

MELBOURNE METRO RAIL PROJECT ENVIRONMENT EFFECTS STATEMENT
INQUIRY AND ADVISORY COMMITTEE

MMRA TECHNICAL NOTE

TECHNICAL NOTE NUMBER: 032

DATE: 19 August 2016

PRECINCT: All Precincts

EES/MAP BOOK REFERENCE: EES Chapter 13; Technical Appendix I – Noise and Vibration Impact Assessment (**NVIA**)

SUBJECT: Noise and vibration

Response to Section 7 of the ‘Preliminary Matters and Further Information’ Request.

NOTE:

1. This Technical Note has been prepared with the assistance of AJM and responds to the matters identified in Section 7 of the ‘Preliminary Matters and Further Information’ request made by the IAC on 25 July 2016 (**Request**).
2. For ease of reference, this Technical Note adopts the topic headings set out in the Request and reproduces the relevant ‘references’ and ‘requests’ prior to setting out MMRA’s response.

7.1 Consequence rating criteria

(i) Reference

Technical Appendix I, Noise and Vibration Table 4.3 provides consequence rating criteria and refers noise criteria being exceeded ‘occasionally’ or for ‘extended’ periods.

(ii) Request

The IAC requests clarification on:

27. *what length of time is meant by the terms ‘occasionally’ and ‘extended’.*

Response:

3. The consequence criteria framework adopted for the Project risk assessment defined:
 - a. 'moderate' impacts (as they relate to biophysical/environmental consequences) as "Long term but limited changes to local environmental setting that are able to be managed": (NVIA at Table 4-2);
 - b. 'major' impacts (as they relate to biophysical/environmental consequences) as "Long term, significant changes resulting in risks to human health and/or the environment beyond the local environmental setting": (NVIA at Table 4-2).
4. Consistent with this framework, in the context of noise impacts associated with construction:
 - c. the corresponding 'moderate' level of impact was described as:
 - i. in the case of airborne noise: "construction noise occasionally above applicable project noise criteria at sensitive receptors"; and
 - ii. in the case of ground-borne noise: "ground-borne construction noise occasionally above project guideline targets."
 - d. the corresponding 'major' level of impact was described as:
 - i. in the case of airborne noise: "extended period(s) during which construction noise would be greater than project noise criteria at sensitive receptors"; and
 - ii. in the case of ground-borne noise: "extended period(s) during which ground-borne construction noise would be greater than project guideline targets."
5. An 'occasional' exceedance in the context of the moderate consequence risk rating would relate to a period of up to three hours in aggregate during the evening/night time period [over the course of a week].
6. An 'extended period' in the context of the major consequence risk rating would relate to a continuous period of at least 3 hours per evening/night extending over at least 3 consecutive evening/nights.

7.2 Vibration criteria – human comfort

(i) Reference

Technical Appendix I, Section 3.2.3.4 provides guideline targets for Vibration Dose Values (VDV) for construction vibration with respect to human comfort.

In regards to assessing human response to vibration, British Standard BS5228-2:2009 states that "for construction, it is considered more appropriate to provide guidance in terms of PPV" (peak particle velocity). This is particularly relevant to continuous vibration from sources such as the TBM.

The Environmental Performance Requirements (EPR) for the construction noise and vibration are silent on whether the proposed further noise and vibration investigations (referenced below) will include an assessment of guideline values in relation to human comfort

(ii) Request

The IAC requests clarification on:

- 28. whether proposed further noise and vibration investigations (as referenced below in 7.3) will include an assessment of PPV values in relation to human comfort*
- 29. why the proponent has chosen to use VDV over PPV with respect to human comfort.*

Response:

7. EPR NV9, which nominates vibration dose values (**VDV**) in respect of human comfort, is based on the corresponding values specified in BS6472-1:2008 and in “Assessing Vibration: A Technical Guideline, February 2006, NSW Department of Environment and Conservation”: (see B.3.iii of Appendix B to the NVIA). These guidelines constitute best practice and establish appropriate guideline targets for the purposes of the EPRs.
8. For past projects, including large infrastructure projects, Australian Standard AS2670.2 – 1990: Evaluation of human exposure to whole body vibration has been used to provide satisfactory magnitudes of building vibration with respect to human response. This standard is now withdrawn. SAI Global has advised that it has been replaced with ISO 2631-2:2003: Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 2: Vibration in buildings (1 Hz to 80 Hz). This document does not include magnitudes of vibration for human comfort. In fact it states:

“At present it is not possible to give guidance on acceptable magnitudes of vibration until more information has been collected in accordance with this part of ISO 2631.”
9. As the standard which provided levels for human comfort in PPV has been withdrawn, and the replacement does not include them and goes as far as to say that it is not possible to provide them, a decision was made to rely on the VDV criteria for human comfort, despite it being convenient to refer to the PPVs in AS2670.2 – 1990.
10. Notwithstanding this, MMRA recognises that the V DVs specified in EPR NV9 measure frequency-weighted vibration levels combined with the duration of exposure to provide a vibration dose over a period (daytime or night time), and that there may be practical benefits (in terms of real time monitoring and the capacity to address exceedances in a more timely manner) in converting those measures to comparable PPVs once the contractor has selected a specific construction technique and equipment.

11. Provision is made for this to occur in note 2 to NV9 and would be given effect as part of the noise and vibration construction management plan.

7.3 Further noise and vibration investigations - construction

(i) Reference

Technical Appendix I, Noise and Vibration in Sections 7.7, 8.7, 9.7, 10.7, 11.7, 12.7, 13.7, 14.7 and 15.6 provides the following Environmental Performance Requirements for construction noise and vibration impact:

Appoint an acoustic and vibration consultant to predict construction noise and vibration (through modelling) and update the modelling to reflect current construction methodology, site conditions and specific noise and vibration levels (this would require noise and vibration measurements). The model would be used to determine appropriate mitigation to achieve the Environmental Performance requirements.

