A9 DUALLING
PERTH TO INVERNESS

# Appendix 16.1

## Air Quality

Transport Scotland

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TRANSPORT SCOTLAND
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## Chapter



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# 1. Approach and Methods

## 1.1. Legislation, Policy and Guidance

### Air Pollutants

1.1.1. Nitrogen dioxide ($NO_2$) is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and $NO_2$ are collectively referred to as $NO_x$. About a quarter of the UK $NO_x$ emissions are from road transport. The majority of $NO_x$ emitted from vehicles is in the form of NO, which oxidises rapidly in the presence of ozone to form $NO_2$. In high concentrations $NO_2$ can affect the respiratory system and can also enhance the response to allergens in sensitive individuals. Additionally, there is increasing awareness of an association between long-term average concentrations of $NO_2$ and mortality[1]. Elevated concentrations of $NO_x$ can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from $NO_x$ emissions contribute to acidification and/or eutrophication of sensitive habitats.

1.1.2. Particulate Matter (PM) in vehicle exhaust gases consists of carbon nuclei onto which a wide range of compounds are absorbed. These particles have an effective aerodynamic diameter of less than 10 micrometres (µm). Particles in this size range are referred to as $PM_{10}$. The principal sources of 'primary' polluting particles are combustion processes which include traffic and industry. Road transport produces 13% of primary $PM_{10}$ emissions in the UK, of which the majority of emissions are from diesel engines. Finer fractions of particulate matter appear to be associated with a range of symptoms of ill health including effects on the respiratory and cardiovascular systems, on asthma and on mortality. Reviews by the World Health Organisation (WHO) and Committee on the Medical Effects of Air Pollutants (COMEAP) have suggested exposure to a finer fraction of particles ($PM_{2.5}$ particles with a diameter of less than 2.5µm, which typically make up around two thirds of $PM_{10}$ emissions and concentrations) give a stronger association with the observed ill health effects

### *Dust*

1.1.3. Dust is the generic term for solid particles that can be suspended in the atmosphere. Dust per se is not considered as a local air pollutant but is inevitably encountered in the outdoor environment. It is defined within the Institute of Air Quality Management (IAQM) Construction Dust Guidance[i] as solid particles that are suspended in air or have settled out onto a surface after having been suspended in air. It includes particles that give rise to soiling (deposited dust) and to human health effects (particulate matter as discussed above) and ecological effects.

1.1.4. Dust that may deposit in the local area close to a source (such as a construction site) typically comprises particles between 10 and 75 micrometres (µm) in diameter, the larger size particles settling to the ground within a few tens of metres from the source. Small particles settle more slowly over a larger area and therefore contribute relatively little to the general ambient dust levels. Such particles are also more susceptible to being blown away. Excessive accumulations of dust on exposed surfaces, particularly in residential locations, may cause a perceived loss of amenity and give rise to public complaint.

[1] COMEAP (2015) *Interim Statement on Quantifying the Association of Long-Term Average Concentrations of Nitrogen Dioxide and Mortality.* Retrieved 2017, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485373/COMEAP_NO2_Mortality_Interim_Statement.pdf

1.1.5. The IAQM Construction Dust Guidance states that there is evidence that major construction sites can lead to an increase in annual mean $PM_{10}$ concentrations and the number of exceedances of the short term (24-hour mean) objective for $PM_{10}$. In addition, demolition and construction activities have the potential to cause higher than normal levels of dust deposition in the surrounding area. Dust emissions from a site may be mechanically generated due to land preparation (e.g. demolition, land clearing and earth moving) or as a result of release from site plant and movement of road vehicles on temporary roads, and open ground and haul routes.

## Air Quality Criteria

1.1.6. The Government's Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland[ii] provides details of national air quality standards and objectives for a number of local air pollutants including $NO_2$ and particulates ($PM_{10}$ and $PM_{2.5}$). These criteria are included in The Air Quality Standards (Scotland) Regulations 2010 (SSI 2010/204)[iii] and The Air Quality (Scotland) Amendment Regulations 2016 (SSI 2016/162)[iv]. These regulations implement the EU Directive 2008/50/EC[v] on ambient air quality and cleaner air for Europe (the Air Quality Directive).

1.1.7. The air quality standards define the level of pollution below which health effects are unlikely to be experienced even by the most sensitive members of the population. These are based upon recommendations of the Expert Panel on Air Quality Standards (EPAQS). The air quality objectives are targets for air pollution concentrations which take account of the costs and benefits of achieving the standard. In the case of short-term targets, the permissible number of hours or days above the objective concentration is also specified. The number of permissible "exceedances" is considered when determining compliance with the short-term objectives over an annual period. Local authorities are not legally obliged to achieve the air quality objectives. They are, however, required to work towards the objectives.

1.1.8. It should be noted that the air quality criteria only apply in locations where there may be a 'relevant exposure'. These human health objectives are applicable where members of the public may be exposed to pollutant levels for periods equal to or exceeding the averaging periods set for these criteria. Locations of relevant exposure include building façades of residential premises, schools, public buildings and medical facilities. Places of work, other than certain community facilities, are excluded.

1.1.9. The air quality criteria for the protection of human health in Scotland, for the key pollutants relevant to the assessment, are presented in Table 1.1 below.

**Table 1.1: Relevant Air Quality Criteria (Human Health)**

| Pollutant | Objective | Compliance Date | |
|---|---|---|---|
| | | AQS Objective | EU limit value |
| Nitrogen dioxide, $NO_2$ | Hourly average concentration should not exceed 200µg/m$^3$ more than 18 times a year<br><br>Annual mean concentration should not exceed 40µg/m$^3$ | 31 Dec 2005<br><br>31 Dec 2005 | 1 Jan 2010<br><br>1 Jan 2010 |
| Particulate matter, $PM_{10}$ | Daily average concentration should not exceed 50µg/m$^3$ more than 7 times a year | 31 Dec 2004<br><br>31 Dec 2004 | 1 Jan 2005<br><br>1 Jan 2005 |

| Pollutant | Objective | Compliance Date | |
|---|---|---|---|
| | | AQS Objective | EU limit value |
| | Annual mean concentration should not exceed 18µg/m$^3$ | | |
| Particulate matter, $PM_{2.5}$ | Annual mean concentration should not exceed 10µg/m$^3$ | 31 Dec 2020 (Authorities in Scotland only) | - |

### *Dust*

1.1.10. There are no national standards or guidelines for dust deposition as a nuisance currently set for the UK, nor by the European Union or World Health Organisation. This is mainly due to the difficulty in setting a standard that would need to relate to dust being a perceptual problem rather than being specifically related to health effects. Typically, there is a 'likelihood of complaint' in residential areas where measured dust deposition rates (as an average measured over a month using a passive deposition gauge) are 200 mg/m$^2$/day or greater[vi].

### *Ecological Criteria*

1.1.11. The EU has set limit values for the protection of vegetation for oxides of nitrogen based on the work of the United Nations Economic Commission for Europe (UNECE) and WHO and these limit values have been incorporated into The Air Quality Standards (Scotland) Regulations 2010 (SSI 2010/204).

