

**ENDORSEMENT )**  
**CITY & SOUTHWEST ACOUSTIC ADVISOR )**

<b>Review of</b>	<b>Construction Noise and Vibration Impact Statement Addendum Report – Northern Connection North MPR Works</b>	<b>Document reference:</b>	<b>Sydney Metro City and South West Line Wide Works – CNVIS Addendum Report – Northern Connection MPR Works</b>  Prepared by Renzo Tonin & Associates for Systems Connect.  <i>TK685-03-02F03 CNVIS_ADD C2B_P3 NC Nth MPR works (r3). Dated 15 September 2021</i>
<b>Prepared by:</b>	Larry Clark, Alternate Acoustics Advisor		
<b>Date of issue:</b>	30 September 2021		

As approved Alternate Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed the Construction Noise and Vibration Impact Statement (CNVIS) Addendum for Line-Wide Works Northern Connection North MPR Works, as required under A27 (d) of the project approval conditions (SSI 15-7400).

I am satisfied that the CNVIS is technically valid, and includes appropriate noise and vibration mitigation and management. On this basis I endorse revision 3 of the CNVIS in respect of Line-Wide Works Northern Connection North MPR Works.



Larry Clark, City & Southwest Alternate Acoustics Advisor #



15 September 2021

TK685-03-02F03 CNVIS\_ADD C2B\_P3 NC Nth MPR works (r3)

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## Sydney Metro City and South West Line Wide Works - CNVIS Addendum Report - Northern Connection North MPR Works

### 1 Introduction

#### 1.1 Overview of works

This technical memorandum is an addendum to the report *Construction Noise and Vibration Impact Statement: Portion 3 - Northern Connection* (Northern Connection CNVIS<sup>1</sup>) and has been prepared on behalf of Systems Connect in accordance with the Construction Noise and Vibration Management Plan (CNVMP) [SMCSWLWC-SYC-1NL-PM-PLN-000032] for the Design and Construction of the Line-Wide Works (LWW) of the Sydney Metro City & Southwest Project (the Project).

Changes to the Northern Connection works being carried out by Systems Connect have been triggered by MPR 60 CSR Ancillary Works and MPR 61 Segregation Fencing. The works are both inside the current Project area assessed in the Northern Connection CNVIS, and to the north of the current work area up to Chatswood Station. The MPR 60 CSR Ancillary Works will include modifications to the existing Galvanised Steel Troughing (GST), in-ground pit and pipe works, in-ground works on service crossings beneath the rail line (ULX works) and cable tray works within Chatswood Station. The MPR 61 Segregation Fencing works will involve the drilling and mounting of segregation fencing to the top of the capping beam in the dive area and on the concrete foundations from the dive structure north to Chatswood Station. The work areas are shown in APPENDIX C. The works are anticipated to commence in November 2021 and could take up to seven weekend possessions to complete.

This memorandum has been prepared to address the potential construction noise and vibration impacts from the MPR 60 CSR Ancillary Works and MPR 61 Segregation Fencing works that occur outside the areas assessed in the Northern Connection CNVIS. The works will be possession based and will be undertaken during standard construction hours and out of hours works.

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<sup>1</sup> *Sydney Metro City & Southwest – Line Wide Works, Construction Noise and Vibration Impact Statement: Portion 3 - Northern Connection*, reference: TK685-03-02F01 CNVIS C2B\_P3 Northern Connection, revision 8, dated 24 February 2021



## 1.2 Justification for OOH construction works

The works would be completed within the rail corridor between Mowbray Road and Chatswood Station under Rail Possession. The existing rail traffic would impose major risks to rail users and construction workers due to the extremely close proximity between all parties involved. Conducting works during rail shutdown possessions would minimise the risks of rail traffic and work site interaction. Works would need to be conducted 24 hours per day during the weekend rail possession periods to allow the planned works to be completed within the shutdown period.

EPL Condition L4.13 allows construction activities to be undertaken outside of standard construction hours for works which must be undertaken during rail possessions.

Any work outside standard construction hours must be undertaken in accordance with the Out of Hours Works Procedure and the CNVMP.

## 2 Construction noise assessment

### 2.1 Construction activities

Key details regarding the location and layout of the noise generating plant that will operate during these works were informed by the Construction and Environmental Teams and are summarised in Table C1 in APPENDIX C. Table C1 presents the list of plant proposed to be used for these works and their assumed sound power levels.

The proposed works may be carried out concurrently with the construction activities already assessed in the *Northern Connection CNVIS*.

### 2.2 Predicted construction noise levels

Predicted construction noise levels at the closest noise sensitive receivers are summarised in Table 2.1 and compared to the ICNG NMLs (see APPENDIX B). Detailed noise predictions are compared to ICNG NMLs and presented in APPENDIX D.

The results presented in Table 2.1 show that receivers adjacent to the rail corridor are predicted to experience noise levels above the NMLs for all assessment periods. The nearest affected receivers in NCAs CDS\_03 and CDS\_04 are likely to experience highly intrusive noise levels during the night-time period due to their close proximity to the works. Note that these works are linear, so as works progress along the corridor, the nearest receivers will be less noise affected. To assist with understanding the impacts from these progressive works, the work areas have been subdivided into five work areas, as shown in the map in APPENDIX C.



