14 Amenity

Authorised by the Victorian Government,
1 Treasury Place, Melbourne

Tables

Figures

14.1 Overview

This chapter provides an assessment of potential amenity impacts of the project in relation to air quality and greenhouse gas, and noise and vibration.

This chapter has been informed by the air quality, and noise and vibration impact assessments, included in Appendix B: *Air quality impact assessment* and Appendix H: *Noise and vibration impact assessment* of this EES.

For the purpose of this EES, impact to amenity may include:

- dust and emissions at levels below that which may affect physiological health, but still impact on quality of life
- unreasonable noise and/or vibration disturbance.

The EES scoping requirements require the project *"To minimise adverse air quality, noise or vibration effects on the amenity of residents and local communities, as far as practicable during construction and operation"* and to identify mitigation measures to avoid, reduce or manage air quality, noise and vibration effects. The assessment of amenity discussed in this chapter includes air quality, greenhouse gas, noise and vibration assessments.

14.2 EES objectives

The draft evaluation objective set in the *Scoping Requirements for Beaufort Bypass Environment Effects Statement* (DELWP 2016) relevant to the amenity assessment is:

> ***Amenity:*** *To minimise adverse air quality, noise or vibration effects on the amenity of residents and local communities, as far as practicable during construction and operation.*

This chapter discusses the key issues identified in the scoping requirements as relevant to amenity, outlined in Table 14.1 below.

Table 14.1 EES key issues – Amenity

Key issues
Increased noise levels from the project's construction and operation could affect amenity in areas in close proximity to the road alignment alternatives.

Specific aspects to be addressed were also detailed in the scoping requirements. These are detailed in Table 14.2 below.

Table 14.2 EES requirements – Amenity

EES requirements
Priorities for characterising the existing environment
Characterise the existing noise setting in adjacent established residential, rural residential, commercial and open space areas and at other sensitive land use locations.
Design and mitigation measures
Identify design responses or other mitigation measures to avoid, reduce or manage any significant noise, air quality or vibration effects at sensitive land use locations during the project construction and operation, in the context of relevant guidelines, planning policy and VicRoads *Traffic Noise Reduction Policy 2005*.
Assessment of likely effects
Assess likely noise increases (due to operation) at sensitive land use locations along each alignment alternative, both with and in the absence of the proposed mitigation measures.

EES requirements
Approach to manage performance
Identify proposed measures to manage residual effects on amenity during project implementation, including: noise and dust emissions and the effects of vibration during and after project construction.
Include identified measures in the Environmental Management Framework.

14.3 Legislation and policy

The relevant legislation, policies and standards related to amenity are outlined in Table 14.3.

Table 14.3 Relevant legislation, policies and standards

Legislation/policy/standard	Description
Commonwealth	
National Environmental Protection Air Quality Measure	The *National Environmental Protection Air Quality Measure* defines the national standards for air pollutants in Australia. These standards establish protection levels for exposure to air pollutants. The key air pollutants relevant to a road project are: • carbon monoxide • nitrogen dioxide • particulate matter.
National Environment Protection (Air Toxics) Measure	The *National Environment Protection (Air Toxics) Measure* establishes monitoring investigation levels for air toxics: • benzene • toluene • formaldehyde • xylenes • benzo(a)pyrene as indicator for Polycyclic Aromatic Hydrocarbons.
State	
Transportation Integration Act 2010	Part 2, Division 2, Section 10 of the *Transportation Integration Act 2010* outlines the transport objectives relating to environmental sustainability. These are: '*The transport system should actively contribute to environmental sustainability by:* • *protecting, conserving and improving the natural environment* • *avoiding, minimising and offsetting harm to the local and global environment, including transport-related emissions and pollutants and the loss of biodiversity* • *promoting forms of transport and the use of forms of energy and transport technologies which have the least impact on the natural environment* • *improving the environmental performance of all forms of transport and the forms of energy used in transport*'.
Environment Protection Act 2017	Air quality in Victoria is managed by the Environment Protection Act 2017, under the subordinate Environmental Reference Standards. The Environmental Reference Standard generally adopted previous Air Quality State Environment Protection Policies: • State Environment Protection Policy (Air Quality Management) 2001 • State Environment Protection Policy (Ambient Air Quality) 1999.

Legislation/policy/standard	Description	
	State Environment Protection Policy (Air Quality Management) 2001 (superseded by Environmental Reference Standards)	Construction dust emissions and operational vehicle emissions (gases and particulates) are managed by, and need to comply with Environmental Reference Standards which are informed by the superseded provisions of the State Environment Protection Policy (Air Quality Management) 2001. The criteria for assessing the effects of vehicle emissions in road corridors are in Clause 40 of the policy – "*Management of Large Line and Area-Based Sources of Emissions*". As the Environment Protection Authority Victoria has not yet published protocols for assessing road construction and operation, Environment Protection Authority Victoria has, in the interim, adopted the Intervention Levels (defined by Schedule B of State Environment Protection Policy (Air Quality Management)) to apply to specific roadway projects. Background air pollutant levels for modelling emissions from the roadway are added to predicted values to provide predicted ambient concentrations to be compared against the State Environment Protection Policy (Air Quality Management) intervention levels. The State Environment Protection Policy advises that the 70th percentile concentration should be used as the background concentration. The State Environment Protection Policy (Air Quality Management) requires road projects to be assessed under Part D of Schedule C, which includes modelling of emissions to air from proposed transport corridors.
	State Environment Protection Policy (Ambient Air Quality) 1999 (superseded by Environmental Reference Standards)	Environmental Reference Standards which are informed by the superseded State Environment Protection Policy (Ambient Air Quality) adopts the requirements of the National Environmental Protection Air Quality Measure and operates in conjunction with State Environment Protection Policy (Air Quality Management). The State Environment Protection Policy (Ambient Air Quality) is concerned with ambient air quality in Victoria and outlines seven environmental indicators that require measurement and reporting for compliance against State objectives and goals (concentrations within the ambient air shed), and which must be taken into consideration when proposing any changes to the environment.

Legislation/policy/standard	Description	
	Environmental Reference Standards	A subordinate instrument to the Environment Protection Act 2017, Environmental Reference Standards articulate community expectations about the state of the environment, providing a basis for assessing and reporting on environmental conditions. Over time the Environmental Reference Standards will replace the existing suite of State Environment Protection Policy publications as they are reviewed and updated.
Environment Protection Authority Victoria Publication 1834 (November 2020) *Civil Construction, Building and Demolition Guide*	The *Civil Construction, Building and Demolition Guide* provides framework and criteria for the management of construction related noise to protect nearby receptors from unreasonable noise.	
VicRoads Traffic Noise Reduction Policy 2005	Traffic noise is required to be assessed to VicRoads *Traffic Noise Reduction Policy 2005*. The Policy seeks to: • reduce noise emitted by vehicles and road surfaces • encourage compatible land uses next to major roads • limit traffic noise from new arterial roads and roads upgraded to carry significantly more traffic • retrofit noise barriers on older freeways. There is no legislative framework in Victoria to address road operational noise. However, RRV has determined that noise impacts for the project are required to be assessed to the VicRoads *Traffic Noise Reduction Policy 2005*.	

14.4 Methodology

The assessment of amenity impacts is based on the air quality and greenhouse gas assessment and the noise and vibration assessment. These assessments describe the existing amenity conditions within the project study area and Beaufort township, assess potential construction and operational impacts on surrounding sensitive receptors, and identify appropriate mitigation measures to minimise those impacts. The methodology undertaken for these assessments is summarised below, with full details found in the assessments provided in Appendix B: *Air quality impact assessment* and Appendix H: *Noise and vibration impact assessment* of this EES.

Sensitive receptors: defined as residences, schools, camping grounds or other sites of permanent or regular use by persons, as well as vineyards or other horticulture that may be sensitive to elevated dust or increased levels of noise and vibration.

The focus of the air quality and noise and vibration impact assessments was informed by a risk assessment, which was undertaken to identify high risk activities and inform the assessment of potential impacts to amenity in the project study area and Beaufort township.

14.4.1 Air quality

The air quality assessment included the characterisation of ambient air quality and meteorological conditions of the Beaufort area, identification of sensitive receptors, modelling of dust and emissions, and a greenhouse gas assessment. The methodology of the assessment is described below.

Existing conditions

Ambient air quality and meteorological conditions

The assessment reviewed available data to determine the current climatic conditions for the sensitive receptors in the project study area and Beaufort township. This included the review of temperature, rainfall and wind data obtained from the Bureau of Meteorology weather stations at Ararat, Ballarat and Beaufort.

As there are no previous air quality studies or monitoring stations in the study area, ambient air quality was extrapolated from data gathered during two Environment Protection Authority Victoria monitoring data campaigns in the wider area, including around Ballarat.

Impact assessment

Dust modelling

Dust modelling was carried out as part of the air quality impact assessment to predict the PM_{10} and Total Suspended Particulates concentrations on a typical cross section (north-south) across the roadway.

The modelling assumed excavation occurs every working day (although this is unlikely to occur in wet weather) and excavation at every site along the route, although in practice excavation will progress from section to section.

Both Total Suspended Particulates and PM_{10} concentrations were modelled using the weather conditions of the two worst (i.e. hottest and windiest) days for erosion and transport of dust using 2013 to 2017 weather data.

Peak Total Suspended Particulates and PM_{10} concentrations were calculated for the following construction stages:

- excavation
- filling and compaction activities
- pavement (road surface) construction and landscaping activities.

The dust modelling used information such as the anticipated volume of excavation and fill, length of construction, and type of construction activity and machinery, to model the levels and spread of dust which may occur during project construction. These predicted levels were then measured against acceptable levels as prescribed in the State Environment Protection Policy (Air Quality Management) to determine a zone of potential impact.

- **Total Suspended Particulates:** particles in the air with a diameter of up to around 100 micrometres. These particles can be generated by non-combustion sources (e.g. earthworks) as well as combustion sources (e.g. motor vehicle exhausts).
- **Particulate matter (PM):**
  - **PM_{10}:** particulates that are less than 10 microns in diameter. These particulates can enter the lungs when inhaled and can cause negative health effects.
  - **$PM_{2.5}$:** particulates that are less 2.5 microns in diameter. These particulates can pass through the lungs into the bloodstream. Exposure to $PM_{2.5}$ particulates over long periods can result in negative health effects.
- **Carbon monoxide (CO):** an odourless gas, which is formed as a product of incomplete combustion of fuel.
- **Nitrogen dioxide (NO_2):** a gas primarily produced from burning fuel. The main source of NO_2 is from motor vehicle exhausts, and can cause or aggravate respiratory problems.

