

Regional Rail Link

Noise Impact Assessment Report Section 1 (Moonee Ponds Creek to Deer Park)

July 2011

Version 1

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Attachment 1
RRL1 Noise Technical Assessment

Executive Summary

Purpose of Noise Impact Assessment Report

This Noise Impact Assessment Report (**Report**) has been prepared by the Regional Rail Link Authority (**RRLA**) to satisfy condition 1 of the former Minister for Planning's decision that an Environment Effects Statement is not required for Regional Rail Link 1 from Moonee Ponds Creek to Deer Park (**RRL1**).

Victoria does not have any legislative requirements with numerical noise standards which apply to noise and vibration from railway operations. Nevertheless, relevant policies are set out in the *Transport Integration Act 2010* (Vic), the *Planning and Environment Act 1987* (Vic) and associated planning policies, and there are previous Victorian decisions relating to operational noise from railways.

The Victorian government has also endorsed a draft *Framework for Noise from Future Passenger Rail Investments in Victoria*. The draft Framework identifies four draft Principles (**Principles**) which are designed to inform the management of noise emissions from future passenger rail projects. RRLA notes that historically Victoria has not required noise barriers to be built as part of rail projects and the draft Framework is the commencement of policy development in this area.

Given the Victorian government has only recently endorsed the draft Principles, this Report does not respond in detail to each aspect of the draft Principles. However, where relevant, the Report makes observations about how decisions which have been made in relation to RRL1 address the draft Principles.

As required by the former Minister for Planning's decision, the Environment Protection Authority (**EPA**) has been consulted in the preparation of this Report.

The Report was also provided to Wilkinson Murray Pty Ltd, acoustical consultants, for peer review. The peer review report accompanies this Report.

Benefits and impacts of Regional Rail Link

Regional Rail Link is a major rail project that will deliver very significant social, economic and environmental benefits. It will unlock the potential of west, south west and north west metropolitan Melbourne to accommodate a projected population increase in these areas by improving the capacity and reliability of the Werribee, Melton and Sunbury metropolitan passenger service lines. It will also improve the capacity and efficiency of regional services to Geelong, Ballarat and Bendigo. These improved services will remove a barrier to economic and regional development in the western region, and make it a more attractive place for people to live and businesses to locate. Residents of the western regions will also have much improved access to major employment, education and health hubs of national and state significance in inner and central Melbourne.

Regional Rail Link will also reduce road congestion, and thereby reduce greenhouse gas emissions.

Regional Rail Link will nevertheless impact on local communities, in particular through the emission of train noise. While these local impacts could be avoided completely by not undertaking the RRL1 project, the State would forego the substantial benefits of the project identified above. Recognising this, the RRLA developed a Reference Design for RRL1 that was sensitive to the potential impacts of RRL1 train noise on local communities.

Design option constraints

The Reference Design for RRL1 follows the existing rail alignment from Moonee Ponds Creek to Deer Park. The Reference Design had to take account of complex railway engineering and systems considerations, as well as ecological and physical constraints, within and adjacent to the rail corridor. This was particularly the case for the section from Southern Cross Station to Sunshine, where construction works involved two new tracks, a one kilometre viaduct, new rail bridges, rail-over-road separations, and a flyover. In contrast, RRL1 does involve minor construction works between Sunshine to Deer Park primarily signalling and local road modifications.

Despite these physical and operational constraints, the Reference Design is responsive to potential noise impacts on neighbouring areas. For example, the designers of RRL1 considered alternative flyover locations, and sought to maximise the separation distance between RRL1 tracks and residential areas where feasible and practical.

Consideration and analysis of noise mitigation options

RRLA considered nine noise mitigation options identified by RRLA's engineering design consultants, a joint venture between KBR and Arup (**KAJV**). Based on KAJV's advice, the RRLA assessed which options are feasible and effective for reducing noise levels from trains that use the RRL1 tracks. Some of these options related to at-source mitigation, while others related to mitigation of noise received at identified noise-sensitive locations.

RRLA has incorporated three feasible and effective at-source mitigation measures into the Reference Design:

- design of railway alignment;
- track and rail roughness control; and
- track and wheel maintenance.

Track and wheel maintenance delivers a noise benefit of between 1-3dB(A). Track and rail roughness control typically delivers routewide benefits of 1-3dB(A).

Three of the remaining options namely resilient rail fixings; rail dampers and noise differentiated tracks were not considered further by RRLA because KAJV identified them as being ineffective in reducing noise levels from RRL1.

The other options consisted of various forms of noise barriers. It was recognised that noise barriers could be effective in reducing rail noise from RRL1. However, there is also amenity, social and safety drawbacks of constructing noise barriers on a large scale along the existing rail corridor, which must be considered. Furthermore, RRL is being developed along an existing and long-standing rail alignment where rail noise already prevails.

In the absence of settled Government policy which provides guidance or direction on these issues, conventional noise barriers have not been included in the RRL1 Reference Design. RRLA has investigated the merit of noise barriers after it reviewed and evaluated the noise impacts of the RRL1 Reference Design on nearby communities.

Operational noise and vibration assessment

KAJV modelled and predicted the noise impacts of the RRL1 Reference Design. The noise modelling is based on the estimated number of future railway movements likely within the railway corridor documented in the Regional Rail Link Capacity Upgrade Phases Report (Department of Transport, 2010), and includes RRL1 (V/Line), MTM and freight movements. The noise modelling accounts for increases in corridor-wide railway movements from projects that have current funding.

KAJV modelled three scenarios: the pre-RRL1 noise scenario (2012), 'Day 1' on opening of RRL1 in 2014, and Year 10 (2024), focussing on 9 hour night-time average, 15 hour daytime average, 24 hour average, and maximum noise levels. In response to the former Minister for Planning's requirements, the predicted noise levels were compared with New South Wales and Queensland rail noise guidance.

In general terms, the impact of the noise mitigation measures included in the Reference Design will be effective, typically by up to 1-3dB(A). The character and extent of noise impact varies at different parts of the alignment, and there are clear distinctions in the impact between the section from Moonee Ponds Creek to Tottenham, and between Sunshine to Deer Park.

Moonee Ponds Creek to Tottenham

In general, daytime and night-time average and maximum noise levels between Moonee Ponds Creek and Tottenham are expected to increase only marginally (between 1 to 2 dB(A)) as a result of RRL1. This change in sound level is unlikely to be perceptible. The reason for this small change in noise levels is because this section of the alignment is already heavily trafficked with regional, metropolitan and freight movements, and the relative increase in overall rail movements as a result of RRL will be small.

Small reductions in noise levels are also predicted at some locations at South Kensington, Sunshine and Middle Footscray, due to the transfer of existing services from shared metropolitan lines to dedicated RRL1 tracks.

Sunshine to Deer Park

An increase in average noise levels of up to 5dB is predicted at some locations between Sunshine and Deer Park. This will be a discernible, but not substantial, change to existing noise levels. This increase is due to the greater intensification in the number of services as a result of the Geelong services being routed onto this section of the rail corridor, compared to the already much busier alignment between Footscray and Sunshine. Importantly, no track construction activity is planned for this section of the corridor although there is a small section of minor realignment and track modification to the west of Deer Park providing access to the Tarneit/Wyndham Vale section of RRL.

Even though this part of the alignment will experience the greatest change in average noise levels, these levels (daytime, night-time, and 24 hour) will still be up to 10dB less than the equivalent noise levels that will be experienced around Middle and West Footscray, and will be less than the current noise levels in Middle and West Footscray.

Comparison to NSW and Qld guidelines

Both the current and predicted post-RRL daytime and night-time average noise levels for the Year 10 (2024) scenario exceeded New South Wales and Queensland guideline levels at South Kensington, Footscray, Middle and West Footscray, and Sunshine. The maximum current noise limits exceed the New South Wales guideline limit in numerous locations along the alignment, in particular South Kensington, West Footscray and Tottenham, Sunshine, Ardeer, and Deer Park.

Consideration of noise barriers

As a result of the existing rail noise levels along the rail corridor between Moonee Ponds Creek and Tottenham, and also because of the change in noise levels predicted between Sunshine and Deer Park, the RRLA scrutinised the feasibility of the following two noise barrier scenarios.

‘Status quo’ noise barrier scenario

RRLA instructed KAJV to design and predict the effectiveness of a noise barrier scenario for the Reference Design that would maintain the ‘status quo’ in locations where the predicted noise levels without noise barriers exceeded the New South Wales guidance limits. That scenario proposed up to 19,500m² of noise barriers, with a cost of approximately \$49 million. This cost estimate assumes that the barriers are constructed with concrete and acrylic and includes installation costs for occupation of the rail corridor. This figure would be subject to further detailed design (including consideration of land acquisition, if any required) and stakeholder consultation.

EPA consultation

During consultation with the EPA, it emphasised the need to consider night-time noise in particular.

Consequently, RRLA examined a scenario to be designed to achieve a night-time noise level of 60dB(A) $L_{Aeq,9hr}$, where the residence was also subject to a noise level increase of more than 2 dB(A) (daytime or night-time) or 3 dBL A_{max} attributable to the operation of RRL1 (**Night-time Noise Level**).

RRLA instructed KAJV to design a noise barrier scenario that would achieve that Night-time Noise Level. That scenario proposed up to 9,080m² of noise barriers, with a cost of approximately \$21 million. This cost estimate assumes that the barriers are constructed with concrete and acrylic. This figure would be subject to further detailed design design (including consideration of land acquisition, if any required) and stakeholder consultation.

Outcomes

Using the ‘status quo’ noise barrier configuration RRLA then considered the possibility of providing targeted noise barriers to specific locations – such as at Footscray or West Footscray, where existing noise levels are high, or at Deer Park, where the change in noise levels will be discernible.

The difficulty with the targeted noise barrier approach is that it requires the adoption of different approaches along the corridor which would result in different outcomes for residents depending on where they are located. Such an approach would be under circumstances where there is no settled policy guidance on how such a judgment is to be made. Consideration would also need to be given as to whether it is equitable and appropriate to arbitrarily select groups or locations to benefit from additional noise mitigation expenditure, and not others.

Under the scenario that achieves the Night-time Noise Level along the alignment, a smaller number of sensitive receptors would benefit from noise barriers.

Further third party mitigation considerations

The Department of Planning and Community Development and planning authorities could also consider the introduction of planning controls to ensure that new development in the vicinity of the rail corridor is responsive to current and future rail noise. For example, on the land that will remain available adjacent to the rail corridor, following completion of construction.

Conclusions

The draft Principles propose that the approaches to managing passenger rail noise should take account of the specific circumstances at individual locations. They also suggest that approaches to managing noise should focus on the changes to noise levels caused by the passenger rail investment, rather than address existing rail noise issues. With regard to these draft Principles, RRL1 will only increase noise levels between Moonee Ponds Creek and Tottenham by 1-3dB(A). Whilst between Sunshine and Deer Park, where the increase in noise levels will be more discernible [approximately 5dB(A)], that increase is due to the proportionally greater intensification in the number of passenger rail services along this part of the alignment due to the Geelong services being routed onto this section of the rail corridor.

RRLA considers that the mitigation measures which have been incorporated into the Reference Design (including the design of the alignment, track and rail roughness control and wheel track maintenance) provide one type of appropriate response.

While noise barriers could be delivered and will provide some acoustic benefit to impacted residents, the benefits of noise barriers must be balanced against other relevant considerations. Further, amenity impacts must also be considered, for example, in some locations the noise barriers will be vulnerable to vandalism and cause overshadowing.

A noise barrier scenario may nevertheless be feasible for RRL1. However, in the absence of a settled Government policy which provides guidance on what noise barriers are appropriate in the context of RRL1, RRLA has not incorporated noise barriers into the Reference Design. However, this does not exclude the provision of noise barriers in the future by RRLA or a third party. Once the outcome of further policy development in this area is known, further consideration of the feasibility of installing noise barriers may be considered by Government.

1 Introduction

This Noise Impact Assessment Report (**Report**) has been prepared to satisfy condition 1 of the former Minister for Planning's decision that an Environment Effects Statement is not required for Regional Rail Link 1. This condition requires that:

Within 4 months from the date of this decision, or such other time as agreed by the Minister for Planning, the proponent is to prepare a noise impact assessment report, in consultation with the Environment Protection Authority. The report is to provide a robust analysis of likely noise levels in the vicinity of Regional Rail Link Section 1 that will be associated with expected changes in rail operations, to the satisfaction of the Minister for Planning, including:

- i the likely change in overall noise levels in adjoining residential areas and sensitive receptors from current levels, that is, from existing sources;*
- ii a comparison of predicted noise levels with relevant standards or guidelines for operational rail noise from other Australian jurisdictions; and*
- iii an evaluation of the effectiveness of proposed mitigation measures, as well as the feasibility and effectiveness of additional measures that might be implemented either as part of the project or by third parties to reduce noise levels affecting sensitive receptors.*

Before being finalised by the proponent, the noise impact assessment report is to be subject to peer review by one or more relevant experts that are to be nominated by the Secretary of the Department of Planning and Community Development. Final advice from the peer reviewer is to be provided to the Minister for Planning.

This Report refers to and incorporates relevant findings of the RRL1 Technical Assessment Report prepared by the KBR-Arup Joint Venture (**KAJV**), final report dated 7 July 2011 (**KAJV Report**). The KAJV Report is annexed to this Report.

As required by the former Minister for Planning's decision, the Environment Protection Authority (**EPA**) has been consulted in the preparation of this Report. The Report was also provided to Wilkinson Murray Pty Ltd, acoustical consultants, for peer review. The peer review report accompanies this Report.

Chapter 2 presents a more detailed description of the RRL1 project, describes the characteristics of the impacted communities, and summarises the potential impacts of train noise on those communities. **Chapter 3** summarises the key Victorian guidance for the control of railway noise and vibration, including the draft Principles, and provides context to the former Minister for Planning's requirement for the noise assessment of RRL1 to be benchmarked against interstate rail noise guidelines and standards.

Chapters 4 and 5 describe the relevant design options and constraints in developing the Reference Design for RRL1, based on the technical advice from KAJV which is set out in the KAJV Report. The Reference Design consists of two elements – the vertical and horizontal alignment design of the railway, and the noise mitigation options which are built into that design. Chapter 4 focuses on the key design decisions that were made in developing the Reference Design and their noise implications, while Chapter 5 analyses the feasibility and effectiveness of the various noise mitigation options that were

considered and ultimately adopted by RRLA in the Reference Design. Chapter 6 then describes the operational noise impacts.

Chapter 7 responds to the requirement that this Report evaluate the effectiveness of noise mitigation measures that could be implemented as part of the RRL1 project or by third parties. It does this in two ways.

Firstly, Chapter 7 considers potential noise mitigation options that could be implemented by third parties. In particular, it considers the potential to introduce a new rail noise planning control such as an overlay to regulate the development of properties in the vicinity of RRL that will be affected by rail noise.

Secondly, Chapter 7 describes and assesses the effectiveness of a noise barrier option designed by KAJV on RRLA's instructions following the noise modelling of the Reference Design. The technical description and assessment of noise barriers is based on the KAJV Report, while RRLA has evaluated the noise barrier option in the context of Victorian government policy and other considerations.

Chapter 8 provides a brief conclusion and summary of the way this Report responds to the former Minister for Planning's requirements and the Victorian Government's draft Principles for consideration of noise impacts of passenger rail investments.

2 Project description and rail noise

2.1 Project description

(a) Overview

The RRL is a major railway project that will increase the capacity and improve the reliability of passenger services on the Geelong, Bendigo and Ballarat regional lines and the Werribee, Sunbury/Sydenham and Craigieburn metropolitan lines. Many of these lines are at or near capacity.

This will be achieved by separating regional trains from metropolitan trains, giving Geelong, Bendigo, and Ballarat trains their own dedicated tracks through the metropolitan system from Sunshine to Southern Cross Station. This will include the diversion of trains from Geelong onto dedicated train tracks at West Werribee, which will deliver passengers to Southern Cross Station via Deer Park.

RRL includes:

- up to 50 kilometres of new rail track, allowing diesel regional services to run direct into Melbourne without sharing tracks with the growing number of suburban services;
- two new platforms at Southern Cross Station;
- the reconfiguration of Sunshine and Footscray Stations; and
- the construction of a new rail bridge over the Maribyrnong River.

