A417 Missing Link
TR010056

6.2 Environmental Statement

Chapter 5 Air Quality

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A417 Missing Link

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6.2 Environmental Statement

Chapter 5 Air Quality

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5 Air quality

5.1 Introduction

5.1.1 This Environmental Statement (ES) chapter reports the potential effects from the construction and operation of the A417 Missing Link (the scheme) on air quality. following the methodology set out in Design Manual for Roads and Bridges (DMRB) *LA 105 Air quality*[1].

5.1.2 This chapter details the methodology followed for the air quality assessment, summarises the regulatory and policy framework related to air quality and describes the existing environment in the area surrounding the scheme. The potential effects on human health and designated habitats are assessed during the construction and operation of the scheme. Following this, the mitigation and residual effects of the scheme are discussed, along with the limitations of the assessment.

5.2 Competent expert evidence

5.2.1 The Air Quality Lead expert is a senior air quality consultant with over 10 years' experience with air quality assessment, they have a MSc from Imperial College and are a Chartered Environmentalist, Chartered Scientist, Full Member of the Institution of Air Quality Management and Member of the Institution of Environmental Science. Full details of relevant project experience are provided in ES Appendix 1.2 Competent Expert Evidence (Document Reference 6.4).

5.3 Legislative and policy framework

Legislation

5.3.1 The following legislation is of relevance to the assessment of air quality and has informed the assessment methodology:

- Part IV of the Environment Act 1995.
- Air Quality Standards Regulations 2010.

5.3.2 The Air Quality Standards Regulations 2010 (amended in 2016) set legally binding air quality limit values for the UK and have been set with the aim of avoiding, preventing or reducing harmful effects on human health and on the environment as a whole. Further details on legislation are provided in ES Appendix 5.1 Air quality legislation, policy and guidance (Document Reference 6.4).

National policy

5.3.3 The national policies of relevance include:

- National Policy Statement for National Networks (NPSNN).
- National Planning Policy Framework (2019) (para 170 and 181) (NPPF).
- Clean Air Strategy 2019[2].

5.3.4 As documented in ES Chapter 1 Introduction (Document Reference 6.2) the NPSNN is the primary planning policy for the scheme and forms the principal basis for making decisions on DCO applications in England. The NPPF is noted as being 'important and relevant' and is to be considered, however, if there is a conflict between the NPSNN and NPPF, the NPSNN takes precedence.

5.3.5 Table 5-1 identifies the NPSNN policies relevant to air quality and specifies where in the ES chapter information is provided to address the policy.

Table 5-1 Relevant NPSNN for applicant's air quality assessment

Relevant NPSNN paragraph reference	Requirement of the NPSNN	Where in the ES chapter is information provided to address this policy.
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 applicant should undertake an assessment of the impacts of the proposed project as part of the environmental statement.	The effects of the scheme on compliance are described in section 5.10. There are no significant effects associated with the scheme and there is no risk of affecting the UKs ability to achieve compliance.
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.	Existing air quality levels are described in section 5.7 Baseline conditions and ES Appendix 5.4 Air quality baseline data (Document Reference 6.4). Forecasts of air quality at the time of opening are described in section 5.10 Assessment of likely significant effects and full results are provided in ES Appendix 5.6 Air quality operational phase impacts (Document Reference 6.4). There are no significant effects associated with the scheme. The justification of the conclusion is described in section 5.10 Assessment of likely 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. 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 Highways England for vehicle emissions[3]. The impact of emissions has been assessed using detailed modelling as described in section 5.4 Assessment methodology and ES Appendix 5.2 Air quality operational assessment methodology (Document Reference 6.4).
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.	The scheme would not affect the UK's ability to comply with the air quality limit values. Results are provided in section 5.10 Assessment of likely significant effects.
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	Section 5.7 Baseline conditions and ES Appendix 5.4 Air quality baseline data (Document Reference 6.4) describe the AQMAs in the study area. There are no significant effects predicted in AQMAs or at designated ecological sites as described in section 5.10 Assessment of likely significant effects.

Relevant NPSNN paragraph reference	Requirement of the NPSNN	Where in the ES chapter is information provided to address this policy.
	SSSIs, 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.	
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.	The scheme would not affect the UK's ability to comply with the air quality limit values and would not result in any significant effects at sensitive receptors. 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 scheme 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.	The scheme would not affect the UK's ability to comply with the air quality limit values. Results are provided in section 5.10 Assessment of likely significant effects.

Regional policy

5.3.6 The regional planning policies of relevance include:

- *Cotswolds AONB Management Plan 2018-2023*, in particular Policy CE11: Major Development.
- *Gloucestershire's Local Transport Plan 2015-2031*, in particular Policy LTP PD 4.9 Environment.
- *Joint Core Strategy for Gloucester, Cheltenham and Tewkesbury* (JCS) *2011-2031* (December 2017), in particular Policy SD3: Sustainable Design and Construction.

Local planning policy

5.3.7 The local planning policies of relevance include:

- *Cheltenham Local Plan 2011-2031*, in particular Policy BG2 Cotswold Beechwoods Special Area of Conservation Air Quality.
- *Cotswold District Council Local Plan 2011-2031*, in particular Policy EN15 Pollution and Contaminated Land.
- *Gloucester City Council Draft Local Plan 2016-2031*, in particular Policy C5 Air quality.

- *South Gloucestershire Council Local Plan (Core Strategy) 2006 – 2027*, in particular Policy CS9 – Managing the Environment and Heritage.
- *Stroud District Council Local Plan 2015-2031*, in particular ES5 Air quality.
- *Swindon Borough Local Plan 2026*, in particular Policy TR1: Sustainable Transport Networks and Policy EN7: Pollution.
- *Tewkesbury Borough Council Draft Local Plan 2011-2031*.
- *West Berkshire Core Strategy (2006 – 2026)*, in particular Transport (CS 13).
- *West Oxfordshire Local Plan 2031*, in particular Policy OS3: Prudent use of natural resources, Policy CO16, and Policy EH8: Environmental protection.
- *Wiltshire Council Local Plan (Core Strategy) 2026*, in particular Policy 55: Air quality.

5.3.8 Potential effects on air quality resulting from the scheme have been assessed following the methodology set out in Design Manual for Roads and Bridges (DMRB) *LA 105* Air quality[4] and the *Defra Local Air Quality Management Technical Guidance* (LAQM TG.16)[5].

5.3.9 Further details of relevant national and local policy, guidance and air quality action plans have been provided in ES Appendix 5.1 Air quality legislation, policy and guidance (Document Reference 6.4).

