

16 Air Quality

16.1 Introduction

- 16.1.1 This chapter presents the Design Manual for Roads and Bridges (DMRB) Stage 3 Environmental Impact Assessment (EIA) of the potential air quality impacts with associated with the proposed A9 Dualling scheme from Glen Garry to Dalwhinnie (Central Section, Project 7). The Proposed Scheme alignment that has been assessed is described in **Chapter 5**.
- 16.1.2 The assessment has been undertaken in accordance with the DMRB Volume 11, Section 3, Part 1 (HA207/07) (Highways Agency, 2007). The agreed Stage 3 assessment approach is described in **Chapter 6**.
- 16.1.3 This chapter includes a review of existing baseline air quality conditions, a summary of relevant air quality policy and legislation, the methodology used and the results of the assessment. Mitigation options are considered for any potentially significant adverse effects.

16.2 Approach and Methods

- 16.2.1 At the early design and assessment stage, the assessment of potential operational air quality impacts of the Proposed Scheme determined that a detailed assessment at DMRB Stage 3 was not justified. Therefore a 'Simple Assessment' was carried out using the DMRB screening methodology in order to consider design changes and traffic changes since DMRB Stage 2.
- 16.2.2 This section details the approach and methodology used to complete the assessments of air quality for the construction and operational phases of the Proposed Scheme. Included in the discussion is a review of the relevant legislation and guidance used as well as the criteria to define significant impacts in order to recommend adequate mitigation measures if required.
- [Air Quality Objectives](#)
- 16.2.3 This assessment considered international and national legislation relevant to assess the impacts of transport schemes on air quality.
- 16.2.4 The European Union (EU) set pollutant concentration limit values in a series of Directives with statutory dates for member states to reach these targets. It also required member states to regularly review and assess air quality in order to meet limit values by the required dates.
- 16.2.5 The UK government is responsible to the European Commission (EC) for ensuring that it complies with the provisions of the EU Directives. This prompted the Environment Act 1995, of which Part IV established the National Air Quality Strategy (AQS) and the basis of Local Air Quality Management (LAQM).
- 16.2.6 The UK AQS objective for particulate matter (PM) smaller than 10µm aerodynamic diameter (PM₁₀) annual mean is 40µg m⁻³. However, Scotland has adopted a more stringent annual mean objective of 18µg m⁻³. The UK AQS objective for the 24-hour mean PM₁₀ concentration is 50µg m⁻³, not to be exceeded on more than 35 days per calendar year. The more stringent Scottish objective requires that daily mean PM₁₀ concentrations do not exceed 50µg m⁻³ on more than seven days per year.

16.2.7 PM smaller than 2.5µm aerodynamic diameter (PM_{2.5}), is not currently included in the DMRB HA207/07 air quality guidance; however, the Scottish Government has adopted the World Health Organisation (WHO) guideline value of 10µg m⁻³ as an annual mean objective.

16.2.8 The air quality objectives of most relevance to the Proposed Scheme are shown in **Table 16-1**.

Table 16-1: Air Quality Objectives for NO_x, NO₂, PM₁₀ and PM_{2.5}

Pollutant	Averaging Period	Limits (µg/m ³)
Nitrogen Dioxide (NO _x) (for the protection of vegetation and ecosystems)	Annual mean	30
Nitrogen Dioxide (NO ₂) (for human health)	Annual mean	40
	1-hour mean (not to be exceeded more than 18 times per year)	200
Particulate Matter (PM ₁₀) (for human health)	Annual mean	18
	24-hour mean (not to be exceeded more than 7 times per year)	50
Particulate Matter (PM _{2.5}) (for human health)	Annual mean	10

16.2.9 When the annual mean NO₂ concentration is below 60µg/m³, it is not considered to represent a risk of exceedance of the 1-hour mean NO₂ objective (for human health) (Air Quality Consultants, 2003).

Scope and Guidance

16.2.10 For DMRB Stage 3, potential impacts on local air quality resulting from both the construction and operation of the Proposed Scheme were assessed in accordance with relevant guidance outlined in DMRB HA207/07, associated Interim Advice Notes (IANs), Defra's 'Local Air Quality Management Technical Guidance' (LAQM.TG(16)) and the Institute of Air Quality Management (IAQM) 'Guidance on the assessment of dust from demolition and construction' (Version 1.1).

16.2.11 Highways England's IANs used in this assessment are listed below:

- IAN 170/12: 'Updated air quality advice on the assessment of future NO_x and NO₂ projections for users of DMRB Volume 11, Section 3, Part 1 Air Quality' (Highways Agency, 2012)
- IAN 174/13: 'Updated advice for evaluating significant local air quality effects for DMRB Volume 11, Section 3, Part 1 Air Quality' (Highways Agency, 2013a)
- IAN 175/13: 'Updated air quality advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans' (Highways Agency, 2013b)

16.2.12 In accordance with IAN 175/13, Pollution Concentration Mapping (PCM) links have been considered as part of the assessment to verify the potential risk related to EU compliance. No PCM links were found in the area of the Proposed Scheme and this was therefore not considered further in the assessment.

16.2.13 IAN 185/15 has not been adopted by Transport Scotland, with an exception where a scheme passes through an Air Quality Management Area (AQMA); this guidance was, therefore, not applicable for this Proposed Scheme or assessment.

Study Area

- 16.2.14 This sub-section discusses the study areas assumed for the assessment of the construction and operational impacts. The study area for the local air quality assessment is shown in **Drawing 16.1**, as contained in **Volume 3**, and the construction dust impact area defined in the assessment is shown in **Drawing 16.2 (Volume 3)**.
- 16.2.15 The extent of the study area for the construction phase has been defined according to IAQM construction dust guidance (2014), which includes sensitive receptors such as houses and schools within 350m of construction activities that are expected to generate dust.
- 16.2.16 The study area for the operational assessment has been defined according to DMRB HA207/07 guidance, which is based on the change in traffic and road alignment associated with the Proposed Scheme. The study area covers receptors within 200m of roads that are expected to be affected by the Proposed Scheme. These receptors were identified using address data from Ordnance Survey (OS, 2015) and maps available in ArcMap 10.4.1 (ESRI Inc., 2017).