Emissions modelling

Construction

The dust emission rate for each stage of construction was developed from estimates of the dust generation by major items of equipment and wind erosion of dust from exposed soil surfaces and stockpiles of soil. The derived emission rates were developed using emission factors published in the *National Pollutant Inventory Emission Factor Estimation Techniques Manual* (Commonwealth of Australia, 2012).

It is assumed that work on the project would be carried out during the recommended hours for construction work set out in Environment Protection Authority Victoria Publication 1834.

Operation

The vehicle emissions modelling used predicted traffic data including traffic numbers, vehicle types and Environment Protection Authority Victoria vehicle emissions projections to model the levels and dispersal of these contaminants across the project study area and Beaufort township. These were compared to Environment Protection Authority Victoria intervention levels stipulated in the State Environment Protection Policy (Air Quality Management) to establish areas of potential impact.

The emissions modelling was undertaken for the following four contaminants, which are the key Class 1 contaminants for which vehicle emissions are a major source:

- Carbon monoxide (CO)
- Nitrogen dioxide (NO_2)
- Fine particles (PM_{10}; and $PM_{2.5}$).

Emission rates, outlined in Table 14.4 below for 2021 and 2031, were derived from vehicle testing data provided by Environment Protection Authority Victoria, checked against current and predicted Permanent International Association of Road Congresses (now known as the World Road Association) emission factors and the actual emission rates from the CityLink tunnel exhausts. Emission controls for vehicles are becoming more stringent over time with vehicles manufactured after November 2013 having to meet strict emissions standards. Emission rates in 2041 are expected to be significantly lower than in 2031. As Australia has lead-free and low sulphur fuels, lead and sulphur dioxide were not assessed.

Table 14.4 Adopted vehicle emission rates for key vehicle contaminants in 2021 and 2031

Year	Vehicle emission rate G/KM			
	Carbon monoxide	Nitrogen dioxide	PM_{10}	$PM_{2.5}$
2021	4.0	0.46	0.064	0.045
2031	3.6	0.41	0.057	0.040

Projected traffic numbers were derived from the traffic impact assessment conducted as part of this EES. Predicted traffic numbers for the years 2017 and 2031 for the project are detailed in Table 14.5 below.

Table 14.5 Traffic projections for the project

Traffic projections	2017		2031	
	Average day	Peak hour	Average day	Peak hour
East bound	4,300	464	4,900	528
West bound	3,570	380	4,070	433
Total vehicles	7,870	844	8,970	961
% heavy vehicles	26%	27%	26%	27%

Modelling of vehicle emissions during operation of the project was carried out for the year 2031 using the Austroads dispersion model to predict the concentrations of the four Class 1 contaminants on a typical cross section. This is the standard model used to predict near-road concentrations of contaminants.

Greenhouse gas assessment

The greenhouse gas assessment evaluated the project's potential greenhouse gas emissions during construction and operation. The methodology for the assessment was to:

- establish the fuel use of construction equipment and estimate greenhouse gas emissions during construction
- establish the fuel use of the vehicle fleet during operations and estimate greenhouse gas emissions
- use comparative greenhouse gas emissions data as the basis for assessment.

14.4.2 Noise and vibration

Existing conditions

Noise monitoring

Existing noise conditions were established through the placement of noise monitoring equipment (noise loggers) at select sensitive receptors, including those most likely to experience an increase in noise levels such as dwellings near the alignment. The aim was to determine the most conservative estimates that may affect a residence. Loggers were also placed within the town centre along the Western Highway to measure existing noise levels within the town for the purpose of assessing changes in road traffic noise after the project becomes operational.

To facilitate the accuracy of the data, noise monitoring was completed over a period of approximately two weeks and the results were averaged, with bad weather conditions considered to reduce the effects of any abnormal noise conditions during the monitoring period.

Impact assessment

Noise modelling

Construction phase

Potential construction noise impacts are required to be assessed to the VicRoads *Traffic Noise Reduction Policy 2005*. Time periods and guideline noise levels applicable to construction noise set by the VicRoads *Technical Guidelines: Noise Guidelines – Construction and Maintenance Works 2007* are defined in Table 14.6. These are referenced from the Environment Protection Authority Victoria Publication 1834 (November 2020) *Civil construction, building and demolition guide*.

It is expected that construction of the project will comply with Environment Protection Authority Victoria Publication 1834 and the VicRoads *Technical Guidelines*.

Exceptions to specified construction work hours for unavoidable works must be approved by the Environment Protection Authority Victoria. Unavoidable works are works that cannot practicably meet the schedule requirements because the work involves continuous work (such as a concrete pour) or would otherwise pose an unacceptable risk to life or property or risk a major traffic hazard. Affected premises should be notified of the intended work, its duration and times of occurrence. In such cases the Environment Protection Authority Victoria must be consulted in accordance with Environment Protection Authority Victoria Publication 1834 and any necessary approvals sought for works outside of applicable hours.

Table 14.6 Time periods and guideline noise levels

Time period	Applicable hours	Guideline noise levels ($L_{Aeq,15min}$)	
		Up to 18 months	18 months or more
Normal Working Hours	• 7:00 am to 6:00 pm Monday to Friday • 7:00 am to 1:00 pm Saturdays	No specified guideline noise level - noise reduction measures apply	
Weekend/Evening Work	• 6:00 pm to 10:00 pm Monday to Friday • 1:00 pm to 10:00 pm Saturdays • 7:00 am to 10:00 pm Sundays & Public Holidays	Noise level at any residential premises not to exceed background noise by 10 dB(A) or more	Noise level at any residential premises not to exceed background noise by 5 dB(A) or more
Night works	• 10:00 pm to 7:00 am Monday to Sunday	Noise should not be above background levels inside any adjacent residence	

Based on these guidelines, high level predictions of construction noise were made to determine likely impacts to sensitive receptors and indicative controls for the project. This included an assessment of typical construction scenarios (i.e. bulk earthwork, vegetation clearing, bridge works (driven piles) and paving) and the times at which they are proposed to occur (e.g. during normal working hours or outside of normal working hours) and the locations where construction activities are likely to be carried out.

Sound pressure levels for construction equipment typically used during each of the construction scenarios were predicted using sound power data from *Construction Noise and Vibration Guidelines – NSW Roads and Maritime Services* and *AS 2346:2010 – Guide to Noise and Vibration Control on Construction Demolition and Maintenance Sites*. The total sound pressure level for each scenario was predicted at varying distances as shown in Figure 14.1.

L_{Aeq} – The A-weighted sound pressure level in decibels of a continuous steady sound that has, within a specified time interval (T), the same energy as the sound being measured. It can be considered the ‘average’ noise over time interval, T.

A-weighting refers to a frequency weighting devised to attempt to take into account the fact that human response to sound is not equally sensitive to all frequencies.

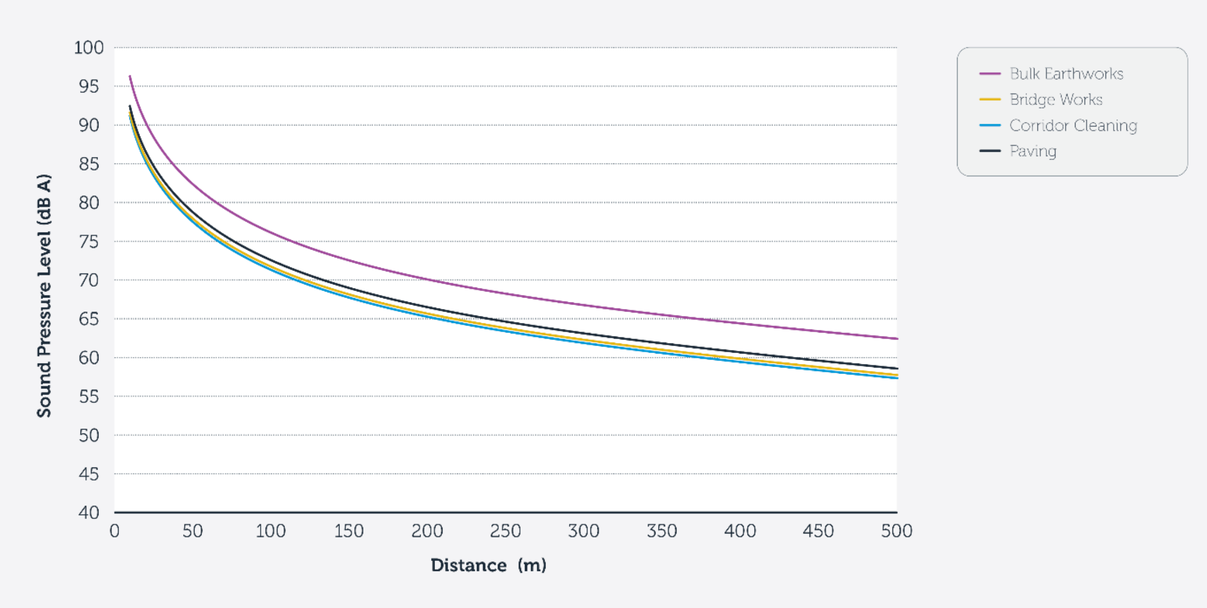

Figure 14.1 Construction noise for tested scenarios over distance

Operation phase

A noise model was prepared using an algorithm accepted by RRV to predict noise from road traffic operations. The model uses traffic volume, speed, percentage of heavy vehicles, road geometry and terrain to estimate the noise levels at noise-sensitive receptors, and considers the different road surface types as these can also affect noise levels.

Sleep disturbance

A sleep disturbance assessment was undertaken to understand potential night-time noise levels and impacts on sensitive receptors in the investigation area. The methodology outlined in Practice Note iii of NSW *Environmental Noise Management Manual* 2001 was used for the sleep disturbance assessment, which defines maximum noise level events likely to cause awakening reactions (i.e. sleep disturbance).

Internal noise targets were set at 55 dBA in accordance with the NSW 2001 *Environmental Noise Management Manual*. Accounting for the reduction of sound from outside to inside a given house requires knowledge of the construction of the walls, roof and glazing. As the construction of each property is not known and as each construction may differ, a difference of 10 dB through an open window, as is commonly used, was assumed for the sleep disturbance assessment. The external maximum event noise level to be used as a criterion in this case is therefore **65 dBA L_{max}.**

A **sleep disturbance event** is defined in the NSW 2001 *Environmental Noise Management Manual* as:

- above 65 dBA external L_{max} AND
- a difference of 15 dBA or more between the maximum noise levels and the one-hour L_{eq}

Two scenarios were modelled to predict maximum event noise levels from truck pass-bys. These were:

- truck under engine brakes
- heavy truck full throttle.

