technical report F

noise and vibration.

Environment Effects Statement | May 2021

western outer ring main

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APA VTS (Operations) Pty Ltd

Western Outer Ring Main - Environment Effects Statement

Noise and Vibration Report

May 2021

This Noise and Vibration Report (Report):

1. Has been prepared by GHD Pty Ltd ("GHD") for APA VTS (Operations) Pty Ltd (APA);
2. May only be used for the purpose of informing the Environment Effects Statement and Pipeline Licence Application for the Western Outer Ring Main Project (and must not be used for any other purpose); and
3. May be provided to the Department of Environment, Land, Water and Planning for the purpose of public exhibition as part of the Environment Effects Statement and Pipeline Licence Application for the Western Outer Ring Main Project.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in section 5 of this Report. The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report (Assumptions), as specified in section 1.3 and section 5.5 and throughout this Report. GHD excludes liability for errors in, or omissions from, this Report arising from or in connection with any of the assumptions being incorrect. Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation. GHD has not, and accepts no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was signed.

Executive summary

Overview

The Western Outer Ring Main Project (the Project) is a buried 600 millimetre nominal diameter high pressure gas transmission pipeline between APA's existing Plumpton Regulating Station (approximately 38 kilometres north west of Melbourne's CBD) and Wollert Compressor Station (approximately 26 kilometres north east of Melbourne's CBD), providing a high pressure connection between the eastern and western pipeline networks of the Victorian Transmission System (VTS).

The Project includes a new buried pipeline, three above-ground mainline valves along the pipeline alignment, and an additional compressor unit and regulating station at the existing APA Wollert Compressor Station.

APA is the proponent for the Project.

On 22 December 2019, the Minister for Planning determined that the Project would require an Environment Effects Statement (EES) under the *Environment Effects Act 1978* (EE Act).

GHD was commissioned to undertake a noise and vibration impact assessment for the purpose of the EES for the Project.

Noise and vibration context

If not appropriately managed, high noise and vibration associated with the construction or operation of a project may, result in detrimental physical and psychological effects on human health. Evidence of the health risks associated with exposure to prolonged or excessive noise or vibration is well-established and recognised by scientific and government bodies. Possible human responses to adverse levels of noise or vibration may include:

- Annoyance (that is stress, loss of concentration)
- Productivity loss and/or inability to continue to perform work duties
- Lack of sleep or sleep disturbance
- Negative health effects due to long-term exposure to high noise levels.

In relation to the Western Outer Ring Main Project specifically, the risks of adverse noise and vibration impacts are primarily associated with the construction of the Project. This is because once construction is complete, the gas pipeline would be buried below ground and the operation of the pipeline would not generate noise or vibration. In addition, given the distance between sensitive receptors and the Wollert Compressor Station, with the closest sensitive receptor being around 700 metres away from the existing facility, the risk of adverse noise and vibration from the expanded facility is expected to be negligible.

Maintenance of the mainline 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-time. Accordingly, the risk of noise generated by maintenance activities is also likely to be negligible.

Existing conditions

The proposed pipeline would be approximately 51 kilometres in length, from the Plumpton Regulating Station in the south, terminating at the Wollert Compressor Station. The Project is primarily situated in a rural farming zone where existing background noise levels are expected to be low (35 dB(A)), which is typical for areas with negligible and low transportation as defined in Australian Standard 1055.3:1997 *Acoustics- Description and measurement of environmental noise. Part 3: Acquisition of data pertinent to land use.* The Project also runs adjacent to the suburban 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.

The Wollert Compressor Station is situated in a farming zone with scattered individual residences and farm houses. The nearest noise sensitive receptors are located at a distance of approximately 700 metres. Background noise in the vicinity of the compressor station is low, which is typical for rural areas. Other sources of noise in the Project area include agricultural activities, local and main roads, industrial emissions (from local businesses, industries and Melbourne Airport), sand and rock quarries and landfills.

Within the Project study area, there are 525 representative sensitive receptors within approximately one kilometre of the construction corridor. 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 has been used to provide an estimate on the actual number of sensitive receptors where exceedances of the construction noise limits are predicted, as discussed below.

Impact assessment

Pipeline construction

Construction of the pipeline would primarily be via open trench. Crossing of roads, rail and watercourses would be undertaken using specific construction methodologies such as open trench construction, horizontal directional drilling (HDD), horizontal boring or pipe jacking, relevant to each type of crossing.

It is expected that construction would progress at a rate of up to 700 metres per day for open trench construction and associated activities. This would minimise the duration of noise impacts on sensitive receptors. Where works occur near to a noise sensitive receptor, construction activities may result in short term noise and/or vibration impacts. This includes some suburban sensitive receptor areas located near to the construction corridor such as Hillside, Fraser Rise and Mickleham.

Recommended noise limits used in the assessment are based on environmental guidelines for major construction sites, EPA Publication 480 (now superseded by EPA Publication 1834), EPA Publication 1834, *Civil Construction, Building and Demolition guide*, 2020, and informed by recommendations contained in other relevant standards and guidelines, as outlined in Section 4.

In some locations where sensitive receptors are located close to the Project's construction corridor, noise is predicted to exceed the recommended construction noise criteria for open trench construction. Typically, these nearest receptors are isolated rural dwellings, with the highest number of predicted exceedances near Morefield Court and Bulla-Diggers Rest Road in Diggers Rest (approximately eight predicted exceedances).

While open trench construction is expected to occur during the day, HDD, boring and hydrostatic testing would sometimes be required during the evening and at night-time. Without mitigation, exceedance of evening and night-time criteria is predicted to occur at several locations, with the largest number of impacted receptors at the suburban areas of Hillside, Fraser Rise and Mickleham. 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.

Noise and vibration mitigation measures as identified in this report include the application of general construction noise management practices and specific mitigation measures as appropriate to the location and construction activity. Where works are proposed outside of normal construction hours, noise mitigation measures would be implemented to reduce the risk of disruption and sleep disturbance.

Assessment of construction vibration indicates that there is a low risk of structural damage from general construction activities as predicted levels are below the recommended limits relating to structural integrity for typical dwellings.

Human comfort vibration impacts are predicted where vibration generating works are within 100 metres of an occupied residential building. The duration of human comfort vibration impact for any individual receptor is expected to be short due to continuous progress of works along the construction corridor.

As blasting is proposed in some locations along the construction corridor, a preliminary blasting study has been undertaken. Where hard rock is present and there are no nearby sensitive receptors or structures, there is an opportunity for blasting to accelerate construction works and completion of the Project. 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 are expected for blasts with the use of charges greater than one kilogram, but less than eight kilograms.

Accurate estimates of current site constants relating to blasting vibration or overpressure propagation are unknown. Therefore, to determine the site constants a detailed blasting study would be undertaken prior to any construction blasting, once further detail on construction methods and sequencing are known. The resulting site constants would then be used to determine suitable maximum charge size and blasting configuration. The results would also inform whether additional mitigation measures are required to minimise the potential of impacts or adverse reaction at sensitive receptors and structures.

Given that construction at the Wollert Compressor Station would occur during normal working hours only and that there is a substantial separation distance to the nearest sensitive receptor, the impact from construction activities is expected to be minimal.

Overall, with the proposed mitigation measures implemented, the extent, severity and duration of residual impacts during construction are expected to be low.

Wollert Compressor Station

The Victorian *State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1* (SEPP N-1) provides procedures for establishing noise criteria based on planning zones and existing background noise levels. Assessment of noise from the expanded facility is predicted to comply with the applicable noise limits at all sensitive receptors during the day and night during neutral and adverse metrological conditions. Accordingly, the risk of noise impacts during operation is considered to be negligible.

As the existing and proposed operational plant and equipment at the Wollert Compressor Station are not considered to be significant vibration sources, and considering the distance to the nearest sensitive receptor (approximately 700 metres), there is a low risk of impacts caused by vibration.

Assessment results found that specific noise or vibration mitigation measures are not required for the Wollert Compressor Station, however, equipment faults and normal equipment wear may cause noise levels to change over time. The APA Wollert facility undertakes ongoing maintenance works necessary to ensure all equipment is operating efficiently and any faulty components are addressed.

Environmental management measures

Where work is predicted to exceed noise criteria, measures to avoid, minimise and reduce the impact would be implemented. The construction contractor would be required to develop and implement a detailed Construction Noise and Vibration Plan that would contain a range of measures particularly for noisy construction activities such as non-destructive testing (NDT) and coating. With the mitigation measures in place, it is expected that noise impacts would be reduced for the majority of sensitive receptors. While there may be some instances where the residual impact is still expected to exceed the recommended night-time criteria (after mitigation measures have been implemented), information on the impact would be discussed with affected residents. Depending on the circumstances, further measures to minimise noise impact may be considered including alternative temporary accommodation or other respite option.

Based on relevant standards (including Structural Vibration in Buildings – Part 3: Effects on structures*, German Standard* (DIN 4150:2016) and Code of practice for noise and vibration control on construction and open sites*, British Standard* (BS 5228-2:2009)), typically at a distance of 100 metres from the vibration generating activity, construction vibration is expected to meet the 0.3 mm/s human perception guidance value (BS 5228-2:2009). For most construction activities associated with the Project, maintaining these distances would generally be sufficient to be below the human comfort level and to avoid potential damage to vibration sensitive structures. However, exceedance of the human comfort level may occur when undertaking intensive operations (including the use of a dozer), and vibration may be perceivable at distances of up to 100 metres (without mitigation). While these impacts may be short-term, notification of these residents and minimising the time of exposure would avoid and minimise the impact. Vibration from the construction of the Project is expected to be below the level of structure damage to dwellings and buildings.

With regards to blasting, sensitive receptors are separated by a significant buffer from proposed blasting locations (at least 100 metres to residential buildings). At this distance, blast vibration and overpressure are expected to be below structural damage and human comfort criteria with the use of low charges (not greater than 1.2 kilogram). Use of an eight kilogram charge may be required at one area, in the northern end of the Project, and this charge may exceed the human comfort levels, but would be below the structural damage criterion.

Accurate estimates of current site constants relating to blasting vibration or overpressure propagation are unknown and the preliminary assessment has been undertaken considering the existing environment (site characteristics such as terrain, ground and soil composition, and surface features) along the construction corridor where blasts are proposed. Site constants would be determined through a detailed blasting study prior to any construction blasting, and the resulting site constants would then be used to determine suitable maximum charge size and blasting configuration.

The results would also inform whether additional mitigation measures are required to minimise potential of impact or adverse reaction at sensitive receptors and structures. The use of smaller charges and special blasting techniques can also help to mitigate overpressure and vibration impacts.

Community concerns relating to construction noise and vibration could be alleviated through targeted communication with residents predicted to be impacted by construction noise and vibration or blasting. Details of the work and information on the impact would be discussed with affected residents prior to the commencement of construction to assist with setting noise and vibration expectations from the Project. This could also reduce the probability of complaints during construction.

The operational noise assessment indicated that noise levels from the Wollert Compressor Station is expected to be below the strictest night-time limits at sensitive receptors. Vibration impacts from on-site operations are not expected to be perceptible due to the substantial separation distance to the nearest sensitive receptors. Therefore, specific noise mitigation measures are not required for site operations.

In summary, provided that the recommended mitigation measures are implemented, the potential for noise and vibration impacts from construction of the Project is considered to be low. Regarding operation of the Project, there are no predicted exceedances in relation to the operational noise criteria and considering the distance to the nearest sensitive receptor (approximately 700 metres), impacts due to noise and vibration during operation are not expected.

Abbreviations

Abbreviation	Definition
APA	APA VTS (Operations) Pty Ltd, trading as APA Group, the proponent for the Project
DELWP	Department of Environment, Land, Water and Planning
EMP	Environment Management Plan
EES	Environment Effects Statement
FZ	Farming Zone under the Victorian Planning Provisions
GWZ	Green Wedge Zone under the Victorian Planning Provisions
HDD	Horizontal directional drilling
ICCP	Impressed current cathodic protection system
IN2Z	Industrial 2 Zone under the Victorian Planning Provisions
MIC	Maximum instantaneous charge
MLV	Main line valve
NDT	Non-destructive testing
OEMP	Operational Environment Management Plan
PPV	Peak particle velocity
RCZ	Rural Conservation Zone under the Victorian Planning Provisions
R1Z	Residential 1 Zone under the Victorian Planning Provisions
SEPP N-1	State Environment Protection Policy (Noise)
SUZ	Special Use Zone 4 under the Victorian Planning Provisions
SWL	Sound power (SWL)
VDV	Vibration dose value
VTS	Victorian Transmission System
WORM	Western Outer Ring Main

Glossary

Term	Description
Background Noise Level	For a day, evening or night period means the arithmetic average of the L_{A90} levels for each hour of that period for which the commercial, industrial or trade premises under investigation normally operates. The background level shall include all noise sources except noise from commercial, industrial or trade premises which appear to be intrusive at the point where the background level is measured (Victorian Government, 1989).
dB	Unit of measurement for Sound Pressure Level known as a decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	‘A-weighted’ decibel measurement as specified in Australian Standard AS IEC 61672- 2004 Electroacoustics - Sound level meters or its replacements.
EPA	Environment Protection Authority.
GDA94	The Geocentric Datum of Australia is a system of latitudes and longitudes, or east and north coordinates used to track locations.
$L_{Aeq\ (period}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time which 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.
L_{Amax}	The maximum sound level recorded during the measurement period.
L_{Amin}	The minimum sound level recorded during the measurement period.
Lin	LIN or linear is a device or circuit with a linear characteristic, meaning that a signal passing through the circuit is not distorted and/or it excludes a filter.
Mitigation	Reduction in severity.
Receptor (Sensitive Use)	A noise modelling term used to describe a map reference point where noise is predicted. A sensitive receptor would be a home, work place, church, school or other place where people spend time at which noise from the development can be heard. The assessment in this report looks at impacts within 10 m of the façade of the building as defined in the SEPP-N1.
SEPP-N1	State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N–1 No. S31, 16/5/1989, Gazette 15/6/1989; - As varied 15/9/1992, No. G37, Gazette 23/9/1992 - As varied 31/10/2001, No. S183, Gazette 31/10/2001

Term	Description
Sound Pressure Level (SPL)	The Sound Pressure level is the change in air pressure above and below the average atmospheric pressure (amplitude) caused by a passing pressure wave; this is then converted to decibels and can be abbreviated as SPL or L_p. The SPL can be calculated as: $$SPL\ or\ Lp = 10\ Log_{10}\left(P^2/P_0^2\right)\ [dB]$$ or more simply $$SPL\ or\ Lp = 20\ Log_{10}\ P + 94\ [dB]$$ Where: SPL or L_p = Sound Pressure Level P = Root-mean-square (rms) sound pressure (Pascals or Pa) P_0 = International reference pressure 20 micropascals.
Sound Power Level (PWL)	This is defined as the average rate at which sound energy is radiated from a sound source and is measured in watts (W). The Sound Power Level can be abbreviated as PWL or L_w. The PWL can be calculated as: $$PWL\ or\ Lw = 10\ Log_{10}\left(W/W_0\right)\ [dB]$$ or more simply $$PWL\ or\ Lw = 10\ Log_{10}(W) + 120\ [dB]$$ Where: PWL or L_w = Sound Power Level W = acoustic energy of the source given in watts (W) W_0 = International reference sound power of 10^{-12} Watt (W)

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1. Introduction

1.1 Purpose of this report

The Western Outer Ring Main (WORM) gas pipeline project (the Project) is a proposed 600 millimetre nominal diameter high pressure gas transmission pipeline that will provide a high pressure connection between the eastern and western pipeline networks of the Victorian Transmission System (VTS).

APA is the proponent for the Project. APA is Australia's largest natural gas infrastructure business and is the proponent for the WORM Project. In Victoria, the VTS is owned and maintained by APA and consists of some 2,267 kilometres of gas pipelines. The VTS serves a total consumption base of approximately two million residential consumers and approximately 60,000 industrial and commercial users throughout Victoria.

The Project has been designed to provide critical infrastructure for Victoria's gas supply, distribution, and consequent security, efficiency and affordability. The key objectives of the Project are to:

- Improve system resilience and security of gas supply
- Increase the amount of natural gas that can be stored for times of peak demand
- Improve network performance and reliability
- Address potential gas shortages as forecasted by AEMO in the March 2020 Victorian Gas Planning Report update

The Minister for Planning determined on 22 December 2019 that APA and the Project requires an Environment Effects Statement (EES) under the *Environment Effects Act 1978* (EE Act). The EES will inform assessment of approvals required for the Project including under the *Pipelines Act 2005*, *Aboriginal Heritage Act 2006 and Environment Protection and Biodiversity Conservation Act 1999.*

This report discusses the existing noise environment in the Project area and the surrounding sensitive land uses. Noise and vibration impacts are predicted and environmental management measures considered for the operational and construction stages of the project. This report will inform the Noise and Vibration Impact Assessment Chapter in the Project EES document and support other relevant studies.

1.2 Why understanding of noise and vibration impact is important

Exposure to excessive noise and vibration during construction and operation of the Project may have detrimental physical and psychological effects on human health. An individual response to noise and vibration is highly variable. Human sensitivity to noise is commonly influenced by many factors including character and duration of the noise, expectations of affected residents, and the existing acoustic environment. Amenity expectations may be high in quiet rural or sparsely populated areas. Evidence of the health risks associated with exposure to prolonged or excessive noise has been analysed by many scientific and government bodies.

Possible human responses to noise may include:

- Annoyance (i.e. stress, loss of concentration)
- Productivity loss and/or inability to continue to perform business duties
- Lack of sleep or sleep disturbance
- Negative health effects due to during long term exposure to high noise levels.

Ground-borne vibration can also have negative impacts on the affected sensitive receptors and structures. Excessive vibration can result in annoyance and responses similar to reaction to excessive noise. High levels of vibration can also result in cosmetic damage (such as minor cracks) or more significant structural damage to buildings and infrastructure. Operation of vibration sensitive equipment may be also affected by high levels of vibration.

There are hundreds of sensitive receptors in the vicinity of the Project. The potential for excessive noise and vibration therefore requirements assessment and the associated risks to be identified. To minimise risks associated with potential impacts to the community and structures, the analysis and results of this assessment have informed recommendations for effective mitigation measures for the Project, in order to minimise risks associated with potential impacts to the community and structures.

1.3 Assumptions

The following assumptions were made during the preparation of this report:

- The proposed site layout has been used for this assessment and is based on the available information provided by APA for the Project
- This is an assessment of noise from the Project only and does not include assessment of noise from other sources in the area.
- Operational noise was modelled to be continuous throughout the day, evening and night time periods
- Assumed all HDD and bore crossing locations will require night works however, a more detailed analysis is currently being undertaken to determine whether works could be completed during day time hours at each location.
- Day, Evening and Night periods were designated as follows (as per SEPP N-1) and apply to the construction and operation of the Project:
  - Day 7 am to 6 pm (11 hours)
  - Evening 6 pm to 10 pm (4 hours)
  - Night 10 pm to 7 am (9 hours)
- Baseline noise monitoring was undertaken by a third party at nearest residential locations around Wollert compressor station to establish relevant regulatory requirements. The monitoring results are assumed to be valid and representative for other noise sensitive receptors in the adjacent area.
- Wollert Compressor Station operational noise assessment and concept blasting study were performed by third parties (Wood and TechNick Consulting). Findings and recommendations in the report are assumed by GHD to be correct and relevant.
- Site topography and three dimensional terrain has been incorporated into the acoustic model

- At this stage, not all of the preferred suppliers have been selected, the final equipment specifications and noise spectra are not available. GHD has therefore used source spectra from available databases and references
- As no spectra has been supplied due to the early stage of this assessment, GHD has assumed for the operational assessment that no tonality or other penalty invoking noise characters will be audible at the nearest receptors.

2. EES scoping requirements

2.1 EES evaluation objectives

The scoping requirements for the EES, released by the Minister for Planning, set out the specific environmental matters to be investigated and documented in the Project's EES, and informs the scope of the EES technical studies. The scoping requirements include a set of evaluation objectives. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing and operating the Project.

The following evaluation objective is relevant to the Noise and Vibration Impact Assessment:

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

2.2 EES scoping requirements

The scoping requirements relevant to the noise and vibration evaluation objectives are summarised in Table 1, as well as the location where these items have been addressed in this report, or where relevant in other reports.

Table 1 Scoping requirements relevant to noise and vibration

Scoping requirement	Section addressed
The Minister identified key environmental risks that would need to be addressed in the EES: • Effects of project construction and operation on amenity, including potential air quality and noise effects on nearby sensitive receptors (especially residents).	Section 8 of this report
Avoid and minimise potential adverse effects on native vegetation, listed threatened and migratory species and ecological communities, and habitat for these species, as well as restore and offset residual environmental effects consistent with state and Commonwealth policies. Key Issues: • Indirect loss of vegetation or habitat quality, that may support any listed species or other protected fauna, resulting from hydrological or hydrogeological change, edge effects, habitat fragmentation, loss of connectivity, or other disturbance impacts arising from construction or operation, including noise, vibration and lights.	See Technical Report A *Biodiversity*
The framework is required to include the following: The proposed objectives, indicators and monitoring requirements (including parameters, locations and frequency) for managing (at least): • Noise, vibration, and emissions to air, including dust and greenhouse gases;	Sections 4, 5 and 9 of this report
Minimise potential adverse social, economic, amenity and land use effects at local and regional scales: • Potential for increases in noise and vibration levels during project construction or operation to affect amenity adversely for sensitive receptors including residential areas (including from blasting activities where required).	Sections 7 and 8 of this report

Scoping requirement	Section addressed
Existing environment: • Identify dwellings and any other potentially sensitive receptors (e.g. residential, commercial, industrial, recreational areas, etc.) that could be affected by the project's potential effects on air quality, lighting, noise, odour or vibration levels, especially vulnerable receptors including children and the elderly • Monitor and characterise background levels of air quality (e.g. dust), noise and vibration near the project, including established residential areas and other sensitive receptors.	Section 6 of this report
Environmental management framework (likely effects): • Assess likely noise, vibration, traffic, lighting and visual impacts at sensitive receptors adjacent to the project during project construction and operation (both with and in the absence of the proposed mitigation measures), relative to standards. This should include assessment of noise and vibration impacts from any proposed blasting activities. Mitigation measures: • Identify potential and proposed design responses and/or other mitigation measures to avoid, reduce and/or manage any significant effects for sensitive receptors during project construction and operation arising from specified air pollution indicators, noise, vibration, odour, traffic and lighting, in the context of applicable policy and standards	Section 8 and 9 of this report

2.3 Linkages to other reports

This report relies on or informs the technical assessments as indicated in Table 2.

Table 2 Linkages to other technical reports

Specialist report	Relevance to this technical study
Technical Report A *Biodiversity*	Identifies flora and fauna that could be affected by construction and operational impacts, including the Project's potential effects from noise and vibration
Technical Report K *Social*	Assesses social effects as a result of the potential noise and vibration impacts

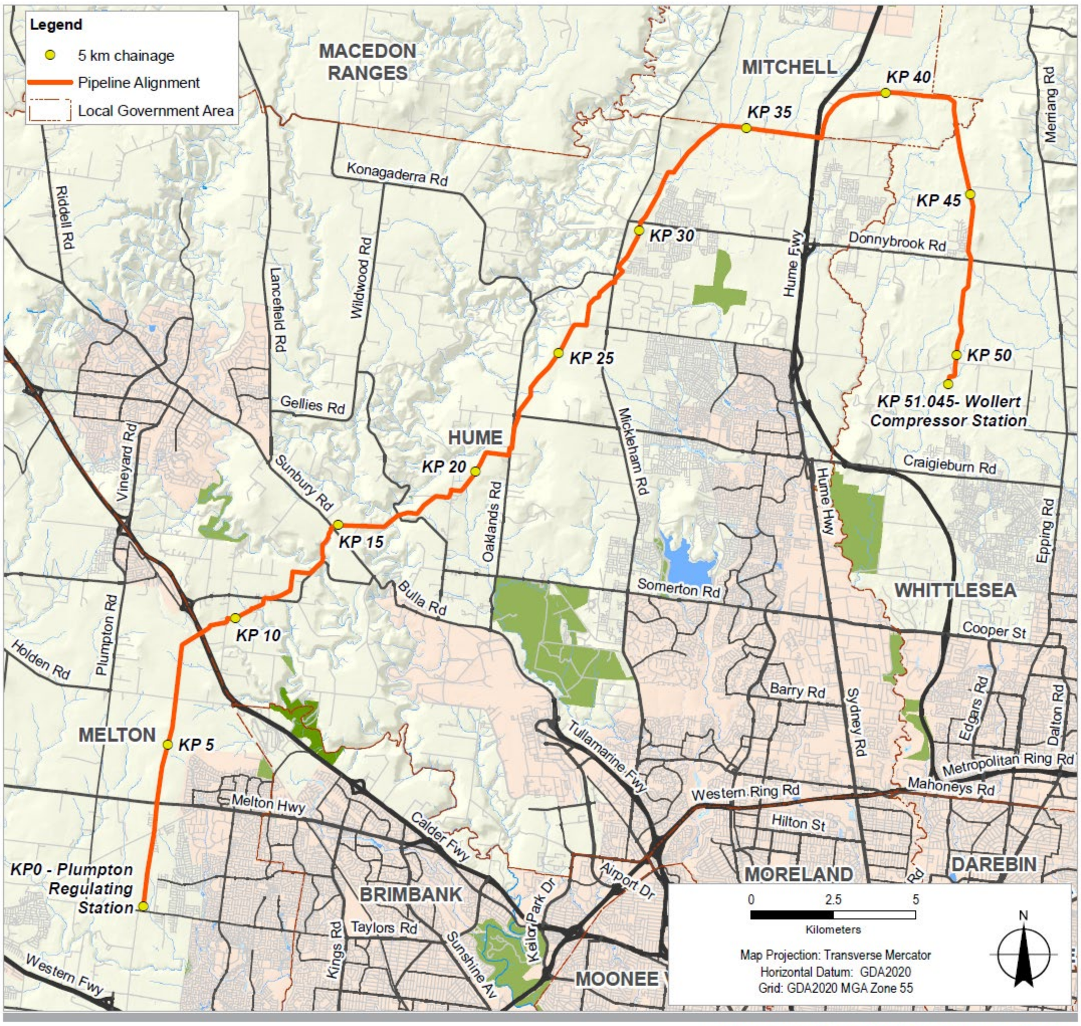
3. Project description

3.1 Overview

The Project provides a new link between APA's existing Plumpton Regulating Station (approx. 38 kilometres north west of Melbourne's CBD) and Wollert Compressor Station (approx. 26 kilometres north east of Melbourne's CBD). The Project includes the following key components:

- **A new pipeline:** The pipeline would be approximately 51 kilometres in length. The pipeline would be within a 15 metre wide permanent easement and be buried for its entire length to a minimum depth of cover of 750 millimetres.
- **Mainline valves:** Three mainline valves (MLV) would be located along the pipeline alignment. The area required for mainline valves would be subdivided and acquired by APA to provide ongoing access for any maintenance or inspection activities from the existing roads. The mainline valves would be spaced at intervals of approximately 15 kilometres, and located at approximately KP 6, KP 22 and KP 35.
- The **Wollert Compressor Station upgrade**: The installation of a new Solar Centaur 50 compressor, an end of line scraper station and a pressure regulating station within the existing APA facility at Wollert

A schematic illustration of the Project context is shown in Figure 1.



Data source: APA, 2020; GHD, 2020'; DELWP, Vicmap, 2020 Created by:kgardner

Figure 1 Western Outer Ring Main (WORM) overview

3.2 Construction

Subject to the staging of the works, construction for the entire Project is expected to take approximately 9 months. Key construction activities for the Project include:

- Establishing offsite construction sites and construction/laydown areas
- Constructing the pipeline
- Constructing three mainline valves
- Construction of upgrades associated with the Wollert compressor station
- Rehabilitation

3.2.1 Construction sites

Two temporary construction sites would be established for construction.

One offsite compound for pipeline works. This would be nominally 200 metres x 200 metres, include laydown and storage areas and would be located on a site where the activity is permitted under the relevant Planning Scheme, most likely within an existing industrial area.

The second temporary laydown area and construction offices would be established for the Wollert Compressor Station construction works. The construction offices and site laydown area for the compressor station equipment would be located within the existing compressor site area at Wollert.

3.2.2 Pipeline construction area

The Project would require a construction area for the pipeline, which would typically comprise a 30 metre wide corridor along the pipeline alignment. Most construction activity would be located within this construction area. The activities and facilities within the construction corridor would include access tracks and additional work areas such as vehicle turn around points and additional work spaces for crossings, stockpiling of materials and storage of pipe. Additional work areas up to 50 m x 50 m or 50 m x 100 m (such as for vehicle turn-around points, areas to accommodate HDD) would be required in some locations.

3.2.3 Pipeline construction methodology

The techniques used to construct the underground pipeline would include various methods including, open trench construction and alternative techniques at certain locations such as horizontal directional drilling (HDD) or horizontal boring.

Where crossing watercourses, major roads, rail line reserves or other constraints, the pipeline may be constructed using trenchless construction techniques such as HDD or shallow horizontal boring, to avoid construction disturbance within the sensitive area.

The pipeline construction sequence starts with survey works and continues with site establishment (including laydown area), clearing and grading, pipe stringing, pipe bending, welding and coating, open trench construction, lowering pipe into trench, hydrostatic testing, commissioning, and finally rehabilitation.

There would be dedicated access points into the construction corridor with vehicular movements along the Project alignment kept within the construction corridor.

3.2.4 Construction of other facilities

The construction sequence for the Wollert Compressor Station works starts with survey works and continues with site establishment (including laydown area), bulk earthworks, civil works (concrete slab and footings), mechanical works, electrical and instrumentation works, hydrostatic testing, commissioning, and site completion.

Various components of the compressor are assembled offsite. When delivered to site the various components are assembled together in-situ. Cranes are used to lift the compressor into place with all connecting pipework fitted. Given that construction at the Wollert Compressor Station would occur during normal working hours only and that there is a substantial separation distance to the nearest sensitive receptor, the impact from construction activities is expected to be minimal.

3.3 Operation

Following the reinstatement of land as part of the pipeline construction, the land would be generally returned to its previous use. When commissioned, the pipeline would be owned and maintained by APA. The pipeline would be contained within a 15 metre wide permanent easement corridor (within the area that formed the 30 metre construction corridor). Routine corridor inspections would be undertaken in accordance with APA procedures and AS2885 to monitor the pipeline easement for any operational or maintenance issues.

Excavating or erecting permanent structures, buildings, large trees or shrubs over the underground pipeline would be prohibited in accordance with the *Pipelines Act 2005* and pursuant to easement agreements with landowners.

Maintenance and inspections of the MLVs and the Wollert compressor station would also be conducted periodically in accordance with APA procedures. The activities usually include vegetation management, valve and compressor operation and corrective maintenance.

The key operation and maintenance phase activities include:

- Easement maintenance (vegetation control, weed management, erosion and subsidence monitoring)
- Pipeline, MLVs and compressor station maintenance
- Specialist pigging operations
- Cathodic protection surveys for mechanical and electrical preventative and corrective maintenance
- Monitoring and routine inspections and surveillance

3.4 Design, construction and operation considerations relevant to noise and vibration

3.4.1 Construction

The Project involves open trench construction for the majority of the Project area. A variety of construction activities are associated with the Project:

- Clear and grade
- Stringing and bending
- Excavation
- Welding, grit blasting and coating

- Horizontal drilling and coating
- Horizontal drilling and micro tunnelling
- Lowering and backfilling
- Special crossings
- Site reinstatement (rehabilitation)
- Hydrostatic testing

Details of equipment that are proposed to be used for construction can be found in section 8.2 and Appendix D.

3.4.2 Operation

The existing Wollert Compressor Station comprises the following:

- Wollert City Gate: Four regulator runs that reduce the gas pressure from the 6890 kPa Pakenham to Wollert pipeline system to the 2760 kPa metropolitan system, with a 3MW gas fired water bath heater
- T74 Pressure Regulating Station: Provides Bi-directional flow of gas between the Pakenham to Wollert pipeline 6,890 kPa and the Wollert to Euroa pipeline 8,800 kPa. Two uni-directional pressure/flow regulator runs (one duty and one stand-by) which provide pressure reduction of gas
- T119 Pressure regulating Station: The facility provides pressure reduction of gas from the Wollert to Barnawartha pipeline Maximum Allowable Operating Pressure (MAOP), 10,200 kPa Maximum Operating Pressure (MOP) into the Wollert to Euroa pipeline 8,800 kPa MAOP. The facility comprises one regulator run.

Compressor Station:

- Station A - Three Solar Turbines – Saturn 10 gas turbine driven compressor units with one lube oil cooler per unit. A common fin fan gas cooler, a back-up gas engine generator, instrument gas and a station vent
- Station B - Two Solar Turbines - Centaur 50 gas turbine driven compressor units with one fin fan gas cooler and one lube oil cooler per unit. A station instrument air compressor system, and a station vent.

The proposed upgrade to the Wollert Compressor Station includes three main components:

- One new Solar Centaur 50 compressor

  The new Solar - Centaur 50 gas turbine driven compressor unit, along with associated valves, pipework and equipment, would be installed within the existing Wollert compressor station, which currently contains two existing Solar - Centaur 50 and three existing Solar - Saturn 10 gas turbine driven compressor units.

- End of line scraper station

  The routine operation of gas pipelines require the periodic running of a pipeline inspection tool (pig) to inspect the pipe wall. Scraper stations are required to launch and receive pigs under pipeline pressure. A new scraper station is required at the Wollert end of the pipeline and would be located within the existing APA facility at Wollert.

- Regulating station

  When high pressure gas in a pipeline is required to be delivered at a lower pressure into another pipeline, a regulating station is used to do this. The pressure regulating station enables flow of gas from the (proposed) high pressure WORM pipeline to the (existing) Pakenham-Wollert pipeline, which is designed for a lower operating pressure.

The facility operates on an on-demand basis. In the current facility, a compressor (unit 4 or unit 5) runs on average every second day, most often during the night time and early morning periods.

4. Legislation, policy, guidelines and assessment criteria

4.1 Overview

The EES is prepared under the EE Act and will inform assessment of approvals required for the Project. The relevant approvals and legislation are:

- Commonwealth approval under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). For the component of the Project that is located outside of the Melbourne Strategic Assessment (MSA) program area, the Project requires assessment and approval under the EPBC Act, under the assessment bilateral agreement with Victoria made under section 45 of the EPBC Act.
  The MSA program is the Victorian Government's approach to managing the impact of urban development in Melbourne's growth areas on significant vegetation communities, plants and animals. Areas within the approved Melbourne Strategic Assessment (MSA) area occur between approximately KP 0 to KP 3.2, KP 28.16 to KP 28.57, and KP 32 to KP 51. Areas outside of the MSA occur approximately between KP 3.2 to KP 28.1, and KP 28.57 to KP 32.
- Pipeline Licence under the *Pipelines Act 2005* (Vic) (Pipelines Act). Licence approval is required under the Pipelines Act for the Western Outer Ring Main Project. The Pipeline Licence application is exhibited with the EES.
  Section 49 of the Pipelines Act requires that the following matters be considered before granting a licence:
  - *(a) the potential environmental, social, economic and safety impacts of the proposed pipeline*
  - *(f) the assessment of the Environment Effects Minister in relation to the proposed pipeline, if an assessment has been made*
  - *(g) any written comments received from the Planning Minister or the relevant responsible authority on the effect of the proposed pipeline on the planning of the area through which it is to pass*
  - *(h) any written comments received from the Water Minister and from the relevant Crown Land Minister on the impact of the proposed pipeline*

  Section 3 of the Pipelines Act sets out the objectives of the Act including:
  - *(a) to facilitate the development of pipelines for the benefit of Victoria*
  - *(e) to protect the public from environmental, health and safety risks resulting from the construction and operation of pipelines*
  - *(f) to ensure that pipelines are constructed and operated in a way that minimises adverse environmental impacts and has regard for the need for sustainable development*

  Section 4 of the Pipelines Act sets out the principles of sustainable development to be given regard in implementing the Act including that decision-making should be guided by a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable and an assessment of the risk-weighted consequences of various options.

Section 54(c) of the Pipelines Act states that conditions on a licence may include conditions concerning the protection of the environment.

- Cultural Heritage Management Plan (CHMP) under the *Aboriginal Heritage Act 2006* (Vic) (AH Act). Two CHMPs are currently in progress for the Project (CHMP 16593 and CHMP 16594).

4.2 Key noise and vibration legislation, policy and guidelines

The *Environment Protection Act 1970* creates a legislative framework for the protection of the environment in Victoria. Of particular importance to this assessment are the SEPP noise policy and supplementary documents. This key legislation, policy and related documents are summarised in Table 3. Further detail is provided in Section 4.3 to 4.4.

Table 3 Key legislation and policy applicable

Legislation/policy	Relevance to this impact assessment
Environment Protection Act 1970	The Act establishes the powers, duties and functions of the EPA which include: • The administration of the Act and its regulations • The making and review of State environment protection policies (SEPPs) • Issuing works approvals, licences, permits, and pollution abatement notices
State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1 (SEPP N-1) (Victorian Government, 1989)	The SEPP N-1 sets broad noise goals and noise limits that are applicable to industrial and commercial noise sources in the zone of applicability of the noise policy.
A guide to the measurement and analysis of noise. EPA publication 280, 1991	The document provides additional guidance on measurements of noise impact as applicable to SEPP N-1.
Environmental guidelines for major construction sites. EPA publication 480, 1996 (superseded)	The document provides recommendations on management of environmental impact from construction sites.
Civil construction, building and demolition guide. EPA Publication 1834, 2020	The document provides recommendations on management of environmental impact from construction sites.
SEPP N-1 and NIRV explanatory notes. EPA publication 1412, 2011.	The document provides clarifications and examples on applicability of SEPP N-1 and NIRV guidelines.
Australian Standard AS 1055:2018 Acoustics – Description and measurement of environmental noise. Standards Australia, 2018.	The standard provides guidance on noise data acquisition and analysis.

EPA publication 480 Environmental guidelines for major construction sites. EPA publication 480 was superseded by EPA publication 1834 during the process of preparing this report. It is noted that the recommended construction noise criteria are generally consistent between these documents. EPA Publication 1834 gives recommendation on inaudibility of noise during night time based on "background + 0 dB(A)" noise level, which was not included in the superseded document.

4.3 Noise criteria- operations

The key industrial noise control document currently used in Victoria is the *State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1* (SEPP N-1) (Victorian Government, 1989).

The SEPP N-1 is applicable for sensitive receptors located in a *Major Urban Area (MUA)*, with potential impact from industrial noise. A '*Major Urban Area*' is defined as:

- The part of *Melbourne* that is within the *SEPP N-1 boundary*; or
- The part of *Melbourne* that extends beyond the *SEPP N-1 boundary*, but is within the *Melbourne Urban Growth Boundary* (UGB); or
- Land within the '*Major Urban Area'* boundary of an Urban Centre with a population greater than 7000; or
- Land zoned either Residential Zone, Industrial Zone, Business Zone or Urban Growth Zone that is transected by the '*Major Urban Area'* boundary of an Urban Centre with a population greater than 7000, then the whole of that zone shall be considered as part of the MUA

The Noise from Industry in Regional Victoria Guidelines (NIRV, VIC EPA Publication 1411) is applicable for sensitive receptors located in a rural area outside of those areas outlined above that may potentially be impacted from industrial noise. A rural area is defined as:

> '*A rural area is land that is not within a major urban area. It includes land in cities or towns with population below 7000, and rural locations outside major urban areas*' (EPA Victoria, 2011).

The Project area is located within the zone of applicability of Victoria State Environment Protection Policy (Control of Noise from Industry, Commerce and Trade) No. N-1 (SEPP N-1). Boundaries of the SEPP N-1 are shown in Figure 2.

SEPP N-1 envisages recommended noise limits depending on:

- Planning zones for receptor and noise source (distance adjusted)
- Existing background noise
- Baseline criteria

The applicable limits are derived based on comparison of background levels and derived planning zones criteria and cannot be less than the minimum baseline criteria.

