

MARTIN PLACE METRO TOWERS

Addendum Construction Noise and Vibration Management Plan

15 December 2020

Lendlease Group

TK422-16-02 F01 Martin Place Towers Addendum CNVMP (r2)

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Prepared for:	Lendlease Group
Address:	Level 14, Tower Three, International Towers Sydney Exchange Place, 300 Barangaroo Avenue, Barangaroo NSW 2000
Attention:	Jason Ambler

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1 Introduction

1.1 Project background

The Sydney Metro CSSI Approval (CSSI 7400) approves the demolition of existing buildings at Martin Place, excavation and construction of the new station (above and below ground) along with construction of below and above ground structural and other components of the future OSD, although the fit-out and use of such areas are the subject of separate development approval processes.

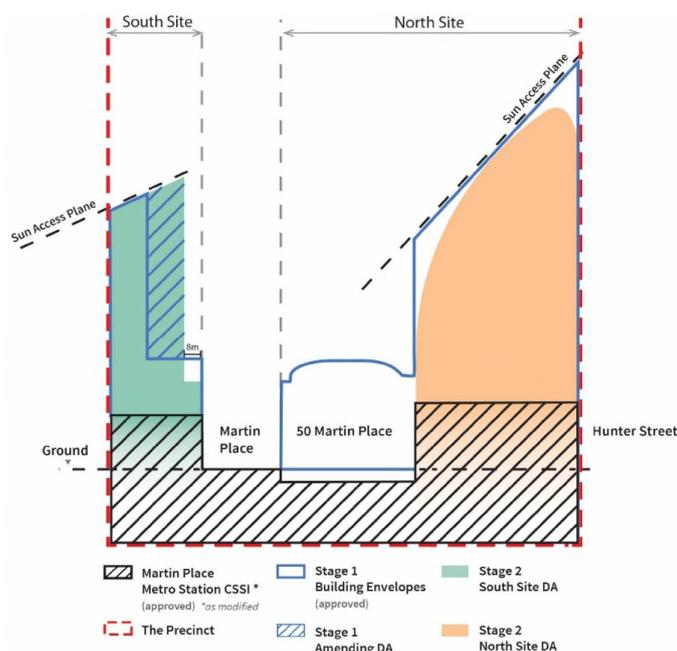
On 22 March 2018, the Minister approved Modification 3 to the Sydney Metro CSSI Approval. This enabled the inclusion of Macquarie-owned land at 50 Martin Place and 9-19 Elizabeth Street within Metro Martin Place station, and other associated changes (including retention of the opening to the existing MLC pedestrian link).

On 22 March 2018, the Minister approved a Concept Proposal (SSD 17_8351) relating to Metro Martin Place Precinct. The Concept Proposal establishes the planning and development framework through which to assess the detailed Stage 2 SSD DAs. Specifically, the Concept Proposal encompassed:

- Building envelopes for OSD towers on the North Site and South Site comprising:
 - 40+ storey building on the North Site
 - 28+ storey building on the South Site.

Figure 1 is a diagrammatic cross section representation of the key planning applications by Macquarie for the Martin Place Precinct and the locations of the Stage 2 North and South sites.

Figure 1: Relationship of the key planning applications for the North Site OSD and South Site OSD within the Martin Place Precinct



1.2 Overview

The construction of two Over Station Development (OSD) towers, at Martin Place are to be undertaken by Lendlease (LL), on behalf of Macquarie Corporate Holdings Pty Limited (Macquarie), as part of two separate State Significant Developments (SSD):

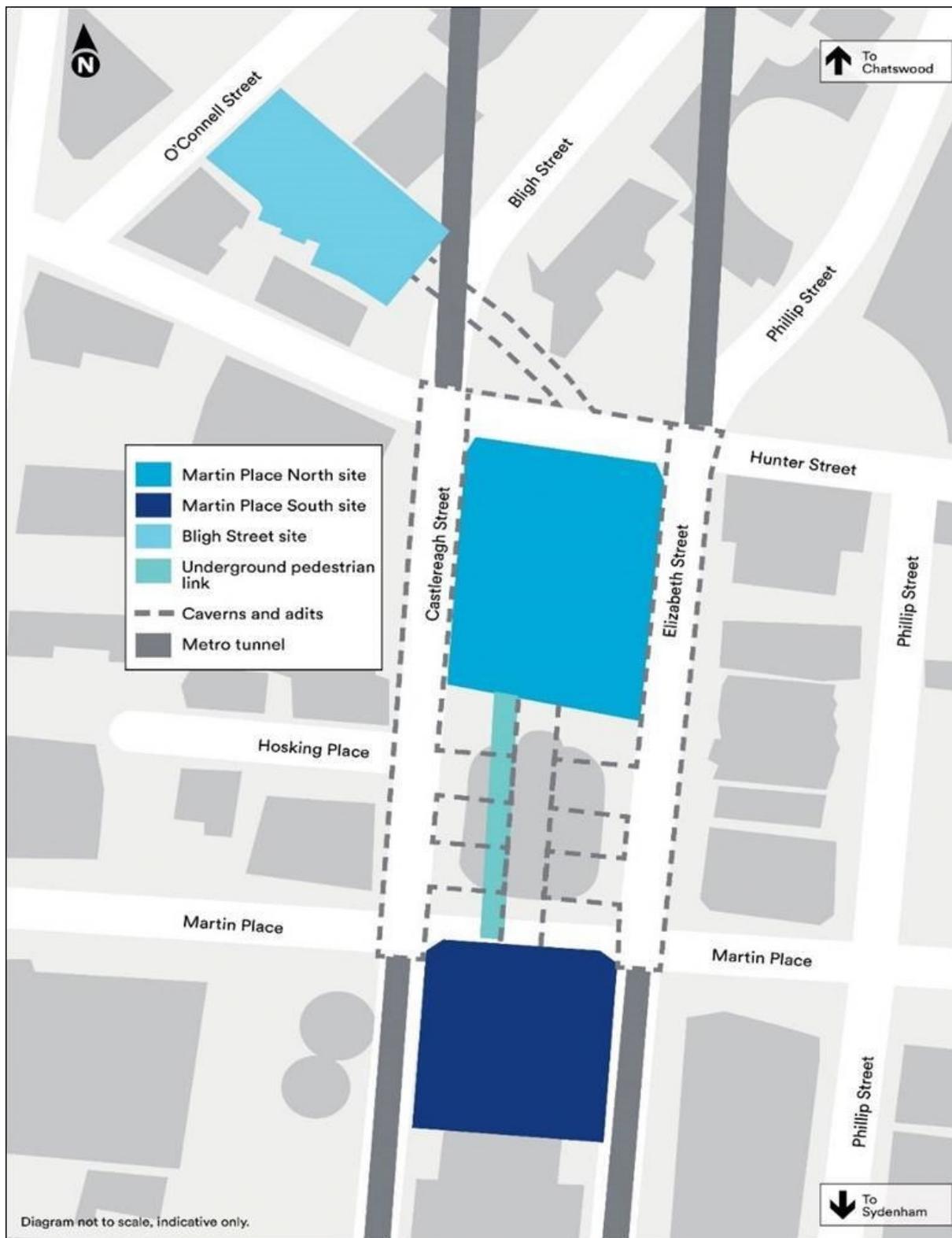
- North Site Over Station Development (OSD) (SSD 9270)
- South Site OSD (SSD 9326)