Noise assessment terminology

Noise measurements (dB): Noise is usually measured in decibels (dB), a logarithmic measure of sound pressure. A-weighted decibel (dBA) is a unit used to represent the airborne sound pressure level. A-weighting applies a frequency filter to measured noise to represent how the human ear hears sound. In dBA, decibel values at low frequencies are reduced because the human ear is less sensitive at low frequencies. Noise limits for environmental impacts are typically specified in dBA.

Human response to noise level changes:

- ± less than 3 dBA = no perceivable difference
- ± 3 dBA = barely perceptible difference
- ± 5 dBA = readily perceptible difference
- ± 10 dBA = subjective 'doubling' or 'halving' of sound level.

L_{max}: the maximum sound level measured during a noise event

L_{eq}: the 'equivalent continuous sound level', which refers to the average sound pressure level over a measurement period. This unit of measurement is used to describe sound levels that fluctuate over time.

14.4.3 Mitigations

Specific design, construction and operational mitigation measures were developed in consultation with RRV to manage the potential amenity (air quality, noise and vibration) impacts of the project. All identified mitigations have been informed by technical specialist experience, with proven feasible control measures for major civil infrastructure projects, industry best practice measures and regulatory measures defined by State, Commonwealth and International agencies.

14.5 Study area

The study area for the project includes approximately 1,800 ha of land north of the Beaufort township. This study area and the Beaufort township were assessed to determine potential amenity impacts and constraints associated with the project.

14.5.1 Air quality investigation area

The investigation area for the air quality assessment aligns with the project study area (refer to Figure 14.2). Amenity impacts from the project were modelled and assessed for these locations.

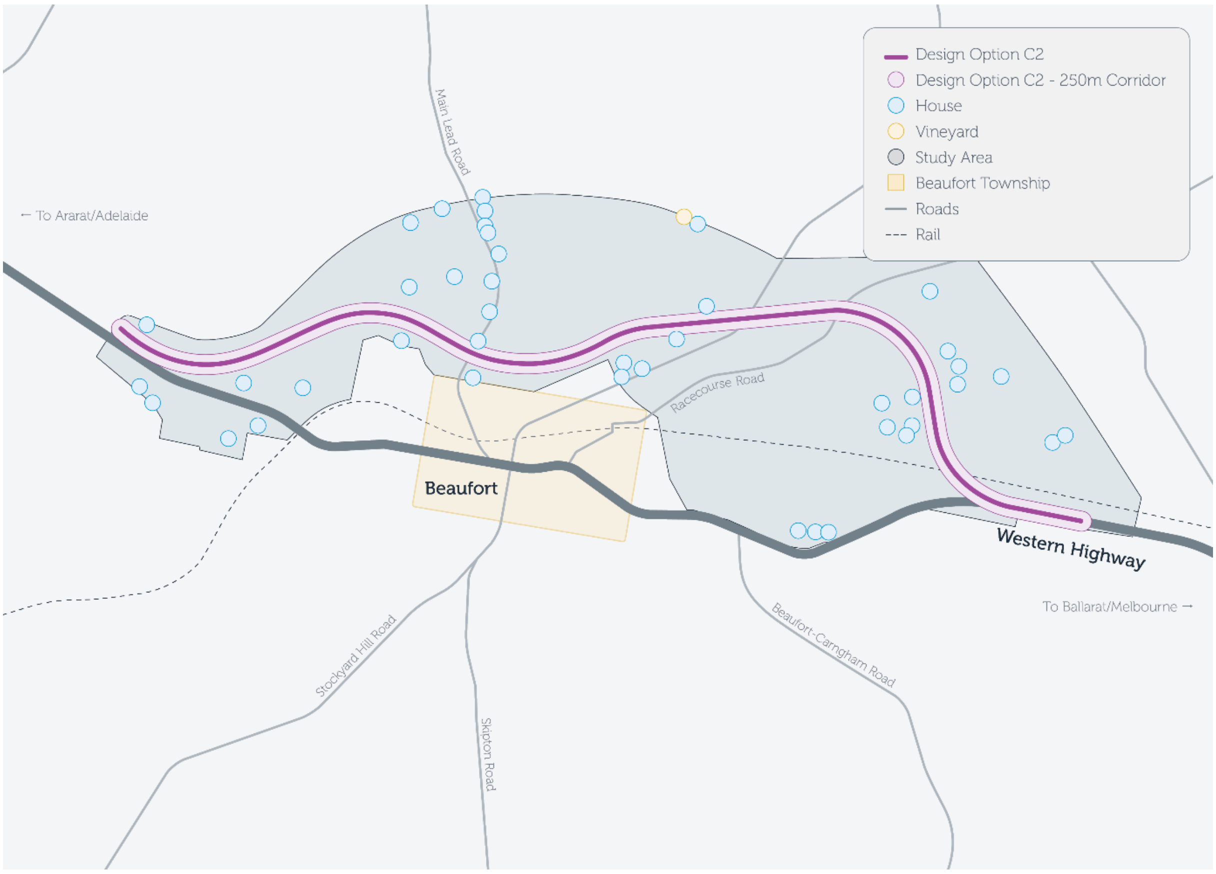

Figure 14.2 Air quality investigation area

14.5.2 Noise and vibration investigation area

The noise and vibration assessment investigation area includes the project study area and Beaufort township, and the identified sensitive receptors within Figure 14.3 that fall outside the study area.

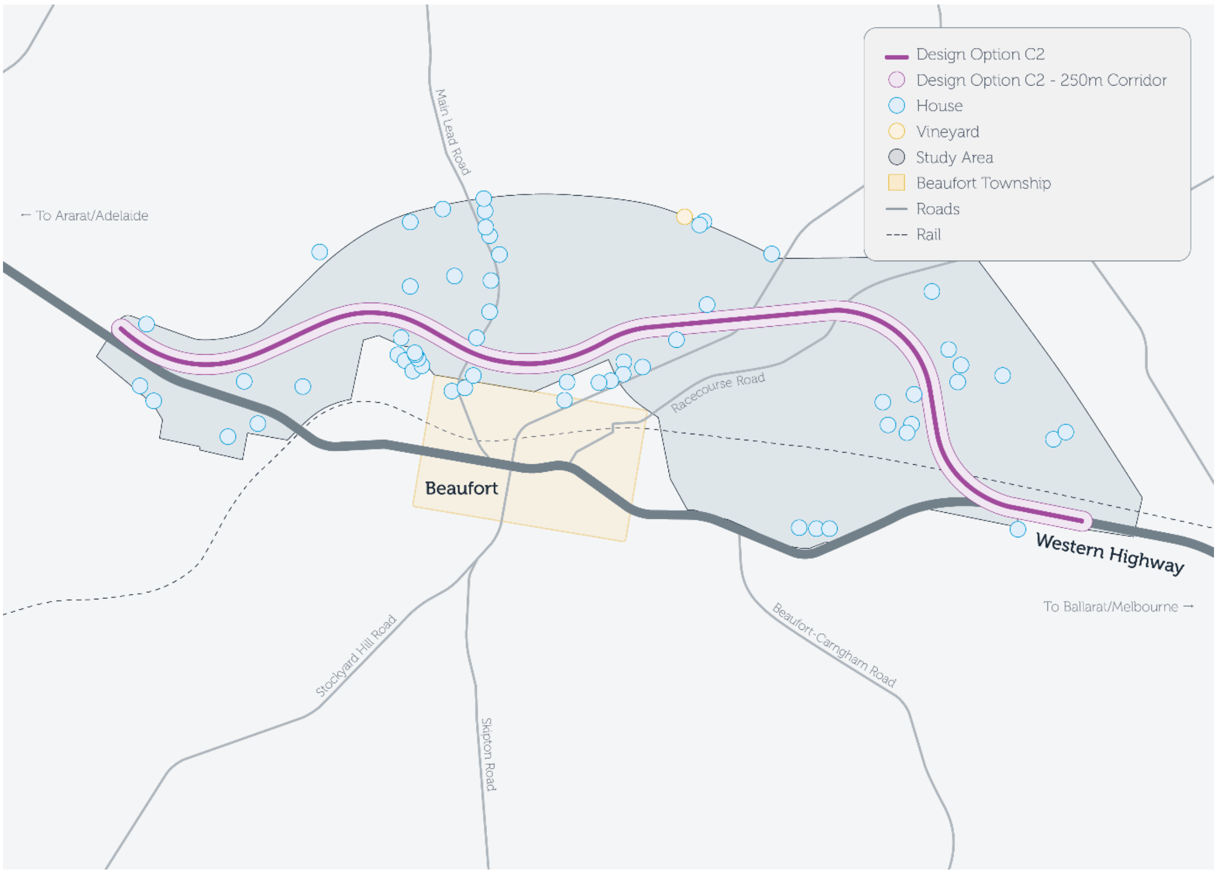

Figure 14.3 Noise and vibration assessment investigation area

14.6 Existing conditions

This section outlines the existing local climate, current ambient air quality, and the noise and vibration levels experienced in the study area and Beaufort township.

14.6.1 Air quality

Sensitive receptors

A total of 15 sensitive receptors for air quality were identified for the project, listed in Table 14.7 below and shown in Figure 14.2 above. As per the VicRoads Air Quality Screening procedure, the distance to a sensitive receptor is measured from the closest edge of any trafficked lane to the nearest boundary of the sensitive receptor.

Table 14.7 Air quality sensitive receptors and distance from the closest trafficked lane

Distance	Number of sensitive receptors
Within 100 m	2
Within 200 m	4
Within 300 m	9

There are approximately 15 rural residences within 300 m of closest trafficked lane that collect rainwater from their roof for domestic use. There is a vineyard in the study area, located approximately 1 km from the project area.

Meteorological conditions

The prevailing meteorology and climate influence the generation and the dispersion of emissions.

Generally, the maximum air temperature in the study area is below 20°C during April to November and above 20°C during December through to March. Mean monthly minimum temperatures are below 10°C for most of the year. Mean monthly temperatures are presented in the Table 14.8.