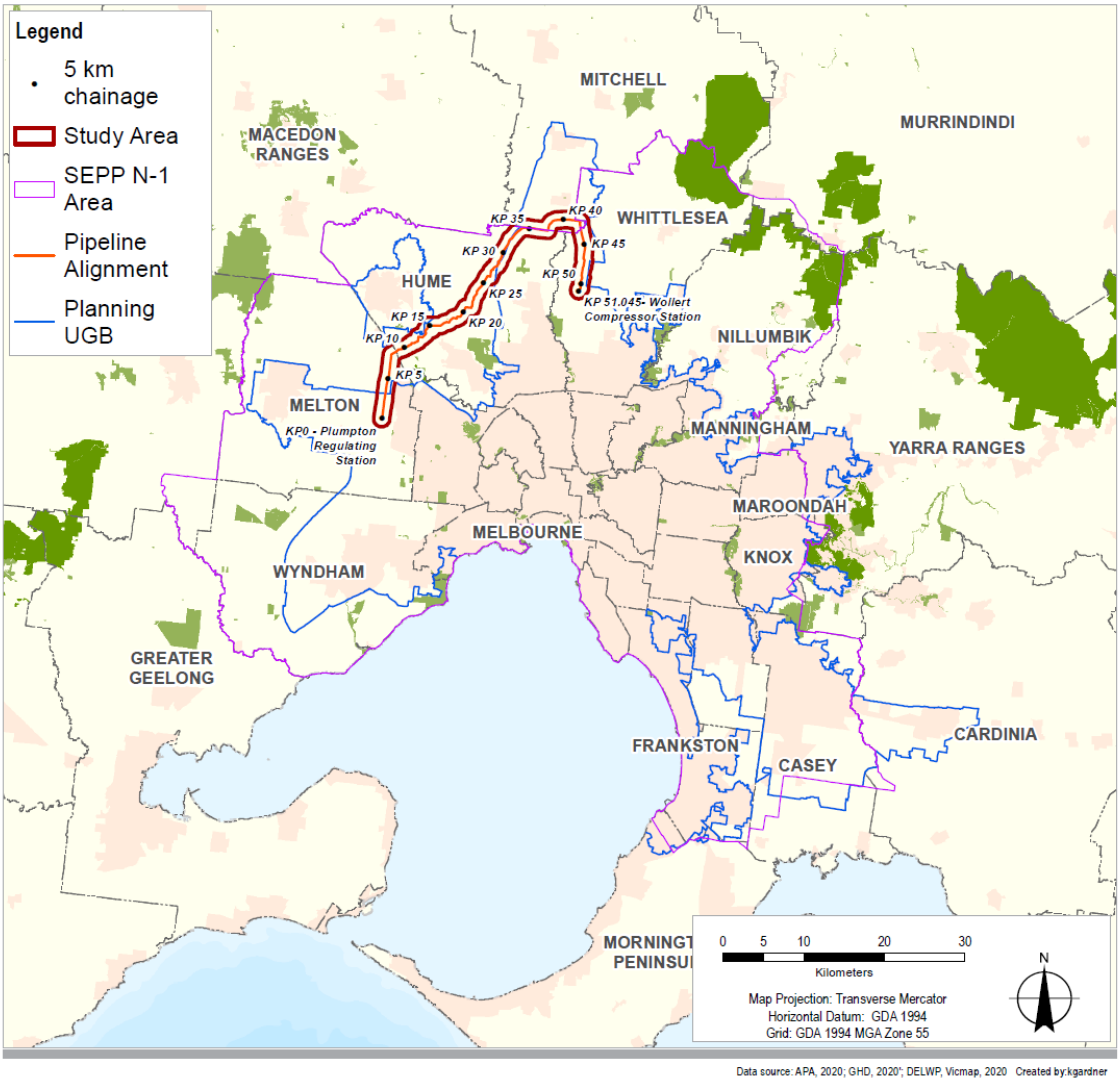


Figure 2 Zone of applicability of noise policy SEPP N-1

Noise sensitive receptors in the vicinity of the Project area are situated in different planning zones and are characterised by different background noise, therefore applicable noise criteria vary accordingly. Since the Project may impact on many receptors in the adjacent area, operational noise criteria are derived for the nearest receptors, which are then considered to be representative of other nearby receptors. Typically, this approach adds extra conservatism to the assessment.

It is understood that policy SEPP N-1 will be replaced by *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA Publication 1826, March 2020*)* from 1 July 2021*.* Review of the document indicates that only minor amendments would be made to the current SEPP N-1 and NIRV methodology for determining criteria and assessing noise produced by commercial and industrial premises. It is acknowledged that the boundary of applicability of provisions under the new regulation may change. However, maps of the major urban areas under the new publication have not yet been published. Consequently, it is difficult to identify if there will be difference between the current and proposed methodologies in future.

4.4 Noise and vibration criteria- construction

4.4.1 Construction noise criteria

Victoria does not have statutory limits for airborne construction noise. EPA Victoria has published two guidance documents addressing construction noise control:

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

In the absence of clear guidance in Victoria on construction noise thresholds for day time, the *NSW Interim Construction Noise Guidelines 2009* have been adopted for this assessment because other relevant documents do not provide clear objectives for day time construction noise. The NSW document recommends that the 75 dB(A) criterion should be met during day time hours to avoid a situation where residences in the adjacent area are highly affected by noise.

Recommended construction noise limits from VIC and NSW guidelines are summarised in Table 4.

Table 4 Guidelines recommended construction noise criteria

<table>
<tr><th>Sensitive use</th><th>Period</th><th>Construction noise criterion, LAeq</th></tr>
<tr><td>Residential</td><td rowspan="4">Standard EPA construction hours
Mon-Fri: 7am - 6pm
Sat: 7am - 1pm</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: 6pm - 10pm
Sat: 1pm - 10pm
Sundays and public holidays: 7am- 10pm</td><td>Noise level at any residential premises not to exceed background (LA90, dB) noise by:
• 10 dBA or more for up to 18 months
• 5 dBA or more after 18 months</td></tr>
<tr><td>Residential</td><td>Night time
Mon-Sun: 10pm - 7am</td><td>Noise inaudible within a habitable room of any residential premises.</td></tr>
</table>

The Project may require unavoidable evening and night time works to be conducted for HDD drilling, boring and hydrostatic testing. Weekend and evening construction noise criteria have been assessed based on EPA Publication 1834, which recommends evening and weekend limits based on the background noise level measurements that prevail in the area plus 10 or 5 dB(A) depending on the project duration. The expected construction duration is less than 18 months, therefore the “background + 10 dB(A)” criterion has been adopted. Night time limits are also based on EPA Publication 1834, which recommends inaudibility within a habitable room of any residential premises. A reference level of “background + 0 dB(A)” criterion is acceptable as ‘inaudible’ for construction works.

Due to COVID19 and associated Victorian Government restrictions, transportation, air travel, industry and other noise sources are not typical in 2020. Also due to these restrictions background monitoring was not able to be conducted as part of this assessment. While at the time of preparing this report, some restrictions have lifted, traffic and human activity has not returned to ‘normal’. As such, noise monitoring at this time would not be representative of the background noise levels. Therefore, evening noise criteria are suggested based on recommendations in the standard AS1055.3:1997.

The standard provides guidelines on the description and measurement of environmental noise.

Appendix A in the Australian Standard *AS1055.3 - 1997 Acoustics – Description and measurement of environmental noise – Part 3 Acquisition of data pertinent to land use* has been adopted as a guide to typical background noise levels (Table 5). It is noted that AS 1055:1997 is now superseded by AS 1055:2018 in which the estimated average background sound pressure levels are no longer provided. However, in the absence of other suitable guidelines, the estimated average background levels in *AS 1055.3: 1997* are adopted. *AS 1055.3:1997* notes an estimated background noise level of 35 dB(A) for the evening period in areas with negligible transportation, 40 dB(A) in areas with low density transportation and 45 dB(A) in areas with medium transportations. These assumed background levels are considered applicable to this Project and utilised to suggest evening/weekend and night time construction noise limits for affected receptors. Depending on the receptor noise category this provides an evening time criteria of 45 dB(A) to 55 dB(A) for the first 18 months of construction and 40 to 50 dB(A) subsequent to this during weekends or evening periods. It is not expected the construction of the Project would take longer than 18 months and as such the 45-55 dB(A) range of limits is adopted in this study.

Table 5 Estimated average A-weighted background (from AS 1055.3:1997)

Noise area category	Description of neighbourhood	Average background, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or with commerce or industry	55	50	45	55	50	45

4.4.2 Construction vibration criteria

Victoria does not have statutory limits for vibration criteria. It is recommended practice to use approaches in relevant international standards to specify limits.

Damage to buildings and structures.

There are two widely used national standards that are recommended for assessing the potential for vibration damage from construction works:

- German Standard DIN 4150: Structural Vibration in Buildings – Part 3: Effects on structures (2016)
- British Standard BS 7385: Evaluation and Measurement for Vibration in Buildings Part 2 (BS 7385)

German Standard DIN 4150 represents more stringent criteria for building damage caused by vibration and is recommended for use on this Project. Structural damage criteria are summarised in Table 6. The majority of buildings surrounding the site, which may potentially be affected by construction activities fall into Group 2. Therefore, these vibration criteria have been adopted as the baseline building vibration limits for construction of the Project.

Table 6 Structural vibration criteria: DIN 4150

Group	Type of structure	Vibration velocity (PPV) in mm/s			
		At foundation at a frequency of[1]			Vibration at horizontal plane of highest floor (all frequencies)
		< 10 Hz	10 Hz – 50 Hz	50 Hz – 100 Hz	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. heritage-listed)	3	3 to 8	8 to 10	8

Note: 1. For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

German Standard DIN 4150 also provides target vibration levels to minimise damage to buried pipework for short-term vibration as summarised in Table 7. Very brittle pipes, such as cast iron, may require specific consideration. In all cases, where the owner of the asset has specific requirements, these take priority and should not be exceeded.

Table 7 Short term vibration on pipework (peak component level mm/s): DIN4150

Pipe material	Guideline value on pipe (mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with/without flanges)	80
Masonry, plastic	50

Notes:

1. Refer to the standard in all situations

2. Long term exposure may warrant a reduction in the guideline value by 50%

3. Pipework assumed to be in good condition and laid with current technology

Human comfort vibration criteria

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its content. The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is 'normal' or 'abnormal', depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus, or train is considerably higher than what is perceived as 'normal' in a shop, office, or dwelling. The degree of perception for humans in terms of peak particle velocity (PPV) is suggested by the vibration level categories given in British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites*, as shown in Table 8.

Table 8 Guidance -human comfort vibration levels (BS 5228.2)

Approximate vibration level, PPV	Typical degree of perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Based on Table 8, the human response to vibration could be summarised as:

- A vibration level in the range between 0.14 mm/s to 0.3 mm/s would generate a low probability of an adverse comment or complaints from residents
- A vibration level in the range between 0.3 mm/s to 1 mm/s would generate the possibility of adverse comments or complaints from residents
- A vibration level greater than 1 mm/s would likely cause adverse comment or complaint

For intermittent construction activities, a PPV criterion of 0.3 mm/s is recommended, particularly if there are scheduled night works.

Vibration dose value (VDV)

The Commonwealth or Victorian Governments do not have specific guidelines or criteria that relate specifically to human comfort from vibration generated by construction activities. The NSW EPA's Assessing Vibration: a technical guideline (2006) provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV). This metrics is different from PPV. The VDV is dependent upon the level and duration of the vibration event, as well as the number of events occurring during the daytime or night-time period.

The VDVs recommended in the guideline for vibration of an intermittent nature are presented in the British Standard 6472 (1992) *Guide to evaluation of human exposure to vibration in buildings* (updated in 2008 as BS6472.1:2008), which nominates criteria for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a low probability of adverse comment from occupants.

The vibration criteria are summarised in Table 9 as VDV limits. Supplementary limits can be adopted as VDV 0.2 $m/s^{1.75}$ for night time works and 0.4 $m/s^{1.75}$ for evening and day time works to reduce the probability of adverse comments from residents.

Table 9 Vibration Dose Values ($m/s^{1.75}$) above which various degrees of adverse comment may be expected in residential buildings

Location	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings - 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings - 8 hour night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices	0.4 to 0.8	0.8 to 1.6	1.6 to 3.2
Workshops	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

* The above target levels apply for both the vertical and lateral directions, provided appropriate weightings are used.

4.4.3 Noise and vibration criteria for blasting operations

Blasting is planned for some Project areas where structures are situated at sufficient separation distance. There are no clearly defined noise and vibration limits for construction blasting in Victoria's regulatory framework. It is suggested to adopt the *Ground Vibration and Airblast Limits for Blasting in Mines and Quarries* Guidelines (VIC Earth Resources). Noise limits in this document can be summarised as follows:

- For existing sites, airblast at sensitive sites should be below 120 dB (Lin Peak) at all times
- For new sites, the condition above should be satisfied and airblast at sensitive sites should be below 115 dB (Lin Peak) for 95 per cent of all blasts

Australian standard AS 2187.2 – 2006 *Explosives- storage and use* recommends limits that are 5 dB less stringent than above for human comfort if blast operations last less than 12 months or less than 20 blasts. Table 10 shows that the standard recommends structural damage control limits for blasting operations. They are greater than the recommended human comfort limits. The probability of damage increases as the airblast levels increase above 133 dB. Windows are the building element currently regarded as most sensitive to airblast, and damage to windows is considered as improbable below 140 dB. Therefore 133 dB limit is considered sufficiently conservative for structural damage.

Table 10 Air Blast Limits for damage control (Table J5.4(B) of AS 2187.2 – 2006)

Category	Type of blasting operations	Peak sound pressure level (dBL)
Damage Control Limits		
Structures that include masonry, plaster and plasterboard in their construction and also unoccupied structures of reinforced concrete or steel construction	All blasting	133 dBL maximum unless agreement is reached with owner that a higher limit may apply.
Service structure such as pipelines power lines and cables located above the ground.	All blasting	Limit to be determined by structural design methodology

Airblast limit of 115 dB L_{peak} is suggested for this assessment for occupied dwellings to decrease probability of adverse reaction of residents. Higher structural integrity limit of 133 dB can be applied to non- sensitive receptors to prevent cosmetic damage.

Vibration impact from blasting may potentially result in adverse effects on residents and structures. Vibration limits as defined in the *Ground Vibration and Airblast Limits for Blasting in Mines and Quarries* Guidelines can be summarised as follows:

- For existing sites, ground vibration at sensitive sites should be below 10 mm/s (peak particle velocity, PPV) at all times
- For new sites, vibration should meet the requirements above as well as the following:
  - Ground vibration at sensitive sites should be below 5 mm/s (PPV) for 95 per cent of all blasts

Standard AS 2187.2 recommends similar vibration limits for operations lasting longer than 12 months or more than 20 blasts in terms of human comfort. The limits can be increased in accordance with the standard to 10 mm/s for less frequent blast works. AS 2187.2 also refers to standard BS 7385-2 for structural damage vibration criteria and advises that the limit can be increased up to PPV 100 mm/s for unoccupied structures of reinforced concrete or steel.

The human comfort limit of 5 mm/s should be targeted for sensitive receptor structures where possible. Since frequent blast works are not suggested in the same area, structural PPV limit of 10 mm/s is suggested as the vibration limit applicable to structures for this assessment. This limit is consistent with recommendations in standard DIN4150-3. The structural limit can be increased for non-sensitive structures in some cases in accordance with recommendations in AS 2187.2. It is also understood that APA intends to engage a specialised company to perform blasting works and perform detailed assessment for blasting operations.

5. Methodology of noise and vibration impact assessment

The key sections of the noise and vibration impact assessment consist of:

- **Review of existing conditions:** Identify affected noise sensitive receptors, baseline noise monitoring locations at key Project areas, applicability of noise criteria based on background and planning zones.
- **Risk assessment:** To inform the impact assessment, perform a qualitative risk assessment by evaluating the potential environmental impacts on sensitive receptors due to the Project.
- **Impact assessment:** Carry out prediction of noise and vibration levels associated with the Project's operation and construction, identify potential exceedances above the applicable criteria.
- **Mitigation measures:** Recommend general and specific noise and vibration mitigation measures for the construction and operational phases of the Project in order to reduce the level and extent of predicted impacts.

5.1 Study area

The Project is primarily situated in a rural farming zone where existing background noise levels are expected to be low, which is typical for areas with negligible and low transportation. Suburban areas in the localities of Hillside (KP 3-5) and Fraser Rise (KP 0-3) are situated at distances of about 750 metres from the Project. The Project also runs as close as 150 m from the western edge of the suburban area within Mickleham (KP 30-32). As the Project is situated on the rural-facing side of these localities the acoustic environment can generally be characterised as quiet for most nearby receptor areas. Some exceptions may be present in the vicinity of major highways or arterial roads that the Project crosses.

Table 11 shows the local planning zones in which the sensitive receptors were identified.

Table 11 Planning zones of identified receptors

Planning Zone	Applicable KP (direction from construction corridor)
Urban Growth Zone (multiple schedules)	0-3.2
	28 – 33.1 (east)
	35.4 – 48 (road, rural conservation and public use zones in between)
Green Wedge Zone (multiple schedules)	3.3 – 28 (road and public use zones in between)
	28 – 33.5 (west)
Farming Zone	34 – 35.4 (north)
	49.3 – 50.6 (east)

Victorian regulatory documents do not provide clear guidance on study area extents for noise or vibration, however it is considered appropriate to identify sensitive receptors potentially impacted by operational or construction activities. A study area approximately one kilometre from the Project area was considered appropriate based on experience with similar projects and the expected level of impact from similar construction activities. The study area extents in the Project context are presented in Figure 3.

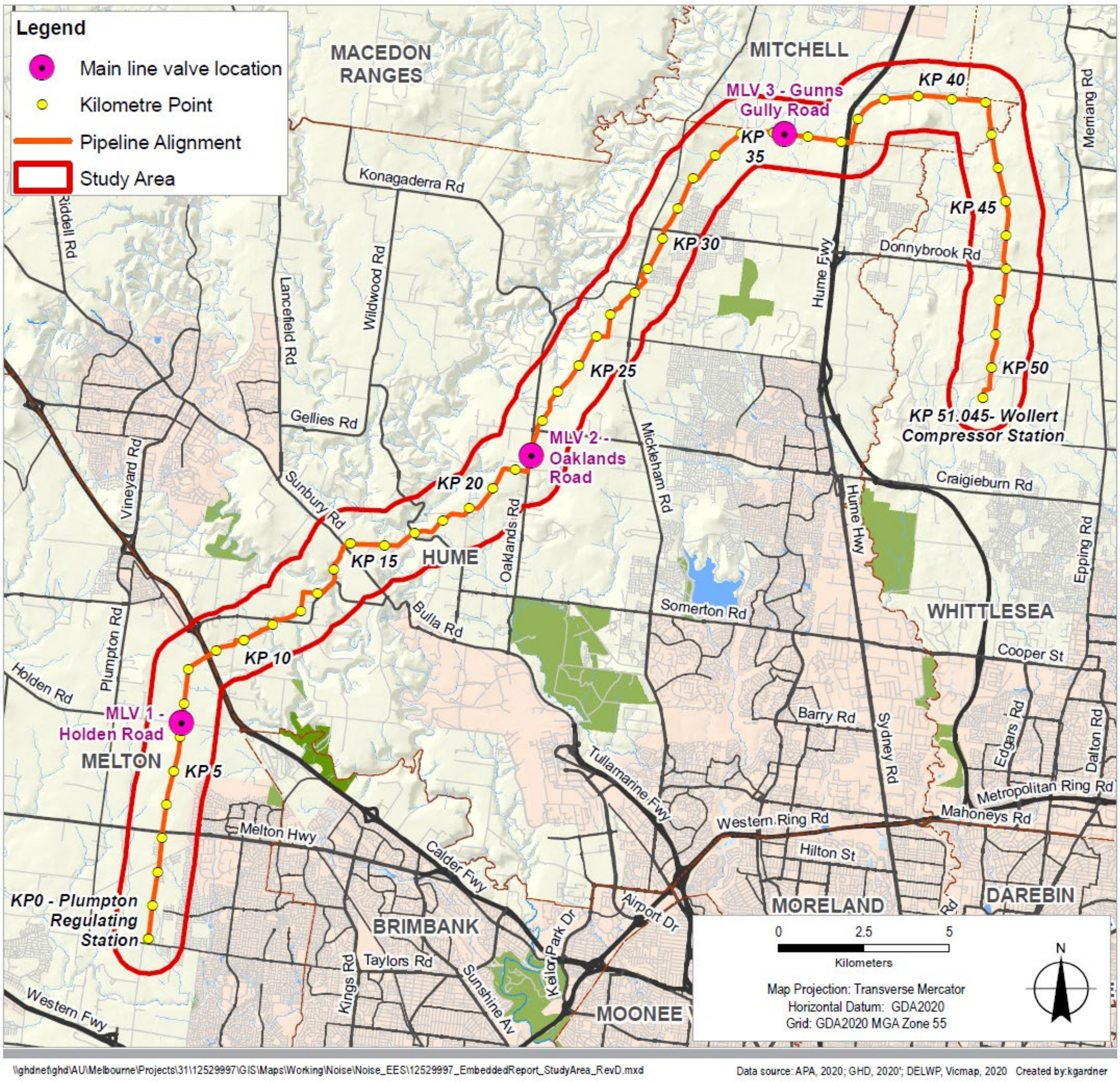


Figure 3 Study area of Project site

An access road running adjacent to the railway line in Beveridge is a possible access option for use by the Project. The access road is an existing access track recently constructed by Yarra Valley Water and no physical construction works is proposed by the Project. As such this access track has not been considered further with regards to the assessment for noise and vibration. A second informal access track option may be used by machinery and equipment to access the construction footprint from the north. This track follows the existing APA easement. No physical construction is expected to be required to establish this access and therefore this access track has not been considered further with regards to the assessment for noise and vibration.

5.2 Existing conditions method

An assessment of existing conditions within the study area is required to understand the existing acoustic environment and identify the location of noise and vibration sensitive receptors relevant to the Project.

This information is used to develop noise criteria to inform the impact assessment process.

Noise policy SEPP N-1 considers setting applicable operational noise criteria based on:

- Pre-existing background noise for day, evening and night time periods
- Planning zones criteria

Background noise in the Wollert Compressor Station area was acquired during a long term monitoring program undertaken in April 2020 (*APA Wollert Compressor Station Environmental Noise Assessment,* Wood, 2020). This report is included in (Appendix A).

Desktop investigations were also undertaken to understand the existing conditions within the pipeline construction area, comprising of aerial image searches and a review of Victorian Government planning maps.

Non-statutory documents for the assessment of construction noise recommend derivation of construction noise criteria for evening, night time and weekend periods. In the absence of actual measurements, the assumed background approach from Australian Standard AS 1055.3:1997 has been used, which is based on the classification of the receptor area.

5.3 Risk assessment method

A risk assessment for the Project was carried out using an approach that is consistent with Australian/New Zealand Standard AS/NZS ISO 31000:2018 Risk Management Process.

This risk assessment was used to identify the issues for assessment and apply a structured approach to the level of assessment and analysis undertaken of potential environmental effects within each technical study. Applying the risk framework across all technical studies facilitated a consistent approach to identify and then investigate issues with a focus proportionate to the risk, and to consider management measures focused on reducing identified risks.

The risk assessment methodology included:

- Defining the context for the risk assessment based on the existing assets, values and uses (baseline) assessments of each technical area and the proposed Project activities which interact with those existing conditions
- Identifying the risk pathways for the Project based on a specific cause and effect
- Identifying standard management/mitigation measures (including those in guidelines and standards) and whether additional mitigation measures may be required
- Analysing the consequence and likelihood of the identified risk based on a consequence guide developed for each technical area and a likelihood guide
- Defining the risk level based on the risk matrix

The identification, analysis and evaluation of risks was conducted within each technical area and across technical areas where there was input or connection across disciplines.

The consequences of a noise and vibration risk occurring were assigned using consequence categories from insignificant to severe. The ratings were developed for noise and vibration based on the existing conditions and values in the study area. The consequence levels and descriptors are provided in Table 12.

Table 12 Noise and vibration consequence rating

Level	Qualitative description	
	Noise	Vibration
Insignificant	Construction - noise is just audible. Operation - no increase in noise level.	Construction - vibration is within applicable limits - no damage to structures.

Level	Qualitative description	
	Noise	Vibration
Minor	Construction - noise is audible but within Project noise criteria. Operation - noise levels increase but comply with the applicable limits.	Construction - isolated exceedances of applicable limits - no damage to structures. Operation - isolated exceedances of applicable limits - no damage to structures.
Moderate	Construction - noise is occasionally above Project criteria at sensitive receptors. Operation - noise levels increase and are greater than the Project criteria.	Construction - extended periods of exceedances of applicable limits - superficial damage to structures.
Major	Construction - noise levels above Project criteria for extended periods of time. Operation - noise levels significantly increase and are greater than Project criteria	Construction - long-term exceedances of applicable limits - structural damage.
Severe	Construction - noise levels significantly above Project criteria for extended periods of time. Operation– noise levels significantly increase and are above Project criteria for extended periods of time.	Construction - vibration causes structural damage to many affected structures.

A likelihood rating for each identified risk was assigned ranging from ‘almost certain’ where the event is expected to occur to ‘rare’, where the event may occur only in exceptional circumstances. The likelihood levels and descriptors are summarised in Table 13.

Table 13 Likelihood definitions

Level	Description
Rare	The event may occur only in exceptional circumstances
Remote	The event could occur but is not anticipated and may occur if certain abnormal circumstances prevail
Unlikely	The event is unlikely but could occur if certain circumstances prevail
Likely	The event will probably occur in most circumstances
Almost certain	The event is expected to occur in most circumstances or is planned to occur

The consequence and likelihood were combined to arrive at a risk rating, using the risk assessment matrix shown in Table 14.

The risk ratings were revisited during the impact assessment where additional environmental management measures were applied to identify the residual impacts and risks.

A summary of recommended mitigation measures and residual risks are presented in section 9 based on results of predicted noise and vibration impacts.

Table 14 Risk rating matrix

		Consequence rating				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood rating	Almost certain	Low	Medium	High	Very high	Very high
	Likely	Low	Low	Medium	High	Very high
	Unlikely	Negligible	Low	Medium	High	High
	Remote	Negligible	Negligible	Low	Medium	High
	Rare	Negligible	Negligible	Negligible	Low	Medium

5.4 Impact assessment 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 (km) from the centre of the Project construction corridor (two kilometres in total), as shown in Figure 3. This area was determined based on the expected level of impact from 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 (i.e. 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 has been 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 8.
- For the purposes of the vibration assessment, the sensitive receptors located within 50 metres of the construction corridor were identified. The EPA guidelines *Environmental Guidelines for major construction sites* (Publication 480, now superseded) notes that nuisance from construction activities is unlikely to occur if the operation is conducted at distances greater than 50 metres. As EPA Publication 1834 does not specify separation distances relating to vibration impacts, the previous guidelines have been considered.
- Establishment of recommended noise and vibration criteria through consideration of relevant policies, guidelines and standards as described in sections 4 and 8.
- Characterisation of existing conditions through:
  - Noise monitoring undertaken at the Wollert Compressor Station to establish the noise emissions from the existing equipment (Wood, 2020). 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 the Australian Standard (AS) 1055.3:1997 Acoustics- Description and measurement of environmental noise. Part 3: Acquisition of data pertinent to land use (AS 1055.3:1997) [1] 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.
- A risk-based review of potential impacts to prioritise the focus of the impact assessment
- Operational and construction noise modelling was carried out with the following inputs:
  - Meteorological conditions favourable for noise propagation
  - Operation or construction scenarios with greatest expected noise emission
- Blast overpressure and vibration predictions were made using following inputs:
  - Planned instantaneous charges
  - Distance to the nearest receptors
  - Assumed site propagation constants
- 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 sound power of equipment to inform modelling
  - Prediction of construction noise and vibration levels
  - Estimation of overpressure and vibration levels of planned blast works
  - Identifying noise emissions from the Wollert Compressor Station and modelling to predict noise impacts
- Development of environmental management measures (EMMs) in response to the impact assessment.
- Assess the residual impacts of the Project assuming implementation of the EMMs.
- Specify the monitoring required to evaluate whether the Project meets the EMMs and detail contingency measures as required.

It should be noted that Victoria does not have mandatory limits for construction noise and vibration. Section 4 and 8 suggest applicable noise and vibration limits based on relevant guidelines and standards.

5.4.1 Operation assessment method

Noise emission from the Wollert compressor station are subject to the requirements in SEPP N-1. Results of noise monitoring (Wood, 2020) were utilised to derive applicable noise limits. Night time operations of the facility are expected to meet the strictest night time criteria, and therefore also satisfy evening and day time limits.

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[1] Australian Standard 1055.3:1997 *Acoustics- Description and measurement of environmental noise. Part 3: Acquisition of data pertinent to land use*

Two major operational assessment scenarios for the Wollert Compressor Station were modelled as part of this assessment:

- Verification of noise impact for current operations
- Worst case operational scenario for upgraded compressor station

Relevant noise prediction algorithms were utilised as described in section 8.2.

5.4.2 Construction noise and vibration assessment method

The sound power was estimated for construction scenarios as described in section 8.2 . The following scenarios with the greatest expected noise impacts to occur during construction works have been evaluated to provide a representative conservative assessment.

Construction of the crossings involves various work methods such as horizontal directional drilling (HDD) or boring. Impacts from these activities have also been evaluated where they are proposed within the Project area.

NDT and coating: These operations involve light trucks with compressors, grit blasting and other equipment. Grit blasting is expected to result in the greatest noise levels. Noise levels were predicted assuming activities occur within the corridor intended for open trench construction.

Earth moving operations: Open trench construction, clearing and grading of the area will be undertaken to provide a safe and efficient area for construction activities. Graders, bulldozers and excavators are generally used for these activities. These plant items and activities are common during the construction phase of a Project.

Crossings (open trench construction): The construction work method is similar to the proposed open trench construction and will involve similar equipment. This will involve open trench construction around existing 3rd party services.

Crossings (HDD and bore): The operations involve a variety of equipment for mini and major HDD crossings. Since these operations may be carried out 24 hours a day, noise impact from them is to be assessed against the stricter evening and night time construction noise criteria.

Blasting operations are planned for particular areas of the Project where rock will be encountered and the separation distance to the nearest receptors is deemed to be sufficient to mitigate overpressure and vibration down to recommended levels. A high level assessment is based on the recommendations in the concept blast study (WORM Blasting Study, Technick Consulting Pty Ltd, 2020) and methodology in Australian Standard AS 2187.2 : 2006.

Details of the methods and assumptions used for the impact prediction and assessment are included into section 8.

Due to the relatively short period of construction and the staged progression of works along the pipeline corridor, potential noise emissions from construction activities and equipment are temporary and do not result in a prolonged impact on sensitive receptors.

5.5 Limitations, uncertainties and assumptions

Uncertainties relate to the accuracy of the modelling and methods from relevant standards and guidelines relating to noise and vibration prediction. The adopted methods and modelling approaches are typical for predicting noise and vibration levels for large scale projects and results in the assessment meeting regulator’s requirements.

5.6 Stakeholder engagement

No community engagement was specifically required to inform this assessment, however GHD consulted with the EPA on the methodology for the assessment.

EES *Attachment III Community and Stakeholder Consultation Report* provides details of the consultation activities undertaken for the Project more broadly and outcomes from those activities. Table 15 summarises the feedback in relation to noise and vibration and APA's response to that feedback

Table 15 Project response to issues and concerns (noise and vibration)

Issue/concern	APA response and environmental management measures
Noise and vibration: Potential impacts on sensitive receptors from construction noise and vibration of the Project and operation of the Wollert Compressor Station	Technical Report F Noise and Vibration, has assessed the noise and vibration impacts of the Project during construction and operation of the Wollert Compressor Station. The assessment found that: • Where works would occur in proximity to sensitive receptors, construction activities may result in short-term noise and vibration impacts • Noise from the operation of the expanded Wollert Compressor Station is predicted to comply with the applicable noise limits (*State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1* (SEPP N-1) at all of the sensitive receptors during the day, evening and night-time. • To avoid and minimise noise and vibration impacts during construction APA will implement a range of measures including preparation and implementation of a Construction Noise and Vibration Plan detailing measures to avoid and minimise construction and vibration, and condition/dilapidation surveys where required (EMM NV1). • Following the implementation of the Construction Noise and Vibration Plan and where noise is still predicted to exceed the adopted criteria, information on the impact will be discussed with affected residents and depending on the circumstances, further measures to minimise noise impact will be considered including alternative temporary accommodation or other respite options (EMM NV7). • 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).

6. Existing conditions

The determination of the existing conditions of the land surrounding the proposed Project site is important for the identification of sensitive noise and vibration receptors. This is necessary to develop noise criteria from the relevant guidelines.

6.1 Sensitive receptors - operational

6.1.1 Wollert compressor station

The pipeline terminates at APA's existing gas compression station located at 365 Summerhill Rd, Wollert. Section 3.4 provides a description of the existing Wollert Compressor Station.

APA commissioned Wood to assess the noise impact of the proposed facility expansion in accordance with the State Environmental Protection Policy (Control of Noise from Industry, Commerce and Trade) No. N1 (SEPP-N1). Receptors around the site are summarised in the Wood report provided Appendix A, in total the report estimated around 30 noise sensitive receptors close to the compressor station with nearest being approximately 700 m away from the site. Results of previous noise monitoring programmes show that the area around the site is relatively quiet and is characterised by low night time background noise.

6.1.2 Main Line Valves

The Project involves construction of three main valve sites (MLV). They are situated in sparsely populated areas with substantial separation distances from residential receptors. The valve sites are shown in Figure 4.

The closest sensitive receptor to the site of MLV1 (KP 6.4) is separated by a buffer of over 1 km. The area around the site is primarily rural, without substantial traffic, and is expected to be characterised by low background noise.

The site of MLV2 (KP 22) is located approximately 600 m away from the nearest sensitive receptor, and approximately 250 m away from the Oaklands Rd crossing. MLV3 (KP 35.2) is closer to the nearest sensitive receptor with a separation distance of approximately 300 m to the nearest receptor, which is located south east of the site.

In view that maintenance activities of the valves are scheduled rarely and their duration does not exceed 1-2 min, detailed operation noise assessment is not included in this report. Emergency venting events would only be required during emergency events and therefore may not happen during the lifetime of the Project.

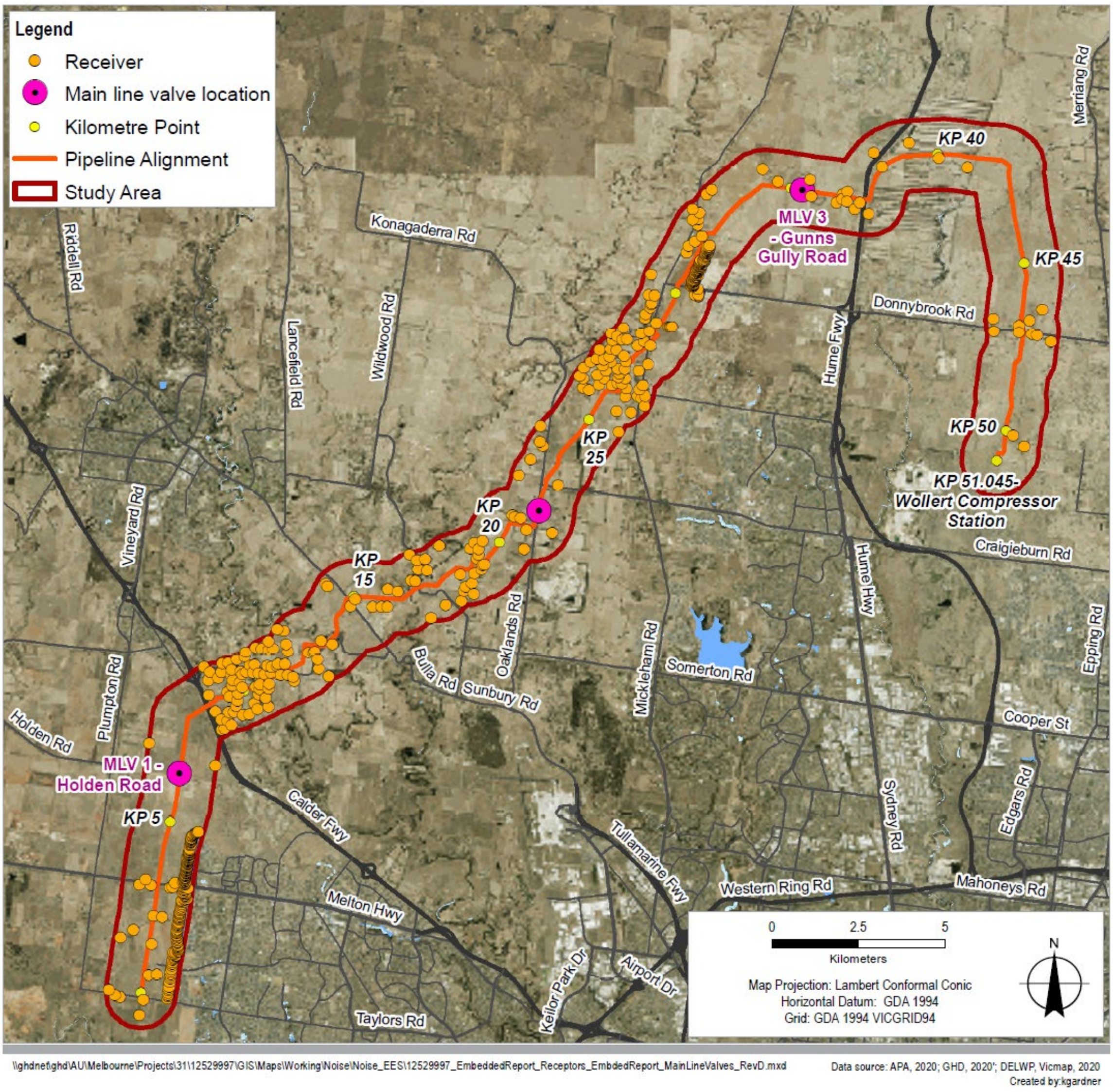


Figure 4 Location of MLV sites and nearest receptors

6.2 Sensitive receptors- construction

The proposed construction alignment stretches through sparsely populated rural areas and road reserves. It also runs adjacent to existing and proposed residential areas in Hillside, Fraser Rise and Mickleham.

Within the wider pipeline corridor, other sources of noise emission include agricultural activities, local and main roads, industrial emissions (from local businesses, industries and Melbourne Airport), sand and rock quarries, landfills and existing compressor stations associated with the Project.

6.2.1 Sensitive receptor locations - noise

The identification of sensitive receptors was conducted through the study of available aerial imagery from VicMaps, Google Imagery and ArcGIS MapServer. Further land use and cadastral data obtained from DELWP was used.

Within the Project study area, 525 sensitive receptors have been identified within approximately 1 km of the construction corridor. This includes both individual sensitive receptors (i.e. 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. Representative receptors (being the closest receptors to the Project) were used for densely populated locations (Hillside, Fraser Rise and Mickleham) being the closest receptors to the construction corridor and therefore those with the highest impact..

Table 11 in Section 5.1 identifies the applicable planning zones of the sensitive receptors to be a mix of:

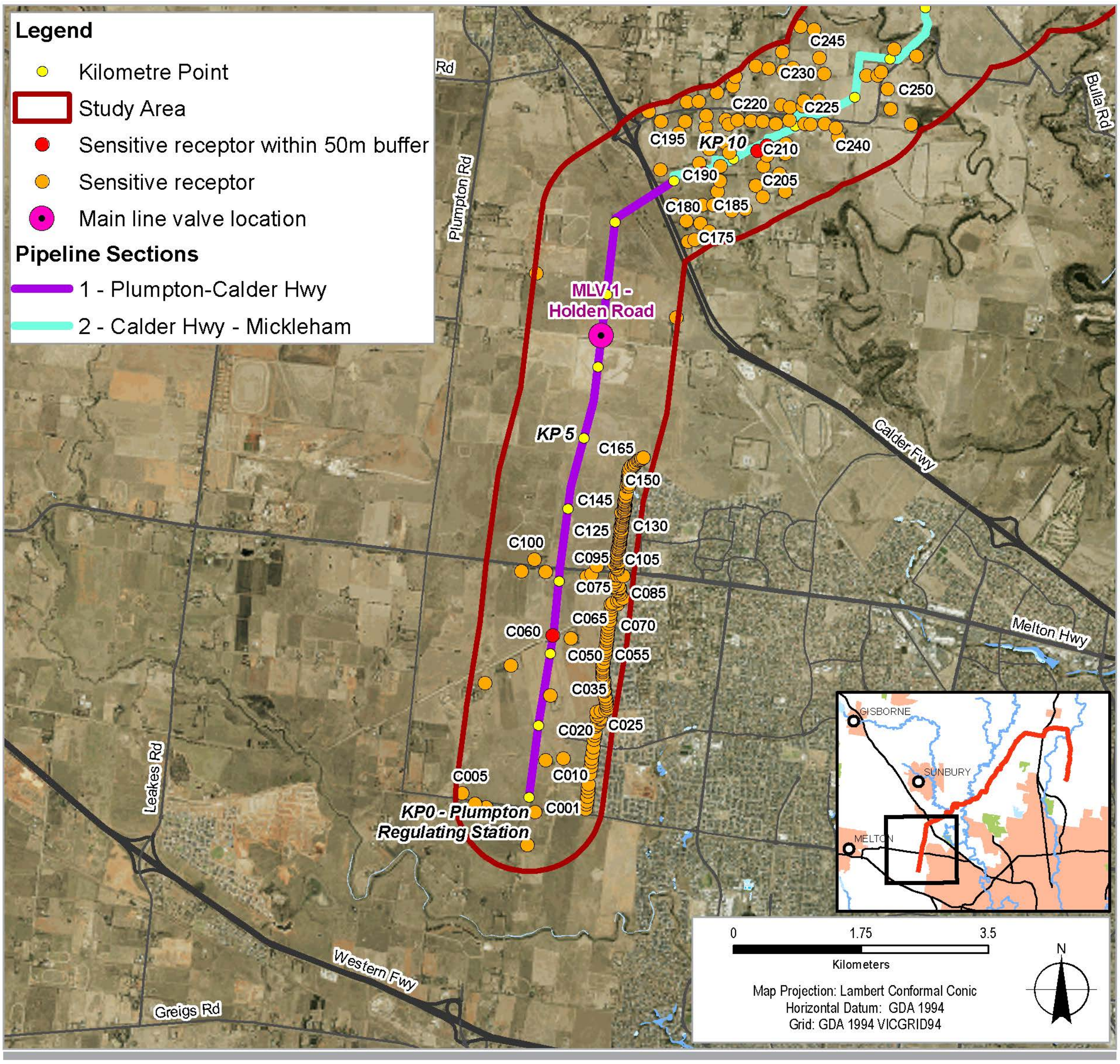
- Urban Growth Zone (multiple schedules)
- Green Wedge Zone (multiple schedules)
- Farming Zone

There are several community facilities along the length of the pipeline that have been identified as sensitive receptors. These include:

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

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

Some Project areas don’t have receptors in close proximity to the planned zone of construction works. These receptors can be seen in Figure 5 through Figure 8 below and are summarised in Appendix B.