1.1.12. The limit value for oxides of nitrogen for the protection of vegetation is an annual mean of 30µg/m$^3$. This is the same as the AQS objective. The limit values for the protection of vegetation apply to locations more than 20 km from towns with more than 250,000 inhabitants or more than five km from other built-up areas, industrial installations or motorways. This objective does not apply in those areas where assessment of compliance with the limit value is not required. However, as the UNECE and the WHO have set a critical level for $NO_x$ for the protection of vegetation, the policy of the statutory nature conservation agency (in Scotland, Scottish Natural Heritage) is to apply the criterion as a benchmark, on a precautionary basis, in internationally designated conservation sites (Ramsar, Special Area of Conservation (SAC), Special Protection Area (SPA) and Sites of Special Scientific Interest (SSSIs)).

1.1.13. In addition, critical loads for nitrogen and acid deposition have been set by the UNECE, that represent (according to current knowledge) the exposure below which there should be no significant harmful effects on sensitive elements of the ecosystem. The critical loads vary by type of ecosystem, and are available from the Air Pollution Information System (APIS) website[vii].

## Local Air Quality Review and Assessment

1.1.14. Under Part IV of the Environment Act 1995[viii] all local authorities are responsible for Local Air Quality Management (LAQM), the mechanism by which the Government's air quality objectives are to be achieved. As part of this LAQM role, local authorities are required to periodically review air quality in their area and to assess the present and likely future air quality against AQS objectives. The findings are reported and published following public consultation and review by the Department for Environment, Food and Rural Affairs (Defra). Where a local authority determines an AQS objective to be breached, it must designate an Air Quality Management Area (AQMA) and develop an action plan to improve pollution levels.

### Planning Policy

1.1.15. The Scottish Government's planning guidance of general relevance for air quality is found within the National Planning Framework for Scotland (NPF3)[ix]. This states that:

1.1.16. "Reducing the impact of the car on city and town centres will make a significant contribution to realising their potential as sustainable places to live and invest by addressing congestion, air pollution and noise and improving the public realm. Significant health benefits could be achieved by substantially increasing active travel within our most densely populated areas."

1.1.17. NPF3 is supported by a Draft Action Programme for implementation of the NPF strategy. There are no actions specific to the improvement of air quality.

#### *Local Planning Policy*

1.1.18. The Highland-wide Local Development Plan published in April 2012[x] contains a comprehensive policy approach for air quality. Policies relevant to air quality include:

- Policy 28:Sustainable design

"Proposed developments will be assessed on the extent to which they impact on air quality"

- Policy 72 Pollution; and

"Proposals that may result in significant pollution such as air, will only be approved where a detailed assessment report on the levels, character and transmission and receiving environment of the potential pollution is provided by the applicant to show how the pollution can be appropriately avoided and if necessary mitigated"

- Policy 73 Air Quality.

"Development proposals which, individually or cumulatively, may adversely affect the air quality in an area to a level which could cause harm to human health and wellbeing or the natural environment must be accompanied by appropriate provisions, such as an Air Quality Assessment, which demonstrate how such impacts will be mitigated."

## 1.2. Construction Dust Assessment Methodology

1.2.1. Assessment of the potential impact of the construction phase of the proposed development on air quality with regards dust and $PM_{10}$ emissions has been carried out with reference to the four step process described in the IAQM Construction Dust Guidance. These steps are summarised below:

- **Step 1** (screening) – Identification of the number of human receptors within 350m of the boundary of the Site and/or within 50m of the route(s) used by construction vehicles on the public highway up to 500m from the Site entrance. Identification of ecological receptors within 50m of either the boundary of the Site and/or of the route(s) used by construction vehicles on the public highway up to 500m from the site entrance. No further assessment is required if there are no receptors.
  - 'Human' receptors include residential dwellings and other premises that may have a particular sensitivity to dust deposition or to the health effects of $PM_{10}$ e.g. vehicle showrooms, museums, hospitals, schools and residential care homes.
  - 'Ecological' receptors include sites with statutory designations e.g. Ramsar sites, Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Sites of

Special Scientific Interest (SSSI), as well as non-statutory sites such as locations with very specific ecological sensitivities e.g. horticultural operations.

- **Step 2** – Assessment of the risk of dust effects in the area around the Site in the context of potential dust impacts (demolition, earthworks, construction activities and trackout (mud deposits on the road from road vehicles leaving the site)) and distance to nearby receptors in relation to proposed activities.
  - Step 2A – Dust emission magnitude classes of 'large', 'medium' and 'small' are used to define the level of risk arising from each site depending on nature and scale of operation.
  - Step 2B – The sensitivity of the surrounding area is defined for each of the three different effects: dust soiling; human health; and ecological; as 'high', 'medium' and 'low' depending on the receptor sensitivity (as shown in Table 1.2) and the distance from the source. In addition, for the effect on human health, background $PM_{10}$ concentrations are taken into account. The definitions are provided in Tables 2, 3 and 4 of the IAQM's Construction Dust Guidance.
  - Step 2C - Tables 6 to 9 in the IAQM's Construction Dust Guidance are used to define the risk of impact based on the dust emission magnitude and sensitivity of area. These are reproduced in Table 1.3 to Table 1.5.
- **Step 3** – Determination of site specific mitigation in terms of the identified risks.
- **Step 4** – Assessment of the significance of the dust impacts, after the application of the site specific mitigation. Once mitigation has been applied, there should not be any significant adverse impacts.

**Table 1.2: Examples of Sensitive Receptors**

| Type of Receptor | High Sensitivity | Medium Sensitivity | Low Sensitivity |
|---|---|---|---|
| Sensitive to Dust Soiling Effects | Dwellings, museums, long-term car parks, car showrooms | Parks, places of work | Playing fields, farmland, footpaths, short-term car parks |
| Sensitive to Health Effects of $PM_{10}$ | Residential properties, hospitals, schools, residential care homes | Office and shop workers | Public footpaths, playing fields, parks and shopping streets |
| Sensitive to Ecological Effects | Locations with an international or national designation and the designated features may be affected by dust soiling | Locations with a national designation where the designated features may be affected by dust deposition | Locations with a local designation where the features may be affected by dust deposition |

**Table 1.3: Risk of Dust Impacts – Demolition**

| Sensitivity of Area | Dust Emission Magnitude | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Medium Risk |
| Medium | High Risk | Medium Risk | Low Risk |
| Low | Medium Risk | Low Risk | Negligible |

**Table 1.4: Risk of Dust Impacts – Earthworks and Construction**

| Sensitivity of Area | Dust Emission Magnitude | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Medium Risk | Low Risk |
| Low | Low Risk | Low Risk | Negligible |

**Table 1.5: Risk of Dust Impacts – Trackout[a]**

| Sensitivity of Area | Dust Emission Magnitude | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Low Risk | Negligible |
| Low | Low Risk | Low Risk | Negligible |
| [a] Trackout can be defined as the deposition of dust and dirt from the construction site onto the public road network, where it may then be resuspended by vehicles using the network. | | | |

## 1.3. Scheme Monitoring

1.3.1. A $NO_2$ diffusion tube monitoring survey was carried out for a period of six months from December 2015 until May 2016 in the vicinity of the proposed Scheme. Results from the baseline monitoring survey have been bias corrected by applying the national bias adjustment factor gained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet. Following adjustment, the six month average diffusion tube results were annualised following analysis of data from three background AURN monitoring sites (Aberdeen, Dundee and Fort William) in accordance with guidance within LAQM.TG(16). The adjusted December 2015 to May 2016 period average and the annualised mean for 2016 are presented for the diffusion tube survey in Table 1.6.

