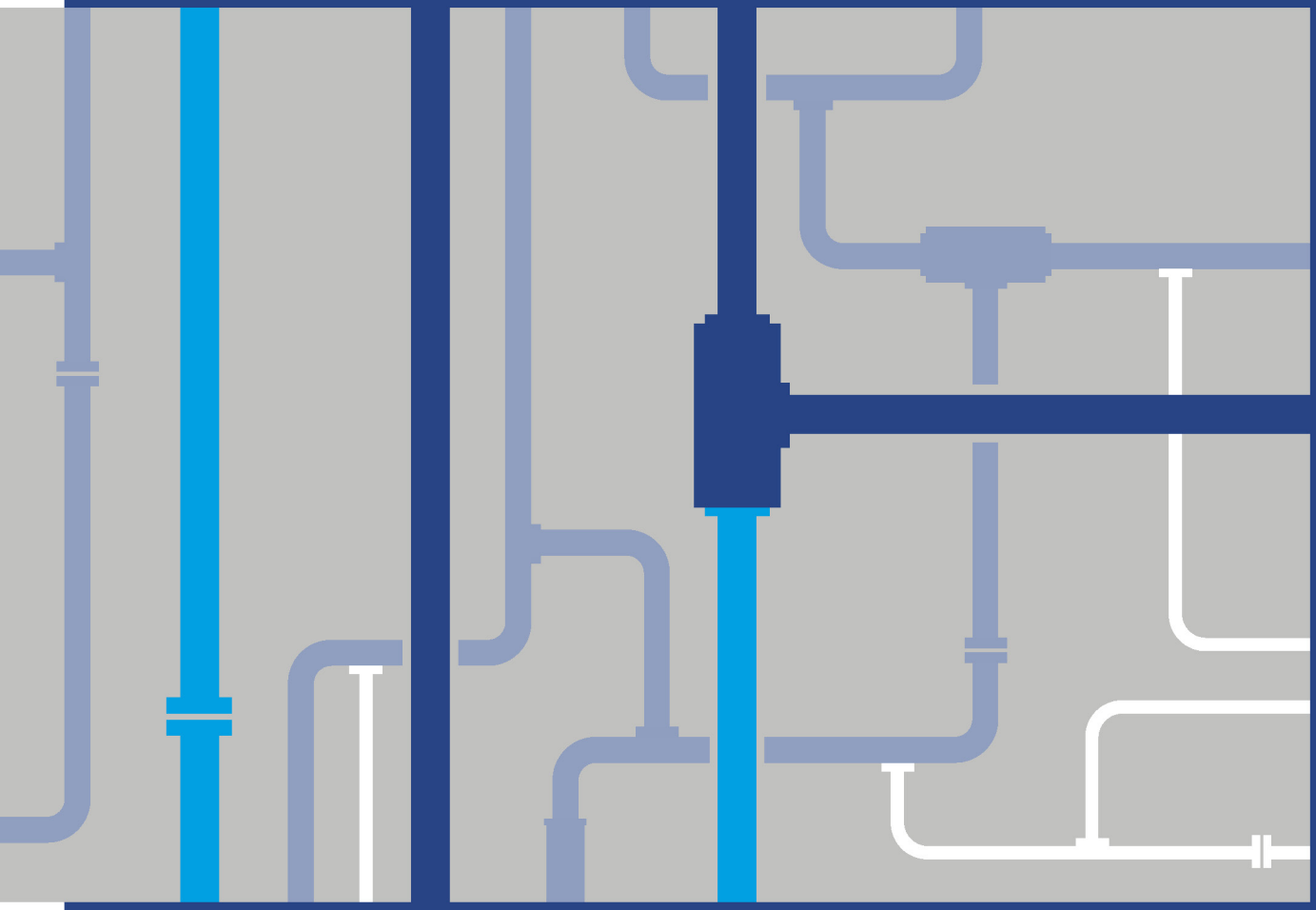
chapter 12

noise and vibration.



Environment Effects Statement | May 2021

western outer ring main

a project of apa

Contents

Chapter 12

12.1 Introduction

This chapter provides an overview assessment of the noise and vibration impacts associated with the construction and operation of the Western Outer Ring Main (WORM) gas pipeline project (the Project). This chapter is based on the impact assessment presented in Technical report F *Noise and vibration.*

The Project is located within a predominately rural environment which extends adjacent to existing and planned residential developments in some locations. Within this context, the use of bulldozers, excavators, graders and vacuum trucks during construction could result in noise and vibration, which if not appropriately managed, could impact nearby sensitive receptors situated close to the construction corridor.

An individual's response to noise and vibration can be highly variable and human sensitivity is influenced by factors such as character and duration of the noise and vibration, the surrounding environment and an individual's expectations. High levels of noise and vibration have the potential to, if not appropriately managed, result in physical effects on human health including annoyance, productivity loss, lack of sleep or disturbance, or health issues due to prolonged exposure. High levels of vibration can also impact buildings and infrastructure resulting in cosmetic damage (such as minor cracks) or more significant structural damage.

The EES scoping requirements set out the following evaluation objectives:

- Minimise potential adverse social, economic, amenity and land use effects at local and regional scales.

To assess the potential effects of noise and vibration from the construction and operation of the Project, a noise and vibration impact assessment was undertaken.
The assessment included desktop analysis, modelling and noise monitoring to gain an understanding of the conditions in the area and potential impacts of the Project.

What is a sensitive receptor?

Sensitive receptors are locations where the occupants are more susceptible to adverse effects. A sensitive receptor could be a home, place of worship, school or other place where people spend time.

Sensitive receptors have been used as locations or points at which noise and vibration from the Project has been measured or predicted.

Other aspects closely related to the above evaluation objective include air quality, landscape and visual, land use and social. These are addressed in the following reports and chapters:

- Technical report G and chapter 11 *Air quality*
- Technical report J and chapter 14 *Landscape and visual*
- Technical report K and chapter 15 *Land use*
- Technical report L and chapter 16 *Social.*

This chapter provides an overview assessment of the noise and vibration impacts of the Project on sensitive receptors, buildings and structures. Technical report A *Biodiversity and habitat* provides an assessment of the potential effects on fauna as a result of noise and vibration.

12.2 Method

The noise and vibration assessment comprised the following key tasks:

- Review of relevant legislation and policy at a national, state and local level to identify noise criteria relevant to the Project

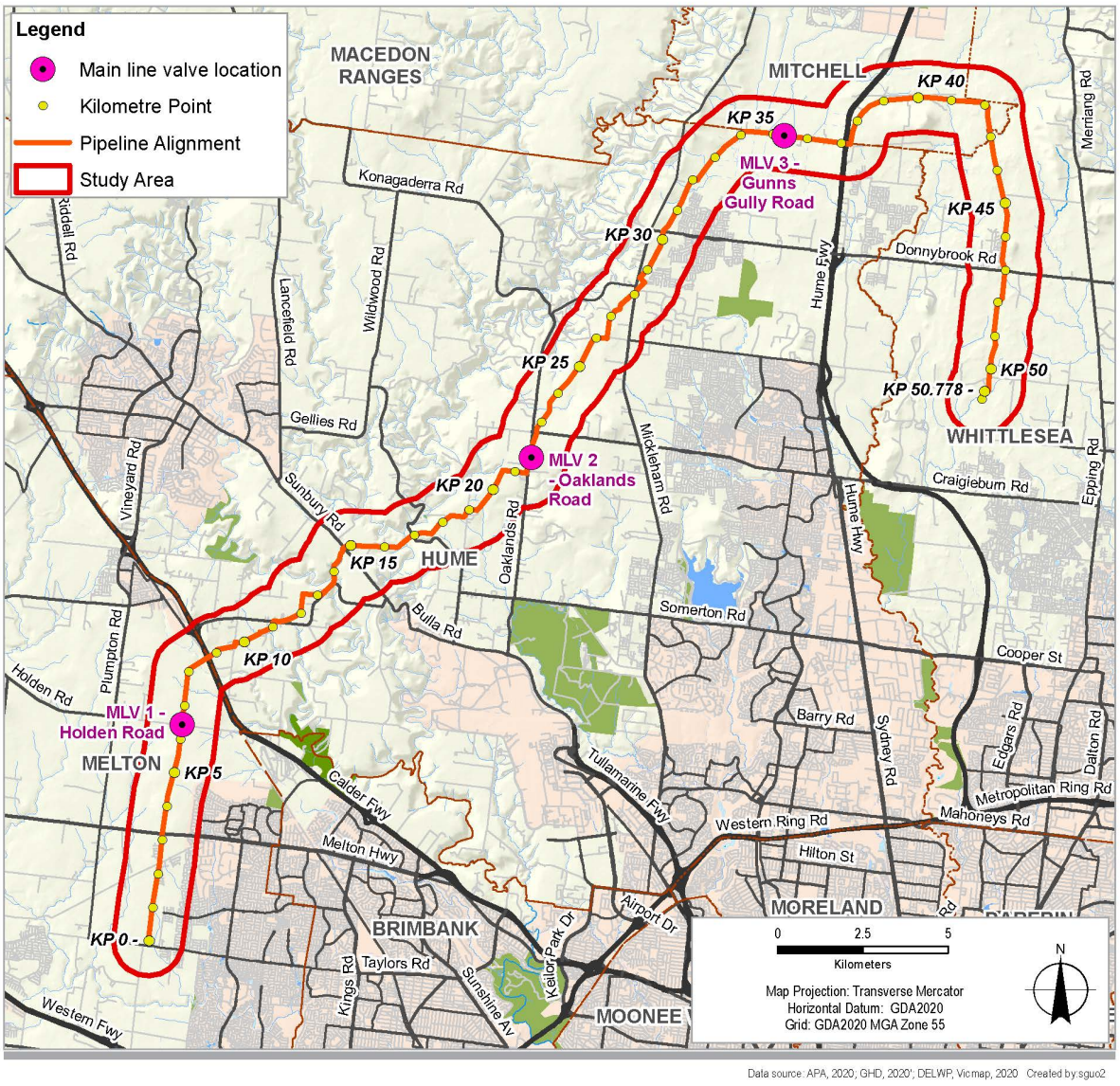
- Establishment of a study area for noise and vibration. This was defined as a corridor of approximately one kilometre from the centre of the Project construction corridor (two kilometres in total), as shown in Figure 12-1. This area was determined based on experience with similar projects and the expected level of impact from similar construction activities
- Sensitive receptors within the study area were identified through the aerial imagery and cadastral and land use data. This includes both individual sensitive receptors (that is, one dwelling) as well as representative sensitive receptors which account for a number of receptors at densely populated locations such as Hillside, Fraser Rise and Mickleham. Aerial imagery was used to provide an estimate on the actual number of sensitive receptors where exceedances of the construction noise limits are predicted, as discussed in Section 12.5
- For the purposes of the vibration assessment, sensitive receptors located within 50 metres of the construction corridor were identified. The EPA guidelines *Environmental Guidelines for major construction sites* (Publication 480, 1996) now superseded by EPA Publication 1834 *Civil construction, building and demolition guide* notes that ground vibration and building damage from construction activities is unlikely to occur if the operation is conducted at distances greater than 50 metres
- Characterisation of existing conditions via:
  - Noise monitoring undertaken at the Wollert Compressor Station to establish noise emissions from existing equipment (Wood, 2020)[1]. Noise measurements were taken on 2 April 2020 and an unattended noise logger was installed for a one week period from 29 April to 5 May 2020
  - Desktop assessment to determine background noise levels based on AS 1055.3:1997 Acoustics – Description and measurement of environmental noise – Part 3: Acquisition of data pertinent to land use (AS 1055.3:1997)[2] which classifies the receptor area into categories based on the land use. Due to COVID-19 restrictions, background monitoring representative of normal background conditions along the pipeline alignment could not be undertaken as part of this assessment. While at the time of preparing the impact assessment presented in Technical report F *Noise and vibration* some restrictions had lifted, traffic and human activity had not returned to pre-COVID levels. As such, noise monitoring would not be representative of the background noise levels. The use of background levels from AS1055.3:1997 is a sufficiently conservative approach and the majority of surrounding areas have been assumed to have low levels of background noise, which is typical for areas with negligible and low density transportation
- A risk-based review of potential impacts to prioritise the focus of the impact assessment
- Assessment of the potential noise and vibration impacts during construction and operation of the Project including:
  - Identifying construction scenarios, work methods and necessary equipment
  - Identifying local meteorological conditions and ground elevation data (topography) to inform modelling
  - Modelling to predict construction noise and vibration levels
  - Estimation of overpressure and vibration levels of planned blast works

1 Wood, 2020. *APA Wollert Compressor Station Environmental Noise Assessment,* Melbourne.

2 Australian Standard 1055.3:1997 *Acoustics – Description and measurement of environmental noise. Part 3: Acquisition of data pertinent to land use.*

  - Identifying noise emissions from the Wollert Compressor Station and modelling to predict impacts
- Development of environmental management measures (EMMs) in response to the impact assessment. Refer to Chapter 19 *Environmental management framework* for the full list of environmental management measures
- Assessment of the residual impacts of the Project assuming implementation of the environmental management measures
- Specifying the monitoring required to evaluate whether the Project meets the environmental management measures and detailing contingency measures as required.

Figure 12-1 Noise and vibration study area



12.3 Existing conditions

The following sections outline the existing conditions of the Project study area in relation to noise and vibration.

The Project construction corridor extends from the Plumpton Regulating Station in the south, through sparsely populated rural-residential areas and road reserves, terminating at the Wollert Compressor Station. The Project also runs adjacent to suburban areas in the areas of Hillside and Fraser Rise and the edge of the suburban area within Mickleham. As the Project is situated on the rural-facing side of these localities the acoustic environment is generally quiet for most nearby sensitive receptors. However, receptors in the vicinity of major highways or arterial roads (such as the Calder Freeway and the Hume Highway) are exposed to a higher level of background noise, as discussed further in the sections below.

