

In the matter of the Melbourne Metro Rail Project

Planning Panels Victoria

Proponent: Melbourne Metro Rail Authority

**Expert Witness Statement of
Dave Anderson**

CONFIDENTIAL & PRIVILEGED

Expert on behalf of Melbourne Metro Rail Authority

Melbourne Metro Rail Project

Expert witness statement of Dave Anderson

1 Name and address

Dave Anderson
Director
Acoustic Studio Pty Ltd
Unit 27, 43-53 Bridge Road
Stanmore, NSW 2048

2 Area of expertise

- (a) I hold the degree of Master of Engineering (MEng) in Acoustics and Vibration from the Institute of Sound and Vibration Research, University of Southampton, UK.
- (b) For the past 25 years I have been involved in acoustics, noise and vibration.
- (c) My qualifications and experience are detailed in Annexure A.

3 Scope

3.1 Instructions

I was commissioned by Melbourne Metro Rail Authority (MMRA) to carry out a peer review of the Noise and Vibration Impact Assessment (NVIA) completed as part of the Melbourne Metro Environmental Effects Statement (EES) by the AJM Joint Venture (AJMJV).

I have now been engaged to prepare a witness statement, to prepare responses to relevant submissions and to give evidence to the Panel on the following aspects of the NVIA:

- airborne noise from the construction stage of the project,
- airborne noise, ground borne vibration and ground borne noise from the operational stage of the project.

3.2 Process and Methodology

(a) Peer Review

The purpose of my peer review was to assess the NVIA, identify issues for consideration prior to the NVIA being finalised, and to provide recommendations for further consideration through the EES process. The scope of the peer review covered the following aspects of the NVIA:

- The noise and vibration standards and criteria,
- The noise and vibration prediction methodologies used, and the prediction results,
- The proposed noise and vibration mitigation and the assessment of residual impacts.

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I carried out a desktop review of the NVIA by reviewing and commenting on a number of draft versions of the NVIA (and associated Appendices). During the review, I was also provided with a copy of the proposed Environmental Performance Requirements (EPRs).

A number of specific technical issues were discussed at meetings and teleconferences with AJMJV during the review process, particularly relating to:

- Ground borne vibration from excavation and construction in the Parkville precinct, and
- Ground borne noise and vibration from future rail operations throughout the project area.

My peer review report was exhibited with the EES as Appendix G of the NVIA.

(b) Preparation of Evidence

Following the exhibition of the EES, I have been engaged to provide responses to relevant submissions and to give evidence at the panel hearing.

My witness statement addresses airborne noise from the construction stage of the project. I understand that Dr John Heilig will address ground borne vibration / ground borne noise from construction of the project.

My witness statement addresses both airborne noise and ground borne vibration / ground borne noise from the operational phase of the project.

In carrying out this work I have:

- undertaken site inspections throughout the project area,
- attended a workshop with the AJMJV team responsible for the NVIA,
- met with MMRA's transport expert to discuss management of noise from construction traffic,
- met with MMRA's constructability advisor to confirm likely construction scenarios and proposed noise mitigation, and
- reviewed submissions and prepared responses, including consideration of changes or additions to the EPRs, where relevant.

3.3 Persons assisting with this work

I was assisted in the peer review by my colleague Sav Shimada.

Sav holds a Bachelor of Engineering Degree in Mechanical Engineering and has over 10 years experience as an acoustic consultant and rail noise specialist.

Sav's role on the peer review was to check and comment on the airborne noise aspects of the NVIA.

I was assisted in the preparation of evidence by my colleagues Sav Shimada and Hadi Khairuddin.

Hadi holds a Master of Environmental Science and Law and has 10 years experience in environmental management, including management of construction noise and vibration from transport infrastructure projects.

4 Findings

4.1 Summary of Opinions

My peer review concluded that the criteria adopted in the NVIA are appropriate and that the noise and vibration modelling has been carried out competently and to an appropriate level of detail for the scale of the project and the stage of the assessment. The majority of comments raised during my review were satisfactorily addressed prior to finalisation of the NVIA.

My peer review recommended that some minor issues be addressed through the EES process, to ensure that:

- Construction noise impacts are described fully and mitigation is proposed, even where numerical noise limits are not specifically prescribed by the EPA Guidelines (eg for Daytime and Unavoidable works);
- Procedures for respite and temporary relocation during construction are clearly defined;
- The risk of damage due to construction vibration is clearly communicated so as to avoid undue stakeholder concern; and
- Feasibility of attenuating noise from fixed plant can be demonstrated.

These issues have been progressed since the exhibition of the EES, as summarized in sections 4.2 to 4.4 below.

4.2 Construction Noise Impacts

Construction of the Melbourne Metro Rail Line would involve long term construction works at a number of locations near sensitive receivers, with some of the works undertaken outside standard daytime hours. Construction is an inherently noisy activity and it is likely that noise levels at some properties would be intrusive at times.

The majority of the airborne noise impacts from the construction of the project are concentrated at the worksites for each of the five proposed stations and the two portals, rather than along the entire length of the alignment. For the affected receivers, each of these sites could be considered as a significant construction project in its own right.

Based on my review, I conclude that the Concept Design assessed in the EES has established that it is feasible to implement substantial and worthwhile mitigation to reduce construction noise impacts to affected receivers. In particular, I note that:

- A significant proportion of the work would be carried out within purpose-built acoustic sheds (or below purpose-built decking structures) to ensure compliance with stringent noise limits for long-term night-time work. Being semi-permanent structures, these sheds and enclosing structures would also reduce noise from construction activities carried out in these locations during daytime and during Unavoidable Work in the evening or night.
- Daytime and Unavoidable Work that does not take place within acoustic sheds or enclosures would be minimized as far as practical. The main work proposed outside acoustic sheds or enclosures is:
 - The construction of diaphragm walls or piled walls at each of the station excavation sites, and the initial excavation that takes place before a decking slab and/or acoustic shed is constructed. This would be carried out during daytime hours only and would include standard noise mitigation practices, including site hoardings.

