



# Noise and Vibration Management Plan

Sydney Metro City & Southwest

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PDCS Reference

1.	Introduction .....	4
1.1.	Purpose .....	4
1.2.	Scope .....	4
1.3.	Role of Acoustic Integrator during design stage .....	5
1.4.	The OTS PPP & OTS2.....	5
1.5.	Consultation .....	5
2.	Background .....	6
2.1.	ONVMP requirements .....	6
2.1.1.	CSSI 7400 Consolidated Conditions of Approval .....	6
2.1.2.	OTS2 Project Deed compliance table .....	6
2.1.3.	Revised Environmental Mitigation Measures .....	9
2.1.4.	Track attenuation and operational ground-borne noise review .....	13
2.1.5.	Sydney Metro Environment Protection License.....	13
2.2.	Noise sensitive receivers.....	13
2.3.	Operational noise and vibration criteria.....	14
2.3.1.	Airborne noise from train operations .....	14
2.3.2.	Ground-borne noise from train operations .....	15
2.3.3.	Ground-borne vibration from train operations .....	16
2.3.4.	Airborne noise from fixed facilities .....	18
2.3.5.	Structure-borne noise and vibration from fixed facilities.....	22
2.3.6.	Noise via draught relief shafts .....	22
2.4.	Ground-borne noise and vibration monitoring after the commencement of operations .....	22
2.5.	Ongoing noise and vibration compliance monitoring .....	23
3.	Complaints management system .....	23
4.	Conclusion .....	24
	<b>Appendix A. Document control.....</b>	<b>26</b>
	Appendix A1. Document information .....	26
	Appendix A2. Approval record .....	26
	Appendix A3. Consultancy record .....	26
	Appendix A4. Amendment record.....	27
	<b>Appendix B. List of acronyms .....</b>	<b>29</b>
	<b>Appendix C. Related documents .....</b>	<b>32</b>
	<b>Appendix D Public address system noise .....</b>	<b>34</b>
	<b>Appendix E Glossary of terminology.....</b>	<b>37</b>
	<b>Appendix F. Sydney Metro CSW Acoustics Advisor Endorsement of ONVMP .....</b>	<b>40</b>
	<b>Appendix G: Noise and Vibration Monitoring Procedure.....</b>	<b>42</b>

# Table of Contents

## List of Tables

Table 1 OTS2 Section 3.20 (d) summary.....	7
Table 2 Summary of REMMs as per the SPIR .....	10
Table 3 Summary of noise sensitive receiver types (external to the project).....	14
Table 4 Airborne heavy rail noise trigger levels for residential land uses .....	14
Table 5 Airborne heavy rail noise trigger levels for sensitive land uses other than residential .....	15
Table 6 Ground-borne noise trigger levels for heavy rail project.....	15
Table 7 Sydney Metro ground-borne noise trigger levels .....	16
Table 8 Acceptable vibration dose values for intermittent vibration.....	17
Table 9 Sydney Metro ground-borne vibration goals .....	17
Table 10 Applicable LAeq noise criteria.....	18
Table 11 Noise via draught relief shafts.....	22
Table 12 Community response process .....	23
Table 13 List of acronyms .....	29
Table 14 Related documents.....	32
Table 15 PAS coverage areas and announcement types.....	35
Table 16 Glossary .....	37

## List of Figures

No table of figures entries found.

# 1. Introduction

## 1.1. Purpose

Renzo Tonin & Associates was engaged by Metro Trains Sydney (MTS) to prepare an Operational Noise and Vibration Management Plan (ONVMP) for the Sydney Metro City & South West (SMCSW) project.

The Project involves the operation of a metro rail line and associated stations between Chatswood Station and just north of Sydenham Station. The Project passes through the local government areas (LGAs) of Willoughby, North Sydney, Sydney and Marrickville. Key operational components of the Project include:

- About 15.5 kilometres of twin rail tunnels (two tunnels located side-by-side) between Mowbray Road, Chatswood and Bedwin Road, Marrickville. The tunnel corridor extends about 30 metres either side of each tunnel centre line and around all stations.
- About 250 metres of above ground metro tracks between Chatswood Station and the northern dive structure.
- A northern dive structure (about 400 metres in length) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood.
- A southern dive structure (about 400 metres in length) and tunnel portal north of Sydenham Station and south of Bedwin Road, Marrickville.
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street (Gadigal) and Waterloo, as well as underground platforms at Central Station and above ground platforms at Sydenham Station.
- Underground pedestrian links and connections to other modes of transport (such as the suburban rail network) and surrounding land uses.
- Services within each of the stations, including mechanical and fresh air ventilation equipment and electrical power substations.
- A permanent power supply from Surry Hills to Gadigal Station.
- A substation (for traction power supply at Artarmon).
- A services facility (for traction power supply and an operational water treatment plant) adjacent to the southern dive structure.

The purpose of this ONVMP is to summarise the noise and vibration criteria for the project, outline the complaint and response process for the project, detail the monitoring and reporting processes that will take place for the project, and how ongoing compliance with the operational noise and vibration criteria will be monitored and assessed.

## 1.2. Scope

This ONVMP applies to all facilities and infrastructure encompassed within the C2S section of the SMCSW project. The ONVMP is required to address the requirements in the SMCSW C2S Conditions of Approval (CoA), the SMCSW OTS2 Project Deed, and other operational noise and vibration design criteria established by Sydney Metro and contained within various Scope of Works and Technical Criteria (SWTC) documents.

The SMCSW project included a large number of contracts. Some of the key contracts and responsibilities are summarised below:

- **TSE (Tunnel and Station Excavation)** – This contract was responsible for building the twin railway tunnels from Chatswood to Sydenham and excavating six new stations, the tunnel dives, etc.
- **Sydenham Upgrade & Southwest Metro Corridor** – This contract was responsible for upgrading Sydenham Station and the existing railway infrastructure between Sydenham and Bankstown to metro rail standards.
- **Northern Corridor Works** – This contract was responsible for delivering work on the T1 North Shore Line to prepare for the start of Sydney Metro services, including the realignment of the existing tracks near the northern dive and the construction of additional noise barriers.
- **Central Station Main Works** – This contract was responsible for delivering the new Sydney Metro platforms under Central Station as well as the new Central Walk underground pedestrian concourse.
- **Linewide Works (LWW)** – This contract was responsible for converting the empty rail tunnels into a working railway, including the railway track, overhead wiring, and other infrastructure works. The contract was

responsible for building the new Sydney Metro Trains Facility South at Marrickville and the new electrical substations along the SSC corridor.

- **Station Contracts** – A range of station contracts were awarded to various contractors. These contracts were responsible for the construction and fit-out of each station and related facilities. Some of these contracts included the construction of new commercial buildings above the stations.
- **Operations Trains and Systems 2 (OTS2)** – This contract is responsible for delivering the core rail systems for SMCSW, integrating the new line with the Sydney Metro Northwest line, and providing the operations and maintenance for the 66 km Sydney Metro network from Tallawong to Bankstown.

### 1.3. Role of Acoustic Integrator during design stage

To assist Sydney Metro in achieving the operational noise and vibration criteria for the project, an Acoustic Integrator was appointed. The role of the Acoustic Integrator was to prepare a strategy to ensure the successful coordination and integration of acoustic design between all contracts. An Acoustic Design Integration Strategy (ADIS) was developed which outlined the roles and responsibilities of each contract. The ADIS established noise and vibration budgets for each contractor, related to their design scope. The noise and vibration budgets for each contract were set below the overall project noise and vibration requirements to ensure that the overall levels from each contract combined achieves the overall project requirements.

Within this ONVMP, the operational noise and vibration criteria are based on the overall levels for the project. These have been derived from the applicable noise and vibration guidelines, the overall noise and vibration criteria summarised in the ADIS, and relevant detailed design documents for fixed facilities and stations.

### 1.4. The OTS PPP & OTS2

Sydney Metro (the Principal) engaged NRT Pty Ltd (OpCo) and NRT CSW Pty Ltd (OpCo2) to deliver the Sydney Metro Northwest (SMNW) and Sydney Metro City and Southwest (SMCSW) Public Private Partnership (PPP) contracts, respectively.

These two PPP contracts were awarded by government effectively as ‘packages’, each comprising three separate main entities, OpCo or OpCo2 plus two Core Contractors, each including three distinct roles:

- SMNW PPP (OTS), comprising OpCo (finance), the D&C Contractor (delivery) and the O&M Contractor (‘MTS’) (operations & maintenance);
- SMCSW PPP (OTS2): OpCo2 (finance), the Integrator (delivery) and MTS (operations & maintenance).

The delivery and the operations & maintenance obligations are ‘passed down’ virtually in their entirety to the relevant Core Contractor (e.g. to MTS, under the OTS and OTS2 O&M Contracts). SPR obligations of OpCo / OpCo2 are Core Contractor obligations. Accordingly, operation and maintenance obligations of OpCo and OpCo2 for OTS and OTS2 are obligations of MTS.

OTS and OTS2 are currently two separate and distinct PPP contracts in different phases. They effectively ‘merge’ together at the Incorporation Date (completion of OTS2 Phase 1, City section) from an operations & maintenance perspective and become a single operating railway under a single PPP contract (i.e. OTS2), with MTS responsible for all operations and maintenance obligations.

### 1.5. Consultation

In accordance with CoA D3 (d) of the Project’s Development Consent, the NVMP must be prepared in consultation with relevant government agencies and stakeholders. The status of consultation with these parties and a summary of key issues raised is presented in Table 1 below.

Agency/ stakeholder	Key issues raised	MTS update	Date Closed
DPHI	Further clarification is required in relation to complaints management. The document refers to conditions B6 and following by that framework for complaints management only applies for the duration of works and for a minimum for 12 months following completion of construction of the CSSI. Please clarify if this framework will be extended for the life of the infrastructure or if the complaints management approach will change after the 12-month period lapses.	The conditions B6 – B14 refers to construction phase complaints management and not operations. Therefore, any information related to B6 – B14 has been removed, and the MTS complaints management process has remained as this is the true operational complaints management process MTS will use moving forward.	Open – Sent to DPHI for review

## 2. Background

### 2.1. ONVMP requirements

#### 2.1.1. CSSI 7400 Consolidated Conditions of Approval

CSSI 7400 CoA D13 and D14 relate to operational noise and vibration, and state that an Operational Noise and Vibration Monitoring Program must be prepared to confirm that operational noise and vibration levels meet applicable requirements, and the procedure required when those requirements are not met.

This monitoring program will be undertaken by MTS to confirm compliance with the operational noise and vibration predictions. At the time of submission of version 3 of this NVMP, the Operational Noise and Vibration Monitoring Program is currently in development. If the monitoring program identifies that any additional mitigation or management measures are necessary to achieve or demonstrate ongoing compliance with the operational noise and vibration objectives, then these will be included in an update to this ONVMP.

