CONTENTS

FIGURES

APPENDICES

None

5 Air Quality

5.1 Introduction

5.1.1 This chapter presents the Preliminary Environmental Information (PEI) for the air quality assessment, which follows the requirements for the *Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality* (Highways England, 2019)[1].It details the methodology followed for the assessment, summarises the regulatory and policy framework related to air quality, and describes the existing environment in the area surrounding the project. Following this, the design, mitigation and residual effects of the project are discussed, along with the assumptions and limitations of the assessment.

5.1.2 There may be interrelationships related to the potential effects on air quality and other disciplines; therefore, please also refer to:

- Chapter 6: Biodiversity
- Chapter 7: Climate
- Chapter 13: Population and Human Health.

5.1.3 *DMRB LA 105* provides guidance for determining if a 'simple' or 'detailed' assessment is appropriate. A 'simple' assessment provides *"sufficient information to confirm that the project does not result in any exceedances of the air quality thresholds."* A 'detailed' assessment is appropriate "where there is a risk of exceeding air quality thresholds and for the detailed design stage of the project lifecycle." The Environmental Scoping Report (ESR) determined that a 'detailed' level of assessment will be required for the Environmental Impact Assessment (EIA) and reported within the Environmental Statement (ES) to be submitted with the Development Consent Order (DCO) application. The preliminary assessment of the preferred route alignment (PRA) has been undertaken on the basis for the whole route. Where alternatives are under consideration for schemes, the alignment that is closest to the preferred route has been included in the route wide model. For the ES, assessment results will be reported both routewide and on a localised geographic scheme-by-scheme basis.

5.1.4 A number of alternatives are set out in Chapter 2. The alternative alignments between Temple Sowerby and Appleby (Red and Orange Alternatives in addition to the Blue Alternative), between Appleby and Brough (Blue and Orange Alternatives in addition to the Black Route), as well as the junction alternatives between Cross Lanes and Rokeby (Blue Alternative and Red Alternative) have been assessed using the simple assessment approach. This approach qualitatively compares the potential differences in effect that could arise if the alternative alignments are implemented. For this reason, where alternatives exist for part of the scheme (e.g. Appleby to Brough) the comparison is for each individual alternative section, rather than route-wide combinations. This simple approach is considered to be sufficient to understand the potential variation in impacts between the alternatives where there is considered to be minimal risk of any exceedances of the air quality thresholds (as is demonstrated by the modelling to be the case for Appleby to Brough and Cross Lanes to Rokeby). Detailed modelling using ADMS-Roads will be undertaken on a route wide basis for the ES based on the final project design.

5.1.5 The preliminary assessment has been undertaken to:

- Identify relevant sensitive receptors (human or designated sites).

[1] Highways England (2019) Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality, available at: https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90 [accessed 9 September 2021]

- Estimate pollutant concentrations at these sensitive receptors to assess the local operational air quality effects of the project focusing on nitrogen dioxide (NO_2) for human health and nitrogen deposition for ecological sites.
- Determine compliance with Air Quality Directive Limit Values (LV).
- Identify any areas at risk of exceeding the Air Quality Objectives (AQO).
- Determine the change i.e., impact, in pollutant concentrations at the sensitive receptors resulting from the project.
- Determine whether there is a risk that the project could lead to a significant effect on air quality.

5.2 Legislative and Policy Framework

Legislation

5.2.1 The following key legislation is relevant to this assessment:

- Directive 2008/50/EC on ambient air quality (Air Quality Directive)
- Part IV of the Environment Act 1995
- Air Quality Standards Regulations 2010[2], as amended
- The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019
- The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020

National policy statement for national networks

5.2.2 The primary policy basis for deciding whether or not to grant a Development Consent Order (DCO) is the *National Policy Statement for National Networks (NPSNN)* (Department for Transport, 2014)[3], which sets out policies to guide how DCO applications will be decided and how the effects of national networks infrastructure should be considered by the relevant decision maker. The policies for air quality include statements that:

"Increases in emissions of pollutants during the construction or operation phases of projects on the national networks can result in the worsening of local air quality (though they can also have beneficial effects on air quality, for example through reduced congestion). Increased emissions can contribute to adverse impacts on human health, on protected species and habitats…The geographical extent and distribution of these effects can cover a large area, well beyond an individual scheme. Air quality impacts are generated by all types of infrastructure development to varying extents. Development on the national networks in general and road schemes in particular, creates complex challenges with regards to air quality, given the very wide geographical area over which impacts (positive and negative) can potentially be felt." (NPSNN paragraphs 5.3 and 5.5)

5.2.3 The NPSNN also advises:

"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 scheme. 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

[2] The Air Quality Standards Regulations 2010, SI 2010/1001, available at: https://www.legislation.gov.uk/uksi/2010/1001/contents/made [accessed 9 September 2021]
[3] Department for Transport (2014) National Policy Statement for National Networks, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf [accessed 06 September 2021]

secure appropriate mitigation measures with a view to ensuring so far as possible that those thresholds are not breached." (NPSNN paragraph 5.10)

5.2.4 Table 5-1: Relevant NPSNN policies for the air quality assessment methodology, identifies the NPSNN policies relevant to the air quality assessment methodology.

Table 5-1: Relevant NPSNN policies for the air quality assessment methodology

Relevant NPSNN paragraph reference	Requirement of the NPSNN (paraphrase)
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 UKs ability to comply with the Air Quality Directive, the application should undertake an assessment of the impacts of the proposed project as part of the environmental statement.
5.7	The environmental statement should describe: • existing air quality levels; • forecasts of air quality at the time of opening, assuming that the scheme is not built (the future baseline) and taking account of the impact of the scheme; 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.
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. Applicant's assessment should be consistent with this but may include more detailed modelling to demonstrate local impacts.
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.
5.11	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.

National planning policy framework (NPPF)

5.2.5 The *NPPF* (Ministry of Housing Communities & Local Government, 2021)[4] 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. The *NPPF* is *"an important and relevant matter to be considered in decision making for NSIP".*

Local planning policy

5.2.6 The following local planning policies are relevant to the assessment:

- *County Durham Plan 2020* (Durham County Council, 2020)[5] 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)[6] Policy ENV7
- *Richmondshire Local Plan 2012-28: Core Strategy* (Richmondshire District Council, 2012)[7] Core Policy CP3: Achieving Sustainable Development.
- Cumbria County Council *Local Transport Plan 2011-2026* (Cumbria County Council, 2011)[8], this plan includes Health and well-being throughout life and World class environmental quality strategy priorities.