Data source: APA, 2020; GHD, 2020; DELWP, Vicmap, 2020 Created by:kgardner
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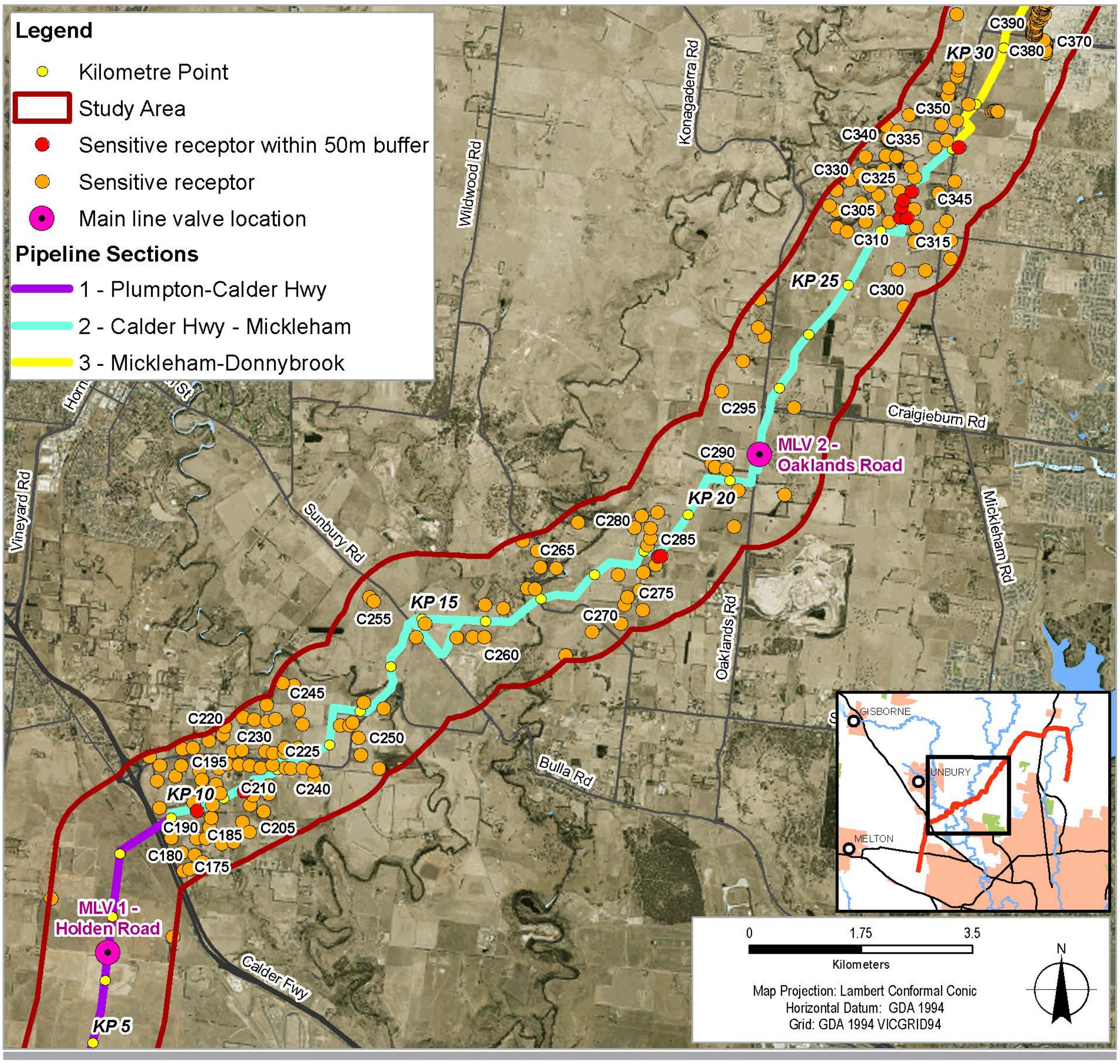
Figure 5 Sensitive receptors for kilometre points (KP) 1 – 12



Data source: APA, 2020; GHD, 2020'; DELWP, Vicmap, 2020 Created by:kgardner
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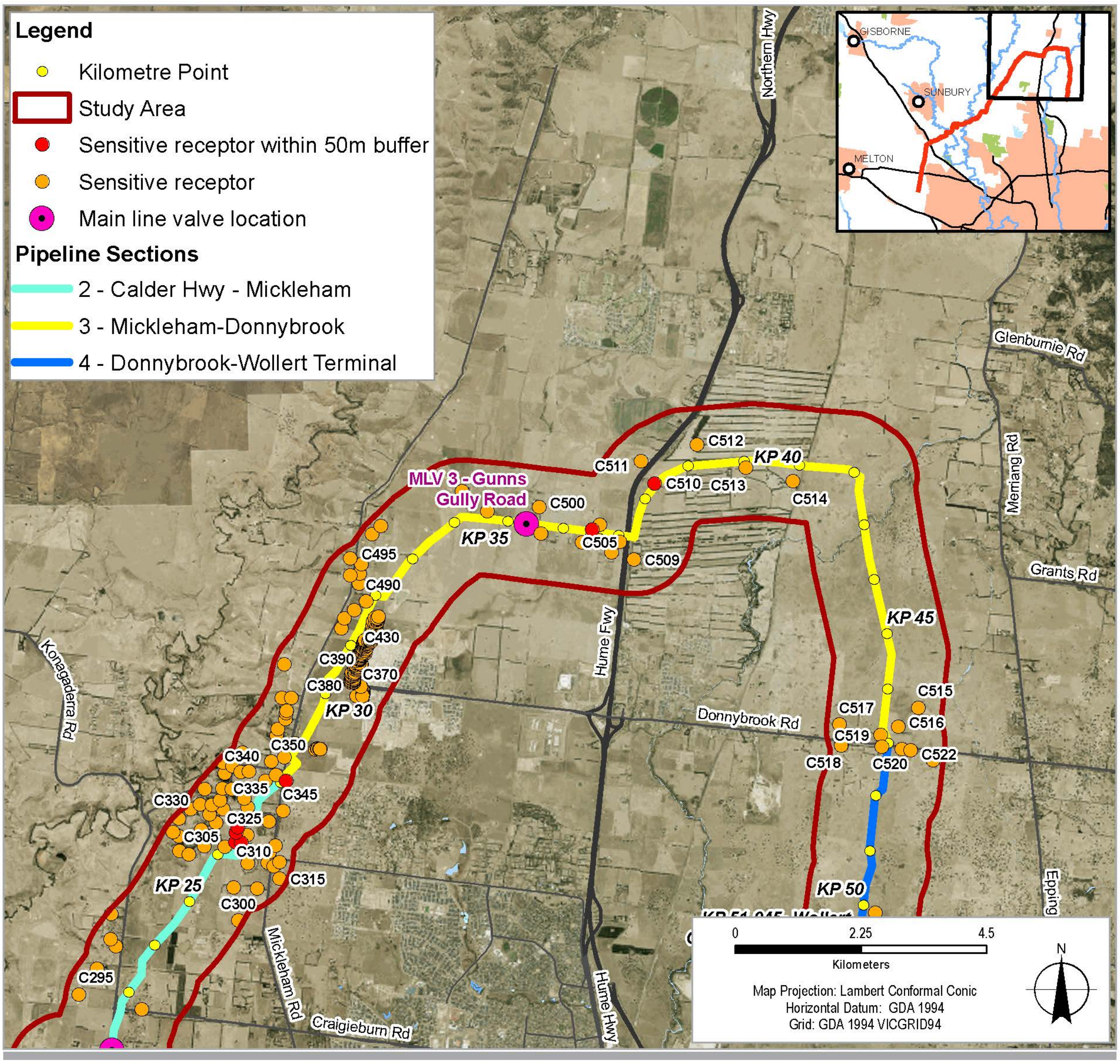
Figure 6 Sensitive receptors for kilometre points (KP) 6 – 30



Data source: APA, 2020; GHD, 2020'; DELWP, Vicmap, 2020 Created by:kgardner
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Figure 7 Sensitive receptors for kilometre points 23 – 50

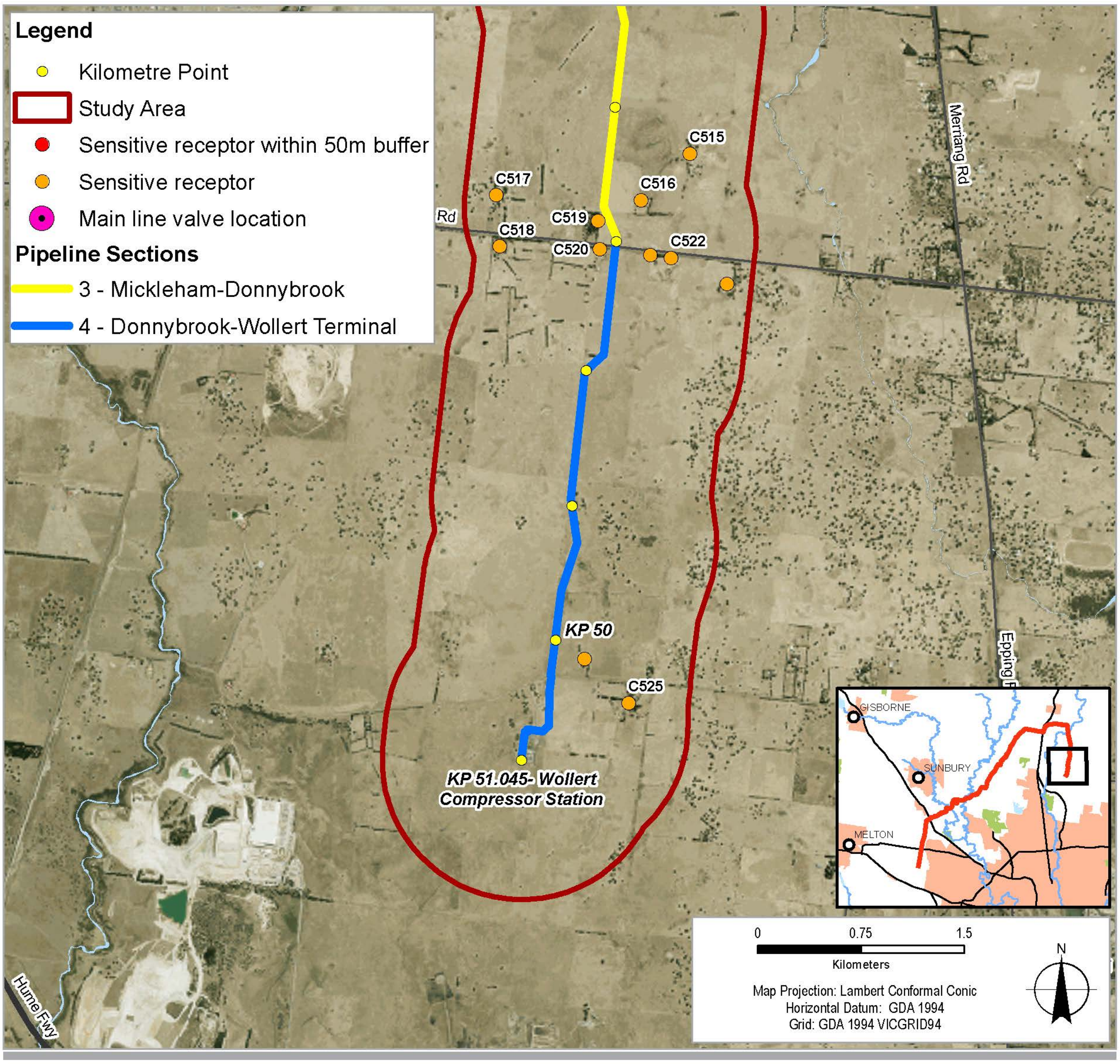

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Figure 8 Sensitive receptors for kilometre points 46 – 51

6.2.2 Sensitive receptor locations- vibration

VIC EPA guidelines for major construction projects recommend assessment of vibration from non-blasting sources for receptors that are located within 50 m distance from the work zone (EPA Publication 480, superseded). These locations are shown in Figure 5 to Figure 8.

There are 14 receptors identified to be within 50 metres of the pipeline's 30 m wide construction corridor (as measured from the edge of the construction corridor). These 14 receptors are comprised of:

- 1 receptor at KP 2.3 (C060, commercial receptor)
- 3 receptors between KP 9 and KP 11 (C188, C211, C215)
- 2 receptors near KP 19.2 (C284, C285)
- 5 receptors between KP 26 and KP 28 (C319, C320, C323, C324, C334)
- 1 receptor at KP 28.1 (C349)
- 1 receptor at KP 36.5 (C503)
- 1 receptor at KP 38.4 (C510)

There are no guidelines in Victoria that set recommended vibration limits for construction. Information from relevant standards and guidelines is provided in section 4.4.2. It does not necessarily mean that all sensitive receptors within 50 m from the Project boundary may experience high vibration impact. Construction vibration impact is assessed in section 8.3.2 and recommended separation distances are proposed as a result of this assessment.

7. Risk assessment

A risk assessment of Project activities was undertaken in accordance with the method described in Section 5.3.

The initial risk ratings presented in Table 16 consider an initial set of mitigation measures (where relevant), which is based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of similar type, scale and complexity. Risk ratings were applied to each of the identified risk pathways assuming that these mitigation measures were in place.

Where the initial risk ratings were categorised as medium or high, these risks were the focus of the impact assessment in section 8. Additional mitigation measures, summarised in section 9, were based on the results of the impact assessment. These Project specific mitigation measures are expected to be incorporated into the Construction Noise and Vibration Plan and/or Project design, as relevant. Residual risks after implementation of recommended mitigation measures is also included in Table 16.

The assessment of the potential impacts associated with the identified noise and vibration risks during the construction and operation of the Project is presented in Section 8.

Five construction risks and one operation risk were identified and assessed. These are briefly described below. Appendix G provided the full risk register including consequence and likelihood ratings.

Risk NV1 General construction noise

Construction equipment such as bulldozers, excavators, graders and vacuum trucks are significant noise sources. Impact is variable and depends on construction scenarios and the associated activities may result in significant noise impact if separation distance from sensitive receptors to the work zones does not provide sufficient attenuation. The consequences of the possible impact from noisy construction works are rated as moderate as the impact can cover a large area, however there is opportunity for effective control. This risk also may be attributed to cumulative impact from possible simultaneous projects in the area.

Risk NV2 Construction noise- out of hours

The current construction plan envisages construction periods that extend beyond standard construction hours and cover evening periods and weekends. Some operations like HDD drilling, boring and hydrostatic testing may involve continuous works including the evening and night time periods. These works therefore have the potential to cause increased disturbance to affected residents. It is expected that noise levels from evening or night time works will be lower than those from day time operations due to the absence of other construction activities. However, as applicable construction noise criteria are significantly stricter for evening and night time periods, the overall risk is considered medium.

Risk NV3 Construction noise (blasting)

Planned blasting may result in a short term significant impact in surrounding areas. Blasting works are planned for particular areas of the Project where rock will be encountered and where the separation distance to the nearest sensitive receptors is deemed to be large enough to sufficiently mitigate overpressure and vibration levels. Expected overpressure is below structural integrity limits and initial risk is considered medium.

Risk NV4 Construction vibration

Some of construction activities like excavation and rock breaking may result in ground transmitted vibration. The impact may be perceivable at sensitive receptors adjacent to the construction corridor. The impact is not expected to be long lasting or significantly above the human perception threshold and the initial risk associated with general construction vibration is considered medium.

Risk NV5 Blast vibration

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. Blast vibration propagation depends on many factors and there is uncertainty in predicting vibration levels. If actual impact exceeds recommended cosmetic damage limits, the consequences of this may be severe. Therefore, vibration due to blasting has an initial high risk rating.

Risk NV6 Operational noise

The significant separation distance from Wollert Compressor Station to the nearest noise sensitive land uses provides significant attenuation of noise propagating from the site. Engineering noise control measures are embedded into the station design and existing operations are not known to cause exceedances of applicable noise limits. Upgrade of the station is not expected to result in additional noise compared to the existing situation. Initial risk is considered to be negligible.

Table 16 Initial noise and vibration risk assessment

Risk ID	Works area	Risk name	Risk pathway	Initial risk	Residual risk rating
NV1	All	General construction noise	Noise amenity impacts on sensitive receptors from general construction works	Mediu m	Low
NV2	Zones of out of hours works	Construction noise (out of hours)	Out of hours construction works result in noise amenity impacts on sensitive receptors	Mediu m	Low
NV3	Blast works	Construction noise (blasting)	Construction blasting operations result in noise amenity impacts on sensitive receptors or cause structural damage to buildings	Medium	Low
NV4	All	Construction vibration	Vibration amenity impacts on sensitive receptors from general construction works	Mediu m	Low
NV5	Zones of blasting works	Blast vibration	Construction works result in vibration causing structural damage to buildings or underground assets or impacting on amenity of affected residents.	High	Low
NV6	Wollert compressor station, MLV	Operational noise	Operational noise impacts on sensitive receptors, from the Wollert compressor station, valves and auxiliary equipment.	Negligible	Negligible

8. Noise and vibration impacts

The noise and vibration impact assessment for the Project has been undertaken in accordance with the assumptions and limitations outlined in Section 5.5 and 1.3, the relevant legislation and guidelines outlined in Section 4, and the methodology outlined in Section 5, and the methodology outlined in Section of this report.

As discussed in Section 5, this impact assessment has been informed through a standard impact assessment process which has included review of existing conditions (Section 6) and an initial risk assessment (Section 7).

8.1 Operational noise predictions

8.1.1 Methodology- operational noise assessment

Assessment of Project operation is limited to surface noise and vibration impacts. The operational noise assessment was carried out by Wood based on information provided by APA. The Wollert Compressor Station and mainline valves (MLVs) are the only substantial upgrade of operational noise or vibration generating infrastructure that is associated with the Project.

Noise monitoring was undertaken by Wood at several locations around the Wollert Compressor site (Appendix A), where background noise monitoring permission was provided by the landholder. Specific locations of interest may not have been monitored due to lack of availability, poor site suitability or monitoring instrument security at the location of interest.

The number of sensitive receptors throughout the study area was estimated using available GIS information (section 6). Inputs used to develop the Project construction and operational noise models were based on the construction program and operational information available at the time of reporting.

Operational noise levels have been assessed where additional above ground infrastructure has been proposed (on the basis that the underground pipeline operation once completed does not generate perceivable noise).

The MLV sites are separated by substantial buffers from the nearest noise sensitive receptors (refer to section 6.1.2). It is understood that rare maintenance routines involve opening/closing valve operations that last for 1-2 minutes; this would not result in excessive noise impact when scheduled during a day time period, taking into account 30 min compliance checking periods in accordance with noise policy SEPP N-1.

Emergency venting of MLVs is only expected where gas needs to be isolated in the pipeline for safety purposes during an emergency. It is possible these events might not occur during the life time of the Project. Therefore, assessment of noise for emergency MLV venting has not been included in the operational noise model.

The risk of human disturbance because of ground vibration generated by the operation of the Project is considered very low. This is due to substantial separation distances and was therefore not further assessed.

The operational noise assessment is relevant to surface infrastructure only as the noise impact of buried infrastructure is expected to be negligible.

8.1.2 Operational noise assessment- Wollert compressor station

8.1.2.1 Applicable noise criteria

The current zoning map of the area surrounding the Wollert Compressor Station and the land uses for the surrounding area are included into Appendix A. The land uses surrounding the site are primarily Type 1 (noise sensitive), as scheduled in SEPP-N1.

Data acquired during the noise monitoring program was used to derive applicable noise criteria. The facility is expected to be in operation at any time of the day and is required to meet the strictest night time criteria. The noise limits are summarised in Table 17 (extracted from the Wood assessment), location of the receptors is shown in Appendix A of the operational noise assessment report (Appendix A of this report). The lowest applicable night-time noise limit under the noise policy SEPP N-1 is 39 dB(A) for the nearest receptors, which are in the same planning zone as the compressor site. Appendix A of this report).

Table 17 Noise criteria- Wollert Compressor Station

Receptors	Zoning	Influencing Factor	Background Noise Level	Night time zoning Level	Night time noise limit (L_{Aeq}, dB(A))
R01	Farming Zone (FZ)	0.125	36	41	41
R04, R27	FZ	0	36	39	39
R02	Industrial 2 Zone (IN2Z)	1	36	56	49
R03	Special Use Zone 4 (SUZ4)	1	36	56	49
R05, R06, R07, R08, R09, R10	Green Wedge Zone (GWZ)	0	36	39	39
R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26	Residential 1 Zone (R1Z)	0	36	39	39
R28	IN2Z	1	36	56	49
R31	R1Z	0	36	39	39
R29, R30	Rural Conservation Zone (RCZ)	0	36	39	39

8.1.2.2 Operational noise prediction

A noise model of the Wollert Compressor station was developed by Wood using SoundPlan version 7.4 noise modelling software. SoundPlan calculates predicted sound pressure levels at nominated receptor locations and can produce noise contours over a designed area of interest around noise sources. SoundPlan can be used to model different sources of environmental noise such as industrial noise, road traffic and rail noise and aircraft noise.

The noise prediction software provides a range of widely used noise propagation prediction algorithms that can be selected by the user. The CONCAWE algorithm was used for this study.

The inputs to the CONCAWE algorithm are noise source sound power data, locations and heights of barriers and screens, ground topographical and absorption type data, meteorological conditions and receptor locations. The model was validated for existing compressor station operations using results of a long term monitoring program carried out at four off site and on site monitoring locations. The variation between the predicted and observed (measured) values at the off-site locations (#1 to #3) was within -1.6 to +1.3 dB (refer to Appendix A for details).

Noise levels were predicted by Wood for an expected worst case operational scenario. Noise from the maximum operating capacity was modelled for the current and expanded facility. Expansion of the existing facility is predicted to have only minor effect on the levels at the affected receptors. Noise levels due to the facility are predicted to comply with the applicable noise limits at all of the affected receptors (Table 18). Specific noise mitigation measures are not required for the station operation based on the results of the acoustic modelling.

Table 18 Predicted operational noise levels- expanded compressor station

Receptor	Predicted SPL, dB(A)	Noise criterion, dBA	Compliance
R01	28	41	Y
R02	23	49	Y
R03	33	49	Y
R04	34	39	Y
R05	26	39	Y
R06	22	39	Y
R07	20	39	Y
R08	20	39	Y
R09	17	39	Y
R10	16	39	Y
R11	17	39	Y
R12	17	39	Y
R13	17	39	Y
R14	19	39	Y
R15	18	39	Y
R16	21	39	Y
R17	22	39	Y

Receptor	Predicted SPL, dB(A)	Noise criterion, dBA	Compliance
R18	20	39	Y
R19	21	39	Y
R20	22	39	Y
R21	21	39	Y
R22	22	39	Y
R23	24	39	Y
R24	25	39	Y
R25	26	39	Y
R26	28	39	Y
R27	34	39	Y
R28	17	49	Y
R29	15	39	Y
R30	23	39	Y
R31	24	39	Y

The Wollert Compressor Station is the only significant industrial noise source in the area that may operate during night time therefore assessment of cumulative impacts is not necessary.

The highest predicted noise level at a noise sensitive receptor is 4.7 dB below the SEPP-N1 noise limit.

8.2 Construction noise prediction

The area of construction works stretches across many suburbs and is close to residential houses in some places. Width of the construction temporary work areas is planned to be 30 m for most of the pipeline corridor. Additional areas are required at some locations to provide additional space for vehicle turn-arounds, laydown and storage. It is not expected that the construction activities will impact on the nearest individual receptors for prolonged periods. Noise generated by the Project construction activities may temporarily increase overall levels relative to the existing environment.

The potential impacts from construction were identified as part of the risk assessment process (sections 5 and 7).

8.2.1 Project specific construction noise criteria

Based on available information, typical construction works may occur for up to 11 hours per day, seven days a week. Construction sites typically have a start-up and shut-down phase each work day and work breaks at times (lunch, inductions etc).

Crossings construction (HDD drilling) and hydrostatic testing may be performed as a continuous activity that have the potential to span day, evening and night periods. Noise impacts may therefore occur beyond standard construction hours and be performed during evenings, nights and on weekends. Construction noise criteria have been adopted for this assessment based on the methodology outlined in section 4.4.1 for day, evening and weekend work.

Regarding night time work, most recent Victorian *guidelines Civil construction, building and demolition guide* (EPA Publication 1834, Nov. 2020) suggests that noise level "background + 0 dB" may be used as a reference for inaudibility. Night time criteria for affected receptors based on this recommendation are included into Appendix B.

The applicable limits for different working hours are presented in Table 19 below. There are 525 sensitive receptors included in this assessment and the coordinates and recommended evening time/weekend noise limits are presented in Appendix B.

Table 19 Applicable construction noise criteria

Time period	Guideline level, L_{Aeq}
Normal working hours Monday to Friday 7:00 am to 6:00 pm Saturdays 7:00 am to 1:00 pm	75 dB(A)
Weekend and evening work hours Monday to Friday 6:00 pm to 10:00 pm Saturdays 1:00 pm to 10:00 pm Sundays and public holidays 7 am to 10 pm	No more than 10 dBA above the background
Night 10:00 pm to 7:00 am any day	Noise must not be audible within a habitable room of any residential premises. Equivalent to background external noise level.

8.2.2 Construction activities

The high-pressure gas pipeline between Plumpton and Wollert involves construction works along an approximately 51 km long corridor. An open trench construction method is primarily used for large greenfield and brownfield sections of the Project. An approximate 2 metre deep and 0.8 metre wide trench is used for the purpose of this assessment. The trench depth will vary in locations such as entry and exit points of horizontal bore locations, creek crossings and clearance of third-party services.

The duration of pipeline construction is expected to be approximately five months followed by three months for the rehabilitation. This is for the entire Project, with construction and rehabilitation activities being completed in four to six months in one location. The clear and grade would progress along the corridor at approximately 1 km per day.

The current construction plan proposes a progress rate of up to 700 metres per day (approximately) for open trench construction and associated activities. This would minimise the duration of noise impact on affected residents. Where works occur near to a noise sensitive receptor, construction activities may result in a short-term noise and/or vibration impacts. This includes some suburban receptor areas located near to the proposal construction corridor (Hillside, Fraser Rise and Mickleham).

Crossings and some of the sections of the pipe alignment will generally be constructed using horizontal boring or directional drilling, however some of the crossings will involve open trench construction. Horizontal drilling is characterised by substantially lower daily rates and may take up to 6 weeks to complete works for the larger crossings. Horizontal drilling distances on the Project range from approximately 20 m (Deep Creek crossing) to 125 m (Calder Freeway crossing). Current information on crossings is summarised in Appendix C.

Construction methods involve a variety of activities and equipment. The data summarised in Table 20, shows the equipment/plant and associated sound power levels that have been used to predict the noise impacts from the Project construciton activities. The sound power of each activity is estimated based on available references and GHD's noise source database. The sound power of individual construction equipment is represented in Appendix D.

Table 20 Sound power (SWL) of construction sources

Scenario	Activity	Equipment*	SWL, dB(A)
S1	Clear and grade	• 35 Ton Excavator x 2 • 14G Grader x 1 • 16G Grader x 1 • D7 x Dozer x 1 HDD areas: • 35 Ton Excavator x 1 • 14G Grader x 1	118
S2	Stringing and bending	• 35 Ton Excavator with vac lift x 1 • 572 side boom x 1 • Bending machine • Prime movers (stinging trucks) x 3 • Skid truck x 2	128
S3	Excavation, earth moving operations	• 45 Ton Excavator with Hammer x 6 (each spread approx. 50m apart) • Rock chain Trencher x 2 (spread apart approx. 200m) • Trucks x 6 (assume carting of material from excavations)	125
S4	Welding	• 572 Side boom • Light Truck with Welding Machines x 2 • Tack Rig x 1	119
S5	NDT and coating	• Light Truck with Generator x 1 • Light Truck, 400 cfm Compressor and Grit Blasting Pot x 1 • Coating Light Truck (spray unit)	129
S6	HDD & Micro tunnelling	• Mini HDD – Shorter drills & mud tanks on trailer, vacuum truck • Major HDD – 35 Ton Excavator x 1 – Mud tanks – Generator (self bunded or within container) – Vacuum Truck x 2	120 123

Scenario	Activity	Equipment*	SWL, dB(A)
		• Micro Tunneling – 35 Ton Excavator x 1 – Boring Machine (diesel powered) – Prime mover for casing pipes and steel pipes	120
S7	Lowering in and backfilling	• 35 Ton Excavator x 2 • 572 Side Booms x 2 • 583 Side Boom • Loader x 2 • 350 Padding Machine x 1 • Trucks to haul in bedding material (6) • Flowcon Truck x 1 • Grader x 1 • D7 Dozer x 1	126
S8	Tie in's / Special Crossings	• 35 Ton Excavator x 2 • 572 Side Booms x 2 • Welding Truck • Coating & Blasting system on Truck	129
S9	Reinstatement Rehabilitation	• 35 Ton Excavator x 2 • Graders 16G x 1 • Grader 14G x 1 • D7 Dozer • Tractor - reseeding	120
S10	Hydrostatic testing	• Fill pump • High pressure squeeze pump • 750cfm Compressor • 1200cfm compressor for drying • Vacuum drying unit	118

*Number of machinery in each scenario assumed from information provided by APA

8.2.3 Prediction method

The noise levels generated by construction activities have been estimated using computer software Computer Aided Noise Abatement (CadnaA V2020 MR1) to predict noise levels at the nearest sensitive receptors.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA was set to calculate sound propagation according to ISO 9613-2:1996, *Acoustics – Attenuation of sound during propagation outdoors* and other embedded algorithms. The ISO 9613-2 algorithm takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.

Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations. The noise model inputs and assumptions for the construction assessment are provided in the table below.

Table 21 Construction noise modelling assumptions

Modelling component	Assumption
Prediction algorithm	*ISO 9613 – 2 Acoustics – Attenuation of sound during propagation outdoors*
Modelling period	Typical worst case 30 minute period of operation where the loudest items of equipment are running at full power
Meteorology	ISO 9613 considers the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation
Ground absorption coefficient	G = 0.5
Atmospheric absorption	Based on an average temperature of 10°C and an average humidity of 70%
Receptor heights	1.5 m above building ground level (ground floor)
Operating intensity	Construction scenario sound power levels have been adopted as a conservative case. The loudest plant items per scenario are assumed to be operating at the worst case position within the construction corridor relative to each sensitive receptor.

The magnitude of the noise levels associated with construction activities would be dependent upon a number of factors:

- The intensity and location of construction activities
- The type of equipment used
- Intervening terrain
- The prevailing weather conditions

8.2.4 Construction noise levels

Most common construction activities associated with the Project are summarised in Table 20. NDT and coating operations would be performed in open trench construction areas of the Project and result in the greatest sound power output (scenario S5). Scenario 8 was also modelled for open trench construction of the Project. Earth moving operations are typical for the open construction and have significant spectral component in mid frequencies. Crossing operations as per Appendix C are assumed to be either open trench or involve horizontal drilling or bore operations. Noise levels for the crossings operations were modelled in accordance with assumed scenario S6 or S8 in Table 20. Predicted construction noise levels for affected receptors are summarised in Appendix E.

The results indicate that there is a number of receptors where recommended day, evening and night time construction noise limits are exceeded. Noise mitigation measures are recommended to be implemented as suggested in section 9.

The results of noise modelling indicate that the highest expected noise impacts are associated with Scenario S5 *NDT and coating* primarily due to the high noise levels associated with the grit blasting. This scenario has the greatest predicted noise level of 107.7 dB(A) at receptor C060 (compared to recommended noise criterion of 75 dB(A)). This is because the affected residence does not have the benefit of significant distance attenuation or acoustic screening and is directly adjacent to the construction zone. Noise contours for this scenario are presented in Appendix F and represents the predicted highest impacts.

For scenario S5 Figure 9 shows areas with number of receptors where the construction noise for the open trench sections is predicted to exceed the day time limit of 75 dB(A) for affected residences. The predicted construction noise levels for each identified receptor can be found in Appendix E. The higher impact is mainly predicted where the construction zone is approaching boundaries of the residential allotments. Generally, along the construction corridor there are a low number (fewer than 5) sensitive receptors in any particular location where construction is expected to exceed the daytime criteria. The exception to this is around Morefield Court and Bulla-Diggers Rest Rd in Diggers Rest where there are approximately eight predicted exceedances.

For scenario S8, construction of open trench crossings (as distinct from general open trench works as modelled for scenario S5 and shown in Figure 9) is predicted to cause exceedance of day time criterion at ten receptors. The predicted noise levels at each receptor can be found in Appendix E.

For Scenario S6 noise levels from crossings with HDD drilling and bore operations are predicted to meet the day time criterion. Evening and night time operations may be scheduled for some HDD and bore crossings. Noise from these construction activities is predicted to exceed the evening and night time criteria for many sensitive receptors since the criteria are much lower than the day time criterion. Figure 10 and Figure 11 show the approximate number of receptors that are predicted to be above the evening and night time criteria (during unavoidable works associated with HDD and boring). These estimates were gathered from available aerial photography, adopted criteria and predicted noise contours.

Figure 10 shows areas with number of receptors where the construction noise for the HDD and bored crossings is predicted to exceed the evening time limit of “background + 10 dB”. Since evening time criteria are significantly stricter than day time, there are twelve locations along the construction corridor where evening time works may result in noise impact exceeding the recommended criteria. During the evening it is estimated that not more than 15 individual sensitive receptors are likely to be affected at each location where exceedances occur.

Figure 11 shows areas with number of receptors where the construction noise for the HDD and bored crossings is predicted to exceed the night time criteria. Specific criteria for each identified representative sensitive receptor can be found in Appendix B. Similar to the evening time operations, night time criteria are strict. Therefore, number of sensitive receptors impacted by night time works may be high in spite of the fact that planned construction activities result in lower predicted noise levels than day time operations. As shown in Figure 11, there are fourteen areas where noise from night time operations may be above the recommended criteria. Number of the houses with predicted exceedances in these zones can reach 100 and even exceed this estimate in two areas with high housing density.

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 crossings at Fraser Rise, Hillside and Donnybrook Road. HDD and bored crossings construction could take between two to three weeks at a particular location.

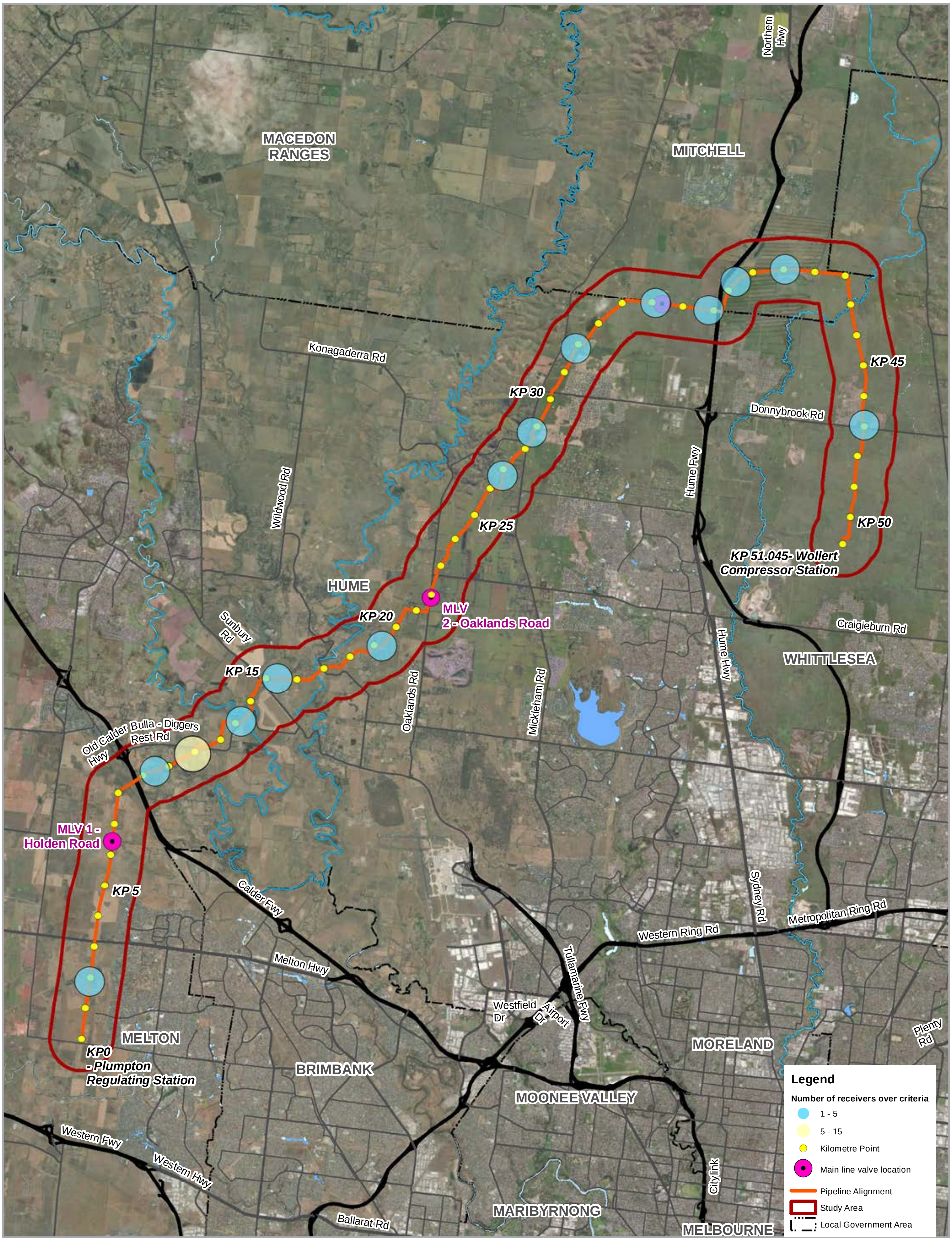
Where noise is predicted to be above the construction noise criteria, all feasible and reasonable work practices to minimise noise would be implemented. This would include mitigation measures identified in section 9. Planned activities outside normal construction hours are expected to occur infrequently and the duration of construction activities outside of normal construction hours would be minimised as far as practicable. When works are required outside of normal working hours (as defined by EPA Publication 1834), such as for HDD, boring and hydrostatic testing, 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 is to be prepared by the construction contractor would specify which activities fall within these categories and would be undertaken outside of normal working hours.

Several receptors in the HDD zones are located close to the area of works (C006, C226, C334,C349, C508, C520). If it is not possible to schedule HDD works for the day time only, mitigation measures would be put in place to provide attenuation to reduce noise down to the recommended criteria (as identified in Table 19). If this cannot be achieved, then respite options such as alternative temporary accommodation could be considered in consultation with the affected residents (EMM NV7).

Exact locations for assumed hydrostatic testing equipment are not yet known and therefore for the purposes of the assessment, it has been assumed that this could occur anywhere within the open trench construction areas. There is potential for the exceedance of evening or night time criteria at some of the residential receptors if the works are scheduled outside of the standard construction hours. Noise mitigation measures described in this section would be implemented if the activities are planned close to residential houses during evening/weekend periods or nights.

Several identified receptors are located very close to the area of works. In some cases, mitigation measures that reduce sound levels at these locations to the criteria defined in Section 4.4 may be impracticable.

The advanced notification of the affected receptors is recommended as a specific mitigation measure. If no quieter work method is feasible and practicable, consultation with impacted receptors is recommended to be undertaken including explanation of the duration and noise levels of the works, implemented mitigation measures. Recommendations on noise management practices are provided in section 9.



