

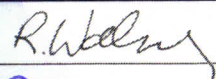
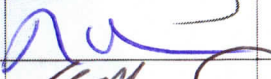
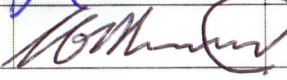


## Construction Noise and Vibration Impact Statement

Sydney Metro City & Southwest  
Package B – Martin Place

Project/Plan No: MD1968/09A  
for Transport for NSW

Controlled Document Number: 01

Details	Title	Name	Signature	Date
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## Contents

1	Project Information .....	4
1.1	Introduction .....	4
1.2	Scope.....	4
2	Objectives.....	5
3	Demolition Activities and Tasks .....	5
4	Sensitive Receivers.....	8
5	Noise and Vibration Management Levels .....	10
5.1	Out of Hours Work .....	10
6	Demolition Noise Management Levels .....	10
6.1.1	Airborne and Structure Borne Noise .....	10
6.1.2	Respite for Receivers .....	10
6.1.3	Demolition Traffic Noise .....	11
6.2	Vibration Criteria.....	11
6.2.1	Human Comfort Continuous and Impulsive Vibration Criteria.....	11
6.2.2	Structural Damage Site Vibration Control Criteria.....	12
7	Demolition Methodology - Noise and Vibration Sources.....	12
7.1	Demolition Activities .....	12
7.2	Noise and Vibration Sources .....	16
7.2.1	Plant and Equipment .....	16
7.2.2	Correction Factors .....	17
8	Demolition Noise and Vibration Assessment.....	17
8.1	Airborne Noise .....	17
8.2	Structure Borne Noise and Vibration .....	20
9	Discussion of Results.....	20
10	Mitigation Measures.....	21
11	Noise and Vibration Monitoring.....	22
11.1	Plant and Equipment Noise Auditing .....	26
11.2	Reporting.....	26
11.3	Inspections .....	26
12	Conclusion .....	26
	Appendix A - Acoustic Terminology.....	28
	Appendix B – Predicted Airborne Internal Noise Level Maps.....	29
	Appendix C – Predicted Structure Borne Noise Level Maps.....	30

## CNVIS - Revision Control

Issue number	Date Issued	Amended Page(s)	Action / Amendment Description	Approved By
001	10/03/17		Created	Bert Musch
002	08/05/17	As per tracking sheet	Issued for endorsement by A.A. and E.R.	Bert Musch
003	10/5/17	Table 5 Page 12	Issued for endorsement by A.A. and E.R.	Bert Musch

## CNVIS – Review

Date Reviewed	Reviewed By	Was Revision Required

## CNVIS - Controlled Document Distribution

Copy	Issued To	Organisation	Date	Authority
01				
02				
03				

# 1 Project Information

## 1.1 Introduction

The New South Wales (NSW) Government through Transport for NSW (TfNSW) is implementing *Sydney's Rail Future*, a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of commuters and customers in the future.

Sydney Metro is a new standalone rail network identified in *Sydney's Rail Future*. The Sydney Metro network consists of Sydney Metro Northwest (previously known as the North West Rail Link) and Sydney Metro City & Southwest.

The proposed Sydney Metro City & Southwest (SMC&SW) comprises of two core components:

- The Chatswood to Sydenham project involves the construction and operation of an underground rail line approximately 15.5 kilometres long inclusive of new stations between Chatswood and Sydenham.
- The second core component will involve upgrading the 13.5 kilometre rail line and existing stations from Sydenham to Bankstown.

## 1.2 Scope

Metropolitan Demolitions Pty Ltd (MD) is undertaking the Sydney City Metro & Southwest, Package B - Martin Place (the project) which consists of the demolition and removal of four buildings located at:

- 55 Hunter Street
- 5 Elizabeth Street
- 7 Elizabeth Street;
- 8 to 12 Castlereagh Street.

The project demolition scope of works includes:

- Demolition and removal of buildings elements and infrastructure including basement levels, excluding:
  - Concrete slab on ground
  - Section of walls acting as retaining structures
- Disconnect and cap all utilities/services at relevant property boundaries or as per provided location
- Traffic management
- Waste sorting and removal
- Site remediation
- Asbestos removal
- Decommissioning of plant
- Designing and installation of Temporary Works
- Remove all water meters and return to Sydney Water
- Protection of structures
- Transport of waste
- Preparation of Management Plans
- Preparation and submission of Survey Plan
- Coordination of the interface Work

Key stages of the project will be carried out as described in **MD1968/03.A Demolition Work Plan** (DWP) prepared for the project. Work will generally follow the sequence as indicated below.

1. Receive handover of site and sign off services
2. Site induction
3. Demarcate site and define exclusion zones
4. Install environmental controls
5. Practical removal of hazardous materials
6. Soft strip structure

7. Erect scaffold and protection
8. Mechanical demolition
9. Remove rubble and rubbish from site
10. Handover
11. Demobilisation.

All works will be completed in accordance with *Code of Practice: Demolition work, AS2601: The demolition of structures* and shall meet the requirements of the *Work Health and Safety Act 2011 (NSW)* and *Work Health and Safety Regulation 2011 (NSW)*.

## 2 Objectives

The Condition E33 of the Sydney Metro City & Southwest Chatswood to Sydenham Infrastructure Approval (CoA, under Section 115ZB of the Environmental Planning Act 1979, Application No: SSI 15\_7400) requires that a Construction Noise and Vibration Impact Statement (CNVIS) must be prepared for each construction site prior to undertaking works which may cause adverse noise and vibration impacts. The key objectives of the CNVIS are to:

- Identify noise and vibration sensitive receivers.
- Predict the noise and vibration impacts from the proposed construction works.
- Based on the predictions, assess the noise and vibration impacts against the objectives set out in the Construction Noise and Vibration Management Plan (CNVMP).
- Where exceedances of the nominated noise and vibration objectives have been predicted, include site specific mitigation measures to reduce noise and vibration impacts.

This subplan has been prepared to comply with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy (CNVS), the Interim Construction Noise Guidelines (Department of Environment and Climate Change, 2009) (ICNG) and the conditions in the Infrastructure Approval (CoA, under Section 115ZB of the Environmental Planning Act 1979, Application No: SSI 15\_7400). Where there are any inconsistencies between these documents, the conditions of the latest document have been adopted. In addition, this subplan draws guidance from the Construction Noise and Vibration Management Plan (CNVMP, MD Document Reference: MD1968/09).

This document may be altered during the course of works. Any changes to this document will be submitted to relevant parties for approval prior to implementation.

## 3 Demolition Activities and Tasks

The site associated with Work Package B is Martin Place. The works generally involves stripping out, all building interiors; including existing fixtures, fittings and equipment, demolishing the structure, awnings and services and disposing of all building materials. Work Package B will include the demolition of:

- 55 Hunter Street
- Elizabeth Street
- Elizabeth Street
- 8-12 Castlereagh Street

Table 1 presents an overview of each demolition activity together with the tasks involved.

**Table 1 Demolition Activities and Tasks**

Activity	Tasks
Early Works	<ul style="list-style-type: none"> <li>Heritage removal</li> <li>Prepare loadout, dropzone and hoist</li> <li>Erect 'B' class hoardings</li> <li>Site office and amenities</li> <li>Install man and materials hoist</li> </ul>
Hazmat Removal	<ul style="list-style-type: none"> <li>Removal of hazardous materials</li> </ul>
Scaffolding	<ul style="list-style-type: none"> <li>Erect scaffolding with shade cloth and mesh</li> </ul>
Soft Strip	<ul style="list-style-type: none"> <li>Removal of all internal loose fixtures and fittings as well as fixed items</li> <li>Remove non-structural components</li> </ul>
Hard Demolition	<ul style="list-style-type: none"> <li>Demolition of structural components</li> </ul>
Completion of the Work	<ul style="list-style-type: none"> <li>Install shoring and anchors</li> <li>Install 'A' class hoarding and removal of awning</li> <li>Final clean and demobilise</li> </ul>

The proposed demolition works have been divided into four stages as follows:

- Stage 1 – 55 Hunter Street, Levels 17 to 21
- Stage 2 – 55 Hunter Street, Levels 15 and 16
- Stage 3 – 55 Hunter Street, 5 Elizabeth Street and 8-12 Castlereagh Street, Levels 12 to 14
- Stage 4 – 55 Hunter Street, 5 Elizabeth Street, 7 Elizabeth Street and 8-12 Castlereagh Street, Levels 13 to B2

Figure 1 presents the preliminary demolition program for the Martin Place demolition works.