Standards and guidance

5.2.7 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]
- *NPPF*, paragraph 186
- UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations (Department for Environment, Food and Rural Affairs and Department for Transport, 2017)[10]

[4] Ministry of Housing Communities & Local Government (2021) National Planning Policy Framework, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf [accessed 10 August 2021]
[5] Durham County Council (2020) County Durham Plan (adopted 2020), available at: https://www.durham.gov.uk/media/34069/County-Durham-Plan-adopted-2020-/pdf/CountyDurhamPlanAdopted2020vDec2020.pdf?m=637424969331400000 [accessed 9 September 2021]
[6] Eden District Council (2018) Eden Local Plan 2014 to 2032, available at: https://www.eden.gov.uk/media/5032/edenlocalplan2014-2032finalwithoutforeword.pdf [accessed 9 September 2021]
[7] Richmondshire District Council (2012) Richmondshire Local Plan 2012-28: Core Strategy, December 2014, available at: https://www.richmondshire.gov.uk/media/9616/core-strategy-2012-28.pdf [accessed 9 September 2021]
[8] Cumbria County Council (2011) Local Transport Plan 2011-2026, available at: https://cumbria.gov.uk/elibrary/Content/Internet/544/942/41075102846.PDF [Accessed 9 September 2021]
[9] Department for Environment, Food and Rural Affairs (2019) Clean Air Strategy, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf [accessed 9 September 2021]
[10] Department for Environment, Food and Rural Affairs and Department for Transport (2017) UK plan for tackling roadside nitrogen dioxide concentrations, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/633270/air-quality-plan-detail.pdf [Accessed 9 September 2021]

- Highways England Air Quality Strategy (Highways England, 2017)[11].
- *Design Manual for Roads and Bridges* (DMRB) *LA 105* Air quality[12]
- Department for Environment, Food and Rural Affairs (Defra) *Local Air Quality Management Technical Guidance (LAQM TG.16)* (Department for Environment, Food and Rural Affairs, 2018)[13]

Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, 2018 (NEA001)[14]

5.3 Assessment Methodology

Construction

5.3.1 Chapter 2: The Project contains a summary of the construction programme including details of construction activities, construction compounds and site access locations[15]. A qualitative assessment of the impacts 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 recommended where required.

5.3.2 At the time of writing, detailed data on the movement of construction-related vehicles were not available. A quantitative assessment of associated emissions has therefore not been possible but will be undertaken as part of the EIA and reported in the ES, where appropriate. Further qualitative discussion on this is provided in Section 5.10 Assessment of the Likely Significant Effects.

5.3.3 The emissions from site equipment and non-road mobile machinery (NRMM) 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 in the Environmental Management Plan (EMP), as set out in LAQM.TG16 Section 7.26.

Operation

5.3.4 A preliminary, route wide detailed assessment of the Preferred Route Announcement has been undertaken to identify whether there is a risk that the project could lead to a significant impact on air quality.

5.3.5 The assessment has focused on reviewing updated traffic data to identify areas of change and has been undertaken for the baseline, 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 Standards Regulations 2010*. These are set out in

[11] Highways England (2017) Air Quality Strategy, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/634933/N160081_Air_Quality_Strategy_Final_V18.pdf [accessed 9 September 2021]
[12] Design Manual for Roads and Bridges (DMRB) LA 105 Air quality, available at: https://www.standardsforhighways.co.uk/prod/attachments/10191621-07df-44a3-892e-c1d5c7a28d90?inline=true [accessed 9 September 2021]
[13] Department for Environment, Food and Rural Affairs (2018) Local Air Quality Management Technical Guidance (TG16), available at: https://laqm.defra.gov.uk/guidance/ [accessed 9 September 2021]
[14] Natural England (2018) Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations (NEA001), available at: http://publications.naturalengland.org.uk/publication/4720542048845824 [Accessed 9 September 2021]
[15] Further information on construction is set out in the Statutory Consultation document called the Construction Method Statement however this was produced after this PEIR assessment was completed so has not been taken into account for the purposes of this chapter.

Table 5-2: AQO Relevant to the assessment of local air quality impacts. The traffic data used for the assessment are based on an opening year (2031), later than that which is used throughout this PEI Report (2029). Please see further information on this in paragraphs 5.3.11 and 5.4.6.

Table 5-2: AQO Relevant to the assessment of local air quality impacts

Pollutant	Concentration 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			
Nitrogen dioxide (NO_2)	40	Annual Mean	None
	200	1-hour (hourly) mean	No more than 18
Fine particulate matter (PM_{10})	40	Annual Mean	None
	50	24-hourly (daily) mean	No more than 35
Set for the protection of ecosystems (critical level)			
Oxides of nitrogen (NO_x)	30	Annual Mean	None

5.3.6 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.

5.3.7 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 (Highways Agency, 2013)[16]. To account for this, the future baseline projections scenarios will also be calculated for the opening year following the methodology in Section 2.47 of *DMRB LA 105*.

5.3.8 Traffic data have been provided for the air quality assessment by the project transport team representing the annual average daily traffic (AADT, vehicles/day) flows together with the following data parameters:

- Percentage heavy duty vehicle (HDV)
- Vehicle speeds, in kilometres per hour (km/hr)
- Speed band information for use in calculation of emission factors in accordance with *DMRB LA 105*

5.3.9 Route wide traffic data have been generated for the Preferred Route Announcement as well as the alternatives considered here.

5.3.10 The air quality assessment has used data provided from the traffic model for the future years which includes current future committed developments. This will be updated prior to the final assessment presented in the ES.

5.3.11 The inconsistency between the traffic modelling opening year (2031) and the opening year that is used throughout this PEI Report (2029) is due to changes in the original construction programme and is recognised in the limitations set out in paragraph

[16] Highways Agency (2013) Note on HA's Interim Alternative Long-Term Annual Projection Factors (LTT_{E6}) for Annual Mean NO_2 and NO_x Concentrations Between 2008 and 2030, available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010019/TR010019-002231-Environment%20-%20Air%20Quality%20-%20Appendix%20E%20-%20IAN%20170_12%20NOx%20and%20NO2%20_631077_0.pdf [accessed 9 September 2021]

5.4.6. Both the traffic and air quality modelling will be revised and the final assessment presented in the ES will use an opening year of 2029.

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

5.3.13 Simple assessment of the alternatives under consideration from Temple Sowerby to Appleby, Appleby to Brough and between Cross Lanes and Rokeby, shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results, has been undertaken using the vehicle flows and alignments specific to the alternative being assessed using Highways England's DMRB Air Quality Model (V8, EFTv10.1). This contains vehicle emission factors and estimates pollutant concentrations at different sensitive receptor locations based on the alternative alignments.