Table 2.1: Predicted noise levels at the closest noise sensitive receivers (PPA Conditions E41/E42)

NCA	Address	Type of receiver	Predicted levels $L_{Aeq,15min}$ , dB(A)										External equivalent NML, Condition E41/E42 (8pm – 7am) $L_{Aeq,15min}$ , dB(A)
			CSR works - MPR-60					Segregation Fencing works - MPR-61					
			WA1	WA2	WA3	WA4	WA5	WA1	WA2	WA3	WA4	WA5	
CDS_03	84-86 Albert Avenue, Chatswood	Residential	51	58	64	72	68	51	57	67	73	70	55
CDS_03	2 Nelson Street, Chatswood	Residential	62	57	51	49	45	62	56	51	49	45	55
CDS_03	1-3 Gordon Avenue, Chatswood	Residential	49	47	44	42	41	49	48	44	43	41	55
CDS_04	6 Chapman Avenue, Chatswood	Residential	71	67	56	51	48	68	65	57	51	48	55
CDS_04	11-13 Hopetoun Avenue, Chatswood	Residential	57	54	50	48	45	59	52	49	48	45	55

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 1 pm Saturday  
D(O): out-of-hours day period from 1pm to 6pm Saturday, 8 am to 6 pm Sunday and Public holidays - OOHW P1  
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1  
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2



It is noted that the noise predictions in Table 2.1 represent a realistic worst-case scenario when power hand tools are being operating continuously at the worst-case location for each receiver for the assessment periods. Actual noise levels can often be less than the predicted levels presented in this CNVIS when measured over the assessment period, depending on the location of the works relative to the receivers.

Assessment of cumulative impacts with other Systems Connect rail possession works will be undertaken using Gatewave.

The results presented in Table 2.1 show that the predicted noise levels are above the PPA Conditions E41 and E42 noise goals for receivers adjacent to the rail corridor.

In accordance with Planning Project Approval (PPA) Condition E32 and APPENDIX A2 of the *Sydney Metro City and Southwest Construction noise and Vibration Strategy (SMCSNVS)*<sup>2</sup>, additional mitigation measures must be considered. Recommended mitigation measures are presented in Section 2.3.

## 2.3 Noise mitigation and management

### 2.3.1 Site noise control measures

In addition to the noise mitigation measures identified in the CNVIS (see Section 5.4.2), the following Table 2.2 presents additional noise control measures recommended to reduce and manage potential noise impacts.

**Table 2.2: Site noise control measures**

Control type	Control measure	Typical use
Path mitigation measures	Temporary or Mobile noise screens	Where practicable, a mobile noise screen/tent would be used to reduce noise from moving plant items e.g. concrete saw, road saw, pipe cutter. Temporary screens utilise temporary construction fencing, with acoustic blanket/ quilt (e.g. Echo-barrier, FlexShield or similar) attached to one side. Mobile noise screens utilise aluminium mobile scaffold (or similar), with acoustic blanket/ quilt attached on up to four sides (including the top, where there is no solid platform). Mobile noise screens can provide 5 to 10 dB noise reduction, <u>where they can break line of sight</u> .

### 2.3.2 Consultation with affected receivers (PPA Condition E33)

As outlined in Section 5.4.1 of the *Northern Connection CNVIS*, consistent with requirements in PPA Conditions E33, Systems Connect will continue to consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation measures applicable to the construction works at the Northern Connection site.

<sup>2</sup> Transport for NSW Sydney Metro City & Southwest Construction Noise Strategy (ref: 610.14213-R3) 08 August 2016

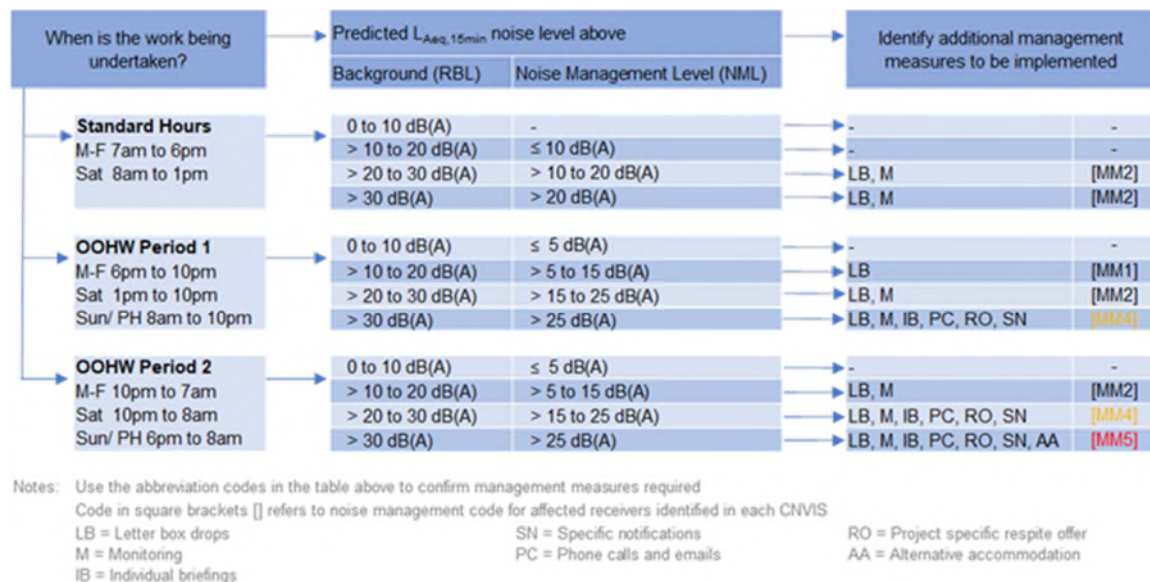


In consultation with the affected receivers, Systems Connect will provide respite offers to noise affected residences identified in this report and in response to complaints following discussion with the Systems Connect Community Team. The respite offers are made in consideration of the individual circumstances of the affected residents, the duration and the extent of impacts. Respite offers may include customised earmolds, noise cancelling headphones or meal vouchers. The respite to be offered will be tailored to circumstances noting that not all respite offers will be appropriate during the COVID 19 pandemic. Current or future COVID 19 restrictions will guide what respite offers can be provided, for example, meal vouchers can be replaced by general-use Eftpos/Mastercard vouchers. Offers of alternative accommodation will also be considered and made in appropriate circumstances.

