21 Air quality

21.1 Introduction

This section describes the existing air quality conditions, examines the potential effects of the Northern Expressway on those conditions and proposes appropriate management measures.

Motor vehicles emit pollutants such as nitrogen dioxide and carbon monoxide to the atmosphere. The effects of the emissions from vehicles will depend on the traffic volumes and composition, existing air quality levels, the local meteorological conditions, and the distance of sensitive receptors from the roadway.

An air quality assessment was undertaken to determine the effects of the proposed Northern Expressway on the existing air quality of the study area and to determine if any air quality criteria would be exceeded in the future at any sensitive receptors. Air quality effects of the Expressway were raised during the consultation, particularly relating to increased air pollution and the effect on human health, viticultural and horticultural activities.

21.2 Legislation and policy requirements

21.2.1 State

Environment Protection Act 1993

The *Environment Protection Act 1993* addresses air quality issues in South Australia. The Act provides for the development of environment protection policies. Air quality is covered by the *Environment Protection (Air Quality) Policy 1994*. This policy provides for the regulation of industrial pollution and associated source-oriented monitoring and testing where required. However, the policy does not deal specifically with sources of diffuse pollution, such as that caused by motor vehicles.

South Australia has adopted the NEPM (National Environment Protection Measure) guideline limits for air quality through the *Environment Protection Act 1993* and the *National Environment Protection Council (South Australia) Act 1995*. As a result, the NEPM limits provide environmental protection policies under the *Environment Protection Act 1993 (SA)*. Such policies are to be 'taken into account' by the South Australian Environment Protection Authority, in assessing air quality concerns and issues.

National Environment Protection (Ambient Air Quality) Measure

The National Environment Protection (Ambient Air Quality) Measure (Air NEPM) was introduced in 1998 to provide a consistent approach to the measurement of ambient air quality around Australia, with the ultimate aim of providing equivalent protection to all Australians, wherever they live. The Air NEPM established ambient air quality standards for six common pollutants:

- carbon monoxide (CO)
- nitrogen dioxide (NO_2)
- ozone (O_3)
- sulphur dioxide (SO_2)

- particulate matter less than 10 micrometres (µm) in diameter (PM10)
- lead (Pb).

In 2003, a variation was made to the Air NEPM to include particulate matter of less than 2.5 µg/m^3 in diameter (PM2.5).

For carbon monoxide, nitrogen dioxide and fine particles (PM10), the National Environment Protection Council (NEPC) has specified *national environmental protection* standards. For fine particles expressed as PM2.5, the NEPC has specified an *advisory* standard, which does not have a time frame for compliance. For air toxics, NEPC has specified *monitoring investigation levels*, and some further risk assessment should be undertaken if they are exceeded. Table 21.1 outlines the standards and goals for CO, NO_2, PM10 and PM2.5.

Table 21.1
National Environment Protection (Ambient Air Quality) Measure – standards and goals

Pollutant	Averaging time	Maximum concentration as listed in NEPM*	Maximum concentration as µg/m^3*
Carbon monoxide	8-hour	9.0 ppm	10,440
Nitrogen dioxide	1-hour	0.12 ppm	228
	1-year	0.03 ppm	57
Particles as PM10	1-day	50 µg/m^3	50
Particles as PM2.5**	1-day	25 µg/m^3	25
	1-year	8 µg/m^3	8

** NEPM limits are given for two concentration units: ppm (as used in the NEPM reports) and µg/m^3 (as used in air quality modelling).*

*** The standards and goals for 'Particles as PM2.5' are advisory. The National Environment Protection Council has specified this pollutant as a reporting standard that does not have a time frame for compliance.*

21.2.2 National Environment Protection (Air Toxics) Measure

For air toxics, the National Environment Protection Council has specified monitoring investigation levels, and some further risk assessment should be undertaken if they are exceeded. Table 21.2 outlines the NEPM monitoring investigation levels for benzene, PAH (as BaP), formaldehyde, toluene and xylenes.

