14 Air Quality

Air quality modelling has been undertaken to determine the impacts of the proposed scheme on ambient air quality concentrations and the overall emissions from road traffic. Potential local impacts during construction were also considered.

The following pollutants emitted from vehicles were assessed: Oxides of Nitrogen (NO_x), Nitrogen Dioxide (NO_2) and particulate matter less than 10 microns in diameter (PM_{10}). The potential effect of construction on ambient particulate matter concentrations was also considered.

Following a review of Perth & Kinross Council's Air Quality Review and Assessment it was necessary to undertake an air quality survey to establish baseline air quality conditions.

Air quality monitoring in the vicinity of the proposed scheme shows that nitrogen dioxide concentrations and fine particulate concentrations meet the prescribed air quality objectives (AQOs).

Impacts of the proposed scheme were assessed for the year of opening (2019) using detailed dispersion modelling. A regional air quality assessment was undertaken for the year of opening (2019) and the design year (2034). The conclusion after detailed dispersion modelling was that there are no significant local air quality impacts at either human health locations or designated habitat sites. The regional assessment predicts the emissions of NO_x and CO_2 will increase as a result of the proposed scheme.

14.1 Introduction

14.1.1 Air quality is measured in relation to the concentrations of certain pollutants in the air, taking account of the effects of pollution on human health and ecosystems. Emissions from vehicle exhausts are the major contributor to the concentrations of these pollutants in the UK. In rural areas, such as in the vicinity of the A9, vehicle emissions are often the main source of air pollutants. Changes to road alignments and junctions can therefore affect air quality, as they can change the quantity, location and speed of traffic in a local area. Air quality is therefore an important consideration in any development proposal involving significant changes in the nature and location of emissions to air.

14.1.2 This chapter presents the assessment of potential air quality impacts of construction and operation of the proposed scheme. It outlines relevant air quality legislation, details the existing ('baseline') air quality situation, and identifies predicted air quality impacts. Additional information to support this chapter is presented in the following appendices:

- Appendix A14.1 (Air Quality Technical Information);
- Appendix A14.2 (Dispersion Model Set Up, Model Verification and Traffic Data); and
- Appendix A13.2 (Local Air Quality - Specific Receptor Modelled Results – NO_2 and PM_{10}).

Relevant Air Quality Policies and Legislation

14.1.3 This assessment considers the relevant Air Quality legislation and Local Air Quality Management (LAQM) Technical Guidance. Relevant planning policy is considered at the national, regional and local level. The key air quality legislation is listed below in Table 14.1.

Table 14.1: 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
The Air Quality Standards Regulations (Scotland) 2010	Transpose formalised limit values set out in the EU ambient air quality directive 2008/50/EC to UK law
The National Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland, 2007	Updates the 2000 Air Quality Strategy

14.1.4 Directive 2008/50/EC was published to consolidate previous European Directives on ambient air quality. Although published in 2007, the Air Quality Strategy remains consistent with Directive 2008/50/EC.

14.1.5 The National Air Quality Strategy 2007 establishes Air Quality Objectives (AQOs) for a number of specific pollutants. The main air pollutants relating to road traffic are NO_2 and PM_{10}. The other pollutants in the AQS are screened out here as being unlikely to be of concern based on DMRB guidance (Highways Agency, 2007), because these AQOs are unlikely to be at risk of being breached as a consequence of a road development.

14.1.6 The National Air Quality Strategy 2007 introduces measures to control exposure to $PM_{2.5}$ (the fraction of particulate matter with an average aerodynamic diameter less than 2.5 micrometres; µm). These are intended to be applied at national level, so the control of $PM_{2.5}$ concentrations has not been incorporated into Local Air Quality Management, and authorities have no statutory obligation to review and assess against them.

14.1.7 For a full description of the terms used in relation to air quality, reference should be made to the AQS documents, and to the supporting guidance: Local Air Quality Management Technical Guidance TG(09) (Defra, 2009) referred to hereafter as LAQM TG(09).

14.1.8 There are no available robust assessment methods for short-term concentrations from road traffic. Therefore, compliance with the short-term AQOs is assessed by following the guidance presented in LAQM TG(09), 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.

14.1.9 The EU Limit Values are now prescribed under the Air Quality Standard Regulations 2010, which have replaced the Air Quality Limit Value Regulations 2003. The 2010 Regulations transfer EU Directives regarding ambient air quality into UK Law. The Air Quality Limit Values are legally binding through the Scottish Government.

14.1.10 The relevant objective values and limit values listed in Table 14.2.

Table 14.2: Relevant EU Air Quality Limit Values and National Air Quality Objectives

Pollutant	Averaging Period	Objective/Limit Value	Objective Target Date
Nitrogen dioxide (NO_2)	1 hour mean	200 µg/m^3, not to be exceeded more than 18 times/yr	31/12/2005
	Annual mean	40 µg/m^3	31/12/2005
Oxides of nitrogen (NO_x) for protection of vegetation	Annual mean	30 µg/m^3	19/07/2001
Particulate matter (PM_{10})	Daily mean	50 µg/m^3, not to be exceeded more than 7 times/yr	31/12/2010
	Annual mean	18 µg/m^3	31/12/2010

