7 Air Quality

People living near busy roads, such as the A9 Perth – Inverness Trunk Road or A96 Aberdeen – Inverness Trunk Road (hereafter referred to as the A96), are potentially exposed to air pollution concentrations from road traffic. Changes in traffic flows associated with the proposed A9/A96 Inshes to Smithon scheme could result in changes in the concentrations of air pollutants at nearby residential properties or other sensitive receptors.

A detailed Design Manual for Roads and Bridges (DMRB) Stage 3 air quality assessment has been carried out, based on computer modelling of future conditions. The assessment used forecast traffic data for the opening year (2022) and the design year (2037) in addition to other predicted parameters as part of the modelling procedure, in accordance with the relevant DMRB guidance; DMRB Volume 11 Section 3 Part 1 HA207/07 Air Quality and associated Interim Advice Notes (IANs).

The local air quality assessment focused on the pollutants nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) at 76 worst-case human receptor locations. Longman and Castle Stuart Bays Site of Special Scientific Interest (SSSI), the Inner Moray Firth Special Protection Area (SPA) and Ramsar site were considered and scoped out of the air quality assessment due to being not sensitive to nitrogen effects. Oxides of nitrogen (NOx), particulate matter and carbon dioxide (CO_2) emissions were also assessed. The results illustrate that there are no predicted exceedances of the NO_2, PM_{10}, or $PM_{2.5}$ Air Quality Objectives (AQOs) in either the Do Minimum (DM) (without scheme) or Do Something (DS) (with scheme) scenario in the opening year.

The outcome of the air quality assessment indicates that no exceedances of the relevant AQOs are predicted to occur at representative sensitive receptors with the proposed scheme in place. The air quality impact of the proposed scheme is therefore considered to be not significant. The predicted change in emissions across the affected road network represents a nominal proportion of the UK total road transport emissions. The wider effects on regional air quality are also considered to be not significant.

7.1 Introduction

7.1.1 Air quality is a consideration in any development proposal involving significant changes in the nature and location of emissions to air. A Design Manual for Roads and Bridges (DMRB) 'detailed' air quality assessment has been undertaken to establish the potential effects of the A9/A96 Inshes to Smithton scheme (hereafter referred to as the proposed scheme) upon local air quality. A regional air quality assessment has been undertaken following the DMRB 'simple' assessment approach. This chapter describes the assessment of the construction and operational effects arising from the proposed scheme.

7.1.2 This chapter presents the DMRB Stage 3 assessment which consists of the following aspects:

- baseline air quality: the review and assessment of the existing air quality situation within the study area;
- local air quality: a detailed assessment of the potential air quality impacts of the proposed scheme upon representative sensitive receptors within the study area;
- designated sites: an assessment of the potential for air quality impacts from the proposed scheme upon relevant designated sites within the study area; and
- regional air quality: a simple assessment of the potential air quality impacts of the proposed scheme upon the wider area.

7.1.3 This assessment is supported by the following appendices and figures:

- Appendix A7.1: Air Quality Dispersion Model Set Up;
- Appendix A7.2: Air Quality Verification and Adjustment;
- Appendix A7.3: Air Quality Construction Assessment;
- Appendix A7.4: Air Quality Receptor Results;
- Figure 7.1: Constraints Plan;
- Figure 7.2: Baseline NO_2 Concentrations (2017);
- Figure 7.3: Do Minimum NO_2 Concentrations (2022);

- Figure 7.4: Do Something NO_2 Concentrations (2022); and
- Figure 7.5: Change in NO_2 Concentration.

Pollutants

7.1.4 A brief description of the key air pollutants for road schemes is provided below.

7.1.5 NO_2 is a colourless, odourless gas which has been shown to have adverse health effects, including respiratory irritation in asthmatics. There is believed to be a threshold at which it has an effect. It is formed principally from the oxidation of nitric oxide (NO) through the action of ozone in the atmosphere. Combustion in air forms mainly NO and some NO_2 (collectively termed 'NOx') from the combination of atmospheric nitrogen and oxygen. NOx is emitted from internal combustion engines as well as other forms of combustion and formed from natural sources such as lightning. NOx is also a precursor to PM_{10} and $PM_{2.5}$.

7.1.6 Particulate matter (PM), which are referred to as PM_{10} and $PM_{2.5}$, where the numbers denote the fractions of particulate matter (e.g. dust) in the air with an average aerodynamic diameter of less than 10 and 2.5µm, respectively. This size range of particulate matter can penetrate deep into the lungs and has been shown to have a range of adverse health effects. These include a causal association with cardiovascular and respiratory illnesses. According to the Air Quality Strategy (AQS 2007) (refer to Table 7.1 below), '*it is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health*'. That is to say, scientific research cannot prove that human health is at less risk with smaller dose exposure. There is no proven safe threshold. In terms of harm, economically PM is costed as being more harmful than NO_2 by Department for the Environment, Food and Rural Affairs (Defra). PM is formed from both man-made and natural sources. Primary PM is formed from the incomplete combustion of fuel (e.g. soot from diesel exhausts), sea-salt and wind-blown dust. Secondary PM is formed in the atmosphere from other pollutants such as NOx and sulphur oxides, and in certain circumstances in photochemical smogs. PM has a residence time of several days in the atmosphere, so pollution events can occur in the UK when polluted air is blown from the continent.

Legislative and Policy Background

7.1.7 This section, and Table 7.1 provides a summary of the relevant air quality legislation and standards that have been referenced for this assessment.

Table 7.1: Relevant Air Quality Legislation

Legislation	Description
Environment Protection Act 1990 Part III	Provides statutory nuisance provisions for nuisance dust.
Environment Act 1995, Part IV	Defines requirements for Local Air Quality Management (LAQM).
The Air Quality (Scotland) Regulations 2000, and The Air Quality (Scotland) (Amendment) Regulations 2002	Legislates for the Air Quality Objectives (AQOs) for pollutants set out in the 2007 Air Quality Strategy.
The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland, 2007	Updates the 2000 Air Quality Strategy, and sets out how local air quality is managed, through the application of AQOs based on the Air Quality (Scotland) Regulations 2000 and 2002 Amendments.
The Air Quality (Scotland) Regulations 2010	Transpose formalised limit values set out in the EU Ambient Air Quality Directive 2008/50/EC to UK law.
The Air Quality (Scotland) Amendment Regulations 2016	Updates the $PM_{2.5}$ objectives.
Conservation (Natural Habitats etc) Regulations (as amended) 1994	The presence of protected habitats and ecosystems within the air quality study area introduces legislative requirements that must be taken into account in assessing air quality impacts. The substances associated with potential impact on habitats and ecosystems are NOx, and associated nitrogen deposition.
Cleaner Air for Scotland 2015	A strategy setting out the Scottish Government's proposals for delivering further improvements to air quality.

7.1.8 European Union Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe (European Union 2008) was published to consolidate previous European Directives on ambient air quality. These

European Directives form the basis for UK air quality legislation. Although published in 2007, the Air Quality Strategy (AQS 2007) is consistent with The Air Quality Standards Regulations (Scotland) 2010.

7.1.9 The UK government is currently responsible to the European Commission (EC) for ensuring that it complies with the provisions of the EU Directives. The UK government and governments of other member states are currently in negotiations with the EC over breaching limit values for nitrogen dioxide (NO_2) and PM_{10} (particulate matter with an aerodynamic diameter of less than 10 microns).

7.1.10 On the UK government's behalf, the Department for Transport (DfT) and Department for Environment Food and Rural Affairs (Defra) have Public Service Agreements relating to EU Limit Values.

7.1.11 The responsibilities of Local Authorities with respect to meeting air quality standards are not the same as the responsibilities of the UK government to the EC. Local Authorities do have statutory duties for Local Air Quality Management (LAQM) but are not obliged to ensure AQOs are met but rather are worked towards in the shortest practical time. Under Part IV of the Environment Act 1995, and the establishment of the Scottish Environment Protection Agency (SEPA), the UK Government introduced LAQM, which placed duties on local authorities to undertake periodic reviews of air quality in their areas to assess present and likely future air quality against the AQOs. Where these objectives are not likely to be met, the local authority must designate an AQMA, and produce an action plan for improvement in air quality.

