Midland Metro

6.5 Air Quality and Climate Change

6.5.1 Introduction

This section considers the potential effects of the operation of the scheme on air quality and climate change. Short term and construction impacts are considered in *Section 7.5*.

At a local level, the scheme has minimal emissions to air. However, emissions are associated with the generation of electricity used to power vehicles, which occur outside the immediate vicinity of the proposed alignment.

The operation of the scheme may also give rise to changes in traffic flows, and hence, changes in emissions from road vehicles. These changes may be positive, for instance where there is a modal shift from private cars to Midland Metro, or negative, where the scheme results in congestion on roads carrying the tram.

6.5.2 Assessment Methodology

The assessment of impacts considers the existing air quality in the area by comparing measured concentrations with health based air quality criteria. This provides a basis for any changes in air quality, and helps to put these changes into context. Operational effects are considered by estimating pollutant concentrations at receptors near a selection of roads that are predicted to have the largest change in traffic flows as a result of the scheme.

In undertaking the assessment, the following sources of information have been utilised:

- baseline air quality data obtained from the Automatic Urban and Rural Network (AURN) and the UK Nitrogen Dioxide Diffusion Tube Network, centrally managed by the National Environmental Technology Centre (NETCEN) at AEA Technology;
- Sandwell MBC and Dudley MBC Review and Assessment of Air Quality Reports;
- Ordnance Survey maps of the local area; and
- information relating to the design of the proposed scheme.

The TA ([27]) conducted as part of the scheme has indicated that the reduction in vehicle journey length will be 410 km (approximately 0.2%compared to the baseline).

A critical level of 10 percent change in vehicle flow is defined by the former DTLR ([28]) as a useful indicator for potentially significant changes in air quality.

Consequently, a scheme that changes traffic flows by less than 10 percent can usually be scoped out, unless there are particular sensitivities (eg traffic queuing). For the purpose of this EIA, assessments following the methodology outlined in the Design Manual for Road and Bridges ([29]) (DMRB) have been carried out at sensitive receptors close to the road network, where predicted changes brought about by the scheme are greater than 10 percent.

In addition to local air quality issues, a quantitative assessment of the emissions of carbon dioxide (CO_2), a gas with potential for global warming, from the source of the electricity used to power the scheme has been carried out. This has been compared to the reduction in road vehicle emissions arising from a modal shift to the scheme.

6.5.3 Assessment Criteria

Table 6.17 describes the air quality standards and objectives for the pollutants assessed in this study.

Table 6.17 Summary of the Health-Based Air Quality Objectives in The Air Quality (England) Regulations 2000[1] and The Air Quality Limit Values Regulations 2001[2].

Pollutant	Concentration	Measured as	Date to be achieved by
Nitrogen dioxide (NO_2)	200 µg m^{-3}	1 hour mean not to be exceeded more than 18 times a year (99.79%ile)	Dec 31, 2005
	40 µg m^{-3}	Annual mean	Dec 31, 2005
Sulphur dioxide (SO_2)	266 µg m^{-3}	15 minute mean not to be exceeded more than 35 times a year (99.90%ile)	Dec 31, 2005
	350 µg m^{-3}	1 hour mean not to be exceeded more than 24 times a year (99.73%ile)	Dec 31, 2004

	125 µg m^{-3}	24 hour mean not to be exceeded more than 3 times a year (99.18%ile)	Dec 31, 2004
	50 µg m^{-3}	WHO annual mean[3]	Current
Carbon monoxide (CO)	11.6 mg m^{-3}	Running 8 hour mean	Dec 31, 2003
Lead	0.5 µg m^{-3}	Annual mean	Dec 31, 2004
	0.25 µg m^{-3}	Annual mean	Dec 31, 2008
Benzene	16.25 µg m^{-3}	Running annual mean	Dec 31, 2003
	5 µg m^{-3}	Annual mean	Dec 31, 2010
1,3-Butadiene	2.25 µg m^{-3}	Running annual mean	Dec 31, 2003
Particulate Matter (PM_{10})	50 µg m^{-3}	24 hour mean not to be exceeded more than 35 times a year (90.41%ile)	Dec 31, 2004
		24 hour mean not to be exceeded more than 7 times a year (98.08%ile)	Dec 31, 2010
	40 µg m^{-3}	Annual mean	Dec 31, 2004
	20 µg m^{-3}	Annual mean	Dec 31, 2010

(1)Statutory Instrument 2000 No. 928. The Air Quality (England) Regulations 2000. H.M. Government, London.