CSSI 7400 CoA D13 is copied verbatim below:

*The Proponent must prepare an **Operational Noise and Vibration Monitoring Program** to confirm that the operational noise and vibration levels meet the CSSI proposed design objectives as determined in the **Track Attenuation and Operational Ground-borne Noise Review** in Condition D9 following the commencement of operations.*

CSSI 7400 CoA D14 is copied verbatim below:

*Should the operational noise and vibration levels exceed the CSSI design objectives, the Proponent is to prepare a report, outlining actions that will be taken so that the CSSI meets the design objectives in the future. The report is to be prepared within three (3) months following the identification of the exceedance and be forwarded to the Secretary for information. All recommendations in the report must be implemented within three (3) months of the date of the report or as agreed with the Secretary.*

#### 2.1.2. OTS2 Project Deed compliance table

The OTS2 Project Deed (OTS2), Section 3.20 requires the development of an Operations Phase Environmental and Sustainability Plan, part of which is a Noise and Vibration Management Plan. Section 3.20 (d) of the Deed states the requirements of the Noise and Vibration Management Plan. Table 1 below addresses each of the points in Section 3.20 (d) of the OTS2 Deed.



Table 1 OTS2 Section 3.20 (d) summary

OTS2 Project Deed Section 3.20 (d)	Fulfilment of requirement
(i) Include an outline of the Operational Noise and Vibration Review required by the Environmental Documents.	The Environmental Documents do not include specific requirements to prepare an Operational Noise and Vibration Review for the C2S section. In lieu of this, the NSW Department of Planning & Environment appointed a ground-borne noise specialist to review the project design pursuant to CSSI 7400 CoA D9. This is outlined in Section 2.1.4 to fulfil this requirement.
(ii) Include the strategy for complying with the noise and vibration specifications relating to Train operations on surface and tunnel track, including the track design, Rolling Stock design, the proposed maintenance strategies and other mitigation measures such as acoustic panels, rail dampers and noise barriers.	Sydney Metro's Acoustic Integrator was responsible for preparing an Acoustic Design Integration Strategy (ADIS) for the project and assuring compliance with the overall noise and vibration design objectives. Individual contractors prepared their own Acoustic Design Integration Plans (ADIPs) that demonstrated how compliance with the ADIS-assigned noise and vibration budgets would be achieved.
(iii) Describe where the proposed Rolling Stock has been used on other rapid transit systems, noise measurement reports must be provided which quantify the wayside noise levels and in-car noise levels (for tunnel and surface track). The measurement reports must fully describe the measurement locations, Train speeds, tunnel / track design, rail condition and other factors influencing the measurement results.	The proposed rolling stock for SMCSW currently operates on the Sydney Metro Northwest network, since May 2019. Noise measurement reports were prepared as part of the Sydney Metro Northwest approval which quantify the noise levels from train operations on surface track and within the tunnels.
(iv) Describe the strategy for complying with the noise specifications relating to industrial noise emissions from the stabling and maintenance facility, stations, services facilities and other fixed facilities.	The ADIS details the strategy for complying with the noise specifications relating to industrial noise emissions from the stabling and maintenance facility, stations, services facilities and other fixed facilities. Individual contractors prepared their own Acoustic Design Integration Plans (ADIPs) that demonstrated how compliance with the ADIS-assigned noise and vibration budgets would be achieved.
(v) Describe the proposed Rolling Stock measures, physical mitigation measures and operational measures that are likely to be required to reduce the potential impacts for the Sydney Metro Trains Facility and Sydney Metro Trains Facility (South).	<p>The proposed rolling stock that will utilise the SMTF and SMTF-S is consistent with the rolling stock currently utilised on the Sydney Metro Northwest network. No additional noise mitigation measures are required for the SMTF at Tallawong. For SMTF-S, fixed facilities have been designed with appropriate noise controls to comply with the operational noise limits at all nearby sensitive receivers. Operational procedures to minimise noise impacts from train stabling and, maintenance activities include:</p> <ol style="list-style-type: none"> <li>1. Heavy cleaning of trains on Road 7 or 8 will be limited to one train at a time.</li> <li>2. No more than 10 trains will be started-up simultaneously during the 10pm to 5am night-time period.</li> <li>3. No more than 8 trains will be started-up simultaneously during the 5am to 7 am shoulder period.</li> <li>4. Whilst stabled in the yard, pantographs will be lowered and trains powered down, except during presentation services or for cleaning or light maintenance works.</li> </ol>

OTS2 Project Deed Section 3.20 (d)		Fulfilment of requirement
		<p>5. The maintenance workshop will accept deliveries only between 7am and 10pm.</p> <p>6. The maintenance workshop will be used only between 7am and 6pm.</p>
(vi)	Describe how the proposed public announcement emergency warning intercommunication system design will comply with the environmental noise specifications (NSW Industrial Noise Policy and NSW EPA Sleep Disturbance Screening Criterion) for stations and rail facilities.	<p>The ADIS states that the public address (PA) system in the stations is not set, and consequently requires integration of the PA system design, the station acoustic performance (in terms of reverberation time) and noise levels within areas where the PA system is required to operate.</p> <p>Renzo Tonin &amp; Associates prepared an ONVR for CSSI-5414 Sydney Metro Northwest<sup>3</sup>, which detailed recommendations for PA system noise. This is directly extracted in Appendix D.</p>
(vii)	Describe how the internal noise level criteria, reverberation times and public announcement emergency warning intercommunication system criteria are likely to be achieved. Details of the proposed noise modelling algorithms must be provided for Stations and Station Precincts.	<p>The ADIS details the strategy for complying with the internal noise criteria, reverberation times and public announcement system requirements. Individual contractors prepared their own Acoustic Design Integration Plans (ADIPs) that demonstrated how compliance with the ADIS-assigned noise and vibration budgets and requirements would be achieved.</p>
SPR Appendix 44		
2.3 (f)	During Operations Activities, OpCo2 must ensure that there are no audible rattles, buzzes, hums, whines, whistles or squeals. These must be subjectively determined with the human ear and if detected, the source of the objectionable noise must be located and rectified.	<p>These Noise and Vibration elements are included in the Weekly Environmental Checklist located in the Intelex Mobile App for station staff to complete. If any audible rattles, buzzes, hums, whines, whistles or squeals are heard/found, they will notify their supervisor and report it into Intelex and the associated actions will be followed up.</p>



### 2.1.3. Revised Environmental Mitigation Measures

CSSI 7400 CoA A2 states, in part, that the project must be carried out in accordance with the Submissions and Preferred Infrastructure Report<sup>4</sup> (SPIR), part of which details the Revised Environmental Mitigation Measures (REMMs) and Revised Environmental Performance Outcomes (REPOs). These are extracted from the Environmental Impact Statement (EIS) for the project. The REMMs and REPOs as per the SPIR are outlined below in Table 2.

Table 2 Summary of REMMs as per the SPIR

Reference	Condition	Applicable sites	Notes
<b>REMM OPNV1</b>	The height and extent of noise barriers adjacent to the northern surface track works would be confirmed during detailed design with the aim of not exceeding trigger levels from the Rail Infrastructure Noise Guidelines (Environment Protection Authority, 2013). At property treatments would be offered where there are residual exceedances of the trigger levels.	Surface track works	<p>Noise barriers have been designed and constructed adjacent to the northern surface track works as part of the detailed design.</p> <p>The responsible organisation will implement the at property treatments where there are residual exceedances of the trigger levels. If required, MTS will work with the responsible organisation to ensure completion of the implementation to the affected parties.</p>
<b>REMM OPNV2</b>	Track form would be confirmed during the detailed design process in order to meet the relevant ground-borne noise and vibration criteria from the Rail Infrastructure Noise Guidelines (EPA, 2013) and the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECC, 2007a).	Metro rail tunnels	The track form for the tunnels has been designed to achieve the requirements in REMM OPNV2. Further details are provided in Section 2.1.4.
<b>REMM OPNV3</b>	Stations and ancillary facilities including train breakout noise from draught relief shafts would be designed to meet the applicable noise criteria derived from the Industrial Noise Policy (EPA, 2000).	All except metro rail tunnels	The ADIS details the strategy for complying with the applicable noise criteria for stations, ancillary facilities and draught relief shafts. Individual contractors prepared their own Acoustic Design Integration Plans (ADIPs) that demonstrated how compliance with the ADIS-assigned noise and vibration budgets and requirements would be achieved.
<b>REMM OPNV4</b>	<p>Procedural mitigation measures would be implemented to minimise noise emissions from the Sydney Metro Trains Facility South with the aim of meeting the relevant criteria derived from the Industrial Noise Policy (Environment Protection Authority, 2000). This would consider measures such as:</p> <p>Minimising the number of trains being cleaned simultaneously</p> <p>Cleaning trains without air conditioning systems in use</p>	SMTF-S	<p>For SMTF-S, fixed facilities have been designed with appropriate noise controls to comply with the operational noise limits at all nearby sensitive receivers. Operational procedures to minimise noise impacts from train stabling and maintenance activities include:</p> <ol style="list-style-type: none"> <li>1. Heavy cleaning of trains on Road 7 or 8 will be limited to one train at a time.</li> <li>2. No more than 10 trains will be started-up</li> </ol>

Reference	Condition	Applicable sites	Notes
	<p>Limit cleaning and start-up operations during the night-time and early morning periods to the trains stabled furthest from the most affected residences.</p> <p>In the event that procedural measures are not sufficient to achieve compliance with the criteria derived from the Industrial Noise Policy, at-property treatments would be offered to affected receivers.</p>		<p>simultaneously during the 10pm to 5am night-time period.</p> <p>3. No more than 8 trains will be started-up simultaneously during the 5am to 7 am shoulder period.</p> <p>4. Whilst stabled in the yard, pantographs will be lowered and trains powered down, except during presentation services or for cleaning or light maintenance works.</p> <p>5. The maintenance workshop will accept deliveries only between 7am and 10pm.</p> <p>6. The maintenance workshop will be used only between 7am and 6pm.</p>
REMM OPNV5	<p>Further detailed investigations would be undertaken of the phased operations once the detail of these changes are determined. This investigation would include determination of the likely change in noise levels at receivers and consideration of the need for any feasible and reasonable mitigation measures taking into consideration the likely duration of the phased operations.</p>	Surface Trackwork (Southwest)	<p>This REMM concerns the SSC stage of the project. Additional assessment will be undertaken once the detail of the SSC operations are confirmed.</p>
REPO OPERATIONAL NOISE AND VIBRATION	<p><b>Noise and vibration – amenity</b></p> <p>Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and well-being of the community. – Noise levels would comply with the Rail Infrastructure Noise Guidelines (Environment Protection Authority, 2013).</p> <p><b>Noise and vibration – structural</b></p> <p>Increases in noise emissions and vibration affecting environmental heritage as defined in the Heritage Act 1977 during operation of the project are effectively managed. – The project would avoid any damage to buildings from vibration.</p>	Sensitive Receivers	<p>The ADIS details the strategy for complying with the applicable noise and vibration criteria. Individual contractors prepared their own Acoustic Design Integration Plans (ADIPs) that demonstrated how compliance with the ADIS-assigned noise and vibration budgets and requirements would be achieved.</p>



## 2.1.4. Track attenuation and operational ground-borne noise review

CSSI 7400 CoA D9 concerns operational ground-borne noise, and it is copied verbatim below:

*The Proponent must nominate, for the Secretary's approval, a ground-borne noise specialist who is independent of the design and construction personnel, to review:*

- a. *the appropriateness of the proposed design (noise) objectives for ground-borne noise sensitive receivers; and*
- b. *predictions for operational ground-borne noise impacts, before the installation of track, in order to confirm the appropriate track attenuation required to meet the design (noise) objectives identified in a).*

*The ground borne noise specialist must be submitted for the Secretary's approval before the review commences and the review must be submitted to the Secretary at least one month before the installation of track.*

Pursuant to CSSI 7400 CoA D9, a ground-borne noise specialist independent of the design and construction personnel has reviewed the project design with respect to ground-borne noise at sensitive receivers and track attenuation. This review was submitted for the Planning Secretary's approval in two parts, on 24 December 2020 and 22 June 2021.