These towers are located above and integrated with Metro Martin Place station (part of the NSW Government's approved Sydney Metro project). The key elements of the works covered by this CNVMP are:

- **The North Site OSD** is located between Hunter Street, Elizabeth Street and Castlereagh Street, with the OSD situated above. The northern entrance to Metro Martin Place station will fronting onto Hunter Street. This project was granted approval 13 August 2019 and is applicable for construction works from Level 7 upwards. Below Level 7, the structure is approved under the Sydney Metro CSSI 7400. Internal fit out for various SSD areas will occur within the station structure area. SSD facade works will occur from ground level upwards. These areas are defined by the detailed demarcation plans that supplement the SSD planning approval.
- **The South Site OSD** is located on Martin Place in between Elizabeth Street and Castlereagh Street, with the OSD located above. The southern entrance to Metro Martin Place station located at 39-49 Martin Place. This project was granted approval 13 August 2019 and is applicable for construction works from Level 7 upwards. Below Level 7, the structure is approved under the Sydney Metro CSSI 7400. Internal fit out for various SSD areas will occur within the station structure area. SSD facade works will occur from ground level upwards. These areas are defined by the detailed demarcation plans that supplement the SSD planning approval.
- The construction works will be supported by a construction compound located between O'Connell Street and Bligh Street (20-26 O'Connell Street, Sydney), known as the **Bligh Street compound**.

The locations of the worksites are presented in Figure 2.

Figure 2: Location of the North Site OSD and South Site OSD within the Martin Place Precinct



1.3 Purpose and scope

Renzo Tonin & Associates was engaged by LL to prepare an addendum Construction Noise and Vibration Management Plan for works (SSD CNVMP) to cover the construction works for both the North Site OSD (SSD 9270) and the South Site OSD (SSD 9326).

This plan has been specifically written to address SSD 9270 Consent Condition (CoC) C20(a) and SSD 9326 CoC C20(a). Both SSD 9270 CoC C20(a) and SSD 9326 CoC C20(a) state that the CNVMP can be prepared as an addendum to the CNVMP applicable to CSSI 7400 (CSSI CNVMP). As such, the SSD CNVMP to cover construction works related to the North Site OSD and the South Site OSD has been prepared as an addendum to the CSSI CNVMP prepared for the Martin Place Metro construction works approved under CSSI 7400. This has been done both to satisfy these consent conditions and also to ensure consistency between these relevant management documents for the following reasons:

- These works are located at the same project site locations as the CSSI project works.
- Even though there are separate project approvals, some OSD works will occur within the areas of the CSSI approval, and from a sensitive receiver perspective they will be seen as a continuation of the same construction works.
- These works will impact the same receivers.

As such, this SSD CNVMP makes reference to the CSSI CNVMP (Document reference: TK422-F03 Martin Place CSSI CNVMP), and so should be read in conjunction with the CSSI CNVMP.

The SSD CNVMP covers construction works associated with the construction of the North Site Over Station Development (OSD) and South Site OSD for the following development:

- Construction of the 39 story North Tower, comprising a reinforced concrete structure with a glass lift core on Castlereagh Street.
- Integration of the North Tower and 50 Martin Place with interconnecting bridges at nominated levels, and a link to the ground floor, which will form the basis of the Stage 2 North Tower DA application.
- Construction of the 29 story South Tower, comprising a rear core reinforced concrete structure with a podium level to 45 metres, which will form the basis of the Stage 2 South Tower DA application.
- Operation of the Bligh Street construction compound from December 2020, that has been previously utilised by the Tunnelling and Station Excavation (TSE) contractor.

The above works are referred to as 'the Project' within this SSD CNVMP. This SSD CNVMP forms part of the Construction Environmental Management Plan (CEMP) that has been developed for the Project.

Further details for the project phases, timeframes and construction activities are presented in the following:

- Sydney Metro Martin Place Station – Integrated Station Development, Construction Management Plan North Site Stage 2 DA, LendLease, (reference: CSWSMP-MAC-SMA-CM-REP-000120)

- Sydney Metro Martin Place Station – Integrated Station Development, Construction Management Plan South Site Stage 2 DA, LendLease, (reference: CSWSMP-MAC-SMA-CM-REP-000110)

This SSD CNVMP describes how noise and vibration will be managed and mitigated during construction of the Project. This Plan has been prepared to address the relevant requirements of project development consents.

1.4 Objectives

The objectives for this SSD CNVMP are to ensure:

- Compliance with the Minister for Planning's Project Development Consent (SSD 9326);
- Compliance with the Minister for Planning's Project Development Consent (SSD 9270);
- Noise levels would be minimised with the aim of achieving the noise management levels where feasible and reasonable;
- The project would avoid any damage to buildings from vibration;
- Affected sensitive receivers are notified of upcoming works and any out-of-hours works;
- Reasonable and feasible mitigation measures are implemented to minimise and manage noise and vibration impacts on surrounding residents, commercial and other sensitive receivers;
- Any complaints are addressed in a timely and efficient manner.

1.5 Plan Structure

1.5.1 Interaction with other management documents

This plan (SSD CNVMP) is a sub-plan of the Construction Environmental Management Plan for the Project. It has the following interrelationships with other management plans and documents:

- **CSSI 15_7440 Construction noise and Vibration Management Plan (CSSI CNVMP)**, which this sub-plan makes direct reference to for substantial sections of detail applicable for this plan, and so this plan should be read in conjunction with the CSSI CNVMP.
- **Construction Noise and Vibration Impact Statements (CNVIS's)** will detail predicted noise impacts and activity-specific mitigation measures for the various stages of works.
- The **Community Communication Strategy (CCS)** developed for the Project, which details the procedures and processes for community notification, consultation and complaints management.

1.5.2 Construction Noise and Vibration Impact Statements (CNVIS)

Under the SSD CNVMP sit individual CNVISs that provide detailed predictions, assessment and management of impacts for individual construction activities. Section 2 and Section 5.3 provides more detail of the Project

construction activities, and CSSI CNVMP Section 7.1.2 provides additional detail on the CNVIS process. Activity-specific CNVISs, as detailed in CSSI CNVMP Section 7.1.2, will be prepared by Renzo Tonin and Associates to address construction of the Project. Adjacent residential and other sensitive receivers, Noise Catchment Areas (NCAs) and site-specific management measures identified in the CNVIS will be progressively incorporated into the CEMP.

1.6 Training

Training requirements will be as per Section 1.6 of the CSSI CNVMP.

1.7 Consultation

Consultation requirements will be as per Section 1.7 of the CSSI CNVMP.