7.1.12 It is important to recognise the difference between the EU Limit Values (for which compliance is determined at a national level by government) and the AQO (for which compliance is determined at a local level by local authorities under the LAQM regime). Whilst the Limit Values and AQOs for the relevant pollutants (NO_2 and PM_{10}) may be set at the same concentration value (e.g. 40µg/m^3, as an annual mean) the means of determining compliance are fundamentally different, and they must be considered separately.

7.1.13 Article 3 of the EU Directive requires Member States to nominate the competent authority for the assessment of air quality (which in the UK is the Secretary of State for the Environment) and it may be interpreted that only the competent authority can determine compliance with the Limit Values. Compliance is determined via the national monitoring network and national model (the Pollution Climate Mapping (PCM) model), and there are a number of important differences between this and the monitoring/modelling carried out by local authorities to determine compliance with the objectives. Some of these differences are summarised in Table 7.2.

Table 7.2: Comparison Between National and Local Compliance Approaches

Factor	National Compliance	Local Compliance
Relevant exposure	Limit Values apply everywhere there is public access	Annual mean objectives only apply at locations where public exposure is relevant to the averaging period, e.g. at residential building facades
Treatment of junctions	Monitoring is not carried out within 25 metres of a junction and the same constraint is applied to the modelling	Junctions are specifically considered in both monitoring and modelling
Microscale	Excludes micro-environments and focuses on locations representative of 100m lengths of roads	Focuses on 'hot-spot' locations
Roadside	Modelled concentrations apply to a distance of 4m from kerbside of the national road network. Local roads are excluded from the model	Focus is on concentrations at the building façade, whatever distance from the kerb and alongside any road
Monitoring	Restricted to monitoring stations in the national network, operated to meet the Data Quality Objectives of the Directive	Principally based on local authority monitoring, including both automatic and passive diffusion samplers

7.1.14 Because of these differences, there are many locations across the UK where the national compliance with the Limit Values, and local compliance with the AQOs, are not in agreement. For the purpose of this assessment, they are treated separately. This is consistent with the advice in the relevant Planning Advice Notes (PANs) produced by the Scottish Government which provide further guidance on specific topics.

Air Quality Strategy and Local Air Quality Management (LAQM)

7.1.15 The AQO applicable to LAQM in Scotland are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97), the Air Quality (Scotland) (Amendment) Regulations 2002 (Scottish SI 2002 No 297). AQOs are health-based standards that were set at a level to provide protection to the whole population. The pollutants relevant to this assessment are NO_2, PM_{10} and $PM_{2.5}$. The National Air Quality Strategy for England, Scotland, Wales and Northern Ireland (the AQS) also provides for a non-statutory objective for NOx. The relevant AQOs are presented in Table 7.3.

Table 7.3: National Air Quality Objectives (AQOs)

Pollutant	AQOs	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times/year	1 hour mean
	40µg/m^3	Annual mean
Oxides of Nitrogen (NOx) for the protection of vegetation and ecosystems	30µg/m^3	Annual mean
Particulate Matter (PM_{10})	50µg/m^3 not to be exceeded more than 7 times/year	24 hour mean
	18µg/m^3	Annual mean
Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)	10µg/m^3	Annual mean

7.1.16 For a full description of the terms used in relation to air quality, the science and the legislation, reference should be made to the AQS documents, and to the supporting Local Air Quality Management Technical Guidance (Defra, 2018a) (hereafter referred to as LAQM TG(16)).

7.1.17 It is very difficult to produce robust predictions of short-term concentrations from road traffic. Therefore, compliance with the short-term AQOs is assessed by following the guidance presented in LAQM TG(16), which provides a relationship between the annual mean concentration and the number of periods per year where the short-term AQO is likely to be exceeded. These relationships have been derived from examination of monitoring data across the UK.

7.1.18 It is accepted that it is unlikely that the annual mean 1-hour NO_2 AQO will be exceeded, where the annual mean is below 60µg/m^3. The annual mean equivalent concentration for the PM_{10} 24-hour mean AQO to be exceeded is 22.4µg/m^3 (based on 7 permitted exceedances per year), refer to LAQM TG(16) paragraph 7.92.

7.1.19 The AQS introduces measures to control exposure to $PM_{2.5}$ (the fraction of particulate matter with an average aerodynamic diameter less than 2.5µm). This is intended to be delivered at the national level, so the control has not been incorporated into LAQM, authorities have no statutory obligation to review and assess against them.

7.1.20 Following their review of the LAQM system, the Scottish Government has decided to replace the existing Scottish $PM_{2.5}$ objectives with the World Health Organisation (WHO) guideline values, refer to Table 7.1 (The Air Quality (Scotland) Amendments Regulations 2016). LAQM TG(16) details a PM_{10} annual mean for Scotland of 18µg/m^3 and $PM_{2.5}$ annual mean of 10µg/m^3.

7.1.21 Responsibility for determining whether AQOs are complied with lies with Local Authorities within the system of LAQM. This LAQM regime is under review by Defra. Currently, Local Authorities are required to review and assess air quality within their districts, against the AQOs. Where the AQOs are not being met at relevant locations, they must declare Air Quality Management Areas (AQMAs) and develop an Air Quality Action Plan (AQAP) setting out measures to work towards reducing the concentrations of the relevant pollutants to below the relevant AQOs. The given dates for compliance with the AQOs as described in the AQS have all now passed.

7.1.22 Pollutants such as benzene and 1,3 butadiene are associated with the use of fuels for road transport (petrol and diesel). The other pollutants are potentially associated with emissions from diesel combustion. However, based on review and assessment across the UK, DMRB specifies that there is

no potential risk of exceedance of the AQO or significant impacts for any pollutants other than NO_2 and PM_{10} as a result of a road scheme.

Dust Nuisance

7.1.23 One of the main concerns regarding the air quality impact during construction is the potential of impacts from fugitive dust. There are no nationally recognised criteria defining levels of dust that can cause an annoyance.

7.1.24 Fugitive dust effects can be controlled under the Statutory Nuisance provisions of Part III of the Environmental Protection Act (Environmental Protection Act 1990). Where required, best practice fugitive dust control measures outlined in the Institute of Air Quality Management (IAQM 2016) Guidance, have been identified.

Planning Policy

7.1.25 Scottish Planning Policy (SPP) notes that decision making in the planning system should contribute to the reduction in greenhouse gasses in line with the targets set in the Climate Change (Scotland) Act 2009 (Scottish Government 2009). The Act sets a target of an 80% reduction in emissions by 2050 and an interim target of a 42% reduction by 2020 for Scotland. The design of new development should address the causes of climate change by minimising carbon and other greenhouse gas emissions. Annual targets for 2010 to 2022 are set out in the Climate Change (Annual Targets) (Scotland) Order 2010 (Scottish Government, 2010).

7.1.26 An assessment of compliance of the proposed scheme against National, Regional and Local Planning Policies relevant to air quality is reported in Appendix A18.2 (Assessment of Development Plan Policy Compliance) and summarised in Chapter 18 (Policies and Plans).

7.2 Methodology

7.2.1 This air quality assessment identifies potential air quality impacts by predicting the changes in concentrations of air pollution as a result of the combination of background concentrations and the contributions from road traffic emissions, including the proposed scheme, in the study area.

7.2.2 This assessment conforms to the standard practice of Environmental Impact Assessment (EIA), whereby a baseline is established, and then a future situation with the proposed scheme in place (Do Something (DS)) is compared with the situation without the proposed scheme in place (Do Minimum (DM)).

Construction Phase

7.2.3 Major construction projects can give rise to increased long term and short term PM_{10} concentrations. There is also the potential for dust nuisance at receptors within 350m of construction sites; and/ or 50m from the edge of proposed haulage roads; up to 500m from the site exit associated with the proposed 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.

7.2.4 Very high levels of dust deposition can also affect plants and ecosystems, by covering their leaf surfaces or changing the chemical composition and texture of the soil. The maximum distance at which dust effects are likely to be experienced at ecological receptors is 50m from the source. There were no ecological receptors identified.

7.2.5 The assessment considers the potential air quality impacts of dust at potentially sensitive receptors following the methodology outlined within the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction v1.1, 2016 (IAQM, 2016).