For the purposes of the noise and vibration assessment the Project study area was divided into four sections based along the construction corridor as shown in Figure 12-2 to Figure 12-5. This is:

- Section 1: Plumpton to Calder Highway
- Section 2: Calder Highway to Mickleham
- Section 3: Mickleham to Donnybrook
- Section 4: Donnybrook to Wollert Compressor Station.

Within the Project study area, 525 sensitive receptors were identified. These are discussed in the sections below. There are several community facilities along the pipeline alignment that have been identified as sensitive receptors including:

- Slovenian Australian Social and Sports Club Jadran (sensitive receptor C176) approximately 930 metres from KP 9
- Mickleham Musallah Muslims Sunni (sensitive receptor C313) approximately 650 metres from KP 26.5
- Mickleham Primary School (sensitive receptor C314) approximately 700 metres from KP 26.5
- Broadhangar Equestrian (sensitive receptor C500) approximately 320 metres from KP 35.5.

All other sensitive receptors are considered to be either residential or rural-residential.

The new gas pipeline would connect into APA's existing Wollert Compressor Station at KP 51. The area surrounding the Wollert Compressor Station is discussed in Section 12.3.5.

12.3.1 Section 1: Plumpton to Calder Highway

This section of the Project passes through land which is predominately agricultural and rural-residential in nature, although residential development is planned to the south of the Melton Highway.

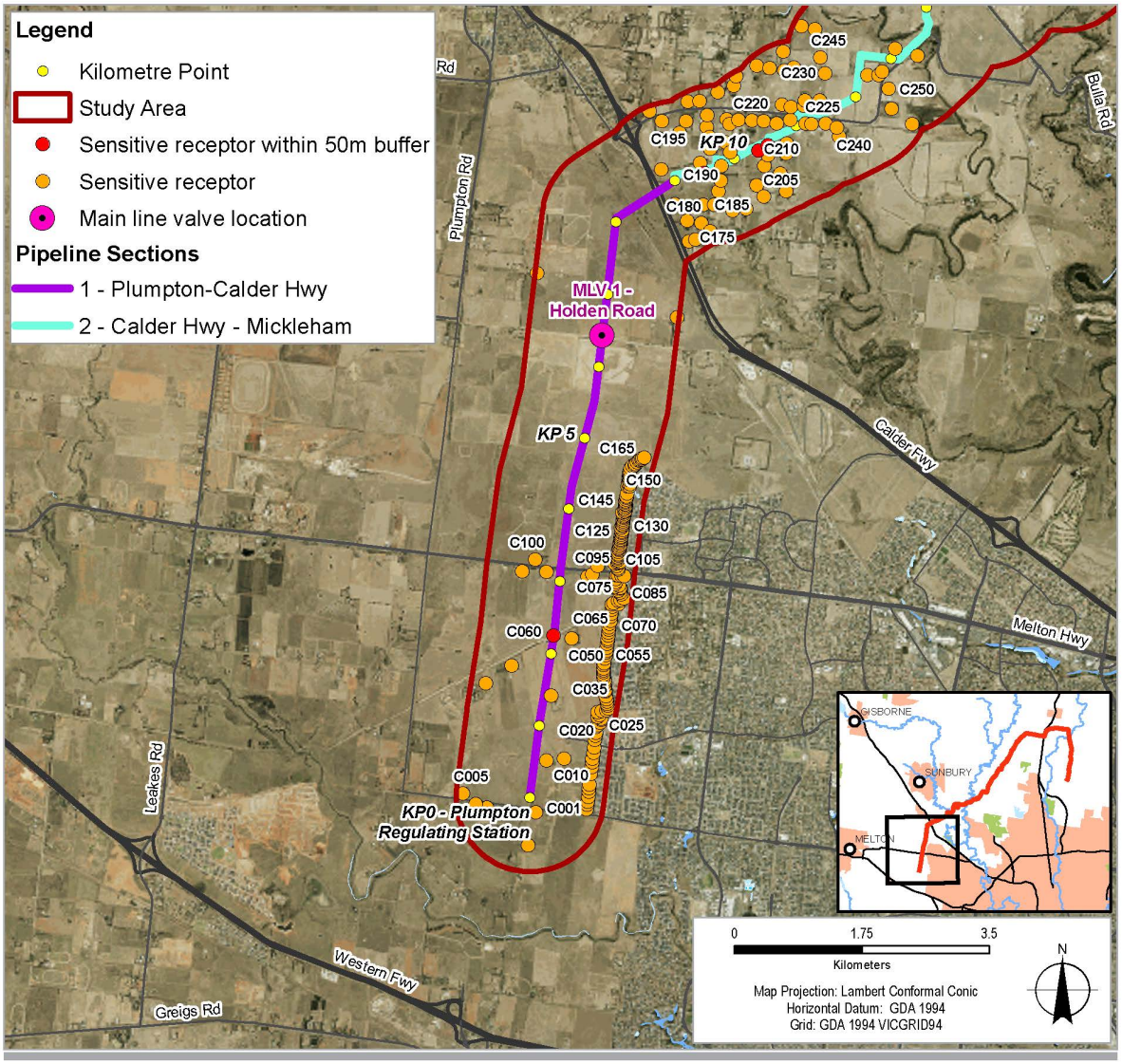
This section of the Project falls within the City of Melton, with land zoned Green Wedge, Public Use and Urban Growth under the Melton Planning Scheme. The suburb of Hillside to the east of the Project is zoned General Residential. Within this section of the Project sources of existing noise emissions include agricultural activities, local and main roads and some industrial emissions (from local businesses, industries and Melbourne Airport).

There are 179 sensitive receptors within this section of Project as shown in Figure 12-2. One sensitive receptor is located within 50 metres of the construction corridor (as identified in Figure 12-2) and potentially subject to construction vibration.

Applying the neighbourhood description and land use categories in AS 1055.3:1997, the majority of sensitive receptors within this section of the Project are located within areas of negligible to low density transportation. Based on AS 1055.3:1997, background noise levels during the daytime are expected to generally be between 40–45 dB(A) and during the night-time between 30–35 dB(A). Locations in the vicinity of the Calder Freeway are within an area with medium density transportation as defined under AS 1055.3:1997 with some commerce or industry, with background noise levels during the daytime expected to generally be around 50 dB(A) and during the night-time generally around 40 dB(A).

The Project includes the construction of three main valve sites (MLV), one of which would be located at the site of KP 6.4 (MLV1). The closest sensitive receptor to this MLV is approximately 1 km to the north-east.

Figure 12-2 Section 1: Plumpton to Calder Highway sensitive receptors



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12.3.2 Section 2: Calder Highway to Mickleham

Calder Highway to Mickleham traverses agricultural land with pockets of rural-residential development. This section of the Project falls within the City of Hume, with land zoned Green Wedge under the Hume Planning Scheme.

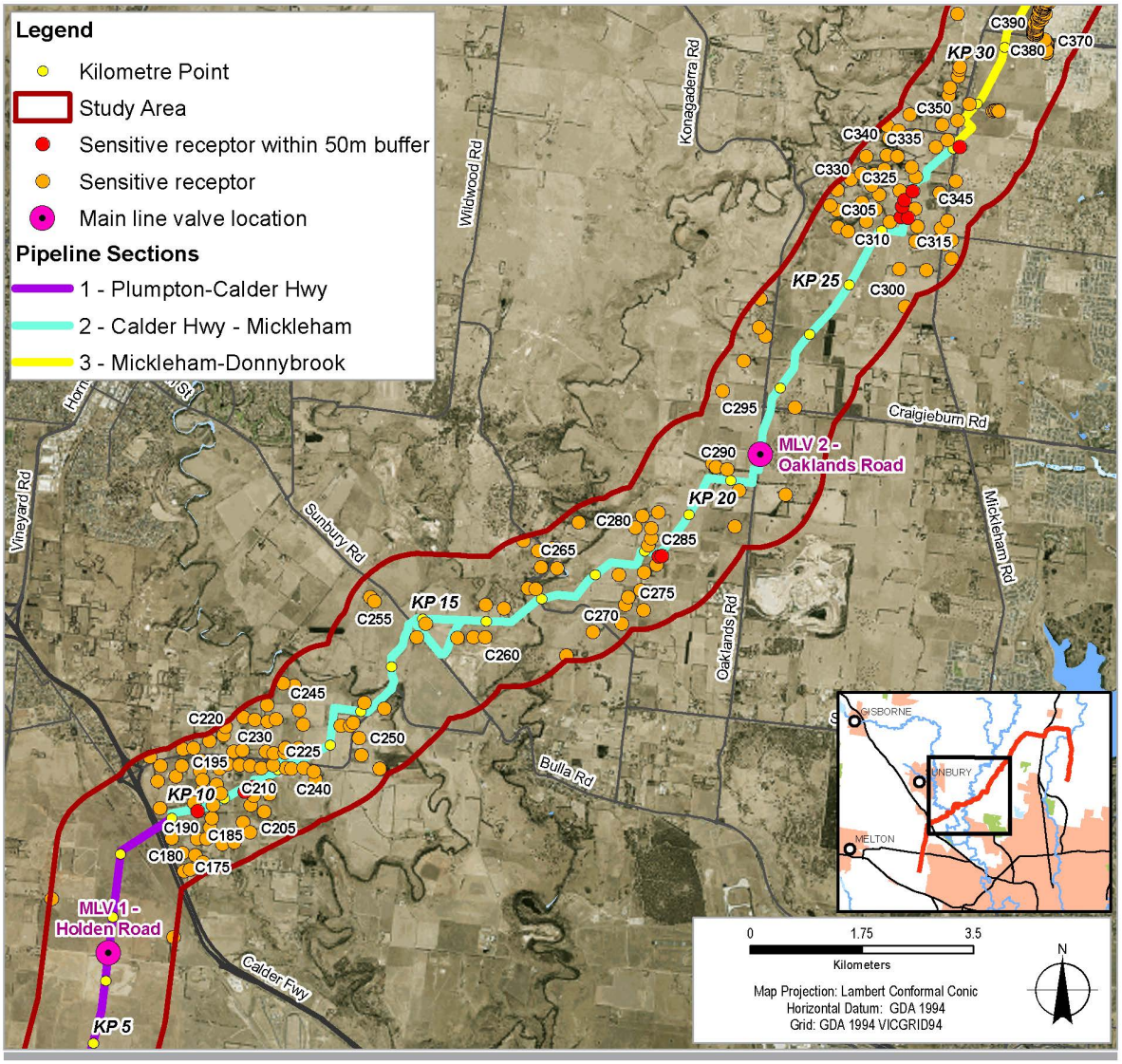
There are 167 sensitive receptors within this section of Project, within approximately one kilometre of the construction corridor (refer Figure 12-3). Within this section, sensitive receptors are located within areas with negligible to low density transportation as defined under AS 1055.3:1997, with the exception of the sensitive receptors within the vicinity of the Calder Freeway which are within an area with medium density transportation. Within this section of the Project sources of existing noise emissions include agricultural activities and local and main roads.

Based on AS 1055.3:1997, background noise levels during the daytime are expected to generally be between 40–45 dB(A) and during the night-time between 30–35 dB(A). In locations surrounding the Calder Freeway background noise levels are expected to be higher and as defined in AS 1055.3:1997, background noise levels are expected to generally be around 50 dB(A) and during the night-time generally around 40 dB(A).

There are ten sensitive receptors located within 50 metres of the construction corridor as identified in Figure 12-3.

The site of MLV2 (KP 22) is located approximately 600 metres away from the nearest sensitive receptor, and approximately 250 metres away from the Oaklands Road crossing.