These reviews considered if the criteria in the Secretary's Environmental Assessment Requirements (SEARs) have been adopted correctly, verifying that the criteria are appropriate by comparing them against overseas guidelines where applicable, and ensuring that the specific requirements of particularly sensitive receivers have been addressed.

The reviews concluded that the proposed design objectives were appropriate for the majority of receivers. More stringent criteria were recommended at three locations. The recommended criteria are summarised in Sections 2.3.2 and 2.3.3.

## 2.1.5. Sydney Metro Environment Protection License

The existing Sydney Metro operations between Tallawong and Chatswood are regulated by the NSW Environment Protection Authority (EPA), in accordance with EPA License 21247.

When operations commence on SMCSW, it is expected that EPA License 21247 will be updated to incorporate the section of new track between Chatswood and Sydenham. EPA License 21247 includes noise and vibration requirements relating to following:

- Noise and vibration associated with railway operations, including airborne noise, ground-borne noise and tactile vibration levels.
- Requirements relating to track maintenance to minimise noise impacts on sensitive receivers.
- Minimise noise impacts on sensitive receivers from horn usage.
- Minimise noise impacts from railway maintenance and construction activities.
- Maintain a register of noise and vibration complaints.
- Prepare a Compliance Assessment Monitoring Plan (CAMP) that demonstrates practical compliance with the applicable operational noise and vibration objectives.

It is assumed that the above requirements will be applicable to SMCSW.

## 2.2. Noise sensitive receivers

The SMCSW system interacts with a large number of sensitive receivers along the route. The ONVMP is only concerned with receivers external to the project. Acceptable levels of noise and vibration for each receiver come from a range of sources, including the Rail Infrastructure Noise Guideline (RING), the Industrial Noise Policy (INP) and Assessing Vibration – a technical guideline. The noise sensitive receiver types relevant to this ONVMP are summarised in Table 3.

Table 3 Summary of noise sensitive receiver types (external to the project)

Receiver Category	Definition	Sensitivity	Location
<b>External</b>	Any sensitive space within a building affected by SMCSW.	ABN GBNV SBNV	System wide
<b>ISD/OSD</b>	Developments within or directly over the top of stations. May be residential or commercial. Still considered external to the project.	ABN GBNV SBNV	Sydney Metro Stations
<b>Public</b>	Any public area outside the bounds of SMCSW.	ABN	Public areas outside the bounds of SMCSW

Key: ABN = Airborne Noise; GBNV = Ground-borne noise and vibration; SBNV = Structure-borne noise and vibration

## 2.3. Operational noise and vibration criteria

The project is required to meet a number of operational noise and vibration criteria. These are outlined in the following subsections.

### 2.3.1. Airborne noise from train operations

Airborne noise from rail operations has the potential to affect noise sensitive receivers when the rail line is outside a tunnel. For electric passenger trains, most noise is generated by the interaction of the train wheels with the track and this noise travels through the air into the surrounding area, creating the potential for airborne noise impacts on the community.

The Rail Infrastructure Noise Guideline (RING) (NSW EPA 2013) contains the applicable noise trigger levels for heavy rail projects, including SMCSW. All above-ground sections of the SMCSW project are located within existing railway corridors (Chatswood, Marrickville, and SSC). Therefore, the above-ground sections of rail constitute redevelopment of existing railway lines. As such, the applicable airborne noise trigger levels for residential and non-residential land uses are shown in Table 4 and Table 5 respectively.

Table 4 Airborne heavy rail noise trigger levels for residential land uses

Type of development	Noise trigger Levels dB(A) (External)	
	Day (7am-10pm)	Night (10pm-7am)
Redevelopment of existing rail line	Development increases existing $L_{Aeq(9h)}$ rail noise levels by 2 dB or more, or existing $L_{Amax}$ rail noise levels by 3 dB or more and predicted rail noise levels exceed:	
	65 $L_{Aeq(15h)}$ or 85 $L_{AFmax}$	60 $L_{Aeq(9h)}$ or 85 $L_{AFmax}$
Note: $L_{AFmax}$ refers to the maximum noise level not exceeded for 95% of rail pass by events and is measured on the 'fast' response setting on a sound level meter.		

Table 5 Airborne heavy rail noise trigger levels for sensitive land uses other than residential

Other sensitive land uses	Noise trigger Levels dB(A) (when in use)
	Redevelopment of existing rail line.
	Development increases existing rail noise levels by 2 dB(A) or more in $L_{Aeq}$ for that period and resulting noise levels exceed:
Schools, educational institutions and childcare centres	45 $L_{Aeq(1h)}$ internal
Places of worship	45 $L_{Aeq(1h)}$ internal
Hospital wards	40 $L_{Aeq(1h)}$ internal
Hospitals other uses	65 $L_{Aeq(1h)}$ internal
Open space – passive use	65 $L_{Aeq(15h)}$ external
Open space – active use	65 $L_{Aeq(15h)}$ external

## 2.3.2. Ground-borne noise from train operations

Ground-borne noise commences as vibration energy due to the wheel and rail interaction. The vibration energy travels through the ground, which transfers into the building walls and floors and re-radiates as low frequency noise which can be heard by occupants. Ground-borne noise has the potential to be evident where railway tracks are underground or in deep cuttings, where the air-borne noise path is not present or negligible. Table 6 below shows the applicable ground-borne noise trigger levels applicable to heavy rail projects.

Table 6 Ground-borne noise trigger levels for heavy rail project

Sensitive land use	Time of day	Internal noise trigger Levels dB(A)
		Development increases existing rail noise levels by 3 dB(A) or more, and resulting rail noise levels exceed:
Residential	Day (7am – 10pm)	40 $L_{ASmax}$
	Night (10pm – 7am)	35 $L_{ASmax}$
Schools, educational institutions, places of worship	When in use	40-45 $L_{ASmax}$

Note:  $L_{ASmax}$  refers to the maximum noise level not exceeded for 95% of rail pass by events and is measured on the 'slow' response setting on a sound level meter.

In addition, Sydney Metro established additional design requirements in the SWTC for other sensitive receiver areas, which are shown in Table 7.



Table 7 Sydney Metro ground-borne noise trigger levels

Location	Requirement
General office areas	$L_{Amax (slow)}$ 45dB(A) (when in use)
Private offices and conference rooms	$L_{Amax (slow)}$ 40dB(A) (when in use)
Retail areas	$L_{Amax (slow)}$ 50dB(A) (when in use)
Cinemas	$L_{Amax (slow)}$ 35dB(A) (when in use)
Public halls	$L_{Amax (slow)}$ 35dB(A) (when in use)
Lecture theatres	$L_{Amax (slow)}$ 35dB(A) (when in use)
Film/TV/sound recording studios	NR15 (refer AS/NZS2107:2000)
Medical institutions	$L_{Amax (slow)}$ 40dB(A) (when in use)
Drama theatres	NR 25 (refer AS/NZS2107:2000)
Other critical spaces	Satisfactory levels in AS/NZS2107:2000
The Great Synagogue, 166 Castlereagh Street, Sydney	$L_{Amax (slow)}$ 35dB(A) (when in use) <sup>1</sup>
City Recital Hall at Angel Place, near Martin Place, Sydney	NR 15 (refer AS/NZS2107:2000) <sup>1</sup>
Note 1: For these locations, the recommended criteria are based on the recommendations in the track attenuation and operational ground-borne noise review (refer Section 2.1.4).	

### 2.3.3. Ground-borne vibration from train operations

Ground-borne vibration commences as vibration energy due to the wheel and rail interaction. The vibration energy travels through the ground, which transfers into the building walls and floors and may be felt as tactile vibration by building occupants. The C2S section of the project includes 15 km of underground tunnels between Chatswood and Marrickville.

Assessing Vibration: a technical guideline (AVTG) (DEC 2006) presents preferred and maximum vibration values for different receiver types. For railway operations, the preferred intermittent vibration dose values (VDVs) are applicable. These are shown in Table 8.

Table 8 Acceptable vibration dose values for intermittent vibration

Location	Vibration dose value (m/s <sup>1.75</sup> )	
	Preferred value	
	Day-time (7am-10pm)	Night-time (10pm-7am)
Critical areas <sup>1</sup>	0.1	0.1
Residences	0.2	0.13
Offices, schools, educational institutions and places of worship	0.4	0.4
Workshops	0.8	0.8

Note 1: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

For railway operations, Sydney Metro has specified more stringent requirements in the SWTC than the VDV criteria in the above table. The Sydney Metro ground-borne vibration goals are shown in Table 9 and are consistent with the preferred continuous vibration criteria in AVTG.

Table 9 Sydney Metro ground-borne vibration goals

Location	Requirement
Residential (Day)	106 dBV (0.2 mm/s)
Residential (Night)	103 dBV (0.14 mm/s)
Commercial	112 dBV (0.4 mm/s)
Educational	112 dBV (0.4 mm/s)
Place of worship	112 dBV (0.4 mm/s)
Industrial	118 dBV (0.8 mm/s)
Theatres	106 dBV (0.2 mm/s)
Other critical spaces	Generic Vibration Criterion curves in Institute of Environmental Sciences and Technology industry Standard IEST-RP-CC012.1.Considerations in Clean Room Design (2007)
Crows Nest Day Surgery, Clarke Street, Crows Nest	100 dBV (0.1 mm/s) <sup>1</sup>

Note 1: For this location, the recommended criterion is based on the recommendations in the track attenuation and operational ground-borne noise review (refer Section 2.1.4).

## 2.3.4. Airborne noise from fixed facilities

Airborne noise is often generated by items of plant and equipment at fixed facilities such as stations, buildings or electrical substations. Noise levels travel between the source and receiver via an airborne noise path and may be heard at nearby sensitive receivers.

