CityLink Tulla Widening
VicRoads
28-Apr-2015

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Air Quality Assessment

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Client: VicRoads

ABN: 61760960480

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

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Quality Information

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Prepared by Adam Plant and Holly Marlin

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A	12-Feb-2015	Draft for internal review	Ben Mahon Senior Planner	
B	12-Mar-2015	Draft for external review	Ben Mahon Senior Planner	
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Executive Summary

The CityLink Tulla Widening (CTW) project seeks to upgrade the M1 and M2, inclusive of sections of the Tullamarine Freeway, CityLink and West Gate Freeway. The study area for this assessment is from the Tulla-Calder Interchange in the north to the Domain / Burnley Tunnels in the south.

The Victorian Environment Protection Authority's State Environment Protection Policy – Air Quality Management (SEPP – AQM) requires the air pollutant impacts of proposed transport corridors, such as roads, to be assessed against the SEPP's Intervention Levels (ILs). The changes in the near-road air pollutant concentration with the up-grading of a road corridor can be assessed against the same criteria. This air quality assessment examined the existing air quality in the area, the local meteorology and considered the likely effect on air quality as a result of emissions during the operational phase of the upgrade.

Near-road air pollution concentrations were determined using the CALINE-based CAL3QHCR road dispersion model (as approved by the Victorian EPA for road assessments) to assess the impact of the changes in vehicle emissions associated with the project for both the current traffic volumes (2014) and those expected in future years (2035). The upgraded road corridor, including entry and exit ramps, was included in the road model, together with the location of receptors adjacent to the corridor and local meteorology. Emission rates were calculated using expected traffic numbers and emission factors provided by the Victorian EPA.

The motor vehicle air pollutants modelled for this assessment were nitrogen dioxide (NO_2), airborne Particulate Matter (as PM_{10}), and carbon monoxide (CO). The background air pollutant concentrations were determined from the annual air monitoring results for the EPA's Footscray monitoring station; this station is the closest station to the Western Link. Annual data for the years 2008 to 2012 were reviewed, and the highest annual 75th percentile concentrations were adopted as the background air pollutant concentrations in the Western Link corridor. The project was assessed in three sections.

The results for Section 1 - Bulla Road to Moreland Road – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

The results for Section 2 - Moreland Road to Dynon Road – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

The results for Section 3 - Dynon Road to the Domain / Burnley tunnels – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

With the introduction of stricter vehicle emissions requirements, the gradual removal of older vehicles from the national fleet, the likely change in vehicle composition towards electric and hybrid cars, the retention / installation of noise barriers along the roadway (which could not be adequately incorporated into the model and are likely to significantly reduce impacts at receptors), and a degree of double counting of the CityLink contribution to the cumulative value by using a background value measured during the current operation of the CityLInk, it is likely that the predictions of the potential impacts on local receptors presented in the assessment are conservative.

The assessment indicates that the operation of the CTW project is not likely to result in pollutant concentrations at local receptors that exceed the SEPP-AQM IL levels for either 2014 or 2035 conditions. No mitigation measures have, therefore, been recommended with regards to the operation of the upgrade.

1.0 Introduction

AECOM was commissioned by VicRoads to assess the potential effects on air quality associated with the proposed widening of CityLink (Western Link) (referred to as CityLink Tulla Widening, or CTW) inclusive of sections of the Tullamarine Freeway, CityLink and West Gate Freeway. For the purposes of the air quality impact assessment, the project was assessed in three sections:

- Bulla Road to Moreland Road;
- Moreland Road to Dynon Road; and
- Dynon Road to the Westgate Freeway Domain/Burnley Tunnels.

The sections are shown in **Figure 1**. The proposed widening will result in changes to traffic volumes and flow patterns along the corridor and in the wider network, with subsequent changes in pollutant emissions. This Air Quality Assessment focused on emissions associated with the operational phase of the project from vehicles using the widened roadway. Concentrations of nitrogen dioxide (NO_2), particulate matter with a diameter less than ten microns (PM_{10}) and carbon monoxide (CO) were predicted at receptor locations adjacent to the Project using the CAL3QHCR dispersion model.

1.1 Scope of Works

The assessment included the following works:

- Review of relevant air quality policy and guidelines;
- Determination of existing background air quality;
- Dispersion modelling of the vehicle emissions predicted from expected traffic conditions for the current roadway (baseline 2014) and the proposed roadway in 2035; and
- Comparison of the prediction near-road concentrations of NO_2, PM_{10} and CO at sensitive receptor locations against Victorian Environment Protection Authority (Vic EPA) criteria.

The near-road concentration of air pollutants is the sum of the background air pollutant concentration and the estimated near-road air pollutant levels resulting from the road development.

Meteorological data used in the dispersion modelling were obtained from the Vic EPA for Footscray for the year 2008. Existing background pollutant concentrations were assumed to represent future background concentrations for the purpose of this assessment.

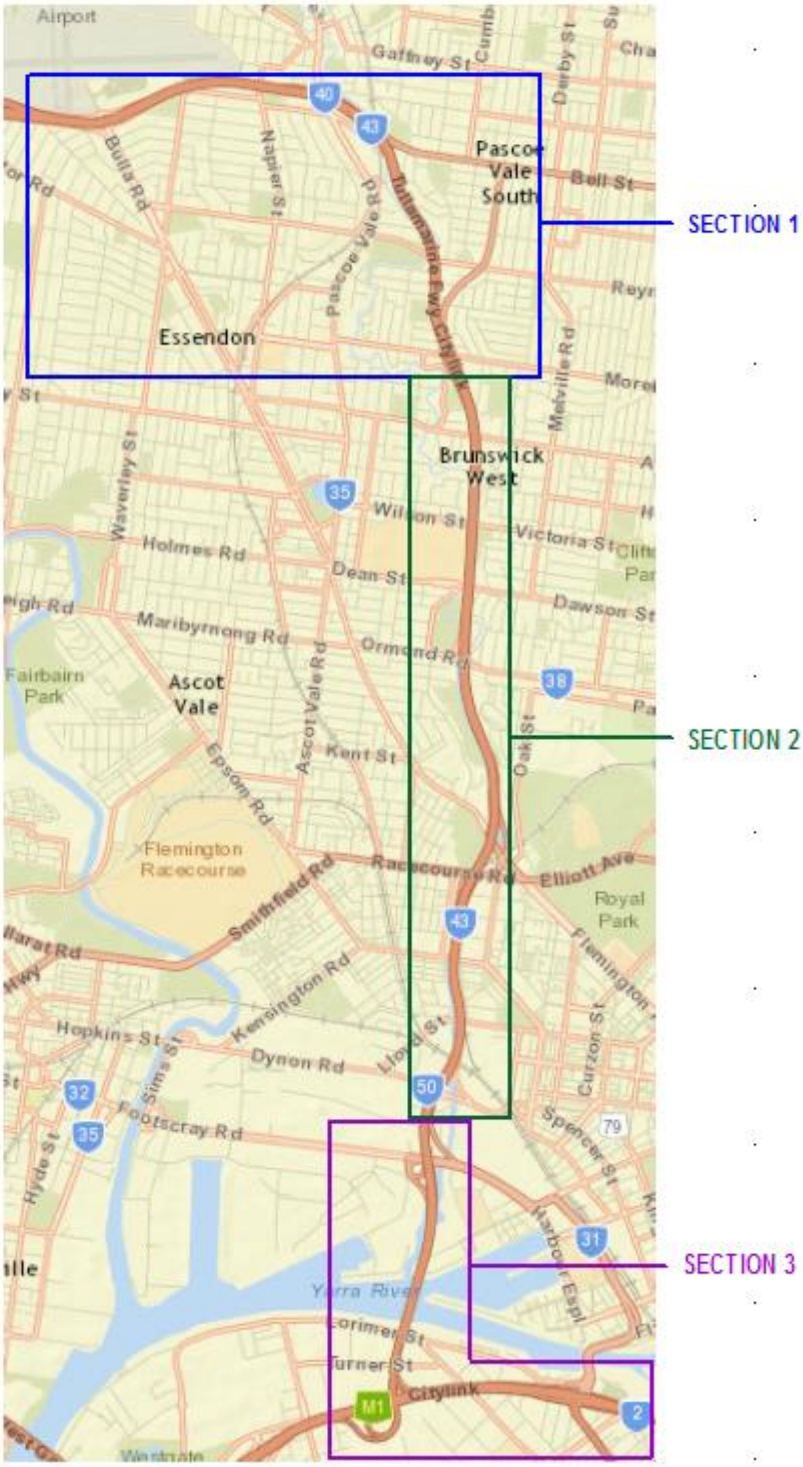


Figure 1 Study Area

2.0 Project Description

The CTW project seeks to upgrade the M1 and M2, inclusive of sections of the Tullamarine Freeway, CityLink and West Gate Freeway. The study area for this assessment is from the Tulla-Calder Interchange in the north to the Domain/Burnley Tunnels in the south.

