Ballarat Line Upgrade

MELBOURNE METRO
RAIL AUTHORITY

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Operational Noise Impact Assessment

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AJM
Joint Venture

Aurecon, Jacobs,
Mott MacDonald

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121 Exhibition Street
Melbourne VIC 3000

PO Box 23061 Docklands VIC 8012 Australia

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Author signature		**Approver signature**	
Name	David Larner	**Name**	Tim Kitchen

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Appendices

Glossary and Abbreviations

The meanings of the terms used in this report are set out below.

<table>
<tr><th>TERM</th><th>MEANING</th></tr>
<tr><td>Ambient Noise Level</td><td>The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration.</td></tr>
<tr><td>dB</td><td>Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal (Newtons per square meter). Some typical noise levels are presented below:
<table>
<tr><th>Sound Pressure Level, dB(A)</th><th>Example</th></tr>
<tr><td>130</td><td>Threshold of pain</td></tr>
<tr><td>120</td><td>Jet aircraft take-off at 100 m</td></tr>
<tr><td>110</td><td>Power tool at 1 m</td></tr>
<tr><td>100</td><td>Nightclub</td></tr>
<tr><td>90</td><td>Heavy trucks at 5 m</td></tr>
<tr><td>80</td><td>Kerbside of busy street</td></tr>
<tr><td>70</td><td>Loud radio (in typical domestic room)</td></tr>
<tr><td>60</td><td>Office</td></tr>
<tr><td>50</td><td>Domestic fan heater at 1m</td></tr>
<tr><td>40</td><td>Quiet, night-time urban area</td></tr>
<tr><td>30</td><td>Quiet whispering</td></tr>
<tr><td>20</td><td>Rural environment on still night</td></tr>
<tr><td>10</td><td>Sound insulated test chamber</td></tr>
<tr><td>0</td><td>Threshold of hearing</td></tr>
</table></td></tr>
</table>

TERM	MEANING
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception over a number of different types of sounds. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
EPA	Environment Protection Authority
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), which is defined as one cycle per second. Human hearing ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
L_{A90}	The A-weighted sound pressure level that is exceeded for 90% of the measurement period. Usually used to represent the background noise level.
L_{eq}	The equivalent continuous sound pressure level. The steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.
L_{Aeq}	The A-weighted equivalent continuous sound pressure level is denoted $L_{Aeq.}$
L_{Max}, L_{FMax}, L_{SMax} L_{AMax}, L_{AFMax}, L_{ASMax}	The maximum measured linear (un-weighted or Z) sound pressure level. The L_{Max} variations, L_{FMax}, L_{SMax} are the L_{Max} levels using the "Fast" and "Slow" networks respectively. The A-weighted variations are also used in various guidelines and standards, L_{AMax}, L_{AFMax} and L_{ASMax}.
L_W / SWL	The Sound Power Level of a source is a measure of the total acoustic power radiated by a source. It is a characteristic of the sound source which is not affected by the environment within which the source is located.
Major Urban Area (NIRV)	Defined in NIRV as; » The part of Melbourne that extends beyond the SEPP N-1 area, but is within the Melbourne Urban Growth Boundary » Land within the “Urban Centre Boundary” (as defined by the Australian Bureau of Statistics) of an Urban Centre with a population greater than 7000.
NATA	National Association of Testing Authorities.
NIRV	*Noise from Industry in Regional Victoria Guideline,* EPA Publication 1411 October 2011
Noise Barrier	An outdoor noise wall, consisting of a surface area of minimum 15 kg/m^2, contiguous with no gaps or holes. This may be treated with sound absorbing material.
Noise Reduction Coefficient (NRC)	The arithmetic average (rounded to the nearest 0.05) of the absorption coefficient of a material at the 250 Hz, 500 Hz, 1 kHz and 2 kHz octave band frequencies.

TERM	MEANING
Noise Sensitive Areas (SEPP N-1)	a) That part of the land within the apparent boundaries of any piece of land which is within a distance of 10 m outside the external walls of any of the following buildings: dwelling and residential building b) That part of the land within the apparent boundaries of any piece of land on which is situated any of the following buildings which is within a distance of 10m outside the external walls of any dormitory, ward or bedroom of such buildings: · Caretaker's house · Hospital · Hotel · Institutional Home · Motel · Reformative Institution · Tourist Establishment · Work Release Hostel
PRINP	Victorian *Passenger Rail Infrastructure Noise Policy*, April 2013
SEPP N-1	Victorian *State Environment Protection Policy (Control of Noise from Industry, Commerce and Trade) No. N-1.*

Executive Summary

The Aurecon, Jacobs, Mott MacDonald Joint Venture (AJM) has been engaged by the Melbourne Metro Rail Authority (MMRA) to provide an operational noise impact assessment for the Ballarat Line Upgrade (the project). The noise impact assessment undertaken by AJM has included:

- An assessment of noise associated with a proposed V/Line train stabling yard, consisting of six 250 m long stabling roads, to be located at Maddingley (Kerrs Road).
- An operational railway noise assessment to evaluate compliance with the *Passenger Rail Infrastructure Noise Policy (PRINP), April 2013* for a number of rail upgrades. The assessment considered the operational rail noise from passenger services along the Ballarat line following the project rail upgrades including:
  - » Track duplication between Deer Park West and Melton
  - » New passing loop of approximately 5 km to be established at Ballan (two options are considered)
  - » New passing loop of approximately 4 km to be established at Spreadeagle
  - » Track duplication for approximately 3 km to be established near Warrenheip.
- Ambient noise monitoring has been conducted at locations along the alignment. This included:
  - » short-term attended night time noise measurements to determine noise requirements with regard to noise from the stabling yard
  - » Week-long unattended noise monitoring to provide a baseline and also to validate the operational rail noise model.

The operational noise assessment has been based on the Concept Design for the project. It is anticipated that noise modelling will be re-visited during the detailed design phase of the project, to ensure that the predicted impacts and required mitigation measures remain consistent with the design goals presented in this report.

The main findings of the respective assessments are summarised as follows.

Maddingley Stabling Yard (Kerrs Road)

An assessment of the predicted noise levels from the Maddingley stabling yard has been undertaken using an acoustic model. The acoustic model was developed using source noise levels measured at the existing Bacchus Marsh stabling yard, which houses the same trains that will be stabled at Maddingley. This model has been used to predict noise levels at Noise Sensitive Areas (NSAs), namely residential dwellings, in the vicinity of the Maddingley stabling yard, to enable comparison with specified noise requirements.

The noise is predicted to comply with the noise requirements at all NSAs surrounding the stabling yard.

Railway Noise Assessment

The Ballarat Line Upgrade has been assessed for compliance against the requirements of the PRINP, a policy that is triggered when statutory approval is required for, amongst other things, redevelopment of existing rail passenger rail infrastructure. The PRINP investigation undertaken for this project is for *redevelopment of existing passenger rail infrastructure*. An acoustic model has been developed based on the rail design developed by AJM and the MMRA. Noise levels are predicted at nearby sensitive receivers due to the future operating scenario, which is split into two categories:

- Future A – Use of the current rolling stock on the Ballarat rail line, which includes both N-Class and VLocity trains
- Future B – Use of VLocity trains as the sole passenger service vehicle on the Ballarat rail line.

These two future cases have been compared to the Base-Case, corresponding to the situation that would have occurred one day prior to the Ballarat Line Upgrade opening if the project did not proceed.

The assessment has identified a number of noise sensitive receivers where it has been predicted that noise will exceed the PRINP, specifically at the following locations:

- One property located in the vicinity of Stewart Crescent, Rockbank
- A number of properties (up to 7) located in the vicinity of James Melrose Drive, Brookfield
- A number of properties (up to 3) located in the vicinity of a different section of James Melrose Drive, Brookfield.

A number of mitigation options are available in order to achieve compliance with the PRINP. As the project is located adjacent to an existing rail line in a constrained corridor, options for mitigation are limited, and changes to the design are not feasible. As such, for this project, acoustic treatments either along rail corridors or at the dwellings are considered a practical and cost-effective form of mitigation. By way of example, the noise assessment has proposed noise barrier locations that result in an appropriate level of noise mitigation required.

Construction noise is not assessed in this Operational Noise Impact Assessment, however construction noise will be managed in accordance with the *Environmental Guidelines for Major Construction Sites,* Publication 480 and EPA *Noise Control Guidelines* Publication 1254 (EPA 1254).

Based on the assessment undertaken, it is considered that while there would be some changes in operational noise at nearby sensitive receptors on completion of the project, these do not involve a significant increase or a significant number of dwellings having regard to the rail corridor and the suburban and regional areas that will benefit from the project works. Environmental Performance Requirements (EPRs) to be approved by the Minister for Planning as part of the proposed Incorporated Document for the project will require that operational noise outcomes comply with relevant criteria. On this basis, operational noise will not have a significant adverse effect on residential amenity.

1 Introduction

1.1 Project

In October 2016, the Victorian Government appointed the Melbourne Metro Rail Authority (MMRA) as the delivery agency for the Ballarat Line Upgrade (the project). Pending the timely provision of planning and environmental approvals, major construction works are expected to commence in 2018, with early works starting in the fourth quarter of 2017. The project is expected to be completed in 2019.

The project comprises a series of new rail and station upgrades to the existing Ballarat railway line to improve transport services on the Ballarat rail line between Deer Park West, in Melbourne's outer western suburbs and Warrenheip, outside Ballarat. The new rail and station upgrades involve duplication of track and installation of passing loops, station upgrades, new stabling facilities and associated works.

The project area extends along the Ballarat rail corridor from Deer Park West through to Warrenheip Road, Warrenheip. The project does not involve works along the entire length of the rail line, with new rail and station upgrades at five discrete locations (elements). The new railway and station upgrades are located within the VicTrack rail corridor.

The project area as shown in Figure 1.1 shows the five 'project elements'. Details of the scope of work for the new railway and station upgrades in the five elements are provided in Table 1-1.

TABLE 1-1 BALLARAT LINE UPGRADE SCOPE OF WORK BY ELEMENT

ELEMENT	SCOPE OF WORK FOR THE NEW RAILWAY AND STATION UPGRADES
Element 1: Deer Park West and Melton	· Duplicate approximately 18 km of rail line between Deer Park West and to the west of Melton Station. · Rebuild platforms at Rockbank station, provision of a pedestrian link between platforms, and a new sealed car park. · Site preparation works for a future station at Toolern, including raised tracks and pedestrian infrastructure.
Element 2: Bacchus Marsh Second Platform / Maddingley Stabling	· Remove overnight stabling facilities at Bacchus Marsh station. · Construct a second platform at Bacchus Marsh station, providing a pedestrian link between original and new platforms, and sealed car parking areas. · Construct a new train stabling yard and driver facilities at Kerrs Road, Maddingley.

Element 3: Ballan Loop	· Construct approximately 5 km of crossing loop situated either
	  · from Ingliston Road to approximately 2 km west of Ballan station ; OR
	  · from Ballan Station to just west of the East Moorabool River crossing
	· Build a second platform at Ballan station and new pedestrian link between the new and original platform.

Element 4: Spreadeagle (new Bungaree) Loop	· Construct a new 4 km crossing loop between West Moorabool River and Old Melbourne Road · Widen two roads over rail bridges at Peerewerrh and Spreadeagle Roads
Element 5: Warrenheip Duplication	· Duplicate approximately 3 km of rail line east of Warrenheip Road, Warrenheip.

1.2 Purpose

The purpose of this report is to present an assessment of potential noise impacts associated with the operation of the proposed Maddingley stabling yard (at Kerrs Road), and operation of the Ballarat rail line as a result of the proposed modifications.

1.3 Objectives

The objectives of this assessment are to:

- Assess noise associated with the proposed stabling yard operations. In particular, to:
  - Predict the stabling yard noise levels at nearby Noise Sensitive Areas (NSAs)
  - Assess the predicted noise levels against the applicable regulatory requirements
  - Recommend acoustic mitigation options
- Assess noise associated with the operational railway. In particular, to:
  - Predict the rail noise levels at nearby sensitive locations
  - Assess the predicted noise levels with respect to the applicable regulatory requirements
  - Recommend acoustic mitigation.

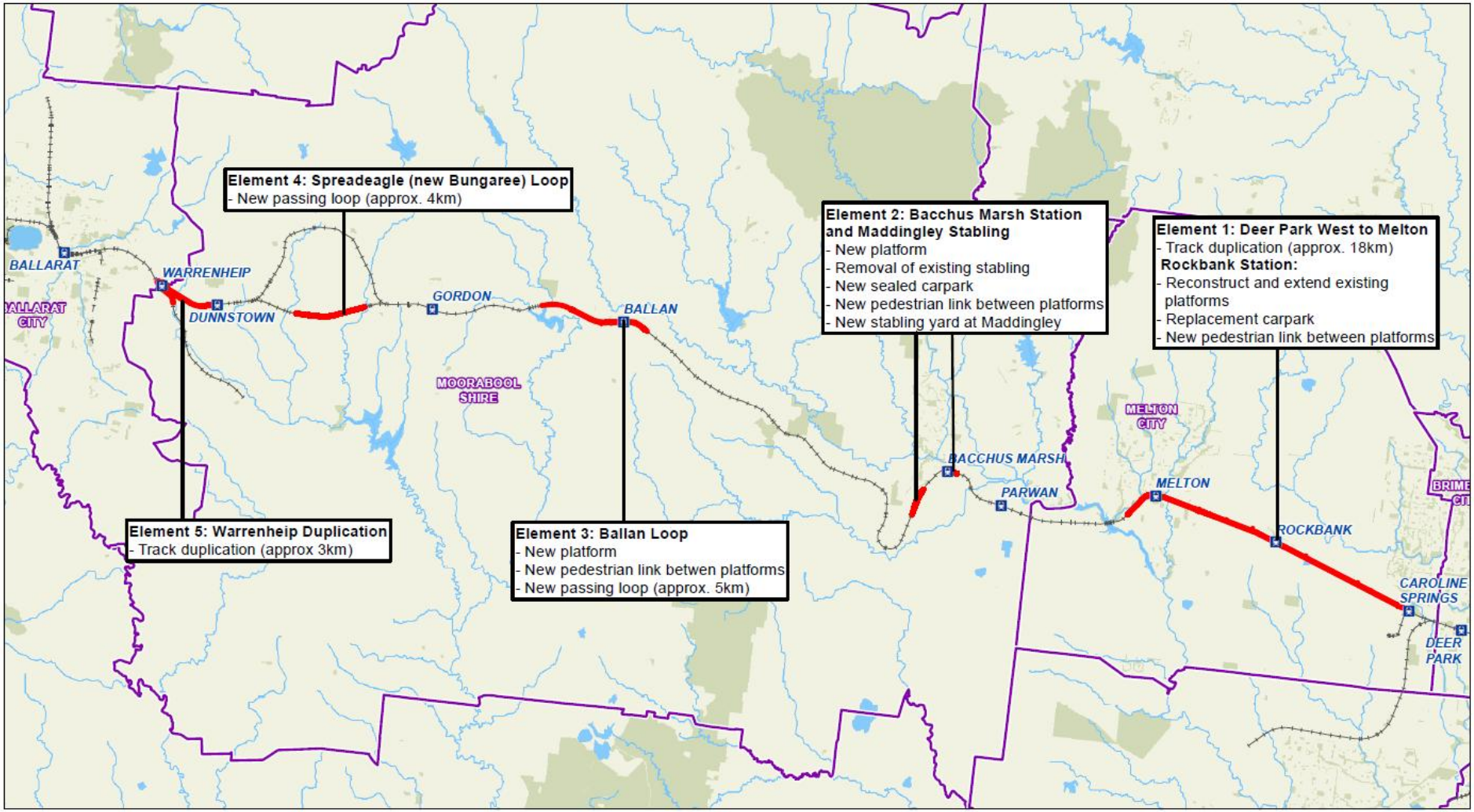


FIGURE 1-1: PROJECT AREA AND WORK ELEMENTS, BALLARAT LINE UPGRADE

2 Project Details

2.1 Stabling Yard

The Ballarat Line Upgrade business case has identified the need for a second platform to be constructed at Bacchus Marsh. To enable this to occur, the existing six road stabling yard at Bacchus Marsh will need to be de-commissioned. The overall stabling strategy is to provide and maintain six 250 m long stabling roads at Maddingley, to replace those being removed at Bacchus Marsh (see Figure 2-1).

2.2 Track upgrades

There are a number of track upgrades that will be required to be constructed as part of the project, including the following:

- Track duplication between Deer Park West and Melton - shown in Figure 2-2.
- New passing loop of approximately 5 km to be established near Ballan. There are two options that are being considered for this passing loop, with Option 1 shown in Figure 2-3 and Option 2 shown in Figure 2-4.
- New passing loop of approximately 4 km to be established near Spreadeagle - shown in Figure 2-5.
- Track duplication of approximately 3 km to be established near Warrenheip - shown in Figure 2-6.