**Table 1.6: Monthly and Annualised Mean Concentrations (µg/m$^3$) at Diffusion Tube Survey Sites**

| Site ID | Dec-15 | Jan-16 | Feb-16 | Mar-16 | Apr-16 | May-16 | 6 month average | Adjusted 6 month average ($^+$0.92) | Annualised 2016 annual mean* |
|---|---|---|---|---|---|---|---|---|---|
| DS01 | 1.9 | | | 3.4 | 2.6 | 2.2 | 2.5 | 2.3 | 2.3 |
| DS02 | 16.3 | 14.2 | 15.5 | 15.4 | 11.7 | 9.8 | 13.8 | 12.7 | 11.7 |
| DS03 | 3.7 | | 3.3 | 6.8 | 4.3 | 3.5 | 4.3 | 4.0 | 3.9 |
| DS04 | 10.0 | | 9.5 | 12.0 | 7.6 | 7.7 | 9.4 | 8.6 | 8.5 |
| DS05 | 10.4 | 11.2 | 8.6 | 8.9 | 6.6 | 6.1 | 8.6 | 7.9 | 7.3 |
| DS06 | 7.2 | 8.1 | 6.7 | | | | 7.4 | 6.8 | 5.4 |
| DS07 | 19.7 | | 14.4 | 18.2 | 9.5 | 13.3 | 15.0 | 13.8 | 13.7 |
| DS08 | 14.9 | 14.4 | 13.0 | 15.3 | 11.1 | 9.3 | 13.0 | 11.9 | 11.0 |
| DS09 | 18.7 | 18.1 | 17.6 | 17.5 | 16.1 | 15.5 | 17.3 | 15.9 | 14.6 |
| DS10 | 19.0 | 20.0 | 18.9 | 20.3 | 10.0 | 15.0 | 17.2 | 15.8 | 14.5 |
| DS11 | 13.4 | 12.1 | 11.1 | 11.4 | | 7.9 | 11.2 | 10.3 | 9.0 |

| Site ID | Dec-15 | Jan-16 | Feb-16 | Mar-16 | Apr-16 | May-16 | 6 month average | Adjusted 6 month average (+0.92) | Annualised 2016 annual mean* |
|---|---|---|---|---|---|---|---|---|---|
| DS12 | 5.6 | 5.8 | 4.4 | 5.3 | 3.6 | 3.4 | 4.7 | 4.3 | 3.9 |
| DS13 | 11.1 | 11.0 | 12.0 | 12.8 | 9.4 | 7.5 | 10.6 | 9.8 | 9.0 |

+ National bias adjustment of 0.92 from National Diffusion Tube Bias Adjustment Factor Spreadsheet v09/17

*six different annualisation factors were used differing on the period of each diffusion tube exposure time (ranging between 0.79 and 1.00)

## 1.4. Background Data

1.4.1. Background maps are provided by the Air Quality in Scotland website[xi] to assist Scottish local authorities in support of the review and assessment of local air quality[xii]. These provide background concentrations of $NO_x$, $NO_2$, and $PM_{10}$. Mapped background concentrations of each pollutant can be downloaded for each 1km by 1km grid square in Scotland and are modelled based on monitoring and meteorological data for the year 2015 and projected for future years to 2030.

1.4.2. Defra also provides background maps for Scotland, providing concentrations of $NO_x$, $NO_2$, and $PM_{10}$ and $PM_{2.5}$. Background mapping is not currently available for $PM_{2.5}$ from the Air Quality in Scotland website, therefore $PM_{2.5}$ concentrations were estimated by applying the ratio of Defra mapped background concentrations[xiii] of $PM_{10}$ to $PM_{2.5}$ to the Scottish background mapping of $PM_{10}$. The scaling factor applied to the annual mean $PM_{10}$ concentrations to estimate annual mean $PM_{2.5}$ concentrations is unique to each grid square with factors applied across the study area ranging between 0.65 and 0.74

1.4.3. The mapped background concentrations were adjusted to remove Trunk A-Road and Primary A-Road contributions to the total mapped concentrations in each grid square. This is undertaken to avoid double counting, in accordance with Defra guidance using the background sector removal tool[xiv]. This tool was developed for use with the Defra mapped background concentrations and therefore the adjusted $NO_2$ and $NO_x$ mapped background concentrations used in the assessment have been taken from the Defra datasets.

1.4.4. The 2016 Defra background mapped concentrations were also compared with the monitoring survey result for the background monitoring sites DS01 and DS12. The comparison is presented in Table 1.7. The measured result at DS12 was over 50% higher than the mapped background for the grid square containing the monitoring site. It is therefore considered appropriate (in line with LAQM.TG16) to factor the mapped background estimates to characterise background air quality conditions in the study area in 2016 and 2026. An average adjustment factor of 1.24 was derived from the comparison at DS01 and DS12.

1.4.5. The comparison of the 2016 Defra background mapped annual mean $NO_2$ concentrations with the monitoring survey results for the background monitoring sites DS01 and DS12 are presented in Table 1.7 below.

**Table 1.7: Comparison of Monitored and Mapped $NO_2$ Concentrations (µg/m$^3$)**

| Site ID | Monitored | Mapped | Monitored - Mapped | Monitored / Mapped | % Difference |
|---|---|---|---|---|---|
| DS01 | 2.3 | 2.5 | -0.16 | 0.94 | -6.5 |
| DS12 | 3.9 | 2.6 | 1.38 | 1.54 | 53.8 |

| Site ID | Monitored | Mapped | Monitored - Mapped | Monitored / Mapped | % Difference |
|---|---|---|---|---|---|
| Average adjustment | | | | 1.24 | |

1.4.6. The monitored annual mean $NO_2$ concentrations at Inverness, Aberdeen, Dundee and Fort William background AURN are presented below in Table 1.8.

**Table 1.8: Annual Mean $NO_2$ Concentrations at AURN sites (µg/m$^3$)**

| Site | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| Fort William | 12 | 9 | 11 | 13 | 10 |
| Inverness | 29 | 21 | 21 | 27 | 24 |
| Aberdeen | 21 | 20 | 22 | 23 | 21 |
| Dundee | 10 | n/a | 13 | 10 | n/a |

## 1.5. Model Verification

1.5.1. It is good practice to compare modelled estimates of pollutant concentrations with real-world monitoring to assess the model's performance. This is undertaken for a base year and informs the interpretation of model results for future years. From the full survey of ten diffusion tubes, only those representative of selected sensitive receptor locations and with sufficient data capture were deemed suitable for the purpose of model verification. Following an evaluation of each monitoring location, seven diffusion tube sites were taken forward in the model verification. Table 1.9 lists the sites removed from the verification process and the reason why.