Table 21.2
National Environment Protection (Air Toxics) Measure – monitoring investigation levels

Pollutant	Averaging time	Maximum concentration as listed in NEPM*	Maximum concentration as µg/m^3*
Benzene	Annual	0.003 ppm	9
PAH (as BaP)	Annual	0.3 ng/m^3	0.0003
Formaldehyde	24-hour	0.04 ppm	49
Toluene	24-hour	1 ppm	3,770
	Annual	0.1 ppm	380
Xylenes	24-hour	0.25 ppm	1,085
	Annual	0.2 ppm	870

** The NEPM limits are given for three concentration units: ppm (as used in the NEPM reports), µg/m^3 (as used in air quality modelling) and ng/m^3.*

21.3 Air quality assessment methodology

The air quality assessment included:

- reviewing concept plans of the Northern Expressway Project and inspecting the route to locate sensitive receptors near the existing and proposed roadways
- analysing traffic information to determine likely traffic volumes and fleet composition for years 2011 and 2021
- determining traffic fleet emission rates for the project for years 2011 and 2021
- selecting appropriate wind files for use in modelling air quality
- determining background air quality for the study area
- calculating peak concentrations of the following constituents using the computer model AusRoads, for the averaging times listed below, for comparison with the NEPM limits:
  - carbon monoxide — 1-hour average
  - nitrogen dioxide — 1-hour average
  - PM10 — 24-hour average
  - PM2.5 — 24-hour average
  - benzene — 1-hour average
  - toluene — 1-hour average
  - formaldehyde — 1-hour average
  - PAH — 1-hour average
  - butadiene — 1-hour average
  - xylenes — 1-hour average
- assessing the implications and preparing a report on the findings and any necessary mitigation measures.

Near-road air quality modelling for the Northern Expressway and the Port Wakefield Road Upgrade was undertaken for the years 2011 and 2021. The emission factors used in this assessment were based on vehicle emission factors provided by the Victorian EPA (Ng 2005), as emission factors for South Australia are yet to be developed. The emission factors used for this study were the most recent available at the time. Emission factors have been developed for the years 2008, 2011 and 2021, and are not available for years 2016 and 2026. Therefore, the years of 2011 and 2021 were used in this assessment.

21.4 Existing air quality

The existing air quality levels in the study area are influenced by the regional land uses such as urban development, agriculture and commercial industry.

Existing air quality levels of the study area have been obtained from a number of sources, including the South Australian EPA's air quality monitoring stations at Gawler and Elizabeth. The Elizabeth monitoring station is located at Elizabeth Downs Primary School, and is not located near industry or heavy transport corridors. As such, the EPA considers this monitoring site representative of background air quality for the

northern suburbs of Adelaide. Where local air quality monitoring data were not available, background levels have been adopted from other studies.

The following section summarises the existing (or background) air quality levels of the study area.

21.4.1 Background air quality

A conservative representation of background air quality was achieved by using, where available, the 90 percentile measured values for the area (i.e. the levels in the atmosphere are lower than the selected background levels for 90% of the time).

It is considered that background air quality in the northern suburbs in 2011 will be much the same as in recent years. There is a trend for reduced emissions per kilometre from vehicles, but this is balanced by growth in the number of vehicles travelling through the region, and further residential and commercial development in the region.

Table 21.3 summarises the background levels adopted for the Northern Expressway. These levels are considered conservative as background levels for the study area which is a semi-rural environment on the outskirts of Adelaide.

21.4.2 Dust during almond harvesting

Almond groves are currently located adjacent to the proposed Northern Expressway. Significant plumes of dust are generated during almond harvesting. The dust contributes to the amounts of particulate matter in the local airshed (i.e. the area or region defined by settlement patterns or geology that results in discrete atmospheric conditions).

The dust plumes may create a road hazard depending on prevailing winds. DTEI will work with the operators of the almond groves to manage any potential safety hazard that may arise.