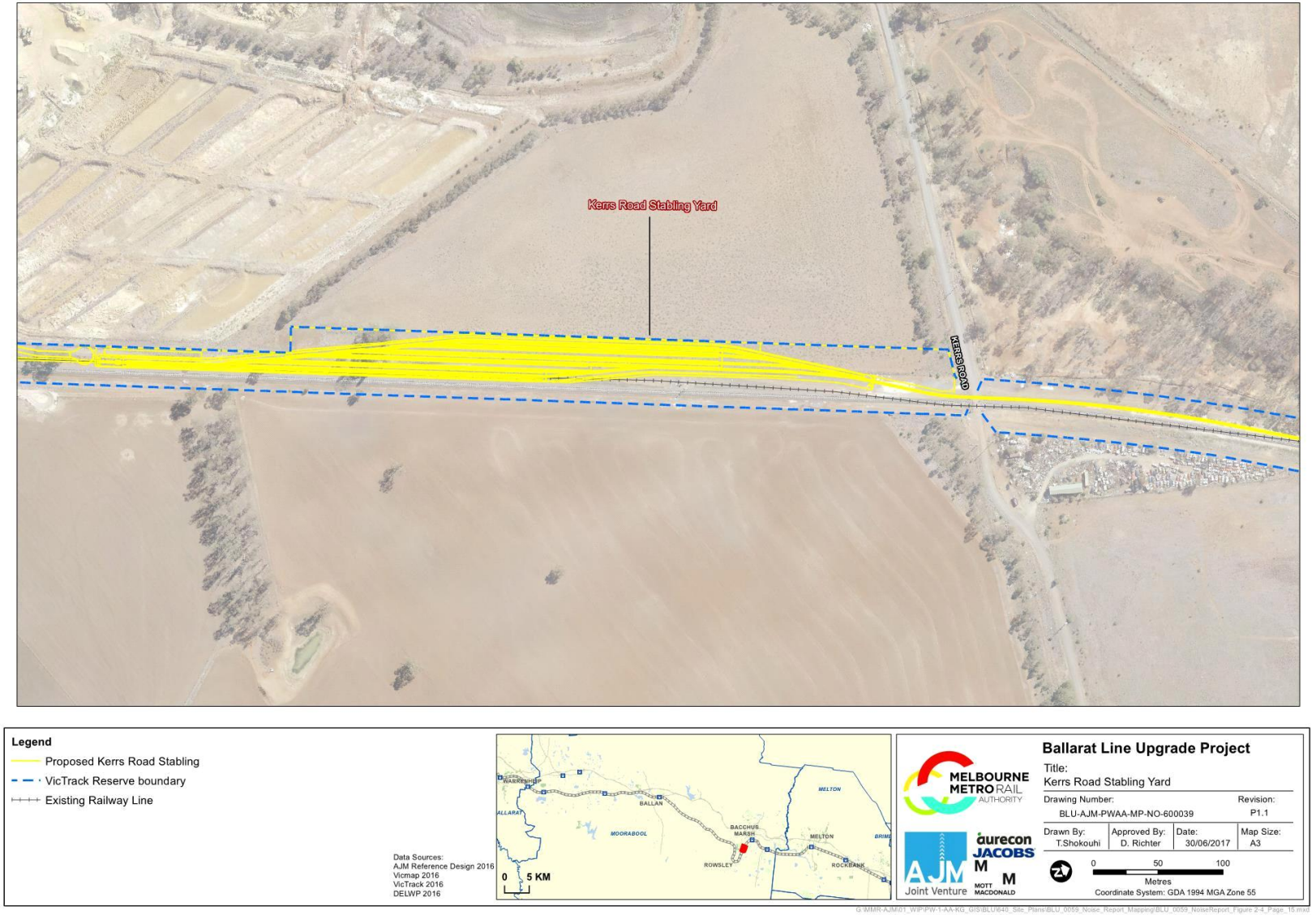


FIGURE 2-1: KERRS ROAD DISTRICT: LOCATION OF MADDINGLEY STABLING YARD

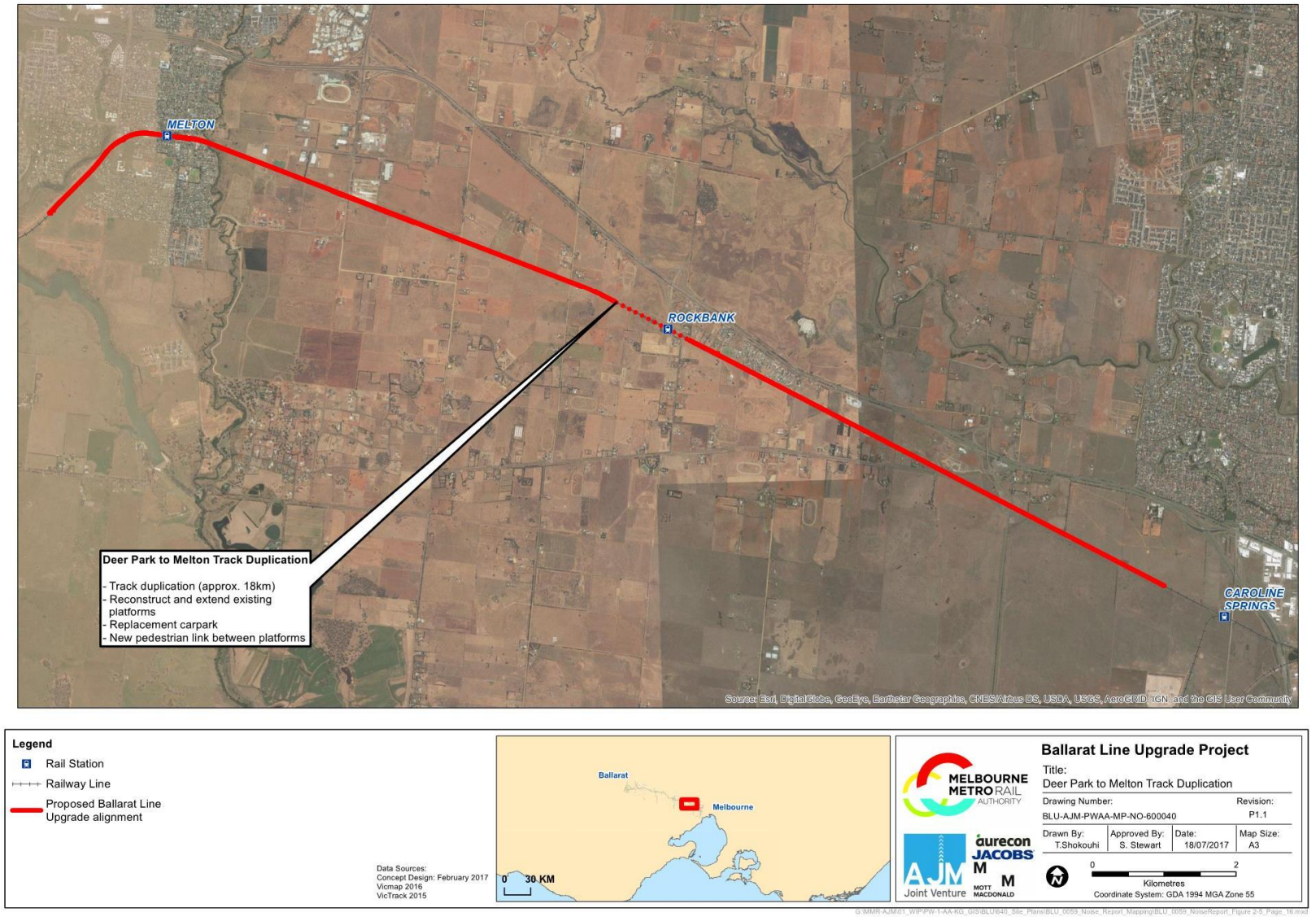


FIGURE 2-2: LOCATION OF DEER PARK WEST TO MELTON TRACK DUPLICATION

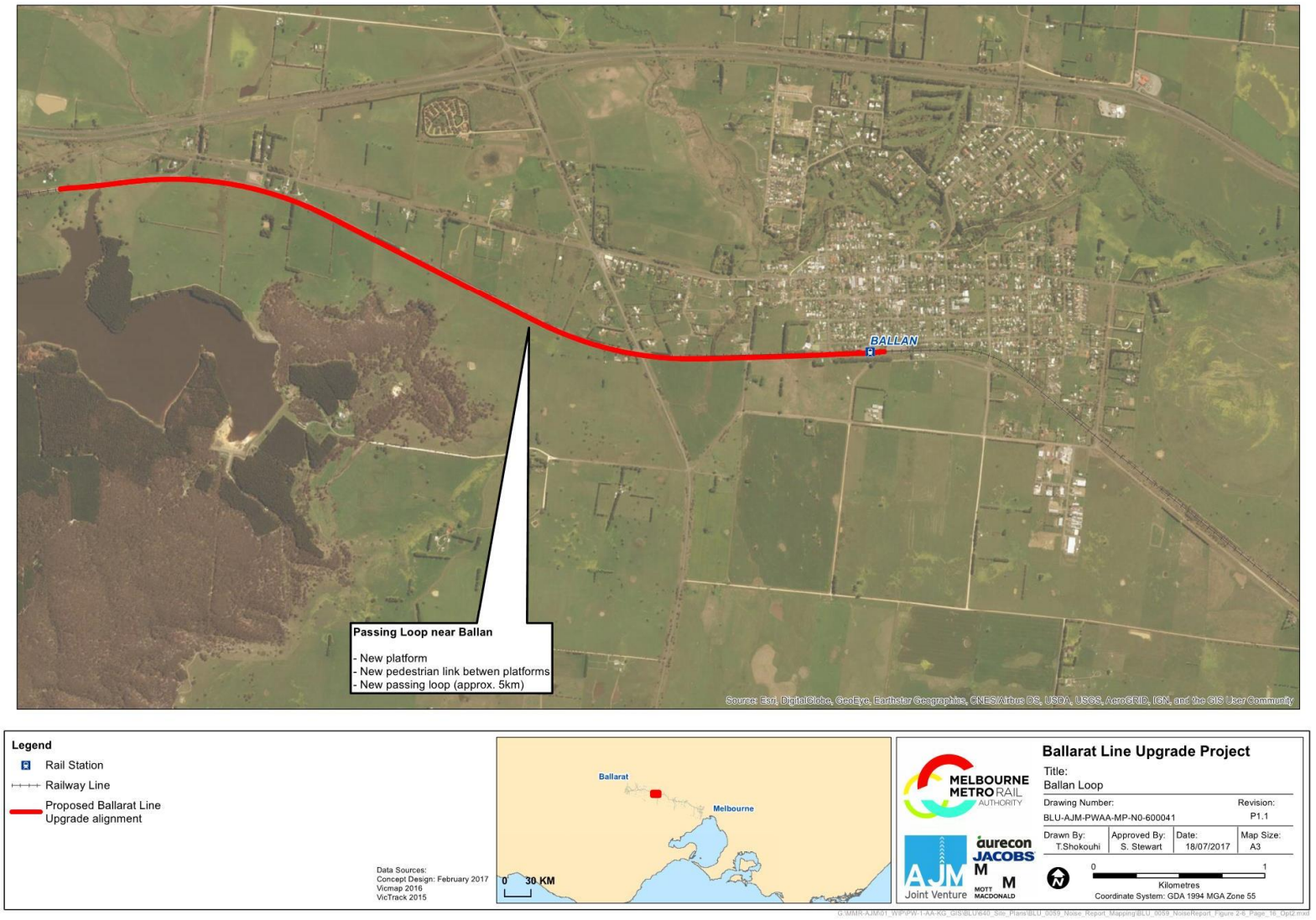


FIGURE 2-3: LOCATION OF BALLAN PASSING LOOP – OPTION 1

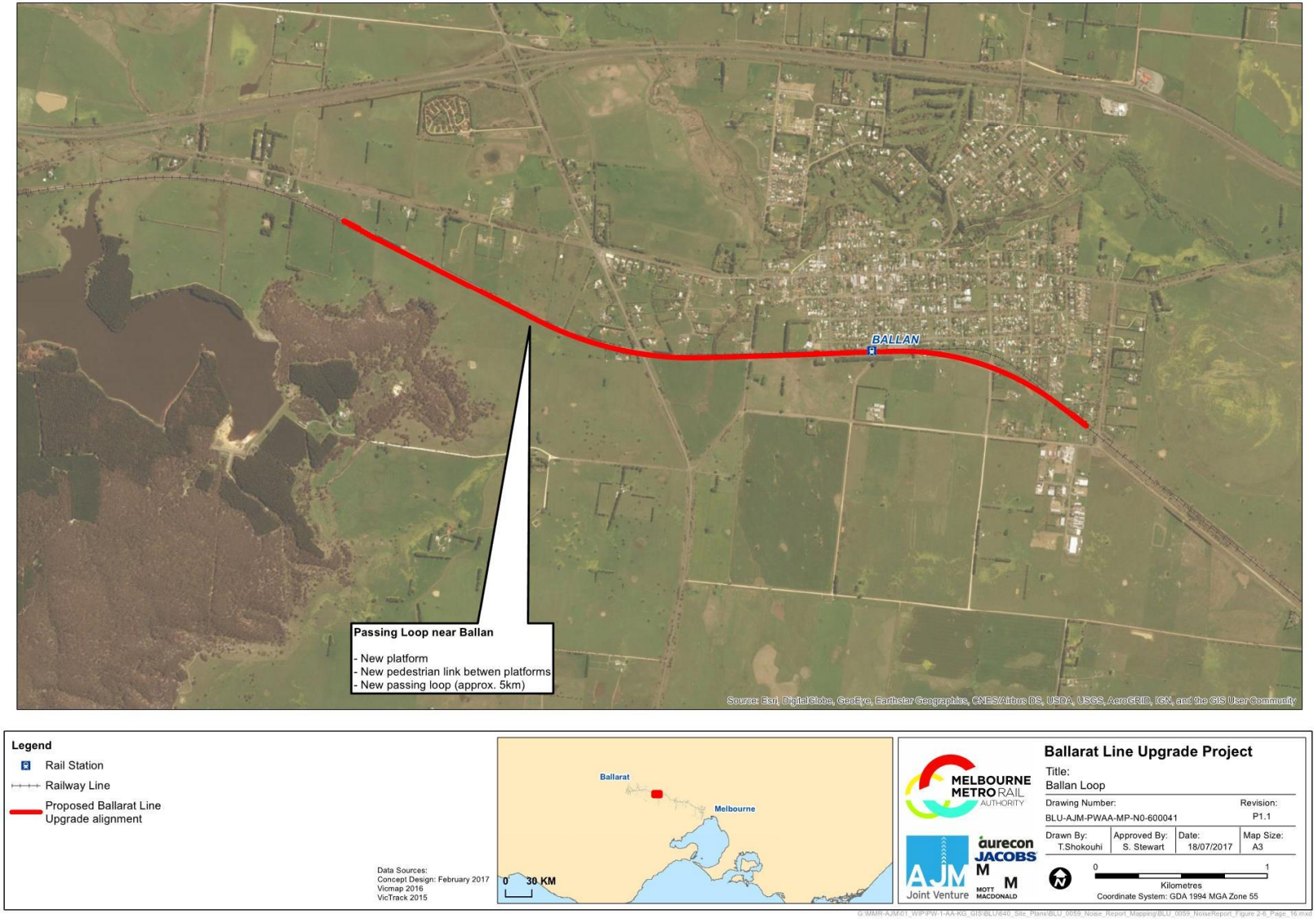


FIGURE 2-4: LOCATION OF BALLAN PASSING LOOP – OPTION 2

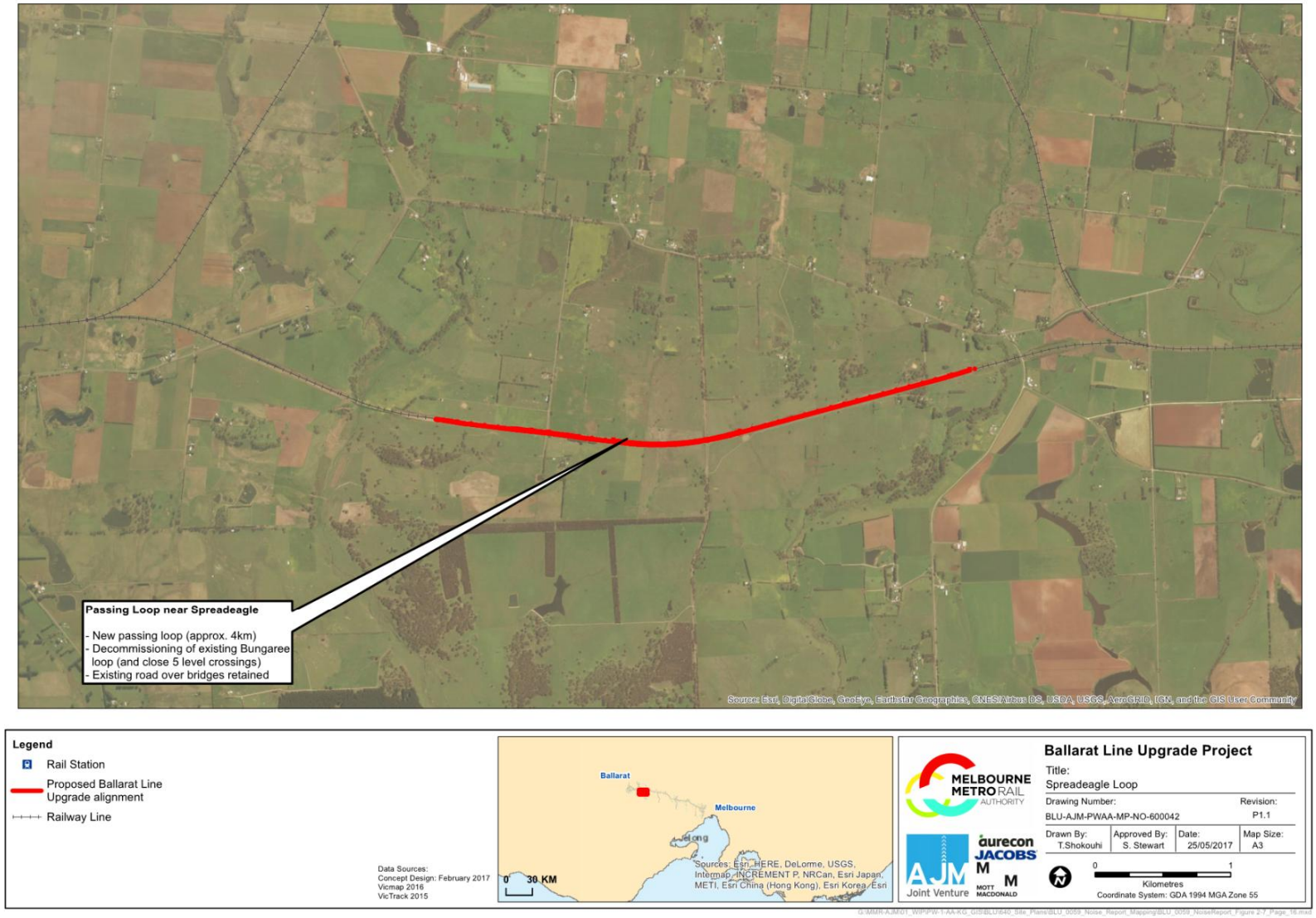


FIGURE 2-5: LOCATION OF SPREADEAGLE PASSING LOOP

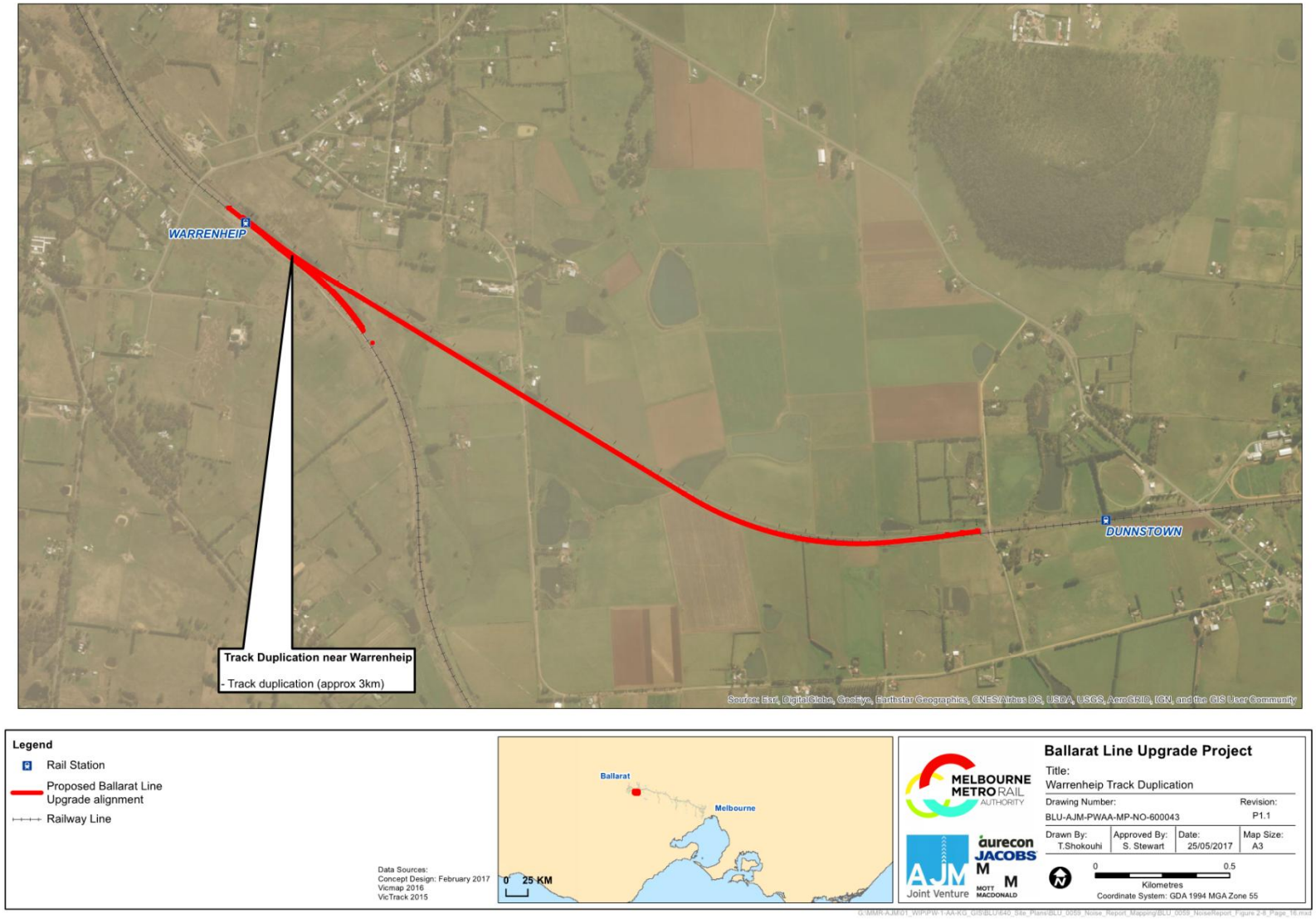


FIGURE 2-6: LOCATION OF WARRENHEIP TRACK DUPLICATION

3 Legislation and Policy

3.1 Noise associated with Stabling Yards

3.1.1 TRANSPORT (COMPLIANCE AND MISCELLANEOUS) ACT 1983 – SECTION 251B

Section 251B of the *Transport (Compliance and Miscellaneous) Act 1983* excludes the following from constituting a nuisance:

> *Any noise emanating from rolling stock –*
>
> *(a) Whilst the rolling stock is travelling on a railway track or tramway track; or*
>
> *(b) Whilst the rolling stock is entering or exiting a siding, yard, depot or workshop; or*
>
> *(c) While the rolling stock is in a siding, yard, depot or workshop and is -*
>
> *(i) Powering up to commence to be used in connection with the provision of a passenger service; or*
>
> *(ii) Shutting down after being used in connection with the provision of a passenger service*

Noise from plant and equipment in stabling yard areas and from fixed infrastructure (such as power transformers and ancillary equipment) is not subject to Section 251B because the noise is not emitted from the passenger rail service itself. The noise requirements will be assessed by either the *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) Number N-1* (SEPP N-1) or *Noise from Industry in Regional Victoria* (NIRV) as described below.

3.1.2 STATE ENVIRONMENT PROTECTION POLICY (CONTROL OF NOISE FROM COMMERCE, INDUSTRY AND TRADE) NUMBER N-1 (SEPP N-1)

SEPP N-1 is a statutory requirement. The purpose of SEPP N-1 is to protect people from commercial, industrial or trade noise that may affect an NSA, while taking into consideration the existing land use around the NSA, and is specifically applicable across metropolitan areas. An NSA is defined in SEPP N-1 and consists of dwellings, residential buildings and similar types of accommodation. It should be noted that where either the noise emitter or the noise receiver is within a Major Urban Area, the SEPP N-1 approach is applicable. As such, SEPP N-1 is the applicable regulation with respect to noise emission from the Maddingley stabling yard, for those NSAs located within a Major Urban Area.

It is noted that despite the exemption that is potentially applicable for noise from rolling stock, as outlined in Section 3.1.1, the noise assessment has incorporated noise from rolling stock to ensure that the assessment is as comprehensive as possible. The sources incorporated in the modelling have been summarised in Section 4.5.1.

The SEPP N-1 assessment requires the following:

- Determination of Effective Noise Levels predicted to be experienced at the NSA, with adjustments for noise character, duration and measurement position
- Determination of Noise Limits, based on the measured background noise level and land use zoning of the area around the NSA
- A comparison between the Effective Noise Level and the Noise Limit. For compliance, the Effective Noise Level is not to exceed the Noise Limit.

The Noise Limits are determined following the methodology in Schedule B of SEPP N-1 and are based on the specific time periods, as defined by SEPP N-1 and shown in Table 3-1.

TABLE 3-1: SEPP N-1 TIME PERIODS

TIME PERIOD	TIME
Day	7am to 6pm Monday to Friday 7am to 1pm Saturday
Evening	6pm to 10pm Monday to Friday 1pm to 10pm Saturday 7am to 10pm Sunday and Public Holiday
Night	10pm to 7am All days

The Noise Limits determined using this methodology should not be less than the Base Noise Limits, which are provided in Table 3-2. If the Noise Limit determined is lower than the Base Noise Limit, then the Base Noise Limit becomes the Noise Limit.

TABLE 3-2: SEPP N-1 BASE NOISE LIMITS

TIME PERIOD	BASE NOISE LIMIT DB(A)
Day	45
Evening	40
Night	35

The Noise Limits are applicable to the combination of all noise associated with commerce, industry and trade. Therefore, noise from each facility may need to be less than the given Noise Limit. SEPP N-1 does not include noise from traffic on road and rail corridors.

3.1.3 NOISE FROM INDUSTRY IN REGIONAL VICTORIA (NIRV)

Properties in the vicinity of the Maddingley stabling yard that fall outside of a Major Urban Area have been assessed under the NIRV guideline.

The NIRV guideline applies to industry in regional Victoria in all locations outside the SEPP N-1 assessment areas. This guideline sets Recommended Maximum Noise Levels (Recommended Levels), which can be applied to manage the impacts of noise on NSAs. The Recommended Levels provide different degrees of amenity protection in different land-use zones. The Recommended Levels promote normal domestic use of the

home and sleep at night. NIRV is a non-statutory guideline and the recommended levels are only legally binding when applied through statutory instruments, such as a planning permit or notice.

The NIRV time periods are the same as for SEPP N-1 and the Base Noise Levels are provided in Table 3-3.

TABLE 3-3: NIRV BASE NOISE LEVELS

TIME PERIOD	BASE NOISE LEVEL DB(A)
Day	45