The standard governing the assessment of airborne noise emissions from fixed facilities is the NSW Industrial Noise Policy 2000 (INP). Additional requirements are introduced through REMMs, REPOs and the SWTC.

The assessment procedure in the INP has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- maintaining noise level amenity for particular land uses for residences and other land uses.

### 2.3.4.1. Intrusive noise criteria

According to the INP, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the  $L_{Aeq}$  descriptor) does not exceed the background noise level measured in the absence of the source by more than 5 dB(A).

The intrusiveness criterion is summarised as follows:

- $L_{Aeq,15minute} = \text{Rating Background Level (RBL) plus 5 dB.}$

### 2.3.4.2. Amenity noise criteria

The INP amenity criteria are designed to maintain noise level amenity for particular land uses, including residential and other land uses. The INP recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and other sensitive receivers in Table 2.1 of the INP. Noise from new sources need to be designed such that the cumulative effect does not produce levels that would significantly exceed the criterion.

### 2.3.4.3. Noise criteria

Table 10 below summarises the project-specific noise levels for each fixed facility as per the INP.

Table 10 Applicable  $L_{Aeq}$  noise criteria

Fixed facility/station	Receiver type/description	Project-specific noise level $L_{Aeq}(15 \text{ min})$ , dB(A)			
		Shoulder	Day	Evening	Night
Northern Dive <sup>5</sup>	Residential <sup>1</sup> West of Service Building	N/A	61	61	57
	Residential <sup>2</sup> North of Service Building		46	45	40
	Residential <sup>3</sup> East of Service Building		55	50	44
	Residential <sup>2</sup> South of Service Building		47	45	39
	Commercial		65 (external) when in use		
	Industrial		75 (external) when in use		
Artarmon Substation <sup>6</sup>	Residential	N/A	60	50	45

	North of Artarmon Substation				
	Commercial		65 (external) when in use		
	Industrial		75 (external) when in use		
<b>Crows Nest Station</b> <sup>7</sup>	Residential (Pacific Highway)	N/A	59	57	53
	Residential (Clarke Lane)		58	53	52
	Commercial		65 (external) when in use		
<b>Victoria Cross Station</b> <sup>13</sup>	Residential Towers to the south of the northern end station	N/A	-	-	56
	Commercial West of the southern end station		65 (external) when in use		
	Commercial South of the southern end station		65 (external) when in use		
	Commercial South-west of the southern end station		65 (external) when in use		
	Educational facility North-west of the southern end station		-	-	55
	Mixed-use East of the southern end station		-	-	55
<b>Barangaroo Station</b> <sup>8</sup>	Residential	N/A	51	54	45
	Commercial		65 (external) when in use		
	Educational		45 (external) when in use		
<b>Martin Place Station</b> <sup>13</sup>	Residential West of the southern end of the station	N/A	-	-	52
	Residential East of the southern end of the station		-	-	52
	Residential West of the northern end of the station		-	-	52
	Commercial		65 (external) when in use		
	Educational facility		-	-	55

	South of the southern end of the station				
<b>Gadigal Station – North</b> <sup>9</sup>	Residential	N/A	59	59	55
	Hotel		64	64	60
	Commercial		65 (external) when in use		
	Place of worship		40 (internal) when in use		
<b>Gadigal Station – South</b> <sup>9</sup>	Residential (including OSD)		61	57	55
	Hotel		66	62	60
	Commercial		65 (external) when in use		
	Place of worship		40 (internal) when in use		
<b>Central Station</b> <sup>13</sup>	Residential	N/A	-	-	50
	Commercial		65 (external) when in use		
	Hospital		-	-	50
<b>Waterloo Station</b> <sup>10</sup>	NCA01 <sup>12</sup> Residential	N/A	60	58	51
	NCA02 <sup>12</sup> Residential		55	48	43
	NCA03 <sup>12</sup> Residential		55	48	43
	OSD NCA01 <sup>12</sup>		60	58	51
	OSD NCA02/3 <sup>12</sup>		55	48	43
	Place of worship		40 (internal) when in use		
	Commercial		65 (external) when in use		
	Active recreation		55 (external) when in use		
<b>Sydenham Station</b> <sup>13</sup>	Residential South of the tunnel portal openings	N/A	-	-	43
	Residential North-east of the tunnel portal openings		-	-	40
<b>SMTF-S and Southern Dive</b> <sup>11</sup>	NCA-A <sup>12</sup> Residential <sup>1,3</sup> North-West of SMTF-S	50	56	48	43
	NCA-B <sup>12</sup>	53	59	56	43

	Residential <sup>1,3</sup> North-East of SMTF-S				
	NCA-C <sup>12</sup>				
	Residential <sup>1,3</sup> South-East of SMTF-S	55	61	58	46
	NCA-D <sup>12</sup>				
	Residential <sup>1,3</sup> South-West of SMTF-S	48	52	52	44
	School	N/A	35 (internal)* when in use		
	Place of Worship		40 (internal)* when in use		
	Commercial		65 (external) when in use		
	Active Recreation		55 (external) when in use		
Notes	<p>1 Assessment in areas of high traffic noise as per Section 2.2.3 of the INP.</p> <p>2 Noise amenity area - Suburban (Residence) as per Table 2.1 of the INP.</p> <p>3 Noise amenity area - Urban (Residence) as per Table 2.1 of the INP.</p> <p>4 An outside-to-inside façade loss (windows open scenario) has been conservatively assumed for receivers with an internal noise criterion.</p> <p>5 Criteria for Northern Dive taken from TK685-01F17 Chatswood Northern Dive NV Design Report Stage 3 (r1) by Renzo Tonin &amp; Associates, dated 16/9/20.</p> <p>6 Criteria for Artarmon Substation taken from TK685-01F07 Artarmon Substation NV Design Report Stage 3 (r2) by Renzo Tonin &amp; Associates, dated 9/11/20.</p> <p>7 Criteria for Crows Nest Station taken from SMCSWSCN-SMC-SCN-NA-REP-000382.C.RVW.C.01 by SMEC, dated 6/5/20.</p> <p>8 Criteria for Barangaroo Station taken from SMCSWSBR-MET-SBR-NA-REP-000004.A.RVW.A.01 by Metron, dated 28/9/22.</p> <p>9 Criteria for Gadigal Station – North and Gadigal Station – South taken from TL093-01F03 Stage 3 Report (r12) SMCSWSPS-REN-STA-NA-REP-000001-B.2 by Renzo Tonin &amp; Associates, dated 29/10/21.</p> <p>10 Criteria for Waterloo Station taken from TL216-01F04 Stage 3 Report (r8) SMCSWSWL-JHG-SWL-NA-REP-000001-E by Renzo Tonin &amp; Associates, dated 2/9/21.</p> <p>11 Criteria for SMTF-S and Southern Dive taken from TK685-05F02 SMTF South NV Design Report Stage 3 (r5) by Renzo Tonin &amp; Associates, dated 29/9/21.</p> <p>12 Receiver type name taken from original document.</p> <p>13 Criteria for Victoria Cross Station, Martin Place Station, Central Station and Sydenham Station taken from TK685-01F09 Tunnel Ventilation Design Report Stage 3 (r6) by Renzo Tonin &amp; Associates, dated 15/10/2020.</p> <p>Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sundays &amp; Public Holidays.</p> <p>Evening: 6pm to 10pm Monday to Sunday &amp; Public Holidays.</p> <p>Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sundays &amp; Public Holidays.</p> <p>Shoulder: a 'Shoulder' period has been established for 5am to 7am. The shoulder period rating background level is taken to be the mid-point between the rating background levels between the two assessment periods that are on either side of the shoulder period.</p> <p>Noise levels apply at the property boundary that is most exposed to industrial noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence, except where otherwise noted. Noise levels may be higher at upper floors of the noise affected residence.</p>				

The noise criteria listed in Table 10 apply under normal operating conditions for fixed facilities. Although noise emissions during an emergency are not controlled under the INP, noise impacts are required to be managed during testing of fixed facilities in 'Emergency Mode', which is expected to be undertaken infrequently and for short periods of time. Testing of equipment in Emergency Mode is required to be undertaken at the least sensitive time of day and for the shortest duration that is feasible considering the needs of an operating railway and should be accompanied by an appropriate community notification plan.

### 2.3.5. Structure-borne noise and vibration from fixed facilities

For fixed facilities, structure-borne noise and vibration is most likely to be caused by equipment with moving components, such as ventilation fans. Although these are generally mounted on anti-vibration mountings, there remains a possibility that vibration during operation is transmitted to nearby sensitive receivers.

Structure-borne noise is managed in accordance with AS/NZS2107:2016. This standard includes a large range of receiver types. Should any structure-borne noise complaints be received, noise levels will be compared with the relevant preferred and maximum noise levels in AS/NZS2107:2016 to determine if any additional mitigation measures are required.

Structure-borne vibration is managed in accordance with AVTG 2006. The continuous vibration levels in AVTG are applicable. This type of vibration can be assessed on the basis of the weighted rms acceleration values or as rms velocity levels. The rms velocity levels are consistent with the values provided in Table 9.

### 2.3.6. Noise via draught relief shafts

Noise levels from train movements in the tunnels which escapes to the atmosphere via draught relief shafts must not exceed the following SWTC noise limits at the nearest residential and commercial premises.

Table 11 Noise via draught relief shafts

Receiver type	Requirement
Residential	55 dB(A) L <sub>AFmax</sub>
Commercial	65 dB(A) L <sub>AFmax</sub>
<b>Note:</b> L <sub>AFmax</sub> refers to the maximum noise level not exceeded for 95% of rail pass by events and is measured on the 'fast' response setting on a sound level meter.	

## 2.4. Ground-borne noise and vibration monitoring after the commencement of operations

CSSI 7400 CoA D13 states that:

*The Proponent must prepare an **Operational Noise and Vibration Monitoring Program** to confirm that the operational noise and vibration levels meet the CSSI proposed design objectives as determined in the **Track Attenuation and Operational Ground-borne Noise Review** in Condition D9 following the commencement of operations.*

After the commencement of operations, noise and vibration monitoring will be undertaken by Renzo Tonin. At the time of submission of Version 3 of this NVMP, MTS is working collaboratively Renzo Tonin to create and implement an Operational Noise and Vibration Monitoring Program to confirm that the operational noise and vibration levels meet the CSSI proposed design objectives as determined in the Track Attenuation and Operational Ground-borne Noise Review. The Operational Noise and Vibration Monitoring Program will be created and implemented by Q4 2024..

CSSI 7400 CoA D14 states that if the operational noise and vibration levels exceed the CSSI design objectives, MTS is to prepare a report, outlining actions that will be taken so that the CSSI meets the design objectives in the



future. The report is to be prepared within three months following the identification of the exceedance and be forwarded to the Secretary for information. All recommendations in the report must be implemented within three months of the date of the report or as agreed with the Secretary.