### 2.3.3 Additional mitigation measures

Figure 2-1 will be used to advise the appropriate additional mitigation during construction.

Figure 2-1: Additional airborne noise mitigation measures



APPENDIX E presents a summary of the additional noise mitigation measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels are still above the relevant NMLs.

### 2.3.4 Noise monitoring

Attended noise monitoring will be undertaken to verify that the construction activities are consistent with the assessed noise modelling scenarios and that noise levels resulting from construction works are not higher than the levels predicted in this CNVIS. Attended monitoring on private property is subject to obtaining the property owner/occupier's consent (where required).



Attended noise monitoring will be undertaken in the NCAs most impacted by the works. The nominated monitoring locations are identified in Table 2.3, and have been selected as they present the best opportunity to validate the predicted noise levels.

**Table 2.3: Nominated verification monitoring locations**

NCA	Nominated receiver address	Monitoring location at 1 m from
CDS_03	2 Nelson Street, Chatswood	Northern facade
CDS_03	1-3 Gordon Avenue, Chatswood	Southern facade
CDS_04	6 Chapman Avenue, Chatswood	Northern facade
CDS_04	11-13 Hopetoun Avenue, Chatswood	Southern facade

Note: Monitoring on private property is subject to owner consent and where relevant, occupier consent. If property access is denied, monitoring will still be carried out outside property boundaries.

If verification monitoring shows that the external noise levels from the construction works are above the predicted levels, investigation will be undertaken to understand the cause of the exceedance and relevant reasonable and feasible mitigation measures will be implemented.

## 2.4 Construction vibration impact

### 2.4.1 Minimum working distances for vibration intensive plant

From the plant and equipment listed in APPENDIX C, high vibration generating plant and equipment are summarised for each construction work activity in Table 2-4 below.

**Table 2-4: Vibration generating plant and equipment**

Construction work activity	Vibration intensive plant/equipment	Time period		
		Standard hours	OOHW Period 1	OOHW Period 2
MPR 60 CSR ancillary works	Plate compactor/ Wacker packer	✓	✓	✓
MPR 61 segregation fencing works	Plate compactor/ Wacker packer	✓	✓	✓

Potential vibration generated to receivers is dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration, and the receiver structure. The recommended minimum working distances for vibration intensive plant in Table 2-5 and Table 2-6 are taken from a database of vibration levels measured at various sites. They are not specific to these works as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Site specific minimum working distances for vibration significant plant items must be measured on site where plant and equipment are likely to operate close to or within the recommended minimum working distances for cosmetic damage (Table 2-5).



**Table 2-5: Minimum working distances (m) for cosmetic damage (continuous vibration).**

Plant item	Minimum working distance (m)		
	Reinforced or framed structures (e.g. commercial buildings) <sup>1</sup>	Unreinforced or light framed structures (e.g. residential buildings) <sup>1</sup>	Sensitive structures (e.g. heritage structures) <sup>2</sup>
Compactor / Wacker packer	<1 <sup>3</sup>	<1 <sup>3</sup>	1

Note 1: Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.

Note 2: A site inspection should determine whether a heritage structure is structurally unsound.

Note 3: Avoid contact with structure.

**Table 2-6: Minimum working distances (m) for human annoyance and / or equipment function (continuous vibration).**

Plant item	Minimum working distances, m				
	Critical areas <sup>1,4</sup>	Residences		Offices <sup>3,4</sup>	Workshops <sup>4</sup>
		Day <sup>2</sup>	Night <sup>2</sup>		
Compactor / Wacker packer	10	5	5	5	5

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

2: Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

3: Examples include offices, schools, educational institutions and place of worship.

4: Applicable when in use.

## 2.4.2 Vibration assessment

### 2.4.2.1 Structural damage

The numbers of buildings which are close to or within the minimum working distances for cosmetic damage are shown in Table 2-7. More detailed results are presented in APPENDIX F. The figures in APPENDIX F identify the minimum working distances for vibration over aerial photographs that also show the work areas and the land uses.

**Table 2-7: Number of buildings within minimum working distances for cosmetic damage**

Construction work activity	Plant item	Number of buildings	
		Screening criteria for non-heritage structures	Screening criteria for heritage structures
MPR 60 CSR ancillary works	Compactor / Wacker packer	0	0
MPR 61 segregation fencing works	Compactor / Wacker packer	0	0

The table above shows there is negligible risk of structural damage to nearby structures during MPR 60 and MPR 61 works.

### 2.4.2.2 Human annoyance

The number of properties which are close to or within the minimum working distances for human annoyance are shown in Table 2-8.



**Table 2-8: Properties within minimum distances for human annoyance**

Construction work activity	Plant item	Critical areas <sup>1,4</sup>	Residences <sup>5</sup>		Offices <sup>3,4</sup>	Workshop <sup>4</sup>
			Day <sup>2</sup>	Night <sup>2</sup>		
MPR 60 CSR ancillary works	Compactor / Wacker packer	0	0	0	0	0
MPR 61 segregation fencing works	Compactor / Wacker packer	0	0	0	0	0

Notes: 1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.  
 2. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7 am.  
 3. Examples include offices, schools, educational institutions and place of worship.  
 4. Applicable when in use.  
 5. Hotels and childcare centres are included in the residence category.