2 Summary of project works

2.1 Construction works

A preliminary construction program for the project has been developed by LL and is presented in Table 2.1. Three major elements of the Project which are:

1. North Site OSD
2. South Site OSD
3. Bligh Street construction compound.

The location of the worksites are presented in Figure 2.

Table 2.1: Project worksites, construction works and approximate program

Project worksites	Details	Commencement	Completion
North Site OSD	39 storey (plus rooftop plant) commercial OSD tower. Key construction elements: <ul style="list-style-type: none"> • Main structure construction (steel/formwork/concrete) • Façade installation • Buildings services installation works • Internal fit-out 	March 2021	December 2023
South Site OSD	29 story South Tower, comprising a rear core reinforced concrete structure with a podium level to 45 metres. Key construction elements: <ul style="list-style-type: none"> • Main structure construction (steel/formwork/concrete) • Façade installation • Buildings services installation works • Internal fit-out 	June 2021	December 2023
Bligh Street construction support compound	Support site for the North Site OSD and South Site OSD	March 2021	December 2023

2.2 Construction traffic

The worksite will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work
- Heavy vehicle movements generated by:
 - Delivery vehicles bringing raw materials, plant, and equipment to the site
 - Trucks removing construction material and equipment from the site

The access/exit point/s for the North Site are to be located on Castlereagh Street and Elizabeth Streets, while for the South Site the access/exit point is to be located on Castlereagh Street.

LL will work with local City of Sydney, TfNSW, CBD Co-ordinators Office and Sydney Buses to secure the necessary construction zone approvals and vehicular access required off both Elizabeth (North Site only) and Castlereagh Street (North and South Sites) throughout the duration of Metro Martin Place development.

Construction traffic on the site is included as part of the construction noise assessment of the work activities, while when construction-related traffic moves on the public road network, a different noise assessment methodology is appropriate as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

As part of the planning works for the project, LL has developed a Construction Traffic Management Plan. Noise impacts from construction related traffic on public roads will be reviewed and addressed in each CNVIS, to mitigate the potential impacts throughout the construction of the Project.

3 Environmental requirements

The applicable environmental requirements for the SSD CNVMP are as per Section 3 of the CSSI CNVMP, with the following exceptions:

- **CSSI CNVMP Section 3.3 – Environmental performance outcomes** is not applicable to the Project as these were specifically developed for the SMCSWCS project.
- **CSSI CNVMP Section 3.5 – Environmental Representative and Acoustic Advisor Environmental performance** is not directly applicable to the Project as these were required by the approval for the SMCSWCS project. The SSD CNVMP will generally adopt the approach presented in the TfNSW's Construction Noise Strategy (Report No. 7TP-ST-157/2.0, 2012) to guide management of construction noise and vibration impacts. All references to the Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Report No. 610.14213-R3, 2016 in addition to Addendum A v2) are not applicable, as the relevant approval conditions and project roles for this strategy do not apply to the Project.
- **CSSI CNVMP Section 3.6 – Environmental Representative and Acoustic Advisor Environmental performance** is not applicable to the Project as these roles were established for the SMCSWCS project and do not cover construction works for the Project.
- **CSSI CNVMP Section 3.7 – Collaboration with Sydney Metro, ER, IC and AA** is not applicable to the Project as these roles were established for the SMCSWCS project and do not cover construction works for the Project.

4 Existing noise environment and noise/vibration sensitive receivers

4.1 Surrounding receivers and land use

The location of the project site, and the nearby surrounding land use is presented in Appendix B. They have been identified consistent with the approach adopted in the CSSI CNVMP.

4.2 Existing acoustic environment and residential receivers

In accordance with SSD 9270 CoC E20(b(iv)) and SSD 9326 CoC C20(b(iv)), and for consistency with the CSSI CNVMP, the existing noise environment for the purpose of determining noise management levels (NML) for construction works has been based upon the noise levels established in the CSSI CNVMP.

The EIS noise and vibration assessment reports (North Site OSD, ARUP, report reference: CSWSMP-MAC-SMN-NA-REP-999902, Revision 1, dated 29 August 2018 and South Site OSD, ARUP, report reference: CSWSMP-MAC-SMS-NA-REP-999902, Revision 1, dated 23 August 2018) review the background noise levels in the vicinity of the project, and adopted the same RBL values as those adopted in the CSSI CNVMP.

Table 4.1 below summarises the NCAs for the Project and the representative Rating Background Levels (RBLs). These are used to establish construction noise management levels (NMLs) at residential receivers in accordance with the NSW ICNG.

Table 4.1: Nearest noise and vibration sensitive residential receivers and rating background noise levels (RBLs)

NCA	Monitoring location ¹	Relationship to EIS NCAs ¹	RBL Day	RBL Evening	RBL Night
MP_01	Location EIS B.11	Combined EIS NCAs A,G & F	61	56	52
MP_02	1 Hoskings Place, Sydney	EIS Martin Place Station_B	61	56	52
MP_03		EIS Martin Place Station_C	61	56	52
MP_04		EIS Martin Place Station_D & E	61	56	52

Notes: 1. Based upon EIS and Submissions and Preferred Infrastructure Reports for the Sydney City Metro & Southwest (Chatswood to Sydenham) (SMCSWCS) project
2. Location EIS B.11 was long term measurements undertaken at 1 Hoskings Place, Sydney.

4.2.1 Noise and vibration sensitive receivers

The comprehensive updated land-use survey for nearby noise and vibration sensitive receivers and the relevant NCAs are included in Appendix B, consistent with the approach adopted in the CSSI CNVMP.

4.2.2 Heritage receivers

Refer to Section 4.2.2 of the CSSI CNVMP for identification of vibration sensitive heritage items/structures.

5 Hours of work, construction activities and program

5.1 Construction hours

The construction hours for the Project are defined by the SSD 9270 CoC G1 and G2 and SSD 9326 CoC D1 and D2 and are summarised in Table 5.1 below. The standard hours and out-of-hours work (OOHW) periods are depicted in Table 5.1 below. The OOHW periods are further defined as OOHW Period 1 and 2, based on the TfNSW's Construction Noise and Vibration Strategy (TfNSW CNVS).

Table 5.1: Construction hours (SSD 9270 and SSD 9326)

Day	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Monday																								
Tuesday																								
Wednesday																								
Thursday																								
Friday																								
Saturday																								
Sunday																								
Public Holiday																								

Guidance has been taken from the TfNSW CNVS to further define OOHW time periods for the purpose of managing impacts and identifying additional mitigation measures. The TfNSW CNVS defines two OOHW periods as OOHW Period 1 and OOHW Period 2. The naming of the OOHW periods assists when reviewing, assessing and managing impacts from OOHW.

5.2 Out of hours works

SSD 9270 CoC G3 and SSD 9326 CoC D3 allow for construction work to be undertaken outside standard construction hours, under defined circumstances, which are as follows:

- by the Police or a public authority for the delivery of vehicles, plant or materials
- in an emergency to avoid the loss of life, damage to property or to prevent environmental harm.