Planning Policy

14.1.11 The Scottish Planning Policy (SPP) was published in 2010 (Scottish Government, 2010) and contains this relevant policy on air quality in paragraph 37: '*The planning system has an important role in supporting the achievement of sustainable development through its influence on the location, layout and design of new development. Decision making in the planning system should: take into account the implications of development for water, air and soil quality'.* However, this planning policy is deemed as being out of date and has been put under review by Scottish Government. Following this review a draft SPP was published on 30 April 2013 (Scottish Government, 2013) which contains an updated policy relevant to air quality for this assessment:

> '*Planning has an important role in realising sustainable development. It contributes by encouraging and approving development that is of a good quality and: protects, enhances and promotes access to natural heritage, including water, air, soil, green infrastructure, landscape and biodiversity'.*

14.1.12 Transport Scotland's approach to evaluating significant air quality impacts reflects current policy, national planning policy and the requirements of the EIA Directive. Further details on legislation policy and pollutants are provided in Appendix A14.1 (Air Quality Technical Information).

14.2 Approach and Methods

Overall Approach

14.2.1 The potential air quality impacts of the proposed scheme have been assessed using the DMRB Volume 11 guidance on Air Quality (Highways Agency *et al.*, 2007) and the LAQM TG(09) guidance published by Defra. For the proposed procedure, a detailed assessment has been carried out for sensitive residential receptors adjacent to roads affected by the proposed scheme. Assessment of the significance of impacts on local air quality has been undertaken using the DMRB guidance, informed by Interim Advice Note (IAN) 170/12 (Highways Agency *et al.*, 2013a).

14.2.2 This assessment considers the air quality in five cases:

- 2012 Baseline scenario (i.e. existing conditions at the start of the assessment);
- 2019 Opening Year: Do-Minimum (DM) (i.e. without the proposed scheme in place);
- 2019 Opening Year: Do-Something (DS) (i.e. with the proposed scheme in place);
- 2034 Design Year: Do-Minimum (DM); and
- 2034 Design Year: Do-Something (DS).

14.2.3 The assessment covers two different geographic scales: Local air quality, for NO_2 and PM_{10}; and regional air quality focusing on NO_x, PM_{10} and carbon dioxide (CO_2).

14.2.4 This assessment consists of the following elements:

- review of the existing 'baseline' air quality situation;
- collation of finalised road traffic data and identifying 'affected roads' to form an assessment study area;
- assessment of the potential for the construction of the proposed scheme to create nuisance dust is considered;
- assessment of the potential impacts on local air quality at representative sensitive receptors (human and ecological) arising from the operation of the proposed scheme using detailed dispersion modelling; and
- assessment of the regional impacts of the proposed scheme on pollutant levels, as a result of the traffic flows on new road alignment, and changes to traffic flows on the adjoining road network.

Traffic Data and Study Area

14.2.5 Traffic data were provided for the following parameters for each road link for the Baseline and Opening Year scenarios:

- Annual Average Daily Traffic (AADT):
  - (i) Total traffic flow (AADT24);
  - (ii) Percentage Heavy Duty Vehicles (HDV); and
  - (iii) Vehicle speed (kph).

14.2.6 The baseline traffic data were prepared using 12 hour count information, with projected traffic growth over time based on levels within the Transport Model for Scotland (TMfS07), (the latest model available at the time of this review). Whilst the proposed scheme is not considered likely to

notably affect the traffic demand at a local level (Luncarty to Pass of Birnam), it is anticipated that the wider programme of proposed dualling of the A9 from Perth to Inverness may attract additional traffic to this strategic route when this opens in full after 2019. The traffic data utilised in this assessment therefore assumes that the full programme of works to dual the A9 will be implemented, although this is not relevant to the 2019 opening year, but would affect the 2034 regional emissions calculations.

14.2.7 The local air quality study area covers receptors within 200m of roads that are expected to be affected by the proposed scheme. The DMRB (Highways Agency *et al.*, 2007) provides a methodology for assessing local air quality. The criteria in DMRB to determine the affected road network are presented below:

- road alignment change by 5 m or more; or
- daily traffic flows change by 1,000 AADT flow or more; or
- HDV flows change by 200 AADT or more; or
- daily average speed change by 10 kph or more; or
- peak hour speed change by 20 kph or more.

14.2.8 The regional air quality assessment assesses the change in emissions resulting from the proposed scheme. This is required as emissions not only affect local air quality, but also have an impact on a regional, national and international scale. Under the DMRB methodology for regional air quality, affected roads are defined as:

- 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.

14.2.9 A plan showing the local air quality assessment study area based on the roads that have been included within the dispersion model is in Figure 14.1. Further information on traffic data is provided in Appendix A14.1 (Air Quality Technical Information), and full traffic data for the proposed scheme is provided in Appendix A14.2 (Dispersion Model Set Up and Model Verification).

14.2.10 The air quality modelling has been undertaken based on the Stage 3 design. This design includes the demolition of Ladner Cottage (Receptor 19). The results of this receptor are included in the DM scenario, but not in the DS because the receptor will not exist.