As can be noted from the table above, there are no receiver buildings that may be exposed to vibration above the screening limit for human annoyance. These receivers are identified in APPENDIX F.

The above assessment is based on vibration-generating equipment operating at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human annoyance, vibration control and management measures will be provided to reduce vibration impact (see Section 2.4.3).

### 2.4.3 Vibration mitigation measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort vibration and structural damage limits identified in Section 2.4.1.

**Table 2.9: Site vibration control measures**

Control type	Control measure	Typical use
Construction Planning	Community consultation	Implement community consultation measures – inform community of construction activity & potential impacts – inform community that the level of vibration at which people perceive it, or at which loose objects may rattle, is far lower than the level at which minor cosmetic damage is expected to occur
Complaints Management	Construction Complaints Management System	Complaints will be managed in accordance with the Construction Complaints Management System. Each complaint shall be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods such as using smaller equipment and establishment of minimum working distances as mentioned above.

### 2.4.4 Vibration monitoring

Attended vibration monitoring may be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. Because there are no properties within



the minimum working distances for cosmetic damage, vibration monitoring is recommended only in the event of a complaint in relation to vibration. Properties located within the minimum working distances for human annoyance are identified in APPENDIX F.

## 2.5 Other assessments

Ground-borne noise and construction related traffic were respectively assessed in Sections 7 and 8 of the *Northern Connection CNVIS*.

For this assessment, the findings within the *Northern Connection CNVIS* for ground-borne noise and construction related traffic is unchanged (i.e. no adverse impacts).

## 3 Conclusion

This technical memorandum is an addendum to the report *Northern Connection CNVIS* to review the potential noise and vibration impacts for the proposed MPR 60 CSR Ancillary Works and MPR 61 Segregation Fencing works at the Northern Connection worksite. The works are anticipated to commence in November 2021 and could take up to seven weekend possessions to complete.

### Construction noise

The noise levels from the proposed works are predicted to be above the NMLs at the nearest noise sensitive receivers for all assessment periods. For the OOHW period, predicted noise levels are expected to be above the ICNG NMLs up to 26dB(A) in the evening and 31dB(A) during the night, and above the external equivalent NML of CoA E41 and E42 by up to 16dB(A).

It is noted that the noise predictions in this CNVIS represent a realistic worst-case scenario when the works occur at worst-case intensity and the worst-case location throughout the assessment periods. Actual noise levels can often be less than the predicted levels presented in this CNVIS when measured over the assessment period, depending on the location of the works within the corridor relative to the receivers. Additional mitigation measures will be implemented in accordance with the CNVMP and the SMCSNVS. Noise monitoring will be undertaken to verify compliance with the predicted noise levels.

### Construction vibration and ground-borne noise

The vibration impact from the proposed works is minimal and vibration monitoring is recommended only in the event of a complaint in relation to vibration.

### Other assessments

The findings within the *Northern Connection CNVIS* for ground-borne noise and construction related traffic is unchanged (i.e. no adverse impacts).



## Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
02.08.2021	Initial issue	0	1	R. Zhafranata	T. Gowen	T. Gowen
20.08.2021	Respond to Systems Connect comments	-	2	R. Zhafranata	T. Gowen	T. Gowen
15.09.2021	Minor edits	-	3	R. Zhafranata	T. Gowen	T. Gowen
File Path: R:\AssocSydProjects\TK651-TK700\TK685 PK SMCSW Linewide Works (CPB UGL)\1 Docs\100 CONSTRUCTION\3-02 CNVIS C2B_P3 Northern Connection\TK685-03-02F03 CNVIS_ADD C2B_P3 NC Nth MPR works (r3).docx						

### Important Disclaimers:

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

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

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

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

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

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

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

External cladding disclaimer: No claims are made and no liability is accepted in respect of any external wall and/or roof systems (eg facade / cladding materials, insulation etc) that are: (a) not compliant with or do not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes; or (b) installed, applied, specified or utilised in such a manner that is not compliant with or does not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes.



## 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.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
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.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
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, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	<p>The units that sound is measured in. The following are examples of the decibel readings of every day sounds:</p> <p>0dB The faintest sound we can hear</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)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	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.
Frequency	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.
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.
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.
L <sub>Max</sub>	The maximum sound pressure level measured over a given period.
L <sub>Min</sub>	The minimum sound pressure level measured over a given period.



L <sub>1</sub>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L <sub>10</sub>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L <sub>90</sub>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L <sub>eq</sub>	The “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	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 L <sub>eq</sub> sound levels over any period of time and can be used for predicting noise at various locations.
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 through its conversion into thermal energy.
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 pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
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.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.



## APPENDIX B      Noise management levels



Table B1: Noise Sensitive Receivers and Construction Noise Management Levels (airborne noise) NORTHERN CONNECTION