Construction Assessment Methodology

- 16.2.17 The assessment of potential construction impacts has been undertaken in accordance with the IAQM construction dust guidance (2014). The assessment methodology is presented in detail in **Appendix 16.1**, contained in **Volume 2**.
- 16.2.18 The aim of the assessment was to determine the risk of dust impacts from four construction activities: demolition, earthworks, construction and track-out (track-out is the transport of dust and dirt from the construction site to an appropriate waste facility via the local roads) to identify the level of required mitigation. The assessment included the identification of sensitive receptors within 20m, 50m, 100m, 200m and 350m from the construction boundary. Beyond 350m, any construction effects in terms of air quality (primarily dust deposition) would be minimal. Human and ecological receptors have been chosen based on their sensitivity to dust soiling and PM₁₀ exposure.
- 16.2.19 The methodology has taken the scale to which impacts are likely to be generated (classed as small, medium or large) into account. The distance of the closest receptors and background PM₁₀ concentrations have also been taken into account to determine the sensitivity of the surrounding area.
- 16.2.20 Construction impacts have been assessed qualitatively to determine the overall level of risk of impacts for dust soiling, human health and ecology and identify suitable mitigation measures. Professional judgement was applied to define the overall significance of impacts taking into account any additional project specific factors.

Operational Assessment Methodology

- 16.2.21 The transport model covers the full A9 route from Perth to Inverness. Potential operational impacts have been assessed on the basis of the information obtained from the transport model outputs. The model included the full length of the A9, however the local air quality assessment presented in this chapter only considered data within the Project 7 extent. Other sections of the A9 are considered in separate project assessments.
- 16.2.22 The following scenarios have been considered in the local air quality assessment:
- 2015: Base Year

- 2026: Opening Year Do-Minimum (DM) without A9 Dualling
- 2026: Opening Year Do-Something (DS) with A9 Dualling

16.2.23 An additional scenario to represent the Design Year of the Scheme (2041) has been considered in the regional assessment.

Local Air Quality

16.2.24 The local air quality assessment involves estimating the change in pollutant concentrations resulting from the operation of the Proposed Scheme. Under DMRB HA207/07 guidance, affected roads are defined where:

- road alignment will change by 5m or more, or
- daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) flow or more, or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more, or
- daily average speed will change by 10kph or more, or
- peak hour speed will change by 20kph or more.

16.2.25 There is the potential for operational air quality impacts to occur on the existing road network where the Proposed Scheme leads to changes in traffic that trigger any of the DMRB HA207/07 criteria.

16.2.26 Following a DMRB HA207/07 screening of DMRB Stage 3 traffic data for the Proposed Scheme, the affected road network (ARN) identified for the local air quality assessment encompassed the full length of the A9 mainline within Project 7 and some local roads surrounding the proposed Dalnaspidal Junction. Other roads were screened in primarily due to alignment changes, as a result of the new carriageway along the A9, and new slip roads around the Dalnaspidal Junction. Total traffic volume changes also screened in on roads along the A9. New roads around Dalnaspidal Junction were also included in the ARN. The ARN is presented in **Drawing 16.1 (Volume 3)** of this report.

16.2.27 The local pollutant component at receptors considered in this assessment will be strongly controlled by emissions associated with road traffic. Emissions of pollutants were calculated for each affected road using the latest Defra's Emission Factor Toolkit (EFT version 7.0, July 2016).

16.2.28 Changes from the DMRB Stage 2 assessment, including changes in modelled traffic volumes in the opening year as well as some alignment changes to the Proposed Scheme, led to air quality impacts requiring a reassessment in DMRB Stage 3. The same method used for DMRB Stage 2 was carried out here. The model calculations were based on distance from the road, fleet composition and traffic volume. The concentrations of NO₂ were calculated using Defra's NO_x to NO₂ calculator v5.1 (https://laqm.defra.gov.uk/documents/no2tonox9_ja-forweb_june2016.xls).

16.2.29 Total air pollutant concentrations comprise a background and local component. It is common practise to validate these against any background monitoring data. A comparison of background pollutant concentrations to background monitoring data could not be carried out as the nearest monitoring sites were more than 10 km from the Proposed Scheme extent. In addition, background values are well below the AQS objectives for relevant pollutants (NO₂ and PM₁₀).

16.2.30 Pollutant concentrations of NO₂, PM₁₀ and PM_{2.5} predicted for the opening year Do Minimum (DM) and Do Something (DS) scenarios for the Proposed Scheme have been compared to ascertain the impact of the Proposed Scheme on local air quality.

Regional Air Quality

16.2.31 The regional air quality assessment considered the change in emissions resulting from the Proposed Scheme. This was required as emissions not only affect local air quality, but could also have an impact on a regional scale.

16.2.32 Under the DMRB HA207/07 guidance for regional air quality, affected roads are expected to have:

- A change of more than 10% in AADT, or
- A change of more than 10% HDVs, or
- A change in daily average speed of more than 20 kph

16.2.33 Following the DMRB screening criteria, it was determined that the same study area is applicable to the regional assessment as the one used for the local assessment. It includes the A9 Project 7 mainline and the local roads surrounding the Dalnaspical Junction.

16.2.34 Regional air quality emissions have been calculated using Defra's Emission Factor Toolkit 7.0 (EFT v7.0). For future years the assessment was undertaken for the scheme opening year (2026) and the design year (2041). It should be noted that EFT v7.0 only provides emission estimates up to the year 2030. Year 2030 emissions have therefore been used to represent emissions in the Design Year. Emissions are expected to decline in future years as a result of more stringent emission controls on vehicles; therefore, this approach provides a worst-case assessment of Design Year emissions.

Ecological Designated Sites

16.2.35 Ecological designated sites refer to habitats and species within nature conservation sites (designated sites) that contain features sensitive to air pollution. These can include Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI) and Ramsar sites. Following DMRB HA207/07 Annex F guidance, these sites have been considered where they are within 200m of the ARN. The full ecological impact assessment is presented in **Chapter 12**.

16.2.36 The pollutants of most concern in relation to vegetation and ecosystems near roads are oxides of nitrogen (NO_x). Total NO_x concentrations and rates of nitrogen deposition have been calculated along transects that extend from the Proposed Scheme into nearby designated sites.