Evening	37
Night	32

The NIRV guideline does not include noise from traffic on road and rail corridors.

Noise from multiple sites should be accounted for during approvals and compliance decisions.

3.1.4 THE VICTORIAN PASSENGER RAIL INFRASTRUCTURE NOISE POLICY

It should also be noted that the stabling yard has not been assessed under the Victorian *Passenger Rail Infrastructure Noise Policy*, April 2013 (PRINP) as it does not apply to these works, Section 5 of the PRINP states:

> *(Applicable transport bodies and planning authorities) need not have regard to this policy (PRINP) when exercising powers or performing functions in regards to:*
>
> - *New freight rail or tram infrastructure projects or;*
> - *Where the State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) Number N-1 provisions apply.*

Therefore the assessment of the stabling yard has been undertaken using SEPP N-1, although the assessment of the rail corridor has been undertaken using the PRINP.

3.1.5 LOCAL

There are no local policies that apply with respect to noise from fixed infrastructure.

3.2 Noise associated with Railway Operation

3.2.1 TRANSPORT (COMPLIANCE AND MISCELLANEOUS) ACT 1983 – SECTION 251B

As per Section 3.1.1.

3.2.2 THE VICTORIAN PASSENGER RAIL INFRASTRUCTURE NOISE POLICY

Operational rail noise associated with the project would need to comply with PRINP. The PRINP is a state government policy that is triggered when there is a statutory approval required for construction of new passenger rail infrastructure, redevelopment of existing passenger rail infrastructure or where there is a change in land use adjacent to a rail corridor. The PRINP provides Investigation Thresholds to guide transport bodies

when assessing the impacts of rail noise on nearby communities. The thresholds are not a limit on allowable noise emissions. If they are exceeded, then options for avoiding, minimising and mitigating rail noise should be considered as proposed in the PRINP.

The Investigation Thresholds for redevelopment of existing passenger rail infrastructure are applicable and are provided in Table 3-4.

TABLE 3-4 EXTERNAL INVESTIGATION THRESHOLDS FOR REDEVELOPMENT OF EXISTING PASSENGER RAIL INFRASTRUCTURE

TIME	TYPE OF RECEIVER	INVESTIGATION THRESHOLDS
Day (6am – 10pm)	Residential dwellings and other buildings where people sleep including aged persons homes, hospitals, motels and caravan parks Noise sensitive community buildings, including schools, kindergartens, libraries.	65 dBL_{Aeq} and a change in 3 dB(A) or more or 85 dBL_{Amax} and a change in 3 dB(A) or more.
Night (10pm – 6am)	Residential dwellings and other buildings where people sleep including aged persons homes, hospitals, motels and caravan parks.	60 dBL_{Aeq} and a change in 3 dB(A) or more or 85 dBL_{Amax} and a change in 3 dB(A) or more.

Notes:

1. If an investigation shows that the thresholds are not exceeded, then no further action is considered under this policy.
2. L_{Amax}, for this assessment, is defined as maximum A-weighted sound pressure level and is the 95 percentile of the highest value of the A-weighed sound pressure level reached within the day or night.
3. The location of assessment is at 1 metre from the centre of the window of the most exposed habitable room.

The Investigation Thresholds are used as target noise levels with respect to operational railway noise.

3.2.3 LOCAL

There are no local policies that apply with respect to operational rail noise.

4 Noise from Maddingley Stabling Yard

4.1 Introduction

A stabling yard is proposed to be established at a site at Maddingley (Kerrs Road) as shown in Figure 4-1. An assessment of the predicted noise generated from the activities at the Maddingley stabling yard has been undertaken.

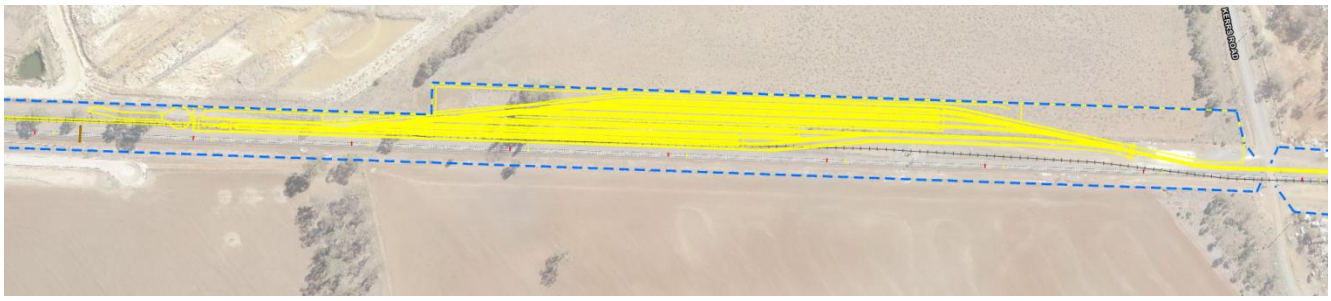


FIGURE 4-1: STABLING AT MADDINGLEY

4.2 Methodology

The following methodology has been used to assess the impact of noise from the stabling yards:

- Noise measurements of the potential noise sources were undertaken in the vicinity of the existing Bacchus Marsh stabling yard
- Background noise measurements were undertaken in the vicinity of the Maddingley stabling yard
- Relevant noise requirements at the NSAs were determined
- An acoustic model was created, and used to predict noise levels likely to be experienced at the NSAs
- Assessment of the predicted noise from the stabling yards, and a comparison against the determined noise requirements were undertaken.

4.2.1 ASSUMPTIONS

The following assumptions have been made for the noise impact assessment:

- The noise assessment has been based on the Concept Design for the project. It is anticipated that noise modelling will be re-visited during the detailed design phase of the project, to ensure that the predicted impacts, and required mitigation measures, remain consistent with the design goals presented in this report.
- The site is currently within the Industrial 2 Zone and the operational noise assessment has been undertaken on this basis. The MMRA will engage with VicTrack as the owner of this land to confirm whether it is appropriate to re-zone the land to PUZ4 prior to the commencement of project operation. If VicTrack wishes to pursue rezoning to PUZ4 in accordance with its plans as landowner for the current and future use of the land, then it would be appropriate to give further consideration to operational noise at sensitive receptors as part of the assessment to support rezoning.