NCA	Receiver Type	Applicable Worksite	Reference RBL	Existing Noise Levels, dB(A)			Airborne NMLs based on ICNG (external)				Sleep Dist. L <sub>Amax</sub>		Comments
				RBL Day	RBL Evening	RBL Night	NMLDS	NMLDO	NMLE	NMLN	L <sub>Aeq</sub> (15min)	L <sub>AFmax</sub>	
Portion 2 & 3	Chatswood to Sydenham (C2S)												
CDS_01	Residential buildings on Pacific Hwy and along Mowbray Road, south of Mowbray Rd. Traffic noise affected.	Chatswood Dive	RTA TH511-L02 516 Pacific Hwy, Chatswood	55	54	42	65	60	59	47	47	57	
CDS_02	Residential apartments on Pacific Highway opposite site and along Mowbray Road, north of Mowbray Rd. Traffic noise affected.	Chatswood Dive	RTA TH511-L02 516 Pacific Hwy, Chatswood	55	54	42	65	60	59	47	47	57	
CDS_03	Residential apartments north of Nelson St and west of rail line	Chatswood Dive	C2S EIS B.24	50	47	39	60	55	52	44	44	54	
CDS_04	Residential buildings north of Mowbray Rd, east of railway line (behind rail barrier)	Chatswood Dive	C2S EIS B.25	41	40	35	51	46	45	40	40	52	
CDS_05	Residential buildings south of Mowbray Rd, east of railway line (behind rail barrier)	Chatswood Dive	C2S EIS B.22	42	41	34	52	47	46	39	40	52	
CDS_06	Residential apartments south of Mowbray Rd and west of rail line	Chatswood Dive	C2S EIS B.24	50	47	39	60	55	52	44	44	54	
CDS_07	Residential buildings west of Pacific Hwy and south of Mowbray Road, shielded by CDS_01	Chatswood Dive	C2S EIS B.22	42	41	34	52	47	46	39	40	52	
CDS_08	Residential buildings west of Pacific Hwy and north of Mowbray Road, shielded by CDS_02	Chatswood Dive	C2S EIS B.25	41	40	35	51	46	45	40	40	52	
Other sensitive receivers													
Studio building (music recording studio)							45	45	45	45	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Studio building (film or television studio)							50	50	50	50	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Cinema space, theatre, auditorium							55	55	55	55	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Hotel (Sleeping areas: Hotels near major roads)							60	60	60	60	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Classrooms at schools and other educational institutions							55	55	55	55	Source: ICNG, assuming a conservative façade loss of 10 dB(A)		
Chilcare centre (internal play and sleeping areas)							50	50	50	50	Source: AAAC - guideline for Child Care Centre Acoustic Assessment, assuming a conservative façade loss of 10 dB(A)		
Hospital wards and operating theatres							65	65	65	65	Source: ICNG, assuming a conservative façade loss of 20 dB(A)		
Places of worship							55	55	55	55	Source: ICNG, assuming a conservative façade loss of 10 dB(A)		
Library (reading areas)							65	65	65	65	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Office building (general office areas)							65	65	65	65	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Hotel (bars and lounges)							70	70	70	70	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Community centres – Municipal Buildings							60	60	60	60	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 10 dB(A)		
Restaurant, bar (Bars and lounges/ Restaurant)							70	70	70	70	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Railway platform and concourse areas							75	75	75	75	Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)		
Café/ Restaurant/ Bar (outdoors)							60	60	60	60	Source: AS2107 ‘maximum’ <sup>1</sup>		
Passive recreation areas (e.g. area used for reading, meditation)							60	60	60	60	Source: ICNG		
Active recreation areas (e.g. sports fields)							65	65	65	65	Source: ICNG		
Commercial premises (including offices and retail outlets)							70	70	70	70	Source: ICNG		
Industrial premises							75	75	75	75	Source: ICNG		

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday  
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1  
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1  
NS: night shoulder period from 10 pm to 12 am Monday to Sunday - OOHW P1  
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2  
MS: morning shoulder period from 5 am to 7 am Monday to Friday, from 6 am to 8 am Saturday, Sunday and Public holidays - OOHW P1





LEGEND

Noise sensitive receivers

Residential

Mixed use

Commercial

Industrial

Hotel/Motel/Hostel

Medical facility

Place of Worship

Community centre

Recording studio

Library/Museum

Childcare

Educational

Theatre/Auditorium

Cinema

Laboratory

Flight simulator

Horse Stable

Recreational - Passive

Recreational - Active

Other

Heritage

NCA

Work Area

0

50

100 m

1:2000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

Systems Connect

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RENZO TONIN & ASSOCIATES

inspired to achieve

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SYDNEY METRO - CHATSWOOD TO SYDENHAM