(2) Statutory Instrument 2001 No. 2315. The Air Quality Limit Values Regulations 2001. H.M. Government, London. Obtained from: www.legislation.hmso.gov.uk/si/si2001/20012315.htm.

(3) Not included in the Regulations. Source: Air Quality Guidelines for Europe. Second Edition. WHO Regional Publications, European Series, No. 91. WHO Regional Office for Europe, Copenhagen.

NB: Objectives for the protection of vegetation and ecosystems and defined in (2) have not been included in this *Table*, as these objectives are not applicable in urban areas.

6.5.4 Local Authority Review and Assessment of Air Quality

Sandwell MBC and Dudley MBC have recently undertaken a review and assessment of air quality within their districts. This has been done in conjunction with the other metropolitan district councils in the West Midlands conurbation, and has been conducted as a result of a statutory requirement of the Environment Act 1995. Local authorities are required to review the quality of air within their areas and assess it against the relevant air quality objectives. These objectives are defined in the Air Quality Regulations 2000 ([30]).

Since the completion of the Stage 3 Review and Assessment Sandwell MBC have declared six AQMAs within their Borough. Dudley MBC are currently evaluating the need for an AQMA.

Figure 6.2 below shows the AQMA designations in the area.

Figure 6.2 AQMA Designations for the Sandwell and Dudley Area

The Sandwell MBC Air Quality Review and Assessment Report ([31]) and the Dudley Air Pollution Report 2000 ([32]) conclude that levels of the seven

pollutants defined in the Air Quality (England) Regulations 2000 are not likely to result in an exceedence of the air quality objectives by the relevant dates – 2003 to 2010. The reports state that concentrations of all the pollutants, with the exception of nitrogen dioxide (NO_2) measured as an annual mean, already meet the air quality objectives. Although the annual average objective for NO_2 concentrations is exceeded at present next to busy roads, the reports forecast that existing trends and national policies are likely to lead to the objective being met at all locations by 2005.

Figure 6.3 below indicates that all areas in Sandwell and Dudley are expected to be below 36 µg m^{-3} by the end of 2005, which is below the objective concentration of 40 µg m^{-3}.

Figure 6.3 Modelled Annual Average NO_2 Concentrations for 2005 in Sandwell and Dudley.

Source: Review and Assessment of Air Quality in Sandwell, Stage 3: An Assessment of Air Quality for 1999 and Onwards to 2005, Birmingham City Council, 2000. Obtained from www.sandwell.gov.uk.

6.5.5 Baseline Conditions

Overview

Pollutant concentrations have been monitored at a number of sites within or close to the study area. Measurements have been made using automatic 'on-line' analysers or passive diffusion tubes. For the purposes of this assessment, only NO_2 and PM_{10} will be considered further, as these are the only pollutants that have a possibility of exceeding any air quality standard or objective in the study area.

Automatic Monitoring Sites

Only one site within Sandwell and Dudley, Sandwell Centre, currently operates as part of the Department of the Environment, Food and Rural Affairs (DEFRA) Automatic Urban and Rural (AURN). The data from this site is archived in the National Air Quality Information Archive ([33]) run by the National Environmental Technology Centre (NETCEN). The data from one other DEFRA site, which ceased monitoring in 1998, has also been detailed in this report. There are three other automatic monitoring sites in Sandwell and Dudley operated by the local authorities.