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- Some of the construction activities that occur during road or rail occupations, which are relatively short-term but typically occur 24hrs per day. Noise mitigation would include site hoardings and site management procedures as well as consideration of respite and relocation (see section 4.3 below).
- Noise from construction trucks would be managed by ensuring that loading and unloading occurs within sheds and enclosures as far as practical; that truck routes are selected with due consideration for sensitive receivers; and that operational procedures are put in place to minimize truck noise.

In summary, while the scale of the overall project is very large, the airborne construction noise impacts can be considered as comparable to a series of discrete construction projects, each of which affects surrounding receivers in that area. Unlike many construction projects, the majority of the work would be carried out within acoustic sheds or underground, which means that airborne noise from that work would not be audible in surrounding residential premises.

4.3 Procedures For Respite And Temporary Relocation

EPR SC2 requires the development of a relocation management framework for households affected by construction of the project. Following the publication of the EES, MMRA has provided me with a working draft of Residential Impact Management Guidelines for Construction (RIMG). This draft guideline outlines the way additional noise and vibration mitigation measures could be considered, selected and applied at residential receivers affected by the construction stage of the project.

I support the approach set out in the draft guidelines because it provides:

- Clarity about the way respite and temporary relocation would be managed;
- A hierarchy of measures based on the duration and level of noise impact;
- Consideration of acoustic treatment to homes, as well as respite and relocation.

I recommend that EPR SC2 be amended to require that Residential Impact Management Guidelines for Construction (RIMG) are finalised and implemented for the project.

4.4 Attenuation Of Noise From Fixed Plant

The EPRs (specifically NV16) require compliance with specific noise limits for fixed mechanical plant and ventilation sites along the alignment, based on the State Environmental Policy (Control of Noise from Commerce, Industry and Trade) No. N1 (SEPP N-1). These limits apply to residential receivers and I note that this would also necessitate noise attenuation for fixed facilities located near to other receivers, such as educational, medical and commercial facilities.

Following my peer review, I have sought further clarification to confirm the practicality noise attenuation for cooling plant (chillers, condensers etc) associated with fixed facilities.

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5 Submissions

I have reviewed the submissions that relate to airborne noise from construction and to noise and vibration from the operational phase of the project. My response to these submissions is detailed in Annexure C. The summary below provides an overview of the key issues and my responses.

Issue	Response
Construction noise impacts, including 24hr works	<p>I have reviewed the construction methodology and construction noise mitigation concepts assessed in the EES and consider that they include best practical measures to mitigate and manage noise impacts, as discussed in section 4.2 above.</p> <p>I am satisfied that the proposed EPR NV1 is appropriate and that the mitigation measures described in the EES are indicative of the approach required to comply with the EPA Guidelines.</p>
Noise from construction traffic, particularly at night	<p>I have recommended that a construction vehicle noise management plan be developed to implement operational procedures and controls that minimise noise from trucks.</p>
Construction noise affecting medical and research facilities in Parkville	<p>I understand that MMRA has established a Parkville Reference Group to coordinate discussions with affected receivers in the Parkville area.</p> <p>I understand that the Reference Group will develop a detailed management plan to minimise construction noise impacts in the precinct and I believe that this process will address relevant concerns about impacts on medical and research facilities.</p>
Operational rail noise and vibration impacts	<p>I believe that the criteria adopted in the EES for operational rail noise and vibration are appropriate for the types of sensitive receivers affected by future rail operations. Based on my review of the noise and vibration assessments carried out for the EES, I am satisfied that the proposed EPRs NV14 to NV18 are appropriate and that the mitigation measures described in the EES are sufficient to achieve these criteria.</p>
Baseline noise monitoring at representative locations	<p>I am satisfied that the baseline noise monitoring presented in the EES is representative of the locations that are likely to be affected by airborne noise impacts during construction.</p> <p>There are locations in the tunnel precinct that are not represented in the baseline noise and vibration monitoring, but I note that the potential impacts in these areas are the tunnelling process (which is short-term) and ground borne noise and vibration from future train operations. I believe that the EPRs include operational noise and vibration criteria that are appropriate for quiet residential areas and I note that, in any case, these criteria are not dependant on existing baseline levels.</p>

6 Technical Notes

I have reviewed Technical Notes 1 to 18 provided by MMRA and used these to inform my overall assessment. I have not recommended any changes to the EPRs based on my review of the Technical Notes.

7 Environmental Performance Requirements (EPRs)

I recommend the addition of two EPRs to manage noise from construction.

Firstly, I recommend that EPR SC2 be amended to require that Residential Impact Management Guidelines for Construction (RIMG) are finalised and implemented for the project.

Secondly, I recommend an additional EPR requiring that the project “Develop and implement a construction vehicle noise management plan that gives effect to operational procedures and controls that minimise truck noise, including, but not limited to, consideration of the following:

1. Where practical, limit construction vehicle movements to Normal Working Hours;
2. Where practical, select traffic routes with existing heavy vehicle usage and avoid local roads (e.g. residential streets), particularly for 24-hour activities;
3. Install ‘no engine braking’ signs on designated routes;
4. Ensure trucks are fitted with mufflers that comply with the original equipment manufacturer specifications;
5. Enforce speed restrictions on all construction vehicles;
6. Complete regular maintenance checks of road surfaces and trucks;
7. Implement temporary changes to traffic light sequences on designated routes to minimise trucks starting and stopping at junctions;
8. Monitor construction vehicle driver behaviour.”

8 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have to my knowledge been withheld from the Panel.

Signed 

Dated ...11 August 2016

Annexure A – Qualifications

Qualifications

Master of Engineering (MEng) in Acoustics and Vibration from the Institute of Sound and Vibration Research, University of Southampton, UK, 1989.

Professional associations

Member of the Australian Acoustical Society

Member of the Institute of Acoustics, UK

Chair of the international committee for the International Workshop on Railway Noise

Employment history and achievements

I have 25 years of experience in acoustics, noise and vibration across a wide range of fields and am a recognised expert in railway noise and vibration.