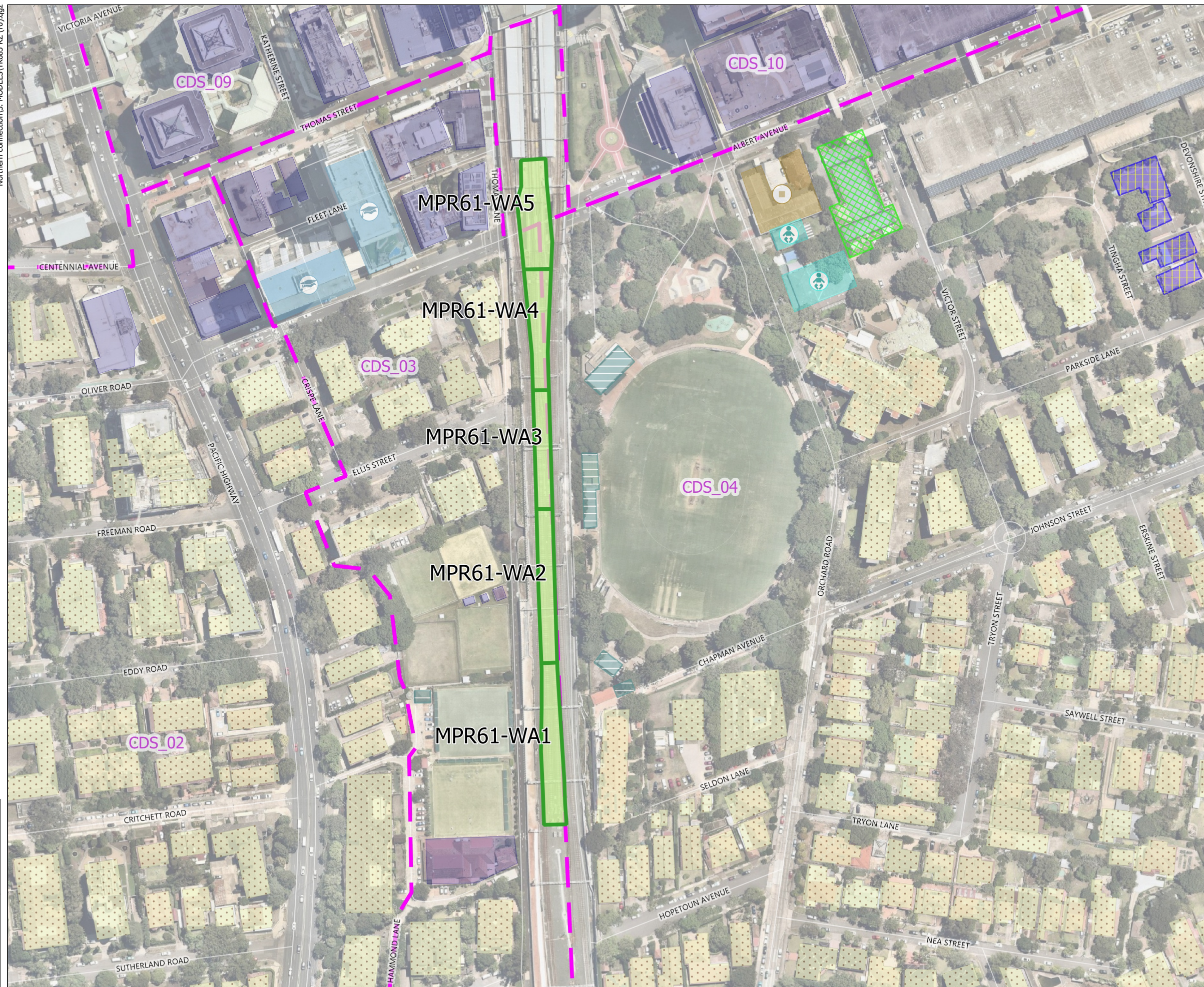
LINE WIDE WORKS

Land Use, NCAs and Work Areas

Work area: MPR60






















Sheet 1 of 2





## LEGEND

### Noise sensitive receivers

- |   |                    |   |                        |
|---|--------------------|---|------------------------|
|  | Residential        |  | Childcare              |
|  | Mixed use          |  | Educational            |
|  | Commercial         |  | Theatre/Auditorium     |
|  | Industrial         |  | Cinema                 |
|  | Hotel/Motel/Hostel |  | Laboratory             |
|  | Medical facility   |  | Flight simulator       |
|  | Place of Worship   |  | Horse Stable           |
|  | Community centre   |  | Recreational - Passive |
|  | Recording studio   |  | Recreational - Active  |
|  | Library/Museum     |  | Other                  |
|   |                    |  | Heritage               |

**F** NCA

 Work Area

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r0	RZ	19/08/21	Prepare figures	TG
REV	BY	DATE	DESCRIPTION	APPROVER
A3 Original			Co-ordinate System: MGA Zone 56	

0 50 100 m

1:2000



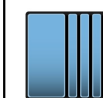
FULL SIZE A3

NOTE: Do not scale from this drawing.

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**& ASSOCIATES**  
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SYDNEY METRO - CHATSWOOD TO SYDENHAM
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LINE WIDE WORKS  
Land Use, NCAs and Work Areas  
Work area: MPR61



## APPENDIX C      Construction timetable/ activities/ management



Table C1: Construction timetable/ activities/ equipment

NORTHERN CONNECTION

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	Duration (Weeks)	L <sub>Aeq</sub>	Penalty	L <sub>Amax</sub>			
MODIFICATION SCOPE														
Segregation fencing	Segregation fencing	Excavator 13t w auger attachment	2						103	-	108	-	-	Both up and down shores
		Concrete agitator - hirail	1	1	1				108	-	111	-	-	Hirail agi on up shore line (possibly on down shore also)
		Generator	1	1	1				94	-	95	-	-	
		Concrete agitator	1 per hour	1 per hour	1 per hour				108	-	111	-	-	At drop pipe in Hopetoun Ave
		Concrete pump	1	1	1				103	-	107	-	-	At drop pipe in Hopetoun Ave
		Hydrema	2	2	2				109	-	119	-	-	
		Sucker Truck	1	1	1				107	-	111	-	-	
		Wacker Packer	1	1	1				108	-	110	-	X	
		Handtools / power drill/ angle grinder	1	1	1				108	-	118	-	-	Fence posts/ panels cut to length
		Multi crane - hirail	1	1	1				104	-	108	-	-	Fence panel installations
Combined Services Route (CSR)	CSR	Excavator 13t	3	3	3				103	-	108	-	-	
	Majority involves modifications to existing GST (cutting and modifying) modifying)	Flatbed truck	1 per hour	1 per hour	1 per hour				106	-	111	-	-	
		Sucker Truck	1	1	1				107	-	111	-	-	
		Wacker Plate and plate compactor	1	1	1				108	-	110	-	X	
	Potentially a new CSR ULX	Small truck	1	1	1				106	-	111	-	-	
		Hydrema	2	2	2				109	-	119	-	-	Up shore
		Handtools / power drill/ angle grinder	1	1	1				108	-	118	-	-	Fence posts/ panels cut to length



## APPENDIX D      Detailed predicted construction noise levels

*The detailed predicted levels have been provided to Systems Connect in a spreadsheet table in order to more adequately mitigate and manage potential noise impacts.*