**Table 1.9: Monitoring sites removed from the verification process**

| Site | Reason for exclusion from verification |
|---|---|
| DS01 | Background site too far from road source signal. |
| DS04 | Located in a layby with possible lorry stops, therefore difficult to replicate in the model. |
| DS06 | Remote location with the adjacent road excluded from the traffic model. |
| DS12 | Background site too far from road source signal. |
| DS13 | Remote location considered background. |

1.5.2. Uncertainty in modelled estimates has been considered by calculating root mean square error (RMSE) and fractional bias statistics in accordance with Defra's Technical Guidance LAQM.TG(16). An air dispersion model can be considered to perform reasonably well if the majority of modelled concentrations are within 25% of measured concentrations. The RMSE should ideally be within 10% of the relevant air quality criterion, i.e. less than 4 µg/m$^3$ in relation to the 40 µg/m$^3$ objective concentration for annual mean $NO_2$, but is acceptable where it is within 25% of the relevant air quality criterion. The Fractional Bias (FB) has an ideal value of 0, but is acceptable between +2 and -2.

1.5.3. Unadjusted modelled estimates of total annual mean $NO_2$ concentrations were first compared against measured annual mean $NO_2$. Out of eight comparisons, one modelled estimate was within +/- 25% of measured, as shown in Table 1.10.

Substantial model underestimates of more than 25% were found at the remaining seven sites.

**Table 1.10: Comparison of Modelled and Measured $NO_2$ Concentrations (µg/m$^3$)**

| Site | Measured $NO_2$ | Modelled Total $NO_2$ | Modelled - Measured | Modelled / Measured | % Difference |
|---|---|---|---|---|---|
| DS02 | 11.7 | 6.8 | -4.9 | 0.6 | -42% |
| DS03 | 3.9 | 3.2 | -0.7 | 0.8 | -19% |
| DS05 | 7.3 | 5.2 | -2.1 | 0.7 | -29% |
| DS07 | 13.7 | 7.6 | -6.1 | 0.6 | -45% |
| DS08 | 11.0 | 6.8 | -4.1 | 0.6 | -38% |
| DS09 | 14.6 | 8.3 | -6.3 | 0.6 | -43% |
| DS10 | 14.5 | 7.4 | -7.2 | 0.5 | -49% |
| DS11 | 9.0 | 5.8 | -3.2 | 0.6 | -35% |

1.5.4. The RMSE for unadjusted modelled estimates of $NO_2$ compared to measured concentrations, is 4.8 µg/m$^3$, which is acceptable when compared to the recommended value in LAQM.TG(16). The overall performance (based on the majority of comparisons) of the unadjusted model can, however, still be improved.

1.5.5. Overall, the unadjusted model tends to underestimate total concentrations of $NO_2$, as indicated by a fractional bias value of 0.51.

1.5.6. The second stage of verification compares modelled estimates of road contributed annual mean $NO_x$ with the road $NO_x$ component derived from monitoring data. As only diffusion tube data are available for annual mean $NO_2$ and this analysis requires the estimation of the monitored road $NO_x$ component, a conversion must be carried out using Defra's $NO_2$ to $NO_x$ calculator. The comparison is presented in Table 1.11. The unadjusted model underestimates concentrations of road $NO_x$ between -38 to -70%.

**Table 1.11: Comparison of Modelled and Measured $NO_x$ Concentrations (µg/m$^3$)**

| Site | Modelled Road $NO_x$ | Measured Road $NO_x$ | Modelled - Measured | Measured/ Modelled | % Difference |
|---|---|---|---|---|---|
| DS02 | 8.5 | 17.5 | -9.0 | 2.1 | -52% |
| DS03 | 2.2 | 3.5 | -1.3 | 1.6 | -38% |
| DS05 | 4.9 | 8.6 | -3.8 | 1.8 | -44% |
| DS07 | 9.5 | 20.9 | -11.4 | 2.2 | -54% |
| DS08 | 8.0 | 15.7 | -7.6 | 1.9 | -49% |
| DS09 | 7.9 | 19.6 | -11.7 | 2.5 | -59% |
| DS10 | 5.6 | 18.9 | -13.3 | 3.4 | -70% |
| DS11 | 5.9 | 11.7 | -5.8 | 2.0 | -50% |

1.5.7. Further examination suggests that the data can be divided into two distinct groups to improve model performance; those adjacent to the A9 and A-roads, and those adjacent to A-roads within the urban area of Aviemore (DS09 and DS10). Those locations adjacent to the A9 and A-roads underestimated monitored road $NO_x$ by an average of -48%, where as those within Aviemore underestimated by an average of -65%.

1.5.8. Modelled road $NO_x$ concentrations were adjusted by taking the slope of each linear regression line that has been forced through zero, as shown in Figure 1.1 and Figure 1.2. The model adjustment factors to apply to road $NO_x$ are:

- Adjacent to the A9 and A-roads: 2.040;
- Within Aviemore: 2.767.

**Figure 1.1: Modelled vs. Monitored road $NO_x$ before adjustment - adjacent to the A9 and A-roads**

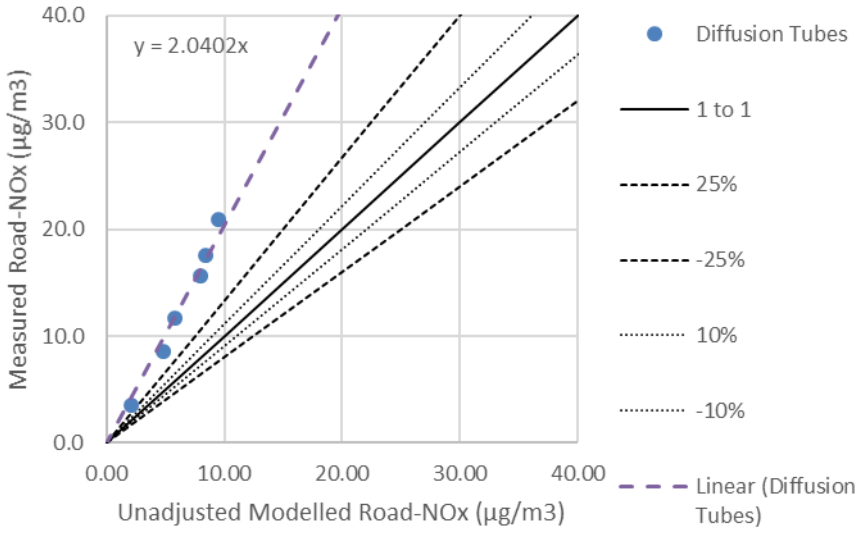
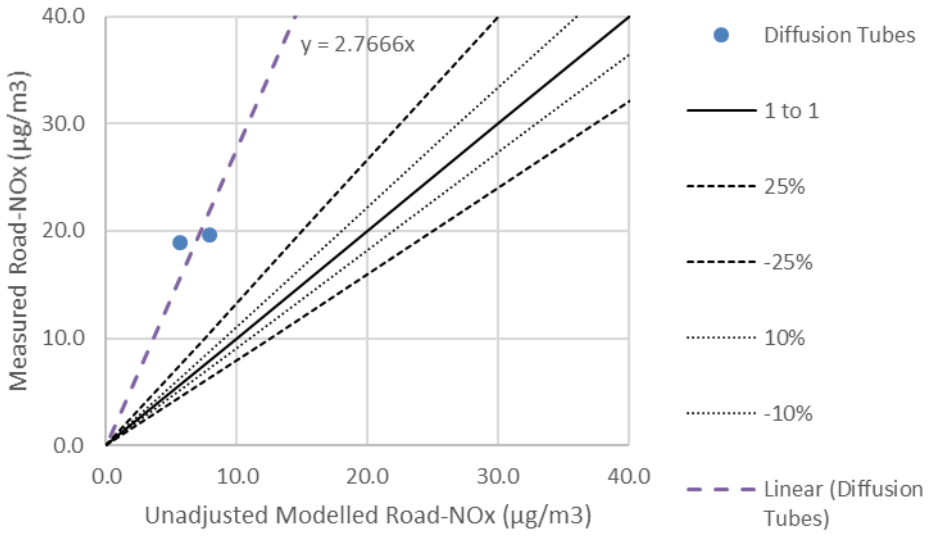



