44 Air Quality

This chapter describes the potential local air quality impacts associated with the Fastlink section of the proposed scheme. Baseline air quality in this area is very good and impacts of the proposed scheme are expected to range from Moderate adverse to Moderate beneficial. Most of the adverse impacts would be caused by exhaust emissions from vehicles using the new road. The beneficial impacts would be due to reduced traffic on existing roads. More locations within 500m of the Fastlink will experience adverse impacts than beneficial impacts, but air quality will remain very good with or without the proposed scheme.

This assessment has not identified any requirement to mitigate the air quality impacts, other than those measures that area already built into the scheme design.

44.1 Introduction

44.1.1 Air pollutants emitted from road vehicles can worsen local air quality, which may lead to health effects or damage to particularly sensitive vegetation. A new road scheme will alter driving patterns and thus change the numbers of vehicles on particular roads, as well as potentially reducing congestion and changing driving speeds, and as such can influence local air quality not only close to the new road, but also across a much wider road network. Where a new road brings vehicles into an area, air quality is likely to deteriorate. At the same time, air quality is likely to improve near to roads that are relieved by the new road.

44.1.2 Nationally, there are two local air pollutants of greatest concern in terms of road traffic: nitrogen dioxide and fine particles (normally measured as PM_{10} – particulate matter less than 10 micrometres diameter). Air quality assessments carried out by Aberdeenshire Council (e.g. Aberdeenshire Council, 2005) have confirmed that these are the only two road traffic pollutants of potential concern in this area. The assessment thus addresses the impacts of the proposed scheme on ambient concentrations of both nitrogen dioxide and PM_{10}. Concentrations of oxides of nitrogen (NOx, which covers nitrogen dioxide and nitric oxide) are also assessed in relation to areas of sensitive vegetation.

44.1.3 Existing (2005) concentrations of these pollutants close to the proposed route are described. Concentrations are also predicted for the year 2011 both with and without the proposed scheme in place. For the purposes of this air quality assessment, 2011 has been assumed to be the opening year for the scheme, even though opening is actually expected to be 2012. Because of national and international measures that have been set in place to reduce emissions from road transport and many other sectors, current projections assume that concentrations of both nitrogen dioxide and PM_{10} will fall in the future. Thus, assessing 2011 is a worst-case approach.

44.2 Approach and Methods

Study Area

44.2.1 This chapter describes the local air quality impacts that are expected within 500m of the Fastlink during its operation. This ‘Fastlink corridor’ is shown in Figures 44.1a-b. As explained in Appendix A14.1, this is only a small part of the overall study area for the air quality assessment, which extends 10km from the proposed scheme. Local air quality impacts outside of the route corridor, as well as total emissions and greenhouse gas emissions, are all addressed in Chapter 55 of Part E of the ES (Air Quality Cumulative Impact Assessment). Air quality Impacts within 500m of the Northern Leg and Southern Leg are addressed in Chapters 14 and 29 respectively. Air quality impacts during the construction phase are addressed in Chapter 48 (Disruption due to Construction).

44.2.2 The recommended approach to Stage 1 and 2 DMRB assessments is to assess air quality within 200m of all roads with significantly affected traffic flows (not just within 200m of the proposed scheme itself). This requirement does not apply to a Stage 3 assessment, and in this case a detailed dispersion model has been used that encompasses a wider study area that extends 10km from the proposed scheme. Results from the model are presented separately for the Northern Leg, Southern Leg and Fastlink sections of the proposed scheme in order to highlight the impacts that the proposed scheme will have on residents living close to the proposed route. To retain consistency with other sections of this ES, these corridors extend 500m to either side of the scheme. Impacts across the whole study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Policy Context

44.2.3 The air quality assessment has been carried out in accordance with the DMRB Volume 11, Section 3, 2003 and with reference to the following documents:

- The Environment Act 1995, Part IV;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum, 2003;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: A consultation document for further improvements in air quality, 2006;
- The Air Quality (Scotland) Regulations 2000; and
- The Air Quality (Scotland) Amendment Regulations 2002.

44.2.4 During May 2007, the Highways Agency published Advice Note HA 207/07 (Highways Agency, 2007), which supersedes Volume 11, Section 3, Part 1 of the DMRB (Highways Agency, 2003). The assessment reported in this chapter was carried out prior to May 2007 and thus references the previous publication. It is considered that if this assessment were to be carried out following the May 2007 guidance, the conclusions would be unaltered. Reference has also been made to Interim Advice Note 61/05 Highways Agency (2005), which has been issued as a supplement to DMRB Volume 11.3 (IAN 61/05 is now incorporated within Advice Note 207/07 (Highways Agency, 2007)). The implications of the above documents in terms of this air quality assessment are outlined below.