Table 21.3
Adopted background levels for the Northern Expressway

Substance	Unit	Averaging period	Background level
Nitrogen dioxide	µg/m^3	1-hour	20
	µg/m^3	Annual	8
Carbon monoxide	µg/m^3	8-hour	120
PM10	µg/m^3	24-hour	29
PM2.5	µg/m^3	24-hour	8
	µg/m^3	Annual	4.9
Benzene	µg/m^3	Annual	1
Formaldehyde	µg/m^3	24-hour	6
BaP	µg/m^3	Annual	0.00019
Toluene	µg/m^3	24-hour	8
	µg/m^3	Annual	3
Xylenes	µg/m^3	24-hour	11
	µg/m^3	Annual	2

21.5 Effects of the project on air quality

21.5.1 Near-road air quality modelling methodology

The air quality assessment used the air quality model AusRoads version 1.0 (approved Victorian EPA regulatory near-road model) including project-specific background concentrations for all contaminants; detailed measurements of property boundaries and building locations from project plans and site inspections; projected traffic volumes for each hour of a typical day for the years 2011 and 2021; and the meteorological file for Edinburgh airfield.

Modelling to determine the concentrations of the air contaminants near the Northern Expressway at 2011 (upon opening) and 2021 was carried out using the following information:

- AusRoads model (current version 1.0) as issued by the Victorian EPA
- 1-hour, 8-hour, 24-hour and 1-year averaging times as appropriate
- fleet composition
- fleet emission rates
- traffic volumes
- one year meteorological file for Edinburgh airfield
- background concentrations as listed above
- surface roughness of 0.4 m
- other model parameters to best suit the area.

Land uses on each side of the roadway were identified from aerial photographs and site inspections.

Air quality sensitive receptors

Sensitive receptors can be defined as residences, schools and other non-commercial properties that are permanently occupied by people.

Residential areas that will be adjacent to the edge of the road reservation are the most sensitive land uses from an air quality perspective.

A 25 m wide buffer zone is proposed on either side of the roadway. The Expressway alignment has been chosen and the corridor width set at a minimum of 70 m, so that there will not be any residences, or other sensitive receptors, within 25 m of the edge of the road.

21.5.2 Air quality model predictions for the Northern Expressway

The current approved version of the Victorian EPA regulatory near-road model (AusRoads) was used to predict the effect on air quality of traffic from the proposed Northern Expressway. Due to the range of assumptions in the model, the average modelling accuracy is of the order of +/- 20%.

The AusRoads model predicts the peak concentrations of each contaminant at various distances from the roadway, including the background level. The resulting concentration pattern has been predicted for various sections along the proposed roadway. Highest concentrations are predicted to occur on the

roadway, with concentrations returning to near background levels approximately 100 m from the centre of the road. The decline in concentrations is much the same on each side of the road, but not completely symmetrical due to the local wind patterns coming from different directions.

As noted above, the corridor for the Northern Expressway has been defined to include a buffer zone of 25 m on each side of the roadway. Thus, the pertinent concentration for assessment of air quality effects is the peak level of each contaminant at 25 m from the edge of the roadway.

Table 21.4 lists the predicted peak concentrations of each contaminant at 25 m from the Northern Expressway, for the zone with the highest predicted truck and total vehicle numbers. The table shows that despite the increase in traffic volumes from 2011 to 2021 on the Expressway, the predicted peak concentrations for all parameters at 25 m from the edge of the road will either decrease or remain the same due to improvements in fuel standards and emission standards from vehicles. The modelling also shows that whilst there will be an increase in the concentration of some parameters at 25 m from the roadway in 2011 and 2021, the peak concentrations for all contaminants are lower than the air quality criteria. Thus, it is concluded that the Northern Expressway will not cause adverse air quality effects at any sensitive receptor, because of the 25 m buffer zone.