7.2.6 The construction process consists of a series of different activities, each with its own duration and potential for dust generation, which would vary substantially over different phases of the construction period. If the construction phase were to produce excessive emissions of dust, the impact on sensitive locations near to the sites (namely residential properties) could potentially be significant.

7.2.7 In line with the IAQM Guidance (IAQM 2016), a construction dust assessment should be undertaken when data is available. The assessment has been undertaken using the best available information at the time of writing. Any assumptions have been clearly stated. The dust assessment provides a qualitative risk-based appraisal with reference to the proposed scheme in relation to sensitive locations, the planned construction process and local site characteristics.

7.2.8 Mitigation measures and site controls can be used to reduce the impact of dust during the construction phase. The level of measures and controls differs in relation to the level of risk for potential for dust nuisance. The mitigation measures are generally suitable for inclusion in a Construction Environmental Management Plan (CEMP) which would normally be agreed with the respective Local Authority prior to commencement of activity on the site. Mitigation measures and controls for this proposed scheme are detailed further in Section 7.5 (Mitigation).

7.2.9 The methodology for the construction dust assessment is provided in greater detail in Appendix A7.3 (Air Quality Construction Assessment). A summary is provided in Table 7.4.

Table 7.4: Summary of IAQM Construction Dust Assessment Methodology

Step	Methodology Summary
Step1	Screen the need for a detailed assessment.
Step2a	Determine the potential dust emission magnitude - Small, Medium and Large-scale risk, for each site activity – Demolition, Earthworks, Construction and Trackout*.
Step 2b	Define the Sensitivity of the Area – Low, Medium or High which includes: Specific sensitivities of receptors based on proximity and numbers of those receptors and the local background PM_{10} (pertinent to human health effects).
Step 2c	Define the Risk of Impacts, based on the dust risk and area sensitivity conclusions from Step 2a and 2b (without mitigation).
Step 3	Site Specific Mitigation (if required).
Step 4	Determination of Significant Residual Effects.

*Trackout is the transport of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when Heavy Duty Vehicles (HDVs) leave the construction site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

Operational Phase

Local Air Quality Modelling Methodology

7.2.10 This assessment conforms to the standard practice of EIA, whereby a baseline is established, and then a future situation with the proposed scheme in place (Do Something (DS)) is compared with the situation without the proposed scheme (Do Minimum (DM)). For the purposes of the assessment, the Opening Year has been assumed as 2022, and the Design Year (15 years after opening) has been assumed as 2037.

7.2.11 The potential impacts of the proposed scheme have been assessed following DMRB Volume 11, Section 3, Part 1 HA207/07 Air Quality (Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 1993) (hereafter referred to as HA207/07) and associated DMRB Interim Advice Notes (IANs), and LAQM TG(16); however, no speed banding has been applied in the context IAN185/15 (Highways Agency, Transport Scotland, Welsh Assembly Government and the Department of Regional Development for Northern Ireland 2015) (refer also to paragraph 7.2.25). Following the process set out in DMRB, a detailed assessment has been carried out for local air quality using the dispersion modelling software, Air Dispersion Model Software (ADMS)-Roads. A detailed assessment is normally undertaken, as per DMRB, where there is the potential for air quality exceedances especially for a Stage 3 type assessment, such as this. In addition to the DMRB guidance, the assessment has also included the assessment of $PM_{2.5}$ to address the greater regulatory requirements applied in Scotland.

7.2.12 The detailed assessment of the potential air quality effects of the proposed scheme has been undertaken using the ADMS-Roads software. It is an atmospheric dispersion modelling system that focuses on road traffic as a source of pollutant emissions and is a recognised tool for carrying out air quality impact assessments. Version 4.1.1 (January 2018) was used for this assessment. Further information on the modelling methodology can be found in Appendix A7.1 (Air Quality Dispersion Model Setup).

7.2.13 A simple assessment has been undertaken for the regional assessment given the expected changes in relation to national emissions will be small and are adequately assessed at the simple level.

Assessment Scenarios

7.2.14 This assessment consists of one study area that covers two different geographic scales:

- local air quality concentrations, focusing only on the headline pollutants of NO_2, PM_{10} and $PM_{2.5}$; and
- regional air quality emissions, focusing on NOx, PM_{10}, $PM_{2.5}$ and carbon dioxide (CO_2).

7.2.15 The assessment method is to quantify the ambient pollution concentrations and annual emissions for the road traffic scenarios as follows:

- baseline year (2018 (modelled as 2017));
- modelled opening year (2022) – without proposed scheme – DM; and
- modelled opening year (2022) – with proposed scheme – DS.

7.2.16 As well as this, future scenarios (15 years after the modelled opening year) are also considered for the regional assessment (emissions only):

- design year (2037) – DM; and
- design year (2037) – DS.

Study Area

Construction Phase

7.2.17 Potential air quality impacts as a result of construction activities were considered within 350m of the proposed scheme boundary and 50m from haul route roadsides up to 500m from the construction site exit. Sensitive receptors are banded at the following distances from dust raising activities (distances from the site boundary), in accordance with IAQM guidance (IAQM, 2016):

- 0 to 20m;
- 21 to 50m;
- 51 to 100m; and
- 101 to 350m

7.2.18 With regard to construction haul routes, the assessment has considered the most realistic approach in the absence of confirmed information at the time of writing.

Operational Phase

7.2.19 In accordance with DMRB HA207/07 (Highways Agency *et al*) potential air quality impacts from the proposed scheme were considered at a local and regional level.

7.2.20 The study area for the assessment was defined following the screening process outlined within DMRB HA207/07(Highways Agency *et al*), which identifies the 'affected road network' (ARN) based on changes between the Do Minimum (DM) and Do Something (DS) scenarios that would occur as a result of the proposed scheme being implemented, using qualifying criteria, as follows:

- horizontal road alignment would change by 5m or more;

- daily traffic flows would change by more than 1,000 Annual Average Daily Traffic (AADT);
- heavy Duty Vehicle (HDV) flows would change by more than 200 AADT;
- daily average speed would change by more than 10kph; or
- peak hour speed would change by more than 20kph.

7.2.21 The study area covers the proposed scheme, as well as sections of the wider local road network serving these areas.

7.2.22 Representative sensitive receptor locations (typically, locations where the greatest change in pollutant concentration or highest concentrations are likely to occur as a result of a scheme) were identified within 200m of the ARN (the ARN is depicted in Figure 7.1). These were modelled and considered for the assessment of potential impacts to local air quality.

7.2.23 The regional assessment was based on the ARN defined above for local air quality.

Traffic Data

7.2.24 Traffic data for the modelling scenarios has been provided from the traffic models, which have been developed by Jacobs. The base year air quality modelling uses traffic data, pollution measurements and meteorological measurements from 2017.

7.2.25 IAN185/15 (Highways Agency *et al*) provides supplementary guidance to HA207/07 (Highways Agency *et al*) regarding traffic speeds and the generation of speed-band banding for vehicle emissions. However, whilst the air quality assessment used speed pivoted data, IAN 185/15 (Highways Agency *et al*) speed banding (and subsequent emission factoring) has not been included in the assessment. Compliance with IANs is not compulsory in Scotland and this approach to the assessment has been confirmed with Transport Scotland.

7.2.26 Traffic data which represents the average conditions occurring in specific time periods was provided for the periods specified in Table 7.5.

Table 7.5: Annual Average Time Periods Used

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

7.2.27 For each time period, the following traffic data parameters were provided:

- total traffic flow, defined as vehicles/hour;
- percentage HDV; and
- vehicle speed, in kilometres per hour (kph).

Vehicle Emissions

7.2.28 The dispersion modelling process takes into account the emissions produced by Light Duty Vehicles (LDV, less than 3.5 tonnes) and HDV travelling at a certain speed along a section of road over an average hour for the period considered, and predicts the dispersion of these emissions. Emissions for light and heavy duty vehicles are derived from the Defra Emissions Factor Toolkit (EFT) Version v8.0.1 (Defra 2017a).

Meteorological Data

7.2.29 The effect of meteorological conditions on dispersion is given a complex treatment within the model. The most significant factors in the dispersion of emitted pollutants are wind speed and direction. The meteorological data site considered to be most representative of conditions across the study area was Inverness Airport for 2017. The meteorological dataset used was complete with no data gaps for the year.