Details of all these monitoring sites are shown in *Table 6.18* below.

Table 6.18 Automatic Static (non-mobile) Air Quality Monitoring Stations in Sandwell and Dudley

Site	Site Type	Location	Pollutants Measured	Data Held By
Sandwell Centre (Sandwell West Bromwich)	Urban centre	Council Offices, West Bromwich	CO, NO_x, NO, O_3, SO_2, $PM_{2.5}$	NETCEN
Sandwell Oldbury	Urban background	No address details held. Monitoring finished 1998.	CO, NO, NO_2, NO_x, O_3, SO_2	NETCEN
Sandwell 1	Urban residential	Doulton Road, Rowley Regis	CO, NO_x, NO, SO_2, $PM_{2.5}$	Sandwell MBC
Sandwell 2	Mixed urban/ residential/ industrial	Greenside Way, Yew Tree	NO_x, NO, SO_2, $PM_{2.5}$	Sandwell MBC
Dudley Centre	Urban centre	Ednam Road, Dudley	CO, NO, NO_x, PM_{10}, O_3, SO_2	Dudley MBC

6.5.6 Nitrogen Dioxide

Table 6.19 below presents the results from the last four years of the automatic monitoring of NO_2 from the two sites in the study area that form part of the AURN. The Sandwell Centre site recorded concentrations below the relevant assessment criteria, with the exception of an exceedence of the annual mean NO_2 objective concentration for 1998. Concentrations since then have been significantly below the objective concentration. Monitoring at Sandwell Oldbury ceased in 1998, and the latest annual concentration recorded was below the objective. It is likely that, as has been the case for the Sandwell Centre site, concentrations have fallen in this location since 1998. NO_2 concentrations measured at Dudley Centre in 2001 are available on the Dudley website ([34]) and have been reproduced in *Table 6.19*. With respect to the short term average objective, there were no exceedences of the objective concentration in any of the years presented in *Table 6.19* (the objective allows for 18 exceedences per year).

Due to the predicted success of cleaner fuels and technology in vehicles, concentrations are not expected to rise in the period to 2005. Based on

the methodology as defined in DEFRA guidance, concentrations in 2005 at both sites are expected to be significantly below the objective.

Table 6.19 Measured Nitrogen Dioxide Concentrations (µg m^{-3}) at AURN Sites in Sandwell and Dudley and Predicted Concentrations for 2005.

Monitoring Site	Year	Annual mean	No of 1-hour means >200 µg m^{-3}
Sandwell Centre	1998	44	0
	1999	34	0
	2000	32	0
	2001	34	0
	2005	*30(a)*	*(b)*
Sandwell Oldbury	1997	40	0
	1998(c)	36	0
	2005	*29(a)*	*(b)*
Dudley Centre	2001	31	0
	2005	27(a)	(b)
Assessment Criterion		*40*	*18*

(a) DEFRA guidance (TG4.00) provides the following correction factors, to be applied to monitoring data from 2001, to allow the correction of measurement data to 2005: Annual mean background concentration in 2001 x (0.74/0.84) = 2005 concentration; and Annual mean background concentration in 1998 x (0.74/0.93) = 2005 concentration. For this Table, the correction factor for the intermediate/kerbside concentrations has been used as this provides a worst case scenario.

(b) DEFRA guidance (TG4.00) states that provided the area is **not** subject to the influence of local industrial stack emissions, it can be generally assumed that the 99.79 percentile objective is **unlikely to be exceeded** in 2005 if the annual mean objective is not breached (the 99.79 percentile of 1 hour averages is the equivalent to the 18th highest 1 hour value in a year).

(c) Monitoring ceased in 1998.

Diffusion tubes have also been used to measure NO_2 concentrations. Monitoring of NO_2 with diffusion tubes by participants of the UK NO_2 Diffusion Tube Network takes place at urban locations that are defined below.

Roadside: 1-5m from a busy road. Formerly named 'Kerbside'. One site during years up to and including 2000 - two sites from 2001 onwards.