RRL consists of two sections – Deer Park to Moonee Ponds Creek (**RRL1**), and West Werribee to Deer Park (**RRL2**). RRL1 and RRL2 are subject to separate environmental and planning assessment and approval processes.

(b) RRL1

RRL1 runs from Moonee Ponds Creek to Deer Park, providing an additional two tracks for use by regional rail services from Bendigo (diverging at Sunshine), Ballarat (remaining on existing Ballarat rail corridor) and Geelong (diverging at Deer Park to enter RRL2).

The main components of RRL1 are as follows:

- the construction of two new tracks between Moonee Ponds Creek and Sunshine;
- a viaduct approximately 1 km long from South Kensington to Footscray, including a new rail bridge over the Maribyrnong River adjacent to the existing bridges;
- a new rail bridge adjacent to the existing structure over Stony Creek;
- new tracks on the existing rail bridges over Moonee Ponds Creek and Lloyd Street and upgrade works on the existing rail bridge over Kororoit Creek, Sunshine;
- a surface level expansion of the existing rail corridor through Footscray;
- replacement of existing road over rail bridges at Nicholson and Albert Streets in Footscray;
- a new rail over rail bridge and replacement of an existing rail over rail bridge adjacent to Footscray Station;

- new platforms and modifications to the existing pedestrian bridge at Footscray Station;
- replacement of West Footscray Station;
- potential new or expanded rail over road separation at Ashley Street, Tottenham;
- new or expanded rail over road separations at Kensington Road, Kensington, Victoria Street, Footscray and Robinsons Road, Deer Park; and
- platform and pedestrian access improvements at Sunshine Station.

The locality and alignment for RRL1 are shown in Figure 1.

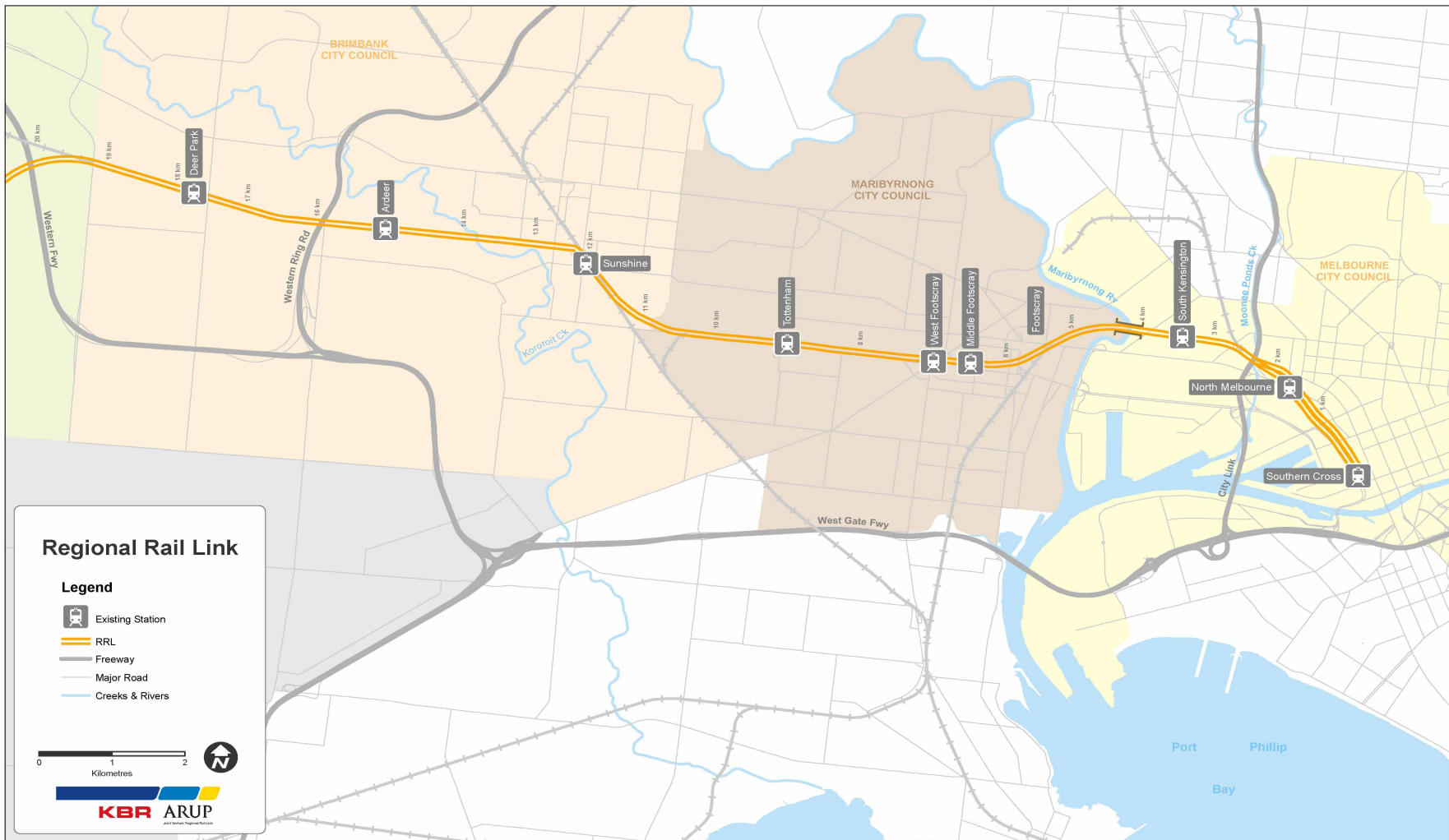


Figure 1: RRL1 alignment

2.2 Potential impacts of train noise

Railways have the potential to create noise adjacent to the track alignment during their construction and operation. The source and potential effects of rail noise are described below.

(a) Sources and forms of noise

Noise from the operation of railway vehicles generally comes from the following sources:

- Rolling noise from the wheel–rail interface. This is dependent on the combined wheel–rail roughness amplitude and speed of the rail vehicle;
- Engine and motor noise – this varies between engine types; and
- Aerodynamic noise – typically only at higher speeds (generally at 250km/h and above, therefore, it will not be an issue for trains on RRL which only reach speeds of 160km/h).

The noise generated from these sources may be perceptible at locations adjacent to railway alignments in the following forms:

- Airborne noise: noise propagated through the air to the receiver; and
- Groundborne noise: low frequency airborne noise that is reradiated from vibrating structures, generally heard indoors as a ‘rumble’.

For ‘at grade’ railways (i.e. built directly at or near the natural ground surface), the airborne noise impacts are typically higher and therefore more critical than the impacts of groundborne noise. It is usually only underground railways or railways with significant shielding (e.g. in deep cuttings), where the airborne noise is reduced to a very large extent, that groundborne noise is the predominant impact.

In addition to the track and rolling stock, noise can also be generated by fixed railway infrastructure, such as the railway stations, signalling and electrical infrastructure. The KAJV Report identifies at Chapter 2.2 the existing noise controls which apply to this type of noise. Noise is also generated during the construction of the railway. These are not considered further in this report, as construction noise is controlled by existing EPA regulations and policies.

(b) Subjective response of humans to railway noise

The subjective response of humans to noise varies between individuals. Broadly, the potential impacts of noise for the community in the vicinity of the rail alignment may include:

- loss of amenity;
- discomfort;
- adverse health effects (stress, loss of concentration, increase in blood pressure)¹; and
- sleep disturbance.

Railway noise has generally been found to be significantly less annoying to nearby receivers (i.e. people) than equivalent noise levels from road traffic^{2,3,4}

¹ Berglund, B et al Guidelines for Community Noise, World Health Organisation 1999

² Fastl, H., Fruhmann, M. and Ache, S., *Railway bonus for sounds without meaning?*, Proc. Eighth Western Pacific Acoustics Conference, April 2003.

(c) Noise Sensitive Receivers

Condition 1(i) of the former Minister's decision that an Environment Effects Statement is not required for RRL1 requires RRLA to provide a robust analysis of the likely change in overall noise levels in adjoining residential areas and sensitive receptors from current levels (i.e. from existing sources). To comply with this condition, the first step is to characterise the sensitive receptors for which changes in noise levels need to be assessed.

For the purposes of assessing the level of rail noise that is appropriate, RRLA referred to the definition of 'Noise Sensitive Receiver' used in the KAJV Report (see Chapter 5.7) and noise modelling. KAJV's advice is that noise sensitive receivers identified in the vicinity of the RRL1 rail corridor are predominantly residential, which is considered the most sensitive type of land-use due to its night-time sensitivity. Child care centre/pre-school centre and primary schools are also considered 'Noise Sensitive Receivers'.

KAJV has advised RRLA that further analysis and ground surveys of the rail corridor to confirm the location and type of all noise sensitive receivers in the vicinity would typically only be undertaken at the detailed design stage of a rail project's noise barriers (if proposed).

2.3 RRL1 communities

(a) Land uses

RRL1 traverses the four municipalities of Melbourne, Brimbank, Maribyrnong and Melton. The land uses adjacent to RRL1 within each municipality are generally commercial, industrial and residential. The key residential areas include South Kensington, Footscray, Middle Footscray and West Footscray, Sunshine and Deer Park. The key commercial and industrial areas are at Tottenham and Sunshine.

Table 1 summarises the land use zoning for that area, and the key residential or commercial zones, for each portion of the alignment.

Table 1 Land-use summary

Area	Description of land use
East of the Maribyrnong River	Predominantly commercial (B3Z), industrial (IN1Z) and public use zone transport (PUZ4). To the north of the alignment, between Hobsons Road and Bellair St (Kensington), there is some residential development (CDZ1 and R1Z) and JJ Holland Park (PPRZ).
Between the Maribyrnong River and the centre of Footscray	Suburb of Footscray. A mixture of priority development zones, including the Joseph Road Precinct (PDZ1 & 2), residential (R1Z), business (B3Z) and public park & recreation (PPRZ).
East of Geelong Road	Residential (R1Z) to the north, and mixed use (MUZ) and residential (R1Z) to the south, apart from the Footscray Central Activity Area (CAA) (B1Z).

³ Flindell, I, *A comparison of exposure-response relationships for railway noise and road traffic noise*, J. Sound and Vibration, 87(2), 1983.

⁴ Miedema, H.M.E., Vos, H. *Exposure-response relationships for transportation noise*, J. Acoustical Soc. America, 104, 1998.

Area	Description of land use
From Geelong Road to the Sunshine Industrial land	To the north the zoning is predominantly residential (R1Z). However, residential areas are separated by a significant buffer of undeveloped land (PUZ4). A large industrial section (IN1Z) extends to the south. There is an area of residential (R1Z) between Sredna and Cala Streets.
Sunshine Central Business District	Sunshine retail precinct is located to the north of the RRL track, between Anderson Road and Withers St (B1Z).
Suburban Sunshine	Predominantly residential (R1Z) with some parkland and green zones (PPRZ). The area to the east of Withers St, comprising residential areas and Parsons Reserve, Tom O'Brien Park, Kevin Wheelahan Gardens and Matthew Hill Reserve.
Suburban Sunshine West to the south and Albion to the north	Predominantly residential from Anderson Road to the Western Ring Road (R1Z) with some parkland (PPRZ).
Land bounding the rail easement between the Western Ring Rd and Mt Derrimut Rd	Industrial land (IN2Z) to the north and mostly vacant industrial land to the south, with few industrial buildings (IN1Z).
Between Mt Derrimut Rd and Robinsons Rd	Residential area of Deer Park to the north (R1Z), including Bon Thomas Reserve. Mixed use (MUZ) to the south with new residential estate under development.
Beyond Robinson Road and the Deer Park Bypass	Predominantly Business 3 Zone (B3Z), Green Wedge Zone (GWZ) and Special Use Zone (SUZ1) to the south. Industrial developments to the north concentrated around Westwood Drive (IN3Z).

(b) Noise sensitive uses

The definition of Noise Sensitive Receivers used in the KAJV Report and adapted in this Report is discussed in Chapter 2.2(c) above. The KAJV Report identifies the primarily residential sensitive receptors along the RRL1 corridor. One primary school, Our Lady of the Immaculate Conception, is located approximately 200 metres from the corridor in Sunshine.

Hospitals are not considered by KAJV as 'Noise Sensitive Receivers' however they can be considered to be sensitive land uses. There are no hospitals in the vicinity of the RRL1 alignment.

Commercial and business areas adjacent to the RRL1 alignment outlined above, are not 'Noise Sensitive Receivers' and were not considered by KAJV in its analysis of noise levels.

(c) Urban conditions

There are some general differences in the urban conditions along the RRL1 corridor, in particular the:

- distance between houses and the rail corridor;
- density of houses in the vicinity of the rail corridor; and
- housing type and quality (including existing noise mitigation treatments).

These urban conditions have the potential to affect the rail noise experienced at sensitive receptors along the RRL1 alignment, particularly indoors.

When assessing the communities along the RRL1 alignment, it is considered relevant to distinguish generally between the inner urban area between the Maribyrnong River and West Footscray (Melbourne and Maribyrnong municipalities), and the middle/outer urban area between Tottenham and Deer Park (Brimbank and Melton municipality). This is because indoor acoustic quality of timber framed houses will typically be more vulnerable to train noise than brick or stone houses. The KAJV noise assessment does not make this distinction because its noise measurements are taken one metre from the centre of the window at the most exposed façade.

The key differences between the inner urban section and the middle/outer urban section are set out in Table 2 below. The description of these differences are general, and are not indicative of every house along the alignment within the inner urban and middle/outer urban sections.

Table 2 Key differences between these two sections of the rail corridor

Characteristic	Inner urban section – Melbourne and Maribyrnong	Middle/outer urban section – Brimbank and Melton
Housing location	Housing generally closer to the rail corridor with numerous dwellings having a rear abuttal to the rail corridor with the rail lines within metres of these properties.	Housing generally separated from the rail corridor by open space and/or roads with some front setbacks capable of assisting with noise mitigation within the property itself.
Housing construction	Many older style timber dwellings.	Mix of older style timber and brick dwellings as well as brick dwellings from the 1950s onwards.
Lot sizes	Mainly single dwellings on small lots.	Dispersal of single dwellings and multi dwelling brick walk up flats and villa units on larger allotments.
Open space	Very small private open spaces which are mainly to the rear of the dwellings.	Generally suburban sized private open spaces to the rear of dwellings.
Residential Development Potential	Some areas are protected under heritage overlays or are of an allotment size that is unlikely to experience much redevelopment due to being small allotments.	Suburban sized lots have potential for redevelopment for multi dwelling development.
Large Scale Development Potential	Areas within the Footscray CAA and on land earmarked in the planning scheme for major redevelopment provide potential to reduce future noise impacts by architectural design, internal layouts etc.	Scope for large scale redevelopment on land zoned for residential development is limited due to subdivision/likely land tenure pattern, and relatively recent age of existing building stock. Some limited scope for redevelopment around the Sunshine activity centre.

Characteristic	Inner urban section – Melbourne and Maribyrnong	Middle/outer urban section – Brimbank and Melton
Truck noise	Noise intrusion from truck movements on some roads is already compromising standard of amenity e.g. Geelong Road, Buckley Street.	Noise intrusion from truck movements in areas such as Sunshine and Braybrook due to the large tracts of industrial development. This section also includes the Tottenham Railyards, which caters for rail freight, which is an additional source of noise.
Existing rail noise	Currently experiences significant levels of operational rail noise due to high volume of existing rail services.	The part of RRL1 from Sunshine to Deer Park currently experiences lower levels of operational rail noise than Footscray to Sunshine due to fewer existing rail services.

The urban conditions of the inner urban section of the rail corridor (particularly the closer proximity of residences to the rail corridor, the older style timber dwellings with poor noise mitigation treatment) may generally mean that the perceptible rail noise at these residences, particularly indoors, is more intrusive than for residences in the middle/outer urban section where the houses are generally further away from the alignment, and made from brick.

Furthermore, the presence of heritage overlays and concentrations of smaller allotments at the inner urban section means there is generally limited opportunity for future redevelopment of individual premises, which could provide potential to reduce future noise impacts by architectural design and reconfiguration of internal layout. There is generally greater opportunity to redevelop suburban sized residential lots in the middle/outer urban section to multi dwelling development that incorporates noise mitigation measures.