5.3.14 For the detailed route wide assessment, traffic emissions have been calculated using the emission factors provided in the latest version of the Highways England speed band emissions factors spreadsheet.

5.3.15 The ADMS-Roads model (v5.0.0.1) developed by Cambridge Environmental Research Consultants Ltd has been used to predict pollutant concentrations at sensitive receptor locations adjacent to the affected road network (ARN) shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results, where the detailed assessment approach has been followed.

5.3.16 The detailed modelling approach has been verified at appropriate locations using local authority data from 2018 taken from roadside monitoring locations adjacent to the ARN. The locations of these monitoring sites are presented in Table 5-3: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2015-20), and shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results. Model verification was also undertaken as part of the simple assessment by comparing modelled results against the same monitoring locations. The outcome of the simple assessment model verification was consistent with the outcome of the verification from the detailed modelling. Therefore, the verification factor derived from the detailed modelling was applied to the simple assessment results for consistency.

5.3.17 Meteorological data used in the detailed assessment have been obtained from the closest meteorological station, Warcop Range, for 2018. This is consistent with the base/verification traffic year. The site is located one mile (1.6km) north east of the project. The potential effects of alternative meteorological data sites, together with potential transient meteorological conditions, such as the Helm Wind, will be considered in the ES.

5.3.18 The resultant predictions at sensitive receptors, defined below, 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.

Evaluating the outcomes

5.3.19 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 has been used in this assessment. At a sensitive receptor location, 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) this might result in a significant air quality effect.

5.3.20 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.

5.3.21 As per *DMRB LA 105*, an assessment of the risk of the project resulting in an exceedance of the NO_2 LV and being non-compliant with the Air Quality Directive has been undertaken.

5.3.22 The impacts of the project (i.e., the change in concentrations predicted by the ADMS-Roads model) have been added to the modelled concentrations from the Defra Pollution Climate Mapping (PCM) model for the opening year of the project. To determine the compliance risk of the project, the Compliance Risk Flow Chart in Figure 2.79 in *DMRB LA 105* has been followed.

5.3.23 Ecological sites within 200m of the ARN have been identified and nitrogen deposition calculated for comparison against the critical loads for the habitat.

5.3.24 Determining the significance of the potential changes to nitrogen deposition requires habitat specific assessment from the biodiversity team. The predicted changes in pollutant concentrations and deposition rates have been shared with the biodiversity team who have considered the potential impacts at the ecological designations and then assessed the relative significance. The findings will be summarised in this PEI Report chapter, but full details are reported in Chapter 6.9: Biodiversity.

5.3.25 The assessment approach has determined whether the project complies with the *NPSNN* and in particular paragraphs 5.12 and 5.13 (see Section 0: Legislative and Policy Framework) which provides the advice to the decision maker to be used when determining whether a project should receive consent.

5.3.26 A summary of the results and the findings of the compliance assessment have been provided in Section 5.10: Assessment of the Likely Significant Effects.

5.4 Assessment Assumptions and Limitations

5.4.1 The construction programme is given in Chapter 2 and includes details of construction activities, construction compounds and site access locations; however, at the time of writing, detailed information relating to construction vehicles movements was not available. A quantitative assessment of associated emissions has therefore not been possible but will be undertaken as part of the EIA and reported in the ES, where appropriate.

5.4.2 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

5.4.3 The preliminary assessment has sought to be proportionate and has utilised the traffic data available at the time of the assessment associated with the preliminary design.

5.4.4 A reduced speed limit will be imposed on the approach to Kemplay Bank Roundabout through to M6 Junction 40 providing emergency vehicle access. This design conclusion has not been included in the traffic data provided for this preliminary assessment but is anticipated to be negligible. This and further design conclusions will be reflected in the data used for the ES.

5.4.5 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.

5.4.6 The traffic data used for the operational phase modelling is based on an opening year (2031) later than that which is used throughout this PEI Report (2029). This is likely to be conservative because the growth in traffic between 2029 and 2031 is likely to

outweigh any improvements in background concentrations and vehicle emissions through efficiencies and technological improvements in the national fleet between 2029 and 2030. Overall, the difference in effects is considered unlikely to be significant, however this will be reviewed at the ES stage for an assessment opening year of 2029.

5.4.7 Sensitivity testing of emissions data has been carried out using the most recent methodology 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 will be discussed in the Combined Modelling and Appraisal Report for the project which will be published as part of the DCO. These limitations have been minimised as far as possible by verifying the modelled concentrations against monitoring results in appropriate locations.

5.4.8 The potential effects of vehicle-related ammonia (NH_3) emissions upon nitrogen deposition at designated ecological sites has been considered qualitatively in this PEI Report. This has not been assessed qualitatively as Highways England is currently developing a method for the assessment of NH_3 emissions which has yet to be released. It is expected that this method will be available for use at the ES stage and therefore the potential ecological impacts will be updated accordingly. Further details are provided in Section 5.10: Assessment of the Likely Significant Effects.

5.4.9 Veteran and ancient tree data, and Local Wildlife Site data for Co Durham and Lancashire (ARN) have not been considered in detail as part of this PEI Report due to an incomplete dataset at the time of writing. The potential for likely significant effects at these sites is set out in Section 5.10: Assessment of the Likely Significant Effects and is noted in Chapter 6: Biodiversity, however this will be reviewed robustly at the ES stage.

5.4.10 With reference to the Local Traffic Report, it is considered reasonable to assume that the scheme impact forecast by the traffic modelling which has been prepared for Statutory Consultation will not vary significantly once updated for DCO submission. As such, the air quality modelling considered in this chapter which relies on that modelling can be considered sufficient to enable consultees to have an 'informed' view of the air quality effects of the scheme, as per the EIA Regulations.

5.4.11 At the ES stage, the air quality modelling will be based on the traffic data presented with the DCO application.

5.5 Study Area

5.5.1 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 at this stage has been considered on a qualitative basis); 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

5.5.2 The study area for the construction phase dust assessment includes all sensitive receptors within 200m of the draft DCO boundary. Table 2.58b of *DMRB LA 105* 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

5.5.3 The assessment of construction traffic has not been undertaken as sufficiently detailed information relating to potential construction-related vehicle movements, haul routes and temporary diversions is not yet available. Potential areas affected by construction-related traffic are likely to be those roads identified as designated haul routes, as well as any local roads near to specific areas of work and construction compounds, which have human or ecological sensitive receptors present. These data will be expected to be available at the ES stage, where the potential impacts from construction traffic will be considered and assessed.

Operation

5.5.4 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. For the ES, assessment results will be reported on a localised geographic basis.