## APPENDIX E      Additional noise mitigation

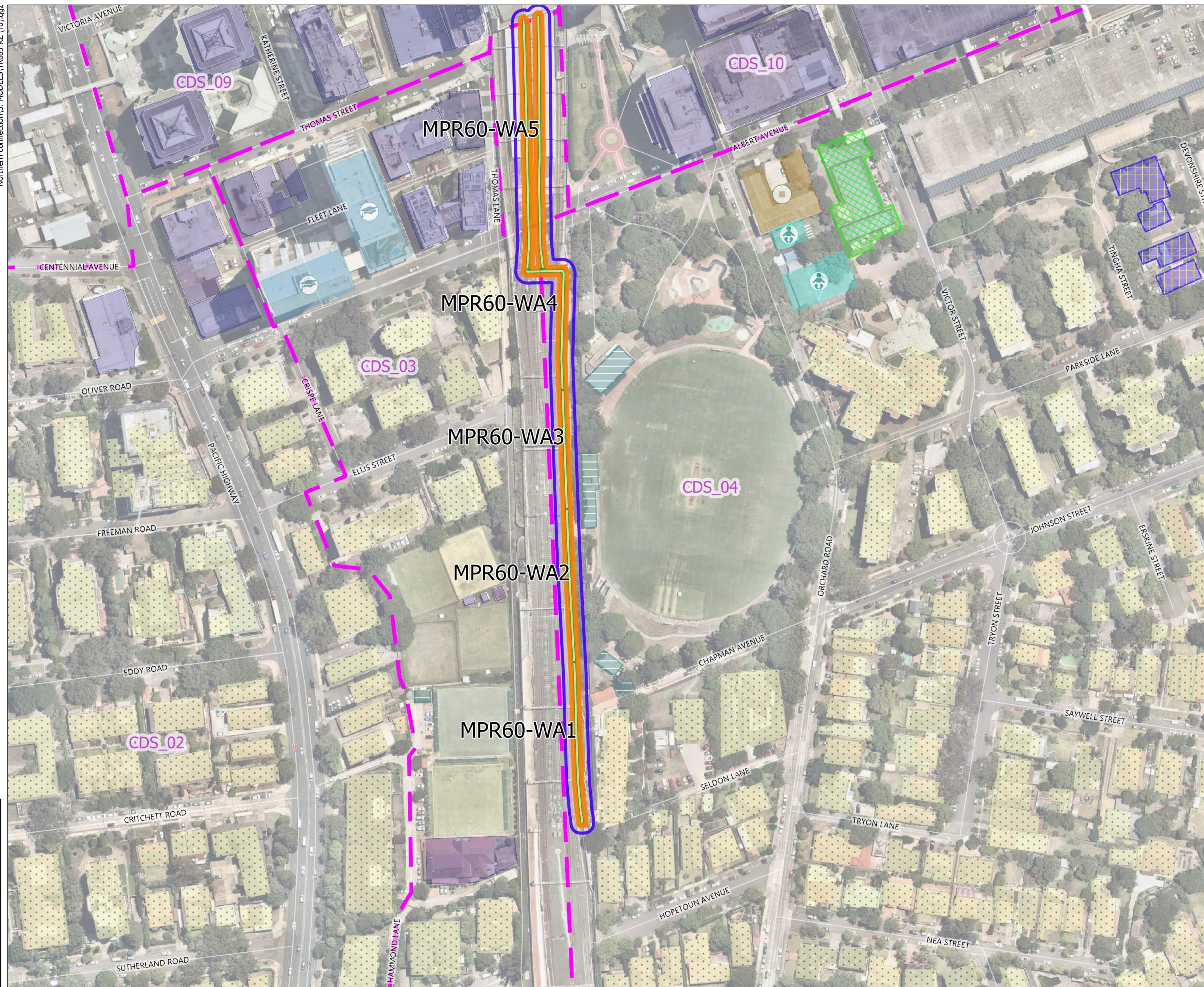
*The additional mitigation measures have been provided to Systems Connect in a spreadsheet table in order to more adequately mitigate and manage potential noise impacts.*



## APPENDIX F      Vibration impact






















### F.1      Minimum working distances – Vibration





## LEGEND

### Noise sensitive receivers

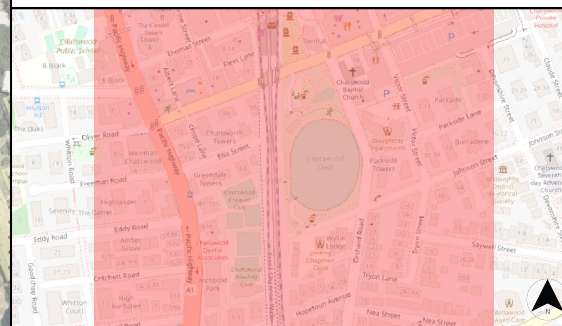
- |   |                    |   |                        |
|---|--------------------|---|------------------------|
|  | Residential        |  | Childcare              |
|  | Mixed use          |  | Educational            |
|  | Commercial         |  | Theatre/Auditorium     |
|  | Industrial         |  | Cinema                 |
|  | Hotel/Motel/Hostel |  | Laboratory             |
|  | Medical facility   |  | Flight simulator       |
|  | Place of Worship   |  | Horse Stable           |
|  | Community centre   |  | Recreational - Passive |
|  | Recording studio   |  | Recreational - Active  |
|  | Library/Museum     |  | Other                  |
|   |                    |  | Heritage               |

**F** NCA

 Work Area

MWD for cosmetic damage and human annoyance  
for Plate compactor

☐ Unreinforced and Heritage structures

☐ Human annoyance - Residential (night)

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r0	RZ	19/08/21	Prepare figures	TG
REV	BY	DATE	DESCRIPTION	APPROVER
A3 Original			Co-ordinate System: MGA Zone 56	