Opportunity does exist for future noise mitigation measures in areas marked for major redevelopment, such as the Footscray CAA and Joseph Road Precinct, and areas undergoing a process of 'gentrification' through renovation, such as Footscray more broadly. In the middle/outer urban section, there is some limited opportunity for redevelopment around the Sunshine activity centre.

3 Victorian guidance for the control of railway noise

3.1 Overview

Victoria does not have any legislative requirements or guidance limits on noise from railway operations.

The *Transport Integration Act 2010* (Vic) (**TIA**) is Victoria's primary piece of transport legislation and provides a framework for the provision of an integrated and sustainable transport system that contributes to an inclusive, prosperous and environmentally responsible State.⁵ The TIA sets out a number of objectives for the Victorian transport system, relevantly that '[the] transport system should actively contribute to environmental sustainability by avoiding, minimising and offsetting harm to the local and global environment, including through transport related emissions and pollutants'.⁶

Some general regulation and policy guidance is also found in the *Planning and Environment Act 1987* (Vic) (**PE Act**) and associated planning policy seeking to manage the growth and development of Melbourne metropolitan and regional areas.

Condition 1(ii) of the former Minister's decision requires RRLA to compare predicted noise levels with relevant standards or guidelines for operational rail noise from other Australian jurisdictions. This comparison is provided at Chapter 2 of the KAJV Report.

In the absence of any Victorian legislative requirements or guidance limits on noise from railway operations, the Victorian government has endorsed four draft Principles, which are intended to inform the management of noise emissions from future passenger rail projects. The Department of Transport will undertake further work to prepare an issues paper on *Developing a Future Passenger Rail Investment Noise Policy* for consideration by government, rail and acoustics experts, the community and other stakeholders.

To satisfy the former Minister for Planning's requirements, the noise assessment carried out by KAJV considered the noise standards applied in NSW and Queensland. However, while the interstate standards provide some guidance for a planning decision about the noise impacts of RRL1, they have not been applied as a *de facto* Victorian rail noise standard, as this would pre-empt the outcome of the government's proposed rail noise policy. Furthermore, the draft Framework proposes a set of draft Principles to be applied on a case-by-case basis, rather than a prescriptive standard to be applied regardless of the broader social or economic implications of the passenger rail investment, or the specific local conditions and constraints.

3.2 Draft Principles

(a) What are they?

In June 2011, the Victorian government endorsed four draft Principles for rail noise. The draft Principles were developed by the Department of Transport and the Department of Planning and Community Development, and are designed to be applied to future passenger rail investments. The draft Principles are the basis for the development of a noise policy for future passenger rail investment.

The purpose of the draft Principles is to ensure that decisions made in relation to passenger rail investments are more consistent and are focused on

⁵ Sections 1 and 6 of the TIA.

⁶ Section 10 of the TIA.

improving outcomes for the community. The draft Principles align with the TIA and will help ensure that decisions about noise are considered early so that all possible treatment options are available. It is proposed that the draft Principles are to be applied in both the design and planning and environment assessment of rail projects.

While the draft Principles post-date the formulation and some of the key design decisions which informed the Reference Design for RRL1, they have been adopted as the most relevant basis upon which to consider noise impacts and potential mitigation options. The draft Principles are:

Integrated early consideration

Impacts of noise from rail projects and options for noise reduction should be considered early in the proposed development and an integrated approach should be taken to identifying the options.

Affordability and equity

Noise reduction should be cost effective and take account of the total budget available, while sharing costs and benefits equitably.

Balancing objectives

Decisions about managing the impact of noise from future passenger rail investments should balance noise reduction against other objectives.

Best fit solutions

All reasonable efforts to limit impacts of noise should be made taking account of what is practicable, reasonable and cost effective, given the specific local circumstances and the broader public good.

(b) Applying the draft Principles

The draft Principles provide some guidance for meeting the requirements of the TIA for an integrated and sustainable approach to transport and related planning decisions.

The application of the draft Principles require that assessments of noise impacts and decisions about managing noise from passenger rail investments be made at several stages in the investment process. When the alignment for a rail line is being determined, assessments of the noise impacts from different options will need to be made. Then, when decisions are being made about the type of rail and rolling stock to be used, further assessments and decisions about treatment options will need to be undertaken.

The draft Principles recognise that at different stages of the investment development process, a different range of treatment options will be available. As the investment progresses, some treatment options will be locked out. For example, when the alignment for a rail line is being determined, the treatment options will include changing the actual alignment and influencing the abutting land-use. Once the alignment has been determined, the choice of treatment options will be limited to what is practical for that alignment.

Different treatment options will have different social and environmental impacts when applied to local circumstances. Some treatment options may also have implications for the operational and service objectives of the investment. Determining the appropriate treatment requires trade-offs to be made between these differing impacts.

While the Victorian Government's endorsement of the draft Principles post-dates the design of RRL1, RRLA considers that the draft Principles are reflected in the analysis of noise mitigation options undertaken by RRLA, as described in this Report.

(c) Summary of response to draft Principles

This Report outlines how key decisions in developing the RRL1 Reference Design have been made, and how the RRLA considered and addressed the noise impacts of RRL1. Reference has been made to the way these decisions respond to the draft Principles so that RRL1 can be evaluated against the draft Framework to the extent practical.

RRLA's understanding is that, in developing the draft Principles, the Victorian Government did not intend that decisions about rail infrastructure projects should be analysed against each draft Principle separately. Rather, a decision that has noise implications should be made taking into account all of the draft Principles.

However, for ease of reference, a brief summary of the aspects of this Report which most specifically address each draft Principle are identified below.

- (1) Integrated early consideration
 - Development of the Reference Design for RRL1 with consideration of noise impacts by RRLA in conjunction with representatives of other government agencies, in particular the Department of Planning and Community Development. (Chapter 4)
 - RRLA has also carried out extensive stakeholder engagement with the affected local councils and local communities. (Chapters 2, 4)
- (2) Affordability and equity
 - Assessment of potentially effective mitigation options, including treatment of noise at source or off-reservation by RRLA. (Chapters 4, 5)
 - Assessment of additional mitigation options following modelling of Reference Design, including consideration of appropriateness of implementing noise barriers in some but not all areas of the alignment, and/or applying architectural treatments which benefit individuals rather than groups or communities. (Chapter 7)
- (3) Balancing objectives
 - Substantial benefits of RRL1 in achieving beneficial outcomes relating to land use, planning and transport infrastructure, particularly in relation to identified growth areas in northern and western areas of Melbourne. (Chapter 2)
 - Material reduction in greenhouse gas emissions by displacing road transport use. (Chapter 5.3)
 - The most effective means of avoiding the noise impacts of the RRL1 project would be to not undertake the project and forego the other substantial benefits including service improvements.
 - Benefits of various design options and noise mitigations which result in different levels of benefit and disbenefit to individuals, groups and communities along the rail corridor. (Chapters 2, 4, 5, 7)

- (4) Best fit solutions
 - Selection of noise mitigation options that are integrated into the Reference Design, deliver a benefit along the entire RRL1 alignment, and are representative of modern, benchmark rail design techniques. (Chapter 5)
 - Consideration of the relative contribution of RRL1 to noise impacts in the context of existing noise at those locations, and the role of the RRL1 project in addressing systemic noise impacts where the Victorian Government has commenced a process to develop policy on that very issue. (Chapters 3, 7)
 - Consideration of extent of noise impacts from RRL1 compared with extent of benefit from various noise mitigation options in identified locations along the rail corridor. (Chapters 4, 5, 6, 7)
 - Assessment of other impacts of various noise mitigation options, extent of noise impact in comparison with extent of benefit from reduced noise impacts. (Chapters 4, 5, 7)

3.3 State Planning Policy

(a) Objectives of planning in Victoria

The PE Act regulates planning development in Victoria. The objectives set out in section 4 of the PE Act relevant to the provision of rail infrastructure and associated community impacts include:

- (1) to provide for the fair, orderly, economic and sustainable use, and development of land;
- (2) to secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria;
- (3) to protect public utilities and other assets and enable the orderly provision and coordination of public utilities and other facilities for the benefit of the community; and
- (4) to balance the present and future interests of all Victorians.

The Victoria Planning Provisions (**VPP**) are a suite of planning policies, zones, overlays and other provisions which apply to land use, development and subdivision in all planning schemes throughout Victoria. These include overarching policy objectives for key aspects of strategic planning, strategies for achieving the objectives, and guidelines for decision making, with the aim of achieving these strategic planning outcomes consistently throughout the State.

(b) Rail transport policies

Clause 18 of the State Planning Policy Framework (**SPPF**) recognises the integral function of rail transport in the urban environment and the importance of rail infrastructure in achieving desirable economic, social and environmental outcomes, stating that:

Planning should ensure an integrated and sustainable transport system that provides access to social and economic opportunities, facilitates economic prosperity, contributes to environmental

sustainability, coordinates reliable movements of people and goods, and is safe.

As stated in Clause 18.02-3 – Principal Public Transport Network of the SPPF, two strategies specific to RRL1 are:

- Establish fast train services that serve key regional cities and townships and connect them with Central Activities Areas Principal and Major Activity Centres along the radial routes connecting to Central Melbourne; and
- Identify key strategic transport corridors capable of providing fast, reliable and frequent public transport services.

The contribution of RRL1 towards achieving the broad transport policy objectives set out in the SPPF is discussed further in Chapter 5.3.

(c) Integrating rail transport policies with other planning policies

The VPP also recognises that strategic planning must integrate the provision of rail infrastructure in urban and future urban areas with other planning objectives, including:

- the need to contain urban expansion of metropolitan Melbourne; and
- encourage higher density housing and mixed use development, coupled with increased employment opportunities, close to public transport services and activity centres.

Integration of land use and transport objectives is important to achieving good planning outcomes for the development of urban zoned vacant land, and redevelopment of strategically significant land close to activity centres, public transport services and employment nodes. This integrated approach is acknowledged in Clause 18.01 'Integrated Transport' of the VPP, as well as in the draft Noise Principles. State planning policy in Clause 18.01-1 requires that improvements to public transport should be coordinated with the on-going development and redevelopment of the urban area.

State planning policy also seeks, among other things, to provide communities with a high standard of amenity as well as good health and well being. The amenity impacts of development, such as increased operational noise impacts from rail infrastructure projects, can result in a loss of amenity and liveability. Clause 11 'Settlement' recognises the need to balance competing objectives, providing that, while planning should contribute towards land use and transport integration:

Planning is to prevent environmental problems created by siting incompatible land uses close together.

The VPP recognises that rail corridors that traverse established urban areas, such as the rail corridor to be developed for RRL1, will have already influenced the standard of amenity experienced by people living and working in close proximity to these corridors. Nevertheless, clause 18.01-2 indicates that future rail works and operational characteristics which may increase existing noise levels, as well as the frequency of such noise experiences, in urban areas should adopt transport practices, including design, construction and management, to reduce environmental impacts associated with those new works and operations.

In terms of noise abatement, Clause 13.04 'Noise and Air' aims to 'assist the control of noise effects on sensitive land uses'. The strategy to achieve this State planning policy objective is to:

Ensure that development is not prejudiced and community amenity is not reduced by noise emissions, using a range of building design,

urban design and land use separation techniques as appropriate to the land use functions and character of the area.

At present there is no policy guideline referred to in Clause 13.04 that specifically addresses noise and vibration from passenger rail transport, so guidance is limited to this broad policy statement. It is apparent that clause 13.04 contemplates managing noise at source, but it also contemplates the planning system addressing noise impacts through controls on the development of land in the vicinity of the noise source. Clause 13.04 also refers to the State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1 (**SEPP N-1**), which will regulate noise from fixed infrastructure in the RRL1 project as discussed in Chapter 3.4 below.

The SPPF illustrates the policy tension that exists between the objectives and strategies relating to transport, such as improved rail transport within metropolitan Melbourne, and those relating to settlement and environmental issues such as noise. The competing policy imperatives are recognised in the draft Principles, which seek to identify desirable outcomes and balance competing demands taking into account the economic, social, environmental and financial implications of passenger rail transport decisions.

3.4 Fixed infrastructure sites

Operational noise associated with fixed infrastructure sites (e.g stations, maintenance facilities and stabling) is required to comply with the SEPP N-1. Noise emissions from RRL1 fixed infrastructure sites must comply with SEPP N-1.

Chapter 2.2 of the KAJV Report discusses the requirements of SEPP N-1 in further detail.

3.5 Interstate guidance

There is no numerical noise standard for assessing rail projects in Victoria. Nevertheless, to satisfy Condition 1(ii) of the former Minister for Planning's decision that an EES is unnecessary for RRL1, KAJV has compared the predicted noise emissions from RRL1 with NSW and Queensland guidelines.

An overview of the NSW and Queensland guidelines is provided in Chapter 2 of the KAJV Report, and their comparison of predicted noise levels with these guidelines is provided in Chapter 6 of the KAJV Report.

The New South Wales and Queensland noise guidelines for residential land uses are summarised below:

	New South Wales Guidelines*	Queensland Guidelines**
Daytime average	65dB _{L_{Aeq}} ,15hr	-
Night-time average	60dB _{L_{Aeq}} ,9hr	-
Maximum	85dB _{L_{Amax}}	95dB _{L_{Amax}}
24 hour average	-	65dB _{L_{Aeq}} ,24hr

* IGANRIP (2007) for the redevelopment of existing rail line, but the noise levels above these limits are only considered to have 'increased' if the redevelopment also results in an increase of 2dB(A)_{L_{Aeq}} in any hour, or an increase of 3dB(A)_{L_{Amax}}

**Code of Practice – Railway Noise Management, Queensland Rail, Version 2, November 2007

These noise guideline levels are for *external* noise.

4 Project design constraints and options

4.1 Overview

RRL1 is a complex project that has undergone a lengthy and robust engineering design and community consultation process, with the cooperation and input of other government stakeholders.

The Reference Design of RRL1 has two elements. The first element is the conceptual design of RRL1, and the second element is the selection and incorporation of proposed mitigation measures. This Chapter considers the conceptual design element, while Chapter 5 considers the noise mitigation options that were assessed and selected for inclusion in the Reference Design.

The Reference Design for RRL1 is responsive to potential noise impacts on neighbouring areas. The key Reference Design decisions have balanced noise reduction against other objectives, as well as the existing physical and operational constraints along the rail corridor. In doing this, RRLA has achieved the outcome intended by the draft Principle of 'Balancing objectives'.

Furthermore, the RRL1 Reference Design also shows regard to the 'Early Integration' Principle, as impacts of noise from RRL1 and options for noise reduction have been considered early in the proposed development, and an integrated approach has been taken to identifying the options for noise reduction.

4.2 Design constraints

RRL1 presented the challenge, common to most major linear projects, of acknowledging that localised impacts will occur no matter where the rail corridor is located.

Typically for new linear projects such as railways, a key way to reduce the extent of these localised impacts is to select an alignment which, when balanced against other relevant priorities, minimises the number of sensitive noise receptors. Because RRL1 follows an existing rail alignment, it was impractical to apply this mitigation measure to RRL1 except in discrete locations.

Furthermore, designing RRL1 has been subject to complex railway engineering and systems considerations (such as alignment geometry and integration within the existing rail network) and ecological and physical constraints within and adjacent to the rail corridor. Key examples of these are briefly described below:

- the RRL tracks from Southern Cross Station to the vicinity of South Kensington Station generally utilise existing tracks which, although proposed to be upgraded, remain on the same alignment. The alignment is already within and adjacent to other existing lines used for freight and passenger services;
- the location of existing stations, such as Footscray, Middle Footscray and West Footscray, and access requirements for users of these stations, drives engineering solutions;
- the need for adequate vertical clearance between key arterial roads and RRL1. Important examples of this are Hopkins, Nicholson, Albert and Victoria Streets in Footscray;
- integrating RRL1 with existing transport networks, such as Buckley Street/Sunshine Road and the Geelong Road overpass, also provide significant constraints to the design of the rail alignment, as these major transport routes must be maintained;

- Tottenham railyards – the corridor in this vicinity was constrained by:
 - the need for a vertical separation between RRL1 and the existing freight corridor to Newport;
 - the existing rail tracks, and geometric constraints on curves necessary to allow a feasible alignment for RRL1 tracks into Sunshine; and
 - the need to avoid impacts on native grasses to the north of the existing rail alignment and the nationally protected Sunshine diuris orchid population located to the south-west; and
- the section of RRL1 on the Ballarat line at Sunshine where it crosses Anderson Road is proposed to be placed in a cut to facilitate the road grade separation at Anderson Road.