14.2.11 In July 2011, Defra published a report examining the long-term air quality trends in NO_x and NO_2 concentrations. This identified that ambient air quality concentrations are not decreasing in the future as is predicted using the current established methods of assessment (defined in the LAQM TG(09), which was issued before the 2011 report). To address this, a Gap Analysis methodology has been developed as set out in IAN 170/12 (Highways Agency *et al.*, 2013a) to adjust model predictions to better reflect measured long-term trends of NO_x and NO_2. Full details of the model prediction process are set out in Appendix A14.1 (Air Quality Technical Information).

Baseline Conditions

14.2.12 In order to assess the significance of any new development proposal in terms of air quality, it is necessary to identify and understand the baseline conditions at and around the study area. This provides a reference level against which any potential changes in air quality can be assessed.

14.2.13 As the baseline air quality changes into the future, baseline data are extrapolated forward to the opening year of the proposed scheme, so that the DM scenario is the predicted baseline for the opening year. For the purpose of this assessment the baseline year is 2012.

14.2.14 Under Part IV of the Environment Act 1995, all local authorities are required to undertake a regular review of air quality in their area of jurisdiction, and assess whether the AQOs are being achieved. This is known as Local Air Quality Management (LAQM). The local authority must designate any areas where ambient concentrations of pollutants exceed or are predicted to exceed the relevant objective values as an Air Quality Management Area (AQMA). The relevant LAQM assessments from Perth & Kinross Council have been obtained and reviewed as part of this assessment.

14.2.15 Although Perth & Kinross Council undertakes a variety of automatic and non-automatic air quality monitoring within the district, none of the locations are representative of the proposed scheme. Therefore, a baseline NO_2 diffusion tube survey was undertaken as part of this assessment. This is described in more detail in Section 14.3 (Baseline Conditions) and monitoring locations are shown on Figure 14.1. The results from this survey compliment the data obtained from both Perth & Kinross Council and Defra, and were used in the model evaluation and verification process.

14.2.16 As well as this, mapped background concentrations available from Defra (Defra, 2013a) have been used as the source of background concentrations in this study. A background concentration is the average concentration of pollution in the air where it is not being directly affected by a pollution source. This is described in more detail in Section 14.3 (Baseline Conditions).

14.2.17 The baseline information obtained from the study has informed a detailed dispersion model, with data from the base year traffic model being validated against the baseline measurements to provide a verification of the modelling.

Impact Assessment

Construction

14.2.18 As fugitive emissions of airborne particulate matter are produced through the action of abrasive forces on materials, it is reasonable to assume that a wide range of site preparation and construction activities have the potential to create this type of emission. This can include demolition work, earthworks (including the handling and storage of materials), construction activities and the transfer of dust making materials from site to the local road network.

14.2.19 Respirable particulate matter (PM_{10}) has the aerodynamic diameter of less than 10µm, and is of greatest concern in relation to potential impacts on human health. The majority of construction dust is larger than 10 µm in diameter and, therefore, increased levels of dust in the air do not necessarily equate to an increase in levels of PM_{10}. In general, construction dusts rarely represent an adverse risk to human health due to its temporary nature, and are more typically associated with consequences of material depositing onto property.

14.2.20 This assessment is consistent with the approach as set out in DMRB. When assessing the impact of construction dust emissions, receptors are defined as the nearest potentially sensitive receptor to the perimeter of the site in each direction. These receptors have the potential to experience impacts of greater magnitude when compared with other more distant receptors, and therefore represent worst-case examples. The identification of sensitive receptors considers residential properties and other potentially sensitive properties such as schools and hospitals.

Operation (Local Air Quality)

14.2.21 The assessment of the potential air quality impacts of the proposed scheme has been undertaken using the ADMS-Roads Air Dispersion Modelling Software, developed by Cambridge Environmental Research Consultants Ltd (CERC) and is a version of an atmospheric modelling system that focuses on road traffic as a source of pollutant emissions.

14.2.22 ADMS-Roads is a recognised tool for carrying out air quality impact assessments and has been comprehensively validated by both the manufacturers and independently. It is used both by regulatory authorities and commercially to assist in decisions related to air quality and traffic

management, urban planning and public health in many countries around the world. Version 3.1 (released August 2011) was used for this assessment.

14.2.23 The software takes into account various inputs, including the finalised traffic model data (including average speed, percentage of HDV vehicles, road links), emission factors, historical hourly sequential meteorological information (including wind speed, wind direction, temperature and cloud cover) to produce predictions of pollutant concentrations at sensitive receptor locations. The use of the available data and its application in the model was conducted in accordance with the methodology described in LAQM TG(09). More information about the methodology used for model verification can be found within Appendix A14.2 (Dispersion Model Set Up and Model Verification).

Operation (Designated Sites)

14.2.24 DMRB guidance states that any designated nature conservation sites ('designated sites') should be identified and assessed as part of the air quality assessment. Sites that should be considered for an ecological assessment are those for which the designated features are sensitive to air pollutants, either directly or indirectly, and which could be adversely affected by the effect of air pollution on vegetation. These include Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI) and RAMSAR sites.

14.2.25 High concentrations of NO_x can have an adverse effect on vegetation. NO_x concentrations were calculated at the Cairnleith Moss SSSI and compared to the relevant objective. There are no sections of the River Tay SAC that are sensitive to nitrogen within the air quality study area, and this designated site was therefore scoped out of assessment.