<u>Local Air Quality</u>

44.2.5 The significance of both existing and future pollutant concentrations is best assessed by reference to the national air quality standards and objectives, established by the Government to protect human health. The ‘standards’ are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The ‘objectives’ set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. The objectives are prescribed within the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) Amendment Regulations 2002. The objectives for nitrogen dioxide were to be achieved by 2005 and will continue to apply in each subsequent year. The current objectives for PM_{10} were to be achieved by 2004 and will continue to apply in each subsequent year. The current PM_{10} objectives are, however, supplemented by a set of more stringent objectives to be applied from 2010 onward. A summary of these objectives is provided in Table 44.1. Patterns across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than $60\mu g/m^3$ (Laxen and Marner, 2003). Therefore, 1-hour mean nitrogen dioxide concentrations will only be considered in this assessment if the annual mean concentration is likely to be above this level.

44.2.6 The European Union has also set limit values for both nitrogen dioxide and PM_{10} and the UK has a legal obligation to meet these limits nationally. The EU limit value for nitrogen dioxide is the same level as the UK objective but is to be achieved by the later date of 2010. The EU limit values for PM_{10} are the same level as the 2004 UK objectives, and had to be achieved by 2005. Thus, assessing against the nitrogen dioxide and PM_{10} objectives for Scotland as set out in Table 44.1, provides the most stringent approach.

Table 44.1 – Air Quality Objectives for Pollutants Relevant to this Scheme, as Defined in the Air Quality (Scotland) Regulations 2000 and Amendment Regulations 2002

Pollutant	Air Quality Objective		Strategy Compliance Date
	Concentration $\mu g/m^3$	Measured as:	
Nitrogen dioxide (NO_2)	200	1 hour mean; not to be exceeded more than 18 times per year	31 December 2005
	40	Annual mean	31 December 2005
Particles (PM_{10}) (gravimetric)	50	24 hour mean; not to be exceeded more than 35 times per year	31 December 2004
	40	Annual mean	31 December 2004
	50	24 hour mean; not to be exceeded more than 7 times per year	31 December 2010
	18	Annual mean	31 December 2010

44.2.7 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000 and its 2003 Addendum set out how different sectors can contribute to achieving the air quality objectives. Local Authorities are seen to play a particularly important role, and must each carry out a review and assessment of air quality in their area in order to identify whether the objectives will be achieved by the relevant date. If this is not expected to be the case, the Authority must declare an Air Quality Management Area (AQMA), and prepare an action plan for improvements in air quality. The AQMA can be larger than the area of exceedence if the Local Authority believes that this is beneficial.

44.2.8 The air quality objectives only apply at locations where members of the public are likely to be exposed to air pollution for the time period specified in the objective. Thus, for the annual mean and 24-hour objectives that are the focus of this assessment, the primary receptors will be residential properties. However, in order to ensure that all potentially sensitive locations were accounted for, the review of the Fastlink corridor also included a search for any sensitive non-residential receptors such as schools.

<u>Air Quality Impacts on Vegetation</u>

44.2.9 There is evidence that elevated concentrations of NOx can damage particularly sensitive vegetation. In addition, there is evidence that the deposition of reactive nitrogen from the air can damage certain habitats. Critical levels have been defined to prevent gaseous pollutants directly affecting plants. Defra (2001) defines a critical level as '*the concentration of a pollutant in the atmosphere, below which vegetation is unlikely to be damaged according to present knowledge*'. In addition to the critical levels, critical loads have been defined to prevent the long-term effects of deposition. Defra (2001) defines critical loads as '*the amount of pollutant deposited below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge*'.

44.2.10 In the UK, the statutory nature conservation agencies use a critical level for NOx of $30\mu g/m^3$ at internationally designated conservation sites and SSSIs. The same level is also set as an EU Limit Value, which only applies more than 20km from towns with more than 250,000 inhabitants or more than 5km from other built-up areas. The critical loads are specific to different types of habitat.

Assessment Criteria

44.2.11 As described in Chapter 5 (Overview of Assessment Process), impact significance has been determined with respect to the sensitivity of the baseline conditions and the magnitude of potential impact.

44.2.12 There is no official guidance for the UK on defining air quality impact magnitude and significance, and the criteria used in this assessment, and described below, are ultimately based on professional judgement. They are, however, the same as those defined by the Irish National Roads Authority in its Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (NRA, 2006) and are presented as an example in the Planning for Air Quality guidance prepared by the National Society for Clean Air and Environmental Protection (NSCA, 2006).