- The scenario modelled is the realistic worst case scenario and consists of the maximum number of trains expected to be running at the same time over a 30-minute period. This consists of:
  - » Train idling
  - » Train revving
  - » Train horn
  - » Train movement (for the VLocity)
  - » Head-end power revving (for the N-Class)

  Time weighting factors have been taken into account for the different activities.

- Activity will occur during the Night period as defined by SEPP N-1 and indicated in Table 3-1 (i.e. 10pm to 7am). Activities are not continuous during this period. Trains are assumed to be starting up at, or around 4am.

- Two N-Class trains were assumed to be stationery during the half hour period, at the stabling yard location, which is considered to represent a realistic noise generation profile for the operation.

- When the N-Class trains are phased out they will be replaced with the VLocity vehicles. The noise levels associated with these will be lower than for the N-Class vehicles (specifically because there will be no HEP revving or general engine revving).

4.3 Noise Measurements

Noise levels were measured at the existing Bacchus Marsh stabling yard to determine the source noise levels for the proposed activities associated with the Maddingley stabling yard. Details of the noise measurements are provided in Appendix A Section A1. For the measurements, the following were obtained:

- L_{Aeq} including the one-third octave band spectrum 25 Hz to 10 kHz

- L_{Amax} including the one-third octave band spectrum 25 Hz to 10 kHz

- Recording and time history data.

The source noise levels were typically measured at locations close to the noise sources. The results of these measurements are detailed in Table 4-1 and the measurement locations are shown in Figure 4-2. Noise loggers were located at a greater distance from the noise sources (as shown in Figure 4-2) and were used for verification of the acoustic model.

TABLE 4-1: MEASUREMENT DETAILS

MEASUREMENT LOCATION	EQUIPMENT	MEASUREMENT	SOUND PRESSURE LEVEL
1	SLM	VLocity Idling (Back) @ 1 m	79 dB $L_{Aeq,30s}$:
		VLocity Horn during Idling @ 1 m	106 dB L_{Amax}:
2	SLM	VLocity Idling (Front) @ 1 m	83 dB $L_{Aeq,30s}$:
3	SLM	VLocity Passby @ 1 m	81 dB $L_{Aeq,30s}$:
4	SLM	N-Class Idling @ 1 m	81 dB $L_{Aeq,30s}$:
		N-Class Revving @ 2 m	89 dB $L_{Aeq,30s}$:

MEASUREMENT LOCATION	EQUIPMENT	MEASUREMENT	SOUND PRESSURE LEVEL
		N-Class Head-end power (HEP) revving @ 1 m	81 dB $L_{Aeq,30s}$:
		N-Class Horn during Idling @ 4 m	109 dB $L_{Amax:}$
5	Noise Logger	Whole measurement period – verification point	N/A
6	Noise Logger	Whole measurement period – verification point	N/A

FIGURE 4-2: MEASUREMENT LOCATIONS AT BACCHUS MARSH STABLING YARD

4.4 Noise Requirements

Due to the proposed location of the Maddingley stabling yard (and its proximity to the southern edge of Bacchus Marsh), SEPP N-1 applies to the stabling yard however NSAs have been assessed that are located either within, or outside, an area corresponding to a Major Urban Area as defined by SEPP N-1. As such, an assessment of compliance against SEPP N-1 or NIRV is required to be undertaken, depending on the location of the NSAs.

The applicable regulatory noise requirements for each of the NSAs in the vicinity of the Maddingley stabling yard, the representative Background Noise Level, and the corresponding noise requirements, are provided in Table 4-2. Indicative locations of the NSAs are also shown in Figure 4-3.

Ambient noise measurements were undertaken at NSAs in the vicinity of the stabling yard for the assessment. Information about the monitoring undertaken is provided in Appendix A Section A.1.

TABLE 4-2: NIGHT TIME NOISE LIMITS OF SENSITIVE RECEIVERS SURROUNDING THE MADDINGLEY STABLING YARD

LOCATION REFERENCE	PROPERTY LOCATION	APPLICABLE EPA REQUIREMENTS	MEASURED REPRESENTATIVE BACKGROUND NOISE LEVEL DB(A)	NIGHT TIME NOISE REQUIREMENT DB(A)
1	Property near Osborne Street, Maddingley	NIRV	26	40
2	Property near Osborne Street, Maddingley	NIRV	26	36
3	Property near Warde Close, Maddingley	NIRV	26	37
4	Property near South Maddingley Road, Maddingley	NIRV	26	37
5	Property near Bacchus Marsh-Balliang Road, Maddingley	NIRV	36	41
6	Property near Fourth Mews, Maddingley	SEPP N-1	30	38
7	Property near Tenth Mews, Maddingley	SEPP N-1	26	36
8	Property near Moon Court, Maddingley	SEPP N-1	30	40

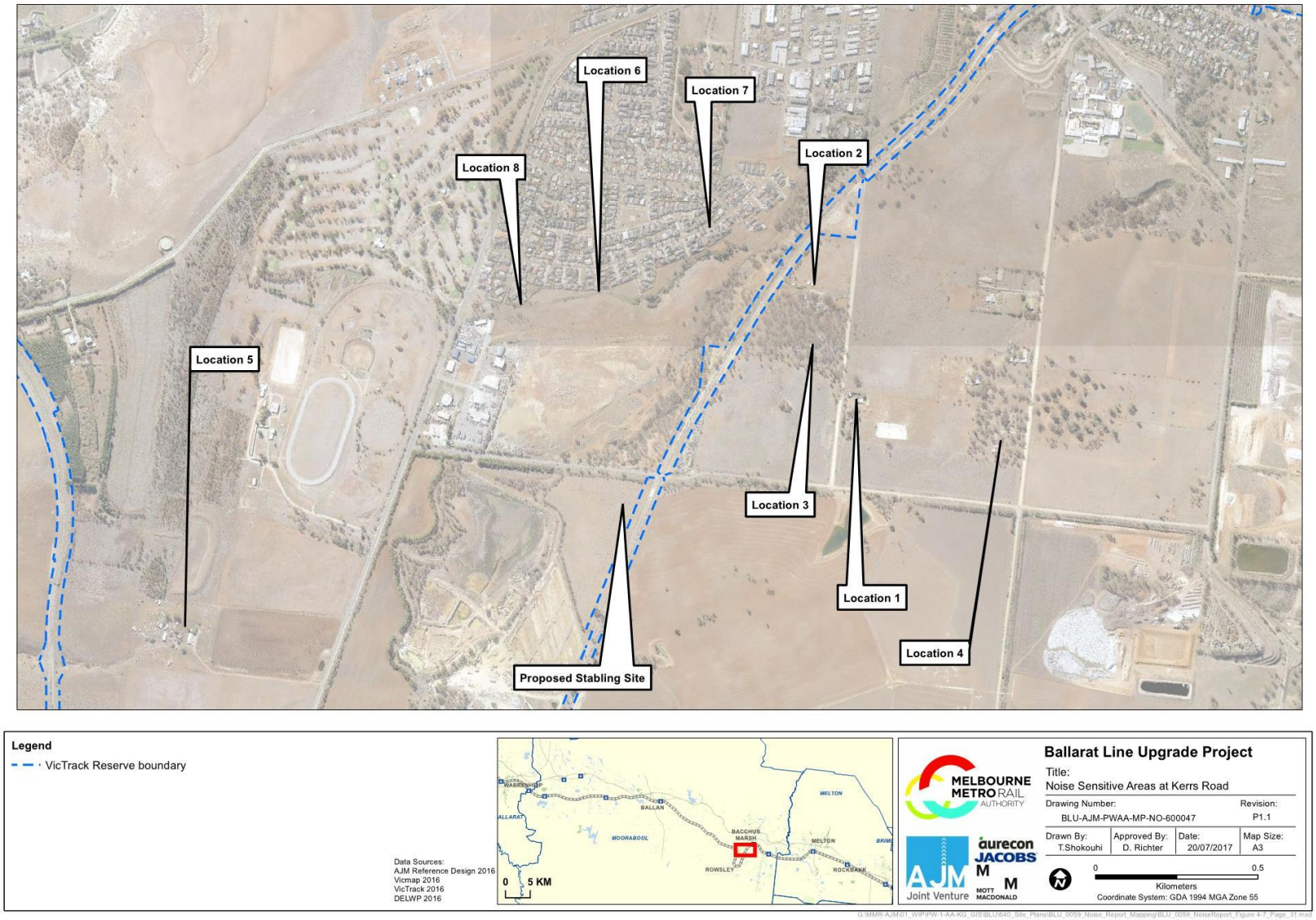


FIGURE 4-3: NOISE SENSITIVE AREAS ASSESSED IN THE VICNITY OF MADDINGLEY STABLING YARD

4.5 Acoustic Modelling

An acoustic model has been developed for the proposed stabling yard operation in the acoustic software SoundPLAN version 7.4. This is an environmental noise modelling software package which has implemented the ISO 9613-2: 1996[1] noise propagation model. This methodology considers noise attenuation by:

- Geometrical spreading
- Atmospheric absorption
- Ground effects
- Barriers.

The model assumes meteorological conditions favourable to propagation from sources of known sound emission.

The model in SoundPLAN includes:

- Topography
- Building structures
- Noise sources
- Receivers
- Ground absorption
- Air absorption.

The Sound Power Levels of the noise sources in the acoustic model were calculated from the noise measurements of various activities at the existing Bacchus Marsh stabling yard. The L_{Aeq} of each sound source was measured in close proximity to the source using a handheld sound level meter over a representative time period. Two noise loggers were also placed on site at a distance set back from the noise sources and served as verification points.

4.5.1 SOURCE NOISE LEVELS

The sound power level (SWL) for each noise source used in the acoustic model has been calculated from the L_{Aeq} and L_{Amax} measurements at the Bacchus Marsh stabling yard. The model has then been calibrated using the results of the noise levels measured at the noise logger verification points. The calibrated SWLs have also been adjusted using the duration adjustment defined in SEPP N-1. The duration adjustment is used when the noise emission is not audible over a 30-minute period, and a weighting factor is applied to the overall sound level.

The values used in the acoustic model for each noise source are presented in Table 4-3.

[1] ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Troups Road North: General method of calculation (1992)

TABLE 4-3: CALCULATED SOUND POWER LEVELS BEFORE AND AFTER DURATION ADJUSTMENTS

SOURCE	ADJUSTMENT	SOURCE TYPE	OCTAVE BAND SOUND POWER LEVELS (SWL) DB(A)									TOTAL SWL DB(A)	TIME DURATION OF SOURCE PER 30 MINUTES
			31.5HZ	63HZ	125HZ	250HZ	500HZ	1KHZ	2KHZ	4KHZ	8KHZ		
N-Class													
Idling	No duration adjustment	Area	73	89	84	86	94	93	87	78	68	98	2 minutes
	With duration adjustment		61	77	72	74	82	82	75	67	56	87	
Engine Revving	No duration adjustment	Area	66	90	94	91	100	102	95	89	80	106	3 minutes
	With duration adjustment		**56**	**80**	**84**	**81**	**90**	**92**	**85**	**79**	**70**	**96**	
HEP Revving	No duration adjustment	Area	62	76	82	85	93	95	95	90	81	100	25 minutes
	With duration adjustment		**62**	**75**	**81**	**84**	**92**	**94**	**94**	**89**	**81**	**99**	
Horn [Note 1]	No duration adjustment	Point	65	82	82	120	127	128	114	100	94	131	10 seconds [Note 2]
	With duration adjustment		**37**	**53**	**54**	**92**	**99**	**100**	**85**	**72**	**66**	**103**	

Notes:

1. The horn sound power levels have been calculated using the L_{Amax}.
2. The horn duration is two seconds in length. In accordance to SEPP N-1, impulse noise sources must be increased to a length of ten seconds.

4.5.2 PREDICTED NOISE LEVELS

There are a small number of NSAs in the near vicinity of the Maddingley stabling yard. The predicted noise levels at the NSAs, in various directions from the proposed stabling yard site, are based upon two N-Class trains running during the half hour assessment duration period.

The N-Class trains are ultimately to be replaced by VLocity trains. As the N-Class are noisier than the VLocity trains, the predicted noise levels would be lower once the N-Class are replaced by VLocity trains.

The noise levels predicted at the NSAs are provided in Table 4-4 along with the predicted night time noise requirements and any predicted exceedance.

TABLE 4-4: PREDICTED NOISE LEVELS AT SENSITIVE RECEIVERS IN THE VICINITY OF THE MADDINGLEY STABLING YARD

LOCATION REFERENCE	PROPERTY LOCATION	APPLICABLE EPA REQUIREMENTS	NOISE REQUIREMENT DB(A)	PREDICTED NOISE LEVELS DB(A)	EXCEEDANCE DB(A)
1	Property near Osborne Street, Maddingley	NIRV	40	37	-
2	Property near Osborne Street, Maddingley	NIRV	36	35	-
3	Property near Warde Close, Maddingley	NIRV	37	36	-
4	Property near South Maddingley Road, Maddingley	NIRV	37	32	-
5	Property near Bacchus Marsh-Balliang Road, Maddingley	NIRV	41	31	-
6	Property near Fourth Mews, Maddingley	SEPP N-1	38	31	-
7	Property near Tenth Mews, Maddingley	SEPP N-1	36	34	-
8	Property near Moon Court, Maddingley	SEPP N-1	40	34	-

No exceedances to the noise requirements are predicted to occur at the NSAs in the vicinity of the Maddingley stabling yard.

A colour noise contour map of the scenario modelled above is provided in Figure B1 provided in Appendix B.

5 Railway Noise

The impact of airborne train noise due to the improvements has been assessed.

Airborne noise from railways is generally due to:

- Rolling noise from the wheel-rail interface (this includes wheel squeal, flanging)
- Traction systems
- Fans and air-conditioning units
- Exhaust
- Engine and motor noise
- Aerodynamics noise (this would not apply to the project as it only usually occurs at trains speeds above approximately 250 km/h)

The primary source of rail noise from the wheel-rail interface is due to:

- Roughness of the rail and wheel (including wheel flats)
- Rail corrugation
- Wheel Squeal (or track curves)
- Track imperfections
- Joints, switches and crossings

The subjective response of humans to noise varies between individuals. Typical impacts include:

- Loss of amenity
- Discomfort
- Stress
- Loss of concentration
- Health effects (increase in blood pressure)
- Sleep arousal

Rolling stock for the Ballarat rail line includes:

- Diesel Multiple Units (DMUs) (VLocity)

- Locomotive (Freight, N Class and P Class)
- Wagons / Carriage

It is assumed good practice has been employed in the rail design to reduce rail noise levels, including:

- Where possible, avoiding tight radius curves which can result in noise from curving noise (flanging or wheel squeal). This can occur on tracks with a curve radius of 500 m or less. If curving noise results it would need to be controlled using gauge face lubrication or top-of–rail friction modifiers supplied from trackside applicators
- Use of continuously welded rail
- Minimising the number of joints, switches and crossings
- Good maintenance regime

All noise mitigation elements would need to be carefully integrated into the design to ensure a safe, reliable and maintainable railway.

The railway noise is to comply with the PRINP.

5.1 Methodology

5.1.1 APPROACH

The following approach is proposed to assess airborne noise from trains:

- Train noise measurements were undertaken
- Noise monitoring at sensitive receivers along the existing rail corridor in the vicinity of the project were undertaken
- Creation of an acoustic model of the existing operational railway in the vicinity of the project
- Verification of the acoustic model using the noise monitoring
- Updating the acoustic model to include the infrastructure associated with the project
- Prediction of noise levels for a number of scenarios. For all scenarios, the rail noise modelling is completed across the entire corridor (extending from Deer Park West to Warrenheip), even though the proposed works are restricted to a number of discrete locations along the corridor. The scenarios investigated, are as follows:
  - » Existing: existing noise levels along the existing rail corridor – this information was used to verify the acoustic model and has been used for comparison with measured noise levels only
  - » Future Base-Case: The Base-Case is defined as representing the situation if the project did not proceed.
  - » Future A: 5-years after the opening where the regional fleet consists of N-class and VLocity
  - » Future B: 10 years after opening where all of the regional fleet are VLocity
- Where the Investigation Thresholds as defined in the PRINP are predicted to be exceeded, options for avoiding, minimising and mitigating rail noise have been considered.

5.1.2 SCENARIOS

Acoustic modelling has been assessed for a number of different operating scenarios and track locations. The operating scenarios are defined as follows:

- Base Case - As the Ballarat rail line is considered to be running at capacity, the existing case has been assumed to represent the Base-Case.
- Future Case A - consists of the Ballarat rail line being upgraded, with the current rolling stock in operation.
- Future Case B - consists of the Ballarat rail line being upgraded, where the regional fleet consists only of VLocity trains.

Train noise levels have been predicted for each of the above operating scenarios, incorporating each of the project elements (for the Future Cases).