The scope of works includes the installation of new gantries, signage, safety barriers, line-marking, bridge widening, bridge realignment (Flemington Road) and pavement widening. The majority of the works to deliver additional traffic lanes will be within the existing road pavement, requiring only the remarking of lanes. Where pavement widening occurs, the majority will be within the existing Declared Road boundary / CityLink lease boundary. In several areas, widening outside of the road boundary / CityLink lease boundary will be required.

The works are inclusive of:

- Pavement widening;
- Road barriers;
- Line marking;
- New structures for the Bell Street Ramp, Bell Street Collector Distributor, new Bridge on Mount Alexander Road, realignment, Bolte Bridge to West Gate Freeway entry ramp, and widening of the West Gate Freeway elevated structure west of Montague Street;
- Widening of existing bridges over Moonee Ponds Creek;
- Road signage and traffic management;
- Noise walls;
- Landscaping;
- Drainage works;
- Services relocations;
- Lighting; and
- Intelligent Transport Systems.

Construction of the CTW project is planned to commence in mid-late 2015. Construction is expected to take approximately two years.

3.0 Statutory Context

3.1 State Environment Protection Policy – Air Quality Management

State Environment Protection Policy – Air Quality Management (SEPP – AQM) 2001 specifies the requirements for assessments of development. The SEPP – AQM specifically states that road operations to be assessed, as reproduced below:

> ***40. Management of Large Line and Area-Based Sources of Emissions***
>
> *(1) The Authority will develop protocols for environmental management in accordance with this policy for assessing and managing the impacts of large line and area-based sources of air quality indicators in partnership with relevant Government of Victoria agencies, local government and other stakeholders.*
>
> *(2) These industries include, but are not limited to:*
>
> *(a) mining;*
>
> *(b) quarrying; and*
>
> *(c) road construction and operation.*

Whilst the SEPP - AQM does not address up-graded roads like the CTW project, the criteria in the SEPP can be used as a means of assessing the impacts of this project.

Schedule C of the SEPP – AQM specifies that proposed transport corridors must be assessed using one of the regulatory models for near-road modelling; the relevant text is reproduced below. Until recently the AusRoads model, developed by the Victorian EPA, was the most commonly used model. Advice has been provided to AECOM by the Victorian EPA (letter dated 31 March 2015 and provided in Appendix A) that they no longer provide support for the AusRoads model and are currently reviewing alternative options. As the CAL3QHCR model is widely used in Australia and is the recommended road model by the US EPA, approval has been provided by the Victorian EPA to use the CAL3QHCR model in this assessment. More details of the model are provided in **Section 5.1**.

> ***SEPP AQM, SCHEDULE C, PART D***
>
> ***MODELLING OF EMISSIONS TO AIR FROM PROPOSED TRANSPORT CORRIDORS.***
>
> *1. Proposed transport corridors such as roads must be assessed using one of the regulatory models for near-road modelling.*
>
> *2. A regulatory model for near-road modelling may be modified. However, such modified models may only be used for an assessment after written justification for the modifications has been submitted to and approved in writing by the Authority.*

The SEPP - AQM specifies Intervention Levels (IL), which can be used as criteria for assessing the impacts of a project. The relevant levels for this project are specified in **Table 1**.

Table 1 SEPP – AQM Intervention Levels

Substance	Units	Averaging Time	Intervention Level (IL)
Nitrogen dioxide (NO_2)	ppm	1 hour	0.14
PM_{10}	mg/m^3	24 hour	0.06
Carbon monoxide	ppm	1 hour	29

PM_{10} – particulate matter less than 10 microns
ppm – parts per million
mg/m^3 – milligram per cubic metre

The IL applies to the total pollutant load within an area rather than just a single source. As such, existing background concentrations should be added to concentrations predicted for a particular activity before comparison to the relevant IL.

3.2 Background Pollutant Concentration

Part B of the SEPP – Air Quality Management provides for “Modelling of emissions to air from Stationary Sources”. Schedule C “Modelling emissions to air” of the SEPP- AQM states:

> ***3. Estimate background concentrations and identify any additional local sources of the pollutant.***
>
> *(a) Proponents must include background information in the model simulation, except where the proponent can demonstrate to the satisfaction of the Authority that background levels of the pollutant are not significant.*
>
> *(b) Proponents required to include background data where no appropriate hourly background data exists must add the 70th percentile of one year’s observed hourly concentrations as a constant value to the predicted maximum concentration from the model simulation. In cases where a 24-hour averaging time is used in the model, the background data must be based on 24-hour averages.*
>
> *(c) Proponents for new or modified sources of emissions adjacent to existing sources of the same pollutant must include emissions from the existing sources in the model.*

Due to data availability, the 75th percentile pollutant concentrations were used in this assessment rather than the 70th percentile recommended in the SEPP. The difference between the 75th and 70th percentiles would be small, with the 75th percentile concentration being slightly higher than the 70th percentile data. Using the 75th percentile data for the assessment is, therefore, a conservative approach.

3.3 Pollutant Parameters Investigated

Motor vehicle emissions include a range of pollutants, such as nitrogen dioxide, particulate matter PM_{10}, carbon monoxide and PAHs. The EPA has undertaken ambient monitoring of most of the pollutants for which there is an IL. Pollutants such as toluene, xylenes, formaldehyde, benzene, PAHs, and 1,3-butadiene are not significant in the normal back ground air quality, and are not major motor vehicle emission pollutants.

Motor vehicles are a major source of NO_2 and PM_{10}. These pollutants are monitored at several locations in the Melbourne airshed, and the data are readily available from the EPA. The near-road modelling was undertaken for these pollutants in this assessment of the CTW project.

Carbon monoxide has been monitored at several locations within the Melbourne airshed. The Victorian EPA monitoring system and subsequent reports are designed to assess compliance against the National Environment Protection (Ambient Air Quality) Measure (NEPM), of which CO is reported as an 8 hour average. The regional 8 hour values presented for CO for the past five years are substantially lower than the NEPM goals. Due to the EPA not reporting CO 1 hour data, the low 8 hour values reported, and the expected low contribution from the CTW project, background CO levels were not considered in this assessment. Should the CTW predicted results be elevated, then this assumption would be revisited.

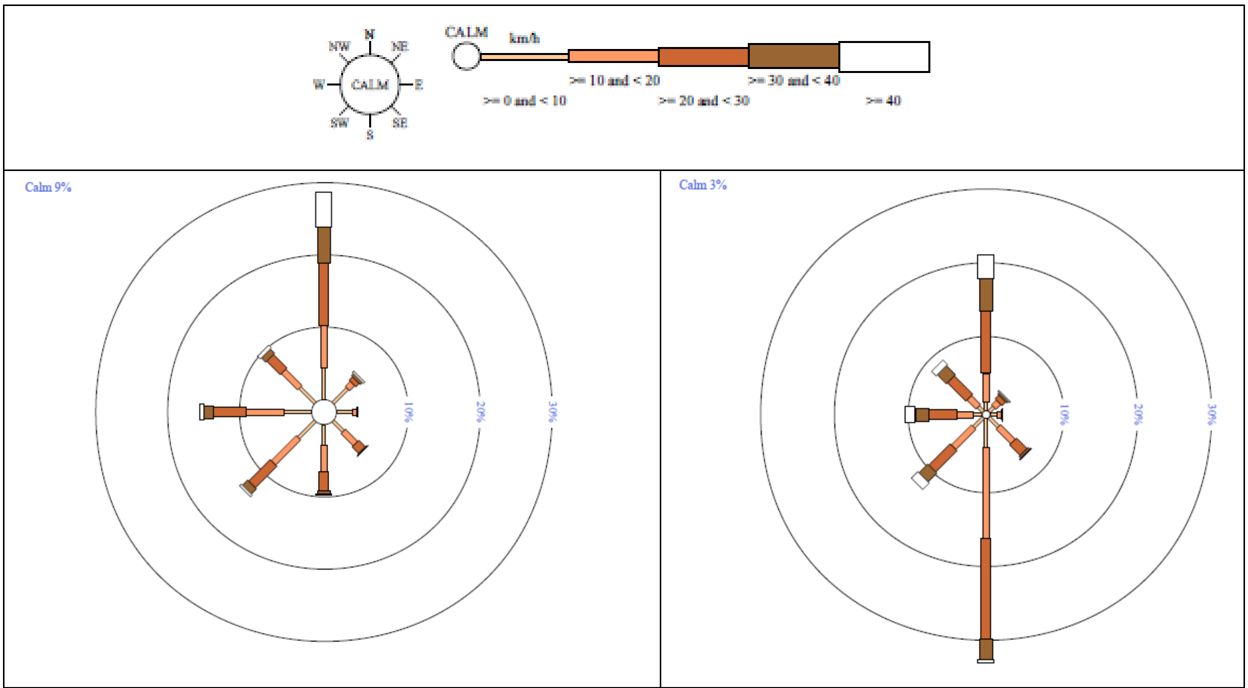
Ambient levels and vehicle emissions of sulfur dioxide (SO_2) are very low and the total pollutant concentration in the atmosphere would not approach 10% of the IL of 0.21 ppm (parts per million) for a 1-hour average. As such, SO_2 was not assessed.