5.4 Assessment methodology

5.4.1 The A417 Missing Link EIA Scoping Report[6] 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 and part of the scheme area is within an AQMA. The detailed assessment includes construction traffic and operational phase impacts.

5.4.2 A detailed air quality assessment has therefore been undertaken to establish the potential effects of the scheme on local air quality as outlined in the EIA Scoping Report[6].

5.4.3 ES Appendix 4.5 Changes to scope and methodology (Document Reference 6.4) outlines the changes in scope and methodology since the submission of the Scoping Report in May 2019.

5.4.4 This assessment followed the methodology set out in Design Manual for Roads and Bridges (DMRB) *LA 105 Air quality*[7] for operation and construction phase assessment.

5.4.5 A regional air quality assessment of total emissions of NO_2 and particulate matter is no longer required under the latest air quality standard (DMRB *LA 105*). A regional assessment of total carbon emissions is undertaken in ES Chapter 14 Climate (Document Reference 6.2) following DMRB *LA 114 Climate*.

5.4.6 A detailed assessment of PM_{10} (particulate matter of 10 microns or less) and $PM_{2.5}$ (particulate matter of 2.5 microns or less) has been screened out as there are no AQMAs in the study area declared for any exceedance of the Government's Air Quality Strategy (AQS) PM_{10} or $PM_{2.5}$ objectives and local monitoring has indicated there is no risk of exceeding the AQS PM_{10} or $PM_{2.5}$ objective or limit value (LV).

Construction phase assessment

5.4.7 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.

5.4.8 Construction, demolition and earthwork activities from the scheme 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 PM_{10} from construction areas onto the road network.

5.4.9 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 200 metres of dust producing activities have been identified and appropriate mitigation recommended where required.

5.4.10 The emissions from heavy goods vehicles (HGVs) associated with the construction of the scheme have been scoped into this assessment as the duration of works would be greater than two years and there would be greater than 200 HGV movements per day. The emissions from construction traffic follow the same modelling methodology set out in section 5.4 Assessment methodology 'Local air quality assessment'.

5.4.11 The emissions from site equipment have been scoped out of the assessment due to the temporary nature of the works and the minimal impact the site equipment would have on overall pollutant concentrations. Best practice measures to reduce emissions from site equipment are included in ES Appendix 2.1 Environmental Management Plan (EMP) (Document Reference 6.4).

Local air quality assessment

5.4.12 A detailed assessment has been carried out using an atmospheric dispersion model ADMS-Roads v5[8] to determine the potential effects on annual mean NO_2 concentrations at selected sensitive receptors (locations of relevant human exposure and ecological sites, detailed in Appendix 5.3 Air quality receptors (Document Reference 6.4), in accordance with DMRB *LA 105*. In particular, modelled concentrations have been compared with the 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 with the LV.

5.4.13 DMRB *LA 105* provides instructions on determining whether an assessment should be detailed or simple. A detailed assessment would usually involve dispersion modelling to assess the scheme impacts, whereas a simple approach would usually follow a spreadsheet-based assessment of changes in emissions. At the scoping stage it was identified that a detailed assessment would be carried out due to the potential for significant effects. This chapter provides the results of the detailed assessment.

Assessment scenarios

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

- 2016 Baseline scenario.
- 2026 Do-minimum (DM) scenario: the traffic scenario at the modelled opening year without the scheme
- 2026 Do-something (DS) scenario: the modelled opening year with the scheme.

5.4.15 For the ES, the traffic models are based on an opening year of 2026.

5.4.16 For local air quality, the modelled opening year of the scheme 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.

5.4.17 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 2026 following the methodology in section 2.47 of DMRB *LA 105*.

5.4.18 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 (ComMA) Report (Document Reference 7.6).

Local air quality modelling

5.4.19 The inputs to the modelling process included:

- Traffic data.
- Receptor locations.
- Meteorological data.
- Background concentrations.

5.4.20 Further details of the dispersion modelling inputs are provided in ES Appendix 5.2 Air quality operational assessment methodology (Document Reference 6.4).

Traffic data

5.4.21 Traffic data has been provided for the air quality assessment by the scheme transport modelling specialists. Traffic data provided represents the average conditions occurring in four specific time periods in a day (AM peak, inter-peak, PM peak and off-peak). For the time periods in Table 5-2 the following data parameters were provided:

- Traffic 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 following DMRB *LA 105*.

Table 5-2 Traffic time periods

Traffic period	Time period
AM peak (AM)	3 hours (07:00 – 10:00)
Inter-peak (IP)	6 hours (10:00 – 16:00)
PM peak (PM)	3 hours (16:00 – 19:00)
Off-peak (OP)	12 hours (19:00 – 07:00)

5.4.22 Emissions from traffic data were calculated using the emission factors provided in the latest version (version 2.3) of the Highways England speed band emissions factors spreadsheet[9]. Using this methodology allows the effects of reducing or creating congestion to be more effectively assessed within the air quality study area.

5.4.23 The geographic information system (GIS) software, ArcMap, was used to assist in inputting the road link information into the air quality model.

Receptors

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

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

Human receptors

5.4.26 To assess the impacts on ecosystems the study area was reviewed to identify human receptors within 200 metres of the affected road network (ARN) following section 2.18 of DMRB *LA 105*.

5.4.27 A total of 106 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 scheme in that region
- Whether they are at risk of exceeding the annual mean NO_2 Air Quality Objective (AQO)

5.4.28 The list includes dwellings, hospitals and educational establishments; they are shown as dots in ES Figure 5.3 Human receptors (Document Reference 6.3). All locations, referred to as ‘receptors’ are treated as being equally sensitive. Selection of receptors is intended to be representative of the highest pollutant concentrations or anticipated to experience the highest level of change in concentration. If exceedances are predicted, then additional receptors are included in the assessment.

Designated habitat sites

5.4.29 To assess the impacts on ecosystems the study area was reviewed to identify designated ecological habitats within 200 metres of the ARN following sections 2.25 to 2.26.1 of DMRB *LA 105*. 27 designated habitat sites were identified along the ARN. Details of the designated sites are provided in ES Appendix 5.3 Air quality receptors (Document Reference 6.4). Additional information is provided in ES Chapter 8 Biodiversity (Document Reference 6.2). All 27 sites are shown in ES Figure 5.4 Assessed ecology receptors (Document Reference 6.3). This assessment also feeds into the Habitat Regulations Assessment: Statement to Inform Appropriate Assessment (Document Reference 6.5) as appropriate.