14.2.26 The conclusions of NO_x concentration calculations were provided to the ecological assessment where the impacts of the proposed scheme on the integrity of relevant designated sites, and the significance of those impacts, is discussed in Chapter 10 (Ecology and Nature Conservation).

Operation (Regional Air Quality)

14.2.27 Predicted mass emissions of NO_x, PM_{10}, and CO_2 were calculated for each of these scenarios using the latest verions of the Emission Factor Toolkit (version 5.2c) issued by the Defra (Defra, 2013b).

Impact Significance

Construction

14.2.28 An air quality assessment of demolition and construction activities was undertaken using an approach consistent with the DMRB methodology. Potential mitigation measures consistent with the level of risk are identified using the Institute of Air Quality Management's (IAQM, 2012) Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of Significance.

Operation (Local Air Quality)

14.2.29 The model results were used to assess whether there are any significant impacts as a result of the proposed scheme. The approach to evaluating significant air quality impacts is set out in IAN 174/13 and 175/13 published in June 2013 (Highways Agency *et al.*, 2013b; 2013c).

14.2.30 The EU Directive on Ambient Air Quality sets limit values for a range of pollutants. The purpose of the Directive is to protect human health, and the environment as a whole. Defra reports annually, on behalf of the UK government, on the status of air quality to the European Commission. The compliance risk assessment test as detailed in IAN 175/13 (Highways Agency *et al,* 2013c) has been developed to enable decision makers to judge a scheme's likelihood of non-compliance with the EU Directive. The compliance risk assessment test also informs the air quality significance test.

14.2.31 The approach to air quality assessment identifies and assesses sensitive receptors near roads where air quality might be affected. Consequently, areas where national AQOs might be expected to be exceeded are considered, which includes Air Quality Management Areas (AQMAs). The model results are used to identify those receptors which are in exceedence of AQOs in either the DM or DS scenario. These are the only receptors which are considered in the judgement of significance. The change in predicted concentration is then calculated as the difference between DS and DM model results at these receptors.

14.2.32 Where the difference in concentrations are less than 1% of the AQO (e.g. less than 0.4 µg/m³ for annual average NO_2), then the change at these receptors is considered to be imperceptible and they can be scoped out of the judgement on significance.

14.2.33 The DMRB guidance provides a framework on the number of receptors for each of the magnitude of change categories that might result in a significant impact. These are guideline values only, and are to be used to inform professional judgement on significant impacts of the proposed scheme. The guideline bands are intended to help provide consistency across all major road schemes. The significance categories and guideline property numbers are summarised in Table 14.3.

Table 14.3: Guideline to Number of Properties Constituting a Significant Impact

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

14.2.34 The significance of the change is 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_{10} thresholds are exceeded, then more significance should be attributed to these impacts.

14.2.35 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, then consideration should be given to all the evidence that may support or detract from a conclusion of a significant impact when coming to a concluding view. The further above the upper guideline band the more likely it is that local air quality impacts would be significant.

14.2.36 Where the results reside between the lower and upper guideline bands for any of the magnitude criteria then impacts of the proposed scheme could be significant and professional judgement is required taking into account the results for all six categories. This judgement will be based on the technical knowledge and experience of the air quality professional. To assist this judgement consideration should be given (but not limited) to the following.

14.2.37 Impacts of the proposed scheme are more likely to be significant where:

- there are no / few receptors with any improvements;
- PM_{10} 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_{10}.

14.2.38 Impacts of the proposed scheme are more likely to be not significant where:

- there are receptors with small, medium or large improvements;
- PM_{10} 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_{10}.

14.2.39 The establishment of overall air quality significance for the proposed scheme should also consider whether the proposed scheme detracts or supports measures set out in relevant local authority Air Quality Action Plans, if the proposed scheme represents a low or high compliance risk with the EU directive on air quality, the impacts on any designated site(s) affected, and potential impactive mitigation.

Operation (Designated Sites)

14.2.40 Concentrations of NO_x are used as the main basis for evaluating significance. Where the assessment indicates a potentially significant impact on a designated site due to anticipated changes in NO_x concentrations, then changes in nutrient nitrogen deposition were calculated as supporting information to further assist in the assessment. This follows specific guidance in IAN 174/13 (Highways Agency *et al.*, 2013b).

14.2.41 Where NO_x concentrations are assessed to be below their AQO or 'Critical Level' (30 µg/m^3) then significant impacts are not anticipated. If the objective is exceeded, then significant impacts may occur, and further consideration is given to the magnitude of change. The exception to this is where changes are less than 0.4 µg/m^3, for which impacts are considered to be imperceptible and unlikely to be significant.

14.2.42 Where the Critical Level is exceeded and predicted changes in NO_x concentrations are greater than 0.4 µg/m^3 then this information together with changes in nutrient nitrogen deposition were provided to the ecology team to determine the significance of impacts based on their professional judgement.

Operation (Regional Air Quality)

14.2.43 No formal significance criteria are available for the assessment of regional air quality assessment. The assessment therefore presents the likely emissions but does not assign significance to these.

Limitations to Assessment

14.2.44 Whilst the base year model can be verified against monitoring data, there is an inherent limitation in the accuracy of background concentrations and vehicle emission factors projections into future years. The approach followed uses conservative assumptions and is consistent with current best practice and government guidance.