Figure 1 Preliminary Demolition Program

Stage	July 2017				August 2017				September 2017				October 2017				November 2017				December 2017				January 2018				February 2018				March 2018							
	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4	Wk1	Wk2	Wk3	Wk4				
1																																								
2																																								
3																																								
4																																								

## 4 Sensitive Receivers

The project has noise and vibration sensitive receivers within adjoining or adjacent buildings to the construction site. The properties identified to be potentially most affected by the works are detailed in Table 2. Figure 2 shows the site plan together with surrounding noise and vibration sensitive receivers.

*Table 2 Noise and Vibration Sensitive Receivers at Martin Place site*

Address	Building Usage	Heritage Vibration Sensitivity	Near point Distance to Works
17 Castlereagh Street	Medical – 9th Floor Only Commercial (Offices/Retail) – All Floors	No	22 m
15 Castlereagh Street	Child Care – 1 <sup>st</sup> and 2 <sup>nd</sup> Floors Commercial (Offices) – All Floors	No	20 m
9 Castlereagh Street	Child Care - Ground Floor Only Café – Ground Floor Only Commercial (Offices/Retail) - All Other Floors	No	22 m
1 Castlereagh Street	Commercial (Offices/Retail) – All Floors	No	19 m
37 Bligh Street	Wine Bar – Ground Floor Only Commercial (Offices) – All Floors	No	50 m
66 Hunter Street	Restaurant – Ground and 1 <sup>st</sup> Floors Medical – 5th Floor Only Mediation Centre – 10 <sup>th</sup> Floor Only Commercial (Offices) – All Floors	Yes	20 m
8 Chifley Square	Restaurant – Ground Floor Only Commercial (Offices/Retail) – All Floors	No	32 m
48 Martin Place (Macquarie Bank)	Commercial (Offices) – All Floors	Yes	<1 m
9-19 Elizabeth Street (Macquarie Bank)	Commercial (Offices) – All Floors Recording Studio <sup>1</sup>	No	<1 m
32 Martin Place	Commercial (Offices) – All Floors	Yes	37 m
52 Martin Place	TV Studio – Ground to 4 <sup>th</sup> Floors Commercial (Offices/Retail) – All Floors	No	37 m
1 Hosking Place	Residential – All Floors	No	55 m

Note 1: It is understood that Macquarie Bank operates a recording studio within the building located at 9-19 Elizabeth Street. MD have negotiated with Macquarie Bank to coordinate high noise activities around the operation of the recording studio. This building will not be further considered as a recording studio for assessment purposes.



Figure 2 Site Plan



Note 1: The Receiver Type colour coding presented represents the highest noise sensitive usage throughout the entire building. Refer to Table 2 for detailed building usage.



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**Metropolitan Demolitions Group**  
Sydney Metro City & Southwest  
Works Package B - Martin Place  
Site Plan



This document may be based on data provided by third parties for which VMS Australia Pty Ltd cannot guarantee the accuracy.

## 5 Noise and Vibration Management Levels

The standard construction hours as outlined in the contract and as per CoA E36 are as follows:

- a) 7:00 am to 6:00 pm, Mondays to Fridays, inclusive;
- b) 8:00 am to 1:00 pm on Saturdays; and
- c) at no time on Sundays or public holidays.

Where works are to be undertaken outside of the standard construction hours presented in CoA E36, an Out of Hours Work Protocol must be prepared in consultation with the EPA and submitted to the Secretary for approval before construction commences.

In addition to the standard construction hours presented in CoA E36, CoA E37 and E38 specifically name Martin Place as a site where works may be conducted between 7:00 am and 8:00 pm provided that internal LAeq(15 minute) noise levels at sensitive receivers are restricted to no more than 60 dBA for 50% of the time (6.5 hours) and no more than 55 dBA for 25% of the time (3.25 hours). Notwithstanding, the period between 6.00 pm and 8.00 pm is still considered to be outside of standard construction hours and the Out of Hours Work Protocol is to be followed should work be conducted between these times.

The approved construction hours do not apply in the event of a direction from police or other relevant authority for safety reasons, to prevent environmental harm or risk to life. Construction hours may be extended in accordance with CoA E47 and E48.

### 5.1 Out of Hours Work

Construction hours are to be in accordance with the CoA and may be extended or varied in accordance with CoA E 47. Where Out of Hours Works are to be undertaken, they must be in accordance with the Sydney Metro Out of Hours Work Protocol.

Subject to the Out of Hours Work Protocol, haulage and delivery of spoil and materials may be undertaken 24 hours per day, seven (7) days per week.

The use of hydraulic hammers or other annoying activities is not permitted outside of standard construction hours, unless the Noise Management Levels present in Section 7 can be achieved at all sensitive receivers.

## 6 Demolition Noise Management Levels

### 6.1.1 Airborne and Structure Borne Noise

CoA E37 and E38 requires that internal noise levels be less than LAeq(15minute) 60 dBA for at least 6.5 hours between 7.00 am and 8.00 pm, of which at least 3.25 hours must be below LAeq(15minute) 55 dBA. Noise levels equal to or above LAeq(15minute) 60 dBA are allowed for the remaining 6.5 hours between 7.00 am and 8.00 pm. Where rock breaking or any other annoying activity is to be undertaken, a 5 dB penalty is to be applied.

It is understood that the internal noise limits imposed by CoA E37 and E38 apply to all receivers regardless of their usage.

### 6.1.2 Respite for Receivers

Where it has been predicted that internal noise levels may exceed LAeq(15minute) 60 dBA, MDG must consult with all affected receivers with the objective of determining appropriate hours of respite so that construction noise does not exceed the criteria presented in E37 and E38.

In addition to the above, high noise and vibration generating activities, such as jackhammering, rock hammering, rock breaking and saw-cutting, may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.

### 6.1.3 Demolition Traffic Noise

Assessing permissible noise increases for construction traffic aims to protect sensitive receivers against decreases in amenity as a result of the construction works. An increase of up to 2 dB on existing noise management levels represents a minor impact barely perceptible in the CBD. Where levels are expected to exceed an increase of 2 dB feasible and reasonable noise mitigation measures are to be applied. The extent and type of mitigation measures are to consider the existing actual noise levels associated with traffic.

It is proposed that heavy construction vehicle movements associated with the demolition works would be restricted to enter and exit the site via Elizabeth Street. In addition, it is understood that the proposed haulage routes are on arterial and sub-arterial roads with significant existing traffic flows whereby increased traffic flows are not likely to exceed existing traffic flows by 60%. It is therefore expected that increased traffic noise due to demolition works is likely to be less than the 2 dB allowance at all locations.

## 6.2 Vibration Criteria

### 6.2.1 Human Comfort Continuous and Impulsive Vibration Criteria

Vibration and its associated effects on people are usually classified as continuous, impulsive or intermittent as follows:

- Continuous vibration: machinery, steady road traffic, continuous construction activity such as underground drilling
- Impulsive vibration: infrequent activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading
- Intermittent vibration: trains, nearby intermittent demolition activity, rock breakers and jack hammers.

Structural vibration in buildings can be detected by the occupants possibly affecting them in various ways including reducing working efficiency and quality of life. Complaint levels from occupants of the buildings subject to vibration depend on the use of the building and the time of day.

Acceptable levels of continuous vibrations depend on the time of day and the activity being undertaken. The preferred values for continuous and impulsive vibration for office and residential buildings are presented in Table 3 and Table 4 below (as presented in the EPA's *Assessing Vibrations: a technical guideline, Table C1.1*). It is noted that the Conditions of Approval define a "perceptible level of vibration" as the "preferred" peak velocity levels presented in Table 3 and Table 4.