Background Concentrations

7.2.30 Scottish Air Quality (Scottish Air Quality 2018) and Defra (Defra 2018b) provide empirically-derived national background maps, which provide estimates of background pollutant concentrations on a 1km x 1km grid square resolution. This model relates the National Atmospheric Emissions Inventory (NAEI) to the national network of pollution measurements. Data for NOx, NO_2 and PM_{10} have been obtained from Scottish Air Quality, and $PM_{2.5}$ and PM_{10} data also obtained through Defra for The Highland Council area. The ratio of the Defra $PM_{2.5}$ to PM_{10} was applied to the Scottish PM_{10} on a grid square basis to derive and equivalent $PM_{2.5}$ background concentration.

7.2.31 The 'in-grid square' contribution from road sectors included in the model (motorway, Trunk roads and Primary A-roads) has been removed from the background annual mean NOx, PM_{10} and $PM_{2.5}$ concentration estimates, and background annual mean NO_2 estimates have been corrected using the Defra Sector Removal tool Version v6 (Defra 2017b), and Defra NOx to NO_2 Calculator Version v6.1 (Defra 2017c). This process has been undertaken to avoid double counting of road traffic emissions. The predicted background pollutant concentrations in the study area are well below the AQOs.

Verification and Adjustment

7.2.32 The ADMS-Roads model is used to predict the road traffic contributions to NOx, PM_{10} and $PM_{2.5}$ concentrations at specified receptors. Adjustments are applied to the model predictions based on a comparison against measured air quality concentrations, in a process known as model verification and adjustment.

7.2.33 The modelled road contributions were adjusted to correct them against measured road components derived from air quality monitoring data obtained through the project specific diffusion tube survey. The diffusion tubes results were biased adjusted and annualised. These adjustments followed the methodology set out in LAQM TG(16). The adjustment factors applied to the model outputs are provided in Appendix A7.2 (Air Quality Verification and Adjustment).

7.2.34 A total environmental concentration is then produced by the addition of the adjusted modelled road contribution to the background concentration.

7.2.35 In July 2011, Defra published a report examining the long-term air quality trends in NOx and NO_2 concentrations (Defra 2011). This identified that there has been a clear decrease in NO_2 concentrations between 1996 and 2002. Thereafter, NO_2 concentrations have stabilised with little to no reduction between 2004 and 2014. The report presents a similar pattern for the change in NOx concentrations over the same time period. However, the stabilisation in concentration is not reflected in the emissions factors and modelling methodology. The report concluded the identification of a gap between current projected vehicle emission reductions and measurements on the annual rate of improvements in ambient air quality, which are built into the vehicle emission factors, and the projected background maps.

7.2.36 The current trends in air quality are based on measurements of emissions from the existing vehicle fleet. New vehicles will need to comply with the more stringent Euro 6/VI emissions standards from September 2014 onwards. Vehicles complying with the Euro 6/VI emissions standard are not yet present in the datasets used to analyse long term air quality monitoring trends. If the Euro 6/VI fleet emissions perform as predicted, then this would lead to substantial reductions in predicted future road emissions, overall reducing air quality concentrations.

7.2.37 An approach to adjust for this issue is known as the Gap Analysis method, as set out in IAN170/12v3 (Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2013b), which has been used in this assessment.

Receptors

7.2.38 Sensitive receptors have been identified that represent where the maximum potential impacts of the proposed scheme may occur (i.e. worse case). Building usage was determined using the Ordnance Survey Address Base Plus Layer dataset, and calculations are made at the nearest façade to the busiest road. Identified worst-case receptors have included residential receptors, educational facilities, care homes and a prison.

7.2.39 A total of 76 human sensitive receptors (within 200m of affected road links) were included in the assessment and were selected using professional judgement and are either close to the affected roads, or representative of the likely maximum impacts of a route option in that area. Receptors were usually those closest to roads within the study area, or the proposed scheme. The identified receptor modelling locations are shown on Figure 7.2 to Figure 7.5.

7.2.40 There are a number of consented planning applications within the study area (refer to Chapter 15: People and Communities – Community and Private Assets) and some of these include consent for residential dwellings which have the potential to increase the number of residential receptors within the study area. The locations of relevant planning applications have been reviewed as part of this assessment, and modelled receptor locations within relevant planning application areas have been included. These are noted as 'Future Receptors' within Appendix A7.4 (Air Quality Receptor Results).

7.2.41 Land which is allocated for development within the local development plan, and where no extant planning permission is present, has been excluded from this assessment due to the level of uncertainty that this land would be developed and therefore increase the number of sensitive receptors within the study area. The assessment of the impacts of the proposed scheme on the amenity (air, noise and visual) of these development allocations has been considered within Chapter 15 (People and Communities: Community and Private Assets) and where required within Chapter 19 (Assessment of Cumulative Effects).

Designated Sites

7.2.42 As well as the effect on human health, the proposed scheme may result in potential air quality impacts upon the natural environment. Concentrations of pollutants in the air and deposition of nitrogen can damage vegetation directly or affect plant health and productivity. The pollutant of most concern for sensitive vegetation and ecosystems near roads is NOx. Increases in concentrations of NOx directly increase nutrient nitrogen and acid deposition.

7.2.43 Consideration of designated sites sensitive to nitrogen and within 200m of the affected roads in accordance with the methodology in Annex F of HA207/07 (Highways Agency *et al*) and IAN174/13 (Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2013b) has been undertaken. In accordance with DMRB HA207/07 (Highways Agency *et al*), defined ecological sites are those of national or international significance (e.g. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Areas (SPAs) and Ramsar sites).

7.2.44 Longman and Castle Stuart Bays (SSSI) and the Inner Moray Firth (SPA and Ramsar) are within 200m of the ARN. The SSSI is designated for intertidal habitats including eelgrass beds, which support a variety of birdlife, including 13 non-breeding bird species for which the site is also designated (see Chapter 11: Ecology and Nature Conservation for more detail). The Inner Moray Firth (SPA) is designated for non-breeding/ foraging species, whilst the Ramsar is designated for intertidal habitats and non-breeding birds (see Chapter 11: Ecology and Nature Conservation for more detail). The Moray Firth (SAC) does not cover the inter-tidal zone (i.e. the area of the SSSI) nor contain nitrogen sensitive features. Discussions with the project ecologist resulted in the conclusion that the above sites are not sensitive to nitrogen and therefore air quality impacts on these sites are considered to be 'not significant'. An ecological assessment has therefore, been scoped out and no further consideration is provided in this report.

Regional Assessment

7.2.45 A simple level DMRB regional air quality assessment has been undertaken for the study area. The regional assessment includes emissions of NOx, PM_{10}, $PM_{2.5}$ and carbon dioxide (CO_2) per year from all vehicles on the affected roads. The assessment was undertaken using the Defra Emissions Factor Toolkit (v8.0.1) (Defra 2017), using the ARN traffic data for the base (2017) opening (2022) and design year (2037). The results have then been compared to the NAEI national (UK) emissions for road transport (Defra 2016).

Impact Assessment and Significance

7.2.46 In order to convey the level of impact of the proposed scheme, it is necessary to determine significance. The significance of an environmental impact is a function of the sensitivity of the receptor and the scale or magnitude of the impact. All assessed receptors are considered of equal sensitivity.

7.2.47 Box 1.1 of LAQM TG(16) details that annual mean objectives should apply to '*all locations where members of the public might be regularly exposed, building facades of residential properties, schools, hospitals, care homes etc*'.

7.2.48 As noted in LAQM TG(16), there is not a specific requirement to define sensitivity or importance of receptors when using the magnitude of change criteria. If the receptor is the façade of a residential building, it is assumed that any member of the public could be present within the building, including the elderly, infants, or other vulnerable groups. The sensitivity of all receptors, such as dwellings, hospitals or schools are therefore assumed to be equal. The magnitude of change is determined by comparing the DS and DM scenarios.

7.2.49 IAN 174/13 (Highways Agency *et al*) provides updated advice for evaluating significant local air quality effects. In line with this, the magnitude of change criteria for the assessment of air quality is provided in Table 7.6.