I graduated from the Institute of Sound and Vibration Research in the UK and joined Arup Acoustics in 1989. I moved to the Australian office of Arup Acoustics in 1995, and then joined the Rail Infrastructure Corporation (which later became RailCorp and Transport for NSW) as in-house noise specialist in 2002. I joined Acoustic Studio Pty Ltd in February 2014.

My experience includes:

- Design of vibration isolation systems for buildings near railways, including the Manchester Concert Hall in the UK and Angel Place Recital Hall in Sydney.
- Design of the track support systems for rail projects for compliance with applicable ground borne noise and vibration criteria, including the Sydney Airport Rail Link and the Rail Enclosure Structure at Chatswood in Sydney.
- Noise assessment and mitigation design for rail projects including the Central Coast Rail Upgrade project in NSW.
- Research and development on a range of issues in the field of rail noise and vibration, including wheel squeal and propagation of rail vibration in buildings.
- Feasibility review and scoping studies for proposed rail project, including the Western Sydney Freight Line and the Newcastle Rail By-pass.
- Expert review of operational noise mitigation proposals for the Rail Clearway program in Sydney, the Northern Sydney Freight Corridor program and the North West Rail Link in Sydney.
- Technical Advisor on noise and vibration from the construction and operation of Sydney Metro NorthWest and Sydney Metro City & SouthWest

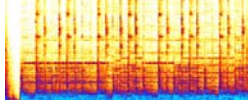
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Annexure B – Curriculum Vitae for Dave Anderson

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acoustic studio



Career Overview

Dave joined **Acoustic Studio** Pty Ltd in 2014, from RailCorp NSW. He has over 25 years of experience in acoustics, noise and vibration across a wide range of fields and is a recognised expert in transport noise and vibration.

Dave graduated from the **Institute of Sound and Vibration Research** in the UK and joined **Arup Acoustics** in 1989. He moved to the Australian office of Arup Acoustics in 1995, and then joined the **Rail Infrastructure Corporation** (which later became RailCorp and Transport for NSW) as in-house noise specialist in 2002.

Dave has in-depth experience in noise and vibration issues associated with rail and tunnel projects and has co-authored numerous technical papers on the subject (a selection of relevant references is attached at the end of this CV).

Dave has extensive experience in communicating with a range of stakeholders, including community, project design teams, researchers, regulators, operations and maintenance personnel and senior executives.

Dave Anderson

Acoustic Engineer Director, Acoustic Studio

Qualifications

Master of Engineering (MEng) in Acoustics and Vibration

Professional Associations

Member of the Australian Acoustical Society
Member of the Institute of Acoustics, UK
Chair of the international committee for the **International Workshop on Railway Noise**
Chartered Engineer, UK

Expertise Areas

Dave's in-depth experience in noise and vibration includes prediction, impact assessment and design; the review, assurance and commissioning roles for numerous rail and tunnel projects; trouble-shooting and research & development for operational rail noise issues; and the role of Industry Chair for a Cooperative Research Centre project on rail noise.

In summary, Dave has in-depth experience in all areas of rail and tunnel acoustics, noise and vibration and across all stages of the asset life-cycle.

Key Projects

Western Port Rail Freight Line, Victoria

Feasibility study, expert witness statement and presentation to panel hearing (2014). Client: Department of Economic Development, Jobs, Transport and Resources, Victoria.

Sydney Metro North West (ongoing)

Sydney Metro is Australia's largest public transport infrastructure

project. It includes construction of twin 15 km tunnels from Bella Vista to Epping, which are Australia's longest rail tunnels. The North West component has a project value of \$8.3bn.

Dave leads Acoustic Studio's role as the **Technical Advisor** for Transport for NSW for acoustics, noise and vibration.

Singapore Circle Line, Stages 2 & 3 (2002), for LTA

Noise & vibration study encompassing empirical and numerical modelling of ground borne noise and vibration from the operation of the new line.

Scope included in-tunnel and ground surface vibration measurements near Novena Station on the existing North-South line.

Sydney Airport Rail Link ('97-'99)

Noise and vibration prediction, assessment, design and commissioning for tunnel fit-out contractor, Rail Services Australia. Vibration mitigation design included the first significant use of under-ballast mats in Australia [2].

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Other Relevant Experience

Sydney Light Rail, Sydney ('95-'97)

Dave provided expert advice to CityWest Development Corporation on noise and vibration impacts and mitigation requirements for residential and commercial redevelopments in Pymont, adjacent to the new light rail system.

Epping Chatswood Rail Link, Sydney ('02-'09)

Dave had extensive involvement in this project throughout the design, construction and commissioning stages, including:

- Peer review during design phase.
- Construction noise and vibration management during interface works at Chatswood and Epping.
- Noise and vibration design for track support system in Rail Enclosure Structure at Chatswood.
- Technical leader of noise task force during 2008, to resolve issues with in-train noise (culminating in the first use of rail dampers in Australia [4]).

Rail Clearways, Sydney ('05-'09)

Dave led the in-house technical review of noise and vibration impact assessments and mitigation designs for rail clearways projects, including:

- Cronulla Duplication
- Kingsgrove to Revesby Quad
- South West Rail Link

RailCorp Environment Protection Licence ('02-'11)

Dave provided technical support for compliance with Pollution Reduction Programs required under RailCorp's Environment Protection Licence.

Wheel squeal research and development ('04-'13)

Dave has had a long-term involvement with wheel squeal issues, both in NSW and also in collaboration with rail agencies in South Australia and Queensland. The work spans:

- The first use of top-of-rail friction modifiers in Australia [5];
- The installation of a wayside angle-of-attack monitoring system on a curve (a world first) [6];
- Industry Chair of a Cooperative Research Centre (CRC) project on rail noise, including wheel squeal [6,7];
- Extensive track-based testing of lubrication and friction modifier treatments [8];
- Engagement with rail operators to investigate rolling stock curving performance.

Strategic Noise Action Plan, NSW ('12-'13)

Dave was seconded to the Freight and Regional Development Division of Transport for NSW to assist with the implementation of the Strategic Noise Action Plan (SNAP), which addresses noise from rail freight operations by tackling noise at source as well as ensuring appropriate controls are incorporated in the planning and the design of new projects.