Table 14.8 Mean Temperatures (°C) for Ballarat aerodrome weather station (1908 to 2019)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max Temp (°C)	25.2	25.1	22.3	17.7	13.7	10.8	10.1	11.4	13.9	16.7	19.7	22.7	**17.4**
Mean Min Temp (°C)	11.0	11.5	10.0	7.5	5.7	4.0	3.2	3.7	4.8	6.2	7.8	9.5	**7.1**

The highest rainfall occurs in winter and spring and the lowest rainfall in January to March (refer to Figure 14.4). There is a large variability in the pattern of annual rainfall and the total rainfall from year to year in Beaufort. This variability makes it difficult to predict the rainfall in the period of construction.

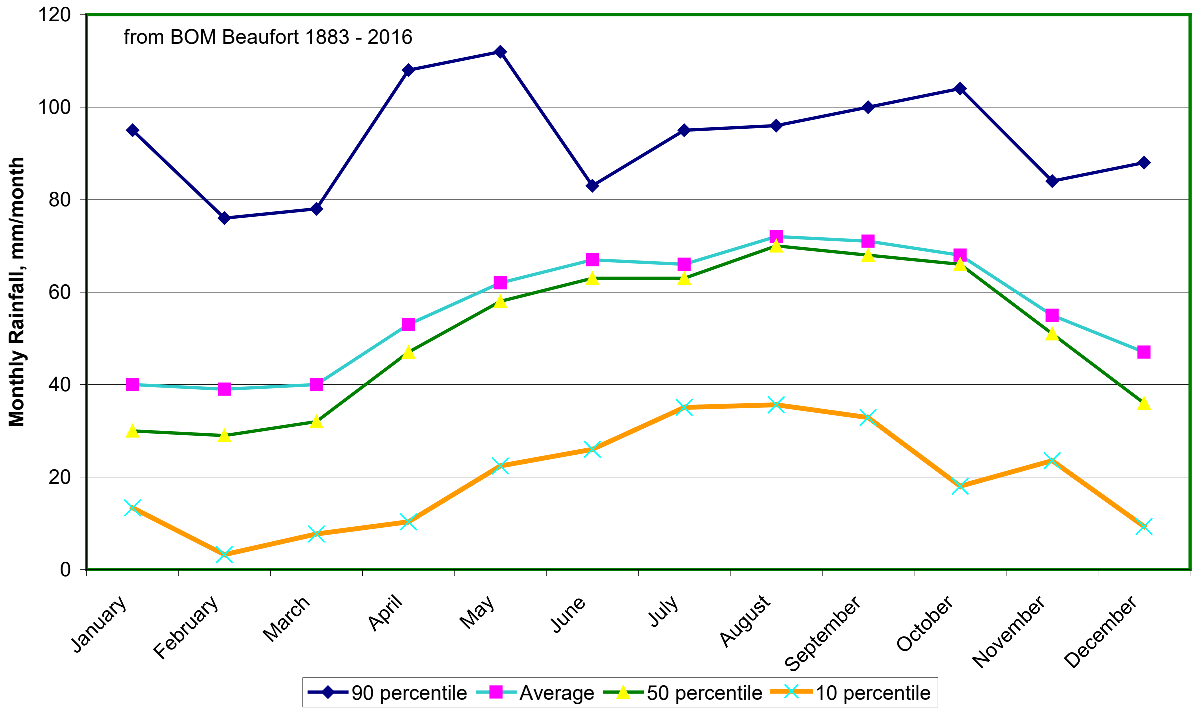

Figure 14.4 Monthly rainfall range recorded at Beaufort

Wind data from nearby weather stations indicate that morning wind speeds (8–14 km per hour) are consistently lower than afternoon wind speeds (13–18 km per hour). There is also a strong seasonal cycle, with higher wind speeds in spring and early summer and lower wind speeds in winter. The prevailing winds are season-dependent, with winds typically from the north in the summer and from the south in the winter.

Ambient air quality

There is no known source of air quality monitoring data from the study area however air quality in Doveton Street, Ballarat (as monitored by the Environment Protection Authority Victoria from August 2005 to August 2006) was used to set baseline conditions as Ballarat is the closest monitoring site to the study area (Table 14.9).

Table 14.9 Background concentrations (1-hour averaging period)

Contaminant	1-hour background concentration (µg/m^3)
Carbon monoxide (CO)	1,000
Nitrogen dioxide (NO_2)	40
Fine particles (PM_{10})	20
Very fine particles ($PM_{2.5}$)	15

The results of the air quality monitoring showed that Ballarat had generally good air quality but was locally impacted by bushfires and, on colder evenings, contributions from domestic wood smoke. The monitoring ultimately determined that maximum carbon monoxide, nitrogen dioxide and ozone levels at Ballarat all met air quality objectives. As Ballarat is a larger centre, air contaminant levels would be expected to be lower in Beaufort, so the background concentrations used represent a conservative estimate.

14.6.2 Noise and vibration

The construction and operation of the project has the potential to affect a range of noise-sensitive receptors throughout the noise and vibration investigation area. The following section presents an overview of identified key sensitive receptors and the existing ambient noise environment.

> *Ambient noise* – The ambient noise level at a location is the overall environmental noise level caused by all noise sources in the area. Ambient noise is usually assessed as an average over a set time period.

Sensitive receptors

A total of 69 noise sensitive receptors were identified for the purposes of the assessment. Sensitive receptors considered within the noise and vibration assessment are described as two categories (A and B) and are summarised below in Table 14.10.

Table 14.10 Sensitive receptor categories for the assessment of noise and vibration

Building types	
Category A	Residential dwellings, aged persons' homes, hospitals, motels, caravan parks and other buildings of a residential nature.
Category B	Schools, kindergartens, libraries and other noise-sensitive community buildings.

There are a number of Category A sensitive receptors located within the investigation area which were considered in the impact assessment. All of these locations were residential properties, with one also including a vineyard.

While there are known Category B sensitive receptors located to the south of the existing Western Highway and within the township of Beaufort, such as schools and aged care facilities, these are outside of the investigation area and considered unlikely to be impacted by construction or operational noise issues from the project.

Existing noise levels

To assess the background noise levels within the investigation area, loggers were deployed to select sensitive receptor locations to monitor and record normal conditions in that area. The locations were strategically selected to represent the spread of these receptors though the investigation area and are shown in Figure 14.5. This included noise monitoring at four locations within the township of Beaufort along the existing Western Highway (shown as locations L-A, L-B, L-C and L-D on Figure 14.5 below). The normal background levels established by the noise monitoring were used to assess the potential impacts of noise and vibration caused by construction activities as well as the normal operation of the road.

> ***L_{A10}* –** The A-weighted sound pressure level in decibels exceeded for 10 per cent of the measurement period, T.
>
> The **$L_{10,18hour}$** noise levels are used to determine operation traffic noise objectives.

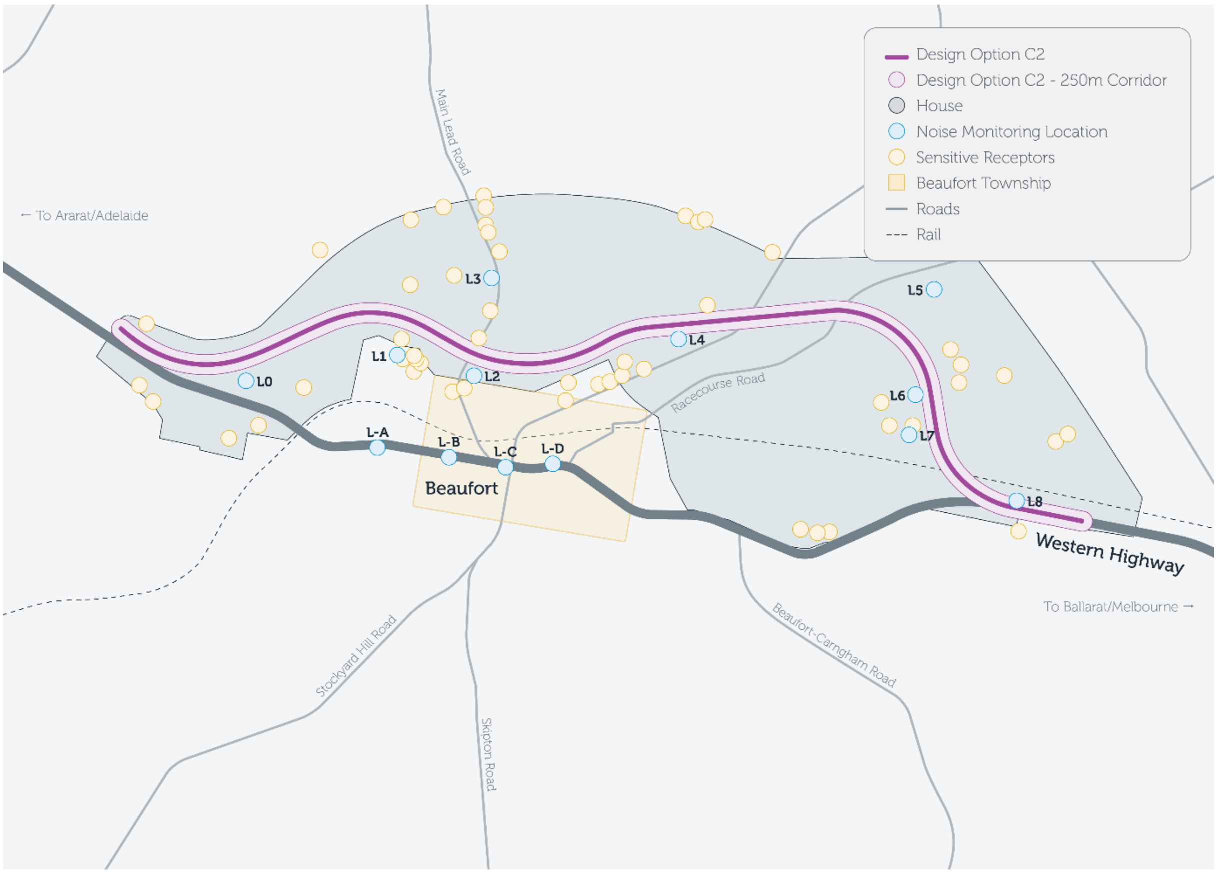

Figure 14.5 Noise logger locations within the study area (L0 to L8) and Beaufort township (L-A to L-D)

Figure 14.6 Noise logger deployed in the field

Study area noise measurement results

The results of the measurements indicate that most locations have noise levels below 50 $dBL_{A10,18HR}$. Two locations were measured to have existing noise levels above 50 $dBL_{A10,18HR}$, up to 66 $dBL_{A10,18HR}$. Full results of the monitoring are presented in Appendix H: *Noise and vibration impact assessment* and summarised in Table 14.11.