5.1.3 PREDICTION METHODOLOGY

Airborne railway noise levels have been predicted at the nearby noise sensitive receivers using the methodology from Nord 2000 - New Nordic Prediction Method for Rail and Traffic Noise (NORD2000). This methodology allows the prediction of the daytime ($L_{Aeq,16hour}$), night time ($L_{Aeq, 8hour}$) and the L_{Amax} noise levels. NORD2000 has been implemented in SoundPLAN version 7.4.

The model has been used to predict noise levels at the nearby noise sensitive receivers and is based upon:

- Air absorption
- Atmospheric refraction
- Split height source modelling
- Ground effects
- Meteorological effects
- Screening
- Reflection
- One-third octave band source levels
- Operational timetables
- Train lengths / speed

5.2 Noise Monitoring

Baseline noise monitoring has been undertaken as part of this assessment. The results of the baseline noise monitoring are provided in Table 5-1. The details of the noise monitoring are provided in Section A.2 of Appendix A.

TABLE 5-1: RESULTS OF BASELINE NOISE MONITORING

LOCATION NO.	ADDRESS	DAY $L_{AEQ, 16\ HOURS}$, DB(A)	NIGHT $L_{AEQ,8HOURS}$, DB(A)
1	Property on O'Connor Road, Deer Park	61	56
2	Property on Jonah Parade, Deer Park	64	58
3	Property on Greigs Road, Rockbank	53	51
4	Property on Stewart Crescent, Rockbank	59	54
5	Property near Stewart Crescent, Rockbank	58	53
6	Property on Blamey Drive, Melton South	54	46
7	Property on Finn Court, Maddingley	47	38
8	Property on Lay Court, Ballan	49	43
9	Property on Peerewerrh Road, Millbrook	49	43
10	Property on Ti Tree Road, Warrenheip	56	48

5.3 Noise Predictions

5.3.1 SOURCE NOISE LEVELS

NOISE EMISSIONS

Rail noise emissions have been based on the following:

- The Rail Noise Guideline[2]

[2] Rail Noise Guideline, October 2016 Version 4.0 Final Draft

- The NSW Rail Noise Database Stage III Measurement and Analysis - January 2015 prepared by SLR for the NSW Transport Asset Authority (TfNSW train noise database)
- NORD2000 for the reference source noise levels for trains
- A comparison of both the Sound Exposure Level (SEL) and the 95th percentile of the maximum noise levels from the rail bound vehicle source noise levels ($L_{Amax,\ 95\%}$) with the reference source noise levels from the Train Reference Noise Levels outlined in Rail Noise Guideline 2016. These noise levels are presented in Table 5-2.
- Noise source heights are as defined by default in NORD2000. All noise source heights are above rail height and are:
  - 0.01 m (wheel / rail)
  - 0.35 m (wheel)
  - 0.7 m (engine)
  - 2.5 m (engine – low frequency content)
  - 4.2 m (exhaust)
- Noise levels have been predicted at all sensitive building levels and façade reflection has been included.

TABLE 5-2: NOISE LEVELS FOR TRAINS TRAVELLING AT 80 KM/H (AS PER RAIL NOISE GUIDELINE (VERSION 4.0)

TRAIN SET	$L_{SEL(REF)}$[1] DB(A)	$L_{AMAX(REF)}$[1] DB(A)
VLocity	84	88
N Class and P Class (Locomotives)[2]	88	96
Passenger Wagon (Wagon)[3]	79	-
Freight (Locomotive)[2]	88	96
Freight (Wagon)[3]	79	-

Notes:

1. $L_{SEL(ref)}$ is at 100 m, $L_{MAX(ref)}$ is at 10 m
2. Locomotives are 20 m in length
3. Since wagons are always hauled by an accompanying locomotive, the maximum noise level is determined by the locomotive

RAIL BRIDGE NOISE

For this assessment, the bridge along the new rail alignment (in the vicinity of Bostock Reservoir, Ballan) has been modelled as a ballasted concrete bridge structure. The following correction has been applied for the appropriate span length:

- Concrete with Ballast, +0 dB

(Reference: NSW Rail Noise Database Stage III Measurement and Analysis - January 2015, Table 19 'Bridge Noise Level Correction Factors' and the Rail Noise Guideline 2016).

SPEED LIMIT ADJUSTMENTS

Speed limits due to the rail curvature have been provided along the alignment, and are shown in Table 5-3. In other areas, the operational speed has been applied.

TABLE 5-3: SPEED LIMIT LOCATIONS

CHAINAGE RANGE	SPEED LIMIT (KM/H)
36800 - 37700	100
37700 - 38400	65
38400 - 40200	80
78000 - 82600 (Passing loop only – Ballan Option 2)	80
79300 - 84400 (Passing loop only – Ballan Option 1)	80
95000 - 99000 (Passing loop only)	80
104200 - 108000	80

TRACK JOINT, SWITCH AND CROSSING NOISE

Switches and crossings built into rail tracks can result in noise from interaction with the wheel and the rail head joints. Noise from this effect can increase with severity depending on the complexity of the joint (i.e. diamond crossings).

The following overall noise corrections have been applied to these sections of track:

- 6 dB addition to the source noise levels for turnout crossings.

(Reference: Nord 2000 - New Nordic Prediction Method for Rail and Traffic Noise – December 2001, Section 2.3.4 'Corrections for track conditions' and the Rail Noise Guideline 2016).

TRAIN TIMETABLES

The type and number of rail vehicles assumed to be travelling in the rail corridor are provided in:

- Table 5-4 (Existing Base-Case)
- Table 5-5 (Future Case A before new rolling stock) and
- Table 5-6 (Future Case B where the regional fleet only consists of VLocity)

This information has been supplied by the MMRA and is based on the Concept of Operations (the COO) developed by the PTV and current PTV Timetables.

TABLE 5-4: BASE-CASE (EXISTING) TRAIN TIMETABLE

RAIL CORRIDOR (SECTION)	TRAIN TYPE	NUMBER OF TRAINS		OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
		DAY PERIOD	NIGHT PERIOD		
Deer Park to Melton	Push/Pull	4	2	100	145
	N-Class	8	2	115	136

RAIL CORRIDOR (SECTION)	TRAIN TYPE	NUMBER OF TRAINS		OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
		DAY PERIOD	NIGHT PERIOD		
	VLocity	58	9	160	150
	Freight	0	1	60	700
Melton to Bacchus Marsh	Push/Pull	5	1	100	145
	N-Class	7	2	115	136
	VLocity	55	9	160	150
	Freight	0	1	60	700
Bacchus Marsh to Ballan	Push/Pull	0	0	-	-
	N-Class	0	0	-	-
	VLocity	38	6	160	150
	Freight	0	1	60	700
Ballan to Spreadeagle	Push/Pull	0	0	-	-
	N-Class	0	0	-	-
	VLocity	38	6	160	150
	Freight	0	1	60	700
Spreadeagle to Warrenheip	Push/Pull	0	0	-	-
	N-Class	0	0	-	-
	VLocity	38	6	160	150
	Freight	1	2	60	1200

TABLE 5-5: FUTURE CASE A TRAIN TIMETABLE

RAIL CORRIDOR (SECTION)	TRAIN TYPE	NUMBER OF TRAINS		OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
		DAY PERIOD	NIGHT PERIOD		
Deer Park to Melton	N-Class	12	0	115	136
	VLocity	91	9	160	150
	Freight	0	1	60	700
Melton to Bacchus Marsh	N-Class	9	3	115	136
	VLocity	81	9	160	150
	Freight	0	1	60	700
Bacchus Marsh to	N-Class	0	0	-	-

RAIL CORRIDOR (SECTION)	TRAIN TYPE	NUMBER OF TRAINS		OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
		DAY PERIOD	NIGHT PERIOD		
Ballan	VLocity	53	6	160	150
	Freight	0	1	60	700
Ballan to Spreadeagle	N-Class	0	0	-	-
	VLocity	53	6	160	150
	Freight	0	1	60	700
Spreadeagle to Warrenheip	N-Class	0	0	-	-
	VLocity	53	6	160	150
	Freight	1	2	60	1200

TABLE 5-6: FUTURE CASE B TRAIN TIMETABLE

RAIL CORRIDOR (SECTION)	TRAIN TYPE	NUMBER OF TRAINS		OPERATIONAL SPEED (KM/H)	MAXIMUM LENGTH (M)
		DAY PERIOD	NIGHT PERIOD		
Deer Park to Melton	VLocity	103	9	160	150
	Freight	0	1	60	700
Melton to Bacchus Marsh	VLocity	90	12	160	150
	Freight	0	1	60	700
Bacchus Marsh to Ballan	VLocity	53	6	160	150
	Freight	0	1	60	700
Ballan to Spreadeagle	VLocity	53	6	160	150
	Freight	0	1	60	700
Spreadeagle to Warrenheip	VLocity	53	6	160	150
	Freight	1	2	60	1200

Notes:

1. The number of trains is combined for up and down tracks
2. All trains are assumed to operate at their maximum length
3. Lengths of all trains do not change throughout scenarios
4. Operational speed changes as per speed limits in Table 5-3

5.3.2 ASSUMPTIONS

- The new housing estate in Cobblebank was treated as 'Existing' as construction of houses in this area is already underway.
- As per the Precinct Structure Plans for Paynes Road and Rockbank, responsibility for noise attenuation rests with the developer. For houses not currently under construction, the possible future residential properties in these areas are not assessed.
- Existing tracks have the same radius of curvature as the new alignment.

5.3.3 METEOROLOGY

Meteorological conditions were modelled under the following conditions:

- Relative Humidity: 70%
- Temperature: 15 degrees Celsius
- Air Pressure: 1013 mbar

These meteorological conditions are considered neutral weather conditions.

5.3.4 VERIFICATION

Noise levels have been predicted for the existing train timetable. The levels predicted have been compared with noise monitoring at strategically selected properties. Along the project alignment, the following properties were used as verification points;

- Property near Stewart Crescent, Rockbank
- Property near Stewart Crescent, Rockbank
- Property near O'Connor Road, Deer Park

At these locations the rail noise levels were predicted to be within 2 dB of the measured noise level, after taking site conditions into consideration (including fencing) in the verification model. This is considered to be a good correlation. It should be noted that all fences were removed for the Base-Case, Future A and Future B prediction models, which is consistent with standard modelling practice and reflective of the variable nature, and hence noise attenuation performance, of standard property fences.

5.3.5 ACOUSTIC MODELLING

5.3.5.1 Base-case

Current train noise levels have been predicted for the following scenarios:

- Base-Case, Day Period predicted train noise levels
- Base-Case, Night Period predicted train noise levels
- Base-Case, L_{Amax} predicted train noise levels.

The predicted Base-Case noise levels are compared with the Future Case noise levels across the entire corridor (extending from Deer Park West to Warrenheip).

5.3.5.2 Future Case A

Future Case A: removal of the Push-Pull locomotives and increase of N-Class locomotives and VLocitys on the alignment.

Train noise levels have been predicted for the following scenarios:

- Future, Day Period predicted train noise levels
- Future, Night Period predicted train noise levels
- Future, L_{Amax} predicted train noise levels.

The investigations thresholds are predicted to be exceeded at some residences along the project. Noise level increases were associated with:

- Addition of track closer to properties
- A turnout being located in close proximity to properties

Table 5-7 presents the sensitive receiver locations where noise exceedances are predicted.

TABLE 5-7: LOCATION OF EXCEEDANCES FOR THE BALLARAT LINE UPGRADE ALIGNMENT (FUTURE CASE A)

LOCATION	BUILDING LEVEL	EXCEEDANCE TRIGGER	PREDICTED INCREASE WITH RESPECT TO BASE-CASE (DB)
Property on Stewart Crescent, Rockbank	Ground Floor	$L_{Aeq\ (Day)}$	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	L_{Amax}	3
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	4
	Ground Floor	$L_{Aeq\ (Night)}$	3
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	4
	Ground Floor	$L_{Aeq\ (Night)}$	3
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	4
	Ground Floor	$L_{Aeq\ (Night)}$	3

5.3.5.3 Future Case B

Future Case B: removal of Push-Pull and N-Class locomotives, with only VLocity vehicles in the passenger rail service.

Train noise levels have been predicted for the following scenarios:

- Future, Day Period predicted train noise levels
- Future, Night Period predicted train noise levels
- Future, L_{Amax} predicted train noise levels.

The investigations thresholds are predicted at some sensitive receivers along the Ballarat line. Noise level increases were only associated with a turnout being located in close proximity to properties. Table 5-8 presents the sensitive receiver locations and level of noise exceedance for the project alignment.

TABLE 5-8: LOCATION OF EXCEEDANCES FOR THE BALLARAT LINE UPGRADE ALIGNMENT (FUTURE CASE B)

LOCATION	BUILDING LEVEL	EXCEEDANCE TRIGGER	PREDICTED INCREASE WITH RESPECT TO BASE-CASE (DB)
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	3
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	3
Property on James Melrose Drive, Brookfield	Ground Floor	$L_{Aeq\ (Day)}$	3

5.3.6 MITIGATION

The investigation thresholds are predicted to be exceeded at some nearby sensitive receivers as a result of the project. A number of mitigation options have been considered. As the project is adjacent to an existing rail line in a constrained corridor, options for the proposed rail locations are limited, and changes to the design are not feasible. For this project, acoustic treatments either along rail corridors or at the dwellings are considered practical and cost-effective forms of mitigation. By way of example, the following noise barrier locations would be appropriate to act as noise mitigation along the rail corridor, although noting that the noise modelling is based on the details of the Concept Design which will be subject to further modification during the detailed design stage:

- A barrier along the rear of a property in Stewart Crescent, Rockbank.
- A barrier along the rear of properties (up to 7) along James Melrose Drive, Brookfield
- A barrier along the rear of properties (up to 3) along a different section of James Melrose Drive, Brookfield.

Alternative mitigation in the form of acoustic treatment at the residences could also be considered.

Mitigation is not required (for either of Future A or Future B scenarios) for the Ballan Loop – Option 2, even though the rail vehicles come in close proximity to this property. The passing loop in this area is located on a berm and the raised track sits above the receiver height. The terrain for the new Ballan passing loop track configuration provides shielding for both the wheel and exhaust noise of the passing trains on the existing

alignment resulting in an overall decrease in the noise levels when compared with the “base case” at this receiver location.

MMRA’s Environmental Management Framework for the Ballarat Line Upgrade will incorporate a number of Environmental Performance Requirements (EPRs) for noise and vibration. The aim of these noise and vibration EPRs is to ensure that the final design will minimise operational noise at sensitive receptor locations in accordance with the PRINP. The EPRs will be approved by the Minister for Planning as part of the proposed Incorporated Document for the project.

6 Conclusion

6.1 Stabling Yard

Noise levels associated with the Maddingley stabling yard have been predicted at a number NSAs located in the vicinity of the stabling yard. The noise levels are predicted to comply with the night period noise requirements and therefore mitigation is not required.

6.2 Railway Noise

The operational noise levels from passenger services along the Ballarat rail line following the project works have been predicted at the nearby sensitive receivers. These predictions are based on the Concept Design developed by AJM and MMRA, which are subject to ongoing modification during the detailed design stage.

Exceedances to the PRINP are predicted at some sensitive receivers in the vicinity of the project due to new track proximity and turning points, at the following locations:

- One property located on Stewart Crescent, Rockbank
- A number of properties (up to 7) located along a section of James Melrose Drive, Brookfield
- A number of properties (up to 3) located along a different section of James Melrose Drive, Brookfield.

A number of mitigation options are available in order to achieve compliance with the PRINP. As the project is located adjacent to an existing rail line in a constrained corridor, options for mitigation are limited, and changes to the design are not feasible. As such, for this project, acoustic treatments either along rail corridors or at the dwellings are considered a practical and cost-effective form of mitigation. By way of example, the noise assessment has proposed noise barrier locations that result in an appropriate level of noise mitigation required.

Based on the assessment undertaken, it is considered that while there would be some changes in operational noise at nearby sensitive receptors on completion of the project, these do not involve a significant increase or a significant number of dwellings having regard to the rail corridor and the suburban and regional areas that will benefit from the project works. Environmental Performance Requirements to be approved by the Minister for Planning as part of the proposed Incorporated Document for the project will require that operational noise outcomes comply with relevant criteria. On this basis, operational noise will not have a significant adverse effect on residential amenity.

Appendix A

Ambient Noise Measurements

A.1 Stabling Yard Ambient Noise Monitoring

Short-term ambient noise measurements were undertaken in the vicinity of the Maddingley stabling yard site. Four locations were considered to be representative of areas with the potential to be affected by the stabling yard. Two 10-minute measurements were performed at each location during the Night period. Locations are presented in Table A-1.1 and shown in Figure A-1.1.