The future Operational Noise and Vibration Monitoring Program will outline the process MTS will follow if operational noise and vibration levels exceed the CSSI design objectives. The program will cover the process of obtaining the results from the monitoring of MTS activities, preparing a report of the results, sending the report to SMA as well as managing the process outlined in D14 if an exceedance is recorded. Such as preparing the report within three months of the identification of the exceedance and forwarding it to the Secretary for information. MTS will then review and implement the recommendations made in the report by the Secretary.

Once the Operational Noise and Vibration Monitoring Program has been created, it will be sent to SMA and DPHI for information to ensure it covers the required Conditions of Approval and is fit for purpose of monitoring the Noise and Vibration of MTS activities on the CSW network.

## 2.5. Ongoing noise and vibration compliance monitoring

The project approval does not identify any ongoing requirements to perform noise and vibration compliance monitoring.

As noted in Section 2.1.5, it is expected that existing EPA License 21247 relating to Sydney Metro Northwest will be updated to incorporate the section of new track between Chatswood and Sydenham. The EPA license may include additional noise and vibration monitoring requirements.

However, MTS will conduct Noise and Vibration monitoring in accordance with the Noise & Vibration Monitoring Procedure (See Appendix G) and the Asset Engineering Notification - Rail Corrugation Assessment - AEN2023-07-10-PW-01S (NWRLOTS-NRT-SWD-AV-RPT-905834).

This ONVMP will be updated as required to include any additional monitoring, mitigation or management measures that may be required as part of any commissioning or post-commissioning noise and vibration assessments.

## 3. Complaints management system

MTS will respond to community inquiries and complaints received during the operation and maintenance of the network relating to Noise and Vibration. Where community complaints are received about specific times or sections of the network, these are investigated through a review of the complaint via observation and noise monitoring as per the Noise & Vibration Monitoring Procedure. These complaints will also be sent to Sydney Metro Authority for their own knowledge and review.

This Community Response Process is integrated into the Stakeholder and Community Involvement Plan (SCIP, reference SMCSWTS2-MTS-CSW-PM-PLN-002162).

Table 12 Community response process

An environmental enquiry or complaint is received via TfNSW's Customer Information service on 131 500 and online at <a href="http://www.transport.info">www.transport.info</a> .			
Step	Action	Timeframe	
		Operational hours	Engineering hours
1	<b>Initial contact</b> <ul style="list-style-type: none"> <li>TfNSW notifies MTS of enquiry or complaint (operational hours).</li> <li>MTS receives complaints where 131 500 is diverted (engineering hours).</li> <li>SMA/TfNSW-related online enquiry or complaint is received by MTS via Salesforce.</li> </ul>	<ul style="list-style-type: none"> <li>Immediately.</li> <li>131 500 phone calls are entered into Salesforce and responsibility assigned to MTS.</li> <li>Web-based enquiry or complaint is entered into Salesforce and responsibility assigned to MTS.</li> </ul>	<ul style="list-style-type: none"> <li>Immediately.</li> <li>131 500 passed off to MTS-designated number between 12am – 6am.</li> <li>Web-based form entries are provided to MTS the next business day by TfNSW.</li> </ul>
2	<b>Investigation</b> For complaints, MTS Customer Information	Within 24 hours when only trains are operating.	<ul style="list-style-type: none"> <li>Within two hours or as agreed with complainant when maintenance and</li> </ul>

	Delivery Partner (ISC) investigates and contacts complainant to seek any additional information.		repair works are occurring in Environmental Protection Licence licenced premise. <ul style="list-style-type: none"><li>• Within 24 hours when only trains are operating or not within EPL licenced premise.</li></ul>
3	<b>Escalation</b> (Beyond a usual operational issue) Where is cannot be resolved by the MTS SMCIC, DCRC or GMOCE, for dissemination, coordination of Subject Matter Expert or SMA/TfNSW involvement (as required) and response.	Within two business days.	
4	<b>Review</b> SME involvement, review of complaint, investigate work practices and mitigations. Develop response including proposed monitoring and any proposed additional mitigation measures.	Within five business days.	
5	<b>Resolve</b> MTS CRO communicates the resolution with complainant.	Target five business days. Where a complaint requires a detailed investigation, may require significant mitigation* and may take longer than 20 days, the complainant will be kept informed of progress on a regular basis until the matter is resolved.	
<p>* Significant mitigation is defined by MTS to be mitigation that:</p> <ul style="list-style-type: none"><li>a. has a cost of more than \$10,000; or</li><li>b. will require further noise modelling to determine the scope of reasonable and feasible mitigation measures (e.g., height and size of noise barriers, or specifications for at-property treatments).</li></ul>			

## 4. Conclusion

This Operational Noise and Vibration Management Plan has been prepared in accordance with the requirements of the OTS2 Project Deed and the Consolidated Conditions of Approval for CSSI 7400. This ONVMP reviews the design process followed for the SMCSW project and confirms the implemented mitigation measures address the relevant CoAs and requirements of the SWTC.

# A

## APPENDIX

# Appendix A. Document control

## Appendix A1. Document information

Document Number:	SMCSWTS2-MTS-CSW-EM-PLN-002106
Version:	04
Issue Date:	12/09/2024
Network:	City and Southwest

## Appendix A2. Approval record

Function	Position	Name	Signature	Date
Prepared by:	Environment and Sustainability Advisor, City South West	Peter Scioscia		
Reviewed by:	Head of Safety, Quality, Risk and Environment	Melissa Northey		
Endorsed by:	General Manager Safety, Quality, Risk & Environment	Amanda Calvez		
Approved by:	MTS Chief Executive Officer	Daniel Williams		
Endorsed by:	MTR Representative	Ronnie Tong		
Endorsed by:	OpCo2 Delivery Director	Phil Dark		
Approved by:	NRT Chief Executive Officer	Steve Herman		

## Appendix A3. Consultancy record

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
24/10/2023	Draft		1	J. Iaconis	C. Weber	C. Weber
01/12/2023	Final Draft		2	J. Iaconis	C. Weber	C. Weber

### Important Disclaimers:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian/New Zealand Standard AS/NZS ISO 9001.

This document is issued subject to review and authorisation by the suitably qualified and experienced person named in the last column above. If no name appears, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client.

It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented, or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate, or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

## Appendix A4. Amendment record

Date	Rev	Amendment description	By
07/04/2024	01	Updated to MTS branding standards.	Peter Simcic
03/05/2024	01	Review by MTR and OpCo2.	Ronnie Tong / Katrina Milburn
15/05/2024	01	Update based on review comments.	Peter Scioscia
28/06/2024	02	Updated for final submission to Sydney Metro Authority and DPHI after external stakeholder consultation	Peter Scioscia
28/07/2024	03	Further update for final submission to DPHI	Peter Scioscia
12/09/2024	04	Updated as per DPHI's comments	Peter Scioscia

# B

## APPENDIX

# Appendix B. List of acronyms

Table 13 List of acronyms

Acronym	Definition
AAT	Acoustic Assurance Tool
ABN	Airborne Noise
ADIP	Acoustic Design Integration Plan
ADIS	Acoustic Design Integration Strategy
AVTG	Assessing Vibration: a technical guideline (NSW DEC 2006)
C2S	Chatswood to Sydenham
CBD	Central business district
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
DEC	Department of Environment and Conservation
DPHI	Department of Planning, Housing and Infrastructure
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
GBN	Ground-borne Noise
GBNV	Ground-borne Noise and Vibration
GBV	Ground-borne Vibration
GIS	Geographic Information System
INP	Industrial Noise Policy (NSW EPA 2000)
ISD	Integrated Station Development
LW	Linewide
LWW	Linewide Works
MTS	Metro Trains Sydney
NCW	Northern Corridor Works
O&M	Operations and Maintenance
ONVMP	Operational Noise and Vibration Management Plan
OSD	Over-site Development
OTS / OTS2	Operations, Trains, and Systems
PPP	Public Private Partnership
REMM	Revised Environmental Mitigation Measure
REPO	Revised Environmental Performance Outcome
RING	Rail Infrastructure Noise Guideline (NSW EPA 2013)
SEAR	Secretary's Environmental Assessment Requirements
SCIP	Stakeholder Community Involvement Plan
SMNW	Sydney Metro North West
SMCSW	Sydney Metro City and South-west



Acronym	Definition
<b>SMTF</b>	Sydney Metro Trains Facility
<b>SMTF-S</b>	Sydney Metro Trains Facility (South)
<b>SPIR</b>	Submissions and Preferred Infrastructure Report
<b>SPR</b>	Scope and Performance Requirements
<b>SSC</b>	Southwest Stations and Corridor
<b>SSI</b>	State Significant Infrastructure
<b>SSJ</b>	Sydenham Station and Junction
<b>SBN</b>	Structure-borne noise
<b>SBNV</b>	Structure-borne noise and vibration
<b>SWTC</b>	Scope of Works and Technical Requirements
<b>TSE</b>	Tunnel and Station Excavation
<b>TSOM</b>	Trains, Systems, Operations and Maintenance

# C

## APPENDIX

# Appendix C. Related documents

**Note:** some documents will be closely interconnected and will need to be reviewed when this one is changed. Others are simply related content that supplement the material in this document.

Table 14 Related documents

Document Number	Document Title	Review
NWRLOTS-NRT-SWD-AV-RPT-905834	Asset Engineering Notification - Rail Corrugation Assessment - AEN2023-07-10-PW-01S	Yes
SMCSWTS2-MTS-CSW-EM-PLN-002107	Carbon and Energy Management Plan	Yes
NWRLOTS-NRT-ADM-EM-PRO-720473-01	Fauna Handling Procedure	Yes
SMCSWTS2-MTS-1NL-EM-PLN-002711	Flooding and Hydrology Plan	Yes
NWRLOTS-NRT-PRD-PM-PLN-000874	Flora & Fauna Management Plan	Yes
SMCSWTS2-MTS-1NL-EM-PLN-002712	Groundwater Management Plan	Yes
SMCSWTS2-MTS-CSW-HE-PLN-002100	Heritage Management Plan	No
NWRLOTS-NRT-ADM-PM-PLN-721419	Human Resource Plan	No
NWRLOTS-NRT-ADM-PM-PLN-721417	Incident Management Plan	No
NWRLOTS-NRT-SWD-FA-POL-723353	MTS Procurement Policy	No
NWRLOTS-NRT-ADM-EM-PRO-720474-01	Noise & Vibration Monitoring Procedure	No
SMCSWTS2-MTS-CSW-EM-PLN-002105	Operational Environmental Management Plan	Yes
SMCSWTS2-MTS-CSW-EM-PLN-002697	Operations Phase Environment and Sustainability Plan	Yes
NWRLOTS-NRT-ADM-EN-PLN-720416	Pollution Incident Response Management Plan	Yes
NWRLOTS-NRT-ADM-PM-PLN-721403	Quality Management Plan	No
NWRLOTS-NRT-ADM-PM-PLN-721405	Risk Management Plan	No
NWRLOTS-NRT-SWD-AM-PLN-723029	Severe Weather Conditions Response Plan	No
NWRLOTS-NRT-SWD-RS-FRW-720717	SMS Element 17: Procurement and Contract Management	No
NWRLOTS-NRT-ADM-EM-PRO-720472-01	Spill Management Procedure	Yes
NWRLOTS-NRT-ADM-EN-PLN-720252	Stakeholder Community Involvement Plan	No
NWRLOTS-NRT-ADM-PM-PLN-721415	Training Management Plan	No
NWRLOTS-NRT-ADM-EM-PRO-720475-01	Unexpected Heritage Finds Procedure	No
NWRLOTS-NRT-ADM-EM-PRO-720476-01	Unexpected Contaminated Finds Procedure	Yes
NWRLOTS-NRT-ADM-EM-PRO-720471-01	Waste Resource Management Procedure	Yes
NWRLOTS-NRT-ADM-EM-PRO-720478-01	Water Quality Monitoring Program	Yes
NWRLOTS-NRT-ADM-EM-PRO-720479-01	Weed Management Procedure	Yes

# D

## APPENDIX

# Appendix D Public address system noise

## Extract from NWRLOTS-NRT-SWD-AV-RPT-105008-B.

Each station will include public address system (PAS) for the purpose of making safety and other announcements at platform areas, station entry points, paid / unpaid concourse areas and back of house (staff) areas. The table below provides a guidance on the types of announcements, frequencies, times of day and locations within station areas where these announcements may occur.