**Table 3 Criteria for exposure to Continuous Vibration**

Space Occupancy	Time of Day	Peak velocity(mm/s)	
		Preferred <sup>1</sup>	Maximum
Residential	Day	0.28	0.56
	Night	0.20	0.4
Offices	Day/Night	0.56	1.1

Note 1: The Preferred Peak Velocity presented represent a "perceptible level of vibration".

**Table 4 Criteria for exposure to Impulsive Vibration**

Space Occupancy	Time of Day	Peak velocity(mm/s)	
		Preferred <sup>1</sup>	Maximum
Residential	Day	8.6	17.0
	Night	2.8	5.6
Offices	Day/Night	18.0	36.0

Note 1: The Preferred Peak Velocity presented represent a "perceptible level of vibration".

### 6.2.2 Structural Damage Site Vibration Control Criteria

Based on the information contained in the CNVS and EIs, site specific structural damage vibration control criteria haven been nominated in the CNVMP and are reproduced in Table 5.

**Table 5 Nominated Structural Damage Site Vibration Control Criteria**

Building type	Included Buildings	Site Control Criteria <sup>1</sup>	
		Operator warning level (mm/s)	Operator halt level (mm/s)
Reinforced frame structure	17 Castlereagh Street 15 Castlereagh Street 9 Castlereagh Street 1 Castlereagh Street 37 Bligh Street 8 Chifley Square 9-19 Elizabeth Street 2 Martin Place	20	25
Bank Vault	48 Martin Place (vault area)	5	7.5
Heritage (structurally sound)	48 Martin Place (all other areas) 66 Hunter Street 32 Martin Place	5	7.5
Unreinforced or light framed structures	N/A <sup>2</sup>	5	7.5

Note 1: An exceedance of the operator warning level does not require activities to cease, but will alert the Project Manager and Foreman to proceed with caution at a reduced force or load.

Note 2: No unreinforced or light framed structures have been currently identified within the vicinity of the demolition works.

## 7 Demolition Methodology - Noise and Vibration Sources

### 7.1 Demolition Activities

Demolition activities will comprise two stages of work: site preparation and demolition of the existing building.

The site preparation involves erection of hoardings, amenities and offices, dilapidation surveys, scaffolding and establishment of site access. Minimal noise will be generated during these activities however this stage will include mobile cranes, trucks and installation of the hoarding and site sheds.

Demolition will comprise removal of internal and external hazardous materials, internal strip-out of non-structural components of the building and structural demolition. Noise and vibration will be generated from a range of activities including hammering of concrete and loading materials into trucks. In order to reduce noise and vibration emissions, concrete slabs will be demolished using an excavator with shear attachment where possible.

In order to reduce structure borne noise and vibration impacts at the directly adjoin receivers located at 48 Martin Place and 9-19 Elizabeth Street, saw-cutting of concrete slabs would be undertaken in order to “decouple” structural components of the adjoining structures. In addition, it is understood that there is already a void between the structures which will significantly reduce structure borne noise and vibration impacts to these receivers.

Table 6 presents each demolition stage, together with the associated tasks and the proposed usage of hydraulic hammers.

**Table 6 Demolition Methodology**

Staging Level	Task Number	Task	Use Of Hydraulic Hammers
<b>Stage 1</b>			
<b>55 Hunter Street</b>			
	1	Asbestos and SMF removal on external roof	No hammering, over 1 day
	2	Lift down plant, lift-up 13T excavator & skid steer to roof	No hammering, over 1 day (Out-of-hours Work / Sunday)
	3	Demo plant room roof slab (L-21)	13T excavator, 6 hours, hammering over 2 days
	4	Demo plant, internal walls, etc.	13T excavator, 12 hours, hammering over 4 days
	5	Demo plant room slab (L-20)	13T excavator, 6 hours, hammering over 1 day
	6	Ramp down and clean up	13T excavator, 3 hours, hammering over 3 days
	7	Demo perimeter walls of plant room level	13T excavator, 15 hours, hammering over 3 days
	8	Demo plant room slabs (L-19)	13T excavator, 6 hours, hammering over 1 day
	9	Ramp down and clean up	13T excavator, 3 hours, hammering over 3 days
	10	Demo perimeter walls of plant room level	13T excavator, 15 hours, hammering over 3 days
	11	Demo plant room slabs (L-18)	13T excavator, 6 hours, hammering over 1 day
	12	Ramp down and clean up	13T excavator, 3 hours, hammering over 3 days
TOTAL = 81 Hours hammering over 29 Days (for all levels) = 27.9% of the time hammering NOTE: This duration and steps 1 to 12 cover plant room levels and terrace level, i.e. 29 days = 4 levels and based on a 10-hr day			
<b>Stage 2</b>			
<b>55 Hunter Street</b>			
	1	Lift-up of 20T excavator to roof	No hammering, over 1 day (Out-of-hours Work / Sunday)
	2	Hammer slab near core	20T excavator, 3 hours, hammering over half day
	3	Ramp down and clean up	No hammering, over half day
	4	Demo slab, internal beams and core (incl. clean up) (L-17)	13T + 20T excavators, 16 hours, hammering over 4 days
	5	Demolish perimeter walls and beams (incl. clean up)	13T + 20T excavators, 6 hours, hammering over 2 days
	6	Repeat steps 2-5 for demolition of L-16	-
TOTAL = 25 hours of hammering over 8 days (for each level) = 31.3% of the time hammering NOTE: This duration and steps 1 to 6 cover typical floors to be 8 days each level and based on a 10-hr day. Also at this stage, the proposed demolition methodology on the bays adjoining Macquarie Bank will be implemented to lessen the structural vibration impact during demolition. The proposed methodology will include the use of 5T excavator hammering the slab bays to be followed by saw cutting the columns adjoining Macquarie Bank. An assessment will be made if this is to be an ongoing requirement for the entirety of the project.			
<b>Stage 3</b>			
<b>55 Hunter Street</b>			
	1	Hammer slab near core	20T excavator, 3 hours, hammering over half day
	2	Ramp down and clean up	No hammering, over half day

Staging Level	Task Number	Task	Use Of Hydraulic Hammers
	3	Demo slab, internal beams and core (incl. clean up) (L-15)	13T + 20T excavators, 16 hours, hammering over 4 days
	4	Demolish perimeter walls and beams (incl. clean up)	13T + 20T excavators, 6 hours, hammering over 2 days
	5	Repeat steps 1-4 for demolition of L-14 to L-13	-
TOTAL = 25 hours of hammering over 7 days (for each level) = 35.7% of the time hammering			
<b>5 Elizabeth Street</b>			
	1	Lift-up 20T + 5T excavators to roof and lift plant down	No hammering, over 1 day (Out-of-hours Work / Sunday)
	2	Demo plant room roof slab (L-14)	20T + 5T excavators, 4 hours, hammering over 2 days
	3	Demo plant, internal walls, etc. (incl. ramp down)	20T excavator, 20 hours, hammering over 5 days
	4	Demo plant room slab (L-13)	20T + 5T excavators, 10 hours, hammering over 2 days
	5	Ramp down and clean up	20T + 5T excavator, 3 hours, hammering over 1 day
	6	Demo perimeter walls of plant room level	20T + 5T excavators, 12 hours, hammering over 4 days
TOTAL = 49 hours of hammering over 15 days (for all levels) = 32.7% of the time hammering NOTE: This duration and steps 1 to 6 cover plant room levels, i.e. 15 days = 2 levels and based on a 10-hr day			
<b>8-12 Castlereagh Street</b>			
	1	Lift down plant, lift-up 13T + 20T excavators & skid steer to roof	No hammering, over 1 day (Out-of-hours Work / Sunday)
	2	Demo plant room roof slab (L-14)	13T + 20T excavators, 4 hours, hammering over 2 days
	3	Demo plant, internal walls, etc. (incl. ramp down)	13T + 20T excavators, 10 hours, hammering over 4 days
	4	Demo plant room slab (L-13)	13T + 20T excavators, 5 hours, hammering over 1 day
	5	Ramp down and clean up	13T excavator, 3 hours, hammering over 3 days
	6	Demo perimeter walls of plant room level	13T + 20T excavators, 15 hours, hammering over 3 days
TOTAL = 37 hours of hammering over 14 days (for all levels) = 26.4% of the time hammering NOTE: This duration and steps 1 to 5 cover plant room levels, i.e. 14 days = 2 levels and based on a 10-hr day			
<b>Stage 4</b>	<b>55 Hunter Street</b>		
	1	Hammer slab near core	20T excavator, 3 hours, hammering over half day
	2	Ramp down and clean up	No hammering, over half day
	3	Demo slab, internal beams and core (incl. clean up) (L-12)	13T + 20T excavators, 16 hours, hammering over 4 days
	4	Demolish perimeter walls and beams (incl. clean up)	13T + 20T excavators, 6 hours, hammering over 2 days