Table 14.11 Existing noise levels within the study area (red highlighted cells indicate locations with existing noise levels above 50 $dBL_{A10,18HR}$)

Monitoring location	Measured noise level, dB			
	$L_{A10,18h}$	Day	Evening	Night
L0	57	43	43	34
L1	44	34	33	27
L2	49	38	37	32
L3	49	34	33	29
L4	50	36	36	31
L5	40	30	28	24
L6*	49	38	37	32
L7	41	31	29	25
L8	66	42	42	34

**L6 was not used for developing Project Objective Noise Levels due to excessive extraneous noise recorded during monitoring*

In-town noise measurement results

The results of the measurements indicate that most locations have noise levels above 70 $dBL_{A10,18hr}$. Full results of the monitoring are presented in Appendix H: *Noise and vibration impact assessment* and summarised in Table 14.12.

Table 14.12 Existing noise levels within the Beaufort township (red highlighted cells indicate locations with existing noise levels above 50 $dBL_{A10,18HR}$)

Monitoring location	Measured noise level, dB			
	$L_{A10,18h}$	Day	Evening	Night
L-A	71	46	46	39
L-B	72	48	44	36
L-C	71	55	51	43
L-D	67	48	42	37

Project Objective Noise Levels

Project Objective Noise Levels have been established in accordance with the VicRoads *Traffic Noise Reduction Policy* and Road Design Note 06-01 (RDN 06-01) for the project (summarised in Table 14.13). Figure 14.7 presents the methodology used to assess and establish the Project Objective Noise Level.

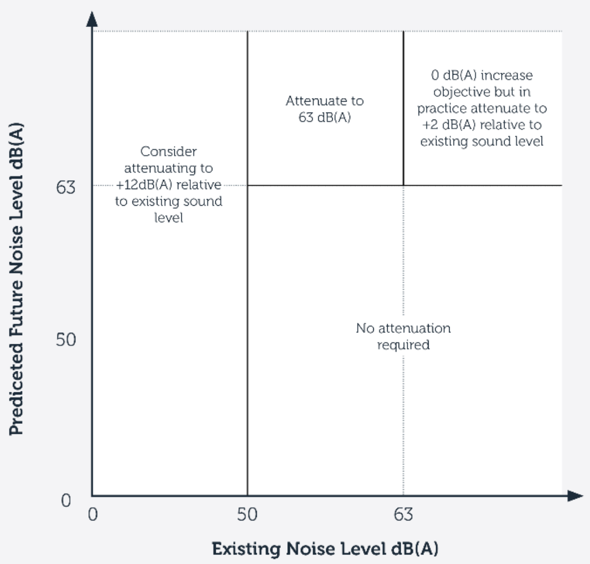

Figure 14.7 Project noise level objective diagram (source: Road Design Note 06-01 – Interpretation and application of VicRoads Traffic Noise Reduction Policy)

These Project Objective Noise Levels are appropriately spaced along the project area and are used to set the maximum acceptable noise levels at sensitive receptors along the project area. Sensitive receptors near the below locations will have the same Project Objective Noise Levels.

Table 14.13 Project Objective Noise Levels

Monitoring location	Measured noise level, $dBL_{A10,18h}$	Criteria to establish Project Objective Noise Level	Project Objective Noise Level, dB $L_{A10,18h}$
L0	57	63 $dBL_{A10,18h}$	**63**
L1	44	Limit to +12 dB above existing	**56**
L2	49	Limit to +12 dB above existing	**61**
L3	49	Limit to +12 dB above existing	**61**
L4	50	63 $dBL_{A10,18h}$	**63**
L5	40	Limit to +12 dB above existing	**52**
L6	49	Limit to +12 dB above existing	**61**
L7	41	Limit to +12 dB above existing	**53**
L8	66	Limit to +2dB above existing	**68***

* *The Project Objective Noise Level is set to limit the increase noise to 0 dBA but in practice to attenuate +2 dBA relative to the existing noise levels*

14.7 Impact assessment

14.7.1 Construction

Air quality

As noted in Section 14.3, the State Environment Protection Polices will be replaced by Environmental Reference Standards as they are reviewed and updated. The air quality impact assessment has been assessed against the existing State Environment Protection Polices. The project will need to comply with the relevant legislation at the time of project construction.

Construction dust

Figure 14.8 shows the predicted peak 2-day concentration of Total Suspended Particulates over distance from the project for each of the construction stages in relation to the State Environment Protection Policy (Air Quality Management) Design Criteria of 100 $\mu g/m^3$.

The peak Total Suspended Particulates concentration is highest during the filling and compaction stage, when a lot of material is being placed, spread and compacted in layers. Lower Total Suspended Particulates emissions and concentrations will occur in the excavation and pavement construction stages.

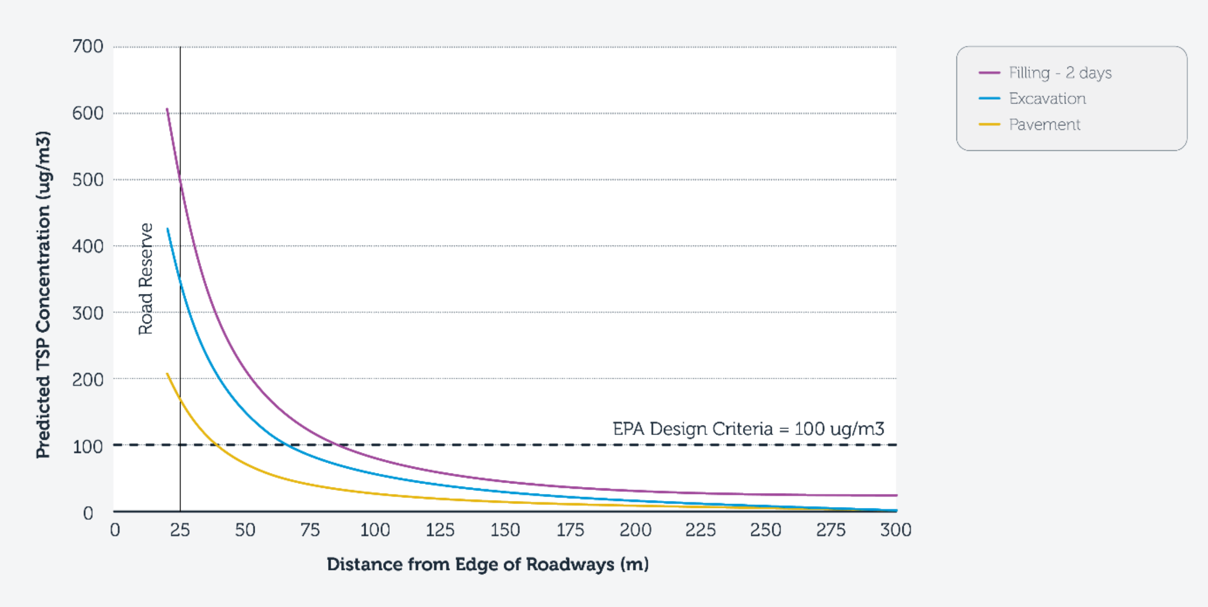

Figure 14.8 Modelled peak Total Suspended Particulates concentration from the edge of the road for the three stages of construction

Additional modelling was undertaken to determine PM_{10} levels over the worst two, 10 and 30 days of the filling activities during the construction period to understand the worst case scenario of dust impacts to amenity (i.e. hot, dry conditions with blustering northerly winds). Figure 14.9 shows that the peak PM_{10} level is high on the roadway, as would be expected in the centre of construction activity.

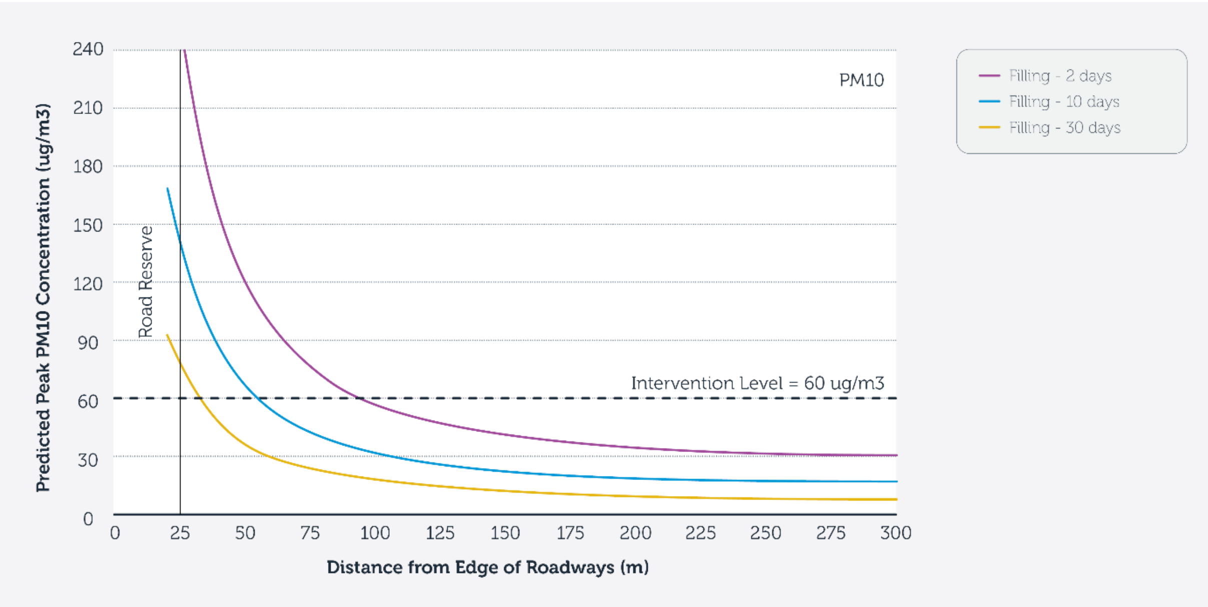

Figure 14.9 Predicted peak PM_{10} concentration distribution

Based on the assessment, construction dust concentrations are predicted to be highest during filling operations and to be less during later stages of construction. The zone of nuisance dust is predicted to extend up to about 200 m from the edge of construction on days of unfavourable weather, although generally the nuisance zone should be less than 150 m for most of the construction period.

The two sensitive receptors within 0–100 m of the project may experience elevated dust levels on about 30 days per year during the period of construction. A moderate impact is predicted for those 30 days. For the four receptors within 100 m–200 m, elevated dust levels are only modelled to occur on a few hot days per year, with a moderate impact predicted on those few days.