APA VTS (Operations) Pty Ltd
Western Outer Ring Main Gas Project

Open Cut Construction Exceedances (daytime)

Project No. 31-12529997
Revision No. A
Date 12/03/2021

Figure 9-1

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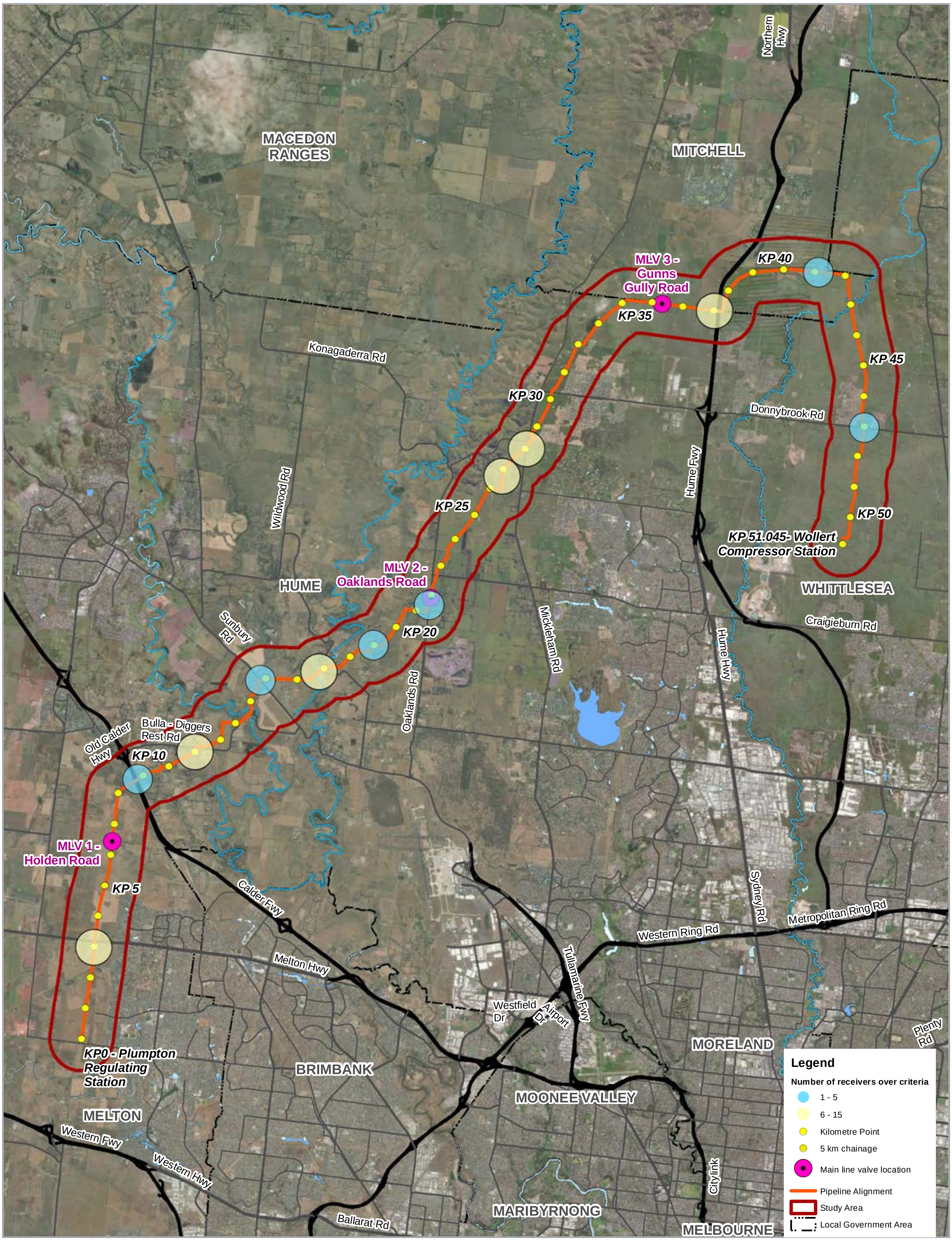
Data source: DELWP, VicMap 2020; GHD, 2021 Created by: kgardner



Paper Size ISO A4

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

APA VTS (Operations) Pty Ltd
Western Outer Ring Main Gas Project

HDD
Exceedances (evening)

Project No. 31-12529997
Revision No. A
Date 12/03/2021

Figure 9-3

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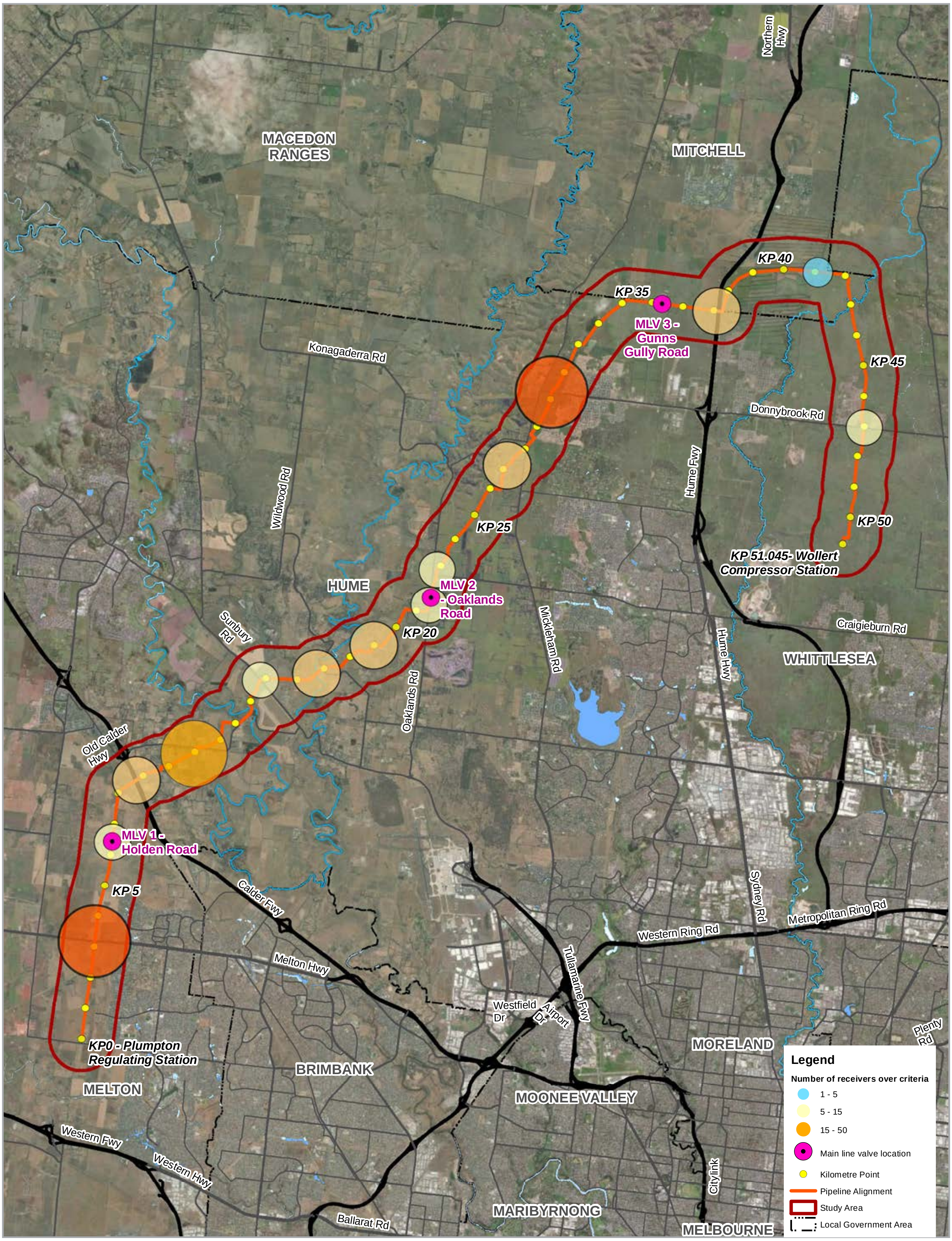

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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GHD

APA VTS (Operations) Pty Ltd
Western Outer Ring Main Gas Project

HDD
Exceedances (night)

Project No. 31-12529997
Revision No. A
Date 12/03/2021

Figure 9-2

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8.2.5 Blast overpressure prediction

Planned blast operations may result in a short term significant impact in surrounding areas. A high level assessment has been undertaken here to provide guidance should blasting be required for creating pipe alignment in a hard rock. Ground blast overpressure was estimated using the distance relationship calculation outlined in Australian standard AS 2187.2 – 2006:

$$P = K_a \left(\frac{R}{Q^{1/3}}\right)^a,$$

where

P- pressure in kilopascals

R-distance from charge, in metres

Q-explosive charge mass, kg

K_a-Site constant

a-Site exponent

The standard recommends a site constant of K_a=10 to 100 for confined blasthole charges and K_a=516 for unconfined surface charges. The site exponent of *a*=-1.45 is considered as a typical input for predicting blast overpressure.

Air blast is proportional to the cube root of the charge mass. A variety of factors are important in reducing the noise level (blast overpressure) from the blast event such as the blast design parameters including charge size, stemming height and delay timing.

Blast Maximum Instantaneous Charge (MIC) is suggested for some areas in the preliminary blast study (WORM Blasting Study, Technick Consulting Pty Ltd, 2020). The equation above was used to identify possible MIC values based on the receptor distance and air blast criteria at sensitive receptors. It is understood that the selection of locations where blast operations may occur is preliminary and not yet finalised. Potential areas of blast operations and types of charges are summarised in Table 22. These potential areas have been used to inform this assessment. Any other or additional sections of the Project would be considered at the later stages of construction planning.

Table 22 Potential areas of blast operations

No	KP In	KP Out	Section Length, m	Distance to nearest receptors, m	Assumed charge	Note
1	8.000	8.283	283	610	Normal or reduced, 0.8-1 kg	Residential receptor
2	8.327	8.602	275	355	Normal or reduced, 0.8-1 kg	Residential receptor
3	20.205	21.136	931	52	Normal (Type E), 1.2 kg	Shed, residence is approx. 140 m away
4	21.244	21.570	336	49	Normal (Type E), 1.2 kg	Shed, residence is approx. 165 m away

No	KP In	KP Out	Section Length, m	Distance to nearest receptors, m	Assumed charge	Note
5	27.934	27.993	59	110	Reduced or restricted (Type D1), 0.5-1.2 kg	Shed, residence is approx. 250 m away
6	28.766	32.162	3396	105	Reduced or restricted Type B. 0.3-1 kg	Residential receptor
7	36.168	37.033	865	55	Restricted, reduced, normal (Type D and E), 0.4-1.2 kg	Shed, residence is approx. 105 m away
8	37.267	38.270	1003	60	Restricted, reduced, normal (Type D and E), 0.4-1.2 kg, sometimes up to 8 kg	Shed or industrial, residence is approx. 100 m away, 125 m to the road
9	41.149	42.114	965	125	Reduced or normal (Type F and G), 0.8-1.2 kg	Shed, residence is approx. 370 m away
10	42.139	42.781	642	320	Reduced or normal (Type F and G), 0.8-1.2 kg	Shed, 1200 m to the house
11	42.845	45.732	2887	620	Reduced or normal (Type F and G), 0.8-1.2 kg	Agricultural structures, 940 m to the house
12	47.161	50.229	3068	65	Reduced or normal (Type F and G), 0.8-1.2 kg	Industrial structure, 125 m to the house
13	50.377	50.626	249	70	Reduced or normal (Type F and G), 0.8-1.2 kg	Industrial structure, 350 m to the house

The typical charge intended for the blast operations is 0.8-1.2 kg with smaller charges suggested for use in restricted areas. Increase of charge mass (MIC) up to 8 kg is planned where there are no sensitive receptors or structures within the relevant impact buffers from the blast locations.

It is understood that typical blast types involve drilling holes for the charges. A preliminary assessment of air blast overpressure impacts is considered using minimum, maximum and average site constants of K_a=10, K_a=55, and K_a=100 that are typical for blasthole blasts. The standard recommended site exponent of a=-1.45 was used for calculations. Blast distances are taken as distance from the charge.

Air blast overpressure predictions are presented in Figure 12 through Figure 14 below. Human comfort limit for 95% of the blasts at 115 dB is shown as per the standard AS 2187.2 – 2006 and the Guidelines Ground Vibration and Airblast Limits for Mines and Quarries. The absolute human comfortable level of 120 dB and the structural damage limit of 133 dB are also shown in accordance these standards.

When predicting blast-induced noise and vibration '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 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. For the purposes of undertaking a preliminary assessment of impacts from air blasts, a site constant of K_a=10 has been used, as informed by the preliminary blast study and considering the existing environment along the construction corridor where blasts are proposed.

Separation distances to the residential houses is 100 m or more in proposed blasting locations. Use of charges below 1 kg is not expected to result in overpressure exceeding 115 dB. Marginal exceedance is predicted for greater charges 1-1.2 kg, but overpressure is still expected to be below 120 dB absolute human comfort criterion at the sensitive receptors.

Use of 8 kg MIC charges is proposed for one zone only with section length of approximately 1 km. Blast impact may exceed 120 dB at the nearest residence (receptor C510), but is expected to be below the structural damage criterion of 133 dB at the nearest shed structure. Taking into account that the blasting works are not expected to be performed on regular basis, and based on the preliminary assessment, it is predicted that structural damage to buildings would not occur.

Separation distances to non- sensitive receptors are expected to be sufficient to meet the structural damage criterion assuming that special techniques proposed by the blast contractor will be implemented to reduce overpressure (i.e. K_a=10). However, should the actual site constant be higher than assumed (i.e. higher than K_a=10), the airblast effect can be greater and may exceed the cosmetic damage threshold. For example, if the average site constant (K_a=55) is used for the calculations, the overpressure may exceed 133 dB at distances of 100 m for an 8 kg charge mass.

Assessment of blasting overpressure and vibration indicates that separation distances are expected to be sufficient for levels to be lower than the structural damage criteria. However, in the case of higher than assumed propagation constants, human comfort or structural damage impacts may occur where high mass of instantaneous charge is used. Current site constants relating to blasting vibration or overpressure propagation are unknown, therefore it is recommended that the site constants are determined using a preliminary blasting study prior to any construction blasting. This assessment may make use of calibration charges to establish the site constant especially in the areas where sensitive or non- sensitive structures are relatively close to the zone of blast works and higher mass charges are proposed (for example section 8 in Table 22). The resulting site constants would then be used to determine suitable maximum charge size and blasting configuration. The results would also inform whether additional mitigation measures are required to minimise potential of impact or adverse reaction at sensitive receptors and structures.

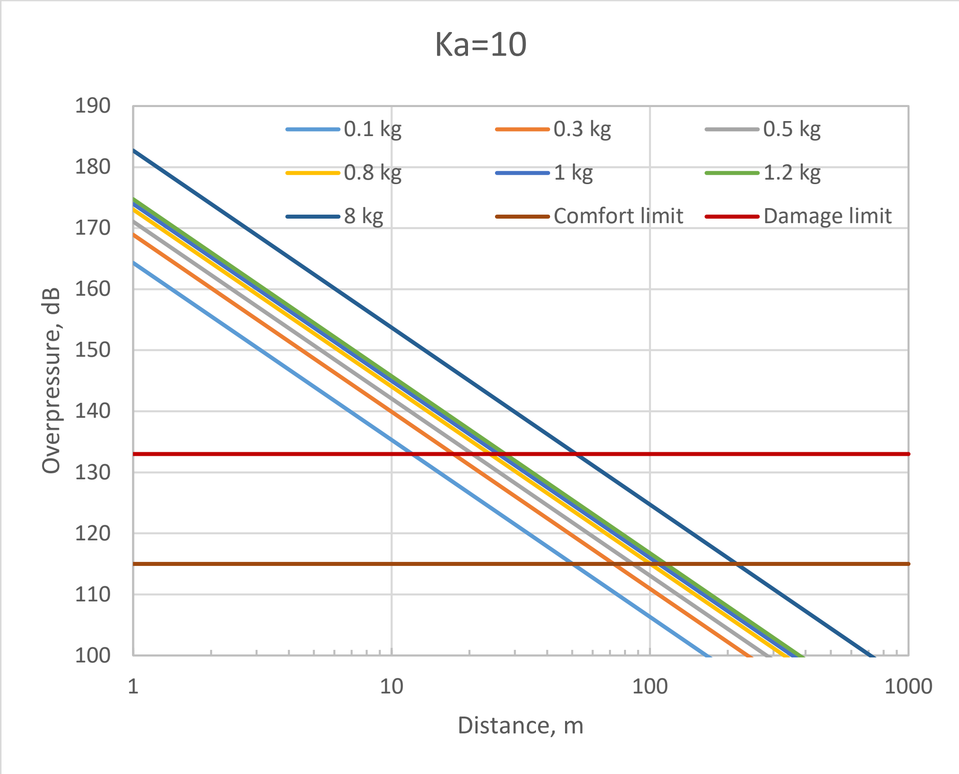

Figure 12 Airblast overpressure at various distances and Maximum Instantaneous Charge (MIC) (Ka=10, and a=-1.45)

Figure 13 Airblast overpressure at various distances and Maximum Instantaneous Charge (MIC) (Ka=55, and a=-1.45)

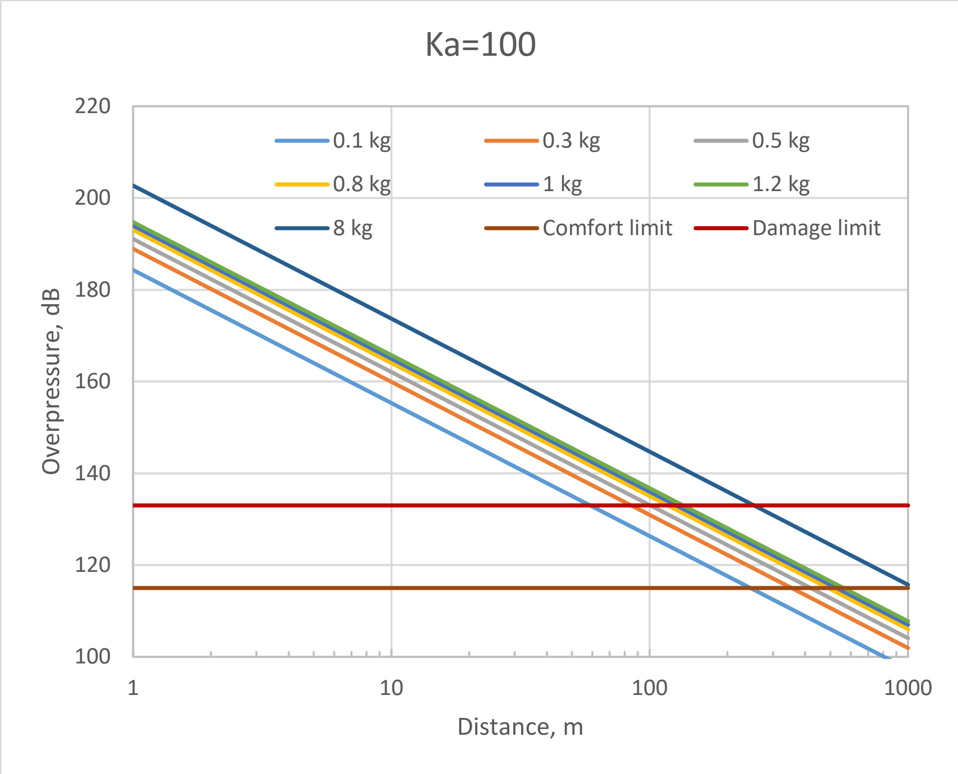

Figure 14 Airblast overpressure at various distances and Maximum Instantaneous Charge (MIC) (Ka=100, and a=-1.45)

8.3 Construction vibration prediction

8.3.1 Methodology- construction vibration assessment

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (i.e. impulsive, reciprocating, rolling or rotating equipment)
- The frequency content
- The impact medium stiffness
- The type of wave (surface or body)
- The ground type and topography

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The NSW RTA Environmental Noise Management Manual (ENMM) 2001 (Roads and Traffic Authority of New South Wales, 2001) provides typical construction equipment ground vibration levels at 10 metres.

The rate of vibration attenuation can be calculated from the following formula:

$V = kD^{-n}$, *where*

V - Peak Particle Velocity

D - Distance

k - site constant (if k is unknown, the site constant can be calculated from the other known parameters)

n - site attenuation exponent.

The value of the site attenuation exponent, *n*, depends on the soil and ground type. *Construction noise and vibration impact on sensitive premises, Proceedings of Acoustics* (Roberts, 2009) suggests the following values for *n*:

- 1.4 for weak or soft soils such as loose soils, mud, loose beach sand, dune sand and ploughed ground
- 1.3 for competent soils such as most sands, sandy clays, gravel, silts and weathered rock
- 1.1 for hard soils such as dense compacted sand, dry consolidated clay and some exposed rocks
- 1 for hard competent rock such as bedrock and freshly exposed hard rock

Lower values of *n* imply a more efficient vibration transmission rate. A conservative site attenuation exponent value of 1.2 has been assumed for this assessment.

8.3.2 Predicted vibration levels and safe working distance

Typical levels for vibration generating equipment potentially associated with construction works are detailed in Table 23.

Table 23 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

Based on available information about work method used for the Project, excavation would result in the most significant vibration.

Taking into account maximum vibration inputs from Table 23, the predicted ground vibration at various distances is shown in Table 24 for typical vibration generating equipment that may be used on-site. There are 14 receptors within the 50 m buffer as described in section 6.2.2. It is assumed that boundaries of the construction corridor would be as close as three to four metres to the nearest building, however these receptors are commercial and are eligible for a greater vibration criterion (C60). As works would generally occur along the centre of the construction corridor, the actual separation distance from the zone of excavation to the commercial receptor structures is expected to be approximately 13 m. Sensitive receptors (residential) are separated by a greater buffer from the construction corridor that exceeds 20 m.

Table 24 Typical vibration levels at distances (Peak mm/s)

Plant Item/Distances from Source	Peak Particle Velocity, 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

The EPA (Publication 480, now superseded) advises that nuisance from ground vibration is unlikely to occur if the operation is conducted at distances greater than 50 metres. As EPA Publication 1834 does not specify separation distances relating to vibration impacts, the previous guidelines have been considered.

As identified in Table 24, the predicted vibration from excavation at 50 m (minimum separation distance to the nearest receptor) meets the 0.3 mm/s human perception guidance value for excavator operations, but sometimes may be perceivable during dozer operations if the greatest vibration input from Table 23 is assumed. Vibration can be perceivable and cause annoyance at times, even when below structural integrity limits suggested in Section 4.4.2.

Heavy trucks passing over a normal road surface typically generate low vibration levels in the range of 0.01 – 0.2 mm/s at a building's footings located 10-20 m from the roadway. Generally, ground vibration from trucks is 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 radiation from the trucks. While this may cause concern to residents, the phenomenon is no different from those caused by adverse weather condition (e.g. wind) and is typically transient and short term in nature.

Vibration mitigation measures detailed in Section 9.2 would be implemented to minimise construction vibration impacts at nearby sensitive receptors if necessary. A number of measures can be implemented to minimise human disturbance that results from vibration exceeding the human perception threshold. They would be considered in areas where sensitive receptors are located within 100 m from construction zone and subject to vibration generating construction activities.

In cases where it is not possible to achieve a 100 metres separation from the construction corridor to sensitive receptors, additional mitigation would be considered to minimise human comfort impacts caused by construction vibration, as discussed in Section 9. There are 23 sensitive receptors within 100 metres of the construction corridor.

8.3.3 Vibration levels - blasting operations

The large scale of the Project increases probability that areas with hard rocks may be encountered during the construction phase. The use of explosives may be a preferable way of trenching if there are no sensitive receptors nearby. The principal hard rock zones requiring blasting are columnar basalts which are expected to be weathered and jointed nearer the surface. Many areas that will be traversed by the Project will have rock structures similar to those found in a number of commercial quarries west of Melbourne.

Methodology from Australian Standard AS2187.2:2006 "*Explosives - Storage and use of explosives*" is recommended to be used for predicting vibration from blast operations. Peak particle velocity can be calculated as follows:

$V = K(\frac{D}{\sqrt{Q}})^{-B}$, *where*

V- Peak Particle Velocity (mm/s)

D- Distance (m)

Q- explosive charge per delay (kg)

K and *B* - site constants related to the site and rock properties.

A preliminary blasting study was prepared for APA (WORM Blasting Study, Technick Consulting Pty Ltd, 2020). It suggests use of conservative site constant *K*=2200 for PPV estimates. The standard recommends use of average site exponent *B*=1.6 and site constant *K*=1140. PPV estimates using the preliminary study site parameters are represented in Figure 15 and Figure 16. The figures also show PPV limits that are recommended for 95% of blasts (5 mm/s) and absolute limit for sensitive structures (10 mm/s). A greater vibration limit for buried pipes at 80 mm/s is also included into the figures for clay, concrete, reinforced concrete, pre-stressed concrete and metal pipes (refer to Table 7) however, criteria for potentially impacted underground services would be confirmed by the services owner prior to works.

Current site constants relating to blasting vibration or overpressure propagation are unknown, therefore it is recommended that the site constants are determined using a preliminary blasting study prior to any construction blasting. This assessment may make use of calibration charges to establish the site constant especially in the areas where sensitive or non- sensitive structures are relatively close to the zone of blast works and higher mass charges are proposed (for example section 8 in Table 22). The resulting site constants would then be used to determine suitable maximum charge size and blasting configuration. The results would also inform whether additional mitigation measures are required to minimise potential of impact or adverse reaction at sensitive receptors and structures.

The results of blasting trials may also indicate that vibrations are rapidly attenuated, which is the case where they travel through a fractured or discontinuous medium. The preliminary study suggests that a decoupling of the existing pipes from the rock mass causes attenuation of vibration transmission due to internal friction and shearing of discontinuous particles. The preliminary study accounts for this attenuation in the case of an existing pipeline placed on sands or gravels in an excavated trench by applying a multiplier of 0.75 times the 'raw' vibration calculated value.

It is understood that the locations of proposed blasting are not finalised. Potential areas of blasting operations are summarised in Table 22.

The preliminary blast study indicates typical charge sizes intended for the blast operations are 0.8-1.2 kg with smaller charges suggested for use in restricted areas. Increase of charge mass (MIC) up to 8 kg is planned where there are no sensitive receptors or structures within the relevant impact buffers from the blast locations.

Figure 15 and Figure 16 show vibration magnitudes calculated for different charges and site constants. The figures show that the “comfort” criterion of 5 mm/s (for 95% of blasts) can be met at all residential houses for charges up to 1.2 kg when residences are located 100 m or more away from the proposed blast locations. Use of 8 kg MIC charges is proposed for one area only with section length of approximately 1 km. Blast impacts may exceed 5 mm/s at the nearest residence if conservative site constant *K*=2200 is used for the calculations, however the PPV is expected to be below absolute 10 mm/s limit suggested for sensitive structures. Taking into account that the blast works will not be repeated after completion of the section of the Project, no structural damage is expected to occur to sensitive receptors.

Separation distances to non- sensitive receptors are estimated to be sufficient to comply with the 10 mm/s criterion, with the exception of the zone where 8 kg charges are proposed. In this location (at the northern end of the Project between KP35 and KP40) the predicted PPV exceeds 16 mm/s at the nearest building which is a shed / industrial building. This is still below the 25 mm/s maximum limit suggested by Australian standard AS 2187.2 for occupied non-sensitive sites such as factories and commercial premises. Prior to any works the suitability of this criterion is to be verified by considering the character of the affected structure and with agreement from the owner. In the absence of verification or agreement regarding a non-sensitive structure the threshold of 10 mm/s is recommended with a commensurate reduction in charge mass. Structures of particular sensitivity or heritage value are to be treated with a higher degree of caution and on a case-by-case basis.

Precautionary approach would be adopted in areas with short separation distance to the blast works. A detailed blast vibration study would be undertaken before commencing construction of the Project as a part of blast work approval process. It may require blast with calibration charges to establish the site constant especially in the areas where sensitive or non- sensitive structures are relatively close to the site of blast works and greater charges may be used (for example section 8 in Table 22).In addition, notification would be provided to residents in the adjacent areas about the date and time of planned blast works and consultation undertaken with above and below ground utility asset owners to confirm construction vibration criteria. Condition/dilapidation surveys may be offered where high blast charges are required as informed by the detailed blast study and impact management plan.

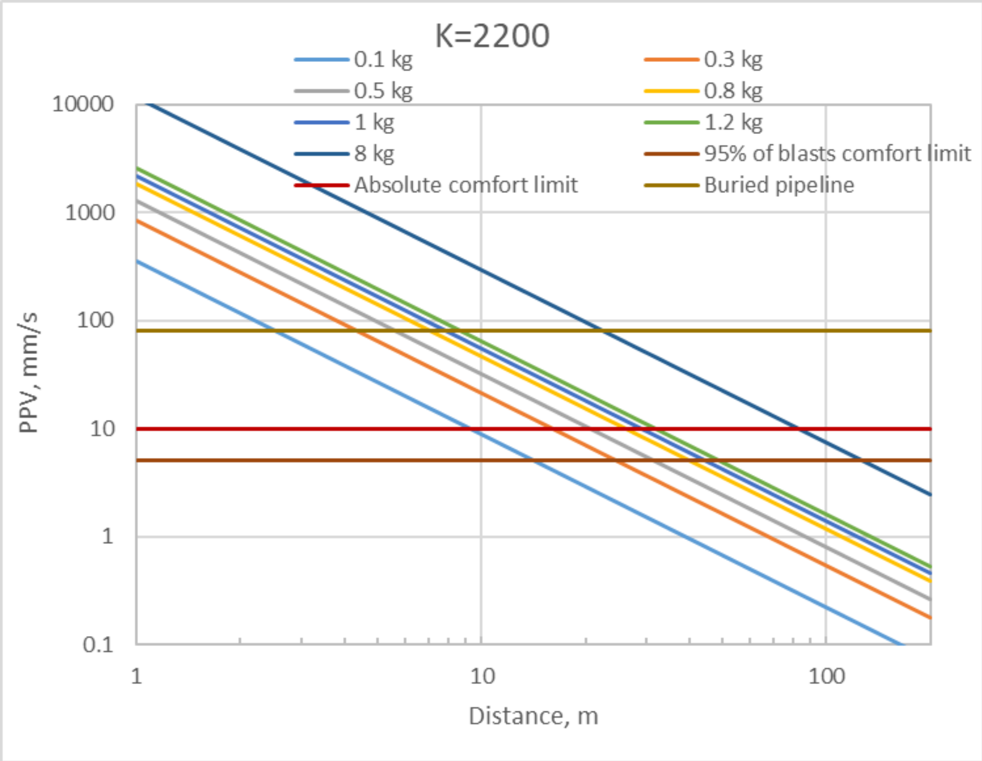

Figure 15 PPV estimates from blast operations at K=2200

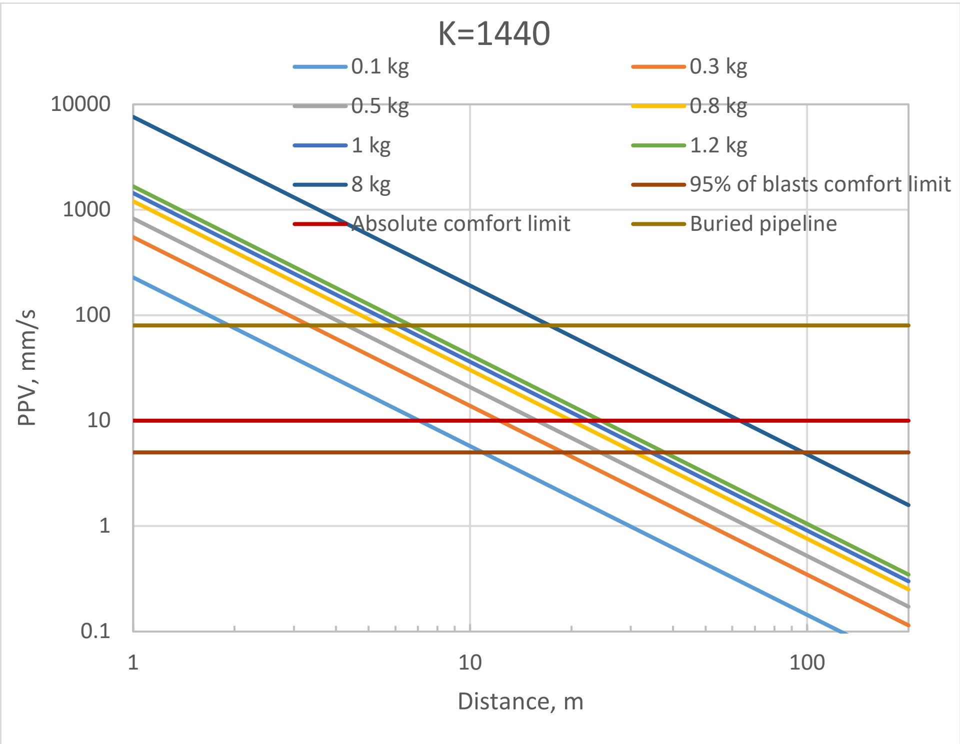

Figure 16 PPV estimates from blast operations at K=1440

8.4 Cumulative impacts

A high level cumulative impact assessment was conducted for the Project. This involved the consideration of other nearby projects that have the potential to generate additional noise and vibration impacts on sensitive receptors identified in this report. These additional noise and vibration impacts could lead to an increase in predicted levels at affected sensitive receptors, which could warrant additional mitigation measures.

Potential future projects in the vicinity of the WORM project that may be constructed at the same time include:

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

Details in terms 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.

The details of the Sunbury Road Upgrade and Melbourne Water's Bald Hill to Yan Yean pipeline construction method and equipment used are unknown at this stage. As such, a detailed cumulative impact assessment cannot be completed. A qualitative assessment has been conducted in the absence of construction details for each project.

8.4.1 Sunbury Road Upgrade

The Sunbury Rd Upgrade construction would cross perpendicular to the WORM pipeline.

Figure 17 below shows the approximate location of the Sunbury Rd Upgrade construction corridor with respect to the WORM pipeline. A cumulative impact could be expected to occur at the nearest sensitive receptors C251 to C261 (11 sensitive receptor), with possible impact at receptors further from the construction corridor depending on the construction method and equipment used. Table 25 shows the predicted levels for the WORM project at the nearest sensitive receptors for (scenario 5 (NDT and coating) and scenario 6 (HDD & Micro tunnelling)). Exceedances of the noise criteria are already predicted at sensitive receptors C252, C256 and C257 as a result of the construction of the WORM project (without any mitigation measure implemented) and further construction noise (from the Sunbury Road Upgrade project) would likely increase this. The cumulative impact from the Sunbury Road Upgrade project would also likely cause exceedances at several of the other receptors that are close to the day time criterion of 75 dB(A), namely C251, C253, C258 and C260. While it is not yet known whether construction during the evening and night time would be required for the Sunbury Road project, and whether this would occur simultaneously to the WORM project, if this did occur, it is likely that exceedances of the evening and night time criteria would occur. In this case additional noise mitigation measures may be necessary.

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.

Table 25 Predicted noise levels at receptors close to Sunbury Rd Upgrade construction corridor

Receptor	Predicted noise level (dB)		Criteria (dB)		
	Open trench (S05)	HDD/boring (S06)	Day	Evening	Night
C251	74	40.3	75	50	35
C252	75.2	38.5	75	50	35
C253	74.6	60.8	75	50	35
C254	51	42.7	75	50	35
C255	58.4	49.6	75	50	35
C256	81.7	58	75	50	35
C257	79.8	42.7	75	50	35
C258	69.8	43	75	50	35
C259	60.9	50.7	75	45	35
C260	70.1	45.2	75	45	35
C261	65.4	54	75	45	35

Figure 17 Approximate position of Sunbury Road Upgrade construction corridor

Paper Size A4
0 90 180 360 540 720
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

APA VTS (Operations) Pty Ltd
Western Outer Ring Main Gas Project

Sunbury Line Upgrade

Job Number 12529997
Revision A
Date 29 Mar 2021

Figure 17

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Data source: APA, 2020; GHD, 2020'; DELWP, Vicmap, 2020 Created by:oso

8.4.2 Bald Hill to Yan Yean Pipeline

The Bald Hill to Yan Yean Pipeline construction would occur parallel to the WORM pipeline from KP 40 – 42. Figure 18 below shows the approximate location of the Bald Hill to Yan Yean Pipeline construction corridor with respect to the WORM pipeline.

Table 26 shows the predicted noise levels for the WORM project at the nearest sensitive receptors that could be affected by cumulative impacts should the construction of both projects occur at the same time. The day time criteria of 75 dB may be exceeded due to WORM construction activities at receptor C513 (without mitigation measures implemented), and any cumulative impacts as a result of the Bald Hill to Yan Yean Pipeline project would be expected to increase this. Exceedances could also potentially occur at receptors C512 and C514 depending on noise contribution from the Bald Hill to Yan Yean Pipeline project and the timing of works.

Table 26 Predicted noise levels at receptors close to Bald Hill to Yan Yean Pipeline construction corridor

Receptor	Predicted noise level (dB)		Criteria (dB)		
	Open trench (S05)	HDD/boring (S06)	Day	Evening	Night
C512	65.8	33.3	75	50	35
C513	78.1	37.2	75	50	35
C514	68.3	54.8	75	50	35

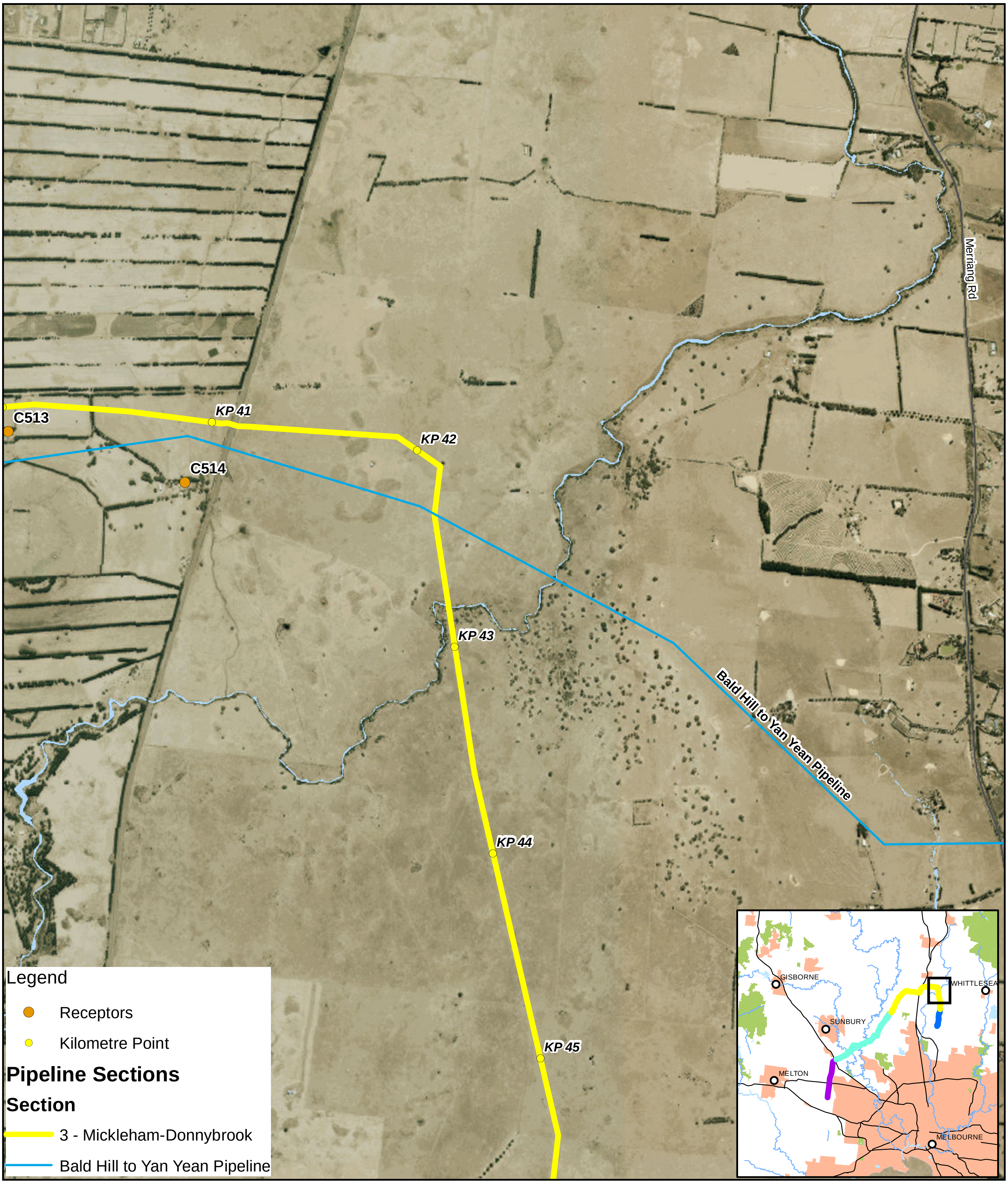

Figure 18 Approximate position of Bald Hill to Yan Yean Pipeline construction corridor

Paper Size A4

0 90 180 360 540 720

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

APA VTS (Operations) Pty Ltd
Western Outer Ring Main Gas Project

Bald Hill to Yan Yean Pipeline

Job Number 12529997
Revision A
Date 29 Mar 2021

Figure 18

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\\ghdnet\ghd\AU\Melbourne\Projects\31\12529997\GIS\Maps\Working\Noise\Noise_EES\12529997_018_EmbeddedReport_BaldHillToYanYeanPipeline_A4P_RevA.mxd

Data source: APA, 2020; GHD, 2020'; DELWP, Vicmap, 2020 Created by:oso

9. Environmental management measures

9.1 Findings from assessment

Noise and vibration generated by the Project activities has the potential to impact on sensitive receptors. The potential impacts due to the construction and operation of the Project were established as part of the risk assessment process (section 5.3 and section 7) and the potential impacts have been assessed (section 8). A summary of the risk assessment results is presented in Appendix G.

Results of the noise and vibration assessment show that noise mitigation measures are necessary for construction activities to reduce the impacts. The mitigation measures are intended to avoid and minimise the construction noise and vibration from the Project, in accordance with relevant policies and standards.

The construction contractor would be required to develop and implement detailed measures that focus on mitigation and control of noise and vibration impacts as part of a site/activity specific environment management plan.

The operational noise assessment shows that expected levels of noise will be below the night time criteria and therefore operational noise mitigation measures are not considered to be necessary.

9.2 Recommended noise and vibration mitigation measures

The construction noise and vibration mitigation measures for the Project are predicated on the legislation, policy and guidelines discussed in Section 4, the methodology and assumptions outlined in relevant sections of the report, and the assessment in section 8.

The mitigation hierarchy has been applied in the development of the mitigation measures. It is the nature of construction projects that the complete avoidance of noise and vibration is not possible. For this reason, the next highest level of the hierarchy has been applied in that measures taken to reduce the duration, intensity and extent of noise and vibration have been proposed. With the implementation of the recommended mitigation measures as outlined in Table 27, overall the impacts of noise and vibration from the Project impacts are considered to be low.

No specific operational noise mitigation measures are required for Wollert Compressor Station, however, equipment faults and normal equipment wear may cause noise levels to change over time. The APA Wollert facility undertakes ongoing maintenance works necessary to ensure all equipment is operating efficiently and any faulty components are addressed.

Table 27 lists the recommended environmental management measures relevant to the noise and vibration assessment. In general, these EMMs have been developed in accordance with EPA Publication 1856: Reasonably practicable (September, 2020), Publication 1834 Civil construction, building and demolition guide and other standards as set out in Table 27.