The PAS includes speakers placed at strategic locations to assist with achieving the minimum speech intelligibility criteria in 95% of station coverage areas. Where possible, speakers are placed close to receiver positions so that announcements are intelligible, and the volume of announcements is minimised. This approach improves the intelligibility of the announcements within the public areas of stations and reduces the potential noise spill outside station areas at nearby sensitive receivers.

The proposed PAS includes ambient noise compensation technology. This allows the volume of announcements to be set on the basis of the current noise environment in different areas of the station. During peak periods when ambient noise levels are high, the volume of announcements is increased so that announcements remain clear. During off-peak periods, when ambient noise levels are low, the volume of announcements is automatically reduced.

In relation to the PAS strategy in the table below, it is noted that regular announcements will occur for each train arrival (Type 1) and to convey other educational, reminder or promotional information (Types 3 to 6).

For noise modelling purposes, the following assumptions have been adopted:

- The volume of announcements at receiver positions 1.5 m above platform and concourse areas is assumed to be 10 dB higher than the ambient noise levels. Ambient noise levels from mechanical ventilation systems is required to be less than 55 dB(A). In the presence of other noise sources, ambient noise levels are likely to be in the range of 55 dB(A) to 60 dB(A), with the volume of announcements being typically 65 dB(A) to 70 dB(A) at receiver positions in station areas. For environmental noise prediction purposes, the volume of announcements is assumed to be 65 dB(A) in concourse areas and 70 dB(A) in platform areas.
- In each 15-minute period when regular announcements are made (6:00am to 10:00pm), the total duration of announcements is assumed to be 3 minutes in platform areas and 1 minute in paid/unpaid concourse areas. A 5 dB(A) noise penalty has been included in the predicted noise levels at nearby sensitive receivers to account for the potential annoying characteristics of PAS voice announcements.

For elevated and open cut stations and the station entry points of underground stations, these announcements will not be made during the 10:00pm to 6:00am night-time period to avoid potential nuisance to nearby residential receivers. The noise associated with regular PAS announcements during the 6:00 am to 10:00 pm period is included as part of the assessment undertaken for each station in the following sections.

Announcements related to train service delays, crowd control or emergencies (Types 2, 7 and 8) will only be made when required, and may occur at any time of the day or night. The frequency of such announcements is anticipated to be minimal and therefore does not warrant specific assessment.

Table 15 PAS coverage areas and announcement types

Announcement Type									
	Time period	1	2	3	4	5	6	7	8
Coverage Area		Only platform concerned	Platform concerned, concourse & entrance	Concourse, platform & station entrance					All areas
Announcement Frequency	AM peak 6:00am to 8:30am PM peak 4:30pm to 7:30pm	Per rail traffic movements	2 min (adjustable) or when required	15 min (adjustable)				3 min or when required	2 min or when required
	Off peak train periods 8:30am to 4:30pm and 7:30pm to 10:00pm	Per rail traffic movements							
	10pm to 6am night-time	Only underground stations		Only underground stations					
Announcement Types	1: Automatic announcements of train arrival at platform concerned. 2: Train service delay announcements. 3: Educational announcements (e.g. escalator safety). 4: Reminder announcements (e.g. beware of slippery floor during wet weather). 5: Promotional announcements (e.g. advertising). 6: Directional announcements (e.g. giving information relating to which station exit should be used for events). 7: Crowd control announcements. 8: Emergency announcements (e.g. station evacuation during incident).								

# E

## APPENDIX



# Appendix E Glossary of terminology

Table 16 Glossary

Acronym	Definition																																						
<b>Adverse weather</b>	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).																																						
<b>Ambient noise</b>	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.																																						
<b>Assessment period</b>	The period in a day over which assessments are made.																																						
<b>Assessment Point</b>	A point at which noise measurements are taken or estimated.																																						
<b>Background noise</b>	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).																																						
<b>Decibel [dB]</b>	<p>The units that sound is measured in. The following are examples of the decibel readings of common sounds in our daytime environment:</p> <table><tr><td rowspan="2">threshold of hearing</td><td>0 dB</td><td>The faintest sound we can hear</td></tr><tr><td>10 dB</td><td>Human breathing</td></tr><tr><td rowspan="2">almost silent</td><td>20 dB</td><td></td></tr><tr><td>30 dB</td><td>Quiet bedroom or in a quiet national park location</td></tr><tr><td rowspan="2">generally quiet</td><td>40 dB</td><td>Library</td></tr><tr><td>50 dB</td><td>Typical office space or ambience in the city at night</td></tr><tr><td rowspan="2">moderately loud</td><td>60 dB</td><td>CBD mall at lunch time</td></tr><tr><td>70 dB</td><td>The sound of a car passing on the street</td></tr><tr><td rowspan="2">loud</td><td>80 dB</td><td>Loud music played at home</td></tr><tr><td>90 dB</td><td>The sound of a truck passing on the street</td></tr><tr><td rowspan="2">very loud</td><td>100 dB</td><td>Indoor rock band concert</td></tr><tr><td>110 dB</td><td>Operating a chainsaw or jackhammer</td></tr><tr><td rowspan="2">extremely loud</td><td>120 dB</td><td>Jet plane take-off at 100m away</td></tr><tr><td>130 dB</td><td></td></tr><tr><td>threshold of pain</td><td>140 dB</td><td>Military jet take-off at 25m away</td></tr></table>	threshold of hearing	0 dB	The faintest sound we can hear	10 dB	Human breathing	almost silent	20 dB		30 dB	Quiet bedroom or in a quiet national park location	generally quiet	40 dB	Library	50 dB	Typical office space or ambience in the city at night	moderately loud	60 dB	CBD mall at lunch time	70 dB	The sound of a car passing on the street	loud	80 dB	Loud music played at home	90 dB	The sound of a truck passing on the street	very loud	100 dB	Indoor rock band concert	110 dB	Operating a chainsaw or jackhammer	extremely loud	120 dB	Jet plane take-off at 100m away	130 dB		threshold of pain	140 dB	Military jet take-off at 25m away
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	130 dB																																						
threshold of pain	140 dB	Military jet take-off at 25m away																																					
<b>dB(A)</b>	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the “A” filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.																																						
<b>dB(C)</b>	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing																																						

Acronym	Definition
	from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
<b>Frequency</b>	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
<b>Impulsive noise</b>	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
<b>Intermittent noise</b>	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
<b>LMax</b>	The maximum sound pressure level measured over a given period.
<b>LMin</b>	The minimum sound pressure level measured over a given period.
<b>L1</b>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
<b>L10</b>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
<b>L90</b>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
<b>Leq</b>	The “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
<b>Reflection</b>	Sound wave changed in direction of propagation due to a solid object obscuring its path.
<b>SEL</b>	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
<b>Sound</b>	A fluctuation of air pressure which is propagated as a wave through air.
<b>Sound absorption</b>	The ability of a material to absorb sound energy through its conversion into thermal energy.
<b>Sound level meter</b>	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
<b>Sound pressure level</b>	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
<b>Sound power level</b>	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
<b>Tonal noise</b>	Containing a prominent frequency and characterised by a definite pitch.

# F

## APPENDIX

# Appendix F. Sydney Metro CSW Acoustics Advisor Endorsement of ONVMP



## APPROVAL CITY & SOUTHWEST ACOUSTICS ADVISOR

<b>Review of:</b>	Metro Trains Sydney Operational Noise and Vibration Management Plan Sydney Metro City & Southwest	<b>Document reference:</b>	SMCSWTS2-MTS-CSW-EM- PLN-002106
<b>Prepared by:</b>	Daniel Weston Acoustics Advisor		Prepared by Metro Trains Sydney
<b>Date of issue:</b>	28 June 2024		28 June 2024
			Version 02

As approved Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed the Operational Noise and Vibration Management Plan (ONVMP) prepared by Metro Trains Sydney, as required under A27 (d) of the project approval conditions.

I am satisfied that the document (Version 02) meets the requirements of relevant project approval conditions, approve the ONVMP, and consider that the document is suitable for submission to the Secretary for information.