16.2.37 Road-traffic contributions have been combined with annual background mapped concentrations in order to calculate the total NO_x concentration along each transect. NO_x concentrations have been adjusted following DMRB's Interim Advice Note (IAN 170/12v3) on long-term trend (LTT) Gap Analysis methodology.

16.2.38 The World Health Organization (WHO) have set a critical level for NO_x for the protection of vegetation. The Statutory Nature Conservation Agencies' (in Scotland, Scottish Natural Heritage (SNH)) policy is to apply this 30 µg m³ criterion, on a precautionary basis, as a benchmark, in internationally designated conservation sites and SSSIs.

Baseline Data Sources

- 16.2.39 The Proposed Scheme extents fall within The Highland Council (THC) and Perth and Kinross Council (PKC) local authority areas, and the Cairngorms National Park Authority (CNPA); THC and PKC have responsibility for air quality. Key baseline data were reviewed from the 2015 THC Air Quality Progress Report (THC, 2015), the 2015 PKC Updating and Screening Assessment, and the Air Quality in Scotland website (<http://www.scottishairquality.co.uk/>).
- 16.2.40 Background pollutant concentrations of NO_x, NO₂, and PM₁₀ were obtained from the Scottish Air Quality website (<http://www.scottishairquality.co.uk/data/mapping?view=data>). PM_{2.5} concentrations were obtained from Defra's LAQM background maps (<https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013>).
- 16.2.41 Baseline nitrogen deposition and NO_x information relevant to the ecological designated sites present within the study area were obtained from Air Pollution Information Systems (APIS).
- 16.2.42 Traffic data was provided for Base (2015), Opening (2026) and Design Years (2041) without scheme (DM) and with scheme (DS) scenario options. Data was provided for each traffic model link as both one and two way flows.

Limitations to Assessment

- 16.2.43 The DMRB HA207/07 screening method is based on a distance drop-off calculation that does not take into account local atmospheric conditions such as wind speed and direction, which directly influence the rate at which pollutants disperse. A wind speed of 2m/s is assumed and no weighting for wind direction is applied; therefore, the equations used have a tendency to overestimate the pollutant concentrations.
- 16.2.44 Verification of the calculated pollutant concentrations against measured data was not carried out as no diffusion tube monitoring was undertaken within the Central Section. The nearest available monitoring data was not considered to be representative of the Proposed Scheme study area. Furthermore, resulting pollutant concentrations are predicted to be <25% of the AQS objectives for annual mean NO₂ and PM. Even considering the uncertainty associated within the DMRB screening calculation methodology, it is unlikely that the Proposed Scheme will lead to any exceedances of the AQS Objectives for NO₂ and PM.
- 16.2.45 There is uncertainty attached to critical load (or critical level) values for ecological sites, which has implications for the interpretation of the APIS data. The empirical critical loads of total nitrogen deposition for vegetation were derived primarily from field experiments and field observations, while for NO_x critical loads the primary source is experimental studies. There are also uncertainties in the Land Use cover map that is used to assign broad habitats and default values are often based on measurements at a limited number of sites across the UK (APIS, 2016).

Assigning Sensitivity

Construction

- 16.2.46 Tables 16-1-1 to 16-1-5 in **Appendix 16.1 (Volume 2)** provide details on the criteria used to assign sensitivity for the temporary construction dust assessment. The discussion below summarises the findings from these tables.
- 16.2.47 According to IAQM (2014) sensitive receptors to dust are “any location where a person or property may experience the adverse effects of airborne dust or dust soiling”. They are

categorised based on their sensitivity to potential dust impacts (high, medium and low). High sensitivity receptors include residential properties, schools and care homes; medium sensitivity receptors include hotels and offices; low sensitivity receptors encompass short-term car parks and footpaths.

- 16.2.48 Similar to human receptors, ecological receptors to dust are categorised as high, medium or low. High sensitivity ecological receptors include sites with international or national designation, such as SACs that contain habitats that are sensitive to dust deposition. Medium sensitivity ecological receptors include sites with important plant species whose dust sensitivity is uncertain and sites with national designation containing features that may be affected by dust deposition. Low sensitivity ecological receptors include locations with a local designation where the features may be affected by dust deposition.

Operation - Local Air Quality and Ecological Designated Sites

- 16.2.49 During operation sensitive receptors are defined as:

- Relevant locations with public exposure (including residential, medical and educational premises if present) that are potentially sensitive to NO₂, PM₁₀ and PM_{2.5}
- Internationally and nationally designated ecological sites in the vicinity of the Proposed Scheme (SSSI, SAC, SPA and Ramsar sites)

Assigning Magnitude and Significance of Impact

- 16.2.50 IAN 174/13 (Highways Agency, 2013a) provides advice on determining the significance of a proposed scheme's impact on local air quality and ecological designated sites.

Construction

- 16.2.51 IAQM (2014) provides guidance on assessing the risk of impacts on human health and ecology in order to define appropriate construction dust mitigation measures. The assessment methodology applied in this work is presented in detail in **Appendix 16.1 (Volume 2)**.

Operation - Local Air Quality

- 16.2.52 The significance of an impact is based on the magnitude of the change in pollutant concentration in relation to air quality objectives, as well as absolute concentrations in relation to air quality objectives. Only receptors that exceed the air quality objective in either the DM or DS scenarios are used to inform significance.
- 16.2.53 The magnitude of change criteria for NO₂ and PM₁₀ concentrations used to assess operational impacts are shown in **Table 16-2**. The concentration changes less than 0.4 µg/m³ for NO₂ and 0.2 µg/m³ for PM₁₀ are 'imperceptible' and are scoped out of the impact significance.
- 16.2.54 Requirements for assessing PM_{2.5} are not included in the DMRB HA207/07 air quality guidance, and accordingly no significance criteria are provided. However, in Scotland there is a PM_{2.5} air quality objective (EU's Air Quality Directive 2008/50/EC), and to enable consideration of PM_{2.5} this assessment adopted the same criteria from IAN 174/13.