Note that in the later sections of this report, pollutant concentrations are reported in µg/m^3 rather than ppm (NO_2) or mg/m^3 (PM_{10}) to reflect the units used in the model to determine the near-road pollutant concentrations. The NO_2 IL of 0.14 ppm is equivalent to 263 µg/m^3 (at 25 ^{o}C and 1 atmosphere pressure).

4.0 Existing Environment

4.1 Meteorology and Climate

The Bureau of Meteorology operates a monitoring station in the vicinity of the Project at the Essendon Airport. The monitoring station is located approximately 1.2 kilometres northwest of the northern end of the CTW. Wind roses from the Essendon Airport (**Figure 2**) show that winds predominantly blow from the north in the morning, and from both the south and north in the afternoon, where the northerly winds are somewhat less frequent but stronger.



9 am wind rose, Essendon Airport (April 1939 – September 2010)

3 pm wind rose, Essendon Airport (April 1939 – September 2010)

Figure 2 Wind Roses – Essendon Airport (Bureau of Meteorology)

4.2 Background Air Quality

The EPA operates monitoring stations in the Melbourne, Geelong and Latrobe Valley. Other locations are monitored on a less permanent basis depending upon the EPA's monitoring programme. **Figure 3** shows the EPA monitoring stations in metropolitan Melbourne. The nearest EPA air pollution monitoring station to the CWT project with a full complement of air pollution monitoring equipment is located at Footscray. Both PM_{10} and NO_2 have been monitored at Footscray for many years. As discussed above, background CO levels were not considered in this assessment.

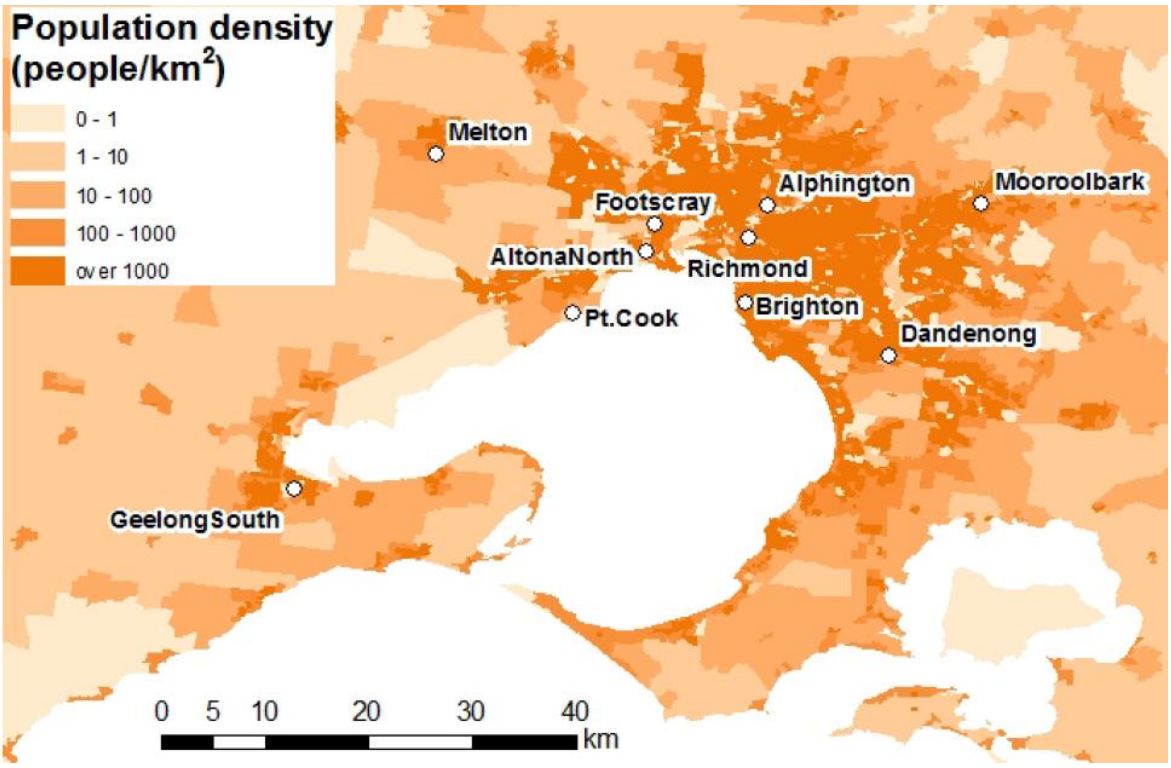


Figure 3 Locations of EPA Air Pollution Monitoring Stations

The 75th percentile pollutant concentrations for 24 hour PM_{10} and 1 hour NO_2 recorded at Footscray between 2008 and 2012 are shown in **Table 2.** The maximums are denoted in bold text.

Table 2 Measured 1 hour NO_2 and 24 Hour PM_{10} Concentrations, Footscray

Year	75th Percentile Concentrations, Footscray	
	1 hour NO_2 (µg/m^3)	24 hour PM_{10} (µg/m^3)
2012	50.7	20.1
2011	50.7	19.9
2010	48.9	20.1
2009	**54.6**	**22.8**
2008	**54.6**	21.8

The background pollutant concentrations used in the CTW project assessment were the highest 75th percentile levels recorded between 2008 and 2012; shown in **Table 3**.

Table 3 Adopted Assessment Criteria

Pollutant	Averaging Period	Adopted Background Pollutant Concentrations (µg/m^3)
PM_{10}	24 hour	22.8
NO_2	1 hour	54.6

5.0 Dispersion Modelling Methodology

5.1 Model

CAL3QHCR is one of the models in the CALINE series of steady-state dispersion models and is the preferred/recommended model for modelling highways by the US EPA[1]. Advice has also been provided to AECOM by the Victorian EPA (per comms 19 Feb 15) that the use of CAL3QHCR is appropriate for use in Victorian road projects. The model has been successfully used for the recent NorthConnex project in NSW (approved by the NSW EPA and Roads and Maritime Services) as well as other projects nationally and globally.

The model is used to determine pollutant concentrations at receptor locations downwind of roads located in relatively uncomplicated terrain. The CAL3QHCR model was considered to be the most appropriate choice for modelling the traffic movements on the Project due to its ability to process hourly-varying data and large numbers of receptors. The line source model predicts pollutant concentrations of NO_2, PM_{10} and CO from idle or moving motor vehicles based on the Gaussian diffusion equation. The model was accessed through the CALRoads View user interface.

Note that the near-road model has limited capacity to model the effects of noise barriers adjacent to Western Link. Various studies undertaken on the effect of noise barriers on the dispersion of near-road air pollutants have shown that the presence of a high noise barrier will reduce the concentration of air pollutants on the residential side of a noise barrier. A report by Hagler (2011) *Model evaluation of roadside barrier impact on near-road air pollution* (further discussed in **Appendix D**) concluded that computer modelling undertaken suggests that solid barriers (loosely represent low-porosity vegetation) significantly reduce maximum and ground-level concentrations downwind of a major roadway relative to an unobstructed flow situation. The modelled results presented in this report are not adjusted for the potential air pollutant concentration reduction offered by noise barriers; the results are therefore conservative and potentially higher than the actual situation.