4.3 Key Reference Design decisions

In addition to the design response to the engineering considerations and constraints described above, there have also been a number of key decisions following consultation with other stakeholders, when developing the Reference Design of RRL1. These decisions have implications for the extent of rail noise from RRL1 experienced in residential areas. These key decisions have been:

- the location of flyovers;
- how best to develop the project in the densely populated Footscray area, including whether a tunnel, at-grade, or elevated rail solution should be provided through Footscray, and whether to acquire all of the residential properties south of the rail corridor and on the northern side of Buckley Street;
- the placement of RRL1 within the existing rail corridor between Tottenham railyards and Sunshine Station; and
- the number of tracks required between Sunshine and Deer Park to accommodate regional services from Geelong, Ballarat and Bendigo.

Further information about these design decisions, and a brief description of their noise implications, is described in sections 4.4 to 4.7 below.

4.4 Flyover – Maribyrnong River to Hopkins Street

The new RRL1 tracks are located on the south side of the Werribee and Sydenham tracks, between Spion Kop Junction (to the east of South Kensington Station) and the west bank of the Maribyrnong River. The RRL1 tracks need to cross the Werribee tracks somewhere along this section to enable the RRL1 tracks to continue along the Sydenham corridor and the Werribee tracks to align with the Werribee corridor.

The Reference Design contemplates that the track crossing is located between the Maribyrnong River and Hopkins Street and is achieved via a grade separated structure (flyover) to enable conflict between train services on the two lines to be avoided. The rail corridor in this section also needs to be widened to create space for the new RRL1 tracks to fit between the Werribee tracks and the Sydenham tracks.

(a) Consideration of Alternative Flyover Locations

The need for the new flyover presented the challenge, common to most major linear projects, of accepting that localised impacts that will occur no matter where it is located. In this context, it was established that the flyover must be located between Spion Kop Junction and Hopkins Street. RRLA considered a range of alternative options for a flyover within this section of the rail corridor:

- (1) The current Reference Design location between the Maribyrnong River and Hopkins Street, either with the electrified trains over the RRL1 tracks (as indicated in the RRL1 EES Referral) or RRL1 tracks over the electrified tracks. The latter is included in the Reference Design.;
- (2) Between the Maribyrnong River and South Kensington Station; and
- (3) Between Spion Kop Junction and South Kensington Station.

There were several key considerations in deciding which option to adopt. These included the physical, geographical and geotechnical constraints existing along the rail corridor in this area, track gradients, required grade separations and safety features, as well as ease of access for construction, operation and maintenance. It was determined that the Reference Design location was the preferred option because of the potential to cause least disruption to rail operations and because of less restrictive physical, geographical and geotechnical constraints.

(b) Key Considerations

The construction of the new rail tracks and flyover will have noise impacts on existing residential land-users. This will particularly be the case at the nearest residences to the north of the existing rail corridor at Railway Place, Footscray, and also on the Joseph Road Precinct to the south of the existing rail corridor.

Railway Place: Following consultation with the owners of the Railway Place residences, it was apparent that the owners did not wish their properties to be acquired for the purposes of RRL1. RRL1 has been designed to avoid direct impact on these properties so that they do not need to be acquired. It is acknowledged that there will be noise impacts at these residences.

Joseph Road Precinct: The Joseph Road Precinct is in a Priority Development Zone 2 (PDZ2) in the Maribyrnong Planning Scheme. The precinct is identified as an important site for future change from its current commercial/industrial use to a mix of retail, entertainment and recreation, showroom and office uses with higher density residential use. The Joseph Road Precinct lies on the fringe of the Footscray major activity centre area identified in the planning scheme around the Footscray CAA, and the objectives of the PDZ2 include to facilitate redevelopment of the precinct as a catalyst for investment and renewal in the CAA.

PDZ2 and the incorporated Joseph Road Precinct Framework Plan identify noise sources, including the existing and future rail development, as factors to be taken into account in designing development within the Joseph Road Precinct.

The RRL1 Incorporated Document (dated October 2010) requires that prior to the commencement of development, a Development Plan be prepared to the Minister for Planning's satisfaction for the 'Land abutting the Joseph Road Precinct, Footscray'. The Development Plan must be prepared in consultation with the local Council and, where relevant, VicRoads and Melbourne Water Corporation.

The combination of planning controls for the Joseph Road Precinct to take account of nearby noise sources, in conjunction with the planning control in the Incorporated Document which requires a Development Plan for RRL1 in this location, provide the statutory tools to address the impact of operational rail noise (current and future) on this precinct.

A further control mechanism may be to impose an Overlay under the Maribyrnong Planning Scheme to make the Joseph Road Precinct a 'Noise

Attenuation Area', to ensure that the development of this area near the RRL1 alignment is undertaken with appropriate noise attenuation measures. This is discussed in detail at Chapter 7.2.

4.5 Footscray Area

(a) Maribyrnong River to West Footscray

The following options for the 2.35 kilometres of rail corridor between the Maribyrnong River and West Footscray (**Footscray Area**) were analysed:

- (1) **Tunnel:** a tunnel from the west side of the Maribyrnong River to West Footscray with underground platforms at Footscray Station, continuing west to the vicinity of Geelong Road, where the tunnel alignment returns to the surface for the remainder of the route to Sunshine;
- (2) **New track pair at-grade:** the construction of a major new viaduct to enable the RRL1 tracks to pass over the Werribee line near the Maribyrnong River and continue at grade level through to West Footscray and beyond. Two additional platforms would be provided at Footscray Station for the new tracks to use; and
- (3) **Elevated viaduct:** Early in the concept design stage for the Footscray Area, consideration was given to the possibility of the RRL1 tracks being on an elevated structure from the Maribyrnong River area through to West Footscray, generally along the same alignment as the tunnel options described above. This option was rejected by RRLA due to the potential for adverse noise and visual impacts of the elevated rail, particularly for nearby residences.

Detailed Options Analysis

An analysis of the tunnel and at-grade options for the Footscray Area was undertaken by the RRL Interdepartmental Working Group, consisting of representatives from the Department of Transport, the Department of Planning and Community Development, the Department of Treasury and Finance, and the Department of Premier and Cabinet. The options analysis was based on high-level concept design information.

In general terms, the following options were considered:

- (1) regional diesel trains in tunnel;
- (2) Sydenham suburban electric trains in tunnel; and
- (3) two new tracks at-grade through Footscray.

Following the Integrated Working Group's detailed analysis of these options, the at-grade solution was approved.

The noise implications of the at-grade concept design for RRL1 are assessed in this Report and demonstrate that the highest average and maximum noise levels are expected to continue to be experienced around Footscray and West Footscray, where existing properties are located nearest to the existing rail corridor (see discussion at Chapter 6.3 of this Report). A tunnel option would have reduced the noise levels experienced at most residences in the Footscray Area due to RRL1. However, there were many factors which influenced the

decision to select the at-grade solution in the Footscray Area. The key reasons were:

- running diesel trains in a tunnel carries a significant risk profile due to risk of fire, life and safety (by potential high intensity diesel-fuelled fire). In particular, the proposed tunnel in conjunction with the rolling stock type and frequency would be without any precedent known to RRLA, and so would raise questions about the reliability of an extrapolated analysis of safety risk;
- regional diesel trains in the tunnel would require large ventilation stacks (up to 60 m high) in the vicinity of Footscray Station (plus one 10 m high stack at each portal). This would potentially give rise to:
 - community concern about the ventilation stacks; and
 - impacts on visual amenity in the area;
- due to the relatively shallow depth required for a rail tunnel because of the gradient requirements, a tunnel option did not mitigate the property impacts associated with RRL1. Furthermore, for the electric trains in tunnel option, considerable engineering and construction difficulties, with consequential impact on rail operations, would be encountered where the tunnel passed under the existing rail corridor.

Mitigation Measures for At-Grade Rail

Chapter 5 of this Report sets out a detailed analysis of the benefits, costs and suitability of noise mitigation options, and presents RRLA's proposed noise mitigation strategy for the RRL1 Reference Design. In summary, the operational noise mitigation measures included as part of the RRL1 Reference Design are:

- Design of railway alignment;
- Track and rail roughness control; and
- Track and wheel maintenance.

Footscray Station Precinct: The Footscray Station Precinct (bounded by Napier, Irving, Leeds, Hopkins and Napier Streets, Footscray) is in a Priority Development Zone 1 (**PDZ1**) in the Maribyrnong Planning Scheme.

The objectives of the PDZ1 include creating a high quality public transport interchange, to revitalise and stimulate private sector investment and urban renewal in the area, and to create a socially and economically sustainable mixed use precinct that provides a diverse range of housing, commercial, retail and public recreation opportunities.

PDZ1 and the incorporated plan *Footscray Station Urban Framework Plan* requires the noise conditions of the precinct to be appropriately considered. Planning permits to use land in the precinct must include an assessment of the likely effects of railway noise and vibration on the proposed use, and proposed measures to attenuate any adverse effects.

The RRL1 Incorporated Document (dated October 2010) requires that prior to the commencement of development of RRL1, a Development Plan be prepared to the Minister for Planning's satisfaction for the 'Footscray Station'. The Development Plan must be prepared in consultation with the local Council and, where relevant, VicRoads and Melbourne Water Corporation.

The combination of planning controls for the Footscray Station Precinct to take account of railway noise, in conjunction with the planning control in the Incorporated Document which requires a Development Plan for RRL1 in this location, provide the statutory tools to address the impact of operational rail noise (current and future) on this precinct.

It should also be noted that the Victorian Government is looking into preparing an integrated set of planning controls for the Footscray CAA, which takes into consideration RRL1. There may be scope within this review to impose further noise attenuation requirements on future development within and around the Footscray Area between Maribyrnong River to West Footscray to manage noise impacts of rail operations in this area. The planning controls that could be implemented for this and other locations in the vicinity of RRL1 are discussed in detail at Chapter 7.2 of this Report.

(b) Buckley Street, between Victoria Street and Geelong Road

(1) Alignment

The RRL1 rail tracks are generally located at the southern side of the existing rail corridor. This maximises the separation distance between these tracks and the extensive residential area to the north of the corridor, which would be adversely impacted by noise from RRL1 if the corridor was placed to the north of the corridor.

(2) Acquisition of Property and Other Social Impacts

The decision to place the RRL1 tracks along the southern side of the rail corridor has meant that houses on Buckley Street, between Victoria Street and Geelong Road, have been acquired.

Under section 112(1) of the *Major Transport Projects Facilitation Act 2009 (Vic)*, land can only be acquired within a designated project area 'for the purposes of an approved project or any purpose connected with the approved project'. It was decided to acquire certain properties in this location on the basis of a number of criteria, including that the alignment of RRL1 will impact on a property requiring part of the building to be demolished.

A consequence of this is that residences that would be most severely affected by noise impacts of RRL1 between Buckley Street and the rail corridor have been acquired, which reduces the overall number of residences affected by noise. However, it is acknowledged that by removing these residences, the noise impacts for properties on the south side of Buckley Street between Victoria and Margaret Streets has the potential to increase.

(3) Future Development

Once RRL1 is constructed, the land acquired north of Buckley Street (**Buckley Street Land**) will be available for redevelopment. Any development of the Buckley Street Land will act as a barrier to the transmission of noise from RRL1 to the residential properties south of Buckley Street.

The Buckley Street Land is in a Mixed Use Zone (**MUZ**) under the Maribyrnong Planning Scheme. Clause 22.02 of the Planning Scheme recognises that Buckley Street is part of a declared main road route from the docks in the east to the western industrial area. Because of its largely non-residential nature, the Buckley Street Land has also been identified as a suitable route for heavy truck transport.

The MUZ Policy 1, under clause 22.02 of the Maribyrnong Planning Scheme, applies to the Buckley Street Land. A relevant objective of the MUZ Policy 1 is to 'encourage the growing mixed use character of [this] precinct – in particular, to encourage non-residential activity and create new opportunities for a wide range of sustainable employment.'

Importantly, it is already policy of the MUZ Policy 1 to require new dwellings within 20 metres of Buckley Street to incorporate noise attenuation measures, which will help ensure that new dwellings within this section of RRL1 are protected from associated noise impacts.

As outlined at Chapter 4.5 above, the Victorian Government is looking into preparing an integrated set of planning controls for the Footscray CAA, which takes into consideration RRL. There may be scope to impose further noise attenuation requirements on future development within the existing Footscray CAA, and surrounding areas which protects these areas from noise impacts associated with the extensive rail operations in this area. The planning controls that could be implemented for this location are discussed in detail at Chapter 7.2.

4.6 Corridor between Tottenham Railyards and Sunshine Station

(a) Overview

The rail corridor between the location of the proposed West Footscray Station and the intersection of Sunshine Rd and Sara Grove, Sunshine, includes the Tottenham freight yards near Tottenham station. The rail corridor is therefore much wider in this location than elsewhere. This presented some scope to locate the new RRL1 rail tracks to either the north or south of the existing yards.

(b) Constraints

The key constraints in the location of RRL1 in this area included:

- the need for a vertical separation between the RRL1 tracks and the existing freight corridor to Newport;
- the existing rail tracks, and geometric constraints on curves necessary to allow a feasible alignment for RRL1 tracks into Sunshine; and
- the need to avoid impacts to native grasses to the north of the existing rail alignment and the EPBC Act-protected Sunshine diuris located to the south-west.

(c) Reference Design and Noise Impacts

The Reference Design includes that the RRL1 tracks be situated to the south of the existing tracks and the Tottenham railyards, adjacent to the Sunshine Road reserve. This maximises the separation distance between the new tracks and the existing residential area to the north of the corridor. Between West Footscray Station and Ashley Street and along Ruby Way, significant residential development exists to the north of the rail corridor, whereas residential development to the south of the rail corridor is more limited, confined essentially between Cala and Sredna Streets.

Accordingly this design:

- reduces the potential noise effects of regional trains on the more extensive residential area located to the north of the rail corridor; and
- provides the opportunity for the Sunshine Road reserve to function as a separation buffer between the RRL1 tracks and the residences to the south of this Road.

4.7 Sunshine to Deer Park

RRL1 does not involve the construction of new train tracks within this stretch of the existing rail corridor. However, the routing of Geelong trains onto existing tracks within this corridor will result in a greater number of trains using this part of the rail corridor. The noise effects of this increase are set out in Chapters 6.3 and 7 of this Report.

5 Noise mitigation in the Reference Design

5.1 Introduction

Noise mitigation elements are an important part of railway design, and must be integrated with other key design constraints to ensure a safe, reliable and maintainable railway. It was important for the Reference Design for RRL1 to incorporate these elements, where appropriate, based on the acoustic and technical advice in the KAJV Report.

The Report is required to evaluate the feasibility and effectiveness of various mitigation measures. RRLA has done this by weighing up and balancing the benefits of the RRL project overall, and the costs and benefits of mitigating localised noise impacts.

To satisfy Condition 1(iii) of the EES Decision, RRLA has adopted the following approach to evaluate the noise options:

- Consider, based on advice from KAJV, which noise mitigation options could be effective in mitigating the noise impacts of RRL1 along the railway corridor given the specific circumstances of this project;
- for each of the options identified as potentially effective in mitigating noise from RRL1, consider the feasibility of those options by reference to social, environmental and economic benefits of RRL overall, and the benefits and drawbacks of each mitigation option; and
- on the basis of that analysis, determine which options, on balance, are effective and feasible for RRL1, and which are not.

Residents who live in the vicinity of the existing rail corridor have experienced rail noise for decades or, in the case of inner western Melbourne, for well over a century. RRLA therefore believes that any reasonable evaluation of the noise mitigation options must acknowledge the existing rail noise environment, and focus on any problematic changes in noise levels brought about by RRL1. It must assess that marginal increase in noise impacts against the benefits of the project. The assessment presented in this Chapter responds to the incremental noise increase attributable to trains operating on the RRL1 tracks.