Table 21.4
Air quality concentrations at 25 m from the edge of the road (µg/m^3)

Substance	Averaging period	Background level (without NExy) 2011	Predicted peak concentration at 25 m (with NExy)		NEPM limits	Will meet NEPM limits at nearest sensitive receptor
			2011	2021		
Nitrogen dioxide	1-hour	20	53	46	228	Yes
	Annual	8	9.2	9.0	57	Yes
Carbon monoxide	8-hour	120	346	304	10,440	Yes
PM10	24-hour	29	30.8	30.2	50	Yes
PM2.5	24-hour	8	9.2	8.9	25	Yes
	Annual	4.9	5.2	5.1	8	Yes
Benzene	Annual	1	1.10	1.06	9	Yes
Formaldehyde	24-hour	6	6.1	6.1	49	Yes
BaP	Annual	0.00019	0.00019	0.00019	0.00030	Yes
Toluene	24-hour	8	8.7	8.4	3,770	Yes
	Annual	3	3.2	3.1	380	Yes
Xylenes	24-hour	11	11.4	11.2	1,085	Yes
	Annual	2	2.1	2.1	870	Yes

21.5.3 Air quality at Main North Road, Angle Vale Road and Heaslip Road

The Northern Expressway will draw traffic from the existing network and hence lead to lower traffic volumes on Main North Road, Angle Vale Road and Heaslip Road. It is predicted that there will be a major reduction in the proportion of heavy vehicles on Angle Vale Road and Heaslip Road, and a small reduction on Main North Road.

The combined effect of the reduction in vehicles numbers and the reduction in the proportion of heavy vehicles will be to decrease the concentrations of air contaminants at receptors near these roads. For

nitrogen dioxide, as an example, the expected reduction in concentrations at 10–20 m from the roadway is as follows:

- Main North Road 30% reduction
- Angle Vale Road 70% reduction
- Heaslip Road 60% reduction.

It is apparent that the Northern Expressway will produce a substantial reduction in near-road concentrations of contaminants and hence an improvement in local air quality adjacent to Main North Road, Angle Vale Road and Heaslip Road.

21.5.4 Air quality effects during construction

The main issues during construction from an air quality perspective are dust and the emission of combustion particles by heavy construction equipment. The latter can be controlled by ensuring the equipment used on the project is fitted with appropriate filters and control systems and is appropriately maintained.

Dust can be more difficult to control, as the rate of erosion of excavated surfaces, stockpiles of soil and recently placed material depends on weather as well as construction practices. A dust management plan for all construction activities and stockpiles and any material handling will be developed and included in the Construction Environmental Management Plan (CEMP).

Real-time dust monitors may be installed and used to identify periods with high dust levels, as a basis for controlling dust effects around sensitive receptors.

21.6 Environmental management

21.6.1 Measures to minimise effects during planning and design

The Northern Expressway road corridor is proposed to be 70 m wide. The chosen alignment provides a buffer of at least 25 m from the edge of the roadway to the nearest sensitive receptor.

21.6.2 Measures to minimise effects during construction

The key air quality issue during construction is the management of dust.

Measures to manage dust effects during construction will be specified in the EMP and include:

- developing the project schedule to minimise the area of cleared land during the drier months of the year when dust generation will be greater
- providing a temporary gravel surface, a temporary seal or watering on haul roads. The frequency of watering should be determined by weather conditions and the character of the soil
- watering exposed areas other than haul roads if they are a source of dust
- ensuring that smooth soil surfaces are deep ripped and left rough and cloddy to reduce wind velocity at the soil surface
- applying dust suppression measures whenever needed

- constructing wind fences as necessary to restrict dust generation at the site.

21.6.3 Measures to minimise effects during operation

The air quality assessment for the Northern Expressway identified that within 25 m of the Expressway, peak concentrations for all contaminants are considerably lower than the NEPM air quality limits. Therefore, measures to minimise air quality effects during operation will not be required.

21.7 Conclusion

The NEPM limits are designed to protect public health. The air quality model predictions for the Northern Expressway have determined that the Northern Expressway will not exceed any of the NEPM limits at the nearest sensitive receptors in 2011 and 2021. All viticultural and horticultural activities will occur further away than the nearest sensitive receiver.