5.2 Input Data

The data required by the CAL3QHCR program are summarised below and described further in the following sections:

- Road geometry information such as road link end coordinates, lane number, lane width and link type (at grade, depressed, fill, bridge, parking lot).
- Road traffic densities (vehicles/hour) and emission factors (grams/vehicle kilometre travelled).
- A meteorological data file containing hourly meteorological data such as wind speed, direction, mixing depths and so on.
- Receptor locations or points where concentration or deposition is to be calculated (receptors).

Project data are discussed in the following sections, while project assumptions are summarised in **Appendix D.**

5.2.1 Road Links

A total of 420 links were modelled in the assessment. A link is a straight-line segment that may represent an entire road, or a portion of the road that has a break in it (thereby defining a new link segment) due to the presence of a stoplight, an intersection, a bend in the road, or a significant change in the road gradient. Only free-flow traffic was reviewed in this assessment and is reflected in the link selection.

5.2.2 Traffic Volumes and Speeds

Hourly varying traffic volumes were supplied by VicRoads for the year 2014 and forecast traffic volumes for the year 2035 for the main carriageways and entry / exit ramps; a summary of the traffic data used is provided in **Appendix B**. The VicRoads data included the composition of heavy vehicles in the fleet; further notes and assumptions relating to the traffic data are provided in **Section 5.2.3**, and **Appendix D**.

[1] http://www.epa.gov/scram001/dispersion_prefrec.htm

For the purposes of this air quality assessment, the road corridor was divided into the following three sections:

1) Bulla Road to Moreland Road;
2) Moreland Road to Dynon Road; and
3) Dynon Road to the Domain / Burnley Tunnels.

The AM peak hour is assumed to be the largest hourly volume prior to 9 am. The PM peak hour is assumed to be the largest hourly volume after 4 pm. The following traffic speeds were applied in the assessment; the Bolte VMS strategy refers to the time periods 6 am – 11 am and 3 pm - 7 pm:

- Modelling period 2014
  - Southbound traffic Bulla to Racecourse Rd - 100 km/h.
  - Southbound traffic Racecourse Rd to Footscray Rd is 100 km/h outside the Bolte VMS strategy and 80 km/h within.
  - Southbound traffic Footscray Rd to West Gate Freeway is 80 km/h outside the Bolte VMS strategy and 60 km/h within.
  - Southbound traffic (travelling east) West Gate Freeway Bridge to Domain / Burnley Tunnels is 80km/h.
  - Northbound traffic (travelling west) from the Domain / Burnley Tunnels to the West Gate Freeway Bridge is travelling at 80 km/h.
  - Northbound traffic from the West Gate Freeway to Bulla Rd is travelling at 100 km/h.
- Modelling period 2035
  - All traffic is travelling at 80 km/h.

Hourly varying data was applied in the model based on traffic speed, traffic volume and emission rate to create a 24 hour diurnal cycle and applied to all days in the modelling period. Where existing traffic heavy vehicle counts were not provided, the average of those sections with data was applied.

5.2.3 Emissions Factors

In order to assess the potential impact of the corridor upgrade on local air quality, estimated emissions of the pollutants are required. The pollutants of primary concern for motor vehicles are NO_x, PM_{10} and CO and predicted concentrations of these pollutants in identified areas were compared with the SEPP – AQM Intervention Levels.

Motor vehicle emission factors developed by the VicEPA were used in this assessment. The values were provided for the years 2011, which were used in this assessment to represent 2014, and 2021, which were used to represent 2035. The emission factors in grams of air pollutant per kilometre are derived for various classes of vehicle, fuel type and vehicle speed. The emission factors used in the modelling are shown in **Table 4** for 2011 and **Table 5** for 2021.

As the fuel type composition of each vehicle type was not known, the Australian Bureau of Statistics (ABS) *Motor Vehicle Census* figures for the years 2008 and 2013 were used to extrapolate the fleet fuel composition for the years 2014 (baseline traffic data) and 2021 (further emission factor year). It was not considered appropriate to extrapolate the data to the modelling year 2035, as vehicle composition that far in the future is likely to be substantially different than current values due to the likely increase in hybrid and electric cars. As discussed in **Appendix D**, vehicle mix together with expected emission reductions through improved fuel efficiency technology and standards, it is likely that the emissions from cars in 2035 would be less than that estimated for 2021, therefore the emissions from the 2035 assessment are considered conservative.

Hourly varying data were applied in the model based on traffic speed, traffic volume and emission rate to create a 24 hour diurnal cycle and applied to all days in the modelling period.

Table 4 Vehicle Emission Factors for 2011

Vehicle type	Fuel	Emission Factor (g/km)					
		80 km/h			100 km/h		
		NOx	PM_{10}	CO	NOx	PM_{10}	CO
Passenger vehicle	Petrol	0.91	0.015	4.9	0.94	0.015	5.3
	Diesel	1.29	0.187	0.9	1.44	0.212	1.0
Light commercial vehicle	Petrol	0.93	0.017	7.0	0.94	0.018	7.3
	Diesel	1.6	0.197	2.2	1.79	0.219	2.5
Articulated truck	Diesel	13.38	0.236	1.3	14.46	0.255	1.4

Table 5 Vehicle Emission Factors for 2021

Vehicle type	Fuel	Emission factor (g/km)					
		80 km/h			100 km/h		
		NOx	PM_{10}	CO	NOx	PM_{10}	CO
Passenger vehicle	Petrol	0.64	0.014	3.4	0.66	0.014	3.8
	Diesel	0.73	0.029	0.4	0.82	0.031	0.5
Light commercial vehicle	Petrol	0.4	0.015	2.7	0.4	0.016	3.0
	Diesel	1.02	0.031	1.1	1.14	0.043	1.3
Articulated truck	Diesel	8.44	0.067	0.5	9.23	0.72	0.6

5.2.4 Meteorological Data

The meteorological data file used in the dispersion modelling was provided by Vic EPA. The file represented data measured at the Footscray monitoring station in 2008.

5.2.5 Receptors

Specific sensitive receptors are chosen to ensure that those receptors that are most likely to be affected by the road's operation are assessed. Residences located in proximity to the road corridor are chosen, as are schools, hospitals and other sensitive developments. The receptors can also be placed at varying heights on the same coordinates, known as flagpole receptors, to represent the various levels of multi-story buildings.

A total of 122 sensitive receptors were applied in this project, which included:

- Strathmore College;
- Pascoe Vale South Primary School;
- Moonee Ponds Primary School;
- Reggio Calabria Club;
- Multi-story developments on Racecourse Rd, Mt Alexander Rd, and Cade Way (with flagpole receptors);
- Multi story commercial / residential developments on Lorimer St, Docklands; and
- Multi story commercial / residential development on Clarendon St, City Rd and Clarke St, South Melbourne.

A full list of the sensitive receptors included in the model is provided in **Appendix C**.

5.2.6 Background Pollutant Concentrations

The background pollutant concentrations used in the CTW project assessment were the highest 75th percentile levels recorded between 2008 and 2012 as reported in **Table 2** (i.e. 55 $\mu g/m^3$ 1 hour average for NO_2 and 23 $\mu g/m^3$ for 24 hour average PM_{10}).

The EPA reviewed trends in NO_2 concentrations and forecast future concentrations in its "Future Air Quality in Victoria – Final Report" publication (2013). The average NO_2 concentration decreased from a concentration of approximately 22 $\mu g/m^3$ (12 parts per billion) in the late 1990s to less than 19 $\mu g/m^3$ (10 ppb) in 2010. The forecast concentration in 2030 is approximately 13 $\mu g/m^3$ (7 ppb). While no forecast data are provided for the 70th or 75th percentiles, these concentrations would also expect to decrease over time. For the purpose of this assessment, however, background concentrations were not considered to change over time. It should be noted that the EPA review did not consider expected decreases in emission levels. No trends or forecasts were provided for PM_{10}.

It should also be noted that the CityLink was operational during the monitoring period from which the background data was sought and was contributing to the background levels measured. The impact assessment would therefore have a degree of double counting by adding the background, which includes a contribution from CityLink, to the CAL3QHCR CityLink model predictions to calculate the cumulative value.

5.2.7 Other Modelling Parameters

Table 6 lists the other parameters that were used as model inputs.

Table 6 Other Modelling Parameters

Parameter	Value
Surface roughness (cm)	100
Urban/rural setting	Urban
Receptor height (m)	1.8
Mixing zone width	Total lane width+ an additional 6 m (as per manual)

5.2.8 Assumptions and Limitations

Details of the assumptions and limitations of the assessment are provided in **Appendix D**.