RRLA considers that this approach reflects the Government's draft Principles by:

- taking into account the resources available to develop RRL, while sharing costs and benefits equitably;
- balancing noise reduction against other objectives; and
- making reasonable efforts to limit the impacts of noise taking account of what is practicable, reasonable and cost effective, given the specific local circumstances and the broader public benefit of RRL.

5.2 Effectiveness of noise mitigation options

Table 3 sets out the noise mitigation options discussed in Chapter 3 of the KAJV Report, the effectiveness of each option in reducing noise from RRL1 and, where relevant, provides an explanation of the suitability and effectiveness of the option.

Table 3: Effectiveness of noise mitigation options

Option	Typical reduction in noise level	Comments	'Effectiveness' for RRL
Design of railway alignment	Variable	While RRL1 follows the existing rail alignment, where practicable the rail alignment sought to maximise distances between RRL1 and residential areas, particularly around Tottenham.	Effective in specific locations where it can be done
Track and rail roughness control	1-3dB(A)	A contemporary track system which minimises the number of rail joints and surface roughness will reduce wayside noise levels, and can be applied along the entire alignment.	Effective
Track and wheel maintenance	Variable: - 1–3 dB(A) (routewide); and - 5–10 dB(A) (local defects). -	Regular maintenance of the track profile and train wheels can deliver significant railway noise reductions along the entire alignment.	Effective
Conventional noise barriers	Up to 12dB(A), depending on barrier height	Noise barriers are generally a proven and robust means of noise control and are used for railway noise mitigation in Europe, Asia and Australia. The amount of noise attenuation provided by the barrier (whether traditional 'fence' or earth bunds and embankments) depends on the height, length and location of the barrier relative to the noise source and receiver.	Effective
Low-level track side noise barriers	3-6dB(A)	Low-level track side barriers can be effective at mitigating noise in some circumstances, but are less effective for sections of the alignment that have a large number of adjacent tracks, as each track would require a separate low-level barrier. This restricts inspection and maintenance access and emergency egress. There is also a safety and collision risk.	Effective
Resilient rail fixings	No impact on airborne noise	Highly resilient rail fixings do not reduce the extent of airborne noise emission from the railway, and can sometimes increase noise emissions through increased rail mobility.	Not Effective
Rail dampers	1-3dB(A)	Rail dampers can be used to reduce noise emissions from the rail itself, particularly when highly resilient rail fixings are also used. The use of this type of rail damper in Victoria would require a detailed approval process. As the use of resilient rail fixings is not proposed for the reasons outlined by KAJV, and the rail mobility will be relatively low, it is not expected that rail dampers would provide any significant control of airborne noise emissions from RRL1.	Not Effective

Option	Typical reduction in noise level	Comments	'Effectiveness' for RRL
Noise differentiated track access charges (NDTAC)	1-3dB(A)	<p>A system of NDTAC is most useful to incentivise railway operators to reduce noise levels produced by their rolling stock where railways are used by a number of operators. This type of system is particularly suited to European conditions, where operators require incentives to upgrade from their older, noisier, wagon fleet with cast-iron brake blocks.</p> <p>NDTAC programmes are logistically difficult and expensive, since it is necessary to install and maintain a costly recording and billing system – for example, using RFID or GPS identification of train passages.</p> <p>An NDTAC system is unlikely to promote significant noise reductions for RRL1, since the typical rolling stock is modern, has reasonable (non-cast iron) braking systems, and wheel conditions.</p>	Not Effective
Off-reservation architectural acoustic treatments	10-20dB(A) (locally)	<p>Can provide effective noise mitigation to the internal areas of treated buildings, provided that the building structure type is appropriate for the available types of treatment and that doors and windows remain closed.</p> <p>Architectural acoustic treatments provides noise mitigation to individual dwellings, and do not reduce noise impacts external to the buildings nor provide an overall improvement to noise amenity along the rail corridor.</p>	Effective for individual dwellings in some circumstances

Based on the analysis carried out by KAJV and summarised above, RRLA concluded that the following types of noise mitigation measure would not be effective in reducing noise levels experienced in the vicinity of RRL1, and hence would not satisfy the 'best fit' draft Principle:

- resilient rail fixings;
- rail dampers; and
- NDTAC.

These options have therefore not been included in the RRL1 Reference Design.

KAJV identified that the following measures could be effective in mitigating the noise impacts of the RRL1:

- Design of railway alignment;
- Track and roughness control;
- Track and wheel maintenance; and/or
- Noise barriers.

While architectural acoustic treatments are a potentially useful noise mitigation measure, they were not relevant to the Reference Design of RRL1 itself. Architectural acoustic treatments, and how the planning system could require these treatments to be implemented, are addressed in Chapter 7.2 and 7.3.

5.3 Project Objectives and Benefits

The next step is to evaluate the feasibility of the effective noise mitigation options, by reference to the benefits and drawbacks of each of those options, when compared to the social, environmental and economic benefits of RRL overall.

The starting point for this analysis is to set out the objectives and benefits of RRL.

(a) Background

The population projections in *Victoria in the Future 2008* indicate that Victoria's population will increase from 5.13 million in 2006 to 7.40 million by 2036 (an increase of 2.27 million people, or 44.2 per cent)⁷.

A significant proportion of this growth is projected to occur in western, south-western and north-western metropolitan Melbourne, which has a projected population increase of 270,000 in these areas by 2026. This would represent an increase of almost 60% relative to the estimate of the population in 2011. The cities of Melton and Wyndham are forecast to experience considerable growth, with their populations increasing by 117,000 and 161,100, respectively, by 2030. Almost 280,000 people are forecast to live in the City of Wyndham in 2026, which is an increase of 72% compared to 2011. In particular, it is estimated that there will be 160,000 people living in the Wyndham North Statistical Local Area⁸. More modest but nevertheless significant population growth is also forecast in most relevant regional centres, such as Geelong, Bendigo and Ballarat.

In addition to this population growth, there has also been an increase in public transport patronage. This increase is mainly attributable to increased petrol prices, increased road congestion, and a greater awareness and concern for

⁷ DPCD, *Victoria in the Future 2008*, 'Victorian State Government Population and Household Projections 2006 – 2036', Second Release: September 2009, at http://www.dpcd.vic.gov.au/_data/assets/pdf_file/0008/32201/DPC056_VIF08_Bro_Rev_FA2.pdf

⁸ Wyndham - North Statistical Local Area is one of Australian Bureau of Statistics' defined three statistical local areas that comprises the Wyndham Local Government Area.

the environmental effects of car use on the environment. Train-ridership has increased 70% in the last decade, with a 40% increase in the last 3 years.

The current metropolitan rail network is close to capacity, and this is particularly the case for the northern and western rail group of lines, where population growth has been the highest and where there is little opportunity to easily expand the capacity on those lines. Due to the expected population increases in the cities of Melton and Wyndham, the increase in patronage demand will be most significant on the sections inbound from Manor Lakes and Melton.

(b) Objectives of RRL

The primary objective of the RRL project is to respond to the challenges described above by increasing capacity and improving reliability of passenger services on the Geelong, Bendigo and Ballarat regional lines and the Werribee, Sunbury/Sydenham and Craigieburn metropolitan lines, many of which are at or near capacity. RRL will also support the future population growth and public transport demand along the corridor, particularly in the cities of Melton and Wyndham.

More specifically, the RRL project will:

- increase the capacity of the Werribee and Sydenham services;
- increase the capacity of the Geelong and Bendigo and Ballarat services;;
- provide more frequent and reliable regional rail services, including removing the bottlenecks where country trains – particularly Fast Rail trains from Geelong, Ballarat and Bendigo – reach the metropolitan network. Benefits will also flow on to the metropolitan rail system, boosting capacity across the State’s network by 9,000 extra passengers an hour;
- make all new infrastructure provided as part of this project compliant with relevant disability discrimination legislation;
- achieve an operational outcome that is consistent with the overall Rail Network Capacity Program;
- achieve integrated development around rail stations, including multi-modal connections, with high quality transit oriented mixed use development; and
- take advantage of attractive opportunities to integrate with and encourage urban development at existing and new stations.

(c) Benefits of RRL

By achieving these objectives, the RRL project will deliver a number of social, economic and environmental benefits for Victorians.

In particular, RRL will unlock the potential of the west, southwest and northwest metropolitan Melbourne to accommodate the projected population increases by providing rail access to growth areas and improving the capacity and reliability of passenger services on the Werribee, Melton and Sunbury lines and to regional centres such as Geelong, Ballarat and Bendigo. This will provide these areas with a level of access to passenger train services similar to what is provided to most other parts of Melbourne.

RRL will also remove a barrier to economic and regional development in the western region and make it a more attractive place for people to live and businesses to locate. In particular, new stations at Wyndham Vale and Tarnet provide the opportunity to broaden the diversity of housing, urban realm and lifestyle opportunities to these growth areas, as rail is a critical enabler to these outcomes.

By improving the passenger rail capacity to inner Melbourne, residents of the western regions will have much improved access to major employment, education and health hubs of national and state significance in Inner and Central Melbourne. These include financial and advanced business services, Melbourne University and RMIT, and key hospital precincts such as at Parkville (Royal Women's and Children's). As of 2006, 1 in 6 residents in Wyndham that work have their workplace located in the City of Melbourne Local Government Area. Of these, 32% use public transport to get to their workplace. The journey to work public transport mode share for those who work in the CBD and its fringe is higher at 57.9%⁹. There is therefore scope for residents of suburban areas to increase public transport utilisation.

Organisations in the growing knowledge based industries, such as finance, advanced business services, consulting, legal and government, have a propensity to locate in central and inner Melbourne. These employers will have access to a growing and much broader and deeper pool of appropriately skilled employees that will reside in the western areas.

The rail service will also improve access to capital city services and activities located in central Melbourne, including administration, shopping and sporting and recreational events.

The increase in the rail capacity brought about by RRL will reduce road congestion. This will have three important benefits:

- (1) it will reduce the increase in the number of road vehicles accessing inner and central Melbourne from the western metropolitan area. It is anticipated that the number of vehicles crossing the Maribyrnong and Yarra Rivers at either Ballarat Road, Dynon Road, Footscray Road and West Gate Bridge during the two hour morning peak period will be reduced by 8% in 2016¹⁰. This benefit is expected to increase with increased population growth in the west, and employment growth in Inner and Central Melbourne;
- (2) it will assist the improvement in travel times for remaining traffic on these roads. This includes freight road traffic that accesses the Port of Melbourne, which is expected to grow by 4.75% per annum to 2031¹¹. The reduction in travel time is anticipated to be up to 10% in the morning peak in 2016, and this benefit is expected to increase over time (see Footnote 10). Access to the Port is important to maintain Victoria's competitiveness; and
- (3) For every full time employee who lives in Wyndham Vale and works in the CBD that travels by rail instead of car, there will be a saving of 3,200 kg of greenhouse gases per year¹².

⁹ Australian Bureau of Statistics, Census, 2006.

¹⁰ Based on comparing Melbourne Integrated Transport Model results for scenarios with and without the Regional Rail Link Project in the 2016 AM Peak, unpublished results produced in 2010 and 2011.

¹¹ Growth in port related truck trips forecast by the Freight Logistics and Marine Division of the Department of Transport, *Freight Futures: Victorian Freight Network Strategy*, 2008.

¹² This figure has been calculated by assuming (i) a one way travel distance of 25km (ie. two way 50km per weekday); (ii) for 46 weeks x 5 working days; and (iii) vehicle emits 278 grams of CO₂ per vehicle kilometre (assumed vehicle CO₂e emission is based on an average of Australia's two top selling cars, the Mazda 3 and Holden Commodore Omega, running on an urban cycle), www.greenvehicleguide.gov.au, April 2011.

5.4 Feasibility assessment

The next step in developing the Reference Design was to consider whether the measures identified as potentially effective were feasible in the context of RRL1. When carrying out this feasibility analysis, it was important to do so by reference to the:

- design constraints on the project within the existing rail corridor, which are discussed in Chapter 4;
- potential for a significant noise mitigation response to impact on the delivery of other elements of RRL1, such as rail safety, access, and amenity; and
- the overall net community benefit of RRL1 in delivering the economic and social benefits described in Chapter 5.3, rather than focusing only on localised impacts and benefits.

This approach is consistent with the draft Principles and in ensuring any planning decision delivers a net community benefit.

RRLA's feasibility assessment is summarised below.

(a) Design of railway alignment

As discussed in Chapter 4, there are a number of aspects of the RRL1 Reference Design which have taken noise amenity impacts into account as part of the scoping and design considerations.

The benefits of this mitigation option will be experienced equitably along the entire RRL1 rail corridor. RRLA considers that this mitigation option was an appropriate and effective mechanism to minimise the noise impacts of RRL1 along the railway corridor, and has been applied to the extent feasible along the route.

(b) Track and Rail Roughness Control

The RRLA considers that track and rail roughness control measures are appropriate and effective to mitigate operational noise from RRL1. The following approaches to track and rail roughness control have been adopted in the RRL1 Reference Design to control noise emission from the wheel–rail interface:

- Concrete sleepers;
- Continuous welded rail (CWR) to minimise the number of rail joints; and
- large-radius curves with super-elevation (cant).

Under Victoria's rail franchising system, the accredited rail operator (**ARO**) manages track and wheel roughness by undertaking regular maintenance of the track profile and wheels. Requirements for re-railing and quality standards for the provision of new or upgraded rail are included in the ARO's commitments under the Asset Management Plan, which is enforced by the Department of Transport's compliance team.

While the overall noise reduction of 1-3dB(A) is modest, the benefits of this mitigation option will be experienced equitably along the entire RRL1 rail corridor, which contributes to the overall net community benefit that will be delivered by RRL. RRLA consider that this is an effective and feasible measure to reduce noise levels.

(c) Track and Wheel Maintenance

The RRLA considers that track and wheel maintenance measures are appropriate and effective to mitigate operational noise from RRL1. The benefits of this mitigation option will be experienced equitably along the entire length of RRL1, which contributes to the overall net community benefit that will be delivered by RRL.

KAJV has advised that it is reasonable to assume that track and wheel maintenance will result in reduction of noise levels of 1-3dB(A) routewide and 5-10dB(A) in the local vicinity of defects, when compared with a poor maintenance regime.

In order for the modelling undertaken by KAJV to be conservative in its assumptions, a numerical noise reduction has not been assumed for this mitigation option. Rather, RRLA considered it important for track and wheel maintenance to form an integral part of the Reference Design. As noted above, under Victoria's rail franchising system, the ARO is required to undertake regular maintenance of the track profile and wheels, including rail grinding. This maintenance will remove wear and track defects such as corrugation and uneven welds.

Maintenance requirements and frequency are addressed in the contracts between the Department of Transport and the relevant ARO, including the Asset Management

Plan, and are a standard requirement of ARO contracts in Victoria. RRLA considers this to be an effective and feasible measure to reduce noise levels.

(d) Noise Barriers

While the three mitigation measures discussed above relate to at-source noise reduction, noise barriers aim to reduce noise experienced at selected sensitive locations which benefit from the noise barrier.

The amount of noise attenuation provided by a noise barrier (including earth bunds and low-level trackside barriers) depends on the height, length and location of the barrier relative to the noise source and receiver. The KAJV Report identifies that noise barriers of up to two metres in height can reduce noise levels by 3-8dB(A), while barriers of up to 4 metres can reduce noise levels by up to 12dB(A). They therefore potentially provide reasonable-to-good noise reduction.

However, noise barriers are not always a preferred approach to reduce railway noise because of other considerations. These considerations include rail operational and safety considerations, amenity, and cost.

In the railway environment, there are several issues which affect the position in which a noise barrier can be located. These include, for example, maintenance access requirements, walkways, electrical cable routes, overhead electrical clearances, and signal sighting distances. These issues are imperatives for safe operation of the railway. However, accommodating these issues can result in the noise barriers being located in a position that reduces their effectiveness in mitigating noise impacts.

Low-level track side barriers are less effective for sections of the alignment that have a large number of adjacent tracks, as each track requires a separate low-level barrier. This restricts inspection and maintenance access and emergency egress. There is also a safety and collision risk.

Noise barriers can also have undesirable amenity impacts, as they can lead to overshadowing and loss of natural light, can be visually intrusive, and are subject to vandalism. Earth bunds also require additional land-take and can result in greater land acquisition to conventional noise barriers.