5.5.5 The study area for the assessment of operational effects has been determined following the methodology outlined in *DMRB LA 105* and has been defined by the changes in traffic flows on the local road network. *DMRB LA 105* provides guidance on specific changes in traffic flows that are required to trigger an assessment of the project's impacts on air quality.

5.5.6 The following screening criteria, based on *DMRB LA 105*, has been used to determine the extent of the air quality study area on roads within the traffic reliability area (TRA), shown in the 'Local Traffic Report', and includes:

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

5.5.7 The extent of the TRA can be seen in the Local Traffic Report and covers the extent of all alternative alignments.

5.5.8 All roads that trigger the traffic screening criteria, as defined in Section 2.1 of *DMRB LA 105*, and adjoining roads within 200m are defined as the ARN (Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results). It includes the following key areas:

- The project alignment (including alternatives)
- M6 between junction 35 and junction 45
- A1(M) between junction 48 and junction 59
- Local roads joining those outlined above.

5.6 Overview of Consultation to Date

5.6.1 Initial consultation on air quality has been undertaken with stakeholders at Eden District Council, Durham County Council and Richmond District Council. The

following comments on the scope and approach to the air quality assessment were raised:

- The application of detailed modelling and simple screening
- The air quality assessment study area, traffic reliability area (TRA) and proximity with AQMAs
- Model verification
- Monitoring data
- Pollutants to be considered in the assessment
- Effects on sensitive ecological habitats
- Meteorological data and local weather phenomenon.

5.6.2 Where it has not been possible to address any of the above comments within this preliminary assessment, these will be addressed in the ES.

5.7 Baseline Conditions

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

- AQMA Interactive Map (Department for Environment, Food and Rural Affairs, 2021)[17]
- Local Authority air quality monitoring data taken from relevant annual status reports (ASRs).
- Defra *Background Maps* (Department for Environment, Food and Rural Affairs, 2019)[18] of predicted background NO_X, NO_2 and PM_{10} concentrations.
- Boundaries of relevant designated ecological sites (Department for Environment, Food and Rural Affairs, 2021)[19].
- Background Nitrogen (N) Deposition for designated habitats included in the assessment have been obtained from *Air Pollution Information System website* (APIS) (Air Pollution Information System, 2016)[20].
- Location of sensitive receptors (including ecological and human receptors – e.g. residential properties) that could be impacted on by the project.
- Defra information used in its reporting of compliance with the *European Union (EU) Directive 2008/50/EC on Ambient Air Quality* (European Union, 2008) (which has included the *Pollution Climate Mapping (PCM) Model* (Department for Environment, Food and Rural Affairs, 2017)[21] published modelled results).

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

5.7.3 Durham County Council has designated two AQMA (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.

5.7.4 Eden District Council and Richmond District Council have not designated any AQMA, 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

[17] Department for Environment, Food and Rural Affairs (2021) Air Quality Management Areas Interactive Map, available at: https://uk-air.defra.gov.uk/aqma/maps/ [accessed 9 September 2021]
[18] Department for Environment, Food and Rural Affairs (2019) Background Mapping data for Local Authorities, available at: https://uk-air.defra.gov.uk/data/laqm-background-home [accessed 9 September 2021]
[19] Department for Environment, Food and Rural Affairs (2021) Magic Interactive Map, available at: https://magic.defra.gov.uk/magicmap.aspx [accessed 9 September 2021]
[20] Air Pollution Information System (2016) Background Nitrogen Depositions, available at: http://www.apis.ac.uk [accessed 9 September 2021]
[21] Department for Environment, Food and Rural Affairs (2021) 2020 and PM NO_2 projections data (2018 reference year), available at: https://uk-air.defra.gov.uk/library/no2ten/2020-no2-pm-projections-from-2018-data [accessed 9 September 2021]

declared at Castlegate and details of the extent of this AQMA have not been made available however, this will be reviewed again and updated in the ES if that has changed.

5.7.5 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. Local authority data from 2018 taken from roadside monitoring locations adjacent to the ARN have been used to verify both the detailed and simple modelling approaches and is presented in Table 5-3: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2015-20).

5.7.6 The nearest Defra PCM links to the project, used to determine compliance with the Air Quality Directive, are in Penrith and are well below the annual mean NO_2 EU LV of 40micrograms per cubic meter of air (µg/m³) (less than 20µg/m³ in 2019).

5.7.7 The predicted Defra background concentrations along the route are well below the annual mean objectives for NO_2 and PM_{10} with maximum NO_2 concentrations of 8.9µg/m³ predicted in Penrith and maximum PM_{10} concentrations of 10.8µg/m³ predicted at the junction with the A1(M).

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

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 six years (2015-2020).

5.7.10 Table 5-3: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2015-20), 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 75% or more in 2018. Additional Eden District Council monitoring data are also presented for Castlegate, Penrith; however, these sites were not used for model verification as they are located outside of the ARN. Where data are above the AQO, these are highlighted in bold.

5.7.11 Comparing baseline conditions for relevant pollutants against the AQO detailed in the *Air Quality Standards Regulations 2010* (given in Table 5-2: AQO Relevant to the assessment of local air quality impacts) and the LV, the following has been concluded:

- National assessments have demonstrated that there is no risk of carbon monoxide, 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 would lead to exceedances for these pollutants.
- For particulate matter (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. Impacts from PM_{10} and $PM_{2.5}$ have been considered but have not been taken forward for detailed assessment based on the findings that no significant effects are considered likely due to the low background concentrations in the area. It is acknowledged that local authorities have a duty to understand potential impacts to PM_{10} and $PM_{2.5}$ in their administrative areas, therefore this will be reviewed again as part of the ES.

- 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 data for Castlegate, Penrith is borderline with the AQO. On this basis, NO_2 is the focus of this preliminary assessment.