5.4.30 Effects at ecological receptors have been assessed in accordance with the method set out in section 2.97 to 2.102 of DMRB *LA 105*.

5.4.31 Receptor transects (receptor points every 10 metres away from the roadside) for each of the assessed designated sites up to 200 metres 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 zero metres. Transects are used to give an indication of change in deposition rates with distance from source since the whole designated area is potentially sensitive to pollution.

5.4.32 Following DMRB *LA 105*, in the first instance, the magnitude of change in annual mean nitrogen (N) 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 of species and unlikely to be significant.

Meteorological data

5.4.33 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. The meteorological data site considered to be most representative of conditions across the study area was Little Rissington. The site is located 16.7 miles (27 kilometres) east of the scheme. Data from this site was obtained from ADM Ltd in model-ready format. The wind rose shown in Chart 1.1 (Wind rose for Little Rissington for 2016) within ES Appendix 5.2 Air quality operational assessment methodology (Document Reference 6.4) derived from this data identified the predominant wind directions as being south-westerly. Further detail on the meteorological data is provided in ES Appendix 5.2 Air quality operational assessment methodology (Document Reference 6.4).

Background concentrations

5.4.34 '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 be 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.

5.4.35 The Defra air quality website[10] provides nitrogen oxide (NO_x) and nitrogen dioxide (NO_2) and $PM_{2.5}$ for each one kilometre by one kilometre grid square covering England.

5.4.36 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[11]. This process has been undertaken to avoid double counting of road traffic emissions from those road sources included in the dispersion model.

5.4.37 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 locations compared, concentrations varied by +/- 2.9 µg/m^3. Details of the comparison and details of sites selected are provided in ES Appendix 5.4 Air quality baseline data (Document Reference 6.4).

Model verification

5.4.38 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, 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 200 metres of the ARN to provide information for the verification exercise. The locations of selected verification points are shown in ES Figure 5.5 Verification points (Document Reference 6.4).

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

5.4.40 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.

5.4.41 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.

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

5.4.43 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 5.5 Air quality sites used for verification (Document Reference 6.4).

5.4.44 Further detail on the verification process is provided in ES Appendix 5.5 Air quality sites used for verification (Document Reference 6.4).

NO_x to NO_2 conversion

5.4.45 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 scheme, the concentrations of ozone and the different proportions of primary NO_2 emissions in different years. This approach is available as a spreadsheet calculator[12]; the version released in August 2020 (v8.1) has been used.

5.4.46 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* (section 2.47 to 2.55) provides a method to address uncertainty in predicted future roadside NO_2 concentrations. This assessment has followed the method set out in DMRB *LA 105* to calculate the projected base year and apply gap factors to the modelled results.

Compliance risk assessment

5.4.47 DMRB *LA 105* provides a method for the assessment of the risk of the scheme being non-compliant with the LVs. 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.
- Defra's Pollution Climate Mapping (PCM) model outputs for the compliance road network[13].
- Defra's zones and agglomerations maps[14].

5.4.48 Defra uses the PCM model to report against compliance. The current PCM model results have concentrations predicted for each year between 2017 and 2030.

5.4.49 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.

5.4.50 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 15 metres. 21 receptors have been added along the PCM links and corresponding local model four metre validation points were added.

5.4.51 To determine the compliance risk of the scheme, the Compliance Risk Flow Chart in Figure 2.79 of DMRB *LA 105* has been followed.

Operational assessment criteria

5.4.52 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 whether the scheme triggers a significant air quality effect:

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

5.4.53 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.

5.4.54 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 scheme 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 5-3.

5.4.55 To aid the interpretation of significance of public exposure as a result of the scheme, 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 5-3 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)	10-30	10-30
Small (>0.4)	30-60	30-60

5.4.56 The significance of nitrogen deposition results requires evaluation by an ecologist and therefore the significance of changes in pollutant concentrations and deposition rates at ecological designations is also discussed in section 8.10 of ES Chapter 8 Biodiversity (Document Reference 6.2). The flow chart (Figure 2.98) in DMRB *LA 105* has been used to determine significance at ecological sites.

Stakeholder engagement

5.4.57 Local authorities in the study area were contacted to inform them of the scheme and the method of assessment being used. It was clarified with the Environmental Health Officer at Cotswold District Council that receptors selected for modelling have been identified using OS Address Base Plus data and locations are set out in ES Appendix 5.3 Air quality receptors (Document Reference 6.4) and ES Appendix 5.6 Air quality operational phase impacts (Document Reference 6.4). The Environmental Health Officer at Wiltshire Council was advised that the ARN is defined using the criteria in DMRB *LA 105* and enters the Wiltshire local authority area.

5.4.58 Natural England provided guidance to help competent authorities understand the application of the Habitats Regulations when undertaking its role as statutory adviser, all engagement was carried out by ecology experts as detailed in the ES Chapter 8 Biodiversity (Document Reference 6.2).

5.5 Assessment assumptions and limitations

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

- The traffic data used in the model.
- The traffic emissions data.
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere.
- The background concentrations.
- The meteorological data.

5.5.2 To reduce uncertainty, sensitivity testing of emissions data has been carried out using the most recent standard from Highways England, set out in DMRB *LA 105*. The methodology used in this assessment is designed to provide a robust assessment, reducing uncertainty caused by the above limitations.

5.5.3 The most up to date emission factors and background concentrations have been used to calculate emissions and process results in the assessment. The earliest year available for this is 2018 which is after the baseline year (2016) for traffic data. The change as a result of the new tools will not affect the conclusion of the assessment.

5.5.4 It is not possible to determine the long-term impacts of the Covid-19 pandemic on traffic patterns and the consequential impact this might have on air quality related

to the scheme impacts on traffic emissions. Traffic patterns have been modelled using the most up to date Transport Appraisal Guidance (TAG) which does not accommodate impacts of the Covid-19 pandemic.

5.5.5 Uncertainties or limitations related to transport data are reported in the Combined Modelling and Appraisal (ComMA) Report (Document Reference 7.6). The ComMA Report outlines the forecasting assumptions and deals with uncertainty in forecasting. It also outlines modelling assumptions for the development of the base model and reports on the data collection for the traffic model. These limitations have been overcome as far as possible by verifying the modelled concentrations against monitoring results in appropriate locations. The traffic data used is appropriate for the purposes of this air quality assessment.

5.5.6 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 accords with the current guidance.

5.5.7 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.

5.5.8 The construction of the scheme would be undertaken in phases. The qualitative assessment of construction dust effects described in this chapter considers the construction of the scheme 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 scheme are at the most frequent.