**Figure 1.2: Modelled vs. Monitored road $NO_x$ before adjustment - within Aviemore**




1.5.9. The final stage of the verification process compares adjusted estimates of total annual mean $NO_2$ with measured concentrations. The findings are presented in Table 1.12: Comparison of Adjusted Modelled and Measured $NO_2$ Concentrations ($\mu g/m^3$)and shown graphically in Figure 1.3. All estimated concentrations are within +/-25% of measured concentrations. The majority of sites tend to underpredict (five of eight between -0.3% and -17.5% post adjustment [one of which is less than -10%]). The remaining three sites overpredict between 3.5% and 3.7% post adjustment.

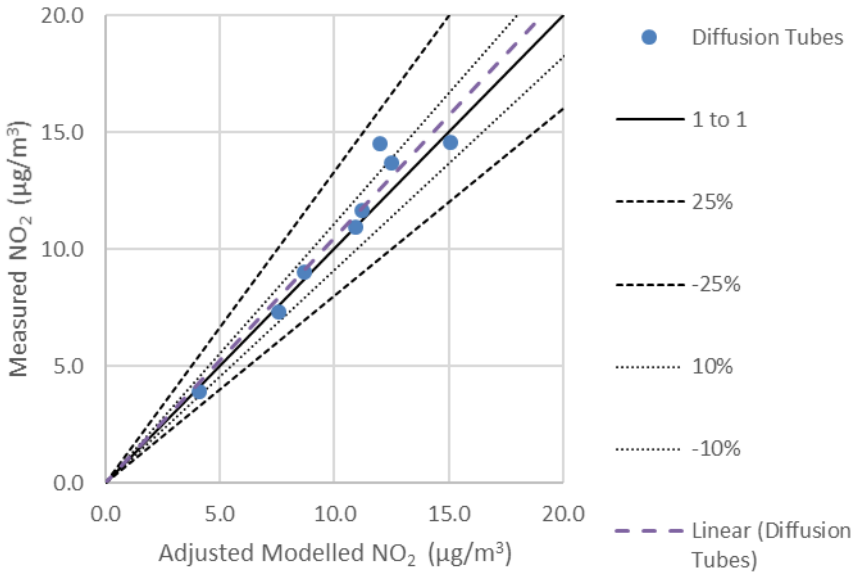
1.5.10. The RMSE for adjusted modelled $NO_2$ concentrations compared to monitored concentrations is 1.04 µg/m$^3$. The application of adjustment factors has therefore improved the overall model performance.

1.5.11. Overall, the adjusted model tends to slightly underestimate total concentrations of $NO_2$, as indicated by a fractional bias value of less than 0.04. The adjusted model therefore performs sufficiently well in accordance with LAQM.TG(16).

**Table 1.12: Comparison of Adjusted Modelled and Measured $NO_2$ Concentrations (µg/m$^3$)**

| Site | Measured $NO_2$ | Modelled Total $NO_2$ | Modelled - Measured | Modelled / Measured | % Difference |
|---|---|---|---|---|---|
| DS02 | 11.2 | 11.7 | -0.5 | 1.0 | -4.3% |
| DS03 | 4.1 | 3.9 | 0.1 | 1.0 | 3.7% |
| DS05 | 7.6 | 7.3 | 0.3 | 1.0 | 3.5% |
| DS07 | 12.5 | 13.7 | -1.2 | 1.1 | -8.7% |
| DS08 | 10.9 | 11.0 | 0.0 | 1.0 | -0.3% |
| DS09 | 15.1 | 14.6 | 0.5 | 1.0 | 3.6% |
| DS10 | 12.0 | 14.5 | -2.5 | 1.2 | -17.5% |
| DS11 | 8.7 | 9.0 | -0.3 | 1.0 | -3.3% |

**Figure 1.3: Modelled vs. Monitored road contributed $NO_2$ after adjustment**




1.5.12. Monitoring of particulate matter is not carried out within the study area; therefore, the model performance for this pollutant has not been verified. Given the very low background concentrations and relatively small contribution of road traffic emissions to total concentrations, compared with emissions of $NO_x$, this is considered to be a reasonable approach and is in line with other scheme assessments.

# 2. Local Air Quality Assessment Results

2.1.1. The results for annual mean $NO_2$, $PM_{10}$ and $PM_{2.5}$ are presented below in Table 2.1toTable 2.3. None of the modelled human health receptors below are located within Aviemore, therefore only the A9 / A-road adjustment factor was used. Further details of the receptors are provided within Chapter 16 Table 16.1 and receptor locations are shown on Figure 16.1.

**Table 2.1: Annual Mean $NO_2$ Concentrations, µg/m$^3$**

| Receptor | Base | IAN 170/12 Gap Factors | | | | | Defra LAQM TG16 $NO_2$ Projection Factors | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DM | DS | Change | Magnitude of Change | Significance | DM | DS | Change | Magnitude of Change | Significance |
| 1 | 10.0 | 11.2 | 12.2 | 1.0 | Small | Not significant | 7.1 | 7.7 | 0.6 | Small | Not significant |
| 2 | 2.4 | 2.3 | 2.4 | 0.1 | Imperceptible | Not significant | 1.5 | 1.5 | 0.0 | No Change | Not significant |
| 3 | 8.3 | 8.2 | 9.5 | 1.3 | Small | Not significant | 5.2 | 6.0 | 0.8 | Small | Not significant |
| 4 | 5.3 | 5.2 | 6.0 | 0.8 | Small | Not significant | 3.3 | 3.8 | 0.5 | Small | Not significant |
| 5 | 7.0 | 6.7 | 7.6 | 0.9 | Small | Not significant | 4.3 | 4.8 | 0.5 | Small | Not significant |
| 6 | 13.5 | 13.6 | 16.6 | 3.0 | Medium | Not significant | 8.6 | 10.6 | 2.0 | Small | Not significant |
| 7 | 9.0 | 8.9 | 13.6 | 4.7 | Large | Not significant | 5.6 | 8.6 | 3.0 | Medium | Not significant |
| 8 | 13.8 | 13.7 | 16.9 | 3.2 | Medium | Not significant | 8.7 | 10.7 | 2.0 | Small | Not significant |
| 9 | 8.4 | 8.3 | 9.3 | 1.0 | Small | Not significant | 5.3 | 5.9 | 0.6 | Small | Not significant |
| 10 | 11.3 | 11.4 | 13.6 | 2.2 | Medium | Not significant | 7.3 | 8.7 | 1.4 | Small | Not significant |
| 11 | 5.2 | 5.0 | 5.2 | 0.2 | Imperceptible | Not significant | 3.2 | 3.3 | 0.1 | Imperceptible | Not significant |
| 12 | 7.6 | 7.4 | 9.9 | 2.5 | Medium | Not significant | 4.7 | 6.3 | 1.6 | Small | Not significant |
| 13 | 2.6 | 2.4 | 2.6 | 0.2 | Imperceptible | Not significant | 1.5 | 1.7 | 0.2 | Imperceptible | Not significant |
| 14 | 8.4 | 8.3 | 10.6 | 2.3 | Medium | Not significant | 5.3 | 6.7 | 1.4 | Small | Not significant |
| 15 | 3.4 | 3.2 | 4.0 | 0.8 | Small | Not significant | 2.0 | 2.5 | 0.5 | Small | Not significant |
| 16 | 4.5 | 4.3 | 5.0 | 0.7 | Small | Not significant | 2.7 | 3.2 | 0.5 | Small | Not significant |
| 17 | 6.0 | 7.6 | 8.8 | 1.2 | Small | Not significant | 4.8 | 5.6 | 0.8 | Small | Not significant |