Daniel Weston, City & Southwest Acoustics Advisor

# G

## APPENDIX

## **Appendix G: Noise and Vibration Monitoring Procedure**

# **NOISE AND VIBRATION MONITORING PROCEDURE**

Document Information

Document Number:		
PDCS reference:		
Version:	1.0	
Date:	Issue Date	Next Review date
	26/07/2024	26/07/2025
Network	City & South West	

## VERSION HISTORY

### Approval Record

Function	Position	Name	Signature	Date
Prepared by	Environment and Sustainability Advisor	Peter Scioscia		
Reviewed by	Head of Safety, Quality, Risk & Environment	Melissa Northey		
Approved by	<b>General Manager Safety, Quality, Risk &amp; Environment</b>	Amanda Calvez		

### Amendment Record

Date	Rev	Amendment description	By
26/07/2024	1.0	Prepared as part of the Operational Noise and Vibration Management Plan (ONVMP) for City & Southwest	Peter Scioscia



## Table of Contents

<b>Purpose &amp; Scope .....</b>	<b>46</b>
1.1 Purpose .....	46
<b>Implementation .....</b>	<b>46</b>
<b>Training.....</b>	<b>47</b>
<b>Monitoring Procedure .....</b>	<b>47</b>
4.1 When is Monitoring Required? .....	47
4.2 Noise and Vibration Assessment Criteria.....	47
<b>1 Noise Procedure .....</b>	<b>47</b>
4.2.1 Short-Term Attended Monitoring .....	47
<b>2 4.2.2 Equipment.....</b>	<b>48</b>
<b>3 4.2.3 Assessment Criteria.....</b>	<b>49</b>
<b>4 4.3 Vibration Procedure.....</b>	<b>54</b>
4.3.1 Short-Term Attended Monitoring .....	54
4.3.2 Equipment Calibration .....	55
4.3.3 Structure-borne noise and vibration from fixed facilities .....	56
<b>Management and Mitigation.....</b>	<b>56</b>
<b>Related Documents .....</b>	<b>56</b>

## List of Tables

Table 1: Ground-Borne (Internal) Noise Objectives .....	49
Table 2: Rail Traffic Noise Trigger Levels for Residential Land Uses .....	49
<del>Table 3: Rail Traffic Noise Trigger Levels for Sensitive Land Uses Other Than Residential .....</del>	<del>50</del>
<del>Table 4: SMTF Operational Noise Targets (dB(A)) .....</del>	<del>50</del>
Table 5: Applicable LAeq noise criteria.....	51

## Purpose & Scope

### Purpose

There are two components to noise and vibration monitoring for the operation of the Sydney Metro City and Southwest being:

- General operational noise and vibration monitoring of new activities in new areas (in accordance with the Works Approval Protocol) or in response to a community complaint; and
- To collect actual noise and vibration data for the purpose of undertaking a Noise and Vibration Compliance Assessment against the planning approval SSI-7400.

This Noise and Vibration Monitoring Procedure has been prepared to set the process that is to be employed for the undertaking of general operational noise and vibration monitoring for the operation and maintenance of the Sydney Metro City and Southwest rapid transit network. It does not set up the processes required to meet the needs of the Operational Noise and Compliance Assessment. The noise and vibration monitoring regimes required to meet the needs of SSI-7400 CoA D13 and D14 and will be developed at the outset of operation of the Sydney Metro City and Southwest, together with a noise and vibration consultant.

### Implementation

This procedure will be implemented in accordance with the MTS Works Approval Protocol which provides the processes, procedures for assessment and sign-off for maintenance works and activities which have the potential to generate environmental impacts, including noise and vibration.

The Works Approval Protocol will address potential noise and vibration impacts from the operation of the Sydney Metro network and associated maintenance and repair works, including possessions.

With regards to noise and vibration impacts, the Protocol will be implemented where proposed O&M works:

- Are occurring as part of the biannual possession program;
- Are occurring for the first time, in a new area;
- Are scheduled to occur between:
  - 2200 and 0700 – Sunday to Thursday; and / or
  - 2200 and 0800 – Friday to Sunday and Public Holidays.

The Protocol will act as a means of checking:

- Compliance with:
  - Ministerial Conditions of Approval (CoA);
  - Environmental Protection License (EPL);
  - Other relevant standards or guidelines.
- Appropriate mitigation is implemented prior to commencement of works to minimise any potential impacts.

## Training

All personnel are to undertake project inductions identifying their environmental and compliance obligations under the relevant CoA, EPL and other legislative requirements for the Project.

Obligations and responsibilities relevant to dewatering procedures will be included in project induction, or targeted environmental awareness training as appropriate.

Noise and vibration monitoring equipment training for selected personnel.

## Monitoring Procedure

When is Monitoring Required?

MTS will undertake noise and vibration monitoring as follows:

- Where the implementation of the Works Approval Protocol (Appendix C) finds that new proposed works (works not previously approved) or an activity to be undertaken is going to be undertaken and there is a potential impact on sensitive receivers:
  - As part of the annual possession program and poses a new / changed risk;
  - For the first time, in a new area and are scheduled to occur between:
    - 2200 and 0700 – Sunday to Thursday; and / or
    - 2200 and 0800 – Friday to Sunday and Public Holidays.
  - In response to a community complaint.

## Noise and Vibration Assessment Criteria

Predicted noise and vibration criteria, including ground borne and air borne noise, have been developed in the preparation of the ONVMP. These criteria will be used as the baseline operational criteria against which noise and vibration monitoring will be undertaken at the outset of operation.

## Noise Procedure

### Short-Term Attended Monitoring

Short-term noise monitoring shall be recorded over 15 minute sample intervals. Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory and reported are the following A-weighted noise levels: Lmin, L90, Leq, L10, L1 and Lmax.

In addition to measuring and reporting overall A-weighted noise levels, statistical L90, Leq, L10 noise levels shall also be measured and reported in third-octave band frequencies from 31.5Hz to 8kHz.

Outdoor noise monitoring is to be undertaken at least 3.5m from any reflecting structure other than the ground. The preferred measurement height is 1.2-1.5m above the ground. Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Measurements inside buildings should be at least 1m from the walls or other major reflecting surfaces, 1.2 m to 1.5m above the floor, and about 1.5m from windows.

Conditions such as wind velocity, wind direction, temperature, relative humidity and cloud cover shall also be recorded during short-term noise monitoring.

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

## Equipment

Referenced Standards & Guidelines include:

- AS IEC 61672.1      Electroacoustic - Sound Level Meters – Specifications;
- AS 1055              Acoustics - Description and Measurement of Environmental Noise;
- DCCEEW            NSW Interim Construction Noise Guideline 2009; and
- EPA                  NSW Industrial Noise Policy 2000.

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All noise monitoring equipment used must be at least Type 2 instruments as described in AS IEC 61672.1 2004 'Electroacoustic - Sound Level Meters - Specifications' and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the monitoring equipment shall also be checked in the field before and after the noise measurement period

All environmental noise measurements shall be taken with the following meter settings:

- Time Constant - FAST (i.e. 125 milliseconds)
- Frequency Weightings - A-weighting
- Sample Period - 15 minutes

All outdoor noise measurements shall be undertaken with a windscreen over the microphone. Windscreens reduce wind noise at the microphones.

Measurements of noise should be disregarded when it is raining and/or the wind speed is greater than 5 m/s (18 km/HR).

## Assessment Criteria

*Table 17: Ground-Borne (Internal) Noise Objectives*

(Extract: Table 9 of ONVMP)

Location	Requirement
<b>Residential (Day)</b>	106 dBV (0.2 mm/s)
<b>Residential (Night)</b>	103 dBV (0.14 mm/s)
<b>Commercial</b>	112 dBV (0.4 mm/s)
<b>Educational</b>	112 dBV (0.4 mm/s)
<b>Place of worship</b>	112 dBV (0.4 mm/s)
<b>Industrial</b>	118 dBV (0.8 mm/s)
<b>Theatres</b>	106 dBV (0.2 mm/s)
<b>Other critical spaces</b>	Generic Vibration Criterion curves in Institute of Environmental Sciences and Technology industry Standard IEST-RP-CC012.1.Considerations in Clean Room Design (2007)
<b>Crows Nest Day Surgery, Clarke Street, Crows Nest</b>	100 dBV (0.1 mm/s) <sup>1</sup>
Note 1: For this location, the recommended criterion is based on the recommendations in the track attenuation and operational ground-borne noise review (refer Section 2.1.4).	

*Table 18: Rail Traffic Noise Trigger Levels for Residential Land Uses*

Rail Traffic Noise Trigger Levels for Residential Land Uses

(Extract: Table 4 of the ONVMP)

Type of development	Noise trigger Levels dB(A) (External)	
	Day (7am-10pm)	Night (10pm-7am)
Redevelopment of existing rail line	Development increases existing $L_{Aeq(15h)}$ rail noise levels by 2 dB or more, or existing $L_{Amax}$ rail noise levels by 3 dB or more and predicted rail noise levels exceed:	
	65 $L_{Aeq(15h)}$ or 85 $L_{Amax}$	60 $L_{Aeq(9h)}$ or 85 $L_{Amax}$
Note: $L_{Amax}$ refers to the maximum noise level not exceeded for 95% of rail pass by events and is measured on the 'fast' response setting on a sound level meter.		

Table 19: Rail Traffic Noise Trigger Levels for Sensitive Land Uses Other Than Residential

(Extract: Table 5 of the ONVMP)

Other sensitive land uses	Noise trigger Levels dB(A) (when in use)
	Redevelopment of existing rail line.
	Development increases existing rail noise levels by 2 dB(A) or more in $L_{Aeq}$ for that period and resulting noise levels exceed:
Schools, educational institutions and childcare centres	45 $L_{Aeq(1h)}$ internal
Places of worship	45 $L_{Aeq(1h)}$ internal
Hospital wards	40 $L_{Aeq(1h)}$ internal
Hospitals other uses	65 $L_{Aeq(1h)}$ internal
Open space – passive use	65 $L_{Aeq(15h)}$ external
Open space – active use	65 $L_{Aeq(15h)}$ external

Table 20: SMTF Operational Noise Targets (dB(A))

(Extract: Table 9 of the ONVMP)

Location	Requirement
<b>Residential (Day)</b>	106 dBV (0.2 mm/s)
<b>Residential (Night)</b>	103 dBV (0.14 mm/s)
<b>Commercial</b>	112 dBV (0.4 mm/s)
<b>Educational</b>	112 dBV (0.4 mm/s)
<b>Place of worship</b>	112 dBV (0.4 mm/s)
<b>Industrial</b>	118 dBV (0.8 mm/s)
<b>Theatres</b>	106 dBV (0.2 mm/s)
<b>Other critical spaces</b>	Generic Vibration Criterion curves in Institute of Environmental Sciences and Technology industry Standard IEST-RP-CC012.1.Considerations in Clean Room Design (2007)
<b>Crows Nest Day Surgery, Clarke Street, Crows Nest</b>	100 dBV (0.1 mm/s) <sup>1</sup>

Note 1: For this location, the recommended criterion is based on the recommendations in the track attenuation and operational ground-borne noise review (refer Section 2.1.4).