Figure 12-3 Section 2: Calder Highway to Mickleham sensitive receptors



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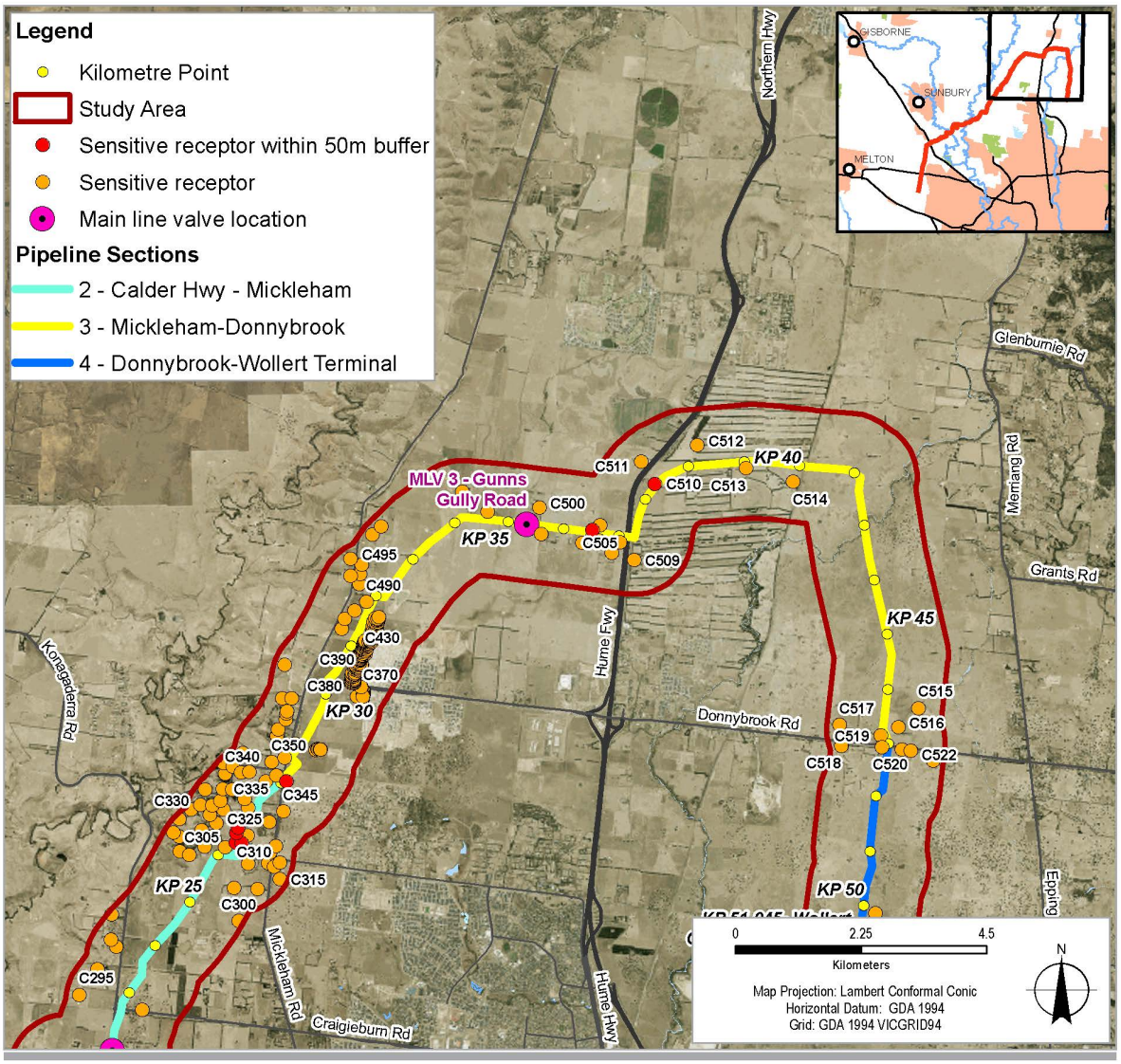
12.3.3 Section 3: Mickleham to Donnybrook

This section of the Project passes through agricultural and rural-residential land, with residential development to the east. This section of the Project study area traverses the Hume, Mitchell and Whittlesea Council jurisdictions. Land within this section of the Project is zoned Green Wedge, Special Use and Urban Growth, with a Rural Conservation Zone applying to land around Jacksons Creek as identified in the Hume, Mitchell and Whittlesea Planning Schemes.

There are 172 sensitive receptors within this section of the Project as identified in Figure 12-4, with three of these being within 50 metres of the construction corridor. The majority of sensitive receptors within this section of the Project are located within areas with negligible to low density transportation as defined under AS 1055.3:1997. MLV3 (KP 35.2) is approximately 300 metres away from the nearest sensitive receptor. Based on AS 1055.3:1997, background noise levels during the daytime are expected to generally be between 40–45 dB(A) and during the night-time between 30–35 dB(A).

Figure 12-4 Section 3: Mickleham to Donnybrook sensitive receptors



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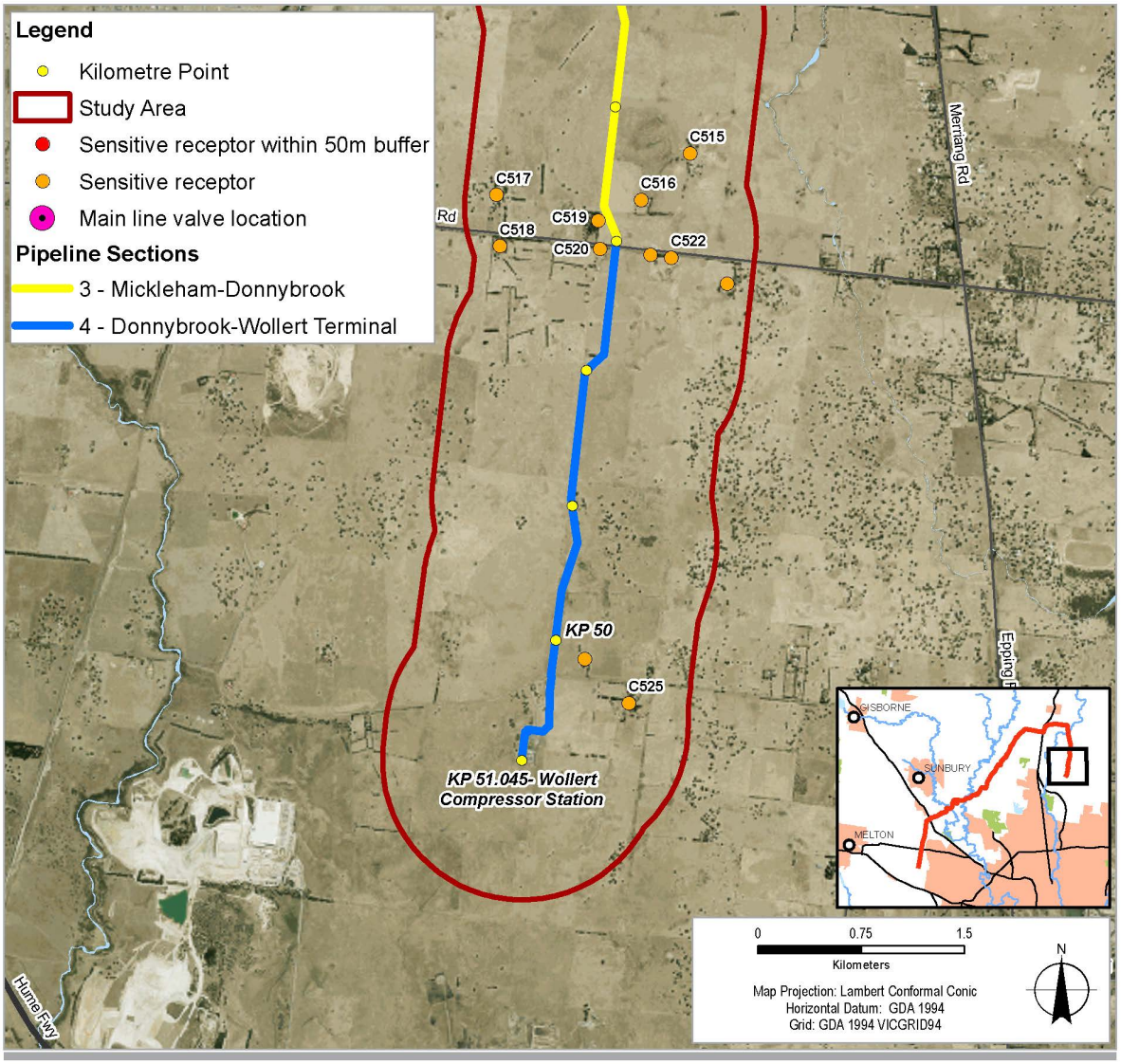
12.3.4 Section 4: Donnybrook to Wollert Compressor Station

The section of the Project is the northern section of the works, connecting into the Wollert Compressor Station. This section traverses the Whittlesea Council jurisdiction. Land within this section is zoned Urban Growth, Farming and Rural Conservation under the Whittlesea Planning Schemes.

Seven sensitive receptors have been identified within this section of Project (as shown in Figure 12-5), with all of these being further than 50 metres from the construction corridor. All of these sensitive receptors are located within areas with negligible to low density transportation as defined under AS 1055.3:1997, with background noise levels expected to generally be between 40–45 dB(A) and during the night-time between 30–35 dB(A).

Figure 12-5 Section 4: Donnybrook to Wollert Compressor Station sensitive receptors



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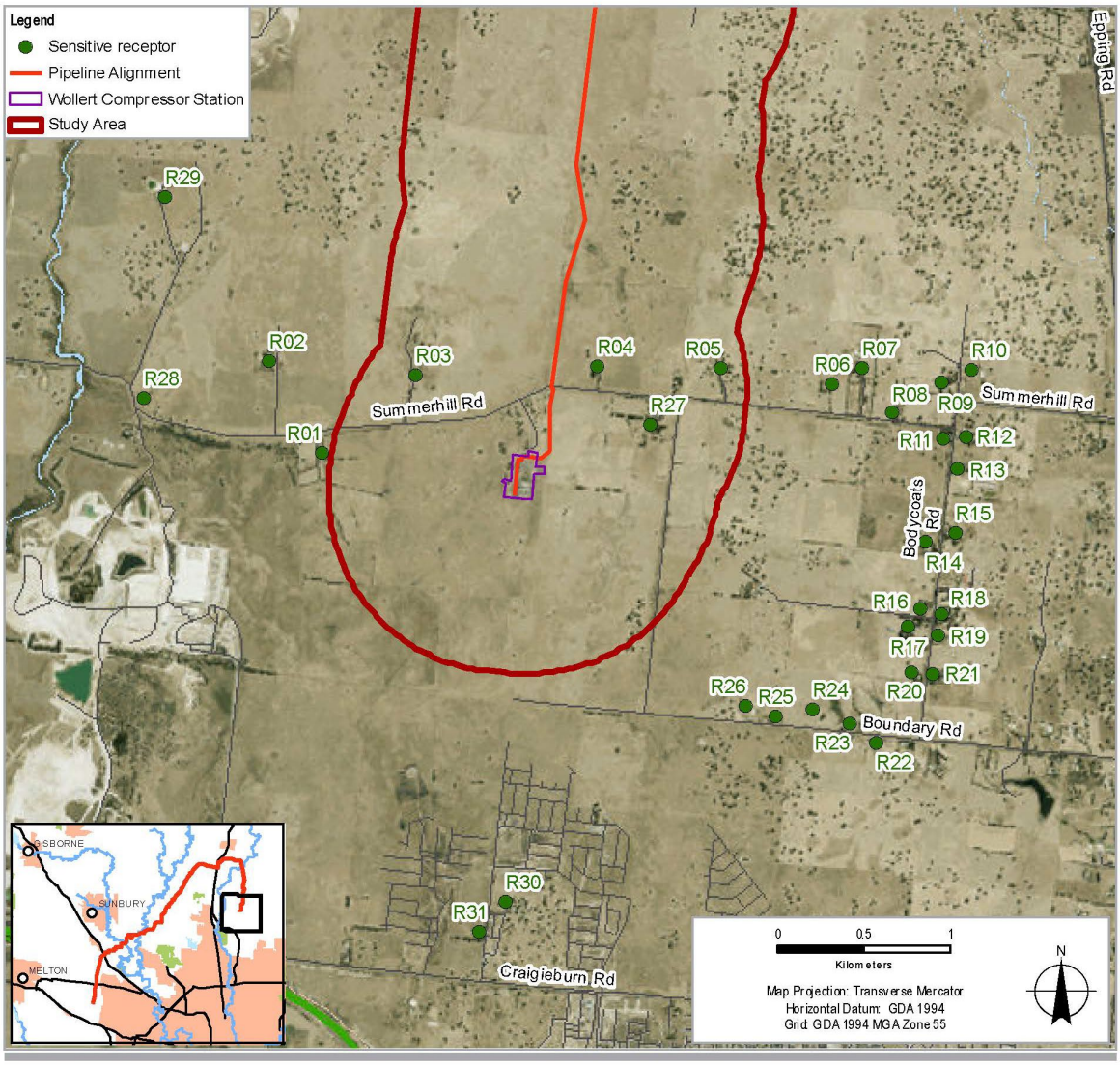
12.3.5 Wollert Compressor Station

The Project terminates at APA's existing gas compression station at 365 Summerhill Road, Wollert. The existing compressor station comprises gas turbines, compressors, a gas cooler, a generator and associated equipment. The gas compression facility operates on an on-demand basis, running on average every second day, most often during the night-time and early morning periods.

The Wollert Compressor Station is within the City of Whittlesea, located on land zoned Farming under the Whittlesea Planning Scheme. There are 31 scattered individual residences and farm houses located within 3 kilometres as shown in Figure 12-6. The nearest sensitive receptors are around 700 metres away from the existing facility.

Results of previous noise monitoring programs (Wood, 2020) have found that background noise levels in the area surrounding the compressor station are low (with and without the compressor station operating), which is typical for rural areas. There is a brickworks 2 km to the south-east of the facility and a quarry 3 km to the northeast of the facility which operate during the day only.

Figure 12-6 Wollert Compressor Station sensitive receptors



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12.4 Risk assessment

The risk assessment identified the risks associated with noise and vibration as a result of the Project's construction and operation in accordance with the method described in Chapter 5 *Evaluation and assessment framework.*

For the EES, risk ratings were applied to each identified risk pathway, assuming that initial mitigation measures were in place. Where the initial risk ratings were categorised as medium or higher, additional mitigation measures were developed to lower the residual risk where possible. Each risk pathway shows the initial risk rating based on standard management measures, and a residual risk rating based on additional management measures (if required) recommended through the impact assessment process.

Table 12-1 presents a summary of the five construction risks and one operation risk identified and assessed as part of the noise and vibration assessment. Table 12-8 identifies the environmental management measures proposed to address noise and vibration. The medium and high risk ratings were the focus of the impact assessment as outlined in Section 12.5 and Section 12.6.

Risk ID NV01 and NV02 relates to impacts from construction activities including from equipment such as bulldozers, excavators, graders and vacuum trucks. The consequence of this risk has been rated as moderate as the impact can cover a large area, however, there is opportunity for effective control. Night-time works would be required for some activities such as HDD drilling, boring and hydrostatic testing and these works have the potential to cause disturbance to surrounding residents. It is expected that noise levels from evening or night-time works would be lower than those from day operations due to the absence of other construction activities, however, as the applicable construction noise criteria are significantly stricter for evening and night-time periods, the initial risk is considered medium. With the mitigation in place, the risk of noise impacts on sensitive receptors as a result of the Project's construction is considered to be low.