5.5.9 Whilst there is the potential for the scheme to open in phases, for the air quality assessment it has been assumed that there would be a single year of opening. The quantitative assessment of road traffic emissions therefore considers the point of full opening, at which the greatest change in road traffic movements would be experienced.

Limits of Deviation (LoD)

5.5.10 An assessment has been conducted within the LoD outlined in LoD within ES Chapter 2 The project (Document Ref 6.2).

5.5.11 The screening criteria used to select the ARN includes where a road alignment changes by five metres or more in any direction, therefore the LoD will not give rise to any materially new or materially worse adverse environmental effects from those reported in this Chapter.

5.6 Study area

5.6.1 The air quality assessment comprises three sub-topics:

- 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 scheme.
- Operational traffic assessment, which relates to pollutants with potential to affect human health and designated sites at a local level during the operational phase of the scheme.

Construction dust assessment

5.6.2 The study area for the construction phase dust assessment includes all sensitive receptors within 200 metres of the DCO Boundary (200m is used for roads assessment following *LA 105* section 2.57). Table 2.58b of *LA 105* was used to identify the predicted dust risk potential based on the number of receptors within 0-50 metres, 50-100 metres and 100-200 metres.

5.6.3 ES Figure 5.8 Construction dust map (Document Reference 6.3) shows the construction dust study area.

Construction traffic

5.6.4 The study area for the construction traffic assessment (shown in Volume 6 Document Ref 6.3 Figure 5.1) has been determined based on proposed traffic routes for the additional HGVs which are a result of the scheme. This includes HGVs used to remove surplus excavated material from the construction site and HGV movements on a haul route. It is considered up to 420 HGV movements may occur each day for a period of greater than two years (further details are provided under the heading “Construction compounds, access and vehicle movements” in ES Chapter 2 (Document Reference 6.2). The study area includes:

- The scheme road layout.
- From the scheme, along the A417 to the M5 J11.
- From the scheme, along the A417 to the junction with the A429 near Cirencester.

5.6.5 Beyond the study area emissions from HGVs associated with the construction of the scheme have been scoped out of the assessment due to the minimal impact the additional vehicles would have on overall pollutant concentrations.

Local air quality study area (construction traffic and operational traffic)

5.6.6 The study areas for the assessment of local air quality has been defined following standards in DMRB *LA 105*. It comprises:

- Worst case receptors within 200 metres of the centre line of the existing road, at the scheme location.
- Receptors within 200 metres of the centre line of the scheme.
- Receptors within 200 metres of the centre line of any other ‘affected roads’.

5.6.7 The ARN for the purposes of a local air quality assessment is defined as those roads within a defined ‘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). A road is included in the ARN if one or more of the following criteria are met:

- Road alignment would change by 5 metres or more.
- Daily traffic flows would change by >=1,000 annual average daily traffic (AADT).
- HDV flows would change by >=200 AADT.
- A change in speed band.

5.6.8 ES Figure 5.1 Construction traffic study area (Document Reference 6.3) shows the construction traffic study area.

5.6.9 ES Figure 5.2 Affected road network (Document Reference 6.3) shows the operational traffic study area.

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

- The scheme alignment.
- A417 towards the M5.
- A417 towards Cirencester.

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

- The scheme alignment.
- A417 between Gloucester and Cirencester.
- A419 between Cirencester and Swindon.
- M5 between Tewkesbury and Falfield (J14).
- M4 J14-J15.
- A40 between Gloucester and Burford.
- Local roads joining the highways outlined above.

5.7 Baseline conditions

Current baseline

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 modelled opening year. The 'do-minimum' scenario is the predicted baseline for the modelled opening year and includes any other proposed schemes with a high level of certainty of being built.

5.7.2 Baseline air quality data has been gathered from the following sources for the air quality study area:

- Defra AQMA website[15].
- Defra PCM data for relevant years[16].
- Data from monitoring surveys carried out by Highways England and from local authority monitoring.
- GIS locations of sensitive receptors (residential properties, schools, hospitals and care homes) from OS Address Base Plus mapping.
- GIS boundaries of designated ecological sites from Natural England[17].

Local air quality management summary

5.7.3 Comparing baseline conditions for relevant pollutants against the AQOs detailed in the UK Government's Air Quality Strategy (AQS)[18] 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 UK AQOs 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 these pollutants would be a cause for concern in terms of potential exceedances as a result of the scheme.

- For particulate matter (PM_{10} and $PM_{2.5}$), there are no AQMAs designated for an exceedance of UK AQOs and LV thresholds in the study area. Impacts from PM_{10} and $PM_{2.5}$ are scoped out of further assessment.
- Exceedances of the annual mean NO_2 AQO of 40µg/m^3 have been identified in the air quality study area. On this basis, NO_2 is the focus of the air quality assessment for the scheme.

Air quality management areas (AQMA)

5.7.4 There are two AQMAs within 200 metres of the ARN:

- Birdlip AQMA in Cotswold District.
- Cheltenham AQMA in Cheltenham Borough.

5.7.5 Cotswold District Council (CDC) declared the Birdlip AQMA for exceedances of the annual mean NO_2 objective. The Birdlip AQMA is located within the DCO Boundary and includes the Air Balloon public house and the residential houses opposite known as Air Balloon cottages.

5.7.6 Cheltenham Borough Council (CBC) has declared the whole of its local authority area as an AQMA. This was declared for exceedances of the annual mean NO_2 objective.

5.7.7 The AQMAs are shown in ES Figure 5.6 Air Quality Management Areas (AQMAs) (Document Reference 6.3). A summary of Air Quality Action Plans created to address air quality issues in these AQMAs is shown in ES Appendix 5.1 Air Quality Legislation Policy and Guidance.

Monitoring data

5.7.8 Local authorities have conducted air quality monitoring along the ARN. Monitoring of air quality for NO_2 concentrations has been undertaken across the scheme area by Highways England. The location of the local authority and scheme-specific monitoring points within 200 metres of the ARN are shown in ES Figure 5.7 Monitoring locations (Document Reference 6.3). Information from the monitoring has been used to estaesblish baseline air quality conditions.

Local authority monitoring data

5.7.9 The study area extends into ten local authorities (South Gloucestershire Council, Swindon Borough Council, West Berkshire Council, Wiltshire Council, Cheltenham Borough Council, Cotswold District Council, Gloucester District Council, Stroud District Council, Tewksbury Borough Council and West Oxfordshire District Council). Among these ten local authorities, Cheltenham, Cotswold, Gloucester, Stroud, Tewkesbury and Swindon have air quality monitoring within the study area. Concentrations of annual mean NO_2 have been recorded as exceeding the objective in the study area at the Birdlip AQMA between 2014 and 2017, as well as at the monitoring site ‘Cheltenham 18’ within the Cheltenham AQMA.