5.3 Conversion of NO_X to NO_2

Nitrogen oxides are produced in most combustion processes and are formed during the oxidation of nitrogen in fuel and nitrogen in the air. During high-temperature processes, a variety of oxides are formed including nitric oxide (NO) and NO_2. NO will generally comprise 95 % of the NO_X by volume at the point of emission. The remaining NO_X will consist of NO_2. Ultimately, however, all nitric oxides emitted into the atmosphere are oxidised to NO_2 and then further to other higher oxides of nitrogen.

CAL3QHCR assumes that the pollutants are inert gases; i.e. the model does not account for any chemical transformations. As such, the transformation of NO_x to NO_2 needs to be done in the post-processing stage.

There is no industry standard NO_x to NO_2 conversion ratio for road projects. Holmes Air Sciences (HAS 2001) conducted studies that estimate that NO_2 comprises approximately 5 % of tailpipe emissions, with this contribution varying depending on environment factors. The report reviewed the ratio of NO_2 to NOx for vehicle emissions in a busy city area and found that an hourly NO_2 ratio of 15% was a good representation of the measured data. The reported 15 % value was applied in this assessment and represents a typical value used in air quality assessments across Victoria (GHD 2008) and Australia.

6.0 Modelling Predictions

6.1 Overview

This section provides an assessment of the potential impacts on sensitive receptors and the surrounding environment from the operational phase of the project for 2014 and 2035. The predicted results are provided for each specified road section.

A NO_x to NO_2 ratio of 0.15 (or NO_x conversion rate of 15 %) was used in this assessment for all receptor locations as detailed in **Section 5.3**.

6.2 Section 1 - Bulla Road to Moreland Road

The maximum predicted 1 hour NO_2, 24hour PM_{10} and 1 hour CO concentrations at the sensitive receptor locations assessed resulting from operation of the CTW project are summarised below. The data are presented for both the project excluding background (road-way impacts alone) and cumulatively (road-way impacts + background). The cumulative value should be compared against the SEPP-AQM intervention level (IL).

Table 7 Maximum Predicted Pollutant Concentrations – Section 1 - Bulla Road to Moreland Road

Pollutant	Averaging Period	Background Pollutant Concentrations (µg/m^3)	Maximum Predicted Pollutant Concentration (µg/m^3)				SEPP AQM IL (µg/m^3)
			Excluding Background		Including Background		
			2014	2035	2014	2035	
NO_2	1 hour	55	136	180	191	235	263
PM_{10}	24 hour	23	8	5	31	28	60
CO	1 hour	NA	3,374	2,674	NA	NA	33,350
NA: not assessed							

As shown, no exceedences of the SEPP-AQM IL of NO_2, PM_{10} or CO were predicted at any of the assessed locations for either 2014 or 2035 for the road in isolation or when combined with the existing background pollutant concentrations. As the CO contributions from the road were minor, no further consideration of background data was made.

6.3 Section 2 - Moreland Road to Dynon Road

The maximum predicted 1 hour NO_2, 24hour PM_{10} and 1 hour CO concentrations at the sensitive receptor locations assessed resulting from operation of the CTW project are summarised below. The data are presented for both the project excluding background (road-way impacts alone) and cumulatively (road-way impacts + background). The cumulative value should be compared against the SEPP-AQM IL.

Table 8 Maximum Predicted Pollutant Concentrations – Section 2 - Moreland Road to Dynon Road

Pollutant	Averaging Period	Background Pollutant Concentrations (µg/m^3)	Maximum Predicted Pollutant Concentration (µg/m^3)				SEPP AQM IL (µg/m^3)
			Excluding Background		Including Background		
			2014	2035	2014	2035	
NO_2	1 hour	55	156	207	211	262	263
PM_{10}	24 hour	23	10	7	33	30	60
CO	1 hour	NA	3,851	3,118	NA	NA	33,350
NA: not assessed							

As shown, no exceedences of the SEPP-AQM IL of NO_2, PM_{10} or CO were predicted at any of the assessed locations for either 2014 or 2035 for the road in isolation or when combined with the existing background pollutant concentrations. As the CO contributions from the road were minor, no further consideration of background data was made.

Although compliance is achieved at all modelled sensitive receptors, it is acknowledged that the cumulative 2035 maximum prediction is close to the SEPP-AQM IL for NO_2. The elevated concentration close to the SEPP AQM IL is expected to be lower than the predicted value in reality. As previously stated, there are several conservative assumptions made in the assessment that are likely to result in an overestimate of the ground level predictions:

- Vehicle emission rates are likely to be lower in 2035 than the 2021 data used in the assessment a result of the introduction of stricter vehicle emissions requirements over time and the gradual removal of older vehicles from the national fleet.
- The actual 2035 vehicle composition is likely to be substantially different than that modelled due to the likely increase in hybrid and electric cars, resulting in lower pollution emissions.
- Noise barriers have been shown to significantly reduce emissions at property's on the urban side of the wall, however the road model does not adequately account for these reductions. The receptors with the elevated road contributions were in locations with large noise barriers.
- There is a degree of double counting when assessing the cumulative results as the background data applied was measured during the operation of CityLink which is then added again by the road model.

6.4 Section 3 - Dynon Road to the Domain / Burnley Tunnels

The maximum predicted 1 hour NO_2, 24hour PM_{10} and 1 hour CO concentrations at the sensitive receptor locations assessed resulting from operation of the CTW project are summarised below. Again, the project excluding background (road-way impacts alone) and cumulative (road-way impacts + background) concentrations are provided. The cumulative value should be compared against the SEPP-AQM intervention level (IL).

Table 9 Maximum Predicted Pollutant Concentrations – Section 3 - Dynon Road to Domain / Burnley Tunnels

Pollutant	Averaging Period	Background Pollutant Concentrations (µg/m³)	Maximum Predicted Pollutant Concentration (µg/m³)				SEPP AQM IL (µg/m³)
			Excluding Background		Including Background		
			2014	2035	2014	2035	
NO_2	1 hour	55	83	107	138	162	263
PM_{10}	24 hour	23	3	2	26	25	60
CO	1 hour	NA	1,696	1,357	NA	NA	33,350
NA: not assessed							

As shown, no exceedences of the SEPP-AQM IL of NO_2, PM_{10} or CO were predicted at any of the assessed locations for either 2014 or 2035 for the road in isolation or when combined with the existing background pollutant concentrations. As the CO contributions from the road were minor, no further consideration of background data was made.

6.5 Other pollutants

On the basis that $PM_{2.5}$ particles form a high proportion of the total PM_{10} concentrations, the particle size $PM_{2.5}$ was not specifically modelled in the assessment due to the following:

- The Victorian EPA petrol and diesel vehicle emission factors used in the assessment show that between 64% to 90% of the total PM_{10} concentration is $PM_{2.5}$;
- The maximum predicted project contribution of PM_{10} was relatively low (10 ug/m3), and the maximum cumulative PM_{10} value (contribution plus background concentration) predicted in this assessment was 33 ug/m^3;
- The SEPP-AQM Intervention Level for $PM_{2.5}$ is 36 ug/m^3 (Schedule B, SEPP240), which is greater than the maximum cumulative PM_{10} value predicted in this assessment of 33 ug/m^3 in 2035; and

- As $PM_{2.5}$ is a subset of PM_{10}, the $PM_{2.5}$ concentrations must be lower than the PM_{10} levels (based on the EPA emission factors, $PM_{2.5}$ levels would be between 64% and 90% of the predicted PM_{10} contributions; a similar ratio would also be expected for background concentrations).

As discussed, because the maximum predicted PM_{10} levels are less than the $PM_{2.5}$ criterion, the $PM_{2.5}$ levels would be below the SEPP-AQM Intervention Level of 36 ug/m^3.

7.0 Conclusion

The CTW project seeks to upgrade the M1 and M2, inclusive of sections of the Tullamarine Freeway, CityLink and West Gate Freeway. The study area for this assessment covered the Tulla-Calder Interchange in the north to the Domain/Burnley Tunnels in the south. The SEPP – AQM requires the air pollutant impacts of proposed transport corridors be assessed against the SEPP's Intervention Levels. The changes in the near-road air pollutant concentration with the up-grading of a road corridor were assessed against these criteria.

The results for Section 1 - Bulla Road to Moreland Road – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

The results for Section 2 - Moreland Road to Dynon Road – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

The results for Section 3 - Dynon Road to the Domain / Burnley tunnels – indicate that, taking into account the default urban background concentrations, there are no predicted NO_2, PM_{10} or CO exceedances of the SEPP-AQM IL at any of the selected locations for either 2014 or 2035.