Table 5-3: Baseline air quality roadside monitoring sites and annual mean NO_2 concentrations (2015-20)

Site ID	Site Name	Co-ordinates (based on OS Grid Reference, m)		Annual Mean NO_2 Concentration (µg/m^3)					
		X	Y	2015	2016	2017	2018	2019	2020
Eden District Council (Eden District Council, 2020)[22]									
EB15*	Glendale	352329	528475	32	32	32	32	27	21
EB18*	Cherry Cottage	352246	528667	35	33	35	33	31	23
EB20*	2 Kemplay Road	352207	528827	30	32	31	32	28	-
V3*	25b King Street	351720	529966	23	23	27	30	27	21
V5*	Front Victoria Road/Langton Cottage	351713	529941	38	35	31	31	28	20
C1	Lower Castlegate#	351413	530069	-	-	-	**48**	**42**	33
C30	40 Castlegate#	351333	530016	38	37	31	30	29	22
GAF04	New Vic#	351363	530046	**50**	39	**47**	**49**	**43**	32
GAF05‡	Station Hotel#	351302	520089	**45**	**53**	33	30	28	22
Richmondshire District Council (Richmondshire District Council, 2020)[23]									
R6†	Gatherley Moor Farm	418066	501490	24	23	21	20	21	-

Notes

Data in **bold** denotes exceedance of the annual mean NO_2 AQO (as given in Table 5-2)

* 2018 monitoring data used to verify the urban roads model

Castlegate Penrith monitoring sites not used for model verification as not located on the ARN

‡ The site coordinates given in the EDC LAQM ASR 2020 have been adjusted to indicate the diffusion tube location on Castlegate, Penrith.

† 2018 monitoring data used to verify the rural roads model.

[22] Eden District Council (2020) LAQM ASR 2020, available at: https://www.eden.gov.uk/media/5997/asr2020accessible.pdf [accessed 9 September 2021]

[23] Richmondshire District Council (2020) ASR 2020, available at: https://www.richmondshire.gov.uk/media/11982/2020-air-quality-annual-status-report.pdf [accessed 9 September 2021]

Sensitive receptors

5.7.12 Receptors that are potentially sensitive to changes in air quality are defined in *DMRB LA 105* as housing, schools, hospitals and designated species or habitats within a designated ecological site, located within 200m of the ARN. All of these receptors have been assigned an equal level of sensitivity within the assessment.

5.7.13 The construction dust study area extends 200m from the draft DCO boundary, with alternative alignments also considered. The number of sensitive receptors (human and designated habitats) within this area have been determined.

5.7.14 Following screening of the traffic data and calculation of the ARN, worst-case receptor locations, that could be sensitive to the potential operational road vehicle exhaust emission impacts, have been identified for use in the detailed and simple assessments.

5.7.15 The sensitive human receptor locations considered in the simple assessment have been included in the detailed assessment.

5.7.16 As part of the development of the air quality assessment for ES, potential future receptors (e.g. residential properties, schools, hospitals, care homes) will be identified.

5.7.17 Additional vehicle trip generation figures as a result of committed developments have been included within the traffic data provided for the future baseline scenario for the project for the preliminary assessment. This will be updated prior to the final assessment which will be presented in the ES.

5.7.18 The compliance risk assessment identified areas with qualifying features on the PCM road network that meet Defra's interpretation of the Air Quality Directive. Qualifying features include public access (e.g. footpaths) and sensitive receptors (e.g. residential properties, schools and hospitals) within 15m of the kerbside, but are not within 25m of a junction.

5.7.19 Designated sites within 200m of the ARN which contain features which are sensitive to nitrogen deposition, are summarised in Table 5-4: Designated ecological sites within the operational assessment air quality study area containing features sensitive to nitrogen. Site relevant critical loads and average nitrogen deposition rates within these designated sites are also presented. These indicate that habitat specific critical loads for nitrogen deposition are currently exceeded at most designated sites in the air quality study area.

5.7.20 The River Eden and Tributaries SSSI and River Eden Special Area of Conservation (SAC) are within 200m of the ARN. Whilst Apis indicates there are nitrogen sensitive riparian species in the SSSI, none have been identified at these locations in the study area and therefore they have not been considered in the preliminary assessment in-line with Section 2.26.1 of *DMRB LA 105*.

5.7.21 Phase 1 ecological site surveys are currently underway as part of the EIA to identify the location of potentially nitrogen sensitive flora and fauna across the project study area. If additional sensitive features are identified, and if within 200m of the ARN, these features will be considered and assessed as part of the ES for the DCO.

Table 5-4: Designated ecological sites within the operational assessment air quality study area containing features sensitive to nitrogen

Designated site[a]	Relevant nitrogen critical load class	Critical load (kg N/ha/yr)[b]	Average nitrogen deposition (kg N/ha/yr)[c]
North Pennine Moors Special Protected Area (SPA)	Moss and lichen dominated mountain summits	5 - 10	18.9
North Pennine Moors SAC	Alpine and subalpine grasslands	5 - 10	19.4
Asby Complex SAC	Alpine and subalpine grasslands	5 - 10	24.5
Argill Woods and Pasture Site SSSI	Non-Mediterranean dry acid and neutral closed grassland	10 - 15	21.7
Augill Valley Pasture SSSI	Low and medium altitude hay meadows	20 - 30	21.8
Bowes Moor SSSI	Raised and blanket bogs	5 - 10	19.8
Crosby Ravensworth Fell SSSI	Dry heaths	10 - 20	25.4
Disused railway line near Newbiggin Local Wildlife Site (CWS)	Broadleaved deciduous woodland	10 - 20	42.1
Chapel Wood CWS	Broadleaved deciduous woodland	10 - 20	38.4
Limekiln Wood LWS	Broadleaved deciduous woodland	10 - 20	40.0
Pallet Hill LWS	Broadleaved deciduous woodland	10 - 20	40.0
Ravensworth Park - Castle Fetch LWS	Valley mires, poor fens and transition mires	10 - 15	20.4
Stephen Bank Road Verge LWS	Neutral grassland	10 - 20	24.4
Morecambe Bay Limestones and Wetlands Nature Improvement Area	Mountain hay meadows	10 - 20	18.9
Augill Beck Wood Ancient Woodland (AW)	Broadleaved deciduous woodland	10 - 20	33.2
Augill Bridge Wood AW			33.2
Bessygill Wood AW			39.8
Borrowdale Wood AW			29.0
Chapel Wood AW			38.4
Cocklet Wood AW			36.3
Deepdale Wood AW			30.8
Deep Gill AW			28.7

Designated site[a]	Relevant nitrogen critical load class	Critical load (kg N/ha/yr)[b]	Average nitrogen deposition (kg N/ha/yr)[c]
Gill Beck Wood AW			51.5
Graham's Gill/Jack-Wood AW			36.1
Limekiln Wood AW			40.0
Lowgill Wood AW			28.7
Lowhurst Wood AW			45.5
Newbiggin Wood AW			45.5
Oglebird Plantation AW			36.1
Raughtonguill Wood AW			51.5
Sexton Hagg AW			29.8
Sexton Hagg Extension AW			29.8
Tees Bank Plantation AW			36.1
Thorsgill Wood AW			35.6
Warth Wood AW			34.3
Waterfall Wood AW			36.1

Notes

Relevant nitrogen critical load class, critical load and average nitrogen deposition rate data for each site have been taken from Air Pollution Information System website (http://www.apis.ac.uk/). Specific values have been used in the assessment at the modelled locations.

a Veteran and ancient tree data have not been considered as part of the PIE Report but will be reviewed as part of the EIA for DCO.

b Taken from 'Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments' (http://www.apis.ac.uk/indicative-critical-load-values).

c These data are the most recent available from the APIS website and are a three-year average for the period 2017-19.