Blasting works are planned for particular areas of the Project where rock would be encountered and Risk ID NV03 considers the potential air blast or 'overpressure' impacts. This risk is considered to be medium as the overpressure is expected to be below structural integrity limits for the reasons discussed in Section 12.5.3. In terms of blast vibration propagation, this depends on many factors and there is uncertainty in predicting vibration levels. Risk ID NV05 considers the potential for vibration to cause structural damage to buildings or underground assets or impacts on amenity of affected residents. In the event that the impact exceeds the recommended cosmetic damage limits, the consequences of this may be severe. Therefore, vibration due to blasting has been assigned an initial high risk rating. With mitigation in place as discussed in Section 12.5.4, the risk is considered to be reduced to low.

Risk ID NV04 considers vibration during construction generated from construction activities like excavation and rock breaking, which may result in ground transmitted vibration. The impact may be perceivable at sensitive receptors adjacent to the construction corridor, although the impact is not expected to be long lasting. The initial risk associated with general construction vibration is considered medium, however, with mitigation this risk is considered low.

Risk ID NV06 deals with the risk of noise impacts during the operation of the Project. As the gas pipeline would be buried at construction completion, the relevant source of operation noise emissions is the Wollert Compressor Station. There is considerable distance between sensitive receptors and the Wollert Compressor Station, with the closest sensitive receptor being around 700 metres away from the existing facility. Maintenance of the main valve sites would rarely occur (approximately once a year) and would involve opening/closing valve operations that last for around one to two minutes, generally undertaken during the day. Accordingly, the risk of noise impacts during operation is considered to be negligible.

Table 12-1 Noise and vibration risk assessment summary

Risk ID	Works area	Risk pathway	Initial mitigation measures	Initial risk rating	Additional mitigation measures	Residual risk rating
Construction						
NV01	All	Noise amenity impacts on sensitive receptors from general construction works	MM – NV1	Medium	NV2, NV5, NV7, NV9	Low
NV02	Pipeline	Out of hours construction works result in noise amenity impacts on sensitive receptors	MM – NV1	Medium	NV1, NV2, NV5, NV7, NV7, NV9	Low
NV03	Pipeline	Construction blasting operations result in noise amenity impacts on sensitive receptors or causes structural damage to buildings	MM – NV4	Medium	NV3, NV6	Low
NV04	Pipeline, MLV	Vibration amenity impacts on sensitive receptors from general construction works	MM – NV1, NV4	Medium	NV2, NV4, NV6, NV7, NV9	Low
NV05	Pipeline	Construction works result in vibration causing structural damage to buildings or underground assets or impacting on amenity of affected residents	MM – NV4, NV5	High	NV3, NV6, NV8	Low
Operation						
NV06	MLV/ Compressor	Operation noise impacts on sensitive receptors, from the Wollert Compressor Station, valves and auxiliary equipment	None	Negligible	None	Negligible

12.5 Construction impact assessment

This section discusses the construction impacts associated with the Project that relate to surface noise and vibration. These are grouped into three main themes:

- Construction noise – the potential for noise generated by construction activities to impact amenity at sensitive receptors
- Construction vibration – the potential for vibration generated by construction activities to impact the amenity at sensitive receptors or damage buildings and underground services
- Blasting – the potential for blasting to result in amenity impacts or structural damage to buildings.

The potential for impacts associated with these three main themes, as well as relevant guidelines and standards, are discussed in the following sections.

Blasting is the controlled use of explosives or other methods using strong force to break rock for excavation. The potential impacts of blasting have been considered separately to impacts from other general construction activities because blasting is impulsive, short-term and produces different noise and vibration. Blasting is planned in some locations where hard rock is present and this type of excavation is necessary.

12.5.1 Construction noise

The Project involves construction along an approximately 51 kilometre corridor, between Plumpton and Wollert. Open trench construction is the primary method proposed through the greenfield and brownfield sections of the Project, with horizontal directional drilling (HDD) and boring proposed for some creek crossings and road and rail crossings. The use of bulldozers, excavators, graders and vacuum trucks during construction may temporarily increase noise levels and impact receptors situated close to the construction corridor.

The duration of pipeline construction for the entire Project may occur over a period of nine months for up to 11 hours per day, seven days a week. At individual locations, construction and rehabilitation activities are expected to be completed in four to six months.

Construction is expected to progress at a rate of approximately 700 metres per day for open trenching, however, HDD and bored crossings are likely to have lower daily progress rates and could take between two to three weeks at a particular location. The majority of the works would be undertaken during the daytime, however, evening and night-time works may be required for HDD, boring and hydrostatic testing.

Noise guidelines/standards

In Victoria there are no statutory limits for construction noise. Instead, EPA Victoria has published the following documents to provide guidance in addressing construction noise:

- *Civil construction, building and demolition guide*, EPA Publication 1834, 2020
- *Environmental Guidelines for major construction sites,* EPA Publication 480, Best Practice Environmental Management, 1996 (superseded by EPA Publication 1834).

Units of measure

dB – (decibel) – unit of measurement for sound pressure.

dB(A) – relative loudness of sounds as perceived by the human ear.

L_{Aeq} – Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.

$L_{A90\ (period)}$ – The sound pressure level that is exceeded for 90% of the measurement period.

These documents provide evening, night-time and weekend noise targets, and provide information on how to avoid and minimise noise and vibration from construction sites.

During the process of undertaking the noise and vibration assessment in Technical report F *Noise and vibration,* EPA Publication 480 was superseded by EPA Publication 1834. Accordingly, both these documents have been considered. It is noted that the recommended construction noise criteria are generally consistent between these documents, with the main difference being the requirement for noise from construction to be inaudible (background + 0 dB(A)) during the night-time as introduced by EPA Publication 1834 and further discussed below.

In the absence of daytime statutory noise limits for Victoria, the New South Wales *Interim Construction Noise Guideline*[3] has been adopted. This approach is consistent with the approach adopted on other recent Victorian major projects. The NSW document recommends that during the day noise emissions from construction work should be less than 75 dB(A) to avoid a situation where residences in the adjacent area are highly affected by noise.

Table 12-2 identifies the adopted construction noise criteria from Victorian and NSW guidelines.

Table 12-2 Construction noise criteria

Sensitive receptor	Period	Noise criteria, L_{Aeq}
Residential	Standard EPA construction hours Mon–Fri: 7 am – 6 pm Sat: 7 am – 1 pm	75
Educational institutions		60
Parks and recreational areas		65
Community and commercial buildings		70
Residential	Evening and weekend Mon–Fri: 6 pm – 10 pm Sat: 1 pm – 10 pm Sundays and public holidays 7 am – 10 pm	Noise level at any residential premises not to exceed background (L_{A90}, dB) noise by: • 10 dBA or more for up to 18 months

[3] Department of Environment and Climate Change NSW, 2009. *Interim Construction Noise Guideline*, *Publication 2009/265,* Sydney.

Sensitive receptor	Period	Noise criteria, L_{Aeq}
Residential	Night-time: Mon-Sun: 10 pm – 7 am	Noise inaudible within a habitable room of any residential premises. Consistent with EPA Publication 1834, the reference level of background +0 dB(A) has been used to inform the risk assessment regarding noise.

As identified in Table 12-2, the adopted daytime noise criteria at residential receptors is 75 dB(A). For evening and weekend work and as the works are expected to occur over a period of less than 18 months, the noise criteria is 10 dB(A) above that of the existing background noise levels.

Noise is required to be 'inaudible' within a habitable room for night-time work. EPA Publication 1834 uses the reference of background + 0 dB(A) for ‘inaudible’ noise from construction works.

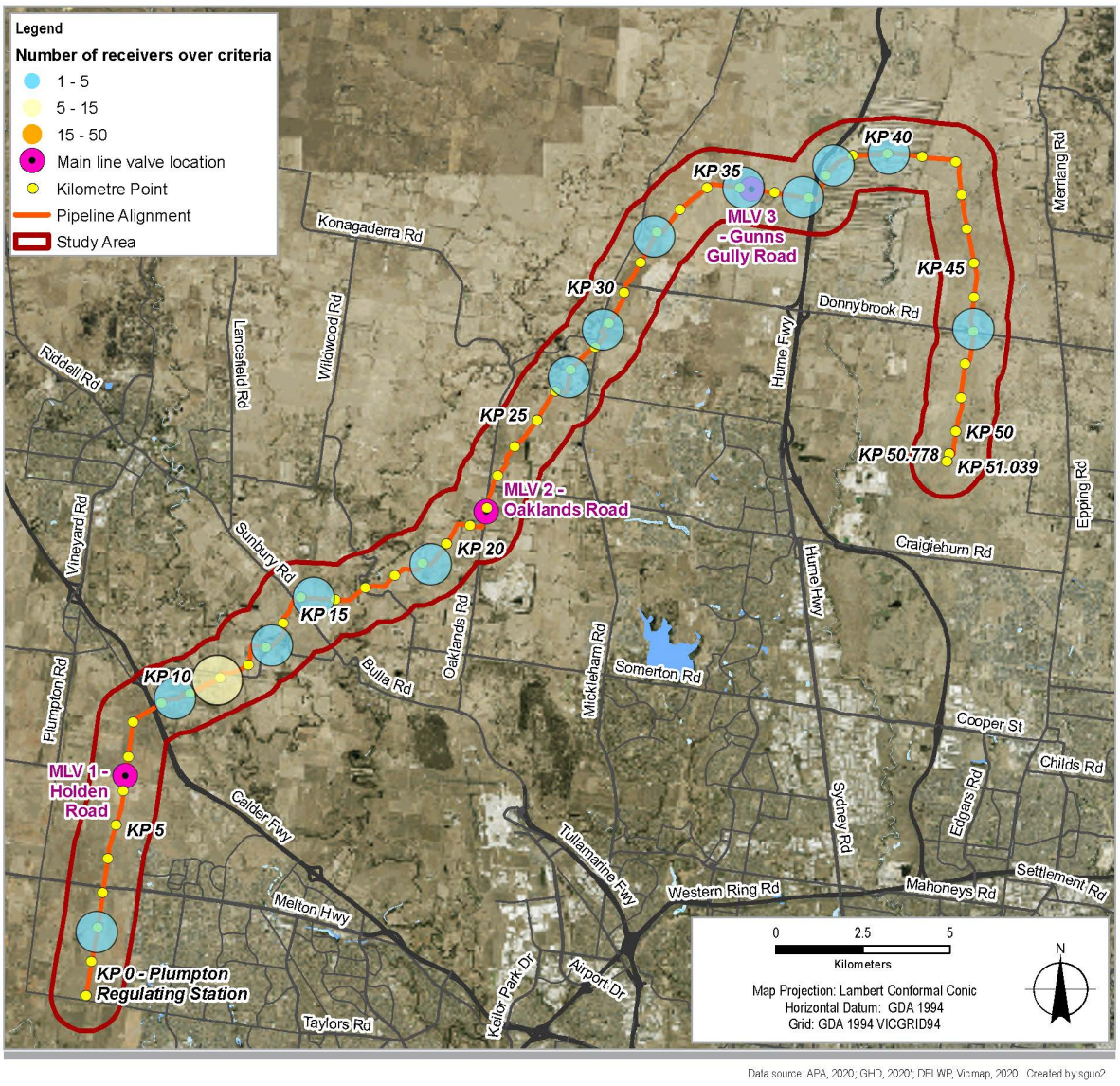
Predicted noise impacts

Open trench construction

Where works would occur near a noise sensitive receptor, construction activities may result in short-term noise impacts. Modelling was undertaken to predict noise levels that may be experienced at sensitive receptors, with results assessed against the noise criteria. The modelling indicates that there is a number of receptors where construction noise criteria would be exceeded without mitigation, with the noisiest activity expected to be associated with non-destructive testing (NDT) which would involve grit blasting, to be undertaken for open trench construction. Grit blasting (also known as sandblasting) is the use of abrasive particles and high pressure to smooth a surface.

Figure 12-7 identifies the sensitive receptors where the noise for open trench construction is expected to exceed the daytime criteria of 75 dB(A) where no mitigation is applied. Generally, along the construction corridor there is less than five sensitive receptors in a particular location where construction is expected to exceed the daytime criteria. The exception is around Morefield Court in Diggers Rest where there is approximately eight sensitive receptors where construction is expected to exceed the daytime criteria. While boundary fences at some properties in this location would provide noise attenuation, even with the fencing, the daytime noise criterion is expected to be exceeded for open trench construction. It is noted that open trench construction is not expected to occur during the evening or night-time. Given that construction is expected to progress at a rate of approximately 700 metres per day, these receptors are not expected to be subjected to noise impacts for long periods of time.

Figure 12-7 Noise level exceedances at sensitive receptors for daytime, open trench construction – without mitigation



HDD and bore construction

Noise levels from crossings with HDD and bore operations are predicted to be below the daytime criterion (refer section 8.2.4 of Technical report F *Noise and vibration* and Appendix E). However, as HDD and boring would sometimes be required during the evening and night-time, these activities have the potential to exceed the evening noise criterion of 10 dB(A) above existing background noise levels as well as night-time criteria where there is no mitigation. Exceedance of evening and night criteria is predicted to occur at a number of locations along the construction corridor, with the largest number of impacted receptors during the night-time at the bored crossing at Fraser Rise, Hillside and Donnybrook Road. Refer to Figure 12-8 (for noise level exceedances during the evening) and Figure 12-9 (for noise level exceedances during the night).

There are 12 locations along the construction corridor where evening time works are predicted to exceed the recommended noise criteria. It is estimated that less than 15 individual sensitive receptors are likely to be affected at each location where these exceedances occur.