Table 27 Construction noise and vibration mitigation measures

EMM	Environmental Management Measure	Stage
NV1	Manage construction noise and vibration in accordance with Chapter 4 (Noise and vibration) of 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 the lowest-noise and vibration work practices and equipment that meet the requirements of the job • Use of 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 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
NV2	Where the construction noise and/or vibration levels are predicted or measured to exceed applicable criteria (as identified in EMM NV10) 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 (e.g. 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
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
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 (e.g. generators used for specific works) within the construction corridor to maximise the distance between source and receptor.	Construction

EMM	Environmental Management Measure	Stage
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’ and response strategies to mitigate the impacts of these works.	Construction
NV6	Where the residual noise and vibration impact (after mitigation measures are being implemented) exceeds the recommended construction noise and vibration criteria or construction works are planned close to the sensitive receptors, notify residents 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 as relevant: • 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 mitigation measures where required and reasonably practicable.	
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
NV8	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.	Construction

EMM	Environmental Management Measure	Stage
NV9	Liaison 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.	Construction
NV10	Undertake all reasonable and practicable actions to comply with the construction noise criteria:	Construction

Sensitive receptor	Period	Noise criteria, LAeq
Residential	EPA normal working hours hours: Mon-Fri: 7am - 6pm Sat: 7am - 1pm	75
Educational institutions		60
Parks and recreational areas		65
Community and commercial buildings		70
Residential	Evening and weekend Mon-Fri: 6pm - 10pm Sat: 1pm - 10pm Sundays and public holidays 7 am to 10 pm	Noise level at any residential premises not to exceed background (LA90, dB) noise by: • 10 dBA or more for up to 18 months
Residential	Night-time Mon-Sun: 10pm - 7am	Noise inaudible within a habitable room of any residential premises. Background +0 dB(A) (external)

Implement management measures if vibration from construction is predicted to exceed the standards for structural damage as identified in the following:

Group	Type of structure	Vibration velocity (PPV) in mm/s			
		At foundation at a frequency of(1)			Vibration at horizontal plane of highest floor (all frequencies)
		< 10 Hz	10 Hz – 50 Hz	50 Hz – 100 Hz	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design	5	5 to 15	15 to 20	15

EMM	Environmental Management Measure	Stage

	and/or occupancy				
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. heritage-listed)	3	3 to 8	8 to 10	8

Implement management measures if vibration from construction is predicted to exceed the standards for structural damage to existing underground pipelines:

Pipe material	Guideline value on pipe (mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with/without flanges)	80
Masonry, plastic	50

Implement management measures if vibration from construction exceeds the human perception of 0.3 mm/s at sensitive receptors.

9.3 Noise and vibration reductions and residual impacts

Section 8.2.4 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 implementation of the proposed management measures, the potential noise impacts are expected to be effectively reduced. Controls would be implemented suited to the individual locations and circumstances and based on experience on other projects, it is expected that on-site management measures (EMM NV1, NV2 and NV4) could reduce the noise levels by around 5 dB(A) (for general mitigation practices) to as much as 50 dB(A) where noise barriers or enclosures are used (refer to Table 28 which identifies the likely noise and vibration reductions following implementation of the environmental management measures). Should more than one management measure be implemented (for example EMM NV1 in combination with EMM NV2), the noise reduction is expected to be additive.

While modelling has not been undertaken to determine the residual impacts as the extent of the noise reduction achieved would depend on site characteristics and what controls the construction contractor employs, it is considered feasible that construction noise could be reduced to be at or below the recommended noise criteria (EMM NV10) with the implementation of on-site management measures. Specifically, Appendix E shows that without mitigation the highest noise level during the daytime is predicted to be 108 dB(A) (for NDT coating), which is above the project day criterion of 75 LAeq. Appendix E also shows that the highest noise level during the evening and night time is predicted to be approximately 75 dB(A) for HDD and bore crossings, which is also above the project evening noise criteria of “background noise +10 dB(A)” and the night criteria of background +0 dB(A) (refer Appendix B for criteria for individual locations).

As 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)), 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 (e.g. barriers) or a receptor's sensitivity to the noise impact.

In terms of vibration impacts, Section 8.3.2 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 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 and individual mitigation would be implemented (EMM NV6).

Vibration associated with blasting is expected to meet the lowest human comfort level (for 95% of blasts) at all sensitive receptors except for where an 8 kg charges may be used. However, vibration from an 8 kg blast is expected to be below the maximum human comfort limit and also the structural damage limit) of 10 mm/s at the nearest sensitive receptor. These estimates are based on preliminary information and blast works layout and would be confirmed by the detailed blast study (EMM NV3).

Overall, with the proposed mitigation measures implemented, the extent, severity and duration of the residual impacts is expected to be low.

Table 28 Construction noise and vibration– expected reductions

Mitigation type	Mitigation	Controls*	Expected reduction,
NV1	General mitigation practices	Optimised work methods and practices, instruction of personal etc.	5 dB(A)
NV2	Source mitigation	Choice of quieter equipment- main noise contributors	5-10 dB(A)
NV2	Source mitigation	Use of special silencers, mufflers local screens	10-15 dB(A)
NV2	Barriers and enclosures	Barriers Enclosures	5-10, maximum 15 dB(A) 15 to 25, maximum of 50 dB(A)
NV2	Source mitigation	Use of less vibration intensive equipment and/or method (regimes)	-

Mitigation type	Mitigation	Controls*	Expected reduction,
NV3	Managerial measures (blast)	Detailed blast study and impact management plan, use of special mitigation techniques	Dependant on outcomes of detailed study -
NV4	Distance mitigation	Increase separation distance for noise and vibration generating equipment, vibration monitoring	Dependant on the site properties
NV5	Managerial measures	Restriction of operating hours and duration of operations during particular periods	Exact reduction will depend on timing and scheduling of works
NV6	Receptor	Notifications about works that may result in temporary high impact on residents	No specific reductions anticipated, but may assist with managing residential expectations.
NV7	Receptor	Respite (for example alternative temporary accommodation) depending on circumstances	No specific reductions anticipated, but may assist with addressing impacts on residents
NV88	Receptor	Discussion with owner on structure/asset impact, condition/dilapidation survey	No specific reductions anticipated, but may assist with managing asset/ building owner expectations and managing works.
NV9	Managerial measures	Liaison with Melbourne Water and Sunbury Road project teams to inform on cumulative noise impact.	Noise reduction will depend on timing and scheduling of works, additional mitigation measures (if required).

*Suggested controls might not be feasible in some situations, e.g. where the use of quieter equipment is not possible

9.4 Monitoring

The requirements for and locations of noise monitoring will 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 will 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 (e.g. dozer) used during the clear and grade and trenching phase causing high levels of vibration), will 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 will 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 Section 4.4.3. Should the results from the initial monitoring determine that the blasting is below the project criteria as identified in Section 4.4.3, 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 Section 4.4.3, then control management measures identified in the blast impact management plan will be implemented.

A response plan will 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 noise and vibration levels (refer EMM NV2, NV6, NV7).

10. Conclusion

The purpose of this technical report is to provide a noise and vibration impact assessment to inform the preparation of the EES required for the Project.

Key findings of the current assessment are summarised below.

10.1 Existing conditions

The Wollert Compressor Station is situated in a farming zone with scattered individual residences and farm houses. The nearest noise sensitive receptors are at a distance of about 700 metres. Background noise in the vicinity of the compressor station is low, which is typical for rural areas.

Monitoring of the existing noise environment at the compressor station has been used to characterise the background noise levels and to derive operational noise criteria. Monitoring results show that noise levels at the nearest receptors are typical for quiet areas without significant traffic.

The proposed pipeline construction corridor is approximately 51 kilometres in length. The Project is primarily situated in a rural farming zone where existing background noise levels are expected to be low, which is typical for areas with negligible and low transportation. Suburban areas in the localities of Hillside and Fraser Rise are situated approximately 750 metres from the Project. The Project also runs adjacent at a distance of 150 metres to the western edge of the suburban area within Mickleham. As the Project is situated on the rural-facing side of these localities the acoustic environment can generally be characterised as quiet for most nearby receptor areas.

Some exceptions may be present in the vicinity of major highways or arterial roads that would be crossed by the Project. An assumed background approach was used in line with Australian Standard AS 1055.3:1997 for the purposes of informing noise evening/weekend criteria for construction works. Recommendations from other standards and guidelines were used to establish noise and vibration impact criteria including blasting operations.

10.2 Impact assessment

10.2.1 Wollert Compressor Station- operation

The Victorian noise policy (SEPP N1) provides procedures for establishing noise criteria based on planning zones and existing background noise levels. The assessment of noise from the expanded facility predicted compliance with the applicable noise limits at all of the sensitive receptors during the day, evening and the night.

As the existing and proposed operational plant and equipment at the Wollert Compressor Station are not considered to be significant vibration sources, and considering the distance to the nearest sensitive receptor (approximately 700 metres), there is a low risk of impacts caused by vibration.

The assessment results indicate that specific noise or vibration mitigation measures are not required for the Wollert Compressor Station, however equipment faults and normal equipment wear may cause noise levels to change over time. The APA Wollert facility undertakes ongoing maintenance works necessary to ensure all equipment is operating efficiently and any faulty components are addressed.

10.2.2 Pipeline construction

Construction of the pipeline would primarily be conducted using open trenching. Crossing of roads, rail and watercourses would be conducted using open trenching, horizontal directional drilling (HDD), horizontal boring or pipe jacking.

For open trench construction it is anticipated to progress at a rate of up to approximately 700 metres per day. This would minimise the duration of noise impact on affected residents. Where works would occur near a noise sensitive receptor, construction activities may result in a short term noise and/or vibration impacts.

For open trench construction and NDT and coating, without mitigation, this has the potential to exceed the recommended daytime noise criteria of 75 dB(A) at some locations along the construction corridor where works would be undertaken close to residential property boundaries. In some locations where receptors are located near to the Project, construction noise is predicted to be substantially above the recommended construction noise criteria. Typically, these nearest receptors are isolated rural dwellings. The area around Morefield Court and Bulla-Diggers Rest Road in Diggers Rest has the highest density of predicted exceedances, with approximately eight receptors where construction noise levels are predicted to exceed daytime criteria. Mitigation measures are recommended to control the noise impact and reduce construction noise to the recommended levels.

Noise from HDD and bore operations are predicted to meet 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 without mitigation. Exceedance of evening and night criteria is predicted to occur at several locations, with the largest number of impacted receptors at the suburban areas of Hillside, Fraser Rise and Mickleham. 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.

Proposed noise and vibration mitigation measures in this assessment include the application of general construction noise management practices and specific mitigation measures according to the location and construction activity. Where works are proposed outside of normal construction hours, noise mitigation measures are recommended to reduce the risk of disruption and sleep disturbance. As noise reductions of 5 dB(A) to 50 dB(A) could be achieved by implementing onsite mitigation measures, it is expected that noise could be reduced to meet the project noise criteria. The assessment has found that construction noise levels are predicted to be below recommended criteria if the noise mitigation measures discussed in Section 9.2 are implemented. 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. These alternate options may be employed for a number of reasons including timing and duration of impact, feasibility of installing mitigation (e.g. barriers) or a receptor's sensitivity to the noise impact.

Assessment of construction vibration indicates that there is a low risk of structural damage from general construction activities as predicted levels are below the recommended criteria relating to structural integrity for typical dwellings.

Human comfort vibration impacts are predicted where vibration generating works are conducted within 100 metres of an occupied residential building. The duration of human comfort vibration impact for any individual receptor is expected to be of short duration due to continuous progress of works along the construction corridor.

Blasting is proposed in some locations along the construction corridor. Where hard rock is present and there are no nearby sensitive receptors or structures, there is an opportunity for blasting to accelerate construction and completion of the Project. Assessment of blasting overpressure and vibration indicates that separation distances are expected to be sufficient for levels to be lower than the structural damage criteria. However, in the case of high propagation constants, human comfort or structural damage impacts may occur where a high mass of instantaneous charge is used (eight kilogram charge). Accurate estimates of current site constants relating to blasting vibration or overpressure propagation are unknown, therefore it is recommended that the site constants are determined using a detailed blasting study prior to any construction blasting. The resulting site constants would then be used to determine suitable maximum charge size and blasting configuration. The results would also inform whether additional mitigation measures are required to minimise potential of impact or adverse reaction at sensitive receptors and structures.

Overall, with the proposed mitigation measures implemented, the extent, severity and duration of the residual impacts is expected to be low.

11. References

Legislation

Environment Effects Act 1978 (Vic)

Environment Protection Act 1970 (Vic)

Environment Protection and Biodiversity Conservation Act 1999

Environment Protection Act 2017, as amended by the *Environment Protection (Amendment) Act 2018* (to take effect from 1 July 2021)

Environment Reference Standards (ERS) (to take effect from 1 July 2021)

Policies and Guidelines

Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978, Victorian Government Department of Sustainability and Environment (June 2006)

State Environment Protection Policy (Control of Noise from Industry, Commerce and Trade) No. N-1, VIC Government, Publication S31 (October 2001)

Environmental Guidelines for Major Construction Sites, EPA, Publication 480 (February 1996)

Civil construction, building and demolition guide. EPA, Publication 1834, (November 2020)

Noise from Industry in Regional Victoria, EPA, Publication 1411 (October 2011)

SEPP N-1 and NIRV Explanatory Notes, EPA, Publication 1412 (October 2011)

Interim Construction Noise Guideline, Department of Environment and Climate Change NSW, Publication 2009/265 (July 2009)

Environmental Noise Management Manual, Roads and Traffic Authority of NSW, RTA Publication Number RTA–Pub.01.142 (December 2001)

Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues (to take effect from 1 July 2021)

Guidelines for Community Noise, World Health Organization, WHO Geneva, 1999

Australian Standards

Australian Standard 2885 Pipelines – Gas and Liquid Petroleum

Australian Standard 2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites

Australian Standard 1055: 2018 Acoustics- Description and measurement of environmental noise

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

AS 2187.2 : 2006 Explosives- Storage and use. Part 2: Use of explosives

Australian/New Zealand Standard 2107: 2016 Acoustics- Recommended design sound levels and reverberation times for building interiors

Australian/New Zealand Standard ISO 31000:2009 Risk Management Process

Overseas and International Standards

German Standard DIN 4150: Part 3 – Structural Vibration in Buildings – Effects on Structures (2016)

British Standards 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting

British Standard 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

Reports

WORM Blasting Study, Technick Consulting Pty Ltd (2020)

APA Wollert Compressor Station Environmental Noise Assessment, Wood. (2020)

Appendices

Appendix A – Operational noise assessment, Wollert Compressor Station (Wood, 2020)

APA WOLLERT COMPRESSOR STATION ENVIRONMENTAL NOISE ASSESSMENT

APA GROUP

Rpt01-1403780-Rev3-22 June 20

www.woodplc.com
Specialist Technical Services
Vibration, dynamics and noise

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EXECUTIVE SUMMARY

APA Group owns and operates a gas compressor station located at 365 Summerhill Rd, Wollert, VIC 3750. The APA Wollert site comprises:

- Wollert City Gate:
  - Four regulator runs that reduce the gas pressure from the country pipeline system to the metropolitan system. A gas fired water bath heater preheats the gas entering the valves.
- Compressor Station:
  - Station A consists of three Solar Saturn 10 gas turbine driven gas compressors (units 1,2 and 3) with one shared fin fan gas cooler and associated equipment;
  - Station B consists of two Solar Centaur 50 gas turbined driven compressors (units 4 and 5) with one fin fan gas cooler and one lube oil cooler per unit; and
  - Auxiliary equipment includes a gas engine generator, an instrument air compressor, a station vent and two pressure regulation valves.

There are around 30 noise sensitive receivers close to the compressor station and the current planning scheme allows for additional residential development near the site.

APA are currently progressing the Western Outer Ring Main Project, which includes addition of a Solar Centaur 50 compressor and associated equipment to the site. APA has commissioned Wood to assess the noise impact of the proposed facility expansion in accordance with State Environmental Planning Policy N1 (SEPP-N1).

Modelling and analysis undertaken by Wood shows that for the expanded facility operating at the maximum operational scenario and under the most adverse meteorological conditions:

- Noise levels would decrease by -0.4 to -2.5 dB at most existing receivers if APA undertook maintenance to address potential fan belt and bearing faults on the unit 4 gas cooler fans; and
- Modelled noise levels fall below the SEPP-N1 limits at all existing receivers.

The highest predicted noise level is 4.7 dB below the SEPP-N1 noise limit. The model was validated against noise levels measured at three locations outside the site boundary and the difference between predicted and observed noise levels ranged from -1.6 to +1.3 dB. Therefore, noise levels generated by the expanded compressor station should fall below the SEPP-N1 noise limits by around 4.5 to 5 dB.

Thus, it was concluded that there are no issues that would prevent the expanded facility from meeting the SEPP-N1 noise limits.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Facility Description

APA Group owns and operates a gas compressor station located at 365 Summerhill Rd, Wollert, VIC 3750. APA are currently progressing the Western Outer Ring Main Project, which includes addition of an additional Solar Centaur 50 compressor to the site.

APA has commissioned Wood to assess the noise impact of the proposed facility expansion in accordance with State Environmental Planning Policy N1 (SEPP-N1).

The APA Wollert site comprises:

- Wollert City Gate:
  - Four regulator runs that reduce the gas pressure from the country pipeline system to the metropolitan system. A gas fired water bath heater preheats the gas entering the valves.
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  - Station A consists of three Solar Saturn 10 gas turbine driven gas compressors (units 1,2 and 3) with one shared fin fan gas cooler and associated equipment;
  - Station B consists of two Solar Centaur 50 gas turbined driven compressors (units 4 and 5) with one fin fan gas cooler and one lube oil cooler per unit; and
  - Auxiliary equipment includes a gas engine generator, an instrument air compressor, a station vent and two pressure regulation valves.

The facility operates on a demand basis and operation of the compressors is controlled by AEMO. At the current facility, a compressor (unit 4 or unit 5) runs on average every second day, most often during the night time and early morning periods. It is very rare that both Solar Centaur 50 compressors (units 4 & 5) run simultaneously during these periods. Wood understands that the three Solar Saturn 10 compressors (units 1, 2 and 3) are not used by APA.

1.2 Surrounding Land Uses and Sensitive Receivers

The current zoning map of the area surrounding the Wollert Compressor Station is shown in Figure 1-1 overleaf; and the land uses for the area to the east of the facility are shown in Figure 1-2 overleaf. The land uses surrounding the site are primarily Type 1 (noise sensitive), as scheduled in SEPP-N1[1]. There is a brickworks 2km to the south-east of the facility and a quarry 3km to the north-east of the facility. These facilities do not operate during night time.

[1] Designation of Types of Zones and Reservations in the Metropolitan Region Planning Schemes for the Purposes of State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1

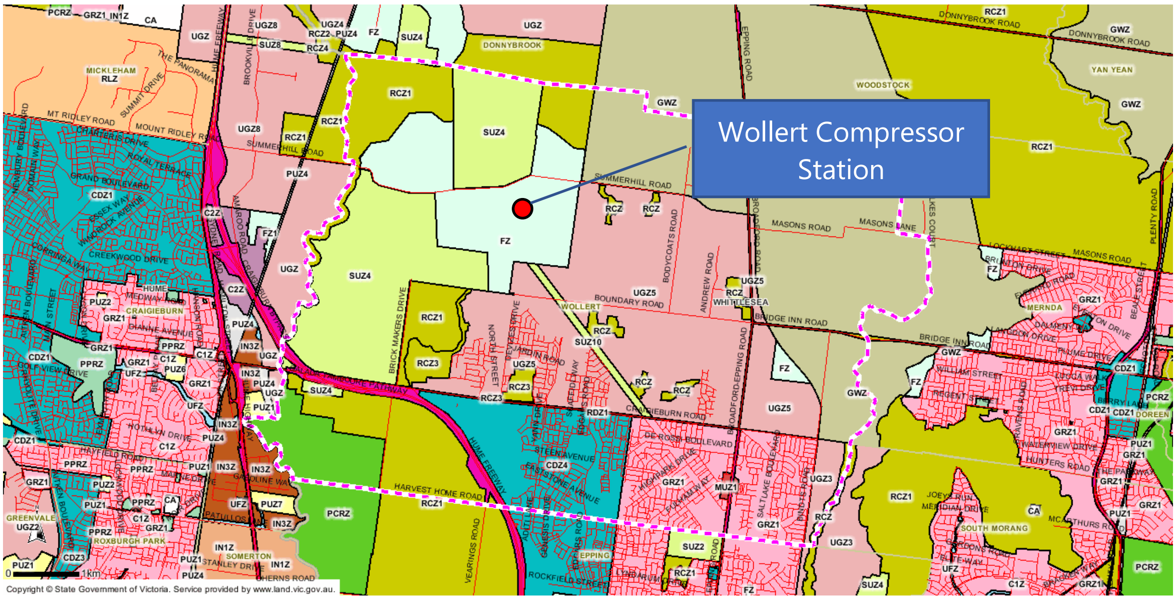

Figure 1-1: Current zoning of surrounding land[2]

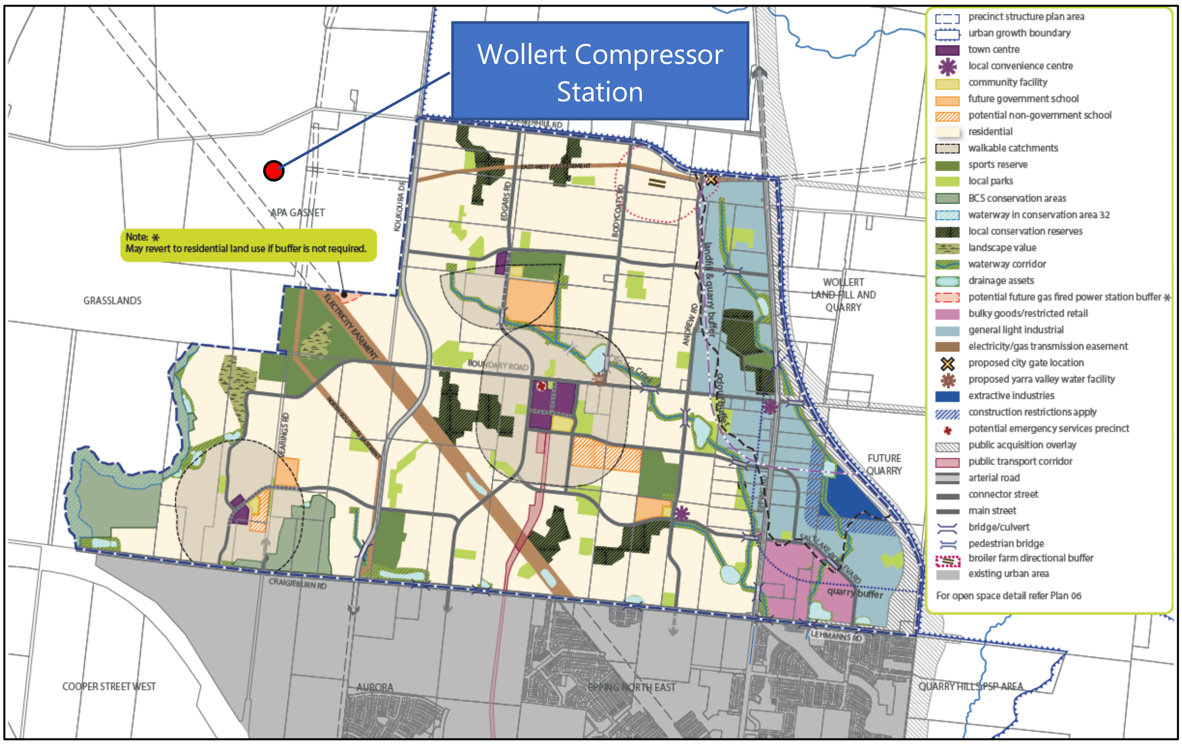

Figure 1-2: Uses of surrounding land in Whittlesea planning scheme[3]

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[2] "Planning Maps Online – Wollert, City of Whittlesea Council", Department of Planning & Community Development, Victoria, available at: http://services.land.vic.gov.au/maps/pmo.jsp , accessed 24 March 2019.

[3] "Wollert Precinct Structure Plan – April 2015", Metropolitan Planning Authority and City of Whittlesea Council.

There are around 30 noise sensitive receivers close to the compressor station (refer Figure 1-3 below).

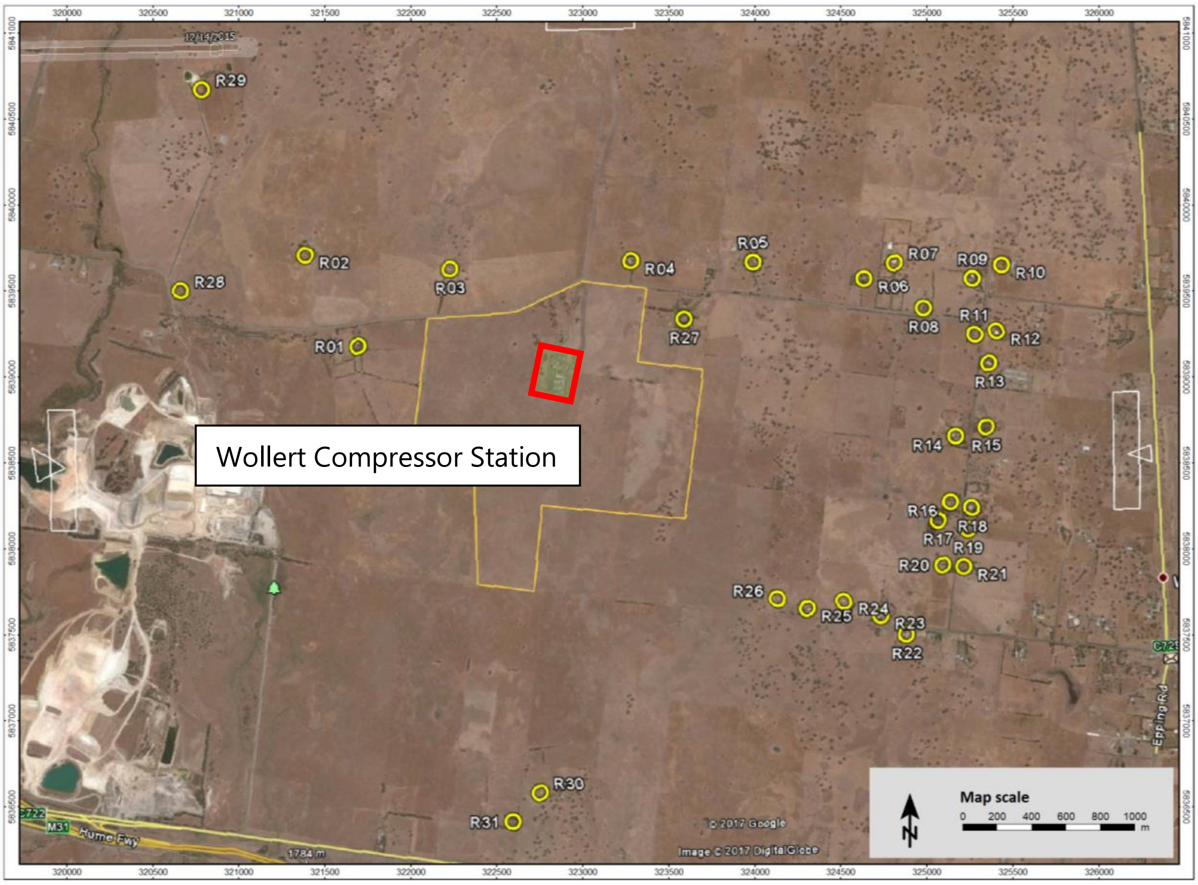


Figure 1-3: Receiver locations

2 NOISE MODELLING

2.1 Modelling Standard

A noise model of the Wollert Compressor Station was built using SoundPlan version 7.4 noise modelling software. SoundPlan calculates predicted sound pressure levels at nominated receiver locations or produces noise contours over a designed area of interest around noise sources. SoundPlan can be used to model different sources of environmental noise such as industrial noise, road traffic and rail noise and aircraft noise.

SoundPlan provides a range of published noise propagation prediction algorithms that can be selected by the user. The CONCAWE[4] algorithm, which is accepted by EPA Victoria, was selected for this study.

The inputs to the CONCAWE algorithm are noise source sound power data, locations and heights of barriers and screens, ground topographical and absorption type data, meteorological conditions and receiver locations.

2.2 Model Inputs

The noise model inputs are summarized in Table 2-1 below. The Terrain, Ground Absorption and Meteorological inputs are explained in the text below the table.

Table 2-1: Summary of noise model inputs

Input	Neutral Conditions	Adverse Conditions
Terrain	Ground elevation data (topography) at 1m intervals supplied by APA Group.	
Ground Absorption Factor	1.0 – Farmland Outside Compressor Station	
Wind Speed (m/s)	0	3.1
Wind Direction	-	Northerly
Pascal-Gifford stability class (Atmospheric Stability)	D	D
Sound Power Levels	Shown in Appendix B	

[4] 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.

Terrain and Ground Properties

Ground elevation data (topography) at 1m intervals, was supplied by APA Group.

The acoustic properties of the ground surface influence noise propagation. The CONCAWE algorithm allows for 'hard' or 'soft' ground only, and if the noise propagation occurs over both hard and soft ground, only soft ground is used. Therefore, a ground absorption factor of 1 has been used because the land surrounding the Wollert Compressor Station is predominantly soil with grass cover. The relatively high openness and porosity of this ground type results in efficient sound absorption

Meteorological conditions

Atmospheric conditions are important factors in noise modelling because temperature and wind shear profiles in the atmosphere can influence the propagation of noise from source to receiver, resulting in deviations in modelled noise level of up to 6dB.

The CONCAWE model defines six meteorological categories (1 to 6). Categories 1 to 3 result in a reduction of received noise, category 4 results in no change and categories 5 and 6 increase received noise. Categories 5 and 6 are defined by the following conditions:

- Category 5: v >3 m/s and A or B; v = 0.5 to 3 m/s and C, D or E; v = -3 m/s to 0.5 m/s and F or G;
- Category 6: v >3 m/s and C, D or E; v = 0.5 to 3 m/s and F or G.

Where v is the averaged wind velocity blowing source to receiver and A to G are Pascal-Gifford stability classes.

The noise guidance published by EPA Victoria does not specify the meteorological conditions to be used for noise modelling. However, SEPP-N1 specifies that noise due to sites where the propagation of noise is affected by atmospheric conditions should be measured on three separate occasions over 30 days (i.e. on 10% of the days in the period) and the average of the measurements be used to assess compliance[5]. This approach implies that conditions occurring much less than 10% of the time can be considered insignificant.

The frequency of noise enhancing conditions at the site has been assessed[6], based on 18 years of data from the BOM weather station at Melbourne airport. The assessment indicates that:

- Calm conditions are rare and averaged wind speed typically exceeds 3m/s.

[5] SEPP-N1 Schedule A, Part A2, Clause 6

[6] Worley Parsons '401010-01412 – AA-REP-0001 Noise Impact Study - 2017 365 Summerhill Rd, Wollert VIC 3750' November 2017

- The prevailing conditions during winter night time, when maximum facility operation is most likely to occur and when noise limits are most stringent, are winds exceeding 3m/s in a northerly direction (53% of the time) and Pascal-Gifford stability class D or E (85% of the time). This results in the category 6 meteorological condition for receivers North of the facility.

- Other noise enhancing conditions occur for much less than 10% of the time over any 30-day period. While F or G stability class conditions occur for around 10% of the night time, this is usually in combination with wind speed exceeding 3m/s, resulting in category 4 or falling outside the CONCAWE meteorological categories. As a result, no other noise enhancing conditions occur frequently enough to justify assessment under SEPP-N1.

Thus, the following 'neutral' (non-enhancing) and 'adverse' (enhancing) meteorological conditions were assumed:

- Neutral Condition (Category 4): Model forced to compute nil enhancement by setting meteorological conditions to Category 4.

- Adverse Condition (Category 6): Pasqual Stability Class D, 3.1m/s northerly wind.

Equipment Sound Power Levels

The sound power levels of equipment operating at the Wollert Compressor Station were measured on the 2nd of April 2019 with compressor 4 operating in recycle mode, which is representative of maximum operating conditions. Further measurements were taken on 29th of April 2020 while Compressors 4 & 5 were run under maximum operating conditions.. The sound power levels are presented in APPENDIX B.

Sound power levels were determined in accordance with AS 1217.7-1985 Acoustics – Determination of Sound Power Levels of Noise Sources, Part 7 – Survey Method. The sound power levels for the proposed equipment were assumed to be the same as the levels measured for similar existing equipment.

Sound intensity measurements were utilized for situations where multiple noise sources contributed to the noise level at the measurement location. Sound intensity measurement is a technique that uses a device with two opposed microphones to isolate the acoustic energy emanating from a specific point or area.

2.3 Model Validation

Noise levels generated by the compressor station were measured on two occasions (2nd April 2019 and 29th April 2020 to 5th May 2020) for the purpose of validating the noise model.

Noise measurements were undertaken on 2nd April 2019, during which time compressor unit 4 was operating in recycle mode. This involves recycling the gas within the compressor station to allow the compressor to operate under conditions representative of maximum operation. Model validation measurements were conducted at locations Env#1 to Env#3, to the south west, south and east of the facility. Validations measurements to the north of the facility were unable to be taken due to the prevailing northerly wind and noise from the city gates (located at the northern end of the facility).

An unattended noise logger was installed at an on-site location between 28th April 2020 to May 5th 2020 to capture noise emissions from the compressor station over a period of a week.

On April 29th 2020, APA liaised with AEMO to operate the current compressors (4 & 5) at maximum run speed and flow rate for a period of 2 hours. The purpose of these measurements was to determine if these operating conditions produced higher noise emissions than running the compressor in recycle mode only. Analysis of the measurement results from both site trips showed no significant changes in noise emissions from the station, therefore measurements from both occasions were used in the noise model.

The meteorological conditions, compressor station operating conditions, measurement locations and measured and predicted noise levels are presented in Table 2-2 below. The measurement locations are also shown in Figure 2-1 below.

The variation between the predicted and observed (measured) values at the off-site locations (#1 to #3) was within -1.6 to +1.3 dB. The model over-predicted noise levels at the on-site location (#4) by up to 5.6 dB, most likely due to the shielding effect of elevated piping located between the measurement location and after coolers.

Table 2-2: Comparison of predicted and observed noise levels

Time and Date	Weather Conditions	Operating Condition	Measurement Location	Noise Level, dB		
				Predicted	Observed	Variance
1200 to 1330 2/4/2019	Calm with intermittent wind gusts. neutral conditions assumed in model.	Unit 4 Centaur running in recycle; and 1 x City Gate value open. Refer Figure 2.2	ENV1 Easting; 322835.20 Northing; 5838354.53	37.5	39.1	-1.6
			ENV2 Easting; 322407.45 Northing; 5838432.64	35.6	34.3	1.3
			ENV3 Easting; 323266.48 Northing; 5838819.77	42.1	43.5	-1.4
29/4/2020	N, 3m/s	Units 4 & 5 running. Refer Figure 2.3	ENV4 Easting; 322906.33 Northing; 5838938.93	70.5	65.3	+5.2
28th April 2020 to 5th May 2020	W, 2m/s Average weather during operating conditions	Unit 5 running. Refer Figure 2.4		63.0	57.4	+5.6

Figure 2-1: Validation Measurement Locations

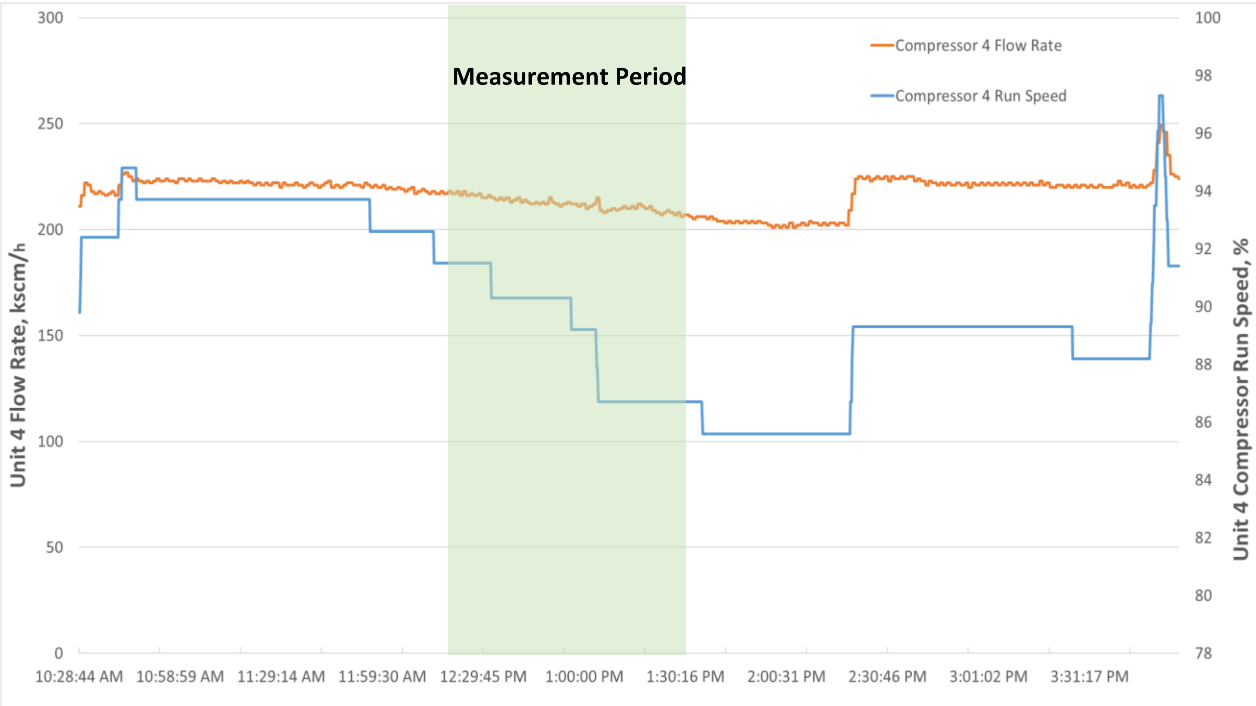


Figure 2-2: Wollert Compressor 4 Run Data (2nd April 2019)

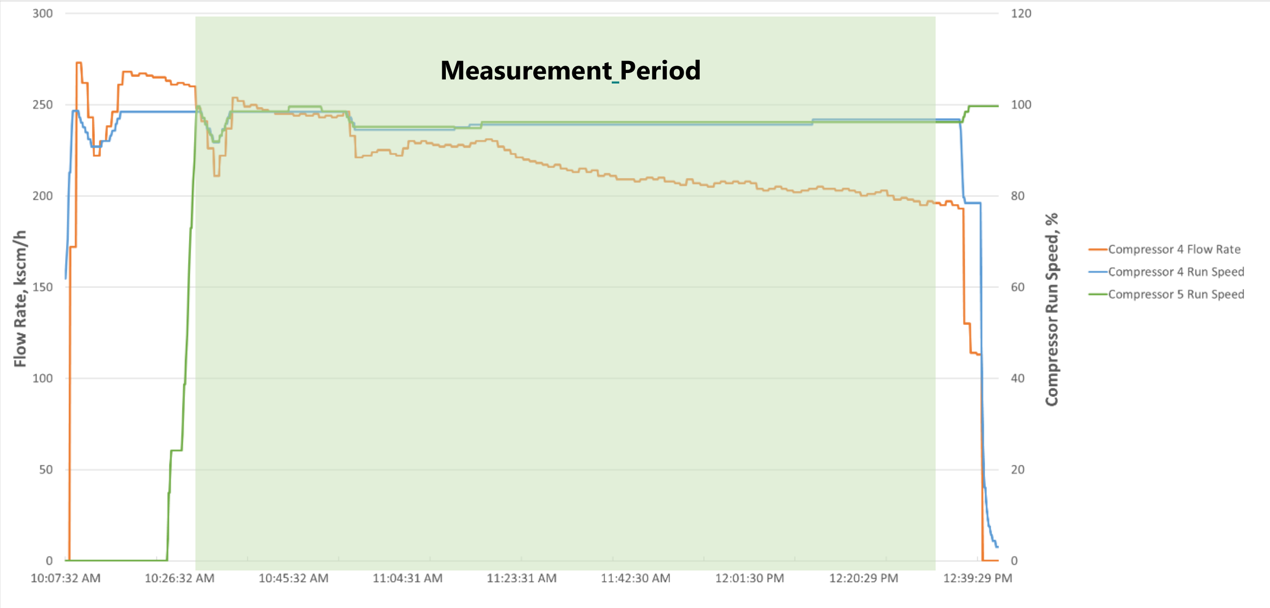


Figure 2-3: Wollert Compressors 4 & 5 Run Data (29th April 2020)

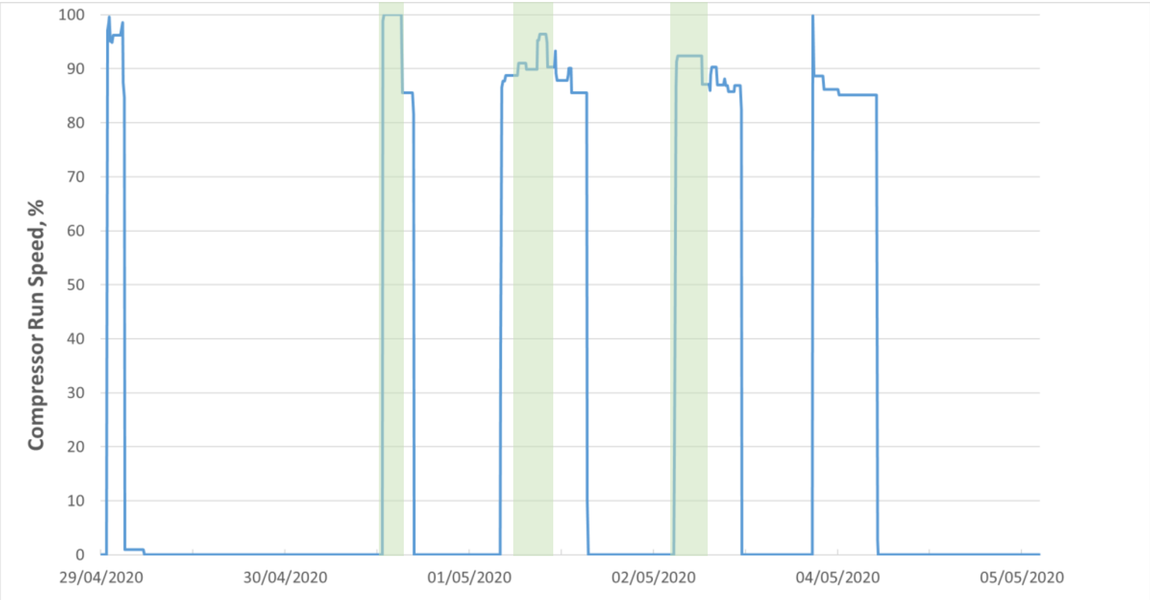


Figure 2-4 Wollert Compressor 5 Run Speed (28th April; 2020 to 5th May 2020) – Validation measurement periods shown by green shading

The noise levels generated by the facility at the validation locations were determined using the 90th percentile (L_{A90}) noise level. The L_{A90} level should exclude the influence of variable extraneous noise present in the measurement (e.g. bird vocalizations, other fauna, wind gusts) while retaining the contribution of the steady noise that would be generated by the Wollert Compressor Station. It is anticipated that given no extraneous noise sources, the LAeq and L_{A90} generated by the compressor station would be almost equal because the source is steady over time.