Sensitivity

44.2.13 In terms of the sensitivity criteria generally used within the ES (i.e. low, medium and high), all of the sensitive receptors at which air quality has been assessed are judged to be of high sensitivity. This is because the air quality objectives protect the health of all members of the public, and because in terms of ecosystem effects, the UK statutory nature conservation agencies treat all relevant SSSIs and other officially designated sites as sensitive.

Impact Magnitude

44.2.14 The definition of impact magnitude is solely related to the degree of change in pollutant concentrations. The impact magnitude criteria are provided in Table 44.2.

able 44.2 – Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude	**Increase/decrease**	
	Annual Mean NO_2 / PM_{10}	**Days PM_{10} >50 $\mu g/m^3$**
very large	> 25%	> 25 days
large	15-25%	15-25 days
medium	10-15%	10-15 days
small	5-10%	5-10 days
very small	1-5%	1-5 days
extremely small	<1%	increase/decrease <1 day

Impact Significance

44.2.15 Impact significance takes account of the impact magnitude and also of the absolute concentrations and how they relate to the air quality objectives or other relevant standards. The impact significance criteria defined in Table 44.3 are consistent with the terminology generally used within the ES except that the additional category of 'Very Substantial' has been added. This criterion is commonly used in air quality assessments (e.g. NRA, 2006) to describe large or very large changes where an air quality objective would be breached.

Table 44.3 – Air Quality Impact Significance Criteria

Absolute Concentration in Relation to Objective	Magnitude of Impact (Change in Concentration)					
	extremely small	very small	small	medium	large	very large
Decrease With Scheme						
Above Objective With Scheme	Slight beneficial	Slight beneficial	Substantial beneficial	Substantial beneficial	Very Substantial beneficial	Very Substantial beneficial
Above Objective Without Scheme and Below Objective With Scheme	Slight beneficial	Moderate beneficial	Substantial beneficial	Substantial beneficial	Very Substantial beneficial	Very Substantial beneficial
Below (but not well below) Objective Without Scheme	Negligible beneficial	Slight beneficial	Slight beneficial	Moderate beneficial	Moderate beneficial	Substantial beneficial
Well Below Objective Without Scheme	Negligible beneficial	Negligible beneficial	Slight beneficial	Slight beneficial	Slight beneficial	Moderate beneficial
Increase With Proposed Scheme						
Above Objective Without Scheme	Slight adverse	Slight adverse	Substantial adverse	Substantial adverse	Very Substantial adverse	Very Substantial adverse
Below Objective Without Scheme and Above Objective With Scheme	Slight adverse	Moderate adverse	Substantial adverse	Substantial adverse	Very Substantial adverse	Very Substantial adverse
Below (but not well below) Objective With Scheme	Negligible adverse	Slight adverse	Slight adverse	Moderate adverse	Moderate adverse	Substantial adverse
Well Below Objective With Scheme	Negligible adverse	Negligible adverse	Slight adverse	Slight adverse	Slight adverse	Moderate adverse

Note: *Below Objective* = *>75% of the objective level*
Well Below Objective = *<75% of the objective level*

Assessment Methods

Local Air Quality

44.2.16 Air quality monitoring methods and collated data are summarised in this chapter, with further technical detail provided in Appendix A14.1.

44.2.17 Information on the existing levels of nitrogen dioxide within the overall air quality study area (as defined in paragraph 44.2.1) has been obtained from direct measurements made over a 12 month period using passive diffusion tubes at the 17 monitoring sites shown on Figure A14.1. Away from roads, baseline annual mean concentrations will be spatially uniform and thus, even though no measurements were made within the Fastlink corridor itself, the measurements made elsewhere in the study area provide a very good indication of concentrations in the Fastlink corridor. Diffusion tube data recorded have been corrected for laboratory bias as per guidance from Defra and the Devolved Administrations (DAs), as explained in full in Appendix A14.1.

44.2.18 The results of the passive diffusion tube monitoring have been supplemented with results of measurements made by Aberdeen City Council and Aberdeenshire Council, as part of on-going monitoring programmes. All of these measurements were made outside of the Fastlink corridor. As explained in Appendix A14.1, the monitoring data provided by the Councils were the most recent available at the time this assessment was undertaken.

44.2.19 DMRB Volume 11.3 recommends that if a scheme is likely to give rise to significant impacts, the Stage 3 Assessment should involve detailed dispersion modelling. As the proposed scheme described in Chapter 4 (The Proposed Scheme) is likely to influence a very large area, some of which has been designated as an AQMA, detailed dispersion modelling has been undertaken.