5.8 Potential Impacts

Construction

5.8.1 During construction, potential air quality effects arise from emissions of construction dust and PM_{10}. These emissions occur as a result of construction activities such as demolition, earthworks, construction and trackout[24]. The quantities of each depend on the scale and intensity of the construction works.

5.8.2 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 impacts to receptors within 200m of construction and haulage routes associated with the project. These impacts can arise through annoyance caused by the soiling of windows, cars,

[24] The term 'trackout' refers to the movement of dust and dirt from a construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

washing and other property. Separate to nuisance impacts, particulate emissions from construction-related activities can also adversely affect human health at nearby sensitive receptors if not properly controlled.

5.8.3 There are a number of receptors which could be directly affected by dust nuisance associated with the project or construction vehicle traffic. As there is the potential for adverse impacts, which would be transient, this has been assessed qualitatively. Best practice construction dust control measures and standard mitigation measures are also set out in Section 5.9: Design, Mitigation and Enhancement Measures.

Operation

5.8.4 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, however speeds are likely to increase due to increased capacity and reduced congestion. These changes will impact on emissions of the main traffic related pollutants, NO_x and PM_{10}. As a result, pollutant concentrations at receptors in the vicinity of the preferred route announcement 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 Design, Mitigation and Enhancement Measures

Construction

5.9.1 Mitigation measures to control dust and traffic emissions will be required during the construction phase.

5.9.2 In relation to construction dust, industry good practice mitigation measures will ensure that construction dust does not result in a significant impact. These measures will be included in the EMP and Traffic Management Plan (TMP) submitted as part of the DCO supporting information and will be based on the standards in *DMRB LA 105*.

5.9.3 Mitigation measures could include, for example, development of a stakeholder communication plan, regular visual inspections and planning the site layout so that dust causing activities are located as far away as possible from receptors and damping of potentially dust-generating activities during periods of dry weather.

5.9.4 Mitigation measures outlined in *DMRB LA 105* will be included in the EMP and will be followed by the contractor to mitigate the impact from construction vehicles. Measures could include using less polluting construction vehicles such as ensuring that HDV meet Euro VI emissions standards which reduce NO_x and PM_{10} emissions.

Operation

5.9.5 Should a significant impact be predicted in the ES, a Project Air Quality Action Plan (PAQAP) may be required to identify options to reduce the impact associated with the project. Measures may include, for example, adjusting vehicle speeds in areas where receptors are being significantly affected, and will be based on guidance in *DMRB LA 105*.

5.9.6 In addition, the impact on compliance with the Air Quality Directive will be assessed again in the ES in accordance with *DMRB LA 105*.

5.10 Assessment of the Likely Significant Effects

Construction

Construction dust

5.10.1 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.

5.10.2 Commensurate with the guidance given in Sections 2.58 to 2.73 of *DMRB LA 105* a preliminary 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.

5.10.3 Sensitive human receptors and designated ecological habitats within 200m of the draft DCO boundary have been identified. 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 contains details of construction activities, construction compounds and site access locations.

5.10.4 The number of human receptors in each distance band of the draft DCO boundary is set out in Table 5-5: Number of human receptors within 200m of construction and demolition activities.

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

Distance (m)	Count at Distance	Cumulative Count
0-50	515	515
50-100	527	1042
100-200	1023	2065

5.10.5 There are 19 designated habitats within 200m of the draft DCO boundary, as detailed in Table 5-6: Designated habitats within 200m of construction and demolition activities, which also include some features that are considered as part of the operational phase assessment, as given in Table 5-4: Designated ecological sites within the operational assessment air quality study area containing features sensitive to nitrogen.

Table 5-6: Designated habitats within 200m of construction and demolition activities

Site Name	Designation
River Eden	SAC
North Pennine Moors	SPA, SAC
River Eden and Tributaries	SSSI
Temple Sowerby Moss	SSSI
Bowes Moor	SSSI
Chapel Wood	AW, CWS
Graham's Gill/Jack-Wood	AW
Oglebird Plantation	AW
Ross Wood	AW, CWS
Salter Wood	AW
Waterfall Wood	AW
Sandford Mire	CWS

Site Name	Designation
Whinfell Forest	CWS
Yanwath Wood	CWS
Skirsgill Wood	CWS
Stephen Bank Road Verge	LWS

5.10.6 Detailed information on construction activities is not available at the time of writing; however, this will be used to inform the detailed assessment presented in the ES.

5.10.7 Construction activities will take place across all schemes, with 12 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 30tonne 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 The roads affected by trackout activities are also not known at the time of writing as access routes, construction traffic levels and programme have yet to be selected and incorporated into traffic management plans.

5.10.10 As shown in Table 5-5: Number of human receptors within 200m of construction and demolition activities, there are 1042 human receptors between 0-100m from the draft DCO boundary. 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 draft DCO boundary the sensitivity is low, as defined in *DMRB LA 105*.

5.10.11 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.

5.10.12 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, daily on site and off site inspections and keeping a record of complaints/exceptional dust events. With appropriate best practice mitigation measures in place the potential impacts from construction are considered to be not significant.

Construction traffic

5.10.13 At the time of writing, due to the early stage of the design, finalised construction and mass haul traffic data were not available; however, a review of initial mass haul calculations for the project indicates that HDV numbers during construction will exceed *DMRB LA 105* thresholds and therefore an assessment of the construction phase traffic will be undertaken for the ES. Upon receipt of detailed construction traffic data, a screening exercise will be undertaken to determine whether this is required and the level of detail necessary.

5.10.14 Due to the nature of the proposed scheme, 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. 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. Suitable haul routes will be identified to mitigate impacts of moving the material on stakeholders and the environment.

5.10.15 Potential areas affected by construction-related traffic are likely to be those roads/routes identified, as well as any local roads near to specific areas of work and construction compounds, which have human or ecological sensitive receptors present.

5.10.16 The greatest risk that the movement of construction-related vehicles have is that they 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, 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 the currently proposed Penrith Castlegate AQMA or other locations with sensitive receptors close to these routes approaching the AQO, though the Construction Traffic Management Plan would aim to ensure construction vehicles avoid this area.

5.10.17 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 cannot be ruled out at this PEI Report stage. Further work will be undertaken to characterise the potential impacts as part of the EIA once these detailed data are available.