The acoustic and vibration consultant would also be required to undertake noise and vibration monitoring to assess levels with respect to Guideline Targets specified in the Environmental Performance Requirements. Where monitoring indicates exceedences of Guidelines targets, apply appropriate management measures as soon as possible.

(ii) Request

The IAC requests clarification on:

30. *whether a detailed scope with indicative time line has been developed for the additional measurements, predictions, modelling and monitoring programme described above.*

Response:

12. At this stage, no detailed scope has been prepared. This will be developed by the relevant contractor once appointed and approved by MMRA, to satisfy EPR NV3.
13. In their tender submissions for the project, potential contractors would provide an outline of their approach and program to developing the noise and vibration model, and their program for monitoring.

7.4 Operational vibration and ground borne noise

(i) Reference

Technical Appendix I, Noise and Vibration in Section 4.8.2 at p55 states that the modelling methodology provided in FTA 2006 (Federal Transit Administration) has been used to predict vibration and ground borne noise levels from the operation of trains. This method is based on "site-specific tests of vibration propagation".

In addition, Technical Appendix I, Noise and Vibration in Sections 7.7, 8.7, 9.7, 10.7, 11.7, 12.7, 13.7, 14.7 and 15.6 provides the following Environmental Performance requirements for operational noise and vibration impact:

Appoint an acoustic and vibration consultant to predict noise and vibration and determine appropriate mitigation to achieve the Environmental Performance Requirements. The acoustic and vibration consultant would also be required to undertake commissioning noise and vibration measurements to assess levels with respect to the Environmental Performance Requirements.

(ii) Request

The IAC requests clarification on:

- 31. whether a program and methodology for on-site testing can be developed in a timely fashion*
- 32. what contingency measures are available if performance requirements are not met.*

Response:

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14. The FTA method incorporates the flexibility to utilise either generic or site-specific, empirical vibration propagation functions, with generic modelling functions typically used at the planning stage and more sophisticated modelling using site-specific test data being appropriate at the detailed design stage.
15. MMRA is confident that a program and methodology for on-site testing can be developed in a timely fashion.
16. Contractors would provide an overview of their approach, program and methodology in the tenders submitted for the project.
17. MMRA has undertaken preliminary work on a program of site-specific tests of vibration propagation parameters which will be made available to the relevant contractor upon completion. This may be supplemented by further targeted testing to be carried out by the relevant contractor in a timely fashion should they wish to expand on the available data set.

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18. The modelling that has been undertaken for operational vibration has used conservative assumptions, and there is significant 'tunability' in the trackforms that have been selected. Consequently, it is expected that the EPRs will be achievable.
19. The contractor has the opportunity to conduct additional vibration propagation tests (once the tunnel is constructed, but prior to installation of vibration isolating tracks) as well as the opportunity to update rail

vehicle source vibration levels based on future tests as a partial verification of model accuracy, and to determine whether any track design changes are required prior to installing the vibration isolating trackforms.

20. Once tracks are installed, it may be possible to reduce noise through a more stringent maintenance regime, which may include management of wheel/rail interface through appropriate wheel grinding and lubrication activities.

7.5 Vibration sensitive equipment, bio resources and highly sensitive areas

(i) Reference

In Appendix B of Technical Appendix I, Noise and Vibration, the following tables provide predicted vibration and ground-borne noise levels:

33. Table B14: Vibration predictions for vibration-sensitive equipment due to construction activities (pages 105-107)

34. Table B15: Vibration and ground-borne noise predictions for biological resources due to construction activities (page 108)

35. Table B16: Vibration and ground-borne noise predictions for highly sensitive areas due to construction activities (page 109)

36. Table B18: Vibration predictions for vibration sensitive equipment due to construction activities.

The tables indicate where the target levels are exceeded and Technical Appendix I gives an approximate overall duration of the exceedences.

(ii) Request

The IAC requests:

- 37. the approximate duration of each listed exceedence.*

Response:

21. The approximate duration of each predicted exceedance has been determined for the calculated responses from the EES for vibration sensitive equipment, biological resources and highly sensitive areas and is shown in amended versions of tables B14, B15, B16, B18 (see **Attachment A**).
22. On review, an additional exceedance was identified at the Robotics laboratory in RMIT building 100 Basement 2. In the EES, it was inadvertently shown as complying with a 100um/s limit. Table B.18 in Attachment A has been amended to reflect a predicted vibration level of 174um/s, with a corresponding duration of exceedance.
23. The assessment approach is intended to be conservative, so it is anticipated that the exceedance durations will be less than calculated. This is

particularly the case where VC-Curves are used, which are in many cases more conservative than equipment supplier vibration criteria. Equipment supplier vibration criteria information is currently being sought from equipment owners, and refined calculations performed as part of the ongoing stakeholder engagement process.

7.6 Façade treatment

(i) Reference

Technical Appendix I, Noise and Vibration on pages xii, 63, 68, 132 and 133 mentions that improving glazing at a number of affected receivers could be used as a possible mitigation measure for both construction and operation noise.

(ii) Request

The IAC requests clarification on:

38. whether any detailed investigations have taken place to determine if such treatment is feasible in the buildings identified for this treatment option.

Response:

24. Whilst detailed investigations have not taken place at this stage, improved glazing is a typical treatment used to reduce airborne noise impacts at affected receivers. This investigation would need to be undertaken by the relevant contractor once appointed on a case by case basis.

CORRESPONDENCE:

No correspondence.

ATTACHMENTS:

A. Tables showing the duration of exceedances for vibration and ground-borne noise guideline targets for vibration sensitive equipment, biological resources and highly sensitive areas.