44.2.20 Dispersion calculations were performed using the AAQuIRE model (described in detail at www.fabermaunsell.com), which is one of the models accepted by Defra and the DAs (2006b) for use in air quality review and assessment, and which is suitable for use in DMRB Stage 3 air quality assessments. The road-transport component of this model is based around the internationally validated CALINE model. The meteorological data required for modelling pollutant dispersion were taken from the Meteorological Office site at Dyce Airport, which is located within the overall study area and is thus ideally suited for this purpose. When modelling began, hourly data for 2005 were the most recent available and were therefore the most appropriate for use in this assessment.

44.2.21 The traffic data used in the air quality assessment were supplied by MVA. This is explained in more detail in Section 4.5 of Chapter 4 (The Proposed Scheme), and Section 5.3 of Chapter 5 (Overview of Assessment Process). The future-year traffic data have been provided for the year 2012, but have been entered into the dispersion model assuming the year is 2011. Because of anticipated trends in traffic volumes and vehicle emissions, this is a worst-case approach.

44.2.22 All of the roads contained within the traffic model that are within 10km of the proposed scheme have been entered into every run of the dispersion model. Thus, emissions outside of the Fastlink corridor are taken into account when predicting concentrations. MVA advised that some of the baseline traffic flows on roads in Aberdeenshire may have been under predicted, but this will not have occurred within the Fastlink corridor and is not significant.

44.2.23 The model has been verified and calibrated against the full set of local measurements from both the study-specific passive diffusion tube monitoring and the measurements provided by Aberdeen City Council, as described in Appendix A14.1. The measurements provided by Aberdeenshire Council have not been used to verify the model because of the potential for under prediction of baseline flows in Aberdeenshire, as discussed above in paragraph 44.2.22.

44.2.24 In order to describe the most significant impacts of the proposed scheme within the Fastlink Corridor, 67 sensitive receptors have been chosen. This selection was based on professional judgement and as shown in Figures 44.1a-b, they represent locations that will experience the full range of scheme-related impacts. Receptors are positioned on the roadside façade of each property. Since air quality has been assessed at such a large number of receptors, numerical results are only presented for a selection of 20 receptors which are labelled as FR1 to FR20 in Figures 44.1a-b. The labelled receptors were chosen to aid description of the results. They include the locations with the largest predicted impacts, as well as other locations that it is helpful to highlight. The results for the other receptors are summarised in Figures as described subsequently. The 24-hour PM_{10} results are not shown in Figures because the annual mean PM_{10} data are more likely to exceed the objectives, and the Figures therefore represent the worst-case scenario. Both the annual mean and the 24-hour PM_{10} results are discussed in the text.

44.2.25 The model requires information on background conditions within the study area. As almost all road traffic in the region has been modelled explicitly (i.e. emissions from each road have been calculated individually), it would be inappropriate to use the national background concentration maps published by Defra and the DAs (2006a) without removing the road-traffic component of these data. The method used to transform the background concentration data is described in Appendix A14.1.

Air Quality Impacts on Vegetation

44.2.26 In accordance with Interim Advice Note (IAN) 61/05 to the DMRB (Highways Agency, 2005), an assessment of potential impacts on vegetation has been carried out. No officially designated sites (i.e. SACs, SPAs, cSPAs, Ramsar sites or SSSIs) were identified within the Fastlink corridor.

44.2.27 There is no requirement in the DMRB to assess impacts of air quality on farming activities. Furthermore, the organic or biodynamic status of farmland is not jeopardised by the presence of a road (see Chapter 37: Land Use). It is, however, recognised that land-owners might be concerned about the potential for traffic-related air pollution to affect farmland. Since there is no set methodology for assessing the potential for such impacts, the pragmatic approach has been taken of treating each organic and biodynamic farm within the Fastlink corridor as if it were a SSSI, SAC, SPA, or Ramsar site. This additional assessment is presented in Appendix A44.1.

Limitations to Assessment

44.2.28 All values presented here are the best possible estimates, but uncertainties in the results might cause over-predictions or under-predictions. All of the measurements presented in Appendix A14.1 have an intrinsic margin of error. Defra and the DAs (2006c) suggest that this is of the order of +/- 20% for diffusion tube data and +/- 10% for automatic measurements. The model results rely on MVA's strategic traffic model and thus any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that during each year, the vehicle fleet within the study area will conform to the national (UK) average composition; it has been assumed the emissions per vehicle conform to the factors published in DMRB 11.3; it has been assumed that wind conditions measured at Dyce airport during 2005 will occur throughout the study area during 2011; and it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. As is explained in Appendix A14.1, an important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, the combined influence of the majority of these uncertainties can be assessed. This comparison is given in Figures A14.7 and A14.9 and Tables 14.1.4 and 14.5.1 of Appendix 14.1. The comparison shows that there is no significant bias in the results and that the model performs consistently well across both built-up urban areas and open rural areas.