With the introduction of stricter vehicle emissions requirements, the gradual removal of older vehicles from the national fleet, the likely change in vehicle composition towards electric and hybrid cars, the retention / installation of noise barriers along the roadway (which could not be adequately incorporated into the model), and a degree of double counting of the CityLink contribution to the cumulative value, it is likely that the predictions of the potential impacts on local receptors presented in the assessment are conservative.

The assessment indicates that the operation of the CTW project is not likely to result in pollutant concentrations at local receptors that exceed the SEPP-AQM IL levels for either 2014 or 2035 conditions. No mitigation measures have, therefore, been recommended with regards to the operation of the upgrade.

8.0 References

GHD (2008) Frankston Bypass – Report on Air Quality Assessment, Technical Report for the Environment Effects Statement, prepared for Southern and eastern Transport Authority (SEITA).

Hagler, G. S. W., et al., (2011) Model evaluation of roadside barrier impact on near-road air pollution, Atmospheric Environment, 45.

Holmes Air Sciences (HAS) (2001). The Cross City Tunnel Project Air Quality Monitoring Report for November, December and January 2000/01, prepared for Roads and Traffic Authority.

Appendix A

CAL3QHCR Approval

Appendix A CAL3QHCR Approval

31 March 2015

EPA VICTORIA

Our Ref: 333851

Environment Protection Authority Victoria

200 Victoria Street
Carlton VIC 3053

GPO Box 4395
Melbourne VIC 3001

DX 210082

T 1300 372 842
1300 EPA VIC

W epa.vic.gov.au

Dear David Rollings
Principal Engineer
AECOM
17 Warabrook Boulevard, Warabrook
HUNTER Region MC NSW 2304

Dear Mr Rollings

USE OF CAL3QHCR MODEL FOR ASSESSING AIR QUALITY IMPACTS FROM THE CITY TO TULLAMARINE WIDENING (CTW) ROADWAY LINK.

Thank you for your correspondence requesting approval to use CAL3QHCR as alternative model to AusRoads for assessing the air quality impacts from the CTW roadway link.

Under Schedule C Part D Clause 1 of the State environment protection policy (Air Quality Management) ("the policy"); Proposed transport corridors such as roads must be assessed using one of the regulatory models for near-road modelling.

AusRoads has been the de-facto standard roadway dispersion model for EPA for a number of years. AusRoads is a number of years old, has not had any upgrades and seems to have become an outdated model.

The model proposed to be used CAL3QHCR is the current US EPA regulatory model for roadway assessments, see 40 CFR 51, App W, Section 3.1. The fundamental modelling engine of CAL3QHCR is similar to the one in AusRoads. CAL3QHCR is the preferred model because it has several enhancements compared to the AusRoads model.

I am satisfied that the use of CAL3QHCR is suitable for assessing air quality impacts from the CTW roadway link.

EPA therefore approves the use of CAL3QHCR with the methodology set out in your correspondence dated 16 February 2015.

If you have any question about the use of the model please contact me.

Yours sincerely

PAUL TORRE
DELEGATE OF THE ENVIRONMENT
PROTECTION AUTHORITY

State Government Victoria

Appendix B

Traffic Volumes

Appendix B VicRoads Traffic Volumes

Section 1 - Bulla Road to Moreland Road

The existing and projected volumes for Section 1 are provided in **Table 10**.

Table 10 Existing and Forecast Future Traffic Volumes; Section 1 - Bulla Road to Moreland Road

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
Southbound					
Existing (2014)					
entry ramp	from Bulla Rd	4788	0.6%	327	343
Bulla Rd	Pascoe Vale Rd	91020	2.1%	7786	5815
Exit Ramp	to Bell St	27761	0.7%	2062	2035
Pascoe Vale Rd	Bell St	63259	2.4%	5724	3780
entry ramp	from Pascoe Vale Rd	6976	0.8%	1085	374
Pascoe Vale Rd	Moreland Rd	70235	2.3%	6809	4136
entry ramp	from Moreland Rd	9193	1.6%	1066	477
2035					
entry ramp	from Bulla Rd	3500	4.5%	NA	NA
Bulla Rd	Pascoe Vale Rd	87491	7.2%	6815	4360
Exit Ramp	to Bell St (Collector Distributor)	33181	3.0%	2275	2440
Pascoe Vale Rd	Bell St (main line only)	87491	8.4%	7917	5228
entry ramp	from Pascoe Vale Rd	11399	5.3%	885	795
Pascoe Vale Rd	Moreland Rd	100868	7.0%	7700	5425
entry ramp	from Moreland Rd	15022	5.2%	1150	1080
Northbound					
Existing (2014)					
exit ramp	to Moreland Rd	9745	1.5%	443	1192
Moreland Rd	Pascoe Vale exit Ramp	69947	1.9%	4180	6842
exit ramp	to Pascoe Vale Rd	7765	0.8%	321	946
Pascoe Vale Exit Ramp	Bell St Entry Ramp	62182	2.0%	3872	5924
entry ramp	from Bell St entry Ramp	26998	0.8%	2208	1898
Pascoe Vale Rd	Bulla Rd	93272	1.8%	5891	7811
exit ramp	to Bulla Rd	3851	0.3%	232	294
2035					
exit ramp	to Moreland Rd	16481	5.1%	928	1550
Moreland Rd	Pascoe Vale exit Ramp	103088	6.9%	4575	8645
exit ramp	to Pascoe Vale Rd	13944	5.0%	648	1459
Pascoe Vale Exit Ramp	Bell St Entry Ramp	89144	7.2%	3927	7186

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
entry ramp	from Bell St	35515	3.3%	2290	2545
Pascoe Vale Rd	Bulla Rd	124659	6.1%	6217	9731
exit ramp	to Bulla Rd	7600	2.4%	NA	NA
NA - Not available at time of reporting					

Section 2 - Moreland Road to Dynon Road

The existing and projected traffic volumes for Section 2 are provided in **Table 11**.

Table 11 Existing and Forecast Future Traffic Volumes; Section 2 - Moreland Road to Dynon Road

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
Southbound					
Existing (2014)					
Moreland Rd	Brunswick Rd	79428	2.2%	7875	4613
Exit Ramp	to Brunswick Rd	8417	0.7%	679	745
Brunswick Rd	Flemington Rd	71011	2.3%	7192	3868
Exit Ramp	to Flemington Rd	21654	1.2%	2291	1131
Flemington Rd	Racecourse Rd	49357	2.5%	4489	2625
entry ramp	from Racecourse Rd	8225	2.8%	533	544
Racecourse Rd	Dynon Rd	57582	2.4%	2208	1898
Exit Ramp	to Dynon Rd	6271	4.0%	938	279
2035					
Moreland Rd	Brunswick Rd	115889	6.7%	8850	6505
Exit Ramp	to Brunswick Rd	14069	3.2%	1040	985
Brunswick Rd	Flemington Rd	101820	6.9%	7810	5520
Exit Ramp	to Flemington Rd	35019	5.2%	2370	1875
Flemington Rd	Racecourse Rd	66802	8.3%	5440	3645
entry ramp	from Racecourse Rd	10192	5.8%	700	655
Racecourse Rd	Dynon Rd	76994	7.9%	6135	4300
Exit Ramp	to Dynon Rd	13017	6.5%	950	710
Northbound					
Existing (2014)					
entry ramp	from Dynon Rd	6512	5.7%	256	1033
Dynon Rd	Racecourse Rd	58362	2.6%	3725	5611
exit ramp	to Racecourse Rd	8082	2.1%	588	633
Racecourse Rd	Mt Alexander Rd	50280	2.5%	3260	5000
entry ramp	from Mt Alexander Rd	21197	0.7%	1098	143
Mt Alexander	Ormond Rd	71477	2.0%	4022	7029
entry ramp	from Ormond Rd	8215	0.6%	584	787

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
Ormond Rd	Moreland Rd	79692	1.9%	4510	7816
2035					
entry ramp	from Dynon Rd	12372	6.6%	347	995
Dynon Rd	racecourse	78012	8.2%	3800	6956
exit ramp	to Racecourse Rd	10381	6.8%	581	683
Racecourse Rd	Mt Alexander Rd	67631	8.4%	3218	6273
entry ramp	from Mt Alexander Rd	38029	7.2%	1438	2805
Mt Alexander	Ormond Rd	105660	7.2%	4656	9078
entry ramp	from Ormond Rd	13909	2.9%	847	1117
Ormond Rd	Moreland Rd	119568	6.7%	5503	10195

Section 3 - Dynon Road to the Domain / Burnley Tunnels

The existing and projected traffic volumes for Section 3 are provided in **Table 12**.