Attended monitoring measurements were undertaken at off-site locations, representative of noise sensitive receptors, on 29th April 2020 while APA operated compressors 4 & 5 at maximum expected run speed and flow rate. Dominant sources during these measurements included extraneous wind noise, train noise and noise from the quarry located to the north of Wollert Compressor Station. Therefore, the measured levels could not be used as background noise levels for the purpose of determining SEPP-N1 noise limits.

Figure 2-5 Attended Monitoring and Noise Sensitive Receptor Locations

Table 2-3 Operator Observations during Attended Monitoring

Receiver	Measurement Position	Operator Observations
R04	AM#1	Measurement dominated by wind noise. Extraneous noise audible from industrial area and trainline located North of measurement location. In periods of lower wind (approx. 2 m/s), noise levels were approximately 38 - 40 dBA. Occasional noise from planes overhead.
R27	AM#2.2	Trees and wind noise dominant. Noise from train line and industrial activities North of measurement location also audible. In periods of lower wind (approx. 2 m/s), noise levels were approximately 40 - 42 dBA. Occasional noise from planes overhead.
R01	AM#4	Compressor station out of line-of-site from measurement location due to crest. Only compressor stacks visible. Wind/rain noise dominant. Extraneous noise from power lines nearby with low frequency fluttering as well as some high frequency buzz

The sound measurement equipment was compliant with IEC 61672, and was field calibrated before and after use with no significant drift identified.

3 NOISE CRITERIA

3.1 State Environmental Planning Policy N1

Noise emissions from commercial, industrial or trade noise sources within the Melbourne Metropolitan region are regulated under State Environmental Planning Policy N1 (SEPP-N1). SEPP-N1 specifies noise level limits at noise sensitive land uses near the activity, within a defined region that encircles the Melbourne metropolitan area. The Wollert Compressor Station falls within the SEPP-N1 area, as shown in Figure 3-1 below.

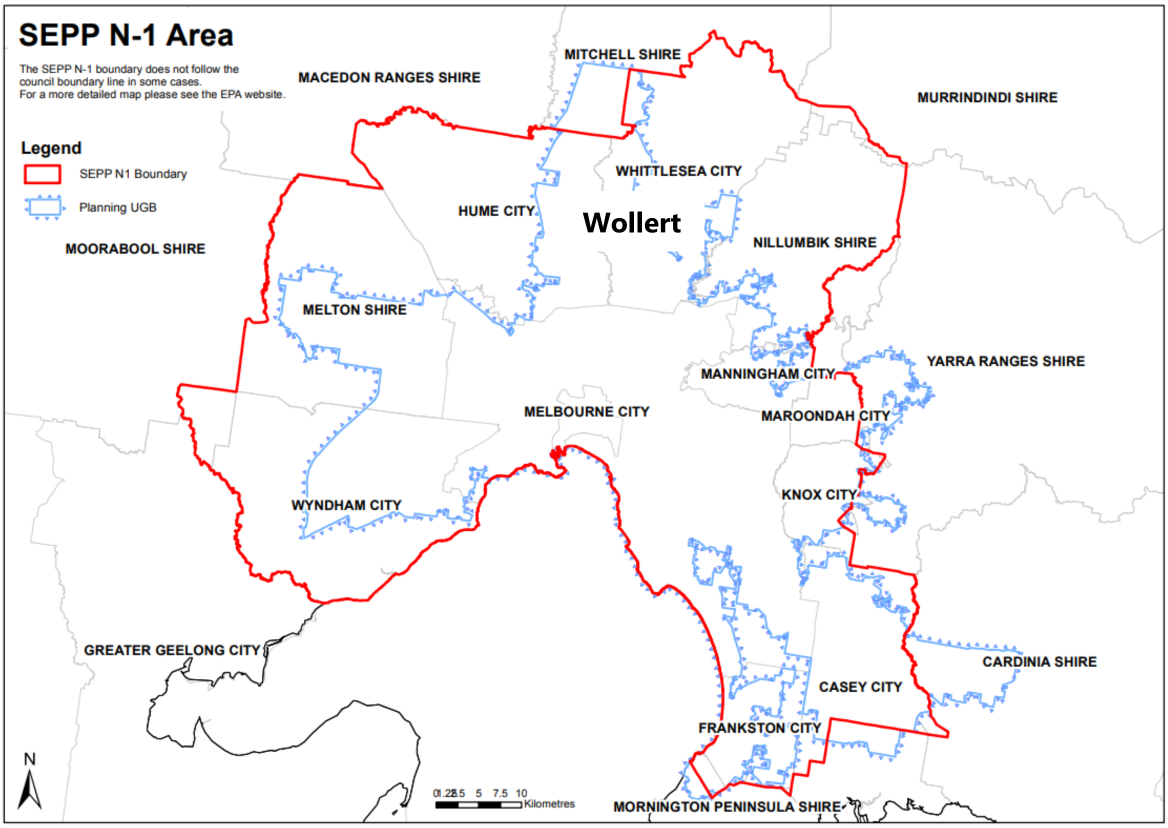


Figure 3-1: Location of Wollert within the SEPP N-1 boundary

The noise limits set by SEPP-N1 are influenced by the zoning of land uses surrounding a noise-sensitive receiver and the existing background noise level. Different limits apply for the day (0700 and 1800 hours), evening (1800 and 2200) and night (2200 to 0700) periods. The noise limit is adjusted (reduced) where non-project industrial noise sources also contribute to industrial noise at a receiver.

The noise limits can be no less than the following values:

- Day Period: 45dB(A)
- Evening Period: 40dB(A)
- Night Period: 35dB(A)

3.2 Noise Limits

The noise limits that apply to the Wollert Compressor Station have been established[7] and these limits were adopted for the study reported here. The night-time noise limits, which are the most stringent, range from 39 dB(A) to 56 dB(A) (refer Table 3-1 below).

Table 3-1: Receiver noise limits

Receiver	Zoning	Influencing Factor	Background Noise Level	Night time zoning Level	Night time noise limit (dB(A))
R01	FZ	0.125	36	41	41
R04, R27	FZ	0	36	39	39
R02	IN2Z	1	36	56	49
R03	SUZ4	1	36	56	49
R05, R06, R07, R08, R09, R10	GWZ	0	36	39	39
R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26	R1Z	0	36	39	39
R28	IN2Z	1	36	56	49
R31	R1Z	0	36	39	39
R29, R30	RCZ	0	36	39	39

Although not the primary aim of the unattended logger stationed at the on-site measurement location (#4), a background night-time noise level was calculated during periods when the compressor station was not operating. The background noise level was estimated using the L_{A90}, which was 40.7 dBA. The compressor station operated most nights during the unattended monitoring period, resulting in minimal periods without operations noise. Therefore, this value is used to confirm the previously calculated background noise levels, and by extension the night-time noise limits. It has not been used to determine a representative background noise level for the receivers.

An intent of SEPP-N1 is to limit the total industrial noise level at a sensitive receiver. Thus, the SEPP-N1 noise limit is adjusted (reduced) where non-project industrial noise sources also contribute to industrial noise at a receiver. However, the Wollert Compressor Station is the only

[7] Worley Parsons '401010-01412 – AA-REP-0001 Noise Impact Study - 2017 365 Summerhill Rd, Wollert VIC 3750' November 2017

existing industrial noise source that could contribute to noise levels at the noise sensitive receivers during night time hours, when the most stringent noise limits are applicable. As a result, this adjustment was not applied.

4 RESULTS FOR MAXIMUM OPERATING SCENARIO

4.1 Maximum Operating Scenario

Noise levels were modelled for the maximum operating scenarios for the current and expanded facility. APA have advised that the maximum operating scenario involves operation of the following equipment:

Current Facility

Rotating Equipment

- Compressor units 4 and 5
- Gas engine generator
- Instrument air compressor
- Unit 4 & 5 Gas Cooler fans (2 fans per cooler) – unit 4 Gas cooler fans may have faulty bearings and fan belts that result in elevated noise levels.
- Unit 4 & 5 Oil Cooler fan (1 fan per cooler)

Valves & Piping

- 4x City gate valves and associated piping, water bath preheater
- T74 PRS (Pressure Reduction Station)
- T119 PRS

Expanded Facility

Rotating Equipment

- Compressor unit 6
- All rotating equipment sources in the 'current facility' scenario – With the exception of unit 4 gas cooler fans which have been replaced with the lower sound power level used for the other gas cooler fans. This simulates the noise generated by unit 4 gas cooler fan bearing and belts when operating as intended.

Valves & Piping

- WORM PRS
- WORM flow control valves

- New T119 Flow control valves
- All valves and piping in the 'current facility' scenario

4.2 Modelled Noise Levels

The noise levels predicted at noise sensitive receivers due to operation of the current and expanded facility under maximum operating conditions, for the worst case (maximum) predicted level for either neutral or adverse weather conditions, are presented in Table 4-1 below. Noise level contours for the current and expanded facility maximum operating scenarios under neutral and adverse conditions are presented in APPENDIX A.

Table 4-1: Maximum predicted noise levels for the maximum operating scenario with neutral or adverse metrological conditions

Receiver	Night Time Limit, dBA	Predicted Noise Level, dBA		Variance
		Current Facility	Expanded Facility	
R01	41	29.6	28.3	-1.3
R02	49	24.9	23.2	-1.7
R03	49	33.4	32.8	-0.6
R04	39	34.3	33.9	-0.4
R05	39	27.9	26.0	-1.9
R06	39	23.3	21.8	-1.5
R07	39	21.8	20.2	-1.6
R08	39	21.0	19.5	-1.5
R09	39	18.9	17.3	-1.6
R10	39	17.7	16.1	-1.6
R11	39	19.0	17.4	-1.6
R12	39	18.2	16.5	-1.7
R13	39	18.3	16.6	-1.7
R14	39	21.2	19.3	-1.9
R15	39	19.7	17.9	-1.8
R16	39	23.2	21.2	-2.0
R17	39	24.2	22.2	-2.0
R18	39	22.4	20.4	-2.0
R19	39	22.9	20.8	-2.1
R20	39	23.8	22.2	-1.6
R21	39	23.2	21.3	-1.9
R22	39	24.0	22.3	-1.7
R23	39	25.2	23.5	-1.7

Receiver	Night Time Limit, dBA	Predicted Noise Level, dBA		Variance
		Current Facility	Expanded Facility	
R24	39	26.7	25.0	-1.7
R25	39	27.8	26.1	-1.7
R26	39	29.2	27.6	-1.6
R27	39	35.5	34.3	-1.2
R28	49	19.7	17.2	-2.5
R29	39	17.2	15.2	-2.0
R30	39	25.1	23.0	-2.1
R31	39	24.0	21.9	-2.1

5 DISCUSSION

The noise levels at nearby noise sensitive receivers due to operation of the current and expanded Wollert Compressor Station at the maximum operating conditions have been modelled.

The modelling and analysis undertaken shows that for the expanded facility operating at the maximum operational scenario and under the most adverse meteorological conditions:

- Noise levels would decrease by -0.4 to -2.5 dB at the existing receivers if the higher noise level generated by the unit 4 gas cooler fans was addressed through maintenance of the fan bearings and belts; and
- Modelled noise levels fall below the SEPP-N1 limits at all receivers.

The highest predicted noise level is 4.7 dB below the SEPP-N1 noise limit. The model was validated against noise levels measured at three locations outside the site boundary and the difference between predicted and observed noise levels ranged from -1.6 to +1.3 dB. Therefore, actual noise levels generated by the expanded compressor station should fall below the SEPP-N1 noise limits by around 4.5 to 5 dB at existing receivers.

Based on observations during validation measurements it is not expected that noise emissions from the compressor station will exhibit tonality or other noise characteristics that may evoke adjustments under the policy, therefore no adjustments have been made to the predicted levels.

There are multiple industrial activities that may contribute to measured noise level at some receivers, to the West and North of the facility, during daytime and evening hours. However, as predicted noise levels from the facility are significantly below the noise limits for daytime and evening operations, an assessment of cumulative noise is not required under SEPP-N1.

6 CONCLUSIONS

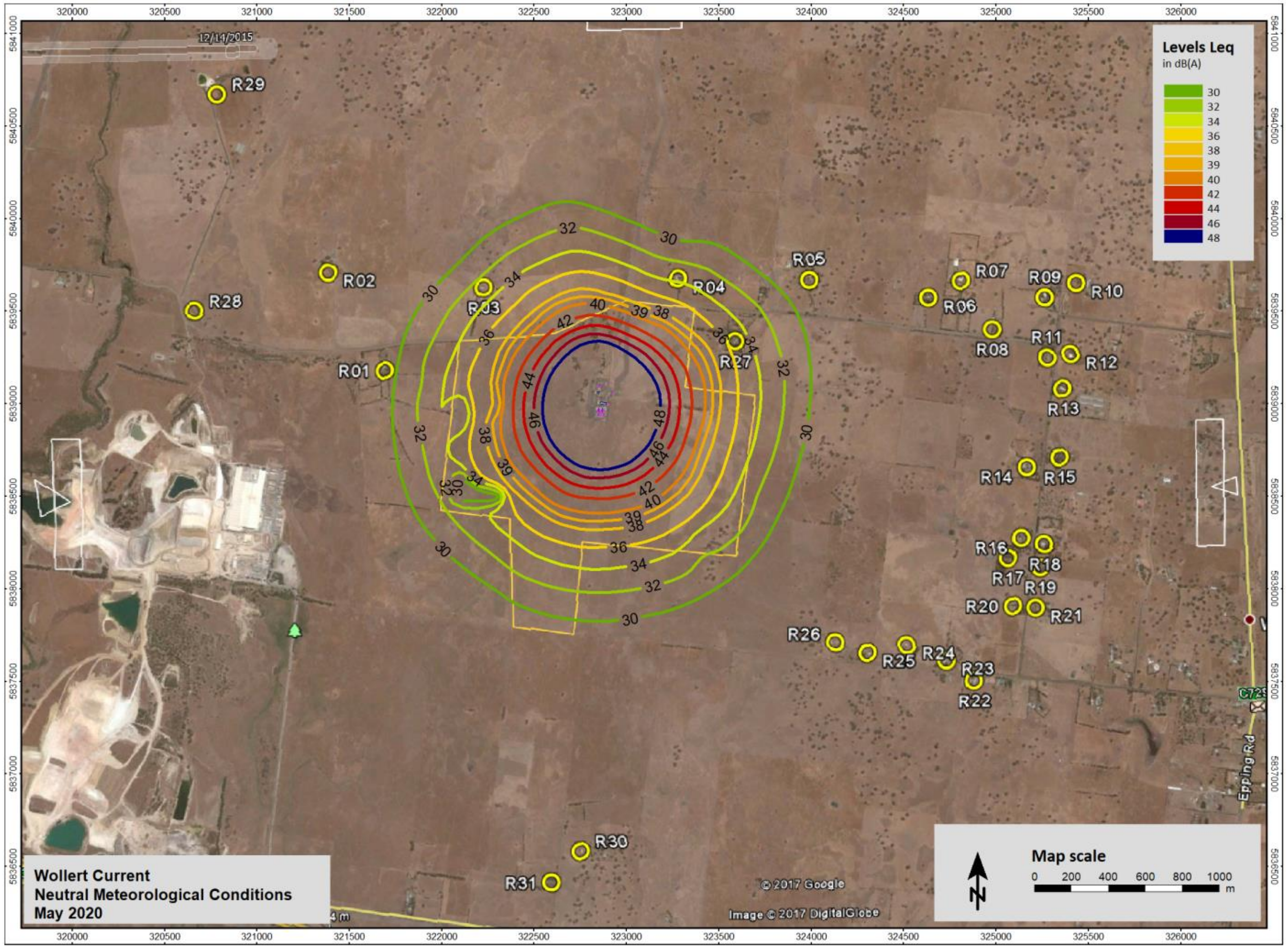
The noise levels generated at nearby noise sensitive receivers due to the maximum operating conditions for the current and expanded Wollert Compressor Station have been modelled. The model was validated against noise levels measured at four locations near the site.

The modelling and analysis undertaken shows that for the expanded facility operating at the maximum operational scenario and under the most frequent adverse meteorological conditions:

- There would be a marginal decrease in noise levels at all existing receivers if APA undertake maintenance to address potential faulty fan belts and bearings on unit 4 gas cooler; and
- Noise levels due to operation of the compressor station are predicted to fall below the SEPP-N1 limits at all existing receivers by a margin of around 5 dB.

Thus, there are no issues that would prevent the expanded facility from meeting the SEPP-N1 noise limits.

APPENDIX A NOISE CONTOURS


Levels Leq
in dB(A)
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32
34
36
38
39
40
42
44
46
48
Wollert Current
Neutral Meteorological Conditions
May 2020
Map scale
0 200 400 600 800 1000
m
R01
R02
R03
R04
R05
R06
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Epping Rd
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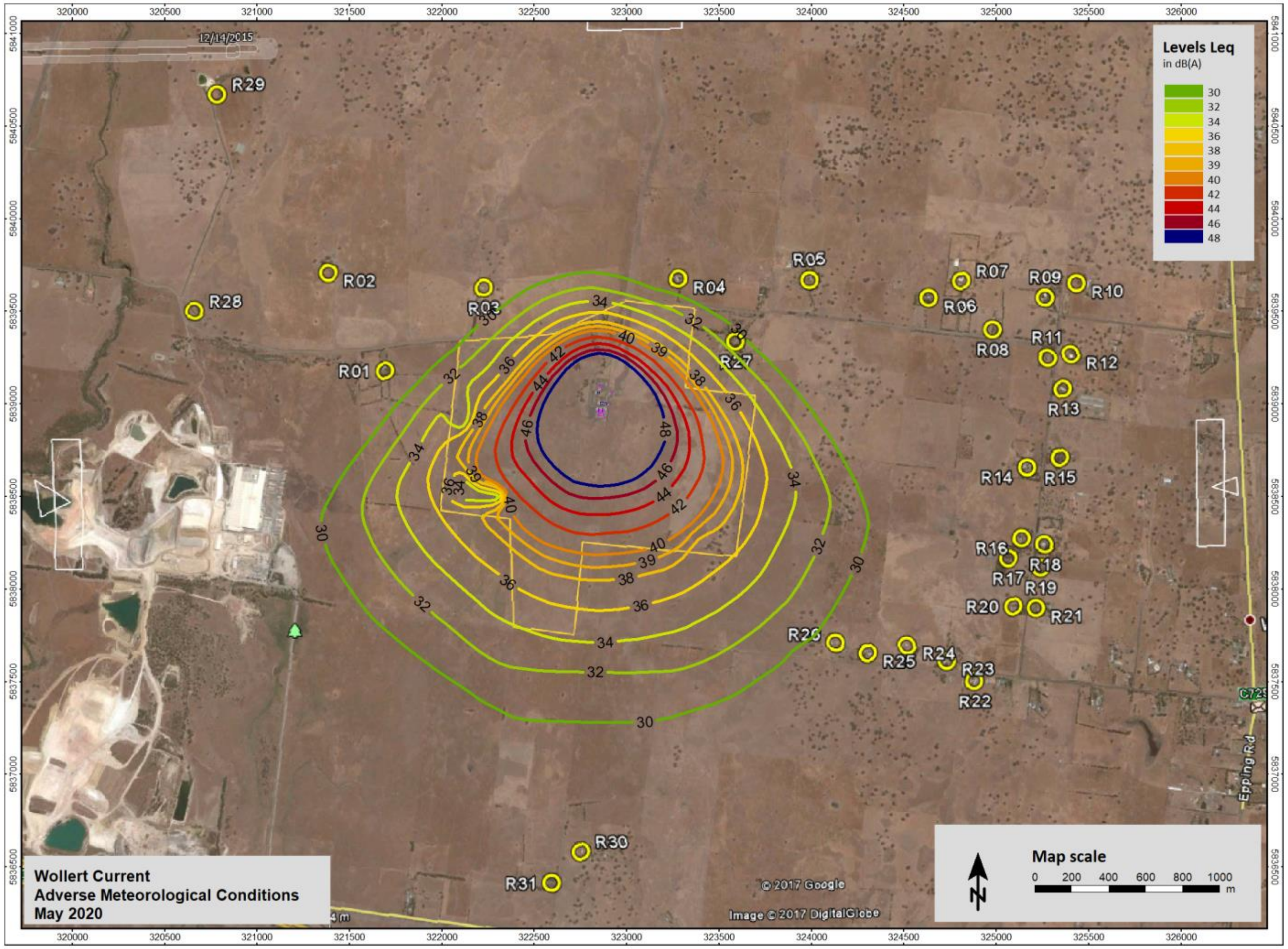
Levels Leq
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Adverse Meteorological Conditions
May 2020
Map scale
0 200 400 600 800 1000
m
R01
R02
R03
R04
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R06
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Epping Rd
© 2017 Google
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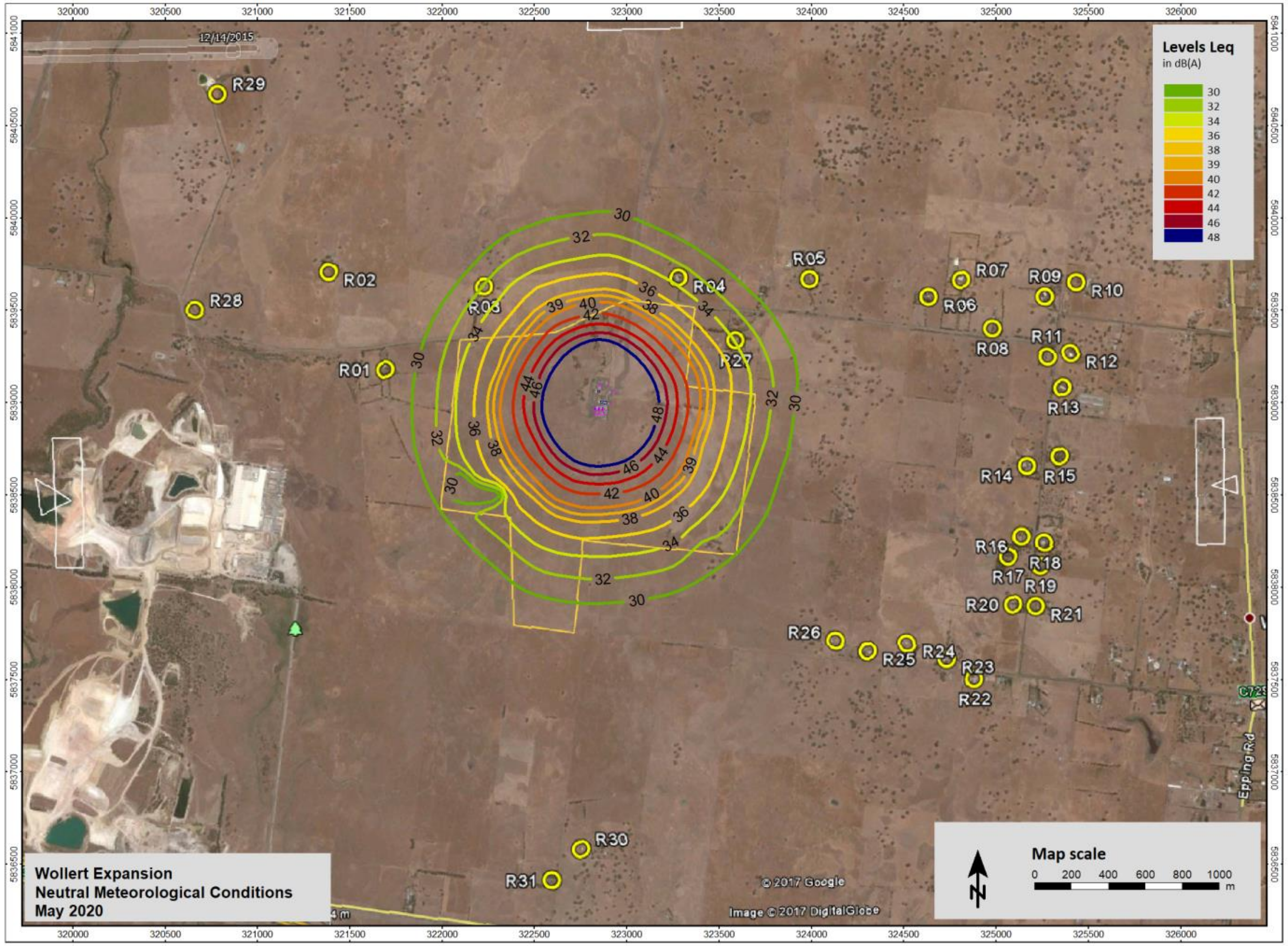
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R25
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R27
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R31
Map scale
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m
Wollert Expansion
Neutral Meteorological Conditions
May 2020
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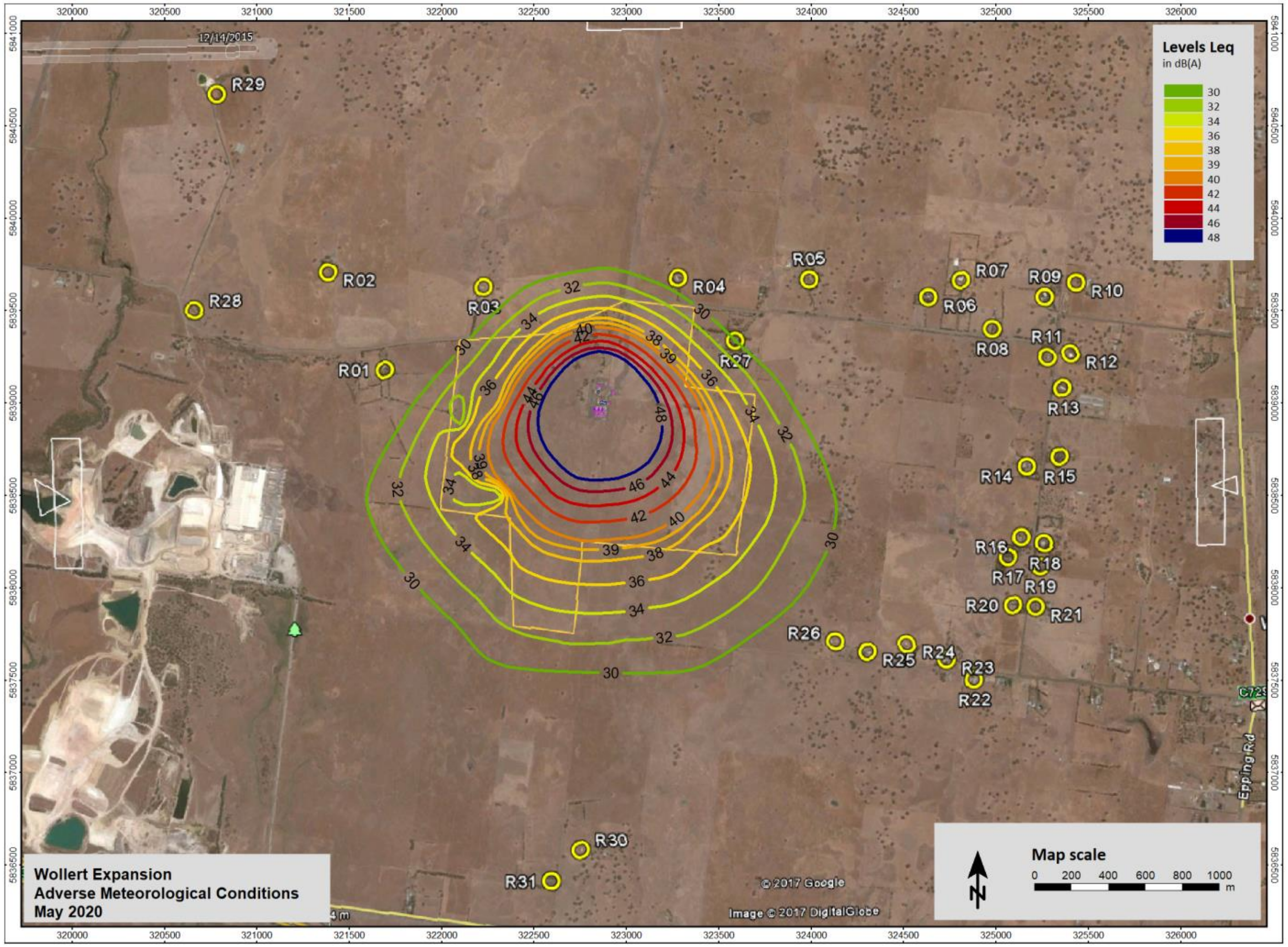
Levels Leq
in dB(A)
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Wollert Expansion
Adverse Meteorological Conditions
May 2020
Map scale
0 200 400 600 800 1000
m
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Epping Rd

APPENDIX B SOUND POWER LEVELS

Source	**Sound Power Level in 1/3 Octave Band, dB**																					**Overall dB(A)**
	50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**	**250 Hz**	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**	**1 kHz**	**1.25 kHz**	**1.6 kHz**	**2 kHz**	**2.5 kHz**	**3.15 kHz**	**4 kHz**	**5 kHz**	
Compressor Enclosure Total																						**102**
Compressor Enclosure West Façade	-	85	-	-	79	76	88	93	71	-	77	78	83	82	84	86	88	83	81	87	89	**97**
Compressor Enclosure East Façade	-	-	-	-	-	75	84	88	71	82	84	78	82	81	83	86	86	81	76	82	90	**96**
Compressor Enclosure North Façade	-	-	-	-	-	81	85	86	77	78	77	73	75	73	72	74	72	69	73	74	91	**93**
Compressor Enclosure South Façade	-	-	80	-	-	57	73	85	-	-	-	-	73	71	80	82	82	77	74	80	76	**90**
Compressor Enclosure Roof	-	96	94	93	84	85	86	86	83	78	84	84	88	84	83	83	81	80	86	86	-	**98**
Compressor 4 Aftercooler Total																						**110**

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Compressor 4 Aftercooler West Façade	91	89	90	89	85	89	93	90	104	104	100	94	93	93	91	89	87	84	84	84	84	**105**
Compressor 4 Aftercooler East Façade	92	90	92	90	87	92	96	92	104	105	104	96	94	95	93	89	88	86	85	85	84	**106**
Compressor 4 Aftercooler North Façade	88	86	88	87	83	89	92	88	98	95	99	90	90	90	88	86	85	83	83	84	84	**101**
Compressor 4 Aftercooler South Façade	88	86	85	86	82	87	89	88	99	98	95	89	90	90	89	86	84	81	80	81	79	**100**
Compressor 4 Aftercooler Top Façade	94	91	95	92	89	94	95	90	96	97	100	92	89	91	90	88	89	84	86	88	86	**102**
Compressor 5 & 6 Aftercooler Total																						**104**
Compressor 5 & 6 Aftercooler West Façade	91	89	88	88	84	86	86	82	84	86	86	80	80	85	79	80	78	79	79	84	80	**93**

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Compressor 5 & 6 Aftercooler East Façade	92	89	89	89	85	86	87	85	90	88	91	82	82	88	82	82	81	80	80	86	82	**96**
Compressor 5 & 6 Aftercooler North Façade	88	84	84	85	80	83	82	78	81	83	83	78	79	81	78	79	78	77	78	87	81	**92**
Compressor 5 & 6 Aftercooler South Façade	87	84	84	87	81	83	82	78	84	83	82	77	77	80	77	77	77	76	76	81	76	**90**
Compressor 5 & 6 Aftercooler Top Façade	94	91	95	92	89	94	95	90	96	97	100	92	89	91	90	88	89	84	86	88	86	**102**
Enclosure ventilation exhaust outlet	96	92	87	78	74	-	-	-	-	-	-	-	-	-	-	63	64	63	58	-	-	**74**
Enclosure ventilation exhaust ducting	-	-	93	-	-	-	82	78	11	76	78	-	-	-	-	-	-	-	-	-	74	**80**
Lube Oil Cooler	103	102	105	105	101	96	95	94	95	92	92	89	89	88	87	87	86	84	84	85	92	**100**
Enclosure Air inlet	-	-	-	-	85	87	91	84	77	74	70	67	69	67	67	66	63	61	60	59	57	**83**

Source	Sound Power Level in 1/3 Octave Band, dB																				Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
Enclosure air inlet ducting	-	-	-	-	-	87	90	81	76	73	65	67	68	67	67	66	63	61	-	58	-	**82**
Air inlet ducting	-	87	94	92	87	90	93	89	85	81	76	80	88	82	77	75	73	70	72	80	83	**94**
Compressor Discharge Piping	-	-	-	-	-	-	-	-	-	-	-	-	70	73	75	79	79	76	78	87	86	**92**
Discharge Piping - Aftercooler Nozzle 2	-	-	-	-	-	-	-	-	-	-	-	-	62	65	67	71	71	68	70	79	78	**84**
Discharge Piping - Aftercooler Nozzle 3	-	-	-	-	-	-	-	-	-	-	-	-	63	66	68	72	71	69	71	79	78	**85**
Compressor Suction Piping	-	-	-	-	-	-	-	-	88	91	82	81	84	83	83	83	86	80	82	88	80	**96**
Suction Header Total																						**97**
Suction Header Piping unit 4	-	-	-	-	-	-	-	64	78	78	80	79	80	88	83	79	80	77	78	79	76	**92**
Suction Header Piping unit 5	-	-	-	-	-	-	-	64	78	77	79	79	79	88	83	79	80	76	77	79	75	**92**
Suction Header Piping unit 6	-	-	-	-	-	-	-	66	79	79	81	80	81	89	84	80	81	78	79	80	77	**93**

Source	**Sound Power Level in 1/3 Octave Band, dB**																					**Overall dB(A)**
	50 Hz	**63 Hz**	**80 Hz**	**100 Hz**	**125 Hz**	**160 Hz**	**200 Hz**	**250 Hz**	**315 Hz**	**400 Hz**	**500 Hz**	**630 Hz**	**800 Hz**	**1 kHz**	**1.25 kHz**	**1.6 kHz**	**2 kHz**	**2.5 kHz**	**3.15 kHz**	**4 kHz**	**5 kHz**	
Discharge Header Total																						**95**
Discharge Header Piping unit 4	66	-	-	-	-	-	-	63	73	77	76	78	78	85	82	78	79	77	78	80	76	**91**
Discharge Header Piping unit 5	66	-	-	-	-	-	-	63	73	77	76	78	78	85	82	78	79	77	78	80	76	**91**
Discharge Header Piping unit 6	66	-	-	-	-	-	-	62	73	76	75	78	77	84	82	78	79	76	77	79	75	**90**
Stack	-	-	-	-	-	102	106	96	92	89	81	83	84	83	83	82	79	76	-	73	-	**98**
Stack Outlet	-	-	-	-	-	102	105	96	91	88	80	82	83	82	82	81	78	76	-	73	-	**97**
City Gate - Run 4 Total																						**108**
City Gate - Run 4 Upstream	80	76	74	86	75	72	70	70	69	66	72	73	69	79	76	85	83	82	85	88	91	**98**
City Gate - Run 4 Downstream	77	73	71	83	73	69	69	67	68	72	71	73	72	81	84	92	89	90	92	95	95	**104**
City Gate - Run 4 Valve	77	73	70	82	71	68	67	69	68	68	73	71	69	80	79	90	90	88	92	95	97	**105**
City Gate - Run 1,2,3 Total																						**106**
City Gate - Run 1,2,3 Upstream	76	75	73	84	72	67	69	68	66	69	74	66	70	73	76	83	84	87	88	90	92	**99**

Source	Sound Power Level in 1/3 Octave Band, dB																					Overall dB(A)
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	
City Gate - Run 1,2,3 Downstream	74	73	71	83	72	68	67	68	67	72	71	66	71	75	78	86	85	88	90	95	94	**101**
City Gate - Run 1,2,3 Valve	73	73	70	82	70	66	64	66	65	69	71	64	69	75	77	86	87	89	91	96	97	**103**
Generator Building	94	92	93	101	101	92	94	95	91	89	88	90	90	89	87	86	86	87	83	81	80	**99**
Regulator Valve (T74)	78	75	73	71	67	65	63	63	60	59	60	58	58	63	61	62	61	63	61	63	63	**73**
Regulator Valve (T119-PRD)	79	78	79	76	71	69	69	64	67	68	70	69	71	72	70	70	70	70	70	70	69	**82**
Compressor 4 Recycle Valve	87	86	89	88	83	84	88	82	83	88	89	83	81	80	80	80	80	77	77	77	75	**92**
Air Compressor Shed	81	80	81	83	82	80	81	77	72	76	73	72	72	74	69	71	70	71	71	68	67	**83**

Appendix B – Construction noise assessment-receptors and evening and night noise limits

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C001	298436	5822840	2	40	50	35	35
C002	298335	5822387	1	35	45	30	30
C003	297765	5822905	2	40	50	35	35
C004	297610	5822949	2	40	50	35	35
C005	297433	5823098	2	40	50	35	35
C006	299135	5822879	2	40	50	35	35
C007	299142	5822945	2	40	50	35	35
C008	299146	5822985	2	40	50	35	35
C009	299154	5823051	2	40	50	35	35
C010	299162	5823117	2	40	50	35	35
C011	299169	5823172	2	40	50	35	35
C012	299172	5823216	2	40	50	35	35
C013	299190	5823364	2	40	50	35	35
C014	299203	5823459	2	40	50	35	35
C015	298585	5823550	2	40	50	35	35
C016	298822	5823570	2	40	50	35	35
C017	299211	5823528	2	40	50	35	35
C018	299216	5823574	2	40	50	35	35
C019	299227	5823655	2	40	50	35	35
C020	299236	5823730	2	40	50	35	35
C021	299247	5823835	2	40	50	35	35
C022	299253	5823887	2	40	50	35	35
C023	299258	5823927	2	40	50	35	35
C024	299264	5824010	2	40	50	35	35
C025	299289	5824036	2	40	50	35	35
C026	299315	5824065	2	40	50	35	35
C027	299336	5824106	2	40	50	35	35
C028	299336	5824120	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C029	299284	5824147	2	40	50	35	35
C030	299311	5824175	2	40	50	35	35
C031	299288	5824217	2	40	50	35	35
C032	299345	5824227	2	40	50	35	35
C033	299407	5824238	2	40	50	35	35
C034	299428	5824258	2	40	50	35	35
C035	299424	5824300	2	40	50	35	35
C036	298650	5824440	1	35	45	30	30
C037	299417	5824328	2	40	50	35	35
C038	297746	5824612	1	35	45	30	30
C039	299413	5824361	2	40	50	35	35
C040	299407	5824390	2	40	50	35	35
C041	299398	5824432	2	40	50	35	35
C042	299390	5824492	2	40	50	35	35
C043	299388	5824512	2	40	50	35	35
C044	299383	5824567	2	40	50	35	35
C045	299372	5824609	2	40	50	35	35
C046	298109	5824849	1	35	45	30	30
C047	299382	5824647	2	40	50	35	35
C048	299370	5824692	2	40	50	35	35
C049	299365	5824722	2	40	50	35	35
C050	299364	5824762	2	40	50	35	35
C051	299368	5824789	2	40	50	35	35
C052	299370	5824814	2	40	50	35	35
C053	299369	5824857	2	40	50	35	35
C054	299376	5824886	2	40	50	35	35
C055	299381	5824945	2	40	50	35	35
C056	299397	5824995	2	40	50	35	35
C057	299400	5825026	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C058	299405	5825057	2	40	50	35	35
C059	299411	5825094	2	40	50	35	35
C060	298678	5825267	2	40	50	35	35
C061	298927	5825227	1	35	45	30	30
C062	299416	5825149	2	40	50	35	35
C063	299424	5825189	2	40	50	35	35
C064	299426	5825219	2	40	50	35	35
C065	299434	5825267	2	40	50	35	35
C066	299430	5825302	2	40	50	35	35
C067	299439	5825342	2	40	50	35	35
C068	299441	5825376	2	40	50	35	35
C069	299447	5825427	2	40	50	35	35
C070	299461	5825468	2	40	50	35	35
C071	299468	5825522	2	40	50	35	35
C072	299474	5825567	2	40	50	35	35
C073	299480	5825616	2	40	50	35	35
C074	299486	5825659	2	40	50	35	35
C075	299484	5825694	2	40	50	35	35
C076	299569	5825693	2	40	50	35	35
C077	299502	5825712	2	40	50	35	35
C078	299569	5825743	2	40	50	35	35
C079	299602	5825749	2	40	50	35	35
C080	299642	5825776	2	40	50	35	35
C081	299613	5825829	2	40	50	35	35
C082	299592	5825856	2	40	50	35	35
C083	299573	5825877	2	40	50	35	35
C084	299551	5825908	2	40	50	35	35
C085	299605	5825912	2	40	50	35	35
C086	299597	5825923	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C087	299527	5825937	2	40	50	35	35
C088	299575	5825955	2	40	50	35	35
C089	299524	5825964	2	40	50	35	35
C090	299538	5826001	2	40	50	35	35
C091	298253	5826143	2	40	50	35	35
C092	299150	5826075	2	40	50	35	35
C093	299536	5826041	2	40	50	35	35
C094	298585	5826141	2	40	50	35	35
C095	299211	5826101	2	40	50	35	35
C096	299544	5826086	2	40	50	35	35
C097	299573	5826087	2	40	50	35	35
C098	299614	5826084	2	40	50	35	35
C099	299654	5826082	2	40	50	35	35
C100	298433	5826308	2	40	50	35	35
C101	299571	5826173	2	40	50	35	35
C102	299287	5826217	2	40	50	35	35
C103	299559	5826185	2	40	50	35	35
C104	299548	5826218	2	40	50	35	35
C105	299518	5826250	2	40	50	35	35
C106	299557	5826255	2	40	50	35	35
C107	299575	5826263	2	40	50	35	35
C108	299596	5826271	2	40	50	35	35
C109	299559	5826295	2	40	50	35	35
C110	299562	5826320	2	40	50	35	35
C111	299565	5826342	2	40	50	35	35
C112	299565	5826360	2	40	50	35	35
C113	299570	5826383	2	40	50	35	35
C114	299572	5826411	2	40	50	35	35
C115	299585	5826433	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C116	299580	5826453	2	40	50	35	35
C117	299586	5826472	2	40	50	35	35
C118	299593	5826490	2	40	50	35	35
C119	299598	5826517	2	40	50	35	35
C120	299594	5826539	2	40	50	35	35
C121	299600	5826566	2	40	50	35	35
C122	299603	5826579	2	40	50	35	35
C123	299606	5826604	2	40	50	35	35
C124	299609	5826620	2	40	50	35	35
C125	299612	5826650	2	40	50	35	35
C126	299617	5826670	2	40	50	35	35
C127	299616	5826687	2	40	50	35	35
C128	299625	5826711	2	40	50	35	35
C129	299611	5826744	2	40	50	35	35
C130	299628	5826771	2	40	50	35	35
C131	299628	5826788	2	40	50	35	35
C132	299631	5826809	2	40	50	35	35
C133	299631	5826832	2	40	50	35	35
C134	299637	5826857	2	40	50	35	35
C135	299646	5826878	2	40	50	35	35
C136	299643	5826895	2	40	50	35	35
C137	299651	5826913	2	40	50	35	35
C138	299650	5826934	2	40	50	35	35
C139	299629	5826956	2	40	50	35	35
C140	299658	5826962	2	40	50	35	35
C141	299664	5826982	2	40	50	35	35
C142	299659	5827002	2	40	50	35	35
C143	299665	5827024	2	40	50	35	35
C144	299672	5827047	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C145	299666	5827067	2	40	50	35	35
C146	299670	5827088	2	40	50	35	35
C147	299668	5827111	2	40	50	35	35
C148	299674	5827134	2	40	50	35	35
C149	299679	5827156	2	40	50	35	35
C150	299683	5827171	2	40	50	35	35
C151	299689	5827215	2	40	50	35	35
C152	299701	5827313	2	40	50	35	35
C153	299726	5827313	2	40	50	35	35
C154	299710	5827356	2	40	50	35	35
C155	299734	5827346	2	40	50	35	35
C156	299713	5827395	2	40	50	35	35
C157	299712	5827423	2	40	50	35	35
C158	299717	5827439	2	40	50	35	35
C159	299720	5827459	2	40	50	35	35
C160	299726	5827480	2	40	50	35	35
C161	299721	5827508	2	40	50	35	35
C162	299729	5827522	2	40	50	35	35
C163	299741	5827563	2	40	50	35	35
C164	299766	5827591	2	40	50	35	35
C165	299794	5827604	2	40	50	35	35
C166	299802	5827621	2	40	50	35	35
C167	299828	5827641	2	40	50	35	35
C168	299857	5827662	2	40	50	35	35
C169	299872	5827676	2	40	50	35	35
C170	299897	5827684	2	40	50	35	35
C171	299905	5827696	2	40	50	35	35
C172	299921	5827709	2	40	50	35	35
C173	300375	5829634	1	35	45	30	30