44.2.29 The assessment is limited to certain pollutants which have been shown by other assessments to be the pollutants of greatest concern. It does not take account of all chemical species that might be released into the air, but it is considered that impacts associated with other pollutants will be smaller than those associated with the pollutants that have been considered.

44.2.30 The UK Government's Air Quality Expert Group (AQEG) has published a draft report on trends in primary nitrogen dioxide in the UK (AQEG, 2006). This examines evidence that shows that while NOx emissions have fallen in line with predictions made previously, the composition of NOx has, in some urban environments, changed. This may have caused nitrogen dioxide levels at some locations to fall less rapidly than was expected. As is explained in Appendix A14.1, the latest guidance from Defra and the DAs has been followed regarding the relationship between NOx and NO_2, but there is still uncertainty as to whether this relationship will continue to apply in 2011. Any effect is likely to be greatest close to roads in the centre of Aberdeen, especially near to roads with a high proportion of buses, where future baseline concentrations may have been underestimated. The issue of primary nitrogen dioxide would not be expected to alter the comparison between concentrations with and without the proposed scheme. The implications for the conclusions of this assessment are therefore judged to be negligible.

44.2.31 The limitations to the assessment should be borne in mind when considering the results set out in subsequent sections. While the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. Clearly in future years the uncertainties are likely to be greater than they are now. The results are 'best estimates' and are treated as such in the discussion.

44.3 Baseline Conditions

Local Air Quality

44.3.1 Aberdeenshire Council has carried out reviews and assessments of air quality across its area over a number of years. No likely exceedences of any of the air quality objectives have been identified within the Fastlink corridor and thus no AQMAs have been declared within the Fastlink corridor.

<u>Nitrogen Dioxide</u>

44.3.2 The assessment has drawn on an extensive range of measurements made within the overall study area. In terms of air pollution dispersion, the Fastlink corridor is a very small area within the study area and because of the spatial uniformity of concentrations away from roads, it has not been necessary to measure levels within this corridor. All measurements for the whole study area are presented in Appendix A14.1.

44.3.3 Figures 44.1a-b show the annual mean nitrogen dioxide concentrations predicted by the model for each of the 67 sensitive receptors within 500m of the Fastlink in 2005, which are taken to represent the current baseline situation. The results for 20 selected receptors are set out in Table 44.4. The largest predicted nitrogen dioxide concentrations are at the properties adjacent to the A90 at Stonehaven (e.g. Receptors FR1 and FR3 in Table 44.4). Even these are less than half of the objective level. Figures 44.1a-b show that the only predicted concentrations in 2005 greater than 10μg/m^3, i.e. one quarter of the objective level, are adjacent to the A90 and B979 near Stonehaven. Elsewhere within the Fastlink corridor, existing nitrogen dioxide concentrations are expected to be even smaller than this and across much of the corridor are less than 5μg/m^3. In a national context, concentrations such as this are exceptional and are below the limit of detection for diffusion tubes, which are the most frequently used measurement technique (i.e. pollutant concentrations are too small to measure).

44.3.4 Figures 44.2a-b show the predicted annual mean nitrogen dioxide concentrations at all of the receptors in 2011 without the proposed scheme in place. The results for the 20 selected receptors are set out in Table 44.4. As noted in paragraph 44.1.3, ambient concentrations of nitrogen dioxide are expected to fall between 2005 and 2011 because of reduced emissions from road transport and other sectors. The predicted concentrations reflect this change. The largest predicted concentration in 2011 is just 11μg/m^3 (at Receptor FR3) and in most locations (57 of the 67 receptors in Figure 44.2) concentrations are expected to be less than 5μg/m^3.

