19 Air quality

This chapter assesses the impacts of the proposed upgrade on air quality. More detail is provided in *Working Paper 12 –Air Quality*.

Environmental assessment requirement	Where addressed
> Impacts to sensitive receivers (e.g. Newrybar school);	Section 19.4.2
> Consideration of local meteorological conditions;	Section 19.2
> Impacts to road users and other receivers at the tunnel section;	Section 19.4.3
> Consideration of airborne pollutant impacts on drinking water catchments.	Section 19.4.4

19.1 Assessment approach

The air quality assessment is based on the use of a computer-based dispersion model to predict air pollutant concentrations near selected sections of the road. The assessment considers the major air pollutants arising from motor vehicles (carbon monoxide, nitrogen dioxide and particulate matter) and the likely effect of the proposed upgrade on local air quality.

The assessment included consideration of predicted concentrations of the air pollutants compared to relevant regulatory air quality criteria at the following locations:

- Near surface roads.
- At Newrybar Public School playing fields.
- In the vicinity of the tunnel portals.
- Near sections of road at grade.

The assessment also included qualitative consideration of the potential impacts of:

- Air pollutants upon the drinking water quality.
- Particulate matter pollution on vegetation (including agricultural vegetation).

19.2 Existing environment

19.2.1 Dispersion meteorology

Dispersion models typically require information on temperature, wind speed, wind direction, atmospheric stability class and mixing height. These factors are important for determining the direction and rate at which pollutants will disperse.

There are no known weather stations near the proposed upgrade which can be used to characterise the local wind patterns. The nearest automatic weather station with wind data that could be used for air dispersion modelling is at Ballina Airport, approximately 10 km to the south of the proposed upgrade.

Meteorological conditions in the hills above the escarpment are likely to differ from those experienced at Ballina due to differences in topography. Nevertheless, the Ballina data is likely to contain some broader scale wind patterns of north coast NSW that are common to both areas.

The Ballina wind data shows that, annually, the predominant winds are from the north although winds from the west-southwest are also common. The northerly winds are observed in the summer months, while winds from the west-southwest are in winter. Autumn and spring show a combination of the summer and winter patterns. Calm conditions (winds less than or equal to 0.5 m/s) occur for 12.5 percent of the time at the Ballina site and the annual average wind speed is 3.9 m/s.

In response to community concerns regarding specific conditions in Tinderbox Creek valley, additional site-specific meteorological data for the Tinderbox Creek valley was created using the Commonwealth Scientific and Industrial Research Organisation (CSIRO) prognostic model – The Air Pollution Model (TAPM). The TAPM generated data for Tinderbox Creek valley show some similarities in wind directions to the Ballina Airport data although the wind speeds are higher. Also, the TAPM data show a much lower frequency of calm conditions.

19.2.2 Local climatic conditions

The Bureau of Meteorology collects climatic information from Byron Bay, to the northeast of the proposed upgrade. Temperature data show that February is typically the warmest month with a mean daily maximum of 27.6°C. July is the coldest month with a mean daily minimum of 11.7°C.

Rainfall data collected at Byron Bay show that January is the wettest month with a mean rainfall of 208 mm over 13 rain days. Byron Bay experiences an average of 1,721 mm of rain annually.

19.2.3 Existing air quality

Air quality monitoring has not been carried out along the proposed upgrade. However, monitoring data have been collected by the RTA at the Pacific Highway near Coffs Harbour, These data have been used to provide an estimate of background levels of pollutants, as they represent a similar environment to the area of the proposed upgrade (**Table 19.1**).

Table 19.1 - Background levels of pollutants (Pacific Highway at Coffs Harbour)

Pollutant	Averaging time	Background level	Criteria
Carbon monoxide (CO)	1 hour	1.2 mg/m^3	30 mg/m^3*
	8 hour	0.3 mg/m^3	10 mg/m^3*
Nitrogen dioxide (NO_2)	1 hour	73.8 µg/m^3	246 µg/m^3*
Particulate matter less than 10 µm (PM_{10})	24 hour	37.8 µg/m^3	50 µg/m^3*
Particulate matter less than 10 µm ($PM_{2.5}$)	24 hour	15.4 µg/m^3	25 µg/m^3**

* NSW Department of Environment and Climate Change (DECC) Impact Assessment Criteria

** National Environment Protection (Ambient Air Quality) Measure goal (there are no project goals for $PM_{2.5}$ in NSW)

In summary, all measured levels of pollutants were below their respective air quality goals. These measured values will include emissions from the traffic on the Pacific Highway which will be the major contributor to carbon monoxide and nitrogen dioxide. Particulate matter will have contributions from other sources.

19.3 Air quality impacts during construction

Dust would be generated from earthworks associated with the proposed upgrade. The total amount of dust would depend on the silt and moisture content in the soil and the types of activities being carried out.

The equipment likely to be used on site is described in **Chapter 6**. The major sources of dust would be bulldozers, excavators and wind erosion from the exposed surfaces.