5.7.10 LAQM.TG16 discusses the relationship between annual mean and hourly mean NO_2 concentrations. It is considered that where monitored annual mean NO_2 concentrations are greater than 60µg/m^3, there is the potential for the hourly mean NO_2 objective to be exceeded. The monitoring location ‘Cotswold T11/N@1S1’ is a diffusion tube in the Birdlip AQMA. It recorded annual mean NO_2 concentrations above 60µg/m^3 in 2014, 2016 and 2017. The monitoring site

is not at a location that sensitive receptors reside and is not considered to be a location of relevant exposure (locations of relevant exposure are defined in accordance with the LAQM.TG(16) guidance as locations where members of the public are likely to be regularly present for the averaging period of the relevant AQO). It is considered there is a low risk of the short-term objective being exceeded at a location of relevant exposure. Assessment against the short-term NO_2 objective is unlikely to be exceeded, this ES includes a review of modelled predictions at the worst case receptors against the 60µg/m^3 threshold.

5.7.11 The results of local authority monitoring at the sites in the study area are presented in ES Appendix 5.4 Air quality baseline data (Document Reference 6.4). The AQMAs and monitoring sites are shown in ES Figure 5.6 Air Quality Management Areas (AQMAs) (Document Reference 6.3) and ES Figure 5.7 Monitoring locations (Document Reference 6.3).

Scheme specific monitoring

5.7.12 Highways England carried out monitoring of NO_2 concentrations using diffusion tubes at 22 monitoring sites from January 2016 to June 2016.

5.7.13 The raw monitored results for each period are provided in ES Appendix 5.4 Air quality baseline data (Document Reference 6.4). Monitored results have been annualised, to determine a representative annual mean concentration for comparison with the annual mean NO_2 objective.

5.7.14 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. The bias adjustment and annualisation was carried out by consultants on behalf of the Applicant for the EIA Scoping Report[19] and has been used for this assessment.

5.7.15 The only scheme specific monitoring site that was recorded to be exceeding the annual mean NO_2 objective was the house opposite the Air Balloon public house within the Birdlip AQMA. The concentration at this site was recorded as 41.7µg/m^3. All other monitoring results were below the objective. Full results are presented in ES Appendix 5.4 Air quality baseline data (Document Reference 6.4).

Defra Pollution Climate Mapping modelling

5.7.16 Predicted roadside NO_2 concentrations were obtained from Defra's PCM model for the years 2015 (2015 reference year baseline projection, no Clean Air Zone (CAZ) or CAZ plus scenarios) and 2026 (2018 reference year). In the study area Defra PCM mapping indicates no exceedances in 2015 at road links in the ARN. In 2026 Defra PCM mapping indicates all links would still comply with LV.

Modelled baseline concentrations

5.7.17 In addition to the air quality monitoring information, baseline concentrations have also been predicted at relevant human and ecological receptor locations across the study area and results of the baseline modelling are included in section 5.10 Assessment of likely significant effects.

Future baseline

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

5.8 Potential impacts

5.8.1 Mitigation measures incorporated in the design and construction of the scheme are reported as embedded mitigation in ES Chapter 2 The Project (Document Reference 6.2) and essential mitigation in section 5.9 Design, mitigation and enhancement measures. Prior to the implementation of the mitigation, the scheme has the potential to affect air quality during construction and operation, both beneficially and adversely.

Construction impacts

5.8.2 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.

5.8.3 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 scheme. 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.

5.8.4 There are a number of receptors which could be directly affected by dust nuisance associated with the scheme 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 ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4). Any potential impacts would be temporary in nature.

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

Operational impacts

5.8.6 During the operational phase, potential air quality effects arise from emissions from vehicles using the road network. These impacts are discussed in section 5.10 Assessment of likely significant effects. On the basis of the available information, including existing monitored concentrations in the wider study area (ES Figure 5.7 Monitoring locations (Document Reference 6.3)), exceedances of the annual mean NO_2 objective are unlikely to occur within 200m of the ARN due to predicted improvements as a result of the scheme.

5.9 Design, mitigation and enhancement measures

Embedded mitigation

5.9.1 The scheme has been designed, to avoid and prevent adverse environmental effects on air quality through the process of design development and consideration of good design principles. Embedded mitigation measures for air quality are reported as part of the scheme description in ES Chapter 2: The project (Document Reference 6.2).

Construction mitigation

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

5.9.3 Best practice mitigation measures to reduce effects from construction dust are included in ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4). 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.

Operation mitigation

5.9.4 On the basis that the scheme would have a positive impact (due to relieving congestion and moving the road away from receptors) on local air quality concentrations, no specific mitigation or Air Quality Action Plans are required for the operation of the scheme.

Enhancement

5.9.5 There are no specific enhancement measures included in the scheme for air quality.

5.10 Assessment of likely significant effects

5.10.1 This section presents the assessment of likely significant effects on air quality resulting from the construction and operation of the scheme.

5.10.2 The assessment of effects takes into account the potential impacts to each receptor following the implementation of embedded and essential mitigation measures to determine the significance of the residual effects.

Construction effects

5.10.3 The construction phase could affect local air quality through the generation and subsequent deposition of construction dust arising from construction activities and vehicle movements.

Construction dust

5.10.4 The scheme is a new dual carriageway bypass, therefore the construction dust risk potential for the scheme has been categorised as large.

5.10.5 Following the method set out in DMRB *LA 105* sensitive human receptors and designated habitats within 200 metres of the DCO Boundary have been identified. The sensitive human receptors identified include those located at the Air Balloon

roundabout, Shab Hill Farm, Acorn House, Grove Farm and other properties in the local area. The number of human receptors is set out in Table 5-4.

Table 5-4 Number of human receptors within 200 metres of construction and demolition activities

Distance	Count at distance	Cumulative count
0-50m	73	73
50-100m	42	115
100-200m	92	207

5.10.6 In addition to human receptors there are designated habitats including Sites of Special Scientific Interest (SSSI), local natures reserves, and ancient woodland that are present within the DCO Boundary and span across the full 0-200 metres distance from the DCO Boundary. The human receptors and designated habitats within 200 metres of the DCO Boundary are shown in ES Figure 5.3 Human receptors (Document Reference 6.3) and ES Figure 5.4 Assessed ecology receptors (Document Reference 6.3).