Table 21: Applicable  $L_{Aeq}$  noise criteria

(Extract: Table 10 of the ONVMP)

Fixed facility/station	Receiver type/description	Project-specific noise level $L_{Aeq}(15 \text{ min})$ , dB(A)			
		Shoulder	Day	Evening	Night
<b>Northern Dive</b> <sup>5</sup>	Residential <sup>1</sup> West of Service Building	N/A	61	61	57
	Residential <sup>2</sup> North of Service Building		46	45	40
	Residential <sup>3</sup> East of Service Building		55	50	44
	Residential <sup>2</sup> South of Service Building		47	45	39
	Commercial		65 (external) when in use		
	Industrial		75 (external) when in use		
<b>Artarmon Substation</b> <sup>6</sup>	Residential North of Artarmon Substation	N/A	60	50	45
	Commercial		65 (external) when in use		
	Industrial		75 (external) when in use		
<b>Crows Nest Station</b> <sup>7</sup>	Residential (Pacific Highway)	N/A	59	57	53
	Residential (Clarke Lane)		58	53	52
	Commercial		65 (external) when in use		
<b>Victoria Cross Station</b> <sup>13</sup>	Residential Towers to the south of the northern end station	N/A	-	-	56
	Commercial West of the southern end station		65 (external) when in use		
	Commercial South of the southern end station		65 (external) when in use		
	Commercial		65 (external) when in use		

	South-west of the southern end station				
	Educational facility North-west of the southern end station		-	-	55
	Mixed-use East of the southern end station		-	-	55
<b>Barangaroo Station <sup>8</sup></b>	Residential		51	54	45
	Commercial	N/A	65 (external) when in use		
	Educational		45 (external) when in use		
<b>Martin Place Station <sup>13</sup></b>	Residential West of the southern end of the station		-	-	52
	Residential East of the southern end of the station		-	-	52
	Residential West of the northern end of the station	N/A	-	-	52
	Commercial		65 (external) when in use		
	Educational facility South of the southern end of the station		-	-	55
<b>Gadigal Station – North <sup>9</sup></b>	Residential		59	59	55
	Hotel	N/A	64	64	60
	Commercial		65 (external) when in use		
	Place of worship		40 (internal) when in use		
<b>Gadigal Station – South <sup>9</sup></b>	Residential (including OSD)		61	57	55
	Hotel		66	62	60
	Commercial		65 (external) when in use		
	Place of worship		40 (internal) when in use		
<b>Central Station <sup>13</sup></b>	Residential		-	-	50
	Commercial	N/A	65 (external) when in use		
	Hospital		-	-	50



Waterloo Station <sup>10</sup>	NCA01 <sup>12</sup> Residential	N/A	60	58	51
	NCA02 <sup>12</sup> Residential		55	48	43
	NCA03 <sup>12</sup> Residential		55	48	43
	OSD NCA01 <sup>12</sup>		60	58	51
	OSD NCA02/3 <sup>12</sup>		55	48	43
	Place of worship		40 (internal) when in use		
	Commercial		65 (external) when in use		
	Active recreation		55 (external) when in use		
Sydenham Station <sup>13</sup>	Residential South of the tunnel portal openings	N/A	-	-	43
	Residential North-east of the tunnel portal openings		-	-	40
SMTF-S and Southern Dive <sup>11</sup>	NCA-A <sup>12</sup> Residential <sup>1,3</sup> North-West of SMTF-S	50	56	48	43
	NCA-B <sup>12</sup> Residential <sup>1,3</sup> North-East of SMTF-S	53	59	56	43
	NCA-C <sup>12</sup> Residential <sup>1,3</sup> South-East of SMTF-S	55	61	58	46
	NCA-D <sup>12</sup> Residential <sup>1,3</sup> South-West of SMTF-S	48	52	52	44
	School	N/A	35 (internal)* when in use		
	Place of Worship		40 (internal)* when in use		
	Commercial		65 (external) when in use		
	Active Recreation		55 (external) when in use		
	Notes	1 Assessment in areas of high traffic noise as per Section 2.2.3 of the INP. 2 Noise amenity area - Suburban (Residence) as per Table 2.1 of the INP. 3 Noise amenity area - Urban (Residence) as per Table 2.1 of the INP.			

4 An outside-to-inside façade loss (windows open scenario) has been conservatively assumed for receivers with an internal noise criterion.

5 Criteria for Northern Dive taken from TK685-01F17 Chatswood Northern Dive NV Design Report Stage 3 (r1) by Renzo Tonin & Associates, dated 16/9/20.

6 Criteria for Artarmon Substation taken from TK685-01F07 Artarmon Substation NV Design Report Stage 3 (r2) by Renzo Tonin & Associates, dated 9/11/20.

7 Criteria for Crows Nest Station taken from SMCSWSCN-SMC-SCN-NA-REP-000382.C.RVW.C.01 by SMEC, dated 6/5/20.

8 Criteria for Barangaroo Station taken from SMCSWSBR-MET-SBR-NA-REP-000004.A.RVW.A.01 by Metron, dated 28/9/22.

9 Criteria for Gadigal Station – North and Gadigal Station – South taken from TL093-01F03 Stage 3 Report (r12) SMCSWSPS-REN-STA-NA-REP-000001-B.2 by Renzo Tonin & Associates, dated 29/10/21.

10 Criteria for Waterloo Station taken from TL216-01F04 Stage 3 Report (r8) SMCSWSWL-JHG-SWL-NA-REP-000001-E by Renzo Tonin & Associates, dated 2/9/21.

11 Criteria for SMTF-S and Southern Dive taken from TK685-05F02 SMTF South NV Design Report Stage 3 (r5) by Renzo Tonin & Associates, dated 29/9/21.

12 Receiver type name taken from original document.

13 Criteria for Victoria Cross Station, Martin Place Station, Central Station and Sydenham Station taken from TK685-01F09 Tunnel Ventilation Design Report Stage 3 (r6) by Renzo Tonin & Associates, dated 15/10/2020.

Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sundays & Public Holidays.  
Evening: 6pm to 10pm Monday to Sunday & Public Holidays.  
Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sundays & Public Holidays.

Shoulder: a 'Shoulder' period has been established for 5am to 7am. The shoulder period rating background level is taken to be the mid-point between the rating background levels between the two assessment periods that are on either side of the shoulder period.

Noise levels apply at the property boundary that is most exposed to industrial noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence, except where otherwise noted. Noise levels may be higher at upper floors of the noise affected residence.

## Vibration Procedure

### Short-Term Attended Monitoring

Vibration monitoring shall be undertaken at the following locations:

- at the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, so to refine the indicative minimum working distances and provide a site-specific table of minimum working distances
- vibration sensitive locations determined to fall within the 'buffer distances' established for each item of plant. Areas likely to require vibration monitoring are identified in this report; and
- where vibration complaints or requests from relevant authorities are received, at the requested location and at any other relevant vibration receiver location with closest proximity to the O&M activities.

Vibration monitoring shall be undertaken over the following period(s):

- for plant operating within the 'buffer distances', during the commencement of use of each plant on site until site-specific minimum working distances are established; and
- for complaints or requests from relevant authorities, during the use of requested plant until site-specific minimum working distances are established.

All attended short-term vibration monitoring shall be recorded over 15 minute sample intervals. The magnitude of vibration is to be recorded at a minimum rate of 10 samples per second. The following minimum range of vibration metrics should be stored in memory and reported:

- Vibration Dose Values (VDVs)
- root-mean-square (rms) – maximums and statistical levels
- peak-particle velocity (ppv) – maximums and statistical levels.

In addition to measuring and reporting overall vibration, statistical vibration shall also be measured and reported in third-octave band frequencies from 1Hz to 250Hz.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant;
- the surface should be solid and rigid in order to best represent the vibration entering the structure of the building under investigation;
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces;
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest; and
- where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that.

## Equipment Calibration

Referenced Standards and Guidelines include:

- AS 2775 Mechanical Mounting of Accelerometers
- AS 2670.2 Part 2: Evaluation of human exposure to whole body vibration
- DECC NSW Assessing Vibration: A Technical Guideline
- DIN 4150.3 Structural Vibration in Buildings – Effects on Structures

- BS 7385:1 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings
- BS 7385:2 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground borne Vibration
- ISO 4866 Mechanical Vibration & Shock – Vibration of Buildings – Guidelines for the Management of the Vibrations and Evaluation of their Effects on Buildings.

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The monitoring system should also have a measurement frequency range down to 1Hz.

## Structure-borne noise and vibration from fixed facilities

For fixed facilities, structure-borne noise and vibration is most likely to be caused by equipment with moving components, such as ventilation fans. Although these are generally mounted on anti-vibration mountings, there remains a possibility that vibration during operation is transmitted to nearby sensitive receivers.

Structure-borne noise is managed in accordance with AS/NZS2107:2016. This standard includes a large range of receiver types. Should any structure-borne noise complaints be received, noise levels will be compared with the relevant preferred and maximum noise levels in AS/NZS2107:2016 to determine if any additional mitigation measures are required.

Structure-borne vibration is managed in accordance with AVTG 2006. The continuous vibration levels in AVTG are applicable. This type of vibration can be assessed on the basis of the weighted rms acceleration values or as rms velocity levels.

## Management and Mitigation

Once monitoring is complete, the Environment and Sustainability Advisor will compare the results against the criteria in this Procedure and where the results exceed the criteria:

- Review the results to determine potential causes of the exceedance;
- Review operating procedures and existing mitigation measures;
- Identify potential areas of improvement or additional measures to be implemented.

## Related Documents

#	DOCUMENT TITLE	DOCUMENT REFERENCE NUMBER
[1]	Operational Phase Environmental & Sustainability Plan	SMCSWTS2-MTS-CSW-EM-PLN-002697

[2]	Operational Environmental Management Plan	SMCSWTS2-MTS-CSW-EM-PLN-002105
[3]	Noise & Vibration Management Plan	SMCSWTS2-MTS-CSW-EM-PLN-002106 NOISE AND VIBRATION MONITORING PROCEDURE NOISE AND VIBRATION MONITORING PROCEDURE
[4]	ONVR SSI-7400	

# Attachment 1 – Noise and Vibration Monitoring Record Sheet

## Noise Monitoring Record Sheet

### Monitoring Details

<b>Monitoring By:</b>	
<b>Name:</b>	Tajwar Dar
<b>Role:</b>	MTS Environment and Sustainability Advisor
<b>Location of Activity</b>	<u>e.g.</u> Up/ Down; Chainage.
<b>Monitoring Location</b>	<u>e.g.</u> Address, Up/ Down; Chainage; Landmark.
<b>Date of Test</b>	<u>i.e.</u> Day, date, month, year. (day important for operating hours)
<b>Time of Test</b>	Note: Include period ( <u>i.e.</u> day, evening, night, shoulder).
<b>Start:</b>	<u>e.g.</u> 2200
<b>End:</b>	<u>e.g.</u> 2215
<b>Distance from Noise Source</b>	Approximate in metres.
<b>Intervening Ground Conditions</b>	<u>i.e.</u> hard, soft, landscaped, concrete, fence/ barrier, flat, hilly, etc.
<b>Meteorological Conditions</b>	<u>e.g.</u> cloud cover; clear; raining; windy.
<b>Wind Speed / Direction</b>	Approximate.
<b>Laboratory Calibration</b>	<u>i.e.</u> Date and calibration level.
<b>Field Calibration</b>	<u>i.e.</u> time, date and calibration level.
<b>Test Procedure</b>	if required.

### Monitoring Requirements & Results

NCA	RBL Level	Predicted Level		Source of Predicted Levels	Predicted Level		Predicted Level	
	Day –							
	Evening –							
	Night –							

Notes: NCA = Noise Catchment Area; RBL= Rating Background Level.

CONNECTING THE FUTURE

[Insert Title]

### Activity Description and Site Diagram

### Monitoring Comments