For the nine receptors within 200–300 m of the closest trafficked lane, increased dust levels will occur on a few hot days each year due to the distance from the project area. This impact is considered low for those few days. On balance, without mitigation, the overall impact from dust to all sensitive receptors within 300 m of the project area is considered low, with temporary and localised moderate impacts occurring throughout the construction period.

Without mitigation, dust and particulates during construction may have a temporary effect on flora and fauna, and result in increased nutrients and turbidity in waterways. As such, the likely degree of impact from dust during the project construction on flora and fauna (particularly wetland habitat) is assessed as moderate. Further discussion on the impacts of dust on local flora and fauna are addressed in EES Chapter 9: *Biodiversity and habitat*.

Construction greenhouse gas emissions

Greenhouse gas emissions during construction are based on the use of fuel (principally diesel) by construction equipment, employee vehicles and delivery vehicles that are directly associated with the construction of the project and the total number of operating hours per year.

CO_2-e: Carbon dioxide equivalent, or CO_2-e, is a unit for measuring the carbon footprint by expressing the impact of different greenhouse gases in terms of CO_2 amounts that would result in an equivalent amount of warming.

These calculations indicate that during the period of excavation, the greenhouse gas production will total about 12,600 tonnes of CO_2-e, while during the period of filling and road formation, the greenhouse gas production will total about 12,000 tonnes of CO_2-e. As a point of reference, the *State and Territory Greenhouse Gas Inventories report* (Department of Environment and Energy, 2017) noted the total greenhouse gas emissions for Victoria in 2015 was 120 million tonnes of CO_2-e gases. The project would therefore contribute 0.02% to the Victoria's annual CO_2-e gases.

Noise and vibration

Construction noise

High level predictions indicate that construction noise is expected to be audible at times within 200 m of the project area. The intensity of noise levels will be dependent on the construction activity and distance to the sensitive receptor. The ten closest sensitive receptors are within 200 m of the closest trafficked lane and are expected to experience noise impact ranging from 65–89 dBA, depending on the location of the receptor and type of construction activity occurring. For the construction phase, this impact has been assessed as high without mitigation.

It is expected that some works during night-time periods may occur, where deemed 'unavoidable'. This may include continuous work that cannot be completed in regular working hours (e.g. concrete pour) or would otherwise pose an unacceptable risk to life or property or risk a major traffic hazard. If construction activities outside standard hours are proposed by the construction contractor, prior approval from the RRV/MRPV superintendent and prior notification to potentially affected residents would be necessary. Approvals would be sought in accordance with Environment Protection Authority Victoria Publication 1834. Noise generated by construction activities would be managed in accordance with VicRoads *Technical Guidelines: Noise Guidelines - Construction and Maintenance Works 2007*, which references applicable Australian Standards and Environment Protection Authority Victoria Guidelines.

Construction vibration

Potential construction vibration impacts are expected to be predominantly associated with driven piling works and vibratory compaction of ground surfaces. Vibration levels depend on several factors such as:

- source levels (based on equipment specs and operation mode)
- soil properties in the investigation area
- coupling losses at soil-foundation interface
- internal building fabric and building type of the sensitive receptor.

Based on information provided in the *NSW Roads and Maritime Services Construction Noise and Vibration Guideline – August 2016,* Table 14.14 provides recommended minimum safe working distances from dwellings for typical vibration intensive plant items.

Table 14.14 Recommended minimum working distances from sensitive receptors for vibration intensive plant

Plant item	Rating/description	Minimum working distance (m)	
		Cosmetic damage	Human comfort
Vibratory Roller	< 50 kilonewton (typically 1–2 tonnes)	5	15 to 20
	< 100 kilonewton (typically 2–4 tonnes)	6	20
	< 200 kilonewton (typically 4–6 tonnes)	12	40
	< 300 kilonewton (typically 7–13 tonnes)	15	100
	> 300 kilonewton (typically 13–18 tonnes)	20	100
	> 300 kilonewton (> 18 tonnes)	25	100
Small hydraulic hammer	(300 kg – 5 to 12 tonne excavator)	2	7
Medium hydraulic hammer	(900 kg – 12 to 18 tonne excavator)	7	23
Large hydraulic hammer	(1600 kg – 18 to 34 tonne excavator)	22	73
Vibratory pile driver	Sheet piles	2 to 20	20
Pile boring	≤ 800 mm	2 (nominal)	4
Jackhammer	Hand-held	1 (nominal)	2

The majority of the receptors nearest to the project area are, at minimum, located 100 m away and are therefore considered a low impact regarding adverse vibration levels with respect to human comfort. It is anticipated that airborne noise levels from construction activities will be the dominant source of any intrusion caused, without the implementation of mitigation measures. Mitigation measures will be put in place to minimise these impacts and maintain human comfort levels. Potential impacts to fauna due to construction noise is discussed in EES Chapter 9: *Biodiversity and habitat*.

14.7.2 Operation

Air quality

Operational dust

Emissions from vehicles are principally gases and fine particles, which are largely controlled by catalytic converters and particle emissions from trucks (diesel engines) and are very fine and slow to settle. Based on modelling data, it is estimated that the monthly average dustfall from the operation of the road will be less than 4 g/m^2 per month, which is below the Environment Protection Authority Victoria operational control requirements and do not trigger the need for controls. As such, dust emissions during operation are not expected to impact sensitive receptors or roof water supplies. The impact of operational dust is rated as negligible.

Operational emissions

For NO_2, $PM_{2.5}$ and PM_{10} averaging periods, the concentrations of air contaminants at all receptors during operation of the project are predicted to satisfy the State Environment Protection Policy (Air Quality Management) Intervention Levels and Design Criteria, and the State Environment Protection Policy (Ambient Air Quality) Environmental Objectives. The air quality predictions for vehicle emissions show that, owing to the small number of vehicles and the separation between the roadway and the nearest receptors, there will be negligible impact of vehicle emissions at all receptors, even those within 100 m of the roadway (Figure 14.10).

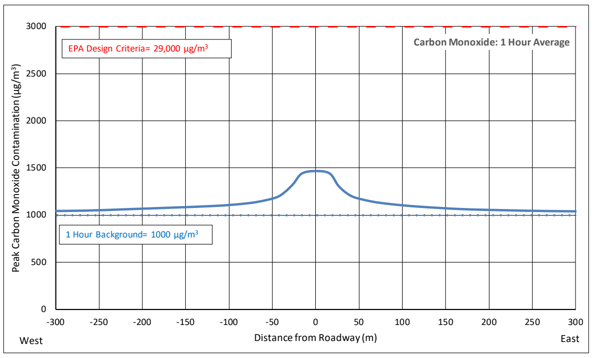

Figure 14.10a Carbon monoxide 1-hour average

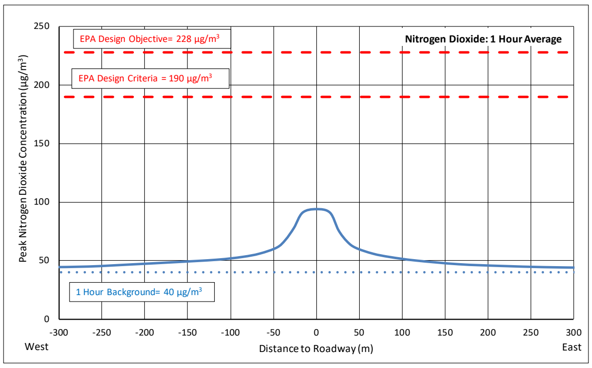

Figure 14.10b Nitrogen dioxide 1-hour average

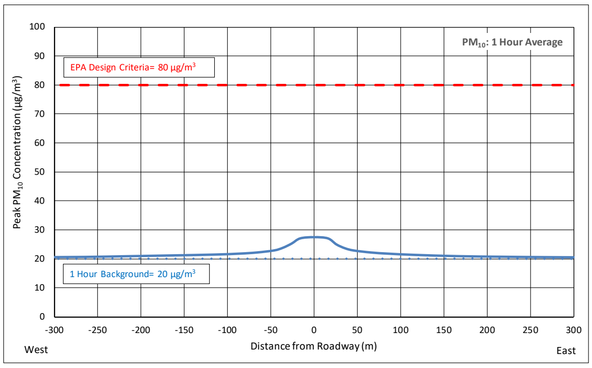

Figure 14.10c PM_{10} 1-hour average

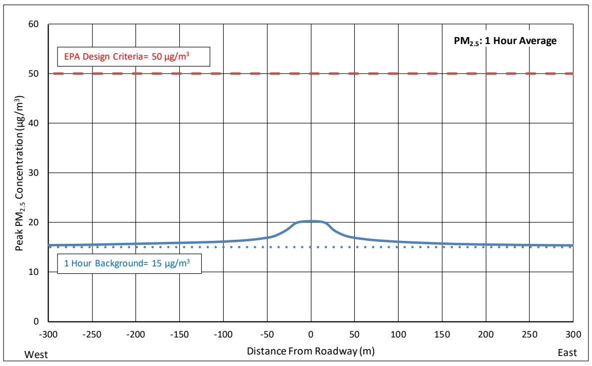

Figure 14.10d $PM_{2.5}$ 1-hour average

Figure 14.10 Predicted distribution for key vehicle contaminants

Operational greenhouse gas emissions

The greenhouse gas implications of vehicles using the project were also calculated based on the projected year 2031 traffic data (refer to Table 14.15). Calculations estimate that vehicles using the project will generate about 13.5 tonnes of CO_2-e per year. Taking into account the increasing proportion of hybrid and electric vehicles, this estimate is conservative.

Table 14.15 Estimated greenhouse gas emissions during operation

Operation stage	No/day	Hours per day	Fuel/hour	Litres per year	$CO_{2\text{-}e}$ tonnes per year
Cars	6,300	0.11	8	2,023,000	5,400
Light Commercial	270	0.11	9	97,000	260
Heavy Commercial	2,400	0.11	35	3,373,000	9,100
Total	**8,970**				**13,460**

In comparison, vehicles travelling through Beaufort face speed restrictions, four changes in the allowable speed, and a proportion of vehicles must stop for traffic lights and pedestrians crossing the road, all of which cause vehicle speeds through Beaufort to be variable. As a result, there would be slightly higher fuel consumption on the average vehicle journey through Beaufort compared to the journey on the bypass. This would equate to an approximate 3% reduction in overall greenhouse gas emissions with the project in operation.