Intermediate: 20-30m from the same or an equivalent road. This category is no longer used, as of December 2000 - one site per local authority in previous years.

Background: >50m from any busy road - two sites per local authority.

Each tube is exposed for a period of one month. The year is divided into 12 pollution 'months', each consisting of four or five whole weeks. Each month begins on a Tuesday, to minimise disruption due to public holidays. Results are averaged over a year to produce an annual average concentration at each site that can then be compared to the annual average objective concentration for NO_2. As the diffusion tubes produce long term average measurements, the results are not suitable for comparison against the short term 1 hour mean objective concentration for NO_2.

The results from the diffusion tube monitoring at UK Diffusion Tube Network sites within Sandwell and Dudley are shown in *Table 6.20* below.

Table 6.20 Measured Annual Mean Nitrogen Dioxide Concentrations using Diffusion Tubes (µg m^{-3}) and Predicted Concentrations in 2005.

Site Name	Site type	1998	1999	2000	2001	*2005*[e]
Dudley 2N	I	32	17	40	(d)	*35*
Dudley 3N	B	19	21	21	19	*17*
Dudley 4N	B	23	(c)	(a)	(a)	*19*
Dudley 5N	K	(a)	53	52	44	*40*
Dudley 6N	B	(a)	25	25	21	*19*
Dudley 7N	K	(a)	(a)	(a)	52	*47*
Sandwell 3N	B	32	(c)	40	34	*30*
Sandwell 5N	K	36	(c)	50	(c)	*44*
Sandwell 6N	I	42	(c)	42	(d)	*37*
Sandwell 7N	B	25	(c)	23	32	*28*
Sandwell 8N	K	(a)	(a)	(a)	48	*44*

(a) No data recorded for this site for this year.

(b) Monitoring commenced 2001.

(c) Less than 6 months of monitoring conducted therefore long term average not calculated for reasons of insufficient statistical validity.

(d) As of December 2000, Intermediate sites are no longer used in the UK Network.

(e) DEFRA guidance (TG4.00) provides correction factors, to be applied to monitoring data from all years to present to allow the correction of measurement data to 2005. Only the correction factor for 2001 has been reproduced here for reasons of brevity. Annual mean **background** concentration in 2001 x (0.74/0.84) = 2005 concentration and Annual mean **intermediate/kerbside** concentration in 2001 x (0.79/0.87) = 2005 concentration. This assessment uses the most recent year for which monitoring data is available for these predictions (generally 2001 but other years where 2001 data was not available).

According to the methodology in the DEFRA guidance ([35]) *Table 6.20* shows that it is likely that none of the diffusion tubes at background and intermediate locations are likely to exceed the annual objective concentration in 2005.

The Air Quality (England) Regulations 2000 state that the objectives are to be achieved in 'relevant locations' (ie where people might reasonably be expected to be located over the relevant averaging period of one year). Therefore, for the purposes of assessing whether an area will meet the objective, kerbside monitoring sites are not generally considered as relevant locations, as they are normally on the kerb of a busy road, where people are unlikely to be located for a period of a whole year. In these locations, the one hour average objective for NO_2 would be more relevant.

6.5.7 Particles (PM_{10})

PM_{10} concentrations have not been measured at either of the two NETCEN run AURN sites in Sandwell and Dudley. Concentrations at the two AURN sites at Birmingham Centre and Birmingham East are presented in *Table 6.21*. Data for 2001 for the Central Dudley Monitoring Site is available on the Dudley website and has been presented in *Table 6.21*.

All of the measured annual mean concentrations were significantly below the objective concentration of 40µg m^{-3}, as an annual mean, to be achieved by the end of 2004. The objective of 20 µg m^{-3}, as an annual mean, to be achieved by 2010 was met in 2001 at Dudley Centre. Achieving the 20 µg m^{-3} objective in Birmingham by 2010 is likely to prove more challenging, although improvement in vehicle technologies, cleaner fuels and construction practices over the next 10 years are expected to lead to significant reductions in local PM_{10} emissions in urban areas of the UK.