0 50 100 m

1:2000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT
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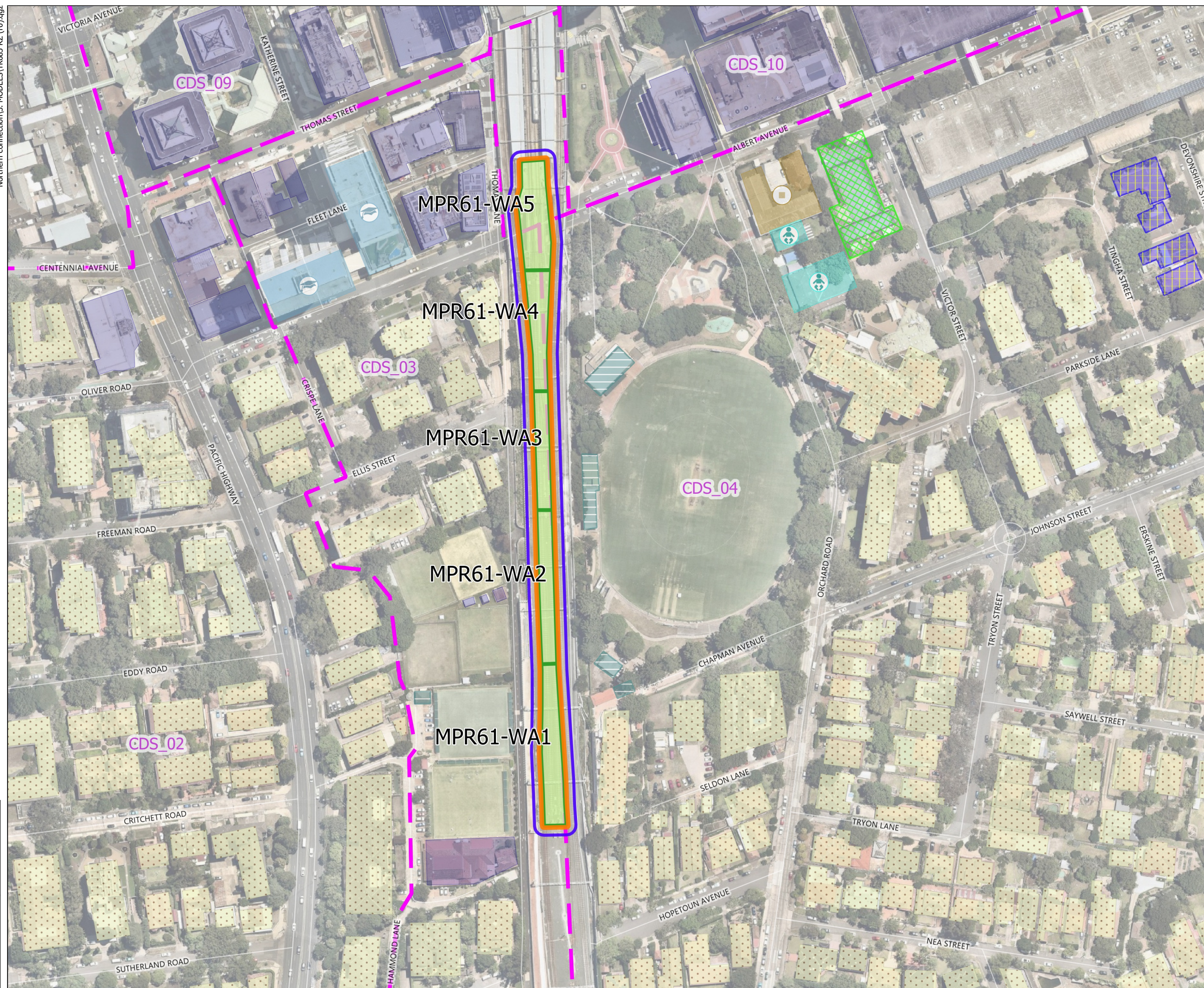
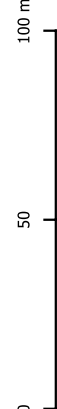


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SYDNEY METRO - CHATSWOOD TO SYDENHAM






















LINE WIDE WORKS  
MWD for cosmetic damage and human annoyance  
Work area: MPR60





## LEGEND

### Noise sensitive receivers

- |   |                    |   |                        |
|---|--------------------|---|------------------------|
|  | Residential        |  | Childcare              |
|  | Mixed use          |  | Educational            |
|  | Commercial         |  | Theatre/Auditorium     |
|  | Industrial         |  | Cinema                 |
|  | Hotel/Motel/Hostel |  | Laboratory             |
|  | Medical facility   |  | Flight simulator       |
|  | Place of Worship   |  | Horse Stable           |
|  | Community centre   |  | Recreational - Passive |
|  | Recording studio   |  | Recreational - Active  |
|  | Library/Museum     |  | Other                  |
|   |                    |  | Heritage               |

**F** NCA

 Work Area

MWD for cosmetic damage and human annoyance  
for Plate compactor

☐ Unreinforced and Heritage structures

☐ Human annoyance - Residential (night)

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r0	RZ	19/08/21	Prepare figures	TG
REV	BY	DATE	DESCRIPTION	APPROVER
A3 Original			Co-ordinate System: MGA Zone 56	

0 50 100 m

1:2000

**FULL SIZE A3**

NOTE: Do not scale from this drawing.

CLIENT
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SYDNEY METRO - CHATSWOOD TO SYDENHAM

LINE WIDE WORKS  
MWD for cosmetic damage and human annoyance  
Work area: MPR61