Night-time exceedances are predicted at 14 locations along the construction corridor and there could be as many as 100 sensitive receptors in some locations, with more at Mickleham, Hillside and Fraser Rise.

HDD and bored crossings construction could take between two to three weeks at a particular location.

Figure 12-8 Noise level exceedances at sensitive receptors for evening, HDD/bored crossing construction – without mitigation

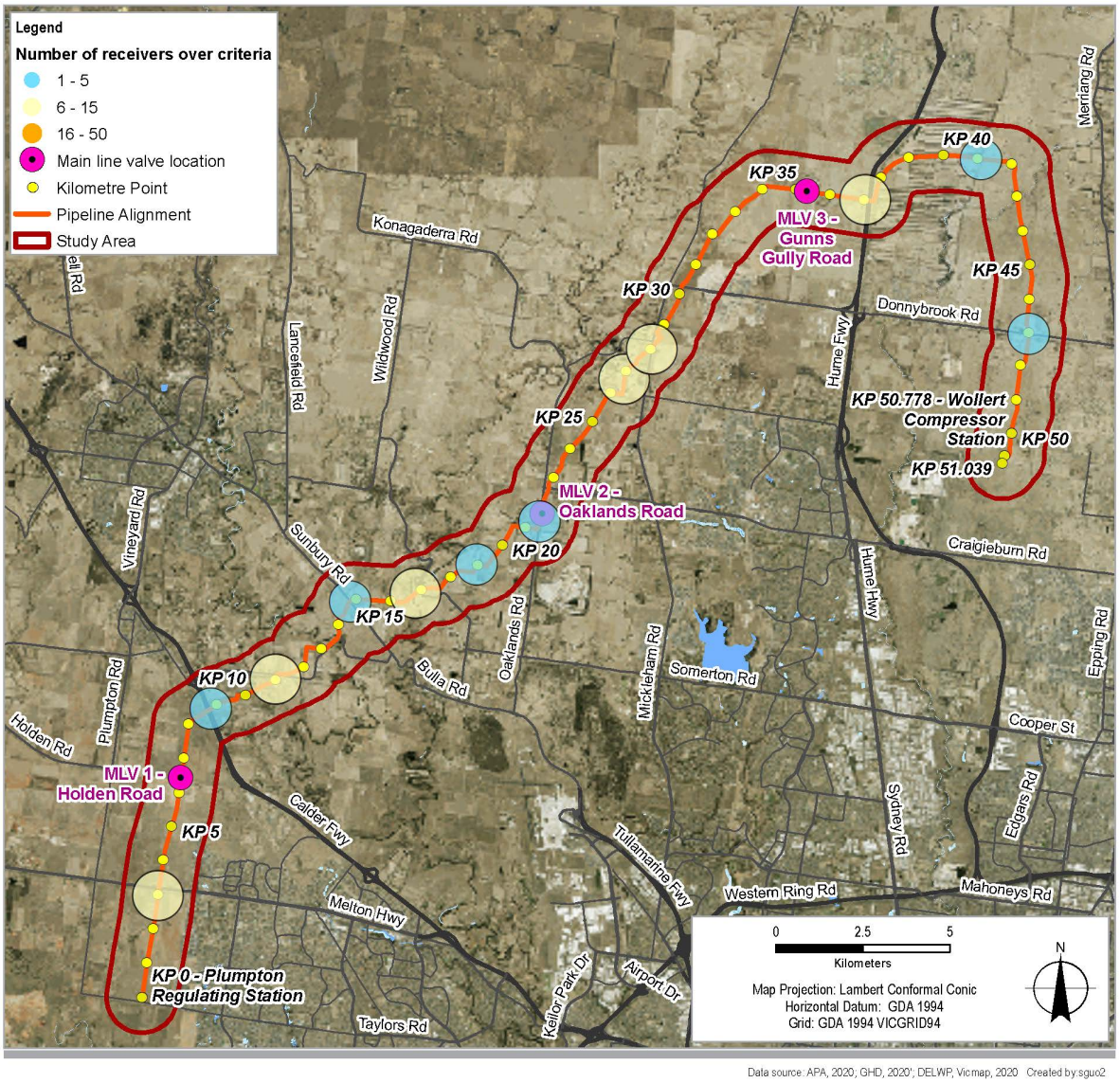
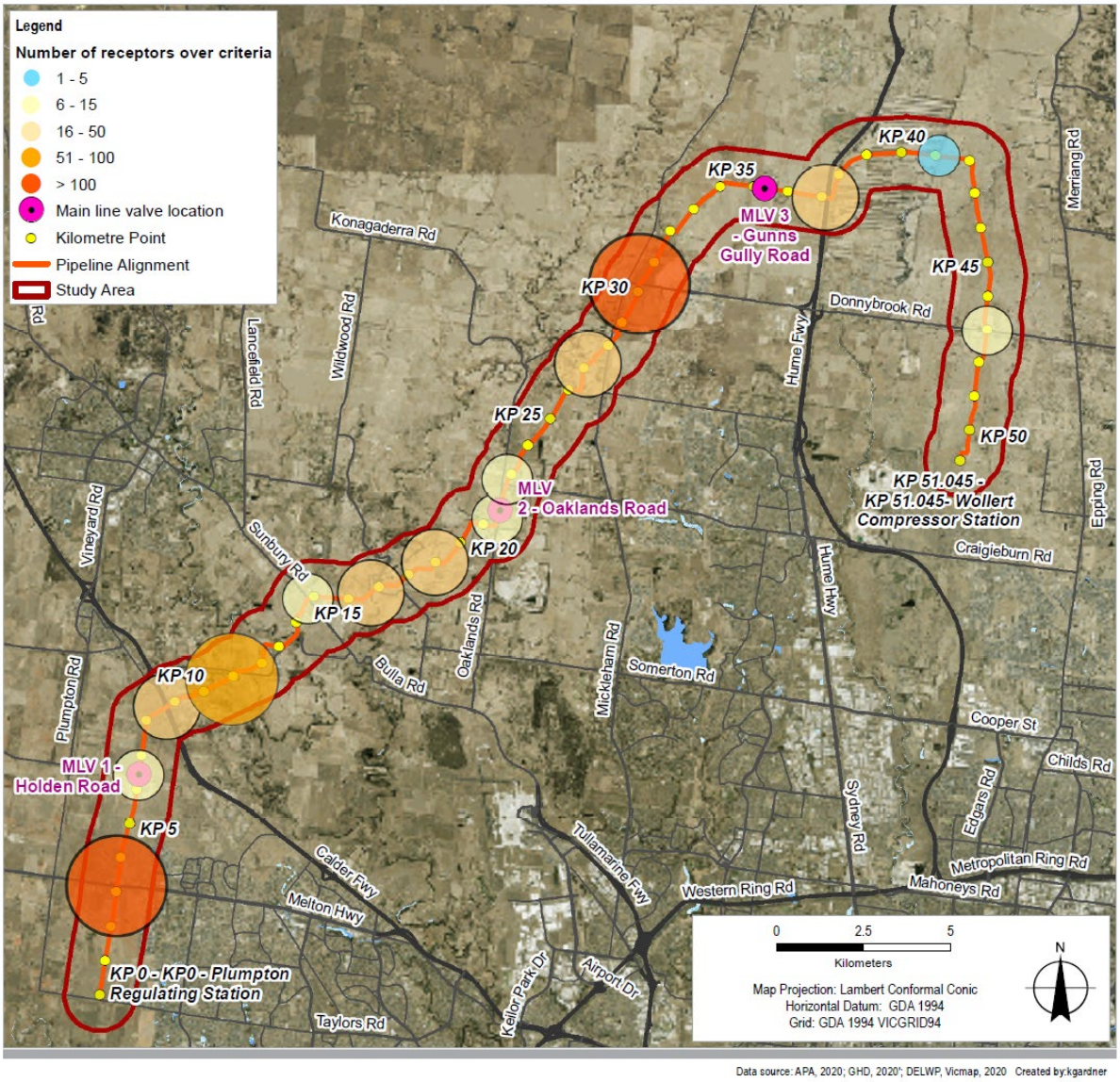


Figure 12-9 Noise level exceedances at sensitive receptors for night-time, HDD/bored crossing construction – without mitigation



Environmental management measures

A range of measures to avoid, minimise and reduce the impacts of noise and vibration during construction would be implemented. The Construction Noise and Vibration Plan to be prepared for the Project would detail these measures including:

- Limiting works to the standard construction hours when possible
- Using the lowest noise work practices and equipment that meets the requirements of the job
- Using broadband reversing alarms on construction vehicles and machinery in preference to beeper reversing alarms
- Identifying designated vehicle routes, parking locations and delivery hours
- Turning off equipment and vehicles when not being used (EMM NV1).

When works are required outside of normal working hours (as defined by EPA Publication 1834), then the contractor would be required to demonstrate that these works fall within the definition of 'low-noise impact' 'managed-impact' or 'unavoidable works' as defined in EPA Publication 1834. The Construction Noise and Vibration Plan to be prepared by the construction contractor would specify which activities fall within these categories and would be undertaken outside of normal working hours (EMM NV5).

Where noise from the Project is predicted to exceed the recommended noise criteria (EMM NV10) after implementation of mitigation measures identified above in EMM NV1, further mitigation will be considered and implemented such as:

- The use of on-site hoarding or temporary screens (EMM NV2)
- Adopting engineering noise controls at the source (for example, silencer, mufflers) (EMM NV2)
- Partial or full enclosures of working areas (EMM NV2)
- Increasing the distance between a sensitive receptor and noise source (EMM NV4).

Depending on the controls implemented at individual locations, the mitigation measures could reduce the noise levels by around 5 bB(A) when selecting quieter equipment and use of silences, to as much as 50 dB(A) where barriers or enclosures are used. Should more than one noise and vibration measure be implemented (for example EMM M1 in combination with EMM NV2), the noise reduction is expected to be additive.

In the event that noise impacts after implementation of further on-site mitigation measures are expected to exceed the recommended noise criteria, or construction activities are planned in proximity to sensitive receptors, information on the impact will be discussed with affected residents (EMM NV7). Depending on the circumstances, further measures to minimise noise impact may be considered including alternative temporary accommodation or other respite options (EMM NV7).

Overall, with the mitigation outlined above in place, the potential impact on sensitive receptors as a result of the Project's construction is considered to be low.

12.5.2 Construction vibration

Energy from construction equipment is transmitted into the ground and transformed into vibration, which attenuates with distance. Typical levels for vibration-generating equipment potentially associated with construction works are detailed in Table 12-3.

Table 12-3 Vibration generating equipment

Equipment	Peak particle velocity source level (mm/s)	Data reference
Concrete saw	0.5 at 10 m	*Environmental Noise Management Manual* (RTA 2001)
Jackhammer	0.5 at 10 m	
Dozer	2.5 to 4 at 10 m	
Excavator	2.5 at 8 m	Tynan, A.E. *Ground Vibration Damaging effects to Buildings*, Australian Road Research Board 1973
Hydraulic rock breakers (levels typical of a large rock breaker operating in hard sandstone)	1.3 mm/s at 10 m 0.4 mm/s at 20 m	Northern Expressway Environmental report, DPTI, 2007

Vibration guidelines/standards

There are no statutory limits for vibration within Victoria, however, the following two international standards are widely used:

- *Structural Vibration in Buildings – Part 3: Effects on structures*, German Standard DIN 4150:2016
- *Code of practice for noise and vibration control on construction and open sites*, British Standard BS 5228-2:2009.

German Standard DIN 4150:2016 provides criteria for building damage caused by vibration and has been used as a basis of assessment for this Project. German Standard DIN 4150 also provides target vibration levels to minimise damage to buried pipework for short-term vibration.

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. An individual's response to that perception, and whether the vibration is 'normal' or 'abnormal', depends on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration a person responds to as 'normal' in a car or bus is considerably higher than what is perceived as 'normal' in a shop, office, or dwelling. The degree of perception for humans is suggested by the vibration level categories in British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites* (BS 5228-2:2009) which is 0.3 mm/s, and this has been used as a basis of assessment for vibration from the Project's construction.

The EPA guidelines (Publication 480 now superseded) states that building damage and nuisance from ground vibration is unlikely to occur if the vibration-generating activity is conducted at distances greater than 50 m from the building or receptor. As there is no equivalent information or distance in the new EPA Publication 1834, the previous guidelines have been considered.

Predicted vibration impacts

Table 12-4 shows the predicted ground vibration at various distances and typical vibration generating equipment that may be used on-site.

As identified in Section 12.3, there are 14 sensitive receptors within 50 metres of the construction corridor. While the construction corridor could be as close as three to four metres from the closest buildings (which are used for commercial purposes and not considered to be sensitive receptors), the actual location of vibration intensive activities such as excavation and hydraulic hammering (rock breaking) is likely to occur in the centre of the corridor, approximately 13 metres from these buildings. Sensitive receptors are located at least 20 metres from vibration generating activities.

Table 12-4 Typical vibration levels at distances (peak mm/s)

Plant item/distances from source	Peak mm/s			
Distance, m	13 m	20 m	50 m	100 m
Excavator	1.4	0.8	0.3	0.1
Dozer	2.9	1.7	0.6	0.3

Typically, at a distance of 50 metres from the vibration generating activity, vibration is expected to be below the 0.3 mm/s human perception guidance value (BS 5228–2:2009). However, considering the type of equipment to be used for the Project (including dozers), the ground and soil composition, and when applying a conservative site attenuation value, it is expected that vibration may be perceivable at distances of up to 100 metres during dozer or other intensive operations (without mitigation). Findings from Technical report F *Noise and vibration* (Section 8.3) show that at 100 metres away, the vibration from a dozer is expected to be perceivable at 0.3 mm/s. However, vibration generated from an excavator is expected to be 0.1 mm/s at 100 metres away, which is below the human perception value.