Table 16-2: Magnitude of change criteria

Magnitude of Change in Annual Mean Concentrations ($\mu\text{g}/\text{m}^3$)	Value of Change in Annual Average NO_2 , PM_{10} and $\text{PM}_{2.5}$
Large (>4) NO_2 Large (>3) NO_x Large (>1.8) PM_{10} Large (>1) $\text{PM}_{2.5}$	Greater than full Measure of Uncertainty (MoU) value of 10% of the air quality objective
Medium (>2 to 4) NO_2 Medium (>1.5 to 3) NO_x Medium (>0.9 to 1.8) PM_{10} Medium (>0.6 to 1) $\text{PM}_{2.5}$	Greater than half of the MoU, but less than the full MoU of 10% of the air quality objective
Small (>0.4 to 2) NO_2 Small (>0.3 to 1.5) NO_x Small (>0.18 to 0.9) PM_{10} Small (>0.1 to 0.5) $\text{PM}_{2.5}$	More than 1% of objective and less than half of the MoU i.e. 5%. The full MoU is 10% of the air quality objective
Imperceptible (≤ 0.4) NO_2 Imperceptible (≤ 0.3) NO_x Imperceptible (≤ 0.18) PM_{10} Imperceptible (≤ 0.1) $\text{PM}_{2.5}$	Less than or equal to 1% of objective
The MoU is due to uncertainty in the air quality monitoring, modelling and traffic data used in the assessment. The approach for defining the MoU is based around the advice in Defra (2009) on the desirability in achieving 10% verification (modelled versus monitored results) where concentrations are close to or above air quality objectives.	

- 16.2.55 The number of receptors in each magnitude of change band were aggregated and compared to the guideline number of receptors provided in IAN 174/13 to determine whether there is a significant adverse or beneficial (i.e. worsening or improvement) effect (shown in Table 16-3).

Table 16-3: Guidelines to numbers of properties constituting a significant impact

Magnitude of Change in Annual Mean NO_2	Total Number of Receptors with	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large	1 to 10	1 to 10
Medium	10 to 30	10 to 30
Small	30 to 60	30 to 60

- 16.2.56 The guideline bands have been developed for each magnitude category, and set the upper level of likely non-significance and the lower level of likely significance. It should be noted that these are guideline values only and are designed to provide consistency in the assessment of significance across all highway schemes.
- 16.2.57 Where the results reside between the lower and upper guideline bands for any of the magnitude criteria (Table 16-2) then scheme effects could be significant and a judgement is required taking into account the results for all six categories (different magnitudes of change for both worsening and improvement).
- 16.2.58 According to DMRB's IAN174/13 this decision will also be based on technical knowledge and consideration given to (but not limited to) whether scheme effects are likely to be significant.
- 16.2.59 Scheme effects are more likely to be significant where:
- There are no / few receptors with any improvements

- PM₁₀ and PM_{2.5} annual averages are also affected by small, medium or large deteriorations
- Short term exceedances may be caused or worsened by the proposed scheme for either NO₂ or PM₁₀

16.2.60 Scheme effects are more likely to be not significant where:

- There are receptors with small, medium or large improvements
- PM₁₀ and PM_{2.5} annual averages are not affected by small, medium or large deteriorations
- Short term exceedances are not caused or worsened by the proposed scheme for either NO₂ or PM₁₀

Ecological Designated Sites

16.2.61 The approach to the air quality assessment of designated sites is outlined in Annex F of DMRB HA207/07.

16.2.62 The magnitude of change categories defined in Table 16-2 were also used for annual average NO_x concentrations (annual mean objective is 30µg/m³ for designated sites). Annual mean NO_x was used as the main basis for evaluating the significant effects on designated sites.

16.2.63 According to DMRB HA207/07 guidance, where NO_x concentrations were assessed to be below the AQS objective then significant effects are not anticipated. If the AQS objective is exceeded, then significant effects may occur, and further consideration should be given to the magnitude of change. The exception to this is where changes are less than 0.4µg/m³, then effects are considered to be imperceptible and unlikely to be significant.

16.2.64 In addition, critical loads for nitrogen deposition have been set that represent (based on current knowledge) exposure below which there should be no significant harmful effects on sensitive elements of the ecosystem. The critical loads vary by type of ecosystem and can be obtained from the APIS website.

16.3 Baseline Conditions

16.3.1 The baseline assessment has considered air quality monitoring within the THC and PKC local authority areas, and Scottish air quality background mapped annual concentrations (<http://www.scottishairquality.co.uk/data/mapping?view=data>) for both local air quality and ecosystems.

16.3.2 The Proposed Scheme does not fall within, nor is it in the vicinity of, any AQMAs. The nearest AQMA is located approximately 60 km away, encompassing the built-up area of Perth and declared for both NO₂ and PM₁₀.

Air Quality Monitoring

16.3.3 There are two principal methods used for measuring air quality, either using passive sampling techniques such as diffusion tubes, or through the use of sophisticated continuous monitoring equipment.

- 16.3.4 As it is likely that current baseline NO₂ and PM₁₀ concentrations meet AQS objectives at sensitive receptors within the study area, no air quality monitoring was deemed necessary in the A9 Central Section for the purposes of this assessment.
- 16.3.5 Two air quality monitoring surveys were carried out for the A9 Dualling programme in the Northern and Southern Sections, by the Atkins-Mouchel Joint Venture (AMJV) and Jacobs UK (JUK), respectively. The monitoring locations and measured annual mean concentrations of NO₂ are reported in **Appendix 16.2 (Volume 2)**. The JUK sites are the nearest monitoring locations to Project 7, situated approximately 10 - 15km south east of Dalnaspidal Junction and were consulted to establish baseline conditions along the A9 to the north and south of the scheme but were deemed too far to be used for model verification purposes. The measured NO₂ concentrations show there is little or no risk of exceeding NO₂ AQS objectives.
- 16.3.6 THC and PKC monitor NO₂ and PM₁₀ from a network of continuous monitoring locations and diffusion tube sites. None of these monitoring sites are located within the vicinity of the Proposed Scheme. The nearest continuous monitoring station is located near James Square in Crieff, more than 55 km south of the Proposed Scheme extents. Both NO₂ and PM₁₀ monitoring data from the James Square site are presented in **Appendix 16.2 (Volume 2)**.