Staging Level	Task Number	Task	Use Of Hydraulic Hammers
	5	Repeat steps 1-4 for demolition of L-11 to basement	-
TOTAL = 25 hours of hammering over 7 days (for each level) = 35.7% of the time hammering NOTE: This duration and steps 1 to 5 cover plant room levels, i.e. 7 days = each level and based on a 10-hr day			
<b>5 Elizabeth Street</b>			
	1	Hammer slab near core	20T excavator, 2 hours, hammering over half day
	2	Ramp down and clean up	No hammering, over half day
	3	Demo slab, internal beams and core (incl. clean up) (L-12)	5T + 20T excavators, 14 hours, hammering over 4 days
	4	Demolish perimeter walls and beams (incl. clean up)	5T + 20T excavators, 6 hours, hammering over 2 days
	5	Repeat steps 1-4 for demolition of L-11 to basement	-
TOTAL = 22 hours of hammering over 7 days (for each level) = 31.4% of the time hammering NOTE: This duration and steps 1 to 5 cover plant room levels, i.e. 7 days = each level and based on a 10-hr day			
<b>7 Elizabeth Street</b>			
	1	Demo plant roof slab/typical slab, internal beams and core - access via 5 Elizabeth St building (L-10)	20T + 5T excavators, 6 hours, hammering over 2 days
	2	Skid steer clean up	No hammering, over 2 days
	3	Demo perimeter walls of plant room level	20T + 5T excavators, 5 hours, hammering over 1 day
	4	Skid steer clean up	No hammering, over 2 days
	5	Repeat steps 1-2 for demolition of L-9 to basement	-
<b>8-12 Castlereagh Street</b>			
	1	Hammer slab near core	20T excavator, 3 hours, hammering over half day
	2	Ramp down and clean up	No hammering, over half day
	3	Demo slab, internal beams and core (incl. clean up) (L-12)	13T + 20T excavators, 16 hours, hammering over 4 days
	4	Demolish perimeter walls and beams (incl. clean up)	13T + 20T excavators, 6 hours, hammering over 2 days
	5	Repeat steps 1-4 for demolition of L-11 to basement	-
TOTAL = 25 hours of hammering over 7 days (for each level) = 35.7% of the time hammering NOTE: This duration and steps 1 to 5 cover plant room levels, i.e. 7 days = each level and based on a 10-hr day			

Note 1: The demolition of concrete slabs and walls, stairs and the like would use a combination of pulverising and hydraulic hammering. Where possible, pulverising would be used as the preferred method over hydraulic hammering in order to lessen noise and vibration impacts.

## 7.2 Noise and Vibration Sources

### 7.2.1 Plant and Equipment

Plant and equipment which have been modelled and assessed for each stage of demolition are identified in Table 7 along with their associated sound power levels and the maximum number of each item operating in any 15 minute period.

*Table 7 Plant and Equipment Sound Power Levels*

Stage	Plant Item	Maximum Number Operating In Any 15 Minute Period	Sound Power Level (dBA)
Stage 1	Excavator 5T	1	95
	Excavator 13T (with Hammer)	1	118
	Concrete Saw	1	118
	Generators	1	104
	Compressor	1	105
	Skidsteer Loader 1T	1	110
	Jackhammer	1	113
	Dump trucks 15T	1	108
Stage 2	Excavator 5T	1	95
	Excavator 13T (with Hammer)	1	118
	Excavator 20T (with bucket/shear) <sup>1</sup>	1	105
	Excavator 20T (with Hammer) <sup>1</sup>	1	118
	Concrete Saw	1	118
	Generators	1	104
	Compressor	1	105
	Skidsteer Loader 1T	1	110
	Jackhammer	1	113
	Dump trucks 15T	1	108
	Stage 3	Excavator 5T	1
Excavator 13T (with Hammer)		3	118
Excavator 20T (with bucket/shear) <sup>1</sup>		3	105
Excavator 20T (with Hammer) <sup>1</sup>		3	118
Concrete Saw		1	118
Generators		1	104
Compressor		1	105
Skidsteer Loader 1T		3	110
Jackhammer		1	113
Dump trucks 15T		1	108
Stage 4		Excavator 5T	1
	Excavator 13T (with Hammer)	3	118



Stage	Plant Item	Maximum Number Operating In Any 15 Minute Period	Sound Power Level (dBA)
	Excavator 20T (with bucket/shear) <sup>1</sup>	3	105
	Excavator 20T (with Hammer) <sup>1</sup>	3	118
	Concrete Saw	1	118
	Generators	1	104
	Compressor	1	105
	Skidsteer Loader 1T	3	110
	Jackhammer	1	113
	Dump trucks 15T	1	108

Note 1: The 20T Excavator may be used with either a bucket, shears, or hammer attachment. These activities would not occur concurrently with the same machine.

### 7.2.2 Correction Factors

CoA E37 and E38 require that construction activities which have been proven to be “annoying” have a 5 dB penalty applied to them. In accordance with CoA E37 and E38, the following activities have been considered as being particularly annoying and as such, a 5 dB correction has been incorporated into the noise modelling process for them.

- Use of concrete saws.
- Jackhammers/rock breakers.

## 8 Demolition Noise and Vibration Assessment

### 8.1 Airborne Noise

Internal airborne noise impacts have been predicted for each stage of the demolition works. The resultant range of worst-case and typical  $L_{Aeq}(15\text{minute})$  noise level predictions for each stage are presented in Table 8 and Table 9 for works including and excluding hydraulic hammering, respectively. The full set of predicted internal noise levels for each receiver location is presented graphically in Appendix B.

In order to predict external to internal noise break-in, assumptions must be made regarding the façade Transmission Loss (TL) performance for each receiver. The ICNG suggestions that the difference between external and internal noise levels is typically 10 dB with windows open for adequate ventilation. A visual inspection of the immediately surrounding receivers however, has concluded that these receivers do not generally have openable windows and as such, the TL may be assumed to be higher. For the purpose of this assessment, all receivers, with the exception of the upper floors of 48 Martin Place, have an assumed TL of 25 dB. It is noted that the glazed dome roof of 48 Martin Place may provide lower TL performance, and so the 10<sup>th</sup> and 11<sup>th</sup> Floors of this building have an assumed TL of 15 dB. The assumed TL values are consistent with measurements undertaken on buildings of similar construction undertaken within the Sydney CBD.

**Table 8 Predicted Internal Daytime Airborne Construction Noise Impacts – Including Hydraulic Hammering**

Receiver Address	Assumed External to Internal Transmission Loss (dB) <sup>1</sup>	Predicted LAeq (15 minute) Internal Noise Level (d	
		Stage 1	
		Worst Case <sup>2</sup>	Typical <sup>3</sup>
48 Martin Place (Ground Floor to 9 <sup>th</sup> Floor)	-25	41	41
48 Martin Place (10 <sup>th</sup> and 11 <sup>th</sup> Floors)	-15	51	51
9-19 Elizabeth Street	-25	45	44
8 Chifley Square	-25	50	47
52 Martin Place	-25	41	38
1 Castlereagh Street	-25	45	41
9 Castlereagh Street (internal)	-25	45	41
9 Castlereagh Street (external Café)	External <sup>6</sup>	<b>70</b>	66
15 Castlereagh Street	-25	42	39
17 Castlereagh Street	-25	39	38
66 Hunter Street	-25	50	48
37 Bligh Street	-25	45	42
32 Martin Place	-25	45	35
1 Hosking Place	-25	35	29

Note 1: In order to predict internal noise levels, assumptions have been made regarding the external to internal transmission loss of each building. These assumptions are based on a visual inspection of the building façade and are considered conservative.