Table 12 Existing and Forecast Future Traffic Volumes; Section 3 - Dynon Road to the Domain / Burnley Tunnels

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
Southbound					
Existing (2014)					
Dynon Rd	Footscray Rd	52571	7%	4185	3029
exit ramp	to Footscray Rd	8888	9%	1213	375
Footscray Rd	between ramps	43684	13%	3061	2654
entry ramp	from Footscray Rd	7038	17%	533	514
Footscray Rd	Lorimer St exit	50722	14%	3526	3168
exit ramp	to Lorimer St (exit 2)	16069	12%	1230	1082
exit ramp	to West Gate Freeway WB (exit 1W)	11394	11%	949	807
ramp from Northlink	WGF	23259	6%	1524	1317
Freeway Merge	from WGF	74026	4%	6188	4651
exit ramp	to Kings Way	10745	2%	1574	1293
Kings Way exit	Montague St exit	40408	1%	6136	4764
exit ramp	to Montague St	9143	1%	1414	1077
Montague St	between ramps	33732	4%	4516	4428
entry ramp	from Montague St	4486	7%	328	417
Montague St	Power St	36235	5%	4794	4845
exit ramp	to Power St	14885	3%	1345	854
Power St	Kings Way on ramp	27936	7%	3534	4008
2035					
Dynon Rd	Footscray Rd	64,000	8.2%	NA	NA

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
exit ramp	Footscray Rd	8,200	7.6%	NA	NA
Footscray Rd	between ramps	55,800	8.3%	NA	NA
entry ramp from	from Footscray Rd	8,800	13.7%	NA	NA
Footscray Rd	freeway diverge	64,600	9.1%	NA	NA
exit ramp	to Lorimer St (exit 2)	20,400	6.6%	NA	NA
exit ramp to	West Gate Freeway WB (exit 1W)	16,600	7.6%	NA	NA
ramp from Northlink	to WGF	27,600	11.7%	NA	NA
Freeway Merge	from WGF	101,900	7.9%	NA	NA
exit ramp	Kings Way	34,900	3.6%	NA	NA
exit ramp	Montague St	27,900	4.1%	NA	NA
Montague St	between ramps	66,700	3.4%	NA	NA
entry ramp	from Montague St	14,000	8.0%	NA	NA
Montague St	Power St	80,700	12.4%	NA	NA
exit ramp	Power St	19,200	6.9%	NA	NA
Power St	Kings Way on ramp	61,500	14.1%	NA	NA
Northbound					
Existing (2014)					
Power St	between ramps	30531	6.4%	4048	4557
entry ramp	from Power St	14907	2.5%	785	1360
Power St	Montague St	38347	3.0%	4833	5917
exit ramp	to Montague St	6474	3.6%	743	348
exit to Montague St	exit to WGF WB (1)	34601	6.0%	4157	5596
exit ramp	to WGF WB (1)	19064	7.2%	2081	3098
exit to WGF WB (1)	entry from Montague	15537	8.3%	2082	2498
entry ramp	from Montague St	9782	3.0%	701	926
entry from Montague	entry from Kings Way	20643	3.9%	2686	3112
entry ramp	from Kings Way path	6053	0.6%	703	924
Kings Way entry	WGF WB (2)	51791	3.1%	3599	3928
exit ramp	to WGF WB (2)	6733	5.6%	720	535
Exit to WGF WB (2)	Entry from WGF EB	45058	7.5%	3162	3474
entry ramp	from WGF EB	11989	9.4%	625	1140
Entry from WGF EB	Exit to Footscray Rd	57047	18.9%	3692	4568
exit ramp	to Footscray Rd	6097	28.3%	429	365
Footscray Rd	between ramps	50949	18.6%	3263	4227
entry ramp	from Footscray Rd	6909	8.9%	372	863
Footscray Rd	Dynon Rd	57859	7.3%	3545	5019

From	To	daily (veh)	HCV (%)	peak am (veh)	peak pm (veh)
entry ramp	from Dynon Rd	6503	5.6%	194	1044
2035					
Power St	between ramps	63,700	14.2%	NA	NA
entry ramp	from Power St	15,800	6.8%	NA	NA
Power St	Montague St	79,500	12.7%	NA	NA
exit ramp	Montague St	6,100	7.5%	NA	NA
exit to Montague St exit	WGF WB (1)	73,300	13.1%	NA	NA
exit ramp	WGF WB (1)	42,000	13.5%	NA	NA
exit to WGF WB (1)	entry from Montague	31,300	12.6%	NA	NA
entry ramp	from Montague St	10,700	4.6%	NA	NA
entry from Montague	entry from Kings Way	42,000	10.6%	NA	NA
entry ramp	from Kings Way path	15,000	4.9%	NA	NA
Kings Way entry	WGF WB exit (2)	57,000	9.1%	NA	NA
exit ramp	WGF WB (2)	8,700	6.5%	NA	NA
Exit to WGF WB (2)	entry from WGF EB	48,300	9.5%	NA	NA
entry ramp	from WGF EB	15,600	8.6%	NA	NA
Entry from WGF EB	exit to Footscray Rd	64,000	9.3%	NA	NA
exit ramp to	Footscray Rd	7,000	15.6%	NA	NA
Footscray Rd	between ramps	57,000	8.5%	NA	NA
entry ramp	from Footscray Rd	8,600	8.5%	NA	NA
Footscray Rd	Dynon Rd	65,600	8.5%	NA	NA

Appendix C

Sensitive Receptors

Appendix C Sensitive Receptors

#	X (m)	Y (m)	Description	#	X (m)	Y (m)	Description
1	315463.0	5821443.0	Residential	21	317456.0	5821308.0	Strathmore Secondary College
2	315548.0	5821483.0	Residential	22	317522.0	5821225.0	Strathmore Secondary College
3	315651.0	5821536.0	Residential	23	317541.0	5821118.0	Strathmore Secondary College
4	316009.0	5821708.0	Residential	24	317829.0	5820707.0	Residential
5	316062.0	5821719.0	Residential	25	317872.0	5820641.0	Residential
6	316168.0	5821750.0	Residential	26	317897.0	5820599.0	Residential
7	316281.0	5821748.0	Residential	27	318028.0	5820461.0	Residential
8	316417.0	5821733.0	Residential	28	317960.0	5820370.0	Residential
9	316560.0	5821729.0	Residential	29	318104.0	5820367.0	Pascoe Vale South Primary School
10	316557.0	5821848.0	Residential	30	318112.0	5820301.0	Pascoe Vale South Primary School
11	316656.0	5821829.0	Residential	31	317972.0	5820319.0	Residential
12	316829.0	5821810.0	Residential	32	317969.0	5820274.0	Residential
13	317012.0	5821789.0	Residential	33	317961.0	5820223.0	Residential
14	317092.0	5821651.0	Residential	34	318244.0	5820230.0	Residential
15	317722.0	5821232.0	Residential	35	318034.0	5820165.0	Residential
16	317702.0	5821155.0	Residential	36	318049.0	5820044.0	Residential
17	317754.0	5821016.0	Residential	37	318004.0	5819905.0	Residential
18	317766.0	5820968.0	Residential	38	318090.0	5819931.0	Residential
19	317788.0	5820897.0	Residential	39	318108.0	5819870.0	Residential
20	317858.0	5820821.0	Residential	40	318034.0	5819774.0	Residential