14.3 Baseline Conditions

14.3.1 A review and assessment of the current baseline air quality monitoring information in the vicinity of the proposed scheme is important to establish a baseline situation by which the assessment results can be compared against.

14.3.2 The baseline assessment includes a desktop review of LAQM reports, a review of Defra background mapping, and a six-month diffusion tube survey to provide accurate background concentrations in the vicinity of the proposed scheme.

A9 Dualling: Strategic Environmental Assessment (SEA)

14.3.3 As noted in Chapter 2 (Need for the Scheme), an SEA of the wider programme of proposed dualling of the A9 from Perth to Inverness has been undertaken. The outcomes of the SEA, including responses from consultees, were reviewed as part of this assessment. Air quality was scoped out of the SEA and as such there were no strategic considerations or recommendations which are applicable to this assessment.

Local Air Quality Management: Perth & Kinross Council

14.3.4 The proposed scheme is located within the authority area of Perth & Kinross Council. As part of this assessment, the recently released 2012 Updating and Screening Assessment (USA) has been obtained and reviewed.

14.3.5 The USA details a summary of the previous rounds of LAQM assessment and reporting. The phased approach to LAQM began in 1999, with the first USA in 2003 leading to a detailed assessment of NO_2 and PM_{10} in 2004. The results from these assessment identified exceedances of NO_2 and PM_{10} in various locations across the city, and as a result, the Council declared an Air Quality Management Area (AQMA) for the whole of the city centre in May 2006. A further detailed assessment in 2007 concluded that the exceedances were due mainly to queuing and congested traffic.

14.3.6 The decision to designate the whole area was to ensure that areas that were close to, but didn't currently exceed the relevant AQOs, were included. This also helped to ensure that the Air Quality Action Plan could be integrated with other council policies.

14.3.7 The 2008 Progress Report concluded that 19 monitoring locations within the city centre continued to exceed the NO_2 annual mean objective, together with locations outside the centre in the nearby town of Crieff. Automatic monitoring has been undertaken in Crieff. The 2009 USA report concluded that 23 locations within the AQMA were above the NO_2 AQO, as well as two in Crieff. After the approval of the Council's Air Quality Action Plan by the Scottish Government in 2009, the 2010 Progress Report showed a slight reduction of exceeding locations, including at automatic monitoring stations.

14.3.8 The 2011 Progress Report considered new air quality monitoring data. This identified exceedances in the daily mean PM_{10} AQO for the first time. The report concluded that the AQMA designation will remain in place and continue with the implementation of the Air Quality Action Plan (AQAP).

14.3.9 The 2012 USA detailed 2011 monitoring data from 58 sites within Perth & Kinross Council. This data identified 15 exceeding locations within Perth, and 4 in Crieff. The AQMA therefore remains the same. A detailed assessment commissioned for Crieff due to the continued exceedances of AQOs in the area is currently being produced and will be available shortly. After reviewing the latest USA there are no AQMAs within the extents of the assessment study area.

14.3.10 The document also details other potential sources of air pollution in the region. This has been reviewed, and there are no new industrial, domestic or commercial sources that have been approved in the vicinity of the proposed scheme that would affect this assessment.

14.3.11 Although Perth & Kinross Council undertakes air quality monitoring, there are no locations within the air quality study area which are suitable for model verification.

Baseline Diffusion Tube Survey

14.3.12 To augment available baseline data for use in this assessment, a six month passive diffusion tube monitoring survey was undertaken from January-July 2013. Ten locations in the vicinity of the proposed scheme were identified in consulation with the Environmental Health Officer of Perth & Kinross Council. The monitored locations are shown in Figure 14.1.

14.3.13 The diffusion tubes were collected and replaced on a monthly basis and sent to an accredited laboratory (ESG) for analysis. The monitoring data have been bias adjusted and annualised to provide a 2012 annual mean equivalent concentration, and can be found in Table 14.4.

Table 14.4: NO_2 Diffusion Tube Monitoring Survey – 2012 Annual Mean Concentrations (µg/m^3)

ID	Location	Grid Coordinates		Conc.	Data Capture (%)
		X	Y		
1	Robertson Road, Perth	308393	724227	18.1	100%
2	Bute Drive, Perth	310236	725528	19.6	100%
3	Westfield, Luncarty	309491	729475	10.8	100%
4	Ladner Cottage	308706	731931	15.9	100%
5	Newmill	308519	732175	12.4	100%
6	East Mains	308005	733079	14.7	100%
7	Innewan Gardens, Bankfoot	307152	734883	19.3	100%
8	Coxland Crescent, Bankfoot	306287	734965	5.3	100%
9	Cairnleith Moss (1 Stewart Tower Farm Cottages)	308971	736166	6.8	100%
10	Station Road, Birnam	303119	741715	15.1	100%
11	High Street CM, Perth	311686	723627	24.3	100%

14.3.14 The diffusion tube survey was co-located at the High Street, Perth continuous analyser. Comparison of the diffusion tube results with the continuous analyser results was undertaken, and a bias adjustment factor for the six month survey of 0.81 was applied following guidance in LAQM TG(09). Further details on model verification methodology used within this assessment are provided in Appendix A14.2 (Dispersion Model Set Up and Model Verification).