Background concentrations

- 16.3.7 The background concentration of a pollutant is determined by regional, national and international emissions and often represents a significant proportion of the total pollutant concentration. The local component is determined by local pollutant sources such as road traffic and chimney stacks.
- 16.3.8 Background pollutant concentrations are spatially and temporally variable. Annual mean background concentrations of NO_x, NO₂, and PM₁₀ are provided annually and are mapped on a grid resolution of 1km² across the whole of Scotland. Values were obtained from the Scottish Government, which calculated them using a Scotland-specific model using Scottish monitoring and meteorological data (<http://www.scottishairquality.co.uk/data/mapping?view=data>). PM_{2.5} background were obtained from Defra background mapping.
- 16.3.9 To prevent double counting of source contributions, background contributions from the traffic sector were subtracted from total background NO_x concentrations using the Defra tool (NO₂ Adjustment for NO_x Sector Removal Tool v5.0). Table 16-4 provides the total emissions and the percentage emissions contributions to NO_x and PM₁₀ in Scotland in 2015 from the latest National Atmospheric Emissions Inventory report (September 2017). For NO_x, transport, energy, industry, and residential and commercial sources contribute the most to total emissions. Residential and commercial sectors are also the largest contributions for PM₁₀, followed by transport, agriculture and industry. The area surrounding the Proposed Scheme, however, does not include any large industrial sources or energy facilities. There are also no large population centres with domestic heating. Therefore, the main source of emissions in the Proposed Scheme study area is from transport.

Table 16-4: NAEI (2017) Total emissions (kt) and source emission contributions (%) by sector for Scotland in 2015

Sector	NO _x	PM ₁₀
Total emissions	84	12
Agriculture	0.0	15.8
Energy Industries	28.2	3.6
Fugitive	0.0	0.0

Sector	NO _x	PM ₁₀
Industrial Combustion	14.4	10.0
Industrial Processes	0.0	13.2
Residential, Commercial & Public Sector Combustion	12.0	30.0
Solvent Processes	0.0	2.8
Transport Sources	43.4	18.5
Waste	0.0	0.0
Other sources*	2.0	6.5
*Other sources include all "other" categories in the NAEI inventory and several categories that are insignificant for a specific pollutant		

- 16.3.10 Background NO₂, PM₁₀ and PM_{2.5} concentrations are shown in **Table 16-5** for receptors within the vicinity of Project 7. Background pollutant concentrations all meet AQS objectives for all receptors within the vicinity of the study area.

Table 16-5: Annual mean background pollutant concentrations ($\mu\text{g m}^{-3}$) at human health receptors.

Receptor ID	Grid Square (m)	Base Year (2015)			Opening Year (2026)		
		NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
R1- R6	264500,773500	2.5	7.8	4.8	1.9	7.5	4.6
R7	262500,779500	2.5	7.4	4.6	1.9	7.1	4.4
R8-R10	263500,779500	2.4	7.4	4.6	1.8	7.1	4.4

Key Receptors

Residential Properties

- 16.3.11 Ten residential receptors were identified within 200m of affected roads associated with the Proposed Scheme and were considered for the local air quality assessment. These were identified at worst-case locations alongside the ARN. Locations of the receptors included in this assessment are presented in **Table 16-6** and in **Drawings 16.3** and **16.6 (Volume 3)**.

Table 16-6: Sensitive human health receptors identified for the local air quality assessment

Receptor ID	Description	Chainage	X	Y
R1	Keepers Cottage	300	264523.5	773107.9
R2	The Old School	300	264603.3	773225.5
R3	Garryview	400	264534.3	773251.4
R4	Station House	600	264394.0	773364.8
R5	Station Cottages 1	600	264413.0	773365.4
R6	Station Cottages 2	600	264405.1	773374.2
R7	Balsporran Cottages	6800	262706.0	779191.5
R8	Drumochter Lodges 1	7350	263142.1	779592.7
R9	Drumochter Lodges 2	7350	263139.0	779603.3
R10	Drumochter Lodges 3	7350	263071.6	779627.6

Ecological Designated Sites

- 16.3.12 The River Spey SAC and the Drumochter Hills SAC, SPA and SSSI designated sites are identified within 200m of the Proposed Scheme (see **Drawing 16.1, Volume 3**).
- 16.3.13 The Drumochter Hills SAC, SPA and SSSI potentially contain ecological features that could be sensitive to changes in nitrogen concentrations, which can have direct and indirect effects on vegetation affecting species composition and ecosystem health. The Drumochter Hills SPA, SAC and SSSI are designated for montane, bog, grassland, shrub and inland rock habitats. The River Spey SAC, however, is designated only for faunal species (Atlantic salmon, freshwater pearl mussel and otter), which are not known to be impacted by nitrogen. The River Spey SAC therefore screened out for this nitrogen deposition assessment.
- 16.3.14 Information on rates of baseline nitrogen deposition rates and critical load ranges for habitats and designated sites across the UK are available from APIS.
- 16.3.15 APIS reports baseline nitrogen deposition data for 2013 (as the average of the period from 2012 to 2014) on a grid with a resolution of 5km². This was projected forward to the base year (2015) and the opening year (2026), assuming a 2% decrease per year (HA 207/07). **Table 16-7** summarises this information below.

Table 16-7: Designated Site Critical Loads for Nitrogen Deposition and Baseline Nitrogen Deposition (kg N ha⁻¹ yr⁻¹) (N/A: Not available)

Designated Site	Habitat Type	Critical Load	Nitrogen Deposition (Average 2012 – 2014)	Base Year (2015) Nitrogen Deposition	Opening Year (2026) Nitrogen Deposition
Drumochter Hills SAC, SPA, SSSI	Broad Habitat: Montane habitats, Bogs, Grassland, shrub heath and inland rock	5-20	8.5	8.1	6.5

- 16.3.16 It is important to note that there is uncertainty attached to these APIS values, which has implications for the interpretation of the data. Critical loads are based on empirical data from field experiments and observations. There is high uncertainty associated with these values as they are based on professional judgement. There are also uncertainties associated with land use cover maps that are used to assign broad habitats, with default values often based on very few measurements from a limited number of sites in the UK. Similarly, baseline nitrogen deposition is provided on a 5km grid, which does not account for sub-grid variability.
- 16.3.17 **Table 16-8** presents a summary of the receptors considered in each part of the construction and operational assessments of local air quality. Ecological receptors in the Drumochter Hills SAC, SSSI and SPA represent medium sensitivity habitats, as despite Drumochter Hills is a site of designated importance, the dust sensitivity impact on plant species is uncertain but it may contain features that may be affected by dust deposition.