Operation

Route wide

5.10.18 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.

5.10.19 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}).

Human receptors

5.10.20 Detailed assessment of the preferred route announcement alignment has been undertaken using ADMS-Roads as set out above.

5.10.21 Pollutant concentrations at 151 human receptor locations as a result of the project have been predicted for the modelled opening year (2031) where there will be a change in vehicle flows which meet the *DMRB LA 105* screening criteria.

5.10.22 Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results shows the predicted NO_2 concentration for the DM scenario i.e., with the project in place, at each human receptor location considered.

5.10.23 Exceedances of the NO_2 AQO have been modelled at 3 locations based on the use of the LTT_{E6} factors. At all other locations considered within the air quality study area, concentrations are predicted to meet relevant AQOs for all pollutants. This is because air quality is already good in the immediate area around the project and because further improvements in air quality are expected by the modelled opening year of the project (2031) due to improvements in background concentrations and reductions in vehicle emissions as cleaner vehicles enter the fleet.

5.10.24 Where the predicted annual mean NO_2 concentration exceeds the AQO in either the DM scenario and/or DS scenario in the opening year, the difference in concentration is calculated and compared to the magnitude of change threshold criteria, given in

Table 5-7: Guideline for number of properties constituting a significant effect. The number of receptors which exceed the magnitude of change threshold criteria are determined and used to inform whether the project triggers a significant effect, as given in Section 2.95.1 of DMRB LA 105.

Table 5-7: Guideline for number of properties constituting a significant effect

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)	1 - 10	1 - 10
Medium (>2 - 4)	10 - 30	10 - 30
Small (>0.4 - 2)	30 - 60	30 - 60

5.10.25 Where the number of receptors falls below the lower guideline bands used to inform significance, then a project is deemed unlikely to have a significant effect (e.g., 20 small magnitude worsening would be unlikely to be classed as significant). If the number of receptors affected is greater than the upper guideline bands (60 small, 30 medium and 10 large), shown in Table 5-7: Guideline for number of properties constituting a significant effect, then a project is more likely to have a significant effect on air quality. Projects which affect receptors between the lower and upper guideline bands require justification to determine whether the effect is considered to be significant, taking into account the following:

- The absolute concentration at each receptor i.e., is the modelled concentration 40µg/m^3 or 60µg/m^3?
- How many receptors are there in each of the magnitude of change criteria, i.e., does the project create more worsening than improvements?
- The magnitude of change in concentration at each receptor e.g., 0.6µg/m^3 vs 1.8µg/m^3.

5.10.26 Where predicted annual mean NO_2 concentrations are below the AQO or the magnitude of change is ≤0.4µg/m^3, the effects are likely to be imperceptible.

5.10.27 The maximum predicted increase in NO_2 is 4.0µg/m^3 at a residential property adjacent to the A66 at Cross Lanes. This is because of the change in traffic flows at this location due to the project. The predicted annual mean NO_2 concentration at this location is below the AQO of 40µg/m^3, as shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results.

5.10.28 The maximum predicted reduction in NO_2 is 13.2µg/m^3 at a residential property southwest of Kirkby Thore. This is due to the construction of the bypass which moves the alignment of the A66 north of the village.

5.10.29 The number of receptors where predicted NO_2 concentrations exceed the AQO and the magnitude of change threshold criteria, are given in Table 5-8.

Table 5-8: Number of properties experiencing a worsening or improvement in air quality as a result of the project

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 - 4)	0	0
Small (>0.4 - 2)	3	0

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
Total	3	0

5.10.30 There are three residential receptors where concentrations in the opening year DS scenario will exceed the AQO, as shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results, and a small increase in annual mean NO_2 concentrations are predicted.

5.10.31 One of these receptors is located between Leeming and Burneston, adjacent to the southbound carriageway of the A1(M). The predicted concentration at this location is 48.7µg/m^3 in the DS scenario and is predicted to lead to a small magnitude worsening in NO_2 because of the change in project related traffic flows. The increase in AADT at this location is 3295 vehicles (2965 light duty vehicles, LDV, and 330 HDV).

5.10.32 There are two further receptors located in Penrith at the junction of Clifford Road and the A592, where predicted concentrations will exceed the NO_2 AQO. The maximum predicted concentration is 41.5µg/m^3 and is predicted to lead to a small magnitude worsening in NO_2. The change in AADT between the DM and DS scenarios is an increase of 2353 vehicles (2225 LDV and 128 HDV).

5.10.33 The number of receptors experiencing a small change in air quality is below the lower banding of 30 properties; consequently, no likely significant effects are anticipated.

5.10.34 It is noted that the background NO_2 concentrations at the receptor locations considered in the assessment are low, ranging from 4µg/m^3 to 13µg/m^3. Consequently, the methodology used to address uncertainty in predicted future roadside NO_2 concentrations has led to an unusually high adjustment factor of 1.8, on average, being produced for the scheme which is significantly increasing the predicted pollutant concentrations in the modelled opening year (2031). As the predicted concentrations are likely to be overly conservative, this warrants further investigation supported by monitoring, which will be presented in the ES.

Compliance links

5.10.35 In this assessment, the PCM model overlaps with the ARN around Penrith for just one link. This comparison has found that this single PCM link is anticipated to be compliant with the LV for the project in the proposed opening year of 2031, the highest predicted NO_2 concentration is 16.6µg/m^3 in the DS scenario.

5.10.36 This indicates that there is a low risk of non-compliance with the Air Quality Directive for the project and thus a PAQAP should not be required for operation of the project.

Air quality management areas

5.10.37 No receptors within AQMAs have been modelled to be in exceedance as a result of the project in the opening year. Although not yet declared, should Eden District Council proceed with an AQMA at Castlegate, Penrith, this will be considered in the assessment as part of the EIA.

Habitat sites

5.10.38 The change in nutrient nitrogen deposition as a result of the project has been predicted at 36 designated ecological sites (903 individual receptor points) given in Table 5-4: Designated ecological sites within the operational assessment air quality study area containing features sensitive to nitrogen. As noted previously, veteran and ancient trees have not been assessed but will be reviewed as part of the EIA for DCO.

5.10.39 The nutrient nitrogen deposition in the baseline year and modelled opening year, and the magnitude of change between DM and DS scenarios for all ecological receptors modelled has been calculated.