14.3.15 The February to July 2013 project specific survey data were adjusted to represent the annual mean concentration in 2012 using three urban background continuous monitoring locations (Dundee Mains Loan, Falkirk Grangemouth and Edinburgh St Leonards), following the guidance in LAQM TG(09). The annualisation factor derived was 1.094.

Sensitive Receptor Locations

14.3.16 For local air quality, the assessment covers 24 receptors (Table 14.5), selected as representative of the maximum impacts of the proposed scheme in that area. Full results for each receptor are detailed in Appendix A14.3, and are presented in Figure 14.2. Ladner Cottage (R19) will be demolished as part of the proposed scheme and therefore will not be a receptor in the DS scenario. Cairnleith Moss SSSI, the River Tay SAC and Mill Dam SSSI are within the air quality study area of the proposed scheme. Assessment of the operational phase of the proposed scheme on the River Tay SAC and Mill Dam SSSI was not required because there are no nitrogen sensitive sections of habitat within 200m of roads affected by traffic flow or alignment change. Cairnleith Moss SSSI was included in the assessment (Receptor R13).

14.3.17 Table 1Cairnleith Moss SSSI, the River Tay SAC and Mill Dam SSSI are within the air quality study area of the proposed scheme. Assessment of the operational phase of the proposed scheme on the River Tay SAC and Mill Dam SSSI was not required because there are no nitrogen sensitive sections of habitat within 200m of roads affected by traffic flow or alignment change. Cairnleith Moss SSSI was included in the assessment (Receptor R13).

Table 14.5: Modelled Air Quality Receptor Locations

Receptor	Grid Coordinates		Location Details
	X	Y	
R01	302745	742007	12 King Duncan's Place, Birnam
R02	303080	741739	2 Station Cottage, Birnam
R03	303622	741447	Carse Na Ty, Birnam
R04	303820	741284	Oakwood, Birnam
R05	303921	741285	11 Torlee Road, Birnam
R06	304504	740208	West Ringwood

Receptor	Grid Coordinates		Location Details
	X	Y	
R07	306528	738834	Canmore Cottage
R08	306633	739024	Garden House
R09	307125	735076	35 Innevan Gardens, Bankfoot
R10	307151	734886	71 Innewan Gardens, Bankfoot
R11	307170	735549	Broom Park Cottage, Bankfoot
R12	307247	734547	Bellfield, Bankfoot
R13	307270	736511	Cairnleith SSSI
R14	307412	734194	Hilton Cottage, Bankfoot
R15	307610	735311	South Barns, Bankfoot
R16	308062	733252	Westwood, Stanley
R17	308072	732989	Barn House, Stanley
R18	308512	732183	Newmill
R19	308711	731931	Ladner Cottage (DM scenario only)
R20	308818	732520	Newmill, Stanley
R21	309180	731191	Atholl Cottage, Luncarty
R22	309252	729309	Kirkhill House, Luncarty
R23	309256	728645	The Paddocks, Luncarty
R24	309408	729463	6 Main Road, Luncarty

Defra Background Maps

14.3.18 Defra provides empirically derived national background maps, which provide estimates of background pollutant concentrations on a 1km x 1km grid square resolution. Mapped background concentrations from the Defra website (Defra, 2013a) have been used as the source of background concentrations in this study. Spatially varying background data have been obtained from the Defra website for 2012 (baseline year) and 2019 (the assumed opening year). These background data provide an estimate of the ambient pollutant concentrations in the vicinity of the site.

14.3.19 The modelled background mapped concentrations of NO_x/NO_2 and PM_{10} produced by Defra in the assessment area are well within the relevant AQOs. Background monitoring data from the project survey for NO_2 are consistent with this. The background concentrations used in this assessment for NO_x/NO_2 and PM_{10} have been derived from the Defra maps.

14.4 Potential Impacts

Construction Phase

14.4.1 There is potential for dust nuisance and damage to habitat to be caused during the construction of 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. Nuisance is regulated under Part III of the Environmental Protection Act 1990.

14.4.2 The assessment of potential air quality impacts from the construction phase relates to the construction activities onsite, the delivery of materials and equipment to and from the site, and construction workers travelling to and from site. The main potential impact on air quality is from fugitive dust.

14.4.3 Based on DMRB, the maximum distance at which dust nuisance may be caused is up to 200m. With regard to the potential for the construction of the proposed scheme to create dust nuisance, there are approximately 203 receptors within 200m of the proposed scheme (including sections of existing roads which will require construction activities), and areas of temporary land-take required during construction. This is shown in Figure 14.3.

14.4.4 The construction of the proposed scheme would consist of the movement of quantities of soil in the site area to achieve a cut and fill balance that minimises the need for material to be brought to the site or taken away from it. Materials for the construction of the road itself would be transported to the site by heavy goods vehicles (HGVs). Details of site specific recommended best practice mitigation measures to control dust are included in Section 14.5 (Mitigation).

14.4.5 The emissions from the plant vehicles and the traffic to site on local air quality concentrations of NO_2 and PM_{10} are considered to be negligible when compared to the normal traffic on the existing road network in the study area. As the construction phase of the proposed scheme is planned to be completed in approximately two years, the impacts of emissions from these vehicles would be temporary in nature. Therefore construction phase road traffic emissions are not considered to be significant.