Finally, noise barriers have generally been found to have a relatively poor cost-effectiveness compared to potential rolling stock improvements and track grinding¹³, where improvements in these can be made. However, in Victoria, where rolling stock and track condition is relatively good, barriers may be more

¹³

Railway Noise in Europe, A 2010 report on the state of the art, International Union of Railways, September 2010.

likely to be cost-competitive with permanent way and rolling-stock improvements.

The noise model was applied to the RRL1 Reference Design. RRLA analysed those results and has prepared a number of noise barrier scenarios. RRLA has noted that Victoria does not have settled government policy to provide guidance or direction on these issues. RRLA has not amended the Reference Design to include noise barriers.

The outcome of the noise modelling is summarised in Chapter 6, and RRLA's analysis of a targeted approach to noise barriers can be found at Chapter 7.3.

5.5 Summary of noise mitigation included in the Reference Design

Based on its assessment of the feasibility and effectiveness of the various noise mitigation options presented by KAJV, the RRLA proposed that the operational noise mitigation measures to be part of the RRL1 Reference Design are:

- design of railway alignment, as described in Chapter 4;
- track and rail roughness controls; and
- track and wheel maintenance.

These mitigation measures were cost-effective and achieve meaningful noise reductions along the entire RRL1 rail corridor.

RRLA then instructed the KAJV to model the noise emissions from RRL1 incorporating these three noise mitigation measures.

6 Noise impacts of the Reference Design

6.1 Ambient noise levels

Chapter 4 of the KAJV Report describes the outcome of ambient noise and vibration measurements conducted:

- between March and June 2010 at 23 locations along the RRL1 alignment; and
- supplementary noise measurements conducted in December 2010 at an additional six locations.

The locations were selected on the basis that they were considered by KAJV to be representative of the various types of locations found in the vicinity of RRL1. All of the measurement equipment had current NATA calibration certificates, and calibration of the equipment occurred before and after each set of measurements.

The typical existing railway noise levels measured in the rail corridor were:

- average weekday existing noise levels of 65-70dB_{L_{Aeq}, 15hr} (daytime);
- average week-night existing noise levels of 58-63dB_{L_{Aeq}, 9h} (night-time); and
- maximum existing noise levels of 100-105dB_{L_{Amax}}.

6.2 Methodology

(a) Modelled scenarios

Chapter 5 of the KAJV Report describes the operational noise and vibration assessment methodology. Using the Nordic Rail Prediction Method, a widely used rail noise prediction methodology, KAJV predicted operational noise levels of passenger trains on the RRL1 tracks. The Nordic methodology was implemented in Sound PLAN version 7.0, a well-established software package for environmental noise prediction.

KAJV modelled noise predictions based upon three scenarios:

- a pre-RRL 'baseline', based on forecast train usage in 2012;
- an immediate post-RRL scenario, KAJV describe this as the '2014 scenario'; and
- the number of trains forecast to be using RRL ten years after it commenced operating (2024).

(b) Key assumptions

In undertaking this modelling, KAJV made assumptions regarding the:

- type, intensity and length of diesel multiple units (**DMUs**) and N and P class locomotive trains that will be using the RRL tracks, as well as the metropolitan and freight trains which use the other tracks within the rail corridor. The RRL assumptions distinguished between peak and off-peak/counter-peak services per hour;
- maximum speed for each train type, and the section of track to which those maximum speeds apply;

- noise source spectrum and noise level for DMUs, EMUs, N and P class locomotives, and passenger wagons. This was achieved by relying on source noise data for similar electric and diesel rail vehicles in New South Wales at a reference speed of 80km measured from 10m, which was then adjusted to reflect the actual speed of the RRL trains; and
- terrain and ground absorption. KAJV used 1m terrain survey contours, and a ground absorption factor of 0.6. The latter was chosen because it was considered to be representative of ground absorption experienced in similar suburban locations.

(c) Validation measurements

The noise levels for DMU and locomotive sources were validated against noise level measurements undertaken adjacent to existing rail lines where those vehicles currently operate, including Geelong, Ballarat and Bendigo lines. The noise levels for EMUs were validated against noise measures undertaken adjacent to the Lilydale line.

KAJV also compared predicted 15 hour average and maximum noise levels with the measured noise levels along the railway in order to validate the model's combined noise source and propagation predictions.

Overall, KAJV concluded that the validation showed reasonable agreement between the predicted and measured noise levels at most locations.

(d) The model domain

All buildings that constituted a potential noise sensitive receiver within 500m of each side of the rail corridor were included in the model. Information about the dimensions of buildings within the modelled domain were imported into the model based on either photogrammetric data or from aerial photography.

Noise sensitive receivers were assumed to be 1.5m above ground level. This is not only consistent with VicRoads practice, but reflects the fact that noise mitigation (apart from architectural treatments) are not usually feasible for multi-storey developments.

6.3 Operational noise predictions

(a) Overview

Based on the noise modelling conducted by the KAJV, noise levels are generally expected to increase as a result of RRL1 due to increased traffic density and vehicle length. However, the extent of impact varies at different parts of the alignment. This is partly due to the relocation of regional services from shared metropolitan lines to dedicated RRL tracks, but mostly because the duration and intensity of train-use within the rail corridor is much greater at its eastern end.

Consequently, the relative contribution of RRL1 to average and maximum noise levels at the eastern end of the alignment is less than at its western end.

(b) Moonee Ponds Creek to Sunshine

In general, daytime and night-time average and maximum noise levels between Moonee Ponds Creek and Tottenham are expected under the Year 10 (2024) scenario to increase only marginally (between 1 to 2 dB(A)) as a result of RRL1, because this part of the alignment is already heavily trafficked with regional, metropolitan and freight movements, and the relative increase in overall rail movements as a result of RRL will be small. When considering the impact of

this change in noise level, it should be noted that KAJV's advice is that a change in noise level of 2-3dB(A) is unlikely to be perceptible.

RRL1 will also result in a small reduction in noise levels at some locations due to the increased distance between the residences and the new RRL railway line - for example, some locations around South Kensington, Middle Footscray and Sunshine.

Despite this, the highest average and maximum noise levels are expected between Footscray and West Footscray, where properties are located nearest to the existing rail corridor and are already experiencing noise levels that exceed the New South Wales recommended noise limits. The highest noise level of about 100dB_{L_{Amax}} is predicted to occur around Middle Footscray.

(c) Sunshine to Deer Park

The greatest noise level increases are expected to occur between Sunshine and Deer Park, due to an intensification of vehicle movements compared to the corridor between Footscray and Sunshine. The larger number of passenger train movements will be brought about by the routing of the Geelong regional trains onto this section of the alignment. However, as noted previously, no track construction activity is planned for this section of the corridor.

The corridor between Sunshine and Deer Park presently has between two trains per hour (each-way, off-peak) and 3.5 trains per hour (peak). By Year 10 (2024), this is expected to increase to 6 and 17 trains per hour respectively. While some increase in rail activity is likely with or without RRL, RRL will result in a greater increase in train services to occur on this section of the network than would be experienced otherwise.

Consequently, daytime and night-time average noise levels west of Sunshine is expected to increase by around 5dB by Year 10.

Even though this part of the alignment will experience the greatest change in average noise levels, these levels (daytime, night-time, and 24 hour) will still be up to 10dB less than the equivalent noise levels that will be experienced around Middle and West Footscray, and will also be less than the current noise levels in Middle and West Footscray.

The 24 hour average noise levels will also increase by about 5dB in this section of the alignment, though maximum noise levels are only predicted to increase by up to 2dB due to the longer length of the trains.

(d) Comparison with NSW and Qld guidelines

The NSW IGANRIP guidelines involve two steps of analysis:

- determining whether development increases noise levels by more than 2dB(A)_{L_{Aeq}} (ie, increase in average noise level) or more than 3dB(A)_{L_{Amax}} (ie, increase in maximum noise level); and, if so
- establishing whether the resulting noise levels exceed the relevant noise trigger level.

If the answer to both questions is in the affirmative, then IGANRIP provides that a noise and vibration assessment should be carried out. If the answer to one of the questions is in the negative, the IGANRIP guideline levels are not exceeded and a noise assessment is not required.

In 2012, 733 properties adjacent to the rail alignment are predicted to experience noise levels which exceed the NSW guideline numerical limits, while 519 properties are predicted to exceed the Queensland numerical limits. (See KAJV Report chapter 6.2)

These figures are forecast to increase to 764 exceeding the NSW numerical limits and 593 properties exceeding the Queensland numerical limits by 2024. However, 522 of the 764 properties exceeding the NSW numerical limits will not have an increased noise level of more than $2\text{dB(A)}_{L_{Aeq}}$ or $3\text{dB(A)}_{L_{Amax}}$. This means that approximately one third of the properties will exceed the NSW criteria.

- Other conclusions which can be drawn from this data are: about 223 properties will experience pre-RRL average night-time noise levels that will exceed the NSW numerical limit. This figure is expected to increase to 411 by 2024;
- fewer properties (154) will experience daytime average night-time noise levels that exceed the NSW guideline. However, by 2024 this figure is predicted to increase to 430; and
- 701 properties will exceed the NSW numerical limit before RRL commences operations and this figure is only expected to increase to 738 by 2024. Similarly, the Qld maximum noise level guidelines will only exceed by a comparatively modest number – from 515 to 572.

7 Further considerations

7.1 Consideration of additional mitigation options for high impact areas

As discussed in Chapter 3, the KAJV Report identified that the design of railway alignment, track and rail roughness control, and track and wheel maintenance measures will make important contributions to reducing noise from RRL1, and were incorporated into the Reference Design.

Based on its review of KAJV's modelling of the noise impacts of the RRL1 Reference Design, the RRLA considered that there were some remaining areas along the RRL1 rail corridor at which predicted operational noise impacts warranted further consideration.

In reaching this conclusion, RRLA noted that there are different factors which influence the current and future experience of rail noise at these locations. For example:

- Some locations, such as Footscray and West Footscray, will experience high cumulative noise levels overall, although most of this will be due to existing rail operations. The additional contribution of RRL1 to the cumulative noise levels is small; and
- Other locations such as Sunshine will experience a discernible change in rail noise level as a result of RRL1, although the overall noise level in this area will remain less than in other areas of the corridor.

As discussed in Chapter 3, there is no numerical standard for operational rail noise in Victoria, and there is no policy assistance in determining which is the more significant – a small incremental addition to existing high noise levels, or a larger incremental addition to lower existing noise levels. RRLA therefore decided that more work needed to be done to determine whether there are additional operational noise mitigation options that would:

- respond appropriately to the draft Principles, in particular focusing on mitigation options that have a beneficial impact for groups or communities, rather than for individuals; and
- be effective and feasible in the context of RRL1.

Three options that could be implemented by RRLA or third parties are planning controls, architectural acoustic treatments and noise barriers. An evaluation of the effectiveness of each of these options is provided below.

7.2 Third party noise mitigation – planning controls

(a) Overview

An objective of State planning policy in clause 13.04-1 of the VPP is to 'assist the control of noise effects on sensitive land uses'. This objective is to be achieved by ensuring that development is not prejudiced and community amenity is not reduced by noise emissions, using a range of building design, urban design and land use separation techniques as appropriate to the land use functions and character of the area. Underpinning this policy is the objective of appropriately managing the interface between noise-producing land uses and nearby sensitive uses, such as residences.

The existing rail corridor presents few opportunities to physically separate RRL1 rail tracks from existing residential and other sensitive areas, though in many

locations, such as the vicinity of the Tottenham railyards, these separation distances have been maximised where feasible.

Another way to manage the rail/residential interface would be to introduce planning controls to control and mitigate noise impacts on urban areas in the vicinity of the rail corridor at locations which are earmarked for redevelopment or urban renewal. Key examples include the Footscray CAA and the Joseph Road Precinct.

One way of doing this would be to impose an Overlay under the relevant planning schemes to designate areas in or around RRL1 as a 'Noise Attenuation Area', to ensure that the development of land near the rail alignment is undertaken with appropriate noise attenuation measures. This could address the noise amenity impacts experienced at those locations due to existing rail operations, in addition to the small overall increase in noise levels due to RRL1. A similar approach has been adopted in a number of existing planning schemes in areas that are impacted by road, aircraft, sports arena noise. The following examples are provided:

(1) **Hume Planning Scheme – Melbourne Airport Environs Overlay**

The purpose of this Overlay is to shield people from aircraft noise by requiring appropriate noise attenuation measures in dwellings and noise sensitive buildings. This Overlay requires compliance with the noise attenuation mechanisms required by Section 3 of Australian Standard AS 2021-2000, Acoustics – Aircraft Noise Intrusion – Building *Siting and Construction*, issued by Standards Australia International Ltd.

(2) **Melbourne Planning Scheme – Design and Development Overlay (DDO) – Schedule 12 Noise Attenuation Area**

The purpose of this Overlay is to ensure that new or refurbished developments for new residential and other noise sensitive uses constructed in the vicinity of the Docklands Major Sports and Recreation Facility include appropriate acoustic measures to attenuate noise levels to achieve a specified internal noise level with windows closed.

All new residential and other noise-sensitive use and development must have external glazing and doors and the air conditioning or ventilation system designed by a recognised acoustic consultant.

(3) **Melbourne Planning Scheme – DDO – Schedule 26, North and West Melbourne Noise Attenuation Area**

The purpose of this Overlay is to ensure that new, refurbished or converted developments for new residential and other noise sensitive uses constructed in the vicinity of the Laurens Street, North Melbourne Industrial Area include appropriate acoustical measures to attenuate noise levels within the building to achieve a specified internal noise level. Furthermore, land use within this area should not adversely affect the viability of industry within the area.

(4) **Brimbank Planning Scheme – DDO – Schedule 2, Connection of Western Freeway to Western Ring Road**

The purpose of this Overlay is to ensure that the development of land near the future alignment of the connection of the Western Freeway to Western Ring Road is undertaken with appropriate noise attenuation measures to minimise the impact of traffic noise on noise sensitive activities. The Overlay includes a list of noise sensitive activities and

requires development of such uses to include noise attenuation measures to the satisfaction of the Roads Corporation. In considering whether any measures proposed are to its satisfaction, the Roads Corporation will consider any appropriate Australian Standards in relation to road traffic noise intrusion.

(b) Rail Noise Overlay

The virtue of introducing a Rail Noise Overlay in the vicinity of land earmarked for redevelopment is that it compels the developer to design the development in a way that provides a reasonable level of amenity to the occupants of the development, based on the prevailing noise levels due to rail operations along the rail corridor.

The downside to introducing such a control is that it may result in a cost-uplift in the development of accommodation and residential development, which must then be absorbed by the developers or passed-through to the buyers or tenants of the properties.

Conversely, in comparable situations the Victorian Government has imposed more rigorous requirements on the community to minimise adverse impacts caused by the environment, despite the potential increase in development cost. Examples include land within bushfire prone areas, land close to the coastline which is vulnerable to potential sea level rise, land subject to flooding, and land subject to erosion. The Victorian Government has also introduced planning controls that require new development to achieve measurable environmentally sustainable development outcomes in terms of energy star ratings. Increasingly, the property owner or property developer is being required to improve the quality of residential accommodation and, incorporate design features which enhance the amenity, safety and well being of the community.

In some locations the rail noise levels already exceed interstate guidelines. This is particularly the case for Footscray and West Footscray. Quite aside from RRL1, particularly given its small overall contribution to predicted noise levels at these locations, the introduction of a Rail Noise Overlay into planning schemes at these locations could be considered by the Government.

(c) Form of potential Rail Noise Overlay

Should such planning controls be considered desirable, it is suggested that the Rail Noise Overlay should:

- address noise amenity impacts due to existing rail operations as well as the small increase in noise levels from RRL1; and
- include a trigger for a planning permit unless a set of 'deemed to comply' provisions can be met.

It is considered that the DDO associated with the Connection of Western Freeway to Western Ring Road (Brimbank Planning Scheme) provides a good template for preparing an RRL1 Overlay for the following reasons:

- road and rail are both linear infrastructure that result in the emission of noise;
- it may be preferable that the DDO applies to a range of noise-sensitive activities along the RRL1 alignment, not just residential development; and
- it may be preferable that the noise attenuation measures must be to the satisfaction of the referral authority rather than reach a specified noise level.