As humans can detect vibration well below levels that may cause risk of damage to a building or its contents, should the vibration levels from an activity be below the 0.3 mm/s, it is considered that buildings and structures would not be structurally impacted. As noted above, while the construction corridor could be as close as two to three metres from the closest sensitive receptors, the location of vibration intensive activities is likely to be approximately 13 metres from the residences. At this distance, vibration generated from an excavator is expected to be 1.4 mm/s and 2.9 mm/s from a dozer, which is below the level of structural damage to dwellings and buildings of 5 mm/s (DIN 415:2016).

Heavy trucks passing over a normal road surface typically generate low levels of vibration which are generally imperceptible in nearby buildings. The rattling of windows, other building elements or items is sometimes more likely to be caused by airborne low-frequency noise radiated from trucks. While this may cause concern to residents, the phenomenon is no different from those caused by adverse weather condition (for example, wind) and is typically transient and short term in nature.

Environmental management measures

Measures to avoid and minimise the impacts of construction vibration would be considered in locations where sensitive receptors are located within 100 metres from construction and subject to vibration-generating construction activities. This would include measures as identified in the Construction Noise and Vibration Plan such as:

- Substituting equipment or work methods that produce high levels of vibration for alternatives that produce less vibration where appropriate
- Adopting engineering noise controls at the source (for example, silencer, mufflers)
- Restricting the hours that vibration-generating activities can occur (respite periods) (EMM NV1)
- Increasing the distance between a sensitive receptor and vibration source (EMM NV4).

Where the vibration impacts after mitigation measures have been implemented are still expected to exceed the recommended vibration criteria (EMM NV10), or construction activities are planned in proximity to sensitive receptors, information on the impact will be discussed with affected residents (EMM NV6). Depending on the circumstances, further measures to minimise vibration impacts may be considered including alternative temporary accommodation or other respite options (EMM NV7).

With these mitigation measures in place, the potential impacts on sensitive receptors and buildings and structures as a result of the construction vibration is considered to be low.

12.5.3 Construction blasting

Where hard rock is present within the construction corridor blasting is proposed to accelerate construction where there is sufficient distance to sensitive receptors or structures. Blasting results in both ground-borne vibration as well as an air blast or 'overpressure', which is the term used to describe the pressure propagated through the air.

The locations where blasting may occur have not yet been confirmed, however, 13 potential locations have been identified along the construction corridor as outlined in Table 12-5.

Table 12-5 Potential areas of blasting for construction of the Project

KP (approx.)	Section length (approx. metres)	Distance (metres) to nearest building/building type
8.1	285	610 – residential building
8.4	275	355 – residential building
20.8	700	75 – shed, residential building is approximately 145 m away
21.5	326	46 – shed, residential building is approximately 165 m away
28.0	59	110 – shed, residential building is approximately 160 m away
31.9	171	266 – residential building
36.4	883	51 – shed, residential building is approximately 105 m away
37.6	997	61 – shed, residential building is approximately 100 m away
40.4	984	120 – shed, residential building is approximately 365 m away
42.3	648	324 – shed, residential building is approximately 1.1 km away
42.6 to 45.5	2888	644 – shed, residential building is 1.1 km away
47.0 to 50.0	3069	70 – shed, residential building is approximately 140 m away
50.3	249	75 – shed, residential building is approximately 350 m away

These potential locations have been used to determine and assess the potential noise and vibration impacts from blasting.

Blasting guidelines/standards

The *Ground Vibration and Airblast Limits for Blasting in Mines and Quarries Guidelines*[4] and AS2187.2:2006[5] were used to establish relevant criteria for air blasts from blasting activities. In addition, British Standard (BS) 7385-2:1993[6] and German Standard DIN 4150:2016 were used for structural damage vibration criteria. The criteria used in the assessment is outlined in Table 12-6.

Table 12-6 Human comfort and structural damage criteria for blasting criteria

Activity	Category	Criteria
Air blasts	Human comfort	Peak sound pressure level (dBL): • 115 dBL for 95% blasts per year • 120 dBL maximum unless agreement with occupier that a higher level may apply
	Structural damage	133 dBL unless agreement is reached with a landowner that a higher limit may apply
Vibration limits	Human comfort	Peak particle velocity (PPV) (mm/s): • 5 mm/s for 95 % of all blasts per year • Operations lasting less than 12 months or less than 20 blasts: 10 mm/s maximum unless agreement is reached with occupier that a higher level may apply
	Structural damage	Peak component particle velocity (mm/s): • Operations lasting less than 12 months or less than 20 blasts: 10 mm/s maximum unless agreement is reached with occupier that a higher level may apply • Pipework steel, clay, concrete, reinforced concrete, pre-stressed concrete, metal: 80 mm/s

Predicted air blast impacts

When predicting noise and vibration from blasting, 'site constants' are used to determine how the blast may be attenuated due to site characteristics such as terrain, ground and soil composition, and surface features.

A preliminary assessment of impacts from air blasts has been carried out as detailed in Technical report F *Noise and vibration* (Section 8.2.5). A site constant of K_a=10 has been used in the preliminary assessment considering the existing site characteristics along the construction corridor where blasts are proposed.

A site constant of K_a=10 describes a location which provides high attenuation and a site with K_a=100 describes a site with a low level of attenuation.

4 Department of Jobs, Precincts and Regions, 2020. Ground Vibration and Airblast Limits for Blasting in Mines and Quarries Guidelines, available at: https://earthresources.vic.gov.au/legislation-and-regulations/guidelines-and-codes-of-practice/ground-vibration-and-airblast-limits.

5 Australian Standard 2187.2:2006 Explosives-Storage and use. Part 2: Use of explosives.

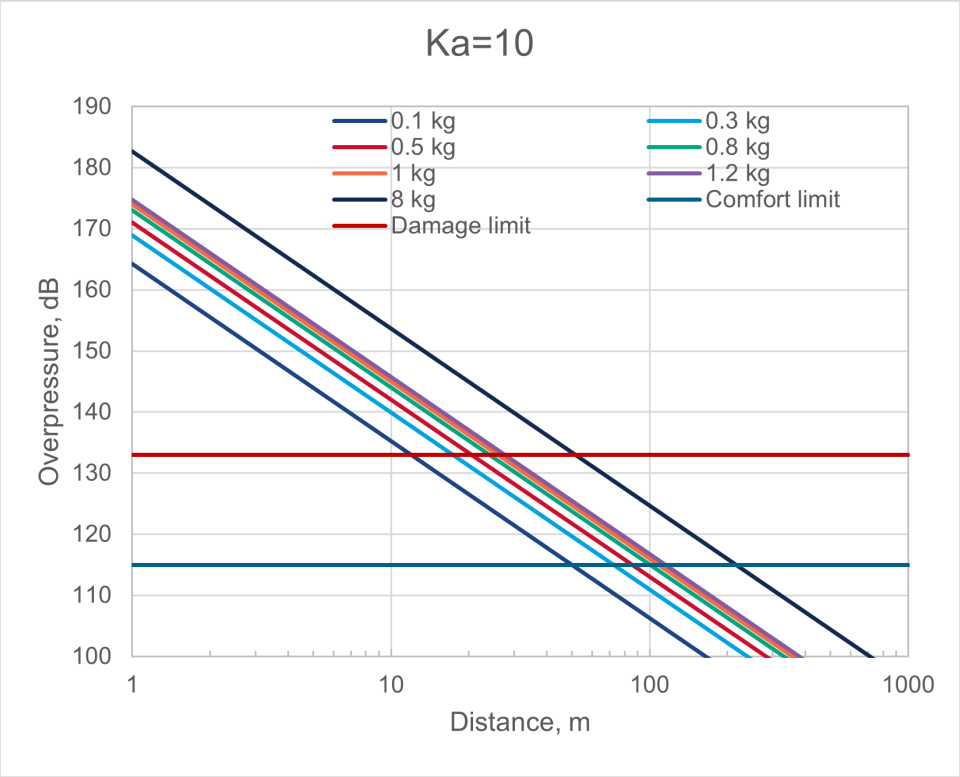
6 British Standard BS 7385-2:1993 British Standard Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.

A range of charge weights have been considered from 0.1 kilograms to a maximum of 8 kilograms, however, it is expected that typically the Project would use charge weights of between 0.8 to 1.2 kilograms. Air blast predictions are presented in Figure 12-10, with reference to the human comfort level of 115 dB for 95 per cent of the blasts, and the structural damage criterion of 133 dB.

As distance increases from the location of the blast, the overpressure reduces. As identified in Table 12-5, residential buildings would be located at least 100 metres or more from potential blast locations. As shown in Figure 12-10, at this distance, blasting with the use of charges of less than one kilogram would not exceed the human comfort or structural damage criterion. Marginal exceedance of the human comfort levels is predicted for charges greater than one kilogram but less than eight kilograms, however, the overpressure is still expected to be below the 120 dB maximum human perception criterion.

Use of an eight kilogram charge may be required at one location, in the northern end of the Project between KP35 and KP40. The blast at this location may exceed 120 dB at the nearest residence (sensitive receptor C510), but is expected to be below the structural damage criterion of 133 dB at the nearest structure associated with the residence, which is a shed. Considering that blasting is not expected to be performed on regular basis, the impact to this receptor is not anticipated to be significant.

Figure 12-10 Air blast overpressure at various distances and charges

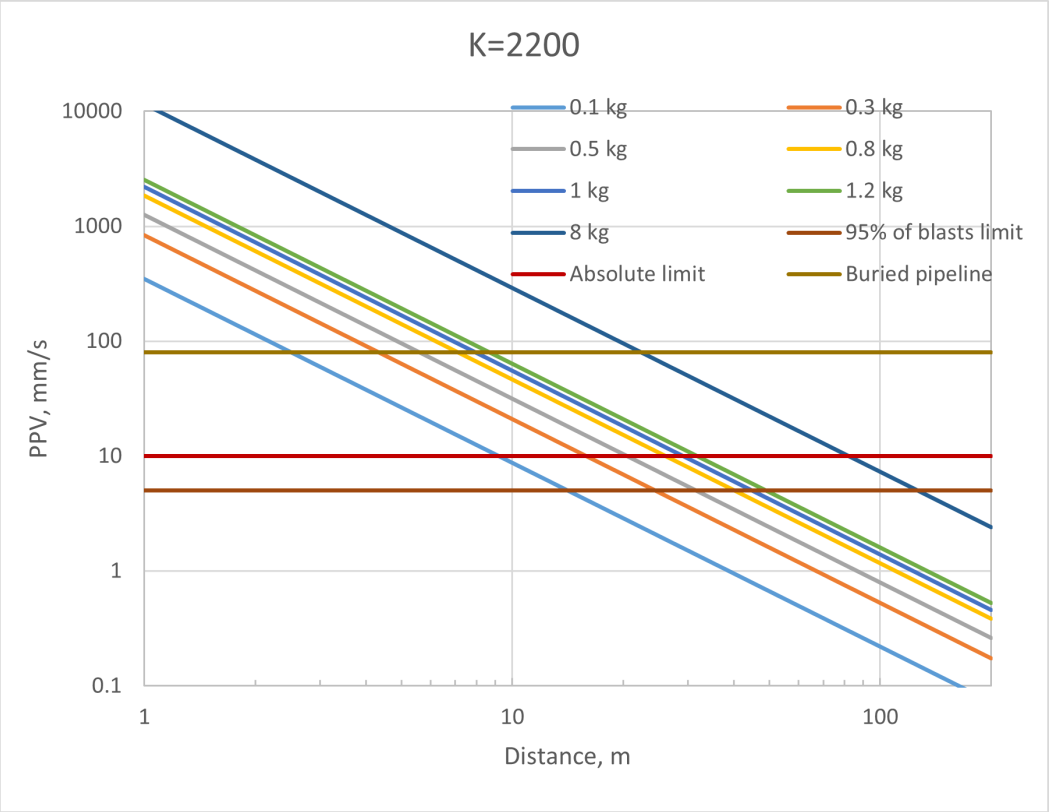


Predicted vibration impacts

Figure 12-11 shows the vibration magnitudes calculated for different charges and site constants of *K*=2200 with reference to the human comfort level of 5 mm/s for 95 per cent of blasts (criteria outlined in Table 12-6) and the structural damage criterion of 10 mm/s for buildings and 80 mm/s for underground pipes.

The findings show that the human comfort criterion of 5 mm/s can be met at all residential buildings for charges up to 1.2 kg as residences would be at least 100 metres or more away from the proposed blast locations. Use of an eight kilogram charge at one location at the northern end of the Project between KP35 and KP40, and at this location the blast impact may exceed the 5 mm/s human comfort criterion. However, at this location the blast impact is expected to be below the maximum human comfort limit and the structural damage to buildings of 10 mm/s limit.

Figure 12-11 Peak particle velocity estimates from blasts at K=2200



Environmental management measures

Overall, criteria for structural damage and human comfort levels are expected to generally be met due to the separation distances between sensitive receptors and potential areas of blasting. Prior to any blasting, a detailed blast study and impact management plan would be developed to confirm predicted blasting impacts and identify any further management measures required such as selection of lower charges (EMM NV3). Condition/dilapidation surveys may be offered where high blast charges are required as informed by the detailed blast study and impact management plan (EMM NV8).