Table 7.6: Air quality magnitude of change criteria (AQO)

Magnitude	Magnitude of Change (Annual Mean)		
	NO_2 (AQO: 40µg/m^3)	PM_{10} (AQO: 18µg/m^3)	$PM_{2.5}$ (AQO: 10µg/m^3)
Imperceptible (<1% +/- of AQO)	<0.4µg/m^3	<0.18µg/m^3	<0.10µg/m^3
Small (1-5% +/- of AQO)	0.4 – 2µg/m^3	0.18 – 0.9µg/m^3	0.10 – 0.50µg/m^3
Medium (5-10% +/- of AQO)	2 – 4µg/m^3	0.9 - 1.8µg/m^3	0.50 - 1.0µg/m^3
Large (>10% +/- of AQO)	>4µg/m^3	>1.8µg/m^3	>1.0µg/m^3

7.2.50 Highways England, in consultation with Transport Scotland, has developed a framework to provide guidance on the number of receptors for each of the magnitude of change categories that might result in a significant effect. These are guideline values only and are to be used to inform professional judgement on significant effects of the proposed scheme. The guideline bands are based on the Highways England/Transport Scotland considered opinion and are intended to help provide consistency across all road schemes. The significance categories and guideline property numbers are summarised in Table 7.7.

Table 7.7: Guideline to Number of Receptors Constituting a Significant Effect

Magnitude of Change in Pollutant Concentration	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	1 to 10	1 to 10
Medium	10 to 30	10 to 30
Small	30 to 60	30 to 60

7.2.51 The significance of the change is likely to be greater, the higher above the air quality thresholds the changes are predicted to occur. Where it is predicted that the short term NO_2 and / or PM thresholds are exceeded, then more significance would be attributed to these effects.

7.2.52 The upper and lower bands presented are guidelines and not absolutes. On occasions when the number of properties affected is above the upper guideline band, consideration should be given to all the evidence that may support or detract from a conclusion of a significant effect when coming to a concluding view. The further above the upper guideline band the more likely local air quality effects would be significant.

7.2.53 Where the results reside between the lower and upper guideline bands for any of the magnitude criteria, then the proposed scheme effects could be significant, and a judgement is required taking into account the results for all six categories of small, medium and large benefit / worsening. This judgement is based on the technical knowledge and experience of the air quality professional.

7.2.54 Proposed scheme effects are more likely to be significant where:

- there are no / few receptors with any improvements;
- PM annual averages are also affected by small, medium or large deteriorations; and
- short term exceedances may be caused or worsened by the proposed scheme for either NO_2 or PM.

7.2.55 Proposed scheme effects are more likely to be not significant where:

- there are receptors with small, medium or large improvements;
- PM annual averages are not affected by small, medium or large deteriorations; and
- short term exceedances are not caused or worsened by the proposed scheme for either NO_2 or PM.

7.2.56 The establishment of overall air quality significance for the proposed scheme would also consider:

- whether the proposed scheme detracts or supports measures set out in relevant local authority AQAPs;
- if the proposed scheme represents a low or high compliance risk with the EU Directive on Ambient Air Quality; or
- if any designated site(s) are affected and potential effective mitigation.

7.2.57 With respect to the EU Directive on ambient air quality and clean air for Europe (2008/50/EC) Defra reports annually (on behalf of the UK government) on the status of air quality to the European Commission.

7.2.58 There are no locations within the air quality study area that are considered at risk of exceeding the EU Limit Values as reported by Defra, refer to paragraph 7.4.22. Therefore, the proposed scheme is unlikely to lead to change in the UK's reported position to the European Commission on national compliance with the Air Quality Directive.

7.2.59 There is no government guidance published for assessing the significance of the effects of individual road schemes on regional or greenhouse gas emissions.

7.2.60 The Climate Change (Annual Targets) (Scotland) Order 2010 (Scottish Government 2010) publishes budgets for the reduction of the emissions of greenhouse gases. However, total Scottish emissions are managed and considered at a national level not on a scheme by scheme basis.

Mitigation

7.2.61 Potential mitigation measures have been considered during this assessment and these are discussed in Section 7.5 (Mitigation).

Limitations

7.2.62 It should be emphasised that the air quality impact assessment is based on a series of computer models of future conditions. The process begins with the modelling of future traffic flows, which is subject to its own inherent degree of uncertainty. This traffic data is then used in the air quality model to compare future air quality conditions both with and without the proposed scheme. The air quality model draws on a number of other trends and parameters that must be projected into the future. The modelling process includes atmospheric dispersion modelling, which provides an estimate of concentrations arising from input emissions and historical meteorological data.

7.2.63 As with any computer model that seeks to predict future conditions, there is therefore uncertainty in the predictions made. Whilst being the best predictions available, elements of impact prediction such as the specific concentration of a given pollutant at a given property, or whether an exceedance of AQOs would or would not occur at a specific location, are not precise and are always subject to a margin for error. However, the assessment process is considered to be based on the most reasonable, robust and representative methodologies taking advice from published guidance.

7.2.64 Identification of sensitive receptors is based on Address Base data. There may in some cases be properties, such as those recently built, which are not yet present within these data sources. Every endeavour has been made to identify and consider all such properties during the DMRB Stage 3 assessment.

7.2.65 Since the air quality modelling was completed additional planning applications have been submitted and validated by the Council. A review of the new receptor locations was undertaken to establish whether the assessment presented in this report adequately covers all potentially affected sensitive receptors. Where an existing modelled receptor location was not present, an equivalent receptor location was used for comparison, which was equidistant (or closer) and likely to experience similar traffic characteristics. It was concluded that as the all the 'comparison locations' are predicted to experience pollutant concentrations that are all well below AQOs (i.e. less than 50% of the AQO), that it was very unlikely that any exceedances would occur. Therefore, based on the above and professional judgement further modelling of the new receptor locations was deemed necessary.

7.2.66 Furthermore, since the air quality modelling was completed the speed limit for the extent of the A9 lane gain/lane drop section has been lowered from 70mph to 50mph. This measure has been introduced to help mitigate departures from standard relating to the geometric design of this element of the scheme. This has resulted in a reduction in flow (predominantly) on the A9 and B9006 Culloden Road, with smaller increases in flow occurring on the proposed scheme link from the B9006 Culloden Road to the proposed A96 Smithton Junction, and the surrounding network. The change in AADT is above the DMRB HA207/07 (Highways Agency *et al*) screening criteria of + or - 1000 AADT (for the potential for significant effects) on the A9 only. As this is a reduction in flow, the predicted pollutant concentrations would be expected to be lower at sensitive receptor locations. In addition, a lowering of the speed limit to 50mph is likely to reduce key air pollutant concentrations rather than increase them, therefore the existing predictions on the A9 can be treated as a worst-case scenario of the impact. Conversely, the increase in traffic flow on other road links would likely result in slight increases in predicted pollutant concentrations, however, these are below the DMRB AADT change criteria and therefore are unlikely to change the already low concentrations significantly. Therefore, based on the above and professional judgement no further modelling was deemed necessary.

7.3 Baseline Conditions

7.3.1 A review and assessment of the current air quality information in the vicinity of the proposed scheme has been undertaken to establish the 'baseline' (current) situation. This has included a desk-based review of Local Authority reports (under LAQM), a review of the latest air quality monitoring, together with air quality background mapping produced by Scottish Air Quality and Defra.

The Highland Council

7.3.2 The study area falls within the local authority area of The Highland Council. The latest LAQM report, the 2018 Air Quality Progress Report (APR) (The Highland Council 2018) has been obtained and reviewed.

7.3.3 The report summarises that air quality within The Highland Council is generally good. An AQMA was declared in 2014 due to exceedances of the annual mean NO_2 AQO. The AQMA is located around the junction of Academy Street and Queensgate, within Inverness city centre. An AQAP is currently being progressed. No other exceedances of AQOs within The Highland Council area were reported. The AQMA is approximately 2.1km west of the nearest section of the proposed scheme and is unlikely to be affected by the proposed scheme.

Continuous Monitoring Data

7.3.4 The Highland Council operates a Continuous Monitoring Station (CMS) in Inverness. Defra operate a further three across the council area as part of the Automatic Urban and Rural Network (AURN). The two CMS stations of relevance to this assessment are presented in Table 7.8. IV3 is roadside and positioned within the AQMA. IV4 is also a roadside location (4m from the A862 and approximately 3.5km west of the proposed scheme). Annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ from 2013 to 2017 are presented in Table 7.8. It should be noted that IV3 commenced operation in September 2016, the concentration presented for 2016 represents only 4 months of monitoring and is indicative only. Neither of the CMS locations are within the study area.