TABLE A-1.1 LOCATION OF MONITORING

LOCATION	APPROXIMATE ADDRESS
1	Property on Delahey Close, Maddingley
2	Property on Bacchus Marsh-Balliang Road, Maddingley
3	Property on Rowsley Station Road, Maddingley
4	Property on South Maddingley Road, Maddingley

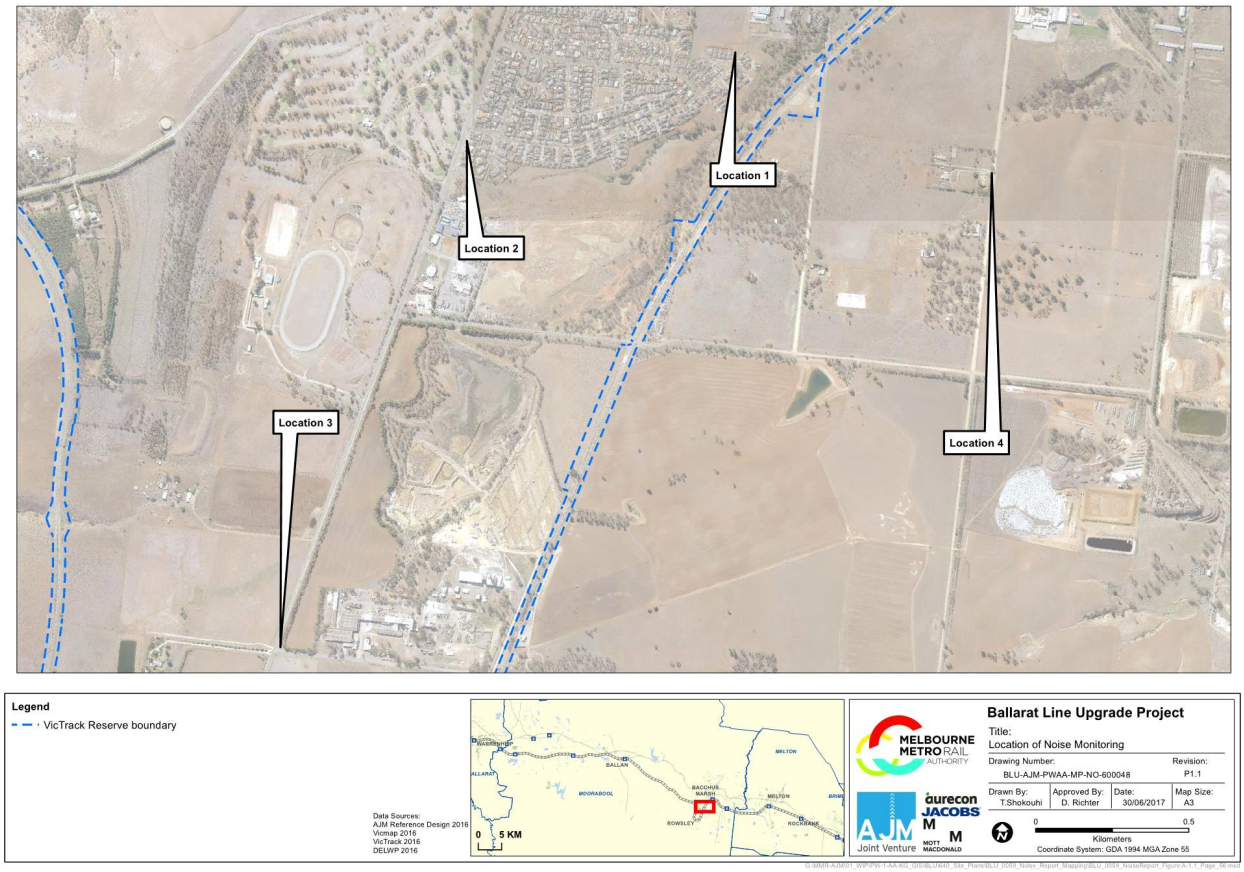


FIGURE A-1.1 LOCATION OF MEASUREMENTS

The equipment used to undertake the attended noise measurements are presented in Table A-1.2.

TABLE A-1.2 EQUIPMENT LIST

EQUIPMENT	SERIAL NUMBER	LAST CALIBRATION DATE
Bruel and Kjaer 2250L Sound Level Meter	2602771	03/09/2015
Bruel and Kjaer Calibrator 4231	2583258	28/09/2015

The sound level meter was checked for calibration before and after the measurement period. All equipment has current NATA certification.

Results of the attended measurements during the night time period are produced in Table A-1.3.

TABLE A-1.3 NIGHT TIME PERIOD MEASUREMENTS

LOCATION	MEASUREMENT 1			MEASUREMENT 2			COMMENTS
	L_{MAX} DB(A)	L_{EQ} DB(A)	L_{90} DB(A)	L_{MAX} DB(A)	L_{EQ} DB(A)	L_{90} DB(A)	
1	47	30	28	50	29	24	-
2	73	47	45	61	32	30	A rumble in the distance was heard for the duration of the first measurement - the source was not identified. Levels in the first measurement have not been used for the assessment due to the large difference in noise levels.
3	53	36	34	55	39	38	-
4	52	28	26	54	34	26	-

A.2 In the vicinity of the rail line upgrade

A.2.1 Methodology

NOISE MONITORING LOCATIONS

Noise monitoring has been conducted at 10 residential locations across the project area. The specific locations are detailed in Table A-2.1 and shown in Figure A-2.1.

TABLE A-2.1: NOISE MONITORING LOCATIONS

LOCATION NO.	ADDRESS	MEASUREMENT DATES
1	Property on O'Connor Road, Deer Park	29/03/17 – 05/04/17
2	Property on Jonah Parade, Deer Park	29/03/17 – 05/04/17
3	Property on Greigs Road, Rockbank	27/04/17 – 03/05/17
4	Property on Stewart Crescent, Rockbank	07/04/17 – 20/04/17
5	Property on Stewart Crescent, Rockbank	29/03/17 – 07/04/17
6	Property on Blamey Drive, Melton South	29/03/17 – 07/04/17
7	Property on Finn Court, Maddingley	27/04/17 – 03/05/17
8	Property on Lay Court, Ballan	29/03/17 – 07/04/17
9	Property on Peerewerrh Road, Millbrook	07/04/17 – 20/04/17
10	Property on Ti Tree Road, Warrenheip	27/04/17 – 03/05/17

NOISE MONITORING APPROACH

Noise monitoring has been conducted in general compliance with Australian Standard AS1055.1-1997 *Acoustics - Description and measurement of environmental noise - Part 1: General procedures* (AS 1055.1). Two locations were used for the microphone of the noise logger:

- At 1 m from the most exposed window of a habitable room, 1.2 m above the ground, where possible.
- If the above location was not possible or suitable, within the boundary of a property, 1.2 m above the ground

ACOUSTIC EQUIPMENT

Details of the acoustic equipment used to conduct these measurements are provided in Table A-2.2.

TABLE A-2.2: ACOUSTIC EQUIPMENT

MANUFACTURER	TYPE OF INSTRUMENT	SERIAL NO.	LAST CALIBRATION DATE
Bruel & Kjaer	Acoustic Calibrator	2583258	28/09/2015
Acoustic Research Laboratories (ARL)	Noise Logger - Ngara	8780E1	29/06/2016
ARL	Noise Logger - Ngara	87811E	29/06/2016
ARL	Noise Logger - Ngara	8780E3	29/06/2016
ARL	Noise Logger - Ngara	8780B6	11/01/2016
ARL	Noise Logger - Ngara	87811F	28/06/2016

The noise loggers were checked for calibration before and after each set of measurements. A windshield was fitted to the microphone for all measurements. All acoustic equipment has current calibration certificates.

METEOROLOGY / ANOMALOUS DATA

Meteorological conditions during the measurement period have been recorded by the Bureau of Meteorology at weather stations in the vicinity of each measurement locations. This information, in addition to subjective observations, and review of the noise monitoring results, has been used to assess the impact of weather at all properties. It is likely that the wind speed will be higher at the weather stations than at the monitoring locations which are more shielded in residential backyards. As such, the measurements have been assessed and judgement used to determine if it is affected by a weather event.

Where anomalous or weather effected data is identified it has been excluded in the determination of acoustic parameters.

A.2.2 Results

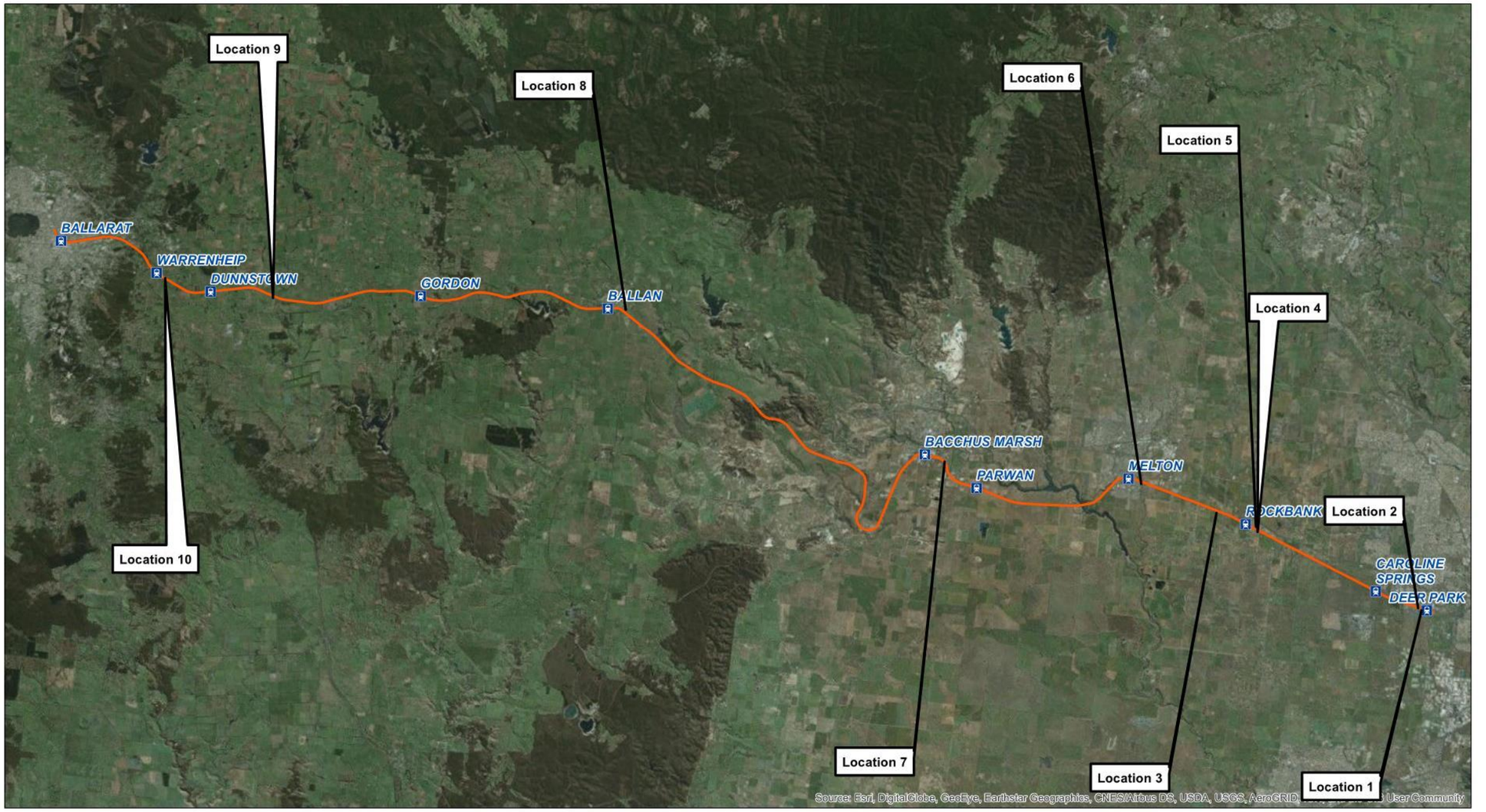
The L_{Amax}, L_{Aeq} and L_{A90} results have been presented on Figures A-2.2 to A-2.11.

The calculated parameters presented have been calculated from the measured weekday data, excluding periods of inclement weather and anomalous data. These are defined as:

$L_{Aeq,16hr}$: The A-weighed equivalent continuous sound pressure level over the day period, 06:00 to 22:00 hours as defined in the PRINP.

$L_{Aeq,8hr}$: The A-weighed equivalent continuous sound pressure level over the night period, 22:00 to 06:00 hours as defined in the PRINP.

Audio recording was not undertaken to maintain privacy of residents.



Legend

- Rail Station
- Ballart Line Upgrade Global Alignment

Data Sources:
Concept Design: February 2017
Vicmap 2016
VicTrack 2015

MELBOURNE METRO RAIL AUTHORITY
AJM Joint Venture
aurecon JACOBS MOTT MACDONALD

Ballarat Line Upgrade Project

Title:
Noise Measurement Locations

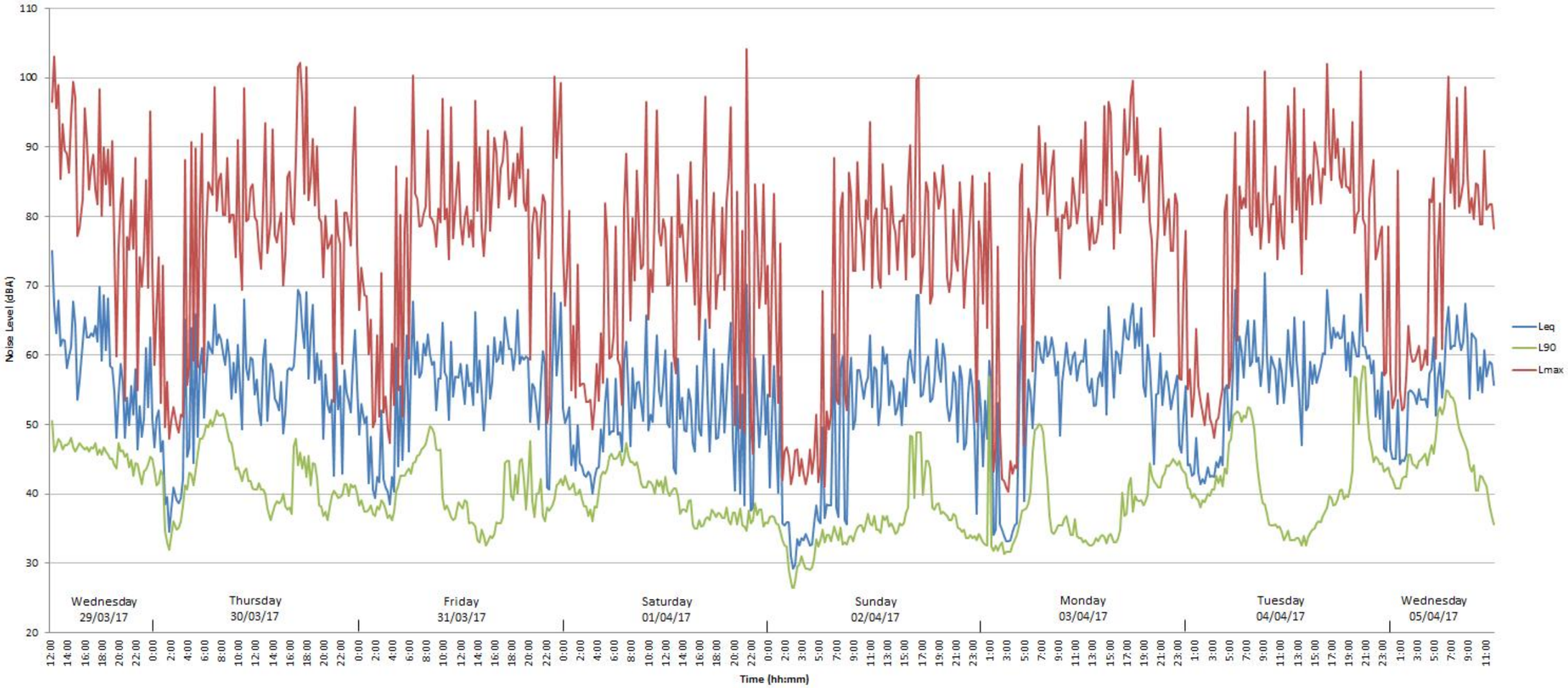
Drawing Number:	Revision:
BLU-AJM-PWAA-MP-NO-600049	P1.1