The number of short term exceedences of the objective concentration at the Birmingham East monitoring site over the past four years are likely to mean that both of the short term objectives are achieved at this site. At the Birmingham Centre site, the number of exceedences is slightly higher, although as discussed above measures to reduce PM_{10} emissions over the next 10 years are likely to result in reductions in PM_{10} concentrations at this site. Daily PM_{10} concentrations measured at the Dudley Centre Site have only exceeded 50 µg m^{-3} on six occasions. This site is therefore compliant with the objectives for 2004 and 2010.

Table 6.21 Measured PM_{10} Concentrations (mg m^{-3}) at AURN Sites in Birmingham.

	Year	Annual mean[1]	No. of 24 hour means[1] >50 mg m^{-3}
Birmingham Centre	1998	25	13
	1999	24	10
	2000	22	10
	2001	22	10
Birmingham East	1998	20	7
	1999	21	7
	2000	20	4
	2001	22	9
Dudley Centre	2001	19.5	6
Criterion		*40 (by end of 2004)*	*35 (by end of 2004)*
		20 (by end of 2010)	*7 (by end of 2010)*
(1) These annual mean concentrations have been multiplied by 1.3 as recommended by DEFRA guidance (TG4(00), in order to compensate for the use of a TEOM instrument within the AURN. The UK air quality objective concentrations are based upon European Directives that are based upon gravimetric samplers that produce higher readings than a TEOM. The 24 hour mean values were also multiplied by 1.3 to give gravimetric equivalent results.			

6.5.8 Summary of Baseline Conditions

Concentrations of the key pollutants in Sandwell and Dudley are in general below the relevant assessment criteria for the protection of human health. PM_{10} concentrations measured in Dudley meet all relevant standards. The only exception is NO_2 where the annual mean objective is exceeded at several kerbside sites.

6.5.9 Predicted Impacts

Local Air Quality

As discussed in *Section 6.5.1* Midland Metro has no local emissions (the exception being very minor emissions of metal particles through track wear), only emissions at the source of electricity generation. The impact to local air quality comes about from a change in traffic flows due to a modal shift from passenger cars to Midland Metro and any alterations to the traffic network, congestion and restrictions. The TA ([36]) states that the scheme is predicted to cause little impact on traffic flows in the Dudley and Brierley Hill area.

The changes to local air quality are assessed using the Design Manual for Roads and Bridges (DMRB) ([37]), which includes a graphical screening tool that is used to predict pollutant concentrations at sensitive receptors for scenarios both with and without the scheme. The predicted pollutant concentrations are compared against each other and the relevant air quality standards as outlined in the section above.

Four receptors in the Dudley area have been selected for the air quality assessment, since traffic flows on the closest roads to the alignment have changed by at least 10% as a result of Midland Metro.

DMRB Assessment

Baseline traffic data for all of the roads considered in the TA was not available at the time of the assessment. Traffic data for scenarios with and without the scheme (provided by Faber Maunsell) have been used in this assessment. The heavy goods composition of the vehicle fleet within the study area has been assumed to be 8.7%. This is the average HGV percentage within the Dudley Cordon as supplied by Dudley MBC.

Predictions for nitrogen dioxide (NO_2), carbon monoxide (CO), benzene, 1,3-butadiene and particulate matter (PM_{10}) concentrations at sensitive receptors along affected roads have been carried out using the DMRB methodology. The receptors chosen for the assessment all lie in the Brierley Hill area and are listed below:

- Primary School on Mill Street;
- site of former Brier School ([38]);
- St Mary's RC School; and
- 2 Nottingham Way.

These properties lie within 200 m of roads with predicted changes in traffic flows greater than 10%. Other roads in the study area are not predicted to experience changes in traffic greater than 10% and have therefore been scoped out. There are significant decreases in traffic flowing along The Embankment as a result of the proposed scheme although none of the properties within 200 m of this road are residential and they have therefore not been assessed.