5.2.1 Out of hours work under Road Occupancy Licence

Construction works may be also required to be completed under Road Occupancy Licence (ROL). Refer to Section 5.2.2 of the CSSI CNVMP for further information. Modification of SSD9270 and SSD9326 to include these unavoidable OOHWs will be requested.

5.2.2 Out of hours deliveries

Oversized deliveries may be required OOHW under approval or escort by the Police or a public authority. Refer to Section 5.2.3 of the CSSI CNVMP for further information.

5.3 Construction activities

The key noise and vibration generating construction activities which have the potential to impact upon nearby sensitive receivers are shown in Table 5.2, which are as follows:

- Site establishment
- Main structure construction
- Façade installation/construction
- Building services installation works
- Construction support activities (Bligh Street compound)

Activities during site establishment and the main structure construction are likely to impact the largest number of receivers due to the higher level of noise emitted by the anticipated equipment.

These construction activities have the potential to impact nearby noise or vibration sensitive receivers via airborne noise, structure-borne or ground-borne noise, or construction vibration. A preliminary assessment of potential construction impacts has been undertaken in the following reports for the Project:

- *Sydney Metro Martin Place Integrated Station Development, North Tower, SSD DA Stage 2: Acoustic Assessment Report, ARUP, Revision 1, 29 August 2018, document reference CSWSMP-MAC-SMN-NA-REP-999902.*
- *Sydney Metro Martin Place integrated station development, South Tower, SSD DA Stage 2: Acoustic Assessment Report, ARUP, Revision 1, 23 August 2018, document reference CSWSMP-MAC-SMS-NA-REP-999902*

The assessment of potential noise and vibration impacts from the Project construction works and the identification of specific feasible and reasonable noise mitigation and management measures to reduce construction noise and vibration impacts will be addressed in the activity specific CNVIS, as detailed in CSSI CNVMP Section 7.1.2. Reasonable and feasible noise and vibration mitigation measures that will be considered for all construction activities are detailed in Section 8.

Table 5.2: Key noise and vibration generating construction activities

Activity	Work to be undertaken	Construction hours
Site establishment	<ul style="list-style-type: none"> • Site accommodation • Site hoarding • Crane installation • Scaffolding • Temporary Works 	Primarily standard construction hours OOHW potentially required due to ROL requirements

Activity	Work to be undertaken	Construction hours
Main structure construction	<ul style="list-style-type: none"> • Concrete core structure construction• • Steel structural framing and bracing • Formwork • Floor slab concrete pours 	Primarily standard construction hours OOHW potentially required for deliveries
Façade construction	<ul style="list-style-type: none"> • Low-level podium façade system installation • Tower curtain wall façade system installation 	Primarily standard construction hours OOHW potentially required for deliveries
Building services and internal fit-out and finishes works	<p>Installation works for:</p> <ul style="list-style-type: none"> • Mechanical services. • Electrical services. • Generator services. • Security services. • Communication services. • Hydraulic services. • Dry and wet fire services. • Vertical transportation (Lift and Escalator). • Internal Works – Fit-out and Finishes <p>Final Commissioning</p>	Primarily standard construction hours OOHW potentially required for deliveries
Construction support activities (Bligh Street compound)	Concrete deliveries	Primarily standard construction hours Community agreement in place for works outside standard construction hours

6 Construction noise and vibration objectives

The applicable construction noise and vibration objectives for the SSD CNVMP are as per Section 6 of the CSSI CNVMP, with the following exceptions:

- **CSSI CNVMP Section 6.2 – Airborne construction noise management level** – This section is to be modified to read as follows:
 - *“Construction noise management levels have been determined using the NSW Interim Construction Noise Guideline (ICNG).”*
- **CSSI CNVMP Section 6.2.1 – Internal noise criteria from Conditions of Approval** is not applicable to the Project as these were specifically developed for the SMCSWCS project. Airborne noise management levels applicable for the Project are as per:
 - **CSSI CNVMP Section 6.2.2 for residential receivers**, which are quantified in CSSI CNVMP Appendix B Table B.1.
 - **CSSI CNVMP Section 6.2.3 for non-residential receivers.**
- **CSSI CNVMP Section 6.4 – Noise intensive activities** - This section is not applicable to the Project as these were specifically developed for the SMCSWCS project.

7 Evaluation, assessment, documentation and consultation

The applicable construction noise and vibration objectives for the SSD CNVMP are as per Section 7 of the CSSI CNVMP, with the following exceptions:

7.1 Construction noise and vibration management system

- **CSSI CNVMP Section 7.1.1 – Overview** - The site-specific Construction Noise and Vibration Impact Statements (CNVIS) will be progressively prepared to address the Project works and will be prepared to cover the works specified in Section 5.3.
- **CSSI CNVMP Section 7.1.2 – Construction noise and vibration impact statements** - The consultation requirements in accordance with CSSI 7400 Condition of Approval E33 are not applicable for the Project.
- **CSSI CNVMP Section 7.1.3 – Management procedures and hold points for OOHW** – The management of procedures for OOHW detailed in CSSI CNVMP Section 7.1.3 are not applicable for the Project. Works are only permitted to occur OOH as detailed in Section 5.2. All OOHW (except in emergency situations) will be documented on the relevant OOHW Form.

7.2 Overview of evaluation and assessment process

- **CSSI CNVMP Section 7.2 – Overview of evaluation and assessment process** – The process step “Under the PPA, an independent Acoustic Advisor (AA) has been engaged by Sydney Metro to review noise and vibration assessments” is not applicable to the Project as the AA role was established for the SMCSWCS project and does not cover construction works for the Project.
- **CSSI CNVMP Section 7.2 – 7.2 Overview of evaluation and assessment process** – The process step “Under the PPA, an independent Acoustic Advisor (AA) has been engaged by Sydney Metro to review noise and vibration assessments” is not applicable to the Project as the AA role was established for the SMCSWCS project and does not cover construction works for the Project.

7.3 Communication and consultation

- **CSSI CNVMP Section 7.3.1 – Overview of approach** – All references to “Project Planning Approval” may not be applicable to the Project as this reference is to the SMCSWCS project in accordance with CSSI 7400 Conditions of Approval. Community Communication Strategy requirements applicable to the SSD CNVMP are detailed in the Community Communication Strategy (CCS), which covers SSD 9270 CoC E11 to E14 and SSD 9326 CoC C11 to C14.
- **CSSI CNVMP Section 7.3.3 – Specific Project Planning Approval requirements** – This section is not applicable to the Project as these were specifically developed for the SMCSWCS project.

- **CSSI CNVMP Section 7.3.4 – Complaints management** – The approach to management of complaints relating to the SSD works is outlined in the project Community Communications Strategy.

7.4 OOHW operation strategy

- **CSSI CNVMP Section 7.4 – OOHW operation strategy** – This section is not applicable to the Project as this is specifically applicable for the SMCSWCS project.