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C174	298453	5830238	1	35	45	30	30
C175	300536	5830675	3	45	55	40	40
C176	300631	5830699	3	45	55	40	40
C177	300345	5831186	3	45	55	40	40
C178	300512	5830957	3	45	55	40	40
C179	300156	5831664	3	45	55	40	40
C180	300711	5830922	2	40	50	35	35
C181	300117	5832090	3	45	55	40	40
C182	299997	5832464	2	40	50	35	35
C183	300166	5832326	2	40	50	35	35
C184	300407	5832161	2	40	50	35	35
C185	300737	5831177	2	40	50	35	35
C186	300830	5830809	2	40	50	35	35
C187	300692	5831748	2	40	50	35	35
C188	300750	5831615	2	40	50	35	35
C189	300889	5831178	2	40	50	35	35
C190	300946	5831360	2	40	50	35	35
C191	300973	5831508	2	40	50	35	35
C192	301142	5831098	2	40	50	35	35
C193	300988	5831707	2	40	50	35	35
C194	300827	5831940	2	40	50	35	35
C195	300498	5832324	2	40	50	35	35
C196	300785	5832241	2	40	50	35	35
C197	300826	5832106	2	40	50	35	35
C198	300521	5832589	2	40	50	35	35
C199	300685	5832600	2	40	50	35	35
C200	300792	5832406	2	40	50	35	35
C201	301044	5832031	2	40	50	35	35
C202	301325	5831120	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C203	301110	5831893	2	40	50	35	35
C204	301466	5831443	1	35	45	30	30
C205	301570	5831284	1	35	45	30	30
C206	301055	5832351	2	40	50	35	35
C207	301096	5832280	2	40	50	35	35
C208	300933	5832718	2	40	50	35	35
C209	301217	5832341	2	40	50	35	35
C210	301579	5831711	2	40	50	35	35
C211	301490	5831917	1	35	45	30	30
C212	301625	5831854	2	40	50	35	35
C213	301874	5831361	1	35	45	30	30
C214	301791	5831603	1	35	45	30	30
C215	301620	5831990	1	35	45	30	30
C216	301313	5832550	2	40	50	35	35
C217	301404	5832333	2	40	50	35	35
C218	301454	5832563	2	40	50	35	35
C219	301570	5832323	2	40	50	35	35
C220	301154	5832806	2	40	50	35	35
C221	301187	5832939	2	40	50	35	35
C222	301877	5831881	1	35	45	30	30
C223	301746	5832292	2	40	50	35	35
C224	301881	5832014	1	35	45	30	30
C225	302137	5832287	2	40	50	35	35
C226	301929	5832339	2	40	50	35	35
C227	301821	5832548	2	40	50	35	35
C228	301938	5832517	2	40	50	35	35
C229	301472	5833085	2	40	50	35	35
C230	301648	5833051	2	40	50	35	35
C231	301851	5833022	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C232	301976	5833058	2	40	50	35	35
C233	301836	5833279	2	40	50	35	35
C234	302117	5832535	2	40	50	35	35
C235	302132	5832604	2	40	50	35	35
C236	302222	5832280	2	40	50	35	35
C237	302334	5832608	2	40	50	35	35
C238	302414	5832289	2	40	50	35	35
C239	302604	5832114	2	40	50	35	35
C240	302568	5832231	2	40	50	35	35
C241	303320	5832496	2	40	50	35	35
C242	303603	5832281	1	35	45	30	30
C243	302406	5832976	1	35	45	30	30
C244	302994	5832955	2	40	50	35	35
C245	302343	5833200	1	35	45	30	30
C246	302270	5833582	1	35	45	30	30
C247	302086	5833625	1	35	45	30	30
C248	303146	5832952	2	40	50	35	35
C249	303194	5833003	2	40	50	35	35
C250	303280	5832766	2	40	50	35	35
C251	303371	5833319	2	40	50	35	35
C252	303681	5833223	2	40	50	35	35
C253	304193	5834339	2	40	50	35	35
C254	303459	5834969	2	40	50	35	35
C255	303524	5834905	2	40	50	35	35
C256	304328	5834551	2	40	50	35	35
C257	304831	5834331	2	40	50	35	35
C258	305080	5834342	2	40	50	35	35
C259	305271	5834853	1	35	45	30	30
C260	305260	5834343	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C261	305560	5834797	1	35	45	30	30
C262	305937	5835114	1	35	45	30	30
C263	306060	5835100	1	35	45	30	30
C264	305866	5835863	1	35	45	30	30
C265	306139	5835447	1	35	45	30	30
C266	306091	5835706	1	35	45	30	30
C267	306321	5835743	1	35	45	30	30
C268	306388	5835426	1	35	45	30	30
C269	306538	5834053	1	35	45	30	30
C270	306953	5834424	1	35	45	30	30
C271	307409	5834555	1	35	45	30	30
C272	306734	5836144	1	35	45	30	30
C273	307359	5835327	1	35	45	30	30
C274	307462	5834856	2	40	50	35	35
C275	307511	5834976	2	40	50	35	35
C276	307705	5835078	2	40	50	35	35
C277	307756	5835357	2	40	50	35	35
C278	307748	5834769	2	40	50	35	35
C279	307624	5836065	2	40	50	35	35
C280	307735	5836249	2	40	50	35	35
C281	307826	5835784	2	40	50	35	35
C282	307869	5835895	2	40	50	35	35
C283	307955	5835485	2	40	50	35	35
C284	307990	5835606	2	40	50	35	35
C285	308038	5835619	2	40	50	35	35
C286	307870	5836055	2	40	50	35	35
C287	307977	5836304	2	40	50	35	35
C288	308828	5837066	1	35	45	30	30
C289	308891	5837014	1	35	45	30	30

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C290	309060	5836979	1	35	45	30	30
C291	309182	5836080	2	40	50	35	35
C292	309246	5836643	1	35	45	30	30
C293	309980	5836584	1	35	45	30	30
C294	310123	5837951	2	40	50	35	35
C295	308989	5838211	2	40	50	35	35
C296	309320	5838676	1	35	45	30	30
C297	309662	5839072	2	40	50	35	35
C298	309567	5839203	2	40	50	35	35
C299	309577	5839653	2	40	50	35	35
C300	311855	5839535	1	35	45	30	30
C301	311765	5840127	1	35	45	30	30
C302	310802	5840780	2	40	50	35	35
C303	310962	5840717	2	40	50	35	35
C304	310783	5841052	2	40	50	35	35
C305	310680	5841123	2	40	50	35	35
C306	311244	5840867	2	40	50	35	35
C307	311393	5841057	2	40	50	35	35
C308	310791	5841363	2	40	50	35	35
C309	311185	5841163	2	40	50	35	35
C310	311615	5840859	2	40	50	35	35
C311	312020	5840559	2	40	50	35	35
C312	312190	5840104	2	40	50	35	35
C313	312382	5840572	2	40	50	35	35
C314	312489	5840510	2	40	50	35	35
C315	312590	5840288	2	40	50	35	35
C316	312590	5840580	2	40	50	35	35
C317	312053	5840792	2	40	50	35	35
C318	312416	5840759	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C319	311796	5840937	2	40	50	35	35
C320	311905	5840927	2	40	50	35	35
C321	312518	5840883	2	40	50	35	35
C322	312010	5841069	2	40	50	35	35
C323	311808	5841106	2	40	50	35	35
C324	311843	5841208	2	40	50	35	35
C325	311449	5841289	2	40	50	35	35
C326	311777	5841350	2	40	50	35	35
C327	311582	5841533	2	40	50	35	35
C328	311004	5841532	2	40	50	35	35
C329	311333	5841436	2	40	50	35	35
C330	311170	5841621	2	40	50	35	35
C331	311375	5841608	2	40	50	35	35
C332	311246	5841893	2	40	50	35	35
C333	311528	5841690	2	40	50	35	35
C334	311977	5841341	2	40	50	35	35
C335	311566	5841906	2	40	50	35	35
C336	311738	5841891	2	40	50	35	35
C337	312019	5841564	2	40	50	35	35
C338	311962	5841722	2	40	50	35	35
C339	312398	5841312	2	40	50	35	35
C340	311610	5842176	2	40	50	35	35
C341	311581	5842367	2	40	50	35	35
C342	311751	5842298	2	40	50	35	35
C343	311893	5842198	2	40	50	35	35
C344	312039	5842209	2	40	50	35	35
C345	312654	5841497	2	40	50	35	35
C346	312334	5842034	2	40	50	35	35
C347	311929	5842549	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C348	312524	5842147	2	40	50	35	35
C349	312712	5842038	2	40	50	35	35
C350	312441	5842385	2	40	50	35	35
C351	312675	5842457	2	40	50	35	35
C352	312539	5842853	2	40	50	35	35
C353	312862	5842716	2	40	50	35	35
C354	312560	5842972	2	40	50	35	35
C355	313230	5842602	2	40	50	35	35
C356	313262	5842614	2	40	50	35	35
C357	313278	5842611	2	40	50	35	35
C358	313305	5842607	2	40	50	35	35
C359	313323	5842604	2	40	50	35	35
C360	312692	5843149	2	40	50	35	35
C361	312709	5843252	2	40	50	35	35
C362	312718	5843297	2	40	50	35	35
C363	312639	5843529	2	40	50	35	35
C364	312800	5843523	2	40	50	35	35
C365	314073	5843504	2	40	50	35	35
C366	314073	5843521	2	40	50	35	35
C367	313970	5843559	2	40	50	35	35
C368	312680	5844124	2	40	50	35	35
C369	314085	5843663	2	40	50	35	35
C370	314084	5843642	2	40	50	35	35
C371	314088	5843602	2	40	50	35	35
C372	314079	5843586	2	40	50	35	35
C373	314075	5843570	2	40	50	35	35
C374	314075	5843558	2	40	50	35	35
C375	314049	5843722	2	40	50	35	35
C376	313868	5843801	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C377	313915	5843802	2	40	50	35	35
C378	313869	5843816	2	40	50	35	35
C379	313917	5843815	2	40	50	35	35
C380	313917	5843829	2	40	50	35	35
C381	313871	5843844	2	40	50	35	35
C382	313874	5843860	2	40	50	35	35
C383	313920	5843844	2	40	50	35	35
C384	313919	5843856	2	40	50	35	35
C385	313875	5843876	2	40	50	35	35
C386	313922	5843870	2	40	50	35	35
C387	313876	5843904	2	40	50	35	35
C388	313878	5843919	2	40	50	35	35
C389	313880	5843940	2	40	50	35	35
C390	313928	5843926	2	40	50	35	35
C391	313887	5843964	2	40	50	35	35
C392	313930	5843944	2	40	50	35	35
C393	313892	5843978	2	40	50	35	35
C394	313936	5843959	2	40	50	35	35
C395	313944	5843980	2	40	50	35	35
C396	313934	5844047	2	40	50	35	35
C397	313983	5844023	2	40	50	35	35
C398	313942	5844070	2	40	50	35	35
C399	313999	5844046	2	40	50	35	35
C400	313964	5844077	2	40	50	35	35
C401	313977	5844073	2	40	50	35	35
C402	313988	5844068	2	40	50	35	35
C403	313969	5844091	2	40	50	35	35
C404	313980	5844086	2	40	50	35	35
C405	313992	5844080	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C406	313954	5844112	2	40	50	35	35
C407	313968	5844138	2	40	50	35	35
C408	314029	5844125	2	40	50	35	35
C409	314004	5844137	2	40	50	35	35
C410	314043	5844120	2	40	50	35	35
C411	314037	5844135	2	40	50	35	35
C412	314053	5844130	2	40	50	35	35
C413	314016	5844152	2	40	50	35	35
C414	313967	5844186	2	40	50	35	35
C415	314024	5844196	2	40	50	35	35
C416	313986	5844227	2	40	50	35	35
C417	314030	5844209	2	40	50	35	35
C418	313990	5844238	2	40	50	35	35
C419	314035	5844223	2	40	50	35	35
C420	313996	5844252	2	40	50	35	35
C421	314042	5844235	2	40	50	35	35
C422	314004	5844273	2	40	50	35	35
C423	314048	5844257	2	40	50	35	35
C424	314009	5844286	2	40	50	35	35
C425	314057	5844272	2	40	50	35	35
C426	314063	5844284	2	40	50	35	35
C427	314023	5844315	2	40	50	35	35
C428	314068	5844295	2	40	50	35	35
C429	314043	5844336	2	40	50	35	35
C430	314122	5844314	2	40	50	35	35
C431	314099	5844325	2	40	50	35	35
C432	314083	5844332	2	40	50	35	35
C433	314061	5844364	2	40	50	35	35
C434	314065	5844381	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C435	314087	5844380	2	40	50	35	35
C436	314116	5844367	2	40	50	35	35
C437	314072	5844397	2	40	50	35	35
C438	314077	5844411	2	40	50	35	35
C439	314116	5844401	2	40	50	35	35
C440	314081	5844421	2	40	50	35	35
C441	314138	5844403	2	40	50	35	35
C442	314117	5844431	2	40	50	35	35
C443	314088	5844451	2	40	50	35	35
C444	314131	5844453	2	40	50	35	35
C445	314089	5844479	2	40	50	35	35
C446	314093	5844491	2	40	50	35	35
C447	314167	5844464	2	40	50	35	35
C448	314098	5844503	2	40	50	35	35
C449	314138	5844483	2	40	50	35	35
C450	314103	5844514	2	40	50	35	35
C451	314157	5844492	2	40	50	35	35
C452	314111	5844523	2	40	50	35	35
C453	314152	5844514	2	40	50	35	35
C454	314112	5844536	2	40	50	35	35
C455	313700	5844771	2	40	50	35	35
C456	314114	5844546	2	40	50	35	35
C457	314195	5844507	2	40	50	35	35
C458	314162	5844535	2	40	50	35	35
C459	314123	5844559	2	40	50	35	35
C460	314184	5844543	2	40	50	35	35
C461	314212	5844529	2	40	50	35	35
C462	314224	5844530	2	40	50	35	35
C463	314215	5844550	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C464	314205	5844567	2	40	50	35	35
C465	314213	5844587	2	40	50	35	35
C466	314243	5844647	2	40	50	35	35
C467	314253	5844673	2	40	50	35	35
C468	314243	5844719	2	40	50	35	35
C469	313750	5844954	2	40	50	35	35
C470	314254	5844745	2	40	50	35	35
C471	314283	5844743	2	40	50	35	35
C472	314299	5844769	2	40	50	35	35
C473	314318	5844778	2	40	50	35	35
C474	314288	5844797	2	40	50	35	35
C475	314260	5844828	2	40	50	35	35
C476	314289	5844824	2	40	50	35	35
C477	314321	5844830	2	40	50	35	35
C478	314300	5844851	2	40	50	35	35
C479	314273	5844893	2	40	50	35	35
C480	314332	5844862	2	40	50	35	35
C481	314313	5844877	2	40	50	35	35
C482	314343	5844891	2	40	50	35	35
C483	313931	5845096	2	40	50	35	35
C484	314327	5844917	2	40	50	35	35
C485	314356	5844924	2	40	50	35	35
C486	314340	5844937	2	40	50	35	35
C487	314303	5844961	2	40	50	35	35
C488	314346	5844948	2	40	50	35	35
C489	314362	5844985	2	40	50	35	35
C490	314138	5845253	2	40	50	35	35
C491	314015	5845574	2	40	50	35	35
C492	314027	5845749	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C493	313860	5845723	2	40	50	35	35
C494	314058	5845923	2	40	50	35	35
C495	313858	5846028	2	40	50	35	35
C496	314247	5846461	2	40	50	35	35
C497	314401	5846603	2	40	50	35	35
C498	315857	5847229	1	35	45	30	30
C499	316312	5846870	2	40	50	35	35
C500	317240	5846948	2	40	50	35	35
C501	317273	5846472	2	40	50	35	35
C502	318009	5846308	2	40	50	35	35
C503	318196	5846547	2	40	50	35	35
C504	318181	5846400	2	40	50	35	35
C505	318329	5846627	2	40	50	35	35
C506	318306	5846348	2	40	50	35	35
C507	318542	5846136	2	40	50	35	35
C508	318689	5846323	3	45	55	40	40
C509	318941	5846004	3	45	55	40	40
C510	319312	5847368	3	45	55	40	40
C511	319066	5847762	3	45	55	40	40
C512	320072	5848066	2	40	50	35	35
C513	320946	5847649	2	40	50	35	35
C514	321788	5847407	2	40	50	35	35
C515	324036	5843350	1	35	45	30	30
C516	323676	5843012	1	35	45	30	30
C517	322621	5843047	2	40	50	35	35
C518	322650	5842676	2	40	50	35	35
C519	323365	5842860	2	40	50	35	35
C520	323380	5842655	2	40	50	35	35
C521	323746	5842612	2	40	50	35	35

Receptor, ID	Coordinates, GDA94 55H		Land category	Evening background noise, dB(A)	Evening noise criterion – background + 10, dB(A)	Night background noise, dB(A)	Night noise criterion – background + 0, dB(A)
	X,m	Y,m					
C522	323898	5842590	2	40	50	35	35
C523	324304	5842404	2	40	50	35	35
C524	323267	5839673	2	40	50	35	35
C525	323589	5839351	2	40	50	35	35

Appendix C – Construction- crossings information

No.*	Location description	Approx. Start KP	Approx. End KP	Construction method assessed at Crossing
1	Beatty's Road (Melton City Council)	2.299	2.37	Bored
2	Holden Road	6.405	6.425	Bored
3	Unknown Creek	8.406	8.411	Open trench
4	Dillon Ct Road (Hume City Council)	8.802	8.945	Open trench
8	Duncans Lane Road (Hume City Council)	9.723	9.744	Open trench
9	Unknown Creek	10.668	10.68	Open trench
10	Morefield Ct (Hume City Council)	10.901	10.924	Bored
11	Bulla-Diggers Rest Road (Hume City Council)	11.267	11.292	Bored
15	Unknown Creek	13.986	14.14	Open trench
18	Wildwood Rd (Hume City Council)	17.085	17.106	Bored
20	Unnamed Road (Hume City Council)	18.414	18.44	Open trench
21	St Johns Rd (Hume City Council)	19.099	19.119	Bored
23	Oaklands Rd (Hume City Council)	21.665	21.705	Bored
24	Craigieburn Rd (Hume City Council)	22.737	22.758	Bored
25	Mt Ridley Rd (Hume City Council)	26.433	26.456	Bored
26	Parkland Cr (Hume City Council)	26.456	27.073	Bored+
28	Mickleham Rd (Hume City Council)	28.063	28.123	Bored
33	Donnybrook Rd (Hume City Council)	30.277	30.308	Bored
37	Unnamed Rd (Hume City Council)	33.802	33.825	Open trench
40	Gunns Gully Rd (Hume City Council - VicRoads)	36.891	36.938	Bored
42	VNIE Crossing	41.959	41.976	Open trench
44	Donnybrook Rd (Whittlesea City Council - VicRoads)	46.864	46.884	Bored
45	Summerhill Rd (Whittlesea City Council - VicRoads)	50.071	50.091	Open trench
46	VNIE Crossing	50.476	50.494	Open trench

No.*	Location description	Approx. Start KP	Approx. End KP	Construction method assessed at Crossing
47	Bendigo Rail Line reserve	8.288	8.326	Bored (Pipe jacking)
48	North Eastern Rail Line reserve	40.925	40.959	Bored (Pipe jacking)
49	Jacksons Creek (vicinity of creek)	13.863	13.898	Open trench
50	Kalkallo Basin (length of property)	33.826	35.316	Open trench
51	Merri Creek (vicinity of creek)	42.639	42.655	Open
52	Sunbury	14.907	14.967	Mini HDD
53	Deep Creek	16.828	16.85	HDD
54	Calder Freeway	8.677	8.802	HDD
55	Hume Freeway	36.938	37.017	HDD
56	Melton Highway	3.148	3.209	HDD

*Crossing numbers provided by APA, missing numbers refer to 3rd party assets (open trench construction method)

+Open trench method is also under consideration for Parkland Cres, but this report has assessed HDD as the worst case noise scenario

Appendix D – Sound Power- Construction Equipment

Noise Source	Octave centre frequency (Hz),L_W dB(A)									L_w dB(A)	L_{lin} (dB)
	31.5	63	125	250	500	1000	2000	4000	8000		
Tracked Excavator - 35 ton	63	88.8	94.9	97.4	101.8	101	99.2	96	85.9	107	117.3
CAT 16G Grader	53.6	77.8	93.9	100.4	105.8	110	106.2	103	97.9	113.4	116.6
CAT 14G Grader	44.6	51.8	77.9	91.4	102.8	110	107.2	104	96.9	113.1	113.4
CAT D7 Bulldozer	43	83.8	98.4	104	107.8	105.8	104.2	99.9	92.3	112.3	118.9
Truck With Lifting Boom	63.4	85.8	92.9	98.4	101.8	103	101.2	96	85.9	107.9	115.5
Bending machine	39	48.8	58.9	66.4	76.8	85	91.2	91	88.9	95.7	95.5
Prime moves- stinging truck	80.6	92.8	103.9	118.4	120.8	113	108.2	101	92.9	123.4	130.2
Skid truck	39.4	76.8	98.9	97.4	103.8	103	102.2	98	85.9	109.1	116.7
Tracked Excavator - 45 ton	65	77.8	95.9	97.4	103.8	104	102.2	97	89.9	109.1	115
Trencher	54	78.8	94.9	97.4	100.8	100	98.2	92	80.9	105.9	113.8
Truck carting materials	37.6	57.8	84.9	93.4	108.8	112	110.2	106	94.9	115.8	116.6
Welding truck	37.6	57.8	84.9	93.4	108.8	112	110.2	106	94.9	115.8	116.6
Tack rig	56.6	71.8	86.9	91.4	93.8	94	93.2	90	79.9	100	107
Truck with generator	49.4	59	87.1	98.4	108.8	112.5	113.9	111.8	103.7	118.3	118.7
Grit blasting truck in operation	58.2	78.2	94.4	107.6	117.5	123.5	124.9	122.3	115.2	129	129
Coating light truck	43.6	57.8	66.2	71.1	71.6	74.8	74.8	70.8	65	80.3	89
HDD drill with mud tank	57.6	71.8	94.9	96.4	99.8	103	104.2	100	90.9	108.7	116.6
Bore machine	84.2	95.3	110.8	105.2	107.4	106.6	104.4	94.3	88.4	114.6	114.6
Vacuum truck	41.1	61.3	88.4	96.9	112.3	115.5	113.7	109.5	98.4	119.3	122.7
Wheeled loader	84	93.8	101.9	106.4	109.8	112	113.2	104	94.9	117.4	123.9
Padding machine	73.4	83.8	85.9	100.4	102.8	109	102.2	93	84.9	111.1	115.2
Tractor	63.4	83.8	85.9	100.4	102.8	109	102.2	93	84.9	111.1	115.2
Compressor 750 cfm	57.1	73.5	75.3	85.6	95	96.3	94.2	94.6	89.3	102	105.3
Compressor 1200 cfm	55.9	75.9	84.4	97.8	103.8	105.6	103.8	97.9	88.1	110	112.7
High pressure squeeze pump	51.3	65.5	76.6	86.1	91.5	97.7	95.9	91.7	83.6	101.3	103.2
Fill pump	74	85.8	96.9	89.4	99.8	102	106.2	105	95.9	110.4	116.6

Appendix E – Predicted construction noise levels

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C001	298436	5822840	64.1	68.7	65.7	Negligible	Negligible
C002	298335	5822387	52.4	55.9	53.9	Negligible	Negligible
C003	297765	5822905	50.6	53.5	52.1	Negligible	Negligible
C004	297610	5822949	48	50.8	49.6	Negligible	Negligible
C005	297433	5823098	45.6	48.1	47.1	Negligible	Negligible
C006	299135	5822879	47.5	50.2	49	Negligible	Negligible
C007	299142	5822945	47.8	50.6	49.3	Negligible	Negligible
C008	299146	5822985	48	50.8	49.5	Negligible	Negligible
C009	299154	5823051	48	50.8	49.5	Negligible	Negligible
C010	299162	5823117	48.2	51.2	49.8	Negligible	Negligible
C011	299169	5823172	47.9	50.9	49.5	Negligible	Negligible
C012	299172	5823216	47.9	50.9	49.4	Negligible	Negligible
C013	299190	5823364	52.1	55.5	53.6	Negligible	Negligible
C014	299203	5823459	48.8	51.9	50.4	30.7	Negligible
C015	298585	5823550	68.5	73	70	31.6	Negligible
C016	298822	5823570	61.3	65.3	62.8	31.8	Negligible
C017	299211	5823528	49.2	52.4	50.7	31.1	Negligible
C018	299216	5823574	47.7	50.4	49.2	31.3	Negligible
C019	299227	5823655	47.6	50.3	49.2	31.8	Negligible
C020	299236	5823730	47.6	50.3	49.2	32.2	Negligible
C021	299247	5823835	47.8	50.5	49.3	32.8	Negligible
C022	299253	5823887	47.7	50.4	49.2	33.2	Negligible
C023	299258	5823927	47.7	50.4	49.2	33.4	Negligible
C024	299264	5824010	47.8	50.5	49.3	34	Negligible
C025	299289	5824036	47.5	50.2	49	34.1	Negligible
C026	299315	5824065	47.2	49.8	48.7	34.2	Negligible
C027	299336	5824106	47	49.6	48.5	34.4	Negligible
C028	299336	5824120	47	49.6	48.5	34.5	Negligible

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C029	299284	5824147	47.8	50.5	49.4	34.9	Negligible
C030	299311	5824175	47.5	50.2	49	34.9	Negligible
C031	299288	5824217	47.9	50.7	49.5	35.4	Negligible
C032	299345	5824227	47.1	49.8	48.7	35.2	Negligible
C033	299407	5824238	46.3	48.9	47.8	35	Negligible
C034	299428	5824258	46.1	48.6	47.6	35	Negligible
C035	299424	5824300	46.2	48.8	47.8	35.4	Negligible
C036	298650	5824440	74.5	79.1	76	39.2	Negligible
C037	299417	5824328	46.4	48.9	47.9	35.6	Negligible
C038	297746	5824612	47	49.6	48.5	35.9	Negligible
C039	299413	5824361	46.5	49.1	48	35.9	Negligible
C040	299407	5824390	46.6	49.2	48.2	36.1	Negligible
C041	299398	5824432	46.8	49.4	48.3	36.4	Negligible
C042	299390	5824492	47.1	49.8	48.6	37	Negligible
C043	299388	5824512	47.2	49.8	48.7	37.1	Negligible
C044	299383	5824567	47.4	50.1	48.9	37.6	Negligible
C045	299372	5824609	47.6	50.3	49.2	38	Negligible
C046	298109	5824849	57.7	61.5	59.2	40.8	Negligible
C047	299382	5824647	47.6	50.3	49.1	38.2	Negligible
C048	299370	5824692	47.9	50.6	49.4	38.7	Negligible
C049	299365	5824722	48	50.8	49.6	38.9	Negligible
C050	299364	5824762	48.1	50.9	49.7	39.3	Negligible
C051	299368	5824789	48.1	50.9	49.7	39.4	Negligible
C052	299370	5824814	48.2	50.9	49.7	39.6	Negligible
C053	299369	5824857	48.3	51.1	49.8	39.9	Negligible
C054	299376	5824886	48.3	51	49.8	40.1	Negligible
C055	299381	5824945	48.3	51.1	49.9	40.4	Negligible
C056	299397	5824995	48.2	51	49.7	40.5	Negligible
C057	299400	5825026	48.4	51.3	49.9	40.6	Negligible

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C058	299405	5825057	48.5	51.4	50.1	40.7	Negligible
C059	299411	5825094	48.8	51.8	50.3	40.8	Negligible
C060	298678	5825267	103	107.7	104.5	75.2	Negligible
C061	298927	5825227	62.8	67.4	64.4	58.9	Negligible
C062	299416	5825149	48.8	51.7	50.3	40.9	Negligible
C063	299424	5825189	48.6	51.5	50.1	40.9	Negligible
C064	299426	5825219	48.6	51.4	50.1	41	Negligible
C065	299434	5825267	48.4	51.2	50	41	Negligible
C066	299430	5825302	48.4	51.2	50	41.4	Negligible
C067	299439	5825342	48.3	51.1	49.8	41.7	Negligible
C068	299441	5825376	48.4	51.1	49.9	42	Negligible
C069	299447	5825427	48.4	51.2	49.9	42.4	Negligible
C070	299461	5825468	48.3	51.1	49.8	42.7	Negligible
C071	299468	5825522	48.1	50.9	49.7	43	Negligible
C072	299474	5825567	48.1	50.9	49.7	43.3	Negligible
C073	299480	5825616	48.1	50.8	49.6	43.7	Negligible
C074	299486	5825659	48.1	50.8	49.6	44	Negligible
C075	299484	5825694	48.2	50.9	49.7	44.3	Negligible
C076	299569	5825693	46.9	49.5	48.4	43.3	Negligible
C077	299502	5825712	47.9	50.6	49.5	44.2	Negligible
C078	299569	5825743	47	49.6	48.5	43.6	Negligible
C079	299602	5825749	46.5	49.1	48.1	43.3	Negligible
C080	299642	5825776	46	48.6	47.6	42.9	Negligible
C081	299613	5825829	46.5	49.1	48	43.6	Negligible
C082	299592	5825856	46.8	49.4	48.4	44	Negligible
C083	299573	5825877	47.1	49.8	48.7	44.3	Negligible
C084	299551	5825908	47.5	50.2	49	44.7	Negligible
C085	299605	5825912	46.7	49.3	48.3	43.6	Negligible
C086	299597	5825923	46.8	49.5	48.4	43.7	Negligible

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C087	299527	5825937	47.9	50.6	49.4	45.2	Negligible
C088	299575	5825955	47.2	49.9	48.7	44.4	Negligible
C089	299524	5825964	48	50.7	49.5	45.3	Negligible
C090	299538	5826001	47.8	50.5	49.4	45.3	Negligible
C091	298253	5826143	52.2	55.2	53.7	49.5	Negligible
C092	299150	5826075	58.9	62.8	60.4	53.9	Negligible
C093	299536	5826041	47.9	50.6	49.4	45.4	Negligible
C094	298585	5826141	64.6	69.2	66.1	62	Negligible
C095	299211	5826101	55.2	58.8	56.7	51.8	Negligible
C096	299544	5826086	47.8	50.6	49.4	45.4	Negligible
C097	299573	5826087	47.4	50.1	49	44.9	Negligible
C098	299614	5826084	46.8	49.5	48.4	44.3	Negligible
C099	299654	5826082	46.3	48.9	47.8	43.8	Negligible
C100	298433	5826308	60	63.9	61.5	57.5	Negligible
C101	299571	5826173	47.6	50.3	49.1	45.1	Negligible
C102	299287	5826217	56.5	60.2	58	50.4	Negligible
C103	299559	5826185	47.8	50.5	49.3	45.3	Negligible
C104	299548	5826218	47.9	50.6	49.4	45.4	Negligible
C105	299518	5826250	48.2	50.9	49.7	45.9	Negligible
C106	299557	5826255	47.6	50.3	49.1	45.3	Negligible
C107	299575	5826263	47.3	50	48.9	45	Negligible
C108	299596	5826271	47	49.6	48.5	44.7	Negligible
C109	299559	5826295	47.5	50.2	49	45.2	Negligible
C110	299562	5826320	47.3	50	48.9	45	Negligible
C111	299565	5826342	47.2	49.9	48.8	44.9	Negligible
C112	299565	5826360	47.3	50	48.9	44.9	Negligible
C113	299570	5826383	47.5	50.1	49	44.7	Negligible
C114	299572	5826411	47.7	50.4	49.3	44.6	Negligible
C115	299585	5826433	47.6	50.3	49.1	44.4	Negligible

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C116	299580	5826453	47.7	50.4	49.3	44.5	Negligible
C117	299586	5826472	47.6	50.3	49.2	42.5	Negligible
C118	299593	5826490	47.6	50.3	49.1	44.1	Negligible
C119	299598	5826517	47.7	50.3	49.2	38.6	Negligible
C120	299594	5826539	48	50.7	49.5	43.4	Negligible
C121	299600	5826566	47.9	50.7	49.5	43.1	Negligible
C122	299603	5826579	47.9	50.6	49.5	43	Negligible
C123	299606	5826604	47.9	50.7	49.5	42.8	Negligible
C124	299609	5826620	47.9	50.6	49.5	42.7	Negligible
C125	299612	5826650	47.9	50.7	49.5	42.7	Negligible
C126	299617	5826670	47.9	50.6	49.4	42.6	Negligible
C127	299616	5826687	47.9	50.6	49.4	42.6	Negligible
C128	299625	5826711	47.8	50.5	49.3	42.5	Negligible
C129	299611	5826744	48.1	50.9	49.7	42.4	Negligible
C130	299628	5826771	47.9	50.7	49.5	42.1	Negligible
C131	299628	5826788	48	50.7	49.5	42	Negligible
C132	299631	5826809	48	50.7	49.5	41.8	Negligible
C133	299631	5826832	48	50.8	49.6	41.7	Negligible
C134	299637	5826857	48	50.7	49.5	41.5	Negligible
C135	299646	5826878	47.9	50.6	49.4	41.2	Negligible
C136	299643	5826895	48	50.7	49.5	41.1	Negligible
C137	299651	5826913	47.9	50.6	49.4	40.8	Negligible
C138	299650	5826934	47.9	50.7	49.5	40.6	Negligible
C139	299629	5826956	48.3	51.1	49.8	40.7	Negligible
C140	299658	5826962	47.9	50.6	49.4	33.1	Negligible
C141	299664	5826982	47.8	50.5	49.4	32.4	Negligible
C142	299659	5827002	47.9	50.7	49.5	40.2	Negligible
C143	299665	5827024	47.9	50.6	49.4	40	Negligible
C144	299672	5827047	47.8	50.6	49.4	31.3	Negligible

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C145	299666	5827067	48	50.7	49.5	39.7	Negligible
C146	299670	5827088	48	50.7	49.5	39.5	Negligible
C147	299668	5827111	48	50.8	49.6	39.4	Negligible
C148	299674	5827134	48	50.7	49.5	39.2	Negligible
C149	299679	5827156	48	50.7	49.5	39	Negligible
C150	299683	5827171	48	50.7	49.5	38.9	Negligible
C151	299689	5827215	48.1	50.8	49.6	38.5	Negligible
C152	299701	5827313	48.3	51	49.8	37.7	Negligible
C153	299726	5827313	47.9	50.6	49.4	37.6	Negligible
C154	299710	5827356	48.3	51.1	49.8	37.4	Negligible
C155	299734	5827346	47.9	50.6	49.4	35.7	Negligible
C156	299713	5827395	48.6	51.5	50.2	37.1	Negligible
C157	299712	5827423	49.3	52.3	50.8	36.9	Negligible
C158	299717	5827439	49.2	52.2	50.7	36.8	Negligible
C159	299720	5827459	49.2	52.2	50.7	36.6	Negligible
C160	299726	5827480	48.9	51.8	50.4	36.4	Negligible
C161	299721	5827508	49	51.8	50.5	30.8	Negligible
C162	299729	5827522	48.7	51.5	50.2	35	Negligible
C163	299741	5827563	48.7	51.5	50.2	35.8	Negligible
C164	299766	5827591	48.4	51.2	49.9	35.5	Negligible
C165	299794	5827604	48	50.8	49.6	33	Negligible
C166	299802	5827621	48	50.7	49.5	34.8	Negligible
C167	299828	5827641	47.7	50.4	49.2	34.3	Negligible
C168	299857	5827662	47.4	50	48.9	34.4	Negligible
C169	299872	5827676	47.4	50.1	48.9	34.5	Negligible
C170	299897	5827684	47.3	50.1	48.9	34.3	Negligible
C171	299905	5827696	47.4	50.2	48.9	34	Negligible
C172	299921	5827709	47	49.7	48.6	33.1	Negligible
C173	300375	5829634	50.3	53.5	51.8	40.7	45.3

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C174	298453	5830238	48.1	51.2	49.6	38.5	40.2
C175	300536	5830675	53	56.5	54.5	50.7	56.5
C176	300631	5830699	52.6	56	54.1	50.3	56.1
C177	300345	5831186	65.2	69.5	66.7	62.5	69.4
C178	300512	5830957	52	55.3	53.5	50.2	55.8
C179	300156	5831664	67.9	72.3	69.4	62.6	69.8
C180	300711	5830922	49.6	52.6	51.2	46.2	51.7
C181	300117	5832090	52.1	55.5	53.6	46.5	55.1
C182	299997	5832464	45.3	47.9	46.8	41.2	46.3
C183	300166	5832326	47.8	50.5	49.3	43.1	48.4
C184	300407	5832161	57	60.8	58.5	45.2	58.9
C185	300737	5831177	56.3	59.8	57.7	50.5	55.7
C186	300830	5830809	48	51	49.5	43.8	49.4
C187	300692	5831748	74.5	79.2	76	48	73.5
C188	300750	5831615	88.1	92.8	89.6	48	77.5
C189	300889	5831178	53.2	56.7	54.8	47.9	56.2
C190	300946	5831360	60.6	64.6	62.2	47.6	61.8
C191	300973	5831508	65.5	70.1	67	47.1	69.9
C192	301142	5831098	50.1	53	51.7	42.1	53.1
C193	300988	5831707	78.3	83	79.8	45.7	80.5
C194	300827	5831940	69.8	74.3	71.3	44.5	69.4
C195	300498	5832324	54.4	58	55.9	48.2	57.5
C196	300785	5832241	56.4	60.1	57.9	43.4	57.4
C197	300826	5832106	63.3	67.5	64.8	48.5	64.1
C198	300521	5832589	46.1	48.7	47.7	39.5	47.7
C199	300685	5832600	48.9	51.8	50.4	39	48.2
C200	300792	5832406	51.7	54.9	53.2	40.5	51.6
C201	301044	5832031	66.1	70.5	67.6	41.3	65.6
C202	301325	5831120	49.1	51.9	50.6	40.2	51.8