The results of the assessment are shown in *Table 6.22* below, where they are also compared with relevant air quality objectives.

Table 6.22 Predicted Pollutant Concentrations at Key Receptors in the Study Area

Receptor	Scenario	Carbon Monoxide Annual Mean Concentration ($\mu g\ m^{-3}$)[(a)]	Nitrogen Dioxide Annual Mean Concentration ($\mu g\ m^{-3}$)	Benzene Running Annual Mean Concentration ($\mu g\ m^{-3}$)	Particulate Matter Annual Mean Concentration ($\mu g\ m^{-3}$)	Particulate Matter Number of days above 50 $\mu g\ m^{-3}$)	1,3-Butadiene Running Annual Mean ($\mu g\ m^{-3}$)
Primary School on Mill Street	2008 Do Nothing	0.21	23.70	0.37	18.61	2	0.13
	2008 With Metro	0.21	23.8	0.37	18.66	2	0.13
Former Brier School, Little Cottage Street	2008 Do Nothing	0.18	21.6	0.34	17.9	1	0.1
	2008 With Metro	0.18	21.5	0.34	17.9	1	0.1
St Mary's RC Primary School	2008 Do Nothing	0.2	23.1	0.36	18.4	2	0.12
	2008 With Metro	0.2	23.0	0.36	18.4	2	0.12
2 Nottingham Way	2008 Do Nothing	0.21	24.4	0.37	18.82	2	0.15
	2008 With Metro	0.21	24.6	0.38	18.9	2	0.16

Assessment Criteria	Not applicable	40	3	50	35	2.25

(a) The current version of the DMRB does not estimate the 8 hour mean carbon monoxide concentration for which there is an objective. There is no objective for the annual mean concentration of carbon monoxide and no solid relationship between the annual mean and the running 8 hour mean. DMRB does however state that if the annual mean carbon dioxide concentration is below 2 mg m^{-3} (which it isn't in this case) then it is unlikely that the short term criteria will be exceeded.

Regional and Global Air Quality

The TA for the scheme has indicated that the reduction in annual vehicle journeys will be 0.2% (192 182 vehicle km to 191 772 vehicle km). Assuming that all the traffic on the network is travelling at 30mph (48 km/h) with an 8.7% HGV concentration, using the DMRB Regional Assessment, the reduction in carbon dioxide emissions is shown in *Table 6.23* below.

Table 6.23 Changes in Carbon Dioxide Emissions from Traffic in the Study Area

Scenario (2008)	**Carbon Dioxide Emissions (tonnes)**
Without Midland Metro	13,220
With Midland Metro	13,191
Change in emissions due to Midland Metro	Decrease of 29

A total annual power consumption of 14000 MWh has been estimated for the Wednesbury to Brierley Hill alignment ([39]) during the operation of the scheme.

Using a factor of 0.43 kg CO_2 per KWh of electricity generated by the National Grid ([40]) this gives a total estimated annual carbon dioxide emission of approximately 6000 tonnes.

6.5.10 Summary of Residual Impacts

The Wednesbury to Brierley Hill scheme is predicted to have a negligible impact on local air quality in the Brierley Hill area.

The majority of the changes in traffic flows as a result of traffic management and redistribution are minimal, with only Mill Hill and Pedmore Road experiencing increases greater than 10%. Sensitive receptors along these two routes (Primary School on Mill Street and 2 Nottingham Way) are predicted to experience negligible increases in pollutant concentrations. It is predicted that there will be a negligible decrease in pollutant concentrations at the former Brier School and St Mary's Roman Catholic School, also identified as potentially sensitive receptors.

In terms of regional and global air quality there is a predicted to be a slight reduction in carbon dioxide emissions from the vehicle fleet travelling within the study area. The annual emissions of carbon dioxide at the source of the electricity generated to power the trams are predicted to be in the region of 6000 tonnes.