Note 2: Predicted “Worst Case” noise levels are representative of the noise intensive equipment located at the near point of the construction footprint to the receiver.

Note 3: Predicted “Typical” noise levels are representative of the location of noise intensive equipment being spatially averaged across the entire construction footprint.

Note 4: **Bold** text indicates that noise levels have been predicted to exceed the Noise Management Levels presented in Section 6.

Note 5: During Stage 4 demolition works, noise impacts on the upper floors of 48 Martin Place will lessen as demolition progresses towards the ground floor. The lower range of noise levels presented represents predicted noise levels during Stage 4 Ground Floor works, while the upper range represents demolition works immediately adjacent to the upper floors of 48 Martin Place.

Note 6: For the purpose of assessing noise impacts to the external area of the café located at 9 Castlereagh Street, external noise levels have been presented for this location and assessed against the Noise Management Levels presented in Section 6.

**Table 9 Predicted Internal Daytime Airborne Construction Noise Impacts – Excluding Hydraulic Hammering**

Receiver Address	Assumed External to Internal Transmission Loss (dB) <sup>1</sup>	Predicted LAeq (15 minute) Internal Noise Level (dBA)							
		Stage 1		Stage 2		Stage 3		Stage 4	
		Worst Case <sup>2</sup>	Typical <sup>3</sup>	Worst Case <sup>2</sup>	Typical <sup>3</sup>	Worst Case <sup>2</sup>	Typical <sup>3</sup>	Worst Case <sup>2</sup>	Typical <sup>3</sup>
48 Martin Place (Ground Floor to 9 <sup>th</sup> Floor)	-25	33	33	36	33	44	37	52	41
48 Martin Place (10 <sup>th</sup> and 11 <sup>th</sup> Floors)	-15	43	43	46	43	54	47	50- <b>62</b> <sup>5</sup>	39-51 <sup>5</sup>
9-19 Elizabeth Street	-25	37	36	37	36	48	39	48	40
8 Chifley Square	-25	42	39	42	39	45	42	45	42
52 Martin Place	-25	33	30	33	30	38	35	39	35
1 Castlereagh Street	-25	37	33	37	33	42	37	42	37
9 Castlereagh Street	-25	37	33	37	33	42	37	42	37
9 Castlereagh Street (external Café)	External <sup>6</sup>	62	58	62	58	67	62	67	62
15 Castlereagh Street	-25	34	31	34	30	37	34	42	37
17 Castlereagh Street	-25	31	30	31	29	36	33	42	33
66 Hunter Street	-25	42	40	43	41	47	42	51	43
37 Bligh Street	-25	37	34	37	34	42	36	42	36
32 Martin Place	-25	37	27	31	26	31	29	36	30
1 Hosking Place	-25	31	29	31	30	29	28	28	26

Note 1: In order to predict internal noise levels, assumptions have been made regarding the external to internal transmission loss of each building. These assumptions are based on a visual inspection of the building façade and are considered conservative.

Note 2: Predicted “Worst Case” noise levels are representative of the noise intensive equipment located at the near point of the construction footprint to the receiver.

Note 3: Predicted “Typical” noise levels are representative of the location of noise intensive equipment being spatially averaged across the entire construction footprint.

Note 4: **Bold** text indicates that noise levels have been predicted to exceed the Noise Management Levels presented in Section 6.

Note 5: During Stage 4 demolition works, noise impacts on the upper floors of 48 Martin Place will lessen as demolition progresses towards the ground floor. The lower range of noise levels presented represents predicted noise levels during Stage 4 Ground Floor works, while the upper range represents demolition works immediately adjacent to the upper floors of 48 Martin Place.

Note 6: For the purpose of assessing noise impacts to the external area of the café located at 9 Castlereagh Street, external noise levels have been presented for this location and assessed against the Noise Management Levels presented in Section 6.

## 8.2 Structure Borne Noise and Vibration

Based on the prediction methods presented in Association of Noise Consultants (ANC) Guideline *Measurement & Assessment of Groundbourne Noise & Vibration – 2012 (Appendix C)*, internal structure borne noise and vibration impacts have been predicted for each stage of the demolition works.

The resultant range of worst-case LAeq(15minute) noise level and Peak Particle Velocity (PPV) vibration level predictions for each stage of demolition are presented in Table 10. The presented range of structure borne noise and vibration levels indicate the use of a 13 tonne and 20 tonne hydraulic hammer respectively. The predictions represent worst case noise and vibration impacts during the use of hydraulic hammering and are predicted to the ground floor of the receiver building. Structure borne noise and vibration impacts from demolition works are expected to be negligible when hydraulic hammering is not being undertaken, and are therefore not presented in this assessment. The full set of predicted internal structure borne noise levels for each receiver location is presented graphically in Appendix C.

**Table 10 Worst Case Predicted Structure Borne Noise and Vibration Impacts**

Receiver Address	Predicted Vibration Peak Particle Velocity (PPV, mm/s) and LAeq (15 minute) Internal Structure Borne Noise Level (dBA)							
	Stage 1		Stage 2		Stage 3		Stage 4	
	PPV	LAeq	PPV	LAeq	PPV	LAeq	PPV	LAeq
48 Martin Place	0.2 - 0.4	35 - 42	0.2 - 0.5	37 - 45	0.3 - 0.7	41 - 47	2.7 – 6.5	<b>60 - 67</b>
9-19 Elizabeth Street	0.2 - 0.4	35 - 42	0.2 - 0.5	37 - 45	0.3 - 0.7	41 - 47	2.7 – 6.5	<b>60 - 67</b>
8 Chifley Square	0.1 - 0.2	31 – 38	0.1 - 0.3	33 - 40	0.1 - 0.3	33 - 41	0.3 - 0.7	41 - 48
52 Martin Place	0.1 - 0.2	31 – 38	0.1 - 0.2	29 - 37	0.1 - 0.2	30 - 37	0.1 - 0.3	33 - 41
1 Castlereagh Street	0.1 - 0.3	33 – 40	0.1 - 0.4	34 - 42	0.2 - 0.4	36 - 43	0.5- 1.3	44 - 53
9 Castlereagh Street	0.1 - 0.3	33 – 40	0.1 - 0.3	34 - 41	0.2 - 0.4	35 - 43	0.4 - 1.1	43 - 52
15 Castlereagh Street	0.1 - 0.3	33 – 40	0.1 - 0.4	34 - 42	0.2 - 0.4	36 - 43	0.4 - 1.2	43 - 52
17 Castlereagh Street	0.1 - 0.3	33 – 40	0.1 - 0.3	34 - 41	0.2 - 0.4	35 - 43	0.4 - 1.1	43 - 52
66 Hunter Street	0.1 - 0.3	33 – 40	0.1 - 0.4	34 - 42	0.2 - 0.4	36 - 43	0.4 - 1.2	43 - 52
37 Bligh Street	0.1 - 0.2	31 – 38	0.1 - 0.2	31 - 38	0.1 - 0.3	32 - 41	0.2 - 0.5	36 - 44
32 Martin Place	0.1 - 0.2	31 – 38	0.1 - 0.3	32 - 41	0.1 - 0.3	32 - 41	0.2 - 0.6	36 - 47
1 Hosking Place	0.1 – 0.2	31 – 38	0.1 – 0.2	31 - 38	0.1 – 0.3	32 - 41	0.2 – 0.4	36 - 43

Note 1: **Bold** text indicates that internal noise levels have been predicted to exceed the Noise Management Levels presented in Section 6.