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C203	301110	5831893	73.7	78.3	75.2	41.7	64.2
C204	301466	5831443	59	62.8	60.5	40.1	53.7
C205	301570	5831284	55.5	59.1	57	39	52.9
C206	301055	5832351	57.8	61.6	59.4	40.1	55.8
C207	301096	5832280	57.6	61.2	59.1	43.1	57.4
C208	300933	5832718	45.9	48.4	47.4	37	48
C209	301217	5832341	59.9	63.8	61.4	41.8	56.3
C210	301579	5831711	59.2	62.9	60.7	44.9	59.7
C211	301490	5831917	81.5	86.3	83	52.1	66
C212	301625	5831854	65.4	70	67	54.3	67.4
C213	301874	5831361	52.4	55.9	53.9	40.8	52.5
C214	301791	5831603	53.4	56.7	55	44	56.2
C215	301620	5831990	83.6	88.4	85.1	52.7	82.5
C216	301313	5832550	51.5	54.9	53	42.2	54.3
C217	301404	5832333	62.2	66.3	63.7	46	62.2
C218	301454	5832563	52.7	55.8	54.2	43.8	55.5
C219	301570	5832323	66.2	70.6	67.7	51.1	70.1
C220	301154	5832806	47	50.1	48.5	38.3	49.1
C221	301187	5832939	45.3	47.8	46.8	37.6	47.7
C222	301877	5831881	62.7	66.8	64.2	57.4	61.8
C223	301746	5832292	69	73.4	70.5	57.4	70.7
C224	301881	5832014	70.8	75.4	72.4	64.2	68.2
C225	302137	5832287	72.3	77	73.8	64.4	77
C226	301929	5832339	75.1	79.6	76.5	66.6	67.2
C227	301821	5832548	62.5	66.7	64	52	60.7
C228	301938	5832517	68.4	73.1	70	57.6	65.8
C229	301472	5833085	46.5	49.2	48.1	39	48.2
C230	301648	5833051	49.4	52.6	50.9	40.6	50.3
C231	301851	5833022	50	52.9	51.6	42.1	52.5

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C232	301976	5833058	51.4	54.7	52.9	41.8	52.6
C233	301836	5833279	46.2	48.8	47.7	38.7	48.5
C234	302117	5832535	72.1	76.6	73.6	58.9	76.2
C235	302132	5832604	64.3	68.7	65.8	51.3	68.6
C236	302222	5832280	72.2	76.8	73.7	60.3	74.5
C237	302334	5832608	68.5	73	70	48.9	63
C238	302414	5832289	71.1	75.7	72.6	53.7	67.7
C239	302604	5832114	61.6	65.6	63.1	47.4	61
C240	302568	5832231	62.3	66.4	63.9	49.1	57.4
C241	303320	5832496	58.2	62.1	59.8	38.4	52.7
C242	303603	5832281	46.5	49.1	48.1	33	48.1
C243	302406	5832976	57.9	61.7	59.4	41.8	56.7
C244	302994	5832955	72.7	77.4	74.2	36.8	52.2
C245	302343	5833200	52	55.1	53.5	39.6	50.1
C246	302270	5833582	48.7	51.6	50.3	35.6	45.6
C247	302086	5833625	46.9	49.8	48.5	35.5	44.8
C248	303146	5832952	64.8	69.1	66.4	33.6	63.5
C249	303194	5833003	68.7	73.1	70.2	37.1	68.7
C250	303280	5832766	60.1	64	61.6	35.1	58.8
C251	303371	5833319	69.4	74	70.9	40.3	73.9
C252	303681	5833223	70.6	75.2	72.2	38.5	75.2
C253	304193	5834339	69.8	74.6	71.3	60.8	70.7
C254	303459	5834969	48.2	51	49.8	42.7	51
C255	303524	5834905	54.9	58.4	56.4	49.6	58.4
C256	304328	5834551	77	81.7	78.5	58	69.1
C257	304831	5834331	75.3	79.8	76.8	42.7	51.2
C258	305080	5834342	65.5	69.8	67	43	47.4
C259	305271	5834853	57.6	60.9	59.1	50.7	45.1
C260	305260	5834343	65.8	70.1	67.3	45.2	45.5

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C261	305560	5834797	61.6	65.4	63.2	54	41.8
C262	305937	5835114	64.5	68.7	66	58.8	43.2
C263	306060	5835100	68.4	72.8	69.9	62.8	43.8
C264	305866	5835863	50.4	53.6	51.9	41.4	42.8
C265	306139	5835447	58.7	62.5	60.2	50.5	46.1
C266	306091	5835706	53.8	57.3	55.3	48.8	45.6
C267	306321	5835743	52.3	55.5	53.7	42.7	48.1
C268	306388	5835426	54.6	57.9	56.1	45	40.9
C269	306538	5834053	45.4	47.9	47	42	40.9
C270	306953	5834424	52.2	55.6	53.7	36.5	48
C271	307409	5834555	47.7	50.7	49.2	39.2	47.8
C272	306734	5836144	46.1	48.9	47.6	36.4	48.3
C273	307359	5835327	68.8	73.2	70.3	49.8	67.5
C274	307462	5834856	50.1	53.2	51.6	39.9	52.4
C275	307511	5834976	58.4	62.2	59.9	45	60
C276	307705	5835078	60.8	64.8	62.3	42.9	57.2
C277	307756	5835357	65.5	70.1	67.1	49.3	61.3
C278	307748	5834769	53.5	57	55	42.4	51.5
C279	307624	5836065	55.7	59	57.2	47.9	53.8
C280	307735	5836249	51.6	55	53.1	43.9	53.8
C281	307826	5835784	74.1	78.6	75.5	60.4	61.2
C282	307869	5835895	62	65.9	63.6	52.6	62.3
C283	307955	5835485	66.9	71.1	68.4	50.8	65.2
C284	307990	5835606	81.2	86	82.7	51.8	65.7
C285	308038	5835619	82	86.7	83.5	44.1	68.7
C286	307870	5836055	61.4	65.5	63	48	59.9
C287	307977	5836304	59.1	63	60.6	42.2	55.8
C288	308828	5837066	66.7	71.1	68.2	41.9	42.7
C289	308891	5837014	68.8	73.3	70.4	43.1	42.8

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C290	309060	5836979	66.2	70.6	67.8	52.1	42.2
C291	309182	5836080	53.8	57.3	55.3	38.3	41.4
C292	309246	5836643	68.2	73.1	69.8	47.2	40.6
C293	309980	5836584	51.6	54.6	53.1	43.4	37.8
C294	310123	5837951	56	59.4	57.6	48.4	Negligible
C295	308989	5838211	53.2	56.7	54.7	44.1	Negligible
C296	309320	5838676	54.3	57.9	55.8	43.6	Negligible
C297	309662	5839072	56.8	60.6	58.3	36.6	Negligible
C298	309567	5839203	54.8	58.4	56.3	38.5	Negligible
C299	309577	5839653	47.9	50.8	49.4	32	Negligible
C300	311855	5839535	45.6	48.1	47.2	35.8	38.8
C301	311765	5840127	51.9	55.2	53.5	43.1	44.2
C302	310802	5840780	41.7	43.8	43.2	30.9	41.4
C303	310962	5840717	52.4	55.3	53.9	37.7	36.7
C304	310783	5841052	46.7	49.1	48.3	29.6	44.1
C305	310680	5841123	45.3	47.7	46.9	28.4	42.3
C306	311244	5840867	59.8	63.5	61.4	48	49.4
C307	311393	5841057	60.8	64.8	62.3	44.4	53.3
C308	310791	5841363	41	43	42.5	31.1	41.5
C309	311185	5841163	52.2	55.3	53.8	40.6	50.6
C310	311615	5840859	70.8	75.2	72.2	53	53.2
C311	312020	5840559	60.4	64	61.9	51.7	49.8
C312	312190	5840104	48.9	51.7	50.4	41.1	43.8
C313	312382	5840572	51.1	54.1	52.7	43.4	48.4
C314	312489	5840510	49	51.8	50.5	41.4	46.9
C315	312590	5840288	46.3	48.9	47.9	39	44.1
C316	312590	5840580	47.7	50.4	49.2	40.3	46.6
C317	312053	5840792	60.7	64.3	62.2	53.5	53.8
C318	312416	5840759	50.8	53.8	52.3	43.4	50.4

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C319	311796	5840937	65.1	69.4	66.6	60.7	57.1
C320	311905	5840927	65.3	69.4	66.8	61.7	57.5
C321	312518	5840883	48.7	51.5	50.3	40.7	51
C322	312010	5841069	63.8	68	65.3	56.4	67.7
C323	311808	5841106	64.5	68.8	66	57.6	68.5
C324	311843	5841208	66.5	71.1	68.1	63.2	70.7
C325	311449	5841289	56.6	60.3	58.1	45.7	58.9
C326	311777	5841350	69.2	73.8	70.7	65.1	72.9
C327	311582	5841533	56.4	60.1	58	53.8	60.1
C328	311004	5841532	42.5	44.4	44.1	31.9	37
C329	311333	5841436	52	55.4	53.5	43.4	54.4
C330	311170	5841621	38.5	40.3	40.1	32	39
C331	311375	5841608	50.4	53.2	51.9	42.7	52.7
C332	311246	5841893	40.5	42.2	42.2	33.2	42.1
C333	311528	5841690	52.1	55.2	53.7	43.4	55.2
C334	311977	5841341	82.1	86.8	83.6	72.8	85.1
C335	311566	5841906	48.3	50.8	49.9	38.4	51
C336	311738	5841891	52.7	55.9	54.3	43.8	54.7
C337	312019	5841564	78.8	83.4	80.3	53.4	68.2
C338	311962	5841722	65.4	69.7	66.9	48.4	63
C339	312398	5841312	63	67.1	64.5	45.5	60.5
C340	311610	5842176	45.1	47.4	46.7	37.1	47.5
C341	311581	5842367	37.6	39.3	39.3	31.9	40.3
C342	311751	5842298	47.9	50.6	49.4	38.7	48.1
C343	311893	5842198	50.7	53.7	52.3	40.9	49.8
C344	312039	5842209	56.6	60.3	58.1	47.8	50.9
C345	312654	5841497	60.1	64	61.6	50.3	55.6
C346	312334	5842034	65.8	70.5	67.4	57.5	55.9
C347	311929	5842549	46.8	49.4	48.3	39.2	48.2

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C348	312524	5842147	69.4	73.9	70.9	63.4	62.5
C349	312712	5842038	89	93.5	90.5	73.5	67.7
C350	312441	5842385	60.7	64.7	62.3	52.7	58.8
C351	312675	5842457	73.1	77.6	74.6	51.4	69.5
C352	312539	5842853	54.3	57.6	55.9	39.5	56.7
C353	312862	5842716	74.6	79.1	76	40.9	75
C354	312560	5842972	58.8	62.6	60.3	38.1	62.5
C355	313230	5842602	63.5	67.6	65	39.8	63
C356	313262	5842614	61.1	65.2	62.7	35	62.1
C357	313278	5842611	60	63.9	61.5	35	61.5
C358	313305	5842607	59.1	63	60.6	34.9	60.5
C359	313323	5842604	58.6	62.5	60.1	34.8	59.9
C360	312692	5843149	58.3	62.2	59.9	39.6	61.9
C361	312709	5843252	56.2	59.7	57.7	38.5	56
C362	312718	5843297	52.1	55.3	53.7	38.8	53.4
C363	312639	5843529	48.5	51.2	50	34	48.9
C364	312800	5843523	57.2	60.9	58.7	41.2	56.2
C365	314073	5843504	49.5	52.4	51.1	40.4	50.2
C366	314073	5843521	49.6	52.4	51.1	40.8	51.2
C367	313970	5843559	56	59.6	57.5	43.5	54.1
C368	312680	5844124	46.9	49.6	48.5	39.7	49.7
C369	314085	5843663	51.6	54.7	53	42.3	52.8
C370	314084	5843642	51.3	54.4	52.7	42.3	52.7
C371	314088	5843602	50.7	53.8	52.2	42	52.4
C372	314079	5843586	50.4	53.2	51.9	42.1	52.4
C373	314075	5843570	50.6	53.5	52.2	42	52.4
C374	314075	5843558	49.9	52.8	51.4	42	52.3
C375	314049	5843722	52.6	55.8	54.1	43.2	53.7
C376	313868	5843801	56.6	59.9	58.2	45	55.8

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C377	313915	5843802	56.1	59.5	57.7	42.4	54.7
C378	313869	5843816	55.4	58.4	56.9	43.3	55.5
C379	313917	5843815	56.3	59.7	57.8	42.3	55.4
C380	313917	5843829	56.5	59.9	58	45.6	57
C381	313871	5843844	53.5	56.5	55.1	40.6	52.3
C382	313874	5843860	54.9	57.9	56.5	41.4	53.6
C383	313920	5843844	56.7	60.1	58.2	42.1	55.6
C384	313919	5843856	56.8	60.3	58.4	42.1	55.7
C385	313875	5843876	54.2	57.3	55.7	40.5	52.3
C386	313922	5843870	57	60.4	58.5	43.4	56
C387	313876	5843904	55.6	58.5	57.1	41.8	53.7
C388	313878	5843919	57	60.2	58.6	43	55.3
C389	313880	5843940	59.2	62.7	60.7	45.7	57.5
C390	313928	5843926	57.7	61.2	59.2	41.8	55.5
C391	313887	5843964	58.8	62.2	60.4	44.9	56.9
C392	313930	5843944	57.9	61.4	59.5	42.2	55.7
C393	313892	5843978	59.3	62.7	60.8	45.1	56.9
C394	313936	5843959	58	61.5	59.6	44.8	55
C395	313944	5843980	63.4	67.6	65	44.7	54.9
C396	313934	5844047	61.8	66.2	63.4	44.7	59.9
C397	313983	5844023	59	63	60.5	44	54.7
C398	313942	5844070	61.1	65.3	62.7	44.4	59.5
C399	313999	5844046	58.3	62.1	59.8	42.5	51.7
C400	313964	5844077	59.6	63.4	61.1	41.5	48.8
C401	313977	5844073	59	62.7	60.5	40.3	46
C402	313988	5844068	58.5	62.2	60.1	38.7	44.6
C403	313969	5844091	59.4	63	60.9	43.8	57.3
C404	313980	5844086	58.9	62.5	60.5	43.6	54.1
C405	313992	5844080	58.5	62	60.1	43.1	52.8

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C406	313954	5844112	60.3	64	61.9	48.8	58.8
C407	313968	5844138	60.3	63.9	61.8	48.2	55.2
C408	314029	5844125	60.1	63.7	61.6	42.2	52.1
C409	314004	5844137	61.8	65.7	63.4	39.9	46.9
C410	314043	5844120	60.7	64.5	62.2	36.7	42.4
C411	314037	5844135	57.9	61.4	59.4	42.2	52.2
C412	314053	5844130	57.4	60.8	58.9	41.6	51.1
C413	314016	5844152	58.9	62.4	60.4	42.6	52.1
C414	313967	5844186	59.5	62.7	61.1	42.8	53.2
C415	314024	5844196	59.4	63	60.9	42.7	52.5
C416	313986	5844227	60.7	64.1	62.2	42.3	52.7
C417	314030	5844209	59.5	63.1	61	42.2	52.3
C418	313990	5844238	60.7	64.2	62.3	42.1	52.5
C419	314035	5844223	59.5	63.1	61.1	41.7	52
C420	313996	5844252	61	64.5	62.5	41.9	52.3
C421	314042	5844235	59.5	63.2	61.1	41.5	51.7
C422	314004	5844273	61.5	65.2	63.1	41.6	51.9
C423	314048	5844257	59.8	63.4	61.3	41.3	51.4
C424	314009	5844286	61.8	65.6	63.4	41.4	51.7
C425	314057	5844272	59.7	63.3	61.3	41	51.2
C426	314063	5844284	59.8	63.4	61.3	40.7	50.8
C427	314023	5844315	62	65.8	63.5	41	51.2
C428	314068	5844295	59.8	63.4	61.3	40.6	50.6
C429	314043	5844336	61.9	65.6	63.4	40.6	50.7
C430	314122	5844314	62.4	66.4	63.9	40	49.9
C431	314099	5844325	63.4	67.4	64.9	37.6	44.6
C432	314083	5844332	62.9	66.8	64.4	40.1	50
C433	314061	5844364	63.7	68.3	65.3	40.1	50.2
C434	314065	5844381	63.5	68.1	65.1	39.9	50

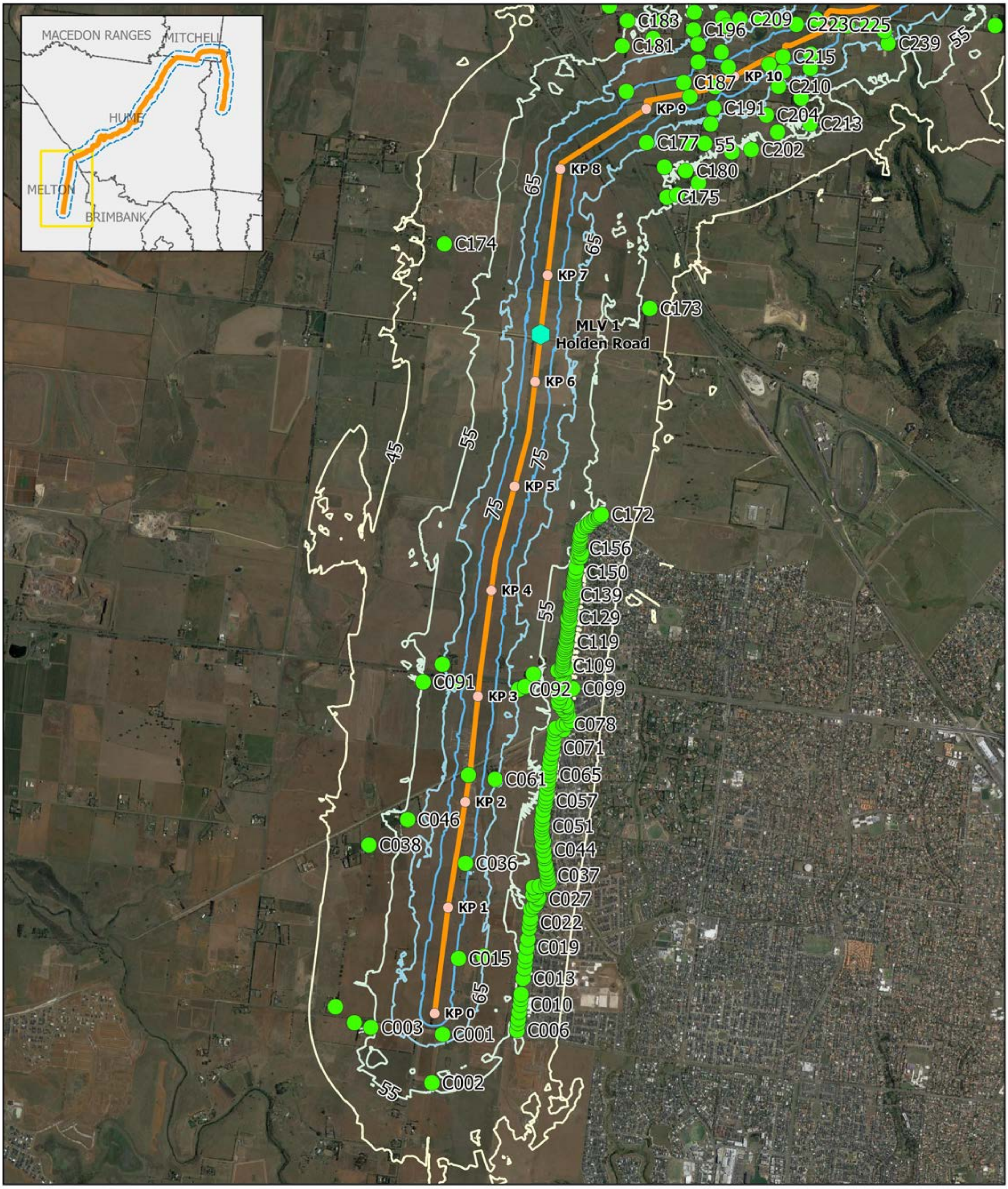
Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C435	314087	5844380	62.9	67.4	64.5	34.4	39.6
C436	314116	5844367	65.5	69.6	67.1	39.6	49.5
C437	314072	5844397	62.8	67.2	64.3	39.7	49.8
C438	314077	5844411	62.4	66.6	63.9	39.6	49.5
C439	314116	5844401	65.5	69.6	67	39.3	49.1
C440	314081	5844421	62.2	66.4	63.7	39.4	49.4
C441	314138	5844403	64.4	68.6	65.9	38.6	47.6
C442	314117	5844431	64.9	69.1	66.4	38.6	47.4
C443	314088	5844451	62.5	66.3	64	39.1	49
C444	314131	5844453	64.8	68.9	66.3	38.7	48.6
C445	314089	5844479	62.6	66.2	64.1	38.7	48.5
C446	314093	5844491	62.4	65.9	63.9	38.5	48.1
C447	314167	5844464	61.8	65.7	63.2	38.4	47.8
C448	314098	5844503	62.8	66.5	64.4	38.4	48.1
C449	314138	5844483	61.6	65.9	63.1	38.5	48.2
C450	314103	5844514	63	66.6	64.5	38.3	48.1
C451	314157	5844492	62	66.1	63.5	37.4	45.7
C452	314111	5844523	63.3	67.1	64.8	38.3	48.1
C453	314152	5844514	61.6	65.8	63.1	38.1	47.8
C454	314112	5844536	63.3	67	64.8	38.2	47.9
C455	313700	5844771	64.2	68.4	65.7	38.1	47.8
C456	314114	5844546	62.8	66.4	64.4	38	47.6
C457	314195	5844507	61.8	66.1	63.4	33.1	42.4
C458	314162	5844535	61.7	65.9	63.2	37.9	47.5
C459	314123	5844559	63.6	67.4	65.2	37.9	47.6
C460	314184	5844543	62.2	66.6	63.7	35.7	42.7
C461	314212	5844529	62.2	66.2	63.7	37.6	47.1
C462	314224	5844530	61.8	65.8	63.3	35.8	45.8
C463	314215	5844550	65.2	69.5	66.7	37.5	46.8

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C464	314205	5844567	59.4	62.8	61	37.1	46.5
C465	314213	5844587	58.8	61.9	60.3	37	46.4
C466	314243	5844647	60.2	63.8	61.8	36.5	45.8
C467	314253	5844673	60.2	63.7	61.7	36.2	45.5
C468	314243	5844719	64.3	68.5	65.8	36	45.1
C469	313750	5844954	63	67.1	64.5	39.3	45.4
C470	314254	5844745	62.2	66.1	63.7	35.7	44.9
C471	314283	5844743	61.3	65.3	62.8	34.3	45
C472	314299	5844769	60.5	64.3	62	35.4	45.4
C473	314318	5844778	59.8	63.5	61.3	29.8	50.9
C474	314288	5844797	61.3	65	62.8	35.2	45.6
C475	314260	5844828	63.2	67.1	64.8	35.1	45.8
C476	314289	5844824	61.7	65.5	63.3	35	45.8
C477	314321	5844830	60.5	64.2	62.1	34.9	46.2
C478	314300	5844851	61.8	65.6	63.4	34.9	46.3
C479	314273	5844893	64	67.8	65.5	34.7	46.6
C480	314332	5844862	60.8	64.6	62.4	34.5	46.5
C481	314313	5844877	61.9	65.7	63.4	34.6	46.6
C482	314343	5844891	61.1	64.9	62.6	34.3	49.9
C483	313931	5845096	67	71.4	68.5	34.6	45.7
C484	314327	5844917	62.1	66	63.7	34.2	52.1
C485	314356	5844924	63.2	67.3	64.8	33.2	51.8
C486	314340	5844937	62.1	65.9	63.6	34.1	51.3
C487	314303	5844961	62.5	65.8	64	34.1	47.6
C488	314346	5844948	63.4	67.6	64.9	34	50.8
C489	314362	5844985	67	71.3	68.5	33.7	48.4
C490	314138	5845253	74.6	79.3	76.1	32.9	49.2
C491	314015	5845574	62.1	66.2	63.6	34.1	50.7
C492	314027	5845749	53.4	56.6	54.9	33.1	52.9

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C493	313860	5845723	45.1	47.4	46.6	30.7	39.9
C494	314058	5845923	53	56.4	54.5	Negligible	56.5
C495	313858	5846028	44.9	47.2	46.4	Negligible	46.7
C496	314247	5846461	49.6	52.8	51.1	Negligible	49.7
C497	314401	5846603	52.5	55.9	53.9	Negligible	55.9
C498	315857	5847229	54.1	57.5	55.6	Negligible	57.5
C499	316312	5846870	71.1	75.7	72.6	Negligible	75.7
C500	317240	5846948	63.3	67.5	64.8	41.5	67.3
C501	317273	5846472	71.2	75.8	72.8	42.6	72
C502	318009	5846308	67.2	71.6	68.8	51.1	58.4
C503	318196	5846547	84.5	89.2	86	52.4	67.1
C504	318181	5846400	73.8	78.3	75.2	54.2	68.6
C505	318329	5846627	71.2	75.8	72.7	56.3	71.9
C506	318306	5846348	70.5	74.9	72	56.7	72.5
C507	318542	5846136	62.9	67	64.4	54.8	66
C508	318689	5846323	73.7	78.4	75.2	69	67.8
C509	318941	5846004	57.3	61.5	58.9	52	53
C510	319312	5847368	88.1	92.6	89.6	41.5	44.7
C511	319066	5847762	58.7	62.6	60.2	39.6	46.4
C512	320072	5848066	61.7	65.8	63.2	33.3	Negligible
C513	320946	5847649	73.5	78.1	75	37.2	Negligible
C514	321788	5847407	64.1	68.3	65.6	54.8	44.9
C515	324036	5843350	48.5	51.2	50	39.4	51.4
C516	323676	5843012	63.1	67.1	64.6	54	67.1
C517	322621	5843047	51	54.1	52.5	38.3	54.2
C518	322650	5842676	51	54.2	52.5	39.5	51.8
C519	323365	5842860	76.3	80.9	77.8	60.4	80.9
C520	323380	5842655	72.7	77.2	74.2	67.1	76.1
C521	323746	5842612	65.6	69.9	67.1	58.3	69.7

Receptor	Coordinates, GDA94 55H		SPL, dB(A)				
			S03	S05	S07	S06	S08
	X,m	Y,m	Excavation	NDT coating	Lowering in & backfilling	HDD and bore crossings	Tie in's / Special Crossings
C522	323898	5842590	58.4	62.3	59.9	52.7	62.3
C523	324304	5842404	46.9	49.5	48.4	39.4	49.3
C524	323267	5839673	66.8	71.2	68.3	Negligible	69.8
C525	323589	5839351	55.6	59.2	57.1	Negligible	58

Appendix F – Construction noise levels - scenario S05



LEGEND

- Study area
- Pipeline
- Receptor
- Main line valve
- Noise level contour LAeq max (dB)

Paper Size A4

0 1,000 2,000 m

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

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Australian Pipeline Limited
APA WORM Environmental Effects Statement Noise Assessment

Predicted noise contours - open cut (KP 1-10)

Project No.	12529997
Revision No.	-
Date.	3/12/2020

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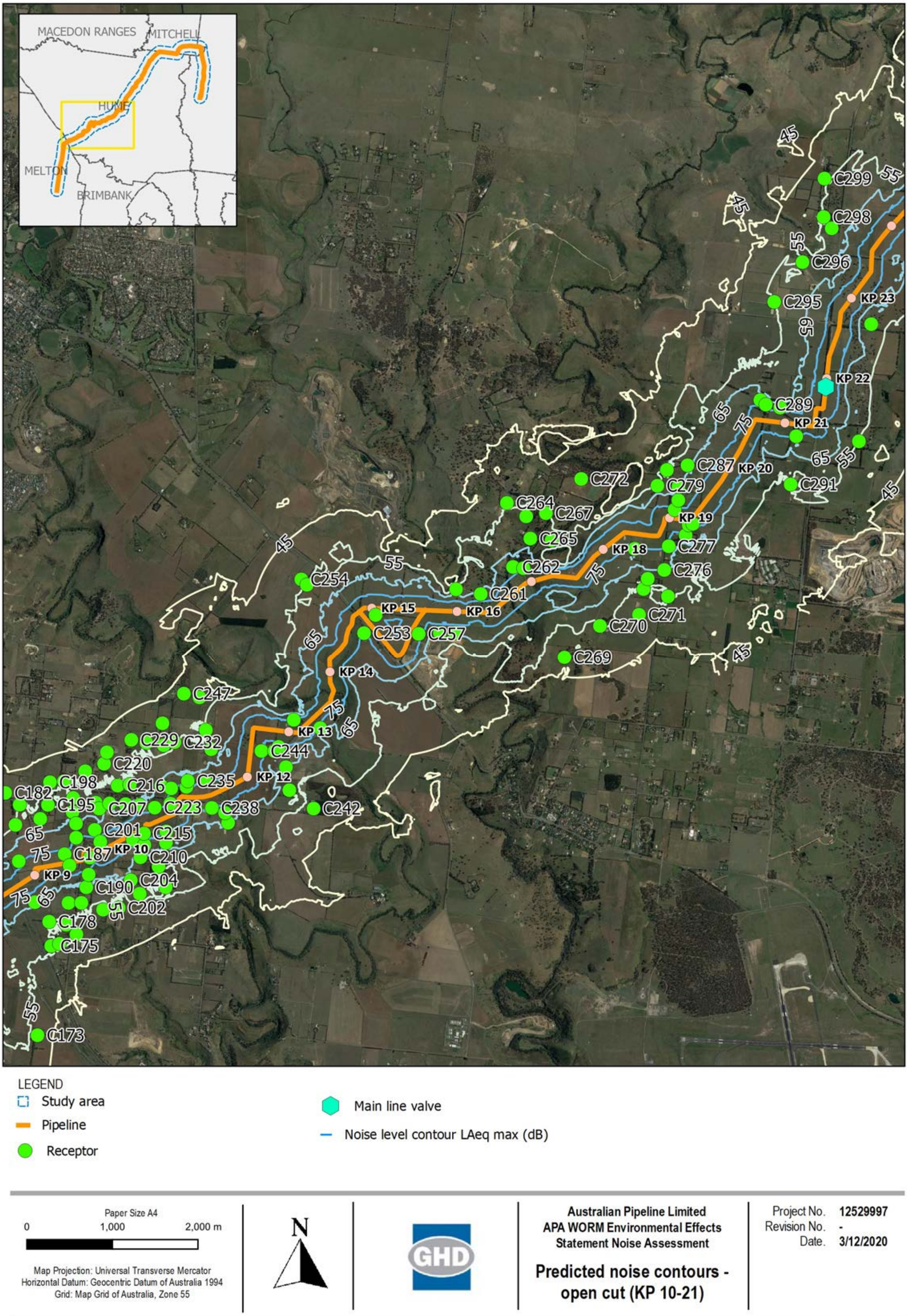
Data source: DELWP, VicMap, Google Earth Imagery 2020. Created by: DM



Australian Pipeline Limited
APA WORM Environmental Effects Statement Noise Assessment

Predicted noise contours - open cut (KP 10-21)

Project No. 12529997
Revision No. -
Date. 3/12/2020

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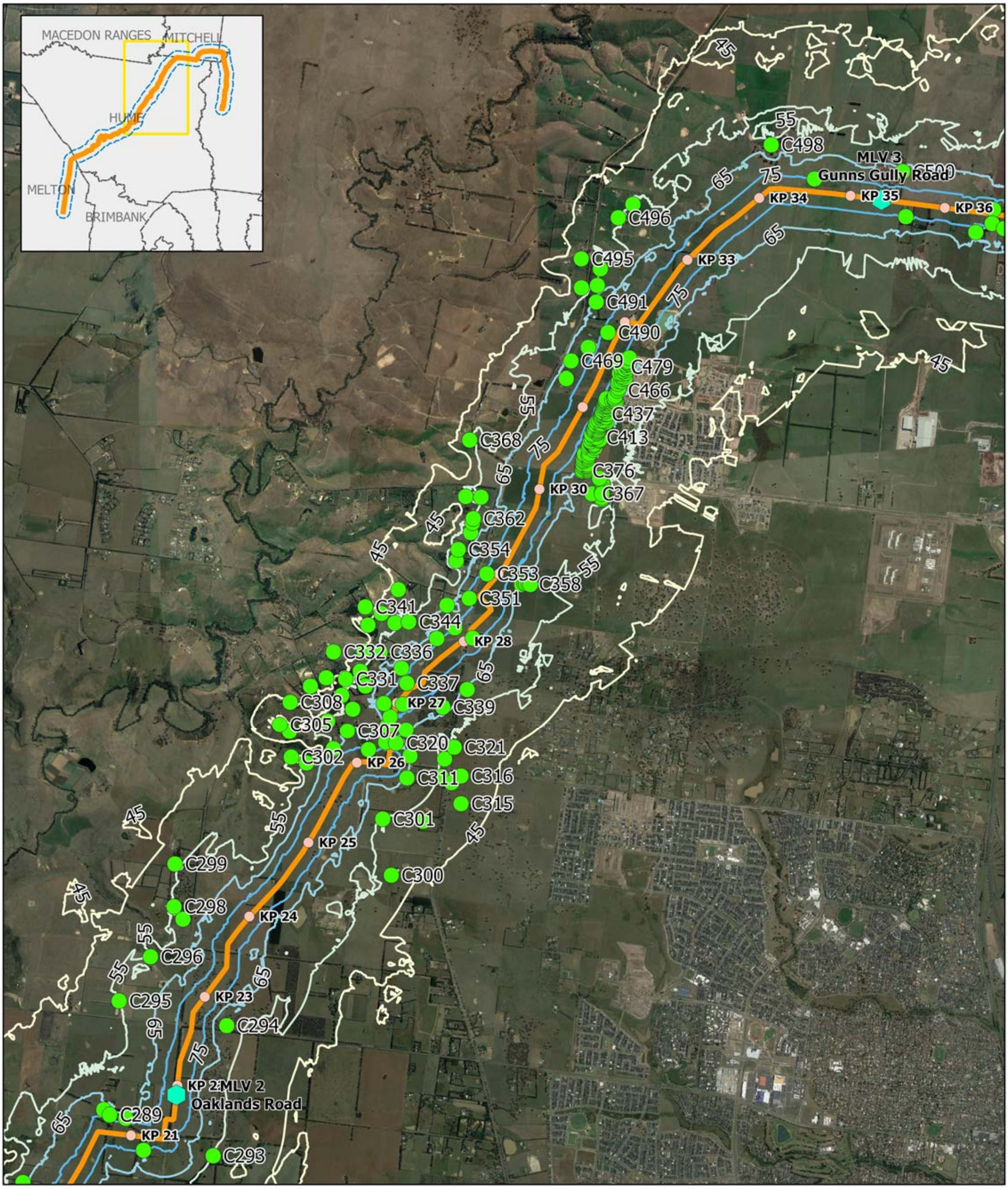
Data source: DELWP, VicMap, Google Earth Imagery 2020. Created by: DM



LEGEND

- Study area
- Pipeline
- Receptor
- Main line valve
- Noise level contour LAeq max (dB)

Paper Size A4

0 1,000 2,000 m

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

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Australian Pipeline Limited
APA WORM Environmental Effects Statement Noise Assessment

Predicted noise contours - open cut (KP 21-35)

Project No.	12529997
Revision No.	-
Date.	3/12/2020

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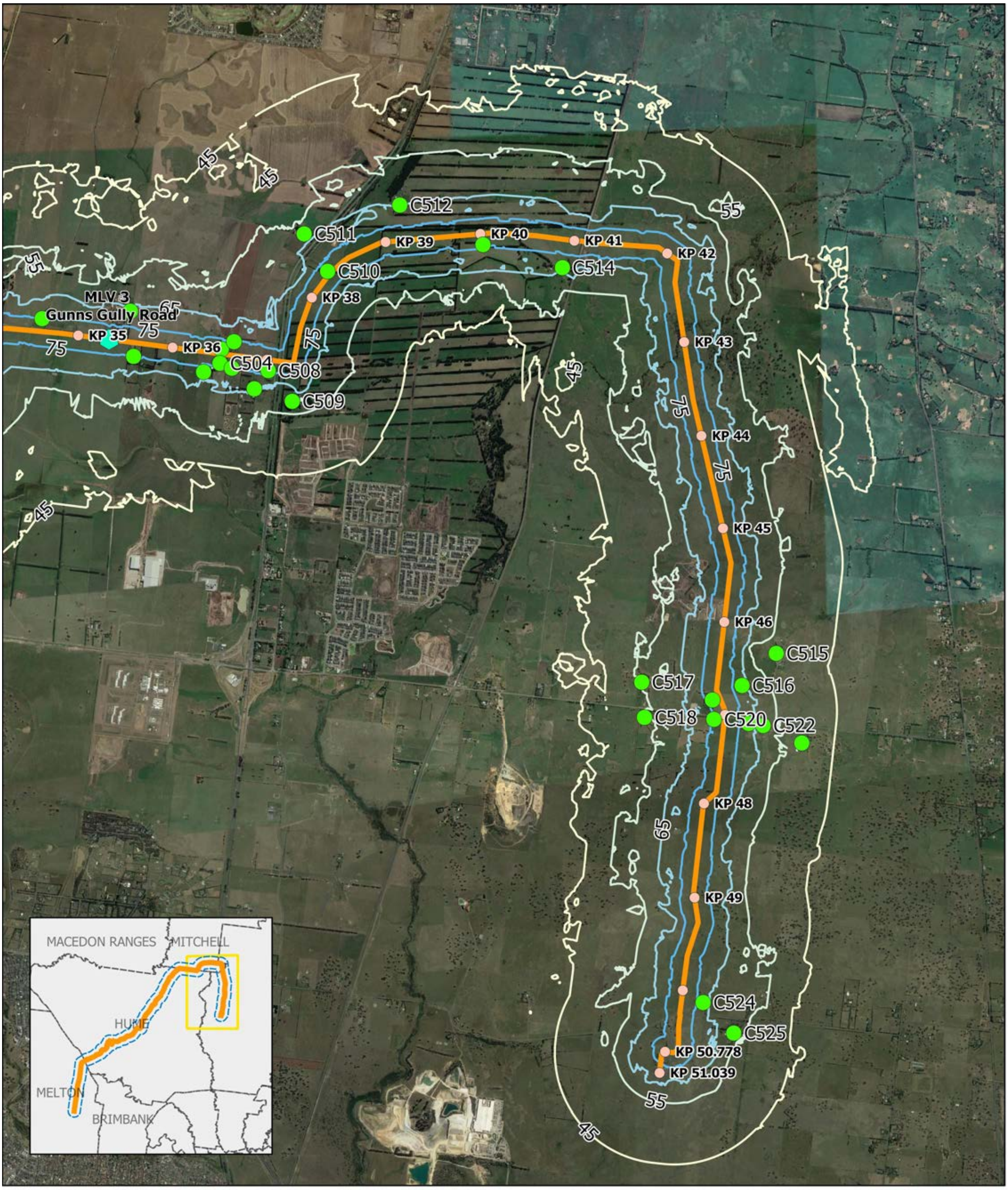
Data source: DELWP, VicMap, Google Earth Imagery 2020. Created by: DM



LEGEND

- Study area
- Pipeline
- Receptor
- Main line valve
- Noise level contour LAeq max (dB)

Paper Size A4

0 1,000 2,000 m

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N

Australian Pipeline Limited
APA WORM Environmental Effects
Statement Noise Assessment

Predicted noise contours - open cut (KP 35-51)

Project No.	12529997
Revision No.	-
Date.	3/12/2020

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Data source: DELWP, VicMap, Google Earth Imagery 2020. Created by: DM

Appendix G – Initial and residual risks- noise and vibration

Risk ID	Description	Pipeline/ MLV/ Compressor	Initial risk			Mitigation measure	Residual Risk		
			C	L	Risk		C	L	Risk
Construction									
NV1	**General construction noise** Construction equipment such as bulldozers, excavators, graders and vacuum trucks are significant noise sources. It may result in noise amenity impacts on sensitive receptors from general construction works	Pipeline	Moderate	Likely	Medium	NV1, NV2, NV5, NV9	Moderate	Remote	Low
NV2	**Construction noise (out of hours)** Some operations like HDD drilling, boring and hydrostatic testing may involve continuous works including the evening and night time periods. These works have the potential to cause increased disturbance to affected residents.	Pipeline	Major	Remote	Medium	NV1, NV2, NV5, NV7, NV7, NV9	Moderate	Remote	Low
NV3	**Construction noise (blasting)** Planned blasting may result in a short term impact in surrounding areas. Blasting works are planned for particular areas of the Project where rock will be encountered. Construction blasting operations may result in noise amenity impacts on sensitive receptors or causes structural damage to buildings.	Pipeline	Major	Remote	Medium	NV3, NV6	Moderate	Remote	Low

Risk ID	Description	Pipeline/ MLV/ Compressor	Initial risk			Mitigation measure	Residual Risk		
			C	L	Risk		C	L	Risk
NV4	**Construction vibration** Construction activities like excavation and rock breaking may results in a high levels of ground transmitted vibration. It may result in amenity impacts on sensitive receptors from general construction works.	Pipeline	Moderate	Likely	Medium	NV1, NV2, NV4, NV6, NV7, NV9	Minor	Unlikely	Low
NV5	**Blast vibration** Vibration due to blasting may result in vibration causing structural damage to buildings or underground assets or impacting on amenity of affected residents.	Pipeline	Severe	Remote	High	NV3, NV6, NV8	Major	Rare	Low
Operation									
NV6	**Operational noise** Operational noise impacts on sensitive receptors, from the Wollert compressor station, valves and auxiliary equipment.	Compressor station	Minor	Remote	Negligible	N/A	Minor	Remote	Negligible

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12529997-79160-676/https://projectsportal.ghd.com/sites/pp17_01/environmentaleffects/ProjectDocs/12529997-REP_Noise_Vibration_Assessment_v7.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	V Lenchine D Mansfield	E Lichkus		S Brattle		05/05/2020

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