Table 7.8: Continuous Monitoring Station (CMS) Data Pertinent to this Assessment

Site ID	Pollutant measured	OS Grid Reference	Annual Mean Concentration (µg/m^3)					Data Capture % (2017)
			2013	2014	2015	2016	2017	
IV3 - Queensgate/ Academy Street	NO_2	266650, 845446	n/a	n/a	n/a	36.8	38.0	95
IV4 - Telford Street, Inverness	NO_2	265709, 845670	21	21	25.3	26.4	20.1	97
	PM_{10}		11.7	10.9	9	8.6	10	93
	$PM_{2.5}$		6	6	5	4.8	4	96

n/a no data available.

7.3.5 The CMS results indicate NO_2, PM_{10} and $PM_{2.5}$ concentrations are within the relevant AQOs. It is noted that the 38.0µ/m^3 measured at site IV3 in 2017, is not representative of relevant exposure.

Non-Automatic Monitoring

7.3.6 The Highland Council is responsible for a network of passive NO_2 diffusion tubes. All of the monitoring locations of potential relevance to this assessment were either located within an urban setting (Inverness town centre or Dingwall) or classified as urban background locations and outside the study area.

7.3.7 Urban background monitoring sites (RC3 and RC4) were compared to estimated mapped background concentrations (across the study area) and were considered to be unrepresentative of the semi-rural character of the study area being located in Dingwall town, approximately 19km north-west of the proposed scheme and likely to be influenced by infrastructure and local traffic. The measured annual mean NO_2 concentrations ranged between 6.6 µg/m^3 to 8.5 µg/m^3, which were typically higher than the mapped background estimates across the study area. Data Capture was also less than 75% at one monitoring site during 2016, further limiting the dataset available for comparison. There were no background monitoring sites for PM_{10} or $PM_{2.5}$ available for comparison.

7.3.8 As part of the DMRB Stage 2 options appraisal, a 6-month passive diffusion tube survey was undertaken at 15 locations around the proposed scheme area (see Figure 7.1), which included a co-location site at Telford Street CMS in Inverness City Centre (with permission from The Highland Council) to allow for bias adjustment. The survey provided good data capture in most areas, and the results were annualised and bias adjusted (in line with LAQM TG(16) guidance). Table 7.9 provides a summary of the bias adjusted and annualised diffusion tube results.

Table 7.9: Annualised NO_2 Concentration Diffusion Tube Results

Tube ID	Location	OS grid co-ordinate		Data Capture (%)	Annualised/Bias Adjusted 2017 Concentration (µg/m^3)
		X	Y		
01_LP	Milburn Crossing	268164	845784	100	23.6
02_LP	Kintail House	268797	844588	100	2.13
03_LP	Briargrove Cresent	268982	843989	100	7.4
04_LP	Culloden Road	269291	844421	100	14.1
05_LP	Simpsons Garden Centre (B9006)	269612	844182	100	17.8
06_LP	A96 Tesco	268918	845702	50	25.8
07_LP	Cradlehall Meadows	270030	844853	100	7.2
08_LP	Sinclair Park	271142	845657	83	8.0
09_LP	Barnchurch Road	270591	846056	100	11.7
10_LP	Barnchurch Road Roundabout	270262	846327	100	24.0
11_LP	Eastfield Way	269441	845357	100	11.1
12_LP	Inshes Church	268749	844004	100	14.2
13_LP	Culloden Road 2 (B9006)	270432	844193	100	15.1
14_LP	Barnchurch Road/Ferntower Avenue	271884	846039	67	9.6
CMS	Co-location at Telford Street Continuous Monitor	265708	845668	100	22.2

7.3.9 There are no exceedances of the annual average NO_2 AQOs. The measured NO_2 concentrations have been adjusted to 2017 and used in the verification review of the assessment models.

Mapped Background Concentrations

7.3.10 Table 7.10 presents the range of estimated mapped background pollutant concentrations applied within this assessment. The range covers the grid squares associated with the receptors modelled. The background concentrations include estimated impacts from other local pollution sources, such as those regulated by SEPA.

Table 7.10: Mapped Pollutant Background Concentrations (Defra and Scottish Air Quality Data Sources)

Pollutant	Annual mean pollutant concentration (µg/m^3)	
	2017	2022
NO_2	4.0 to 7.5	4.0 to 6.9
PM_{10}	7.2 to 9.2	7.1 to 9.0
$PM_{2.5}$	4.8 to 6.2	4.5 to 5.8

7.4 Potential Impacts

7.4.1 The potential impacts reported in this section are assessed in line with approach set out in Section 7.2 (Methodology), with the sensitive receptors identified as outlined in paragraphs 7.2.38 to 7.2.41.

7.4.2 It is acknowledged that the proposed scheme is within an area where large-scale development is planned, as identified in the local development plan and supplementary guidance. In the future the proposed scheme is anticipated to be located within a landscape which has undergone substantial change; the existing (mainly agricultural) land becoming urbanised as an eastern expansion of the City of Inverness. In this situation, it is expected that the potential impacts reported in this section could potentially affect additional sensitive receptors within the study area. The potential cumulative impacts of the proposed scheme in-combination with other committed / reasonably foreseeable developments are assessed in Chapter 19 (Assessment of Cumulative Effects).

Construction Dust Assessment

7.4.3 It is understood that construction vehicles would utilise the existing A9 and A96 and smaller B-roads. All local roads (unsuitable for HGV traffic) would be avoided.

7.4.4 There is the potential for dust nuisance during the construction phase of the proposed scheme. The level and distribution of construction dust emissions will depend on where within the scheme boundary the dust raising activity takes place, the nature of the activity and controls, and weather conditions.

7.4.5 The proposed phases of construction are detailed in Appendix A4.1 (Construction Information) which accompanies Chapter 4 (The Proposed Scheme). Based on this information it has been determined that Phase 1 is likely to give rise to the highest level of dust emissions due to the volume of material to be moved, size of the area and variety of activities. Phase 1 includes the construction of the PS03 Cradlehall Railway Bridge and PS02 Inshes Overbridge (see Chapter 4: The Proposed Scheme for more detail).

7.4.6 Several assumptions have been made as part of the construction dust assessment based on the information available at this stage of the design process. These include the location of haul roads used by construction vehicles accessing/egressing the site; the maximum number of plant on site at any one time; the maximum HDVs outward per day and the AADT HDVs and site vehicles as a result of the proposed scheme.

7.4.7 As the proposed scheme is relatively small scale, additional vehicles on the road network during the construction phase would be limited. At the time of writing it is understood that the average deliveries per day for Phase 1 PS02 earthworks is 24 per day (48 movements), six days a week and for concrete construction an average of 4 deliveries per day (8 movements), six days a week. The average deliveries per day for Phase 1 PS03 earthworks is 59 (118 movements), six days a week and for concrete construction an average of 4 deliveries (8 movements) per day, six days a week. These combined movements are below the DMRB HA 207/07 (HA 2007) screening threshold discussed in paragraph 7.2.20. These represent the largest number of vehicle movements over the proposed construction period (for phases worked in conjunction with each other). It is therefore unlikely that emissions to air from construction vehicles would lead to significant air quality impacts.

Potential Dust Emission Magnitude

7.4.8 The IAQM guidance recommends that the fugitive dust emission magnitude should be based on the scale of the anticipated works for demolition, earthworks, construction and trackout (refer to Table 7.11). The proposed scheme will be built in phases. Sections of the same phase will be constructed concurrently e.g. Phase 1 at the PS03 Cradlehall Railway Bridge is run concurrently with Phase 1 Inshes Overbridge. These sections combined pose the greatest dust magnitude risk and are the most sensitive areas considered. Receptor counts are based on the entire proposed scheme. Full details of how the dust emission magnitudes were derived are shown in Appendix A7.3 (Air Quality Construction Assessment).

Table 7.11: Dust Emission Magnitude for Construction Activities

Activity	Dust Emission Magnitude
Demolition	Not applicable
Earthworks	Large
Construction	Medium
Trackout	Large

Define the Sensitivity of the Area

7.4.9 The sensitivity of the area to dust soiling, human health and ecological effects was defined for each activity using Table 9 in Appendix A7.3 (Air Quality Construction Assessment). The sensitivities are summarised in Table 7.12.