5.10.7 The receiving environment's sensitivity to construction dust has been categorised as high for the 115 human receptors between 0-100 metres from the DCO Boundary and all designated habitats between 0-100 metres from the DCO Boundary. For human receptors and designated habitats between 100-200 metres from the DCO Boundary the sensitivity is low as defined in DMRB *LA 105*.

5.10.8 Overall it is identified that the scheme could impact receptors during the construction phase and mitigation is required to reduce the frequency and intensity of dust impacts. The scheme is considered to have a large construction dust risk potential.

5.10.9 Mitigation to reduce impacts to a negligible level is included in ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4). With best practice mitigation measures in place the impacts are considered to be temporary, neutral and not significant.

Construction traffic

5.10.10 There are predicted to be around 420 daily additional HGV movements associated with the scheme (total HGV movements include those for the removal of surplus excavated material from the construction site).

5.10.11 There are no risks to achieving or delaying compliance with the LV on Defra PCM links as a result of the construction traffic flows. There is only one section of the construction traffic study area which overlaps with a PCM link (located where the A417 crosses the A435). The concentration at the nearest qualifying feature in the base year at that location is 15.0µg/m^3 which is well below the annual mean NO_2 LV.

5.10.12 Impacts to human health are considered to be negligible with no locations where there are new predicted exceedances of annual mean NO_2 objective caused by construction traffic emissions. The greatest impact as a result of the construction phase is predicted to occur at the Air Balloon Cottages at receptor 50 and 51 (change of 0.5µg/m^3 at both) both within the Birdlip AQMA. These receptor locations are representative of the two cottages at the roundabout, there are no other sensitive human receptors in this location. The greatest annual mean NO_2 concentration (43.7µg/m^3) is predicted to be at receptor 50 and is already above the air quality objective. Receptors 50 and 51 are the only receptors predicted to

be exceeding the annual mean NO_2 air quality objective during the construction phase.

5.10.13 Construction traffic does result in increases in nitrogen deposition greater than 1% of the lower critical load at the following designated features:

- Crickley Hill and Barrow Wake (Barrow Wake unit) SSSI.
- Veteran tree (receptor VT84).

5.10.14 These changes at the ecological site cannot be considered to be insignificant as defined in DMRB *LA 105*. Further discussion of the impacts of the scheme on nitrogen deposition at these locations and an evaluation of significance is included in ES Chapter 8 Biodiversity (Document Reference 6.2).

Operational effects

Affected road network

5.10.15 Following DMRB *LA 105* screening criteria, the ARN was identified for the area around the scheme for the 2026 modelled opening year scenario. The 2026 ARN is shown in ES Figure 5.2 Affected road network (Document Reference 6.3).

5.10.16 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 (HDV) volumes. A smaller number of links have also been screened in based on changes in speed. A summary table of traffic changes along the main roads identified in the ARN is provided in Table 5-5.

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

Road section	Do-something (DS) – Do-minimum (DM)
M5 north of Gloucester	3,472
M5 south of Gloucester	-893
A417 Gloucester to Air Balloon roundabout	8,286
A417 Air Balloon roundabout to Cirencester	8,778
A419 Cirencester to Swindon	5,173
M4 Swindon to J14	1,920

Compliance links

5.10.17 Where the ARN overlaps with Defra PCM links, these have been selected and used to determine the risk of delaying compliance with the LV. In this assessment, the PCM model overlaps with the ARN around Cheltenham, Cirencester and Swindon as shown in ES Figure 5.9 Compliance Risk Road Network (Document Reference 6.3).

Model verification

5.10.18 The modelled results at existing monitoring locations were used for model verification based on the method set out in paragraph 5.4.38. Details of the verification process and results are provided in ES Appendix 5.5 Air quality sites used for verification (Document Reference 6.4).

5.10.19 Verification factors were calculated to make appropriate adjustments to modelled results. The verification factors used for each receptor are shown in ES Figure 5.10 Verification factors (Document Reference 6.3).

Human receptors

5.10.20 This section describes the predicted concentrations at human receptor locations as a result of the scheme in the baseline year (2016) and modelled opening year (2026) when there would be a change in vehicle flows which meet the DMRB *LA 105* screening criteria.

5.10.21 The modelled NO_2 concentrations and magnitude of change for all 106 human receptors modelled are presented in ES Appendix 5.6 Air quality operational phase impacts (Document Reference 6.4) – operational phase impacts. There were no predicted exceedances of the AQO at human receptor locations.

5.10.22 Results have been presented in geographic areas known as 'discussion regions'. Selected receptors have been chosen in each discussion region to summarise the changes in air quality as a result of the scheme. The receptors were selected to show the largest changes in concentrations in the region and the highest total concentrations predicted. Two discussion regions have been used and are as follows:

- Discussion region 1: Birdlip AQMA and scheme area.
- Discussion region 2: Wider ARN.

5.10.23 ES Figure 5.11 Annual mean NO_2 concentrations 2026 (Document Reference 6.3) shows the predicted DS annual mean NO_2 concentrations in 2026.

Discussion region 1 – Birdlip AQMA and scheme area

5.10.24 In this discussion region eight receptors (see Table 5-6) have been selected to represent the scale of impacts associated with the scheme. Scheme-specific and local authority monitoring showed that roadside concentrations of annual mean NO_2 in the Birdlip AQMA were above the AQO. A maximum monitored concentration of 61µg/m^3 was recorded at the roadside of the Air Balloon roundabout. It is not representative of receptor exposure in this location as properties are set back further from the road. There are no predicted exceedances of the NO_2 annual mean objective in the baseline scenario at any of the receptor locations. There are two receptors at risk of exceedance at the Air Balloon Cottages (receptors 50 and 51).

Table 5-6 NO_2 concentrations at selected receptors – discussion region 1

Receptor	Grid reference (m)		Figure sheet reference	Annual mean NO_2 (µg/m^3)			Change (DS - DM) (µg/m^3)	AADT change
	X	Y		2016 Base	2026 DM	2026 DS		
46	394545	213635	20	25.7	22.9	12.6	-10.4	-16,448
50	393450	216124	9	43.2	39.9	23.6	-16.4	8,286
51	393457	216129	9	42.7	39.1	22.8	-16.3	8,286
53	393752	215136	9	10.7	8.6	9.5	0.8	2,235
55	393391	215756	9	23.1	19.5	13.6	-5.9	-14,681
73	394208	215344	9	10.1	8.2	10.2	2.0	43,054
96	392879	215807	9	25.3	22.8	22.4	-0.4	8,286
99	392968	215759	9	17.7	15.3	17.2	1.9	8,286

5.10.25 There are no predicted exceedances of the annual mean NO_2 objective in 2026 as a result of the scheme.

5.10.26 Traffic would be moved away from receptors at the Air Balloon roundabout and hence concentrations reduce by 16.4µg/m^3 and 16.3µg/m^3 (receptors 50 and 51). The overall traffic on the A417 route does increase but the traffic flow is improved and moves away from sensitive receptors at the roundabout.