Northern Sydney Freight Corridor, NSW ('11-'13)

Technical advice to support the development of the Operational Noise and Vibration Review.

Sydney City Recital Hall, Angel Place, Sydney ('96-'99)

Project engineer involved in acoustic design, building isolation and commissioning of this 1250 seat international standard chamber music hall in Sydney. The City Recital Hall is now regarded as the benchmark for future concert halls in Australia.

Selected Technical References (copies available on request)

1. Anderson D, "Engineering Prediction Of Railway Vibration Transmitted In Buildings", 1994, Environmental Engineering Volume: 7 Issue Number: 1 ISSN: 0954-5824
2. Anderson D, "Manchester Concert Hall: Vibration Isolation", Proceedings of Internoise 1996, Liverpool UK
3. Anderson D, Harris M, "New Southern Railway, Sydney – Noise and Vibration Attenuation Systems", Proc ExpoRail (Asia), Hong Kong, 2000
4. Coker D, Anderson D, "Reducing In-train Noise on the Epping to Chatswood Rail Link", Proceedings of Conference on Rail Engineering 2010
5. Kerr M, Kalousek J, Elliot G, Mau F, Anderson D, "Squeal Appeal: Addressing Noise at the Wheel/Rail Interface" Proceedings of Conference on Rail Engineering 1998
6. Jiang J, Anderson D, Dowdell D, Wang C, "The impact of angle of attack on curve squeal", Proceedings of World Congress on Railway Research (WCRR) 2013, Sydney, Australia
7. Jiang J, Dwight R, Anderson D, "Field Verification of Curving Noise Mechanisms", Proceedings of 10th International Workshop on Rail Noise, Japan 2010
8. Curley D, Anderson D, Jiang J, Hanson D, "Field trials of gauge face lubrication and top-of-rail friction modification for curve noise mitigation", Proceedings of 11th International Workshop on Rail Noise, Sweden 2013
9. Anderson D and Hiller D, "Noise and vibration issues in tunnels", Tunnel Management International, 2000

Annexure C –SUBMISSIONS RESPONSES

MELBOURNE METRO RAIL PROJECT: EES Noise (Construction & Operation) and Vibration (Operation) Submissions – Responses

Item	Issue	Submission No.	Response
1	General concern regarding construction noise and vibration impacts, appropriate mitigation, monitoring, criteria and 24-hr activities occurring above and below ground throughout the Project	MM008; MM010 MM012; MM058 MM062; MM068 MM080; MM096 MM104; MM107 MM109; MM112 MM117; MM118 MM129; MM137 MM146; MM153 MM159; MM166 MM170; MM183 MM184; MM186 MM190; MM191 MM193; MM196 MM218; MM224 MM226; MM227 MM229; MM231 MM232; MM240 MM242; MM246	<p>I have reviewed the proposed construction methodology and the construction noise mitigation proposals shown in the Concept Design and conclude that they include best practical measures to mitigate and manage the noise impacts. In particular, I note that:</p> <ul style="list-style-type: none"> • A significant proportion of the work would be carried out within purpose-built acoustic sheds (or below purpose-built decking structures) to ensure compliance with stringent noise limits for long-term night-time work. Being semi-permanent structures, these sheds and enclosing structures would also reduce noise from construction activities carried out in these locations during daytime and during Unavoidable Work in the evening or night. • Daytime and Unavoidable Work that does not take place within acoustic sheds or enclosures would be minimized as far as practical. The following main works would be undertaken outside acoustic sheds or enclosures: <ul style="list-style-type: none"> ○ The construction of diaphragm walls or piled walls at each of the station excavation sites, and the initial excavation that takes place before a decking slab and/or acoustic shed is constructed.

		MM250; MM252 MM253; MM256 MM259; MM260 MM263; MM264 MM266; MM267 MM268; MM272 MM273; MM274 MM276; MM281 MM283; MM284 MM285; MM287 MM289; MM291 MM295; MM297 MM304; MM311 MM313; MM314 MM315; MM321 MM325; MM330 MM333; MM338 MM346; MM347 MM348; MM352 MM354; MM356 MM362; MM363 MM365; MM367 MM370; MM371 MM372; MM374 MM377	<p>This would be carried out during daytime hours only and would include noise mitigation via the use of site hoardings, management of construction traffic and ensuring all plant and equipment is in good working order.</p> <ul style="list-style-type: none"> ○ Some of the construction activities that are to occur during road or rail occupations would be relatively short-term but typically undertaken over 24hr. Noise mitigation would include site hoardings and site management procedures as well as consideration of respite and relocation in accordance with a temporary relocation framework developed and implemented under EPR SC2, as amended in accordance with my recommendations below. ● EPR NV3 requires noise and vibration monitoring to be undertaken throughout construction by the appointed noise and vibration consultant to confirm compliance with the guideline targets specified in the relevant EPRs. <p>EPR NV1 requires a construction noise and vibration management plan be developed and implemented for all work areas along the alignment, incorporating an assessment of noise and vibration impacts and appropriate mitigation as per above. The plan(s) would be developed and implemented in accordance with the EPA Publication 1254 Noise Control Guidelines (EPA 1254).</p>
<p>EPR Recommendation I recommend that EPR SC2 be amended to require that Residential Impact Management Guidelines for Construction (RIMG) are finalised and implemented for the project.</p>			