In considering whether any measures proposed are to the referral authority's satisfaction, this may be based on a consideration of an appropriate standard in

line with Australian/International Standards for rail noise. This approach allows for flexibility in the noise attenuation measures that are required, depending on the type of development (e.g. extension of existing dwelling as opposed to a new multi-purpose/residential development or commercial premises).

Alternatively, it may also be desirable for the Overlay to include a 'deemed to comply' provision. This would require a proponent to meet a pre-determined standard of noise attenuation, which may depend on the type of development (e.g. extension of existing dwelling as opposed to a new multi-purpose/residential development or commercial premises).

In either case, RRLA recognises that considerable work would need to be carried out by Government to determine appropriate standards and noise attenuation measures for rail noise, which would form the basis of any Rail Noise Overlay.

RRLA notes that development of a Rail Noise Overlay may also require:

- changes to building regulations relating to construction and materials;
- consideration of fencing requirements for properties adjacent to the rail corridor; and
- whether it would be appropriate for sale contracts for property within the overlay to demonstrate compliance, similar to requirements in other States relating to energy audit reporting.

(d) Scope of application of potential Rail Noise Overlay

It would be necessary to consider whether the Rail Noise Overlay should apply to all land to a specified distance on either side of the rail corridor, defined from the boundary of the Public Use Zone 4 – PUZ4, or whether it should be limited to specific areas earmarked for future development. It is suggested that these specific areas could include:

- (1) The area along Buckley Street between Victoria Street and the Geelong Road. It is noted that Clause 22.02 of the Maribyrnong Planning Scheme also includes noise attenuation measures for any residential development within 20m of Buckley Street, given that this street is a designated truck route;
- (2) The Footscray CAA, where a suite of planning controls are being devised to integrate major redevelopment into this centre and hence there is scope to include in these controls further noise attenuation works to new development, where required; and
- (3) Joseph Road, Footscray Precinct, identified in the Maribyrnong Planning Scheme as Priority Development Zone 2 and subject to the Joseph Road Precinct Framework Plan. Various noise sources impacting on this land, including the existing and future noise from the rail corridor, are identified in the planning scheme. The RRL1 Incorporated Document (October 2010) also requires that a Development Plan for the RRL1 rail corridor abutting this precinct be prepared in consultation with local Council, and where relevant VicRoads and Melbourne Water Corporation, prior to commencement of development.

7.3 Third party noise mitigation – Architectural Acoustic Treatments

(a) Existing sensitive uses

Property owners who are particularly affected by noise from the rail corridor may elect to undertake acoustic treatments to their buildings. This may be of particular relevance in areas such as Footscray that are currently undergoing a process of ‘gentrification’ involving renovation of existing housing stock, noting the limitations on the effectiveness of retrofitting such treatments to some types of dwellings as discussed above.

(b) New sensitive uses and areas along the RRL1 corridor earmarked for development

As discussed in Chapter 7.2, potentially more appropriate is the option for developers of new sensitive uses along the railway corridor to incorporate acoustic treatments into their building design. One option is to leave it to the market to decide whether such treatments should be installed. However, there is the potential for planning policy to determine that such treatments to new sensitive uses along the rail corridor is of sufficient value in achieving a desirable planning and social policy outcome that the imposition of a planning control is appropriate.

(c) Costs and benefits

The KAJV Report identifies that off-reservation architectural acoustic treatments to individual buildings can provide effective noise mitigation to the internal areas of treated buildings, provided that the building structure type is appropriate for the available types of treatment and that doors and windows remain closed. Based on guidance used for road traffic projects in NSW, the allowance for architectural treatments is usually limited to between \$15,000–\$20,000 per affected residence.

However, acoustic treatments are of limited effectiveness on some types of buildings (such as timber dwellings) and it can be difficult to retrofit reasonable solutions. Furthermore, such treatments do not reduce noise impacts external to the buildings, nor provide an overall improvement to noise amenity along the railway corridor.

(d) Implementation

Given the existing level of railway noise experienced along the rail corridor and level of additional noise impacts of the RRL1 project, the RRLA does not consider that it is appropriate to reduce noise impacts at specific properties. Rather, in the context of achieving the objectives of the RRL1 project overall, the RRLA prefers treatments that will provide effective noise mitigation along the railway corridor, rather than to individual buildings or areas.

This accords with the draft Principles of balancing objectives, allocating cost appropriately to achieving community benefits, and consideration of the ‘broader public good’ of the RRL1 project. Architectural acoustic treatments to individual buildings are therefore not proposed by RRLA.

7.4 Noise barriers

(a) Design considerations for noise barrier modelling

The assessment of noise mitigation options at Chapter 3 of the KAJV Report identified that conventional noise barriers could potentially be an effective means of reducing the noise level experienced at groups of sensitive receptors along the corridor.

The KAJV Report notes that the amount of noise attenuation provided by barriers (whether traditional 'fence' barriers or earth bunds and embankments) depends on the height, length and location of the barrier relative to the noise source and receiver. KAJV determined that:

- 2m or 4m conventional noise barriers could potentially be effective along the RRL1 corridor; and
- low level noise barriers may be effective at Ardeer but are likely to be ineffective at Sunshine, Footscray and South Kensington because of the large numbers of tracks at each of these locations, as each track would require a separate low-level barrier.

Additionally low level trackside noise barriers are generally not feasible within the RRL1 corridor given rail maintenance and access requirements.

RRLA therefore commissioned KAJV to undertake further noise modelling to ascertain whether, where and to what extent noise barriers could be effective at reducing the operational noise experience at sensitive receptors at these identified locations. This modelling is reported at Chapter 7 of the KAJV Report and discussed further at Chapter 7.4(b) below.

Based on these results, RRLA then asked KAJV to design noise barrier solutions that would achieve pre-RRL (2012) noise levels, or achieve the NSW IGANRIP levels, at all locations along the corridor (the 'status quo'). The outcomes of this work is described at Chapter 7, Appendix F of the KAJV Report and summarised at Part 7.4(c) below.

During consultation with the EPA, it emphasised the need to consider night-time noise in particular. Consequently, RRLA examined a scenario to be designed to achieve a night-time noise level of $60\text{dB(A)}L_{\text{Aeq},9\text{hr}}$, where the residence was also subject to a noise level increase of more than 2 dB(A) (daytime or night-time) or 3 dBL_{Amax} attributable to the operation of RRL1 (**Night-time Noise Level**).

RRLA instructed KAJV to undertake this work, and the outcomes of this work is summarised at Part 7.4(d) below.

(b) Results of noise modelling of noise barriers at selected locations

Appendix E of the KAJV Report sets out noise contour plots showing the daytime ($L_{\text{Aeq},15\text{hr}}$) and maximum (L_{Amax}) noise levels at the sensitive locations identified at Ardeer, Sunshine, Footscray and South Kensington, depicting noise predictions with:

- no barrier;
- a 2-metre barrier;
- a 4-metre barrier; and
- at Ardeer only, a 1.4 m low-level barrier.

Based on this assessment and analysis, KAJV concluded that, typically:

- 2 m noise barriers can be expected to provide between 3–8 dB(A) noise reduction at the most affected residences;

- 4 m high barrier perform better and provide between 8–12 dB(A) reduction in railway noise levels; and
- the 1.4 m high low-level trackside barriers provide similar noise reductions as the 2 m high barriers.

These results then formed the basis of the further assessment of noise barriers along the whole RRL1 rail corridor described below.

(c) Noise barriers required to achieve ‘status quo’ noise levels at high impact locations

As outlined in Chapter 7 and Appendix F of the KAJV Report, KAJV extrapolated the results of its noise modelling of barriers at selected locations to determine the height and location of all noise barriers necessary to maintain the status quo noise levels (or achieve the NSW guidelines) at all locations along the RRL1 corridor.

The height and locations of noise barriers required to achieve ‘status quo’ noise levels are depicted in Appendix F of the KAJV Report, together with noise contours showing the mitigated noise levels taking into account the barriers 10 years after opening RRL1 (2024) for the daytime period ($L_{Aeq,15hr}$), night-time ($L_{Aeq,9hr}$), 24 hour period ($L_{Aeq,24hr}$) and maximum noise level (L_{Amax}).

Table 12 of the KAJV Report summarises the extent of the barriers required to achieve this result.

It was determined that, generally, noise barriers between 2–3 m high would be required in affected areas to maintain the status quo, although as noted in Table 12 of the KAJV Report, barriers of 4m would be required in some locations.

Barriers would be required at 17 locations along the RRL1 corridor. Table 12 of the KAJV Report identifies that the extent of these barriers varies from 25m in length with an area of 100m², to 1700m in length with an area of 4400m². The majority of the noise barriers would be between 200-900m long.

(d) Noise barriers required to achieve the Night-time Noise Level

As outlined in Chapter 7.2 of the KAJV Report, after consultation with the EPA, RRLA directed KAJV to further extrapolate the results of its noise modelling of barriers at the selected locations to determine the height and location of all noise barriers necessary to maintain compliance with the Night-time Noise Level at all locations along the RRL1 corridor.

The height and locations of noise barriers required to achieve the Night-time Noise Level are depicted in Table 13 and Figure 28 of the KAJV Report.

It was determined that, generally, noise barriers between 2–4m high would be required at 11 locations along the RRL1 corridor to maintain the Night-time Noise Level. Table 13 of the KAJV Report identifies that the extent of these barriers varies from 25m in length with an area of 100m², to 800m with an area of 1600m². The majority of noise barriers would be between 250-570m long.

(e) Cost of noise barriers

RRLA undertook a cost estimate to provide noise barriers under the ‘status quo’ levels and the Night-time Noise Level, and provided this information to KAJV. The costs are for the detailed assessment undertaken for the four sensitive locations at Sunshine, Footscray, Ardeer and South Kensington, taking into account:

- barrier type, height, and length;
- the total number of noise sensitive receptors benefitting from noise reductions due to the barrier; and

- typical noise reduction experienced at those noise sensitive receptors in terms of dB(A) reduction.

This information was used to generate an estimated cost of each type of noise barrier per linear metre, per residence, and per dB reduction.

The cost estimates are based on VicRoads data for installed barriers plus allowances for inflation and contingency. The estimate includes the cost of four weekend occupations of the rail corridor in locations where works cannot be undertaken safely. The costs also include shiftwork rates for after-last-before-first train working.

Depending on the height and length of the noise barriers needed, and the number of properties affected, the cost of noise barriers can be between \$45,000 to \$75,000 per residence for 2 m high barriers, and up to \$85,000 to \$150,000 per residence for 4 m high barriers. These estimates assume the use of concrete and acrylic barriers.

Noise bund costs are considerably lower, at around \$3,500 to \$4,000 per residence for a 2 m high bund. However, earth bunds have a significantly higher land-take than noise barriers – generally around four times their height. Noise bunds are therefore unlikely to be practical for the eastern portion of RRL1, where the new rail line is constrained within the existing corridor. Furthermore, the installation of earth bunds in the rail corridor for the western portion of RRL1 will impede the development of future rail infrastructure within the corridor. Given that this rail corridor is a vital element of Melbourne’s rail infrastructure corridor, such an outcome is highly undesirable and not supported by RRLA.

The approximate cost of the various types of noise barrier is as summarised in the table below, assuming the barriers are constructed of concrete and acrylic:

Table 4 – Cost of noise barriers

Mitigation method	Typical reduction in noise level, dB(A)	Approximate costs [†]
Noise barriers – 2 m	3–8 dB(A)	\$6,200/linear metre \$45,000–\$75,000 per residence \$20,000–\$50,000 per dB per residence reduction
Noise barriers – 4 m	8–12 dB(A)	\$12,400/linear metre \$85,000–\$150,000 per residence \$20,000–\$25,000 per dB per residence reduction
Earth bunds	3–8 dB(A)	\$450/linear metre \$3,500–\$4,000 per residence \$1,200–\$1,500 per dB per residence reduction
Low-level trackside noise barriers	3–6 dB(A)	~\$650/linear metre ~\$5,000 per residence ~\$3,500 per dB reduction

The KAJV Report identifies that, in order to achieve the 'status quo' at the locations of highest impact, the total area of noise barrier would be approximately 19,500m². For the Night-time Noise Level, the area of noise barrier is only 9,080m².

The total cost of these barriers to achieve the status quo for RRL1 at the locations of highest impact identified along the rail corridor could therefore be approximately \$49 million. The total cost of the noise barriers to achieve the Night-time Noise Level along the rail corridor is approximately \$21 million. These figures would be subject to further detailed design (including consideration of land acquisition, if any required) and stakeholder consultation.

These noise barrier solutions developed by KAJV have a number of limitations which are discussed below.

(f) Other considerations relating to noise barriers

Construction of noise barriers in specific locations requires a consideration of a range of issues, in particular:

- amenity impacts of noise barriers;
- safety and maintenance;
- disruption to communities if additional land acquisition is required for siting of noise barriers; and
- equity considerations, including policy support for the selection of locations for barriers, balancing the benefit to specific groups of sensitive receptors against amenity impacts and cost, and consideration of the overall 'public good' in the context of the RRL1 project.

(1) Amenity impacts

Amenity impacts of noise barriers would include overshadowing and loss of natural light where barriers are located adjacent to private (particularly residential) land. While barriers on the north side of the rail corridor would cast shadows mainly on the rail corridor, noise barriers on the south side of the rail corridor have the potential to cast shadows onto private land adjacent to the rail corridor, particularly in the vicinity of Buckley Street and Deer Park.

The visual impact to properties along the rail corridor also warrants consideration. While rail corridors are inherently a form of barrier to connecting the communities on either side of the railway, punctuated by designated crossing areas, it is considered undesirable in terms of community social and visual impact for long lengths of noise barrier to increase this perception of disjunction. Noise barriers also impact the visual amenity from properties along the rail corridor, in particular where adjacent residences currently experience views across the open rail reserve, such as at Ardeer and Deer Park.

Visual amenity impacts could be partially ameliorated by the use of landscaped earth bunds (where available land exists), innovative design and material selection, landscaping and planting. These would be useful strategies where noise barriers are otherwise considered appropriate, particularly in areas with less visually interesting features, prior to construction of the noise barriers. However, these options involve costs additional to the base costs identified by KAJV, which raises the considerations of equity and broader 'public good' discussed further below.

(2) Additional land acquisition

RRLA is mindful of the community disruption caused by the acquisition of private properties and the construction of such a major piece of infrastructure. While it has made every effort to manage the burden on affected communities in acquiring land necessary for the RRL1 project, RRLA considers that compounding the community disruption and anxiety by potentially acquiring further land for noise barriers would be highly undesirable and must be carefully considered.

The 'fencing' type noise barriers identified and modelled by KAJV is not likely to require additional land acquisition, as these can be placed in or adjacent to the rail corridor. However, it is unlikely that earth bunds could be utilised in many locations along the corridor as these typically require a much greater land take than conventional noise barriers.

(3) Safety and maintenance

The length of noise barrier required to achieve the desired result raises issues of safety and access for maintenance, as well as security and vandalism risk. The use of noise barriers of 2–4 m may affect rail operations by restricting signal and obstacle sighting distances and may require AROs to vary their standards. Such outcomes would be undesirable given the overall project objectives of RRL1 to enhance the safety, reliability and functionality of rail services along the RRL1 rail corridor.

In relation to earth bunds, even where these could potentially be developed within the existing rail corridor such as at Deer Park, these would have the effect of limiting the future development or augmentation of rail infrastructure within the corridor.

(4) Equity considerations and local circumstances

Despite the limitations of noise barriers, RRLA considered whether noise barriers could be installed to maintain the 'status quo' at only some of the locations identified by KAJV, where the amenity considerations can be addressed, safety and maintenance issues can be managed, and cost is appropriate in the context of the benefit to be provided to the relevant group of sensitive receptors.

This last issue was particularly important. Based on its community consultations, some residents at Footscray and West Footscray have expressed concerns about the potential impacts of rail noise on their amenity, which would partly be informed by their existing experience of rail noise. RRLA considered whether it was therefore appropriate to provide some noise barriers in these locations to help mitigate those impacts.