5.10.27 Where the scheme moves traffic closer to existing receptors the total annual mean NO_2 concentrations remain well below the objectives. For example, at receptor 99 where the DS concentration is 17.2µg/m^3 and the change is an increase of 1.9µg/m^3.

Discussion region 2 – wider ARN

5.10.28 In this discussion region six receptors (see Table 5-7) have been selected to represent the scale of impacts associated with the scheme. Scheme-specific and local authority monitoring showed that roadside concentrations of annual mean NO_2 across the wider ARN were below the AQO. Modelled baseline concentrations at receptor locations have been predicted to all be below the NO_2 annual mean objective.

Table 5-7 NO_2 concentrations at selected receptors – discussion region 2

Receptor	Grid reference (m)		Figure sheet reference	Annual mean NO_2 (µg/m^3)			Change (DS – DM) (µg/m^3)	AADT change
	X	Y		2016 Base	2026 DM	2026 DS		
6	419929	180861	18	31.4	29.2	31.8	2.6	1,919
14	411208	193324	15	37.8	36.0	37.4	1.4	3,840
17	394924	219349	8	13.4	11.1	11.9	0.9	1854
19	395165	219846	8	12.4	10.2	10.8	0.6	158
22	395837	221478	8	36.5	32.0	31.6	-0.5	-1,097
65	401968	205119	13	15.5	13.9	14.8	0.9	6,665
92	387674	217142	5	37.0	37.0	36.9	<-0.1	-893

5.10.29 There are no predicted exceedances of the annual mean NO_2 objective in 2026 as a result of the scheme. The change in AADT traffic flow is not the sole determinant in the resulting change in NO_2 concentration. The distance from road also determines how much a change in traffic flow may change the concentrations at any given receptor. This is why despite there being such a difference in change of flow at the roads next to receptors 19 and 65, the change in concentration is relatively similar 0.6 µg/m^3 and 0.9 µg/m^3 respectively. Receptor 19 is 13 metres from the nearest road and receptor 65 is 33 metres.

5.10.30 Receptors 17, 19 and 22 are located in the Cheltenham AQMA. Receptor 17 has the largest increase in concentration (0.6µg/m^3) as a result of the scheme. The highest predicted concentration due to the scheme in the Cheltenham AQMA is at receptor 22 (31.6µg/m^3). There are no modelled exceedances in the Cheltenham AQMA.

5.10.31 The maximum predicted concentration in the opening year within the modelled area occurs at receptor 14 located on the A419 in Cricklade. This receptor is located five meters from the kerbside of the A419 and has a predicted concentration of 37.4µg/m^3 in 2026 with a 1.4 µg/m^3 increase as a result of increased traffic on the road.

5.10.32 At locations where traffic is predicted to increase such as on the Existing A417 south of the scheme the concentrations remain well below the AQO at sensitive receptor locations. For example, receptor 65 experiences a 0.9µg/m^3 increase in concentration, where the traffic is increasing by 6,665 AADT, with a total NO_2 annual mean of 14.5µg/m^3.

Air quality management areas

5.10.33 A summary of the scheme's impact on local AQMAs is provided in Table 5-8.

Table 5-8 Summary of AQMA modelled results

AQMA	2026 modelled results
Birdlip AQMA (Air Balloon)	The maximum predicted annual mean NO_2 concentration in the DS scenario in this AQMA occurs at receptor H50 (23.6µg/m^3). This is below the AQO. The predicted change as a result of the scheme is an improvement of 16.4µg/m^3. There are no modelled exceedances of the annual mean NO_2 air quality objective.
Cheltenham AQMA	The maximum predicted annual mean NO_2 concentration in the DS scenario in this AQMA occurs at receptor H22 (31.6µg/m^3). This is below the AQO. The predicted change as a result of the scheme is an improvement of 0.5 µg/m^3 at this receptor. There are no modelled exceedances of the annual mean NO_2 air quality objective in the AQMA.

Ecological receptors

5.10.34 The change in nutrient nitrogen deposition as a result of the scheme has been predicted at 27 ecological receptors and 114 veteran tree locations (with 807 modelled points).

5.10.35 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 5.6 Air quality operational phase impacts (Document Reference 6.4).

5.10.36 The maximum increase in nutrient nitrogen deposition as a result of the scheme in 2026 is predicted to be 1.4kg N/ha/year at receptor point EF21 at the Ullen Wood transect. At this location, as a percentage of the lower critical load for the relevant habitat (10 kg N/ha/yr), there is a 14.0% increase in nitrogen deposition. This receptor point experiences an increase as the new road layout moves closer to the woodland at this location. However, the location of the point is outside of the woodland and the significance has been considered within section 8.10 of ES Chapter 8 Biodiversity (Document Reference 6.2).

5.10.37 The maximum reduction in nutrient nitrogen deposition of -15.7kg N/ha/year has been predicted at Crickley Hill and Barrow Wake SSSI (Barrow Wake unit), which is located adjacent to the Existing A417 carriageway and south of the scheme. This improvement in nitrogen deposition is due to the scheme moving traffic away from the designated habitat and improving traffic flow.

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

- Ullen Wood Ancient Woodland.
- Veteran Tree locations (VT13, VT21, VT42, VT98).

5.10.39 These changes are more than 1% of the relevant critical load and therefore cannot be considered to be insignificant as defined in DMRB *LA 105* without further biodiversity assessment. Further discussion of the impacts of the scheme

on nitrogen deposition at these locations and an evaluation of their significance is included in ES Chapter 8 Biodiversity (Document Reference 6.2).

Compliance with the limit values

5.10.40 DMRB *LA 105* sets the method which has been followed to assess compliance with the LV based on PCM data provided by Defra.

5.10.41 All PCM links in the study area are located around Cheltenham, Cirencester and Swindon. There are no exceedances of the NO_2 air quality objective as a result of the scheme at PCM receptors.

5.10.42 Only two locations (C1 and C15) are predicted to have an increase in concentration greater than 0.4µg/m^3 (1.3µg/m^3 and 0.5µg/m^3). The total concentrations at these locations are predicted to be 27.8µg/m^3 and 21.5µg/m^3 and are not at risk of exceeding, or delaying compliance with the LV.