5.10.40 The results show that the maximum increase in nutrient nitrogen deposition as a result of the project in the opening year DS scenario is predicted to be 2.0kg N/ha/year. This occurs at a receptor point closest to the preferred route announcement alignment within the Stephen Bank Road Verge LWS. At this location, as a percentage of the lower critical load for the relevant habitat (10kg N/ha/year), there is a 20% increase in nitrogen deposition. This receptor point experiences an increase because of the change in traffic flows at this location due to the project. The change in AADT between the DM and DS scenarios is an increase of 8420 vehicles (8071 LDV and 349 HDV). The significance of this has been considered within Chapter 6.9: Biodiversity.

5.10.41 The maximum reduction in nutrient nitrogen deposition of 2.9kg N/ha/year has been predicted at Chapel Wood AW / CWS, which is located north-west of Appleby-in-Westmorland. The 29% reduction in nitrogen deposition (relative to a critical load of 10kg N/ha/year) is due to the change in road alignment which moves it further away from this location.

5.10.42 Increases in nutrient nitrogen deposition are predicted to be above 1% of the lower critical load at 15 designated ecological sites (208 individual receptor points) and these locations are shown in Figure 5.1: ARN Study Area – Air Quality Constraints and Modelling Results:

- North Pennine Moors SPA
- North Pennine Moors SAC
- Argill Woods and Pasture Site SSSI
- Augill Valley Pasture SSSI
- Bowes Moor SSSI
- Pallet Hill LWS
- Stephen Bank Road Verge LWS
- Augill Beck Wood AW
- Augill Bridge Wood AW
- Deepdale Wood AW
- Graham's Gill/Jack-Wood AW
- Newbiggin Wood AW
- Oglebird Plantation AW
- Raughtonguill Wood AW
- Thorsgill Wood AW.

5.10.43 The predicted changes indicate that these locations have the potential to experience likely significant effects as defined in *DMRB LA 105*. Further discussion of the impacts of the project on nitrogen deposition at these locations is included in Chapter 6.9: Biodiversity.

5.10.44 Veteran and ancient tree data have not been considered in detail as part of this PEI Report due to an incomplete dataset at the time of writing. Thirty-five veteran and ancient trees have been identified within 200m of the ARN. Based on the potential for likely significant effects at designated ecological sites identified above, likely significant effects at these locations cannot be ruled at this stage. This will be reviewed as part of the EIA stage.

5.10.45 Highways England is developing a tool for determining the additional contribution of NH_3 emissions from vehicles to deposited nitrogen. If released in time, this will be used in the assessment presented in the ES to support the DCO application. This is likely to result in additional sites exceeding the 1% critical load threshold and therefore additional designated ecological sites over and above those identified in

Section 5.10.42 may be considered to experience likely significant effects. Monitoring will be used to validate the modelling assessment.

Temple Sowerby to Appleby

5.10.46 Simple assessment of the alternatives being considered from Temple Sowerby to Appleby and Appleby to Brough has been undertaken using specific vehicle flows and alignments together with Highways England's DMRB Air Quality Model (V8, EFTv10.1), to estimate pollutant concentrations at sensitive receptor locations.

Blue alternative

5.10.47 The Blue alternative between Temple Sowerby to Appleby bypasses Kirkby Thore and this will result in notable reductions in traffic along the bypassed section of the A66, which will be de-trunked and retained for local access to Kirkby Thore. This is expected to result in an improvement in air quality for those sensitive receptors along the de-trunked A66.

5.10.48 Whilst it is likely that a number of sensitive receptors in close proximity to the Blue alternative will experience a deterioration in air quality compared to the existing situation, no receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

5.10.49 The Blue alternative will result in a new crossing of Trout Beck (part of the River Eden Tributaries SSSI), further to section 5.7.20 this habitat is not considered to contain features which are sensitive to nitrogen. In any event, there will also be a reduction of impacts at the existing crossing of Trout Beck through the bypassed section of the A66, due to relocation of vehicles.

Red alternative

5.10.50 Similarly, to the Blue alternative, the Red alternative between Temple Sowerby to Appleby bypasses Kirkby Thore. This is expected to result in an improvement in air quality for those sensitive receptors along the de-trunked A66.

5.10.51 Whilst it is likely that a number of sensitive receptors in close proximity to the Red alternative will experience a deterioration in air quality compared to the existing situation, no receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

5.10.52 Similarly, to the Blue alternative, the Red alternative will result in a new crossing of Trout Beck, however no significant adverse effects are predicted. There will also be a reduction of impacts at Trout Beck through the bypassed section of the A66 due to relocation of vehicles.

Orange alternative

5.10.53 The Orange alternative between Temple Sowerby to Appleby maintains the current A66 alignment to the west of Kirkby Thore but shifts the carriageway centreline to the west to accommodate the new dual carriageway. This will result in increases in traffic along the newly bypassed section of the A66.

5.10.54 Whilst it is likely that a number of sensitive receptors in close proximity to the Orange alternative will experience changes in air quality (both positive and negative due to the shifting alignment), no receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

5.10.55 The Orange alternative will result in an increase in nitrogen deposition at Trout Beck, however this habitat is not considered to contain features which are sensitive to nitrogen and therefore no significant adverse effects are predicted.

Appleby to Brough

Black-Black-Black route

5.10.56 Whilst it is likely that a number of sensitive receptors in close proximity to the Black-Black-Black route will experience minor changes in air quality (both positive and negative due to the shifting alignment), no human or ecological receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

Blue alternative (central section)

5.10.57 Similarly, to the Black route, whilst it is likely that a number of sensitive receptors in close proximity to the Blue alternative will experience minor changes in air quality (both positive and negative due to the shifting alignment), no human or ecological receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

Orange alternative (eastern section)

5.10.58 The Orange alternative will result in improvements in air quality to a small number of isolated properties to the west of Brough, as the A66 takes an alternative alignment. There will also be a small number of sensitive receptors however in close proximity to the Orange alternative that will experience a minor worsening in air quality due to the shifting alignment. No receptors are predicted to experience any significant adverse effects or pollutant concentrations above the AQO.

Cross Lanes to Rokeby

5.10.59 For all alternatives between Cross Lanes and Rokeby (Black + Black, Blue (Cross Lanes) alternative + Black, Black + Red (Rokeby) alternative and Blue (Cross Lanes) alternative + Red (Rokeby) alternative), whilst there may be minor changes in air quality (both positive and negative due to the shifting alignments), no human or ecological receptors are likely to experience any significant adverse effects or pollutant concentrations above the AQO based on the existing background concentrations and traffic flows.

5.11 Monitoring

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

5.11.2 As this PEI Report for the air quality assessment has identified the potential for likely significant effects at human and ecological receptors, proposals for ambient air quality baseline monitoring for NO_2 and NH_3 in key locations are being considered. The ES will consider the need for any post consent monitoring.