
- Oglebird Plantation AW
- Augill Bridge Wood AW.

5.10.66 These changes cannot be considered to be insignificant as defined in *DMRB LA 105*. Further discussion of the impacts of the Project on nitrogen deposition at these locations is included in Chapter 6: Biodiversity (section 6.10 Assessment of Likely Significant Effects).

In-combination climate change impact assessment results

5.10.67 The future climate conditions have been reviewed as part of the assessment, including changes to long term seasonal averages and extreme weather events as projected by the UKCP18.

5.10.68 Potential effects which could arise due to air quality impacts from the Project in combination with future projected climate conditions on air quality receptors. UKCP18 projections suggest that changes to the climate by the 2020s (construction period) are unlikely to be materially different when compared to current conditions. Any increase in hotter and drier conditions and increased frequency of droughts and heatwaves could exacerbate dust generation during construction. High risk mitigation measures will already be included in the EMP to limit the generation and dispersion of construction dust. This climate change effect will therefore not affect the significance of the air quality assessment.

5.10.69 While the impacts of climate change are likely to affect air quality in general terms, no significant in-combination effects associated with the Project have been identified and no further mitigation is proposed.

Assessment of construction phase significance

5.10.70 The overall assessment of construction phase significance takes into account the Projects effect on human health, designated habitats and the outcomes of the compliance risk assessment.

Human health effects

5.10.71 The assessment of construction traffic and construction dust has predicted one exceedance of the annual mean NO_2 AQO at human receptors in the do-something scenario due to the construction of the scheme. All concentrations of annual mean PM_{10} and $PM_{2.5}$ are predicted to remain below the AQOs.

5.10.72 The number of receptors where predicted NO_2 concentrations exceed the AQO and the magnitude of change threshold criteria, are given in Table 5-17 - construction phase

Table 5-17: Number of properties experiencing a worsening or improvement in air quality as a result of the Project - construction phase

Magnitude of change in NO_2 ($\mu g/m^3$)	Number of receptors with:	
	Worsening of AQO already above objective or creation of a new exceedance	Improvement of an AQO already above objective or the removal of an existing exceedance
Large (>4)	0	0
Medium (>2)	0	0
Small (>0.4)	1	0
Total	1	0

5.10.73 The number of receptors experiencing a small worsening in air quality is below the lower banding of 30 properties, consequently, no likely significant adverse effects are anticipated in relation to human health during the construction phase.

5.10.74 Impacts from construction dust will be managed through best practice mitigation measures as outlined in the EMP. With best practice construction mitigation measures the impact of construction dust would be reduced to a negligible level.

Designated habitats effects

5.10.75 The assessment of effects at designated habitats has identified two sites where the Project would result in an increase in nitrogen deposition greater than 1% of the lower critical load during

the construction phase. An assessment to determine the effect upon ecological habitats is reported in ES Chapter 6 Biodiversity (section 6.10 Assessment of Likely Significant Effects). This concludes that there will be no likely significant effects at designated habitat sites.

5.10.76 With best practice construction mitigation measures being implemented the impact of construction dust would be reduced to a negligible level.

Compliance risk assessment

5.10.77 The construction phase of the Project is not predicted to impact compliance with the LV.

Overall construction phase significance

5.10.78 The assessment of effects from the construction phase are assessed as being temporary and not significant.

Assessment of operational phase significance

5.10.79 The overall assessment of operational phase significance takes into account the Projects effect on human health, designated habitats and the outcomes of the compliance risk assessment.

Human health effects

5.10.80 All concentrations of annual mean NO_2, PM_{10} and $PM_{2.5}$ are predicted to remain below the AQOs.

5.10.81 No likely significant adverse effects are anticipated in relation to human health.

Designated habitat effects

5.10.82 The assessment of effects at designated habitats has identified a number of locations where the Project would result in an increase in nitrogen deposition greater than 1% of the lower critical load. An assessment to determine the effect upon ecological habitats is reported in ES Chapter 6 Biodiversity (Section 6.10 Assessment of Likely Significant Effects). This concludes that there will be no likely significant effects at d m designated habitat sites.

Compliance risk assessment

5.10.83 The Project was not predicted to impact compliance with the LV.

Compliance with NPSNN

5.10.84 The *NPSNN* policies relevant to air quality and species set out in Table 5-2 have been reviewed in light of the potential impacts of the Project. In summary:

- There are no significant effects associated with the Project and there is no risk of affecting the UKs ability to achieve compliance (*NPSNN* paragraph 5.6, 5.7, 5.9, 5.11, 5.12 and 5.13).
- The assessment has been undertaken following published air quality projections on future emissions and fleets (*NPSNN* paragraph 5.8).

5.10.85 The Project will therefore comply with each of the relevant NPSNN policies for air quality.

Overall operational phase significance

5.10.86 The assessment of effects from the operational phase are assessed as being not significant.

Assessment of overall significance

5.10.87 The significance of the construction phase and operational phase effects are both predicted to be not significant. Therefore, it is predicted the effects on air quality at human and ecological receptors would be not significant.

5.10.88 The Project is not predicted to have an effect on the ability to comply with the LV.

5.11 Monitoring

Construction

5.11.1 To aid the efficacy of dust mitigation measures during the construction phase, visual inspections or dust monitoring could be carried out to check where dust soiling is occurring and where appropriate mitigation measures can be enhanced to reduce soiling. This is secured by commitments in the EMP.

Operation

5.11.2 No significant impacts have been identified and therefore there is no requirement for future monitoring of air quality during the operational phase as a result of the Project.

5.12 References

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