8 Reasonable and feasible noise and vibration mitigation measures

The applicable construction noise and vibration objectives for the SSD CNVMP are as per Section 8 of the CSSI CNVMP, with the following exceptions:

- **CSSI CNVMP Section 8.1 - Standard noise and vibration management measures (Table 8.2 Standard noise and vibration source mitigation measures)** – The text “Appropriate construction respites for each stage of the works will be finalised after consultation with receivers identified in accordance with Condition E37” is not applicable for the Project as it was specifically applicable for the SMCSWCS project. Respite during standard construction hours should be provided in accordance with the TfNSW CNVS, in line with the rest of the text in the CSSI CNVMP.
- **CSSI CNVMP Section 8.2 – Additional noise and vibration management measures** – The text in this section prior to Table 8.5 is superseded by with the following text only applicable for the SSD CNVMP:

During the Project construction works there will be circumstances where after application of all reasonable and feasible mitigation measures identified in Table 8.1 to Table 8.4, the construction noise and vibration objectives (refer Section 6) will be exceeded. In these instances, and in accordance with the permitted construction hours and applicable exceptions detailed in SSD CNVMP Section 5.2, additional noise and vibration management may be applicable in accordance with the TfNSW CNVS, taking into consideration when works are being undertaken (standard hours or OOHW) and the level of exceedance. Additional management measures are outlined in Sections 8.2.1 to 8.2.3.

Additional management measures to be applied when mitigating and managing impacts from the Project construction works in the CNVISs are described in Table 8.5.

- **CSSI CNVMP Section 8.2.4 – Applying additional management measures – Exceedances of internal noise levels** – This section is not applicable for the Project as it was specifically applicable for the SMCSWCS project.
- **CSSI CNVMP Section 8.3 – Residual impacts** – The section “A negotiated agreement can be sought with the affected receivers in accordance with PPA Condition E44(e) which requires agreement with a substantial majority of affected receivers.” is not applicable for the Project as it was specifically applicable for the SMCSWCS project.
- **CSSI CNVMP Section 8.3.1 – Short-term OOHW residual impacts** – The section is not applicable for the Project as it was specifically applicable for the SMCSWCS project.

9 Construction noise and vibration monitoring program

The applicable construction noise and vibration objectives for the SSD CNVMP are as per Section 9 of the CSSI CNVMP, with the following exceptions:

9.1 Noise Monitoring

- **CSSI CNVMP Section 9 – Construction noise and vibration monitoring program** – Construction Noise and Vibration Monitoring Program results are not required to be submitted to the EPA and relevant Councils, as PPA Condition C9 is only applicable for works approved under CSSI 7400.
- **CSSI CNVMP Section 9.1.3 – Attended Airborne Noise Monitoring in the Community (Table 9.2)** – These locations may not be appropriate for all Project construction works. Appropriate attended measurement locations with the best opportunity to validate predicted noise levels will be included in the activity specific CNVIS in accordance with Section 5.3 and CSSI CNVMP Section 7.1.2.
- **CSSI CNVMP Section 9.1.4 – Real-time (unattended) noise monitoring** – The section is not applicable for the Project as it was specifically applicable to the SMCSWCS project.

9.2 Vibration Monitoring

The applicable vibration monitoring requirements for the SSD CNVMP are as per Section 9.2 of the CSSI CNVMP, with the following exceptions:

- **CSSI CNVMP Section 9.2.1 – Attended vibration monitoring** – The following points should be added to when vibration monitoring should be undertaken:
 - Vibration monitoring should be undertaken if the use of vibratory compactors are proposed closer than 30 metres from residential or heritage buildings to confirm that the works comply with vibration criteria as per Section 6.
 - In accordance with any required vibration monitoring as part of the tunnel monitoring plan for the protection of Sydney Trains structures in accordance with SSD 9326 CoC A35, that has been agreed with Sydney Trains.
- **CSSI CNVMP Section 9.2.2 – Real-time (unattended) vibration monitoring** – The section is not directly applicable for the Project as it was specifically applicable to the SMCSWCS project works.

9.4 Consultation and documentation

- **CSSI CNVMP Section 9.4 – Consultation and documentation** – The section “*Additionally, PPA Condition C12 requires Construction Monitoring Programs to be developed in consultation with*

relevant government agencies as identified in PPA Condition C9" is not applicable for the Project as it was specifically applicable for the SMCSWCS project.

9.7 Reporting of monitoring results

- **CSSI CNVMP Section 9.7 – Reporting of monitoring results** – The section is not applicable for the Project as it was specifically applicable to the SMCSWCS project. Reporting requirements for monitoring results are detailed in the Construction Framework Environmental Management Plan, as required by SSD 9270 CoC E16 and SSD 9326 CoC C16.

Part B – Systems and tools

Part B of this Plan explains how the noise and vibration impacts of the Project will be minimised. Compliance with all elements of these systems and tools is required at all times to minimise the likelihood of causing unauthorised environmental harm and maximise the uptake of opportunities to reduce environmental impact.

All sections of Part B of the CSSI CNVMP are applicable for implementation in the SSD CNVMP for the Project construction works, with the following exceptions:

- **CSSI CNVMP Part B – Element 2 - Monitoring and Reporting - Noise and vibration monitoring records are maintained** – The reporting requirements for the noise and vibration monitoring results as detailed in the CSSI CNVMP are specific to the CSSI 7400 approval requirements. The results of noise and vibration monitoring for the Project shall be documented, maintained, and published in accordance with the Construction Framework Environmental Management Plan, as required by SSD 9270 CoC E16 and SSD 9326 CoC C16.
- **CSSI CNVMP Part B – Element 3 - Auditing, Review and Improvement - Noise and vibration monitoring records are maintained** – References to the ER and AA as these roles were established for the SMCSWCS are not applicable to the Project, in addition to the requirements for provision of real time noise and vibration monitoring. The SSD CNVMP is to be approved by the Planning Secretary and Certifying Authority as required by SSD 9270 CoC E20 and SSD 9326 CoC C20.
- **CSSI CNVMP Part B – Element 4 – Project Specific Requirements** – The section is not directly applicable for the Project as it was specifically applicable to the SMCSWCS project works. Element 4 is replaced by the following section for the Project, which addresses the requirements of SSD 9270 and SSD 9326.