Operation: Local Air Quality

14.4.6 This section presents the impacts of the proposed scheme during operation upon local air quality in the study area. The proposed scheme involves online widening of an existing major road, and as such effects relate to changes to an existing road network (e.g. as a consequence of changes to traffic speeds; or changes to road alignment that bring traffic closer to, or further from, receptors).

14.4.7 The results presented throughout this section are based on the values predicted based using the Gap Analysis methodology (HA, 2013b), which takes into account the Long-term Trends for NO_x and NO_2. This is considered to be more conservative and representative of opening year impacts than the LAQM TG(09) methodology.

14.4.8 The representative receptors have been selected to demonstrate the greatest modelled concentrations or to illustrate the changes in concentration due to the proposed scheme. A table of results detailing background concentrations, the LAQM TG(09) and the Gap Analysis results for all 24 receptors included within the assessment is provided in Appendix A14.3 (Local Air Quality - Specific Receptor Modelled Results – NO_2 and PM_{10}).

14.4.9 The annual mean objectives for NO_2 and PM_{10} are not predicted to be exceeded in either the DM or DS scenarios at any modelled receptor. Annual mean NO_2 and PM_{10} concentrations for the representative receptors are presented in Table 14.6. Figure 14.4 shows the predicted change in annual mean NO_2 concentration due to the proposed scheme at the modelled receptors.

Table 14.6: NO_2 and PM_{10} Opening Year (2019) Annual Mean Concentrations (µg/m^3) at Representative Receptors

Receptor	DM Concentration		DS Concentration		Change in Concentration (DS-DM)	
	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R1	15.0	10.5	15.2	10.5	0.2	0.0
R2	18.5	11.1	18.5	11.1	0.0	0.0
R3	15.3	10.5	15.5	10.5	0.2	0.0
R4	15.1	10.5	15.1	10.5	0.0	0.0
R5	11.4	9.9	11.4	9.9	0.0	0.0
R6	8.0	9.7	8.2	9.7	0.2	0.0
R7	8.1	9.6	8.1	9.6	0.0	0.0
R8	14.0	10.6	14.1	10.6	0.1	0.0
R9	10.9	11.8	11.4	11.7	0.5	-0.1
R10	13.1	12.6	13.9	12.6	0.8	0.0
R11	15.6	12.5	18.5	12.7	2.9	0.2
R12	13.9	12.7	13.9	12.5	0.0	-0.2
R13	7.1	9.7	7.6	9.7	0.5	0.0
R14	13.8	12.7	14.0	12.6	0.2	-0.1

Receptor	DM Concentration		DS Concentration		Change in Concentration (DS-DM)	
	NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
R15	7.2	11.2	7.5	11.2	0.3	0.0
R16	11.3	11.6	12.8	11.7	1.5	0.1
R17	12.6	12.5	14.0	12.5	1.4	0.0
R18	12.6	12.5	14.2	12.5	1.6	0.0
R19	20.4	13.7	n/a	n/a	n/a	n/a
R20	7.8	11.7	7.8	11.6	0.0	-0.1
R21	10.4	12.7	10.9	12.6	0.5	-0.1
R22	13.4	13.3	13.9	13.3	0.5	0.0
R23	11.8	12.9	11.8	12.8	0.0	-0.1
R24	21.4	14.5	21.6	14.5	0.2	0.0

14.4.10 The maximum worsening in annual mean NO_2 concentration as a result of the proposed scheme, is a medium magnitude increase of 2.9 µg/m^3 at receptor R11. This occurs because the additional lane is approximately 10m closer to the receptor and the additional lane relieves congestion, thus increasing the average speed.

14.4.11 The maximum benefit in annual mean PM_{10} concentration as a result of the proposed scheme is an imperceptible magnitude reduction of 0.2 µg/m^3 at receptor R12. The maximum worsening in annual mean PM_{10} concentration as a result of the proposed scheme is an imperceptible magnitude increase of 0.2 µg/m^3 at receptor R11.

14.4.12 The results for PM_{10} show a similar pattern, but to a lower magnitude because vehicle contributions to roadside concentrations of PM_{10} are much lower than for NO_2.

Operation: Designated Sites

14.4.13 Cairnleith Moss SSSI (Receptor 13) is the only designated site with nitrogen sensitive habitat within 200m of roads affected by the proposed scheme (Table 14.7).

Table 14.7: NO_x Opening Year (2019) Annual Mean Concentrations (µg/m^3) at Designated Sites

Receptor	DM Concentration	DS Concentration	Change in Concentration (DS-DM)
Cairnleith Moss SSSI (R13)	10.1	11.0	0.9

14.4.14 The SSSI is predicted to receive a small magnitude increase in annual mean NO_x concentration, due to the proposed scheme moving closer because of the additional lane at this section. The AQO for annual mean NO_x is not exceeded in either scenario.

Operation: Regional Air Quality

14.4.15 All the roads within close proximity of affected roads for which traffic data have been provided have been subject to emission calculations. Table 14.8 shows that the proposed scheme would increase CO_2 emissions from traffic by approximately 6% relative to the DM in the opening year (2019). This is primarily a result of the increase in average vehicle speed on the A9, and also an increase in the length of the road network at junctions as a result of the proposed scheme.