2	<p>General concern regarding potential noise and vibration impacts associated with proposed construction vehicle routes, particularly through sensitive areas, and the absence of target criteria in relation to construction traffic.</p>	<p>MM012; MM049 MM063; MM079 MM080; MM081 MM096; MM084 MM104; MM115 MM137; MM166 MM170; MM190 MM203; MM226 MM241; MM259 MM266; MM268 MM281; MM283 MM285; MM291 MM304; MM305 MM306; MM309 MM342; MM347 MM348; MM352 MM354; MM356</p>	<p>Noise from construction trucks would be managed by ensuring that loading and unloading occurs within sheds and enclosures as far as practical; that truck routes are selected with due consideration for sensitive receivers; and that operational procedures are put in place to minimize truck noise.</p> <p>I have reviewed the proposed truck routes and understand that the final construction traffic routes would be selected in recognition of a number of factors including sensitive receptors and consideration of gradients to minimize braking and acceleration.</p> <p>I recommend an additional EPR that requires a construction vehicle noise management plan be developed and implemented for the project to ensure that noise impacts associated with truck movements are specifically addressed. Management measures to be considered would include the following:</p> <ul style="list-style-type: none"> - Where possible: <ul style="list-style-type: none"> o Limiting construction vehicle movements to Normal Working Hours; and o Selecting traffic routes with existing heavy vehicle usage and avoiding local roads (e.g. residential streets), particularly for 24-hour activities. <p>The construction vehicle noise management plan would also consider (but not be limited to) the following safeguards to manage truck noise, particularly where sensitive routes cannot be avoided:</p> <ul style="list-style-type: none"> - Installation of ‘no engine braking’ signs on designated routes; - Ensuring trucks are fitted with mufflers that comply with the original equipment manufacturer specifications; - Speed restrictions on all construction vehicles; - Regular maintenance and repairs to road surfaces;
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			<ul style="list-style-type: none"> - Temporary changes to traffic light sequences on designated routes to minimise the need for trucks to start and stop at junctions; - Monitoring driver behaviour.
<p>EPR Recommendation I recommend an additional EPR as follows: Develop and implement a construction vehicle noise management plan that gives effect to operational procedures and controls that minimise truck noise, including, but not limited to, consideration of the following:</p> <ul style="list-style-type: none"> - Limit construction vehicle movements to Normal Working Hours; - Select traffic routes with existing heavy vehicle usage and avoid local roads (e.g. residential streets), particularly for 24-hour activities. - Install 'no engine braking' signs on designated routes; - Ensure trucks are fitted with mufflers that comply with the original equipment manufacturer specifications; - Enforce speed restrictions on all construction vehicles; - Complete regular maintenance checks of road surfaces and trucks; - Implement temporary changes to traffic light sequences on designated routes to minimise trucks starting and stopping at junctions; - Monitor driver behaviour. 			
3	General concern regarding operational noise and vibration impacts associated with rail operations and the necessity for an ongoing maintenance program to ensure operational performance is acceptable.	MM019; MM062 MM112; MM119 MM129; MM146 MM155; MM166 MM174; MM217 MM231; MM240 MM250; MM253 MM261; MM267	<p>Based on the Concept Design, the potential operational noise and vibration impacts are predominantly associated with vibration and ground-borne noise, as opposed to operational airborne noise impacts. This is because rail operations would largely occur below ground within tunnels and underground stations, and any above ground operations (the Eastern and Western Portals; and Western Turn-back) are located in areas with pre-existing rail activities.</p> <p>I believe that the criteria adopted in the EES for operational rail noise and</p>

		MM268; MM281 MM287; MM311 MM314; MM321 MM327; MM338 MM347; MM350 MM363; MM367 MM370	<p>vibration are appropriate for the types of sensitive receivers affected by future rail operations.</p> <p>The EES demonstrates that these criteria would be met by incorporating mitigation measures (such as resilient track support systems) where necessary. I have reviewed the noise and vibration predictions and I am satisfied that the mitigation measures assessed in the EES are representative of the required treatment.</p> <p>EPR NV15, NV17 and NV18 set specific operational targets for noise and vibration and require the application of all reasonable and feasible mitigation to comply with these targets. These EPRs require compliance during the operational phase of the project and I am therefore satisfied that they are sufficient in mandating appropriate noise and vibration performance during the operational phase of the project.</p>
4	General concern raised regarding operational noise and vibration impacts associated with fixed mechanical plant.	MM135; MM190 MM240; MM268 MM285; MM339 MM356; MM367 MM370	EPR NV16 requires compliance with specific noise limits for fixed mechanical plant and ventilation sites along the alignment, based on the State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N1 (SEPP N-1). These limits apply to residential receivers and I note that compliance with these limits is mandatory and would necessitate noise attenuation for fixed facilities located near to other receivers, such as educational, medical and commercial facilities.
5	General concern regarding community notification, consultation and complaints management associated with noise and vibration impacts.	MM182; MM250 MM354; MM367 MM371	EPR SC3 mandates that a community and business involvement plan(s) would be developed by the construction contractor(s) to engage potentially affected stakeholders, notify planned construction activities and project progress and manage community complaints.

6	Concern regarding the impacts of construction noise and vibration on health, particularly for the elderly, young children and those with medical conditions.	MM012; MM104 MM242; MM295 MM330	<p>I believe that the relevant EPRs in respect to the management and minimization of construction noise impacts are suitable. EPR NV5 provides specific internal guideline targets for airborne construction noise for application to Highly Sensitive Areas (based on AS/NZS 2107:2000), including hospital wards and operating theatres.</p> <p>While it would not be practical to entirely eliminate construction noise impacts associated with the project, it would be desirable for a temporary relocation framework under SC2 to acknowledge special circumstances in which residents or receivers may have increased sensitivities to noise impacts, such as those with medical conditions. Special circumstances would be considered when determining appropriate mitigation measures.</p>
7	<p>General concern regarding governance of noise and vibration issues, including:</p> <ul style="list-style-type: none"> - Transparency and public availability of key noise and vibration documentation; and - Independent verification of noise and vibration assessment, management and monitoring 	MM104; MM250 MM370	<p>I support the need for transparency and public availability of key noise and vibration documentation and assume that this would be managed via the communications plans required by EPR NV4 and SC3.</p> <p>Chapter 23 of the EES explains that the Independent Environmental Auditor would undertake environmental audits of the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP), including noise and vibration management.</p>
8	Concern regarding the absence of specific noise	MM104; MM180 MM325; MM357	EPR NV1 requires that a plan be developed and implemented to manage construction noise in accordance with EPA Publication 1254.