Regional Assessment

- 16.3.18 The regional assessment did not consider the impacts of the Proposed Scheme at individual receptors, rather the wider impacts of total emissions from the road network. The sum of pollutant contributions from individual traffic links is considered instead.

Summary

- 16.3.19 **Table 16-7** summarises the key receptors considered in each assessment of air quality impacts, as shown in **Drawings 16-3 to 16-6 (Volume 3)**.

Table 16-8: Summary of key receptors considered in each assessment of air quality impacts

Assessment (Phase)	Description
Local Air Quality (Operational)	Residential properties in Dalnaspidal and approximately 5km south of Dalwhinnie: R1-R10
Ecological (Operational)	Thirteen ecological receptors within three transects extending from the A9, including Drumochter Hills SPA (E1-E5), Drumochter Hills SAC (E6-E10), and Drumochter Hills SSSI (E11-E13).
Dust (Construction)	Human receptors: 9 high sensitivity, 3 medium sensitivity, 0 low sensitivity. Ecological receptors: medium sensitivity receptors within 20m and 50m of the works boundary.

16.4 Potential Impacts Assessment

Impact Assessment Introduction

- 16.4.2 This section considers the potential temporary (construction) and permanent (operational) air quality impacts for proposed Project 7.

Construction Impact Assessment: Temporary

- 16.4.3 Following the construction assessment methodology presented in **section 16.2** and **Appendix 16.1 (Volume 2)**, nine **high** sensitivity receptors, all residential properties, and three **medium** sensitivity receptors, including a lodge and two workplaces, were identified. No low sensitivity receptors were found.
- 16.4.4 The construction assessment considered potential temporary impacts during demolition, earthworks, construction and track-out and the level of any mitigation required. Dust emissions can result in dust soiling and lead to elevated PM₁₀ concentrations. Elevated dust emissions can also have impacts on vegetation via deposition, which can alter photosynthetic processes and cause damage to sensitive habitats. The construction assessment methodology is presented in detail in **Appendix 16.1 (Volume 2)** to this report.
- 16.4.5 Demolition activities along the length of the Proposed Scheme will include partial demolition of the existing Allt Coire Mhic-sith and Allt Coire Bhotie underbridges and the complete demolition of the Allt a'Chaorruin, Allt Dubhaig and Allt Chuirn underbridges. Redundant road signage will also be removed. However, the total building volume to be demolished at each location is expected to be less than 20,000m³. Therefore, according to the IAQM (2014) guidance demolition activities have been considered to have a **Small** magnitude.
- 16.4.6 Considerable earthworks is expected to take place along the Proposed Scheme, including such activities as vegetation clearance, excavation, and other land manipulation for drainage and the Proposed Scheme alignment. The total area comprising earthworks activities is expected to exceed 10,000m². Therefore earthworks is assigned a **Large** magnitude.
- 16.4.7 Construction activities will involve the placement of the new route and the Dalnaspidal Junction, as well as local road realignments to accommodate the junction and alternative access provisions. Specific volumes to be constructed are unknown at this time; however, assuming a

conservative approach, are expected to be between 25,000m³ and 100,000m³. Construction is therefore assigned a **Medium** magnitude.

- 16.4.8 Based on estimates of the number of HDVs there are expected to be more than 50 HDV movements per day to be used during the construction phase of the Proposed Scheme. One movement is equivalent to a single, one-way journey. Track-out is therefore assigned a **Large** magnitude.
- 16.4.9 Construction dust impacts have been assessed within 350m of the permanent works boundary for the Proposed Scheme following IAQM (2014) guidance. Human receptors were identified within 20m, 50m, 100m, 200m and 350m of the Proposed Scheme permanent works boundary.
- 16.4.10 Human health impacts also take the local background PM₁₀ concentration into consideration as dust emissions will lead to localised increases. The background PM₁₀ concentration for the area surrounding the Proposed Scheme is approximately 7.4µg m⁻³ for the Base Year.
- 16.4.11 Based on the number and sensitivity of human receptors, and the background PM₁₀ concentration, the area sensitivity is **Low** for human health impacts and **Medium** for dust soiling.
- 16.4.12 Ecological impacts were assessed within 20m and 50m of the Proposed Scheme permanent works boundary. Drumochter Hills SAC, SPA and SSSI are all within 20 and 50m of the permanent works boundary and contain habitats with unknown sensitivities to dust impacts. However, the portion of the ecological designated sites potentially affected by dust emissions is very limited and therefore, the overall area sensitivity to ecological impacts was assessed as **Medium**. Furthermore, considering the prevailing climatic conditions in the area, with abundant precipitation throughout the year, the sensitivity of habitats to dust emissions is not expected to be high.
- 16.4.13 The sensitivity of the area to specific impacts was combined with the estimated magnitudes of construction activities to inform the assessment of the risk of dust impacts from each construction activity. **Table 16-9** presents the risk of dust impacts for dust soiling, human health and ecology for each of the four construction stage activities.

Table 16-9: Overall risk of dust impacts from the four IAQM defined construction activities

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Track-out
Dust Soiling	Low Risk	Medium Risk	Medium Risk	Medium Risk
Human Health	Low Risk	Low Risk	Low Risk	Low Risk
Ecological	Low Risk	Medium Risk	Medium Risk	Medium Risk

- 16.4.14 There is a **Medium Risk** of impact for dust soiling and ecological impacts from each of the four construction activities. Human health has **Low Risk** of impact. The overall risk of dust impacts for the construction phase of the Proposed Scheme is **Medium** and is considered significant enough to require mitigation. The level of risk was therefore used to inform relevant mitigation measures, listed in **section 16.2**, to reduce negative impacts from construction.
- 16.4.15 The risk of impacts presented above represent the worst-case scenario. Construction works will span a wide area and will move as various parts of the Proposed Scheme are completed. Therefore, construction dust impacts would be expected to be spatially and temporally variable. In addition, meteorological conditions will affect the magnitude of dust emissions; under wet conditions dust emissions are significantly reduced.