Table 7.12 Sensitivity of the Surrounding Area to Dust Soiling and Human Health Effects

Scheme Section	Sensitivity to dust soiling effects		Sensitivity to health effects of PM_{10}		Sensitivity to Ecological Effects	
Proposed Scheme	Demolition	Not applicable	Demolition	Not applicable	Demolition	Not applicable
	Earthworks	Medium	Earthworks	Low	Earthworks	Not applicable
	Construction		Construction		Construction	
	Trackout		Trackout		Trackout	

Risk of Effects

7.4.10 The dust emission magnitude detailed in Table 7.11 was combined with the sensitivity of the area detailed in Table 7.12 to determine the risk of effects with no mitigation applied, as detailed in Table 10, of Appendix A7.3 (Air Quality Construction Assessment). The risks without mitigation applied for dust soiling and human health are provided in Table 7.13.

7.4.11 Across the proposed scheme, it is assumed that the risk of dust emissions from earthworks and construction activities and trackout have a medium level risk of nuisance dust at sensitive human receptors. The assessment estimated a low-level risk to human health and there were no ecological sites in proximity to be affected.

7.4.12 A full description of the assessment of dust from demolition, construction, earthworks and trackout activities, including the assigned risk of impacts and sensitivity of human receptors, is provided in Appendix A7.3 (Air Quality Construction Assessment).

Table 7.13 Summary Dust Risk Table to Define Site-specific Mitigation

Proposed Scheme Section	Dust Risk							
	Demolition		Earthworks		Construction		Trackout	
	Dust Soiling	Human Health	Dust Soiling	Human Health	Dust Soiling	Human Health	Dust Soiling	Human Health
Phase 1 (PS03 + PS02)	n/a	n/a	M	L	M	L	M	L

Key: H (High Risk) / M (Medium Risk) / L (Low Risk)

Operational Local Air Quality Assessment

7.4.13 Dispersion modelling (using ADMS-Roads software) has been used to predict pollutant concentrations at identified sensitive receptor locations.

7.4.14 A total of 76 human health receptors were included in the modelling. Predicted annual mean pollutant concentrations at sensitive receptors with the highest concentrations (in the DS scenario) and representative of impacts across the local air quality study area have been included in this chapter in Table 7.14 (presented in decreasing order of DS NO_2). The results for all receptors assessed can be found in Appendix A7.4 (Air Quality Receptor Results).

7.4.15 This section presents the effects of the operational phase of the proposed scheme upon local air quality. The results presented throughout this section are based on the values predicted using the Gap Analysis methodology which takes into account IAN170/12 (Highways Agency *et al)*, Long Term Trends (LTT_{E6}) for NOx and NO_2. This approach is considered more conservative and representative of opening year impacts than the LAQM TG(16) methodology.

7.4.16 Figure 7.3 and Figure 7.4 show the predicted DM and DS annual mean NO_2 concentrations in 2022, respectively. Figure 7.5 presents the predicted change in annual mean NO_2 concentrations in 2022.

Table 7.14: NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Selected Receptors (Do Minimum 2022 and Do Something 2022)

Receptor	Location	Do Minimum Concentration (Annual mean) (µg/m³)			Do Something Concentration (Annual mean) (µg/m³)			Change in Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$	NO_2	PM_{10}	$PM_{2.5}$
R001	233, Mackintosh Road, IV2 3UB	13.2	10.4	6.4	12.7	10.3	6.4	-0.5	-0.1	0.0
R025	Inshes Holdings, B9006 Inshes Roundabout, IV2 5BA	16.1	10.2	6.3	16.0	10.2	6.2	-0.1	0.0	**-0.1**
R031	51, Old Perth Road, IV2 3UP	19.2	10.6	6.1	18.5	10.5	6.1	-0.7	-0.1	0.0
R036	Crossways Cottage, Culcabock Road, IV2 3UR	16.5	10.2	6.0	15.9	10.1	6.0	-0.5	-0.1	0.0
R044	Millburn Crossing, Millburn Road, Inverness	**33.0**	13.4	7.4	33.0	13.4	7.4	0.0	0.0	0.0
R050	27, Loch Lann Avenue, IV2 7LT	9.6	9.5	6.1	7.7	9.1	6.0	**-1.8**	**-0.4**	**-0.1**
R055	5, Culcabock Road, IV2 3XW	13.1	9.5	5.8	12.9	9.5	5.8	-0.2	0.0	0.0
R056	42, Culcabock Road, IV2 3XQ	14.5	9.7	5.9	14.1	9.6	5.9	-0.4	-0.1	0.0
R063	Inshes Holdings, B9006 Inshes Roundabout, IV2 5BA	14.5	9.9	6.1	14.6	10.0	6.1	0.2	0.1	0.0
R070	Seafield of Raigmore, Inverness Milburn, IV2 7PA	13.0	8.9	5.5	12.3	8.8	5.4	-0.7	-0.1	**-0.1**
R098	Inshes Smithy, B9006 Inshes Roundabout - B9177 Junction	12.3	9.6	5.8	13.0	9.8	5.8	**0.7**	**0.2**	0.0

7.4.17 The maximum predicted NO_2 concentration with the proposed scheme is 33.0µg/m³ at Receptor R044. The results illustrate that there are no predicted exceedances of any of the relevant AQOs at modelled receptors presented in Table 7.14 for; NO_2, PM_{10}, or $PM_{2.5,}$ in both the DM and DS scenario. Similarly, no exceedances are predicted at any of the 76 receptors included within the dispersion modelling assessment.

7.4.18 R098 is predicted to experience the greatest increase in NO_2 of 0.7µg/m³. This receptor is approximately 70m from the proposed scheme. Receptor R050 is predicted to experience the greatest decrease in NO_2 of 1.8µg/m³. This receptor is greater than 1km from the proposed scheme.

7.4.19 The greatest decrease in both PM_{10} is predicted to occur at receptor R050 and the greatest increase at R098. For $PM_{2.5}$ the greatest decrease is seen at R025, R050 and R70, with all the other receptors observing no increase in $PM_{2.5}$ concentrations. The full list of results are presented in Appendix 7.4.

7.4.20 The results indicate that the proposed scheme will give rise to predicted changes in air quality concentrations as would be expected for a proposed road development. Concentrations are predicted to reduce on some road links as traffic redirects onto the proposed scheme. Conversely concentrations are predicted to increase slightly at receptors in the vicinity of the proposed scheme as emissions are brought closer and traffic volume increases.

7.4.21 Of the 76 receptors included in the modelling, 54 are predicted to experience a decrease in NO_2 concentrations, whilst 22 are predicted to experience an increase in NO_2 concentrations.

Compliance Risk Assessment

7.4.22 Using the latest dataset provided by Defra (2017 (2015 dataset)) and in accordance with IAN 175/13 (Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2013c), there are two Pollution Climate Mapping (PCM) model road links within the air quality study area located on the A9. Concentrations on these links were; 31.14µg/m^3 (for 2017), 22.94µg/m^3 (for 2022) and 14.72µg/m^3 (for 2030). It is therefore unlikely that the proposed scheme would lead to non-compliance of the EU limit value on these links.

Regional Air Quality

7.4.23 The regional emissions have been calculated for all affected roads. The results for the regional assessment for Opening Year 2022 are shown in Table 7.15, and for the Design Year 2037 in Table 7.16. Published UK road transport emissions from the National Atmospheric Emissions Inventory (NAEI) (Defra 2016) have been collated for comparison against the proposed scheme contributions are also presented for the opening and design year.

Table 7.15: Regional Air Quality Assessment (Opening Year 2022)

Pollutant (tonnes/yr)	Annual Regional Emission in tonnes					NAEI – Road transport emissions	Percentage of NAEI UK road transport emissions
	Base 2017	DM 2022	DS 2022	Change (DS-DM)	Change %	Kilo tonnes	%
NOx	26.9	31.5	31.5	-0.004	-0.01%	300	-0.000001%
PM_{10}	2.4	3.9	3.9	0.02	0.4%	22	0.0001%
$PM_{2.5}$	1.4	2.2	2.2	0.01	0.4%	6	0.0000001%
CO_2	10,176	17,322	17,343	21.1	0.1%	113,155[a]	0.00002%

[a] NAEI reports Carbon. This has been converted to CO_2 equivalent for comparison against modelled CO_2 total emissions. The NAEI results are presented in kilo tonnes.