Table 44.4 – Summary of Predicted Annual Mean Nitrogen Dioxide Concentrations within the Fastlink Corridor without the Proposed Scheme (µg/m^3)

Location	2005	2011
Receptor FR1	14	10
Receptor FR2	11	8
Receptor FR3	15	11
Receptor FR4	10	8
Receptor FR5	8	6
Receptor FR6	9	7
Receptor FR7	5	4
Receptor FR8	5	4
Receptor FR9	4	3
Receptor FR10	4	3
Receptor FR11	4	3
Receptor FR12	4	3
Receptor FR13	4	3
Receptor FR14	4	3
Receptor FR15	5	3
Receptor FR16	5	3
Receptor FR17	4	3
Receptor FR18	4	3
Receptor FR19	4	3
Receptor FR20	4	3
Objective	**40**	**40**

Particulate Matter (PM_{10})

44.3.5 The annual mean is the more stringent of the two PM_{10} averaging periods in terms of road traffic emissions. The PM_{10} Figures therefore present only the annual mean data and not the 24-hour data, as this represents the worst-case scenario or precautionary approach in terms of objective exceedences. The 24-hour data are discussed in the text.

44.3.6 Figures 44.3a-b show the predicted annual mean PM_{10} concentrations at all of the 67 sensitive receptors within the Fastlink corridor in 2005. The results for the 20 selected receptors are set out in Table 44.5. Table 44.5 also sets out the predicted number of exceedences 50µg/m^3 as a 24-hour PM_{10} concentration in 2005. The largest predicted annual mean PM_{10} concentration for 2005 is 13µg/m^3. This would have been experienced at worst-case properties adjacent to the A90 (e.g. Receptor FR1). Away from the A90, existing concentrations for all of the receptors shown in Figures 44.3a-b are expected to range from 10.5 to 11.4ug/m^3, reflecting the spatial uniformity of background PM_{10} concentrations. All of these concentrations are well below the level of the objective and represent exceptionally clean air.

44.3.7 Figures 44.4a-b shows the predicted annual mean PM_{10} concentrations at all of the receptors in 2011 without the proposed scheme in place. The results for the 20 selected receptors are set out in Table 44.5. As noted in paragraph 44.1.3, concentrations of PM_{10} are expected to fall between 2005 and 2011 because of reduced emissions from road transport and other sectors. As a result of these changes, all of the predicted PM_{10} concentrations within the Fastlink corridor fall between 2005 and 2011. This change is not, however, reflected in Figures 44.4 a-b, which are identical to Figures 44.3 a-b (which represent 2005). This is because none of the predicted changes between 2005 and 2011 are sufficient to cause a change from one of the colour bands used in Figures 44.3 a-b and 44.4 a-b to a different colour band. The largest predicted concentration in 2011 is 12 µg/m^3, while the smallest is 10 µg/m^3. It should be noted that the air quality objectives for PM_{10} in

Scotland will be more stringent in 2011 than in 2005. All of the predicted concentrations are well below both objectives.

44.3.8 There are no predicted exceedences of 50µg/m^3 as a 24-hour PM_{10} concentration at any location within the corridor in either 2005 or 2011. This reflects the very clean air in this environment.

Table 44.5 – Summary of Predicted PM_{10} Concentrations within the Fastlink Corridor without the Proposed Scheme

Location	Annual Mean Concentration (µg/m^3)		No Days > 50 µg/m^3	
	2005	2011	2005	2011
Receptor FR1	13	12	0	0
Receptor FR2	11	11	0	0
Receptor FR3	12	11	0	0
Receptor FR4	11	11	0	0
Receptor FR5	11	10	0	0
Receptor FR6	11	11	0	0
Receptor FR7	11	10	0	0
Receptor FR8	11	10	0	0
Receptor FR9	11	10	0	0
Receptor FR10	11	10	0	0
Receptor FR11	11	10	0	0
Receptor FR12	11	10	0	0
Receptor FR13	11	10	0	0
Receptor FR14	11	10	0	0
Receptor FR15	11	10	0	0
Receptor FR16	11	11	0	0
Receptor FR17	11	10	0	0
Receptor FR18	11	10	0	0
Receptor FR19	11	10	0	0
Receptor FR20	11	10	0	0
Objective	**40**	**18**	**35**	**7**

Note: All results gravimetric equivalent

44.4 Potential Impacts

Local Air Quality

Nitrogen Dioxide

44.4.1 Table 44.6 sets out the annual mean nitrogen dioxide concentrations for 2011 without and with the proposed scheme for the 20 selected receptors, with the 2005 baseline results repeated for ease of comparison. Also shown is the impact magnitude and significance for these 20 selected receptors: defined according to the criteria set out in section 44.2 (Approach and Methods). Figures 44.5a-b show the predicted annual mean nitrogen dioxide concentration in 2011 with the proposed scheme at each of the 67 sensitive receptors. Figures 44.6a-b illustrate the change in annual mean nitrogen dioxide concentrations at each receptor that is attributable to the proposed scheme.