Operational Impact Assessment: Permanent

Local Air Quality

- 16.4.16 Results of the local air quality assessment are presented in **Table 16-3.1** and **Table 16-3.2** in **Appendix 16.3 (Volume 2)**. NO₂, PM₁₀ and PM_{2.5} concentrations were predicted for the Base Year (2015) and Opening Year (2026) DM and DS scenarios.
- 16.4.17 The background pollution maps and vehicle emission factors assume that air quality improves in future years as older vehicles are replaced with modern cleaner vehicles. However, a report produced on behalf of Defra (*Trends in NO_x and NO₂ emissions and ambient measurements in the UK*, Defra 18th July 2011 version) considered NO₂ monitoring data from across the UK and showed that reductions in concentrations had slowed in recent years. This trend is thought to be related to the increased use of modern diesel vehicles which emit more NO_x than expected under urban driving conditions and have higher primary NO₂ emissions than petrol vehicles. To reduce this discrepancy, a LTT gap analysis has been carried out for NO₂, in accordance with IAN 170/12v3 (HA, 2012).
- 16.4.18 On February 2016, Highways England published an interim note about an alternative long term trends projection methodology for NO₂ called LTT_{E6}. The analysis concluded that the previous LTT was too pessimistic. However, in light of recent studies that seem to confirm that a large number of Euro 6 diesel cars are failing to meet the emission standard, the LTT presented in IAN170 has been used as it was deemed the most conservative approach.
- 16.4.19 In all scenarios considered, estimated annual mean concentrations of NO₂, PM₁₀ and PM_{2.5} remain below the respective AQS objectives. No exceedances of the 1-hour NO₂ or 24-hour PM₁₀ AQS objectives are predicted. In addition, according to IAN 174/13 Table 16-2 and 16-3 a significant effect for local air quality is realised when at least 30 receptors have a Small (i.e. > 0.4 µg/m³) pollutant impact magnitude. As presented in **Appendix 16.3 (Volume 2)**, the Proposed Scheme impacts are imperceptible at all receptors for all pollutants considered in this assessment.
- 16.4.20 Despite the permanency of dualling, within the Proposed Scheme extents the addition of another carriageway and junction design changes on the A9 lead to imperceptible changes of pollutant concentrations at sensitive human receptors.
- 16.4.21 Given the low concentrations (well below the AQS objectives) and according to the methodology presented in **section 16.2**, the impact on local air quality associated with the Proposed Scheme is **not considered to be significant**.

Regional Air Quality

- 16.4.22 Regional emissions were predicted for the ARN in the Base Year (2015), and the Opening (2026) and Design (2041) Years DM and DS scenarios.
- NO_x, PM₁₀, and CO₂ emissions are shown to increase for all pollutants due to the Proposed Scheme. Year 2030 emissions were used for the Design Year, as this is the latest year available in the EFT. **Table 16-10** below summarises the regional assessment results.

Table 16-10: Results of the regional assessment for the pollutants NO_x, PM₁₀ and CO₂

Pollutant	Base 2015	Opening Year 2026		Change due to scheme in 2026 (DS-DM)	% Change	Design Year 2041		Change due to scheme in 2041 (DS-DM)	% Change
		DM	DS			DM	DS		
NO _x (kg yr ⁻¹)	22,399	7,369	11,250	+3,836	52.1	7,243	10,463	+3,220	44.4
PM ₁₀ (kg yr ⁻¹)	1,574	1,441	1,786	+345	23.9	1,573	1,899	+326	20.7
CO ₂ (T yr ⁻¹)	8,664	9,370	12,558	+3,188	34.0	10,810	13,390	+2,580	23.9

- 16.4.23 A decrease in emissions is predicted for NO_x and PM₁₀ between 2015 and the 2026 Do-Minimum scenario. This decrease in emissions is the result of the expected improvement in emissions per vehicle due to fleet turnover to later Euro standards, improved emission technologies and fuel economy. CO₂ emissions increase because for this specific pollutant the improved emission technologies are not expected to compensate the increase in the number of vehicles.
- 16.4.24 Increases in regional emissions are predicted for both opening (DS) and design (DS) years, mainly because the Proposed Scheme is expected to lead to an increase in traffic flows due to the increased capacity. Total vehicle kilometres (vkm) also increase in the opening and design years as a result of the Proposed Scheme design, which also contributes to increased regional emissions. This suggests that the extent of the improvement in emissions per vehicle (due to fleet turnover to later Euro standards, improved emission technologies and fuel economy) is less than the increase in emissions associated with traffic growth. It should be noted that the ARN is limited to the A9 mainline and a few secondary local roads. Relative to the total emissions across Scotland for NO_x, PM₁₀ and CO₂, the increase of emissions as a result of the Proposed Scheme is small.
- 16.4.25 According to Scotland's Air Quality Pollutant Inventory (AQPI) (National Atmospheric Emissions Inventory - NAEI, 2016) total NO_x and PM₁₀ emissions from all sectors were 90.8 and 18 kilotonnes in 2014 respectively. No future estimate are available. The increase in emissions associated with the Proposed Scheme (less than 1%) will not significantly affect regional air quality.

Ecological Designated Sites

- 16.4.26 The potential impacts of the Proposed Scheme on habitats within the designated sites have been considered along the Drumochter Hills SAC, SPA and SSSI transects, extending up to 200m from the Proposed Scheme. Each transect was chosen at worst case locations, where the respective designated site was nearest to the A9. The selected receptors are shown in **Drawings 16.4-16.5 (Volume 3)**.
- 16.4.27 Road-traffic contributions have been combined with background concentrations to obtain the total NO_x concentration. Background concentrations used in the assessment of the existing baseline (2015) and opening year (2026) are presented in **Table 16-11**.