While this could be feasible, it is important to consider whether it is an equitable solution given that the change in noise levels brought about by RRL1 will be greater at the western end of the rail corridor, in the vicinity of Deer Park and Ardeer, than at Footscray and West Footscray. Furthermore, existing investments in Footscray and West Footscray can be expected to have taken account of the longstanding existing high noise levels.

There is currently no policy guidance on how to make such judgments in providing targeted noise barriers. Consideration must be given to whether it is equitable and appropriate to arbitrarily select groups or locations to benefit from additional noise mitigation expenditure, and

not others. RRLA considers that to make such a selection may not be in accordance with the draft Principles.

Under the solution that achieves the Night-time Noise Level along the alignment, a smaller number of sensitive receptors would benefit from noise barriers.

(g) Conclusion on noise barriers for the RRL1 Reference Design

RRLA has modelled two noise barrier scenarios for RRL1, which would either:

- maintain the 'status quo' along the alignment; or
- achieve the Night-time Noise Level along the alignment.

There is a significant difference in the number of sensitive receptors that would benefit from the noise barriers under each scenario, and accordingly there is a significant cost difference (approximately \$28 million) between these two solutions.

Noise barriers could be effective to ensuring the existing railway noise levels are maintained at locations of highest impact along the alignment. However, there are other amenity, social and safety drawbacks of constructing noise barriers at the scale, particularly to maintain the 'status quo', along the existing railway corridor. Noise barriers would represent an additional cost (particularly to maintain the status quo) to provide a limited benefit to a selected group of sensitive receptors.

In the absence of a settled Government policy which provides guidance on what noise barrier solution is appropriate in the context of RRL1, RRLA has not incorporated noise barriers into the Reference Design. Once the outcome of further policy development in this area is known, further consideration of the feasibility of installing noise barriers by RRLA or a third party could be considered.

8 Conclusion and summary of response to requirements

8.1 Conclusion

(a) Project benefits and impacts

RRL is a major rail project that will deliver very significant social, economic and environmental benefits to Victoria. It will also impact local communities, in particular through the emission of train noise. RRLA has developed a Reference Design for RRL1 that is sensitive to the potential impacts of noise from trains which utilise the RRL1 tracks.

(b) Noise standards, assessment and mitigation

In the absence of any Victorian legislative requirements or guidance limits on noise and vibration from passenger railway operations, RRLA has adopted the draft Principles as the most relevant basis upon which to consider noise impacts and potential mitigation options for RRL1.

RRLA has incorporated three feasible and effective at-source mitigation measures into the Reference Design, including design of the railway alignment; track and rail roughness control; and track and wheel maintenance..

In response to the former Minister for Planning's decision that an Environment Effects Statement is not required for RRL1, RRLA has also compared predicted noise levels with NSW and Queensland noise standards. Based on the assessments carried out by KAJV, the noise levels between Moonee Ponds Creek and Tottenham are expected to only marginally increase (between 1 to 2 dB(A)) as a result of RRL1.

An increase in average noise levels of up to 5dB is predicted between Sunshine and Deer Park, due to the intensification in the number of services that are predicted to occur along this part of the alignment. Importantly, no new rail tracks are proposed for this section of RRL1. Even though this part of the alignment will experience the greatest change in average noise levels, these levels (daytime, night-time, and 24 hour) will still be up to 10dB less than the equivalent cumulative noise levels that will be experienced around Middle and West Footscray, and will also be less than the current noise levels in Middle and West Footscray.

(c) Consideration of noise barriers

Although noise barriers were not included in the Reference Design, RRLA investigated the merit of a targeted noise barriers after it had reviewed and evaluated the modelled noise impacts of the RRL1 Reference Design on nearby communities. It investigated the effectiveness of noise barrier scenarios to:

- maintain the 'status quo' in locations where the predicted noise levels without noise barriers exceeded the New South Wales guidance limits, and also considered the possibility of providing noise barriers to specific high-impact locations; and
- achieve the Night-time Noise Level.

RRLA's investigation into these two noise barrier scenarios has shown that it requires different approaches along the corridor, which would result in different outcomes for residents depending on where they are located. Currently, there is no policy guidance on how such a judgment is to be made. These scenarios

raise a serious consideration of whether it is equitable to provide targeted or selective noise barriers to some impacted communities, but not others.

Furthermore, based on the draft Principles, government policy must consider whether it is appropriate for RRLA to be resolving noise impacts in circumstances where RRL1 is only marginally increasing those impacts, or where the project is not constructing major new infrastructure.

RRLA considers that mitigation measures already incorporated into the Reference Design (e.g. design of railway alignment; track and roughness control; and track and wheel maintenance) provide one type of appropriate response.

A noise barrier scenario may nevertheless be feasible for RRL1. However, in the absence of a settled Government policy which provides guidance on what noise barriers are appropriate in the context of RRL1, RRLA has not incorporated noise barriers into the Reference Design. Once the outcome of further policy development in this area is known, further consideration of the feasibility of installing noise barriers may be considered by the Government.

(d) Satisfaction of the former Minister for Planning's requirements and draft Principles

This Report satisfies condition 1 of the former Minister for Planning's decision that an Environment Effects Statement is not required for RRL1. A summary of the RRLA's response to the former Minister's requirements is provided in Chapter 8.2. A table summary of response to the draft Principles is provided in Chapter 8.3.

As required, the EPA has been consulted during the preparation of this Report. The Report was also peer reviewed by Wilkinson Murray Pty Ltd, acoustical consultants. The peer review report accompanies this Report.

8.2 Summary of response to former Minister for Planning's requirements

This Report responds to the following conditions of the former Minister for Planning's decision that an Environment Effects Statement is not required for RRL1:

- A robust analysis of the likely noise levels in the vicinity of the RRL1 that will be associated with expected changes in rail operations (Condition 1);
- Documentation of the likely changes in overall noise levels in adjoining residential areas and sensitive receivers from current levels (Condition 1(i));
- Provision of a comparison of predicted noise levels with relevant standards or guidelines for operational rail noise from other Australian jurisdictions (Condition 1(ii)); and
- An evaluation of the effectiveness of proposed mitigation measures, as well as the feasibility and effectiveness of additional measures that might be implemented either as part of the project or by third parties to reduce noise levels affecting noise sensitive receivers (Condition 1(iii)).

(a) Condition 1

A robust analysis of noise levels in the vicinity of the RRL1 has been undertaken and noise levels have been predicted at all of the nearby noise sensitive receivers. These noise levels have been predicted for Phase 0 – the existing noise levels pre RRL (2012), Phase 1 – Day 1 of RRL (2014) and 10 years after opening RRL (2024). The analysis has been based on noise

measurements and predictions. Chapter 6 of this Report and the KAJV Report set out these results.

The highest average and maximum noise levels for overall rail noise (including RRL1) are predicted to continue to be experienced around Footscray and West Footscray, where existing properties are located nearest to the existing railway corridor. In 2024, average daytime noise levels in this area are predicted to be up to 78 dBL_{Aeq,15hr} and night-time levels of around 75 dBL_{Aeq,9hr}. West of Sunshine, average daytime noise levels of 55–65 dBL_{Aeq,15hr} are generally predicted with night-time levels of 55–60 dBL_{Aeq,9hr}.

Typical maximum event noise levels of 90–95 dBL_{Amax} are predicted generally along the RRL1 alignment, with the highest levels of up to 100 dBL_{Amax} around middle Footscray.

(b) Condition 1(i)

The predicted changes in noise level associated with RRL1 when compared with the current noise levels have been documented in Chapter 6 of this Report and the KAJV Report. As highlighted in that Chapter, there are notable differences between the noise impacts RRL1 will have on the along the alignment between Moonee Ponds Creek to Tottenham, and between Sunshine to Deer Park.

Moonee Ponds Creek to Tottenham

Based on predicted noise levels in 2024 around South Kensington a reduction of up to 2 dBL_{Aeq,9hr and 15hr} is predicted. This is a result of regional trains moving to tracks which are further from the residential locations.

Around Footscray to Middle Footscray the increase or decrease is approximately 2 dBL_{Aeq,9hr and 15hr}. However, between Middle Footscray and West Footscray, there are increases of up to 8 dBL_{Aeq,9hr and 15hr} and decreases of up to 10 dBL_{Aeq,9hr and 15hr}. The reasons for these significant changes are due to major changes to the track alignment and property acquisitions (demolitions) which will result in some properties which had been shielded being exposed to rail noise. However following completion of the project surplus land adjacent to the new alignment will be developed which may reduce the noise impact to properties on the southern side of Buckley Street.

Around Tottenham there are predicted increases of up to around 5 dB dBL_{Aeq,15hr}, and 4 dBL_{Aeq,9hr}, and around Sunshine there are increases of less than 6 dB dBL_{Aeq,15hr}, and 5 dBL_{Aeq,9hr} and decreases of less than 5 dBL_{Aeq,9hr and 5hr}.

Sunshine to Deer Park

Between Sunshine and Deer Park the noise level is expected to increase by up to 5 dBL_{Aeq,9hr and 5hr} due to the intensification of railway movements that will occur in this area as a result of RRL1. The corridor between Sunshine and Deer Park currently has only 2 trains per hour (each way, off peak) and 3.5 trains per hour (peak). This is expected to increase in 2024 to 6 trains per hour (each way, off peak) and 17 trains per hour (peak). This section of the rail corridor will therefore experience the greatest increase in railway noise levels due to the relatively higher intensification of railway movements, even though no new tracks are proposed for this section of the alignment.

(c) Condition 1(ii)

Victoria does not provide numerical standards or guidelines for passenger railway noise. However, numerical guidelines are provided in NSW and Queensland.

The noise levels predicted for RRL1 have been compared with the NSW and Queensland numerical guidelines. The noise levels predicted for both Phase 0 (pre RRL) and Phase 2 (2024) both result in exceedances of these targets.

At Phase 0 prior to the opening of RRL, it is predicted that the NSW noise targets for daytime average, night-time average and/or maximum noise level will be exceeded at 733 residential properties, with this number increasing to 764 residential properties at Phase 2. However, only about two thirds of these properties meet the increase of 2 dB or greater criterion identified in the NSW guidelines. The Queensland noise limits are less onerous and at Phase 0, 519 properties exceed the noise limits for 24 hour average and/or maximum noise level, with this number increasing to 593 properties at Phase 2.

(d) Condition 1(iii)

The only way to prevent the impact of RRL1-related rail noise would be to not undertake the project. However, this would mean foregoing the substantial benefits and service improvements of the project. RRLA has therefore taken the view that it is appropriate to incorporate noise mitigation measures as part of its design objectives for the project. In doing so, RRLA has tried to achieve a balance between the resources applied to noise mitigation and the resources applied to service upgrades and improvements.

Several mitigation measures have been considered for RRL1, and some have been adopted in the RRL1 Reference Design. The mitigation measures considered, and their technical effectiveness in reducing noise impacts of the RRL1 project, are shown below.

Table 5: Technical effectiveness of mitigation measures for RRL1

i	Design alignment to minimise noise emission from the railway	Effective routewide – incorporated into Reference Design
ii	Control of track and rail roughness	Effective routewide – incorporated into Reference Design
iii	Track and wheel maintenance	Effective routewide – incorporated into Reference Design
iv	Conventional noise barriers	Effective at some receptors
v	Low level trackside noise barriers	Effective at some receptors
vi	Resilient rail fittings	Not effective
vii	Rail dampers	Not effective
viii	Noise Differentiated Track Access Charges (NDTAC)	Not effective
ix	Architectural acoustic treatments at residences	Effective at individual receptors

The mitigation measures identified as effective have also been assessed with regard to their feasibility. This assessment has been based upon the overall net community benefit of RRL1, rather than focussed only on localised impacts. This is consistent with the Victorian Government's draft Principles for passenger rail investments, which are to inform the management of noise emissions for rail.

Mitigation options (i), (ii) and (iii) are considered by RRLA to be feasible. Mitigation option (iv) may be feasible, however, Government policy is required to provide guidance on what noise barrier scenario is appropriate in the context of RRL1.

Mitigation option (v) is not considered by RRLA to be feasible.

Mitigation option (ix) is also not considered to be feasible due to the high cost associated with treating individual premises, the limitation of effectiveness for timber buildings, and because there is no benefit external to the buildings. Nevertheless, the Victorian Government may consider introducing a Rail Noise Overlay at selected locations in the vicinity of the rail corridor to ensure that new development or re-development projects are designed so as to protect occupant amenity.

8.3 Summary of response to Noise Principles

As demonstrated throughout this Report, RRLA has adopted the draft Principles as the most relevant basis upon which to consider noise impacts and potential mitigation options for RRL1. Chapter 3.2(c) provides a brief summary of the aspects of this Report which most specifically address each draft Principle. Table 6 below provides a summary of how each of the noise mitigation options identified in the KAJV Report as acoustically effective for RRL1 conform with the draft Principles.

Table 6 Summary of how the ‘acoustically effective’ noise mitigation options identified in the KAJV Report conform with the draft Principles:

Option	Typical reduction in noise level	Potential effective application for RRL1	Approximate Cost (excluding cost of additional land acquisition)	Consideration of the draft Principles
Design of railway alignment	Variable	Effective in specific locations (where it can be done) – applied in Reference Design.	Variable	<p>Integrated early consideration through consultation with other Government departments and community stakeholders.</p> <p>Balancing objectives and Best fit solutions within the constraints of the existing rail corridor.</p>
Track and rail roughness control	1-3dB(A)	Effective – applied in Reference Design.	Variable ARO expenses.	<p>Affordability and equity – routewide application.</p> <p>Best fit solution – routewide application to control noise at its source.</p>
Track and wheel maintenance	Variable: - 1–3 dB(A) (routewide); and - 5–10 dB(A) (local defects).	Effective – applied in Reference Design.	Ongoing operational expenses to ARO.	<p>Affordability and equity – routewide application.</p> <p>Best fit solution – routewide application to control noise at its source.</p>

Option	Typical reduction in noise level	Potential effective application for RRL1	Approximate Cost (excluding cost of additional land acquisition)	Consideration of the draft Principles
Noise barriers – 2 m	3–8 dB(A)	Potentially effective routewide – reasonable noise reduction to groups of sensitive receptors.	\$6,200/linear metre \$45,000–\$75,000 per residence \$20,000–\$50,000 per dB per residence reduction	Affordability and equity, Balancing objectives and Best fit solutions - acoustic benefit to some sensitive receptors, but significant cost and other amenity impacts. Issues of equitably determining appropriate location / extent of noise barriers given the varying types of noise impact along the rail corridor due to existing noise profile and additional impact of RRL1.
Noise barriers – 4 m	8–12 dB(A)	Potentially effective routewide in reducing noise to groups of sensitive receptors.	\$12,400/linear metre \$85,000–\$150,000 per residence \$20,000–\$25,000 per dB per residence reduction	Affordability and equity, Balancing objectives and Best fit solutions - acoustic benefit to groups of sensitive receptors but significant cost and possible other amenity impacts. Issues of equitably determining appropriate location / extent of noise barriers given the varying types of noise impact along the rail corridor due to existing noise profile and additional impact of RRL1.
Earth bunds	3–8 dB(A)	Effective in mitigating noise to groups of sensitive receptors but no application for RRL1 due to	\$450/linear metre \$3,500–\$4,000 per residence	Balancing objectives and Best fit solutions. Land-take would either require additional land acquisition or constrain future rail development

		requirement for additional land acquisition.	\$1,200–\$1,500 per dB per residence reduction	within the rail corridor.
Option	Typical reduction in noise level	Potential effective application for RRL1	Approximate Cost (excluding cost of additional land acquisition)	Consideration of the draft Principles
Low-level trackside noise barriers	3–6 dB(A)	Potentially effective noise mitigation in some locations where only 2 tracks.	~\$650/linear metre ~\$5,000 per residence ~\$3,500 per dB reduction	Balancing objectives and Best fit solutions. No application for RRL1 due to operational maintenance requirements.
Off-reservation architectural acoustic treatments	10-20dB(A) (locally)	Effective for individual dwellings in some circumstances. Isolated residential receivers – Footscray to West Footscray. Significant improvement in internal amenity but does not improve external amenity and applies to individual sensitive receptors rather than groups or communities.	\$15,000 - \$20,000 per residence.	Affordability and equity – limited beneficiaries. Balancing objectives and Best fit solutions.

RRL1 Noise Technical Assessment