12.5.4 Summary of residual construction impacts

Section 12.5.1 identifies the locations and number of sensitive receptors that may experience noise from construction activities at levels which are above the Project noise criteria. However, with the proposed mitigation measures to avoid and minimise noise (EMM NV1, NV2, NV4) the potential noise impacts are expected to be effectively reduced. Controls would be implemented suited to the individual locations and circumstances and the mitigation measures could reduce the noise levels by around 5 bB(A) to as much as 50 dB(A) where barriers or enclosures are used. The extent of the noise reduction achieved would depend on site characteristics and what controls the construction contractor employs however, it is considered that substantial noise reduction could be achieved by implementing a combination of onsite mitigation measures (EMM NV1 (General mitigation practices), NV2 (source mitigation and barriers or enclosures) and NV4 (increasing the distance)).

With these on-site management measures (EMM NV1, NV2 and NV4) it is expected that noise could be reduced to meet the project noise criteria in EMM NV10. However, in some locations the contractor may decide to use off-site mitigation measures to minimise noise impacts, and this may include alternative temporary accommodation (EMM NV7). These alternate options may be employed for a number of reasons including timing and duration of impact, feasibility of installing mitigation (for example, barriers) or a receptor's sensitivity to the noise impact.

In terms of vibration impacts, Section 12.5.2 has identified that there are 14 sensitive receptors within 50 metres of the construction corridor where vibration may exceed the human perception guidance value without mitigation, however, buildings and structures would not be structurally impacted. Measures to avoid and minimise the impacts of construction vibration would be considered in locations where sensitive receptors are located within 100 metres from construction and subject to vibration generating construction activities. This would include measures such as alternative work methods, restricted hours and increasing the distance between equipment and sensitive receptor (EMM NV1, NV4). There are 23 sensitive receptors within 100 metres of the construction corridor.

In the event that the residual noise and vibration impacts (after on-site management measures are implemented) exceed the recommended construction noise and vibration criteria or construction works are planned close to the sensitive receptors, information on the impact will be discussed with affected residents and individual mitigation would be implemented (EMM NV6).

The separation distances from sensitive receptors to potential areas of blasting are expected to be sufficient so that structural damage criteria and human comfort levels are generally met, although marginal exceedances of the human comfort levels are expected for blasts with the use of charges greater than 1 kilogram in some locations. At one location in the northern end of the Project, a larger charge (8 kilograms) may exceed the human comfort levels (for 95% of blasts), but would be below the maximum human comfort limit structural damage criterion of 10mm/s. A blasting study would identify any further management measures including appropriate selection of charges (EMM NV3).

With the mitigation in place, noise and vibration from the Project is expected to be below the noise and vibration criteria (as specified in EMM NV10) and the potential residual noise, vibration and blasting impacts on sensitive receptors as a result of the Project's construction is considered to be low.

12.6 Operation impact assessment

This section discusses the impacts associated with the operation of the Project in relation to noise and vibration. As the gas pipeline would be buried once construction has been completed, the relevant source of operation noise emissions is the Wollert Compressor Station. There are 31 sensitive receptors within the vicinity of the Wollert Compressor Station, with the closeted being around 700 metres away from the existing facility.

The MLV sites are separated by substantial buffers from the nearest noise sensitive receptors (refer to Section 12.3), with the closest sensitive receptor being approximately 300 metres away from a MLV site. Maintenance of the MLV sites would be required approximately once a year and would involve opening/closing valve operations that last for around one to two minutes, generally undertaken during the day. Accordingly, noise generated by maintenance activities is not likely to impact on amenity and has not been assessed further.

Emergency venting of MLVs is only expected where gas needs to be isolated in the pipeline for safety purposes during an emergency. As this would have a rare likelihood of occurrence, noise for emergency MLV venting has not been assessed.

12.6.1 Operation noise criteria

The State Environment Protection Policy – *Control of Noise from Commerce, Industry and Trade No. N-1* (SEPP N-1) sets out the noise criteria for sensitive receptors located within a Major Urban Area, defined under SEPP N-1 as the area within the Melbourne Urban Growth Boundary, or land zoned Residential Zone, Industrial Zone, Business Zone or Urban Growth Zone with a population greater than 7000.

The Project is located within a Major Urban Area as defined in SEPP N-1. Under SEPP N-1 noise criteria is specified according to:

- Planning zones for receptor and noise source
- Existing background noise
- Baseline noise criteria.

The applicable limits are derived based on a comparison of background levels and derived planning zones criteria and cannot be less than the minimum baseline criteria. Different criteria apply for the day (0700 and 1800 hours), evening (1800 and 2200) and night (2200 to 0700) periods. The night-time noise limits are the most stringent and are identified in Table 12-7.

Table 12-7 Operation noise criteria – night-time

Sensitive receptor	Land use zoning	Influencing factor*	Background noise level	Night-time noise limit (dB(A))
R01	Farming	0.125	36	41
R04, R27	Farming	0	36	39
R02	Industrial	1	36	49
R03	Special Use	1	36	49
R05, RO6, R07, R08, R09, R10	Green Wedge	0	36	39
R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26	Rural	0	36	39
R28	Industrial	1	36	49
R29, R30	Rural Conservation	0	36	39
R31	Rural	0	36	39

**the influencing factor is determined based on SEPP N-1 and considers the surrounding land use within 400 metres of the receptor.*

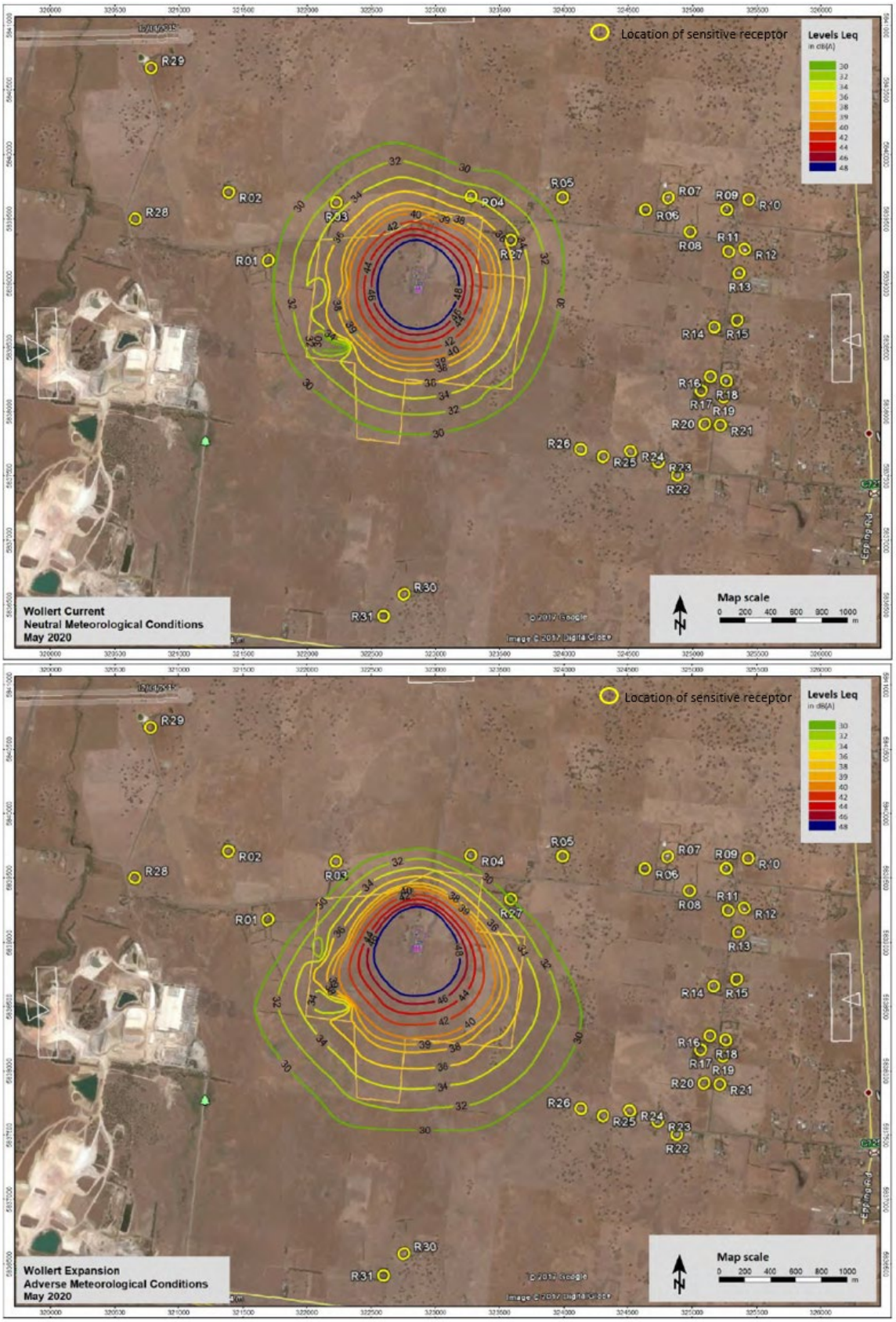
12.6.2 Predicted operation noise

The Wollert Compressor Station operates during the day, evening and night. The noise limits applicable at sensitive receptors are identified in Table 12-7.

Noise levels have been modelled for the maximum operating capacity of the current and expanded compression station. Noise levels at the facility are predicted to comply with the applicable noise limits (as outlined in Table 12-7) at all of the sensitive receptors during the day and the night during neutral and adverse metrological conditions (Wood, 2020)[7]. The highest predicted noise level is 34.3 dB(A), which is 4.7 dB below the most conservative SEPP-N1 night-time noise limits of 39 dB(A) which is applicable to receptors within the Farming, Green Wedge, Rural and Rural Conservation zones. Figure 12-12 provides the noise contours of the operation of the Wollert Compressor Station.

[7] Neutral and adverse metrological conditions as defined in CONCAWE (Conservation of Clean Air and Water in Europe) *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities* Report no. 4/81, May 1981, Den Haag.

Figure 12-12 Noise contours from the Wollert Compressor Station during neutral and adverse meteorological conditions, source: Wood, 2020



12.6.3 Summary of residual operation impacts

Based on the results of the modelling, noise from the operation of the expanded Wollert Compressor Station would comply with the applicable noise limits (SEPP N-1) at all of the sensitive receptors during the day, evening and night-time. Any impacts are expected to be low and no specific mitigation is required.

12.7 Cumulative impact assessment

There are two projects in the vicinity of the WORM project that may be constructed at the same time:

- Melbourne Water's Yan Yean to Bald Hill pipeline project, which coincides with the Project construction activities at KP 40–42. There are three sensitive receptors in this location
- Major Road Projects Victoria's (MRPV) Sunbury Road upgrade project, which traverses the WORM construction corridor at KP15. There are 11 sensitive receptors in the vicinity of both Sunbury Road and the WORM.

Details of sequencing of works and types of activities for these projects is not yet known, however, should construction activities occur at the same time as WORM, there is potential for cumulative noise and vibration impacts at the sensitive receptors and possible exceedances of noise criteria. Liaison with MRPV and Melbourne Water would be undertaken prior to and during construction to avoid, where practicable, WORM construction works being undertaken at the same time and in the same location as these two projects. In the event that this is not possible, measures to avoid and minimise the impacts would be detailed in the Construction Noise and Vibration Plan.

In terms of operation, the Wollert Compressor Station is approximately 700 metres from the nearest residential receptor and 3 kilometres from a quarry. Given these distances, the operation of the expanded Wollert Compressor Station is not considered to have a cumulative impact with other nearby noise sources.

12.8 Environmental management

12.8.1 Environmental management measures

Table 12-8 lists the recommended environmental management measures for noise and vibration.

In developing the environmental management measures, the mitigation hierarchy has been applied, that is, an obligation to first avoid, minimise, restore and only after exhausting those measures, offset the residual impacts that remain. Chapter 3 *Project development* explains how the current form of the Project was selected and discusses how the pipeline alignment avoids residential areas where possible.

It is the nature of construction projects and the operation of pipelines that complete avoidance of noise impacts is not possible. However, avoidance of noise impacts has been achieved where possible through alignment selection by avoiding land where impacts would be higher (for example, commercial, residential, industrial and community land uses).

Where avoidance could not be achieved, due to the nature of the Project, the existing conditions and/or the type of impacts, minimisation is the next level in the mitigation hierarchy proposed. Noise impacts from construction projects are typically minimised by implementing a Construction Noise and Vibration Plan and undertaking Project consultation.

Application of the mitigation hierarchy is outlined in Table 12-8.