Table 16-11: Annual mean background pollutant concentrations ($\mu\text{g m}^{-3}$) used in the assessment

Receptor	Easting (m)	Northing (m)	Background NO _x	
			Base Year (2015)	Opening Year (2026)
Drumochter Hills SPA (E1-E5)	262500	776500	3.1	2.4
Drumochter Hills SAC (E6-E10)	262500	778500	3.2	2.4
Drumochter Hills SSSI (E11 – E13)	262500	778500	3.2	2.4

- 16.4.28 Total NO_x concentrations have been adjusted using the LTT Gap Analysis method discussed in **section 16.2**. The results of the assessment of NO_x concentrations for ecological receptors in the study area are presented in **Appendix 16.3 (Volume 2)**.
- 16.4.29 NO_x concentrations are below the objective of 30 $\mu\text{g m}^{-3}$ in all scenarios for all ecological receptors. Changes in NO_x concentrations are a result of the combination of changes to the alignment of the A9 mainline and increase in traffic volumes along the A9. NO_x concentrations therefore increase for receptors at nearest point of designated sites to road and drop off at receptors further from the A9 becoming imperceptible.
- 16.4.30 IAN 174/13 guidance recommends that the NO₂ impact magnitude criteria in Table 16-2 and Table 16-3 were also used to assess the Proposed Scheme impacts on NO_x in the three designated sites. Where a potentially significant effect is evident due to NO_x concentrations, the nitrogen deposition rates would further assist in the evaluation of significance. However, results for the assessment of NO_x concentrations for all ecological receptors do not constitute a significant effect as the Proposed Scheme does not lead to any exceedances of the NO_x objective (30 $\mu\text{g m}^{-3}$). Nitrogen deposition rates were therefore not assessed further for designated sites within the study area.

16.5 Mitigation and Monitoring Requirements

- 16.5.1 The findings of the assessment presented in **section 16.4** were used to develop relevant mitigation measures for the operational and construction phases of the Proposed Scheme to mitigate significant adverse impacts. **Table 16-12** presents mitigation measures that are common to the A9 Dualling projects and specific to P07.
- 16.5.2 The operational impacts are anticipated to be not significant and therefore no air quality specific mitigation measures have been identified for the operation of the Proposed Scheme.

Monitoring Requirements

- 16.5.3 A strategy shall be developed for construction phase dust monitoring by the construction contractor. This should include a review of risk for construction dust impacts, the identification of monitoring locations and consultation with the local authority. In accordance with IAQM guidance, dust monitoring should be undertaken during the construction of phases that are expected to be 'Medium' or 'High' risk for construction dust emissions. However, due to the low number of receptors nearby, no air quality specific monitoring requirements are anticipated during the operation of the Proposed Scheme.

Table 16-12: Proposed standard and project specific dust emission and air quality construction phase mitigation measures

Mitigation Item	Approximate Chainage/ Location	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required
Standard A9 Mitigation					
SMC-AQ1	Throughout Proposed Scheme	Construction	<p>In relation to minimising fugitive dust emissions from earthworks, material storage and concrete batching the following mitigation items will be implemented:</p> <ul style="list-style-type: none"> • stockpiles and mounds will be at a suitable angle of repose to prevent material slippage, will be enclosed or securely sheeted, and/ or kept dampened as necessary during dry weather; • the surfaces of any long-term stockpiles which give rise to a risk of dust or air pollution will be covered with appropriate sheeting or will be treated to stabilise the surfaces; • mixing of large quantities of concrete will be carried out only in enclosed or shielded areas; • all handling areas will be maintained in a dust free state as far as is practicable with sprinklers and hoses used to prevent dust escaping from the site boundaries; and • procedures will be established so that the site is regularly inspected for spillage of dusty or potentially dusty materials and any such spillage would be dealt with promptly where necessary to prevent dust nuisance. 	To reduce fugitive dust emissions from earthworks, material storage and concrete batching.	None required
SMC-AQ2	Throughout Proposed Scheme	Construction	<p>In relation to minimising dust from vehicle movements within the site the following mitigation items will be implemented:</p> <ul style="list-style-type: none"> • the Contractor will employ appropriate measures, such as covering materials deliveries or loads entering and leaving the construction site by a fixed cover or sheeting appropriately fixed and suitable for the purposes of preventing materials and dust spillage; • where unsurfaced routes are identified as creating dust emissions during periods of dry weather, surfaces will be regularly dampened down using water bowsers; and • appropriate speed limits will be established and enforced over all unmade surfaces. 	To reduce dust from vehicle movements.	None required
SMC-AQ3	Throughout Proposed Scheme	Construction	<p>In relation to appropriate cleaning of public roads the following mitigation items will be implemented:</p> <ul style="list-style-type: none"> • the edges wheel washing facilities will be installed as required and heavy vehicles will be required to use the facilities prior to leaving the site; • subject to approval from Transport Scotland and the network operator, public roads immediately outside the site entrance will be cleaned using vacuum sweeper brushes and other specialised road cleaning equipment as necessary to maintain an appropriate state of cleanliness; and • roads and footpaths adjacent to the Proposed Scheme will be cleaned, with damping if necessary. 	To reduce potential of dust from public roads	Approval required from the Roads Authority
Project Specific Mitigation					
P07-AQ1	-500 to 9,741	Construction	<p>In relation to preparing and maintaining the site, the following additional mitigation item will be implemented:</p> <p>Plan site layout so that machinery and dust causing activities are located as far as possible from receptors.</p> <p>This is particularly relevant around the Dalnaspidal Junction where the greatest number of receptors are located.</p>	Ensuring the site layout minimises the risk of dust emissions.	

16.6 Residual Impacts

- 16.6.1 During the construction of the Proposed Scheme, activities have the potential to give rise to fugitive dust. However, with appropriate mitigation, short-term impacts can be minimised during construction works to become insignificant.
- 16.6.2 No mitigation is proposed for operational air quality as impacts are predicted to be not significant.

Table 16-13: Summary of air quality residual impacts

Environmental topic	Residual Impacts – Air quality and construction dust
Air Quality – During Construction	No significant impact with mitigation in place
Air Quality – During operation	Not significant

16.7 Overall Evaluation of Significant Effects

- 16.7.1 The overall impact assessment of the Proposed Scheme follows guidance presented in IAN 174/13, whereby professional judgement on the significance determination is presented in terms of specific scheme-related questions. **Table 16-14** presents the evaluation of significant air quality effects of the Proposed Scheme.

Table 16-14: Summary assessment of overall air quality effects

Key Criteria Questions	Yes / No
Is there a risk that environmental standards will be breached?	No
Will there be a large change in environmental conditions?	No
Will the effect continue for a long time?	No
Will many people be affected?	No
Is there a risk that designated sites, areas, or features will be affected?	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No
On balance is the Overall Effect Significant?	No

- 16.7.2 The area surrounding the Proposed Scheme is sparsely populated with few sources of air pollution, and low background concentrations. The addition of another carriageway and junction design changes on the A9 lead to imperceptible changes of pollutant concentrations at both sensitive human and ecological receptors. Potential impacts are therefore **not significant**.

16.8 References

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