**Table 2.2: Annual Mean $PM_{10}$ Concentrations, $\mu g/m^3$**

| Receptor | Base | DM | DS | Change | Magnitude of Change | Significance |
|---|---|---|---|---|---|---|
| 1 | 6.1 | 5.9 | 5.9 | 0.0 | No Change | Not significant |
| 2 | 5.5 | 5.3 | 5.3 | 0.0 | No Change | Not significant |
| 3 | 6.5 | 6.3 | 6.3 | 0.0 | No Change | Not significant |
| 4 | 5.9 | 5.7 | 5.7 | 0.0 | No Change | Not significant |
| 5 | 8.7 | 8.3 | 8.4 | 0.1 | Imperceptible | Not significant |
| 6 | 6.1 | 5.8 | 6.0 | 0.2 | Imperceptible | Not significant |
| 7 | 6.4 | 6.2 | 6.5 | 0.3 | Imperceptible | Not significant |
| 8 | 6.7 | 6.4 | 6.6 | 0.2 | Imperceptible | Not significant |
| 9 | 6.7 | 6.5 | 6.5 | 0.0 | No Change | Not significant |
| 10 | 6.6 | 6.3 | 6.5 | 0.2 | Imperceptible | Not significant |
| 11 | 7.9 | 7.6 | 7.6 | 0.0 | No Change | Not significant |
| 12 | 6.0 | 5.7 | 5.9 | 0.2 | Imperceptible | Not significant |
| 13 | 5.6 | 5.4 | 5.4 | 0.0 | No Change | Not significant |
| 14 | 5.9 | 5.7 | 5.7 | 0.0 | No Change | Not significant |
| 15 | 5.7 | 5.5 | 5.6 | 0.1 | Imperceptible | Not significant |
| 16 | 5.7 | 5.5 | 5.5 | 0.0 | No Change | Not significant |
| 17 | 6.0 | 5.9 | 5.9 | 0.0 | No Change | Not significant |

**Table 2.3: Annual Mean $PM_{2.5}$ Concentrations, $\mu g/m^3$**

| Receptor | Base | DM | DS | Change | Magnitude of Change | Significance |
|---|---|---|---|---|---|---|
| 1 | 4.0 | 3.8 | 3.8 | 0.0 | No Change | Not significant |
| 2 | 3.6 | 3.5 | 3.5 | 0.0 | No Change | Not significant |
| 3 | 4.4 | 4.2 | 4.2 | 0.0 | No Change | Not significant |
| 4 | 3.9 | 3.7 | 3.7 | 0.0 | No Change | Not significant |
| 5 | 6.4 | 6.1 | 6.1 | 0.0 | No Change | Not significant |
| 6 | 4.1 | 3.9 | 3.9 | 0.0 | No Change | Not significant |
| 7 | 4.3 | 4.1 | 4.2 | 0.1 | Imperceptible | Not significant |
| 8 | 4.5 | 4.2 | 4.3 | 0.1 | Imperceptible | Not significant |
| 9 | 4.4 | 4.2 | 4.2 | 0.0 | No Change | Not significant |
| 10 | 4.3 | 4.1 | 4.1 | 0.0 | No Change | Not significant |
| 11 | 5.8 | 5.5 | 5.5 | 0.0 | No Change | Not significant |
| 12 | 4.1 | 3.9 | 4.0 | 0.1 | Imperceptible | Not significant |
| 13 | 3.7 | 3.5 | 3.5 | 0.0 | No Change | Not significant |
| 14 | 3.9 | 3.7 | 3.7 | 0.0 | No Change | Not significant |
| 15 | 3.8 | 3.6 | 3.6 | 0.0 | No Change | Not significant |
| 16 | 3.8 | 3.6 | 3.6 | 0.0 | No Change | Not significant |
| 17 | 4.1 | 3.9 | 3.9 | 0.0 | No Change | Not significant |

# 3. Designated Ecological Sites Results

3.1.1. The results for annual mean $NO_x$ and nitrogen deposition within designated ecological sites are presented below in Table 3.1 to Table 3.4.

**Table 3.1: Annual Mean $NO_x$ Concentrations applying IAN 170/12 Gap Factors, µg/m$^3$**

| Receptor | Description | Distance to Centreline in DS | Base | DM | DS | Change |
|---|---|---|---|---|---|---|
| E1 | Alvie SSSI Transect 1 Point A | 11 | 27.4 | 23.9 | 33.3 | +9.4 |
| E2 | Alvie SSSI Transect 1 Point B | 20 | 22.9 | 19.8 | 26.3 | +6.4 |
| E3 | Alvie SSSI Transect 1 Point C | 30 | 18.0 | 15.5 | 20.4 | +4.9 |
| E4 | Alvie SSSI Transect 1 Point D | 40 | 14.5 | 12.4 | 16.2 | +3.8 |
| E5 | Alvie SSSI Transect 1 Point E | 50 | 11.8 | 10.1 | 13.0 | +2.9 |
| E6 | Alvie SSSI Transect 1 Point F | 100 | 5.4 | 4.5 | 5.2 | +0.7 |
| E7 | Alvie SSSI Transect 1 Point G | 150 | 3.5 | 2.8 | 3.0 | +0.2 |
| E8 | Alvie SSSI Transect 1 Point H | 200 | 3.0 | 2.4 | 2.5 | +0.1 |
| E9 | Alvie SSSI Transect 2 Point A | 7 | 6.4 | 5.0 | 5.0 | -0.1 |
| E10 | Alvie SSSI Transect 2 Point B | 10 | 6.2 | 4.9 | 4.8 | -0.1 |
| E11 | Alvie SSSI Transect 2 Point C | 20 | 5.4 | 4.3 | 4.2 | -0.1 |
| E12 | Alvie SSSI Transect 2 Point D | 30 | 4.8 | 3.8 | 3.7 | -0.1 |
| E13 | Alvie SSSI Transect 2 Point E | 40 | 4.3 | 3.4 | 3.4 | 0.0 |
| E14 | Alvie SSSI Transect 2 Point F | 50 | 4.0 | 3.2 | 3.1 | 0.0 |
| E15 | Alvie SSSI Transect 2 Point G | 100 | 3.2 | 2.5 | 2.5 | 0.0 |
| E16 | Alvie SSSI Transect 2 Point H | 150 | 2.9 | 2.3 | 2.3 | 0.0 |
| E17 | Alvie SSSI Transect 2 Point I | 200 | 2.9 | 2.3 | 2.3 | 0.0 |
| E18 | Alvie SSSI Transect 3 Point A | 21 | 5.0 | 4.0 | 5.2 | 1.3 |
| E19 | Alvie SSSI Transect 3 Point B | 30 | 4.5 | 3.6 | 4.5 | 1.0 |