	<p>criteria for Normal Working Hours, Unavoidable Works and non-residential receivers.</p>	MM367	<p>Although EPA 1254 does not provide specific construction noise criteria for Normal Working Hours, Unavoidable Works or non-residential receivers, it does require that reasonable measures be implemented to reduce noise, including the use of enclosures.</p> <p>I note that a significant proportion of the construction work for this project would need to be carried out within enclosures (e.g. in acoustic sheds or below decking slabs) in order to comply with the requirement that noise is inaudible within residential premises at night. Where practical, work during Normal Working Hours or Unavoidable Works would also be carried out within these enclosures, in accordance with EPA 1254.</p> <p>I am satisfied that the management of construction noise in compliance with the existing EPR framework would be sufficient to ensure construction impacts are minimised as far as is reasonably practicable and feasible. It would not be necessary to apply specific noise criteria for Normal Working Hours, Unavoidable Works and non-residential receivers.</p>
9	<p>The Owners Corporation of the Westin Residential Apartments raised concern in relation to the following:</p> <ul style="list-style-type: none"> - Construction noise and vibration impacts - Noise monitoring methodology - Identification and design of appropriate mitigation <p>Independent assessment of</p>	MM310	<p>Refer to Item 1 regarding construction noise impacts and monitoring.</p> <p>EPR NV3 requires that noise monitoring is to be undertaken by an appointed noise and vibration consultant during construction. I understand and expect that a detailed noise monitoring methodology would be included within the contractor's construction noise management plan, prepared as required by EPR NV1. The methodology would consider specific stakeholder concerns and sensitivities.</p> <p>Where noise monitoring indicates exceedance of the EPR guideline targets, mitigation measures would be implemented in accordance with the noise management plan and temporary relocation framework developed and implemented under EPR SC2, as amended in accordance with my</p>

	construction noise impacts and management.		recommendations (see item 1).
10	Concern regarding circumstances in which relocation or acoustic treatment may be considered during construction activities.	MM051; MM066 MM107; MM112 MM190; MM283 MM285; MM339 MM356	<p>Following the publication of the EES, MMRA has provided me with a working draft of proposed RIMG, which provides a suggested framework for additional mitigation of construction noise and vibration impacts. I have recommended that EPR SC2 be amended to capture what I consider to be the important aspects of the draft RIMG, which are</p> <ul style="list-style-type: none"> • Clarity about the way respite and temporary relocation would be managed; • A hierarchy of measures based on the duration and level of noise impact; • Consideration of acoustic treatment to homes, as well as respite and relocation. <p>Circumstances in which relocation or acoustic treatment may be required should be managed on a case-by-case basis in direct consultation with the affected stakeholder.</p>
11	Concern regarding the absence of baseline noise and vibration monitoring for some sensitive areas ('grey areas') in close proximity to the tunnel alignment, particularly residential areas.	MM090; MM095 MM129; MM203 MM217; MM250 MM253; MM299 MM300; MM301 MM350	<p>I am satisfied that the baseline noise monitoring presented in the EES is generally representative of the locations that are likely to be affected by airborne noise impacts during construction.</p> <p>There are locations in the tunnels precinct that are not represented in the baseline noise and vibration monitoring, but I note that the potential impacts in these areas are the tunnelling process (which is short-term) and ground borne noise and vibration from future train operations. I believe that the EES has adopted operational noise and vibration criteria that are appropriate for quiet residential areas and I note that, in any case, these criteria are not dependant on existing baseline levels.</p>

12	Residents and other receivers within Precinct 7 – Domain raised concern regarding potential noise and vibration impacts associated with proposed 24-hour construction vehicle routes.	MM080; MM081 MM137; MM183 MM226; MM241 MM283	<p>Refer to Item 2 in regards to construction vehicle noise and vibration impacts.</p> <p>The EES indicates 24-hour truck movements, however I understand that night construction traffic would be directed via the Botanic Gardens to minimize impacts to residential receivers outside Normal Working Hours. This is consistent with the objectives of the additional EPR I have recommended for managing noise from trucks (Item 2).</p>
13	Residents within Precinct 8 – South Yarra raised concern regarding potential noise and vibration impacts associated with proposed construction vehicles routes through sensitive residential areas	MM012; MM104 MM266; MM348 MM352; MM354	<p>Refer to Item 2 in regards to construction vehicle noise and vibration impacts.</p> <p>The EES indicates 24-hour truck movements would be required during rail occupations. I understand that truck movements during the rest of the construction program would be limited to daytime hours and that a one-way construction traffic route, comprising entry to the project site via Osborne Street and exit via William Street, has been proposed for the South Yarra Precinct to minimize braking, acceleration and reversing activities, and consequently reduce impacts to receivers. This is consistent with the objectives of the additional EPR I have recommended for managing noise from trucks (Item 2).</p>
14	Residents within Precinct 2 – Kensington are supportive of ‘Option B’ as opposed to ‘Option A’ as per the EES, for various reasons including perceived reduction of construction and operational noise and vibration impacts.	MM007; MM030 MM050; MM072 MM092; MM093 MM097; MM101 MM102; MM106 MM111; MM120 MM122; MM124 MM140; MM144 MM154; MM156	<p>As per Items 1 through 3, I am satisfied that the objectives of the relevant EPRs are sufficient to mitigate the impacts of construction and operational noise and vibration associated with either ‘Option A’ or ‘Option B’.</p> <p>I acknowledge that impacts may differ in respect to ‘Option A’ or ‘Option B’, however the same principles of mitigation, as mandated by the EPRs, are applicable to both options.</p>

		MM158; MM161 MM179; MM192 MM230; MM238 MM239; MM248 MM270; MM271 MM282; MM293 MM323; MM324	
15	Concern regarding the design of the Twin Track decline and retaining wall at Childers Street in Kensington and the possibility of incorporating sound absorption into the retaining wall design via a green wall solution.	MM070	The acoustic design and specification of the retaining wall would be resolved at the detailed design stage of the project to ensure compliance with operational noise thresholds required by EPR NV15.
16	Residents within Precinct 2 – Kensington raised general concern regarding construction vehicle noise and vibration impacts associated with both Options A and B.	MM075 MM102 MM179	Refer to Item 2 in regards to construction vehicle noise and vibration impacts. The EES indicates 24-hour truck movements would be required to support short term rail occupations, however where possible, I understand movements would be limited to daytime hours via Childers and Kensington Roads.
17	Concern regarding the additional rail bridge component of Option B in Kensington and the associated traffic noise impacts.	MM070	Refer to Item 11 in relation to operational noise management associated with Options A and B. The rail bridge would be designed and constructed to ensure that operational noise complies with the relevant criteria as per EPR NV15.