## 9 Discussion of Results

The predicted daytime airborne noise levels presented in Table 8 shows that the worst case predicted noise levels of 55 dBA to 60 dBA are likely to occur during Stage 3 and Stage 4 demolition works when hydraulic hammering is being undertaken at the near-point to receivers located at 9-19 Elizabeth Street, 66 Hunter Street, and the ground to 10<sup>th</sup> floors of 48 Martin Place. Greater impacts will be experienced on the 10<sup>th</sup> and 11<sup>th</sup> Floors of 48 Martin Place during Stage 3 and Stage 4 works (up to 70 dBA), however as Stage 4 works progress towards the ground floor impacts will be less.

As internal noise levels of >55 dBA have been predicted at these three receivers, CoA E37 and E38 requires that MD consult with the relevant parties to ensure that appropriate hours of respite are offered and that internal noise levels are kept below 55 dBA for at least 3.25 hours of each day. In addition, alternative demolition techniques such as the use of hydraulic pulverisers and shears would be used instead of hydraulic hammers where possible.

External noise levels of 70 dBA to 75 dBA have been predicted at the outdoor café located at 9 Castlereagh Street when hydraulic hammers are in use. When hydraulic hammers are not in use, predicted external noise levels at this

location are below the respective NML of 70 dBA. As such, alternative demolition techniques would be used where possible, and the mitigation measures presented in Section 10 implemented in order to manage noise emissions.

The “typical” noise levels presented in Table 8 are representative of the location of noise intensive equipment (primarily hydraulic hammers) being spatially averaged across the entire construction footprint. This provides an indicative representation of noise emissions if plant and equipment were to be relocated further away from each receiver, however still within the footprint of the site. The “typical” internal noise levels during hydraulic hammering works are not predicted to exceed 55 dBA at the majority of receiver locations, with the exception of the 10<sup>th</sup> and 11<sup>th</sup> floors of 48 Martin Place, and therefore relocating equipment at sensitive times negotiated with affected receivers could provide sufficient respite while still allowing hydraulic hammering to proceed in other areas of the site. During Stage 3 and Stage 4 demolition works, impacts to the upper floors of 48 Martin Place would be managed by providing periods of respite during sensitive time, using hydraulic pulverisers and shears where possible, and implementing the additional mitigation measures presented in Section 10.

Table 9 presents predicted internal noise levels when hydraulic hammering is not being undertaken. The predicted noise levels do not exceed 55 dBA at the majority of receiver locations, with the exception of the 10<sup>th</sup> and 11<sup>th</sup> floors of 48 Martin Place, and therefore ceasing hydraulic hammering works would provide sufficient respite to all affected receivers while allowing other demolition activities to proceed. Noise levels of up to 62 dBA are predicted at the 10<sup>th</sup> and 11<sup>th</sup> floors of 48 Martin Place during the beginning of Stage 4 works only. These impacts would be managed by implementing the additional mitigation measures presented in Section 10 and providing additional periods of respite where necessary.

Table 10 shows that structure borne noise levels of 60 dBA to 67 dBA are expected at 48 Martin Place and 9-19 Elizabeth Street during Stage 4 demolition works only while hydraulic hammering is being undertaken. As such, alternative demolition techniques such as the use of hydraulic pulverisers and shears would be implemented where possible, and where the use of hydraulic hammers is critical, respite periods of at least 3.25 hours each day must be negotiated with these receivers. All other structure borne noise and vibration emissions are predicted to comply with the relevant criteria during all stages of demolition.

## 10 Mitigation Measures

On the basis of being feasible and reasonable, mitigation measures that will be implemented during the demolition works are summarised as follows:

- Adherence to daytime construction hours is recommended for demolition works, in particular hydraulic hammering activities
- Use hydraulic shears or pulverisers instead of hydraulic hammering where possible
- Use dampened rock hammers
- Night works, where applicable, should be programmed to minimise the number of consecutive nights work impacting the same receivers
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers will result in reduced noise emissions
- Equipment which is used intermittently is to be shut down when not in use
- Where possible, the offset distance between noisy plant items and nearby noise sensitive receivers should be as great as possible
- Where possible, equipment with directional noise emissions should be oriented away from sensitive receivers
- Undertake compliance checks on the noise emissions of plant and machinery used for the Project to indicate whether noise emissions from plant items are higher than noise emissions from well-maintained plant
- Regular noise monitoring during construction at sensitive receivers during critical periods to identify and assist in managing high risk noise events
- Where possible heavy vehicle movements should be limited to daytime hours
- Non-tonal reversing alarms should be fitted to all permanent mobile plant
- Reversing of equipment should be minimised so as to prevent nuisance caused by reversing alarms

- Loading and unloading should be carried out away from sensitive receivers, where practicable
- Installation of localised noise barriers around noisy areas
- Installation of sound barrier screening to scaffolding where permitted noise levels are exceeded at neighbouring noise affected properties
- Provision of respite from noise intensive activities
- Alternate demolition method or other negotiated outcomes with the affected community
- Modifications or alterations to plant and equipment
- Limiting times for certain demolition activities
- Where possible separate structural connections between adjoining buildings using sawcutting and propping, hand held splitters and pulverisers or hand demolition to reduce structure borne noise impacts.

In accordance with CoA E37 and E38, consultation with receivers located at 48 Martin Place, 9-19 Elizabeth Street, 9 Castlereagh Street, 44 Martin Place and 66 Hunter Street has been completed in order to determine the most sensitive time periods for each receiver. This consultation included a power point presentation of the scope of works, methods to be employed, program and mitigation measures.

Whilst no set times have as yet been agreed it was agreed that noise and vibration intensive works (namely hydraulic hammering) would be scheduled to provide periods of respite at each receiver location whereby internal noise levels would not exceed 60 dBA for 50% of the time, and 55 dBA for 25% of the time. This would be verified through the monitoring procedures described in Section 11.

Below is a summary of the discussions with each receiver;

- (a) 48 Martin Place (Macquarie Bank Group);
  - Agree to support an application for extended working hours on Saturdays
  - Requested that extended periods of hydraulic hammering that effected their operations be undertaken between 7am and 9am on weekdays and all-day Saturday where practical
  - Consultation with MBG is ongoing and is including project updates
- (b) 9-19 Elizabeth St;
  - Owned and occupied by Macquarie Bank Group so comments as per above
- (c) 9 Castlereagh St;
  - Building Manager would invite interested tenants to a project briefing to discuss respite periods. To date no response has been received.
- (d) 44 Martin Place;
  - Owners were advised that the model showed little noise and vibration impact to their building. They agreed to reserve their position on respite until full demolition of all four buildings was underway.
- (e) 66 Hunter St;
  - Rockpool Restaurant (RR) advised their daytime trading hours are from 12:00 midday to 3:00pm weekdays and 5:00pm to 12:00 midnight on Saturdays
  - RR requested direct contact with the Project Manager and Site Supervisor if required and JHCPBJV and MDG agreed to this
  - Other tenant representatives agreed to take a wait and see approach
  - MDG offered to do a dilapidation survey of RR and this was accepted. Timing to be agreed.

## 11 Noise and Vibration Monitoring

Management and control of noise and vibration impacts shall be monitored and assessed as described below. Noise and vibration monitoring is to be undertaken by suitably qualified persons in accordance with the CNVMP.

Attended measurements are to be undertaken within a period of 14 days from the commencement of each phase of demolition to confirm that the noise and vibration levels in the adjacent community are consistent with the predictions in the CNVIS. Attended noise measurements would be repeated at a minimum interval of every 2 weeks to ensure ongoing compliance.