#	X (m)	Y (m)	Description	#	X (m)	Y (m)	Description
41	318144.0	5819785.0	Residential	61	318360.0	5817645.0	Residential
42	318160.0	5819736.0	Residential	62	318359.0	5817308.0	Residential
43	318167.0	5819493.0	Residential	63	318374.0	5817148.0	Reggio Calabria Club
44	318180.0	5819469.0	Residential	64	318411.0	5816907.0	Multi story residential
45	318209.0	5819411.0	Residential	65	318411.0	5816907.0	Multi story residential
46	318296.0	5819435.0	Residential	66	318461.0	5816850.0	Multi story residential
47	318303.0	5819386.0	Residential	67	318461.0	5816850.0	Multi story residential
48	318340.0	5819269.0	Residential	68	318467.0	5816407.0	Multi story residential
49	318264.0	5819232.0	Residential	69	318501.0	5816171.0	Multi story residential
50	318290.0	5819131.0	Residential	70	318501.0	5816171.0	Multi story residential
51	318292.0	5819128.0	Residential	71	318501.0	5816171.0	Multi story residential
52	318306.0	5819026.0	Residential	72	318501.0	5816171.0	Multi story residential
53	318315.0	5818909.0	Residential	73	318518.0	5816083.0	Multi story residential
54	318406.0	5818820.0	Residential	74	318518.0	5816083.0	Multi story residential
55	318308.0	5818403.0	Residential	75	318518.0	5816083.0	Multi story residential
56	318015.0	5818460.0	Moonee Ponds Primary School	76	318518.0	5816083.0	Multi story residential
57	318378.0	5818021.0	Residential	77	318522.0	5816021.0	Multi story residential
58	318383.0	5817917.0	Residential	78	318522.0	5816021.0	Multi story residential
59	318287.0	5817833.0	Residential	79	318522.0	5816021.0	Multi story residential
60	318361.0	5817779.0	Residential	80	318522.0	5816021.0	Multi story residential

#	X (m)	Y (m)	Description	#	X (m)	Y (m)	Description
81	318612	5816170	Multi story residential	103	320069	5811344	Multi story residential/commercial
82	318612	5816170	Multi story residential	104	320069	5811344	Multi story residential/commercial
83	318366	5815814	Multi story residential	105	320069	5811344	Multi story residential/commercial
84	318366	5815814	Multi story residential	106	320069	5811344	Multi story residential/commercial
85	318366	5815814	Multi story residential	107	319050	5811635	Multi story residential/commercial
86	318366	5815814	Multi story residential	108	319050	5811635	Multi story residential/commercial
87	318351	5815686	Multi story residential	109	319050	5811635	Multi story residential/commercial
88	318351	5815686	Multi story residential	110	319050	5811635	Multi story residential/commercial
89	318351	5815686	Multi story residential	111	319133	5811624	Multi story residential/commercial
90	318351	5815686	Multi story residential/commercial	112	319133	5811624	Multi story residential/commercial
91	320330	5811220	Multi story residential/commercial	113	319133	5811624	Multi story residential/commercial
92	320330	5811220	Multi story residential/commercial	114	319133	5811624	Multi story residential/commercial
93	320330	5811220	Multi story residential/commercial	115	319233	5811611	Multi story residential/commercial
94	320330	5811220	Multi story residential/commercial	116	319233	5811611	Multi story residential/commercial
95	320411	5811312	Multi story residential/commercial	117	319233	5811611	Multi story residential/commercial
96	320411	5811312	Multi story residential/commercial	118	319233	5811611	Multi story residential/commercial
97	320411	5811312	Multi story residential/commercial	119	320240	5811299	Multi story residential/commercial
98	320411	5811312	Multi story residential/commercial	120	320240	5811299	Multi story residential/commercial
99	320335	5811317	Multi story residential/commercial	121	320240	5811299	Multi story residential/commercial
100	320335	5811317	Multi story residential/commercial	122	320240	5811299	Multi story residential/commercial
101	320335	5811317	Multi story residential/commercial				

Appendix D

Assumptions and Limitations

Appendix D Assumptions and Limitations

The assumptions and limitations of the project not previously discussed are presented in the following sections.

Vehicle Volumes

- All traffic data were supplied to the AECOM air quality team from VicRoads.
- Volumes for 2035 were extrapolated from the predicted 2031 volumes assuming 0.5% growth each year.
- The traffic profile for 2035 was assumed to be the same as that for the baseline case (current).
- LCVs were classified as Austroads vehicle class 3-5 and HCVs were classified as Austroads vehicle class 6-12.
- A single mainline volume was available in each direction, so other mainline volumes were derived from this volume and ramp volumes.
- Where existing 2014 traffic heavy vehicle counts were not provided, the average of the sections with data was applied.
- ABS data were used to separate the traffic data into fuel types for each vehicle classification, and were extrapolated to 2014 and 2021 (which was used for 2035 in the absence of other data) as discussed in **Section 5.2.3**. All heavy vehicles were assumed to be diesel-powered.

Vehicle Emission Factors

Victorian EPA vehicle emission rate data were available for the years 2001, 2011 and 2021. Emission rate data for 2011 were used for the baseline year scenario (2014), while emission rate data for 2021 were used for the future case scenario (2035).

While the traffic volumes are forecast to increase between the year 2014 and 2035, motor vehicle emission rates are forecast to decrease. The decrease in motor vehicle emission rates is a result of the introduction of stricter vehicle emissions requirements over time (Australian Design Rules requirements for emissions from new vehicles) and the gradual removal of older vehicles (with higher pollutant emissions) from the national fleet. Given the expected decrease in vehicle pollutant emission rates between 2021 and 2035, the use of 2021 emission rate data for modelling year 2035 is likely to overestimate the emissions and subsequent receptor impacts presented in the assessment.

As the fuel type composition of each vehicle type was not known, the Australian Bureau of Statistics (ABS) *Motor Vehicle Census* figures for the years 2008 and 2013 were used to extrapolate the fleet fuel type composition for the years 2014 (baseline traffic data) and 2021 (further emission factor year). It was not considered appropriate to extrapolate the data to the modelling year 2035, as vehicle composition that far in the future is likely to be substantially different than current values due to the likely increase in hybrid and electric cars. The likely increase in hybrid and electric cars in 2035 from the 2021 extrapolation may result in an overestimation of the emissions and subsequent receptor impacts presented in the assessment.

Road Configuration – Noise Barriers

The near-road model has limited capacity to model the effects of noise barriers adjacent to Western Link. Various studies undertaken on the effect of noise barriers on the dispersion of near-road air pollutants have shown that the presence of a high noise barrier will reduce the concentration of air pollutants on the residential side of a noise barrier.

A report by Hagler (2011) *Model evaluation of roadside barrier impact on near-road air pollution* concluded:

> *This study utilizes computational fluid dynamics modelling to simulate the transport of inert gaseous emissions from a 6-lane roadway and resulting pollution of the near-road environment, with and without roadside barriers present. The results suggest that solid barriers, which may also loosely represent low-porosity vegetation, do significantly reduce maximum and ground-level concentrations downwind of a major roadway relative to an unobstructed flow situation.*

The modelled results presented in this report are not adjusted for the potential air pollutant concentration reduction offered by noise barriers; the results are conservative and potentially higher than the actual situation.

Future Ambient Air Pollutant Concentrations

As discussed previously, the EPA report “Future Air Quality in Victoria – Final Report” reviews the trends in average concentration of the common ambient air pollutants and attempts to forecast the average concentration of these air pollutants in 2030. The trend for the forecast average NO_2 concentration is that it will decrease over time; there is no forecast for the trend in ambient PM_{10} concentration.

Adopting the existing 75th percentile air pollutant concentration for the year 2035 75th percentile concentration for both NO_2 and PM_{10} is a conservative approach which could lead to an over-estimation of the future near-road pollutant concentrations.

The CityLink was operational during the utilised monitoring period and was contributing to the background levels measured. The impact assessment would therefore have a degree of double counting by adding the background, which includes a contribution from CityLink, to the CAL3QHCR CityLink model predictions to gain the cumulative value.

Future Traffic

The actual year 2035 forecast traffic volumes and hourly traffic volume distribution are likely to be different to the values used in the near-road modelling in this report. The future management of the road network and potential developments feeding into Western Link may be different to the assumptions that were used to develop the forecast future traffic volumes used in this report.

Future Policy

The current SEPP AQM Intervention Levels may not be applicable in 2035. Without knowing what form future state policies managing air quality will take in 2035, the existing Intervention Levels are the best criteria available.

Air Dispersion Model

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes, based on our understanding of the processes involved and their interactions, available input data, processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

The results of dispersion modelling, therefore, provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time.

Specifically, road dispersion models are designed to estimate near-road impacts in relatively uncomplicated terrain. However, all Gaussian line models suffer inherent limitations in that they:

- Only partly account for variation in meteorology within the boundary layer
- Predict ensemble-average concentrations but not the transient peaks
- Assume quasi-steady conditions
- Ignore longitudinal diffusion (parallel to the plume axis)
- Are unsuitable for cases involving atmospheric chemistry
- Use dispersion parameters that are unsuitable for long travel distances.

The potential effects of terrain on pollutant concentrations through an external terrain data file have not been assessed, as Gaussian road models do not include this feature. Its exclusion is not considered to be significant given the local topography and land use.