19.4 Air quality impacts during operation

Emission rate estimates were calculated with consideration of predicted traffic flows for 2012 and 2022 and were based on emission rates for passenger cars using petrol, passenger cars using diesel and heavy goods vehicles using diesel. Emissions from traffic on both the proposed upgrade and the existing highway (with no upgrade) were calculated.

19.4.1 Near surface roads

The maximum predicted concentrations of pollutants occur at the kerbside with concentrations declining with distance from the road. Predictions have been made for both the proposed upgrade and the existing highway without the proposed upgrade. The proposed upgrade splits the traffic between two carriageways and therefore results in lower concentrations close to the existing highway. The predicted maximum concentration for kerbside locations along the existing and proposed routes for 2012 and 2022 emission predictions are shown in **Table 19.2** below. These represent the maximum ground level concentrations as a result of the vehicle traffic. The modelled figures indicate the contribution of emissions by vehicles. Total pollutant concentrations at kerbside can be identified by adding the modelled concentrations with the maximum background concentrations (which are also listed in **Table 19.2** and derived from **Table 19.1**.

Table 19.2 - Predicted concentrations of pollutants at kerbside

Pollutant	Maximum ground level concentrations at kerbside					
	2012		2022		Maximum background concentration	Criterion
	Proposed upgrade	Existing highway with no upgrade	Proposed upgrade	Existing highway with no upgrade		
CO (mg/m^3, 1 hour)	1.1	2.1		2.6	1.2	30
NO2 ($\mu g/m^3$, 1 hour)	41.3	81.4	45.4	89.8	73.8	246
PM10 ($\mu g/m^3$, 24 hour)	8.9*	17.4*	8.9*	17.5*	37.8	50
PM2.5 ($\mu g/m^3$, 24 hour)	8.9**	17.4**	8.9**	17.5**	15.4	25

* Adjusted using time adjustment factor of approximately 0.47 to convert 1-hour predictions to 24-hour averages.

** Assuming 100 percent of PM_{10} emissions are $PM_{2.5}$ fraction

All ground level concentrations predicted for the proposed upgrade are less than the existing highway with no upgrade and also less than the relevant criteria. There are some exceedances for the existing highway with no upgrade for PM10 and PM2.5 when added to the maximum background concentrations.

The predicted maximum concentration for locations 10 m from the kerb along the existing and proposed routes for 2012 and 2022 emission predictions are shown in **Table 19.3.**

Table 19.3 - Predicted concentrations of pollutants 10 m from kerbside

Pollutant	Maximum ground level concentrations at 10 m from kerbside					
	2012		2022		Maximum background concentration	Criterion
	Upgrade	No upgrade	Upgrade	No upgrade		
CO (mg/m^3, 1 hour)	0.5	0.8	0.6	0.7	1.2	30
NO2 ($\mu g/m^3$, 1 hour)	31.5	46.7	34.1	50.4	73.8	246
PM10 ($\mu g/m^3$, 24 hour)	4.5*	6.6*	4.5*	6.6*	37.8	50
PM2.5 ($\mu g/m^3$, 24 hour)	4.5**	6.6**	4.5**	6.6**	15.4	25

* Adjusted using time adjustment factor of approximately 0.47 to convert 1-hour predictions to 24-hour averages.

** Assuming 100% of PM10 emissions are PM2.5 fraction

All ground level concentrations predicted for the proposed upgrade at 10 m from the kerb are less than for the existing highway with no upgrade and also less than the DECC criteria when added to the maximum background concentrations.

The above assessment is based on emission rates assuming that the roadway is flat. However, there will be some sections of the route with steeper grade.

There is a substantial increase of carbon monoxide emissions with grade, with up to a ten-fold increase from zero to 6 percent grade. However the predicted concentrations of carbon monoxide are so far below the goal, that even an increase of this size would not cause any exceedances of air quality goals.

The effect of grade on nitrogen dioxide and particulate matter is not as great with two to threefold increase from zero to 6 percent. Again, the predicted concentrations for these pollutants are low and at 10 m from the kerb, there would only be a slight exceedance for particulate matter in the unlikely event that maximum grade coincides with the location for maximum predicted (flat road based) emissions.

19.4.2 Newrybar Public School

The proposed upgrade would approach to within 30 m of the Newrybar Public School playing fields. The school could therefore be regarded as being a worst case in terms of sensitivity of receivers. Based on the results of the modelling of pollutant levels at 10 m from the kerb, anticipated worst-case concentrations of pollutants would not cause significant deterioration of air quality. Air quality criteria would not be exceeded. The low level of impact at Newrybar Public School suggests that no other sensitive receivers would be subject to emissions that exceed criteria.

19.4.3 In the tunnel and near tunnel portals

As was the case with the roadside concentrations, the predicted concentrations near the proposed tunnel portals are substantially below the relevant criteria. The maximum predicted concentrations in the vicinity of the portals are shown in **Table 19.4.**

Table 19.4 - Predicted concentrations of pollutants in the vicinity of the tunnel portals

Pollutant	Maximum ground level concentration	Maximum background concentration	Criterion
CO (mg/m^3, 1 hour)	0.3	1.2	30
NO2 (µg/m^3, 1 hour)	25	73.8	246
PM10 (µg/m^3, 24 hour)	2.4*	2.4*	50

* Adjusted using time adjustment factor of approximately 0.47 to convert 1-hour predictions to 24-hour averages

Under normal operating conditions the 'piston effect' of vehicle induced air flow in each of the unidirectional tunnel bores would provide satisfactory natural ventilation within the tunnel. With a steady natural air flow through a one way tunnel, in the direction of traffic flow, the exhaust emission concentration increase from the tunnel entrance (ambient air or background value) up to a maximum value near the tunnel portal. The highest value inside the tunnel is therefore likely to be close the maximum values shown in **Table 19.4**.