Table 14.8: Regional Emissions in kg/year (tonnes/year for CO_2)

Pollutant	Annual Regional Emission in kg or tonnes						
	2012	2019 DM	2019 DS	2019 DS-DM	2034 DM	2034 DS	2034 DS-DM
NO_x	60,350	27,741	30,138	2,397	14,644	16,206	1,562

Pollutant	Annual Regional Emission in kg or tonnes						
	2012	2019 DM	2019 DS	2019 DS-DM	2034 DM	2034 DS	2034 DS-DM
PM_{10}	4,961	4,240	4,292	52	4,283	4,318	35
CO_2	18,959	18,663	19,707	1,045	19,436	20,599	1,163
HC	4,446	2,771	2,748	-22	4,871	4,806	-65

Impact Significance

Impact Significance for Local Air Quality

14.4.16 Based on DMRB advice on the guidelines for the consideration of significant impacts, the results for the NO_2 or PM_{10} annual mean AQO are presented in Table 14.9. There are no receptors that are predicted to exceed the NO_2 AQOs in either the DM or DS scenario, and therefore none that could potentially be subject to significant change. These results are based on the Gap Analysis for LTT in NO_x and NO_2 (see Appendix A14.1: Air Quality Technical Information, for further details on the Gap Analysis).

Table 14.9: Local Air Quality Receptors Informing Significance (NO_2 and PM_{10} Annual Mean AQO)

Total Number of Receptors with:		
Magnitude of Change in Annual Average NO_2 or PM_{10} (µg/m³)	**Worsening of AQO already above objective or creation of a new exceedence**	**Improvement of an AQO already above objective or the removal of an existing exceedence**
Large (>4)	0	0
Medium (>2 to 4)	0	0
Small (>0.4 to 2)	0	0

14.4.17 The results show that no receptors in exceedence of the annual mean or short-term AQOs for NO_2 or PM_{10}, and that there are no new or removed exceedences as a result of the proposed scheme.

14.4.18 It is therefore considered that there are no significant impacts related to NO_2 or PM_{10} concentrations as a result of the proposed scheme.

Impact Significance for Designated Sites

14.4.19 No significant impacts were identified at any designated site during the operational phase. Modelled concentrations show no exceedence of the NO_x annual mean AQO or critical level at the Cairnleith Moss SSSI.

14.5 Mitigation

Construction Phase

14.5.1 Control measures for dust arising during construction can be very effective. In order to minimise any potential emissions of fugitive dust during the construction phase, and hence minimise potential impacts, the Construction Environmental Management Plan (CEMP) will adopt comprehensive measures to control fugitive dust. The CEMP should include all appropriate measures from the following activities.

14.5.2 Minimise fugitive dust emissions from earthworks, material storage and concrete batching (**Mitigation Item AQ1**):

- any material stockpiles will be enclosed at all times, dusty materials will be damped down using water sprays during dry weather and the surfaces of any long-term stockpiles sprayed with bonding agents;
- 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. Sprinklers and hoses will be used to prevent dust escape from 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.

14.5.3 Ensure that dust from vehicle movements within the site are minimised (**Mitigation Item AQ2**):

- unsurfaced routes will be regularly dampened down using water bowsers during periods of dry weather;
- appropriate speed limits will be established and enforced over all unmade surfaces; and
- wheel washing facilities will be installed and heavy vehicles leaving the site will be required to use the installation.

14.5.4 Implement appropriate cleaning of the public highway (**Mitigation Item AQ3**):

- subject to approval from the Highway Authority, the public highway 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
- the edges of roads and footpaths adjacent to the development will be cleaned, with damping if necessary.

14.5.5 Implement a public relations service (**Mitigation Item AQ4**):

- the contractor will provide, advertise and maintain a telephone number via which public dust complaints can be received and appropriate action taken;
- details of all such complaints will be notified to the environmental health department of the Council for verification purposes; and
- specific activities with the potential of causing dust problems will be notified to the environmental health department so that appropriate safeguards can be adopted.

14.5.6 Monitor compliance with the above measures (**Mitigation Item AQ5**):

- the contractor will be required to set up a monitoring programme to evaluate compliance with this code; and
- all policies, practices and procedures will be periodically reviewed to ensure their appropriateness.

14.5.7 In addition to the above construction phase measures, the contractor will be encouraged to adopt the following measures (**Mitigation Item AQ6**):

- enter into pre-works discussions with the Council to agree method of works;
- prepare a statement of commitment to control off-site environmental impacts including fugitive dust emissions;
- prepare an environmental management system to ensure procedures are monitored and controlled on a regular basis;
- devise a management and supervisory structure which identifies named responsible individuals working on the site;
- write down policies and procedures and make these available to staff and subcontractors using the site; and
- ensure that all site workers receive adequate training in environmental control procedures including the control of dust and other airborne emissions which might cause off-site impacts.

Operational Phase

14.5.8 No significant impacts are predicted during operation of the proposed scheme, and no mitigation is required.

14.6 Residual Impacts

Construction Impacts

14.6.1 With the implementation of appropriate dust control measures in place, the construction phase of the proposed scheme is not predicted to cause any significant residual impacts, either through dust nuisance or on local air quality or at designated sites.

Operational Impacts

14.6.2 No significant residual operational phase impacts are predicted.

14.7 References

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