Noise and vibration

Traffic noise

The number of exceedances predicted for the project without noise mitigation treatment is 27. The predicted exceedances range between 1 and 16 dBA unmitigated. Noise mitigation solutions are recommended to meet the Project Objective Noise Levels at all identified sensitive receptors within the investigation area, which include:

- lower noise road surface along the entire bypass (surface treatment) (7 mm spray seal)
- targeted noise barriers (up to 4 m in height)
- targeted off-reservation treatments (where reasonable on-reservation treatments have been explored).

Table 14.16 details the Project Objective Noise Levels and the predicted operational noise levels against those Project Objective Noise Levels with standard noise mitigation in place, such as noise barriers and surface treatments. Off-reservation treatments are recommended to be applied to the properties with residual exceedances, following reasonable on-reservation mitigation measures (surface treatments and noise barriers). The extent of off-reservation treatment is dependent on:

Off-reservation treatment: architectural acoustic treatments which can include installing or upgrading door and window seals, double-glazing of glass windows/doors or the sealing of air vents.

- the magnitude of exceedance above the Project Objective Noise Level at the sensitive receptor
- the size and quantity of habitable rooms facing the project area
- the structural/architectural condition of the property.

Impacts to fauna due to operational noise is discussed in EES Chapter 9: *Biodiversity and habitat*.

Table 14.16 Predicted noise level exceedances at residences along the project area (year 2031, dBA $L_{10,18HR}$)

	Existing	Unmitigated		With mitigation					
				Surface treatment only		Surface treatment + 2 m barriers		Surface treatment + 4 m barriers	
House ID	Project Objective Noise Levels ($dB_{LA10,18h}$)	Predicted	+/- Project Objective Noise Level	Predicted	+/- Project Objective Noise Level	Change	+/- Project Objective Noise Level	Change	+/- Project Objective Noise Level
15	56	59	+3	57	+1	57	+1	57	+1
16	56	59	+3	57	+1	56	0	55	0
17	56	65	+9	63	+7	59	+3	57	+1
18	56	63	+7	61	+5	61	+5	61	+5
22	61	65	+4	63	+2	60	-1	56	-5
24	61	68	+7	66	+5	61	0	57	-4
25	61	67	+6	65	+4	60	-1	57	-4
26	61	67	+6	65	+4	60	-1	57	-4
27	61	66	+5	64	+3	59	-2	56	-5
38	63	65	+2	63	0	63	0	63	0
39	52	59	+7	57	+5	57	+5	57	+5
46	53	55	+2	53	0	52	-1	50	-3
48	53	62	+9	60	+7	56	+3	54	+1
49	53	64	+11	62	+9	57	+4	54	+1

	Existing	Unmitigated		With mitigation					
				Surface treatment only		Surface treatment + 2 m barriers		Surface treatment + 4 m barriers	
House ID	Project Objective Noise Levels ($dB_{LA10,18h}$)	Predicted	+/- Project Objective Noise Level	Predicted	+/- Project Objective Noise Level	Change	+/- Project Objective Noise Level	Change	+/- Project Objective Noise Level
50	53	66	+13	64	+11	59	+6	57	+4
52*	53	69	+16	67	+14	67	+14	67	+14
53	53	58	+5	56	+3	56	+3	56	+3
57	68	72	+4	70	+2	70	+2	70	+2
58	53	54	+1	52	-1	52	-1	52	-1
64	56	63	+7	61	+5	56	0	54	-2
65	56	62	+6	60	+4	56	0	53	-3
66	56	62	+6	60	+4	56	0	53	-3
67	56	62	+6	60	+4	55	-1	52	-4
68	56	62	+6	60	+4	55	-1	52	-4
69	56	62	+6	60	+4	56	0	54	-2
70	56	60	+4	58	+2	54	-2	51	-5
78	56	62	+6	60	+4	57	+1	55	-1
Exceedances		**27**		**24**		**11**		**10**	

** House ID 52 shall not be assessed against the Project Objective Noise Level as there is no identified Category A or B building at this location*

Providing a surface treatment (from 10 mm to 7 mm spray seal) with no noise barriers slightly reduces traffic noise levels but is insufficient to meet the Project Objective Noise Levels without additional mitigation.

The 2 m high noise barrier option (in conjunction with surface treatment) significantly reduces the number of properties exceeding the Project Objective Noise Levels, with a small number of properties requiring further off-reservation treatment to achieve compliance. Excluding House ID 52, residual noise level exceedances for the 2 m noise barrier option range from 1 to 6 dB for 10 properties. It is recommended properties with residual exceedances are provided off-reservation treatment.

The 4 m high noise barrier option provides the greatest reduction in properties exceeding the Project Objective Noise Levels. However, this is of marginal benefit over the 2 m high noise barrier option, with only a further reduction of one property. In some cases, doubling the height of the barriers does not change the resultant noise levels, implying that there is minimal benefit for pursuing this option.

The extent of the recommended noise barrier treatment (2 m high barriers with surface treatment) and location of residual exceedances (i.e. those properties requiring off-reservation treatment) are shown in Figure 14.11.

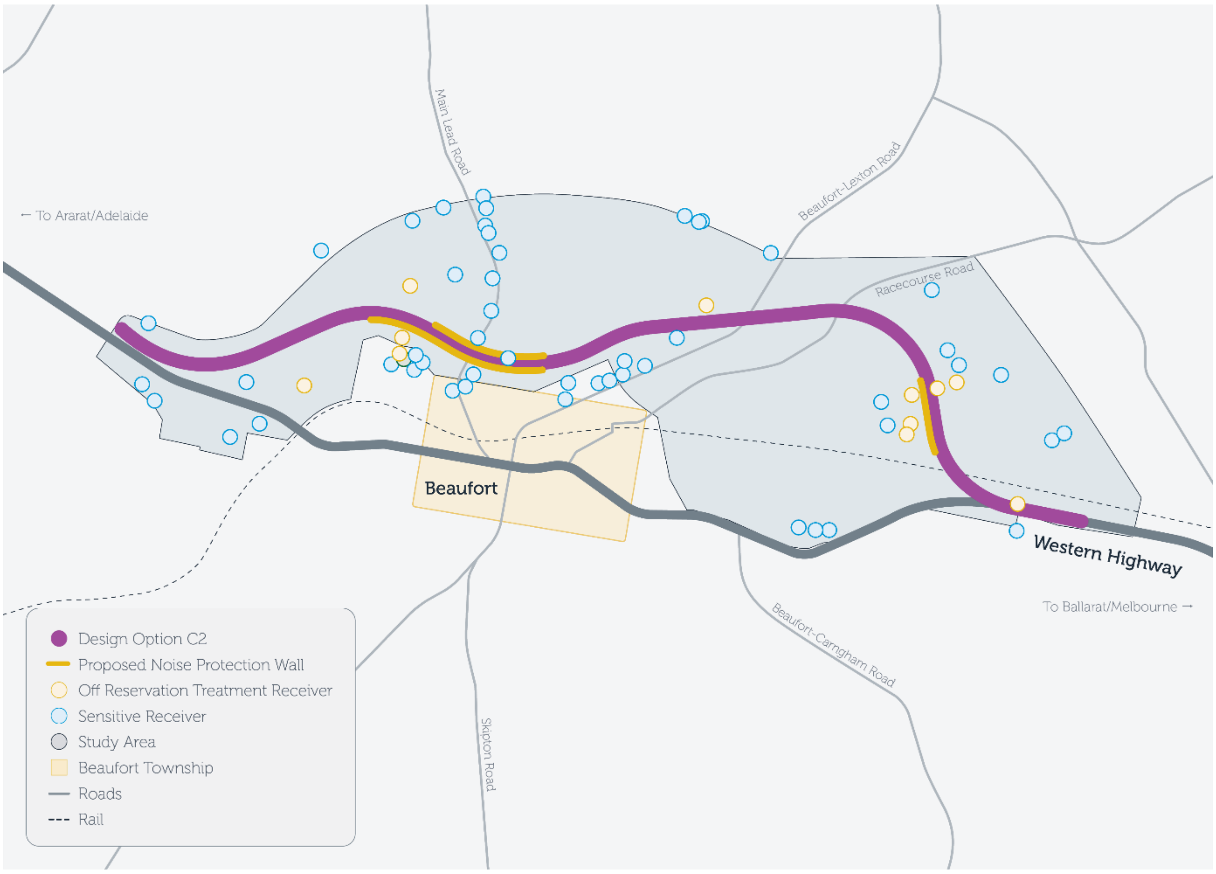

Figure 14.11 Location of proposed noise barriers (2 m high) and residual exceedances (requiring off-reservation treatment)

Beaufort township noise impacts

Projected traffic volumes along the existing Western Highway in Beaufort following the redirection of through traffic to the bypass (refer to EES Appendix M: *Traffic and transport impact assessment*) were used to model the predicted noise levels within the Beaufort township once the project is in operation.

The results show that:

- the in-town noise levels are predicted to decrease by 3 to 6 dB from the 'Predicted (2018)' traffic noise levels once traffic is diverted onto the new bypass. This decrease is considered to be a noticeable to significant perceived reduction in noise level
- without the bypass, the in-town noise levels are predicted to increase by approximately 1 to 2 dB from the 'Predicted (2018)' traffic noise levels. This is not considered a noticeable difference.

Further information on in-town noise assessment can be found in EES Appendix H: *Noise and vibration impact assessment*.

Sleep disturbance

Table 14.17 presents a summary of the number of sensitive receptors above the criteria for surrounding sensitive receptors. To account for the variability in the noise source, a sensitivity of +3 dB and -3 dB was applied to the predicted results.

Table 14.17 Sleep disturbance assessment summary

Scenario	Number of sensitive receptors above criteria	
	Engine brakes	No engine brakes
Reference value as modelled	9	1
Reference value +3 dB	22	7
Reference value -3 dB	1	0

As shown in Table 14.17 above, the sleep disturbance modelling assessment indicates there is a potential impact for up to 22 sensitive receptor locations outside the town from truck engine braking. As the use of engine brakes is determined by the behaviour of the driver, the exact location of a noisy truck is subject to uncontrollable factors.

For the sensitive receptors within the Beaufort township, there is predicted to be a reduction of more than 230 vehicles per night passing through the town with the operation of the project, compared to current night-time traffic volumes. This would likely reduce the number of sleep disturbance events per night for residents within the town. Furthermore, the lower speed limit within the town may currently be a cause of engine braking events as trucks slow before entering the town. This behaviour would also likely reduce due to construction of the project.