Drawn By:	Approved By:	Date:	Map Size:
T.Shokouhi	S. Stewart	20/07/2017	A3

0 5 10
Kilometres
Coordinate System: GDA 1994 MGA Zone 55

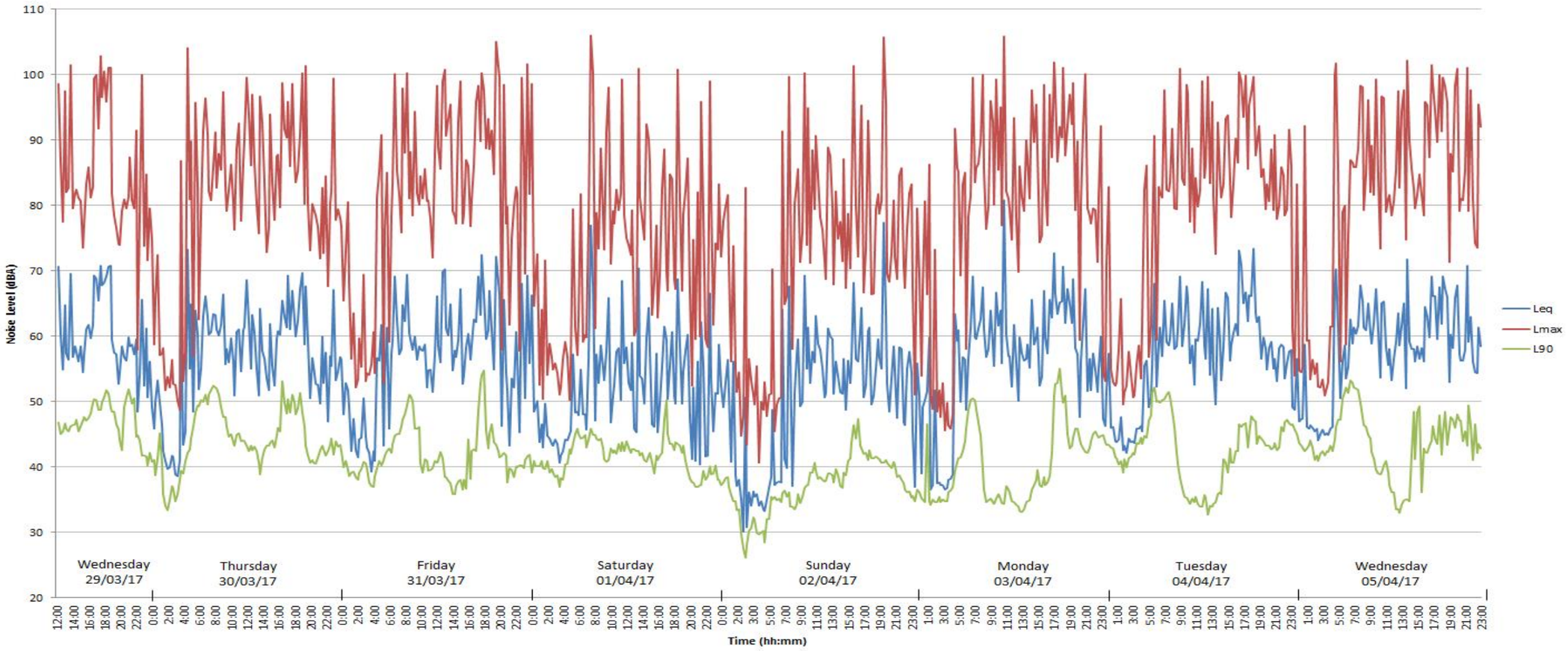
G:\MMR-AJM\01_WIP\PW-1-AA-KG_GIS\BLU\640_Site_Plans\BLU_0059_Noise_Report_Mapping\BLU_0059_NoiseReport_Figure A-2.1_Page_60.mxd

FIGURE A-2.1: NOISE MEASUREMENT LOCATIONS



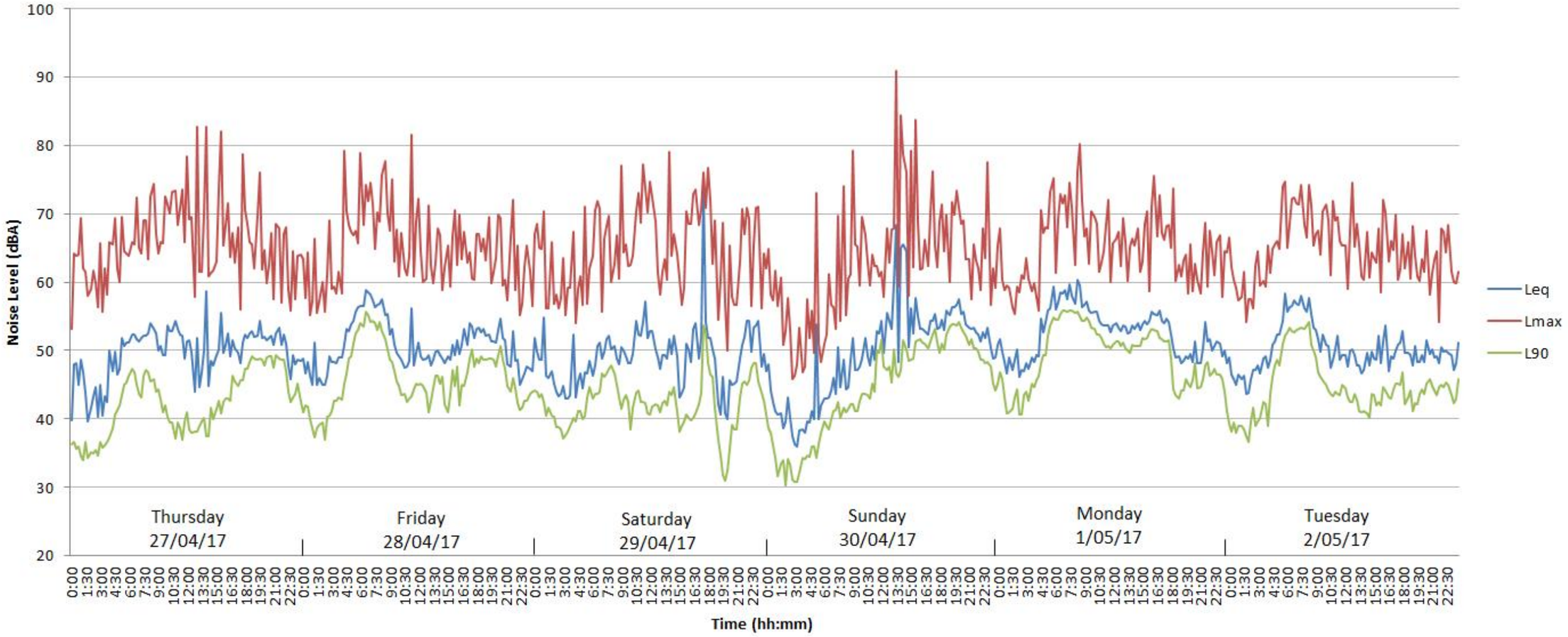
Parameters: $L_{Aeq,16hr}$: 61 dB $L_{Aeq,8hr}$: 56 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at 1 m from the most exposed accessible window. Daylight saving changed the time on the 2/4/17. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 3 mm of rainfall on the 30/03/17

FIGURE A-2.2: LOCATION 1 – NOISE MONITORING RESULTS



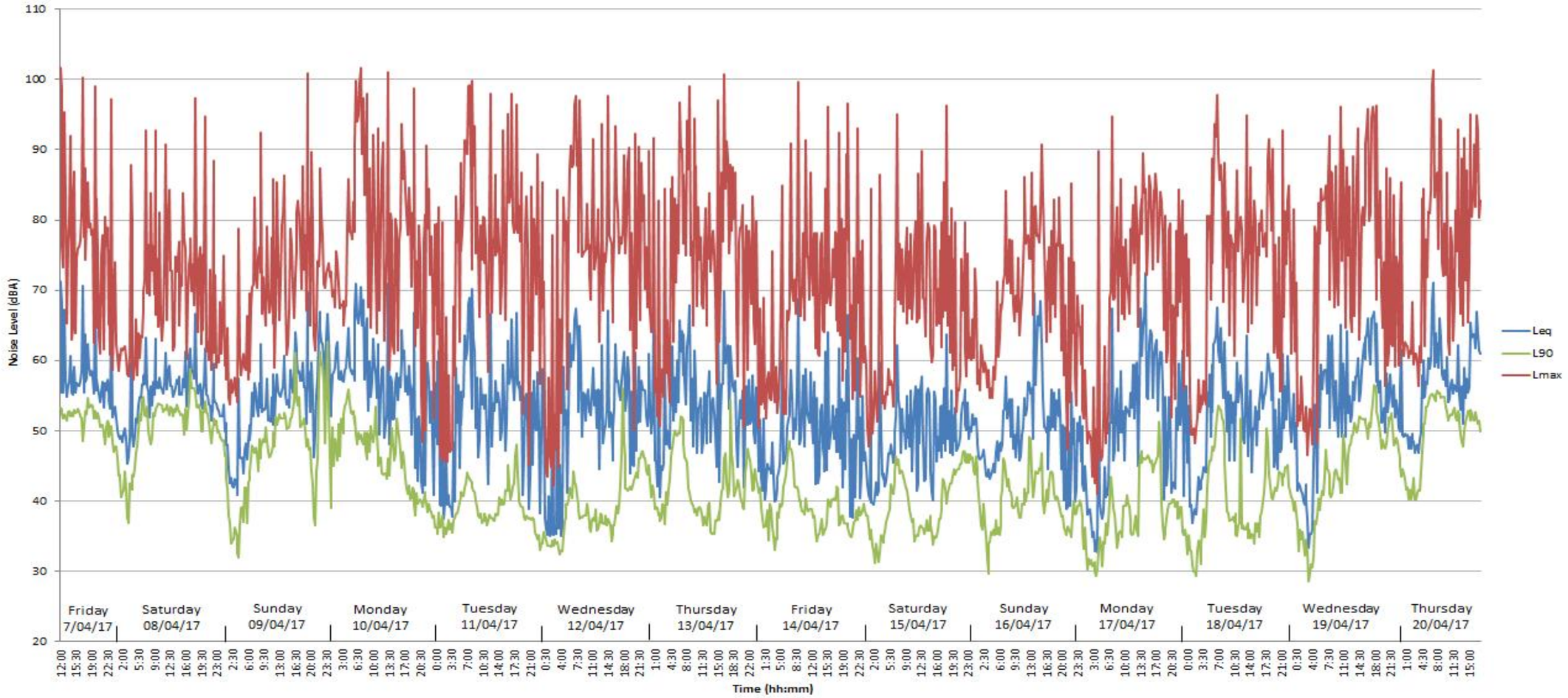
Parameters: $L_{Aeq,16hr}$: 64 dB $L_{Aeq,8hr}$: 58 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at 1 m from the most exposed accessible window. Daylight savings occurred on the 2/4/17. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 3 mm of rainfall on the 30/03/17

FIGURE A-2.3: LOCATION 2 – NOISE MONITORING RESULTS



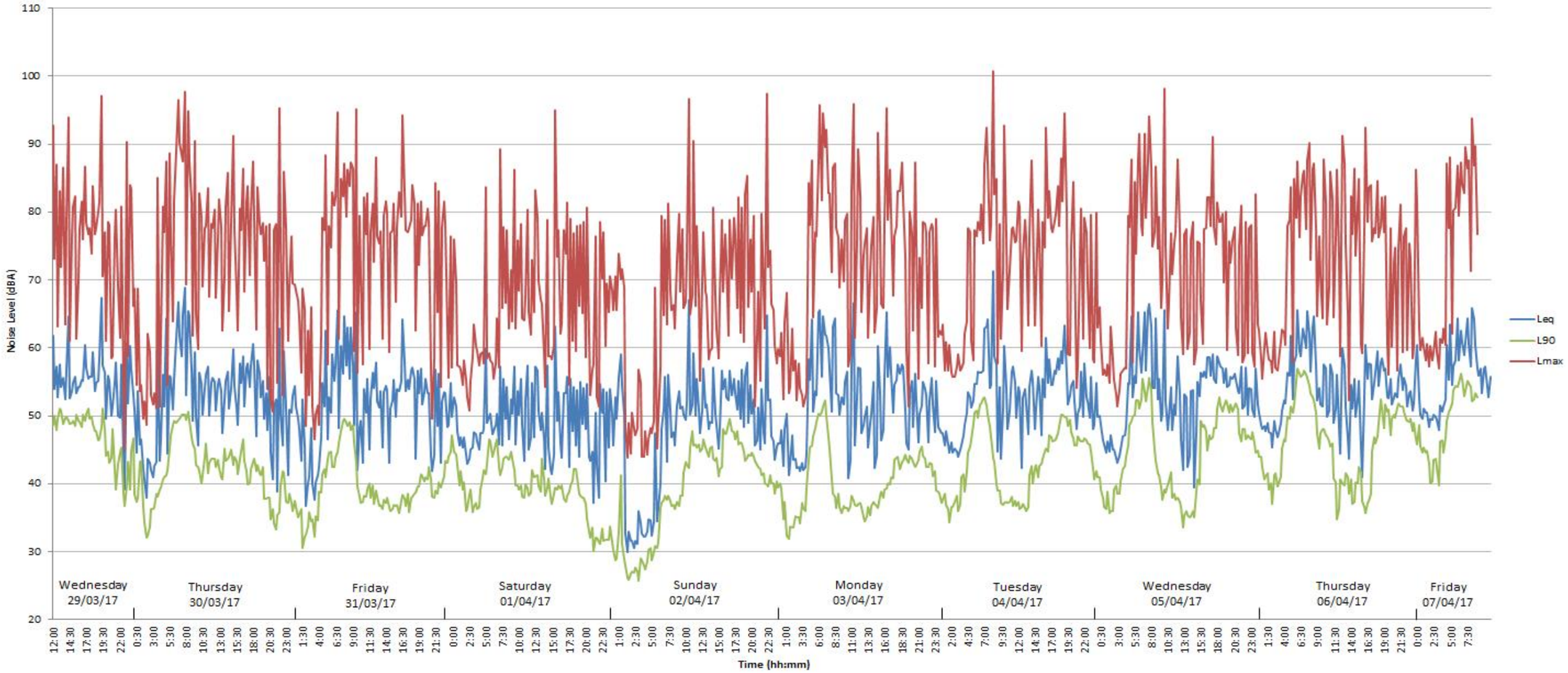
Parameters: $L_{Aeq,16hr}$: 53 dB $L_{Aeq,8hr}$: 51 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 3 m from the most exposed accessible window. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 13 mm of rainfall on the 27/4/17

FIGURE A-2.4: LOCATION 3 – NOISE MONITORING RESULTS



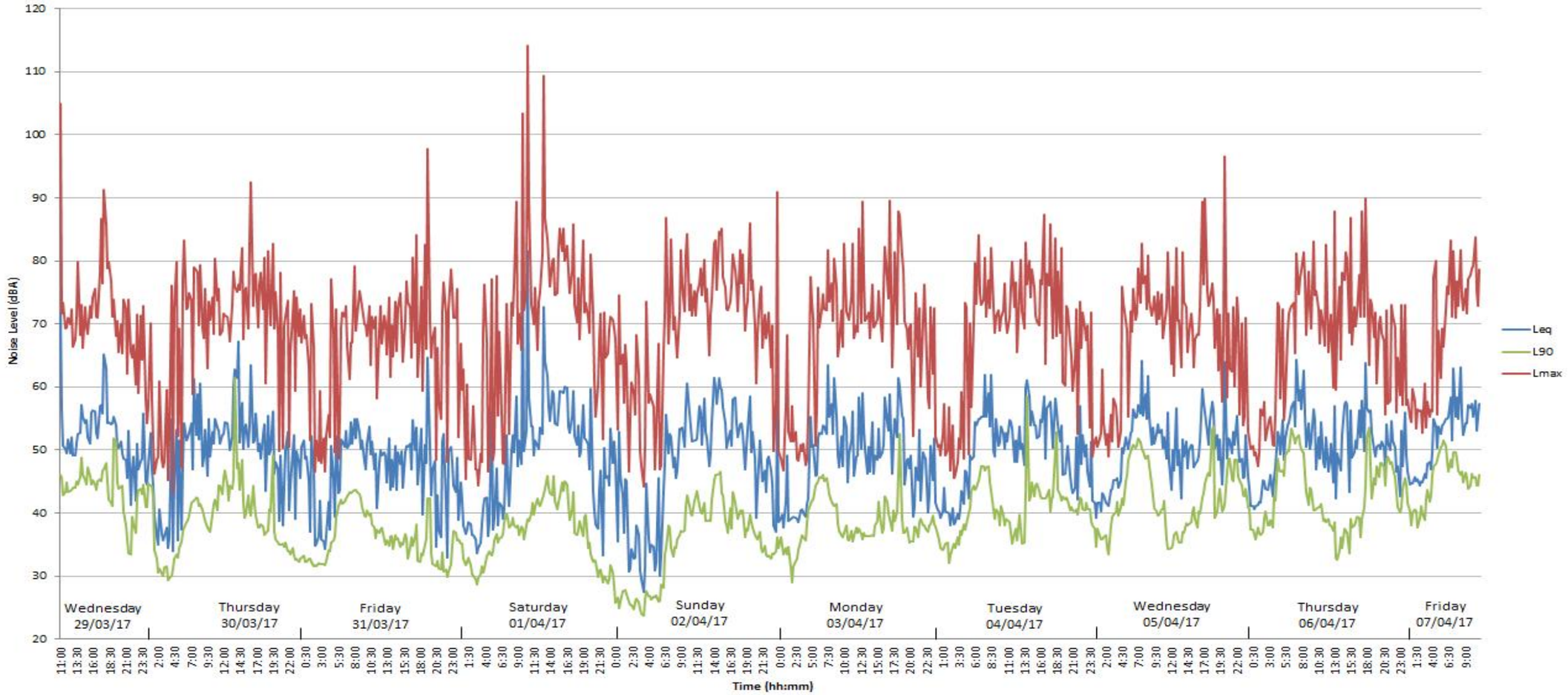
Parameters: $L_{Aeq,16hr}$: 59 dB $L_{Aeq,8hr}$: 54 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 5 m from the most exposed accessible window. Data removed from Monday 17/04/17 due to works on the property. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Heavy rainfall occurred on the weekend periods 08/04/17 14:30 AM – 10/04/17 6:00 AM