Element 4 – Project Specific Requirements

SSD 9270 Development Consent (North Site OSD) and SSD 9326 Development Consent (South Site OSD) (noise and vibration relevant conditions)

SSD 9270 CoC No (North Site)	Requirement	SSD 9326 CoC No. (South Site)	Requirement	Proposed actions	Responsible Key Contributor	Timing	Relevant CNVMP section
PROTECTION OF SYDNEY TRAINS STRUCTURES AND EASEMENT							
-	-	A35	Prior to the issue of the relevant Construction Certificate, a tunnel monitoring plan (including instrumentation and the monitoring regime during excavation and construction phases) is to be submitted to Sydney Trains for review and endorsement or as otherwise agreed by Sydney Trains. The Principal Certifying Authority is not to issue a Construction Certificate until written confirmation has been received from Sydney Trains advising of the need to undertake the tunnel monitoring plan, and if required, that it has been endorsed.	This CNVMP outlines the monitoring expectations for this project (Section 9).	Project Environment Manager Project Noise and Vibration Consultant	Construction	Section 9 and Appendix C
CONSTRUCTION NOISE AND VIBRATION MANAGEMENT SUB-PLAN							
E20	Prior to the issue of the relevant Construction Certificate, the Applicant shall:	C20	Prior to the issue of the relevant Construction Certificate, the Applicant shall:	-	-	-	-
(a)	amend, or prepare an addendum to, the Construction Noise and Vibration Management Sub-Plan (CNVMP) applicable to the CSSI station works (CSSI 7400) to apply to the development. The amended CNVMP must be submitted to the Planning Secretary and Certifying Authority, or	(a)	amend, or prepare an addendum to, the Construction Noise and Vibration Management Sub-Plan (CNVMP) applicable to the CSSI station works (CSSI 7400) to apply to the development. The amended CNVMP must be submitted to the Planning Secretary and Certifying Authority, or	Development of this plan	Project Environment Manager Project Noise and Vibration Consultant	Construction	This plan
(b)	prepare and implement a Construction Noise and Vibration Management Sub-Plan (CNVMP) for the development, independent of the CNVMP approved with the CSSI station works. A copy of the CNVMP must be submitted to the Planning Secretary and Certifying Authority. The Sub-Plan must include:	(b)	prepare and implement a Construction Noise and Vibration Management Sub-Plan (CNVMP) for the development, independent of the CNVMP approved with the CSSI station works. A copy of the CNVMP must be submitted to the Planning Secretary and Certifying Authority. The Sub-Plan must include:	Not applicable as item (a) has been adopted to address SSD 9270 CoC E20 and SSD 99326 CoC C20			

PRE-CONSTRUCTION DILAPIDATION REPORTS:							
C23	Unless already carried out under CSSI 7400 for all relevant affected adjoining buildings, infrastructure and roads, the Applicant is to engage a suitably qualified person to prepare a Pre-Construction Dilapidation Report. The Report is to detail the current structural condition of all adjoining buildings, infrastructure and roads (including the public domain site frontages, the footpath, kerb and gutter, driveway crossovers and laybacks, kerb ramps, road carriageway, street trees and plantings, parking restrictions and traffic signs, and all other existing infrastructure along the street) within the 'zone of influence'. Any entry into private land is subject to the consent of the owner and any inspection of buildings on privately affected land shall include details of the whole building where only part of the building may fall within the 'zone of influence'. The report shall be submitted to the satisfaction of the Certifying Authority prior to the issue of the Construction Certificate. A copy of the report is to be forwarded to the Certifying Authority and each of the affected property owners.	C23	Unless already carried out under CSSI 7400 for all relevant affected adjoining buildings, infrastructure and roads, the Applicant is to engage a suitably qualified person to prepare a Pre-Construction Dilapidation Report. The Report is to detail the current structural condition of all adjoining buildings, infrastructure and roads (including the public domain site frontages, the footpath, kerb and gutter, driveway crossovers and laybacks, kerb ramps, road carriageway, street trees and plantings, parking restriction and traffic signs, and all other existing infrastructure along the street) within the 'zone of influence'. Any entry into private land is subject to the consent of the owner(s) and any inspection of buildings on privately affected land shall include details of the whole building where only part of the building may fall within the 'zone of influence'. The report shall be submitted to the satisfaction of the Certifying Authority prior to the issue of the Construction Certificate. A copy of the report is to be forwarded to the Certifying Authority and each of the affected property owners.	See CSSI CNVMP Table 8.4	Project Environment Manager Construction Managers	Prior to construction	CSSI CNVMP Table 8.4
CONSTRUCTION HOURS							
G1	Construction, including the delivery of materials to and from the site, may only be carried out between the following hours: (a) between 7.00 am and 6.00 pm, Mondays to Fridays inclusive; and (b) between 7.00 am and 5.00 pm, Saturdays.	D1	Construction, including the delivery of materials to and from the site, may only be carried out between the following hours: (a) between 7.00 am and 6.00 pm, Mondays to Fridays inclusive; and (b) between 7.00 am and 5.00 pm, Saturdays.	See Section 5	Construction Managers Project Environment Manager Environment coordinators	Construction	See Section 5
G2	No work may be carried out on Sundays or public holidays.	D2	No work may be carried out on Sundays or public holidays.		Project Noise and Vibration Consultant		
G3	Activities may be undertaken outside of these hours if required: (a) by the Police or a public authority for the delivery of vehicles, plant or materials; or	D3	Activities may be undertaken outside of these hours if required: (a) by the Police or a public authority for the delivery of vehicles, plant or materials; or	See Section 5.2	Construction Managers	Construction	Section 5.2

	(b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm.		(b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm;		Project Environment Manager		
G4	Notification of such activities must be given to affected residents before undertaking the activities or as soon as is practical afterwards.	D4	Notification of such activities must be given to affected residents before undertaking the activities or as soon as is practical afterwards.	See Section 0	Construction managers Project Environment Manager	If emergency works required	Section 0
IMPLEMENTATION OF MANAGEMENT PLANS							
G5	The Applicant must ensure the requirements of the Construction Environmental Management Plan, Construction Pedestrian Traffic Management Plan, Construction Noise and Vibration Management Sub-Plan, Air Quality Management Plan and Construction Waste Management Plan required by Part B of this consent are implemented during construction.	D5	The Applicant must ensure the requirements of the Construction Environmental Management Plan, Construction Pedestrian Traffic Management Plan, Construction Noise and Vibration Management Sub-Plan, Air Quality Management Plan and Construction Waste Management Plan required by Part B of this consent are implemented during construction.		Project Environment Manager		
VIBRATION CRITERIA							
G7	Vibration caused by construction at any residence or structure outside the Site must be limited to:	D7	Vibration caused by construction at any residence or structure outside the Site must be limited to:				
(a)	for structural damage vibration, British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration	(a)	for structural damage vibration, British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration	Vibration impact to be assessed for the worksite in CNVIS. As per SSD CNVMP Section 6 see CSSI CNVMP Sections 6.7, Section 6.8.	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Section 6 (which directs to CSSI CNVMP Sections 6.7, Section 6.8)
(b)	for human exposure to vibration, the evaluation criteria set out in the Environmental Noise Management Assessing Vibration: a Technical Guideline (Department of Environment and Conservation, 2006)	(b)	for human exposure to vibration, the evaluation criteria set out in the Environmental Noise Management Assessing Vibration: a Technical Guideline (Department of Environment and Conservation, 2006)	Vibration impact to be assessed for the worksite in CNVIS. As per SSD CNVMP Section 6	Project Environment Manager Construction managers	Construction	Section 6 (which directs to CSSI CNVMP Sections 6.6)