Table 12-8 Noise environmental management measures

EMM #	Environmental management measure	Stage	Mitigation hierarchy
NV1	Manage construction noise and vibration in accordance with Chapter 4 (Noise and vibration) of EPA Victoria Publication *1834 Civil construction, building and demolition guide*. Prepare and implement a Construction Noise and Vibration Plan that includes the following general good practice measures: • Use lowest-noise and vibration work practices and equipment that meet the requirements of the job • Use broadband reversing alarms on construction vehicles and machinery in preference to 'beeper' reversing alarms. The site will be planned to minimise the need for reversing of vehicles • Turn off equipment and vehicles when not being used • Take care not to drop spoil and construction materials that cause peak noise events • Ensure equipment is operated in accordance with manufacturers requirements • Limit works to the 'normal working hours' (as defined in EPA Publication 1834) as far as reasonably practicable • Minimise the use of loud equipment, generation of unnecessary noise and vibration, and the movement of vehicles on the construction corridor as far as reasonably practicable • Outline designated vehicle routes, parking locations and delivery hours to minimise noise impact on sensitive receptors • Undertake all reasonable and practicable actions to comply with the construction noise and vibration criteria as identified in EMM NV10.	Construction	Avoidance and minimisation
NV2	Where the construction noise and/or vibration levels (as identified in EMM NV10) are predicted or measured to exceed applicable criteria after implementing the general noise mitigation practices, further mitigation measures must be considered and implemented as far as reasonably practicable. These measures may include: • Adopting engineering noise controls at the source (eg silencer, mufflers, enclosures) by all practical means using current technology • Selection of quieter equipment • Installation of onsite barriers such as hoardings or temporary screens to provide a noise barrier between any particularly noisy construction works and the residences • Restricting the hours that the very noisy activities can occur (respite periods).	Construction	Avoidance and minimisation
NV3	Develop a detailed blast study and impact management plan in accordance with AS 2187.2 – 2006 *Explosives – storage and use* and other relevant documents to confirm blasting impacts and implement any further management measures required.	Construction	Avoidance and minimisation

EMM #	Environmental management measure	Stage	Mitigation hierarchy
NV4	As far as reasonably practicable increase the distance between a sensitive receptor and the noise/vibration source to reduce impacts. This can be achieved through strategic placement of stationary equipment (eg generators used for specific works) within the construction corridor to maximise the distance between source and receptor.	Construction	Avoidance and minimisation
NV5	As far as reasonably practicable limit works to the 'normal working hours' (as defined in EPA Publication 1834). Identify activities required to be undertaken outside of normal working hours. The Construction Noise and Vibration Plan must include a clear rationale for defining works as 'low-noise', 'managed impact', or 'unavoidable' (as defined in EPA Publication 1834) and response strategies to mitigate the impacts of these works.	Construction	Avoidance and minimisation
NV6	Where the residual noise and vibration impact (after mitigation measures are implemented) exceeds the recommended construction noise and vibration criteria or construction works are planned close to the sensitive receptors, notify residents will be notified in advance about upcoming construction works. Send notification letters to residents of noise affected dwellings prior to the commencement of works which include information on: • Date and time of the noise intensive works • Expected durations of the noisiest activities • Use and provision of individual protective measures such as earplugs (for short duration impacts of 1 to 2 nights only and on a case-by case basis). Implement a complaints management register that documents: • Name of persons receiving complaint • Name of person making the complaint • Date and time of complaint • Nature of the complaint • Actions taken to rectify the issue • Actions to minimise risk of repeated occurrence • Name of person responsible for undertaking the required actions • Communication of response to the complaint. Implement a complaint system that includes the following measures: • Establish a community liaison phone number and permanent site contact number so that noise related complaints can be received and addressed in a timely manner • Determine whether any unusual activities were taking place at the time of the complaint that may have generated higher noise levels than usual and whether they may be attributed to the construction site activities • Implement additional management mitigation measures where required and reasonably practicable.	Construction	Minimisation
NV7	Where the residual impact is predicted to exceed the recommended noise or vibration criterion for an extended period (after other mitigation measures have been implemented), discuss information on the impact with affected residents. Depending on the circumstances, off-site measures to minimise noise impact must be considered including alternative temporary accommodation or other respite option.	Construction	Minimisation

<table>
<tr><th>EMM #</th><th>Environmental management measure</th><th>Stage</th><th>Mitigation hierarchy</th></tr>
<tr><td>NV8</td><td>Where required, condition/dilapidation surveys may be offered to owners of buildings where high blast charges are required and the detailed blast study and impact management plan identifies possible impact to buildings.</td><td>Construction</td><td>Avoidance and minimisation</td></tr>
<tr><td>NV9</td><td>Liaise with the Melbourne Water Bald Hill to Yan Yean pipeline and Major Road Projects Victoria Sunbury Road upgrade project teams to assess cumulative construction noise impacts. Implement additional noise mitigation measures if required.</td><td>Construction</td><td>Minimisation</td></tr>
<tr><td>NV10</td><td>Undertake all reasonable and practicable actions to comply with the construction noise criteria:
<table>
<tr><th>Sensitive receptor</th><th>Period</th><th>Noise criteria, L_{Aeq}</th></tr>
<tr><td>Residential</td><td rowspan="4">EPA normal working hours
Mon–Fri: 7 am – 6 pm
Sat: 7 am – 1 pm</td><td>75</td></tr>
<tr><td>Educational institutions</td><td>60</td></tr>
<tr><td>Parks and recreational areas</td><td>65</td></tr>
<tr><td>Community and commercial buildings</td><td>70</td></tr>
<tr><td>Residential</td><td>Evening and weekend
Mon–Fri: 6 pm – 10 pm
Sat: 1 pm – 10 pm
Sundays and public holidays 7 am to 10 pm</td><td>Noise level at any residential premises not to exceed background (L_{A90}, dB) noise by:
• 10 dBA or more for up to 18 months</td></tr>
<tr><td>Residential</td><td>Night-time
Mon–Sun: 10 pm – 7 am</td><td>Noise inaudible within a habitable room of any residential premises.
Background +0 dB(A) (external)</td></tr>
</table></td><td>Construction</td><td>Avoidance and minimisation</td></tr>
</table>

<table>
<tr><th>EMM #</th><th>Environmental management measure</th><th>Stage</th><th>Mitigation hierarchy</th></tr>
<tr><td></td><td>
Implement management measures if vibration from construction is predicted to exceed the standards for structural damage as identified in the following:
<table>
<tr><th rowspan="3">Group</th><th rowspan="3">Type of structure</th><th colspan="4">Vibration velocity (PPV) in mm/s</th></tr>
<tr><th colspan="3">At foundation at a frequency of</th><th rowspan="2">Vibration at horizontal plane of highest floor (all frequencies)</th></tr>
<tr><th>< 10 Hz</th><th>10 Hz–50 Hz</th><th>50 Hz–100 Hz</th></tr>
<tr><td>1</td><td>Buildings used for commercial purposes, industrial buildings and buildings of similar design</td><td>20</td><td>20–40</td><td>40–50</td><td>40</td></tr>
<tr><td>2</td><td>Dwellings and buildings of similar design and/or occupancy</td><td>5</td><td>5–15</td><td>15–20</td><td>15</td></tr>
<tr><td>3</td><td>Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg heritage-listed)</td><td>3</td><td>3–8</td><td>8–10</td><td>8</td></tr>
</table>
Implement management measures if vibration from construction is predicted to exceed the standards for structural damage to existing underground pipelines:
<table>
<tr><th>Pipe material</th><th>Guideline value on pipe (mm/s)</th></tr>
<tr><td>Steel (including welded pipes)</td><td>100</td></tr>
<tr><td>Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with/without flanges)</td><td>80</td></tr>
<tr><td>Masonry, plastic</td><td>50</td></tr>
</table>
Implement management measures if vibration from construction exceeds the human perception of 0.3 mm/s at sensitive receptors.
</td><td></td><td></td></tr>
</table>

12.8.2 Monitoring

APA will monitor noise and vibration levels with reference to the criteria for noise and vibration as set out in EMM NV10. Noise and vibration monitoring would assist in informing measures to minimise noise and vibration impacts during construction.

The requirements for and locations of noise monitoring would be informed by construction methods, proximity to sensitive receptors and scheduling of works and will be detailed in the construction contractors Construction Noise and Vibration Plan. At a minimum, monitoring of noise would be undertaken:

- Daily at the nearest noise sensitive receptor (or group of sensitive receptors) where works are undertaken outside of normal working hours (as defined by EPA Publication 1834) to confirm compliance with the project noise criteria as identified in EMM NV10.
- In the event of a complaint regarding noise in relation to an ongoing activity if required in accordance with the complaint management procedure in the Construction Noise and Vibration Plan.

Monitoring of vibration from intensive construction operations (such as plant and equipment (eg dozer) used during the clear and grade and trenching phase causing high levels of vibration), would at a minimum include:

- Initial monitoring of a vibration intensive activity at the nearest sensitive receptor (or group of sensitive receptors) that is within 100 metres of that activity. Should the results from the initial monitoring determine that the vibration intensive activity is below the project vibration criteria as identified in EMM NV10, then further monitoring at that particular location for that activity would not be required. If the results from the initial monitoring determine that the vibration from that activity is the same as or exceeds the project vibration criteria as identified in EMM NV10, then additional mitigation measures would be required (EMM NV2, NV4, NV6 and NV7) and follow up monitoring would be undertaken to confirm compliance.
- In the event of a complaint regarding vibration in relation to an ongoing activity (if required in accordance with the complaint management procedure in the Construction Noise and Vibration Plan).

Monitoring of blasting would at a minimum include:

- Initial monitoring at the nearest sensitive receptor (or group of sensitive receptors) if the detailed blast study identifies locations where the air blast or vibration may be the same as or exceed the human comfort or structural damage criteria as detailed in Table 12-6. Should the results from the initial monitoring determine that the blasting is below the project criteria as identified in Table 12-6, then further monitoring at that particular location would not be required. If the results from the initial monitoring determine that the air blast or vibration is the same as or exceeds the criteria as identified in Table 12-6, then control management measures identified in the blast impact management plan will be implemented.

A response plan would be developed to manage potential impacts if recommended noise or vibration criteria are exceeded, including:

- Any actions taken to rectify the exceedance
- Actions to minimise risk of reoccurrence
- Name of person(s) responsible for undertaking the required actions
- The necessity, type and duration of any further monitoring to be undertaken.

Contingency measures would be implemented should there be adverse residual effects on the noise environment. Contingency measures are incorporated into the relevant EMMs to set out actions to be taken to reduce and vibration noise levels (refer EMM NV2, NV6, NV7).

12.9 Conclusion

This chapter has identified and assessed existing conditions, impacts and mitigation relating to noise and vibration from the construction and operation of the Project.

During construction and where works would occur in proximity to sensitive receptors, construction activities may result in short-term noise and vibration impacts. The key findings of the assessment are:

- Open trench construction – without mitigation this has the potential to exceed the daytime noise criteria at some locations along the construction corridor where works would be undertaken close to the boundary of residential properties. Generally, there is less than five sensitive receptors in a particular location where construction is expected to exceed the daytime criteria. The exception to this is around Morefield Court in Diggers Rest where there is approximately eight sensitive receptors where construction is expected to exceed the daytime criteria. Construction is expected to progress at a rate of approximately 700 metres per day for open trenching and impacts would be short-term at sensitive receptors.
- Noise from HDD and bore operations are predicted to be below the daytime criterion, however, as HDD and boring would sometimes be required during the evening and night-time, these activities have the potential to exceed the relevant evening and night noise criteria pre-mitigation. Exceedance of evening and night criteria is predicted to occur at several locations, with the largest number of impacted receptors at the bored crossing at Fraser Rise, Hillside and Donnybrook Road.
- During the evening it is estimated that less than 15 individual sensitive receptors are likely to be affected at each location where exceedances occur. Night-time exceedances are predicted at 14 locations along the construction corridor and there could be as many as 100 sensitive receptors in some locations, with more at Mickleham, Hillside and Fraser Rise. HDD and bored crossings could take between two to three weeks at a particular location and mitigation measures as outlined below would be required to avoid and minimise impacts during this time.
- There are a number of sensitive receptors within 50 metres of the 30 metre wide construction corridor with the potential to be impacted by vibration from construction activities. Vibration-generating activities such as excavation, and drilling would be positioned as far as practical from nearby sensitive receptors
- The separation distances from sensitive receptors to potential areas of blasting are expected to be sufficient so that structural damage criteria and human comfort levels are generally met, although marginal exceedances of the human comfort levels of 5 mm/s (for 95% of blasts) are expected for blasts with the use of charges greater than one kilogram, but less than eight kilograms. Use of an eight kilogram charge may be required at one location, in the northern end of the Project, and this charge may exceed the human comfort level of 5 mm/s (for 95% of blasts), but would be below the maximum human comfort limit and also the structural damage limit) of 10 mm/s at the nearest sensitive receptor.

Noise from the operation of the expanded Wollert Compressor Station is predicted to comply with the applicable noise limits (SEPP N-1) at all of the sensitive receptors during the day, evening and night-time.

Project environmental management measures have been developed to avoid and minimise impacts associated with noise and vibration during the construction of the Project. These include preparation of a Construction Noise and Vibration Plan detailing measures to avoid and minimise noise and vibration (EMM NV1). Controls would be implemented suited to the individual locations and circumstances and could reduce the noise levels by around 5 dB(A) to as much as 50 dB(A) where barriers or enclosures are used. With the implementation of on-site management measures (EMM NV1, NV2 and NV4), it is expected that noise could be reduced to meet the project noise criteria in EMM NV10. However, in some locations the contractor may decide to use off-site mitigation measures to minimise noise impacts, and this may include alternative temporary accommodation (EMM NV7). These alternate options may be employed for a number of reasons including timing and duration of impact, feasibility of installing mitigation (for example, barriers) or a receptor's sensitivity to the noise impact.

Measures to avoid and minimise the impacts of construction vibration would be considered in locations where sensitive receptors are located within 100 metres from construction and subject to vibration-generating construction activities. This would include measures such as alternative work methods, restricted hours, and increasing distance between equipment and sensitive receptor (EMM NV1, NV4).

In the event that the residual noise and vibration impacts (after on-site management measures are implemented) exceed the recommended construction noise and vibration criteria or construction works are planned close to the sensitive receptors, information on the impact will be discussed with affected residents and individual mitigation would be implemented (EMM NV6).

Prior to any blasting, a detailed blast study and impact management plan would be developed to confirm potential blasting impacts and identify any further management measures required (EMM NV3).

With the mitigation in place, noise and vibration from the Project is expected to be below the noise and vibration levels criteria (as specified in EMM NV10) and the potential residual noise, vibration and blasting impacts on sensitive receptors as a result of the Project's construction is considered to be low.

In response to the EES evaluation objective described at the beginning of this chapter, effects of the Project have been assessed and environmental management measures have been identified to minimise or avoid noise and vibration impacts on amenity values, or damage to buildings and underground services.