FIGURE A-2.5: LOCATION 4 – NOISE MONITORING RESULTS



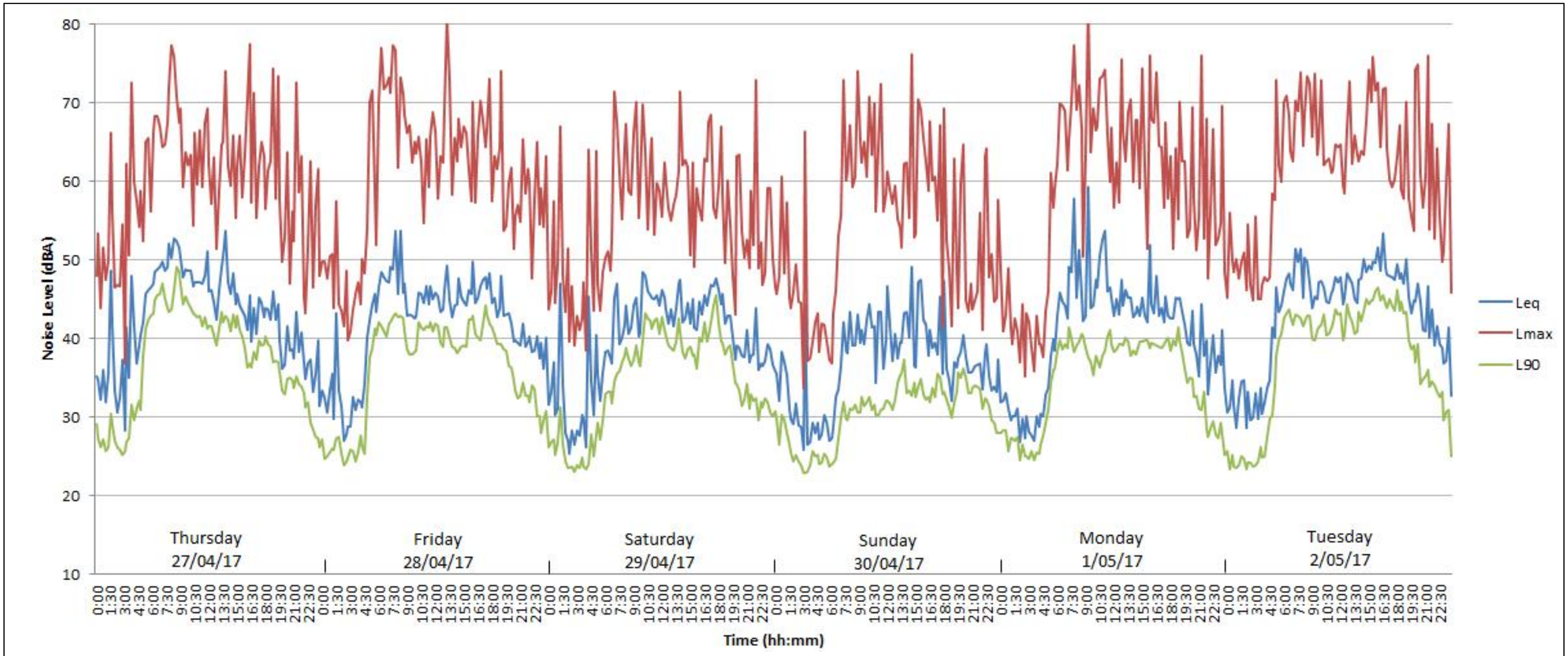
Parameters: $L_{Aeq,16hr}$: 58 dB $L_{Aeq,8hr}$: 53 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 20 m from the most exposed accessible window. Daylight savings occurred on the 2/4/17. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 3 mm of rainfall on the 30/03/17

FIGURE A-2.6: LOCATION 5 – NOISE MONITORING RESULTS



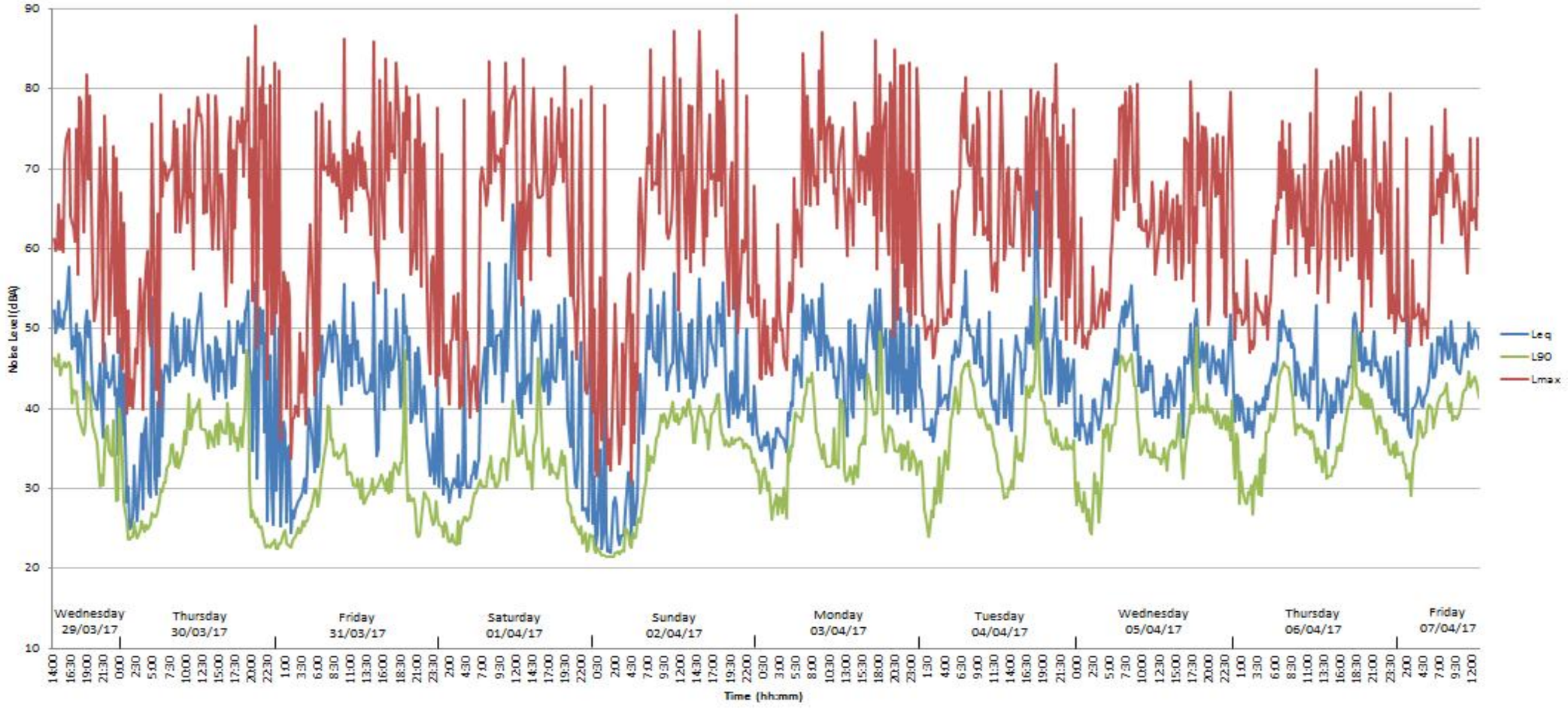
Parameters: $L_{Aeq,16hr}$: 54 dB $L_{Aeq,8hr}$: 46 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 1 m from the most exposed accessible window. Data was not assessed after 6 am 1/4/17 due to tampering with the equipment. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 2 mm of rainfall on the 1/5/17

FIGURE A-2.7: LOCATION 6 – NOISE MONITORING RESULTS



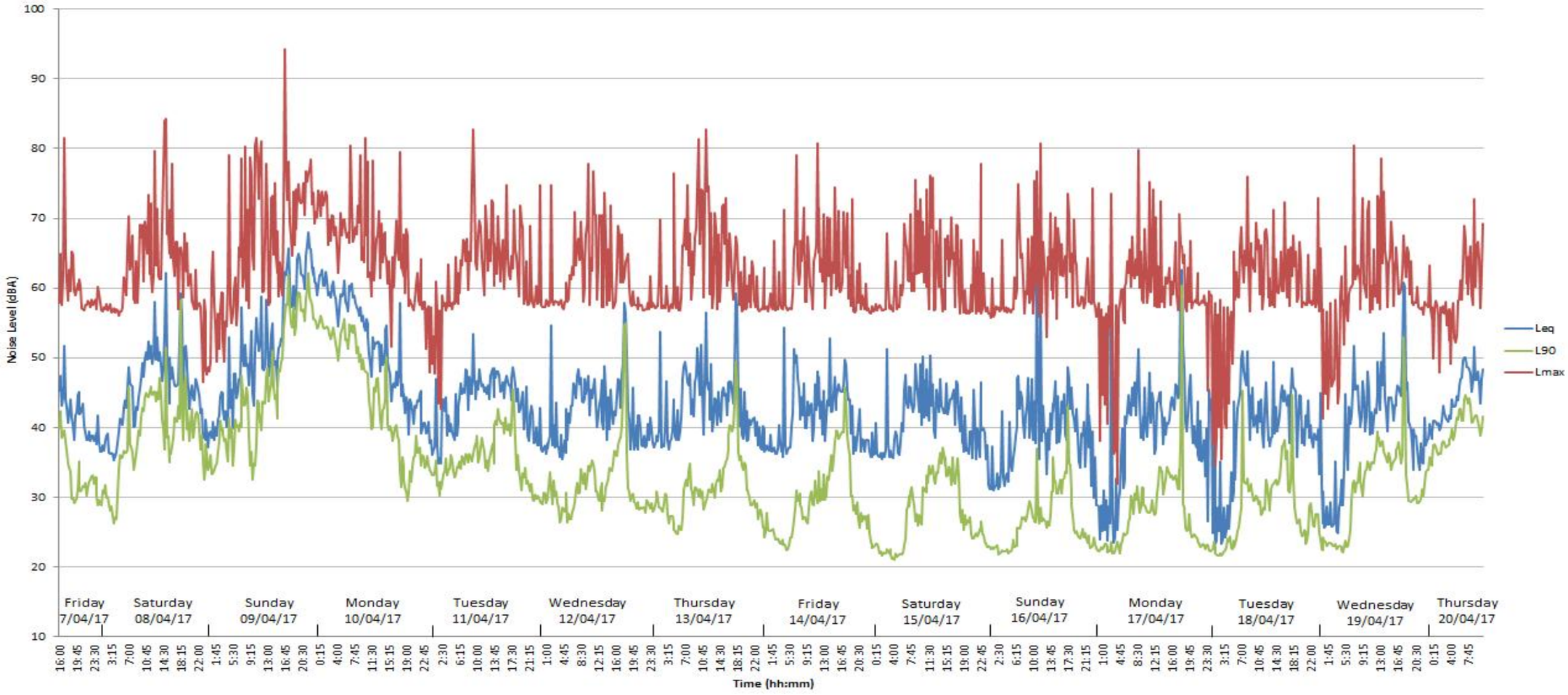
Parameters: $L_{Aeq,16hr}$: 47 dB $L_{Aeq,8hr}$: 38 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 1 m from the most exposed accessible window. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 13 mm of rainfall on the 27/4/17, 3 mm of rainfall on the 1/5/17

FIGURE A-2.8: LOCATION 7 – NOISE MONITORING RESULTS



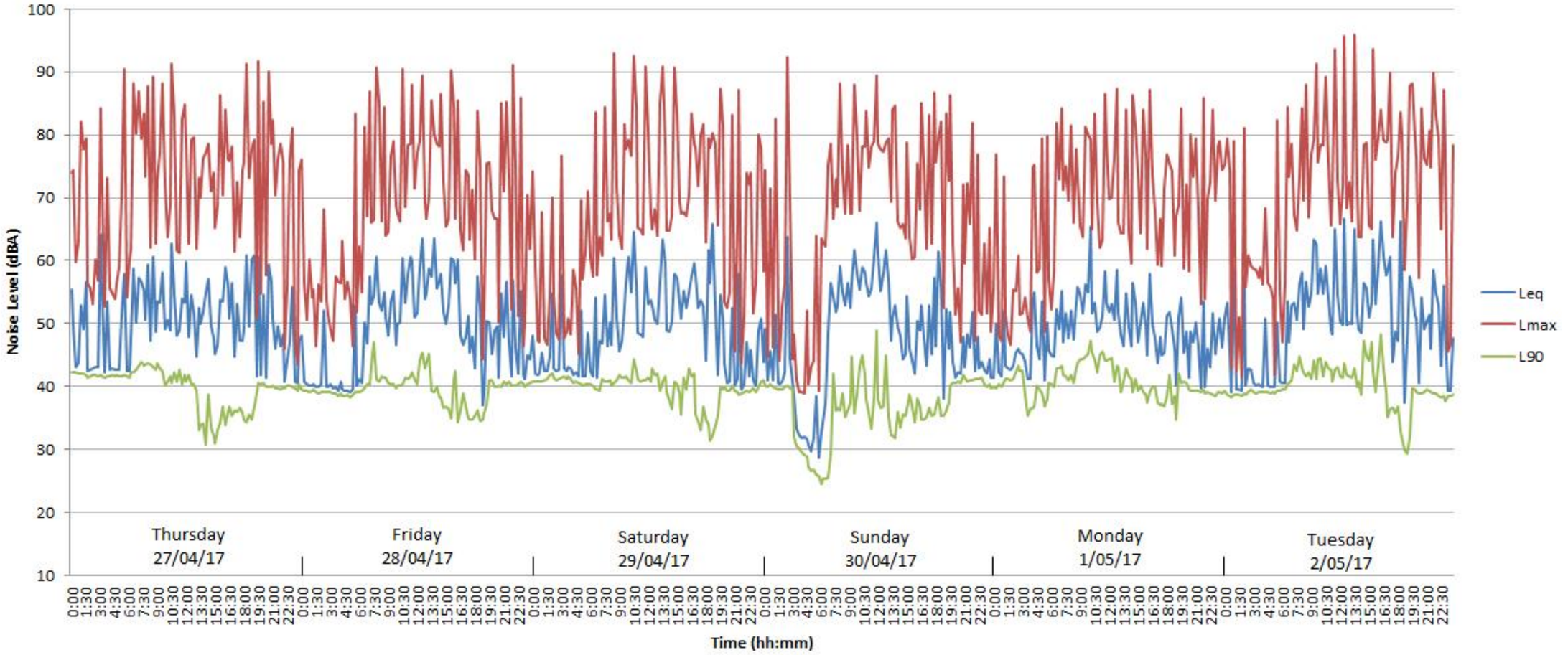
Parameters: $L_{Aeq,16hr}$: 49 dB $L_{Aeq,8hr}$: 43 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 1 m from the most exposed accessible window. Daylight savings occurred on the 2/4/17. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 3 mm of rainfall on the 30/03/17

FIGURE A-2.9: LOCATION 8 – NOISE MONITORING RESULTS



Parameters: $L_{Aeq,16hr}$: 49 dB $L_{Aeq,8hr}$: 43 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 1 m from the most exposed accessible window. There appears to be an anomalous result occurring on the Sunday 9/4/17. This was not used in assessment. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Heavy rainfall occurred on the weekend periods 08/04/17 14:30 AM – 10/04/17 6:00 AM

FIGURE A-2.10: LOCATION 9 – NOISE MONITORING RESULTS



Parameters: $L_{Aeq,16hr}$: 56 dB $L_{Aeq,8hr}$: 48 dB	**Comments:** The logger was in the vicinity of the existing railway and was installed at approximately 1 m from the most exposed accessible window. **Measurement location:** Measurements were conducted in resident's backyard. **Meteorology:** Approximately 3 mm of rainfall on the 1/5/17

FIGURE A-2.11: LOCATION 10 – NOISE MONITORING RESULTS

Appendix B

Stabling Yard Noise Contours

FIGURE B-1 PREDICTED NOISE CONTOURS OF THE MADDINGLEY STABLING YARD WITH TWO N-CLASS TRAINS RUNNING

121 EXHIBITION STREET, MELBOURNE VIC 3000
PO BOX 23061 DOCKLANDS VIC 8012 AUSTRALIA