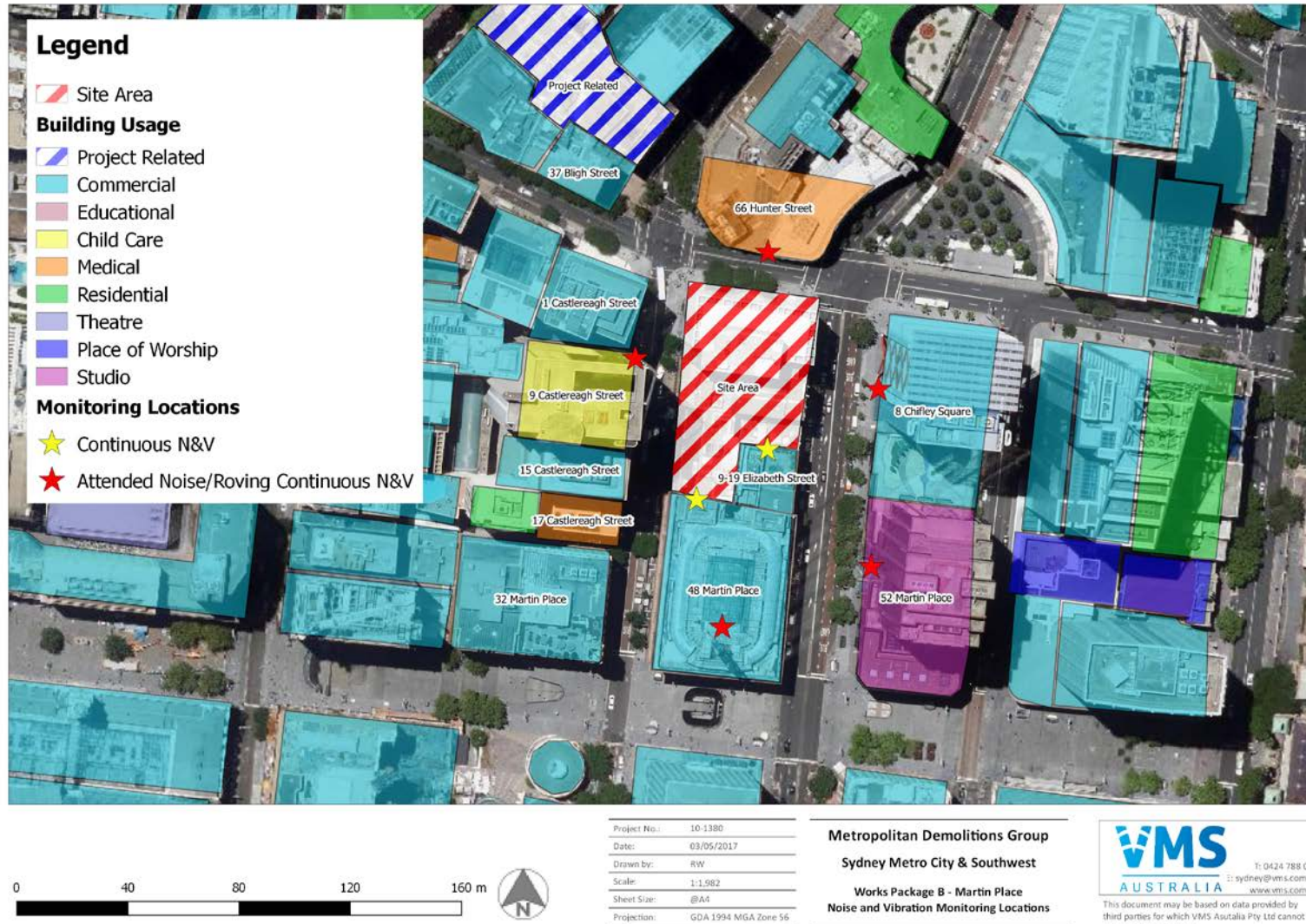
Figure 3 presents the proposed noise and vibration monitoring locations during Martin Place demolition works. Real-time continuous noise and vibration monitoring would be implemented throughout hard demolition at a minimum of

two locations within the Macquarie Bank buildings. In addition, a “roving” real-time continuous noise and vibration monitoring system would be rotated between the most affected receiver locations on Castlereagh Street, Hunter Street and Elizabeth Street during the various stages of demolition

Operator-attended noise monitoring is to be conducted upon commencement of demolition works in order to verify the noise modelling assumptions and results presented in the CNVIS. The following key locations are to be included in this monitoring:

- 48 Martin Place – Macquarie Bank Building
- 9-19 Elizabeth Street – Recording Studio
- 52 Martin Place – TV Studio

Figure 3 Noise and Vibration Monitoring Locations



Note 1: The Receiver Type colour coding presented above represents the highest noise sensitive usage throughout the entire building. Refer to Table 2 for detailed building usage.



Table 11 presents the noise and vibration monitoring program for the demolition works.

Noise measurements shall be undertaken consistent with the procedures documented in *AS 1055.1-1997 Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

Vibration measurements shall be undertaken in accordance with the procedures documented in the OEH's *Assessing Vibration - a technical guideline (2006)*, *AS 2107.2 2006 Explosives – Storage and Use* and *DIN 4150:Part 3-1999 Structural Vibration - Effects of Vibration on Structures*.

**Table 11 Noise and Vibration Monitoring Program**

Type	Location	Timing/Frequency	Purpose
Operator-attended Noise	<ul style="list-style-type: none"> <li>48 Martin Place</li> <li>9-19 Elizabeth Street</li> </ul>	<ul style="list-style-type: none"> <li>Upon commencement of the demolition for the load out zone in Castlereagh Street using machines fitted with hydraulic hammers</li> <li>Twice per week</li> </ul>	<ul style="list-style-type: none"> <li>Verify CNVIS transmission loss assumptions and noise propagation characteristics within the building.</li> <li>Verify compliance.</li> </ul>
Operator-attended Vibration	<ul style="list-style-type: none"> <li>Within the demolition site</li> <li>48 Martin Place (including structural elements, sensitive tiled areas and vault)</li> <li>9-19 Elizabeth Street</li> </ul>	<ul style="list-style-type: none"> <li>Upon commencement of the demolition of the load out zone in Castlereagh Street using machines fitted with hydraulic hammers</li> <li>Twice per week</li> </ul>	<ul style="list-style-type: none"> <li>Establish safe working distances for vibration intensive equipment.</li> <li>Verify compliance.</li> </ul>
Operator-attended Noise	<ul style="list-style-type: none"> <li>48 Martin Place</li> <li>9-19 Elizabeth Street</li> <li>52 Martin Place</li> <li>9 Castlereagh Street</li> <li>66 Hunter Street</li> <li>8 Chifley Square</li> </ul>	<ul style="list-style-type: none"> <li>Upon commencement of the demolition of the plant room to 55 Hunter Street using machines fitted with hydraulic hammers</li> <li>Fortnightly at the beginning of each of the four stages of demolition</li> </ul>	Verify CNVIS noise modelling results and ensure ongoing compliance.
Real-time Continuous Noise and Vibration	<ul style="list-style-type: none"> <li>48 Martin Place</li> <li>9-19 Elizabeth Street</li> </ul>	<ul style="list-style-type: none"> <li>Upon commencement of the demolition of the plant room to 8-12 Castlereagh Street using machines fitted with Hydraulic hammers</li> <li>Continuous</li> </ul>	Ensure ongoing compliance and provide real-time data to MD, ER, AA, DP&E and EPA.
“Roving” Real-time Continuous Noise and Vibration	Roving monitor to be rotated between the affected receivers for each stage of demolition, including: <ul style="list-style-type: none"> <li>48 Martin Place</li> <li>9-19 Elizabeth Street</li> <li>52 Martin Place</li> <li>9 Castlereagh Street</li> <li>66 Hunter Street</li> </ul>	<ul style="list-style-type: none"> <li>Upon commencement of the demolition of the plant room to 55 Hunter St using machines fitted with hydraulic hammers</li> <li>Continuous</li> </ul>	Ensure ongoing compliance and provide real-time data to MD, ER, AA, DP&E and EPA.

	<ul style="list-style-type: none"> <li>8 Chifley Square</li> </ul>		
Operator-attended Noise and/or Vibration	As required.	In response to complaints.	To quantify noise and/or vibration emissions relating to complaints.

### 11.1 Plant and Equipment Noise Auditing

Internal compliance auditing of plant and equipment noise emissions would be undertaken via attended measurements of a representative selection of plant and equipment used on-site are to be undertaken. The representative items of equipment are to be regularly monitored to confirm that the operating noise levels of all noise intensive plant items comply with the maximum levels (LAmax) in Table 11 of the CNVS.