18	Residents raised concern regarding the noise and vibration impacts associated with the proposed tram diversion down St Kilda and Toorak Roads.	MM008; MM080 MM346; MM347	<p>The construction of tram tracks would take place primarily during daytime hours.</p> <p>I note that Toorak Road and St Kilda Road are subject to relatively high noise levels from road traffic and I do not consider that noise and vibration from the future operation of trams is likely to have a significant impact.</p>
19	<p>Concern raised in regards to sensitive equipment and machinery that are susceptible to noise and vibration impacts within Precinct 3 – Arden. Requests the following:</p> <ul style="list-style-type: none"> - Real time noise and vibration monitoring - Alterations to EPRs - Opportunity to review and comment management plans and design 	MM357	<p>Refer to Item 1 regarding to construction noise impacts.</p> <p>EPR B3 requires that direct consultation would be undertaken to understand the specific sensitivities of equipment and machinery at this location. Mitigation would be carried out to ensure construction noise impacts are minimized at the receiver, including real-time monitoring if deemed appropriate.</p> <p>I note that transient noise levels from existing road traffic on Laurens Street are relatively high and that they are higher than the predicted construction noise levels presented in the EES. I have also recommended an additional EPR that requires a construction vehicle noise management plan be developed and implemented for the project to ensure that noise impacts associated with truck movements are specifically addressed (refer Item 2).</p> <p>EPR NV3 requires noise monitoring to be undertaken throughout construction by the appointed noise and vibration consultant.</p>
20	University of Melbourne and Melbourne Health raised concern in regards to the following within Precinct 4 – Parkville on a number of issues, including the	MM318	<p>I understand that MMRA has established a Parkville Reference Group with affected stakeholders to provide a collaborative platform for addressing key concerns and developing recommendations associated with the Project, including construction noise impacts.</p> <p>It is assumed that the findings and recommendations from the reference group would consider specific criteria for sensitive equipment and be</p>

	<p>following:</p> <ul style="list-style-type: none"> - Absence of baseline monitoring and appropriate thresholds/limits for sensitive areas/time periods within the Precinct - Adoption of generic construction and operational noise and vibration targets that do not consider specific sensitive equipment and bio-resources - Inadequate mitigation based on predicted impacts and models as opposed to measured impacts - Stakeholder consultation in the development of noise and vibration communications plans 		<p>incorporated in a detailed management plan to minimise construction noise impacts in this precinct. On this basis, I believe that this process will address relevant concerns about noise and vibration impacts on medical and research facilities.</p>
21	In relation to airborne and ground borne construction	MM180	EPR EM1 requires the development and implementation of a Construction Environmental Management Plan and associated documentation. This must

	<p>noise RMIT recommend inclusion of additional criteria in EPR to protect teaching spaces and other noise sensitive areas within RMIT buildings when in use. This includes but is not limited to the time of operations to consider RMIT education and teaching programs. RMIT seek to be a key stakeholder in respect to the development of these criteria.</p>		<p>include consultation with relevant stakeholders to determine the particular sensitivities for different receivers, including RMIT.</p> <p>Where practical, stakeholder specific mitigation should be implemented to ensure construction noise impacts are minimized at sensitive locations at RMIT.</p> <p>Refer to also to Item 8 regarding additional criteria.</p>
22	<p>RMIT seeks a direct limitation on the ventilation plant noise levels at the facades of the RMIT buildings adjacent to the ventilation structures.</p>	MM180	<p>Refer to Item 4 in relation to operational noise and vibration impacts associated with fixed mechanical plant.</p>
23	<p>RMIT recommends that specific criteria for heavy vehicle traffic noise is included in development of EPR and RMIT are a nominated key stakeholder in the development of these criteria. RMIT consider noise</p>	MM180	<p>Refer to Item 1 regarding construction noise impacts and Item 2 in relation to construction vehicle noise impacts.</p>

	and vibration a key issue and risk during the Project lifecycle and seek to be actively involved in the further development of relevant EPR.		
24	Concern raised by the Melbourne Anglican Trust Corporation (MATC) in regards to construction noise and vibration management and impacts to St Paul's Cathedral building, congregations, staff and visitors.	MM274	<p>Refer to Item 1 regarding construction noise impacts.</p> <p>EPR EM1 requires the development and implementation of a Construction Environmental Management Plan and associated documentation. This must include consultation with relevant stakeholders to determine the particular sensitivities for different receivers, which could include activities associated with the MATC and St Paul's Cathedral.</p> <p>Where practical, stakeholder specific mitigation would be implemented to ensure construction noise and vibration impacts are minimized at the receiver; this would include consideration of respite times, site hoardings and acoustic enclosures.</p>
25	Concern regarding the impacts of construction noise and vibration on the Christ Church Parish and Christ Church Grammar School.	MM159	I believe that construction noise impacts at the Parish and grammar school would be relatively low. This is because the majority of construction in this area would take place underground. The exception is the construction of the Fawkner Park emergency access shaft. I note that based on the Concept Design, the EES indicates a noise barrier could be included on this site and that noise levels at the Parish would be similar to or less than existing levels from road traffic on Toorak Road.
26	Concern regarding the "cut and cover" construction methodology at Precinct 7 – Domain, and associated noise	MM218; MM252 MM260; MM313 MM370; MM374	<p>Refer to Item 1 regarding construction noise impacts.</p> <p>I note that the proposed cut and cover construction methodology at Precinct 7 – Domain involves the "top down" method. This involves the</p>