				see CSSI CNVMP Sections 6.6.	Environment coordinators Project Noise and Vibration Consultant		
(c)	vibratory compactors must not be used closer than 30 metres from residential or heritage buildings unless vibration monitoring confirms compliance with the vibration criteria specified above	(c)	vibratory compactors must not be used closer than 30 metres from residential or heritage buildings unless vibration monitoring confirms compliance with the vibration criteria specified above	Vibration monitoring where vibratory compactors are proposed to be used closer than 30 metres to any residential or heritage building	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Section 9.2
(d)	these limits apply unless otherwise outlined in the amended CSSI CNVMP or the project-specific CNVMP (Condition C21).	(d)	these limits apply unless otherwise outlined in the amended CSSI CNVMP or the project-specific CNVMP (Condition C21).	Vibration impact to be assessed for the worksite in CNVIS. As per SSD CNVMP Section 6	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Section 6 (which directs to CSSI CNVMP Sections 6.6, Sections 6.7 and Section 6.8)
G8	The Applicant must undertake trial testing of vibration intensive equipment that is identified as having the potential to exceed the vibration criteria identified to ensure it is not exceeded at any residence or structure outside the subject site.	D8	The Applicant must undertake trial testing of vibration intensive equipment that is identified as having the potential to exceed the vibration criteria identified in Condition B18* to ensure it is not exceeded at any residence or structure outside the subject site. <i>* Note: CoC B18 does not contain vibration criteria</i>	Monitoring will be conducted as required under the CNVIS. See Section 9.2	Project Environment Manager Construction managers Environment coordinators Project Noise and Vibration Consultant	Construction	Section 9.2

References

1. Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline
1. Environment Protection Authority 1999 NSW Environmental Criteria for Road Traffic Noise
2. Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
3. British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
4. German Standard DIN 4150-3: 1999-02, Structural vibration - Effects of vibration on structures, February 1999
5. ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40
6. Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16
7. Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors*
8. Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
9. Gordon CG 1991 Generic Vibration Criteria for Vibration Sensitive Equipment *Proceedings of International Society for Optical Engineering (SPIE)*, Vol. 1619, San Jose, CA, November 4-6, 1991, pp. 71-85
10. Transport for NSW Construction Noise Strategy (ref: 7TP-ST-157/2.0) April 2012
11. Australian Standard AS2187:2-1993 Explosives - Storage and use Part 2: Use of explosives (superseded by AS2187:2-2006)

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Active recreation	Active recreation area, characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion, e.g. school playground, golf course
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Alternate Solution	An Alternative Solution is a design that complies with the relevant Performance Requirements of the National Construction Code other than by using Deemed-to-Satisfy Provisions.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-6pm, Evening 6pm-10pm, Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"

Decibel [dB]	<p>The units of sound measurement. The following are examples of the decibel readings of every day sounds:</p> <p>0dB The faintest sound we can hear, defined as 20 micro Pascal</p> <p>30dB A quiet library or in a quiet location in the country</p> <p>45dB Typical office space. Ambience in the city at night</p> <p>60dB CBD mall at lunch time</p> <p>70dB The sound of a car passing on the street</p> <p>80dB Loud music played at home</p> <p>90dB The sound of a truck passing on the street</p> <p>100dB The sound of a rock band</p> <p>115dB Limit of sound permitted in industry</p> <p>120dB Deafening</p>
dB(A)	<p>A-weighted decibel. 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 is denoted as dB(A). Practically all noise is measured using the A filter.</p>
dB(C)	<p>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 from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.</p>
Diffraction	<p>The distortion of sound waves caused when passing tangentially around solid objects.</p>
DIN	<p>German Standard</p>
DnT,w	<p>Weighted Standardised Field Level Difference</p> <p>A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ.</p> <p>It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space.</p> <p>The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance.</p>
ECRTN	<p>Environmental Criteria for Road Traffic Noise, NSW, 1999</p>
EPA	<p>Environment Protection Authority</p>
Field Test	<p>A test of the sound insulation performance in-situ. See also 'Laboratory Test'</p> <p>The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion.</p> <p>A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.</p>
Fluctuating Noise	<p>Noise that varies continuously to an appreciable extent over the period of observation.</p>
Free-field	<p>An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.</p>
Frequency	<p>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.</p>
Ground-borne noise	<p>Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.</p>

Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
Impact Noise	The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies.
Impulsive noise	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.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	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.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L ₁	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L _{10(1hr)}	The L ₁₀ level measured over a 1 hour period.
L _{10(18hr)}	The arithmetic average of the L _{10(1hr)} levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).
L _{Aeq} OR L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the L _{Aeq} .
L _{Aeq(1hr)}	The L _{Aeq} noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted L _{eq} during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
L _{Aeq(8hr)}	The L _{Aeq} noise level for the period 10pm to 6am.
L _{Aeq(9hr)}	The L _{Aeq} noise level for the period 10pm to 7am.
L _{Aeq(15hr)}	The L _{Aeq} noise level for the period 7am to 10pm.
L _{Aeq (24hr)}	The L _{Aeq} noise level during a 24 hour period, usually from midnight to midnight.
L _{max}	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the L _{Amax} .
L _{min}	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the L _{Amin} .
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.

LnT,w	<p>Weighted Standardised Field Impact Sound Pressure Level</p> <p>As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.</p> <p>The equivalent measurement in a laboratory is the Ln,w.</p> <p>A lower value indicates a better performing floor.</p>
Laboratory Test	<p>The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.</p>
Loudness	<p>A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.</p>
Microphone	<p>An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.</p>
NCA	<p>Noise Catchment Area. An area of study within which the noise environment is substantially constant.</p>
Noise	<p>Unwanted sound</p>
NRC	<p>Noise Reduction Coefficient.</p> <p>A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material.</p> <p>The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice.</p>
Passive recreation	<p>Area specifically reserved for passive recreation, characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. reading, meditation</p>
PPA	<p>Project Planning Approval</p>
Reflection	<p>Sound wave reflected from a solid object obscuring its path.</p>
Reverberation Time	<p>The time (in seconds) it takes for a noise signal within a confined space to decay by 60dB. The longer the reverberation time (usually denoted as RT60), the more echoic a room. Longer reverberation times generally result in higher noise levels within spaces.</p>
RMS	<p>Root Mean Square value representing the average value of a signal.</p>
Rw	<p>Weighted Sound Reduction Index</p> <p>A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.</p> <p>The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w.</p> <p>The higher the value the better the acoustic performance of the building element.</p>
R'w	<p>Weighted Apparent Sound Reduction Index.</p> <p>As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.</p> <p>The higher the value the better the acoustic performance of the building element.</p>
RNP	<p>Road Noise Policy, NSW, March 2011</p>
SEL	<p>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.</p>

Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the R_w and the sound insulation between two rooms can be described by the $D_{nT,w}$.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 micro Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	<p>A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space.</p> <p>The noise level in a room is affected by reverberation in the room. For example, the $L'_{n,w}$ impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.</p>
STC	<p>Sound Transmission Class</p> <p>A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory.</p> <p>The term has been superseded by R_w.</p>
Structure-borne Noise	<p>Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine.</p> <p>Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example).</p> <p>Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.</p>
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	<p>The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another.</p> <p>For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the R_w or $R'w$ or $D_{nT,w}$.</p>