| Receptor | Description | Distance to Centreline in DS | Base | DM | DS | Change |
|---|---|---|---|---|---|---|
| E20 | Alvie SSSI Transect 3 Point C | 40 | 4.1 | 3.2 | 4.0 | 0.7 |
| E21 | Alvie SSSI Transect 3 Point D | 50 | 3.8 | 3.0 | 3.5 | 0.6 |
| E22 | Alvie SSSI Transect 3 Point E | 100 | 3.3 | 2.6 | 2.7 | 0.2 |
| E23 | Alvie SSSI Transect 3 Point F | 150 | 3.0 | 2.4 | 2.5 | 0.1 |
| E24 | Alvie SSSI Transect 3 Point G | 200 | 2.7 | 2.1 | 2.1 | 0.0 |
| E25 | Craigellachie SSSI Transect Point A | 20 | 21.4 | 18.0 | 24.8 | 6.8 |
| E26 | Craigellachie SSSI Transect Point B | 30 | 18.0 | 15.0 | 19.8 | 4.8 |
| E27 | Craigellachie SSSI Transect Point C | 40 | 15.2 | 12.6 | 16.1 | 3.5 |
| E28 | Craigellachie SSSI Transect Point D | 50 | 13.0 | 10.8 | 13.4 | 2.6 |
| E29 | Craigellachie SSSI Transect Point E | 100 | 5.1 | 4.2 | 4.9 | 0.7 |
| E30 | Craigellachie SSSI Transect Point F | 150 | 3.5 | 2.8 | 3.0 | 0.2 |
| E31 | Craigellachie SSSI Transect Point G | 200 | 3.1 | 2.5 | 2.6 | 0.1 |
| E32 | Loch Vaa SSSI/SPA Transect Point A | 4 | 20.9 | 18.1 | 22.3 | 4.2 |
| E33 | Loch Vaa SSSI/SPA Transect Point B | 10 | 19.1 | 16.5 | 20.2 | 3.7 |
| E34 | Loch Vaa SSSI/SPA Transect Point C | 20 | 15.1 | 13.0 | 15.8 | 2.7 |
| E35 | Loch Vaa SSSI/SPA Transect Point D | 30 | 12.3 | 10.5 | 12.5 | 2.0 |
| E36 | Loch Vaa SSSI/SPA Transect Point E | 40 | 10.2 | 8.7 | 10.2 | 1.5 |
| E37 | Loch Vaa SSSI/SPA Transect Point F | 50 | 8.7 | 7.3 | 8.5 | 1.2 |
| E38 | Loch Vaa SSSI/SPA Transect Point G | 100 | 4.3 | 3.5 | 3.8 | 0.2 |
| E39 | Loch Vaa SSSI/SPA Transect Point H | 150 | 3.3 | 2.6 | 2.7 | 0.1 |
| E40 | Loch Vaa SSSI/SPA Transect Point I | 200 | 3.0 | 2.3 | 2.4 | 0.0 |

**Table 3.2: Annual Mean $NO_2$ Concentrations applying IAN 170/12 Gap Factors, µg/m$^3$**

| Receptor | Description | Distance to Centreline in DS | Base | DM | DS | Change |
|---|---|---|---|---|---|---|
| E1 | Alvie SSSI Transect 1 Point A | 11 | 15.6 | 15.8 | 21.4 | 5.6 |
| E2 | Alvie SSSI Transect 1 Point B | 20 | 13.2 | 13.3 | 17.2 | 3.9 |
| E3 | Alvie SSSI Transect 1 Point C | 30 | 10.6 | 10.6 | 13.6 | 3.0 |
| E4 | Alvie SSSI Transect 1 Point D | 40 | 8.7 | 8.6 | 11.0 | 2.3 |
| E5 | Alvie SSSI Transect 1 Point E | 50 | 7.3 | 7.2 | 9.0 | 1.8 |
| E6 | Alvie SSSI Transect 1 Point F | 100 | 3.7 | 3.6 | 4.0 | 0.4 |
| E7 | Alvie SSSI Transect 1 Point G | 150 | 2.6 | 2.5 | 2.6 | 0.1 |
| E8 | Alvie SSSI Transect 1 Point H | 200 | 2.4 | 2.2 | 2.2 | 0.1 |

**Table 3.3: Annual Mean $NO_2$ Concentrations applying Defra TG16 Gap Factors, µg/m$^3$**

| Receptor | Description | Distance to Centreline in DS | Base | DM | DS | Change |
|---|---|---|---|---|---|---|
| E1 | Alvie SSSI Transect 1 Point A | 11 | 15.6 | 10.4 | 14.1 | 3.7 |
| E2 | Alvie SSSI Transect 1 Point B | 20 | 13.2 | 8.8 | 11.3 | 2.6 |
| E3 | Alvie SSSI Transect 1 Point C | 30 | 10.6 | 7.0 | 9.0 | 2.0 |
| E4 | Alvie SSSI Transect 1 Point D | 40 | 8.7 | 5.7 | 7.2 | 1.5 |
| E5 | Alvie SSSI Transect 1 Point E | 50 | 7.3 | 4.7 | 5.9 | 1.2 |
| E6 | Alvie SSSI Transect 1 Point F | 100 | 3.7 | 2.3 | 2.6 | 0.3 |
| E7 | Alvie SSSI Transect 1 Point G | 150 | 2.6 | 1.6 | 1.7 | 0.1 |
| E8 | Alvie SSSI Transect 1 Point H | 200 | 2.4 | 1.4 | 1.5 | 0.0 |

**Table 3.4: Annual Nitrogen deposition applying IAN 170/12 Gap Factors, kg N ha$^{-1}$ yr$^{-1}$**

| Receptor | Description | Distance to Centreline in DS | Critical Load | DM | DS | Change |
|---|---|---|---|---|---|---|
| E1 | Alvie SSSI Transect 1-Valley mires, poor fens and transition mires | 11 | 10 | 4.6 | 5.2 | 0.6 |
| E2 | | 20 | 10 | 4.4 | 4.8 | 0.4 |
| E3 | | 30 | 10 | 4.1 | 4.4 | 0.3 |

| Receptor | Description | Distance to Centreline in DS | Critical Load | DM | DS | Change |
|---|---|---|---|---|---|---|
| E4 | | 40 | 10 | 3.9 | 4.1 | 0.2 |
| E5 | | 50 | 10 | 3.8 | 3.9 | 0.1 |
| E6 | | 100 | 10 | 3.4 | 3.5 | 0.1 |
| E7 | | 150 | 10 | 3.3 | 3.3 | 0.0 |
| E8 | | 200 | 10 | 3.3 | 3.3 | 0.0 |
| E1 | Alvie SSSI Transect 1-Coniferous woodland | 11 | 10 | 4.6 | 5.2 | 0.6 |
| E2 | | 20 | 10 | 4.4 | 4.8 | 0.4 |
| E3 | | 30 | 10 | 4.1 | 4.4 | 0.3 |
| E4 | | 40 | 10 | 3.9 | 4.1 | 0.2 |
| E5 | | 50 | 10 | 3.8 | 3.9 | 0.1 |
| E6 | | 100 | 10 | 3.4 | 3.5 | 0.1 |
| E7 | | 150 | 10 | 3.3 | 3.3 | 0.0 |
| E8 | | 200 | 10 | 3.3 | 3.3 | 0.0 |