As there is no certain control of air direction or velocity, it is possible that the movement of air in the tunnel could change direction and result in the maximum exhaust concentrations occurring nearer the centre of the tunnel. Natural ventilation cannot be fully relied upon to prevent the build up of unhealthy fumes, obscuration or contamination within the tunnel during still, adverse wind or slow moving traffic conditions.

Consideration of the risk of fires occurring in the tunnel, particularly in respect of smoke control, has identified the need for a number of fire control systems including mechanical ventilation. Longitudinal mechanical ventilation would be provided by jet fans mounted within the tunnel at a limited number of points to create a longitudinal flow of air along the length of the tunnel. The strategy for ventilation within the St Helena tunnel would be to make as much use of natural longitudinal ventilation as possible and supplement this for short periods by jet fans in the event of adverse conditions applying within the tunnel.

19.4.4 Potential effects on drinking water

One of the issues that is sometimes raised as a concern near roadways is the potential impacts of airborne pollution on drinking water. While airborne pollutants can enter water systems directly through deposition from the air or through runoff from soil contaminated with fallout, the levels associated with roadways are generally low.

Australian Drinking Water Guidelines (ADWG) are published by the National Health and Medical Research Council (NHMRC) / Natural Resource Management Ministerial Council (NRMMC) to provide the water supply industry with guidance on what constitutes good quality drinking water. Water suppliers are guided by these criteria in implementing treatment systems. Refer to **Section 5.10.2** and **Chapter 10** for details on water quality treatment for the proposed upgrade.

Lead deposition in the vicinity of roadways has been a potential issue in the past, however lead is no longer in petrol. Polycyclic aromatic hydrocarbons are the other significant motor vehicle emissions (present predominantly in particulate diesel emissions) with the potential to be deposited in the vicinity of roadways. The proposed upgrade is predicted to result a general improvement in air quality due to improved grades and traffic flow and therefore would be very unlikely to result in any deterioration in drinking water quality.

19.4.5 Particulate matter effects on vegetation (including agriculture)

Particulate matter can have a physical and chemical impact on vegetation (including agricultural vegetation). The effect of dust deposited on vegetation depends on the characteristics of the dust, plant species and environmental conditions. Factors important to the deposition rate of particulate matter include ambient concentration, atmospheric condition, aerosol properties, surface roughness and vegetation condition. Impacts on vegetation can include physically smothering the leaves, physically blocking the stomata and an increase in leaf temperature. Critical loads vary with plant function and it is not possible to predict the precise nature of one plant's response from the known response of another.

Doley (2006) examined the physical effects of dust on vegetation and suggested that the most sensitive plant functions may be altered with dust loads of about 8 g/m^2 for dust with medium diameters of 50 µm. The DECC air quality criterion for total dust deposition is 4 g/m^2/month which suggests that compliance with this level would provide protection for the most sensitive plant functions. Compliance with the particulate matter concentration criteria for PM_{10} would typically relate to compliance with the dust deposition criteria, so based on the relatively low PM_{10} concentrations predicted, no adverse air quality impacts on vegetation would be expected.

19.5 Management of impacts

As vehicle emission impacts are effectively managed at source via vehicle fuel standards, vehicle maintenance and emissions testing, no specific operation mitigation measures are proposed.

Air quality management would be incorporated in the overall construction environmental management plan with requirements that include:

- All disturbed areas would be stabilised as soon as practicable to prevent or minimise wind blown dust.
- All unsealed trafficable areas would be kept sufficiently damp during working hours to minimise wind blown or traffic generated dust emissions.
- Water sprays, sprinklers and water carts would be employed if needed to adequately dampen stockpiles, work areas and exposed soils to prevent the emission of dust from the site.
- Stockpiles and handling areas would be maintained in a condition that minimises wind blown or traffic generated dust. Areas that may be inaccessible by water carts would be kept in a condition which minimised wind blown or traffic generated dust using other means.
- All equipment for dust control would be kept in good operating condition. The equipment would be operable at all times with the exception of shutdowns required for maintenance. Construction equipment would be properly maintained to ensure exhaust emissions comply with the *Protection of the Environment Operations Act 1997*.
- Silt would be removed from behind filter fences and other erosion control structures on a regular basis, so that collected silt did not become a source of dust.
- Any dust, soil or mud deposited on public roads associated with construction activities and would be removed immediately and disposed of appropriately.
- Dust monitoring would be carried out during construction to determine the compliance with the Department of Environment and Climate Change dust deposition goals.
- No dust sensitive industries have been identified along the route at this stage, however this would be reviewed prior to construction.