5.10.43 All other increases in concentrations at qualifying features close to PCM links and locations 4 metres from PCM links are imperceptible (<0.4µg/m^3).

5.10.44 Based on the results of this assessment, the compliance testing indicates that the scheme 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 scheme, the date for achieving compliance would not be affected, and there would be no increase in the length of roads in exceedance in the zones.

Compliance with local planning policies

5.10.45 The impacts predicted due to the scheme have been considered against the local planning policies listed in ES Appendix 5.1 Air quality legislation, policy and guidance (Document Reference 6.4) and the actions and measures in the Councils' Air Quality Action Plans.

5.10.46 The scheme is predicted to have no significant impacts in 2026 and therefore does not act against the objectives of local planning policies. The Cotswolds Area of Outstanding Natural Beauty (AONB) Management Plan (Policy CE11) states that upgrades to the Air Balloon junction should help deliver reductions to NO_2 concentrations. The scheme helps deliver reductions in NO_2 concentrations in the locations that are most at risk of exceedance in the Birdlip AQMA.

5.10.47 The scheme along the A417 does not result in any exceedances of the AQOs, it moves traffic away from a number of properties that are currently located within an AQMA and does not act against the objectives of local planning policies.

Assessment of construction phase significance

5.10.48 The assessment of construction phase significance takes into account the scheme's effect on human health, designated habitats and the outcome of the air quality effects arising from emissions from construction HGVs using the road network.

Human health effects

5.10.49 The assessment of construction traffic has predicted no new exceedances of the AQOs at human receptors in the do-something scenario due to the construction of the scheme. There are only two receptors (50 and 51) that are exceeding the annual mean NO_2 air quality objective and the change at each is 0.5µg/m^3. This is considered a small change according to DMRB *LA 105* section 2.94 and

therefore the effect is considered to be not significant. This is due to the low number of affected properties small change in comparison with the objective.

5.10.50 Impacts from construction dust would be managed through best practice mitigation measures as outlined in the EMP ES Appendix 2.1 Environmental Management Plan (Document Ref 6.4). With best practice construction mitigation measures the impact of construction dust would be reduced to a negligible level.

5.10.51 The assessment of effects from the construction phase on human health are assessed as being temporary, neutral and not significant.

Designated habitats effects

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

5.10.53 The assessment of effects from construction dust on designated habitats are assessed as being temporary, neutral and not significant.

5.10.54 The assessment of effects from the construction phase on the Crickley Hill and Barrow Wake (Barrow Wake unit) SSSI and veteran tree (VT84) designated habitats are not significant as evaluated in section 8.10 of ES Chapter 8 Biodiversity (Document Reference 6.2).

Compliance risk assessment

5.10.55 The construction phase of the scheme is not predicted to impact compliance with the LV.

Assessment of operational phase significance

5.10.56 The overall assessment of operational phase significance takes into account the scheme's effect on human health, designated habitats and the outcomes of the compliance risk assessment.

Human health effects

5.10.57 The assessment has predicted no exceedances of the AQOs at human receptors in the do-something scenario. All concentrations of annual mean NO_2 are predicted to remain below the AQOs.

5.10.58 At the Birdlip AQMA the concentrations of annual mean NO_2 reduce from 39.9 $\mu g/m^3$ to 23.6 $\mu g/m^3$ in 2026. This is due to the scheme moving traffic away from receptor locations in the AQMA and reducing congestion. There are no predicted exceedances of the annual mean NO_2 air quality objective at any of the modelled human receptors.

5.10.59 With no exceedances of the AQOs at human receptor locations and improvements in the Air Balloon AQMA it is considered the scheme would have no significant effects on air quality for human health in accordance with DMRB LA105 section 2.90. Overall, the scheme is considered to have a beneficial impact on local air quality due to the reductions in NO_2 concentrations within the AQMA.

5.10.60 The assessment of effects from the operational phase on human health are assessed as being permanent, neutral and not significant.

Designated habitat effects

5.10.61 The assessment of effects from the operational phase on the Ullen Wood Ancient Woodland and local wildlife site, and Veteran Trees (VT13, VT21, VT43 and

VT98) are significant as evaluated in section 8.10 of ES Chapter 8 Biodiversity (Document Reference 6.2).

Compliance risk assessment

5.10.62 The scheme is not predicted to impact compliance with the LVs.

Assessment of overall significance

5.10.63 The significance of the construction phase and operational phase effects are both predicted to be not significant for human receptors.

5.10.64 The significance of the construction phase is predicted to be not significant for ecological receptors.

5.10.65 The significance of the operational phase effects is predicted to be significant for Ullen Wood Ancient Woodland and Veteran Trees (VT VT13, VT21, VT43 and VT98).

5.10.66 The scheme is not predicted to have an effect on the UK's ability to comply with the LVs.

5.11 Monitoring

5.11.1 To aid the efficacy of dust mitigation measures during the construction phase, visual inspections and 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 ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4).

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

5.12 Summary

5.12.1 The assessment has examined the potential effects of the scheme on local air quality during the modelled opening year 2026 using the current traffic data.

5.12.2 A review of the current air quality legislation and planning policies relevant to the scheme has been undertaken. This assessment covers each of the main areas highlighted as being essential for an air quality assessment in the NPSNN.

5.12.3 The baseline assessment demonstrates that there are existing air quality issues in the study area, with exceedances of the NO_2 annual mean AQO being observed in Air Balloon AQMA.

Construction assessment

5.12.4 Assessment of construction phase impacts from construction vehicles and construction dust showed that the scheme effect on human health is considered to be temporary, neutral and not significant.

5.12.5 Assessment of construction phase impacts from construction vehicles and construction dust showed that the scheme effect on designated habitats is considered to be temporary, neutral and not significant.

Operational assessment

5.12.6 Assessment of annual mean NO_2 concentrations in 2026 (modelled opening year) indicated that the scheme effect on human health is considered to be permanent, neutral and not significant.

5.12.7 An assessment of LV compliance concluded that the scheme is not likely to impact the predicted date for compliance with the LV.

5.12.8 Assessment of operational phase impacts showed that the scheme effect on selected designated habitats is considered to be permanent, adverse and significant. The reporting of this significance of effect in Chapter 15 Assessment of cumulative effects (Document Reference 6.2) and Chapter 16 Summary (Document Reference 6.2) will be accounted for under the Biodiversity factor in Chapter 8 Biodiversity (Document Reference 6.2).

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