### 11.2 Reporting

As per the requirements of the CNVS, noise and vibration monitoring reports are to be submitted to the Construction Contractor and the Project Manager and if required the Principal's Representative with noise and/or vibration monitoring results and details of affected sensitive receivers within one week of being undertaken or at weekly intervals for continuous monitoring. In the case of noise exceedances, details of the plant or operations causing the exceedances along with corrective action and the status of its implementation are to be supplied.

All noise monitoring reports would also be made available to the public through a publically accessible website.

### 11.3 Inspections

A log will be used on site to keep an accurate record of demolition activities on a daily basis. This shall be used to correlate on-site activities with measured noise and vibration levels and/or complaints. An acoustic consultant may periodically review the proposed monitoring program with the aim to reduce or increase the monitoring depending on monitoring results and community feedback received.

The Site Supervisor is to conduct regular site inspections, observing any instances of excessively noisy machinery or key activities that are associated with the demolition works. Noise or vibration records are to be reviewed for potential issues arising from works. Results from the inspection are then to be recorded on an environmental checklist.

Copies of noise and vibration monitoring results will be made available to the Client as required.

## 12 Conclusion

Noise and vibration predictions for the demolition works associated with the Sydney Metro City & Southwest "Works Package B" have been undertaken on both a "worst" and "typical" case basis. Due the close proximity of adjacent receivers to the works, some noise intensive activities, such as hydraulic hammering are predicted to result in "worst case" internal noise impacts of between 55 dBA and 60 dBA at 9-19 Elizabeth Street, 66 Hunter Street and the lower floors of 48 Martin Place. Worst case internal noise levels of 58 dBA to 70 dBA have been predicted on the 10<sup>th</sup> and 11<sup>th</sup> floors of 48 Martin Place.

Negotiations would be undertaken with these receivers in order to ensure that appropriate periods of respite are offered during sensitive periods.

Notwithstanding the above, it is predicted that "typical" LAeq(15 minute) internal noise levels would be less than 55 dBA at all receiver locations, except for 10<sup>th</sup> and 11<sup>th</sup> floors of 48 Martin Place which would experience noise levels of up to 62 dBA during the beginning of Stage 4 works. This would be verified throughout the demolition works by implementing a strict noise and vibration program which would include both continuous real-time monitoring, and periodic operator-attended monitoring.

Vibration impacts have been predicted to show compliance with the nominated Site Control Vibration Criteria at all receiver locations. Alternative demolition methodology however, such as saw-cutting and the use of hydraulic pulverisers and shears would be implemented to ensure that vibration emissions do not exceed the relevant structural damage criteria. The predictions show that structure borne noise impacts would be less than 60 dBA at all receiver locations except for 48 Martin Place and 9-19 Elizabeth Street, which may experience structure borne noise levels of 60-67 dBA during Stage 4 demolition works only. As such, periods of respite would be negotiated with these receivers as per above and in accordance with CoA E37 and E38. Structure borne noise impacts are predicted to be negligible at all other receiver locations and for all stages of demolition.

## Appendix A - Acoustic Terminology

Terminology Relating to Noise and Vibration	
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Power	Sound Power is the rate at which sound energy is emitted, reflected, transmitted or received, per unit time. Unlike sound pressure, sound power is neither room-dependent nor distance-dependent.
Sound Pressure Level (SPL)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 <sup>-6</sup> Pascals) on a decibel scale.
Sound Power Level (SWL)	The Sound Power Level is the sound power relative to a standard reference pressure of 1pW (20x10 <sup>-12</sup> Watts) on a decibel scale. The SWL of a simple point source may be used to calculate the SPL at a given distance (r) using the following formula: $SPL = SWL - 10 \times \log_{10}(4 \times \pi \times r^2)$ Note that the above formula is only valid for sound propagation in the free-field (see below).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by $20 \log_{10}(s1 / s2)$ . The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dBA	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
Leq,T	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
Lmax,T	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L90,T	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
L10,T	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.
DnT,w	The single number quantity that characterises airborne sound insulation between rooms over a range of frequencies.
Rw	Single number quantity that characterises the airborne sound insulating properties of a material or building element over a range of frequencies.
Reverberation	The persistence of sound in a space after a sound source has been stopped.
PPV	The particles of a medium are displaced from their random motion in the presence of a vibration wave. The greatest instantaneous velocity of a particle during this displacement is called the Peak Particle Velocity (PPV) and is typically measured in the units of mm/s.
Hertz, Hz	The unit of Frequency (or Pitch) of a sound or vibration. One hertz equals one cycle per second. 1 kHz = 1000 Hz, 2 kHz = 2000 Hz, etc.
Acceleration	Acceleration is defined as the rate of change of Velocity of a particle over a period of time and is typically measured in the units of m/sec <sup>2</sup> .
Vibration Dose, VDV	When assessing intermittent vibration it is necessary to use the vibration dose value (VDV), a cumulative measurement of the vibration level received over an 8-hour or 16-hour period. The VDV formulae uses the RMS Acceleration raised to the fourth power and is known as the Rootmean-quad method. This technique ensures the VDV is more sensitive to the peaks in the acceleration levels. VDV's are typically measured in the units of m/s <sup>1.75</sup> .

## Appendix B – Predicted Airborne Internal Noise Level Maps

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## Appendix C – Predicted Structure Borne Noise Level Maps

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**ENDORSEMENT  
CITY & SOUTHWEST ACOUSTIC ADVISOR**

<b>Review of</b>	<b>CNVMP and CNVIS for Metropolitan demolition works at Martin Place</b>	<b>Document reference:</b>	Construction Noise & Vibration Management Plan prepared by VMS Australia for Metropolitan Demolitions Group Report number MD1968/09 Issue 005  and Construction Noise & Vibration Impact Statement prepared by VMS Australia for Metropolitan Demolitions Group Report number MD1968/09A Issue 004
<b>Prepared by:</b>	Dave Anderson		
<b>Date of issue:</b>	8 November 2017		

As approved Acoustic Advisor for the Sydney Metro City & Southwest project, I have reviewed and provided comment on the Construction Noise & Vibration Management Plan and Construction Noise and Vibration Impact Statement for the Metropolitan demolition works at Martin Place, as required under A27 (d) of the project approval conditions.

I met with VMS Australia to discuss earlier drafts of the documents and to discuss my formal comments. I previously endorsed the CNVMP (issue 002) and CNVIS (issue 002) and note that the current revisions address comments by Macquarie Bank and DPE, as well as some minor comments I noted in my earlier endorsement of the CNVIS.

I endorse the Construction Noise & Vibration Management Plan (issue 005) and Construction Noise and Vibration Impact Statement (issue 004).



Dave Anderson, City & Southwest Acoustic Advisor

Mr Stuart Hodgson  
Director  
Program Sustainability Environment & Planning  
Sydney Metro  
Transport for NSW  
PO Box K659  
HAYMARKET NSW 1240

8 November 2017

Ref: CNVIS-CNVMP Metropolitan

Dear Stuart


**RE: Endorsement of revised Construction Noise and Vibration Management Plan and Construction Noise and Vibration Impact Statement – Martin Place, Sydney Metro City & Southwest**

Thank you for providing the following revised documents for Environmental Representative (ER) review and endorsement as required by the Condition of Approval A24(d) of the Sydney Metro City & Southwest project (SSI – 15\_7400 January 9 2017):

- Construction Noise and Vibration Management Plan (Document Reference: MD1968/09 Issue 005 dated 4-10-17)
- Construction Noise and Vibration Impact Statement (CNVIS) – Package B – Martin Place, (Plan Issue 004; Document Reference MD1968/09A dated 7 -8-17).
- Acoustic Advisor (AA) Endorsement of the above documents dated 8 November 2017

As an approved ER for the Sydney Metro City & Southwest project, I have reviewed the revisions of the above documents. The review did not comprise a technical review, as the ER has relied upon the AA's review of technical aspects of the document. On the basis of the endorsement of the documents by the AA, the documents are endorsed by the ER.

Yours sincerely



Michael Woolley  
Environmental Representative – Sydney Metro – City and South West