7.4.24 The results for the Opening Year (2022) indicate a decrease in NOx emissions of approximately 0.004 tonnes/year; which equates to a change of approximately 0.01% with the proposed scheme in place. PM_{10} and $PM_{2.5}$ emissions are predicted to increase by 0.02 and 0.01 tonnes/year respectively, which equates to a 0.4% change and CO_2 emissions are predicted to increase by 21 tonnes/year, a change of approximately 0.1%.

7.4.25 The regional modelled results have been compared against the most recently published UK road transport emission dataset (2016). The contribution from the proposed scheme is negligible for the opening year. The results for the regional assessment for the Design Year 2037 are shown in Table 7.16.

Table 7.16: Regional Air Quality Assessment (Design Year 2037)

Pollutant (tonnes/yr)	Annual Regional Emission in tonnes					NAEI Road transport emissions	Percentage of NAEI UK road transport emissions
	Base 2017	DM 2037	DS 2037	Change (DS-DM)	Change %	Kilo tonnes	%
NOx	26.9	21.0	21.3	0.3	1.6	300	0.0001%
PM_{10}	2.4	5.1	5.3	0.1	2.4	22	0.001%
$PM_{2.5}$	1.4	2.8	2.8	0.1	2.4	6	0.000001%
CO_2	10,176	21,590	21,958	368	1.7	113,155[a]	0.0003%

[a] NAEI reports Carbon. This has been converted to CO_2 equivalent for comparison against modelled CO_2 total emissions. The NAEI results are presented in kilo tonnes.

7.4.26 The results for the Design Year (2037) indicate an increase in NOx emissions of approximately 0.3 tonnes/year; which equates to an approximate 1.6% change with the proposed scheme in place. PM_{10} and $PM_{2.5}$ emissions are predicted to increase by 0.1 tonnes/year, which equates to an approximate 2.4% change, and CO_2 emissions are predicted to increase by 368 tonnes/year, which equates to approximately 1.7% change in emissions with the proposed scheme in place.

7.4.27 The regional modelled results have been compared against the most recently published UK road transport emission dataset (2016). The contribution from the proposed scheme is negligible for the design year.

7.5 Mitigation

Construction

7.5.1 The Construction Environmental Management Plan (CEMP) (refer to **Mitigation Item SM-01**) will adopt best practice measures to control fugitive dust in compliance with Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction. The contractor will enter into pre-works discussions with The Highland Council to agree the method of works and appropriate dust mitigation measures outlined in a Dust Management Plan (DMP) (**Mitigation Item AQ-01**).

7.5.2 Construction dust mitigation measures (for medium risk sites), based on those outlined by the Institute for Air Quality Management, are detailed within Table 11 of Appendix A7.3 (Dust Mitigation Measures). These mitigation measures will be used as a guide to inform the best practice measures within the DMP and will be reviewed as the contractor confirms further details of the construction activities, location and programme.

7.5.3 It is considered that with an appropriate CEMP and DMP implemented, there would be no significant effects on air quality during the construction phase of the proposed scheme.

Operation

7.5.4 Following the detailed air quality assessment, based on the guidance in IAN174/13 (Highways Agency *et al* 2013b*)*, no mitigation measures are required for the operational phase of the proposed scheme.

7.6 Residual Impacts

7.6.1 The air quality assessment indicates no exceedance of any relevant AQO with the proposed scheme in place at any of the sensitive receptors included within the assessment. Air quality effects are therefore considered not significant. No residual air quality impacts are predicted.

7.6.2 If the dust mitigation controls and measures are implemented and managed during construction activities, as recommended in this assessment, then the dust impact of the proposed scheme is not likely to generate unacceptable effects to adjacent receptors and therefore there are no likely residual impacts.

7.6.3 It should be noted that the measures are recommendations and should be reviewed on a regular basis during construction to ensure they are appropriate to the works taking place, and any complaints received.

7.7 Statement of Significance

7.7.1 The predicted NO_2 concentrations have not identified any receptor locations at risk of experiencing an AQO exceedance in the DM or DS scenarios. There are more receptors that are likely to experience a reduction in NO_2 concentration (and therefore a slight improvement in air quality) than are predicted to experience an increase in NO_2 (a worsening in air quality).

7.7.2 As the concentrations of both PM_{10} and $PM_{2.5}$ are low, there are no expected exceedances of either the annual mean or 24-hour mean AQOs for PM_{10} nor $PM_{2.5}$ across the study area in either the DM or DS scenario. Therefore, it is unlikely that the proposed scheme will give rise to significant effects.

7.7.3 The proposed scheme is not likely to give rise to significant air quality effects as a result of the local air quality assessment.

7.7.4 The predicted contribution to total emissions from the proposed scheme for the opening and design years is nominal in the context of published national road transport emissions. The regional effects to air quality are not significant.

7.8 References

Reports and Documents

Department for Environment, Food and Rural Affairs and the Devolved Administrations (Defra) (2007). The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland.

Department for Environment, Food and Rural Affairs (Defra) (2011). Trends in NOx and NO_2 emissions and ambient measurements in the UK.

Department for Environment, Food and Rural Affairs (Defra) (2016). UK National Atmospheric Emissions Inventory [Online] available from: www.naei.defra.gov.uk/data.

Department for Environment, Food and Rural Affairs (Defra) (2018a). Local Air Quality Management: Technical Guidance Note (LAQM TG(16)).

Department for Environment, Food and Rural Affairs (Defra) (2017a). Emissions Factor Toolkit (v8.01) [Online] Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

Department for Environment, Food and Rural Affairs (Defra 2018b). Background maps-reference year 2015 [Online] Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Department for Environment, Food and Rural Affairs (Defra) (2017b). Sector Removal Tool (v6) 2017 [Online] Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Department for Environment, Food and Rural Affairs (Defra) (2017c). NOx to NO_2 Calculator (v6.1) 2017 [Online] Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland (2007). Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, HA207/07: Air Quality, 2007.

Highways Agency, Transport Scotland, Welsh Assembly Government and the Department of Regional Development for Northern Ireland (2013a). Interim Advice Note (IAN) 170/12v3 Updated air quality advice on the assessment of future NOx and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 Air Quality, 2013.

Highways Agency, Transport Scotland, Welsh Assembly Government and the Department of Regional Development for Northern Ireland (2013b). Interim Advice Note (IAN) 174/13 - Updated air quality advice on the application of the test for evaluating significant effects; for users of DMRB Volume 11, Section 3, Part 1 Air Quality, 2013.

Highways Agency, Transport Scotland, Welsh Assembly Government and the Department of Regional Development for Northern Ireland (2013c). Interim Advice Note (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 for users of DMRB Volume 11, Section 3, Part 1 'Air Quality' (HA207/07).

Highways Agency, Transport Scotland, Welsh Assembly Government and the Department of Regional Development for Northern Ireland (2015). Interim Advice Note IAN 185/15 - supplementary advice to users of DMRB Volume 11, SECTION 3, PART 1 (HA207/07) and PART 7 (HD213/11). Advice is provided on the assessment of link speeds and generation of speed-band vehicle emissions

Institute of Air Quality Management (2016), Guidance on the assessment of dust from demolition and construction, v1.1, 2016.

Scottish Air Quality (2018) [accessed online], www.scottishairquality.co.uk

Scottish Government (2009). Climate Change (Scotland) Act 2009.

Scottish Government (2010). Climate Change (Annual Targets) (Scotland) Order, 2010.

Scottish Government (2014). Scottish Planning Policy (SPP).

The Highland Council (2018). 2018 Air Quality Annual Progress Report December 2018.

EU Directives and Legislation

Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2004

European Union (2008). Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe [2008].

Environment Protection Act 1990 Part III.

Environment Act 1995, Part IV.

The Air Quality (Scotland) (Amendment) Regulations 2002.

The Air Quality (Scotland) Amendment Regulations 2016.

The Air Quality (Scotland) Regulations 2000. Scottish Statutory Instrument 2000 No 97.

The Air Quality Standards (Scotland) Regulations 2010, Statutory Instrument 2010 No. 204