# 4. Regional Assessment Results

4.1.1. The results of the regional emissions assessment are presented below in Table 4.1.

**Table 4.1: Summary of Regional Assessment Results**

| Pollutant | 2016 | 2026 | | 2041 | |
|---|---|---|---|---|---|
| | Base | DM | DS | DM | DS |
| **Total** | | | | | |
| $CO_2$ (t/yr) | 23354 | 26230 | 39833 | 28803 | 43449 |
| $NO_x$(kg/yr) | 56411 | 23352 | 41908 | 19133 | 34069 |
| $PM_{10}$ (kg/yr) | 3316 | 3139 | 5610 | 3434 | 6082 |
| $PM_{2.5}$(kg/yr) | 2227 | 1877 | 3194 | 2042 | 3443 |
| Vehicle km | 270501 | 322601 | 489909 | 350911 | 529930 |
| **% Change from Base** | | | | | |
| $CO_2$ | | 12% | 71% | 23% | 86% |
| $NO_x$ | | -59% | -26% | -66% | -40% |
| $PM_{10}$ | | -5% | 69% | 4% | 83% |
| $PM_{2.5}$ | | -16% | 43% | -8% | 55% |
| Vehicle km | | 19% | 81% | 30% | 96% |
| % Change from DM | | | | | |
| $CO_2$ | | | 52% | | 51% |
| $NO_x$ | | | 79% | | 78% |
| $PM_{10}$ | | | 79% | | 77% |

| Pollutant | 2016 | 2026 | | 2041 | |
|---|---|---|---|---|---|
| | Base | DM | DS | DM | DS |
| $PM_{2.5}$ | | | 70% | | 69% |
| Vehicle km | | | 52% | | 51% |

4.1.2. To put these results into context, total national emissions for Scotland for 2015 have been taken from the National Atmospheric Emissions Inventory (NAEI) website[xv]:

- $NO_x$ 83.8 ktonnes
- $PM_{10}$ 11.7 ktonnes
- $CO_2$ 45,687 ktonnes

# 5. Mitigation during Construction

5.1.1. Table 5.1 outlines construction mitigation measures relating to air quality. Further details are provided in Chapter 21:

**Table 5.1: Mitigation Items for Air Quality**

| Mitigation Item | Description |
|---|---|
| SMC-AQ1 | In relation to minimising fugitive dust emissions from earthworks, material storage and concrete batching the following mitigation items will be implemented:<br>• stockpiles and mounds will be at a suitable angle of repose to prevent material slippage, will be enclosed or securely sheeted, and/or kept dampened as necessary during dry weather;<br>• the surfaces of any long-term stockpiles which give rise to a risk of dust or air pollution will be covered with appropriate sheeting or will be treated to stabilise the surfaces;<br>• mixing of large quantities of concrete will be carried out only in enclosed or shielded areas;<br>• all handling areas will be maintained in a dust free state as far as is practicable with sprinklers and hoses used to prevent dust escaping from the site boundaries; and<br>• procedures will be established so that the site is regularly inspected for spillage of dusty or potentially dusty materials and any such spillage would be dealt with promptly where necessary to prevent dust nuisance. |
| SMC-AQ2 | In relation to minimising dust from vehicle movements within the site the following mitigation items will be implemented:<br>• the Contractor will employ appropriate measures, such as covering materials deliveries or loads entering and leaving the construction site by a fixed cover or sheeting appropriately fixed and suitable for the purposes of preventing materials and dust spillage;<br>• where unsurfaced routes are identified as creating dust emissions during periods of dry weather, surfaces will be regularly dampened down using water bowsers; and<br>• appropriate speed limits will be established and enforced over all unmade surfaces. |
| SMC-AQ3 | In relation to appropriate cleaning of public roads the following mitigation items will be implemented: |

| Mitigation Item | Description |
|---|---|
| | • wheel washing facilities will be installed as required and heavy vehicles will be required to use the facilities prior to leaving the site;<br>• subject to approval from Transport Scotland and the network operator, public roads immediately outside the site entrance will be cleaned using vacuum sweeper brushes and other specialised road cleaning equipment as necessary to maintain an appropriate state of cleanliness; and<br>• roads and footpaths adjacent to the proposed scheme will be cleaned, with damping if necessary. |
| P11-AQ4 | Suitable mitigation measures to be employed for a 'medium' risk category site have been identified from the IAQM Construction Dust Guidance. |

5.1.2. Ensuring the use of established good site management practices, including where appropriate the above proposed measures, should effectively control and minimise dust generation such that there will be no significant dust impacts beyond the site boundary.

[i] IAQM (2014), Guidance on the assessment of dust from demolition and construction [v1.1 updated 01/06/16]. http://iaqm.co.uk/text/guidance/construction-dust-2014.pdf
[ii] Defra, (2007) Air Quality Strategy for England, Scotland, Wales and Northern Ireland; Her Majesty's Stationary Office (HMSO).
[iii] Scottish Government (2010), Air Quality Standards (Scotland) Regulations 2010 (SSI 2010/204); Scottish Government.
[iv] Scottish Government (2016), Air Quality Standards (Scotland) Amendment Regulations 2016 (SSI 2016/162); Scottish Government.
[v] European Parliament (2008), Directive 2008/50/EC of the European Parliament and of the council of 21 May 2008 on ambient air quality and cleaner air for Europe (EU Directive 2008/50/EC). European Parliament.
[vi] IAQM (2012) Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites. http://www.iaqm.co.uk/wp-content/uploads/guidance/monitoring_construction_sites_2012.pdf
[vii] Centre for Ecology and Hydrology and the UK pollution and conservation agencies (2015), Air Pollution Information System: APIS [online] http://www.apis.ac.uk/
[viii] HMSO (1995), Environment Act 1995 Ch.25, London; UK Government. http://www.legislation.gov.uk/ukpga/1995/25/contents
[ix] Scottish Government (2014), National Planning Framework for Scotland 3; Scottish Government. http://www.gov.scot/Resource/0045/00453683.pdf
[x] The Highland Council (2012), Highland Wide Local Development Plan.
[xi] Air Quality in Scotland (2017), Maps of Annual Concentrations [online] http://www.scottishairquality.co.uk/data/mapping?view=data
[xii] Defra (2017) Background Concentration Maps: User Guide. http://laqm.defra.gov.uk/documents/2013-based-background-maps-user-guide-v1.0.pdf
[xiii] Defra (2017) Background Mapping data for local authorities; Air Information Resource [online] https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015
[xiv] Defra (2017), $NO_2$ Adjustment for $NO_x$ Sector Removal; Air Information Resource [online] http://laqm.defra.gov.uk/documents/NO2-Adjustment-for-NOx-Sector-Removal-Tool-v6.1.xls
[xv] NAEI (2017), Air Quality Pollutant Inventories for England, Scotland, Wales and Northern Ireland: 1990-2015. http://naei.beis.gov.uk/reports/reports?report_id=895