44.4.2 Figures 44.5a-b (which show conditions with the proposed scheme) are identical to Figures 44.2a-b (which show conditions without the proposed scheme). This is because the annual mean nitrogen dioxide concentrations would not change from one to another of the 10µg/m^3 colour bands used within this ES. The changes brought by the proposed scheme are thus best illustrated by Figures 44.6a-b, which show that the impacts would range from Moderate adverse to Moderate beneficial. This is because, as is shown by the results in Table 44.6, concentrations adjacent to the proposed route are expected to increase from 3µg/m^3 up to 10µg/m^3 (e.g. Receptor FR14), while concentrations adjacent to the B979 are expected to fall from 8µg/m^3 down to 5µg/m^3 (e.g. Receptor FR4). The location within the Fastlink corridor where predicted levels are worst without the proposed scheme (Receptor FR3) would remain the worst-case location for nitrogen dioxide levels, even though the proposed scheme would bring about a Negligible beneficial impact.

44.4.3 Figure 44.6 shows that within the Fastlink corridor, more locations would experience an adverse impact than a beneficial impact as a result of the proposed scheme, but concentrations of nitrogen dioxide would remain exceptionally low. A comparison of the number of properties at which improvements and deteriorations in air quality are expected across the entire study area is presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Particulate Matter (PM_{10})

44.4.4 Figures 44.7a-b show the predicted annual mean PM_{10} concentration in 2011 at each of the 67 sensitive receptors within the study area with the proposed scheme. Figures 44.8a-b illustrate the changes in annual mean PM_{10} concentrations at each receptor that are attributable to the proposed scheme. These changes are defined according to the impact magnitude and significance criteria set out in section 44.2 (Approach and Methods). The results for the 20 selected receptors are set out in Table 44.7, with the baseline results repeated for ease of comparison.

44.4.5 Figures 44.7a-b are identical to Figures 44.4a-b. This is because, although concentrations of PM_{10} within the corridor may change as a result of the proposed scheme, the changes are not of a magnitude to alter the colour bands within which the results fall (these bands have been set to coincide with an 18 µg/m^3 objective exceedence and with a concentration that is well below (i.e. <75% of) the objective). The changes brought about by the proposed scheme are thus best described by Figures 44.8a-b, which show that even though the concentrations appear not to change in terms of Figures 44.7a-b, the impacts range from Slight adverse to Slight beneficial. This is because, as is shown by the examples in Table 44.7, concentrations adjacent to the proposed route are expected to increase from 10 µg/m^3 up to 11 g/m^3 (e.g. Receptor FR7) while concentrations adjacent to the B979 are expected to fall from 11µg/m^3 down to 10µg/m^3 (e.g. Receptor FR6). At the receptor where the largest PM_{10} concentration is predicted (Receptor FR1) a Negligible adverse impact is expected.

Table 44.6 – Predicted Annual Mean Nitrogen Dioxide Concentrations at Selected Receptors within the Fastlink Corridor (µg/m^3)

Receptor	2005	2011		Impact Magnitude	Impact Significance
		No Scheme	With Proposed Scheme		
FR1	14	10	11	very small increase	Negligible adverse
FR2	11	8	9	medium increase	Slight adverse
FR3	15	11	11	extremely small decrease	Negligible beneficial
FR4	10	8	5	very large decrease	Moderate beneficial
FR5	8	6	5	large decrease	Slight beneficial
FR6	9	7	5	very large decrease	Moderate beneficial
FR7	5	4	6	very large increase	Moderate adverse
FR8	5	4	7	very large increase	Moderate adverse
FR9	4	3	4	very large increase	Moderate adverse
FR10	4	3	6	very large increase	Moderate adverse
FR11	4	3	6	very large increase	Moderate adverse
FR12	4	3	5	very large increase	Moderate adverse
FR13	4	3	7	very large increase	Moderate adverse
FR14	4	3	10	very large increase	Moderate adverse
FR15	5	3	4	medium increase	Slight adverse
FR16	5	3	5	very large increase	Moderate adverse
FR17	4	3	6	very large increase	Moderate adverse
FR18	4	3	5	very large increase	Moderate adverse
FR19	4	3	4	very large increase	Moderate adverse
FR20	4	3	5	very large increase	Moderate adverse
Objective	**40**	**40**	**40**	**-**	**-**

Note: Impact magnitude descriptors based on unrounded numbers. For example, the predicted concentration at Receptor FR3 in 2011 with no scheme is 11.13 µg/m^3, while the predicted concentration in 2011 with the proposed scheme is 11.08 µg/^{m3}, thus the scheme is expected to bring about an extremely small decrease in concentration at this receptor, even though both numbers round to 11 µg/m^3.