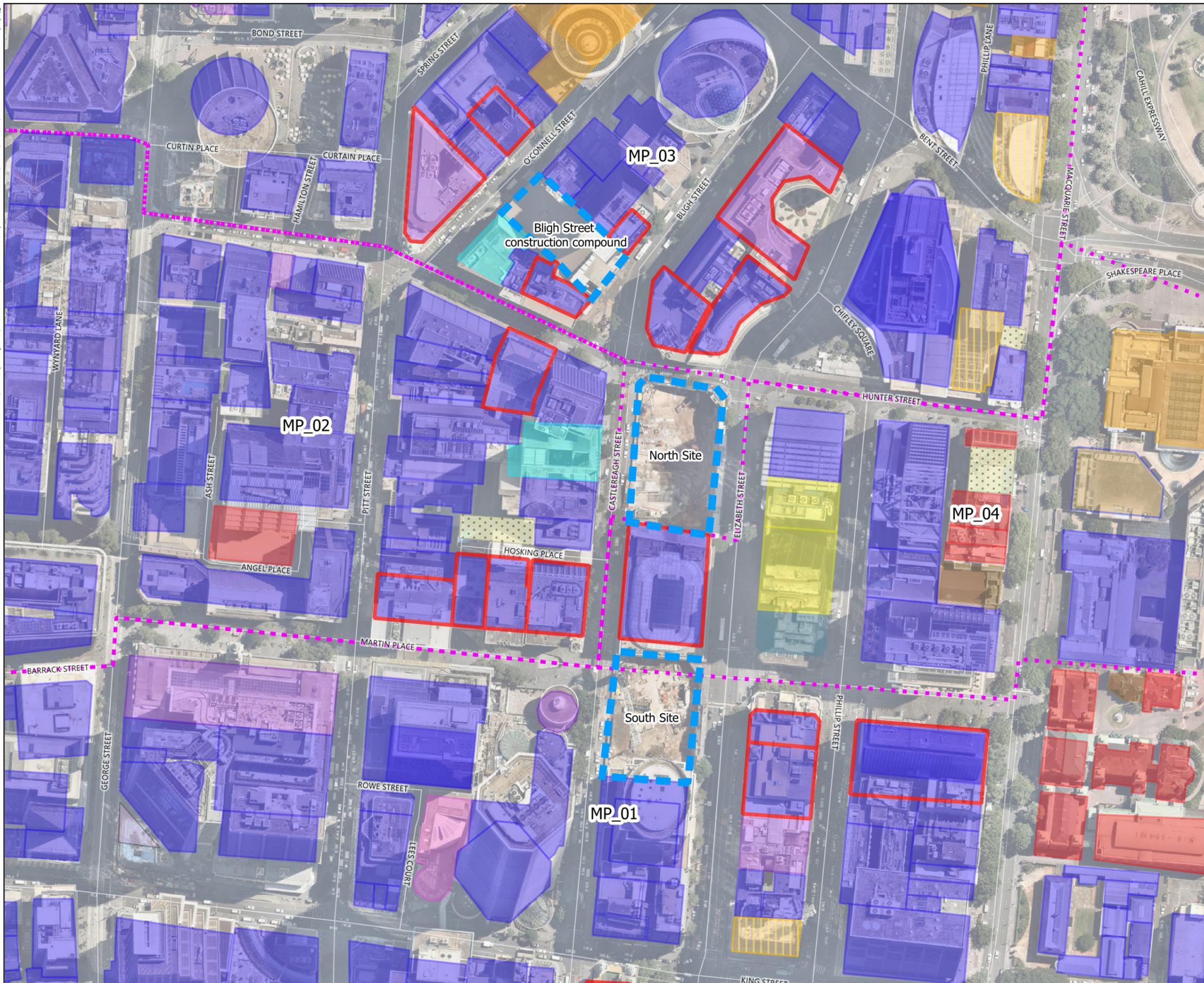
APPENDIX B Land Use Survey and Noise Catchment Areas (NCA)

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels

BL

NCA	Receiver Type	Reference RBL	Rating Background Levels (RBLs)			Residential NMLs based on ICNG (to guide notifications and feasible and reasonable mitigation measures)					Residential External Noise Management Levels (NMLs) ¹ L _{Aeq15min}		Sleep Dist. L _{Amax}		Comments	
			Day	Evening	Night	Day (S)	Day (O)	Evening (6pm-10pm)	Shoulder (10pm - 12am)	Night (12am - 7am)	Day/Evening (7am to 8pm)	Evening/Night (8pm to 7am)	Screening	Max		
			MP_01	Residential CBD	EIS B.11	61	56	52	71	66	61	59	57	80		65
MP_02	Residential CBD	EIS B.11	61	56	52	71	66	61	59	57	80	65	65	75	EIS B.11	
MP_03	Residential CBD	EIS B.11	61	56	52	71	66	61	59	57	80	65	65	75	EIS B.11	
MP_04	Residential CBD	EIS B.11	61	56	52	71	66	61	59	57	80	65	65	75	EIS B.11	
ID	Other Sensitive Receivers															
OSR	Recording studio	ICNG	-	-	-	25 (internal)					60 (internal)		-	-		
OSR	Childcare	ICNG	-	-	-	45 (internal)					60 (internal)		-	-		
OSR	Place of worship	ICNG	-	-	-	45 (internal)					60 (internal)		-	-		
OSR	Hotel	ICNG	-	-	-	40 (internal)					60 (internal)		65	75		
OSR	Commercial	ICNG	-	-	-	70 (external)					60 (internal)		-	-		
OSR	Industrial	ICNG	-	-	-	75 (external)					60 (internal)		-	-		
Notes:	1 - Levels are estimated assuming a closed window (i.e. 20dBA façade loss)															

180 m
160
140
120
100
80
60
40
20
0



LEGEND

Noise sensitive receivers

Childcare	Theatre/Auditorium
Commercial	Mixed use
Educational	Project acquisition
Hotel/Motel/Hostel	Film/TV studio
Industrial	Cinema
Medical	Community centre
Place of Worship	Library
Recording studio	Laboratory
Recreational - Active	Other
Recreational - Passive	Heritage
Residential	

- NCA boundary
- Construction work area



..
r1	ALe	04/12/20	Prepare figures (Sth access walkway)	MT
r0	ALe	04/12/20	Prepare figures	
REV	BY	DATE	DESCRIPTION	APPROVER
A3 Original			Co-ordinate System: MGA Zone 56	

0 20 40 60 80 m

1:2000

FULL SIZE A3
NOTE: Do not scale from this drawing.

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Ph (02) 8218 0500 Fax (02) 8218 0501

APPENDIX C Monitoring procedures

Construction noise and vibration monitoring procedures are detailed in Appendix E of the CSSI CNVMP, these are applicable to the Project and this SSD CNVMP.