	and vibration impacts.		construction of a slab or decking structure as soon as practical, acting as a noise enclosure for subsequent excavation.
27	Concern raised on behalf of the Melbourne Grammar School (MGS) in relation to the absence of fixed noise limits at education facilities. Recommendation to limit noise levels in accordance with the requirements of NSW Interim Construction Noise Guideline (ICNG) (DECC), 2009).	MM367	<p>Refer to Item 1 regarding construction noise impacts and Item 8 in regards to additional criteria within the EPR framework.</p> <p>The EES indicates that the highest noise impacts affecting MGS would occur during the initial excavation of the station box, prior to the construction of acoustic sheds and decking slabs. This work would involve a number of items of large plant, such as piling rigs, operating progressively across the site area. While the EES indicates that these activities may require approximately 8 months for completion, noise levels at MGS would be highest when these items of plant are operating on the part of the site closest to MGS facilities; at other times, noise levels would be lower.</p> <p>A site hoarding of up to 6m was assessed for this worksite and the NVIA showed that construction noise levels at MGS would generally be comparable to noise from existing road traffic on St Kilda Road.</p> <p>EPRs B3 and NV4 requires that direct consultation would be undertaken to understand the specific sensitivities at this location. Mitigation should be implemented to ensure construction noise impacts are appropriately managed at the receiver, including scheduling high noise generating activities around sensitive periods during the school day and term, where practical.</p>
28	Concern regarding noise and vibration impacts associated with the Fawkner Park TBM Southern Launch Site and operational impacts.	MM008; MM246	Technical Note 16 confirms that Fawkner Park is no longer proposed as the alternative location of the TBM Southern Launch Site.

29	<p>EPA Victoria raised the following recommendation in regards to Unavoidable Works:</p> <ul style="list-style-type: none"> - a clear rationale is established to ensure works considered to be Unavoidable Works meet the definition as outlined in EPA Publication 1254 - any information associated with the determination of Unavoidable Works is made publicly available. 	MM291	<p>I agree with the recommendations in regards to Unavoidable Works. As per EPR NV1, construction would be managed in accordance with EPA Publication 1254, including guidance relating to Unavoidable Works.</p>
30	<p>EPA Victoria recommends Precinct-specific Noise and Vibration Management Plans to be developed and implemented as part of the CEMP and SEIP to manage potential noise and vibration impacts associated with construction.</p>	MM291	<p>EPR NV1 mandates that a plan(s) is to be developed and implemented to manage construction noise in accordance with the EPA Publication 1254 Noise Control Guidelines.</p> <p>I agree with the recommendation for precinct specific construction noise and vibration management plans.</p>
31	<p>Concern regarding the absence of baseline noise and</p>	MM090; MM095 MM129; MM203	<p>I am satisfied that the baseline noise monitoring presented in the EES is representative of the locations that are likely to be affected by airborne</p>

	vibration monitoring for some sensitive areas ('grey areas') in close proximity to the tunnel alignment, particularly residential areas.	MM217; MM250 MM253; MM299 MM300; MM301 MM350	noise impacts during construction. There are locations in the tunnels precinct that are not represented in the baseline noise and vibration monitoring, but I note that the potential impacts in these areas are the tunnelling process (which is short-term) and ground borne noise and vibration from future train operations. I believe that the EES has adopted operational noise and vibration criteria that are appropriate for quiet residential areas and I note that, in any case, these criteria are not dependant on existing baseline levels.
32	Concern raised in regards to complaints management and resolution during the operational phase of the Project	MM090	As per EPR SC3, a process for registering and managing complaints would be detailed in the community and business involvement plan.
33	Concern raised in regards to the possibility of trigger values associated with ground-borne noise stipulated exceeding current background levels for sensitive areas in close proximity to the tunnel alignment, particularly residential areas.	MM090 MM095	The EES has adopted operational noise and vibration criteria that are appropriate for quiet residential areas and I note that, in any case, these criteria are not dependant on existing baseline levels. The adopted trigger levels for operational ground-borne noise are consistent with international standards and best practice.
34	Concern regarding a failure to consider the "Oran Park, NSW" tunnel development in relation to the following	MM095; MM129 MM203; MM217 MM250; MM253 MM259; MM299	The criteria adopted in the EES for operational rail noise and vibration are appropriate for the types of sensitive receivers affected by future rail operations. Based on the Concept Design, the EES shows that these criteria would be

	<p>issues:</p> <ul style="list-style-type: none"> - Tunnel depth; - Inferior operational noise and vibration standards; - Design approach; and - Operational maintenance (wheel and track) 	MM300; MM301 MM327	<p>met by incorporating mitigation measures (such as resilient track support systems) where necessary. I have reviewed the noise and vibration assessments and I am satisfied that the assessment addresses the proposed tunnel depth and that the proposed mitigation measures are representative of the required treatment.</p> <p>EPR NV15, NV17 and NV18 set specific operational targets for noise and vibration and require the application of all reasonable and feasible mitigation to comply with these targets. These EPRs require compliance during the operational phase of the project and I am therefore satisfied that they are sufficient in mandating appropriate noise and vibration performance during the operational phase of the project.</p>
35	Concern in regards to compensation for impacts and/or damage to properties as a result of construction and operations	MM095; MM112 MM250; MM253 MM287; MM299 MM363	Based on the Concept Design, EES predictions indicate that any operational vibration impacts would be considerably lower than construction vibration impacts and unlikely to result in structural damage to properties.
36	Concern raised by the Arts Centre Melbourne in regards low background noise and vibration levels within halls and theatres spaces and if this has been appropriately considered in operational noise and vibration models and proposed mitigation.	MM321	Although background or baseline monitoring was not undertaken within the Arts Centre Melbourne, I am satisfied that operational targets for ground-borne noise and vibration stipulated in EPRs NV15, NV17 and NV18 have been adopted in accordance with best practice and national standards. For example, the internal ground-borne noise trigger levels for concert halls and drama theatres (25 dB (A) when in use) has been adopted from the NSW EPA Rail Infrastructure Noise Guideline (2013) and is considered appropriate for application to the halls and theatre spaces of the Arts Centre Melbourne.