Table 44.7 – Predicted Annual Mean PM_{10} Concentrations at Selected Receptors within the Fastlink Corridor ($\mu g/m^3$)

Receptor	2005	2011		Impact Magnitude	Impact Significance
		No Scheme	With Proposed Scheme		
FR1	13	12	12	extremely small increase	Negligible adverse
FR2	11	11	11	very small increase	Negligible adverse
FR3	12	11	11	extremely small increase	Negligible adverse
FR4	11	11	10	very small decrease	Negligible beneficial
FR5	11	10	10	extremely small decrease	Negligible beneficial
FR6	11	11	10	small decrease	Slight beneficial
FR7	11	10	11	very small increase	Negligible adverse
FR8	11	10	11	small increase	Slight adverse
FR9	11	10	10	very small increase	Negligible adverse
FR10	11	10	11	small increase	Slight adverse
FR11	11	10	11	small increase	Slight adverse
FR12	11	10	11	very small increase	Negligible adverse
FR13	11	10	11	small increase	Slight adverse
FR14	11	10	11	medium increase	Slight adverse
FR15	11	10	10	extremely small increase	Negligible adverse
FR16	11	11	11	very small increase	Negligible adverse
FR17	11	10	11	very small increase	Negligible adverse
FR18	11	10	11	very small increase	Negligible adverse
FR19	11	10	11	very small increase	Negligible adverse
FR20	11	10	11	very small increase	Negligible adverse
Objective	**40**	**18**	**18**	**-**	**-**

Note: All results gravimetric equivalent.

Impact magnitude descriptors based on unrounded numbers, therefore, for example, the change at Receptor FR4 is 4.9% (very small) while the change at Receptor FR6 is 5.1% (small).

44.4.6 Figures 44.8a-b show that within the Fastlink corridor, more locations would experience an adverse impact than a beneficial impact as a result of the proposed scheme. Concentrations would, however, remain well below the objective at all locations. Thus, even adjacent to the proposed road, concentrations of PM_{10} would remain exceptionally low. A comparison of the number of properties at which improvements and deteriorations in air quality are expected across the entire study area is presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

44.4.7 The model results show that without or with the proposed scheme, there would be no exceedences of $50\mu g/m^3$ as a 24-hour mean PM_{10} concentration at any location within the Fastlink corridor. Thus, as is noted above, even with the proposed scheme, air quality in this area would remain very good. These results are not presented in a table, as the numbers are all zero.

44.5 Mitigation

44.5.1 This assessment has not identified any requirement to mitigate air quality impacts other than ensuring the proposed route and realigned side roads are as far from sensitive locations as practicable.

44.6 Residual Impacts

44.6.1 Because the impacts set out above are not considered to require any specific mitigation, the residual effects will be the same as those presented in the section 44.5. These are summarised below.

Local Air Quality

Nitrogen Dioxide

44.6.2 Within 500m of the Fastlink, the impacts of the proposed scheme are expected to range from Moderate adverse to Moderate beneficial. The beneficial impacts would result from reduced traffic flows on existing roads. Most of the adverse impacts would result from the direct effects of emissions from vehicles on the proposed scheme. Annual mean nitrogen dioxide concentrations will be well below the level of the Government's health-based air quality objective with or without the proposed scheme in place. In most locations, even directly adjacent to the proposed route, predicted concentrations are expected to remain less than one quarter of the objective level. In a national context, concentrations such as these are considered to represent very clean air.

44.6.3 More locations are expected to experience adverse air quality impacts than would experience beneficial air quality impacts within the Fastlink corridor. The net impacts on local air quality across the entire study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

Particulate Matter (PM_{10})

44.6.4 The impacts of the proposed scheme are expected to range from Slight adverse to Slight beneficial in terms of annual mean PM_{10} concentrations within 500m of the Fastlink. As with nitrogen dioxide, the beneficial impacts would result from changes to traffic flows on existing roads. Most of the adverse impacts would result from the direct effects of emissions from vehicles on the Fastlink. PM_{10} concentrations in 2011 will be well below the Scottish objectives with or without the proposed scheme in place. In a national context, concentrations such as these are considered to be exceptionally low.

44.6.5 More locations are expected to experience adverse air quality impacts than would experience beneficial air quality impacts within the corridor. The net impacts on local air quality across the entire study area are presented in Chapter 55 (Air Quality Cumulative Impact Assessment).

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