Where off-reservation treatment is installed for the control of average traffic noise levels, this will have a beneficial outcome for sleep disturbance by increasing the noise level difference for sensitive receptors.

14.8 Mitigation

14.8.1 Air quality

The bypass construction will be undertaken in accordance with relevant RRV processes and standard specifications including, but not limited to:

- VicRoads Contract Specifications Section 177.C – Air Quality.

These standards set out how RRV projects will comply with relevant legislation and how air quality impacts will be managed during construction and operation of the project.

The mitigations proposed to manage potential impacts to air quality are summarised in Table 14.18 below. The mitigations apply to the construction phase of the project.

Table 14.18 Mitigation measures for air quality impacts

Impacts	Mitigation measures	Mitigation number
Construction		
Dust	Develop and implement a site-specific Dust Management Plan that incorporates the VicRoads standard measures, which includes measures such as: • covering of material that may create a hazard or nuisance dust during transport • installation of directional dust gauges alongside each air quality monitoring station. The site-specific Dust Management Plan is also to incorporate the following additional measures: • install three portable dust monitoring stations near receptors within 200 m of the closest trafficked lane, with rapid response to high readings of dust at monitoring stations. These stations should be sited as advised by an air quality expert • high frequency of watering of exposed surfaces (including exposed stockpiles and unsealed roadways) on days with hot north winds to suppress dust generation • reduce activities with high dust generating potential (including heavy excavations and drilling) when strong winds are blowing towards Beaufort • locating stockpiles away from sensitive receivers, as far as practicable • use mulch or surfactants on stockpiles of topsoil to minimise erosion risk. For stockpiles or temporary soil surfaces lasting more than three weeks, use surfactants to reduce dust emissions • extra controls for trucks moving construction materials, including: – restriction of construction vehicle speeds to minimise wheel-generated dust on unsealed roads – locate haulage routes for rock and soil away from sensitive receptors as much as practical – install truck tyre clean stations at site boundaries for earth moving vehicles to minimise off-site transport of material that could cause dust emissions.	AQ01
Emissions	Project construction shall comply with the requirements of the VicRoads Contract Specifications, including: • emissions of odorous substances or particulates shall not create or be likely to create objectionable conditions for the public • all heavy-duty diesel engines must be fitted with Selective Catalytic Reduction and diesel particulate filters, where practical • install appropriate emission control mechanisms (e.g. fabric filter on crushers, concrete batchers) to minimise air emissions.	AQ02

The concentrations of all air contaminants at all receptors during operation of the project are predicted to satisfy the State Environment Protection Policy (Air Quality Management) Intervention Levels and Design Criteria and the State Environment Protection Policy (Ambient Air Quality) Environmental Objectives. The air quality predictions for vehicle emissions show that, due to the small number of vehicles and the separation between the closest trafficked lane and the nearest receptors, there will be negligible impact of vehicle emissions at all receptors, even those within 100 m of the closest trafficked lane (but outside the defined road reserve). Therefore, no mitigation measures are proposed for operational impacts.

14.8.2 Noise and vibration

The construction phase will be undertaken in accordance with relevant RRV policies and standard specifications including, but not limited to:

- VicRoads Contract Specification Section 177.H – Noise and Vibration
- VicRoads Contract Specification Section 765 – Noise Attenuation
- VicRoads Traffic Noise Reduction Policy 2005
- VicRoads Technical Guidelines: Noise Guidelines - Construction and Maintenance Works 2007.

These standards set out how RRV will comply with relevant legislation and how noise and vibration impacts will be managed.

The mitigations proposed to manage potential impacts to noise and vibration are summarised in Table 14.19 below. The mitigations apply to both construction and operation phases of the project.

Table 14.19 Mitigation measures for noise and vibration impacts

Impacts	Mitigation measures	Mitigation number
Construction		
Noise	A Construction Noise and Vibration Management Plan will be developed by the construction contractor in accordance with Environment Protection Authority Victoria Guidelines to ensure that the impacts of construction noise are minimised as far as practicable. The Construction Noise and Vibration Management Plan will be approved by MRPV and relevant stakeholders, and will include: • establishment of project-specific noise targets for construction • a prediction of noise from each construction scenario • an assessment of each scenario to the established targets • mitigation measures to be implemented to control noise levels • requirements for a noise monitoring regime whereby noise levels are measured and recorded • highlight potential unavoidable evening and night works for seeking prior approval from relevant stakeholders including RRV and the Environment Protection Authority Victoria.	NV01
Vibration	Measures to address construction vibration will include: • mitigations outlined in NV01 • implementation of additional controls such as: – dilapidation surveys – vibration monitoring – alternative methods and/or equipment – specific consultation with residents/asset owners.	NV02
Operation		
Traffic noise	Measures to manage noise impacts to sensitive receptors during operation include: • alternative road surface (7 mm spray seal) • noise barriers (2 m high) at strategic locations, which significantly reduces the number of properties exceeding the Project Objective Noise Levels • targeted off-reservation treatments to individual buildings with residual noise level exceedances to achieve compliance with the Project Objective Noise Levels such as: – fresh air ventilation treatments – upgraded windows/doors – upgrade window and door seals – targeted sealing of wall vents.	NV03
Sleep disturbance	Measures to address sleep disturbance will include • mitigations outlined in NV03.	

14.9 Residual impacts

Following incorporation of mitigations outlined in Section 14.8, the following residual impacts were will apply for the project.

Table 14.20 Air quality residual impacts

Impact	Residual impacts	Residual rating
Construction		
Dust	Air quality residual impacts apply to the following receptors: • for the two sensitive receptors within 100 m of the closest trafficked lane, there will be elevated dust levels on a few days during the period of construction with a moderate impact on those days and otherwise a minor impact for the large part of the construction period • for the four sensitive receptors within 100 m to 200 m of the closest trafficked lane, there will be elevated dust levels on a few hot days per year during the period of construction with a minor impact, but otherwise a negligible impact • for the nine sensitive receptors within 200 m to 300 m of the closest trafficked lane, there will be increased dust levels on a few days per year during the period of construction with a low impact on those days, but otherwise are negligible. For sensitive receptors within 300 m of the closest trafficked lane there will be elevated dust levels on a few days per year during project construction. However, with implementation of additional mitigations outlined in Section 14.8, the overall residual impact will be low.	Low

Table 14.21 Noise and vibration residual impacts

Impact	Residual impacts	Impact rating
Construction		
Noise and vibration	Residual noise and vibration from construction activities may impact sensitive receptors. It is recognised that construction impacts are typically short-term in nature. Where factors necessitate out-of-hours construction work, the residual impacts could be further controlled by the provision of alternative accommodation.	Low-medium
Operation		
Traffic noise Sleep disturbance	Modelling indicates the installation of 2 m high noise barriers and road surface treatment will reduce the number of property noise level exceedances from 27 (unmitigated) to 11. Off-reservation treatments are recommended to be applied to the properties with residual exceedances, following the implementation of road surface treatment and noise barriers (as outlined in Table 14.19). However, for properties that receive off-reservation treatments in combination with noise walls, there may still be a residual impact on outdoor amenity. RRV Policy recognises that off-reservation treatments do not protect against this impact. Specific off-reservation treatments can be realised once inspections have been conducted of the identified properties predicted to exceed Project Objective Noise Levels following on-reservation mitigation.	Negligible-low with off-reservation treatment

14.10 Conclusion

14.10.1 Air quality

Impacts to air quality during construction are expected to extend a short distance beyond the construction corridor on dry days with moderate to strong winds. As such, there are a small number of sensitive receptors adjacent to the closest trafficked lane where there will be periodic but short-term increases in dust levels during construction. A range of management measures have been recommended to limit the extent of dust and adverse effects on sensitive receptors during construction.

Impacts to air quality during project operation are expected to be negligible due to the number of vehicles predicted to be using the bypass in 2031. Outside the road reserve, the concentrations of air contaminants from vehicles are predicted to be well within the State Environment Protection Policy requirements for air quality. When operating, the bypass will result in an improvement in air quality along the main street of Beaufort as the majority of through traffic will have been diverted to the bypass.

14.10.2 Noise and vibration

Impacts on noise and vibration during construction are typically short-term in nature. Noise generated by construction activities would be managed in accordance with VicRoads *Technical Guidelines: Noise Guidelines - Construction and Maintenance Works 2007*. Vibration will be managed in accordance with criteria based on Australian and international standards.

The noise and vibration assessment modelled noise levels for the future project design year (2031). The predicted noise levels for the operation of the project indicate that noise levels are likely to exceed the project objectives. However, the assessment indicates that the road design can achieve the project noise objectives through the design and implementation of noise mitigation such as lower noise road surface (surface treatment), noise barriers, and off-reservation treatments.

Once the bypass is in operation, noise modelling indicates that the in-town noise levels are predicted to decrease by 3 to 6 dB from the 'Predicted (2018)' traffic noise levels once traffic is diverted onto the new bypass. This is a noticeable to significant perceived reduction in noise level within the town. Should the project not proceed, the in-town noise levels are predicted to increase by approximately 1 to 2 dB from the 'Predicted (2018)' traffic noise levels.

With the implementation of a 2 m high noise barrier in the proposed locations, the modelling indicates that this will significantly reduce the number of properties exceeding the Project Objective Noise Levels along the bypass alignment, with a small number of properties requiring further off-reservation treatment to achieve compliance. Compliance with the Project Objective Noise Levels is predicted to be achieved with the application of all noise mitigation options (road surface treatment, noise barriers and off-reservation treatment). With the implementation of mitigations, residual operational noise impacts for sensitive receptors along the alignment corridor will be low.

The sleep disturbance assessment indicates that there is the potential for up to 22 sensitive receptor locations outside the town to be impacted by truck engine braking noise during project operation. Within the Beaufort township, sleep disturbance impacts from trucks would likely reduce with the removal of heavy vehicles from the town centre.

The majority of the receptors nearest to the closest trafficked lane are, at minimum, located 100 m away and are therefore considered a low impact regarding adverse vibration levels with respect to human comfort. Mitigation measures will be put in place to minimise these impacts and maintain human comfort levels.

Based on modelling undertaken as part of the assessment, it is not expected that there will be any vibration impacts to sensitive receptors due to the operation of the road.

14.10.3 Greenhouse gas

The predicted greenhouse gas emissions of the bypass are estimated to be very small in comparison to other sources in Victoria. Transfer of traffic from the current route through the centre of town (where there are traffic lights and pedestrians crossing the road) to the bypass will result in a small reduction in greenhouse gas emissions from the bypass compared to the existing route through Beaufort.